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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/377,617	02/16/2009	Se-Yoon Jeong	022096.0037	8176

89980 7590 10/02/2019

NSIP LAW
P.O. Box 65745
Washington, DC 20035

EXAMINER
FIELDS, COURTNEY D

ART UNIT	PAPER NUMBER
2496	

NOTIFICATION DATE	DELIVERY MODE
10/02/2019	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

pto.nsip@gmail.com
pto@nsiplaw.com

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
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P.O. Box 1450
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In re Patent No. 8,548,060 :
Issue Date: February 16, 2009 :
Application No. 12/377,617 : NOTICE
Filed: February 16, 2009 :
Attorney Docket No. 022096.0037 :

This is a notice regarding your request filed March 21, 2019, for acceptance of a fee deficiency submission under 37 CFR 1.28(c).

The Office no longer investigates or rejects original or reissue applications under 37 CFR 1.56. **1098 Off. Gaz. Pat. Office 502 (January 3, 1989)**. Therefore, nothing in this Notice is intended to imply that an investigation was done.

Your fee deficiency submission under 37 CFR 1.28(c) is hereby **ACCEPTED**.

Status a small entity has been removed. Accordingly, all future fees paid in this patent must be paid at the undiscounted entity rate.

Inquiries related to this communication should be directed to the undersigned at (571) 272-1058.

/Angela Walker/
Angela Walker
Paralegal Specialist
Office of Petitions

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY.DOCKET NO./TITLE	REQUEST ID
12/377,617	02/16/2009	Se-Yoon Jeong	022096.0037	84161

Acknowledgement of Loss of Entitlement to Entity Status Discount

The entity status change request below filed through Private PAIR on 03/21/2019 has been accepted.

CERTIFICATIONS:

Change of Entity Status:

X Applicant changing to regular undiscounted fee status.
NOTE: Checking this box will be taken to be notification of loss of entitlement to small or micro entity status, as applicable.

This portion must be completed by the signatory or signatories making the entity status change in accordance with 37 CFR 1.4(d)(4).

Signature:	/Randall S. Svihla/
Name:	Randall S. Svihla
Registration Number:	56273

Docket No. 022096.0037

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Patent of:

Se-Yoon Jeong et al.

Patent No. 8,548,060 Issued: October 1, 2013

Application No. 12/377,617 Art Unit: 2496

Confirmation No. 8176

Filed: February 16, 2009 Examiner: Courtney D. FIELDS

For: APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

PETITION UNDER 37 CFR 1.28(c) TO ACCEPT PAYMENT OF DEFICIENCY OWED FOR FEES ERRONEOUSLY PAID AS SMALL ENTITY

Mail Stop Petition
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Pursuant to instructions provided by the Office of Petitions, this paper filed via EFS-Web has been coded as "Petition for review by the Office of Petitions."

Small-entity status was claimed in good faith when the application from which this patent issued was filed, and small-entity fees have been paid in good faith up to the date this paper is being filed. However, the applicant has discovered that the entitlement to small-entity status was lost after the patent issued, but the applicant did not recognize this at the time, so the applicant continued paying small-entity fees in good faith after the entitlement to small-entity status was lost. Accordingly, on March 21, 2019, the law firm indicated below changed the entity status of this application from "small" to "undiscounted" using the entity status update function in Private PAIR. Furthermore, pursuant to 37 CFR 1.28(c)(2)(ii)(D), the applicant owes a total deficiency payment of $800 for all of the small-entity fees that were paid after the entitlement to small-entity status was lost.

Pursuant to 37 CFR 1.28(c)(2)(ii)(A)-(C), the table following this paragraph itemizes the total deficiency payment of $800 that is owed by listing each particular type of fee that was erroneously paid as a small entity, the current large-entity fee (including the fee code, the fee amount, the fee quantity, and the total amount), the small-entity fee that was actually paid (including the fee code, the fee amount, the fee quantity, and the total amount), the date the small-entity fee was paid, and the deficiency amount that is owed for each small-entity fee that was erroneously paid.

Fee Type	Current Large-Entity Fee				Small-Entity Fee Actually Paid					Def Amt
	Fee Code	Fee Amt	Fee Qty	Total Amt	Fee Code	Fee Amt	Fee Qty	Total Amt	Mailroom Date	
For maintaining an original or any reissue patent, due at 3.5 years	1551	1,600	1	1,600	2551	800	1	800	03/22/2017	800
TOTAL				**1,600**				**800**		**800**

Pursuant to 37 CFR 1.28(c)(2), please charge the total deficiency payment of $800 that is owed to Deposit Account No. 50-5113 in the name of North Star Intellectual Property Law, PC. Should the Office decide to refund the small-entity fees and charge the large-entity fees, <u>the refund must also be credited to Deposit Account No. 50-5113</u>, rather than to any other form of payment that may have been used to pay the small-entity fees.

Respectfully submitted,

Date: January 31, 2019

/Randall S. Svihla/
Randall S. Svihla
Registration No. 56,273

NSIP Law
P.O. Box 65745
Washington, DC 20035
Telephone (202) 429-0020
Facsimile (202) 315-3758
CYP/RSS

Electronic Acknowledgement Receipt

EFS ID:	35490333
Application Number:	12377617
International Application Number:	
Confirmation Number:	8176
Title of Invention:	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR
First Named Inventor/Applicant Name:	Se-Yoon Jeong
Customer Number:	89980
Filer:	Randall Scott Svihla/Mark Gambriel
Filer Authorized By:	Randall Scott Svihla
Attorney Docket Number:	022096.0037
Receipt Date:	21-MAR-2019
Filing Date:	16-FEB-2009
Time Stamp:	13:24:11
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Petition for review by the Office of Petitions	MISC20190129_0220960037_PetitionAcceptPaymentDeficiencyOwed_Patent_LostAfterIssueDate.pdf	19422 2661e4820ed6ef62c46daf6d09b8ca8a1bea920c	no	2

Warnings:

Information:	
Total Files Size (in bytes):	19422

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/377,617	10/01/2013	8548060	022090.0002	8176

89980 7590 09/11/2013

NSIP LAW
P.O. Box 65745
Washington, DC 20035

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 1199 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Se-Yoon Jeong, Daejon, KOREA, REPUBLIC OF;
Hae-Chul Choi, Daejon, KOREA, REPUBLIC OF;
Jeong-Il Seo, Daejon, KOREA, REPUBLIC OF;
Seung-Kwon Beack, Seoul, KOREA, REPUBLIC OF;
In-Seon Jang, Gyeonggi-do, KOREA, REPUBLIC OF;
Jae-Gon Kim, Daejon, KOREA, REPUBLIC OF;
Kyung-Ae Moon, Daejon, KOREA, REPUBLIC OF;
Dae-Young Jang, Daejon, KOREA, REPUBLIC OF;
Jin-Woo Hong, Daejon, KOREA, REPUBLIC OF;
Jin-Woong Kim, Daejon, KOREA, REPUBLIC OF;
Yung-Lyul Lee, Seoul, KOREA, REPUBLIC OF;
Dong-Gyu Sim, Seoul, KOREA, REPUBLIC OF;
Seoung-Jun Oh, Gyeonggi-do, KOREA, REPUBLIC OF;

Docket No. 022090.0002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Se-Yoon Jeong et al.

Application No. 12/377,617 Art Unit: 2496

Confirmation No. 8176

Filed: February 16, 2009 Examiner: Courtney D. Fields

For: APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

AMENDMENT AFTER ALLOWANCE UNDER 37 CFR 1.312

Mail Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

OK TO ENTER: /C.F./
08/30/2013

This is in response to the Notice of Allowance mailed May 23, 2013, the Supplemental Notice of Allowability of June 13, 2013, and the Office Communication of July 26, 2013. The Issue Fee and the Publication Fee are being paid by EFS-Web concurrently with the filing of this paper.

The following amendments and remarks are respectfully submitted. Entry of this Amendment After Allowance Under 37 CFR 1.312 is respectfully requested.

Amendments to the claims are reflected in the listing of the claims that begins on page 2 of this paper.

Remarks begin on page 4 of this paper.

Index of Claims	Application/Control No. 12377617	Applicant(s)/Patent Under Reexamination JEONG ET AL.
	Examiner COURTNEY FIELDS	Art Unit 2496

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/18/2012	08/17/2012	11/07/2012	05/13/2013	08/30/2013				
	1	✓	✓	✓	=	-				
	2	✓	-							
	3	✓	✓	✓	=	-				
	4	✓	✓	✓	=	-				
	5	✓	✓	✓	=	-				
	6	✓	✓	✓	=	-				
	7	✓	✓	✓	=	-				
	8	✓	✓	✓	=	-				
1	9	✓	✓	✓	=	=				
	10	✓	-							
	11	✓	✓	✓	=	-				
	12	✓	-							
	13	✓	✓	✓	=	-				
	14	✓	✓	✓	=	-				
	15	✓	✓	✓	=	-				
	16	✓	✓	✓	=	-				
	17	✓	✓	✓	=	-				
	18	✓	✓	✓	=	-				
	19	✓	✓	✓	=	-				
	20	✓	-							
	21		✓	✓	=	-				
2	22		✓	✓	=	=				
	23		✓	✓	=	-				
	24		✓	✓	=	-				
	25				=	-				
	26				=	-				

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/377,617	02/16/2009	Se-Yoon Jeong	022090.0002	8176

89980 7590 09/06/2013

NSIP LAW
P.O. Box 65745
Washington, DC 20035

EXAMINER	
FIELDS, COURTNEY D	

ART UNIT	PAPER NUMBER
2496	

NOTIFICATION DATE	DELIVERY MODE
09/06/2013	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

pto@nsiplaw.com
pto.nsip@gmail.com

PTOL-90A (Rev. 04/07)

Response to Rule 312 Communication	Application No. 12/377,617	Applicant(s) JEONG ET AL.
	Examiner COURTNEY FIELDS	Art Unit 2496

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address –

1. ☒ The amendment filed on 23 August 2013 under 37 CFR 1.312 has been considered, and has been:

   a) ☒ entered.

   b) ☐ entered as directed to matters of form not affecting the scope of the invention.

   c) ☐ disapproved because the amendment was filed after the payment of the issue fee.
   Any amendment filed after the date the issue fee is paid must be accompanied by a petition under 37 CFR 1.313(c)(1) and the required fee to withdraw the application from issue.

   d) ☐ disapproved. See explanation below.

   e) ☐ entered in part. See explanation below.

   See Index of Claims Attached

/Andrew L Nalven/
Supervisory Patent Examiner, Art Unit 2496

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

89980
NSIP LAW
P.O. Box 65745
Washington, DC 20035

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/377,617	02/16/2009	Se-Yoon Jeong	022090.0002	8176

TITLE OF INVENTION:

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$890	$300	$0	$1190	08/23/2013

EXAMINER	ART UNIT	CLASS-SUBCLASS

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
   - ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
   - ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
   (1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
   (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

   1 NSIP Law
   2 ____
   3 ____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE	(B) RESIDENCE: (CITY and STATE OR COUNTRY)
Electronics and Telecommunications Research Institute	Daejeon, Republic of Korea
Kwangwoon University Research Institute for Industry Cooperation	Seoul, Republic of Korea
Industry-Academia Cooperation Group of Sejong University	Seoul, Republic of Korea

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ■ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
- ☑ Issue Fee
- ☑ Publication Fee (No small entity discount permitted)
- ☐ Advance Order - # of Copies ____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ☐ A check is enclosed.
- ☑ Payment by credit card. Form PTO-2038 is attached.
- ☑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number 50-5113 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
- ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature /Randall S. Svihla/ Date August 23, 2013

Typed or printed name Randall S. Svihla Registration No. 56,273

Docket No. 022090.0002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Se-Yoon Jeong et al.

Application No. 12/377,617 Art Unit: 2496

Confirmation No. 8176

Filed: February 16, 2009 Examiner: Courtney D. Fields

For: APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

AMENDMENT AFTER ALLOWANCE UNDER 37 CFR 1.312

Mail Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is in response to the Notice of Allowance mailed May 23, 2013, the Supplemental Notice of Allowability of June 13, 2013, and the Office Communication of July 26, 2013. The Issue Fee and the Publication Fee are being paid by EFS-Web concurrently with the filing of this paper.

The following amendments and remarks are respectfully submitted. Entry of this Amendment After Allowance Under 37 CFR 1.312 is respectfully requested.

Amendments to the claims are reflected in the listing of the claims that begins on page 2 of this paper.

Remarks begin on page 4 of this paper.

IN THE CLAIMS:

This listing of the claims replaces all prior versions and listings of the claims in this application.

The text of all pending claims (including any withdrawn claims) is set forth below. Canceled and not entered claims are indicated with claim number and status only. The claims as listed below show added text with <u>underlining</u> and deleted text with ~~strikethrough~~. The status of each claim is listed with one of (Original), (Currently amended), (Canceled), (Withdrawn), (Previously presented), (New), and (Not entered).

Please CANCEL allowed claims 1, 3-8, 11, 13-19, 21, and 23-26 without prejudice or disclaimer in accordance with the following:

1.–8. (Canceled)

9. (Previously presented) A decoding apparatus comprising:

an entropy decoding unit configured to perform entropy decoding of an encoded video to obtain decoded transform coefficients;

a scanning decision unit configured to select a scanning mode for the decoded transform coefficients; and

a video recovery unit configured to recover an input video from the decoded transform coefficients using the selected scanning mode;

wherein the scanning decision unit is further configured to select the scanning mode based on an optimal intra prediction mode that was used to perform intra prediction of the input video to obtain difference values that were encoded to obtain the encoded video.

10.–21. (Canceled)

22. (Previously presented) The decoding apparatus of claim 9, wherein the scanning decision unit is further configured to:

select a horizontal scanning mode when the optimal intra prediction mode is a vertical intra prediction mode; and select a vertical scanning mode when the optimal intra prediction mode is a horizontal intra prediction mode.

23.–26. (Canceled)

REMARKS

In accordance with the foregoing, allowed claims 1, 3-8, 11, 13-19, 21, and 23-26 have been canceled without prejudice or disclaimer. Allowed claims 9 and 22 are pending, with claim 9 being independent.

Entry of Amendment After Allowance Under 37 CFR 1.312

Claims 1, 3-9, 11, 13-19, and 21-26 were allowed in the Notice of Allowance of May 23, 2013. However, allowed claims 1, 3-8, 11, 13-19, 21, and 23-26 have been canceled without prejudice or disclaimer in this Amendment After Allowance Under 37 CFR 1.312, leaving only allowed claims 9 and 22 pending. Since this Amendment After Allowance Under 37 CFR 1.312 merely cancels allowed claims, it is submitted that entry of this Amendment After Allowance Under 37 CFR 1.312 is proper under 37 CFR 1.312 and MPEP 714.16 and 714.16(d)(II) (see MPEP page 700-268).

Continuation Applications to Be Filed

The applicants are planning to file two continuation applications of the present application. One of the continuation applications will include claims corresponding to revised versions of canceled allowed claims 1, 3-8, 21, and 25 of the present application, and the other continuation application will include claims corresponding to revised versions of canceled allowed claims 19 and 24 of the present application. The applicants reserve the right to present claims corresponding to canceled allowed claims 11, 13-18, 23, and 26 of the present application or revised versions of them in one of the continuation applications or in another continuation application.

Conclusion

There being no further outstanding objections or rejections, it is submitted that the application is in condition for allowance. An early action to that effect is courteously solicited.

Finally, if there are any formal matters remaining after this response, the Office is requested to telephone the undersigned to attend to these matters.

Respectfully submitted,

Date: August 23, 2013

/Randall S. Svihla/
Randall S. Svihla
Registration No. 56,273

NSIP Law
P.O. Box 65745
Washington, DC 20035
Telephone (202) 429-0020
Facsimile (202) 315-3758
CYP/RSS

Electronic Patent Application Fee Transmittal

Application Number:	12377617
Filing Date:	16-Feb-2009
Title of Invention:	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR
First Named Inventor/Applicant Name:	Se-Yoon Jeong
Filer:	Randall Scott Svihla/Sean Shoolbraid
Attorney Docket Number:	022090.0002

Filed as Small Entity

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl Issue Fee	2501	1	890	890
Publ. Fee- Early, Voluntary, or Normal	1504	1	300	300

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1190**

Electronic Acknowledgement Receipt

EFS ID:	16674144
Application Number:	12377617
International Application Number:	
Confirmation Number:	8176
Title of Invention:	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR
First Named Inventor/Applicant Name:	Se-Yoon Jeong
Customer Number:	89980
Filer:	Randall Scott Svihla/Sean Shoolbraid
Filer Authorized By:	Randall Scott Svihla
Attorney Docket Number:	022090.0002
Receipt Date:	23-AUG-2013
Filing Date:	16-FEB-2009
Time Stamp:	16:13:36
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$1190
RAM confirmation Number	3072
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1	Issue Fee Payment (PTO-85B)	NOA20130523_0220900002_IssueFeeTransmittal.pdf	90332 82aa5db9cbdaba65fbd9e541d334a720c4856ede	no	1
Warnings:					
Information:					
2		NOA20130523_0220900002_AmdAfterAllowanceAsFiled.pdf	22387 15aa48c5d90469d36000c7af40771cd64dbb7baf	yes	5

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment after Notice of Allowance (Rule 312)	1	1
	Claims	2	3
	Applicant Arguments/Remarks Made in an Amendment	4	5

Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	32354 7563b4061140dd065dae87ca98dbb64cc1269368	no	2
Warnings:					
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		Total Files Size (in bytes):	145073		

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Substitute for PTO/SB/08a/b

Substitute for form 1449/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** ***(Use as many sheets as necessary)***	***Complete if Known***	
	Application Number	12/377,617
	Filing Date	February 16, 2009
	First Named Inventor	Se-Yoon Jeong et al.
	Art Unit	2496
	Examiner Name	Courtney D. Fields
Sheet 1 of 1	Attorney Docket Number	022090.0002

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number - Kind Code[2] *(if known)*	Patent or Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3] - Number[4] - Kind Code[5] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
		EP 0 230 632 A2	08-05-1987	Nishizawa		
		KR 2012-0006149 A	01-19-2002	Chun		X
		KR 2002-0081342 A	10-26-2002	Miyata et al.		X

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author, title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[6]

Examiner Signature	/Courtney Fields/	Date Considered	07/19/2013

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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NSIP LAW
P.O. Box 65745
Washington, DC 20035

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FIELDS, COURTNEY D	

ART UNIT	PAPER NUMBER
2496	

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PTOL-90A (Rev. 04/07)

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APPLICATION NO./ CONTROL NO.	FILING DATE	FIRST NAMED INVENTOR / PATENT IN REEXAMINATION	ATTORNEY DOCKET NO.
12/377,617	16 February, 2009	JEONG ET AL.	022090.0002

	EXAMINER	
NSIP LAW P.O. Box 65745 Washington, DC 20035	COURTNEY FIELDS	
	ART UNIT	PAPER
	2496	20130719

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Commissioner for Patents

The Information Disclosure Statement respectfully submitted on 05 July 2013 has been considered by the Examiner.

/Andrew L Nalven/
Supervisory Patent Examiner, Art Unit 2496

PTO-90C (Rev.04-03)

Substitute for PTO/SB/08a/b

Substitute for form 1449/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** ***(Use as many sheets as necessary)***				***Complete if Known***	
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Sheet	1	of	1	Attorney Docket Number	022090.0002

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Examiner Initials*	Cite No.[1]	Document Number Number - Kind Code[2] (*if known*)	Patent or Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3] - Number[4] - Kind Code[5] (*if known*)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
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		KR 2012-0006149 A	01-19-2002	Chun		X
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Examiner Signature		Date Considered	

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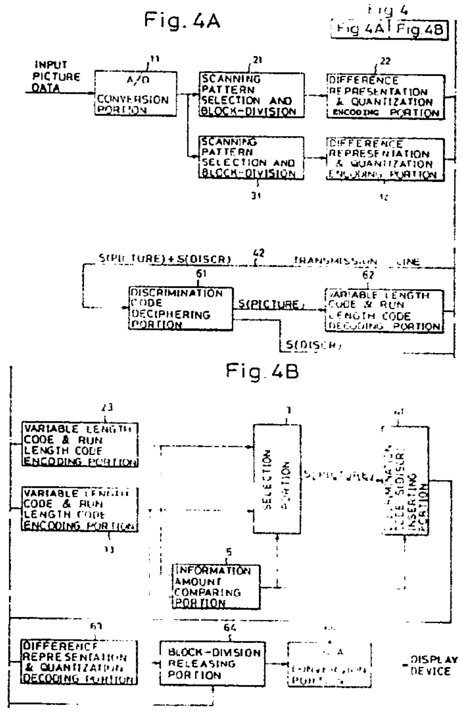
(54) **Video communications system with variable scanning pattern.**

(57) A picture data communication system with a scanning pattern change includes a plurality of scanning pattern selecting units (21, 31) responsive to input picture signals for selecting a type of scanning pattern, a plurality of difference encoding and quantizing units (22, 32) responsive to the outputs of the scanning pattern selecting units (21, 31) for encoding and quantizing differences between data in adjacent frames in a sequence of frames for pixels and quantizing the encoded difference data. The system also includes a plurality of subsequent encoding units (23, 33) responsive to the outputs of the difference encoding and quantizing units (22, 32) for encoding the quantized encoded difference data and encoding and run length data representing the length of a sequence of the same pixel information, a comparison unit (5) for comparing amounts of information between the outputs of the plurality of subsequent encoding units (23, 33) for determining the output of the minimum amount of information, a selection unit (3) responsive to the outputs of the subsequent encoding units (23, 33) and the comparison unit (5) for selecting the output of the minimum amount of information, and in identification unit (41) responsive to the output of the selection unit for inserting a descrimination code to the selected output of the minimum amount of information.

EP 0 230 632 A2

Fig. 4A



PICTURE DATA COMMUNICATION SYSTEM WITH SCANNING PATTERN CHANGE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a picture data communication system. The system according to the present invention is used, for example, for picture data communication in a television conference system.

2. Description of the Related Arts

In general, in the transmitter side of a television conference picture data communication system, a pixel data sequence is block-divided and supplied to an encoding portion of a differential PCM type in which the encoding for difference representation and subsequent quantization is carried out. In a transmission of picture signals, a great amount of data is transmitted, and thus it is necessary to carry out a further encoding for a bandwidth reduction. Accordingly, the output of the encoding portion is supplied to a bandwidth reducing coding portion, such as a variable length code and run length code encoding portion, in which the assignment of variable length codes for difference representation and quantization and run length code is carried out.

The output of the encoding portion for difference representation and quantization is represented by quantization levels of, for example, 4 to 5 bits. The frequency or probability of occurrence is high, e.g., 90%, for relatively low quantization levels, such as +2, +1, 0, -1, and -2.

In the variable length code encoding portion, a sequence of data is produced in which the codes for a high occurrence frequency are represented by relatively short bits and the codes for a low occurrence frequency are represented by relatively long bits. The encoding by the variable length code makes it possible to reduce the amount of generated data, compared with the encoding by the fixed length code.

Also, in the transmission of picture signals in which the sequence of "0" occurs frequently, it has been acknowledged that the run length coding technique is particularly effective for realizing a bandwidth reduction.

As described above, in the prior art, the manner of encoding pixel data is always fixed regardless of the nature of the input picture data. This fixing of the encoding manner has been found to be disadvantageous for attaining the most suitable picture scanning and data encoding, since the prior art encoding of pixel data deteriorates the efficiency of the transmission of data.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved picture data communication system in which the disadvantage in the prior art is eliminated and the transmission efficiency is accordingly enhanced.

In accordance with the present invention, there is provided a picture data communication system with a scanning pattern change in which a transmitter in the system includes: a plurality of block-dividing and scanning units responsive to input picture signals for block-dividing a frame and selecting a scanning pattern direction for each block of picture signals of a frame; an encoding unit operatively connected to the block-dividing and scanning unit for encoding the quantized encoded difference data and run length data representing the length of the sequence of the same pixel information; a comparison unit for comparing amounts of information between the outputs of the encoding units which correspond to a plurality of scanning patterns respectively, for determining the output of the minimum amount of the encoded pixel information; a selection unit for selecting the output of the minimum amount of information; and an identification unit responsive to the output of the selection unit for inserting a discrimination code which identifies the selected scanning pattern. The receiver in the system includes a unit for detecting the identification code, and a unit for arranging decoded data based on a scanning pattern indicated by the decoded code so that the transmitted picture is reproduced.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, Fig. 1 shows a sequence of frames for pixels for television picture data in the prior art;

Fig. 2 shows block-division of a frame for pixels for television picture data in the prior art;

Fig. 3 shows a prior art system of picture data transmission;

Fig. 4 shows a picture data transmission system with a scanning pattern change according to an embodiment of the present invention;

Figs. 5A and 5B show horizontal and vertical scanning patterns that can be used in the system of Fig. 4;

Fig. 6 shows an example of the output of the encoding portion for difference representation and quantization in the system of Fig. 4; and,

Fig. 7 shows an example of the variable length code words corresponding to quantization levels used in the system of Fig. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Before describing the preferred embodiments, an example of the prior art is explained with reference to Figs. 1, 2, and 3. In general, television data is constituted by a sequence of frames for pixels as shown in Fig. 1. Each of the frames is divided into a plurality of blocks, as shown in Fig. 2, and each of the blocks is constituted by a plurality of pixels, for example, a_1 to a_{16} , distributed in a 4 x 4 pixel arrangement.

As shown in Fig. 3, in the transmitter, the input picture data signal expressed as a pixel data sequence is analog-to-digital converted in the analog-to-digital converter 71 into parallel signals of 8 bits and supplied to the block-division portion 72.

In the block-division portion 72, each frame of picture data is divided into a plurality of blocks. Each block consists of, for example, a sequence of pixels a_1 , a_2 , a_3 , ... a_{16}. Writing into a memory or reading from the memory is carried out with this block as a unit. In this block, the sequence of pixels is arranged in 4 rows and 4 columns a_1 to a_4; a_5 to a_8; a_9 to a_{12}; and a_{13} to a_{16}.

The signal from the block-division portion 72 is supplied to the encoding portion 73 for difference representation and quantization. In the encoding portion 73, the data representing the difference between the data of a pixel in a frame and the data of the corresponding pixel in the adjacent frame is obtained, and the obtained pixel difference data is quantized.

The difference-representing and quantized signal from the encoding portion 73 is supplied to the encoding portion 74 for producing a variable length code and run length code.

With regard to the signals of the picture of a television conference, the difference-representing and quantized data are usually represented by the quantization levels of 4 to 5 bits. It has been acknowledged that, in the quantization levels which can be represented by 8 bits, the low quantization levels such as +2, +1, 0, -1, and -2 occur with the highest frequency.

Accordingly, the assignment of a variable length code in the encoding portion 74 is carried out so that, per data of one pixel, short bits are assigned to the code having a high frequency of occurrence and long bits are assigned to the code having a low frequency of occurrence. The data produced by this assignment of bits is arranged as serial data, and the thus arranged serial data is delivered through the transmission line 75.

The serial data delivered through the transmission line 75 is received by the variable length code and run length code decoding portion 81 in the receiver side. In the variable length code and run length code decoding portion 81 in the receiver side, the decoding from the variable length code and run length code is carried out to reproduce the original signal, and this is supplied to the difference representation and quantization decoding portion 82.

In the difference representation and quantization decoding portion 82, the decoding from the signal of the difference representation and quantization is carried out, and the decoded signal is supplied to the block-division releasing portion 83. In the block-division releasing portion 83, the release from the block-division is carried out, and the released signal is supplied to the digital-to-analog converter 84.

In the digital-to-analog converter 84, the supplied digital signals are converted into analog picture signals which are supplied to a display device (not shown), which displays the received picture.

A picture data communication system with a scanning pattern change according to an embodiment of the present invention is shown in Fig. 4. In the transmitter side of the system shown in Fig. 4, there are provided an analog-to-digital conversion portion 11, a first scanning pattern sequence selection and block-division portion 21, a difference representation and quantization encoding portion 22, and a variable length code and run length code encoding portion 23, a second scanning pattern sequence selection and block-division portion 31, a difference representation and quantization encoding portion 32, a variable length code and run length code encoding portion 33, a selection portion 3, a discrimination code inserting portion 41, and an information amount comparing portion 5.

In the receiver side, there are provided a discrimination code deciphering portion 61, a variable length code and run length code decoding portion 62, a difference representation and quantization decoding portion 63, a block-division releasing portion 64, and a digital-to-analog portion 65.

The scanning pattern selection and block-division portions 21 and 31 are arranged so that the scanning according to the horizontal scanning pattern shown in Fig. 5A is adopted in the scanning pattern selection and block-division portion 21, and the scanning according to the vertical scanning pattern shown in Fig. 5B is adopted in the scanning pattern selection and block-division portion 31. The block-division in the portions 21 and 31 is carried out to realize the block division shown in Fig. 2.

Each of the encoding portions 22 and 23 for difference representation and quantization receives a pixel data sequence following the block division shown in Fig. 2 and the scanning shown in Fig. 5A or 5B, and carries out a difference representation operation by obtaining a data difference between a pixel in the present frame and a corresponding pixel in the next frame, and a quantization operation by quantizing the thus-obtained data difference. An example of the result of such difference representation and quantization is shown in Fig. 6.

Each of the variable length code and run length code encoding portions 23 and 33 receives a data sequence produced in one of the difference representation and quantization encoding portions 22 and 23, and carries out an assignment of a code word to the data from one of the encoding portions 22 and 32.

An assignment of a variable length code word to the difference representation and quantization data and an assignment of a variable length code word to the run length data are carried out. In this regard, the run length represents the length of a run (i.e., a sequence) of the same data. If a sequence of the same signals "0,0,0" of the binary signal occurs, the run length of this sequence will be 3.

An example of the assignment of a variable length code word is shown in Fig. 7. In Fig. 7, the correspondence between the level of quantization, the frequency or probability of occurrence, and the variable length code word is shown. It is known that the quantization such as +2, +1, 0, -1, and -2. Variable length code words having a relatively short length are assigned to the quantization levels having a relatively high frequency of occurrence, and variable length code words having a relatively long length are assigned to the quantization levels having a relatively low frequency of occurrence.

Since code words having a relatively short length are assigned to the quantization levels having a relatively high frequency of occurrence, the amount of information generated as the result of the encoding in the system according the present invention is smaller than that in the case where the length of code is fixed for the variation of the quantization levels.

Assignments of variable length code words for the run length code in the portions 23 and 33 are carried out for the data encoded by a variable length code. The variable length code word and the run length code word produced in the encoding portions 23 and 33 are supplied to the selection portion 3 and the information amount comparing portion 5.

In the information amount comparing portion 5, a comparison between the amount of data from the portions 23 and 33 is carried out to produce a selection signal which indicates the selection of the data having the shorter length and carrying less amount of data, after a comparison of the data from the portions 23 and 33. The produced selection signal is supplied to the selection portion 3 and the discrimination code inserting portion 41.

The amount of data produced from the sequence of the portions 21, 22, and 23 according to the horizontal direction scanning may be different from the amount of data produced from the sequence of the portions 21, 32 and 33 according to the vertical direction scanning. In the example of the difference representation and quantization shown in Fig. 6, the amount of data according to the horizontal direction scanning is greater than the amount of data according to the vertical direction scanning.

The change of the direction of scanning is carried out for each of the blocks.

The selection portion 3 selects the data having the shorter length, after a comparison of the data from the portions 23 and 33, and transmits that data to the discrimination code inserting portion 4 through a signal from the portion 5. In the discrimination code inserting portion 41, one of the discrimination signals indicating the kind of scanning pattern is produced and inserted in the data from the portion 3. The data constituted by the data from the portion 3 and the produced discrimination signal is delivered as transmission picture data to the transmission line 42.

The discrimination codes are, for example, "1" and "0" in the binary representation, corresponding to the two kinds of scanning patterns.

In the discrimination code deciphering portion 61 in the receiver side, the deciphering of the transmitted discrimination code is carried out, and the discrimination code and the transmitted picture data are separated.

The picture data without the discrimination code is supplied to the variable length code and run length code decoding portion 62, where the variable length data representing the difference representation and quantization and run length data are reproduced. The reproduced data from the portion 62 is supplied to the difference representation and quantization decoding portion 63 where the difference representation data is reproduced. The reproduced data from the portion 63 is supplied to the block-division releasing portion 64.

In the block-division releasing portion 64, the release from the block-division and the reproduction of the original digital picture data are carried out. The direction of the block reproduction of the portion 64 is changed for each block unit based on the signal S(DISCR) from the portion 61. The data from the portion 64 is supplied to the D/A conversion portion 65, and the output from the portion 65 is supplied to the display device.

In the system according to the present invention, when the run length encoding is used, the amount of information generated is changed in correspondence with the scanning direction. In the system according to the present invention, the scanning direction is changed so as to minimize the amount of information generated, which makes it possible to further reduce the amount of picture data transmitted.

In the above-described embodiment, two kinds of scanning patterns, in horizontal and vertical directions, are used, but it is possible to use more than two kinds of scanning patterns. Namely, it is possible to use a scanning pattern other than in the horizontal or vertical direction, such as in a slant direction.

Claims

A picture data communication system with a scanning pattern change in which picture data is transmitted by a transmitter with a digitization of a picture signal and an encoding of the digitized picture signal, the transmitter in the system comprising

a plurality of block-dividing and scanning means - (21, 31) for block-dividing a frame and selecting a scanning direction for each block of picture signals of a frame;

encoding means (23,33) operatively connected to said block-dividing and scanning means (21, 31) for encoding run length data representing a length of a sequence of said pixel information;

comparison means (5) for comparing amounts of information between outputs of said encoding means (23, 33) which correspond to a plurality of scanning pattern respectively, for determining an output of a ninimum amount of information of encoded pixel information;

selection means (3) for selecting said output of a minimum amount of information; and

identification means (41) responsive to an output of said selection means (3) for inserting a discrimination code which identifies said selected scanning pattern.

Fig. 1

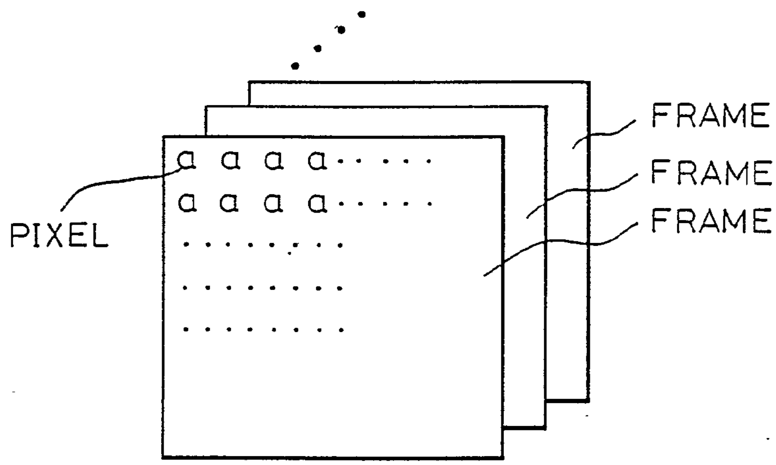

PIXEL
FRAME
FRAME
FRAME
a a a a
a a a a

Fig. 2

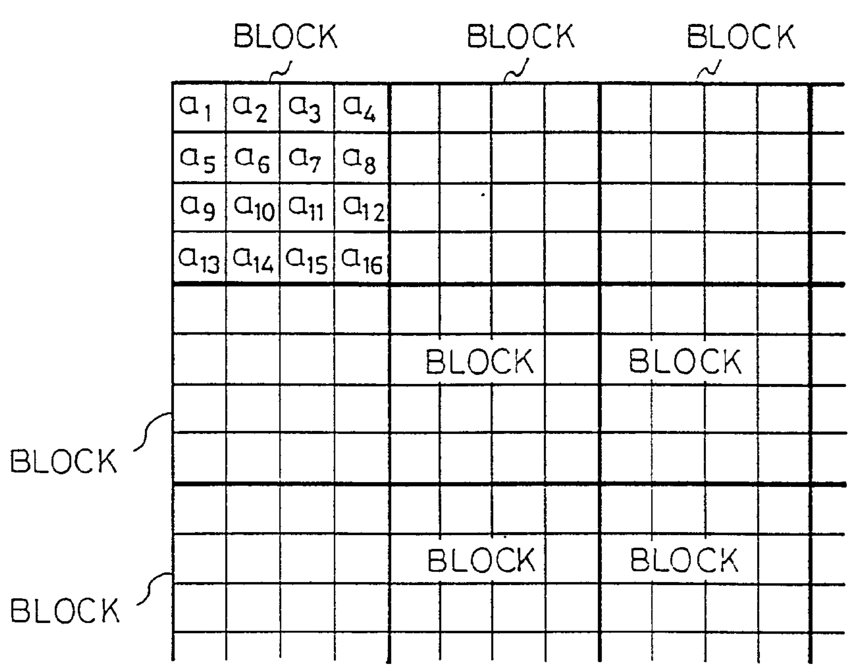

BLOCK
BLOCK
BLOCK
a_1 a_2 a_3 a_4
a_5 a_6 a_7 a_8
a_9 a_{10} a_{11} a_{12}
a_{13} a_{14} a_{15} a_{16}
BLOCK
BLOCK
BLOCK
BLOCK
BLOCK
BLOCK

Fig. 3

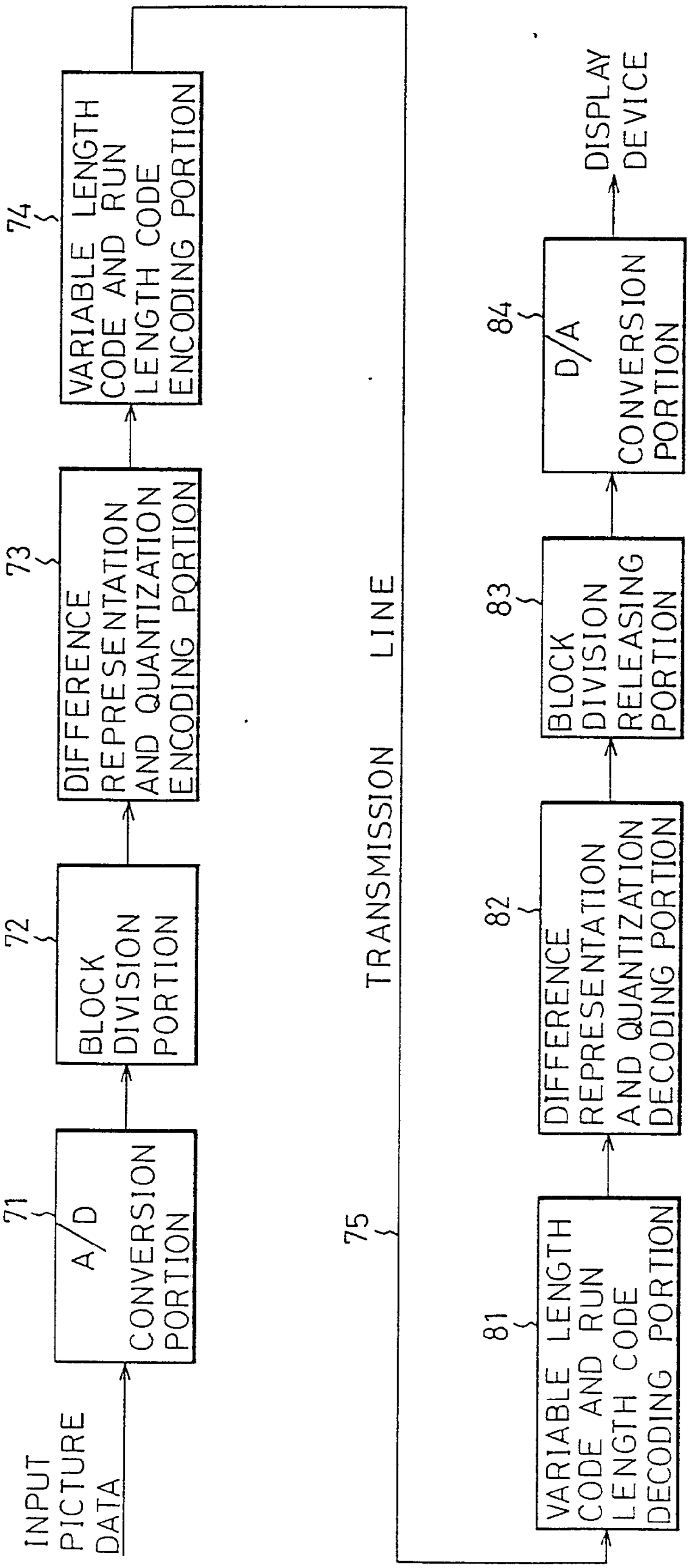

INPUT PICTURE DATA
71
A/D CONVERSION PORTION
72
BLOCK DIVISION PORTION
73
DIFFERENCE REPRESENTATION AND QUANTIZATION ENCODING PORTION
74
VARIABLE LENGTH CODE AND RUN LENGTH CODE ENCODING PORTION
TRANSMISSION LINE
75
81
VARIABLE LENGTH CODE AND RUN LENGTH CODE DECODING PORTION
82
DIFFERENCE REPRESENTATION AND QUANTIZATION DECODING PORTION
83
BLOCK DIVISION RELEASING PORTION
84
D/A CONVERSION PORTION
DISPLAY DEVICE

Fig. 4A

Fig.4

Fig.4A	Fig.4B

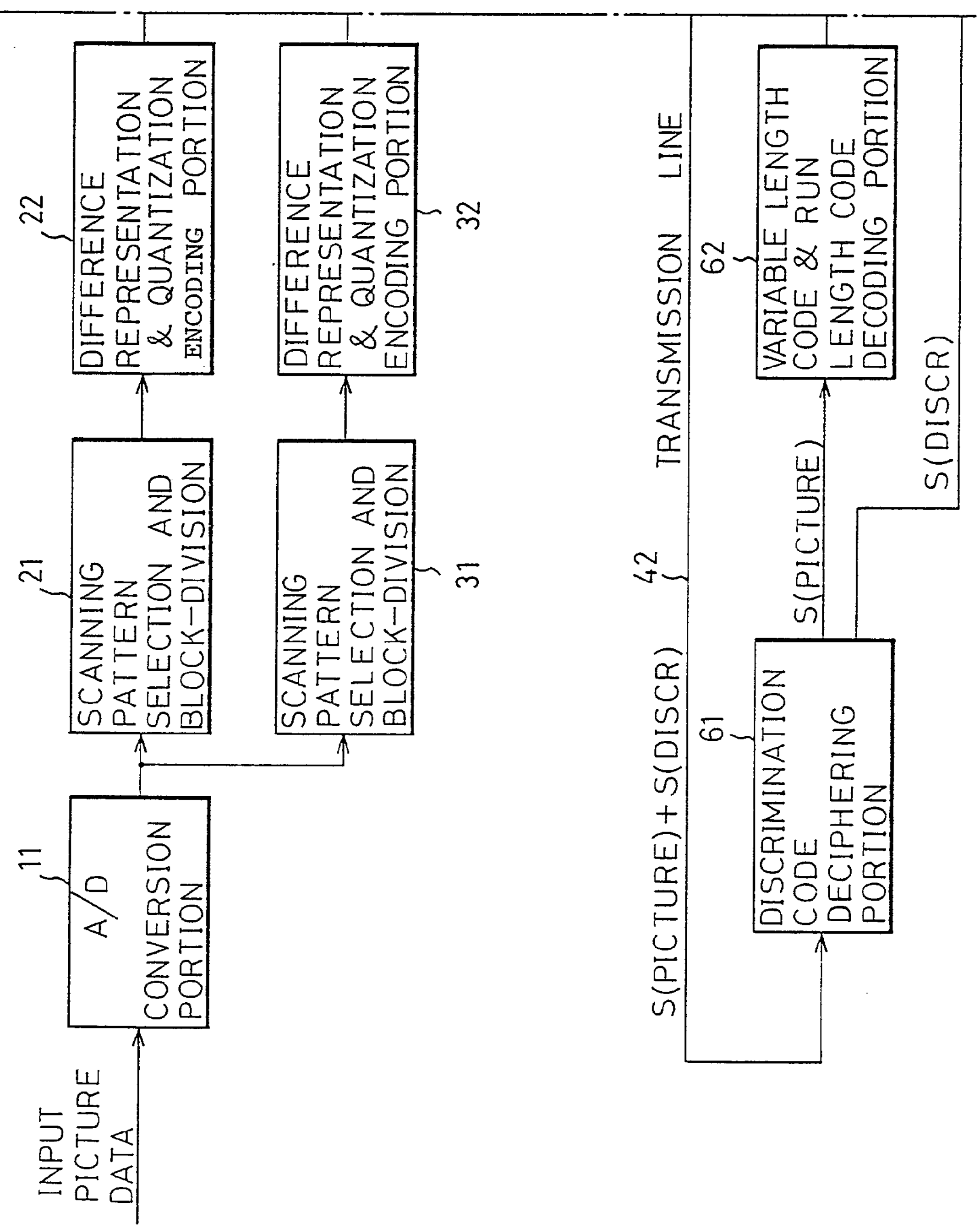


Fig.4B

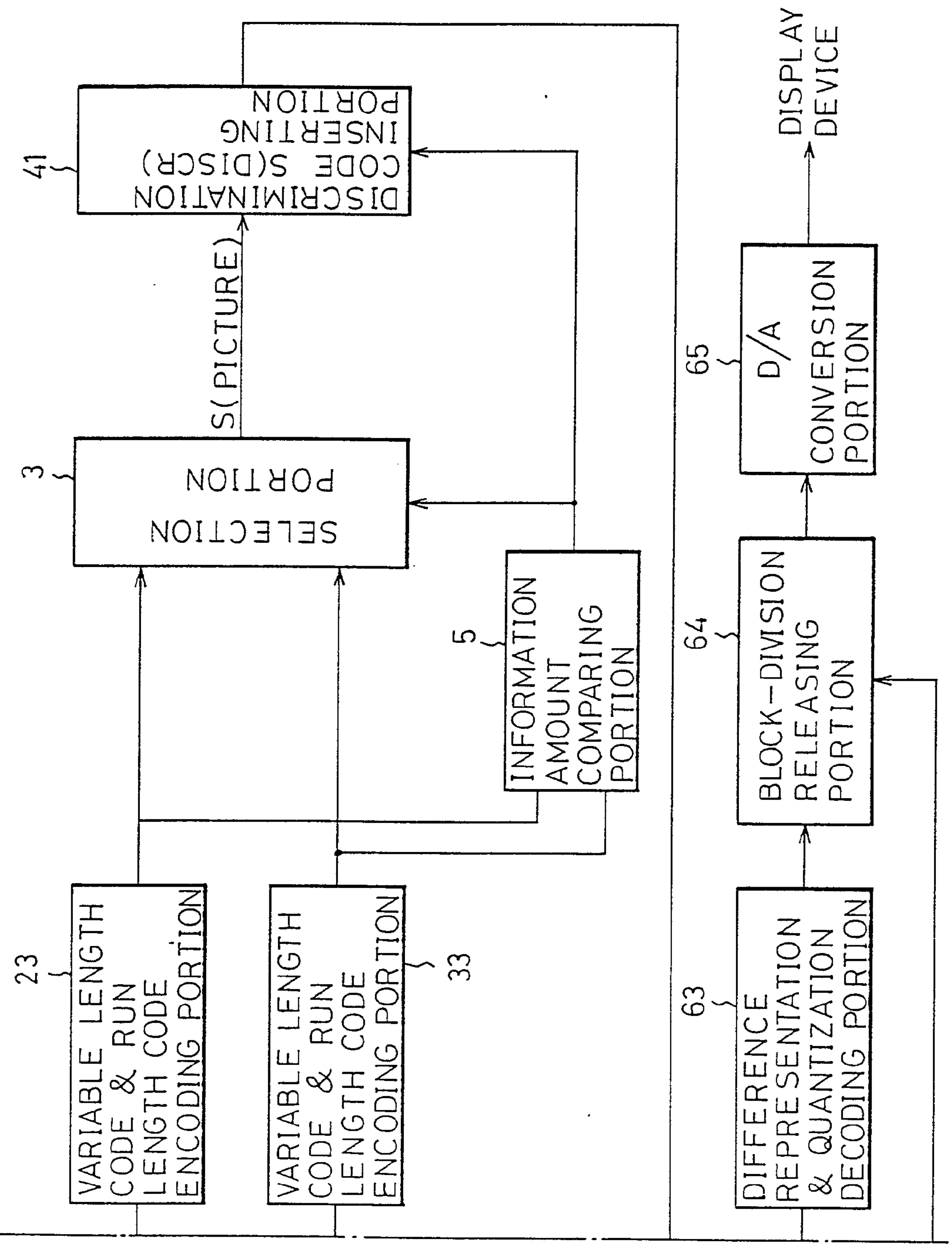

VARIABLE LENGTH CODE & RUN LENGTH CODE ENCODING PORTION
23
VARIABLE LENGTH CODE & RUN LENGTH CODE ENCODING PORTION
33
INFORMATION AMOUNT COMPARING PORTION
5
SELECTION PORTION
3
S(PICTURE)
DISCRIMINATION CODE S(DISCR) INSERTING PORTION
41
DIFFERENCE REPRESENTATION & QUANTIZATION DECODING PORTION
63
BLOCK-DIVISION RELEASING PORTION
64
D/A CONVERSION PORTION
65
DISPLAY DEVICE

Fig. 5A

HORIZONTAL SCANNING PATTERN

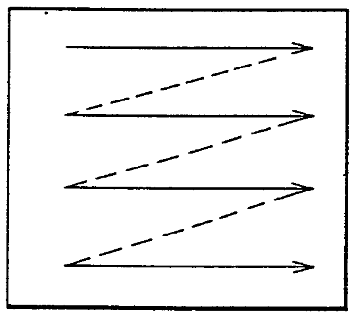


Fig. 5B

VERTICAL SCANNING PATTERN

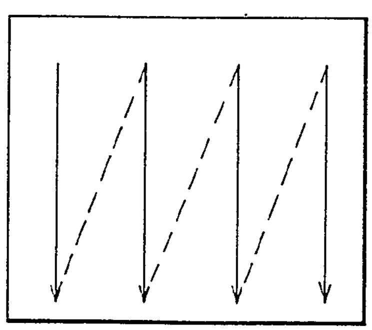


Fig. 6

DIFFERENCE REPRESENTATION AND QUANTIZATION

+3	0	0	0
+1	0	0	0
0	0	0	+1
0	0	0	0

Fig. 7

QUANTIZATION LEVEL	OCCURRENCE FREQUENCY	VARIABLE LENGTH CODE WORD
NO. + 3	0.015625	1 1 1 1 1 0
NO. + 2	0.0625	1 1 1 0
NO. + 1	0.25	1 0
NO. 0	0.5	0
NO. − 1	0.125	1 1 0
NO. − 2	0.03125	1 1 1 1 0
NO. − 3	0.015625	1 1 1 1 1 1

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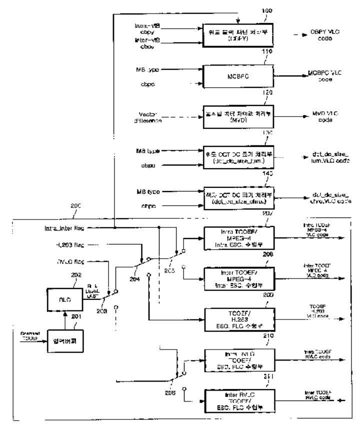
(54) VARIABLE LENGTH CODER OF MOTION PICTURE COMPRESSION CODING APPARATUS



(57) Abstract:

PURPOSE: A variable length coder of a motion picture compression coding apparatus, which variable-length-encodes image information passing through a low transmission line allowed by a transmission channel, is provided to recover loss due to error generated during variable length encoding.

CONSTITUTION: A variable length coder of a motion picture compression coding apparatus includes a luminance block pattern processor(100) for processing a coded block pattern for luminance with a VLC code, an MCBPC(110) for defining a macro block type and coded block pattern for chrominance with the VLC code, and a motion vector difference processor(120). The variable length coder further has a luminance DCT DC size processor(130), a chrominance DCT DC size processor(140), and an input buffer(201) for buffering a DCT coefficient subjected to zigzag scan and outputting it to a run length coder(202) that outputs control information required for VLC coding. The variable length coder also has the first, second, third and fourth switches(203,204,205,206) for selectively various control signals to switch paths from the run length coder.

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요약

본 발명은 동영상압축 부호화장치의 가변 길이 부호화기를 제공하기 위한 것으로, 이러한 본 발명은 동영상 압축 부호화 장치에서 전송 채널이 허용하는 저전송선로를 통하는 비교적 적은 영상정보에 대해 가변 길이 부호화하고, 가변 길이 부호화시 에러 손실을 복구할 수 있으며 역방향 가변 길이 부호화(Reverse Variable Length Coding)와 호환성을 가지도록 한다.

대표도
도 2

색인어
동영상압축부호화, 가변길이부호화, intra프레임, inter프레임, DCT계수, RLC, escape모드, TCOEF테이블, RVLC, MPEG4, H.263

명세서

도면의 간단한 설명

도1은 국제 표준 MPEG4의 부호화기 블럭 구성도,

도2는 본 발명에 의한 동영상압축 부호화장치의 가변 길이 부호화기 블럭 구성도,

도3은 MPEG4 인코드시 escape 모드 처리 작용을 보인 도면,

도4는 본 발명에 의한 다른 실시예 동영상압축 부호화장치의 가변 길이 부호화의 출력을 위한 장치 블럭 구성도,

도5는 도4의 TCOEF VLC/RVLC ESC. 수행부의 내부 블럭 구성도,

도6은 도5의 intra/inter TCOEF VLC & VLC ESC. 수행부의 내부 블럭 구성도,

도7은 도5의 intra/inter TCOEF RVLC & RVLC ESC. 수행부의 내부 블럭 구성도.

< 도면의 주요 부분에 대한 부호의 설명>

100: CBPY 110: MCBPC

120: MVD 130: 휘도 DCT DC 크기 처리부

140: 색차 DCT DC 크기처리부 201: 입력버퍼

202: RLC 203-206: 제1 내지 제4 스위치

207: intra TCOEF/MPEG4 intra ESC. 수행부

208: inter TCOEF/MPEG4 inter ESC. 수행부

209: TCOEF/H.263 ESC. 수행부

210: intra RVLC TCOEF/ESC. FLC 수행부

211: inter RVLC/TCOEF ESC. FLC 수행부

발명의 상세한 설명

발명의 목적

발명이 속하는 기술 및 그 분야의 종래기술

본 발명은 화상전화, 화상회의, PCS(개인휴대통신)용 PDA(Personal Digital Assistant; 휴대용개인단말기), mobile용 전화 및 멀티미디어 장치, IMT-2000(3세대 이동통신 시스템) 영상 서비스를 위한 장치 등에서 동영상 압축 부호화 장치에 관한 것으로, 특히 동영상 압축 부호화 장치에서 전송 채널이 허용하는 저전송선로를 통하는 비교적 적은 영상정보에 대해 가변 길이 부호화하고, 가변 길이 부호화시 에러 손실을 복구할 수 있으며 역방향 가변 길이 부호화(Reverse Variable Length Coding)와 호환성을 가질 수 있도록 한 동영상압축 부호화장치의 가변 길이 부호화기에 관한 것이다.

영상을 부호화하는 가변 길이 부호화 장치에는 기존의 MPEG1,MPEG2, H.261, H.263 등 여러가지 가변 길이 부호화 방법이 제안되어 왔다. 특히 HDTV(High Density TeleVision)의 표준 방식인 MPEG2의 가변 길이 부호화 장치의 특징은, 대용량의 영상 정보를 빠른 시간 안에 처리하기 위해, 헤더 정보와 영상 데이터를 구분하여 헤더 정보는 그대로 부호화하고 영상데이터는 여러 가지 병렬 구조로 구성되는데, 동시에 여러 개의 영상 데이터를 처리하는 것이다.

도1은 국제 표준 MPEG4의 부호화기 블럭 구성을 보인다. 기존의 MPEG2와는 달리 모양 정보 부호화를 추가로 수행하는 것이 가장 큰 차이점이다.

입력된 영상 데이터를 블럭 단위로 움직임 추정(Motion Estimation)을 수행하여 움직임 벡터를 생성하는 움직임 추정부(1)와; 상기 생성된 움직임 벡터를 이용하여 움직임 보상(Motion Compensation)을 수행하는 움직임 보상부(2)와; 상기 움직임보상부(2)에서 움직임 보상이 되지 않은 부분을 영상 정보 부호화(Texture coding)를 수행하는 영상정보 부호화부(4)와; 상기 움직임 보상부(2)에서 움직임 보상된 VOP(Video Object Plane; MEPG4에서 임의의 모양을 가지는 부호화 단위)와, 상기 영상정보 부호화부(4)에서 부호화된 대상물의 내부 정보가 가산되어 현재 영상 바로 이전 영상의 VOP인 이전 VOP를 재구성하는 이전VOP 재구성부(6)와; 입력된 영상의 모양 정보에 대해 모양 정보 부호화(Shape coding)를 수행하는 모양정보부호화부(9)와; 상기 움직임추정부(1)에서 추정된 움직임 정보와, 상기 영상 정보 부호화부(4)에서 부호화된 내부 영상 정보 및 상기 모양 정보 부호화부(9)에서 부호화된 모양 정보를 다중화하는 다중화부(11)와; 상기 다중화부(11)에서 다중화된 비트스트림을 버퍼링한 후 출력하는 출력 버퍼(12)로 구성된다.

상기와 같은 국제 표준 MPEG4의 부호화기의 작용을 설명하면 다음과 같다.

먼저, 영상 화면이 입력되면, 블럭 단위로 움직임 추정(Motion Estimation)을 하고, 여기에서 생성된 움직임 벡터를 전송한다. 그런 후 움직임 벡터로 움직임 보상(Motion Compensation)을 한 후 움직임 보상이 되지 않은 부분을 영상 정보 부호화(Texture coding)를 수행한다.

그리고 영상의 모양 정보에 대해 모양 정보 부호화(Shape coding)를 수행한다. 모양정보 부호화부(9)의 출력 신호는 VOP 부호화기가 적용되는 분야에 따라 사용 여부가 가변되는 것으로, 점선으로 표시된 바와 같이, 모양 정보 부호화부(9)의 출력신호를 움직임 추정부(1), 움직임 보상부(2) 및 영상 정보 부호화부(4)에 입력시켜 움직임 추정, 움직임 보상 및 영상 정보 부호화(texture coding)하는 데 사용할 수 있다.

움직임추정부(1)에서 추정된 움직임 정보와, 영상 정보 부호화부(4)에서 부호화된 내부 영상 정보 및 모양 정보 부호화부(9)에서 부호화된 모양 정보는 다중화부(11)에서 다중화된 후, 출력 버퍼(12)를 통해 비트스트림으로 송신된다.

이렇게 다중화부(11)로 입력되어 송신될 데이터는, 움직임 추정부(1)로부터의 움직임 벡터 정보, 영상정보 부호화부(4)로부터의 매크로블럭 헤더 정보, 영상 데이터 정보 등으로서, 이러한 정보의 대다수가 가변 길이 부호화 코드를 사용하고 있다.

그런데 HDTV의 대용량의 영상 정보를 실시간에 처리해야 하는 경우가 아니라, 전송 채널이 허용하는 저 전송 선로에 대해서도 처리할 수 있는 비교적 적은 영상 정보(CIF: 352*288, QCIF: 176*144)를 효과적으로 가변 길이 부호화해야 하는 경우, 국제 표준 MPEG4의 부호화에서 영상 정보 부호화(texture coding)된 영상 정보를 가변 길이로 부호화하는 장치는 저 전송선로에 대한 비교적 적은 양의 영상 정보를 처리할 수 있도록 구현되어야 한다.

발명이 이루고자 하는 기술적 과제

이에 본 발명은 상기와 같은 종래 기술의 필요에 의해 제안된 것으로, 본 발명의 목적은

동영상 압축 부호화 장치에서 전송 채널이 허용하는 저전송선로를 통하는 비교적 적은 영상정보에 대해 가변 길이 부호화하고, 가변 길이 부호화시 에러 손실을 복구할 수 있으며 역방향 가변 길이 부호화(Reverse Variable Length Coding)와 호환성을 가지도록 한 동영상압축 부호화장치의 가변 길이 부호화기를 제공하는 데 있다.

상기와 같은 목적을 달성하기 위하여 본 발명에 의한 동영상압축 부호화장치의 가변 길이 부호화기는,

영상정보 부호화(texture coding)에서 나오는 매크로블럭 헤더 정보 중 휘도 블럭 패턴(Coded Block Pattern for Luminance; CBPY)을 intra_inter 플래그(intra 프레임 부호화와 inter 프레임 부호화를 선택하기 위한 제어 신호)에 따라 VLC 코드로 처리하는 휘도 블럭 패턴 처리부와;

매크로블럭 헤더 정보 중 매크로블럭 타입(MB type)과 CBPC(Coded Block Pattern for Chrominance)의 정보를 VLC 코드로 정의하는 MCBPC와;

매크로블럭 헤더 정보 중의 하나인 이전의 움직임 벡터와 현재의 움직임 벡터 간의 차이값을 VLC 코드로 처리하는 움직임 벡터 차이값 처리부(Motion Vector Difference; MVD)와;

매크로블럭 헤더 정보 중의 하나인 휘도 DCT DC 크기(dct_dc_size_lum.)를 위한 VLC 코드를 처리하는 휘도 DCT DC 크기 처리부와;

매크로블럭 헤더 정보 중의 하나인 색차 DCT DC 크기(dct_dc_size_chro.)를 위한 VLC 코드를 처리하는 색차 DCT DC 크기 처리부와;

영상정보 부호화(texture coding) 과정에서 zigzag scan을 거친 DCT 계수(TCOEF)를 입력받아 버퍼링하고, escape 모드를 고려한 VLC를 하기 위해 필요한 클럭 레이트(clock rate)에 맞추어 RLC로 출력하는 입력 버퍼와;

상기 입력버퍼에서 출력되는 DCT AC 계수를 RLC(Run Length Coding)를 수행하여, VLC 부호화하기 위해 필요한 제어 정보를 출력하는 RLC와;

역방향 가변 길이 부호화(RVLC)와 가변 길이 부호화(VLC)를 선택하기 위한 제어 신호(RVLC 플래그), H.263 TCOEF VLC를 선택하기 위한 제어 신호(H.263 플래그), intra 프레임 부호화와 inter 프레임 부호화를 선택하기 위한 제어 신호(intra_inter 플래그)를 선택적으로 입력받아, 역방향 가변 길이 부호화(RVLC), intra TCOEF 가변 길이 부호화(VLC), inter TCOEF VLC, H.263 TCOEF VLC가 선택적으로 수행되도록 상기 RLC로부터의 경로를 각각 스위칭하는 제1 내지 제4 스위치와;

상기 제1 내지 제3 스위치에 의해 선택되면 MPEG4 intra TCOEF를 intra escape 모드로 VLC를 수행하는 intra TCOEF/MPEG4 intra ESC. 수행부와;

상기 제1 내지 제3 스위치에 의해 선택되면 MPEG4 inter TCOEF를 inter escape 모드로 VLC를 수행하는 inter TCOEF/MPEG4 inter ESC. 수행부와;

상기 제1 및 제2 스위치에 의해 선택되면 H.263 TCOEF를 inter 프레임 부호화를 사용하여 escape 모드를 수행하는 TCOEF/H.263 ESC. 수행부와;

상기 제1, 제2, 제4 스위치에 의해 선택되면 intra TCOEF를 RVLC 수행하고 escape 모드시 고정길이 부호화(Fixed Length Coding; FLC)를 수행하는 intra RVLC TCOEF /ESC. FLC 수행부와;

상기 제1, 제2, 제4 스위치에 의해 선택되면 inter TCOEF를 RVLC 수행하고 escape 모드시 고정길이 부호화(Fixed Length Coding; FLC)를 수행하는 inter RVLC TCOEF /ESC. FLC 수행부로 이루어짐을 그 기술적 구성상의 특징으로 한다.

상기와 같은 목적을 달성하기 위하여 본 발명에 의한 동영상압축 부호화장치의 가변 길이 부호화기는,

RVLC 플래그에 따라 normal VLC 기능과 RVLC 기능을 수행하고, VLC escape 모드시 FLC를 수행하는 TCOEF VLC/RVLC ESC. 수행부와;

상기 TCOEF VLC/RVLC ESC. 수행부에서 출력되는 가변 길이 부호화 코드와 고정 길이 부호화(FLC) 코드를 블럭(block) 단위로 하나의 비트열로 램(TCOEF VLC/RVLC 버퍼)에 쓰기 위해 재구성하는 TCOEF 비트 스트림 생성기와;

상기 TCOEF 비트 스트림 생성기에서 출력되는 TCOEF 비트열을 저장하는 TCOEF VLC/RVLC 버퍼(램)으로 이루어짐을 그 기술적 구성상의 특징으로 한다.

발명의 구성 및 작용

이하, 상기와 같은 본 발명에 의한 동영상압축 부호화장치의 가변 길이 부호화기를 첨부된 도면에 의거 상세히 설명하면 다음과 같다.

본 발명은 MPEG4 simple profile에 맞는 가변 길이 부호화(Variable Length Coding; VLC)와 H.263의 가변 길이 부호화, 그리고 에러 전송에 효과적인 역방향 가변 길이 부호화(Reversible Variable Length Coding; RVLC)의 복합 구조를 이루고 있고, simple profile에서는 모양 정보 부호화는 고려하지 않고 있다.

MPEG4 simple profile 부호화기의 가변 길이 부호화시 사용되는 가변길이 부호화 테이블(VLC 테이블)이 [표 1]에 구성된다.

[표 1]

	VLC Table Name	Index 개수	비트수	비고
1	mcbpc for I-VOPs	9	1-9	
2	mcbpc for P-VOPs	21	1-9	
3	cbpy for four non-transparent blocks	16	2-6	
4	MVD	65	1-13	
5	dct_dc_size_luminance	9	2-7	Not N-bit
6	dct_dc_size_chrominance	9	2-7	Not N-bit
7	Intra Lum. And Chr. TCOEF	113	3-13	
8	Inter Lum. And Chr. TCOEF	113	3-13	
9	RVLC for intra TCOEF	169	4-16	
10	RVLC for inter TCOEF	169	4-16	

그리고 H.263 VLC 테이블 구성이 [표 2]에 보인다.

[표 2]

	VLC Table Name	Index 개수	비트수	MPEG4와 비교
1	mcbpc for I-VOPs	9	1-9	동일
2	mcbpc for P-VOPs	21	1-9	동일
3	cbpy for four blocks	16	2-6	동일
4	MVD	65	1-13	구성이 다름
5	Inter TCOEF	113	3-13	동일(escape 다름)

도2는 본 발명에 의한 동영상압축 부호화장치의 가변 길이 부호화기 일 실시예 블럭 구성을 보인다.

MPEG4 simple profile에 맞는 가변 길이 부호화와 H.263의 가변 길이 부호화, 그리고 에러 전송에 효과적인 역방향 가변 길이 부호화(Reversible Variable Length Coding; RVLC)의 복합적인 구조를 가진다.

즉, 영상정보 부호화(texture coding)에서 나오는 매크로블럭 헤더 정보와 영상 데이터를 구분하여 처리하게 되는데, 매크로블럭 헤더 정보 중 휘도 블럭 패턴(Coded Block Pattern for Luminance; CBPY)을 intra_inter 플래그(intra 프레임 부호화와 inter 프레임 부호화를 선택하기 위한 제어 신호)에 따라 VLC 코드로 처리하는 휘도 블럭 패턴 처리부(100)와; 매크로블럭 헤더 정보 중 매크로블럭 타입(MB type)과 CBPC(Coded Block Pattern for Chrominance)의 정보를 VLC 코드로 정의하는 MCBPC(110)와; 매크로블럭 헤더 정보 중의 하나인 이전의 움직임 벡터와 현재의 움직임 벡터 간의 차이값을 VLC 코드로 처리하는 움직임 벡터 차이값 처리부(Motion Vector Difference; MVD)(120)

와; 매크로블럭 헤더 정보 중의 하나인 휘도 DCT DC 크기(dct_dc_size_lum.)를 위한 VLC 코드를 처리하는 휘도 DCT DC 크기 처리부(130)와; 매크로블럭 헤더 정보 중의 하나인 색차 DCT DC 크기(dct_dc_size_chro.)를 위한 VLC 코드를 처리하는 색차 DCT DC 크기 처리부(140)와; 영상정보 부호화(texture coding) 과정에서 zigzag scan을 거친 DCT 계수(TCOEF)를 입력받아 버퍼링하고, escape 모드를 고려한 VLC를 하기 위해 필요한 클럭 레이트(clock rate)에 맞추어 RLC(203)로 출력하는 입력 버퍼(201)와; 상기 입력버퍼(201)에서 출력되는 DCT AC 계수를 RLC(Run Length Coding)를 수행하여, VLC 부호화하기 위해 필요한 제어 정보를 출력하는 RLC(202)와; 역방향 가변 길이 부호화(RVLC)와 가변 길이 부호화(VLC)를 선택하기 위한 제어 신호(RVLC 플래그), H.263 TCOEF VLC를 선택하기 위한 제어 신호(H.263 플래그), intra 프레임 부호화와 inter 프레임 부호화를 선택하기 위한 제어 신호(intra_inter 플래그)를 선택적으로 입력받아, 역방향 가변 길이 부호화(RVLC), intra TCOEF 가변 길이 부호화(VLC), inter TCOEF VLC, H.263 TCOEF VLC가 선택적으로 수행되도록 상기 RLC(202)로부터의 경로를 각각 스위칭하는 제1 내지 제4 스위치(203-206)와; 상기 제1 내지 제3 스위치(203-205)에 의해 선택되면 MPEG4 intra TCOEF를 intra escape 모드로 VLC를 수행하는 intra TCOEF/MPEG4 intra ESC. 수행부(207)와; 상기 제1 내지 제3 스위치(203-205)에 의해 선택되면 MPEG4 inter TCOEF를 inter escape 모드로 VLC를 수행하는 inter TCOEF/MPEG4 inter ESC. 수행부(208)와; 상기 제1 및 제2 스위치(203)(204)에 의해 선택되면 H.263 TCOEF를 inter 프레임 부호화를 사용하여 escape 모드를 수행하는 TCOEF/H.263 ESC. 수행부(209)와; 상기 제1, 제2, 제4 스위치(203,204,206)에 의해 선택되면 intra TCOEF를 RVLC 수행하고 escape 모드시 고정길이 부호화(Fixed Length Coding; FLC)를 수행하는 intra RVLC TCOEF /ESC. FLC 수행부(210)와; 상기 제1, 제2, 제4 스위치(203,204,206)에 의해 선택되면 inter TCOEF를 RVLC 수행하고 escape 모드시 고정길이 부호화(Fixed Length Coding; FLC)를 수행하는 inter RVLC TCOEF /ESC. FLC 수행부(211)로 구성된다.

상기 RLC(202)에서 출력되는 VLC 부호화하기 위해 필요한 제어 정보는, 현재 부호화되는 0이 아닌 DCT 계수가 블럭 내의 마지막 0이 아닌 DCT 계수인 지를 나타내는 LAST, 0이 아닌 계수의 값을 나타내는 LEVEL, 부호화되는 계수 앞의 연속적인 0의 개수를 나타내는 RUN이다.

상기 제1 스위치(203)는 상기 RLC(202)에서 출력되는 제어정보(LAST, LEVEL, RUN)를 RVLC 플래그에 따라 제2 스위치(204)와 제4스위치(206) 중 하나로 스위칭하고, 상기 제2 스위치(203)는 상기 제1 스위치(203)에서 출력되는 정보를 H.263플래그에 따라 제3 스위치(205)와 상기 TCOEF/H.263 ESC. 수행부(209) 중 하나로 스위칭하며, 상기 제3 스위치(205)는 상기 제2 스위치(204)에서 출력되는 정보를 intra_inter 플래그에 따라 상기 intra TCOEF/MPEG4 intra ESC. 수행부(207)와 inter TCOEF/MPEG4 inter ESC. 수행부(208) 중 하나로 스위칭하고, 상기 제4 스위치(206)는 상기 제1 스위치(203)에서 출력되는 정보를 상기 intra_inter 플래그에 따라 상기 intra RVLC TCOEF /ESC. FLC 수행부(210)와 inter RVLC TCOEF /ESC. FLC 수행부(211) 중 하나로 스위칭한다.

상기와 같은 본 발명에 의한 동영상압축 부호화장치의 가변 길이 부호화기 일 실시예의 작용을 설명하면 다음과 같다.

입력 버퍼(201)에 입력되는 정보는 영상정보(texture) 부호화에서 나오는 계수(coefficient)로 지그재그 스캔(zigzag scan)을 거친 정보이다. 입력 버퍼(201)에서는 escape mode를 고려한 VLC를 하기 위해 필요한 클럭 레이트(clock rate)에 맞추어 계수를 RLC(202)로 읽어내고 RLC(202)는 RUN,LEVEL,LAST를 구하기 위한 RLC(Run Length Coding)를 한다.

각각의 모듈(207,208,209,210,211)을 선택하기 위해 RVLC 플래그, H.263 플래그, Intra_Inter 플래그가 이용된다.

MPEG4 Inter TCOEF VLC 테이블은 H.263 TCOEF VLC 테이블과 동일하다. 그러나 escape mode는 다르게 구성된다.

영상정보 부호화(texture coding)에서 나오는 매크로블럭 헤더 정보와 영상 데이터를 구분하여 처리하게 되는데, 매크로블럭 헤더 정보 처리 작용에 대해 설명하면, CBPY(100)는 휘도 블럭 패턴을 VLC하고, MCBPC(110)는 MB 타입과

CBPC(Coded Block Pattern for Chrominance)의 정보를 VLC 코드로 정의한다. 그리고 MVD(120)는 이전의 움직임 벡터와 현재의 움직임 벡터의 차이값을 VLC하고, 휘도 DCT DC 크기 처리부(130)는 휘도 DCT DC 크기를 VLC하며, 색차 DCT DC 크기 처리부(140)는 색차 DCT DC 크기를 VLC한다.

이제, 영상 데이터 처리인 입력 버퍼(201)에 이어, RLC의 동작을 설명하면, 입력 버퍼(201)에서 출력되는 AC 계수값을 RLC를 수행하여, LAST, RUN, LEVEL로 이루어진 일련의 EVENT들을 출력해서, VLC 부호화될 수 있도록 한다.

이때 LAST가 '0'인 경우 0이 아닌 계수가 블럭 내에 더 존재한다는 것을 의미하고, '1'인 경우 0이 아닌 계수가 블럭 내에 더 이상 존재하지 않음을 나타낸다.

이렇게 RLC를 수행하여 LAST, RUN, LEVEL을 출력하는 방법을 코드(code)로 나타내면 다음과 같다.

```
count < = count + 1 ;

if(!AC_Coefficient) begin

run_cnt < = run_cnt + 1 ;

RLC_E < = 1'b0 ;

end

else begin

run_cnt < = 0;

LEVEL_tmp < = AC_Coefficient;

RUN_tmp < = run_cnt;

if(LEVEL_tmp != 12'd0)

RLC_E < = 1'b1;

end

LEVEL < = LEVEL_tmp;

RUN < = RUN_tmp;

if(count == 65) begin - - - - - - - - (1)

LAST < = 1'b1;

LEVEL < = LEVEL_tmp;

RUN < = RUN_tmp;

RLC_E < = 1'b1;
```

end

상기에서 input은 AC_Coefficient, count flag(64 or 65) 이고, output은 RUN, LEVEL, LAST, RLC_E(RLC_Enable) 이다. intra mode일 때, (1) 의 count == 65는 DC 값을 빼고 LAST를 결정해야 하므로 64로 바뀐다. 그러나 Intra_dc_thr에 의해 DC값을 AC값과 동일한 방법으로 하여 처리하게 되면 Intra mode이더라도 65로 처리한다. 실제 RUN, LEVEL, LAST의 정보는 RLC_Enable로써 나타낸다.

도3은 MPEG4 인코딩(encoding) 시 escape 모드 처리 작용을 보인다.

기존의 MPEG1, MPEG2, H.261, H.263에서의 escape 모드 처리 방법은 고정 길이 부호화(Fixed Length Coding; FLC) 를 수행했다. 그러나 본 발명에 적용되는 MPEG4 escape mode는 도3에서 보여지는 바와 같이, 영상 압축률을 향상시키기 위해 3단계로 구분하여 처리한다. 즉, Intra TCOEF와 Inter TCOEF로 나누어져 각각 다른 테이블을 이용하며 escape mode에서도 LEVEL과 RUN값을 변화시키는 table이 각각 다르다.

그러나 신호 흐름의 내용은 유사하다. 먼저 RLC(202) 에서 나오는 RUN, LEVEL, LAST값을 가지고 TCOEF VLC 테이블을 참조하여 TCOEF VLC 코드를 결정한다. 그래서 TCOEF VLC 테이블의 해당 인덱스 안에 값이 존재하면 일반적인(normal) VLC를 수행한다(ST11,ST12).

그러나 TCOEF VLC 테이블의 해당 인덱스 안에 값이 존재하지 않으면 escape mode로 선택된다. 그래서 LEVEL 값을 변화시킨다. 변화된 LEVEL값은 LEVEL+로, sign(LEVEL)*[abs(LEVEL) - LMAX] 이다(ST13) (제1단계). 여기서 LMAX는 주어진 쌍 (LAST,RUN) 의 LEVEL의 최대값이다.

이렇게 LEVEL값을 변화시킨 후, 동일한 TCOEF VLC 테이블을 참조하여 해당 인덱스 안에 값이 존재하면 TCOEF VLC 코드를 정한다(ST14,ST15).

그러나 ST14에서 상기 TCOEF VLC 테이블에 값이 존재하지 않아, 다시 escape mode가 선택되면, RUN값을 변화시킨다. 변화된 RUN값은 RUN+로, RUN-(RMAX+ 1) 이다(ST16) (제2단계). 여기서 RMAX는 주어진 쌍 (LAST, LEVEL) 의 RUN의 최대값이다.

이렇게 RUN 값을 변화시킨 후, 다시 동일한 TCOEF VLC 테이블을 참조하여 TCOEF VLC 코드를 정한다(ST17,ST18). 그러나 상기 TCOEF VLC 테이블에 VLC 코드가 존재하지 않아 escape 모드가 선택되면, FLC(Fixed Length Coding) 를 수행한다(ST19) (제3단계).

위와 같은 동작 수행은 Intra일 때와 Inter일 때 동일한 방법으로 수행되고 적용되는 테이블의 구성이 다르다.

도4는 본 발명에 의한 다른 실시예 동영상압축 부호화장치의 가변 길이 부호화의 출력을 위한 장치 블럭 구성을 보인다.

RVLC 플래그에 따라 normal VLC 기능과 RVLC 기능을 수행하고, VLC escape 모드시 FLC를 수행하는 TCOEF VLC/RVLC ESC. 수행부(300) 와; 상기 TCOEF VLC/RVLC ESC. 수행부(300) 에서 출력되는 가변 길이 부호화(VLC) 코드와 고정 길이 부호화(FLC) 코드를 블럭(block) 단위로 하나의 비트열로 램(500) 에 쓰기 위해 재구성하는 TCOEF 비트 스트림 생성기(400) 와; 상기 TCOEF 비트 스트림 생성기(400) 에서 출력되는 TCOEF 비트열을 저장하는 TCOEF VLC/RVLC 버퍼(램) (500) 으로 구성된다.

상기 TCOEF VLC/RVLC ESC. 수행부(300) 는 도5에 도시된 바와 같이, RVLC 플래그가 VLC 수행을 나타내면 normal VLC 기능을 수행하고 VLC escape 모드시 FLC를 수행하는 intra/inter TCOEF VLC & VLC ESC. 수행부(310) 와; 상기 RVLC 플래그가 RVLC 수행을 나타내면 RVLC 기능을 수행하고 RVLC escape 모드시 FLC를 수행하는 intra/inter TCOEF RVLC & RVLC ESC. 수행부(320) 와; 상기 RVLC 플래그에 따라, 상기 intra/inter TCOEF VLC & V

LC ESC. 수행부(310)에서 출력되는 intra/inter TCOEF VLC/FLC 코드와 상기 intra/inter TCOEF RVLC & RVLC ESC. 수행부(320)에서 출력되는 intra/inter TCOEF RVLC/FLC 코드를 다중화하여 VLC 코드와 FLC 코드를 상기 TCOEF 비트 스트림 생성기(400)로 출력하는 TCOEF VLC/FLC 다중화부(330)로 구성된다.

상기 intra/inter TCOEF VLC & VLC ESC. 수행부(310)는 도6에 도시된 바와 같이, TCOEF VLC 테이블에서 원하는 VLC 모드를 검색하여 그 결과에 따라 escape 모드인 지를 판단하고, escape 모드이면 타이밍 컨트롤러(313)로 escape 모드 신호를 전송하며, 판단된 모드에 따라 가변 길이 부호화를 수행하는 intra/inter TCOEF VLC 수행부(315)와; RMAX, RUN+를 계산하는 intra/inter RMAX, RUN+ 계산부(311)와; LMAX, LEVEL+를 계산하는 intra/inter LMAX, LEVEL+ 계산부(312)와; 상기 intra/inter RMAX, RUN+ 계산부(311)에서 계산된 RMAX, RUN+를 제공받고, 상기 intra/inter LMAX, LEVEL+ 계산부(312)에서 계산된 LMAX, LEVEL+를 제공받으며, 상기 intra/inter TCOEF VLC 수행부(315)로부터 전송받는 escape 모드 신호에 따라, LEVEL과 LEVEL+ 선택 기능과 RUN과 RUN+ 선택 기능을 수행하고 각 해당 블럭의 동작 제어 기능을 수행하는 타이밍 컨트롤러(313)와; 상기 타이밍 컨트롤러(313)의 제어에 따라, TCOEF 부호화를 위해 LEVEL의 절대치를 계산하는 LEVEL 절대값 계산부(314)와; 상기 intra/inter TCOEF VLC 수행부(315)에서 RUN, LEVEL, LAST를 이용한 가변 길이 부호화가 끝난 시점에, 상기 LEVEL 절대값 계산부(314)에서 출력되는 데이터를 이용하여 상기 intra/inter TCOEF VLC 수행부(315)로부터의 데이터에 사인비트(sign bit)를 첨가하는 부호비트 에더(sign bit adder)(317)와; 상기 타이밍 컨트롤러(313)의 동작 제어 신호에 따라 동작하여, MPEG4와 H.263의 DCT 계수에 대해 각각 FLC 부호화를 수행하는 MPEG4/H.263 TCOEF FLC 수행부(316)와; 상기 타이밍 컨트롤러(313)의 제어에 따라, 상기 부호 비트 에더(317)의 출력과 상기 MPEG4/H.263 TCOEF FLC 수행부(316)의 출력을 다중화하는 intra/inter TCOEF VLC/FLC 다중화부(318)로 구성된다.

상기 intra/inter TCOEF RVLC & RVLC ESC. 수행부(320)는 도7에 도시된 바와 같이, TCOEF 부호화를 위해 LEVEL의 절대치를 계산하는 LEVEL 절대값 계산부(321)와; 상기 LEVEL 절대값 계산부(321)에서 출력되는 신호, RLC 인에이블 신호, RVLC 플래그, intra_inter 플래그를 입력받아 RVLC를 수행하는 intra/inter TCOEF RVLC 수행부(322)와; 상기 intra/inter TCOEF RVLC 수행부(322)에서 출력되는 RVLC 부호화 코드에 상기 LEVEL 절대값 계산부(321)로부터의 LEVEL sign bit를 첨가하는 sign bit adder(323)와; escape 모드일 때 FLC를 수행하는 TCOEF RVLC FLC 수행부(324)와; 상기 TCOEF RVLC FLC 수행부(324)의 출력과 상기 sign bit adder(323)의 출력을, 상기 intra/inter TCOEF RVLC 수행부(322)로부터의 escape 모드 신호에 따라 다중화하여 상기 TCOEF VLC/FLC 다중화부(330)로 출력하는 intra/inter TCOEF RVLC/FLC 다중화부(325)로 구성된다.

상기와 같은 본 발명에 의한 다른 실시예 동영상압축 부호화장치의 가변 길이 부호화의 출력을 위한 장치의 작용을 설명하면 다음과 같다.

TCOEF VLC/RVLC ESC. 수행부(300)는 RVLC 플래그에 따라 normal VLC 기능과 RVLC 기능을 수행하고, VLC escape 모드시 FLC를 수행한다. TCOEF 비트 스트림 생성기(400)는 TCOEF VLC/RVLC ESC. 수행부(300)에서 출력되는 가변 길이 부호화(VLC) 코드와 고정 길이 부호화(FLC) 코드를 블럭(block) 단위로 하나의 비트열로 램(500)에 쓰기 위해 재구성한다. TCOEF VLC/RVLC 버퍼(램)(500)은 TCOEF 비트 스트림 생성기(400)에서 출력되는 TCOEF 비트열을 저장하고 원하는 곳에 출력한다.

상기 TCOEF VLC/RVLC ESC. 수행부(300)의 작용을 좀더 상세히 설명하면, 도5에 도시된 바와 같이, RVLC 플래그로 2개의 module(310)(320)을 선택한다.

즉, RVLC 플래그가 VLC 수행을 나타내면, intra/inter TCOEF VLC & VLC ESC. 수행부(310)는 normal VLC 기능을 수행하고 VLC escape 모드시 FLC를 수행한다. 그리고 상기 RVLC 플래그가 RVLC 수행을 나타내면 intra/inter TCOEF RVLC & RVLC ESC. 수행부(320)는 RVLC 기능을 수행하고 RVLC escape 모드시 FLC를 수행한다.

intra/inter TCOEF VLC & VLC ESC. 수행부(310)는 MPEG4와 H.263에 대해 같은 TCOEF VLC 테이블을 사용하여 부호화하고, intra/inter TCOEF RVLC & RVLC ESC. 수행부(320)는 MPEG4와 H.263에 대해 다른 VLC 테이블을 사용하여 부호화한다.

TCOEF VLC/FLC 다중화부(330)는 상기 RVLC 플래그에 따라, 상기 intra/inter TCOEF VLC & VLC ESC. 수행부(310)에서 출력되는 intra/inter TCOEF VLC/FLC 코드와 상기 intra/inter TCOEF RVLC & RVLC ESC. 수행부(320)에서 출력되는 intra/inter TCOEF RVLC/FLC 코드를 다중화하여 VLC 코드와 FLC 코드를 상기 TCOEF 비트 스트림 생성기(400)로 출력한다.

그리고 상기 intra/inter TCOEF VLC & VLC ESC. 수행부(310)의 작용을 좀더 상세히 설명하면 도6에 도시된 바와 같이, intra/inter TCOEF VLC 수행부(315)는, RUN, LEVEL, LAST를 가지고 TCOEF VLC 테이블에서 먼저 인덱스를 찾고, 이 때 escape mode이면 타이밍 컨트롤러(313)로 escape 모드 신호를 전송한다. 그러면 타이밍 컨트롤러(313)는 intra/inter LMAX, LEVEL+ 계산부(312)에서 이미 찾아진 LEVEL+ 값을 선택하여 intra/inter TCOEF VLC 수행부(315)로 전송하고, 다시 TCOEF VLC 테이블을 찾도록 한다. 그 결과 escape mode가 다시 선택되면 미리 선택된 RUN+를 가지고 다시 TCOEF VLC 테이블을 참조한다. 그 결과 escape mode가 다시 선택되면 FLC를 수행하도록 타이밍 컨트롤러(313)에서 MPEG4/H.263 TCOEF FLC 수행부(316)를 제어하여 FLC를 수행하도록 한다.

이러한 방법은 Intra TCOEF일 때와 Inter TCOEF일 때 동일하게 적용되고, 실제 구성 테이블과 LEVEL+와 RUN+ 참고 표는 다르다. 그리고 Inter TCOEF VLC는 H.263 VLC와 동일하게 적용된다.

그리고 escape mode일 때 FLC 방법이 다르므로 H.263 플래그에 의해 FLC 방법을 스위칭한다.

한편 LEVEL 절대값 계산부(314)는 LEVEL 값의 절대치를 계산한다. 그리고 signbit adder(부호비트 가산기)는 intra/inter TCOEF VLC 수행부(315)의 출력 신호인 unsigned VLC code에 sign_bit를 붙인다.

intra/inter TCOEF VLC/FLC 다중화부(318)는 타이밍 컨트롤러(313)의 제어에 따라 상기 부호 비트 에더(317)의 출력과 상기 MPEG4/H.263 TCOEF FLC 수행부(316)의 출력을 다중화하여 상기 TCOEF VLC/FLC 다중화부(330)로 출력한다.

또한 intra/inter TCOEF RVLC & RVLC ESC. 수행부(320)의 작용을 상세히 설명하면, 도7에 도시된 바와 같이, RVLC는 Intra RVLC와 Inter RVLC의 테이블 구성이 다르다. RVLC가 escape mode일 때, FLC 방법은 Intra 프레임 부호화와 Inter 프레임 부호화가 모두 같다.

RVLC 부호화를 위해 선택되는 모드 정보를 이용하여 LEVEL의 sign bit를 처리하고, escape 모드일 때 FLC를 수행하며, 이들의 정보를 intra/inter TCOEF RVLC/FLC 다중호부(325)에서 상기 escape 모드임을 나타내는 신호에 따라 다중화하여 상기 TCOEF VLC/FLC 다중화부(330)로 출력한다.

발명의 효과

이상에서 살펴본 바와 같이, 본 발명 동영상압축 부호화장치의 가변 길이 부호화기는, 동영상 압축 부호화 장치에서 전송 채널이 허용하는 저전송선로를 통하는 비교적 적은 영상정보에 대해 가변 길이 부호화하고, 가변 길이 부호화시 에러 손실을 복구할 수 있으며 역방향 가변 길이 부호화(Reverse Variable Length Coding)와 호환성을 가지도록 한 효과가 있다.

(57) 청구의 범위

청구항 1.

동영상 압축 부호화 장치에서 전송 채널이 허용하는 저전송선로를 통하는 비교적 적은 영상정보에 대해 가변 길이 부호화를 수행하기 위한 장치에 있어서,

영상정보 부호화(texture coding)에서 나오는 매크로블럭 헤더 정보 중 휘도 블럭 패턴(Coded Block Pattern for Luminance; CBPY)을 intra_inter 플래그(intra 프레임 부호화와 inter 프레임 부호화를 선택하기 위한 제어 신호)에 따라 VLC 코드로 처리하는 휘도 블럭 패턴 처리부와;

매크로블럭 헤더 정보 중 매크로블럭 타입(MB type)과 CBPC(Coded Block Pattern for Chrominance)의 정보를 VLC 코드로 정의하는 MCBPC와;

매크로블럭 헤더 정보 중의 하나인 이전의 움직임 벡터와 현재의 움직임 벡터 간의 차이값을 VLC 코드로 처리하는 움직임 벡터 차이값 처리부(Motion Vector Difference; MVD)와;

매크로블럭 헤더 정보 중의 하나인 휘도 DCT DC 크기(dct_dc_size_lum.)를 위한 VLC 코드를 처리하는 휘도 DCT DC 크기 처리부와;

매크로블럭 헤더 정보 중의 하나인 색차 DCT DC 크기(dct_dc_size_chro.)를 위한 VLC 코드를 처리하는 색차 DCT DC 크기 처리부와;

영상정보 부호화(texture coding) 과정에서 zigzag scan을 거친 DCT 계수(TCOEF)를 입력받아 버퍼링하고, escape 모드를 고려한 VLC를 하기 위해 필요한 클럭 레이트(clock rate)에 맞추어 RLC로 출력하는 입력 버퍼와;

상기 입력버퍼에서 출력되는 DCT AC 계수를 RLC(Run Length Coding)를 수행하여, VLC 부호화하기 위해 필요한 제어 정보를 출력하는 RLC와;

역방향 가변 길이 부호화(RVLC)와 가변 길이 부호화(VLC)를 선택하기 위한 제어 신호(RVLC 플래그), H.263 TCOEF VLC를 선택하기 위한 제어 신호(H.263 플래그), intra 프레임 부호화와 inter 프레임 부호화를 선택하기 위한 제어 신호(intra_inter 플래그)를 선택적으로 입력받아, 역방향 가변 길이 부호화(RVLC), intra TCOEF 가변 길이 부호화(VLC), inter TCOEF VLC, H.263 TCOEF VLC가 선택적으로 수행되도록 상기 RLC로부터의 경로를 각각 스위칭하는 제1 내지 제4 스위치와;

상기 제1 내지 제3 스위치에 의해 선택되면 MPEG4 intra TCOEF를 intra escape 모드로 VLC를 수행하는 intra TCOEF/MPEG4 intra ESC. 수행부와;

상기 제1 내지 제3 스위치에 의해 선택되면 MPEG4 inter TCOEF를 inter escape 모드로 VLC를 수행하는 inter TCOEF/MPEG4 inter ESC. 수행부와;

상기 제1 및 제2 스위치에 의해 선택되면 H.263 TCOEF를 inter 프레임 부호화를 사용하여 escape 모드를 수행하는 TCOEF/H.263 ESC. 수행부와;

상기 제1, 제2, 제4 스위치에 의해 선택되면 intra TCOEF를 RVLC 수행하고 escape 모드시 고정길이 부호화(Fixed Length Coding; FLC)를 수행하는 intra RVLC TCOEF /ESC. FLC 수행부와;

상기 제1, 제2, 제4 스위치에 의해 선택되면 inter TCOEF를 RVLC 수행하고 escape 모드시 고정길이 부호화(Fixed Length Coding; FLC)를 수행하는 inter RVLC TCOEF /ESC. FLC 수행부로 구성된 것을 특징으로 하는 동영상압축부호화장치의 가변 길이 부호화기.

청구항 2.

제 1 항에 있어서, 상기 RLC에서 출력되는 VLC 부호화하기 위해 필요한 제어 정보는,

현재 부호화되는 0이 아닌 DCT 계수가 블럭 내의 마지막 0이 아닌 DCT 계수인 지를 나타내는 LAST, 0이 아닌 계수의 값을 나타내는 LEVEL, 부호화되는 계수 앞의 연속적인 0의 개수를 나타내는 RUN임을 특징으로 하는 동영상압축부호화장치의 가변 길이 부호화기.

청구항 3.

제 1 항에 있어서,

상기 제1 스위치는 상기 RLC에서 출력되는 제어정보(LAST, LEVEL, RUN)를 RVLC 플래그에 따라 상기 제2 스위치와 상기 제4스위치 중 하나로 스위칭하고, 상기 제2 스위치는 상기 제1 스위치에서 출력되는 정보를 H.263플래그에 따라 상기 제3 스위치와 상기 TCOEF/H.263 ESC. 수행부 중 하나로 스위칭하며, 상기 제3 스위치는 상기 제2 스위치에서 출력되는 정보를 intra_inter 플래그에 따라 상기 intra TCOEF/MPEG4 intra ESC. 수행부와 상기 inter TCOEF/MPEG4 inter ESC. 수행부 중 하나로 스위칭하고, 상기 제4 스위치는 상기 제1 스위치에서 출력되는 정보를 상기 intra_inter 플래그에 따라 상기 intra RVLC TCOEF /ESC. FLC 수행부와 상기 inter RVLC TCOEF /ESC. FLC 수행부 중 하나로 스위칭하는 것을 특징으로 하는 동영상압축 부호화장치의 가변 길이 부호화기.

청구항 4.

동영상 압축 부호화 장치에서 전송 채널이 허용하는 저전송선로를 통하는 비교적 적은 영상정보에 대해 가변 길이 부호화 장치에 있어서,

RVLC 플래그에 따라 normal VLC 기능과 RVLC 기능을 수행하고, VLC escape 모드시 FLC를 수행하는 TCOEF VLC/RVLC ESC. 수행부와;

상기 TCOEF VLC/RVLC ESC. 수행부에서 출력되는 가변 길이 부호화 코드와 고정 길이 부호화(FLC) 코드를 블럭(block) 단위로 하나의 비트열로 램(TCOEF VLC/RVLC 버퍼)에 쓰기 위해 재구성하는 TCOEF 비트 스트림 생성기와;

상기 TCOEF 비트 스트림 생성기에서 출력되는 TCOEF 비트열을 저장하는 TCOEF VLC/RVLC 버퍼(램)으로 구성된 것을 특징으로 하는 동영상압축 부호화장치의 가변 길이 부호화기.

청구항 5.

제 4 항에 있어서, 상기 TCOEF VLC/RVLC ESC. 수행부는,

RVLC 플래그가 VLC 수행을 나타내면 normal VLC 기능을 수행하고 VLC escape 모드시 FLC를 수행하는 intra/inter TCOEF VLC & VLC ESC. 수행부와; 상기 RVLC 플래그가 RVLC 수행을 나타내면 RVLC 기능을 수행하고 RVLC escape 모드시 FLC를 수행하는 intra/inter TCOEF RVLC & RVLC ESC. 수행부와; 상기 RVLC 플래그에 따라, 상기 intra/inter TCOEF VLC & VLC ESC. 수행부에서 출력되는 intra/inter TCOEF VLC/FLC 코드와 상기 intra/inter TCOEF RVLC & RVLC ESC. 수행부에서 출력되는 intra/inter TCOEF RVLC/FLC 코드를 다중화하여 VLC 코드와 FLC 코드를 상기 TCOEF 비트 스트림 생성기로 출력하는 TCOEF VLC/FLC 다중화부로 구성된 것을 특징으로 하는 동영상압축 부호화장치의 가변 길이 부호화기.

청구항 6.

제 5 항에 있어서,

상기 intra/inter TCOEF VLC & VLC ESC. 수행부는, MPEG4와 H.263에 대해 같은 TCOEF VLC 테이블을 사용하여 부호화하고, 상기 intra/inter TCOEF RVLC & RVLC ESC. 수행부는 MPEG4와 H.263에 대해 다른 VLC 테이블을 사용하여 부호화하는 것을 특징으로 하는 동영상압축 부호화장치의 가변 길이 부호화기.

청구항 7.

제 5 항에 있어서, 상기 intra/inter TCOEF VLC & VLC ESC. 수행부는,

TCOEF VLC 테이블에서 원하는 VLC 모드를 검색하여 그 결과에 따라 escape 모드인 지를 판단하고, escape 모드이면 타이밍 컨트롤러로 escape 모드 신호를 전송하며, 판단된 모드에 따라 가변 길이 부호화를 수행하는 intra/inter TCOEF VLC 수행부와; RMAX, RUN+를 계산하는 intra/inter RMAX, RUN+ 계산부와; LMAX, LEVEL+를 계산하는 intra/inter LMAX, LEVEL+ 계산부와; 상기 intra/inter RMAX, RUN+ 계산부에서 계산된 RMAX, RUN+를 제공받고, 상기 intra/inter LMAX, LEVEL+ 계산부에서 계산된 LMAX, LEVEL+를 제공받으며, 상기 intra/inter TCOEF VLC 수행부로부터 전송받는 escape 모드 신호에 따라, LEVEL과 LEVEL+ 선택 기능과 RUN과 RUN+ 선택 기능을 수행하고 각 해당 블럭의 동작 제어 기능을 수행하는 타이밍 컨트롤러와; 상기 타이밍 컨트롤러의 제어에 따라, TCOEF 부호화를 위해 LEVEL의 절대치를 계산하는 LEVEL 절대값 계산부와; 상기 intra/inter TCOEF VLC 수행부에서 RUN, LEVEL, LAST를 이용한 가변 길이 부호화가 끝난 시점에, 상기 LEVEL 절대값 계산부에서 출력되는 데이터를 이용하여 상기 intra/inter TCOEF VLC 수행부로부터의 데이터에 사인비트(sign bit)를 첨가하는 부호비트 에더(sign bit adder)와; 상기 타이밍 컨트롤러의 동작 제어 신호에 따라 동작하여, MPEG4와 H.263의 DCT 계수에 대해 각각 FLC 부호화를 수행하는 MPEG4/H.263 TCOEF FLC 수행부와; 상기 타이밍 컨트롤러의 제어에 따라, 상기 부호비트 에더의 출력과 상기 MPEG4/H.263 TCOEF FLC 수행부의 출력을 다중화하는 intra/inter TCOEF VLC/FLC 다중화부로 구성된 것을 특징으로 하는 동영상압축 부호화장치의 가변 길이 부호화기.

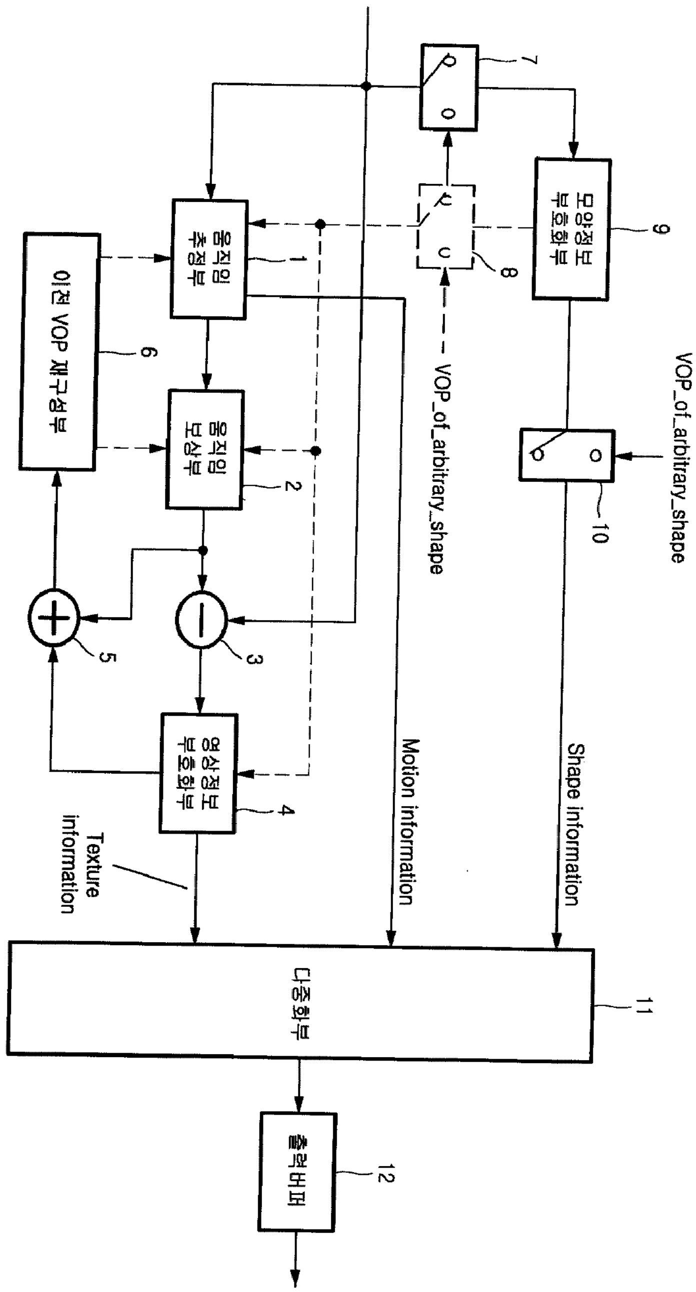
청구항 8.

제 5 항에 있어서, 상기 intra/inter TCOEF RVLC & RVLC ESC. 수행부는,

TCOEF 부호화를 위해 LEVEL의 절대치를 계산하는 LEVEL 절대값 계산부와; 상기 LEVEL 절대값 계산부에서 출력되는 신호, RLC 인에이블 신호, RVLC 플래그, intra_inter 플래그를 입력받아 RVLC를 수행하는 intra/inter TCOEF RVLC 수행부와; 상기 intra/inter TCOEF RVLC 수행부에서 출력되는 RVLC 부호화 코드에 상기 LEVEL 절대값 계산부로부터의 LEVEL sign bit를 첨가하는 sign bit adder와; escape 모드일 때 FLC를 수행하는 TCOEF RVLC FLC 수행부와; 상기 TCOEF RVLC FLC 수행부의 출력과 상기 sign bit adder의 출력을, 상기 intra/inter TCOEF RVLC 수행부로부터의 escape 모드 신호에 따라 다중화하여 상기 TCOEF VLC/FLC 다중화부로 출력하는 intra/inter TCOEF RVLC/FLC 다중화부로 구성된 것을 특징으로 하는 동영상압축 부호화장치의 가변 길이 부호화기.

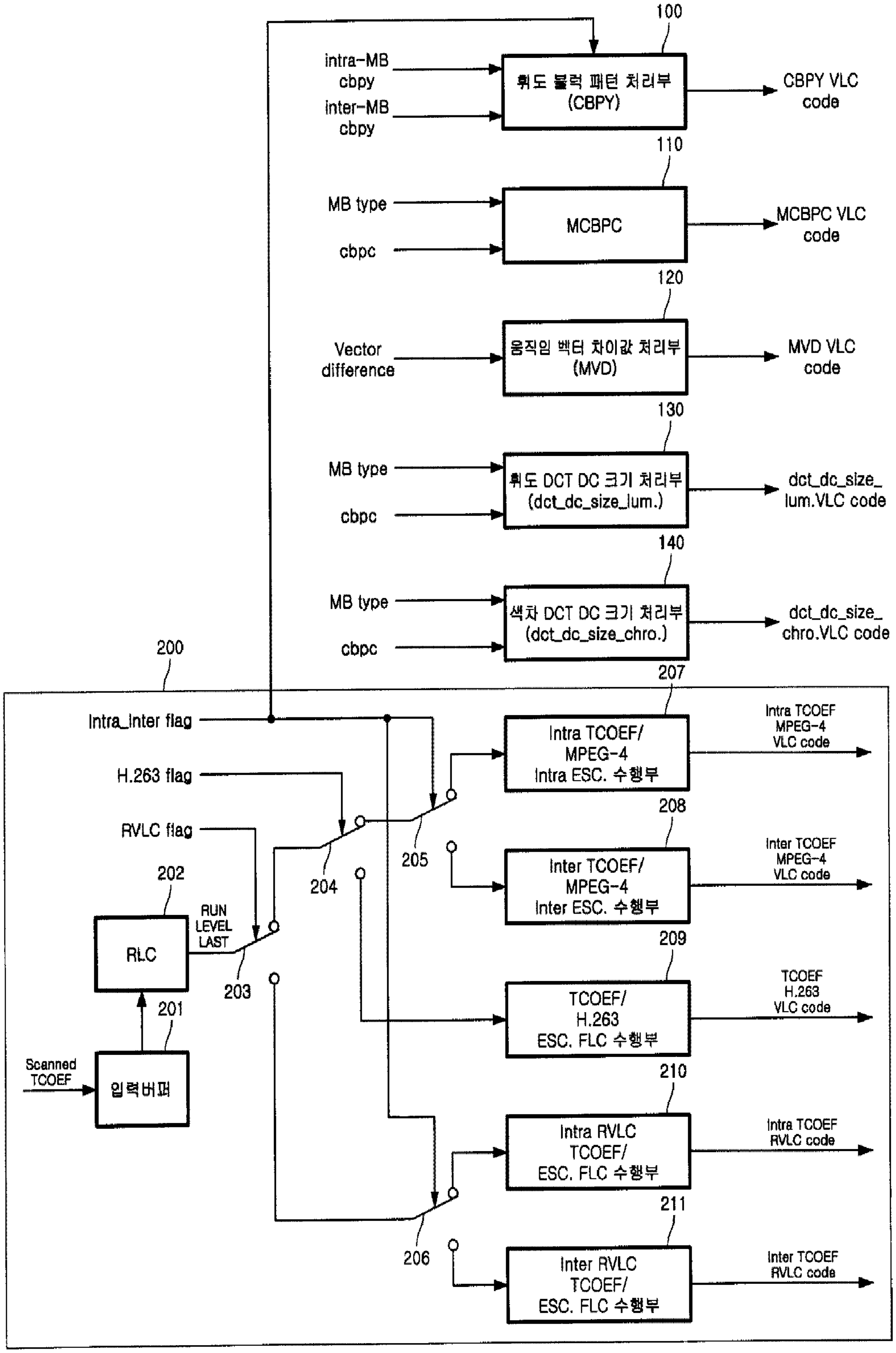
도면

도면 1



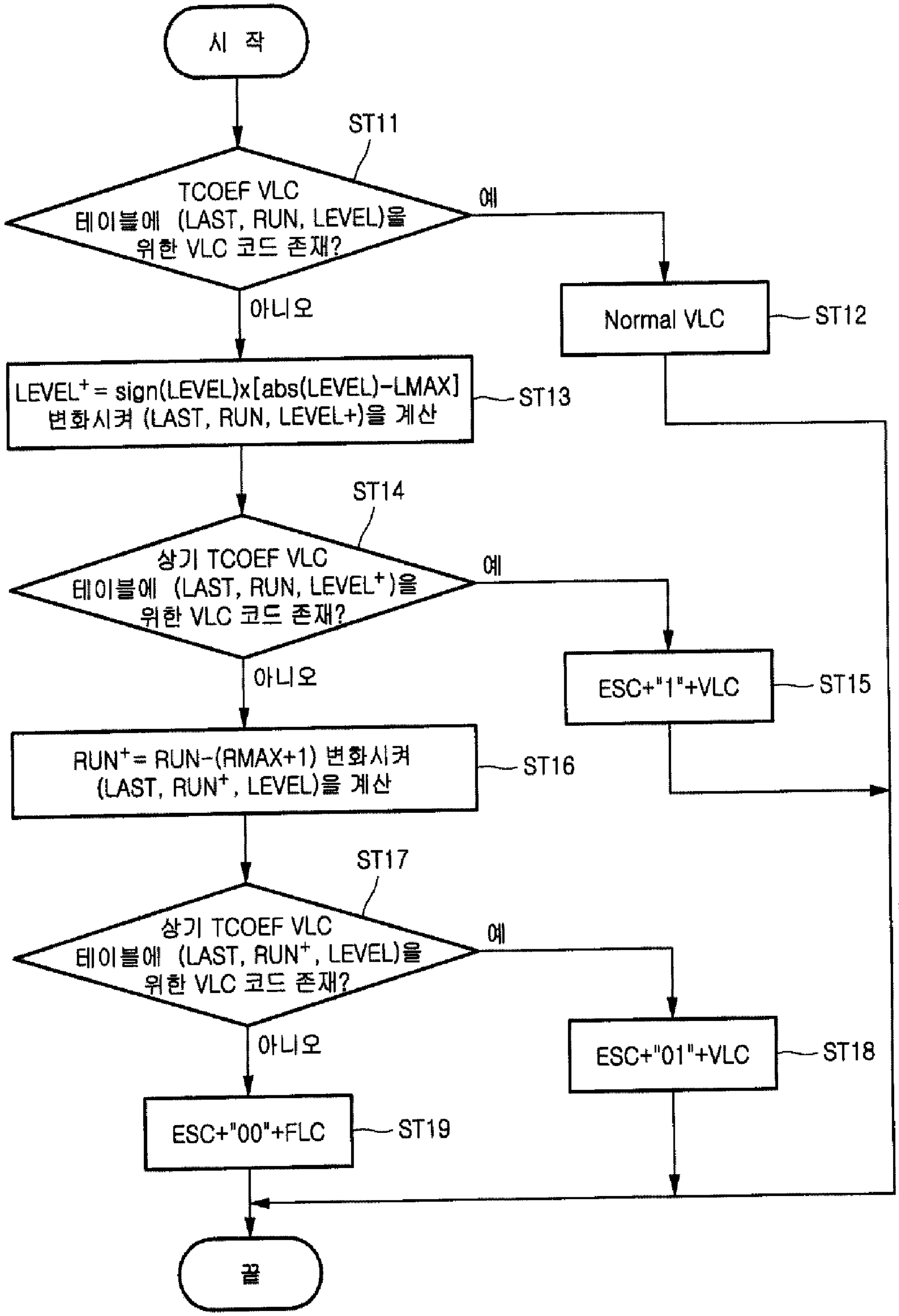
움직임 추정부
움직임 보상부
영상정보 부호화부
이전 VOP 재구성부
모양정보 부호화부
다중화부
출력버퍼
VOP_of_arbitrary_shape
VOP_of_arbitrary_shape
Motion information
Shape information
Texture information
1
2
3
4
5
6
7
8
9
10
11
12

도면 2

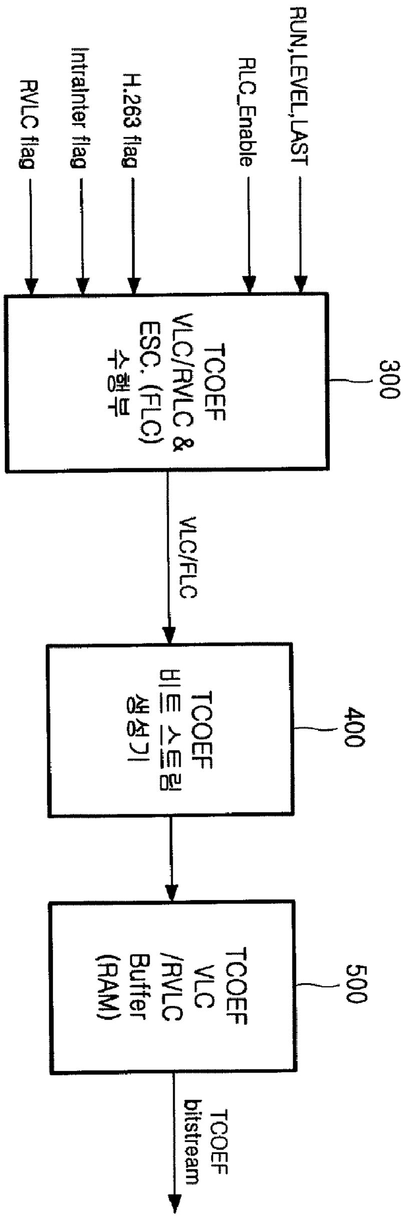


100
intra-MB cbpy
inter-MB cbpy
휘도 블럭 패턴 처리부 (CBPY)
CBPY VLC code
110
MB type
cbpc
MCBPC
MCBPC VLC code
120
Vector difference
움직임 벡터 차이값 처리부 (MVD)
MVD VLC code
130
MB type
cbpc
휘도 DCT DC 크기 처리부 (dct_dc_size_lum.)
dct_dc_size_lum.VLC code
140
MB type
cbpc
색차 DCT DC 크기 처리부 (dct_dc_size_chro.)
dct_dc_size_chro.VLC code
200
207
Intra_Inter flag
H.263 flag
RVLC flag
Intra TCOEF/ MPEG-4 Intra ESC. 수행부
Intra TCOEF MPEG-4 VLC code
208
205
204
202
Inter TCOEF/ MPEG-4 Inter ESC. 수행부
Inter TCOEF MPEG-4 VLC code
RUN LEVEL LAST
RLC
203
209
TCOEF/ H.263 ESC. FLC 수행부
TCOEF H.263 VLC code
201
Scanned TCOEF
입력버퍼
210
Intra RVLC TCOEF/ ESC. FLC 수행부
Intra TCOEF RVLC code
211
206
Inter RVLC TCOEF/ ESC. FLC 수행부
Inter TCOEF RVLC code

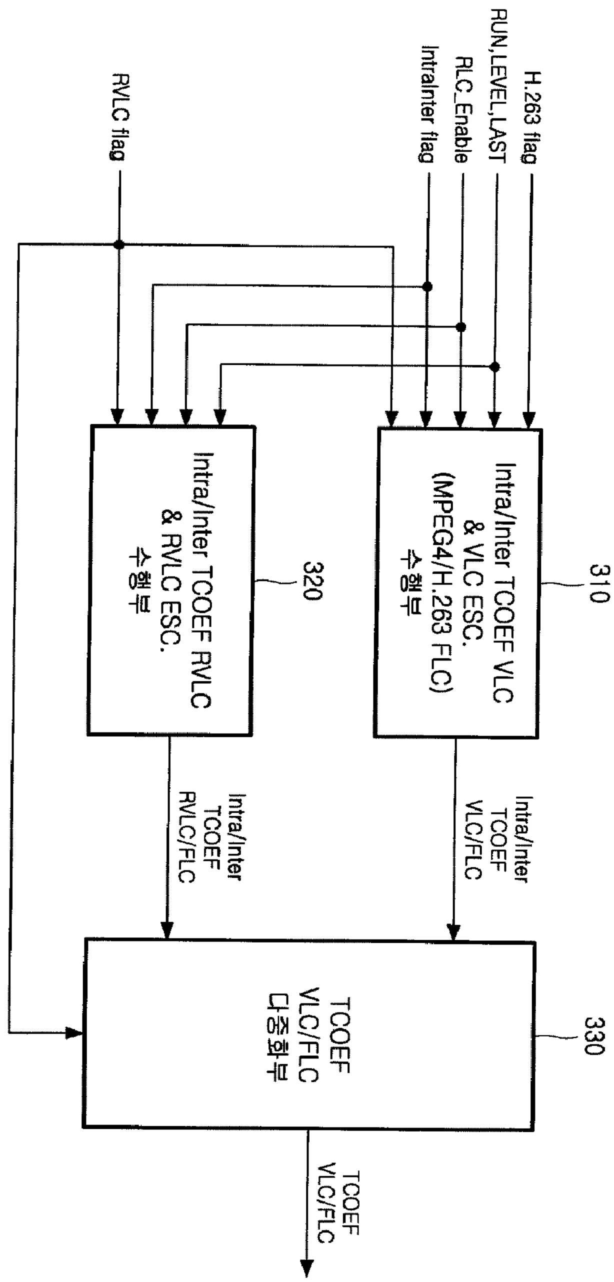
도면 3


시 작
ST11
TCOEF VLC 테이블에 (LAST, RUN, LEVEL)을 위한 VLC 코드 존재?
예
아니오
Normal VLC
ST12
LEVEL+ = sign(LEVEL)x[abs(LEVEL)-LMAX] 변화시켜 (LAST, RUN, LEVEL+)을 계산
ST13
ST14
상기 TCOEF VLC 테이블에 (LAST, RUN, LEVEL+)을 위한 VLC 코드 존재?
예
아니오
ESC+"1"+VLC
ST15
RUN+= RUN-(RMAX+1) 변화시켜 (LAST, RUN+, LEVEL)을 계산
ST16
ST17
상기 TCOEF VLC 테이블에 (LAST, RUN+, LEVEL)을 위한 VLC 코드 존재?
예
아니오
ESC+"01"+VLC
ST18
ESC+"00"+FLC
ST19
끝

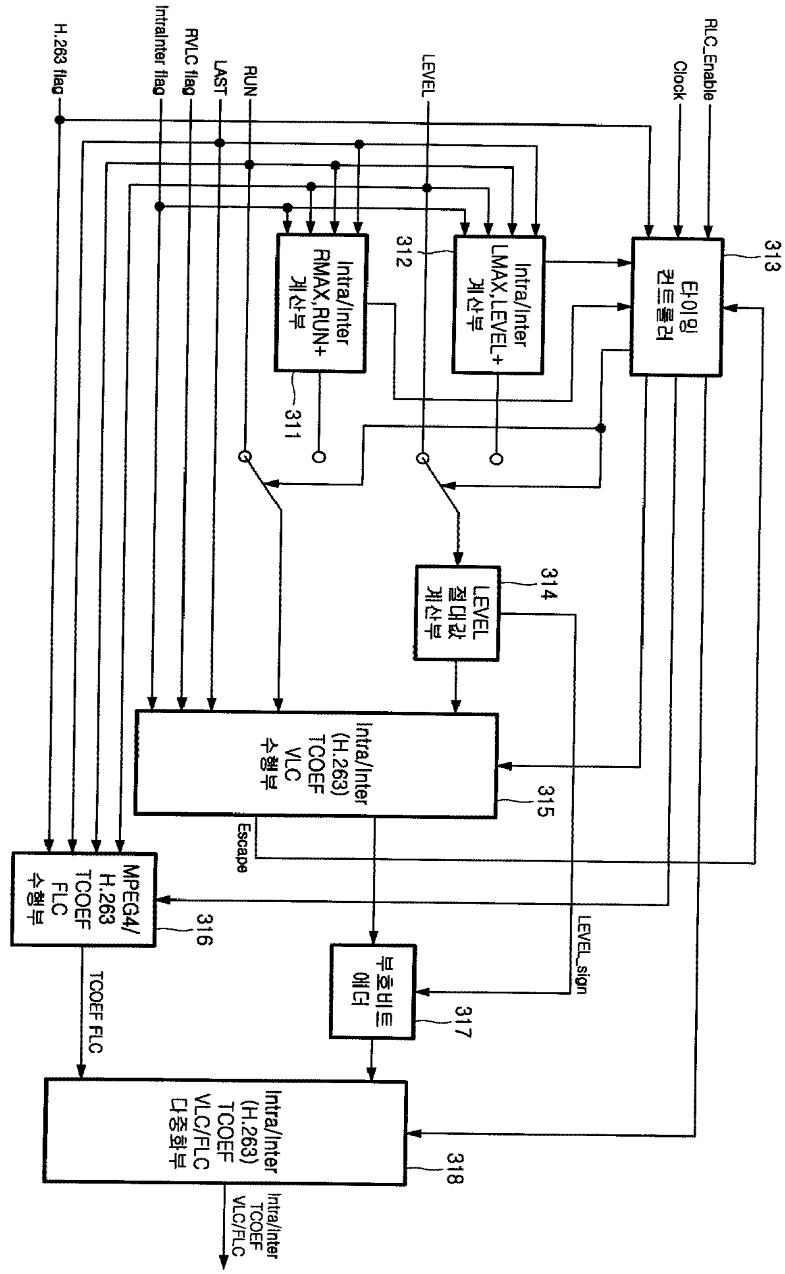
도면 4


RUN,LEVEL,LAST
RLC_Enable
H.263 flag
IntraInter flag
RVLC flag
300
TCOEF
VLC/RVLC &
ESC. (FLC)
수행부
VLC/FLC
400
TCOEF
비트 스트림
생성기
500
TCOEF
VLC
/RVLC
Buffer
(RAM)
TCOEF
bitstream

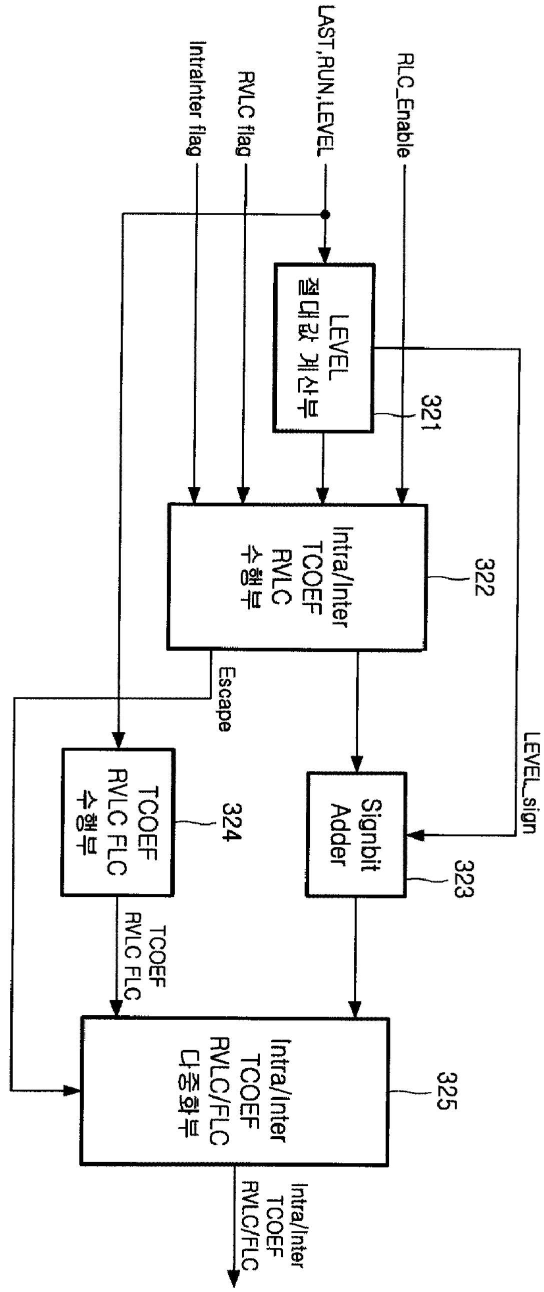
도면 5


H.263 flag
RUN,LEVEL,LAST
RLC_Enable
IntraInter flag
RVLC flag
310
Intra/Inter TCOEF VLC
& VLC ESC.
(MPEG4/H.263 FLC)
수행부
320
Intra/Inter TCOEF RVLC
& RVLC ESC.
수행부
Intra/Inter
TCOEF
VLC/FLC
Intra/Inter
TCOEF
RVLC/FLC
330
TCOEF
VLC/FLC
다중화부
TCOEF
VLC/FLC

도면 6


RLC_Enable
Clock
LEVEL
RUN
LAST
RVLC flag
IntraInter flag
H.263 flag
313
타이밍 컨트롤러
312
Intra/Inter LMAX,LEVEL+ 계산부
Intra/Inter RMAX,RUN+ 계산부
311
314
LEVEL 절대값 계산부
315
Intra/Inter (H.263) TCOEF VLC 수행부
Escape
316
MPEG4/ H.263 TCOEF FLC 수행부
LEVEL_sign
317
부호비트 에더
TCOEF FLC
318
Intra/Inter (H.263) TCOEF VLC/FLC 다중화부
Intra/Inter TCOEF VLC/FLC

도면 7


RLC_Enable
LAST,RUN,LEVEL
RVLC flag
IntraInter flag
LEVEL
절대값 계산부
321
Intra/Inter
TCOEF
RVLC
수행부
322
Escape
LEVEL_sign
Signbit
Adder
323
TCOEF
RVLC FLC
수행부
324
TCOEF
RVLC FLC
Intra/Inter
TCOEF
RVLC/FLC
다중화부
325
Intra/Inter
TCOEF
RVLC/FLC

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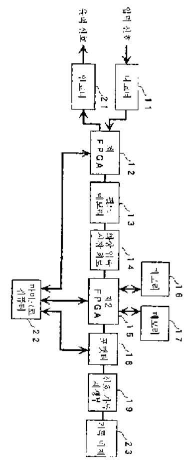
(54) VIDEO RECORDING/REPRODUCING APPARATUS AND VIDEO RECORDING/REPRODUCING METHOD

(57) Abstract:

When a recording stop request is inputted during recording operation, operation of reading data from a memory and operation of recording data on a recording medium are continued. A video recording/reproducing apparatus has a means for stopping writing data in the memory and a means for stopping recording operation after reading the data last written in the memory and writing the data on the recording medium are completed.



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(54) 영상 기록 재생 장치 및 영상 기록 재생 방법

요약

기록 동작 중에 기록 정지 요구가 입력되었을 때, 메모리로부터의 데이터의 판독 동작 및 기록 매체로의 데이터의 기록 동작을 계속시키지만, 메모리로의 데이터의 기입을 정지시키는 수단, 및 메모리에 마지막으로 기입된 데이터의 판독 및 기록 매체로의 기입이 종료한 후에, 기록 동작을 정지시키는 수단을 포함한다.

대표도
도 2

색인어

기록 매체, 영상 기록, 압축 데이터, 영상 데이터, 비디오 테이프, 메모리

명세서

기술분야

본 발명은 디지털 VTR 등의 영상 기록 재생 장치 및 영상 기록 재생 방법에 관한 것이다.

배경기술

종래의 아날로그 VTR에서는, 기록 동작 중에 기록 정지 요구가 발생한 경우에는 즉시 기록 동작을 정지시키면 된다. 예를 들면, 기록 동작 중에 사용자가 녹화 정지 버튼을 누르면, 아날로그 VTR은 즉시 기록 동작을 정지시킨다.

그런데, 감시 카메라에 의해 촬상된 영상을, 예를 들면, JPEG 방식의 화상 압축 장치에 의해 압축한 후에 메모리에 기억하고, 메모리에 소정 용량분의 압축 데이터가 축적되면, 메모리로부터 이들 압축 데이터를 판독하여 비디오 테이프에 기록하는 디지털 VTR가 이미 개발되어 있다.

이러한 종류의 디지털 VTR에서는, 기록 동작 중에 기록 정지 요구가 발생한 경우에 즉시 기록 동작을 정지시키면, 기록 정지 명령 요구가 발생할 때까지 메모리에 축적되고 또한 비디오 테이프에 아직 기록되어 있지 않은 영상 데이터가 비디오 테이프에 기록되지 않게 된다는 문제가 있다.

본 발명은, 기록 정지 명령 요구가 발생할 때까지 메모리에 축적된 영상 데이터를 기록 매체에 기록할 수 있는 영상 기록 재생 장치 및 영상 기록 재생 방법을 제공하는 것을 목적으로 한다.

또한, 본 발명은, 기록 정지 명령 요구가 발생할 때까지 메모리에 축적된 영상 데이터를 기록 정지 명령 요구 후에 메모리로부터 판독하고 있는 도중에, 기록 요구가 발생한 경우에, 메모리 내의 미판독의 영상 데이터(기록 매체에 아직 기록되어 있지 않은 영상 데이터)에 새로운 영상 데이터가 덮어쓰기 되는 것을 방지할 수 있는 영상 기록 재생 장치 및 영상 기록 재생 방법을 제공하는 것을 목적으로 한다.

발명의 상세한 설명

본 발명에 따른 제1 영상 기록 재생 장치는, 기록 시에는, 입력 영상 데이터 또는 그 압축 데이터를 메모리에 기입해 가고, 메모리에 소정 용량분의 데이터가 기입되면, 메모리로부터 이들 데이터를 판독하여 기록 매체에 기록하는 영상 기록 재생 장치로서, 기록 동작 중에 기록 정지 요구가 입력되었을 때, 메모리로부터의 데이터의 판독 동작 및 기록 매체로의 데이터의 기록 동작을 계속시키지만, 메모리로의 데이터의 기입을 정지시키는 수단, 및 메모리에 마지막으로 기입된 데이터의 판독 및 기록 매체로의 기입이 종료한 후에, 기록 동작을 정지시키는 수단을 포함하는 것을 특징으로 하다.

본 발명에 따른 제2 영상 기록 재생 장치는, 기록 시에는, 입력 영상 데이터 또는 그 압축 데이터를 메모리에 기입해 가고, 메모리에 소정 용량분의 데이터가 기입되면, 메모리로부터 이들 데이터를 판독하여 기록 매체에 기록하는 영상 기록 재생 장치로서, 기록 동작 중에 기록 정지 요구가 입력되었을 때, 메모리로부터의 데이터의 판독 동작 및 기록 매체로의 데이터의 기록 동작을 계속시키지만, 메모리로의 데이터의 기입을 정지시키는 회로, 및 메모리에 마지막으로 기입된 데이터의 판독 및 기록 매체로의 기입이 종료한 후에, 기록 동작을 정지시키는 회로를 구비하는 것을 특징으로 한다.

본 발명에 따른 제1 영상 기록 재생 방법은, 기록 시에는, 입력 영상 데이터 또는 그 압축 데이터를 메모리에 기입해 가

고, 메모리에 소정 용량분의 데이터가 기입되면, 메모리로부터 이들 데이터를 판독하여 기록 매체에 기록하는 영상 기록 재생 방법으로서, 기록 동작 중에 기록 정지 요구가 입력될 때, 메모리로부터의 데이터의 판독 동작 및 기록 매체로의 데이터의 기록 동작을 계속시키지만, 메모리로의 데이터의 기입을 정지시키는 단계, 및 메모리에 마지막으로 기입된 데이터의 판독 및 기록 매체로의 기입이 종료한 후에, 기록 동작을 정지시키는 단계를 포함하는 것을 특징으로 한다.

본 발명에 따른 제3 영상 기록 재생 장치는, 기록 시에는, 입력 영상 데이터 또는 그 압축 데이터를 소정의 블록 단위마다 2개의 메모리에 교대로 기입해 가고, 어느 하나의 메모리에 1 블록분의 데이터가 기입될 때마다, 그 메모리로부터 이들 데이터를 판독하여 기록 매체에 기록하는 영상 기록 재생 장치로서, 기록 동작 중에 기록 정지 요구가 입력되었을 때, 메모리로부터의 데이터의 판독 동작 및 기록 매체로의 데이터의 기록 동작을 계속시키지만, 메모리로의 데이터의 기입을 정지시키는 수단, 메모리에 마지막으로 기입된 데이터의 판독 및 기록 매체로의 기입이 종료하기 전에, 기록 요구가 입력되었을 때에는, 현재 데이터의 판독이 행해지고 있는 한쪽의 메모리와는 다른 메모리를 새로운 데이터를 최초로 기입하기 위한 메모리로서 지정한 후, 지정한 메모리로의 데이터의 기입을 재개시키는 수단, 및 메모리에 마지막으로 기입된 데이터의 판독 및 기록 매체로의 기입이 종료하기 전에, 기록 요구가 입력되지 않았을 때는, 메모리에 마지막으로 기입된 데이터의 판독 및 기록 매체로의 기입이 종료한 후에, 기록 동작을 정지시키는 수단을 포함하는 것을 특징으로 한다.

본 발명에 따른 제4 영상 기록 재생 장치는, 기록 시에는, 입력 영상 데이터 또는 그 압축 데이터를 소정의 블록 단위마다 2개의 메모리에 교대로 기입해 가고, 어느 하나의 메모리에 1 블록분의 데이터가 기입될 때마다, 그 메모리로부터 이들 데이터를 판독하여 기록 매체에 기록하는 영상 기록 재생 장치에 있어서, 기록 동작 중에 기록 정지 요구가 입력되었을 때, 메모리로부터의 데이터의 판독 동작 및 기록 매체로의 데이터의 기록 동작을 계속시키지만, 메모리로의 데이터의 기입을 정지시키는 회로, 메모리에 마지막으로 기입된 데이터의 판독 및 기록 매체로의 기입이 종료하기 전에, 기록 요구가 입력되었을 때는, 현재 데이터의 판독이 행해지고 있는 한쪽의 메모리와는 다른 메모리를 새로운 데이터를 최초로 기입하기위한 메모리로서 지정한 후, 지정한 메모리로의 데이터의 기입을 재개시키는 회로, 및 메모리에 마지막으로 기입된 데이터의 판독 및 기록 매체로의 기입이 종료하기 전에, 기록 요구가 입력되지 않았을 때에는, 메모리에 마지막으로 기입된 데이터의 판독 및 기록 매체로의 기입이 종료한 후에, 기록 동작을 정지시키는 회로를 구비하는 것을 특징으로 한다.

본 발명에 따른 제2 영상 기록 재생 방법은, 기록 시에는, 입력 영상 데이터 또는 그 압축 데이터를 소정의 블록 단위마다 2개의 메모리에 교대로 기입해 가고, 어느 하나의 메모리에 1 블록분의 데이터가 기입될 때마다, 그 메모리로부터 이들 데이터를 판독하여 기록 매체에 기록하는 영상 기록 재생 방법으로서, 기록 동작 중에 기록 정지 요구가 입력되었을 때, 메모리로부터의 데이터의 판독 동작 및 기록 매체로의 데이터의 기록 동작을 계속시키지만, 메모리로의 데이터의 기입을 정지시키는 단계, 메모리에 마지막으로 기입된 데이터의 판독 및 기록 매체로의 기입이 종료하기 전에, 기록 요구가 입력되었을 때에는, 현재 데이터의 판독이 행해지고 있는 한쪽의 메모리와는 다른 메모리를 새로운 데이터를 최초로 기입하기 위한 메모리로서 지정한 후, 지정한 메모리로의 데이터의 기입을 재개시키는 단계, 및 메모리에 마지막으로 기입된 데이터의 판독 및 기록 매체로의 기입이 종료하기 전에, 기록 요구가 입력되지 않았을 때는, 메모리에 마지막으로 기입된 데이터의 판독 및 기록 매체로의 기입이 종료한 후에, 기록 동작을 정지시키는 단계를 포함하는 것을 특징으로 한다.

도면의 간단한 설명

도 1은 감시 시스템의 구성을 도시한 블록도.

도 2는 디지털 VTR의 개략 구성을 도시한 블록도.

도 3은 비디오 테이프에 기록되는 1 필드분의 데이터에 대한 포맷을 도시한 모식도.

도 4는 기록 동작 중에 기록 정지 요구가 입력된 경우의 마이크로 컴퓨터의 동작을 설명하는 흐름도.

도 5는 기록 정지 요구가 입력된 후에 메모리로부터의 데이터의 판독 및 기록 매체로의 데이터의 기록이 계속되고 있을 때, 기록 요구가 입력된 경우의 마이크로 컴퓨터의 동작을 설명하는 흐름도.

도 6은 재생 시에 메모리(16, 17)에 저장되는 데이터를 도시한 모식도.

실시예

이하, 도면을 참조하여, 본 발명을, 감시 카메라에 의해 촬상된 영상을 기록 재생하는 디지털 VTR에 적용한 경우의 실시예에 대하여 설명한다.

〔1〕감시 시스템의 전체적인 구성의 설명

도 1은 감시 시스템의 전체적인 구성을 도시하고 있다.

감시 시스템은, 비디오 카메라(이하, 감시 카메라라 함)(101)와, 감시 카메라(101)에 의해 얻어지는 영상 신호를 압축하여 비디오 테이프에 기록하기 위한 디지털 VTR(102)과, 디지털 VTR(102)에 의해 재생된 영상을 표시하는 모니터(103)를 구비하고 있다.

〔2〕디지털 VTR(102)의 영상 신호 처리 회로의 기록 시의 동작에 대한 설명

도 2는 디지털 VTR(102)의 영상 신호 처리 회로의 구성을 도시하고 있다. 영상 신호 처리 회로의 기록 시의 동작에 대하여 설명한다.

기록 시에는, 감시 카메라(101)로부터 전송되어 온 아날로그의 영상 신호는, 디코더(11)에 의해 디지털의 영상 데이터로 변환된다. 디코더(11)에 의해 얻어진 영상 데이터는, 제1 FPGA(12)(필드 프로그래머블 게이트 어레이)로 보내진다.

제1 FPGA(12)는 입력된 영상 데이터를, 사전에 정해진 소정 필드수 주기(이하, 화상 페치 주기라 함)로, 필드 메모리(13)에 저장해 간다. 필드 메모리(13)에 저장된 영상 데이터는, 화상 압축 신장 회로(14)로 보내지고, 화상 압축 신장 회로 (14)에 의해, 필드 단위마다 예를 들면 JPEG 방식으로 압축된다. 화상 압축 신장 회로(14)에 의해 얻어진 압축 영상 데이터(부호화 데이터)는, 제2 FPGA(15)로 보내진다.

제2 FPGA(15)는, 화상 압축 신장 회로(14)로부터 전송되어 온 부호화 데이터에, 기록 시각 정보(현재의 연월일 분초의 정보), 알람 정보, 카메라 번호 등의 부가 정보를 부가한다. 알람 정보란, 시큐러티 상에 중요한 사상(事象)이 발생한 것이 검출된 경우에 발생시키는 알람 신호에 기초하여 생성되는 정보이다. 예를 들면, 감시 카메라(101)는, 입력 영상의 이동 벡터가 소정값 이상으로 되었을 때 알람 신호를 발생하여 마이크로 컴퓨터(22)로 송신한다. 또한, 외부에 설치된 물체 검지 센서로부터 마이크로 컴퓨터(22)에 물체 검지 신호가 입력되었을 때 마이크로 컴퓨터(22)는 알람 신호를 발생한다. 카메라 번호란, 복수의 감시 카메라로부터의 영상이 시분할되어 디지털 VTR(102)에 입력되도록 한 시스템에서, 각 감시 카메라를 식별하기 위한 정보이다.

제2 FPGA(15)는, 부가 정보를 부가한 부호화 데이터를, 복수 필드분의 데이터를 포함하는 소정 블록 단위마다 2개의 메모리(16, 17)에 교대로 기입하고, 1 블록분의 데이터가 메모리에 기입될 때마다, 1 블록분의 데이터의 기입이 종료한 메모리로부터, 데이터를 판독하여, 포맷터(18)로 보낸다. 1 블록은, 본 예에서는, 오디오에 관한 정보도 포함하여, 288 트랙분의 데이터로 구성된다.

즉, 제2 FPGA(15)는 부가 정보가 부가된 부호화 데이터를, 한쪽의 메모리, 예를 들면, 제1 메모리(16)에 기입해 간다. 그리고, 제1 메모리(16)로의 1 블록분의 데이터의 기입이 종료하면, 데이터를 기입하는 메모리가 다른 쪽의 제2 메모리(17)로 전환됨과 동시에, 제1 메모리(16)로부터 데이터의 판독이 개시된다.

제1 메모리(16)로부터 판독된 데이터는, 포맷터(18)로 보내진다. 그리고, 제1 메모리(16)로부터의 1 블록분의 데이터의 판독이 완료하면, 판독이 정지된다.

이 후, 제2 메모리(17)로의 1 블록분의 데이터의 기입이 종료하면, 데이터를 기입하는 메모리가 제1 메모리(16)로 전환됨과 동시에, 제2 메모리(17)로부터, 데이터의 판독이 개시된다. 제2 메모리(7)로부터 판독된 데이터는, 포맷터(18)로 보내진다. 그리고, 제2 메모리(17)로부터의 1 블록분의 데이터의 판독이 완료하면, 판독이 정지된다. 이후, 마찬가지의 처리가 반복된다.

포맷터(18)에서는, 전송되어 온 데이터를 비디오 테이프에 기록할 수 있는 데이터 구조의 데이터로 변환한다. 포맷터(18)에 의해 얻어진 데이터는, 신호 기록 재생부(19) 내의 기록 증폭기 및 비디오 헤드를 통해, 비디오 테이프(기록 매체)(23)에 기록된다. 즉, 비디오 테이프(23)에는, 기본적으로는, 1 블록(288 트랙분) 단위로 영상 데이터가 기록된다. 1 블록 단위의 데이터의 기록이 종료할 때마다, 비디오 테이프는 정지된다.

또, 제2 FPGA(15) 및 포맷터(18)는, 마이크로 컴퓨터(22)에 의해 제어된다.

도 3은, 비디오 테이프에 기록되는 1 필드분의 데이터에 대한 포맷을 도시하고 있다.

1 필드분의 데이터 블록은, 헤더부(51), 오디오 데이터부(52) 및 영상 데이터부(53)로 구성된다.

헤더부(51)에는, 기록 시각 정보, 알람 정보, 카메라 번호 등의 부가 정보, 양자화 테이블(Q 테이블), 음성 부가 데이터 등이 포함되어 있다. 헤더부(51)의 선두에는, 헤더부(51)의 선두인 것을 나타내는 프레임 헤더(예를 들면, "E1FFh")가 삽입되어 있다. 영상 데이터부(53)의 마지막에는, 영상 데이터부의 최후인 것을 나타내는 엔드 코드(EOI; 예를 들면, "D9FFh")가 삽입되어 있다.

〔3〕기록 동작 중에 기록 정지 요구가 입력된 경우의 동작에 대한 설명

기록 정지 요구는, 사용자에 의해 녹화 정지 버튼이 눌러졌을 때, 타이머 기록 시에 기록 종료 시각이 되었을 때, 알람 신호가 입력되어 있을 때에만 영상을 기록하는 등의 알람 기록에서 알람 정보가 입력되지 않게 되었을 때, 발생된다.

도 4는, 기록 동작 중에 기록 정지 요구가 입력된 경우의 마이크로 컴퓨터(22)의 동작을 도시하고 있다.

기록 동작 중에 기록 정지 요구가 입력되면(단계 1), 메모리(16, 17)로의 데이터의 기입을 정지시킨다(단계 2).

단, 메모리(16, 17)로부터의 데이터의 판독 및 기록 매체(23)로의 데이터의 기록은 계속시킨다(단계 3). 그리고, 메모리(16, 17)에 저장되어 있는 데이터 중,마지막으로 기입된 데이터의 판독이 종료하면(단계 4에서 "예"), 메모리(16, 17)로부터의 데이터의 판독을 정지시킨다(단계 5).

그리고, 메모리(16, 17)로부터 판독된 데이터의 기록 매체(23)로의 기록이 종료하며 또한 1 블록분의 데이터량에 미치지 않는 데이터량에 상당하는 더미 데이터의 기록 매체(23)로의 기록이 종료하면(단계 6에서 "예"), 기록 동작을 정지시킨다(단계 7).

[4] 기록 정지 요구가 입력된 후에 메모리(16, 17)로부터의 데이터의 판독이 계속되고 있을 때, 기록 요구가 입력된 경우의 동작에 대한 설명

기록 요구는, 사용자에 의해 녹화 버튼이 눌러졌을 때, 타이머 기록 시에 기록 개시 시각이 되었을 때, 알람 신호가 입력되고 있을 때에만 영상을 기록하는 등의 알람 기록에서 알람 신호가 입력되었을 때, 발생한다.

도 5는, 기록 정지 요구가 입력된 후에 메모리(16, 17)의 한쪽부터의 데이터의 판독이 계속되고 있을 때, 기록 요구가 입력된 경우의 마이크로 컴퓨터(22)의 동작을 도시하고 있다.

기록 정지 요구가 입력된 후에 메모리(16, 17) 중 어느 한쪽으로부터의 데이터의 판독이 계속되고 있을 때, 기록 요구가 입력되면, 메모리(16, 17) 중, 현재, 데이터의 판독이 행해지고 있는 메모리와는 다른 쪽의 메모리를 새로운 데이터를 최초로 기입하는 메모리로서 지정한다(단계 11).

단계 11에서 지정한 메모리가, 전회의 기록 요구에 기초하는 기록 동작 중에 최후의 데이터가 기입된 메모리인지의 여부를 판별한다(단계 12). 단계 11에서 지정한 메모리가 전회의 기록 요구에 기초하는 기록 동작 중에 최후의 데이터가 기입된 메모리인 경우(현재 판독이 행해지고 있는 메모리가, 전회의 기록 요구에 기초하는 기록 동작 중에 최후의 데이터가 기입된 메모리가 아닌 경우)에는, 단계 11에서 지정한 메모리의 어드레스 중, 상기 최후의 데이터가 기입된 어드레스의 다음의 어드레스를 기입 개시 어드레스로서 설정한 후, 단계 11에서 지정한 메모리로의 데이터의 기입을 재개시킨다(단계 13).

이 경우에는, 현재 판독이 행해지고 있는 메모리로부터 1 블록의 잔여 데이터가 판독되어 기록 매체에 기록되면, 비디오 테이프가 일단 정지된다.

단계 11에서 지정한 메모리가, 전회의 기록 요구에 기초한 기록 동작 중에 최후의 데이터가 기입된 메모리가 아닌 경우(현재 판독이 행해지고 있는 메모리가, 전회의 기록 요구에 기초하는 기록 동작 중에 최후의 데이터가 기입된 메모리인 경우)에는, 단계 11에서 지정한 메모리의 선두 어드레스를 기입 개시 어드레스로서 설정한 후, 단계 11에서 지정한 메모리로의 데이터의 기입을 재개시킨다(단계 14).

이 경우에는, 현재 판독이 행해지고 있는 메모리로부터 전회의 기록 요구에 기초한 기록 동작 중에 기입된 최후의 데이터가 판독되면, 이 메모리로부터의 데이터의 판독이 정지된다. 그리고,이 메모리로부터 판독된 데이터의 기록 매체로의 기록이 종료하고, 또한 1 블록분의 데이터량에 미치지 않는 데이터량에 상당하는 더미 데이터가 기록 매체에 기록되면, 일단 비디오 테이프가 정지된다.

기록 요구가 입력되었을 때, 예를 들면, 제1 메모리(16)로부터 데이터가 판독되고 있다고 하면, 제2 메모리(17)가 새로운 데이터를 최초로 기입하는 메모리로서 지정된다. 따라서, 새롭게 입력된 영상 데이터의 압축 데이터(부호화 데이터)는, 제2 메모리(17)에 기입된다.

단, 제2 메모리가, 전회의 기록 요구에 기초한 기록 동작 중에 최후의 데이터가 기입된 메모리인 경우에는, 제2 메모리의 어드레스 중, 상기 최후의 데이터가 기입된 어드레스의 다음의 어드레스가 기입 개시 어드레스로서 설정된다. 제2 메모리가, 전회의 기록 요구에 기초하는 기록 동작 중에 최후의 데이터가 기입된 메모리가 아닌 경우에는, 제2 메모리의 선두 어드레스가 기입 개시 어드레스로서 설정된다.

그리고, 제2 메모리(17)에 1 블록분의 미 판독 데이터가 축적되면, 데이터를 기입하는 메모리가 제1 메모리(16)로 전환됨과 동시에, 제2 메모리(17)로부터, 데이터의 판독이 개시된다.

[5] 영상 신호 처리 회로의 재생 시의 동작에 대한 설명

재생 시에는, 신호 기록 재생부(19) 내의 비디오 헤드에 의해 비디오 테이프로부터 1 블록 단위마다 데이터가 판독된다. 판독된 영상 데이터는, 신호 기록 재생부(19) 내의 재생 증폭기 및 포맷터(18)를 통해 제2 FPGA(15)로 보내진다.

제2 FPGA(15)는, 전송되어 온 데이터(부호화 데이터 및 부가 데이터)를, 블록 단위마다 2개의 메모리(16, 17)에 교대로 기입해 가고, 1 블록분의 데이터가 메모리에 기입될 때마다, 1 블록분의 데이터의 기입이 종료한 메모리로부터 데이터를 판독하여 화상 압축 신장 회로(14)로 보낸다.

도 6은, 제2 FPGA(15)에 의해 메모리(16, 17)에 저장되는 데이터를 도시하고 있다. 제2 FPGA(15)는, 포맷터(18)로부터 전송되어 온 데이터를 메모리(16, 17) 내의 메인 뱅크(MAIN BANK)에 1 필드 단위마다 기입함과 함께, 메인 뱅크에 기입되는 1필드 단위마다의 필드 데이터 D_1, D_2, …, D_n의 기입 어드레스를 인식할 수 있도록 하기 위해, 메모리(16, 17) 내의 서브 뱅크(SUB BANK)에 각 필드 데이터 D_1, D_2, …, D_n의 선두에 있는 프레임 헤더의 선두 저장 어드레스를 저장한다.

도 6에 도시한 바와 같이, 메모리(16, 17)에, D_1, D_2, …, D_n의 순서로 필드 데이터가 기입되었다고 하면, 통상 재생 시에는, D_2, D_2, …, D_n의 순으로, 필드 데이터가 재생된다.

통상 재생 시에는, 마이크로 컴퓨터(22)는, 서브 뱅크의 어드레스를 S_1, S_2,…, S_n의 순서로 순차 지정해 감에 의해, 필드 데이터가 D_1, D_2, …, D_n의 순서로 판독되고, 판독된 필드 데이터 내의 영상 부호화 데이터가 화상 압축 신장 회로(14)로 보내진다.

마이크로 컴퓨터(22)가 서브 뱅크의 어드레스 S_1를 지정한 경우의 동작에 대하여 설명한다. 마이크로 컴퓨터(22)가, 제2 FPGA(15)에 대하여, 서브 뱅크의 어드레스 S_1를 지정하면, 제2 FPGA(15)는, 지정된 어드레스 S_1에 저장되어 있는 선두 저장 어드레스를 취득하고, 취득한 선두 저장 어드레스로부터 필드 데이터 D_1를 판독한다. 이 때, 필드 데이터 D_1로부터 기록 시각 정보 등의 부가 정보가 분리된다. 분리된 데이터는, 마이크로 컴퓨터(22)로 보내진다. 또한, 필드 데이터 D_1로부터 비디오 데이터가 분리된다. 분리된 오디오 데이터는, 음성 신호 처리 회로(도시 생략)로 보내진다. 필드 데이터 D_1 내의 영상 부호화 데이터는 화상 압축 신장 회로(14)로 보내진다.

화상 압축 신장 회로(14)에서는, 전송되어 온 영상 부호화 데이터가 신장된다. 화상 압축 신장 회로(14)에 의해 얻어진 영상 데이터는 필드 메모리(13)에 축적된다. 필드 메모리(13)에 1 필드분의 영상 데이터가 축적되면, 해당 1 필드분의 영상 데이터가 제1 FPGA(12)에 의해 반복하여 판독되어 인코더(21)로 보내진다. 인코더(21)에서는, 전송되어 온 영상 데이터가 아날로그의 영상 신호로 복귀된 후, 모니터(103)로 보내진다.

상기 실시예에 따르면, 기록 정지 명령 요구가 발생할 때까지 메모리에 축적된 영상 데이터를 기록 매체에 기록할 수 있게 된다.

또한, 상기 실시예에 따르면, 기록 정지 명령 요구가 발생할 때까지 메모리에 축적된 영상 데이터를 기록 정지 명령 요구 후에 메모리로부터 판독하고 있는 도중에, 기록 요구가 발생한 경우에, 메모리 내의 미판독의 영상 데이터(기록 매체에 아직 기록되어 있지 않은 영상 데이터)에 새로운 영상 데이터가 덮어쓰기 되는 것을 방지할 수 있게 된다.

(57) 청구의 범위

청구항 1.

기록 시에는, 입력 영상 데이터 또는 그 압축 데이터를 메모리에 기입해 가고, 메모리에 소정 용량분의 데이터가 기입되면, 메모리로부터 이들 데이터를 판독하여 기록 매체에 기록하는 영상 기록 재생 장치에 있어서,

기록 동작 중에 기록 정지 요구가 입력되었을 때, 메모리로부터의 데이터의 판독 동작 및 기록 매체로의 데이터의 기록 동작을 계속시키지만, 메모리로의 데이터의 기입을 정지시키는 수단과,

메모리에 마지막으로 기입된 데이터의 판독 및 기록 매체로의 기입이 종료한 후에, 기록 동작을 정지시키는 수단

을 포함하는 것을 특징으로 하는 영상 기록 재생 장치.

청구항 2.

기록 시에는, 입력 영상 데이터 또는 그 압축 데이터를 메모리에 기입해 가고, 메모리에 소정 용량분의 데이터가 기입되면, 메모리로부터 이들 데이터를 판독하여 기록 매체에 기록하는 영상 기록 재생 장치에 있어서,

기록 동작 중에 기록 정지 요구가 입력되었을 때, 메모리로부터의 데이터의 판독 동작 및 기록 매체로의 데이터의 기록 동작을 계속시키지만, 메모리로의 데이터의 기입을 정지시키는 회로와,

메모리에 마지막으로 기입된 데이터의 판독 및 기록 매체로의 기입이 종료한 후에, 기록 동작을 정지시키는 회로

를 포함하는 것을 특징으로 하는 영상 기록 재생 장치.

청구항 3.

기록 시에는, 입력 영상 데이터 또는 그 압축 데이터를 메모리에 기입해 가고, 메모리에 소정 용량분의 데이터가 기입되면, 메모리로부터 이들 데이터를 판독하여 기록 매체에 기록하는 영상 기록 재생 방법에 있어서,

기록 동작 중에 기록 정지 요구가 입력되었을 때, 메모리로부터의 데이터의 판독 동작 및 기록 매체로의 데이터의 기록 동작을 계속시키지만, 메모리로의 데이터의 기입을 정지시키는 단계와,

메모리에 마지막으로 기입된 데이터의 판독 및 기록 매체로의 기입이 종료한 후에, 기록 동작을 정지시키는 단계

를 포함하는 것을 특징으로 하는 영상 기록 재생 방법.

청구항 4.

기록 시에는, 입력 영상 데이터 또는 그 압축 데이터를 소정의 블록 단위마다 2개의 메모리에 교대로 기입해 가고, 어느 하나의 메모리에 1 블록분의 데이터가 기입될 때마다, 그 메모리로부터 이들 데이터를 판독하여 기록 매체에 기록하는 영상 기록 재생 장치에 있어서,

기록 동작 중에 기록 정지 요구가 입력되었을 때, 메모리로부터의 데이터의 판독 동작 및 기록 매체로의 데이터의 기록 동작을 계속시키지만, 메모리로의 데이터의 기입을 정지시키는 수단과,

메모리에 마지막으로 기입된 데이터의 판독이 종료하기 전에, 기록 요구가 입력되었을 때에는, 현재 데이터의 판독이 행해지고 있는 한쪽의 메모리와는 다른 메모리를 새로운 데이터를 최초로 기입하기 위한 메모리로서 지정한 후, 지정한 메모리로의 데이터의 기입을 재개시키는 수단과,

메모리에 마지막으로 기입된 데이터의 판독이 종료하기 전에, 기록 요구가 입력되지 않았을 때에는, 메모리에 마지막으로 기입된 데이터의 판독 및 기록 매체로의 기입이 종료한 후에, 기록 동작을 정지시키는 수단

을 포함하는 것을 특징으로 하는 영상 기록 재생 장치.

청구항 5.

기록 시에는, 입력 영상 데이터 또는 그 압축 데이터를 소정의 블록 단위마다 2개의 메모리에 교대로 기입해 가고, 어느 하나의 메모리에 1 블록분의 데이터가 기입될 때마다, 그 메모리로부터 이들 데이터를 판독하여 기록 매체에 기록하는 영상 기록 재생 장치에 있어서,

기록 동작 중에 기록 정지 요구가 입력되었을 때, 메모리로부터의 데이터의 판독 동작 및 기록 매체로의 데이터의 기록 동작을 계속시키지만, 메모리로의 데이터의 기입을 정지시키는 회로와,

메모리에 마지막으로 기입된 데이터의 판독이 종료하기 전에, 기록 요구가 입력되었을 때에는, 현재 데이터의 판독이 행해지고 있는 한쪽의 메모리와는 다른 메모리를 새로운 데이터를 최초로 기입하기 위한 메모리로서 지정한 후, 지정한 메모리로의 데이터의 기입을 재개시키는 회로와,

메모리에 마지막으로 기입된 데이터의 판독이 종료하기 전에, 기록 요구가 입력되지 않았을 때에는, 메모리에 마지막으로 기입된 데이터의 판독 및 기록 매체로의 기입이 종료한 후에, 기록 동작을 정지시키는 회로

를 포함하는 것을 특징으로 하는 영상 기록 재생 장치.

청구항 6.

기록 시에는, 입력 영상 데이터 또는 그 압축 데이터를 소정의 블록 단위마다 2개의 메모리에 교대로 기입해 가고, 어느 하나의 메모리에 1 블록분의 데이터가 기입될 때마다, 그 메모리로부터 이들 데이터를 판독하여 기록 매체에 기록하는 영상 기록 재생 방법에 있어서,

기록 동작 중에 기록 정지 요구가 입력되었을 때, 메모리로부터의 데이터의 판독 동작 및 기록 매체로의 데이터의 기록 동작을 계속시키지만, 메모리로의 데이터의 기입을 정지시키는 단계와,

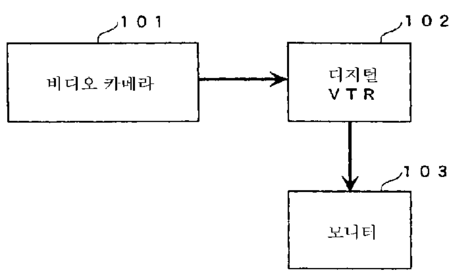
메모리에 마지막으로 기입된 데이터의 판독이 종료하기 전에, 기록 요구가 입력되었을 때에는, 현재 데이터의 판독이 행해지고 있는 한쪽의 메모리와는 다른 메모리를 새로운 데이터를 최초로 기입하기 위한 메모리로서 지정한 후, 지정한 메모리로의 데이터의 기입을 재개시키는 단계와,

메모리에 마지막으로 기입된 데이터의 판독이 종료하기 전에, 기록 요구가 입력되지 않았을 때에는, 메모리에 마지막으로 기입된 데이터의 판독 및 기록 매체로의 기입이 종료한 후에, 기록 동작을 정지시키는 단계

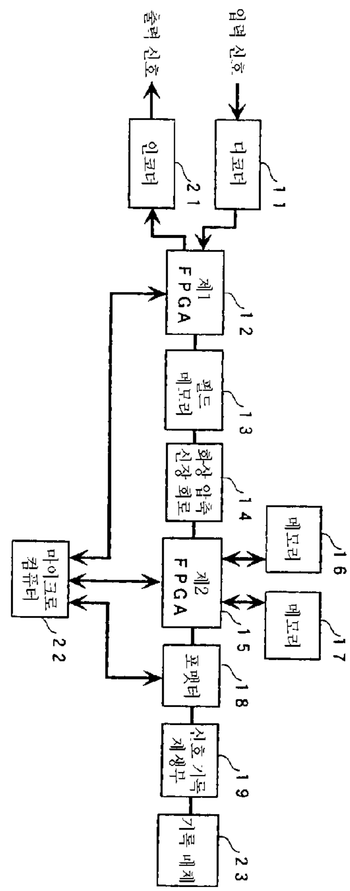
를 포함하는 것을 특징으로 하는 영상 기록 재생 방법.

도면

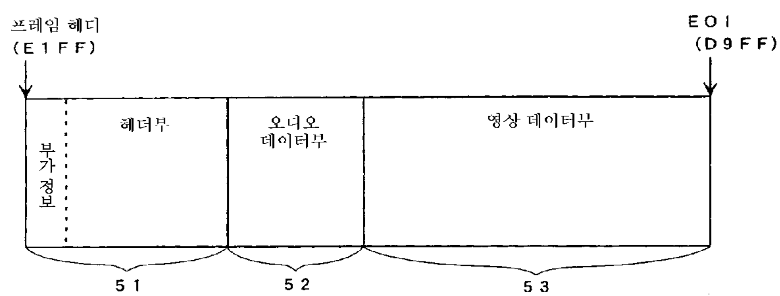
도면 1



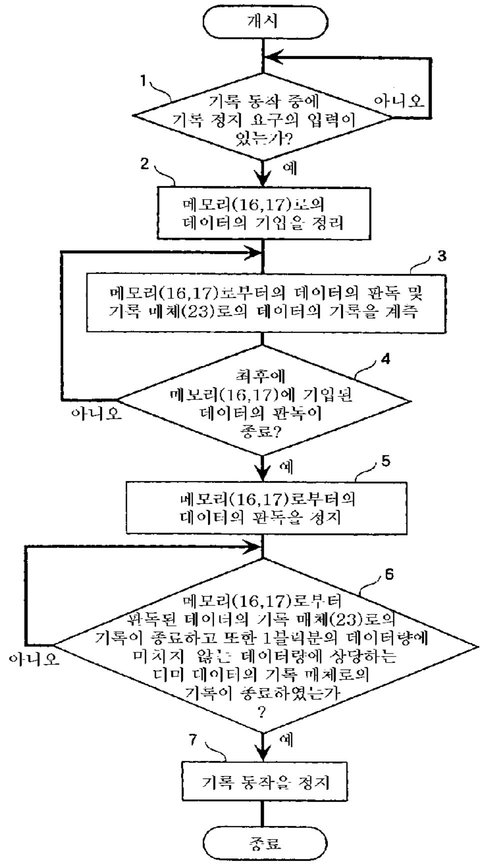
도면 2


입력 신호
출력 신호
디코더
11
인코더
21
제1 FPGA
12
필드 메모리
13
화상 압축 신장 회로
14
메모리
16
제2 FPGA
15
메모리
17
마이크로 컴퓨터
22
포맷터
18
신호 기록 재생부
19
기록 매체
23

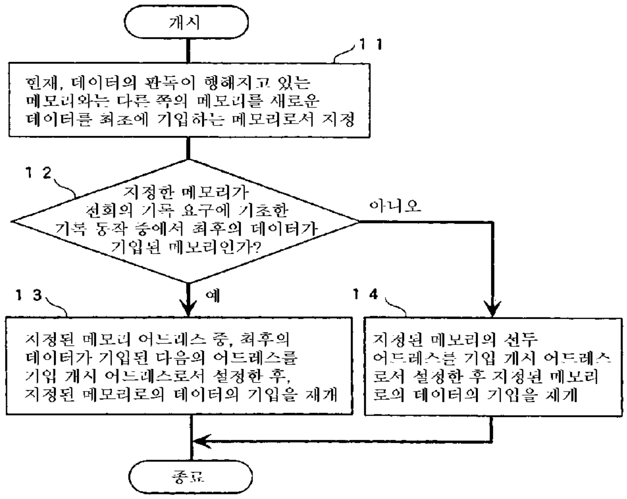
도면 3


프레임 헤더
(E1FF)
EOI
(D9FF)
부가 정보
헤더부
오디오 데이터부
영상 데이터부
51
52
53

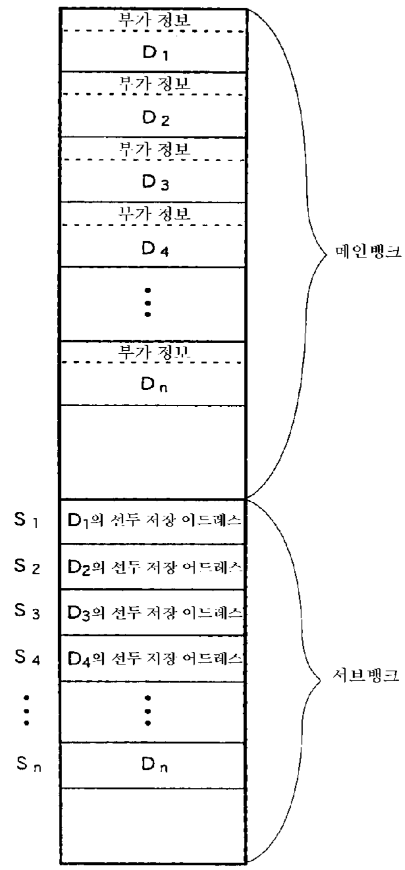
도면 4


개시
1
기록 동작 중에
기록 정지 요구의 입력이
있는가?
아니오
예
2
메모리(16,17)로의
데이터의 기입을 정리
3
메모리(16,17)로부터의 데이터의 판독 및
기록 매체(23)로의 데이터의 기록을 계속
4
최후에
메모리(16,17)에 기입된
데이터의 판독이
종료?
아니오
예
5
메모리(16,17)로부터의
데이터의 판독을 정지
6
메모리(16,17)로부터
판독된 데이터의 기록 매체(23)로의
기록이 종료하고 또한 1블럭분의 데이터량에
미치지 않는 데이터량에 상당하는
더미 데이터의 기록 매체로의
기록이 종료하였는가
?
아니오
예
7
기록 동작을 정지
종료

도면 5


개시
11
현재, 데이터의 판독이 행해지고 있는 메모리와는 다른 쪽의 메모리를 새로운 데이터를 최초에 기입하는 메모리로서 지정
12
지정한 메모리가 전회의 기록 요구에 기초한 기록 동작 중에서 최후의 데이터가 기입된 메모리인가?
아니오
예
13
지정된 메모리 어드레스 중, 최후의 데이터가 기입된 다음의 어드레스를 기입 개시 어드레스로서 설정한 후, 지정된 메모리로의 데이터의 기입을 재개
14
지정된 메모리의 선두 어드레스를 기입 개시 어드레스로서 설정한 후 지정된 메모리로의 데이터의 기입을 재개
종료

도면 6


부가 정보
D1
부가 정보
D2
부가 정보
D3
부가 정보
D4
부가 정보
Dn
메인뱅크
S1
D1의 선두 저장 이드레스
S2
D2의 선두 저장 어드레스
S3
D3의 선두 저장 이드레스
S4
D4의 선두 지장 어드레스
Sn
Dn
서브뱅크

Electronic Patent Application Fee Transmittal

Application Number:	12377617
Filing Date:	16-Feb-2009
Title of Invention:	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR
First Named Inventor/Applicant Name:	Se-Yoon Jeong
Filer:	Randall Scott Svihla/Sean Shoolbraid
Attorney Docket Number:	022090.0002

Filed as Small Entity

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Submission- Information Disclosure Stmt	2806	1	90	90
	Total in USD ($)			**90**

Electronic Acknowledgement Receipt

EFS ID:	16240421
Application Number:	12377617
International Application Number:	
Confirmation Number:	8176
Title of Invention:	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR
First Named Inventor/Applicant Name:	Se-Yoon Jeong
Customer Number:	89980
Filer:	Randall Scott Svihla/Sean Shoolbraid
Filer Authorized By:	Randall Scott Svihla
Attorney Docket Number:	022090.0002
Receipt Date:	05-JUL-2013
Filing Date:	16-FEB-2009
Time Stamp:	12:23:01
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$90
RAM confirmation Number	12038
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1	Transmittal Letter	IDS20130528_0220900002_Statement.pdf	16569 8e19bfad8e76fa566706463cc0d5360d0b9e32d0	no	2
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	IDS20130528_0220900002_IDS.pdf	42214 7be33dc6b1bf0f65dadd94da6eeaf3d162980086	no	1
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
3	Foreign Reference	EP0230632A2.pdf	505228 815f57dc3c678ed1e43b9cb26c1f1c7c47e01e7e	no	12
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Warnings:					
Information:					
			Total Files Size (in bytes):	1298724	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Docket No. 022090.0002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Se-Yoon Jeong et al.

Application No. 12/377,617 Art Unit: 2496

Confirmation No. 8176

Filed: February 16, 2009 Examiner: Courtney D. Fields

For: APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

INFORMATION DISCLOSURE STATEMENT

Mail Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This Information Disclosure Statement is being filed pursuant to 37 CFR 1.97(d) because it is being filed after the mailing date of the Notice of Allowance of May 23, 2013.

The inventor first made a connection between the three documents cited in this Information Disclosure Statement and the present application on April 25, 2013. MPEP 609.04(b)(V) states as follows regarding this situation on MPEP page 600-155:

> The time at which information was known to any individual designated in 37 CFR 1.56(c) is the time when the information was discovered <u>in association with the application</u> even if awareness of the materiality came later.

Accordingly, pursuant to 37 CFR 1.97(d)(1) and 1.97(e)(2), no item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the undersigned attorney signing this certification after making reasonable inquiry, no item of information contained in this Information Disclosure Statement was known to any individual designated in § 1.56(c), more than three months prior to the filing of this Information Disclosure Statement.

Pursuant to 37 CFR 1.97(d)(2), the small-entity fee of $90.00 set forth in 37 CFR 1.17(p) is being paid on even date herewith.

Attached hereto are a sheet entitled "Information Disclosure Statement by Applicant" listing 3 foreign patent documents, and copies of the 3 foreign patent documents (including an English abstract for each of the 2 foreign patent documents that are not in English).

The concise explanation of the relevance of KR 2012-0006149 and KR 2002-0081342 required by 37 CFR 1.98(a)(3)(i) is provided by the English abstracts of these documents.

It is respectfully requested that this Information Disclosure Statement be considered.

Please charge any fees under 1.17(p) that may be required for this paper only to Deposit Account No. 50-5113 in the name of North Star Intellectual Property Law, PC.

Respectfully submitted,

Date: July 5, 2013

/Randall S. Svihla/
Randall S. Svihla
Registration No. 56,273

NSIP Law
P.O. Box 34688
Washington, DC 20043
Telephone (202) 429-0020
Facsimile (202) 315-3758
CYP/RSS

Attachments

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/377,617	02/16/2009	Se-Yoon Jeong	022090.0002	8176

89980 7590 06/13/2013

NSIP LAW
P.O. Box 65745
Washington, DC 20035

EXAMINER	
FIELDS, COURTNEY D	

ART UNIT	PAPER NUMBER
2496	

NOTIFICATION DATE	DELIVERY MODE
06/13/2013	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

info@nsiplaw.com
pto@nsiplaw.com

PTOL-90A (Rev. 04/07)

Supplemental Notice of Allowability	**Application No.** 12/377,617	**Applicant(s)** JEONG ET AL.	
	Examiner COURTNEY FIELDS	**Art Unit** 2496	**AIA (First Inventor to File) Status** No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *06 June 2013*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on______.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *1,3-9,11,13-19 and 21-26*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.
4. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☒ All b) ☐ Some *c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. ______ .
   3. ☒ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

   Interim copies:

   a) ☐ All b) ☐ Some c) ☐ None of the: Interim copies of the priority documents have been received.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/Andrew L Nalven/
Supervisory Patent Examiner, Art Unit 2496

UNITED STATES DEPARTMENT OF COMMERCE
U.S. Patent and Trademark Office
Address : COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450

APPLICATION NO./ CONTROL NO.	FILING DATE	FIRST NAMED INVENTOR / PATENT IN REEXAMINATION	ATTORNEY DOCKET NO.
12/377,617	16 February, 2009	JEONG ET AL.	022090.0002

		EXAMINER	
NSIP LAW P.O. Box 65745 Washington, DC 20035		COURTNEY FIELDS	
		ART UNIT	PAPER
		2496	20130606

DATE MAILED:

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner for Patents

The request for proper acknowledgement of receipt of certified copies of priority documents has been received and acknowledged by the Examiner. The request for US Patent No. 8,199,819 to be listed on the 892 has been received and completed by the Examiner.

/Andrew L Nalven/
Supervisory Patent Examiner, Art Unit 2496

PTO-90C (Rev.04-03)

Notice of References Cited	Application/Control No. 12/377,617	Applicant(s)/Patent Under Reexamination JEONG ET AL.	
	Examiner COURTNEY FIELDS	Art Unit 2496	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-8,199,819	06-2012	Seo et al.	375/240.12
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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NOTICE OF ALLOWANCE AND FEE(S) DUE

89980 7590 05/23/2013

NSIP LAW
P.O. Box 65745
Washington, DC 20035

EXAMINER	
FIELDS, COURTNEY D	
ART UNIT	**PAPER NUMBER**
2496	

DATE MAILED: 05/23/2013

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/377,617	02/16/2009	Se-Yoon Jeong	022090.0002	8176

TITLE OF INVENTION: APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$890	$300	$0	$1190	08/23/2013

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

89980 7590 05/23/2013

NSIP LAW
P.O. Box 65745
Washington, DC 20035

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/377,617	02/16/2009	Se-Yoon Jeong	022090.0002	8176

TITLE OF INVENTION: APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$890	$300	$0	$1190	08/23/2013

EXAMINER	ART UNIT	CLASS-SUBCLASS
FIELDS, COURTNEY D	2496	375-240200

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
   - ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
   - ❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
   (1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
   (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
   1____________________
   2____________________
   3____________________

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies ________________

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ❑ A check is enclosed.
- ❑ Payment by credit card. Form PTO-2038 is attached.
- ❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number __________ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)

- ❑ Applicant certifying micro entity status. See 37 CFR 1.29 — NOTE: Absent a valid certification of Micro Entity Status (see form PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ❑ Applicant asserting small entity status. See 37 CFR 1.27 — NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
- ❑ Applicant changing to regular undiscounted fee status. — NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature ______________________________ Date ______________________________

Typed or printed name ______________________________ Registration No. ______________________________

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/377,617	02/16/2009	Se-Yoon Jeong	022090.0002	8176

89980 7590 05/23/2013

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P.O. Box 65745
Washington, DC 20035

EXAMINER	
FIELDS, COURTNEY D	
ART UNIT	**PAPER NUMBER**
2496	

DATE MAILED: 05/23/2013

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)

(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 682 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 682 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 12/377,617	Applicant(s) JEONG ET AL.	
	Examiner COURTNEY FIELDS	Art Unit 2496	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *20 March 2013*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on______.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *1,3-9,11,13-19 and 21-26*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.
4. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☒ All b) ☐ Some *c) ☐ None of the:
   1. ☒ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. ______ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

   Interim copies:

   a) ☐ All b) ☐ Some c) ☐ None of the: Interim copies of the priority documents have been received.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
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5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)
1. ☒ Notice of References Cited (PTO-892)
2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 20 March 2013
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☐ Examiner's Amendment/Comment
6. ☒ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/Andrew L Nalven/
Supervisory Patent Examiner, Art Unit 2496

DETAILED ACTION

1. Claims 2, 10, 12, and 20 have been cancelled.

2. Claims 25-26 have been added.

3. Claims 1, 3-9, 11, 13-19, and 21-24 have been amended.

4. Claims 1, 3-9, 11, 13-19, and 21-26 are pending.

Response to Arguments

1. Applicant's arguments filed 20 March 2013 have been fully considered and they are persuasive.

Information Disclosure Statement

1. The Information Disclosure Statement respectfully submitted on 20 March 2013 has been considered by the Examiner.

Allowable Subject Matter

2. Claims **1, 3-9, 11, 13-19, and 21-26** are allowed.

3. The following is an examiner's statement of reasons for allowance: The present invention is directed towards an encoding/decoding apparatus and method using an adaptive Discrete Cosine Transform (DCT) coefficient scanning based on pixel similarity. Claims 1 and 11 identifies the uniquely distinct features "**performing entropy encoding of the transform coefficients using a scanning mode selected based on the selected optimal intra prediction mode**". Claims 9 and 19 identifies the uniquely distinct features "**wherein the selecting of a scanning mode comprises selecting the scanning mode based on an optimal intra prediction mode that was used to**

perform intra prediction of the input video to obtain difference values that were encoded to obtain the encoded video".

The closest prior art, Park (Pub No. 2006/0002466) discloses a prediction encoder/decoder and a prediction encoding/decoding method. The prediction encoder includes a prediction encoding unit starting prediction from an origin macroblock of an area of interest of a video frame, continuing prediction in a direction of ripple scanning with respect to a square ring that includes macroblocks and surrounds the origin macroblock, and encoding video by performing intra-prediction in 8.times.8 block units using information about a macroblock that has been just coded in a square ring including a macroblock to be coded and at least one of macroblocks that are adjacent to the macroblock to be coded in a square ring that has been just coded.

However, either singularly or in combination, Park fail to anticipate or render obvious the claimed limitations of performing entropy encoding of the transform coefficients using a scanning mode selected based on the selected optimal intra prediction mode and wherein the selecting of a scanning mode comprises selecting the scanning mode based on an optimal intra prediction mode that was used to perform intra prediction of the input video to obtain difference values that were encoded to obtain the encoded video.

The closest prior art, Boon et al. (US Patent No. 7,995,654) discloses image predictive coding method. When dividing inputted image data to be coded into image data of a plurality of small regions which are adjacent to each other and coding the image data of an objective small region to be processed among the image data of the plurality of divided small regions which are adjacent to each other, reconstructed image data of a reproduction small region adjacent to the image data of the objective small region to be processed is used as image data of an intra-frame prediction small region of the objective small region to be processed, the image data of the intra-frame prediction small region is used as image data of an optimum prediction small region and image data of a difference small region which are differences between the image data of the objective small region to be processed and the image data of the optimum prediction small region is generated. Then, the generated image data of the difference small region is coded and outputted, and then the coded image data of the difference small region is decoded, so that the reconstructed image data of the reproduction small region is generated by adding the decoded image data of the difference small region to the image data of the optimum prediction small region.

However, either singularly or in combination, Boon et al. fail to anticipate or render obvious the claimed limitations of performing entropy encoding of the transform coefficients using a scanning mode selected based on the selected optimal intra prediction mode and wherein the selecting of a scanning mode comprises selecting the scanning mode based on an optimal intra prediction mode that was used to perform intra prediction of the input video to obtain difference values that were encoded to obtain the encoded video.

The closest prior art, Gaedke (US Patent No. 8,107,532) discloses method and apparatus for generating/evaluating in a picture signal encoding/decoding one or more prediction information items. Advanced Video Coding uses intra prediction for 4*4 pixel blocks whereby reconstructed samples from adjacent pixel blocks are used to predict a current block. Nine different intra prediction modes are available in AVC. In order to save bits for signaling the prediction modes, a flag and a 3-bit parameter are used. If this flag is set the most probable prediction mode, which is calculated from previous predictions, is used by the encoder and the decoder to reconstruct the actual prediction mode. If the flag is cleared, the 3-bit parameter is sent to select the prediction mode independently. According to the invention, the flag is applied more frequently, based on a prediction error threshold, instead of applying the optimum prediction mode for a current pixel block.

However, either singularly or in combination, Gaedke fail to anticipate or render obvious the claimed limitations of performing entropy encoding of the transform coefficients using a scanning mode selected based on the selected optimal intra prediction mode and wherein the selecting of a scanning mode comprises selecting the scanning mode based on an optimal intra prediction mode that was used to perform intra prediction of the input video to obtain difference values that were encoded to obtain the encoded video.

The closest prior art, Kanehara (US Patent No. 7,933,334) discloses image encoder and method thereof, computer program of image encoder, and mobile terminal. The present invention provides an image coding method comprising: selecting prediction modes from among prescribed plurality of prediction modes based on processed blocks, the number of selected prediction modes being less than the number of said prescribed plurality of prediction modes; predicting a pixel of a block in an input frame image based on selected prediction modes; calculating a difference between said predicted pixel value and a pixel value of a block in an input frame; determining a coding mode based on the result of said calculation process, said determined coding mode being used for said image coding method. And the present invention also provides an encoding circuit, encoding program, a mobile terminal, an encoding and decoding circuit relevant to the image encoding method above.

However, either singularly or in combination, Kanehara fail to anticipate or render obvious the claimed limitations of performing entropy encoding of the transform coefficients using a scanning mode selected based on the selected optimal intra prediction mode and wherein the selecting of a scanning mode comprises selecting the scanning mode based on an optimal intra prediction mode that was used to perform intra prediction of the input video to obtain difference values that were encoded to obtain the encoded video.

The closest prior art, Wang et al. (US Patent No. 7,817,718) discloses macroblock level adaptive frame/field coding for digital video content. A method and system of encoding and decoding digital video content. The digital video content comprises a stream of pictures which can each be intra, predicted, or bi-predicted pictures. Each of the pictures comprises macroblocks that can be further divided into smaller blocks. The method entails encoding and decoding each of the smaller blocks in each picture in said stream of pictures in either frame mode or in field mode.

However, either singularly or in combination, Wang et al. fail to anticipate or render obvious the claimed limitations of performing entropy encoding of the transform coefficients using a scanning mode selected based on the selected optimal intra prediction mode and wherein the selecting of a scanning mode comprises selecting the scanning mode based on an optimal intra prediction mode that was used to perform intra prediction of the input video to obtain difference values that were encoded to obtain the encoded video.

The closest prior art, Karczewicz et al. (Pub No. 2003/0081850) discloses a method and system for image coding, wherein an image is divided into a plurality of blocks for scanning. The pixels values in the scanned block are represented by a plurality of level-run value pairs, wherein the level value is indicative of a non-zero pixel value and the run value is indicative of the number of consecutive zero pixel values preceding the non-zero pixel value. A plurality of contexts indicative of the level-run value pairs are conveyed to a decoder for allowing the decoder to reconstruct the image based on the contexts. The assignment of the contexts is also based on the level value of a preceding level-run pair. Additionally, instead of an end-of-block symbol, the number of non-zero coefficients is provided to the decoder prior to conveying the contexts thereto.

However, either singularly or in combination, Karczewicz et al. fail to anticipate or render obvious the claimed limitations of performing entropy encoding of the transform coefficients using a scanning mode selected based on the selected optimal intra prediction mode and wherein the selecting of a scanning mode comprises selecting the scanning mode based on an optimal intra prediction mode that was used to perform intra prediction of the input video to obtain difference values that were encoded to obtain the encoded video.

The closest prior art, Gharavi (US Patent No. 4,821,119) discloses a method and apparatus for low bit-rate interframe video coding. As improved low bit-rate interframe video encoder is disclosed of the type known as a hybrid coder. The hybrid coder includes a block subdivider circuit and achieves image compression by using a two-dimensional signal transformation on blocks of differential pel data in the forward loop of a DPCM coder. The transform coefficients of each block are then quantized and entropy coded for transmission. Coding efficiency is in part determined by the size of the transform block. Larger blocks are more bit efficient because of the lower quantity of overhead data required, but require a complex transformer hardware implementation. In addition, larger blocks produce annoying block distortion. After differential combination (307) with a corresponding block from the previous frame, each m X m block of pel data is sub-divided (309) into smaller n X n (n ~ m) blocks of data which are individually transformed by a two-dimensional discrete cosine transformer (311). After the coefficients of each sub-block are quantized (312), the main block is reconstructed (314). An entropy encoder (315) scans the sub-blocks and codes the resultant string of scanned coefficients in such a way that the inter-sub-block correlation is efficiently exploited.

However, either singularly or in combination, Gharavi fail to anticipate or render obvious the claimed limitations of performing entropy encoding of the transform coefficients using a scanning mode selected based on the selected optimal intra prediction mode and wherein the selecting of a scanning mode comprises selecting the scanning mode based on an optimal intra prediction mode that was used to perform intra prediction of the input video to obtain difference values that were encoded to obtain the encoded video.

The closest prior art, He (Pub No. 2007/0274385) discloses a method of increasing coding efficiency and reducing power consumption by on-line scene change detection while encoding inter-frame. A system and method for on-the-fly detection of scene changes within a video stream through statistical analysis of a portion of the macroblocks comprising each video frame as they are processed using inter-frame coding. If the statistical analysis of the selected macroblocks of the current frame differs from the previous frame by exceeding predetermined thresholds, the current video frame is assumed to be a scene change. Once a scene change is detected, the remainder of the video frame is encoded as an intra-frame, intra-macroblocks, or intra slices, through implementation of one or more predetermined or adaptively adjusted quantization parameters to reduce computational complexity, decrease power consumption, and increase the resulting video image quality. As decoding is the inverse of encoding, these improvements are similarly recognized by a decoder as it decodes a resulting encoded video stream.

However, either singularly or in combination, He fail to anticipate or render obvious the claimed limitations of performing entropy encoding of the transform coefficients using a scanning mode selected based on the selected optimal intra prediction mode and wherein the selecting of a scanning mode comprises selecting the scanning mode based on an optimal intra prediction mode that was used to perform intra prediction of the input video to obtain difference values that were encoded to obtain the encoded video.

The closest prior art, Sung et al. (Pub No. 2005/0074062) discloses fast DCT method and apparatus for digital video compression. The present invention provides method and apparatus of a fast DCT implementation. DCT calculation is combined with quantization scales by a procedure of pre-processing. During DCT coefficient calculation, only non-zero coefficients are calculated. If pixel variance range is smaller than a first predetermined threshold, a predetermined lookup table is compared to decide the DCT coefficients. When a pixel variance range of a block pixels is within the second threshold, coupled with the quantization scales, the pre-processing determines the amount of non-zero DCT coefficients need to be calculated. Only a limited amount of LSB bits within a block is applied in the calculation of DCT coefficients. A previously saved pixel with equal or closest pixel value is used to replace the operation of current pixel's multiplication.

However, either singularly or in combination, Sung et al. fail to anticipate or render obvious the claimed limitations of performing entropy encoding of the transform coefficients using a scanning mode selected based on the selected optimal intra prediction mode and wherein the selecting of a scanning mode comprises selecting the scanning mode based on an optimal intra prediction mode that was used to perform intra prediction of the input video to obtain difference values that were encoded to obtain the encoded video.

4. Therefore, **claims 1, 9, 11, and 19** and the respective **dependent claims 3-8, 13-18, and 21-26** are in condition for allowance.

Conclusion

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to COURTNEY FIELDS whose telephone number is (571)272-3871. The examiner can normally be reached on Mon - Fri. 7:00 - 4:00 pm; IFP.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Andrew Nalven can be reached on 571-272-3839. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/Courtney D. Fields/
Examiner, Art Unit 2496
May 13, 2013

/Andrew L Nalven/
Supervisory Patent Examiner, Art Unit 2496

Notice of References Cited	Application/Control No. 12/377,617	Applicant(s)/Patent Under Reexamination JEONG ET AL.	
	Examiner COURTNEY FIELDS	Art Unit 2496	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-			
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N	EP 2207359 A2	07-2010	European Patent	DING, JIUN-REN	
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	Hajer Krichene Zrida, Abderrazek Jemai, Ahmed C. Ammari, Mohamed Abid; "High level H.264/AVC video encoder parallelization for multiprocessor implementation"; April 2009; DATE '09: Proceedings of the Conference on Design, Automation and Test in Europe; pp. 940-945
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

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(54) **Encoder, decoder, encoding method and decoding method**

(57) An encoder, a decoder, an encoding method and a decoding method are provided. The encoder includes a reversible color transform module, a difference pulse code modulation (DPCM) intra prediction module, a quantization module, a reversible frequency transform module and an entropy coding module. The reversible color transform module performs a reversible color transform to output a transformed video signal according to an input video signal. The DPCM intra prediction module performs a DPCM intra prediction to output a least residual according to the transformed video signal. The quantization module performs a quantization operation to output a quantization coefficient according to the least residual. The reversible frequency transform module performs a reversible frequency transform to output a frequency coefficient according to the quantization coefficient. The entropy coding module performs entropy coding to output a compression bit stream according to the frequency coefficient.

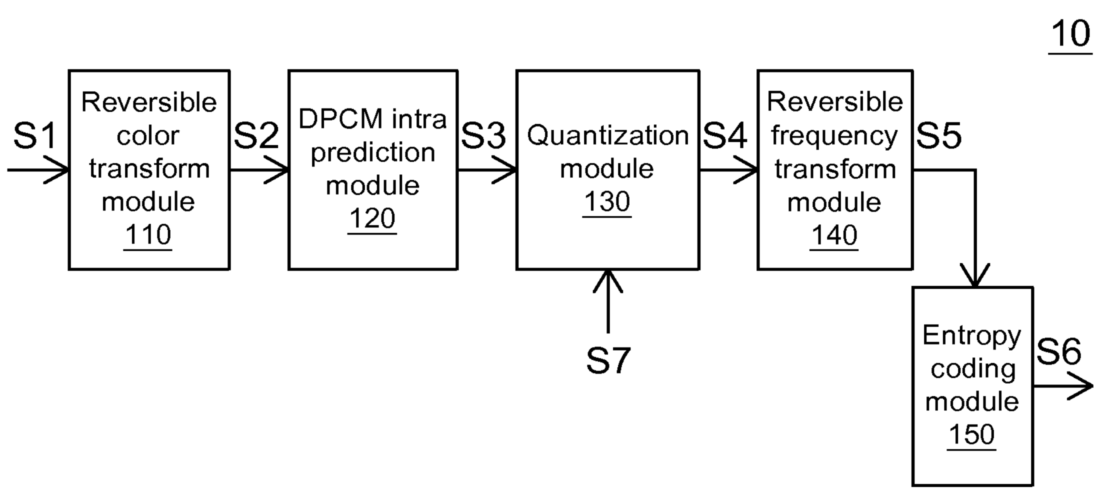

FIG. 1

EP 2 207 359 A2

Description

[0001] This application claims the benefit of Taiwan application Serial No. 98100421, filed January 7, 2009, the subject matter of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The invention relates to an encoder, a decoder, an encoding method and a decoding method.

Description of the Related technology

[0003] Generally speaking, lossless image compression technological trends may be classified into two kinds. The first kind of lossless image compression technology, such as JPEG-LS, H.264-LS, AIC or DPCM-H. 264-LS, does not include the frequency transform and quantization. The second kind of lossless image compression technology, such as JPEG2000-LS or HD photo, includes the frequency transform and quantization, and may be applied to the lossy and lossless image compression technologies simultaneously.

[0004] The lossless image compression technology widely used in the digital archive and the medical image includes JPEG-LS and JPEG2000-LS, which are too old. Although the compression performance of JPEG-LS is far higher than that of JPEG2000-LS, JPEG-LS cannot be simultaneously applied to the lossy image compression in the same encoder. In addition, the application popularization of JPEG2000 is extremely low. Compared with the lossless compression performance, the compression efficiency of JPEG2000-LS and H.264-LS is far lower than that of DPCM-based H.264-LS. However, DPCM-based H.264-LS cannot be applied to the lossy image compression technology. Although the lossless image compression technology is added to the newest H.264 lossy image compression technology, the performance of the added lossless image compression technology is relatively lower than that of each of JPEG-LS and JPEG2000-LS. Although Microsoft has published the image compression technology HD Photo capable of supporting the lossy and lossless conditions, the compression ratio of the lossless image is also far lower than that of each of JPEG-LS and JPEG2000-LS.

[0005] Therefore, it is an important issue in the current image compression to provide the universal encoding technology having the high compression performance and capable of supporting the lossy and lossless conditions simultaneously.

SUMMARY OF THE INVENTION

[0006] According to a first exemplary embodiment of the present invention, an encoder including a reversible color transform module, a difference pulse code modulation (DPCM) intra prediction module, a quantization module, a reversible frequency transform module and an entropy coding module is provided. The reversible color transform module performs a reversible color transform to output a transformed video signal according to an input video signal. The DPCM intra prediction module performs a DPCM intra prediction to output a least residual according to the transformed video signal. The least residual is selected from a plurality of residuals generated in correspondence to a plurality of intra prediction direction modes. The quantization module performs a quantization operation to output a quantization coefficient according to the least residual. The reversible frequency transform module performs a reversible frequency transform to output a frequency coefficient according to the quantization coefficient. The entropy coding module performs entropy coding to output a compression bit stream according to the frequency coefficient.

[0007] According to a second exemplary embodiment of the present invention, an encoding method is provided. The method includes the steps of: performing a reversible color transform to output a transformed video signal according to an input video signal; performing a difference pulse code modulation (DPCM) intra prediction to output a least residual according to the transformed video signal, wherein the least residual is selected from a plurality of residuals generated in correspondence to a plurality of intra prediction direction modes; performing a quantization operation to output a quantization coefficient according to the least residual; performing a reversible frequency transform to output a frequency coefficient according to the quantization coefficient; and performing an entropy coding operation to output a compression bit stream according to the frequency coefficient.

[0008] According to a third exemplary embodiment of the present invention, a decoder is provided. The decoder includes an entropy decoding module, an inverse reversible frequency transform module, an inverse quantization module, a compensation module and an inverse reversible color transform module. The entropy decoding module performs entropy decoding to output a frequency coefficient according to an input compression bit stream. The inverse reversible frequency transform module performs an inverse reversible frequency transform to output a quantization coefficient according to the frequency coefficient. The inverse quantization module performs an inverse quantization operation to output a least residual according to the quantization coefficient. The compensation module performs a difference pulse code modulation (DPCM) intra compensation to output a transformed video signal according to neighboring compensated video signals and the least residual. The least residual corresponds to one of a plurality of residuals generated by an encoder in a plurality of intra prediction direction modes. The inverse reversible color transform module performs an inverse reversible color transform according to the transformed video signal to output an input video signal.

[0009] According to a fourth exemplary embodiment of the present invention, a decoding method is provided. The decoding method includes: performing entropy decoding to output a frequency coefficient according to an input compression bit stream; performing an inverse reversible frequency transform to output a quantization coefficient according to the frequency coefficient; performing an inverse quantization operation to output a least residual according to the quantization coefficient; performing an intra compensation to output a transformed video signal according to neighboring compensated video signals and the least residual, wherein the least residual corresponds to one of a plurality of residuals generated by an encoder in a plurality of intra prediction direction modes; and performing an inverse reversible color transform to output an input video signal according to the transformed video signal.

[0010] The invention will become apparent from the following detailed description of the preferred but non-limiting embodiments. The following description is made with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. 1 is a block diagram showing an image encoder according to an embodiment of the invention.

[0012] FIG. 2 is a flow chart showing an image encoding method according to an embodiment of the invention.

[0013] FIG. 3 is a schematic illustration showing a prediction direction mode.

[0014] FIG. 4 is a schematic illustration showing the prediction direction mode.

[0015] FIG. 5 is a schematic illustration showing the prediction direction mode.

[0016] FIG. 6 is a schematic illustration showing the prediction direction mode.

[0017] FIG. 7 is a schematic illustration showing the prediction direction mode.

[0018] FIG. 8 is a schematic illustration showing the prediction direction mode.

[0019] FIG. 9 is a schematic illustration showing the prediction direction mode.

[0020] FIG. 10 is a schematic illustration showing the prediction direction mode.

[0021] FIG. 11 is a schematic illustration showing the prediction direction mode.

[0022] FIG. 12 is a schematic illustration showing the prediction direction mode.

[0023] FIG. 13 is a schematic illustration showing pixel symbols.

[0024] FIG. 14 is a schematic illustration showing a horizontal direction residual.

[0025] FIG. 15 is a schematic illustration showing a vertical direction residual.

[0026] FIG. 16 is a schematic illustration showing a 135-degree direction residual.

[0027] FIG. 17 is a schematic illustration showing the actual pixel value distribution.

[0028] FIG. 18 shows a residual obtained after executing the intra prediction in the H264 horizontal direction.

[0029] FIG. 19 shows a residual after executing the DPCM intra prediction.

[0030] FIG. 20 is a block diagram showing a video encoder according to an embodiment of the invention.

[0031] FIG. 21 shows static compression performance curves of H.264 and an embodiment of the invention.

[0032] FIG. 22 shows dynamic compression performance curves of H.264 and an embodiment of the invention.

[0033] FIG. 23 shows an image decoder according to an embodiment of the invention.

[0034] FIG. 24 is a flow chart showing an image decoding method according to an embodiment of the invention.

[0035] FIG. 25 is a block diagram showing a video decoder according to an embodiment of the invention.

[0036] FIG. 26 is a schematic illustration showing the comparison between four lossless compression technologies.

DETAILED DESCRIPTION OF THE INVENTION

[0037] FIG. 1 is a block diagram showing an image encoder 10 according to an embodiment of the invention. FIG. 2 is a flow chart showing an image encoding method according to an embodiment of the invention. Referring to FIGS. 1 and 2, the image encoder 10 includes a reversible color transform module 110, a difference pulse code modulation (DPCM) intra prediction module 120, a quantization module 130, a reversible frequency transform module 140 and an entropy coding module 150. The image encoding method includes the following steps.

[0038] First, as shown in step 210, the reversible color transform module 110 performs a reversible color transform to output a transformed video signal S2 according to an input video signal S1. The video signal S1 may be a RGB signal, while the transformed video signal S2 includes a YUV signal or a YCbCr signal having one grayscale image and two color images. Next, as shown in step 220, the DPCM intra prediction module 120 performs a DPCM intra prediction according to the transformed video signal S2, and selects a least residual S3 from residuals of a plurality of intra prediction direction modes.

[0039] Next, as shown in step 230, the quantization module 130 performs a quantization operation to output a quantization coefficient S4 according to the least residual S3. Then, as shown in step 240, the reversible frequency transform module 140 performs a reversible frequency transform to output a frequency coefficient S5 according to the quantization coefficient S4. The reversible frequency transform module 140 may adaptively select whether to perform the reversible frequency transform on the quantization coefficient S5, and the quantization coefficient S5 determines to perform the reversible frequency transform according to the condition that the collected transformed energy is lower than that when the transform is not performed. Finally, as shown in step 250, the entropy coding module 150 performs entropy coding to output a compression bit stream S6 according to the frequency coefficient S5. The quantization module 130 may be adaptively controlled by a quantization parameter S7 so that the entropy coding module 150 may selectively output a lossy compression bit stream, a near lossless compression bit stream or a lossless compression bit stream.

[0040] In brief, the image encoder 10 generally pertains to universal encoding capable of supporting lossy and lossless conditions simultaneously. For example, the lossy compression ability of the image encoder 10 is better than that of each of H.264, JPEG2000, AIC, HD Photo and JPEG, and the lossless compression ability of the image encoder 10 is better than that of each of DPCM_ H.264-LS, JPEG-LS, JPEG2000-LS, HD Photo, H.264-LS and AIC. Furthermore, the image encoder 10 can provide the lossy compression bit stream, the near lossless compression bit stream or the lossless compression bit stream by adjusting the quantization quality parameter under the same encoding architecture according to different image qualities. Furthermore, the intra prediction wastes the longest time in the H.264 lossy image compression encoder, and the image encoder 10 needs not to perform the discrete cosine transform (DCT) and the inverse discrete cosine transform (IDCT) operations to obtain the neighboring prediction coefficients needed for the intra prediction, so that it can be further applied to an embedded system.

[0041] FIGS. 3 to 12 are schematic illustrations showing prediction direction modes. In detail, the prediction direction modes include a plurality of linear direction modes and a rotation direction mode. In order to make the invention be easily understood, ten prediction direction modes are listed in FIGS. 3 to 12. However, the invention is not limited thereto, and the number of the prediction direction modes may be increased or decreased according to the actual application requirement. FIGS. 3 to 12 respectively show prediction direction modes 0 to 9.

[0042] The prediction direction mode 0 in FIG. 3 is vertical; the prediction direction mode 1 in FIG. 4 is horizontal; the prediction direction mode 2 in FIG. 5 is mean; the prediction direction mode 3 in FIG. 6 is diagonal down-left; and the prediction direction mode 4 in FIG. 7 is diagonal down-right.

[0043] The prediction direction mode 5 in FIG. 8 is vertical-right; the prediction direction mode 6 in FIG. 9 is horizontal-down; the prediction direction mode 7 in FIG. 10 is vertical-left; the prediction direction mode 8 in FIG. 11 is horizontal-up; and the prediction direction mode 9 in FIG. 12 is to rotate from outside to inside. It is to be specified that some speckle-like residuals cannot be eliminated owing to the mode 0 to the mode 8, and the DPCM intra prediction module 120 of FIG. 1 can eliminate the speckle-like residuals through the mode 9 and further increase the compression ratio.

[0044] FIG. 13 is a schematic illustration showing pixel symbols. FIG. 14 is a schematic illustration showing a horizontal direction residual. FIG. 15 is a schematic illustration showing a vertical direction residual. FIG. 16 is a schematic illustration showing a 135-degree direction residual. As shown in FIGS. 13 to 16, the reference prediction values generated by the lossless and lossy DPCM intra prediction are different. The reference prediction value generated by the lossy DPCM intra prediction method is quantized and then inversely quantized to obtain a coefficient serving as the reference prediction value of the next coefficient. The prediction direction modes have different reference prediction values generated by different prediction directions. Finally, the least residual is selected from all the modes.

[0045] In FIGS. 13 to 16, the symbols a to p are initial pixel positions, the symbols A to M are the reference prediction values of the neighboring blocks, the symbols a' to p' are the reference prediction values obtained after the neighboring pixels are quantized and then inversely quantized, and Q is a quantization zone. In FIG. 14, the reference prediction values obtained after the neighboring pixels in the horizontal direction are quantized and then inversely quantized may be derived according to the following Equations (1) to (3) and the analogized equations:

$$a' = I - \lfloor (I - a)/Q \rfloor \times Q \quad (1)$$

wherein the symbol ⌊ ⌋ represents a minimum integer obtained after being divided by a predetermined value.

$$b' = a' - \lfloor (a' - b)/Q \rfloor \times Q \quad (2)$$

$$c' = b' - \lfloor (b' - c)/Q \rfloor \times Q \quad (3)$$

The other equations of computing the prediction values of the other neighboring pixels may be analogized according to Equations (1) to (3) so that the other horizontal direction residuals may be calculated. The horizontal direction residuals corresponding to Equations (1) to (3) are sequentially a'-b, b'-c and c'-d, and so on. It is to be specified that the division by the quantization zone Q is to perform a quantization operation, and the multiplication by the quantization zone Q is to perform an inverse quantization operation. After the quantizations through different quantization zones, quantization errors are correspondingly and inevitably generated after the inverse quantization.

[0046] In addition, the neighboring pixels in the vertical direction of FIG. 15 are quantized and then inversely quantized to obtain the reference prediction values, which may be obtained according to the following Equations (4) to (6) and the analogized equations thereof:

$$a' = A - \lfloor (A - a)/Q \rfloor \times Q \quad (4)$$

$$e' = a' - \lfloor (a' - e)/Q \rfloor \times Q \quad (5)$$

$$i' = e' - \lfloor (e' - i)/Q \rfloor \times Q \quad (6)$$

The equations of computing the reference prediction values of the other neighboring pixels may be analogized according to Equations (4) to (6) so that the other reference prediction values in the other vertical direction may be computed. The vertical direction residuals corresponding to Equations (3) to (6) are sequentially a' - e, e' - i and i' - m, and so on.

[0047] Furthermore, the neighboring pixels in the 135-degree direction of FIG. 16 are quantized and then inversely quantized to obtain the reference prediction values, which may be obtained according to the following Equations (7) to (9) and the analogized equations thereof:

$$a' = M - \lfloor (M - a)/Q \rfloor \times Q \quad (7)$$

$$f' = a' - \lfloor (a' - f)/Q \rfloor \times Q \quad (8)$$

$$k' = e' - \lfloor (e' - k)/Q \rfloor \times Q \quad (9)$$

The equations of computing the reference prediction values of the other neighboring pixels may be analogized according to Equations (7) to (9) so that the other reference prediction values in the 135-degree direction may be computed. The 135-degree direction residuals corresponding to Equations (7) to (9) are sequentially a'-f, f'-k and k'-p, and so on.

[0048] FIG. 17 is a schematic illustration showing the actual pixel value distribution. FIG. 18 shows a residual obtained after the intra prediction in the H.264 horizontal direction. FIG. 19 shows a residual after the DPCM intra prediction. When the quantization zone Q is equal to 3, the residuals obtained in the horizontal direction of the DPCM intra prediction are listed in FIG. 19, and the residuals obtained in the horizontal direction of H.264 are listed in FIG. 18. Comparing FIG. 18 with FIG. 19, it is clearly obtained that the residuals obtained in the horizontal direction after the DPCM intra prediction are indeed smaller than the residuals obtained in the horizontal direction of H.264.

[0049] FIG. 20 is a block diagram showing a video encoder 30 according to an embodiment of the invention. The video encoder 30 is obtained after the image encoder 10 is extended. In addition to the reversible color transform module 110, the DPCM intra prediction module 120, the quantization module 130, the reversible frequency transform module 140 and the entropy coding module 150, the video encoder 30 further includes an inverse quantization module 3010, a de-block effect module 3020, a motion estimation module 3030, a motion compensation module 3040, an operating unit 3050, an operating unit 3060 and a switch unit 3070.

[0050] When the intra prediction (t image) is performed, it means that the elimination of the redundant amount between pixels of a single image has to be performed, and the switch unit 3070 switches to the intra prediction. That is, the switch unit 3070 is electrically connected to the operating unit 3050 and the DPCM intra prediction module 120. When the DPCM intra prediction module 120 is predicting the least residual, the quantization module 130 and the inverse quantization module 3010 are simultaneously adopted to obtain the reference prediction values (a' to o') for each intra prediction direction and the residuals having quantization errors. At last, the quantization module 130 outputs the quantization coefficient S4 obtained in the optimum prediction direction of the DPCM intra prediction module 120 after the least residual quantization. Then, the reversible frequency transform module 140 processes the quantization coefficient and outputs the frequency coefficient S5. The frequency coefficient S5 is further processed by the entropy coding module, which then outputs the compression bit stream S6 after the t image compression.

[0051] Then, when the t+1 image S2 is continuously encoded, it means that the redundant amount between two images has to be eliminated, and the switch unit 3070 is switched to the inter prediction. That is, the switch unit 3070 is electrically connected to the operating unit 3050 and the motion compensation module 3040. The inverse quantization module 3010 correspondingly outputs the least residual S9 with the quantization error according to the quantization coefficient outputted from the quantization module 130 at the t image time. The operating unit 3060 summates the direction information S14, predicted by the DPCM intra prediction module 120, and the least residual compensation, outputted from the inverse quantization module 3010, together to obtain the block effect image S10 with the quantization error. The de-block effect module 3020 smoothens the block effect image S10 having the quantization error to obtain the output image S11 (similar to the output image of the decoder), which can be visually accepted. The motion estimation module 3030 processes the output image S11 and the t+1 image and thus outputs a motion vector S8. The motion vector S8 is directly outputted to the entropy coding module 150, which encodes the motion vector S8. The motion compensation module 3040 processes the motion vector S8 and the output image S11 and thus outputs a motion compensation image S12. The motion compensation image S12 is switched to the inter prediction through the switch unit 3070, and then a subtraction between the motion compensation image S12 and the t+1 image is made to obtain a difference image S13. The difference image S13 is then processed by the DPCM intra prediction module 120, the quantization module 130 and the inverse quantization module 3010 so that the quantization coefficient S4 of the t+1 image is obtained. This quantization coefficient is further processed by the reversible frequency transform module 140 so that the frequency coefficient S5 is outputted. The frequency coefficient is further processed by the entropy coding module so that the compression bit stream S6 after the t+1 image is compressed is obtained.

[0052] When the t+2 image S2 is continuously encoded, it means that the redundant amount between two images has to be continuously eliminated. The switch unit 3070 continues to switch to the inter prediction, and the inverse quantization module 3010 correspondingly outputs the least residual S9 having the quantization error according to the quantization coefficient outputted from the quantization module 130 at the t+1 image time, and so on.

[0053] FIG. 21 shows static compression performance curves of H.264 and an embodiment of the invention. FIG. 22 shows dynamic compression performance curves of H.264 and an embodiment of the invention. The entropy coding module 150 shown in FIG. 1 may adopt the embedded block coding with optimized truncation (EBCOT) to replace the context adaptive binary arithmetic coding (CABAC) to obtain the performance curves in FIGS. 21 and 22.

[0054] In FIG. 21, the compression performance curve 2110 represents the continuous static image compression performance curve of the peak signal-to-noise ratio (PSNR) to the bit per pixel (bpp) in H.264, and the compression performance curve 2120 represents the continuous static image compression performance curve of the PSNR to the bpp in the embodiment of the invention. In FIG. 22, the compression performance curve 2210 represents the continuous static image compression performance curve of the PSNR to the bpp in H.264, and the compression performance curve 2220 represents the continuous static image compression performance curve of the PSNR to the bpp in the embodiment of the invention. As shown in FIGS. 21 and 22, it is obtained that at least 4dB of bit rate in average may be increased when the compression ratio is 1 bpp in the embodiment of the invention.

[0055] FIG. 23 shows an image decoder 40 according to an embodiment of the invention. FIG. 24 is a flow chart showing an image decoding method according to an embodiment of the invention. Referring to FIGS. 23 to 24, the image decoder 40 includes an entropy decoding module 410, an inverse reversible frequency transform module 420, an inverse quantization module 430, a compensation module 440 and an inverse reversible color transform module 450. The image decoding method includes the following steps.

[0056] As shown in step 510, the entropy decoding module 410 performs entropy decoding to output the frequency coefficient S5 according to the compression bit stream S6. If the original image is only processed by the entropy decoding of the entropy coding module 150 of FIG. 1 and the entropy coding operation of the entropy decoding module 410, then the output should still be the original image because the entropy coding pertains to the lossless compression technology.

[0057] As shown in step 520, the inverse reversible frequency transform module 420 performs the inverse reversible frequency transform to output the quantization coefficient S4 according to the frequency coefficient S5. If the original image is only processed by the reversible frequency transform of the reversible frequency transform module 140 of FIG. 1 and the inverse reversible frequency transform operation of the inverse reversible frequency transform module 420, then the output should still be the original image because the perfect reconstruction is obtained after the reversible frequency transform operation.

[0058] As shown in step 530, the inverse quantization module 430 performs the inverse quantization operation to output the least residual S3 according to the quantization coefficient S4. If the original image is only processed by the quantization operation of the quantization module 130 of FIG. 1 and the inverse quantization operation of the inverse quantization module 430, then the output should be determined to be still the original image or the lossy image having the quantization error according to the quantization parameter S7.

[0059] As shown in step 540, the compensation module 440 performs the DPCM intra compensation to output the transformed video signal S2 according to the least residual S3. If the original image is only processed by the DPCM intra prediction of the DPCM intra prediction module 120 of FIG. 1 and the DPCM intra compensation of the compensation module 440, then the output should still be the original image.

[0060] As shown in step 550, the inverse reversible color transform module 450 performs the inverse reversible color transform to output the input video signal S1 according to the transformed video signal S2. If the original image is only processed by the reversible color transform of the reversible color transform module 110 of FIG. 1 and the inverse reversible color transform of the inverse reversible color transform module 450, then the output should still be the original image. This is because the perfect reconstruction is obtained after the reversible color transform operation.

[0061] FIG. 25 is a block diagram showing a video decoder 60 according to an embodiment of the invention. Referring to FIG. 25, the video decoder 60 is obtained after the image decoder 40 is further extended. In addition to the entropy decoding module 410, the inverse reversible frequency transform module 420, the inverse quantization module 430, the compensation module 440 and the inverse reversible color transform module 450, the image decoder 40 further includes an operating unit 460. As for the intra compensation, the compensation module 440 performs the addition and compensation through the operating unit 460 according to the DPCM intra compensation direction, the neighboring decoded reference prediction values and the least residual obtained after the inverse quantization module 430 performs the inverse quantization so that the t reconstruction image is obtained. As for the inter-frame compensation, the compensation module 440 performs the addition and compensation through the operating unit 460 according to the t reconstruction image and the motion vector S8 obtained after the decoding of the entropy decoding module 410 so that the compensated t+1 reconstruction image is outputted. The t and t+1 reconstruction images are processed by the inverse reversible color transform module 450, which then outputs the original input video signal without the quantization error or the video signal S1 with the quantization error.

[0062] The encoder, the decoder, the encoding method and the decoding method according to the embodiments of the invention have the better lossy compression ability than H.264, JPEG2000, AIC, HD Photo and JPEG, and the better lossless compression ability than DPCM_ H.264, JPEG, JPEG2000, HD Photo, H.264 and AIC. In addition, the embodiments of the invention can further provide the lossy compression bit stream, the near lossless compression bit stream or the lossless compression bit stream in response to different image qualities under the same encoding architecture. Furthermore, performing the intra prediction wastes the longest time in the image compression. The embodiments of the invention need not to simultaneously perform the discrete cosine transform (DCT) and the inverse discrete cosine transform (IDCT) to obtain the least residual, and can thus be further applied to the embedded system.

[0063] FIG. 26 is a schematic illustration showing the comparison between four lossless compression technologies. As shown in FIG. 26, the lossless compression technology includes JPEG, JPEG2000, H.264 and DPCM H.264. The compression ratios of JPEG, JPEG2000, H.264 and DPCM H.264 are respectively 1.81, 1.77, 1.56 and 2.00. So, the DPCM H.264 has the highest compression ratio among the four lossless compression technologies. The embodiment can adopt the entropy coding operation to make the compression ratio be higher than that of DPCM H.264.

[0064] While the invention has been described by way of example and in terms of a preferred embodiment, it is to be understood that the invention is not limited thereto. On the contrary, it is intended to cover various modifications and similar arrangements and procedures, and the scope of the appended claims therefore should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements and procedures.

Claims

1. An encoder, comprising:

a reversible color transform module for performing a reversible color transform to output a transformed video signal according to an input video signal;
a difference pulse code modulation (DPCM) intra prediction module for performing a DPCM intra prediction to output a least residual according to the transformed video signal, wherein the least residual is selected from a plurality of residuals generated in correspondence to a plurality of intra prediction direction modes;
a quantization module for performing a quantization operation to output a quantization coefficient according to the least residual;
a reversible frequency transform module for performing a reversible frequency transform to output a frequency coefficient according to the quantization coefficient; and
an entropy coding module for performing entropy coding to output a compression bit stream according to the frequency coefficient.

2. The encoder according to claim 1, further comprising:

an inverse quantization module for performing an inverse quantization operation to output the least residual according to the quantization coefficient. The quantization module is controlled by a quantization parameter such that the entropy coding module selectively outputs a lossy compression bit stream, a near lossless compression bit stream or a lossless compression bit stream.
a de-block effect module for processing a block effect image with a quantization error into an acceptable output image;
a motion estimation module for outputting a motion vector to the entropy coding module according to the output image and a next to-be-encoded image; and
a motion compensation module for performing a motion compensation to output a motion com-

pensation image according to the motion vector and the output image.

3. The encoder according to claim 2, further comprising:

an operating unit for subtracting an original image of the transformed video signal from the motion compensation image to output a difference image to the DPCM intra prediction module.

4. The encoder according to claim 3, further comprising:

a switch unit for selectively electrically connecting the operating unit to the DPCM intra prediction module or the motion compensation module. When the DPCM intra prediction is performed, the switch unit is electrically connected to the operating unit and the DPCM intra prediction module; and when an inter prediction is performed, the switch unit is electrically connected to the operating unit and the motion compensation module.

5. The encoder according to claim 2, further comprising:

an operating unit for adding the least residual to the motion compensation image to output a compensated image to the DPCM intra prediction module.

6. The encoder according to claim 1, wherein the prediction direction modes comprise a plurality of linear direction modes and a rotation direction mode; wherein the rotation direction mode is to rotate from outside to inside.

7. The encoder according to claim 1, wherein the quantization coefficient determines to perform the reversible frequency transform according to a condition that energy collected after the reversible frequency transform is lower than that collected when the reversible frequency transform is not performed.

8. An encoding method, comprising the steps of:

performing a reversible color transform to output a transformed video signal according to an input video signal;
performing a difference pulse code modulation (DPCM) intra prediction to output a least residual according to the transformed video signal, wherein the least residual is selected from a plurality of residuals generated in correspondence to a plurality of intra prediction direction modes;
performing a quantization operation to output a quantization coefficient according to the least residual;
performing a reversible frequency transform to output a frequency coefficient according to the quantization coefficient; and
performing an entropy coding operation to output a compression bit stream according to the frequency coefficient.

9. The method according to claim 8, further comprising the step of:

performing an inverse quantization operation to output the least residual according to the quantization coefficient.
processing a block effect image with a quantization error into an acceptable output image;
outputting a motion vector according to the output image and a next to-be-encoded image; and
performing a motion compensation to output a motion compensation image according to the motion vector and the output image.

10. The method according to claim 9, further comprising the steps of:

subtracting an original image of the transformed video signal from the motion compensation image to output a difference image;
performing the DPCM intra prediction, the quantization operation, the reversible frequency transform and the entropy coding operation according to the difference image; and
adding the least residual to the motion compensation image to output a compensated image.

11. The method according to claim 8, further comprising the step of:

performing a de-block effect operation to reduce a block effect caused when the quantization operation is performed; and
In the step of performing the reversible frequency transform, the quantization coefficient determines to perform the reversible frequency transform according to a condition that energy collected after the reversible frequency transform is lower than that collected when the reversible frequency transform is not performed; and the prediction direction modes comprise a plurality of linear direction modes and a rotation direction mode.

12. The method according to claim 11, wherein the rotation direction mode is to rotate from outside to inside.

13. A decoder, comprising:

an entropy decoding module for performing entropy decoding to output a frequency coefficient according to an input compression bit stream;
an inverse reversible frequency transform module for performing an inverse reversible frequency transform to output a quantization coefficient according to the frequency coefficient;
an inverse quantization module for performing an inverse quantization operation to output a least residual according to the quantization coefficient;
a compensation module for performing a difference pulse code modulation (DPCM) intra compensation to output a transformed video signal according to neighboring compensated video signals and the least residual, wherein the least residual corresponds to one of a plurality of residuals generated by an encoder in a plurality of intra prediction direction modes; and
an inverse reversible color transform module for performing an inverse reversible color transform according to the transformed video signal to output an input video signal.

14. The decoder according to claim 13, wherein the compensation module further performs a motion compensation operation according to a motion vector; wherein the motion vector is obtained by the entropy decoding module, which performs the entropy decoding.

15. A decoding method, comprising:

performing entropy decoding to output a frequency coefficient according to an input compression bit stream;
performing an inverse reversible frequency transform to output a quantization coefficient according to the frequency coefficient;
performing an inverse quantization operation to output a least residual according to the quantization coefficient;
performing an intra compensation to output a transformed video signal according to neighboring compensated video signals and the least residual, wherein the least residual corresponds to one of a plurality of residuals generated by an encoder in a plurality of intra prediction direction modes; and
performing an inverse reversible color transform to output an input video signal according to the transformed video signal.

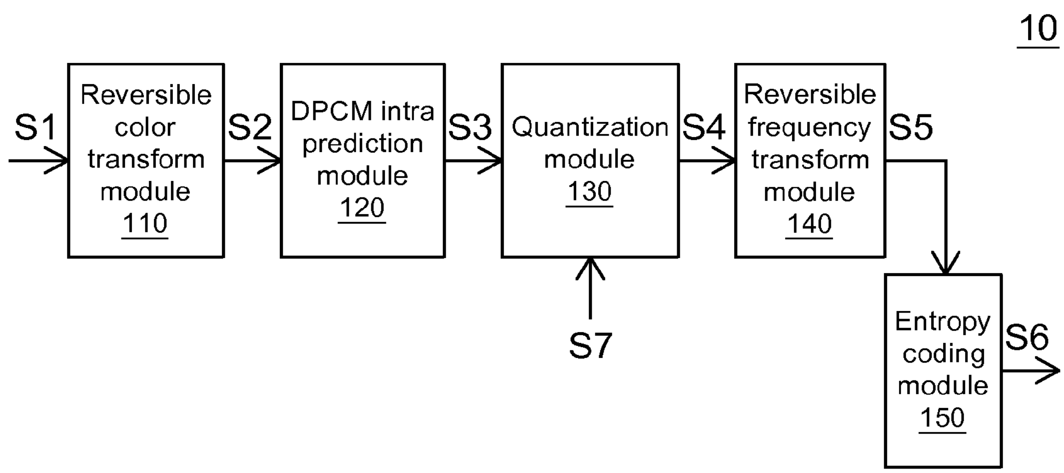
10
S1
Reversible color transform module 110
S2
DPCM intra prediction module 120
S3
Quantization module 130
S4
Reversible frequency transform module 140
S5
Entropy coding module 150
S6
S7

FIG. 1

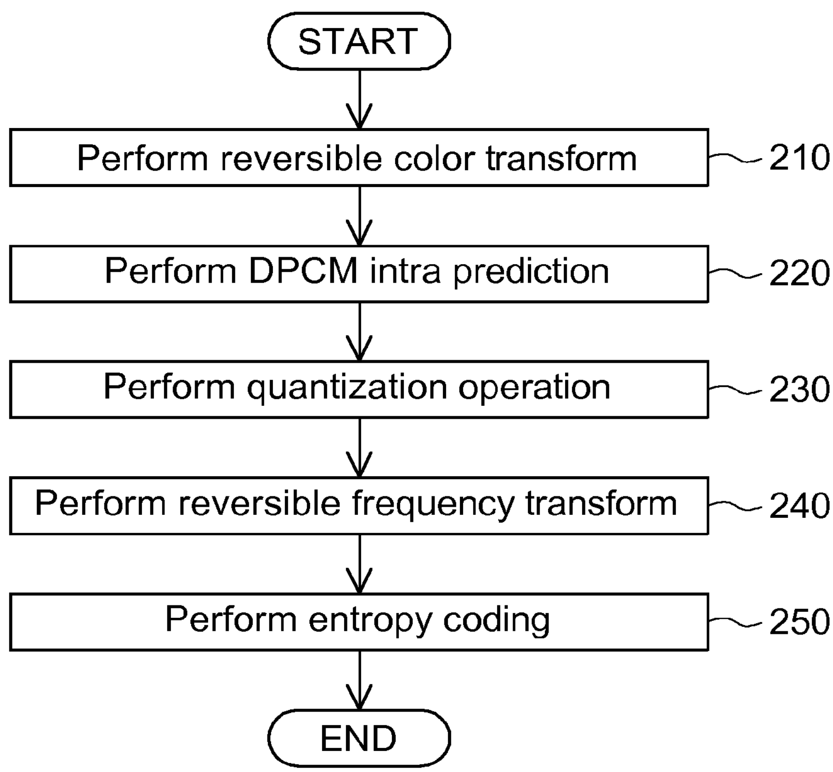
START
Perform reversible color transform
210
Perform DPCM intra prediction
220
Perform quantization operation
230
Perform reversible frequency transform
240
Perform entropy coding
250
END

FIG. 2

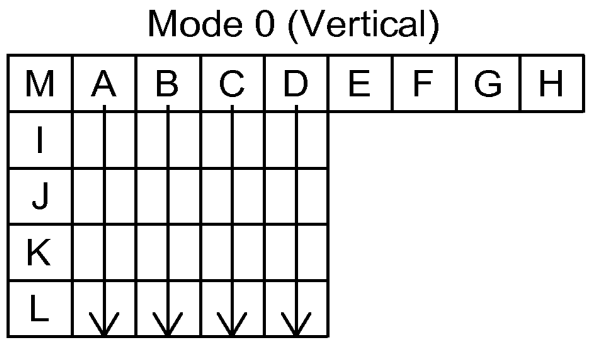

FIG. 3

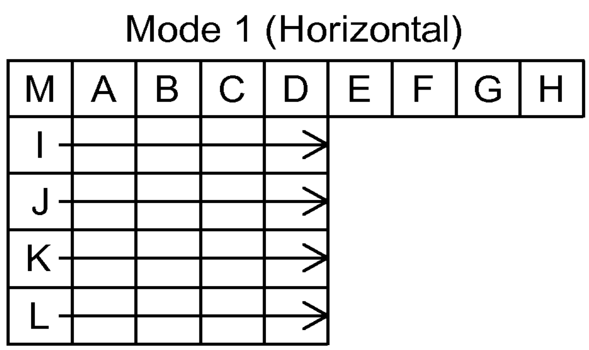

FIG. 4

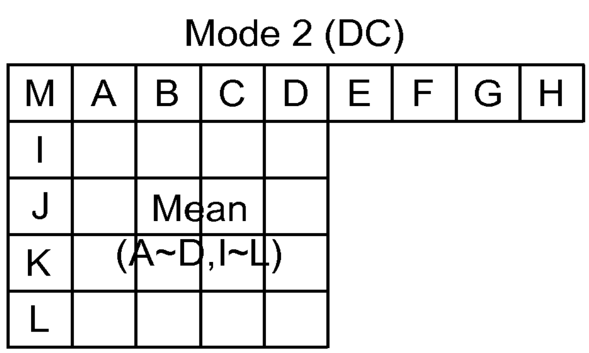

FIG. 5

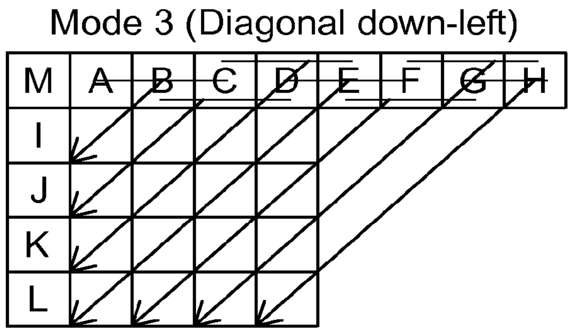

FIG. 6

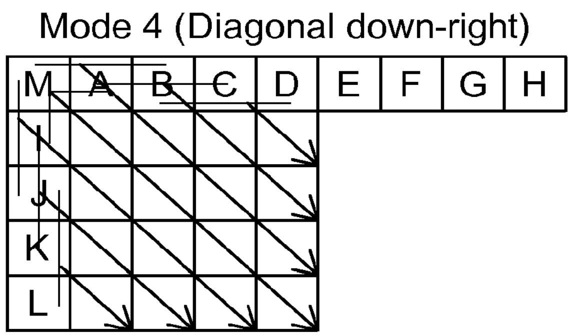

FIG. 7

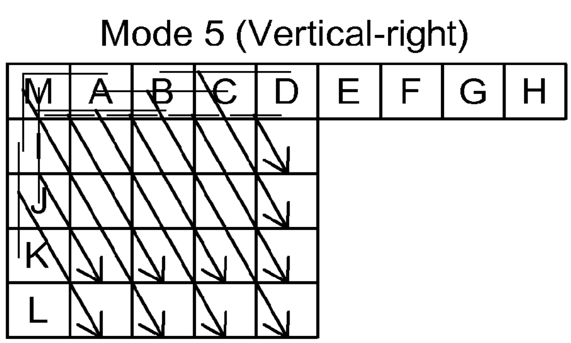

FIG. 8

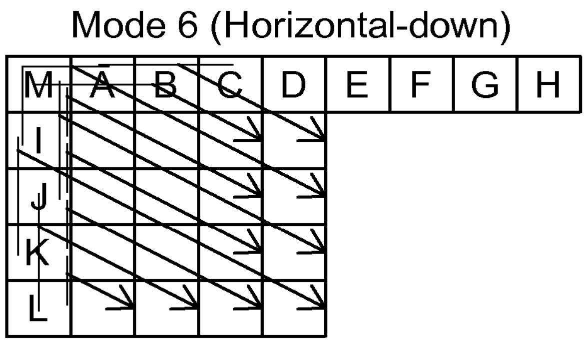

FIG. 9

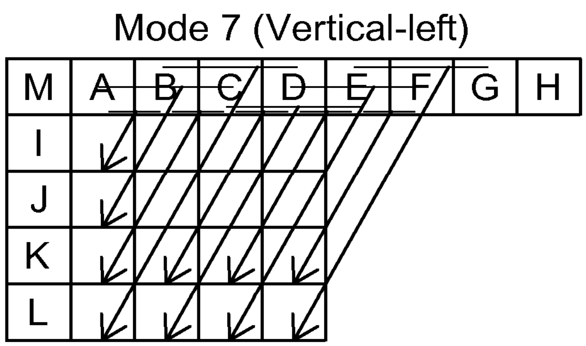

FIG. 10

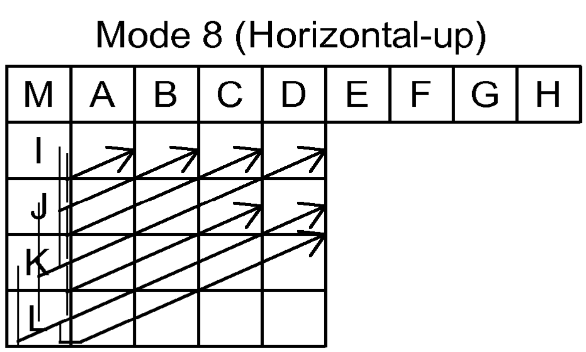

FIG. 11

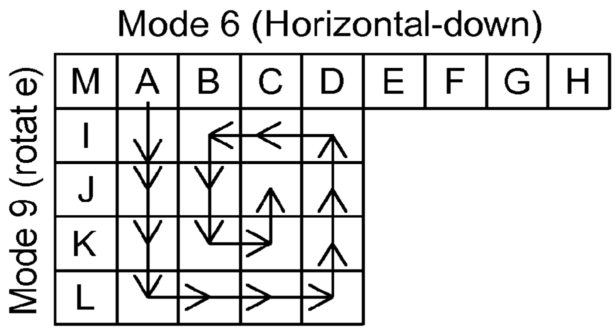

FIG. 12

M	A	B	C	D	E	F	G	H
I	a	b	c	d				
J	e	f	g	h				
K	i	j	k	l				
L	m	n	o	p				

FIG. 13

I-a	a'-b	b'-c	c'-d
J-e	e'-f	f'-g	g'-h
K-i	i'-j	j'-k	k'-l
L-m	m'-n	n'-o	o'-p

FIG. 14

A-a	B-b	C-c	D-d
a-e	b-f	c'-g	d'-h
e'-i	f'-j	g'-k	h'-l
i'-m	j'-n	k'-o	l'-p

FIG. 15

M-a	A-b	B-c	C-d
I-e	a'-f	b'-g	c'-h
J-i	e'-j	f'-k	g'-l
K-m	i'-n	j'-o	k'-p

FIG. 16

76	76	76	76	76	76	76	76	76
76	78	78	76	50				
76	78	77	50	50				
76	76	50	50	50				
76	50	50	50	50				

FIG. 17

76	76	76	76	76	76	76	76	76
76	-2	-2	0	26				
76	-2	-1	26	26				
76	0	26	26	26				
76	26	26	26	26				

FIG. 18

76	76	76	76	76	76	76	76	76
76	-2	-2	0	26				
76	-2	-1	26	2				
76	0	26	2	2				
76	26	2	2	2				

FIG. 19

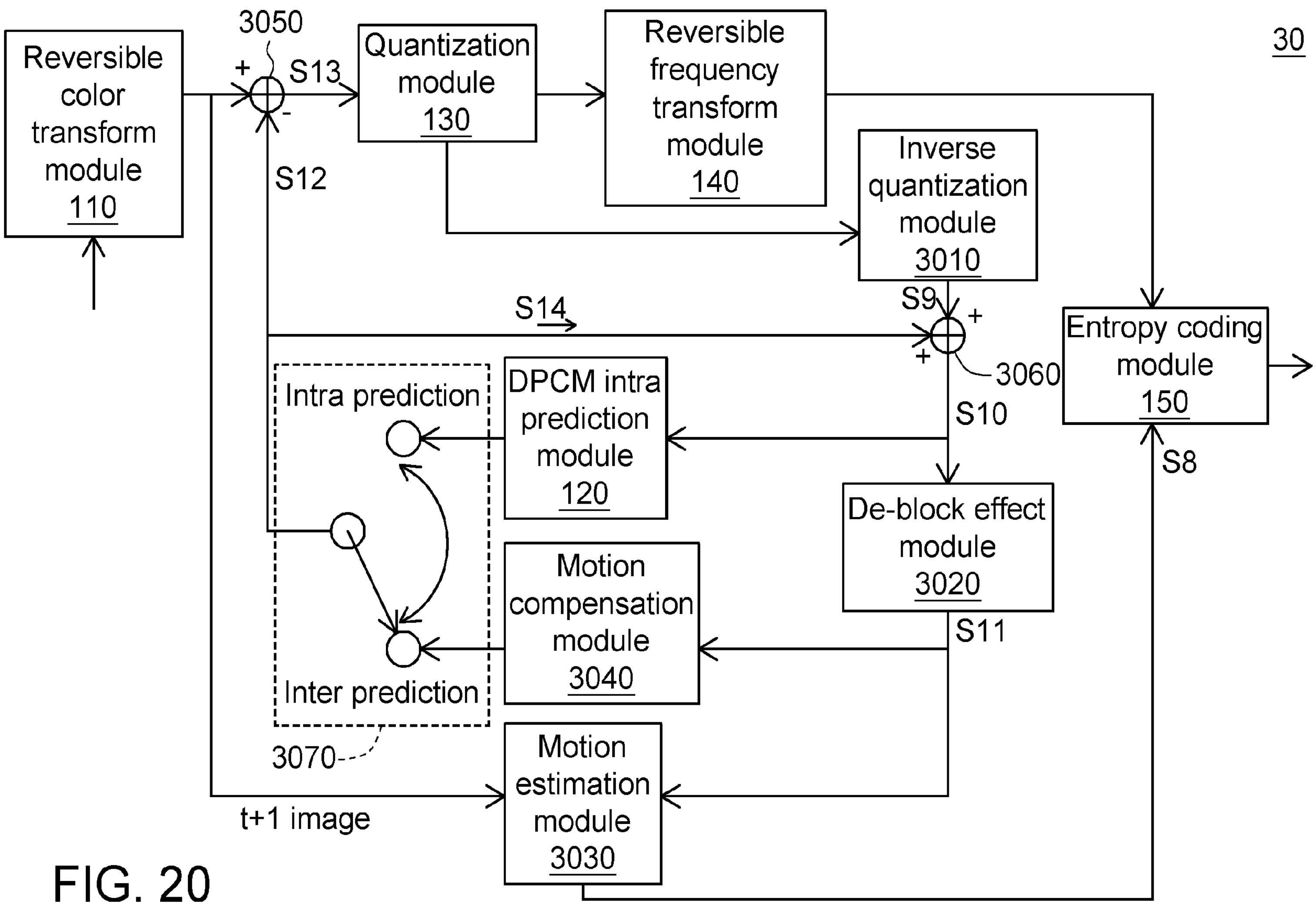
30
Reversible color transform module 110
3050
+
-
S13
S12
Quantization module 130
Reversible frequency transform module 140
Inverse quantization module 3010
S9
+
+
3060
S14
S10
Entropy coding module 150
S8
Intra prediction
Inter prediction
3070
DPCM intra prediction module 120
Motion compensation module 3040
De-block effect module 3020
S11
Motion estimation module 3030
t+1 image

FIG. 20

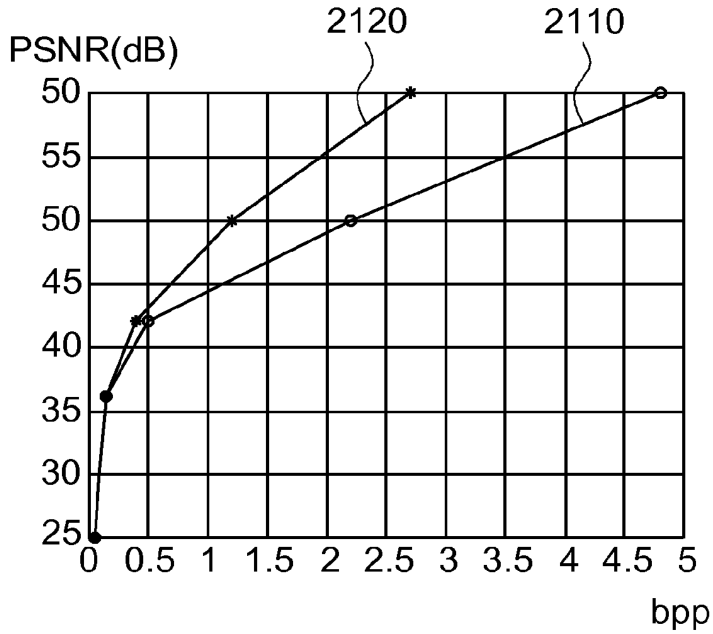
2120
2110
PSNR(dB)
50
55
50
45
40
35
30
25
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
bpp

FIG. 21

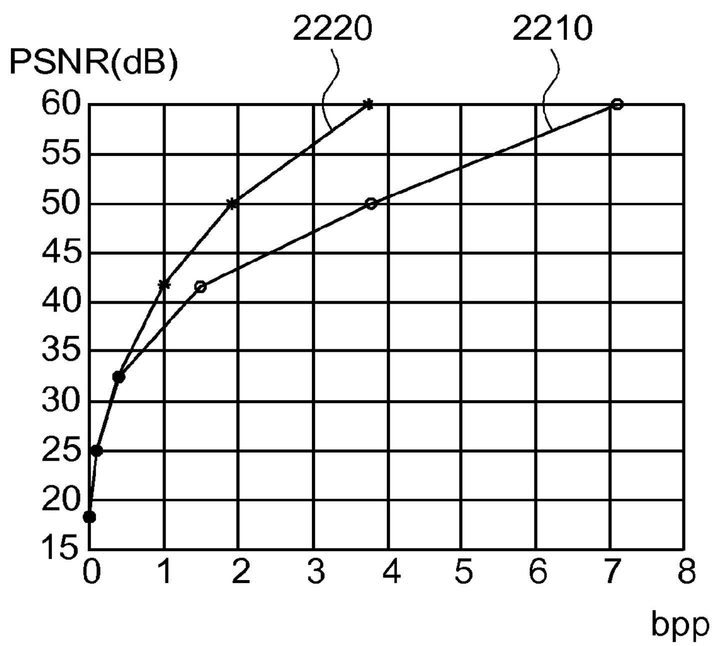
2220
2210
PSNR(dB)
60
55
50
45
40
35
30
25
20
15
0
1
2
3
4
5
6
7
8
bpp

FIG. 22

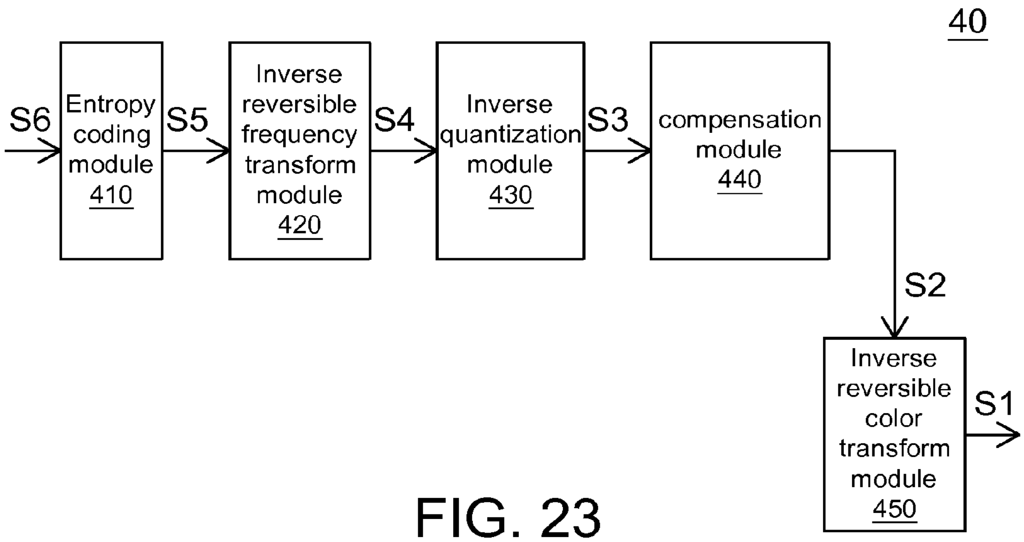
40
S6
Entropy coding module 410
S5
Inverse reversible frequency transform module 420
S4
Inverse quantization module 430
S3
compensation module 440
S2
Inverse reversible color transform module 450
S1

FIG. 23

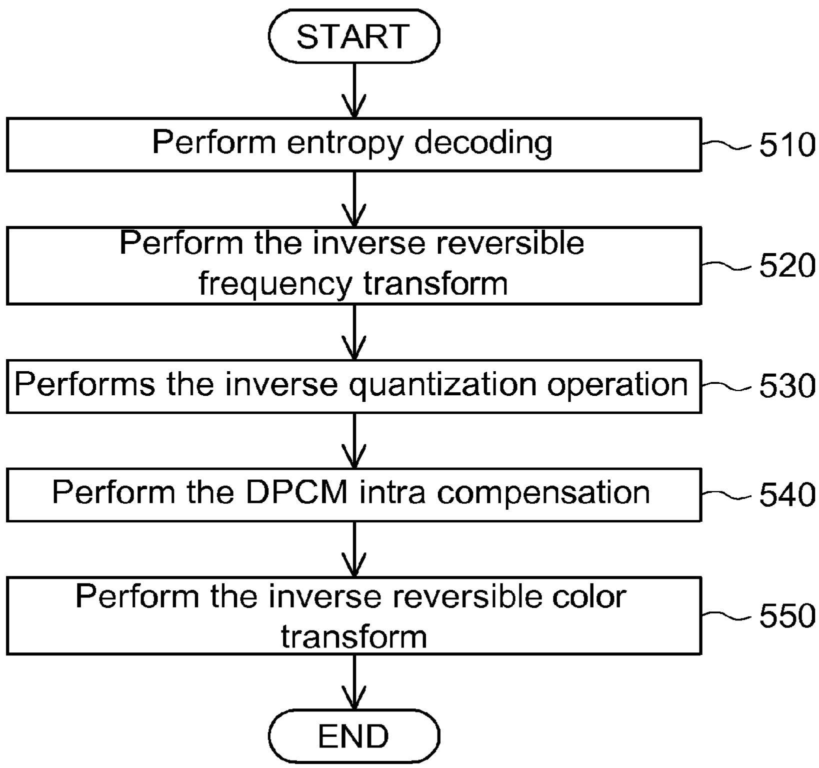
START
Perform entropy decoding
510
Perform the inverse reversible frequency transform
520
Performs the inverse quantization operation
530
Perform the DPCM intra compensation
540
Perform the inverse reversible color transform
550
END

FIG. 24

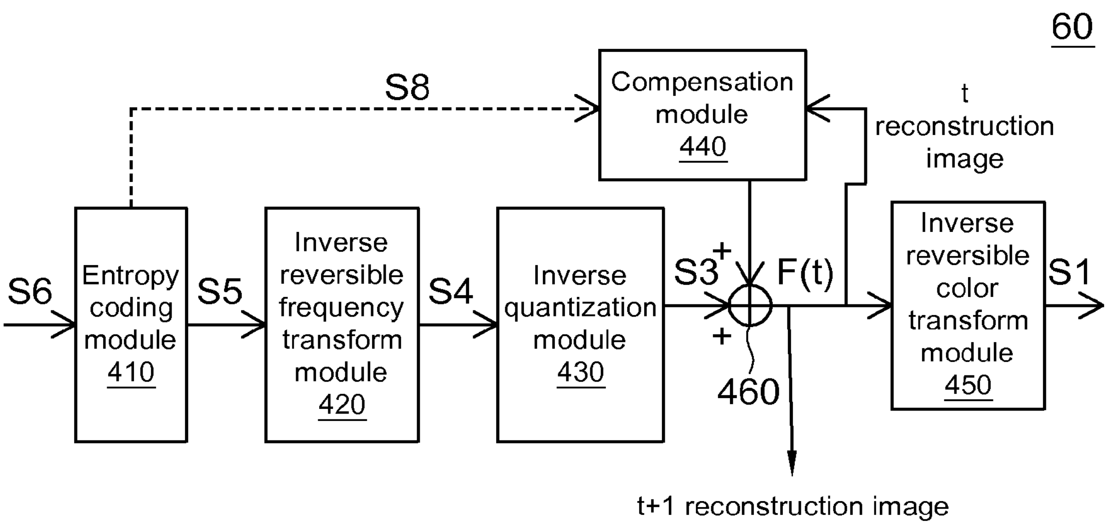

FIG. 25

Lossless compression 512*512 768kB	JPEG	JPEG2000	H. 264	DPCM H. 264
Lena	435	435	421	364
F16	378	369	362	303
Baboon	592	578	759	680
Peppers	456	473	497	418
Goldhill	420	389	396	321
Barbara	442	378	448	335
House	408	404	464	360
Peppers2	329	290	381	237
Oldmill	505	466	488	449
Frymire	386	463	697	405
Average	424	435	491	387
Compression ratio	1.81	1.77	1.56	2.00

FIG. 26

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- TW 98100421 **[0001]**

PUB-NO: EP002207359A2
DOCUMENT-IDENTIFIER: EP 2207359 A2
TITLE: Encoder, decoder, encoding method and decoding method
PUBN-DATE: July 14, 2010

INVENTOR-INFORMATION:

NAME	COUNTRY
DING, JIUN-REN	TW

ASSIGNEE-INFORMATION:

NAME	COUNTRY
IND TECH RES INST	TW

APPL-NO: EP09166550
APPL-DATE: July 28, 2009

PRIORITY-DATA: TW98100421A (January 7, 2009)

INT-CL (IPC): H04N007/26

EUR-CL (EPC): H04N007/26 , H04N007/26 , H04N007/34 , H04N007/50

ABSTRACT:

CHG DATE=20100708 STATUS=N>An encoder, a decoder, an encoding method and a decoding method are provided. The encoder includes a reversible color transform module, a difference pulse code modulation (DPCM) intra prediction module, a quantization module, a reversible frequency transform module and an entropy coding module. The reversible color transform module performs a reversible color transform to output a transformed video signal according to an input video signal. The DPCM intra prediction module performs a DPCM intra prediction to output a least residual according to the transformed video signal. The quantization module performs a quantization operation to output a quantization coefficient according to the least residual. The reversible frequency transform module performs a reversible frequency transform to output a frequency coefficient according to the quantization coefficient. The entropy coding module performs entropy coding to output a compression bit stream according to the frequency coefficient.

SEARCH RESULTS

You searched for: (((encoding/ decoding) AND coefficients) AND intra prediction mode)

105 Results returned

« First | 1 2 3 4 5 Last »

Adaptive spatial prediction in intra coding

Yu Chen ; Lu Yu
Circuits and Systems (ISCAS), Proceedings of 2010 IEEE International Symposium on
Digital Object Identifier: 10.1109/ISCAS.2010.5537587
Publication Year: 2010 , Page(s): 4209 - 4212
IEEE CONFERENCE PUBLICATIONS

Cascaded RLS-LMS Prediction in MPEG-4 Lossless Audio Coding

Haibin Huang , Franti, P. , Dongyan Huang , Rahardja, S.
Audio, Speech, and Language Processing, IEEE Transactions on
Volume: 16 , Issue: 3
Digital Object Identifier: 10.1109/TASL.2007.911675
Publication Year: 2008 , Page(s): 554 - 562
Cited by 5
IEEE JOURNALS & MAGAZINES

Adaptive rate estimation for H.264/ AVC intra mode decision

Ke-Ying Liao , Jar-Ferr Yang , Ming-Ting Sun
Acoustics, Speech and Signal Processing, 2008. ICASSP 2008. IEEE International Conference on
Digital Object Identifier: 10.1109/ICASSP.2008.4517820
Publication Year: 2008 , Page(s): 1157 - 1160
IEEE CONFERENCE PUBLICATIONS

Nonreference Method for Estimating PSNR of MPEG-2 Coded Video by Using DCT Coefficients and Picture Energy

Ichigaya, A. ; Nishida, Y. ; Nakasu, E.
Circuits and Systems for Video Technology, IEEE Transactions on
Volume: 18 , Issue: 6
Digital Object Identifier: 10.1109/TCSVT.2008.920658
Publication Year: 2008 , Page(s): 817 - 826
Cited by 7
IEEE JOURNALS & MAGAZINES

Efficient representation and coding of prediction residuals and parameters in frame-based animated mesh compression

Marpe, D. ; Kirchhoffer, H. ; Muller, K. ; Wiegand, T.
Image Processing, 2008. ICIP 2008. 15th IEEE International Conference on
Digital Object Identifier: 10.1109/ICIP.2008.4712346
Publication Year: 2008 , Page(s): 2680 - 2683
Cited by 1
IEEE CONFERENCE PUBLICATIONS

Overview of the Stereo and Multiview Video Coding Extensions of the H.264/ MPEG-4 AVC Standard

Vetro, A. ; Wiegand, T. ; Sullivan, G.J.
Proceedings of the IEEE
Volume: 99 , Issue: 4

Digital Object Identifier: 10.1109/JPROC.2010.2098830
Publication Year: 2011 , Page(s): 626 - 642
Cited by 58
IEEE JOURNALS & MAGAZINES

A recursive optimal spectral estimate of end-to-end distortion in video communications

Jingning Han ; Melkote, V. ; Rose, K.
Packet Video Workshop (PV), 2010 18th International
Digital Object Identifier: 10.1109/PV.2010.5706825
Publication Year: 2010 , Page(s): 94 - 101
Cited by 4
IEEE CONFERENCE PUBLICATIONS

New Video Coding Scheme Optimized for High-Resolution Video Sources

Asai, K. ; Murakami, T. ; Yamagishi, S. ; Minezawa, A. ; Itani, Y. ; Sugimoto, K. ; Sekiguchi, S.-I. ; Yamada, Y. ; Kato, Y.
Selected Topics in Signal Processing, IEEE Journal of
Volume: 5 , Issue: 7
Digital Object Identifier: 10.1109/JSTSP.2011.2166054
Publication Year: 2011 , Page(s): 1290 - 1297
IEEE JOURNALS & MAGAZINES

A novel video coding scheme for Super Hi-Vision

Sekiguchi, S. , Minezawa, A. ; Sugimoto, K. ; Ichigaya, A. ; Iguchi, K. ; Shishikui, Y.
Picture Coding Symposium (PCS), 2010
Digital Object Identifier: 10.1109/PCS.2010.5702498
Publication Year: 2010 , Page(s): 322 - 325
Cited by 1
IEEE CONFERENCE PUBLICATIONS

Algorithmic Optimization for H.264 Deblocking Filter on Portable Devices

Ren, J. ; Kehtarnavaz, N.
Consumer Electronics, 2007. ISCE 2007. IEEE International Symposium on
Digital Object Identifier: 10.1109/ISCE.2007.4382168
Publication Year: 2007 , Page(s): 1 - 6
Cited by 2
IEEE CONFERENCE PUBLICATIONS

Distributed video coding using wavelet

Xun Guo ; Yan Lu ; Feng Wu ; Wen Gao
Circuits and Systems, 2006. ISCAS 2006. Proceedings. 2006 IEEE International Symposium on
Digital Object Identifier: 10.1109/ISCAS.2006.1693861
Publication Year: 2006 , Page(s): 4 pp. - 5430
Cited by 7
IEEE CONFERENCE PUBLICATIONS

Image set modeling by exploiting temporal-spatial correlations and photo album compression

Ruobing Zou ; Au, O.C. ; Guyue Zhou ; Sijin Li ; Lin Sun
Signal & Information Processing Association Annual Summit and Conference (APSIPA ASC), 2012 Asia-Pacific
Publication Year: 2012 , Page(s): 1 - 4
IEEE CONFERENCE PUBLICATIONS

Error resilient video coding techniques

Yao Wang , Wenger, S. ; Jiantao Wen ; Katsaggelos, A.K.
Signal Processing Magazine, IEEE
Volume: 17 , Issue: 4
Digital Object Identifier: 10.1109/79.855913
Publication Year: 2000 , Page(s): 61 - 82
Cited by 157
IEEE JOURNALS & MAGAZINES

H.261 and MPEG1-a comparison

Von Roden, T.
Computers and Communications, 1996., Conference Proceedings of the 1996 IEEE Fifteenth Annual International Phoenix Conference on
Digital Object Identifier: 10.1109/PCCC.1996.493614
Publication Year: 1996 , Page(s): 65 - 71
Cited by 2
IEEE CONFERENCE PUBLICATIONS

Enhanced long-term predictor for Unified Speech and Audio Coding

Jeongook Song ; Hyen-O Oh ; Kang, Hong-Goo
Acoustics, Speech and Signal Processing (ICASSP), 2011 IEEE International Conference on
Digital Object Identifier: 10.1109/ICASSP.2011.5946451
Publication Year: 2011 , Page(s): 505 - 508
IEEE CONFERENCE PUBLICATIONS

Secure advanced video coding based on selective encryption algorithms

Shiguo Lian ; Zhongxuan Liu ; Zhen Ren ; Haila Wang
Consumer Electronics, IEEE Transactions on
Volume: 52 , Issue: 2
Digital Object Identifier: 10.1109/TCE.2006.1649688
Publication Year: 2006 , Page(s): 621 - 629
Cited by 26
IEEE JOURNALS & MAGAZINES

Scalable video coding with large block for UHD video

Un-Ki Park ; Haechul Choi ; Jung Won Kang ; Jae-Gon Kim
Consumer Electronics, IEEE Transactions on
Volume: 58 , Issue: 3
Digital Object Identifier: 10.1109/TCE.2012.6311339
Publication Year: 2012 , Page(s): 932 - 940
IEEE JOURNALS & MAGAZINES

Isolated regions in video coding

Hannuksela, M.M. ; Wang, Ye-Kui ; Gabbouj, M.
Multimedia, IEEE Transactions on
Volume: 6 , Issue: 2
Digital Object Identifier: 10.1109/TMM.2003.822784
Publication Year: 2004 , Page(s): 259 - 267
Cited by 25
IEEE JOURNALS & MAGAZINES

Block Adaptive Interpolation Filter Using Trained Dictionary for Sub-Pixel Motion Compensation

Jaehyun Cho ; Shin-Cheol Jeong ; Dong-bok Lee ; Byung Cheol Song
Circuits and Systems for Video Technology, IEEE Transactions on
Volume: 22 , Issue: 2
Digital Object Identifier: 10.1109/TCSVT.2011.2160601
Publication Year: 2012 , Page(s): 241 - 248
IEEE JOURNALS & MAGAZINES

Adaptive Golomb Code for Joint Geometrically Distributed Data and Its Application in Image Coding

Jian-Jiun Ding ; Hsin-Hui Chen ; Wei-Yi Wei
Circuits and Systems for Video Technology, IEEE Transactions on
Volume: 23 , Issue: 4
Digital Object Identifier: 10.1109/TCSVT.2012.2211952
Publication Year: 2013 , Page(s): 661 - 670
IEEE JOURNALS & MAGAZINES

A Low-power BitStream Controller for H.264/ AVC Baseline Decoding

Ke Xu ; Chiu-Sing Choy ; Cheong-Fat Chan ; Kong-Pong Pun
Solid-State Circuits Conference, 2006. ESSCIRC 2006. Proceedings of the 32nd European
Digital Object Identifier: 10.1109/ESSCIR.2006.307556
Publication Year: 2006 , Page(s): 162 - 165
IEEE CONFERENCE PUBLICATIONS

A spectral approach to recursive end-to-end distortion estimation for sub-pixel motion-compensated video coding

Jingning Han ; Melkote, V. , Rose, K.
Acoustics, Speech and Signal Processing (ICASSP), 2011 IEEE International Conference on
Digital Object Identifier: 10.1109/ICASSP.2011.5946531
Publication Year: 2011 , Page(s): 825 - 828
Cited by 1
IEEE CONFERENCE PUBLICATIONS

Mobile audio-visual terminal: system design and subjective testing in DECT and UMTS networks

Gill, D. ; Cosmas, J.P. ; Pearmain, A.
Vehicular Technology, IEEE Transactions on
Volume: 49 , Issue: 4
Digital Object Identifier: 10.1109/25.875264
Publication Year: 2000 , Page(s): 1378 - 1391
Cited by 1
IEEE JOURNALS & MAGAZINES

HDTV video compression for professional studio applications

Lopez, P. ; Guillotel, P.
Picture Coding Symposium, 2009. PCS 2009
Digital Object Identifier: 10.1109/PCS.2009.5167412
Publication Year: 2009 , Page(s): 1 - 4
IEEE CONFERENCE PUBLICATIONS

Reconfigurable low energy multiplier for multimedia system design

Suhwan Kim , Papaefthymiou, M.C.
VLSI, 2000. Proceedings. IEEE Computer Society Workshop on
Digital Object Identifier: 10.1109/IWV.2000.844541
Publication Year: 2000 , Page(s): 129 - 134
Cited by 3
IEEE CONFERENCE PUBLICATIONS

< First | 1 | 2 | 3 | 4 | 5 | Last >

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Index of Claims	Application/Control No. 12377617	Applicant(s)/Patent Under Reexamination JEONG ET AL.
	Examiner COURTNEY FIELDS	Art Unit 2437

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/18/2012	08/17/2012	11/07/2012	05/13/2013					
1	1	✓	✓	✓	=					
	2	✓	-							
2	3	✓	✓	✓	=					
3	4	✓	✓	✓	=					
4	5	✓	✓	✓	=					
5	6	✓	✓	✓	=					
6	7	✓	✓	✓	=					
7	8	✓	✓	✓	=					
8	9	✓	✓	✓	=					
	10	✓	-							
9	11	✓	✓	✓	=					
	12	✓	-							
10	13	✓	✓	✓	=					
11	14	✓	✓	✓	=					
12	15	✓	✓	✓	=					
13	16	✓	✓	✓	=					
14	17	✓	✓	✓	=					
15	18	✓	✓	✓	=					
16	19	✓	✓	✓	=					
	20	✓	-							
17	21		✓	✓	=					
18	22		✓	✓	=					
19	23		✓	✓	=					
20	24		✓	✓	=					
21	25				=					
22	26				=					

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12377617	JEONG ET AL.
	Examiner	**Art Unit**
	COURTNEY FIELDS	2496

CPC

Symbol					Type	Version
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CPC Combination Sets

Symbol					Type	Set	Ranking	Version
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			/					

US ORIGINAL CLASSIFICATION					
CLASS	SUBCLASS				
375	240.2				
CROSS REFERENCE(S)					
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				
375	240.03	240.12	240.16	240.24	240.27
382	247				

INTERNATIONAL CLASSIFICATION									
CLAIMED					NON-CLAIMED				
H	0	4	N	7 / 26 (2006.01.01)	H	0	4	B	1 / 66 (2006.01.01)
H	0	4	N	7 / 32 (2006.01.01)	H	0	4	N	11 / 02 (2006.01.01)
H	0	4	N	7 / 34 (2006.01.01)	H	0	4	N	11 / 04 (2006.01.01)
H	0	4	N	7 / 50 (2006.01.01)	H	0	4	N	7 / 12 (2006.01.01)

/COURTNEY FIELDS/ Examiner.Art Unit 2496 (Assistant Examiner)	5/13/2013 (Date)	**Total Claims Allowed:** 22	
/Andrew L Nalven/ Supervisory Patent Examiner, Art Unit 2496 (Primary Examiner)	(Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

Issue Classification	**Application/Control No.** 12377617	**Applicant(s)/Patent Under Reexamination** JEONG ET AL.
	Examiner COURTNEY FIELDS	**Art Unit** 2496

/COURTNEY FIELDS/ Examiner.Art Unit 2496 (Assistant Examiner)	5/13/2013 (Date)	**Total Claims Allowed:** 22	
/Andrew L Nalven/ Supervisory Patent Examiner, Art Unit 2496 (Primary Examiner)	(Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12377617	JEONG ET AL.
	Examiner	**Art Unit**
	COURTNEY FIELDS	2496

☐ **Claims renumbered in the same order as presented by applicant** ☐ **CPA** ☐ **T.D.** ☐ **R.1.47**

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	14	17												
	2	15	18												
2	3	16	19												
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	10	22	26												
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	12														
10	13														
11	14														
12	15														
13	16														

/COURTNEY FIELDS/ Examiner.Art Unit 2496 (Assistant Examiner)	5/13/2013 (Date)	**Total Claims Allowed:** 22	
/Andrew L Nalven/ Supervisory Patent Examiner, Art Unit 2496 (Primary Examiner)	(Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

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Search Notes	Application/Control No. 12377617	Applicant(s)/Patent Under Reexamination JEONG ET AL.
	Examiner COURTNEY FIELDS	Art Unit 2437

CPC- SEARCHED

Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED

Symbol	Date	Examiner

US CLASSIFICATION SEARCHED

Class	Subclass	Date	Examiner
375	240.2	5/13/2013	CDF

SEARCH NOTES

Search Notes	Date	Examiner
EAST Search (USPAT, PG-PUB, DERWENT, IBM, EPO, JPO)	5/13/2013	CDF
Assignee Search	5/13/2013	CDF
Inventorship/Double Patenting Search	5/13/2013	CDF
NPL Search (i.e. ACM, Google, IEEE)	5/13/2013	CDF
Interference Search	5/13/2013	CDF
"Every claim has been reviewed for 35 USC non-statutory subject matter"	5/13/2013	CDF
Consulted with SPE Andrew Nalven	5/8/2013	CDF

INTERFERENCE SEARCH

US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
375	240.2	5/13/2013	CDF
375	240.03	5/13/2013	CDF
375	240.12	5/13/2013	CDF
375	240.16	5/13/2013	CDF
375	240.24	5/13/2013	CDF
375	240.27	5/13/2013	CDF

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
382	247	5/13/2013	CDF

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BIB DATA SHEET

Please amend total and independent claims

CONFIRMATION NO. 8176

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/377,617	02/16/2009 RULE	375	2496	022090.0002

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**** CONTINUING DATA ***************************

This application is a 371 of PCT/KR07/01433 03/23/2007

**** FOREIGN APPLICATIONS ***************************

REPUBLIC OF KOREA 10-2007-0008247 01/26/2007
REPUBLIC OF KOREA 10-2006-0077851 08/17/2006

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED **** ** SMALL ENTITY **
08/04/2010

		STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
Foreign Priority claimed ☑ Yes ☐ No 35 USC 119(a-d) conditions met ☑ Yes ☐ No Verified and Acknowledged /COURTNEY D FIELDS/ Examiner's Signature	☑ Met after Allowance CDF Initials	KOREA, REPUBLIC OF	6	~~20~~ 22	4

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NSIP LAW
P.O. Box 65745
Washington, DC 20035
UNITED STATES

TITLE

APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

	FEES: Authority has been given in Paper	☐ All Fees ☐ 1.16 Fees (Filing)

BIB (Rev. 05/07).

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intra prediction, encoding, decoding, coefficients, quantization, scanning

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wo/2008/020672 apparatus for **encoding** and **decoding** ... - WIPO
patentscope.wipo.int/.../detail.jsf%3Bjsessionid=496E42B92A2EF7EA19...
Feb 21, 2008 – The present invention discloses an **encoding** apparatus using a Discrete ... **coefficients** of a block outputted from the **intra prediction** means; and an ... from the DCT and **quantization** by using a **scanning** mode decided based ...

Patent US20100284459 - APPARATUS FOR **ENCODING** AND ...
www.google.com/patents/US20100284459
... onto residual **coefficients** of a block outputted from the **intra prediction** means; and ... **coefficients** acquired from the DCT and **quantization** by using a **scanning** ... **ENCODING** AND **DECODING** IMAGE USING ADAPTIVE DCT **COEFFICIENT** ...

Patent EP1949703A1 - Apparatus and method for **encoding** and ...
www.google.com/patents/EP1949703A1?cl=en
... a compression rate based on adaptive **scanning** by performing **intra prediction** onto blocks of a predetermined size, and **scanning coefficients** acquired ... and **encoding** the **quantized** residue signal block based on the prediction mode. ... The **decoding** apparatus as recited in claim 6, wherein when the prediction mode is a ...

METHOD AND APPARATUS FOR **INTRA-PREDICTION ENCODING** ...
www.faqs.org/patents/app/20120201295
Aug 9, 2012 – The method includes: selecting an **intra prediction** mode of each block to be .... to a method and an apparatus for **intra-prediction encoding/decoding**. ..... a **quantized** frequency **coefficient**, and performs a **scan** and entropy ...

APPARATUS AND METHOD FOR **ENCODING AND DECODING** ...
www.patentstorm.us/applications/20120224628/claims.html
Sep 6, 2012 – ... when **intra prediction** is applied; a predicting means for predicting pixel. ... for adaptively **scanning** and **encoding** the transformed and **quantized** ... The **encoding** apparatus as recited in claim 1, wherein **coefficients** of a first ...

[PDF] H.264 video **coding and decoding** process
www-ee.uta.edu/Dip/Courses/EE5359/mukkamala.pdf
frames to be **decoded** providing a method for fast random access . **Inter, prediction** or .... **inter-prediction coding, and quantization** of transform **coefficients**. Deblocking filter ... In BP macro blocks need not to be in raster **scan** order, this profile is ...

US 5196933 - Patent Lens - Free Full-Text Patent Search
www.patentlens.net/patentlens/patent/US_5196933/
encoding the **quantized coefficients** to form **encoded coefficients**; ... US 5504530 (Apr 2, 1996) Apparatus and method for **coding and decoding** image signals ... implicit **coefficient prediction** and **scan** adaptation for image **coding and intra** ...

JPEG - Wikipedia, the free encyclopedia
en.wikipedia.org/wiki/JPEG
The **quantized coefficients** are then sequenced and losslessly packed into the .... take place for markers immediately following entropy-coded **scan** data (see JPEG .... In the remainder of this section, the **encoding** and **decoding** processes are ...... Lossless Re-**encoding** of JPEG images using block-adaptive **intra prediction**.

H.261 - Wikipedia, the free encyclopedia
en.wikipedia.org/wiki/H.261
The **inter**-picture **prediction** reduces temporal redundancy, with motion vectors ... parameter, and the **quantized** transform **coefficients** are zig-zag **scanned** and entropy ... The H.261 standard actually only specifies how to **decode** the video. Encoder designers were left free to design their own **encoding** algorithms, as long as ...

[PDF] Review of CAVLC, Arithmetic **Coding, and** CABAC - Springer
www.springer.com/cda/content/.../cda.../9783642147029-c1.pdf?...0...
After intra/**inter prediction** and 4×4 transform and **quantization** of prediction residuals ... After transformed and zig-zag **scanned**, the non-zero **coefficients** are often sequences of ... 2.2, both CAVLC **decoding** and **encoding** must be executed in ...

1 2 3 4 5 6 7 8 9 10 Next

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EAST Search History

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L42	572	encoding AND mode AND selection AND optimal AND intra AND prediction.CLM.	US-PGPUB; UPAD	OR	OFF	2013/05/13 14:37
L43	67	encoding AND mode AND selection AND optimal AND intra AND prediction AND video AND difference AND values AND transformation.CLM.	US-PGPUB; UPAD	OR	OFF	2013/05/13 14:37
L44	109	encoding AND mode AND selection AND optimal AND intra AND prediction AND video AND difference AND values AND transformation AND quantization AND coefficients.CLM.	US-PGPUB; UPAD	OR	OFF	2013/05/13 14:38
L45	40	encoding AND mode AND selection AND optimal AND intra AND prediction AND video AND difference AND values AND transformation AND quantization AND coefficients AND entropy AND encoding AND scanning AND mode.CLM.	US-PGPUB; UPAD	OR	OFF	2013/05/13 14:38
L46	66	encoding AND mode AND selection AND optimal AND intra AND prediction AND video AND difference AND values AND transformation AND quantization AND coefficients AND entropy AND encoding AND scanning AND mode AND decoding.CLM.	US-PGPUB; UPAD	OR	OFF	2013/05/13 14:39
L47	1	encoding AND mode AND selection AND optimal AND intra AND prediction AND video AND difference AND values AND transformation AND quantization AND coefficients AND entropy AND encoding AND scanning AND mode AND decoding AND video AND recovery.CLM.	US-PGPUB; UPAD	OR	OFF	2013/05/13 14:40
L48	0	encoding AND mode AND selection AND optimal AND intra AND prediction AND video AND difference AND values AND transformation AND quantization AND coefficients AND entropy AND encoding AND scanning AND mode AND decoding AND video AND recovery AND encoded AND video AND quantization AND vertical AND scanning AND horizontal AND scanning.CLM.	US-PGPUB; UPAD	OR	OFF	2013/05/13 14:43

5/13/2013 2:45:22 PM
C:\Users\cfields\Documents\EAST\Workspaces\encoding and decoding image using adaptive DCT coefficient scanning allowance.wsp

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L26	0	382/247.ccls. and "entropy encoding" same "optimal" same "intra prediction" same "coefficients"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:39
L25	0	375/240.03.ccls. and "entropy encoding" same "optimal" same "intra prediction" same "coefficients"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:39
L24	2	375/240.16.ccls. and "entropy encoding" same "optimal" same "intra prediction" same "coefficients"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:38
L23	0	375/240.27.ccls. and "entropy encoding" same "optimal" same "intra prediction" same "coefficients"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:38
L22	3	375/240.24.ccls. and "entropy encoding" same "optimal" same "intra prediction" same "coefficients"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:38
L21	6	375/240.12.ccls. and "entropy encoding" same "optimal" same "intra prediction" same "coefficients"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:38
L20	0	375/240.20.ccls. and "entropy encoding" same "optimal" same "intra prediction" same "coefficients"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:38
L10	24	encoder and decoder and "intra	EPO; JPO;	OR	OFF	2013/05/13

		prediction" and "entropy"	DERWENT			12:21
L9	152	encoder and decoder and "intra prediction"	EPO; JPO; DERWENT	OR	OFF	2013/05/13 12:18
L8	1	L3 and L7	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:17
L7	1	"video recovery" and "scanning mode" and "decoded" and "coefficients"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:17
L6	0	"video recovery" near5 "scanning mode" near5 "decoded" near5 "coefficients"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:16
L5	1	"video recovery" near5 "scanning mode"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:15
L4	3134865	"video recovery" near5 scanning mode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:14
L3	3	"entropy encoding" same "optimal" same "intra prediction" same "coefficients" same scan$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:11
L2	8	"entropy encoding" same "optimal" same "intra prediction" same "coefficients"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:09
L1	13	"entropy encoding" same "optimal" same "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:07
S136	4	"entropy encoding" near5 "zigzag"	US-PGPUB;	OR	OFF	2012/11/07

		same "horizontal"	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			19:41
S135	29	"entropy encoding" near5 "zigzag" and "horizontal"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 19:41
S134	0	"entropy encoding" near5 "zigzag" near5 "horizontal"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 19:41
S133	41	"entropy encoding" near5 "zigzag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 19:40
S132	75	"entropy encoding" with "zigzag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 19:40
S131	152	"entropy encoding" same "zigzag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 19:40
S130	5	"mode selection" with "intra prediction" with "DCT" with "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 19:14
S129	138	"mode selection" and "intra prediction" and "DCT" and "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 19:14
S128	1	S97 and "plane"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	2012/11/07 19:07

			IBM_TDB			
S127	1	S97 and "direct current"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:52
S126	6	S97 and "pixels"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:44
S125	8	S97 and "pixel"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:44
S124	0	S97 and "pixel prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:44
S123	3	"20050157797"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:41
S122	1	"video recovery" same "entropy decoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:37
S121	1	"video recovery" with "entropy decoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:37
S120	4	"video recovery" and "decoding" and "entropy"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:33
S119	0	S97 and "recover"	US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	2012/11/07 18:33

			JPO; DERWENT; IBM_TDB			
S118	0	S97 and "recovering"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:33
S117	0	S97 and "video recovery"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:32
S116	4	S97 and (multipl$7)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:31
S115	1	S97 and "dispersion"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:30
S114	3	S97 and "zigzag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:14
S113	0	S97 and "zig zag" and "intra prediction" and "video" and "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:13
S112	0	S97 and "zig zag" and "intra prediction" and "video" and "entropy encoding" and "DCT" and "quantization" and "coefficients" and "horizontal" and "vertical" and "scanning"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:13
S111	1	S97 and "zigzag" and "intra prediction" and "video" and "entropy encoding" and "DCT" and "quantization" and "coefficients" and "horizontal" and "vertical" and "scanning"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:13
S110	0	S97 and "zigzag" and "intra prediction" and "video" and "entropy	US-PGPUB; USPAT;	OR	OFF	2012/11/07 18:13

		encoding" and "DCT" and "quantization" and "coefficients" and "horizontal" and "vertical" and "scanning" and "residual signals" and (multipl$7) and "dispersion"	USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
S109	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction" and "video" and "entropy encoding" and "DCT" and "quantization" and "coefficients" and "horizontal" and "vertical" and "scanning" and "residual signals" and (multipl$7) and "dispersion"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:13
S108	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction" and "video" and "entropy encoding" and "DCT" and "quantization" and "coefficients" and "horizontal" and "vertical" and "scanning" and "residual signals" and (multipl$7)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:12
S107	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction" and "video" and "entropy encoding" and "DCT" and "quantization" and "coefficients" and "horizontal" and "vertical" and "scanning" and "residual signals"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:11
S106	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction" and "video" and "entropy encoding" and "DCT" and "quantization" and "coefficients" and "horizontal" and "vertical" and "scanning" and "residual"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:11
S105	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction" and "video" and "entropy encoding" and "DCT" and "quantization" and "coefficients" and "horizontal" and "vertical" and "scanning"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:11
S104	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction" and "video" and "entropy encoding" and "DCT" and "quantization" and "coefficients"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:11
S103	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction" and "video" and "entropy encoding" and	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	OFF	2012/11/07 18:11

		"DCT" and "quantization"	DERWENT; IBM_TDB			
S102	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction" and "video" and "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:10
S101	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction" and "video"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:10
S100	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:10
S99	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:10
S98	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zig zag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:10
S97	16	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 17:59
S96	4	encod$3 with "9 prediction modes"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 17:58
S95	0	encod$3 with "intra prediction" with "DCT" with "quantization" with "9 prediction modes"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 17:58
S94	0	encod$3 with "intra prediction" with "DCT" with "quantization" with "9 prediction modes" with (entropy	US-PGPUB; USPAT; USOCR;	OR	OFF	2012/11/07 17:57

		encod$3)	FPRS; EPO; JPO; DERWENT; IBM_TDB			
S93	7	encod$3 with "intra prediction" with "DCT" with "quantization" with scan$4 with (entropy encod$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 17:54
S92	7	encod$3 with "intra prediction" with "DCT" with "quantization" with scan$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 17:54
S91	50	encod$3 with "intra prediction" with "DCT" with "quantization"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 17:54
S90	112	encod$3 with "intra prediction" with "DCT"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 17:54
S89	1984	encod$3 with "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 17:54
S88	2	"8199819".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 17:33
S87	5	"20030081850" "4821119".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/06 15:18
S86	23	"vertical scanning" and "entropy encoding" and "horizontal" and "zig-zag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:51
S85	23	"vertical scanning" and "entropy	US-PGPUB;	OR	OFF	2012/08/16

		encoding" and "horizontal" and "zigzag"	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			16:51
S84	44	"vertical scanning" and "entropy encoding" and "horizontal"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:51
S83	46	"vertical scanning" and "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:51
S82	0	"vertical scanning" near "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:51
S81	1	"vertical scanning" near5 "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:50
S80	9	"vertical scanning" same "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:50
S79	22	"coefficient scanning" same "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:47
S78	77	"coefficient scanning" and "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:47
S77	159	"horizontal" and "vertical" and "entropy encoding" and "zig-zag" and "scanning"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	2012/08/16 16:46

			IBM_TDB			
S76	10	"horizontal scan" and "vertical scan" and "entropy encoding" and "zig-zag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:46
S75	21	"horizontal scanning" and "vertical scanning" and "entropy encoding" and "zig-zag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:46
S74	21	"horizontal scanning" and "vertical scanning" and "entropy encoding" and "zigzag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:45
S73	21	"horizontal scanning" and "vertical scanning" and "entropy encoding" and "intra" and "zig-zag" and "pixel" and "residual" and "high"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:44
S72	21	"horizontal scanning" and "vertical scanning" and "entropy encoding" and "intra" and "zig-zag" and "pixel" and "residual"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:44
S71	21	"horizontal scanning" and "vertical scanning" and "entropy encoding" and "intra" and "zig-zag" and "pixel"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:43
S70	0	"horizontal scanning" and "vertical scanning" and "entropy encoding" and "intra" and "zig-zag" and "residual signal"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:43
S69	21	"horizontal scanning" and "vertical scanning" and "entropy encoding" and "intra" and "zig-zag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:43
S68	33	"horizontal scanning" and "vertical scanning" and "entropy encoding" and "intra"	US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	2012/08/16 16:43

			JPO; DERWENT; IBM_TDB			
S67	0	"horizontal scanning" and "vertical scanning" and "entropy encoding" and "intraframe prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:43
S66	39	"horizontal scanning" and "vertical scanning" and "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:43
S65	8	"horizontal scanning" same "vertical scanning" same "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:41
S64	8607	"horizontal scanning" same "vertical scanning"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:41
S63	10754	"horizontal scanning" and "vertical scanning"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:40
S62	14	"horizontal directional" and "vertical" and "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:43
S61	1	"horizontal-directional" and "vertical" and "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:43
S60	1	"horizontal-directional" same "vertical" and "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:43
S59	1	"horizontal-directional" same "vertical intra prediction"	US-PGPUB; USPAT;	OR	OFF	2012/08/15 16:42

			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
S58	1	"horizontal-directional scanning"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:42
S57	9	"difference values" same "DCT" same "quantization" same "intra" and "prediction" and "vertical" and "horizontal"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:36
S56	0	"difference values" same "DCT" same "quantization" same "intra" and "prediction" and "selected mode"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:34
S55	2	"difference values" same "DCT" same "quantization" same "intra" and "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:32
S54	2	"difference values" same "DCT" same "quantization" same "intra" and "prediction" and "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:31
S53	15	"difference values" same "DCT" same "quantization" same "intra" and "prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:30
S52	17	"difference values" same "DCT" same "quantization" same "intra"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:30
S51	1	"difference values" same "DCT" same "quantization" same "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:30

S50	0	"difference values" same "DCT" same "quantization" same "intraprediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:30
S49	51	"difference values" same "DCT" same "quantization"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:29
S48	5	"scanning mode" and "difference values" and "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:24
S47	0	"scanning mode" same "difference values" same "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:24
S46	1	"DCT" same "scan" same "intra prediction" same "video" same (encod$3 or encipher$3 or encrypt$3) and 375/240.27.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:45
S45	5	"DCT" same "scan" same "intra prediction" same "video" same (encod$3 or encipher$3 or encrypt$3) and 375/240.12.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:45
S44	1	"DCT coefficient" near5 "scanning" near5 "pixel" and 375/240.24.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:45
S43	5	"DCT" same "scan" same "intra prediction" same "video" same (encod$3 or encipher$3 or encrypt$3) and 375/240.12	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:45
S42	5	"DCT coefficient" near5 "scanning" near5 "pixel"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	OFF	2012/03/18 13:40

			DERWENT; IBM_TDB			
S41	52	"DCT coefficient" same "scanning" same "pixel"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:40
S40	12	"DCT" same "scan" same "intra prediction" same "video" same (encod$3 or encipher$3 or encrypt$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:35
S39	14	"DCT" same "scan" same "intra prediction" same "video"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:35
S38	19	"DCT" same "scan" same "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:35
S37	0	"DCT scan" same "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:35
S36	0	"discrete cosine transform scanning" same "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:35
S35	0	"DCT scanning" same "intraprediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:34
S34	0	"DCT scanning" same "intra-prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:34
S33	2	"DCT scanning" same "intra prediction"	US-PGPUB; USPAT; USOCR;	OR	OFF	2012/03/18 13:34

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S32	0	"DCT scanning" same "intraprediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:34
S31	4	(discrete cosine transform or (DCT)) near (scan$4) same "intra-prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:32
S30	0	(discrete cosine transform or (DCT)) near (scan$4) near "intra-prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:32
S29	0	(discrete cosine transform or (DCT)) near (scan$4) near "intraprediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:32
S28	0	(discrete cosine transform or (DCT)) near (scan$4) near "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:32
S27	1173383	(discrete cosine transform) or (DCT) near (scan$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:32
S26	2299	(discrete cosine transform or (DCT)) near (scan$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:31
S25	11577	(discrete cosine transform or (DCT)) near5 (scan$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:31
S24	23869	(discrete cosine transform or (DCT))	US-PGPUB;	OR	OFF	2012/03/18

		same "scanning"	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			13:31
S23	900	375/240.2.ccls. and (discrete cosine transform or (DCT))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:30
S22	0	375/240.200.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:30
S21	921	375/240.2.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:30
S20	0	375/240.20.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:29
S19	0	S17 and S18	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:29
S18	7919	electronics and telecommunications.asn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:29
S17	2	S1 and S2 and S3 and S4 and S5 and S6 and S7 and S8 and S9 and S10 and S11 and S12 and S13 and S14 and S15 and S16	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:29
S16	79	dong-kyun.in. and kim.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	2012/03/18 13:28

			IBM_TDB			
S15	55	dae-yeon.in. and kim.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:28
S14	18	chang-beom.in. and ahn.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:28
S13	19	seoung-jun.in. and oh.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:28
S12	32	dong-gyu.in. and sim.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:27
S11	141	yung-lyul.in. and lee.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:27
S10	204	jin-woong.in. and kim.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:27
S9	580	jin-woo.in. and kim.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:26
S8	52	dae-young.in. and jang.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:26
S7	15	kyung-ae.in. and moon.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	2012/03/18 13:26

			JPO; DERWENT; IBM_TDB			
S6	115	jae-gon.in. and kim.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:26
S5	21	in-seon.in. and jang.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:26
S4	23	seung-kwon.in. and beack.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:25
S3	64	jeong-il.in. and seo.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:25
S2	33	hae-chul.in. and choi.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:25
S1	27	se-yoon.in. and jeong.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:25

5/13/2013 12:40:20 PM
C:\Users\cfields\Documents\EAST\Workspaces\encoding and decoding image using adaptive DCT coefficient scanning allowance.wsp

Substitute for PTO/SB/08a/b

Substitute for form 1449/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** ***(Use as many sheets as necessary)***				***Complete if Known***	
				Application Number	12/377,617
				Filing Date	February 16, 2009
				First Named Inventor	Se-Yoon Jeong et al.
				Art Unit	2496
				Examiner Name	Courtney D. Fields
Sheet	1	of	1	Attorney Docket Number	022090.0002

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number - Kind Code[2] *(if known)*	Patent or Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

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NON-PATENT LITERATURE DOCUMENTS

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/C.F./		D.-k. Kim et al., "Adaptive Scanning Using Pixel Similarity for H.264/AVC," *Proceedings of the 2006 Korean Signal Processing Conference*, Vol. 19, No. 1, pp. 1-4, September 23, 2006, Hanyang University Ansan Campus, Ansan, Republic of Korea (in Korean, including English abstract).	

Examiner Signature	/Courtney Fields/	Date Considered	05/13/2013

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1]Applicant's unique citation designation number (optional). [2]See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04(a). [3]Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4]For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6]Applicant is to place a check mark here if English language Translation is attached (X indicates Abstract only provided).

Searching for: (encoding, and decoding, and intra and prediction, and entropy, and coefficients) (start a new search)

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1 Differentiated Services Based Priority Dropping and Its Application to Layered Video Streams
Markus Fidler
May 2002 **NETWORKING '02:** Proceedings of the Second International IFIP-TC6 Networking Conference on Networking Technologies, Services, and Protocols; Performance of Computer and Communication Networks; and Mobile and Wireless Communications
Publisher: Springer-Verlag
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count

In this paper we report on an implementation and evaluation of Internet prioritydropping schemes and their application to layered video transmissions. The incremental decoding of each of the different layers of such an hierarchical video stream leads ...

2 A study of 3D Network-on-Chip design for data parallel H.264 coding
Thomas Canhao Xu, Alexander Wei Yin, Pasi Liljeberg, Hannu Tenhunen
October 2011 **Microprocessors & Microsystems**, Volume 35 Issue 7
Publisher: Elsevier Science Publishers B. V.
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count

In this paper, we implement, analyze and compare different Network-on-Chip (NoC) architectures aiming at higher efficiencies for MPEG-4/H.264 coding. Two-dimensional (2D) and three-dimensional (3D) NoCs based o Non-Uniform Cache Access (NUCA) are analyzed. ...
Keywords: 3D IC design, Coding, Data parallel, H.264, Network-on-Chip

3 H.264 error resilience coding based on multi-hypothesis motion-compensated prediction
Yuh-Chou Tsai, Chia-Wen Lin, Chia-Ming Tsai
October 2007 **Image Communication**, Volume 22 Issue 9
Publisher: Elsevier Science Inc.
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count

In this paper, we propose efficient schemes for enhancing the error robustness of multi-hypothesis motion-compensate predictive (MHMCP) coder without sacrificing the coding efficiency significantly. The proposed schemes utilize the concept of reference ...

Keywords: Error resilience coding, H.264 video coding, Multi-hypothesis prediction, Video streaming, Wireles video

4 High level H.264/AVC video encoder parallelization for multiprocessor implementation
Hajer Krichene Zrida, Abderrazek Jemai, Ahmed C. Ammari, Mohamed Abid
April 2009 **DATE '09:** Proceedings of the Conference on Design, Automation and Test in Europe
Full text available: Pdf (1.04 MB)
Bibliometrics: Downloads (6 Weeks): 1, Downloads (12 Months): 15, Downloads (Overall): 75, Citation Count:

H.264/AVC (Advanced Video Codec) is a new video coding standard developed by a joint effort of the ITU-TVCEG and ISO/IEC MPEG. This standard provides higher coding efficiency relative to former standards at the expense of higher computational requirements. ...

5 Distributed video coding with progressive significance map
Yang Hu, William A. Pearlman
May 2013 **Journal of Visual Communication and Image Representation**, Volume 24 Issue 4
Publisher: Academic Press, Inc.
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count

A distributed video coding (DVC) system based on wavelet transform and set partition coding (SPC) is present in this paper. Conventionally the significance map (sig-map) of SPC is not conducive to Slepian-Wolf (SW) coding, because of the difficulty ...

Keywords: Distributed video coding, Error resilience, LDPCA codes, SPIHT coding, Set partition coding, Significance map, Slepian-Wolf coding, Wavelet transform

6 Framework for the integrated video quality assessment
Mu Mu, Piotr Romaniak, Andreas Mauthe, Mikolaj Leszczuk, Lucjan Janowski, Eduardo Cerqueira
December 2012 **Multimedia Tools and Applications** , Volume 61 Issue 3
Publisher: Kluwer Academic Publishers

Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count

Through years of development Content Networks (CN) have become more sophisticated and more technically diverse. Modern CN are designed to be more adaptive to communication environment, devices and user requirements. However, one open issue is the still ...
Keywords: Content distribution network, Mean opinion score, Perceptual quality, Quality of experience, Videc quality metrics

7 Low-complexity video coding via power-rate-distortion optimization
Li-Wei Kang, Chun-Shien Lu, Chih-Yang Lin
April 2012 **Journal of Visual Communication and Image Representation** , Volume 23 Issue 3
Publisher: Academic Press, Inc.

Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count

Wireless multimedia sensor networks (WMSNs) have been potentially applicable for several emerging applications. The resources, i.e., power and bandwidth available to visual sensors in a WMSN are, however, ve limited. Hence, it is important but challenging ...
Keywords: Hash, Low-complexity video coding, Low-power and power-aware video coding, Motion estimatior Multiview video coding, Power-rate-distortion optimization, Rate-distortion, Wireless multimedia sensor networks

8 Non-periodic frame refreshment based on the uncertainty models of the reference frames
Yong Tae Kim, Youngil Yoo, Dong Wook Kang, Kyeong Hoon Jung, Ki-Doo Kim, Seung-Jun Lee
November 2005 **PCM'05: Proceedings of the 6th Pacific-Rim conference on Advances in Multimedia Information Processing - Volume Part II** , Volume Part II
Publisher: Springer-Verlag
Full text available: Publisher Site

Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count

Intra-frame insertion, conventionally periodic, is inevitable to provide the decoders with the capability of rand access for the streamed videos. In this paper, we propose a new non-periodic intra-frame insertion method which encodes a frame as I-picture ...

9 A framework for end-to-end video quality prediction of MPEG video
Harilaos Koumaras, C. -H. Lin, C. -K. Shieh, Anastasios Kourtis
February 2010 **Journal of Visual Communication and Image Representation** , Volume 21 Issue 2
Publisher: Academic Press, Inc.

Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count

This paper proposes, describes and evaluates a novel framework for video quality prediction of MPEG-based video services, considering the perceptual degradation that is introduced by the encoding process and the provision of the encoded signal over an ...

Keywords: Frame loss, MPEG, PQoS, Packet loss, Prediction, Quality of Experience (QoE), SSIM, Video qualit

10 Sparse and silent coding in neural circuits
AndráS Lőrincz, Zsolt Palotai, GáBor Szirtes
March 2012 **Neurocomputing** , Volume 79
Publisher: Elsevier Science Publishers B. V.

Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count

Sparse coding algorithms find a linear basis in which signals can be represented by a small number of non-zer coefficients. Such coding may play an important role in neural information processing and metabolically efficie natural solutions serve as ...
Keywords: l_1 Norm, Cross-entropy method, Sparse coding

11 A novel scrambling scheme for digital video encryption
Zhenyong Chen, Zhang Xiong, Long Tang
December 2006 **PSIVT'06:** Proceedings of the First Pacific Rim conference on Advances in Image and Video Technology
Publisher: Springer-Verlag

Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count

Nowadays it is easy and fast to deliver and communicate the digital video contents. Therefore, security proble reveals followed in applications such as video-on-demand, videoconference and video chatting system. In this paper, a scrambling scheme employing ...
Keywords: MPEG-4, scrambling, video encryption

12 Improved prediction methods for scalable predictive animated mesh compression
M. Oguz Bici, Gozde B. Akar
October 2011 **Journal of Visual Communication and Image Representation** , Volume 22 Issue 7
Publisher: Academic Press, Inc.
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count

Animated meshes represented as sequences of static meshes sharing the same connectivity require efficient compression. Among the compression techniques, layered predictive coding methods efficiently encode the animated meshes in a structured way such ...
Keywords: 3D dynamic meshes, Angle based prediction, Animated mesh coding, Animated meshes, Compression, Predictive coding, Time consistent mesh sequence, Weighted prediction

13 Estimating the directed information to infer causal relationships in ensemble neural spike train recording
Christopher J. Quinn, Todd P. Coleman, Negar Kiyavash, Nicholas G. Hatsopoulos
February 2011 **Journal of Computational Neuroscience** , Volume 30 Issue 1
Publisher: Springer-Verlag New York, Inc.
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count

Advances in recording technologies have given neuroscience researchers access to large amounts of data, in particular, simultaneous, individual recordings of large groups of neurons in different parts of the brain. A variety of quantitative techniques ...
Keywords: Causality, Functional connectivity, Mutual information, Point processes

14 MPEG-4 to H.264/AVC transcoding
Yongfang Liang, Xiaohui Wei, Ishfaq Ahmad, Vishwanathan Swaminathan
August 2007 **IWCMC '07:** Proceedings of the 2007 international conference on Wireless communications and mobile computing
Publisher: ACM Request Permissions
Full text available: Pdf (218.10 KB)
Bibliometrics: Downloads (6 Weeks): 1, Downloads (12 Months): 16, Downloads (Overall): 424, Citation Count: 1

In this paper, we consider the problem of MPEG-4 visual simple profile to H.264/AVC baseline profile (BP) transcoding. An efficient transcoding algorithm with fast mode selection and motion vector refinement is proposed. The proposed algorithm exploits ...

Keywords: MPEG, transcoding, video coding

15 A high-throughput ASIC processor for 8×8 transform coding in H.264/AVC
Juan A. Michell, José M. Solana, Gustavo A. Ruiz
February 2011 **Image Communication** , Volume 26 Issue 2
Publisher: Elsevier Science Inc.
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count

In July 2004, a new amendment called Fidelity Range Extensions (FRExt) was added to the H.264/AVC as a standardization initiative motivated by the rapidly growing demands when coding higher-fidelity video materia One improvement present in the FRExt ...
Keywords: 8×8 integer cosine transform, ASIC processor, H.264/AVC, Quantization, Transform coding

16 Rate control and mode decision jointly optimization in H.264AVC
Siavash Eshaghi, Hassan Farsi
February 2010 **ISPRA'10:** Proceedings of the 9th WSEAS international conference on Signal processing, robotics and automation
Publisher: World Scientific and Engineering Academy and Society (WSEAS)
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count

In this paper we proposed a new algorithm for rate control in h.264 by performing 16×16 block motion estimation first. Using this primary information, we can estimate the frame complexity and allocate bits to the frames based on their complexities. ...
Keywords: H.264, frame complexity, mode decision, motion estimation, rate control, video coding

17 Fast interframe mode decision algorithm based on mode mapping and MB activity for MPEG-2 to H.264/AVC transcoding
Xingang Liu, Kook-Yeol Yoo
February 2010 **Journal of Visual Communication and Image Representation** , Volume 21 Issue 2

Publisher: Academic Press, Inc.

Recently the latest video coding standard H.264/AVC is widely used for the mobile and low bitrate video codec the various multimedia terminals. On the other hand, the MPEG-2 MP@HL codec has become the center of digital video contents since it is the ...

Keywords: H.264/AVC, Interframe, MB activity, MPEG-2, Mode decision (MD), Mode mapping, RDCost, Transcoding

18 Batch-pipelining for multicore H.264 decoding
Tang-Hsun Tu, Chih-Wen Hsueh, Ja-Ling Wu
July 2012 **Journal of Visual Communication and Image Representation** , Volume 23 Issue 5
Publisher: Academic Press, Inc.

Pipelining has been applied in many area to improve system performance by overlapping executions of hardwa or software computing stages. However, direct pipelining for H.264 decoding is difficult because video bitstreams are encoded with lots of dependencies ...
Keywords: Batch, H.264, HEVC, Multicore, Optimization, Parallelization, Pipelining, Synchronization

19 Transparent encryption techniques for H.264/AVC and H.264/SVC compressed video
Enrico Magli, Marco Grangetto, Gabriella Olmo
May 2011 **Signal Processing** , Volume 91 Issue 5
Publisher: Elsevier North-Holland, Inc.

Transparent encryption of video content requires to provide a video preview that is left in plaintext, while the enhancement information is encrypted. In this paper we propose three algorithms that provide transparent encryption. The first two ones are ...
Keywords: Conditional access, Drift control, H.264/AVC, H.264/SVC, Transparent encryption, Video coding

20 Efficient compression and network adaptive video coding for distributed video surveillance
Praveen Kumar, Amit Pande, Ankush Mittal
January 2012 **Multimedia Tools and Applications** , Volume 56 Issue 2
Publisher: Kluwer Academic Publishers

The availability of cheap network based video cameras and the prevalence of wireless networks has lead to a major thrust towards deployment of large scale Distributed Video Surveillance (DVS) systems. This has opene up an important area of research ...
Keywords: Distributed video surveillance, Segmentation, Video coding, Wavelet transform

Result page: **1** 2 3 4 5 6 7 8 9 10 next

Docket No. 022090.0002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Se-Yoon Jeong et al.

Application No. 12/377,617 Art Unit: 2496

Confirmation No. 8176

Filed: February 16, 2009 Examiner: Courtney D. Fields

For: APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

AMENDMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is in response to the Office Action mailed November 20, 2012, and having a period for response set to expire on February 20, 2013, and extended to March 20, 2013, by the accompanying petition for a one-month extension of time. The additional small-entity claim fee of $80.00 for 2 additional claims in excess of 20 required for this Amendment is being paid on even date herewith.

The following amendments and remarks are respectfully submitted. Reconsideration of the claims is respectfully requested.

Amendments to the specification begin on page 2 of this paper.

Amendments to the claims are reflected in the listing of the claims that begins on page 10 of this paper.

Remarks begin on page 16 of this paper.

An Information Disclosure Statement is attached following page 34 of this paper.

IN THE SPECIFICATION:

The specification as amended below with replacement paragraphs shows added text with underlining and deleted text with ~~strikethrough~~.

Please REPLACE the paragraph on page 2, lines 4-11, with the following amended paragraph:

H.264/Advanced Video Coding (AVC) standard technology can compress video about twice as high as Moving Picture Experts Group 2 (MPEG-2) and about one and a half times as high as MPEG-4 by using such technique as intra prediction encoding, ~~1/4-based~~ 1/4-pixel based variable block motion prediction and compensation, ~~Context-Based~~ Context-based Adaptive Variable Length Coding (CAVLC), and ~~Context-Based~~ Context-based Adaptive Binary Arithmetic Coding (CABAC).

Please REPLACE the two paragraphs on page 3, lines 5-9, with the following amended paragraphs:

Fig. 2 exemplarily illustrates a pixel prediction method in a vertical direction in a 4 x 4 block 200.

As shown in Fig. 2, pixel a 201, pixel ~~b~~ e 202, pixel i 203, and pixel m 204 are predicted based on an adjacent pixel A in the vertical direction.

Please REPLACE the paragraph on page 3, lines 16 and 17, with the following amended paragraph:

Fig. 3 exemplarily illustrates a pixel prediction method in a horizontal direction in a 4 x 4 block 200.

Please REPLACE the three paragraphs on page 3, line 21, through page 4, line 4, with the following amended paragraphs:

Also, pixels e, f, g and h are predicted based on an adjacent pixel J in the horizontal direction, and pixels i, j, k and l are predicted based on an adjacent pixel K in the horizontal direction. Pixels m, n, o and p are predicted based on an adjacent pixel ~~l~~ L in the horizontal direction.

An encoder performs Discrete Cosine Transform (DCT) and quantization onto residual signals (which are of a pixel area) acquired by ~~differentiating~~ calculating differences between the predicted pixels and ~~a~~ the current ~~pixel~~ pixels. Subsequently, the encoder performs zigzag scanning and entropy encoding onto the transformed coefficients obtained from DCT and quantization.

Herein, although the zigzag scanning takes advantage of an energy compaction characteristic of a transformed coefficient that energy converges ~~onto~~ into low frequency components and energy appears little in high frequency components, the energy compaction after intra prediction is not always effective.

Please REPLACE the paragraph on page 6, lines 29-32, with the following amended paragraph:

Also, the present invention can improve a video compression rate by being applied to a video compression technology using intra prediction, which will be developed in the future.

Please REPLACE the paragraph on page 7, lines 5 and 6, with the following amended paragraph:

Fig. 2 exemplarily illustrates a pixel prediction method in a vertical ~~mode~~ direction.

Please REPLACE the paragraph on page 8, lines 20-27, with the following amended paragraph:

The mode selection unit 10 selects an optimal mode among several available prediction modes for intra prediction. In other words, it selects one among a plurality of possible encoding modes when 4 x 4, 16 x 16, or 8 x 8 intra prediction is performed. Generally, the mode selection unit 10 selects one mode according to a rate-distortion optimization method for reducing ~~a rate-distortion~~ an amount of distortion at a given bit rate.

Please REPLACE the two paragraphs on page 9, lines 5-16, with the following amended paragraphs:

The entropy encoding unit 40 arrays DCT coefficients obtained in the DCT and quantization unit 30 by using an adaptive DCT coefficient scanning based on pixel similarity, performs entropy encoding onto the arrayed DCT coefficients, and outputs an encoded video bitstream in accordance with the result.

Herein, the entropy encoding is an encoding technique for enhancing a compression rate by allocating ~~small~~ a few bits to data highly likely to occur and many bits ~~for~~ to data that are not likely to occur. Examples of the entropy encoding used in the present invention include ~~Context~~ Context-based Adaptive Variable Length Coding (CAVLC) or ~~Context-Based~~ Context-based Adaptive Binary Arithmetic Coding (CABAC).

Please REPLACE the paragraph on page 9, lines 28, through page 10, line 2, with the following amended paragraph:

As shown in Fig. 5, the zigzag scanning method used in the present invention is devised in consideration that low frequency components of transformed ~~coefficient~~ coefficients acquired from the DCT and quantization are highly likely to be positioned in the upper left part ~~on~~ of a two-dimensional plane. It takes advantage of a transformed coefficient energy compaction characteristic that coefficients after DCT collectively appear in low frequencies, whereas coefficients after DCT less appear in high frequencies.

Please REPLACE the paragraph on page 10, lines 14-20, with the following amended paragraph:

To describe an example of the vertical prediction mode, the vertical prediction mode is selected as an optimal mode in a rate-distortion optimization process, when the pixel similarity in the vertical direction is high. Herein, significant coefficients are distributed in the first row. Therefore, the horizontal scanning shown in Fig. 6 is more efficient than the typical zigzag scanning.

Please REPLACE the paragraph on page 10, line 33, through page 11, line 4, with the following amended paragraph:

Therefore, if pixel similarities in the vertical and horizontal directions of ~~blocks around~~ a block to be encoded are predicted based on similarity information among adjacent block boundary pixels which are already recovered and an adaptive scanning method according to the prediction result is used, the encoding efficiency can be increased.

Please REPLACE the seven paragraphs on page 11, line 8, through page 12, line 24, with the following amended paragraphs:

As illustrated in Fig. 8, pixels A, B, C and D are positioned ~~in~~ adjacent to the upper part of a current block to be encoded, whereas pixels E, F, G and H are positioned ~~in~~ adjacent to the left part of the current block to be encoded.

Herein, when vertical prediction encoding is performed, the vertical-directional pixel similarity of the pixels a, e, i and m ~~are positioned~~ in ~~a~~ the first ~~row~~ column of the current block to be encoded is the same as the vertical-directional pixel similarity of residual coefficients a-A, e-A, i-A, and m-A after vertical prediction. This is because the residual coefficients a-A, e-A, i-A, and m-A are differentiated by the same prediction ~~pixels as~~ pixel A from the pixels a, e, i and m, and thus the correlation does not change.

~~As described above,~~ Also, the vertical-directional pixel similarity of the pixels in columns 2, 3 and 4 ~~rows~~ of ~~a~~ the current block to be encoded is the same as the vertical-directional pixel similarity of residual coefficients after vertical prediction.

However, the horizontal-directional pixel similarity of the ~~1-row~~ pixels a, b, c and d in the first row of the current block to be encoded is different from the horizontal-directional pixel similarity of residual coefficients a-A, b-B, c-C, and d-D after vertical prediction. Also, the horizontal-directional pixel similarity before vertical prediction ~~becomes~~ is higher than the horizontal-directional pixel similarity after the vertical prediction. Thus, it becomes similar to or higher than the vertical-directional pixel similarity.

Likewise, in the case of the horizontal prediction encoding, the horizontal-directional pixel similarity of the pixels a, b, c and d in ~~a~~ the first row of ~~a~~ the current block to be encoded is the same as the horizontal-directional pixel similarity of residual coefficients a-E, b-E, c-E, and d-E after horizontal prediction. Also, the horizontal-directional pixel similarity of the pixels in rows 2, 3 and 4 ~~rows~~ of the ~~bock~~ current block to be encoded is the same as the horizontal-directional pixel similarity of the residual coefficients after horizontal prediction.

However, the vertical-directional pixel similarity of the ~~1-row~~ pixels a, e, i and m in the first column of the current block to be encoded is different from the vertical-directional pixel similarity of residual coefficients a-E, e-F, i-G, and m-H after horizontal prediction. Also, the vertical-directional pixel similarity before horizontal prediction ~~becomes~~ is higher than the ~~vertical -directional~~ vertical-directional pixel similarity after the horizontal prediction. Thus, it becomes similar to or higher than the horizontal-directional pixel similarity.

As described above, when the pixel similarities in the vertical and horizontal directions ~~become~~ are similar, a general zigzag scanning method is more efficient than the horizontal and vertical scanning methods.

Please REPLACE the paragraph on page 12, line 35, through page 13, line 6, with the following amended paragraph:

When the vertical-directional pixel similarity of recovered 8 pixels A, B, C, D, E, F, G and H of Fig. 8 is referred to as S_VER and their horizontal-directional pixel similarity is referred to as S_HOR, the pixel similarities for increasing the efficiency of 4 x 4 prediction encoding can be calculated ~~as~~ using the following Equation 1.

Please REPLACE the paragraph on page 13, lines 12-16, with the following amended paragraph:

~~where~~ In Equation 1, Variance() denotes a dispersion; E, F, G and H ~~DENOTE~~ denote pixels adjacent to the left part of the current block to be ~~endoed;~~ encoded; and A, B, C and D denote pixels adjacent to the upper part of the current block to be encoded.

Please REPLACE the three paragraphs on page 14, lines 4-15, with the following amended paragraphs:

The ~~vertical~~ vertical-directional and horizontal-directional pixel similarity prediction values acquired in the above methods are compared to each other to decide a scanning method.

Although ~~the example of~~ a 4 x 4 intra prediction mode is described in the above example, the present invention is not limited to the 4 x 4 intra prediction mode, and the present invention can be applied to an M x N intra prediction mode, too.

Hereinafter, a method of selecting a scanning method in the vertical and horizontal intra prediction modes will be described in detail with reference to Figs. 9 and 10.

Please REPLACE the paragraph on page 15, lines 29-35, with the following amended paragraph:

The entropy decoding unit 50 receives an encoded video bitstream encoded in the encoding apparatus of Fig. 4 using an adaptive DCT coefficient scanning based on pixel similarity and decodes it through an entropy decoding method such as CAVLC or CABAC. Then, the entropy decoding unit 50 transmits the entropy-decoded video bitstream to the scanning decision unit 60.

Please REPLACE the two paragraphs and Table 1 on page 16, lines 7-19, with the following amended paragraphs and Table 1:

An ~~experiments~~ experiment was carried out for diverse test videos ~~by~~ using Joint Model 86 (JM86), which is an H.264/AVC Reference Codec, according to the above-described methods. The result of an increase in compression efficiency was as follows. In the experiment, ~~video~~ videos recommended by H.264/AVC as test ~~video was~~ videos were used. The following Table 1 shows conditions of the experiment.

Table 1

Video	News (QCIF)	Container (QCIF)	Coast (QCIF)	Paris (QCIF)	Coast (CIF)
Entire Frame	300 (30 Hz)	300 (30 Hz)	300 (30 Hz)	300 (35 Hz)	300 (30 Hz)
Conditions	CAVLC, Intra only, QP(18,22,26,~~40~~30), rate-distortion optimization				

As shown in Table 1, five ~~pieces of video~~ test videos with different sizes were used for the experiment.

Please REPLACE the paragraph on page 18, lines 7-14, with the following amended paragraph:

The method of the present invention described above may be realized as a program and stored in a computer-readable recording medium such as a CD-ROM, RAM, ROM, floppy disks, hard disks, magneto-optical disks and so ~~fourth~~ forth. Since the ~~process~~ program can be easily implemented by those skilled in the art to which the present invention pertains, ~~to,~~ further description ~~on it~~ of the program will not be provided herein.

IN THE CLAIMS:

This listing of the claims replaces all prior versions and listings of the claims in this application.

The text of all pending claims (including any withdrawn claims) is set forth below. Canceled and not entered claims are indicated with claim number and status only. The claims as listed below show added text with underlining and deleted text with ~~strikethrough~~. The status of each claim is listed with one of (Original), (Currently amended), (Canceled), (Withdrawn), (Previously presented), (New), and (Not entered).

Please AMEND claims 1, 3-9, 11, 13-19, and 21-24 and ADD new claims 25 and 26 in accordance with the following:

1. (Currently amended) An encoding apparatus comprising:

a mode selection unit ~~for selecting~~ configured to select an optimal ~~mode for~~ intra prediction mode;

an intra prediction unit ~~for performing~~ configured to perform intra prediction ~~onto~~ of an input video ~~inputted based on~~ using the selected optimal intra prediction mode to obtain difference values;~~ selected in the mode selection unit;~~

a ~~DCT~~ transformation and quantization unit ~~for performing DCT~~ configured to perform transformation and quantization ~~onto~~ of the difference values to obtain transform coefficients; and ~~outputted from the intra prediction unit; and~~

an entropy encoding unit ~~for performing~~ configured to perform entropy encoding ~~onto DCT~~ of the transform coefficients ~~acquired from the DCT and quantization by~~ using a scanning mode ~~decided~~ selected based on the selected optimal intra prediction mode.

2. (Canceled)

3. (Currently amended) The encoding apparatus of claim 1, wherein the entropy encoding unit is further configured to:

~~performing~~ perform entropy encoding of the transform coefficients using a ~~horizontal-directional scanning,~~ horizontal scanning mode when the selected optimal intra prediction mode is a vertical intra prediction mode and ~~vertical-directional~~ a vertical pixel similarity of the ~~residual signals~~ difference values is high;

~~performing~~ perform entropy encoding of the transform coefficients using a ~~vertical-directional scanning,~~ vertical scanning mode when the selected optimal intra prediction mode is a horizontal intra prediction mode and ~~horizontal-directional~~ a horizontal pixel similarity of the ~~residual signals~~ difference values is high; and

~~performing~~ perform entropy encoding of the transform coefficients using a zigzag ~~scanning,~~ scanning mode when the vertical and ~~horizontal-directional~~ horizontal pixel similarities of the ~~residual signals~~ difference values are similar to each other.

4. (Currently amended) The encoding apparatus of claim 3, wherein the entropy encoding unit ~~decides~~ is further configured to decide that the ~~vertical-directional pixel~~ vertical similarity of the difference values is ~~high,~~ high when a ~~vertical-directional~~ vertical pixel similarity value of the difference values is greater than a value obtained by multiplying a ~~horizontal-directional~~ horizontal pixel similarity value of the difference values by a first multiplication factor.

5. (Currently amended) The encoding apparatus of claim 3, wherein the entropy encoding unit ~~decides~~ is further configured to decide that the ~~horizontal-directional~~ horizontal pixel similarity is ~~high,~~ high when a ~~horizontal-directional~~ horizontal pixel similarity value of the difference values is greater than a value obtained by multiplying a ~~vertical-directional~~ vertical pixel similarity value of the difference values by a second multiplication factor.

6. (Currently amended) The encoding apparatus of claim 4, wherein the entropy encoding unit is further configured to calculate the ~~vertical-directional~~ vertical pixel similarity ~~is calculated~~ of the difference values by ~~performing~~ calculating a dispersion ~~onto~~ of pixels adjacent to a left part of a block of pixels of the input video that is currently being encoded. ~~block.~~

7. (Currently amended) The encoding apparatus of claim 5, wherein the entropy encoding unit is further configured to calculate the ~~horizontal-directional~~ horizontal pixel similarity ~~is calculated~~ of the difference values by ~~performing~~ calculating a dispersion ~~onto~~ of pixels adjacent to an upper part of a block of pixels of the input video that is currently being encoded. ~~block.~~

8. (Currently amended) The encoding apparatus of claim ~~6~~ 4, wherein the first ~~and second~~ multiplication ~~factors are~~ factor is a natural number 2.

9. (Currently amended) A decoding apparatus comprising:

an entropy decoding unit ~~for performing~~ configured to perform entropy decoding ~~onto~~ of an encoded video to obtain decoded transform coefficients;

a scanning decision unit ~~for deciding~~ configured to select a scanning mode for the decoded transform coefficients; and ~~video decoded in the entropy decoding unit; and~~

a video recovery unit ~~for recovering the~~ configured to recover an input video ~~based on~~ from the decoded transform coefficients using the selected scanning mode~~; decided in the scanning decision unit,~~

wherein the scanning decision unit ~~decides~~ is further configured to select the scanning mode based on ~~the~~ an optimal intra prediction mode that was used ~~for~~ to perform intra prediction of the input video to obtain difference values that were encoded to obtain the encoded video.

10. (Canceled)

11. (Currently amended) An encoding method comprising~~; the steps of:~~

selecting an optimal intra prediction mode~~; for intra prediction;~~

performing intra prediction ~~onto~~ of an input video ~~inputted based on~~ using the selected optimal intra prediction mode to obtain difference values~~; selected in the mode selection step;~~

performing ~~DCT~~ transformation and quantization ~~onto~~ of the difference values to obtain transform coefficients; and ~~outputted from the intra prediction step; and~~

performing entropy encoding ~~onto DCT~~ of the transform coefficients ~~acquired from the DCT and quantization by~~ using a scanning mode ~~decided~~ selected based on the selected optimal intra prediction mode.

12. (Canceled)

13. (Currently amended) The encoding method of claim 11, wherein the performing of entropy encoding comprises: ~~step includes the steps of:~~

performing entropy encoding of the transform coefficients using a ~~horizontal-directional scanning,~~ horizontal scanning mode when the selected optimal intra prediction mode is a vertical intra prediction mode and ~~vertical-directional~~ a vertical pixel similarity of the ~~residual signals~~ difference values is high;

performing entropy encoding of the transform coefficients using a ~~vertical-directional scanning,~~ vertical scanning mode when the selected optimal intra prediction mode is a horizontal intra prediction mode and ~~horizontal-directional~~ a horizontal pixel similarity of the ~~residual signals~~ difference values is high; and

performing entropy encoding of the transform coefficients using a zigzag ~~scanning,~~ scanning mode when the vertical and ~~horizontal-directional~~ horizontal pixel similarities of the ~~residual signals~~ difference values are similar to each another.

14. (Currently amended) The encoding method of claim 13, wherein the performing of entropy encoding further comprises deciding that the ~~vertical-directional~~ vertical pixel similarity of the difference values is ~~decided high in the entropy encoding step, when a vertical-directional~~ high when a vertical pixel similarity value of the difference values is greater than a value obtained by multiplying a ~~horizontal-directional~~ horizontal pixel similarity value of the difference values by a first multiplication factor.

15. (Currently amended) The encoding method of claim 13, wherein the performing of entropy encoding further comprises deciding that the ~~horizontal-directional~~ horizontal pixel similarity of the difference values is ~~decided high in the entropy encoding step,~~ high when a ~~horizontal-directional~~ horizontal pixel similarity value of the difference values is greater than a value obtained by multiplying a ~~vertical-directional~~ vertical pixel similarity value of the difference values by a second multiplication factor.

16. (Currently amended) The encoding method of claim 14, wherein the performing of entropy encoding further comprises calculating the ~~vertical-directional~~ vertical pixel similarity ~~is calculated~~ of the difference values by ~~performing~~ calculating a dispersion ~~onto~~ of pixels adjacent to a left part of a block of pixels of the input video that is currently being encoded. ~~block.~~

17. (Currently amended) The encoding method of claim 15, wherein the performing of entropy encoding further comprises calculating the ~~horizontal-directional~~ horizontal pixel similarity ~~is calculated~~ of the difference values by ~~performing~~ calculating a dispersion ~~onto~~ of pixels adjacent to an upper part of a block of pixels of the input video that is currently being encoded. ~~block.~~

18. (Currently amended) The encoding method of claim ~~16~~ 14, wherein the first ~~and second~~ multiplication ~~factors are~~ factor is a natural number 2.

19. (Currently amended) A decoding method comprising: ~~the steps of:~~

performing entropy decoding ~~onto~~ of an encoded video to obtain decoded transform coefficients;

~~deciding~~ selecting a scanning mode for the decoded transform coefficients; and ~~video decoded in the entropy decoding step; and~~

recovering ~~the~~ an input video ~~based on~~ from the decoded transform coefficients using the selected scanning mode; ~~decided in the scanning decision step,~~

wherein the selecting of a scanning mode ~~is decided~~ comprises selecting the scanning mode based on ~~the~~ an optimal intra prediction mode that was used ~~for~~ to perform intra prediction of the input video to obtain difference values that were encoded to obtain the encoded video.

20. (Canceled)

21. (Currently amended) The encoding apparatus of claim 1, ~~the scanning mode is decided as~~ wherein the entropy encoding unit is further configured to:

select a horizontal scanning mode when the selected optimal intra prediction mode is a vertical intra prediction ~~mode,~~ mode; and

~~as~~ select a vertical scanning mode when the selected optimal intra prediction mode is a horizontal intra prediction mode.

22. (Currently amended) The decoding apparatus of claim 9, ~~the scanning mode is decided as~~ wherein the scanning decision unit is further configured to:

select a horizontal scanning mode when the optimal intra prediction mode is a vertical intra prediction ~~mode,~~ mode; and

~~as~~ select a vertical scanning mode when the optimal intra prediction mode is a horizontal intra prediction mode.

23. (Currently amended) The encoding method of claim 11, ~~the scanning mode is decided as~~ wherein the performing of entropy encoding comprises:

selecting a horizontal scanning mode when the selected optimal intra prediction mode is a vertical intra prediction ~~mode,~~ mode; and

~~as~~ selecting a vertical scanning mode when the selected optimal intra prediction mode is a horizontal intra prediction mode.

24. (Currently amended) The decoding method of claim 19, wherein the selecting of a scanning mode ~~is decided as~~ further comprises:

selecting a horizontal scanning mode when the optimal intra prediction mode is a vertical intra prediction ~~mode,~~ mode; and

~~as~~ selecting a vertical scanning mode when the optimal intra prediction mode is a horizontal intra prediction mode.

25. (New) The encoding apparatus of claim 5, wherein the second multiplication factor is a natural number 2.

26. (New) The encoding method of claim 15, wherein the second multiplication factor is a natural number 2.

REMARKS

In accordance with the foregoing, the specification and claims 1, 3-9, 11, 13-19, and 21-24 have been amended, and new claims 25 and 26 have been added. Claims 1, 3-9, 11, 13-19, and 21-26 are pending, with claims 1, 9, 11, and 19 being independent.

Request for Proper Acknowledgement of Receipt of Certified Copies of Priority Documents

In item 13(a)(1) on page 1 (the Office Action Summary) of the Office Action of March 26, 2012, the Office states that certified copies of the priority documents have been received. However, the present application is a National Stage application of International Application No. PCT/KR2007/001433, and copies of the certified copies were received from the International Bureau as can be seen from the image file wrapper of the present application. Accordingly, it is submitted that the Office should have indicated this in item 13(a)(3) on page 1 of the Office Action of March 26, 2012, and it is respectfully requested that the Office indicate this in the next Office Action to correct the record.

Request for Correction of Document Codes in Image File Wrapper

The image file wrapper of the present application contains the following documents that were incorrectly coded by the USPTO when the Office Action of March 26, 2012, the Final Office Action of August 27, 2012, and the Office Action of November 20, 2012, were issued:

> 5-page document with a document code of "NPL", a document description of "Non Patent Literature," and a Mail Room Date of March 26, 2012
>
> 2-page document with a document code of "NPL", a document description of "Non Patent Literature," and a Mail Room Date of August 27, 2012
>
> 1-page document with a document code of "NPL", a document description of "Non Patent Literature," and a Mail Room Date of November 20, 2012

However, these documents are not in fact non-patent literature documents, but are Examiner's search strategy and results. The documents dated March 26, 2012, and November 20, 2012, are Examiner's search strategy and results for a search of "Publications from ACM and Affiliated Organizations," and the document dated August 27, 2012, is Examiner's search strategy and results for a Google search. The correct document code for these documents is "SRNT," which indicates "Examiner's search strategy and results."

Accordingly, it is respectfully requested that the document codes for the three documents discussed above be changed from "NPL" to "SRNT" to correct the image file wrapper before the next Office Action is issued. If necessary, it is respectfully requested that this matter be brought to the attention of an LIE, an LIE Team Leader, or an HSLIE for correction.

Request for Form PTO-892 Listing U.S. Patent No. 8,199,819 Relied on by Office in Office Action of November 20, 2012

On pages 3 and 4 of the Office Action of November 20, 2012, the Office has rejected claims 1, 3-9, 11, 13-19, and 21-24 on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-19 of U.S. Patent No. 8,199,819. However, the Office did not list U.S. Patent No. 8,199,819 in the Notice of References Cited (form PTO-892) attached to the Office Action of November 20, 2012 as required by MPEP 707, which states as follows on MPEP page 700-112:

> The list of references cited appears on a separate form, Notice of References Cited, PTO-892 (copy in MPEP § 707.05) attached to applicant's copies of the action.

Accordingly, it is respectfully requested that the Office provide a form PTO-892 listing U.S. Patent No. 8,199,819 with the next Office Action so that U.S. Patent No. 8,199,819 will be listed in the "References Cited" of any patent that may issue from the present application.

Error in the Status Identifier of Claim 3 in the Amendment After Final Under 37 CFR 1.116 of October 29, 2012

Claim 3 on pages 2 and 3 of the Amendment After Final Under 37 CFR 1.116 of October 29, 2012, has a status identifier of "(previously presented)." However, this status identifier should have been "(currently amended)" because the word "the" was inserted in claim 3, line 9, as indicated by the underlining under the word "the."

Information Disclosure Statement

Attached hereto is an Information Disclosure Statement listing the following references:

KR 10-0180173

D.-k. Kim et al., "Adaptive Scanning Using Pixel Similarity for H.264/AVC," *Proceedings of the 2006 Korean Signal Processing Conference*, Vol. 19, No. 1, pp. 1-4, September 23, 2006, Hanyang University Ansan Campus, Ansan, Republic of Korea (in Korean, including English abstract).

These references were cited in the Information Disclosure Statement of February 18, 2009, and copies of these references were submitted with the Information Disclosure Statement of February 18, 2009. These references were considered in the Office Action of March 26, 2012. However, there are errors in the listing of these references in the Information Disclosure Statement of February 18, 2009, so corrected listings of these references have been provided in the Information Disclosure Statement attached hereto. Since these references have already been considered by the Office, it is submitted that neither a statement under 37 CFR 1.97(e) nor the fee of $180.00 set forth in 37 CFR 1.17(p) is required to provide the corrected listings of these references in the Information Disclosure Statement attached hereto.

It is respectfully requested that the Office provide the following items <u>with the next Office Action</u>:

(1) a copy of the Information Disclosure Statement attached hereto marked to indicate that all of the cited references have been considered; and

(2) a copy of the Information Disclosure Statement of February 18, 2009, with lines drawn through the erroneous listings of the two references discussed above to prevent these erroneous listings from being used to print the "References Cited" section of any patent that may issue from the present application, and marked to indicate that all of the other references have been considered.

Specification Amendments

The specification has been amended to correct errors and improve its form.

In Table 1, "40" has been changed to "30" to be consistent with "30" in Table 2.

Claim Amendments

Claims 1, 3-9, 11, 13-19, and 21-24 have been amended solely to correct errors, use consistent terminology, and improve their form, and to delete the term "DCT" from claims 1 and 11 as being unnecessary. Claims 1, 3-9, 11, 13-19, and 21-24 have not been amended in response to the nonstatutory obviousness-type double patenting rejection of claims 1, 3-9, 11, 13-19, and 21-24 or the rejections of claims 1, 3-9, 11, 13-19, and 21-24 over the prior art. Accordingly, it is submitted that the Office cannot make the next Office Action a Final Office Action if the next Office Action includes any new rejection of any of claims 1, 3-9, 11, 13-19, and 21-24 over the prior art or on the ground of nonstatutory obviousness-type double patenting.

New claims 25 and 26 have been added to recite a feature that was deleted from claims 8 and 18.

Double Patenting Rejections

Claims 1, 3-9, 11, 13-19, and 21-24 have been rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-19 of U.S. Patent No. 8,199,819. This rejection is respectfully traversed.

The Office states as follows:

> 3. Claims 1, 3-9, 11, 13-19, and 21-24 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-19 of U.S. Patent No. 8,199,819. Although the conflicting claims are not identical, they are not patentably distinct from each other because the scope of the claims is the same for the instant application and the issued application. Each claim identical method and apparatus for encoding and decoding images using adaptive scanning of coefficients using DCT (Discrete Cosine Transform) and quantization according to the intra prediction mode.

> 4. Claim(s) 1-19 of U.S. Patent No. 8,199,819 contain(s) every element of claim(s) 1, 3-9, 11, 13-19, and 21-24 of the instant application and as such anticipate(s) claim(s) 1, 3-9, 11, 13-19, and 21-24 of the instant application.

However, claims 1-19 of U.S. Patent No. 8,199,819 do not recite the "optimal" feature of independent claims 1,9, 11, and 19 and dependent claims 3, 13, 21, and 23, or the "intra prediction mode" features of independent claims 1, 9, 11, and 19 and dependent claims 3, 13, and 21-24, or the "similarity" features of dependent claims 3-7 and 13-17, or the "multiplication value" features of dependent claims 4, 5, 8, 14, 15, 18, 25, and 26. Accordingly, it is submitted that claims 1-19 of U.S. Patent No. 8,199,819 do not "contain(s) every element of claim(s) 1, 3-9, 11, 13-19, and 21-24 of the instant application and as such anticipate(s) claim(s) 1, 3-9, 11, 13-19, and 21-24 of the instant application" as alleged by the Office.

Furthermore, it is submitted that the features of claims 1, 3-9, 11, 13-19, and 21-26 discussed above would not have been obvious over claims 1-19 of U.S. Patent No. 8,199,819.

For at least the foregoing reasons, it is respectfully requested that the rejection of claims 1, 3-9, 11, 13-19, and 21-24 on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-19 of U.S. Patent No. 8,199,819 be withdrawn.

<u>Claim Rejections Under 35 USC 102</u>

Claims 1, 9, 11, and 19 have been rejected under 35 USC 102(e) as being anticipated by Park (US 2006/0002466) (newly cited). This rejection is respectfully traversed.

<u>Independent Claims 1 and 11</u>

It is submitted that Park does not disclose or suggest the following feature of independent claim 1:

> an entropy encoding unit configured to perform entropy encoding <u>of the transform coefficients using a scanning mode</u> selected <u>based on the selected optimal intra prediction mode</u>,

or the following feature of independent claim 11:

> performing entropy encoding of the transform coefficients using a scanning mode selected based on the selected optimal intra prediction mode.

Thus, the scanning mode that is selected based on an optimal intra prediction mode as recited in claims 1 and 11 is for scanning transform coefficients.

The Office considers the above features of claims 1 and 11 to be disclosed in paragraphs [0165] and [0173] of Park, which state as follows:

> **[0165]** Referring to FIG. 8, the intra-prediction encoder includes an intra-prediction mode selection unit 1, an intra-prediction unit 2, a motion estimation unit 3, a motion compensation unit 4, a subtraction unit 5, a DCT transform unit 6, a quantization unit 7, a ripple scan unit 8, an entropy encoding unit 9, an inverse quantization unit 10, an inverse DCT transform unit 11, an adder 12, and a filter 13.
>
> **[0173]** The predicted macroblock P is subtracted from a current macroblock by the subtraction unit 5, and thus a difference macroblock Dn is created. The difference macroblock Dn is DCT transformed by the DCT transform unit 6 and is then quantized by the quantization unit 7, and thus quantized transform coefficients X are created. These coefficients X are ripple scanned by the ripple scan unit 8 and are then entropy encoded by the entropy encoding unit 9. The entropy encoded coefficients X create compressed bitstreams along with additional information required for decoding of a macroblock. The additional information includes intra-prediction mode information, quantization operation size information, and motion vector information. In particular, when the intra-prediction mode is selected according to the second embodiment of the present invention, the intra-prediction mode information shown in FIG. 8 contains information about the intra-prediction mode selected by the intra-prediction mode selection unit 1 and can be expressed with 2 bits to indicate 4 modes used in this embodiment of the present invention. These compressed bitstreams are transmitted to a network abstraction layer (NAL) for transmission or storage.

However, as can be seen from FIG. 8 referred to in the above paragraphs, the scanning mode used by the ripple scan unit 8 that is for DCT (transform) coefficients output from the DCT (transformation) unit 6 and the quantization unit 7 is not selected based on the intra-prediction mode information because, as shown in FIG. 8, the intra-mode prediction information is added to the bitstream after the ripple scan unit 8 has already scanned the DCT (transform) coefficients.

Furthermore, it is not seen where Park discloses that the ripple scan unit 8 selects a scanning method based on anything whatsoever during an encoding operation. Rather, it appears that the ripple scan unit 8 uses a single scanning method in all cases. See paragraph [0033] of Park, which states as follows (emphasis added):

> a ripple scan unit starting scanning from the origin macroblock of a frame composed of the quantized DCT coefficients and continuing to scan macroblocks of a next square ring in a ripple scanning direction.

Also see paragraph [0173] of Park, which states as follows (emphasis added):

> The difference macroblock Dn is DCT transformed by the DCT transform unit 6 and is then quantized by the quantization unit 7, and thus quantized transform coefficients X are created. These coefficients X are ripple scanned by the ripple scan unit 8 and are then entropy encoded by the entropy encoding unit 9.

Also see paragraph [0195] of Park, which states as follows (emphasis added):

> In operation 150, the quantized frame is ripple scanned from its center

The various scanning orders shown in FIGS. 5A, 5B, 6A-6D, and 7A-7H of Park are scanning orders of the unencoded macroblocks of the current frame Fn shown in FIG. 8, not scanning orders of the DCT (transform) coefficients that are output from the DCT (transformation) unit 6 and the quantization unit 7 in FIG. 8 as would be necessary to provide the above features of claims 1 and 11.

Independent Claims 9 and 19

It is submitted that Park does not disclose or suggest the following features of independent claim 9:

> a scanning decision unit configured to select a scanning mode for the decoded transform coefficients; and
>
> . . . .
>
> wherein the scanning decision unit is further configured to select the scanning mode based on an optimal intra prediction mode that was used to perform intra prediction of the input video

to obtain difference values that were encoded to obtain the encoded video,

or the following features of independent claim 19:

selecting <u>a scanning mode for the decoded transform coefficients</u>; and

. . . .

wherein the selecting of a scanning mode comprises selecting the scanning mode <u>based on an optimal intra prediction mode</u> that was used to perform intra prediction of the input video to obtain difference values that were encoded to obtain the encoded video.

Thus, the scanning mode that is selected <u>based on an optimal intra prediction mode</u> in claims 9 and 19 <u>is for scanning decoded transform coefficients</u>.

The Office considers the above features of claims 9 and 19 to be disclosed in paragraphs [0179]-[0182] of Park, which state as follows:

[0179] The intra-prediction decoder receives compressed bitstreams from the NAL. Data elements are entropy decoded by the entropy decoding unit 21. At this time, additional information required for decoding of a macroblock and, in particular, intra-prediction mode information according to the second embodiment of the present invention is extracted. This intra-prediction mode information is transmitted to the intra-prediction unit 2 and is used for selection of an intra-prediction mode. In the first embodiment of the present invention, since the scanning order for intra-prediction is predetermined, the intra-prediction mode information is not required. Data samples that are entropy decoded as described above are re-arranged by the ripple scan unit 22 to create a set of quantized coefficients X. The re-arranged data is inversely quantized by the inverse quantization unit 23 and is inverse DCT transformed by the inverse DCT transform unit 24, and thus D'n is created.

[0180] In the first embodiment of the present invention, the intra-prediction unit 2 performs intra-prediction in the predetermined scanning order and creates the predicted macroblock P. In the second embodiment of the present invention, the intra-prediction unit 2 performs intra-prediction according to the intra-prediction mode by referring to header information extracted by the entropy decoding unit 21, in particular, the intra-prediction mode information according to this

> embodiment of the present invention and then creates the predicted macroblock P.
>
> **[0181]** In any of the first embodiment and the second embodiment of the present invention, the intra-prediction unit 2 performs prediction as shown in FIGS. 5A through 7H in the predetermined scanning order or the scanning order according to the intra-prediction mode information.
>
> **[0182]** The predicted macroblock P is the same as the original predicted macroblock P that is created by the intra-prediction encoder. The predicted macroblock P is added to D'n by the adder 25, and thus uF'n is created. uF'n is filtered by the filter 27, and thus a decoded macroblock F'n is created.

However, although paragraph [0181] above states that the intra-prediction unit 2 performs prediction as shown in FIGS. 5A through 7H in the predetermined scanning order or <u>the scanning order according to the intra-prediction mode information</u>, the various scanning orders shown in FIGS. 5A, 5B, 6A-6D, and 7A-7H of Park are scanning orders of the <u>unencoded macroblocks</u> of the current frame Fn shown in FIG. 8, not scanning orders of the <u>DCT (transform) coefficients</u> that are output from the DCT (transformation) unit 6 and the quantization unit 7 in FIG. 8 as would be necessary to provide the above features of claims 9 and 19.

Furthermore, it is not seen where Park discloses that the ripple scan unit 8 <u>selects</u> a scanning method <u>based on anything whatsoever</u> during a decoding operation. Rather, it appears that the ripple scan unit 8 <u>uses a single scanning method in all cases</u>. See paragraph [0041] of Park, which states as follows (emphasis added):

> a ripple scan unit starting scanning from the origin macroblock of a frame composed of <u>entropy-decoded</u> data samples and continuing to scan macroblocks of a next square ring in a ripple scanning direction.

See also paragraph [0219] of Park, which states as follows (information added):

> In operation 320, ripple scanning is performed from the center of the frame <u>that is created through entropy decoded</u>."

<u>Conclusion—Claim Rejections Under 35 USC 103</u>

For at least the foregoing reasons, it is respectfully requested that the rejection of claims 1, 9, 11, and 19 under 35 USC 102(e) as being anticipated by Park be withdrawn.

Claim Rejections Under 35 USC 103

Claims 3-8, 13-18, and 21-24 have been rejected under 35 USC 103(a) as being unpatentable over Park in view of Boon et al. (Boon) (US 7,995,654) (newly cited). This rejection is respectfully traversed.

Dependent Claims 3 and 13

It is submitted that Park and Boon do not disclose or suggest the following features of dependent claim 3:

> wherein the entropy encoding unit is further configured to:
>
> perform entropy encoding of the transform coefficients using a horizontal scanning mode when the selected optimal intra prediction mode is a vertical intra prediction mode and a vertical pixel similarity of the difference values is high;
>
> perform entropy encoding of the transform coefficients using a vertical scanning mode when the selected optimal intra prediction mode is a horizontal intra prediction mode and a horizontal pixel similarity of the difference values is high; and
>
> perform entropy encoding of the transform coefficients using a zigzag scanning mode when the vertical and horizontal pixel similarities of the difference values are similar to each other,

or the following features of dependent claim 13:

> wherein the performing of entropy encoding comprises:
>
> performing entropy encoding of the transform coefficients using a horizontal scanning mode when the selected optimal intra prediction mode is a vertical intra prediction mode and a vertical pixel similarity of the difference values is high;
>
> performing entropy encoding of the transform coefficients using a vertical scanning mode when the selected optimal intra prediction mode is a horizontal intra prediction mode and a horizontal pixel similarity of the difference values is high; and
>
> performing entropy encoding of the transform coefficients using a zigzag scanning mode when the vertical and horizontal pixel similarities of the difference values are similar to each another.

The Office considers the above features of claims 3 and 13 to disclosed in column 39, line 61, through column 40, line 3, and Table 3 of Boon. However, these portions of Boon do not disclose anything whatsoever that may reasonably be considered to correspond to the features "and a vertical pixel similarity of the difference values is high," "and a horizontal pixel similarity of the difference values is high," and "when the vertical and horizontal pixel similarities of the difference values are similar to each another" recited in claims 3 and 13, and the Office did not explain why it considers these portions of Boon to disclose these features of claims 3 and 13. Column 30, lines 61-64, of Boon merely states that "[t]he H/V/Z scan unit 2036 adaptively executes a horizontal scan, a vertical scan or a zigzag scan on the inputted DCT transform coefficients <u>depending on the selected prediction mode</u>." The words "similarity" and "similarities" do not appear in the Boon.

Further, as can be seen from claims 1 and 11 from which claims 3 and 13 depend, the "vertical intra prediction mode" and the "horizontal intra prediction mode" recited in claims 3 and 13 are used <u>to perform intra prediction of an input video</u>. In contrast, as can be seen from FIGS. 24 and 30 of Boon, Boon selects a scanning mode based on a selected prediction mode that is used <u>to predict DCT transform coefficients</u>.

<u>Dependent Claims 4 and 14</u>

It is submitted that Park and Boon do not disclose or suggest the following feature of dependent claim 4:

> wherein the entropy encoding unit is further configured to decide that the vertical similarity of the difference values is high <u>when a vertical pixel similarity value of the difference values is greater than a value obtained by multiplying a horizontal pixel similarity value of the difference values by a first multiplication factor</u>,

or the following feature of dependent claim 14:

> wherein the performing of entropy encoding further comprises deciding that the vertical pixel similarity of the difference values is high <u>when a vertical pixel similarity value of the difference values is greater than a value obtained by multiplying a horizontal pixel similarity value of the difference values by a first multiplication factor</u>.

The Office considers the above features of claims 4 and 14 to be disclosed in column 36, lines 22-32, of Boon, which states as follows:

> First of all, in Step 1059, the indication bit is decoded from the inputted bit stream, and the flag of the indication bit is checked in Step 1060. When it is "0", a DC value is calculated from the average value of the image data of the block located on the upper side and the block located on the left-hand side in Step 1061, and the program flow proceeds to Step 1063. When the answer is NO in Step 1060, the program flow proceeds to Step 1062. When the designator flag checked in Step 1062 is "10", the image data of the left-hand column of the block located on the left-hand side is extracted in Step 1063, and the program flow proceeds to Step 1065.

However, this portion of Boon does not disclose anything whatsoever that may reasonably be considered to correspond to the above features of claims 4 and 14, and the Office did not explain why it considers this portion of Boon to disclose these features of claims 4 and 14. The words "similarity" and "multiplication" do not appear in Boon. The only place any form of the word "multiply" appears in Boon is in column 45, line 45, as part of the phrase "and multiply the coefficient data of each block by a ratio equal to the ratio of the quantization step size of the current block to be coded to the quantization step size of the prediction block," which has absolutely nothing to do with the above features of claims 4 and 14.

Furthermore, column 36, lines 22-32, of Boon relates to the embodiment in FIG. 20 of Boon <u>in which a scanning mode is not selected</u>, whereas the above features of claims 4 and 14 further define <u>how a scanning mode is selected</u> as recited in claims 3 and 13 from which claims 4 and 14 depend.

<u>Dependent Claims 5 and 15</u>

It is submitted that Park and Boon do not disclose or suggest the following feature of dependent claim 5:

> wherein the entropy encoding unit is further configured to decide that the horizontal pixel similarity is high <u>when a horizontal pixel similarity value of the difference values is greater than a value obtained by multiplying a vertical pixel similarity value of the difference values by a second multiplication factor</u>,

or the following feature of dependent claim 15:

> wherein the performing of entropy encoding further comprises deciding that the horizontal pixel similarity of the difference values is high <u>when a horizontal pixel similarity value of the difference values is greater than a value obtained by multiplying a vertical pixel similarity value of the difference values by a second multiplication factor</u>.

The Office considers the above features of claims 5 and 15 to be disclosed in column 36, lines 32-40, of Boon, which states as follows:

> When the answer is NO in Step 1062, the program flow proceeds to Step 1064. When the indicator flag checked in Step 1064 is "11", the image data of the top row of the block located on the upper side is extracted in Step 1065, and the program flow proceeds to Step 1066. Finally, in Step 1066, the DCT transform coefficients obtained or extracted in Steps 1061, 1063 or 1065 is added to the corresponding DCT transform coefficients of the current block.

However, this portion of Boon does not disclose anything whatsoever that may reasonably be considered to correspond to the above features of claims 5 and 15, and the Office did not explain why it considers this portion of Boon to disclose these features of claims 5 and 15. The words "similarity" and "multiplication" do not appear in Boon. The only place any form of the word "multiply" appears in Boon is in column 45, line 45, as part of the phrase "and multiply the coefficient data of each block by a ratio equal to the ratio of the quantization step size of the current block to be coded to the quantization step size of the prediction block," which has absolutely nothing to do with the above features of claims 5 and 15.

Furthermore, column 36, lines 32-40, of Boon relates to the embodiment in FIG. 20 of Boon <u>in which a scanning mode is not selected</u>, whereas the above features of claims 4 and 14 further define <u>how a scanning mode is selected</u> as recited in claims 3 and 13 from which claims 4 and 14 depend.

<u>Dependent Claims 6 and 16</u>

It is submitted that Park and Boon do not disclose or suggest the following feature of dependent claim 6:

> wherein the entropy encoding unit is further configured to calculate the vertical pixel similarity of the difference values by calculating a dispersion of pixels adjacent to a left part of a block of pixels of the input video that is currently being encoded

or the following feature of dependent claim 16:

> wherein the performing of entropy encoding further comprises calculating the vertical pixel similarity of the difference values by calculating a dispersion of pixels adjacent to a left part of a block of pixels of the input video that is currently being encoded.

The Office considers the above features of claims 6 and 16 to be disclosed in column 34, lines 46-53, of Boon, which states as follows:

> (c) Mode 2: DC/AC Prediction from Block Located on the Left-Hand Side
>
> $$E_2(u,0)=C(u,0)-B(u,0),\ u=0,\ \ldots,7,$$
> $$E_2(u,v)=C(u,v),$$
> $$u=0,\ \ldots,7;\ v=1,\ \ldots,7. \qquad (3)$$

However, the first equation above merely calculates difference values, and the second equation above merely sets values of $E_2(u,v)$ equal to values of $C(u,v)$. Neither of these equations calculates a vertical pixel similarity as recited in claims 6 and 16 or calculates a dispersion of pixels as recited in claims 6 and 16. Furthermore, as can be seen from column 33, line 16, through column 34, lines 8, of Boon, the above equations perform calculations on DCT transform coefficients, while claims 6 and 16 recite that the calculations are performed on pixels adjacent to a left part of a block of an input video that is currently being encoded.

Furthermore, column 34, lines 46-53, of Boon relates to the embodiments in FIGS. 16-18 of Boon in which a scanning mode is not selected, whereas the above features of claims 6 and 16 further define how a scanning mode is selected as recited in claims 3 and 13 from which claims 6 and 16 indirectly depend.

Dependent Claims 7 and 17

It is submitted that Park and Boon do not disclose or suggest the following feature of dependent claim 7:

> wherein the entropy encoding unit is further configured to calculate the horizontal pixel similarity of the difference values by calculating a dispersion of pixels adjacent to an upper part of a block of pixels of the input video that is currently being encoded,

or the following feature of dependent claim 17:

> wherein the performing of entropy encoding further comprises calculating the horizontal pixel similarity of the difference values by calculating a dispersion of pixels adjacent to an upper part of a block of pixels of the input video that is currently being encoded.

The Office considers the above features of claims 7 and 17 to be disclosed in column 34, lines 38-45, of Boon, which states as follows:

> (b) Mode 1: DC/AC Prediction from Block Located on the Upper Side
>
> $E_1(0,v)=C(0,v)-A(0,v),\ v=0,\ldots,7,$
>
> $E_1(u,v)=C(u,v),$
>
> $u=1,\ldots,7;\ v=0,\ldots,7 \qquad (2)$

However, the first equation above merely calculates difference values, and the second equation above merely sets values of $E_1(u,v)$ equal to values of $C(u,v)$. Neither of these equations calculates a horizontal pixel similarity as recited in claims 7 and 17 or calculates a dispersion of pixels as recited in claims 7 and 17. Furthermore, as can be seen from column 33, line 16, through column 34, lines 8, of Boon, the above equations perform calculations on DCT transform coefficients, while claims 7 and 17 recite that the calculations are performed on pixels adjacent to an upper part of a block of an input video that is currently being encoded.

Furthermore, column 34, lines 38-45, of Boon relates to the embodiments in FIGS. 16-18 of Boon in which a scanning mode is not selected, whereas the above features of claims 7 and 17 further define how a scanning mode is selected as recited in claims 3 and 13 from which claims 7 and 17 indirectly depend.

Dependent Claims 8 and 18

It is submitted that Park and Boon do not disclose or suggest the following feature of dependent claims 8 and 18:

wherein the first multiplication factor is a natural number 2.

The Office considers the above feature of claims 8 and 18 to be disclosed in column 34, lines 54-65, of Boon. However, Furthermore, this portion of Boon does not disclose "[a] first multiplication factor [that] is a natural number 2" as recited in claims 8 and 18.

Furthermore, this portion of Boon discloses an Equation (4) that is used to calculate the sum SAD_{model} of the absolute values of errors predicted for four luminance signal blocks in a macroblock, and a prediction mode having the minimum value is selected. It is submitted that this has nothing whatsoever to do with "decid[ing] that the vertical similarity of the difference values is high when a vertical pixel similarity value of the difference values is greater than a value obtained by multiplying a horizontal pixel similarity value of the difference values by a first multiplication factor" as recited in claims 4 and 14 from which claims 8 and 18 depend.

Furthermore, this portion of Boon relates to the embodiments in FIGS. 16-18 of Boon in which a scanning mode is not selected, whereas the above features of claims 8 and 18 further define how a scanning mode is selected as recited in claims 3 and 13 from which claims 8 and 18 indirectly depend.

Dependent Claims 21-24

It is submitted that Park and Boon do not disclose or suggest the following features of dependent claim 21:

> wherein the entropy encoding unit is further configured to:
>
> select a horizontal scanning mode when the selected optimal intra prediction mode is a vertical intra prediction mode; and
>
> select a vertical scanning mode when the selected optimal intra prediction mode is a horizontal intra prediction mode,

or the following features of dependent claim 22:

> wherein the scanning decision unit is further configured to:
>
> select a horizontal scanning mode when the optimal intra prediction mode is a vertical intra prediction mode; and
>
> select a vertical scanning mode when the optimal intra prediction mode is a horizontal intra prediction mode,

or the following features of dependent claim 23:

> wherein the performing of entropy encoding comprises:
>
> selecting a horizontal scanning mode when the selected optimal intra prediction mode is a vertical intra prediction mode; and
>
> selecting a vertical scanning mode when the selected optimal intra prediction mode is a horizontal intra prediction mode,

or the following features of dependent claim 24:

> wherein the selecting of a scanning mode further comprises:
>
> selecting a horizontal scanning mode when the optimal intra prediction mode is a vertical intra prediction mode; and
>
> selecting a vertical scanning mode when the optimal intra prediction mode is a horizontal intra prediction mode.

The Office considers the above features of claims 21-24 to be disclosed in FIGS. 27-29 and column 42, lines 41-45, of Boon, which states as follows:

> FIG. 27, FIG. 28 and FIG. 29 are schematic views for explaining the sequence of a horizontal scan, a vertical scan and a horizontal scan used for the coefficient scan of the eighth preferred embodiment. In this case, these scans are collectively referred to as H/V/Z scan.

However, as can be seen from FIGS. 24 and 30 of Boon, Boon selects a scanning mode based on a selected prediction mode that is used to predict DCT transform coefficients. In contrast, claims 1, 9, 11, and 19 from which claims 21-24 depend recite that a scanning mode is selected based on an optimal intra prediction mode that is used to perform intra prediction of an input video. Accordingly, it is submitted that Boon does not disclose the above features of claims 21-24, which relate to selecting a scanning mode based on an optimal intra prediction mode that is used to perform intra prediction of an input video by virtue of their dependency from claims 1, 9, 11, and 19.

Conclusion—Claim Rejections Under 35 USC 103

For at least the foregoing reasons, it is respectfully requested that the rejection of claims 3-8, 13-18, and 21-24 under 35 USC 103(a) as being unpatentable over Park in view of Boon be withdrawn.

Patentability of New Dependent Claims 25 and 26

New dependent claims 25 and 26 recite the following feature:

> wherein the second multiplication factor is a natural number 2.

It is submitted that claims 1-19 of U.S. Patent No. 8,199,819, Park, and Boon do not disclose or suggest the above feature of new claims 25 and 26 for at least the same reasons discussed above that claims 1-19 of U.S. Patent No. 8,199,819, Park, and Boon do not disclose or suggest the similar feature of claims 8 and 18, and an indication to that effect is respectfully requested.

Conclusion

There being no further outstanding objections or rejections, it is submitted that the application is in condition for allowance. An early action to that effect is courteously solicited.

Finally, if there are any formal matters remaining after this response, the Office is requested to telephone the undersigned to attend to these matters.

Please charge any fees under 37 CFR 1.16 and 1.17 that may be required for this paper only to Deposit Account No. 50-5113 in the name of North Star Intellectual Property Law, PC. However, for the reasons discussed on page 18 of this paper, the $180.00 fee set forth in 37 CFR 1.17(p) for submission of an Information Disclosure Statement is not required for the

Information Disclosure Statement attached to this paper, and the Office is not authorized to charge this fee to the deposit account.

Respectfully submitted,

Date: March 20, 2013

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Attachment

Substitute for form 1449/PTO	Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Application Number	12/377,617
(Use as many sheets as necessary)	Filing Date	February 16, 2009
	First Named Inventor	Se-Yoon Jeong et al.
	Art Unit	2496
	Examiner Name	Courtney D. Fields
Sheet 1 of 1	Attorney Docket Number	022090.0002

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number - Kind Code[2] *(if known)*	Patent or Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3] - Number[4] - Kind Code[5] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
		KR 10-0180173 B1	05-01-1999	Jung		X

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author, title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[6]
		D.-k. Kim et al., "Adaptive Scanning Using Pixel Similarity for H.264/AVC," *Proceedings of the 2006 Korean Signal Processing Conference*, Vol. 19, No. 1, pp. 1-4, September 23, 2006, Hanyang University Ansan Campus, Ansan, Republic of Korea (in Korean, including English abstract).	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1]Applicant's unique citation designation number (optional). [2]See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04(a). [3]Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4]For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6]Applicant is to place a check mark here if English language Translation is attached (X indicates Abstract only provided).

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)

Docket Number (Optional) 022090.0002

Application Number 12/377,617	Filed February 16, 2009
For APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING ...	
Art Unit 2496	Examiner Courtney D. Fields

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above-identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

	Fee	Small Entity Fee	
☒ One month (37 CFR 1.17(a)(1))	$150	$75	$100
☐ Two months (37 CFR 1.17(a)(2))	$570	$285	$
☐ Three months (37 CFR 1.17(a)(3))	$1,290	$645	$
☐ Four months (37 CFR 1.17(a)(4))	$2,010	$1,005	$
☐ Five months (37 CFR 1.17(a)(5))	$2,730	$1,365	$

☐ Applicant claims small entity status. See 37 CFR 1.27.

☐ A check in the amount of the fee is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Director has already been authorized to charge fees in this application to a Deposit Account.

☒ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 50-5113.

☒ Payment made via EFS-Web.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

☐ applicant/inventor.

☐ assignee of record of the entire interest. See 37 CFR 3.71. 37 CFR 3.73(b) statement is enclosed (Form PTO/SB/96).

☒ attorney or agent of record. Registration number 56,273.

☐ attorney or agent acting under 37 CFR 1.34. Registration number ______________.

/Randall S. Svihla/	March 20, 2013
Signature	Date
Randall S. Svihla	202-429-0020
Typed or printed name	Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.

☐ * Total of ______________ forms are submitted.

Electronic Patent Application Fee Transmittal

Application Number:	12377617
Filing Date:	16-Feb-2009
Title of Invention:	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR
First Named Inventor/Applicant Name:	Se-Yoon Jeong
Filer:	Randall Scott Svihla
Attorney Docket Number:	022090.0002

Filed as Small Entity

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Claims in excess of 20	2615	2	40	80
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 1 month with $0 paid	2251	1	100	100
Miscellaneous:				
		Total in USD ($)		**180**

Electronic Acknowledgement Receipt

EFS ID:	15315045
Application Number:	12377617
International Application Number:	
Confirmation Number:	8176
Title of Invention:	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR
First Named Inventor/Applicant Name:	Se-Yoon Jeong
Customer Number:	89980
Filer:	Randall Scott Svihla
Filer Authorized By:	
Attorney Docket Number:	022090.0002
Receipt Date:	20-MAR-2013
Filing Date:	16-FEB-2009
Time Stamp:	19:43:12
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$180
RAM confirmation Number	7726
Deposit Account	505113
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1		OA20121120_0220900002_AmdAsFiled.pdf	156953 f21a4d716be218dc841ac410970204ddd2176b8e	yes	34

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Specification	2	9
	Claims	10	15
	Applicant Arguments/Remarks Made in an Amendment	16	34

Warnings:

Information:

2	Information Disclosure Statement (IDS) Form (SB08)	IDS20130320_0220900002_IDS.pdf	41209 5feedf7fc0819c7e7abee2478dd008f1c6986145	no	1

Warnings:

Information:

This is not an USPTO supplied IDS fillable form

3	Extension of Time	OA20121120_0220900002_PetitionForExtensionOfTimeAsFiled.pdf	51269 445d313b8a0fcc82510bf8f5cb955a91e813ffd7	no	1

Warnings:

Information:

4	Fee Worksheet (SB06)	fee-info.pdf	32731 0c7fa3fd44fc98076fc826b19e6a7d6385236fa4	no	2

Warnings:

Information:

Total Files Size (in bytes):	282162

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 12/377,617	Filing Date 02/16/2009	☐ To be Mailed

ENTITY: ☐ LARGE ☒ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	NUMBER FILED (Column 1)	NUMBER EXTRA (Column 2)	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT 03/20/2013	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 22	Minus	** 20	= 2	x $40 =	80
Independent (37 CFR 1.16(h))	* 4	Minus	***4	= 0	x $210 =	0
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	**80**

AMENDMENT	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/KAREN WASHINGTON/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/377,617	02/16/2009	Se-Yoon Jeong	022090.0002

CONFIRMATION NO. 8176

89980
NSIP LAW
P.O. Box 34688
Washington, DC 20043

POA ACCEPTANCE LETTER

OC000000057875391

Date Mailed: 12/06/2012

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 11/24/2012.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/gbien-aime/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/377,617	02/16/2009	Se-Yoon Jeong	CU-7298 WWP

CONFIRMATION NO. 8176

POWER OF ATTORNEY NOTICE

OC000000057875345

26530
LADAS & PARRY LLP
224 SOUTH MICHIGAN AVENUE
SUITE 1600
CHICAGO, IL 60604

Date Mailed: 12/06/2012

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 11/24/2012.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

/gbien-aime/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(b), identified below, or identified in accompanying transmittal(s).

I hereby appoint Patent Practitioner(s) associated with the Customer Number: 89980

as attorney(s) or agent(s) to represent and act on behalf of the undersigned Principal (Applicant/Assignee) before the United States Patent and Trademark Office (USPTO), including in connection with any and all patent applications identified herein/transmittals or assigned to the Principal (Applicant/Assignee) according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(b). I hereby further authorize the Patent Practitioner(s) to act on behalf of the Principal (Applicant/Assignee) to complete the statement under 37 CFR 3.73(b) or the accompanying transmittals.

Please note/change the correspondence address and the fee address for the application identified herein/transmittals or in the attached statement under 37 CFR 3.73(b) to: The address associated with Customer Number:

89980

Principal (Applicant/Assignee) Name and Address:

KWANGWOON UNIVERSITY RESEARCH INSTITUTE FOR INDUSTRY COOPERATION
447-1, WOLGYE-DONG, NOWON-GU, SEOUL, 139-701 REPUBLIC OF KOREA

A copy of this form, together with a statement under 37 CFR 3.73(b) may be filed in each application in which this form is used. The statement under 37 CFR 3.73(b) may be completed by one of the patent practitioners in this form if the appointed patent practitioner is authorized to act on behalf of the Principal (Applicant/Assignee), and must identify the application in which this Power of Attorney is filed.

Signature of Principal (Applicant/Assignee)
The individual whose signature and title is supplied below is authorized to act on behalf of the Principal (Applicant/Assignee)

Signature	J Choi	Date: November 21, 2012
Name	Jin-Joo Choi	Telephone: +82-2-940-5635
Title	President	

NSIP LAW

Docket No. 022090.0002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Se-Yoon Jeong et al.

Application No. 12/377,617 Art Unit: 2496

Confirmation No. 8176

Filed: February 16, 2009 Examiner: Courtney D. Fields

For: APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

STATEMENT UNDER 37 CFR 3.73(b) BY INDUSTRY-ACADEMIA COOPERATION GROUP OF SEJONG UNIVERSITY

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Industry-Academia Cooperation Group of Sejong University, a foundation of the Republic of Korea, states that it is the assignee of an undivided interest in the entirety of Application No. 12/377,617 by virtue of an assignment from the inventors to Electronics and Telecommunications Research Institute, Kwangwoon University Research Institute for Industry Cooperation, and Industry-Academia Cooperation Group of Sejong University that was recorded against Application No. 12/377,617 in the United States Patent and Trademark Office on February 16, 2009, at Reel 022261, Frame 0138.

Industry-Academia Cooperation Group of Sejong University states that Electronics and Telecommunications Research Institute, Kwangwoon University Research Institute for Industry Cooperation, and Industry-Academia Cooperation Group of Sejong University jointly own the entire right, title, and interest in Application No. 12/377,617.

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee Industry-Academia Cooperation Group of Sejong University to complete this Statement Under 37 CFR 3.73(b).

Respectfully submitted,

Date: November 24, 2012

/Randall S. Svihla/
Randall S. Svihla, Attorney
Registration No. 56,273

NSIP Law
P.O. Box 34688
Washington, DC 20036
Telephone (202) 429-0020
Facsimile (202) 315-3758
CYP/RSS

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(b), identified below, or identified in accompanying transmittal(s).

____

____

I hereby appoint Patent Practitioner(s) associated with the Customer Number: 89980

as attorney(s) or agent(s) to represent and act on behalf of the undersigned Principal (Applicant/Assignee) before the United States Patent and Trademark Office (USPTO), including in connection with any and all patent applications identified herein/transmittals or assigned to the Principal (Applicant/Assignee) according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(b). I hereby further authorize the Patent Practitioner(s) to act on behalf of the Principal (Applicant/Assignee) to complete the statement under 37 CFR 3.73(b) or the accompanying transmittals.

Please note/change the correspondence address and the fee address for the application identified herein/transmittals or in the attached statement under 37 CFR 3.73(b) to: The address associated with Customer Number:

89980

Principal (Applicant/Assignee) Name and Address:

INDUSTRY-ACADEMIA COOPERATION GROUP OF SEJONG UNIVERSITY
98, GUNJA-DONG, GWANGJIN-GU, SEOUL, 143-747, REPUBLIC OF KOREA

A copy of this form, together with a statement under 37 CFR 3.73(b) may be filed in each application in which this form is used. The statement under 37 CFR 3.73(b) may be completed by one of the patent practitioners in this form if the appointed patent practitioner is authorized to act on behalf of the Principal (Applicant/Assignee), and must identify the application in which this Power of Attorney is filed.

Signature of Principal (Applicant/Assignee)
The individual whose signature and title is supplied below is authorized to act on behalf of the Principal (Applicant/Assignee)

Signature	[signature]	Date: Nov. 21, 2012
Name	Kim, Sun-Jae	Telephone: +82-2-3408-4097
Title	President	

NSIP LAW

Electronic Acknowledgement Receipt

EFS ID:	14298469
Application Number:	12377617
International Application Number:	
Confirmation Number:	8176
Title of Invention:	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR
First Named Inventor/Applicant Name:	Se-Yoon Jeong
Customer Number:	26530
Filer:	Randall Scott Svihla
Filer Authorized By:	
Attorney Docket Number:	CU-7298 WWP
Receipt Date:	24-NOV-2012
Filing Date:	16-FEB-2009
Time Stamp:	09:54:18
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Assignee showing of ownership per 37 CFR 3.73.	POA20121124_0220900002_StatementUnder37CFR373b_ETRI.pdf	15593 bfd73eb5f944b9a9ce2977dd04316392745693ea	no	2

Warnings:

Information:

2	Power of Attorney	POA20121124_0220900002_POA_ETRI.pdf	114121 787190893dac20f818f1408160d56bf6c108f0ff	no	1
Warnings:					
Information:					
3	Assignee showing of ownership per 37 CFR 3.73.	POA20121124_0220900002_StatementUnder37CFR373b_Kwangwoon.pdf	15786 3b483a1b150a3f45b0435b1c6824786e0337539f	no	2
Warnings:					
Information:					
4	Power of Attorney	POA20121124_0220900002_POA_Kwangwoon.pdf	145923 c444d34c5872eaa8c0360f3e9a230dab9f0e62ac	no	1
Warnings:					
Information:					
5	Assignee showing of ownership per 37 CFR 3.73.	POA20121124_0220900002_StatementUnder37CFR373b_Sejong.pdf	15546 20a499d52c9060b51a27c9627d70aa899f8f811a	no	2
Warnings:					
Information:					
6	Power of Attorney	POA20121124_0220900002_POA_Sejong.pdf	411984 0683c3003e9677ef50a970cb5ebe26f1afa679d9	no	1
Warnings:					
The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing					
Information:					
			Total Files Size (in bytes):	718953	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Docket No. 022090.0002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Se-Yoon Jeong et al.

Application No. 12/377,617 Art Unit: 2496

Confirmation No. 8176

Filed: February 16, 2009 Examiner: Courtney D. Fields

For: APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

STATEMENT UNDER 37 CFR 3.73(b) BY ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Electronics and Telecommunications Research Institute, a non-profit government-funded research institute of the Republic of Korea, states that it is the assignee of an undivided interest in the entirety of Application No. 12/377,617 by virtue of an assignment from the inventors to Electronics and Telecommunications Research Institute, Kwangwoon University Research Institute for Industry Cooperation, and Industry-Academia Cooperation Group of Sejong University that was recorded against Application No. 12/377,617 in the United States Patent and Trademark Office on February 16, 2009, at Reel 022261, Frame 0138.

Electronics and Telecommunications Research Institute states that Electronics and Telecommunications Research Institute, Kwangwoon University Research Institute for Industry Cooperation, and Industry-Academia Cooperation Group of Sejong University jointly own the entire right, title, and interest in Application No. 12/377,617.

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee Electronics and Telecommunications Research Institute to complete this Statement Under 37 CFR 3.73(b).

Respectfully submitted,

Date: November 24, 2012

/Randall S. Svihla/
Randall S. Svihla, Attorney
Registration No. 56,273

NSIP Law
P.O. Box 34688
Washington, DC 20036
Telephone (202) 429-0020
Facsimile (202) 315-3758
CYP/RSS

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(b), identified below, or identified in accompanying transmittal(s).

I hereby appoint Patent Practitioner(s) associated with the Customer Number: 89980

as attorney(s) or agent(s) to represent and act on behalf of the undersigned Principal (Applicant/Assignee) before the United States Patent and Trademark Office (USPTO), including in connection with any and all patent applications identified herein/transmittals or assigned to the Principal (Applicant/Assignee) according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(b). I hereby further authorize the Patent Practitioner(s) to act on behalf of the Principal (Applicant/Assignee) to complete the statement under 37 CFR 3.73(b) or the accompanying transmittals.

Please note/change the correspondence address and the fee address for the application identified herein/transmittals or in the attached statement under 37 CFR 3.73(b) to: The address associated with Customer Number:

89980

Principal (Applicant/Assignee) Name and Address:

ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE
161 Gajeong-dong Yuseong-gu, Daejeon-si 305-700 Republic of Korea

A copy of this form, together with a statement under 37 CFR 3.73(b) may be filed in each application in which this form is used. The statement under 37 CFR 3.73(b) may be completed by one of the patent practitioners in this form if the appointed patent practitioner is authorized to act on behalf of the Principal (Applicant/Assignee), and must identify the application in which this Power of Attorney is filed.

Signature of Principal (Applicant/Assignee)
The individual whose signature and title is supplied below is authorized to act on behalf of the Principal (Applicant/Assignee)

Signature		Date: November 16, 2012.
Name	Gil Won KIM	Telephone: +82-42-860-4908
Title	Director, Intellectual Property Management Team	

NSIP LAW

Docket No. 022090.0002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Se-Yoon Jeong et al.

Application No. 12/377,617 Art Unit: 2496

Confirmation No. 8176

Filed: February 16, 2009 Examiner: Courtney D. Fields

For: APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

STATEMENT UNDER 37 CFR 3.73(b) BY KWANGWOON UNIVERSITY RESEARCH INSTITUTE FOR INDUSTRY COOPERATION

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Kwangwoon University Research Institute for Industry Cooperation, a foundation of the Republic of Korea, states that it is the assignee of an undivided interest in the entirety of Application No. 12/377,617 by virtue of an assignment from the inventors to Electronics and Telecommunications Research Institute, Kwangwoon University Research Institute for Industry Cooperation, and Industry-Academia Cooperation Group of Sejong University that was recorded against Application No. 12/377,617 in the United States Patent and Trademark Office on February 16, 2009, at Reel 022261, Frame 0138.

Kwangwoon University Research Institute for Industry Cooperation states that Electronics and Telecommunications Research Institute, Kwangwoon University Research Institute for Industry Cooperation, and Industry-Academia Cooperation Group of Sejong University jointly own the entire right, title, and interest in Application No. 12/377,617.

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee Kwangwoon University Research Institute for Industry Cooperation to complete this Statement Under 37 CFR 3.73(b).

Respectfully submitted,

Date: November 24, 2012

/Randall S. Svihla/
Randall S. Svihla, Attorney
Registration No. 56,273

NSIP Law
P.O. Box 34688
Washington, DC 20036
Telephone (202) 429-0020
Facsimile (202) 315-3758
CYP/RSS

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/377,617	02/16/2009	Se-Yoon Jeong	CU-7298 WWP	8176

26530 7590 11/20/2012

LADAS & PARRY LLP
224 SOUTH MICHIGAN AVENUE
SUITE 1600
CHICAGO, IL 60604

EXAMINER	
FIELDS, COURTNEY D	
ART UNIT	**PAPER NUMBER**
2496	
NOTIFICATION DATE	**DELIVERY MODE**
11/20/2012	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ChicagoUSPTO@ladas.net

Office Action Summary	Application No.	Applicant(s)	
	12/377,617	JEONG ET AL.	
	Examiner	Art Unit	
	COURTNEY FIELDS	2496	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 October 2012*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *1,3-9,11,13-19 and 21-24* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1,3-9,11,13-19 and 21-24* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☒ Other: *Amendment after final 10/29/2012*.

DETAILED ACTION

1. Claims 2, 10, 12, and 20 have been cancelled.

2. Claims 1, 3-9, 11, 13-19, and 21-24 are pending.

Response to Arguments

1. Applicant's arguments, see pages 1-6, filed 29 October 2012, with respect to the rejection(s) of claim(s) 1, 3-9, 11, 13-19, and 21-24 under Karczewicz et al. (Pub No. 2003/0081850) and Gharavi (US Patent No. 4,821,119) have been fully considered and are persuasive. Therefore, the final rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Park (Pub No. 2006/0002466 and in view of Boon et al. (US Patent No. 7,995,654).

Double Patenting

2. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct

from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

3. Claims 1, 3-9, 11, 13-19, and 21-24 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-19 of U.S. Patent No. 8,199,819. Although the conflicting claims are not identical, they are not patentably distinct from each other because the scope of the claims is the same for the instant application and the issued application. Each claim identical method and apparatus for encoding and decoding images using adaptive scanning of coefficients

using DCT (Discrete Cosine Transform) and quantization according to the intra prediction mode.

4. Claim(s) 1-19 of US Patent No. 8,199,819 contain(s) every element of claim(s) 1, 3-9, 11, 13-19, and 21-24 of the instant application and as such anticipate(s) claim(s) 1, 3-9, 11, 13-19, and 21-24 of the instant application.

5. "A later patent claim is not patentably distinct from an earlier patent claim if the later claim is obvious over, or anticipated by, the earlier claim. In re Longi, 759 F.2d at 896,225 USPQ at 651 (affirming a holding of obviousness-type double patenting because the claims at issue were obvious over claims in four prior art patents); In re Berg, 140 F.3d at 1437, 46 USPQ2d at 1233 (Fed. Cir. 1998) (affirming a holding of obviousness-type double patenting where a patent application claim to a genus is anticipated by a patent claim to a species within that genus). " ELI LILLY AND COMPANY v BARR LABORATORIES, INC., United States Court of Appeals for the Federal Circuit, ON PETITION FOR REHEARING EN BANC (DECIDED: May 30, 2001).

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States

only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 1, 9, 11, and 19 are rejected under 35 U.S.C. 102(e) as being anticipated by Park (Pub No. 2006/002466)

Referring to the rejection of claims 1 and 11, Park discloses an encoding apparatus and comprising: (See Park, Fig. 8)

a mode selection unit for selecting an optimal mode for intra prediction; (See Park, paragraphs 0165 and 0172)

an intra prediction unit for performing intra prediction onto video inputted based on the mode selected in the mode selection unit; (See Park, paragraphs 0165 and 0172)

a DCT and quantization unit for performing DCT and quantization onto difference values outputted from the intra prediction unit; (See Park, paragraphs 0165 and 0173)

and an entropy encoding unit for performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided based on the selected mode. (See Park, paragraphs 0165 and 0173)

Referring to the rejection of claims 9 and 19, Park discloses a decoding apparatus and method comprising: (See Park, Fig. 9 and paragraph 0178)

an entropy decoding unit for performing entropy decoding onto encoded video; (See Park, paragraph 0179)

a scanning decision unit for deciding a scanning mode for the video decoded in the entropy decoding means; (See Park, paragraph 0179) and a video recovery unit for recovering the video based on the scanning mode decided in the scanning decision unit, (See Park, paragraph 0180)

wherein the scanning decision unit decides the scanning mode based on the intra prediction mode used for the encoded video. (See Park, paragraph 018-0182)

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 3-8, 13-18, and 21-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park (Pub No. 2006/002466) in view of Boon et al. (US Patent No. 7,995,654). Park discloses the invention as claimed above, however, Park fails to explicitly disclose zigzag scanning. Boon et al. discloses image predictive coding method.

Referring to the rejection of claims 3 and 13, (Park modified by Boon et al.) discloses wherein the entropy encoding unit: (See Park, paragraphs 0165 and 0173)

performing entropy encoding using a horizontal-directional scanning, when the selected mode is a vertical intra prediction and vertical-directional pixel similarity of the residual signals is high; (See Boon et al., Col. 39, lines 61-67, Col. 40, lines 1-3 and Table 3) performing entropy encoding using a vertical-directional scanning, when the selected mode is a horizontal intra prediction and horizontal-directional pixel similarity of the residual signals is high; (See Boon et al., Col. 39, lines 61-67, Col. 40, lines 1-3 and Table 3)

and performing entropy encoding using a zigzag scanning, when vertical and horizontal-directional pixel similarities of the residual signals are similar. (See Boon et al., Col. 39, lines 61-67, Col. 40, lines 1-3 and Table 3)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine Park's prediction encoder/decoder from an origin macroblock of an area of interest of a video frame and Boon et al.'s image predictive coding method. Motivation for such an implementation would enable pixel values to be adjacent to one another in a vertical direction for predicting intra-frame prediction in a small region. (See Boon et al., Col. 23, lines 26-40)

Referring to the rejection of claims 4 and 14, (Park modified by Boon et al.) discloses wherein the entropy encoding unit decides that the vertical-directional pixel similarity is high, when a vertical-directional pixel similarity value is greater than a value obtained by multiplying a horizontal-directional pixel similarity value by a first multiplication factor. (See Boon et al., Col. 36, lines 22-32)

The rationale for combining Park in view of Boon et al. is the same as claim 3.

Referring to the rejection of claims 5 and 15, (Park modified by Boon et al.) discloses wherein the entropy encoding unit decides that the horizontal-directional pixel similarity is high, when a horizontal-directional pixel similarity value is greater than a value obtained by multiplying a vertical-directional pixel similarity value by a second multiplication factor. (See Boon et al., Col. 36, lines 32-40)

The rationale for combining Park in view of Boon et al. is the same as claim 3.

Referring to the rejection of claims 6 and 16, (Park modified by Boon et al.) discloses wherein the vertical-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to a left part of a currently encoded block. (See Boon et al., Col. 34, lines 46-53)

The rationale for combining Park in view of Boon et al. is the same as claim 3.

Referring to the rejection of claims 7 and 17, (Park modified by Boon et al.) discloses wherein the horizontal-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to an upper part of a currently encoded block. (See Boon et al., Col. 34, lines 38-45)

The rationale for combining Park in view of Boon et al. is the same as claim 3.

Referring to the rejection of claims 8 and 18, (Park modified by Boon et al.) discloses wherein the first and second multiplication factors are natural number 2. (See Boon et al., Col. 34, lines 54-65)

The rationale for combining Park in view of Boon et al. is the same as claim 3.

Referring to the rejection of claims 21-24, (Park modified by Boon et al.) discloses wherein the scanning mode is decided as a horizontal scanning when the intra prediction mode is a vertical prediction mode, and as a vertical scanning when the intra prediction mode is a horizontal prediction mode when the selected mode is a vertical prediction mode, (See Boon et al., Figs. 27-29, Col. 42, lines 41-45)

The rationale for combining Park in view of Boon et al. is the same as claim 3.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

9. Gaedke (US Patent No. 8,107,532) discloses a method and apparatus for generating a picture signal encoding/decoding one or more prediction information items.

10. Wang et al. (US Patent No. 7,817,718) discloses macroblock level adaptive frame/field coding for digital video content.

11. Kanehara et al. (US Patent No. 7,933,334) discloses an image coding method for selecting prediction modes based on processed blocks and pixels within a frame image.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to COURTNEY FIELDS whose telephone number is

(571)272-3871. The examiner can normally be reached on Mon - Fri. 7:00 - 4:00 pm; IFP.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Andrew Nalven can be reached on 571-272-3839. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Courtney D. Fields/
Examiner, Art Unit 2496
November 7, 2012

/Andrew L Nalven/
Supervisory Patent Examiner, Art Unit 2496

Notice of References Cited	Application/Control No. 12/377,617	Applicant(s)/Patent Under Reexamination JEONG ET AL.	
	Examiner COURTNEY FIELDS	Art Unit 2496	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2006/0002466	01-2006	Park, Gwang-hoon	375/240.03
*	B	US-7,995,654	08-2011	Boon et al.	375/240.12
*	C	US-8,107,532	01-2012	Gaedke, Klaus	375/240.12
*	D	US-7,933,334	04-2011	Kanehara, Fumikazu	375/240.16
*	E	US-7,817,718	10-2010	Wang et al.	375/240.16
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application: Se-Yoon Jeong	] Art Unit: 2437
	]
Serial No: 12/377,617	] Ex.: Fields, Courtney D
	]
Filed: February 16, 2009	]

For: APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

AMENDMENT AFTER FINAL UNDER 37 CFR 1.116
EXPEDITED PROCEDURE - TC-2437

OK TO ENTER: /C.F./

11/07/2012

Mail Stop AF
The Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Sir:

In response to the final office action dated August 27, 2012, setting a 3-month shortened statutory period for reply ending on November 27, 2012, the applicants submit the following responsive in the above-identified application. This response is considered to place the application in better condition for allowance. No fee is believed to be required with this amendment, but, if this is not the case, please charge the requisite fee (or credit any overpayment) to Deposit Account No. 12-0400.

Listing of claims is reflected in the listing of claims, which begins on page 2 of this paper.

Remarks/Arguments begin on page 8 of this paper.

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	2	"8199819".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 17:33
L2	1984	encod$3 with "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 17:54
L3	112	encod$3 with "intra prediction" with "DCT"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 17:54
L4	50	encod$3 with "intra prediction" with "DCT" with "quantization"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 17:54
L5	7	encod$3 with "intra prediction" with "DCT" with "quantization" with scan$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 17:54
L6	7	encod$3 with "intra prediction" with "DCT" with "quantization" with scan$4 with (entropy encod$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 17:54
L7	0	encod$3 with "intra prediction" with "DCT" with "quantization" with "9 prediction modes" with (entropy encod$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 17:57
L8	0	encod$3 with "intra prediction" with	US-PGPUB;	OR	OFF	2012/11/07

		"DCT" with "quantization" with "9 prediction modes"	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			17:58
L9	4	encod$3 with "9 prediction modes"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 17:58
L10	16	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 17:59
L11	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zig zag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:10
L12	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:10
L13	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:10
L14	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction" and "video"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:10
L15	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction" and "video" and "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:10
L16	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction" and "video" and "entropy encoding" and "DCT" and "quantization"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	2012/11/07 18:11

			IBM_TDB			
L17	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction" and "video" and "entropy encoding" and "DCT" and "quantization" and "coefficients"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:11
L18	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction" and "video" and "entropy encoding" and "DCT" and "quantization" and "coefficients" and "horizontal" and "vertical" and "scanning"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:11
L19	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction" and "video" and "entropy encoding" and "DCT" and "quantization" and "coefficients" and "horizontal" and "vertical" and "scanning" and "residual"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:11
L20	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction" and "video" and "entropy encoding" and "DCT" and "quantization" and "coefficients" and "horizontal" and "vertical" and "scanning" and "residual signals"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:11
L21	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction" and "video" and "entropy encoding" and "DCT" and "quantization" and "coefficients" and "horizontal" and "vertical" and "scanning" and "residual signals" and (multipl$7)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:12
L22	14	"8107532".pn. "7817718".pn. "7995654".pn. "7933334".pn. "7822119".pn. "8238426".pn. and "zigzag" and "intra prediction" and "video" and "entropy encoding" and "DCT" and "quantization" and "coefficients" and "horizontal" and "vertical" and "scanning" and "residual signals" and (multipl$7) and "dispersion"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:13
L23	0	L10 and "zigzag" and "intra prediction" and "video" and "entropy encoding" and "DCT" and "quantization" and "coefficients" and "horizontal" and "vertical" and "scanning" and "residual signals" and (multipl$7) and "dispersion"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:13
L24	1	L10 and "zigzag" and "intra prediction" and "video" and "entropy encoding" and "DCT" and "quantization" and	US-PGPUB; USPAT; USOCR;	OR	OFF	2012/11/07 18:13

		"coefficients" and "horizontal" and "vertical" and "scanning"	FPRS; EPO; JPO; DERWENT; IBM_TDB			
L25	0	L10 and "zig zag" and "intra prediction" and "video" and "entropy encoding" and "DCT" and "quantization" and "coefficients" and "horizontal" and "vertical" and "scanning"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:13
L26	0	L10 and "zig zag" and "intra prediction" and "video" and "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:13
L27	3	L10 and "zigzag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:14
L28	1	L10 and "dispersion"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:30
L29	4	L10 and (multipl$7)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:31
L30	0	L10 and "video recovery"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:32
L31	0	L10 and "recovering"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:33
L32	0	L10 and "recover"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:33
L33	4	"video recovery" and "decoding" and	US-PGPUB;	OR	OFF	2012/11/07

		"entropy"	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			18:33
L34	1	"video recovery" with "entropy decoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:37
L35	1	"video recovery" same "entropy decoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:37
L36	3	"20050157797"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:41
L37	0	L10 and "pixel prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:44
L38	8	L10 and "pixel"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:44
L39	6	L10 and "pixels"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:44
L40	1	L10 and "direct current"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:52
L41	1	L10 and "plane"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	2012/11/07 19:07

			IBM_TDB			
L42	138	"mode selection" and "intra prediction" and "DCT" and "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 19:14
L43	5	"mode selection" with "intra prediction" with "DCT" with "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 19:14
L44	152	"entropy encoding" same "zigzag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 19:40
L45	75	"entropy encoding" with "zigzag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 19:40
L46	41	"entropy encoding" near5 "zigzag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 19:40
L47	0	"entropy encoding" near5 "zigzag" near5 "horizontal"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 19:41
L48	29	"entropy encoding" near5 "zigzag" and "horizontal"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 19:41
L49	4	"entropy encoding" near5 "zigzag" same "horizontal"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 19:41

11/7/2012 8:26:26 PM
C:\Users\cfields\Documents\EAST\Workspaces\encoding and decoding image using adaptive DCT coefficient scanning.wsp

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12377617	JEONG ET AL.
	Examiner	**Art Unit**
	COURTNEY FIELDS	2437

SEARCHED

Class	Subclass	Date	Examiner
375	240.20	11/7/2012	CDF
375	240.12	11/7/2012	CDF
375	240.24	11/7/2012	CDF
375	240.27	11/7/2012	CDF
375	240.16	11/7/2012	CDF
382	247	11/7/2012	CDF
375	240.03	11/7/2012	CDF

SEARCH NOTES

Search Notes	Date	Examiner
EAST Search (USPAT, PG-PUB, DERWENT, IBM, EPO, JPO)	11/7/2012	CDF
NPL Search (i.e. ACM)	11/7/2012	CDF
Consulted with Primary Gims Philippe - 375 Search Mentor	11/6/2012	CDF

INTERFERENCE SEARCH

Class	Subclass	Date	Examiner

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12377617	JEONG ET AL.
	Examiner	**Art Unit**
	COURTNEY FIELDS	2437

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE									
Final	Original	03/18/2012	08/17/2012	11/07/2012							
	1	✓	✓	✓							
	2	✓	-								
	3	✓	✓	✓							
	4	✓	✓	✓							
	5	✓	✓	✓							
	6	✓	✓	✓							
	7	✓	✓	✓							
	8	✓	✓	✓							
	9	✓	✓	✓							
	10	✓	-								
	11	✓	✓	✓							
	12	✓	-								
	13	✓	✓	✓							
	14	✓	✓	✓							
	15	✓	✓	✓							
	16	✓	✓	✓							
	17	✓	✓	✓							
	18	✓	✓	✓							
	19	✓	✓	✓							
	20	✓	-								
	21		✓	✓							
	22		✓	✓							
	23		✓	✓							
	24		✓	✓							

Searching for: (entropy and encoding, and decoding, and DCT, and quantization, and intra and prediction, and video) (start a new search)
Found **173** within *The ACM Guide to Computing Literature* (Bibliographic citations from major publishers in computing)

Limit your search to Publications from ACM and Affiliated Organizations (Full-Text collection: **360,430** items)

Search Results   Related Magazines   Related SIGs   Related Conferences

Results 1 - 20 of 173   Sort by relevance   in expanded form
Result page: **1** 2 3 4 5 6 7 8 9 next

1 Scalable video encryption of H.264 SVC Codec
Gul Boztok Algin, E. Turhan Tunali
May 2011 **Journal of Visual Communication and Image Representation**, Volume 22 Issue 4
Publisher: Academic Press, Inc.
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count

A new algorithm for encrypting H.264 SVC (Scalable Video Codec) video data is developed. Security requirements of encoded video are examined together with constraints arising from structural properties of th SVC software. Performance analysis of the ...
Keywords: H.264 SVC, Layered security, Multimedia encryption, Perceptual encryption, Scalable video encryption, Selective encryption, Synchronized secure video transmission, Video Coding

2 A model-based adaptive motion estimation scheme using Renyi's entropy for wireless video
Ganesan Ramachandran, Vignesh Krishnan, Dapeng Wu, Zhihai He
August 2005 **Journal of Visual Communication and Image Representation**, Volume 16 Issue 4-5
Publisher: Academic Press, Inc.
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count

Efficient motion estimation is an important problem because it determines the compression efficiency and complexity of a video encoder. Motion estimation can be formulated as an optimization problem; most motion estimation algorithms use mean squared ...

Keywords: Adaptive motion estimation, Model-based motion estimation, Renyi's entropy, Wireless video

3 A novel scrambling scheme for digital video encryption
Zhenyong Chen, Zhang Xiong, Long Tang
December 2006 **PSIVT'06:** Proceedings of the First Pacific Rim conference on Advances in Image and Video Technology
Publisher: Springer-Verlag
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count

Nowadays it is easy and fast to deliver and communicate the digital video contents. Therefore, security proble reveals followed in applications such as video-on-demand, videoconference and video chatting system. In this paper, a scrambling scheme employing ...
Keywords: MPEG-4, scrambling, video encryption

4 Rate control based on linear regression for H.264/MPEG-4 AVC
Sung-Chang Lim, Hyeong-Ryul Na, Yung-Lyul Lee
January 2007 **Image Communication**, Volume 22 Issue 1
Publisher: Elsevier Science Inc.
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count

An efficient rate control algorithm is required to transmit coded video sequences without abrupt changes in quality due to the limited channel bandwidth. Thus, in this paper, an efficient rate control method is proposed for the H.264/MPEG (Moving Picture ...

Keywords: Bit allocation, H.264/MPEG-4 AVC, Linear regression, Rate control, Video coding

5 Optimizing the H.264/AVC Video Encoder Application Structure for Reconfigurable and Application-Specific Platforms
Muhammad Shafique, Lars Bauer, Jörg Henkel
August 2010 **Journal of Signal Processing Systems**, Volume 60 Issue 2
Publisher: Kluwer Academic Publishers
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application: Se-Yoon Jeong	] Art Unit: 2437
	]
Serial No: 12/377,617	] Ex.: Fields, Courtney D
	]
Filed: February 16, 2009	]

For: APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

AMENDMENT AFTER FINAL UNDER 37 CFR 1.116
EXPEDITED PROCEDURE - TC-2437

Mail Stop AF
The Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Sir:

In response to the final office action dated August 27, 2012, setting a 3-month shortened statutory period for reply ending on November 27, 2012, the applicants submit the following responsive in the above-identified application. This response is considered to place the application in better condition for allowance. No fee is believed to be required with this amendment, but, if this is not the case, please charge the requisite fee (or credit any overpayment) to Deposit Account No. 12-0400.

Listing of claims is reflected in the listing of claims, which begins on page 2 of this paper.

Remarks/Arguments begin on page 8 of this paper.

AMENDMENTS TO THE CLAIMS

The listing of claims presented below will replace all prior versions, and listings, of claims in the application.

Listing of claims:

1. (**previously presented**) An encoding apparatus comprising:

a mode selection unit for selecting an optimal mode for intra prediction;

an intra prediction unit for performing intra prediction onto video inputted based on the mode selected in the mode selection unit;

a DCT and quantization unit for performing DCT and quantization onto difference values outputted from the intra prediction unit; and

an entropy encoding unit for performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided based on the selected mode.

2. (cancelled).

3. (**previously presented**) The encoding apparatus of claim 1, wherein the entropy encoding unit:

performing entropy encoding using a horizontal-directional scanning, when the selected mode is a vertical intra prediction and vertical-directional pixel similarity of the residual signals is high;

performing entropy encoding using a vertical-directional scanning, when the selected mode is a horizontal intra prediction and horizontal-directional pixel similarity of the residual signals is high; and

performing entropy encoding using a zigzag scanning, when **<u>the</u>** vertical and horizontal-directional pixel similarities of the residual signals are similar.

4. (**previously presented**) The encoding apparatus of claim 3, wherein the entropy encoding unit decides that the vertical-directional pixel similarity is high, when a vertical-directional pixel similarity value is greater than a value obtained by multiplying a horizontal-directional pixel similarity value by a first multiplication factor.

5. (**previously presented**) The encoding apparatus of claim 3, wherein the entropy encoding unit decides that the horizontal-directional pixel similarity is high, when a horizontal-directional pixel similarity value is greater than a value obtained by multiplying a vertical-directional pixel similarity value by a second multiplication factor.

6. (original) The encoding apparatus of claim 4, wherein the vertical-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to a left part of a currently encoded block.

7. (original) The encoding apparatus of claim 5, wherein the horizontal-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to an upper part of a currently encoded block.

8. (original) The encoding apparatus of claim 6, wherein the first and second

multiplication factors are natural number 2.

9. (**previously presented**) A decoding apparatus comprising:

an entropy decoding unit for performing entropy decoding onto encoded video;

a scanning decision unit for deciding a scanning mode for the video decoded in the entropy decoding unit; and

a video recovery unit for recovering the video based on the scanning mode decided in the scanning decision unit,

wherein the scanning decision unit decides the scanning mode based on the intra prediction mode used for the encoded video.

10. (cancelled).

11. (**previously presented**) An encoding method comprising the steps of:

selecting an optimal mode for intra prediction;

performing intra prediction onto video inputted based on the mode selected in the mode selection step;

performing DCT and quantization onto difference values outputted from the intra prediction step; and

performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided based on the selected mode.

12. (cancelled).

13. (**previously presented**) The encoding method of claim 11, wherein the entropy encoding step includes the steps of:

performing entropy encoding using a horizontal-directional scanning, when the selected optimal mode is a vertical intra prediction and vertical-directional pixel similarity of the residual signals is high;

performing entropy encoding using a vertical-directional scanning, when the selected optimal mode is a horizontal intra prediction and horizontal-directional pixel similarity of the residual signals is high; and

performing entropy encoding using a zigzag scanning, when vertical and horizontal-directional pixel similarities of the residual signals are similar.

14. (original) The encoding method of claim 13, wherein the vertical-directional pixel similarity is decided high in the entropy encoding step, when a vertical-directional pixel similarity value is greater than a value obtained by multiplying a horizontal-directional pixel similarity value by a first multiplication factor.

15. (original) The encoding method of claim 13, wherein the horizontal-directional pixel similarity is decided high in the entropy encoding step, when a horizontal-directional pixel similarity value is greater than a value obtained by multiplying a vertical-directional pixel similarity value by a second multiplication factor.

16. (original) The encoding method of claim 14, wherein the vertical-directional pixel

similarity is calculated by performing dispersion onto pixels adjacent to a left part of a currently encoded block.

17. (original) The encoding method of claim 15, wherein the horizontal-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to an upper part of a currently encoded block.

18. (original) The encoding method of claim 16, wherein the first and second multiplication factors are natural number 2.

19. (**previously presented**) A decoding method comprising the steps of:

performing entropy decoding onto encoded video;

deciding a scanning mode for the video decoded in the entropy decoding step; and

recovering the video based on the scanning mode decided in the scanning decision step,

wherein the scanning mode is decided based on the intra prediction mode used for the encoded video.

20. (cancelled).

21. (**previously presented**) The encoding apparatus of claim 1, the scanning mode is decided as a horizontal scanning when the selected mode is a vertical prediction

mode, and as a vertical scanning when the selected mode is a horizontal prediction mode.

22. (**previously presented**) The decoding apparatus of claim 9, the scanning mode is decided as a horizontal scanning when the intra prediction mode is a vertical prediction mode, and as a vertical scanning when the intra prediction mode is a horizontal prediction mode.

23. (**previously presented**) The encoding method of claim 11, the scanning mode is decided as a horizontal scanning when the selected mode is a vertical prediction mode, and as a vertical scanning when the selected mode is a horizontal prediction mode.

24. (**previously presented**) The decoding method of claim 19, the scanning mode is decided as a horizontal scanning when the intra prediction mode is a vertical prediction mode, and as a vertical scanning when the intra prediction mode is a horizontal prediction mode.

REMARKS/ARGUMENTS

The final office action mailed on August 27, 2012, has been reviewed and carefully considered. Reconsideration is respectfully requested.

Amendments to the Claims

Claims 1, 3-9, 11, 13-19 and 21-24 were pending in the present application prior to this amendment. Claims 1, 3-9, 11, 13-19 and 21-24 are now pending in the present application; among them, claims 1, 9, 11, and 19 are independent claims. **No Claims have been amended as none is deemed necessary for the reasons below**. No new matter has been added.

Claim Rejections - 35 U.S.C. §102

In the final office action (page 2), claims 1, 4-9, 11 and 14-19 stand rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 2003/0081850 (Karczewicz).

Claim Rejections - 35 U.S.C. §103

In the final office action (page 5), claims 3, 13, and 21-24 stand rejected under 35 U.S.C. §103(a) as being obvious over Karczewicz in view of U.S. Patent No. 4,821,119 (Gharavi).

The applicants respectfully disagree.

Comments for 102/103 Rejections

In the claims 1 and 11 below of the present application, the applicants respectfully point out that the claimed encoding apparatus uses scanning mode which is determined according to which intra prediction mode is applied as emphasized below.

1. An encoding apparatus comprising:

a mode selection unit for **selecting an optimal mode for intra prediction**;

an intra prediction unit for performing intra prediction onto video inputted based on the mode selected in the mode selection unit;

a DCT and quantization unit for performing DCT and quantization onto difference values outputted from the intra prediction unit; and

an entropy encoding unit for performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided based on the selected mode [emphasis added].

11. An encoding method comprising the steps of:

selecting an optimal mode for intra prediction;

performing intra prediction onto video inputted based on the mode selected in the mode selection step;

performing DCT and quantization onto difference values outputted from the intra prediction step;

and

performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided based on the selected mode [emphasis added].

Also, in the claims 9 and 19 below of the present application, the applicants respectfully point out that the decoding apparatus uses scanning mode which is determined according to which intra prediction mode was used for encoded video. That is, the scanning mode of the present invention is determined according to which intra prediction mode is used for the claimed decoding process, which the prior art fails to disclose.

9. A decoding apparatus comprising:

an entropy decoding unit for performing entropy decoding onto encoded video;

a scanning decision unit for deciding a scanning mode for the video decoded in the entropy decoding unit; and

a video recovery unit for recovering the video based on the scanning mode decided in the scanning decision unit,

wherein the scanning decision unit **decides the scanning mode based on the intra prediction mode used for the encoded video** [emphasis added].

19. A decoding method comprising the steps of:

performing entropy decoding onto encoded video;

deciding a scanning mode for the video decoded in the entropy decoding step; and

recovering the video based on the scanning mode decided in the scanning decision step,

wherein the scanning mode is decided based on the intra prediction mode used for the encoded video [emphasis added].

Support for the amendments can be found throughout the specification and at least at page 11, line 5 to page 12, line 34 and FIGs. 5-8.

The applicants respectfully point out that nowhere do any of the cited references and especially Karczewicz, teach or disclose **deciding scanning mode according to the intra prediction mode** (specification page 11, line 5 to page 12, line 34 and FIGs. 5-8). Gharavi fails to make up for the deficiency of Karczewicz.

The examiner points out that Karczewicz allegedly discloses same features emphasized above in non-amended claims 1, 9, 11, and 19 in paragraph 0024 and 0030-0031 of Karczewicz.

However, the applicants respectfully point out that nowhere does theses above cited paragraphs or in any paragraphs of Karczewicz discloses **deciding scanning mode according to the intra prediction mode**.

In contrast, paragraph 30 of Karczewicz actually mentions "It further compresses the run and level value using entropy coding, in a manner analogous to that describes above in connection with INTRA-coding mode."

Accordingly, paragraph 30 of Karczewicz verifies that Karczewicz does **not mention nor has any intention of disclosing** any relation between scanning mode and intra prediction mode, which the present invention discloses. More particularly, Karczewicz actually discloses that run and level value can be compressed further by using entropy coding, which teaches away from the presently claimed invention for **deciding scanning mode according to the intra prediction mode**.

Further in contrast, in Karczewicz, the scanning mode being applied is **not** determined by considering any context such as intra prediction mode used or to be used. In fact, Karczewicz discloses using fixed scanning mode, the 'zigzag scan'.

As a result, the applicants respectfully point out that Karczewicz **does not disclose, mention, or teach any relation between a scanning mode and intra prediction mode**.

Accordingly, the applicants respectfully submit that Karczewicz fails to teach and/or disclose each and every one of limitations recited in non-amended claims 1, 9, 11, and 19 of the presently claimed invention recited above. Gharavi fails to make up for the deficiency of Karczewicz.

Therefore, the applicants respectfully submit that claims 1, 9, 11, and 19 are in condition for allowance over the examiner's cited references and especially the cited reference of Karczewicz, where an indication of allowable subject matter with respect to claims 1, 9, 11, and 19 are respectfully requested.

As a result, the applicants respectfully request that the 35 U.S.C. §102/103 rejections of the claims 1, 3-9, 11, 13-19 and 21-24 be withdrawn.

Additionally and in general, the current Office Action makes various statements regarding the pending claims and the cited references, which the applicants respectfully believe are now moot in light of the above comments to the non amended claims 1, 9, 11, and 19. Thus, the Applicants will not address such statements at the present time in order to minimized the time for the examiner's to have to respond to such statements, and which has been do to expedite the examiner's time for responding to Applicants' argument.

However, the Applicants expressly reserve the right to challenge such statements in the future should the need arise (e.g., if such statement should become relevant by appearing in a rejection of any current or future claim). The Applicants also reserve the right to argue additional reasons beyond those set forth above to support the allowability of any claims should such a need arise.

Respectfully, the applicants respectfully note that the examiner's choice of reply in response to this paper is limited to one of the following three, because the applicants have not introduced any new grounds necessitating an additional search (i.e., no claims are amended) in this response:

(1) issuing a Notice of Allowance;

(2) issuing a non-final office action citing a new reference; and

(3) issuing an advisory action entering claims for purpose of appeal.

The applicants respectfully request issuance of a Notice of Allowance in the next action in view of the detailed reasons above, or issuance of a non-final office action citing a new reference, because the cited prior references do not teach claim 1 (an similarly claims 9, 11, and 19) of the present invention for **deciding scanning mode according to the intra prediction mode**.

As shown above, claim 1 (and similarly claims 9, 11, and 19) has not been amended with regard to patentability. Applicants note that MPEP 707.07(a) states that "where the examiner introduces a new ground of rejection that is neither necessitated by applicant's amendment of the claims, nor based on information submitted in an information disclosure statement" a second office action shall not be made final. **Therefore, the applicants respectfully submit that the next Office Action cannot be made final if claim 1, 9, 11, and claim 19 are rejected on new grounds** (see MPEP 707.07(a)).

DEPENDENT CLAIMS

The other claims are dependent from independent claims 1, 9, 11, and 19. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual reconsideration of the patentability of each on its own merits is respectfully requested.

<u>Conclusion</u>

For the reasons set forth above, the applicants respectfully submit that claims 1, 3-9, 11, 13-19 and 21-24, now pending in this application, are in condition for allowance over the cited references. Accordingly, the applicants respectfully request reconsideration and withdrawal of the outstanding rejections and earnestly solicit an indication of allowable subject matter.

This response is considered to be responsive to all points raised in the office action. The examiner is encouraged to contact the undersigned attorney by telephone to expeditiously resolve any remaining questions or concerns.

Respectfully submitted,

Dated: October 29, 2012

Keith S. Van Duyne

Keith S. Van Duyne, Reg. No. 54,505
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Electronic Acknowledgement Receipt

EFS ID:	14095262
Application Number:	12377617
International Application Number:	
Confirmation Number:	8176
Title of Invention:	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR
First Named Inventor/Applicant Name:	Se-Yoon Jeong
Customer Number:	26530
Filer:	Keith Stanley Van Duyne/Jenny Lusk
Filer Authorized By:	Keith Stanley Van Duyne
Attorney Docket Number:	CU-7298 WWP
Receipt Date:	29-OCT-2012
Filing Date:	16-FEB-2009
Time Stamp:	13:14:01
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment After Final	CU7298-RESP-TO-FOA-DTD-2012-08-27.pdf	502681 b606a6a0c545a6baa72aa872fa7791d3a24d3e18	no	13

Warnings:

Information:

Total Files Size (in bytes):	502681

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 12/377,617	Filing Date 02/16/2009	☐ To be Mailed

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY ☒		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
			TOTAL			TOTAL	

* If the difference in column 1 is less than zero, enter "0" in column 2.

APPLICATION AS AMENDED – PART II

AMENDMENT	10/29/2012	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0	X $31 =	0	OR	X $ =	
	Independent (37 CFR 1.16(h))	* 4	Minus	***4	= 0	X $125 =	0	OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE	**0**	OR	TOTAL ADD'L FEE	

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/GAIL WOOTEN/

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/377,617	02/16/2009	Se-Yoon Jeong	CU-7298 WWP	8176

26530 7590 08/27/2012
LADAS & PARRY LLP
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EXAMINER	
FIELDS, COURTNEY D	

ART UNIT	PAPER NUMBER
2437	

NOTIFICATION DATE	DELIVERY MODE
08/27/2012	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ChicagoUSPTO@ladas.net

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No.	Applicant(s)	
	12/377,617	JEONG ET AL.	
	Examiner	Art Unit	
	COURTNEY FIELDS	2437	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *25 June 2012*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *1,3-9,11,13-19 and 21-24* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1,3-9,11,13-19 and 21-24* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

12)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

1. Claims 2, 10, 12, and 20 have been cancelled.

2. Claims 21-24 have been added.

3. Claims 1, 3-9, 11, 13-19, and 21-24 are pending.

Response to Arguments

1. Applicant's arguments, see pages 1-4, filed 25 June 2012, with respect to the rejection(s) of claim(s) 1, 3-9, 11, 13-19, and 21-24 under He (Pub No. 2007/0274385) in view of Sung et al. (Pub No. 2005/0074062) have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Karczewicz et al. (Pub No. 2003/0081850) and Gharavi (US Patent No. 4,821,119).

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1, 4-9, 11, and 14-19 are rejected under 35 U.S.C. 102(b) as being anticipated by Karczewicz et al. (Pub No. 2003/0081850).

Referring to the rejection of claims 1 and 11, Karczewicz et al. discloses an encoding apparatus and comprising: (See Karczewicz et al., paragraph 0015)

a mode selection unit for selecting an optimal mode for intra prediction; (See Karczewicz et al., paragraphs 0016-0017) an intra prediction unit for performing intra prediction onto video inputted based on the mode selected in the mode selection unit; (See Karczewicz et al., paragraph 0018)

a DCT and quantization unit for performing DCT and quantization onto difference values outputted from the intra prediction unit; (See Karczewicz et al., paragraphs 0019-0021)

and an entropy encoding unit for performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided based on the selected mode. (See Karczewicz et al., paragraphs 0024 and 0030-0031)

Referring to the rejection of claims 4 and 14, Karczewicz et al. discloses wherein the entropy encoding unit decides that the vertical-directional pixel similarity is high, when a vertical-directional pixel similarity value is greater than a value obtained by multiplying a horizontal-directional pixel similarity value by a first multiplication factor. (See Karczewicz et al., paragraphs 0035-0036)

Referring to the rejection of claims 5 and 15, Karczewicz et al. discloses wherein the entropy encoding unit decides that the horizontal-directional pixel similarity is high, when a horizontal-directional pixel similarity value is greater than a value obtained by multiplying a vertical-directional pixel similarity value by a second multiplication factor. (See Karczewicz et al., paragraphs 0035-0036)

Referring to the rejection of claims 6 and 16, Karczewicz et al. discloses wherein the vertical-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to a left part of a currently encoded block. (See Karczewicz et al., paragraphs 0052 and 0144-0147)

Referring to the rejection of claims 7 and 17, Karczewicz et al. discloses wherein the horizontal-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to an upper part of a currently encoded block. (See Karczewicz et al., paragraphs 0052 and 0144-0147)

Referring to the rejection of claims 8 and 18, Karczewicz et al. discloses wherein the first and second multiplication factors are natural number 2. (See Karczewicz et al., paragraph 0035)

Referring to the rejection of claims 9 and 19, Karczewicz et al. discloses a decoding apparatus and method comprising: (See Karczewicz et al., paragraph 0037)

an entropy decoding unit for performing entropy decoding onto encoded video; (See Karczewicz et al., paragraph 0039)

a scanning decision unit for deciding a scanning mode for the video decoded in the entropy decoding means; (See Karczewicz et al., paragraphs 0040 and 0054) and a video recovery unit for recovering the video based on the scanning mode decided in the scanning decision unit, (See Karczewicz et al., paragraphs 0039 and 0041)

wherein the scanning decision unit decides the scanning mode based on the intra prediction mode used for the encoded video. (See Karczewicz et al., paragraph 0056)

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 3, 13, and 21-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Karczewicz et al. (Pub No. 2003/0081850) in view of Gharavi (US Patent No. 4,821,119).

Karczewicz et al. discloses the invention as claimed above, however, Karczewicz et al. fails to explicitly disclose a horizontal and vertical scanning. Gharavi discloses a method and apparatus for low-bit rate interframe video coding.

Referring to the rejection of claims 3 and 13, (Karczewicz et al. modified by Gharavi) discloses wherein the entropy encoding unit: (See Gharavi, Col. 6, lines 54-65)

performing entropy encoding using a horizontal-directional scanning, when the selected mode is a vertical intra prediction and vertical-directional pixel similarity of the residual signals is high; (See Gharavi, Col. 7, lines 9-15 and Fig. 7B) performing entropy encoding using a vertical-directional scanning, when the selected mode is a horizontal intra prediction and horizontal-directional pixel similarity of the residual signals is high; (See Gharavi, Col. 7, lines 16-22 and Fig. 7C)

and performing entropy encoding using a zigzag scanning, when vertical and horizontal-directional pixel similarities of the residual signals are similar. (See Gharavi, Col. 7, lines 1-8 and Fig. 7A)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine Karczewicz et al.'s imaging coding method and Gharavi's improved low-bit rate interframe video coding system. Motivation for such an implementation would improve coding efficiency by entropy encoding the coefficients and scan them by using horizontal, vertical or zig-zag patterns. (See Gharavi, Col. 2, lines 61-67 and Col. 3, lines 1-5)

Referring to the rejection of claims 21-24, (Karczewicz et al. modified by Gharavi) discloses wherein the scanning mode is decided as a horizontal scanning when the selected mode is a vertical prediction mode, (See Gharavi, Col. 7, lines 9-15 and Fig. 7B) and as a vertical scanning when the selected mode is a horizontal prediction mode. (See Gharavi, Col. 7, lines 16-22 and Fig. 7C)

The rationale for combining Karczewicz et al. in view of Gharavi is the same as claim 3.

Conclusion

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to COURTNEY FIELDS whose telephone number is (571)272-3871. The examiner can normally be reached on Mon - Thurs. 6:00 - 4:00 pm; off every Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eleni Shiferaw can be reached on 571-272-3867. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Courtney D. Fields/
Examiner, Art Unit 2437
August 17, 2012

/Matthew B Smithers/
Primary Examiner, Art Unit 2437

Notice of References Cited	Application/Control No. 12/377,617	Applicant(s)/Patent Under Reexamination JEONG ET AL.	
	Examiner COURTNEY FIELDS	Art Unit 2437	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2003/0081850	05-2003	Karczewicz et al.	382/247
*	B	US-4,821,119	04-1989	Gharavi, Hamid	375/240.16
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	10754	"horizontal scanning" and "vertical scanning"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:40
L2	8607	"horizontal scanning" same "vertical scanning"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:41
L3	8	"horizontal scanning" same "vertical scanning" same "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:41
L4	39	"horizontal scanning" and "vertical scanning" and "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:43
L5	0	"horizontal scanning" and "vertical scanning" and "entropy encoding" and "intraframe prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:43
L6	33	"horizontal scanning" and "vertical scanning" and "entropy encoding" and "intra"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:43
L7	21	"horizontal scanning" and "vertical scanning" and "entropy encoding" and "intra" and "zig-zag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:43
L8	0	"horizontal scanning" and "vertical scanning" and "entropy encoding" and "intra" and "zig-zag" and "residual signal"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:43
L9	21	"horizontal scanning" and "vertical scanning" and "entropy encoding" and "intra" and "zig-zag" and "pixel"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:43
L10	21	"horizontal scanning" and "vertical scanning" and "entropy encoding" and "intra" and "zig-zag" and "pixel" and "residual"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:44

L11	21	"horizontal scanning" and "vertical scanning" and "entropy encoding" and "intra" and "zig-zag" and "pixel" and "residual" and "high"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:44
L12	21	"horizontal scanning" and "vertical scanning" and "entropy encoding" and "zigzag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:45
L13	21	"horizontal scanning" and "vertical scanning" and "entropy encoding" and "zig-zag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:46
L14	10	"horizontal scan" and "vertical scan" and "entropy encoding" and "zig-zag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:46
L15	159	"horizontal" and "vertical" and "entropy encoding" and "zig-zag" and "scanning"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:46
L16	77	"coefficient scanning" and "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:47
L17	22	"coefficient scanning" same "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:47
L18	9	"vertical scanning" same "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:50
L19	1	"vertical scanning" near5 "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:50
L20	0	"vertical scanning" near "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:51
L21	46	"vertical scanning" and "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:51
L22	44	"vertical scanning" and "entropy encoding" and "horizontal"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:51

L23	23	"vertical scanning" and "entropy encoding" and "horizontal" and "zigzag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:51
L24	23	"vertical scanning" and "entropy encoding" and "horizontal" and "zig-zag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:51

8/16/2012 4:56:12 PM
C:\Users\cfields\Documents\EAST\Workspaces\encoding and decoding image using adaptive DCT coefficient scanning.wsp

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12377617	JEONG ET AL.
	Examiner	**Art Unit**
	COURTNEY FIELDS	2437

SEARCHED

Class	Subclass	Date	Examiner
375	240.20	8/16/2012	CDF
375	240.12	8/16/2012	CDF
375	240.24	8/16/2012	CDF
375	240.27	8/16/2012	CDF
375	240.16	8/16/2012	CDF
382	247	8/16/2012	CDF

SEARCH NOTES

Search Notes	Date	Examiner
EAST Search (USPAT, PG-PUB, DERWENT, IBM, EPO, JPO)	8/16/2012	CDF
NPL Search (i.e. Google)	8/16/2012	CDF
Consulted with Primary Gims Philippe - 375 Search Mentor	8/16/2012	CDF

INTERFERENCE SEARCH

Class	Subclass	Date	Examiner

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	0	"scanning mode" same "difference values" same "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:24
L2	5	"scanning mode" and "difference values" and "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:24
L3	51	"difference values" same "DCT" same "quantization"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:29
L4	0	"difference values" same "DCT" same "quantization" same "intraprediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:30
L5	1	"difference values" same "DCT" same "quantization" same "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:30
L6	17	"difference values" same "DCT" same "quantization" same "intra"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:30
L7	15	"difference values" same "DCT" same "quantization" same "intra" and "prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:30
L8	2	"difference values" same "DCT" same "quantization" same "intra" and "prediction" and "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:31
L9	2	"difference values" same "DCT" same "quantization" same "intra" and "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:32
L10	0	"difference values" same "DCT" same "quantization" same "intra" and "prediction" and "selected mode"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:34
L11	9	"difference values" same "DCT" same "quantization" same "intra" and "prediction" and "vertical" and "horizontal"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:36
L12	1	"horizontal-directional scanning"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:42

L13	1	"horizontal-directional" same "vertical intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:42
L14	1	"horizontal-directional" same "vertical" and "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:43
L15	1	"horizontal-directional" and "vertical" and "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:43
L16	14	"horizontal directional" and "vertical" and "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:43

8/15/2012 4:59:38 PM
C:\Users\cfields\Documents\EAST\Workspaces\encoding and decoding image using adaptive DCT coefficient scanning.wsp

+You Search Images Maps Play YouTube News Gmail Documents Calendar More

entropy encoding, horizontal scanning, vertical scanning, zigzag scanning, DC

Sign in

Search

About 52,400 results (0.71 seconds)

Web
Images
Maps
Videos
News
Shopping
More

Alexandria, VA
Change location

Show search tools

[PDF] Chapter 7 Still Image **Coding** Standard – JPEG
www-ec.njit.edu/~shi/courses/ECE789/ch7.pdf
File Format: PDF/Adobe Acrobat - Quick View
by a multiple **scanning** process. • In each **scan**, **quantized DCT** coefficients partially ... Forward. **DCT**. **Zig-zag**. Reordering. **Quantization**. **Entropy**. **Encoding**. Compressed ... Composite **values** .... a factor of two in both **horizontal** and **vertical** ...

Patent US20100284459 - APPARATUS FOR **ENCODING** AND ...
www.google.com/patents/US20100284459
An encoding apparatus using a **Discrete Cosine Transform** (**DCT**) **scanning**. ... a **DCT** and **quantization** means for performing **DCT** and **quantization** onto ... an **entropy encoding** means for performing **entropy encoding** onto DCT ... a **horizontal** -directional **scanning**, a **vertical**-directional **scanning**, and a **zigzag scanning**. 3.

Patent US20080285644 - Apparatus and Method For **Encoding** and ...
www.google.com/patents/US20080285644
The moving picture **encoding** apparatus includes: a mode selector for ... a residue signal block; a transform/**quantization** unit for performing **DCT** onto the ... and an **encoder** for adaptively **scanning** and **encoding** the **quantized** residue ... the **vertical** mode nor the **horizontal** mode, the adaptive **scanning** is a **zigzag scanning**.

[PDF] Motion analysis in 3D **DCT** domain and its application to video **co**...
citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.91...rep...
File Format: PDF/Adobe Acrobat - Quick View
by N Bozinovic - Cited by 24 - Related articles
followed by motion-adaptive **scanning** of **DCT** coefficients (akin to "**zig-zag**" **scan**-ning in MPEG coders), their adaptive **quantization**, and final **entropy coding**. We .... impulse (1D or 2D, depending on the number of **arguments**). Applying the .... (**horizontal** and **vertical** symmetric extension), again periodically repeated to ...

[PDF] **Scan** order and **quantization** for 3D-**DCT coding**
citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.84...rep...
File Format: PDF/Adobe Acrobat - Quick View
by N Bozinovic - Cited by 13 - Related articles
inefficient **quantization**, **scanning** and **entropy coding** used. ... **scans** proposed to date, such as the 3D **zig-zag scan**.9 ..... (HVS), such as low contrast sensitivity for high, purely **horizontal** (k1), **vertical** (k2) and temporal .... In order to determine the **scan** order, at first **parameters** φ of the dominant spectral plane are found by ...

[PDF] Digital Image Processing Laboratory: Achromatic Baseline JPEG ...
https://engineering.purdue.edu/~bouman/grad-labs/...Coding/.../lab.p...
File Format: PDF/Adobe Acrobat - Quick View
Sequential mode - Block-by-block lossy **encoding** in raster **scan** order based on block ... **entropy** decoding followed by computation of the inverse **discrete cosine** ... After the 8 × 8 FDCT, each of the 64 resulting **DCT** coefficients is **quantized** by a ..... that no more non-zero **values** occur in the **zig-zag scanned** sequence.

[PDF] MPEG-2:
www.home.agilent.com/upload/cmc.../5C06MPEGTUTORIAL1.pdf
File Format: PDF/Adobe Acrobat - Quick View
Zig Zag. **Scan**. **Discrete Cosine Transform**. **Quantization**. 0110110. 0101100. 1101111 ... Huffmann coding; to predict a pixel value from all adjacent pixel **values**, and minimize the ... **DCT's** to the right of the datum are increasingly higher **horizontal** spatial freqs. ... **Entropy coding** removes duplication of **DCT's**, assigning each ...

[PDF] JPEG Compression
eilat.sci.brooklyn.cuny.edu/cis52/userfiles/file/JPEG.pdf
File Format: PDF/Adobe Acrobat - Quick View
Major Steps. •. **DCT** (**Discrete Cosine Transformation**). •. **Quantization**. •. **Zigzag Scan**. •. DPCM on DC component. •. RLE on AC Components. •. **Entropy Coding** ...

visual
mpeg.chiariglione.org/tutorials/...st/.../7-natural_video_paper.htm
by T Ebrahimi - Cited by 131 - Related articles
Texture **coding** is based in 8x8 **DCT**, with appropriate modifications for object ..... used from neighboring blocks to further reduce the **entropy** value of the coefficients. ... MPEG-4 also allows for a non-linear **quantization** of DC **values**. ... Alternate-**vertical scan**: Similar to the **horizontal scan**, but applied in the vertical direction.

[PPT] Compression
www.csee.umbc.edu/~pmundur/courses/.../compression2.ppt
File Format: Microsoft Powerpoint - Quick View
Each pixel value in the 2-D matrix is **quantized** using 8 bits which produces a value ...
All **values** are shifted to the range of -128 to + 127 before computing **DCT** ; All 64 ...
as we move from left to right (**horizontally**) or from top to bottom (**vertically**). ... of the
zig-zag scan; Each AC coefficient **encoded** as a pair of **values** -- (skip, ...

Index of Claims	Application/Control No. 12377617	Applicant(s)/Patent Under Reexamination JEONG ET AL.
	Examiner COURTNEY FIELDS	Art Unit 2437

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/18/2012	08/17/2012							
	1	✓	✓							
	2	✓	-							
	3	✓	✓							
	4	✓	✓							
	5	✓	✓							
	6	✓	✓							
	7	✓	✓							
	8	✓	✓							
	9	✓	✓							
	10	✓	-							
	11	✓	✓							
	12	✓	-							
	13	✓	✓							
	14	✓	✓							
	15	✓	✓							
	16	✓	✓							
	17	✓	✓							
	18	✓	✓							
	19	✓	✓							
	20	✓	-							
	21		✓							
	22		✓							
	23		✓							
	24		✓							

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application: Se-Yoon Jeong	] Art Unit: 2437
Serial No: 12/377,617	] Ex.: Fields, Courtney D
Filed: February 16, 2009	]

For: APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

AMENDMENT UNDER 37 CFR 1.111

Mail Stop Amendment
The Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Sir:

In response to the non-final office action dated March 26, 2012, setting a 3-month shortened statutory period for reply ending on June 26, 2012, the applicants submit the following responsive amendment in the above-identified application. This amendment is considered to place the application in better condition for allowance. No fee is believed to be required with this amendment, but, if this is not the case, please charge the requisite fee (or credit any overpayment) to Deposit Account No. 12-0400.

Amendments to the Claims are reflected in the listing of claims, which begins on page 2 of this paper.

Remarks/Arguments begin on page 8 of this paper.

AMENDMENTS TO THE CLAIMS

The listing of claims presented below will replace all prior versions and listings of claims in the application.

Listing of claims:

1. (**currently amended**) An encoding apparatus ~~**using a Discrete Cosine Transform (DCT) scanning,**~~ comprising:

a mode selection ~~**means**~~**unit** for selecting an optimal mode for intra prediction;

an intra prediction ~~**means**~~**unit** for performing intra prediction onto video inputted based on the mode selected in the mode selection ~~**means**~~**unit**;

a DCT and quantization ~~**means**~~**unit** for performing DCT and quantization onto ~~**residual coefficients of a block**~~ **difference values** outputted from the intra prediction ~~**means**~~**unit**; and

an entropy encoding ~~**means**~~**unit** for performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided based on ~~**pixel similarity of the residual coefficients**~~ **the selected mode**.

2. (**cancelled**).

3. (**currently amended**) The encoding apparatus of claim ~~**2**~~ **1**, wherein the entropy encoding ~~**means**~~**unit**:

performing **entropy** encoding using a horizontal-directional scanning, when **the selected mode is a vertical intra prediction and** vertical-directional pixel similarity of the residual signals is high;

performing **entropy** encoding using a vertical-directional scanning, when **the selected mode is a horizontal intra prediction and** horizontal-directional pixel similarity of the residual signals is high; and

performing **entropy** encoding using a zigzag scanning, when vertical and horizontal-directional pixel similarities of the residual signals are similar.

4. (**currently amended**) The encoding apparatus of claim 3, wherein the entropy encoding ~~means~~**unit** decides that the vertical-directional pixel similarity is high, when a vertical-directional pixel similarity value is greater than a value obtained by multiplying a horizontal-directional pixel similarity value by a first multiplication factor.

5. (**currently amended**) The encoding apparatus of claim 3, wherein the entropy encoding ~~means~~**unit** decides that the horizontal-directional pixel similarity is high, when a horizontal-directional pixel similarity value is greater than a value obtained by multiplying a vertical-directional pixel similarity value by a second multiplication factor.

6. (original) The encoding apparatus of claim 4, wherein the vertical-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to a left part of a currently encoded block.

7. (original) The encoding apparatus of claim 5, wherein the horizontal-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to an upper part of a currently encoded block.

8. (original) The encoding apparatus of claim 6, wherein the first and second multiplication factors are natural number 2.

9. (**currently amended**) A decoding apparatus ~~using a DCT scanning,~~ comprising:

an entropy decoding ~~means~~unit for performing entropy decoding onto encoded video;

a scanning decision ~~means~~unit for deciding a scanning mode for the video decoded in the entropy decoding ~~means~~unit; and

a video recovery ~~means~~unit for recovering the video based on the scanning mode decided in the scanning decision ~~means~~unit,

wherein the scanning decision unit decides the scanning mode based on the intra prediction mode used for the encoded video.

10. (**cancelled**).

11. (**currently amended**) An encoding method ~~using a DCT scanning,~~ comprising the steps of:

selecting an optimal mode for intra prediction;

performing intra prediction onto video inputted based on the mode selected in the mode selection step;

performing DCT and quantization onto ~~residual coefficients of a~~

~~**block**~~**difference values** outputted from the intra prediction step;

~~**deciding pixel similarity of the residual coefficients;**~~ and

performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided ~~**in the pixel similarity decision step**~~**based on the selected mode.**

12. (**cancelled**).

13. (**currently amended**) The encoding method of claim ~~12~~**11**, wherein the entropy encoding step includes the steps of:

performing **entropy** encoding using a horizontal-directional scanning, when **the selected optimal mode is a vertical intra prediction and** vertical-directional pixel similarity of the residual signals is high;

performing **entropy** encoding using a vertical-directional scanning, when **the selected optimal mode is a horizontal intra prediction and** horizontal-directional pixel similarity of the residual signals is high; and

performing **entropy** encoding using a zigzag scanning, when vertical and horizontal-directional pixel similarities of the residual signals are similar.

14. (original) The encoding method of claim 13, wherein the vertical-directional pixel similarity is decided high in the entropy encoding step, when a vertical-directional pixel similarity value is greater than a value obtained by multiplying a horizontal-directional pixel similarity value by a first multiplication factor.

15. (original) The encoding method of claim 13, wherein the horizontal-directional pixel similarity is decided high in the entropy encoding step, when a horizontal-directional pixel similarity value is greater than a value obtained by multiplying a vertical-directional pixel similarity value by a second multiplication factor.

16. (original) The encoding method of claim 14, wherein the vertical-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to a left part of a currently encoded block.

17. (original) The encoding method of claim 15, wherein the horizontal-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to an upper part of a currently encoded block.

18. (original) The encoding method of claim 16, wherein the first and second multiplication factors are natural number 2.

19. (**currently amended**) A decoding method ~~**using a DCT scanning,**~~ comprising the steps of:

performing entropy decoding onto encoded video;

deciding a scanning mode for the video decoded in the entropy decoding step; and

recovering the video based on the scanning mode decided in the scanning decision step,

<u>**wherein the scanning mode is decided based on the intra prediction mode used for the encoded video**</u>.

20. (**cancelled**).

21. (New) The encoding apparatus of claim 1, the scanning mode is decided as a horizontal scanning when the selected mode is a vertical prediction mode, and as a vertical scanning when the selected mode is a horizontal prediction mode.

22. (New) The decoding apparatus of claim 9, the scanning mode is decided as a horizontal scanning when the intra prediction mode is a vertical prediction mode, and as a vertical scanning when the intra prediction mode is a horizontal prediction mode.

23. (New) The encoding method of claim 11, the scanning mode is decided as a horizontal scanning when the selected mode is a vertical prediction mode, and as a vertical scanning when the selected mode is a horizontal prediction mode.

24. (New) The decoding method of claim 19, the scanning mode is decided as a horizontal scanning when the intra prediction mode is a vertical prediction mode, and as a vertical scanning when the intra prediction mode is a horizontal prediction mode.

REMARKS/ARGUMENTS

The non-final office action mailed on March 26, 2012, has been reviewed and carefully considered. Reconsideration is respectfully requested.

Amendments to the Claims

Claims 1-20 were pending in the present application prior to this amendment. Claims 1, 3-9, 11, 13-19 and 21-24 are now pending in the present application; among them, claims 1, 9, 11, and 19 are independent claims. Claims 1, 3-5, 9, 11, 13, and 19 have been amended. Claims 2, 10, 12, and 20 have been cancelled. Claims 21-24 have been added. No new matter has been added.

Claim Rejections - 35 U.S.C. §112

In the office action (page 2), claims 1-10 stand rejected under 35 U.S.C. §112, ¶ 2 as being indefinite for failing to particularly point out and distinctly claim the invention. In response, the Applicants have amended the claims as requested by the examiner such that the claim limitations are no longer interpreted as a limitation under 35 U.S.C. §112, ¶6. Accordingly, the Applicants have revised appropriately each and every one of the claims by addressing each of the Examiner's concerns, which are based on examiner's comments on pages 2-3 of the current office action, and therefore respectfully submit that the claims, as now presented, better conform to the USPTO guidelines for meeting the requirements under 35 U.S.C. §112, ¶2. The Applicants, therefore, respectfully request the Examiner to withdraw the rejection(s) under 35 U.S.C. §112, ¶2 for claims 1-10.

Claim Rejections - 35 U.S.C. §102

In the office action (page 4), claims 1, 9, 11, and 19 stand rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Patent No. 2007/0274385 (He).

Claim Rejections - 35 U.S.C. §103

In the office action (page 5), claims 2-8, 10, 12-18, and 20 stands rejected under

35 U.S.C. §103(a) as being obvious over He in view of U.S. Patent No. 2005/0074062 (Sung).

The applicants have amended claims 1, 9, 11, and 19.

Comments for 102/103 Rejections

The applicants respectfully point out that nowhere does the cited prior art references teach, disclose, or suggest each and every element of amended claims 1, 9, 11, and 19, which relates to the following: --the scanning mode is decided based on the intra prediction mode--.

In contrast, nowhere do the cited prior art references mention deciding scanning mode according to intra prediction mode.

Accordingly, the applicants have amended claims 1, 9, 11, and 19 to better clarify the above described novel aspect of the presently claimed invention, where claim 1 now recites in part:

> --a DCT and quantization ~~**means**~~**unit** for performing DCT and quantization onto ~~**residual coefficients of a block**~~ **difference values** outputted from the intra prediction ~~**means**~~**unit**; and
> an entropy encoding ~~**means**~~**unit** for performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided based on ~~**pixel similarity of the residual coefficients**~~ **the selected mode**--.

Claim 9 now recites in part:

> --**wherein the scanning decision unit decides the scanning mode based on the intra prediction mode used for the encoded video**--.

Claim 11 now recites in part:

> --performing DCT and quantization onto ~~**residual coefficients of a block**~~**difference values** outputted from the intra prediction step;
> ~~**deciding pixel similarity of the residual coefficients;**~~ and
> performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided ~~**in the pixel similarity decision step**~~**based on the selected mode**--.

Claim 19 now recites in part:

> --**wherein the scanning mode is decided based on the intra prediction mode used for the encoded video**--.

Support for the amendments can be found throughout the specification and at least at page 11, line 5 to page 12, line 34 and FIGs. 5-8.

That is: the "Residual coefficients of a block" is amended into "difference values" based on [0050] and Fig 4; in claims 1 and 11, "by using a scanning mode decided based on pixel similarity of residual coefficients" is amended into "by using a scanning mode decided based on the selected mode" (specification [0058], [0059], [0080], [0083], and Figures 9 and 10); in claims 9 and 19, "wherein the scanning decision unit decides the scanning mode based on the intra prediction mode used for the encoded video" (specification [0088]); in claims 3, "the selected mode is a vertical intra prediction and" has been added (specification [0080] and Fig. 9) and "the selected mode is a horizontal intra prediction and" has added (specification [0083] and Fig. 10); in claims 13, "the selected optimal mode is a vertical intra prediction and" has been added (specfication [0080] and Fig. 9) and "the selected optimal mode is a horizontal intra prediction and" has been added (specfication [0083] and Fig. 10); and in claims 3 and 13, "performing encoding" is amended into "performing entropy encoding" (specification at least on Fig. 4 and it's related descriptions).

The applicants respectfully point out that nowhere do any of the cited references and especially He, disclose the following: --the scanning mode is decided based on the intra prediction mode-- (specification page 11, line 5 to page 12, line 34 and FIGs. 5-8). Sung fails to make up for the deficiency of He.

Therefore, the applicants respectfully submit that claims 1, 9, 11, and 19 are in condition for allowance over the examiner's cited references and especially the cited reference of He, where an indication of allowable subject matter with respect to claims 1, 9, 11, and 19 are respectfully requested.

Additionally and in general, the current Office Action makes various statements regarding the pending claims and the cited references, which the applicants respectfully believe are now moot in light of the above amendments to claims 1, 9, 11, and 19. Thus, the Applicants will not address such statements at the present time in order to minimized the time for the examiner's to have to respond to such statements, and which has been do to expedite the examiner's time for responding to Applicants' argument.

However, the Applicants expressly reserve the right to challenge such statements in the future should the need arise (e.g., if such statement should become relevant by appearing in a rejection of any current or future claim). The Applicants also reserve the right to argue additional reasons beyond those set forth above to support the allowability of any claims should such a need arise.

New dependent claims 21-24 have been added, where claim 21 has been added based on specification at least at paragraph [0059] and claims 23 and 24 have been added based on specification at least at paragraph [0058].

DEPENDENT CLAIMS

The other claims are dependent from independent claims 1, 9, 11, and 19. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual reconsideration of the patentability of each on its own merits is respectfully requested.

Conclusion

For the reasons set forth above, the applicants respectfully submit that claims 1, 3-9, 11, 13-19 and 21-24, now pending in this application, are in condition for allowance over the cited references. Accordingly, the applicants respectfully request reconsideration and withdrawal of the outstanding rejections and earnestly solicit an indication of allowable subject matter.

This amendment is considered to be responsive to all points raised in the office action. The examiner is encouraged to contact the undersigned attorney by telephone to expeditiously resolve any remaining questions or concerns.

Respectfully submitted,

Dated: June 21, 2012

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Electronic Acknowledgement Receipt

EFS ID:	13100110
Application Number:	12377617
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Title of Invention:	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR
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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment/Req. Reconsideration-After Non-Final Reject	CU_7298_RESP_TO_OA_DTD_2012-03-26.pdf	463483 18b85384d0bcb8e2b0a50752da4c01d18edb6d16	no	11

Warnings:

Information:

Total Files Size (in bytes):	463483

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

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If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

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If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
FIELDS, COURTNEY D	

ART UNIT	PAPER NUMBER
2437	

NOTIFICATION DATE	DELIVERY MODE
03/26/2012	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ChicagoUSPTO@ladas.net

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No.	Applicant(s)
	12/377,617	JEONG ET AL.
	Examiner	**Art Unit**
	COURTNEY FIELDS	2437

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *16 February 2009*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *1-20* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1-20* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on *16 February 2009* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

12)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date *18 February 2009*.

4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1-20 are pending.

Information Disclosure Statement

2. The Information Disclosure Statement respectfully submitted on 18 February 2009 has been considered by the Examiner.

Priority

1. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 1-10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim limitation “means for” has been interpreted under 35 U.S.C. 112, sixth paragraph, because it uses a non-structural term “means for” coupled with functional language “selecting an optimal mode for intra prediction”, “performing intra prediction onto video”, “performing DCT and quantization onto residual”, “performing entropy encoding”, “performing entropy decoding”, “deciding a scanning mode for the video” and “recovering the video based on the scanning mode" without reciting sufficient structure to achieve the function. Furthermore, the non-structural term is not preceded by a structural modifier. A means plus function “means for” is not recognized as the name of a structure.

Since this claim limitation invokes 35 U.S.C. 112, sixth paragraph, claims 1-10 are interpreted to cover the corresponding structure described in the specification that achieves the claimed function, and equivalents thereof.

A review of the specification shows that the following appears to be the corresponding structure described in the specification for the 35 U.S.C. 112, sixth paragraph limitation: As shown in Figure 4 and on page 8, lines 11-12 and 15, the corresponding structure appears to be an encoding apparatus.

If applicant wishes to provide further explanation or dispute the examiner’s interpretation of the corresponding structure, applicant must identify the corresponding structure with reference to the specification by page and line number, and to the drawing, if any, by reference characters in response to this Office action.

If applicant does **not** wish to have the claim limitation treated under 35 U.S.C. 112, sixth paragraph, applicant may amend the claim so that it will clearly not invoke 35 U.S.C. 112, sixth paragraph, or present a sufficient showing that the claim recites sufficient structure, material, or acts for performing the claimed function to preclude application of 35 U.S.C. 112, sixth paragraph.

For more information, see *Supplementary Examination Guidelines for Determining Compliance with 35 U.S.C. § 112 and for Treatment of Related Issues in Patent Applications*, 76 FR 7162, 7167 (Feb. 9, 2011).

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 1, 9, 11, and 19 are rejected under 35 U.S.C. 102(e) as being anticipated by He (Pub No. 2007/0274385).

Referring to the rejection of claims 1 and 11, He discloses an encoding apparatus and method for using a Discrete Cosine Transform (DCT) scanning, comprising: (See He, page 3, Section 0026)

a mode selection means for selecting an optimal mode for intra prediction; (See He, page 3, Sections 0024-0026)

an intra prediction means for performing intra prediction onto video inputted based on the mode selected in the mode selection means; (See He, page 3, Sections 0024-0026)

a DCT and quantization means for performing DCT and quantization onto residual coefficients of a block outputted from the intra prediction means; (See He, page 3, Section 0026)

and an entropy encoding means for performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided based on pixel similarity of the residual coefficients. (See He, page 3, Sections 0024-0027)

Referring to the rejection of claims 9 and 19, He discloses a decoding apparatus and method for using a DCT scanning, comprising: (See He, Figure 5 and page 4, Section 0029)

an entropy decoding means for performing entropy decoding onto encoded video; (See He, page 4, Section 0029)

a scanning decision means for deciding a scanning mode for the video decoded in the entropy decoding means; (See He, page 4, Section 0029)

and a video recovery means for recovering the video based on the scanning mode decided in the scanning decision means. (See He, pages 3-4, Sections 0025 and 0029)

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 2-8, 10, 12-18, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over He (Pub No. 2007/0274385) in view of Sung et al. (Pub No. 2005/0074062).

He discloses the invention as claimed above, however, He fails to explicitly disclose a scanning mode among a horizontal-directional, vertical-directional, or a zigzag. Sung et al. discloses a method and apparatus for fast DCT for digital video compression.

Referring to the rejection of claims 2 and 12, (He modified by Sung et al.) discloses wherein the scanning mode is any one among a horizontal-directional scanning, a vertical-directional scanning, and a zigzag scanning. (See Sung et al., page 3, Section 0039)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine He's coding efficiency method and Sung et al.'s fast DCT for digital video apparatus. Motivation for such an implementation would enable close correlation between pixels in determining the block pixel variance range and other decision-making for DCT coefficients. (See Sung et al., page 4, Section 0046)

Referring to the rejection of claims 3 and 13, (He modified by Sung et al.) discloses wherein the entropy encoding means:

performing encoding using a horizontal-directional scanning, when vertical-directional pixel similarity of the residual signals is high; (See Sung et al., page 3, Sections 0039 and 0042)

performing encoding using a vertical-directional scanning, when horizontal-directional pixel similarity of the residual signals is high; (See Sung et al., page 3, Sections 0039 and 0042) and performing encoding using a zigzag scanning, when vertical and horizontal-directional pixel similarities of the residual signals are similar. (See Sung et al., page 3, Sections 0039 and 0042)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine He's coding efficiency method and Sung et al.'s fast DCT for digital video apparatus. Motivation for such an implementation would enable close correlation between pixels in determining the block pixel variance range and other decision-making for DCT coefficients. (See Sung et al., page 4, Section 0046)

Referring to the rejection of claims 4 and 14, (He modified by Sung et al.) discloses wherein the entropy encoding means decides that the vertical-directional pixel similarity is high, when a vertical-directional pixel similarity value is greater than a value obtained by multiplying a horizontal-directional pixel similarity value by a first multiplication factor. (See Sung et al., page 4, Sections 0044-0045)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine He's coding efficiency method and Sung et al.'s fast DCT for digital video apparatus. Motivation for such an implementation would enable close correlation between pixels in determining the block pixel variance range and other decision-making for DCT coefficients. (See Sung et al., page 4, Section 0046)

Referring to the rejection of claims 5 and 15, (He modified by Sung et al.) discloses wherein the entropy encoding means decides that the horizontal-directional pixel similarity is high, when a horizontal-directional pixel similarity value is greater than a value obtained by multiplying a vertical-directional pixel similarity value by a second multiplication factor. (See Sung et al., page 4, Sections 0044-0045)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine He's coding efficiency method and Sung et al.'s fast DCT for digital video apparatus. Motivation for such an implementation would enable close correlation between pixels in determining the block pixel variance range and other decision-making for DCT coefficients. (See Sung et al., page 4, Section 0046)

Referring to the rejection of claims 6 and 16, (He modified by Sung et al.) discloses wherein the vertical-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to a left part of a currently encoded block. (See Sung et al., pages 2-4, Sections 0017, 0043, and 0045)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine He's coding efficiency method and Sung et al.'s fast DCT for digital video apparatus. Motivation for such an implementation would enable close correlation between pixels in determining the block pixel variance range and other decision-making for DCT coefficients. (See Sung et al., page 4, Section 0046)

Referring to the rejection of claims 7 and 17, (He modified by Sung et al.) discloses wherein the horizontal-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to an upper part of a currently encoded block. (See Sung et al., pages 2-4, Sections 0017, 0043, and 0045)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine He's coding efficiency method and Sung et al.'s fast DCT for digital video apparatus. Motivation for such an implementation would enable close correlation between pixels in determining the block pixel variance range and other decision-making for DCT coefficients. (See Sung et al., page 4, Section 0046)

Referring to the rejection of claims 8 and 18, (He modified by Sung et al.) discloses wherein the first and second multiplication factors are natural number 2. (See Sung et al., page 4, Sections 0044-0045)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine He's coding efficiency method and Sung et al.'s fast DCT for digital video apparatus. Motivation for such an implementation would enable close correlation between pixels in determining the block pixel variance range and other decision-making for DCT coefficients. (See Sung et al., page 4, Section 0046)

Referring to the rejection of claims 10 and 20, (He modified by Sung et al.) discloses wherein the decided scanning mode is any one among a horizontal-directional scanning, a vertical-directional scanning, and a zigzag scanning. (See Sung et al., page 3, Section 0039)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine He's coding efficiency method and Sung et al.'s fast DCT for digital video apparatus. Motivation for such an implementation would enable close correlation between pixels in determining the block pixel variance range and other decision-making for DCT coefficients. (See Sung et al., page 4, Section 0046)

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to COURTNEY FIELDS whose telephone number is (571)272-3871. The examiner can normally be reached on Mon - Thurs. 6:00 - 4:00 pm; off every Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eleni Shiferaw can be reached on 571-272-3867. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Courtney D. Fields/
Examiner, Art Unit 2437
March 18, 2012
/Eleni A Shiferaw/
Supervisory Patent Examiner, Art Unit 2437

Notice of References Cited	Application/Control No. 12/377,617	Applicant(s)/Patent Under Reexamination JEONG ET AL.	
	Examiner COURTNEY FIELDS	Art Unit 2437	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2007/0274385	11-2007	He, Zhongli	375/240.12
*	B	US-2005/0074062	04-2005	Sung et al.	375/240.2
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

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BIB DATA SHEET

CONFIRMATION NO. 8176

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/377,617	02/16/2009 **RULE**	375	2437	CU-7298 WWP

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Dae-Yeon Kim, Seoul, KOREA, REPUBLIC OF;
Dong-Kyun Kim, Seoul, KOREA, REPUBLIC OF;

** **CONTINUING DATA** *************************

This application is a 371 of PCT/KR07/01433 03/23/2007

** **FOREIGN APPLICATIONS** *************************

REPUBLIC OF KOREA 10-2007-0008247 01/26/2007
REPUBLIC OF KOREA 10-2006-0077851 08/17/2006

** **IF REQUIRED, FOREIGN FILING LICENSE GRANTED** ** ** SMALL ENTITY **
08/04/2010

		STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
Foreign Priority claimed ☑ Yes ☐ No 35 USC 119(a-d) conditions met ☑ Yes ☐ No Verified and Acknowledged /COURTNEY D FIELDS/ Examiner's Signature	☐ Met after Allowance Initials	KOREA, REPUBLIC OF	6	20	4

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LADAS & PARRY LLP
224 SOUTH MICHIGAN AVENUE
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CHICAGO, IL 60604
UNITED STATES

TITLE

APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

☐ All Fees
☐ 1.16 Fees (Filing)

BIB (Rev. 05/07).

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	27	se-yoon.in. and jeong.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:25
L2	33	hae-chul.in. and choi.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:25
L3	64	jeong-il.in. and seo.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:25
L4	23	seung-kwon.in. and beack.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:25
L5	21	in-seon.in. and jang.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:26
L6	115	jae-gon.in. and kim.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:26
L7	15	kyung-ae.in. and moon.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:26
L8	52	dae-young.in. and jang.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:26
L9	580	jin-woo.in. and kim.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:26
L10	204	jin-woong.in. and kim.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:27

L11	141	yung-lyul.in. and lee.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:27
L12	32	dong-gyu.in. and sim.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:27
L13	19	seoung-jun.in. and oh.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:28
L14	18	chang-beom.in. and ahn.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:28
L15	55	dae-yeon.in. and kim.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:28
L16	79	dong-kyun.in. and kim.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:28
L17	2	L1 and L2 and L3 and L4 and L5 and L6 and L7 and L8 and L9 and L10 and L11 and L12 and L13 and L14 and L15 and L16	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:29
L18	7919	electronics and telecommunications.asn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:29
L19	0	L17 and L18	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:29
L20	0	375/240.20.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:29
L21	921	375/240.2.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:30
L22	0	375/240.200.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:30

L23	900	375/240.2.ccls. and (discrete cosine transform or (DCT))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:30
L24	23869	(discrete cosine transform or (DCT)) same "scanning"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:31
L25	11577	(discrete cosine transform or (DCT)) near5 (scan$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:31
L26	2299	(discrete cosine transform or (DCT)) near (scan$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:31
L27	1173383	(discrete cosine transform) or (DCT) near (scan$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:32
L28	0	(discrete cosine transform or (DCT)) near (scan$4) near "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:32
L29	0	(discrete cosine transform or (DCT)) near (scan$4) near "intraprediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:32
L30	0	(discrete cosine transform or (DCT)) near (scan$4) near "intra-prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:32
L31	4	(discrete cosine transform or (DCT)) near (scan$4) same "intra-prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:32
L32	0	"DCT scanning" same "intraprediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:34
L33	2	"DCT scanning" same "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:34
L34	0	"DCT scanning" same "intra-prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:34

L35	0	"DCT scanning" same "intraprediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:34
L36	0	"discrete cosine transform scanning" same "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:35
L37	0	"DCT scan" same "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:35
L38	19	"DCT" same "scan" same "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:35
L39	14	"DCT" same "scan" same "intra prediction" same "video"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:35
L40	12	"DCT" same "scan" same "intra prediction" same "video" same (encod$3 or encipher$3 or encrypt$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:35
L41	52	"DCT coefficient" same "scanning" same "pixel"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:40
L42	5	"DCT coefficient" near5 "scanning" near5 "pixel"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:40
L43	5	"DCT" same "scan" same "intra prediction" same "video" same (encod$3 or encipher$3 or encrypt$3) and 375/240.12	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:45
L44	1	"DCT coefficient" near5 "scanning" near5 "pixel" and 375/240.24.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:45
L45	5	"DCT" same "scan" same "intra prediction" same "video" same (encod$3 or encipher$3 or encrypt$3) and 375/240.12.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:45
L46	1	"DCT" same "scan" same "intra prediction" same "video" same (encod$3 or encipher$3 or encrypt$3) and 375/240.27.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:45

3/18/2012 1:45:47 PM

Index of Claims	Application/Control No. 12377617	Applicant(s)/Patent Under Reexamination JEONG ET AL.
	Examiner COURTNEY FIELDS	Art Unit 2437

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/18/2012								
	1	✓								
	2	✓								
	3	✓								
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	16	✓								
	17	✓								
	18	✓								
	19	✓								
	20	✓								

INFORMATION DISCLOSURE STATEMENT (IDS) BY APPLICANT (FORM PTO-1449 Modified)		
	Application Number	12/377,617
	Filing Date (YYYY-MM-DD)	2009-02-16
	First Named Inventor	Se-Yoon JEONG et al.
	Art Unit	2437
	Examiner Name	C.Fields
	Attorney Docket Number	CU-7298

U.S. PATENTS

EXAMINER INITIAL	U.S. PATENT NUMBER	ISSUE DATE (YYYY-MM-DD)	PATENTEE	CLASS	SUB-CLASS	FILING DATE (YYYY-MM-DD)

U.S. PATENT APPLICATION PUBLICATIONS

EXAMINER INITIAL	U.S. PATENT APPLICATION PUBLICATION NUMBER	PUBL. DATE (YYYY-MM-DD)	PATENTEE	CLASS	SUB-CLASS	FILING DATE (YYYY-MM-DD)
	2003/0007698 A1	2003-01-09	Govindaswamy et al			

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	FOREIGN PATENT DOCUMENT NUMBER	COUNTRY CODE	KIND CODE	PUBL. DATE (YYYY-MM-DD)	NAME OF PATENTEE OR APPLICANT OF THE CITED DOCUMENT	TRANSLATION YES	NO
	2003-006643	JP	A	2003-01-10	Canon Inc		
	2004-348741	JP	A	2004-12-09	Mitsubishi Electric Information Technology Centre Europa BV		
	10-0180173	KR	B1	1998-11-30	Daewoo Electronics Co Ltd		

NON-PATENT LITERATURE DOCUMENTS

EXAMINER INITIAL	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial symposium catalog, etc.) date, page(s), volume-issue number(s), publisher, city and/or country where published.	TRANSLATION YES	NO
	"Proceedings of the 2006 Korean Signal Processing Conference" Held on September 23, 2006 (Saturday) at Hanyang University Ansan Campus.		
	International Search Report: mailed 29 June 2007; PCT/KR2007/001433		

EXAMINER	DATE CONSIDERED
/Courtney Fields/	03/18/2012

EXAMINER: Initial citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

(Form PTO-1449)
02-18-09.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.F./

Search Notes	Application/Control No. 12377617	Applicant(s)/Patent Under Reexamination JEONG ET AL.
	Examiner COURTNEY FIELDS	**Art Unit** 2437

SEARCHED

Class	Subclass	Date	Examiner
375	240.20	3/18/2012	CDF
375	240.12	3/18/2012	CDF
375	240.24	3/18/2012	CDF
375	240.27	3/18/2012	CDF

SEARCH NOTES

Search Notes	Date	Examiner
EAST Search (USPAT, PG-PUB, DERWENT, IBM, EPO, JPO)	3/18/2012	CDF
Assignee Search	3/18/2012	CDF
Inventorship/Double Patenting Search	3/18/2012	CDF
NPL Search (i.e. ACM)	3/18/2012	CDF

INTERFERENCE SEARCH

Class	Subclass	Date	Examiner

Searching for: (encoding, and decoding, and DCT and coefficient, and scanning, and video) (start a new search)

Found **111** within *The ACM Guide to Computing Literature* (Bibliographic citations from major publishers in computing)

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Results 1 - 20 of 111 Sort by relevance in expanded form

Result page: **1** 2 3 4 5 6 next

1 A hybrid gray image representation using spatial- and DCT-based approach with application to moment computation
Kuo-Liang Chung, Yau-Wen Liu, Wen-Ming Yan
December 2006 **Journal of Visual Communication and Image Representation** , Volume 17 Issue 6
Publisher: Academic Press, Inc.
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count:

In this paper, a novel hybrid gray image representation using spatial- and DCT-based approach is presented. In the first phase, according to the bintree decomposition principle under the specified error, an S-tree spatial data structure (SDS) is used ...

Keywords: DCT, Gray image representation, Linear interpolation, Moment computation, PSNR, Spatial data structures

2 High-Performance Embedded Computing: Architectures, Applications, and Methodologies
Wayne Wolf
September 2006 High-Performance Embedded Computing: Architectures, Applications, and Methodologie
Publisher: Morgan Kaufmann Publishers Inc.
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count:

Over the past several years, embedded systems have emerged as an integral though unseen part of many consumer, industrial, and military devices. The explosive growth of these systems has resulted in embedded computing becoming an increasingly important ...
Keywords: Computer Architecture

3 On Design of Parallel Memory Access Schemes for Video Coding
Jarno K. Tanskanen, Reiner Creutzburg, Jarkko T. Niittylahti
June 2005 **Journal of VLSI Signal Processing Systems** , Volume 40 Issue 2
Publisher: Kluwer Academic Publishers
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count:

Some of the modern powerful digital signal processors (DSPs) have byte-addressable internal data memory. Th property is valuable especially in computationally demanding inter frame video encoding, where data accesses are typically unaligned according ...

Keywords: H.263, MPEG-4, SIMD memory architecture, conflict-free access, data alignment, parallel memory access, skewing scheme, storage scheme, subword parallelism, video coding

4 Efficient video encryption scheme based on advanced video coding
Shiguo Lian, Jinsheng Sun, Guangjie Liu, Zhiquan Wang
May 2008 **Multimedia Tools and Applications** , Volume 38 Issue 1
Publisher: Kluwer Academic Publishers
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count:

A video encryption scheme combining with advanced video coding (AVC) is presented and analyzed in this pape which is different from the ones used in MPEG1/2 video encryption. In the proposed scheme, the intra-predictio mode and motion vector difference ...

Keywords: AVC, Digital right management, Multimedia content protection, Video encryption

5 An efficient retinex-like brightness normalization method for coding camera flashes and strong brightness variation in videos
Hoi-Kok Cheung, Wan-Chi Siu, Dagan Feng, Zhiyong Wang

March 2010 **Image Communication** , Volume 25 Issue 3
Publisher: Elsevier Science Inc.

Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count:

Conventional hybrid video coding systems rely on the assumption that the brightness is constant. This does not take inter-frame brightness variations into consideration during motion estimation and compensation processes Under the influence of inter-frame ...

Keywords: Brightness variation, Motion estimation, Retinex image, Video coding

6 Reversible watermarking techniques: an overview and a classification
Roberto Caldelli, Francesco Filippini, Rudy Becarelli
January 2010 **EURASIP Journal on Information Security** , Volume 2010
Publisher: Hindawi Publishing Corp.
Full text available: Publisher Site , PDF (1.15 MB)
Bibliometrics: Downloads (6 Weeks): 4, Downloads (12 Months): 28, Downloads (Overall): 28, Citation Count: 0

An overview of reversible watermarking techniques appeared in literature during the last five years approximate is presented in this paper. In addition to this a general classification of algorithms on the basis of their characteristics and of the ...

7 DCT-Domain Embedded Memory Compression for Hybrid Video Coders
Richard P. Kleihorst, René J. Van Der Vleuten
February 2000 **Journal of VLSI Signal Processing Systems** , Volume 24 Issue 1
Publisher: Kluwer Academic Publishers
Full text available: Publisher Site
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count:

Hybrid video compression schemes such as MPEG2 and H.263 use an image memory for motion-compensated coding. In VLSI implementations, this image is usually stored in external RAM because of its large size. To redu the overall system costs, we propose ...

8 Combined wavelet video coding and error control for internet streaming and multicast
Tianli Chu, Zixiang Xiong
January 2003 **EURASIP Journal on Applied Signal Processing** , Volume 2003
Publisher: Hindawi Publishing Corp.
Full text available: Pdf (973.37 KB)
Bibliometrics: Downloads (6 Weeks): 1, Downloads (12 Months): 10, Downloads (Overall): 62, Citation Count: 0

This paper proposes an integrated approach to Internet video streaming and multicast (e.g., receiver-driven layered multicast (RLM) by McCanne) based on combined wavelet video coding and error control. We design a packetized wavelet video (PWV) coder ...

Keywords: PWV, error control, internet streaming, multicast, wavelet video coding

9 Embedded Zerotree Wavelet Coding of Image Sequence
Mbainaibeye Jerôme, Noureddine Ellouze
December 2001 **WAA '01:** Proceedings of the Second International Conference on Wavelet Analysis and Its Applications
Publisher: Springer-Verlag
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count:

In this paper we present an image sequence coding system based on Embedded Zerotree Wavelet algorithm (EZW). Difference between the image in the coder and the reconstructed previous image in the decoder is used as technique for removing the temporal ...

10 An Error Resilient Scheme for MPEG-4 FGS Video over Packet Erasure Channel That Exhibits Graceful Degradation

Chih-Yeo Lin, I.-Cheng Ting, Chyouhwa Chen, Wen-Jen Ho
December 2002 **PCM '02:** Proceedings of the Third IEEE Pacific Rim Conference on Multimedia: Advances in Multimedia Information Processing
Publisher: Springer-Verlag
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count:

The Fine-Granular-Scalability (FGS) video coding framework has been adopted by the MPEG-4 standard as a streaming profile for streaming applications. However, streaming over packet erasure channels (e.g. the Internet) often suffers from arbitrary packet ...

11 Digital image authentication and recovery: Employing integer transform based information embedding an extraction
Rafiullah Chamlawi, Asifullah Khan
December 2010 **Information Sciences: an International Journal** , Volume 180 Issue 24
Publisher: Elsevier Science Inc.
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count:

Recently, several semi-fragile watermarking approaches with the additional capability of image recovery have been proposed. However, the security, robustness, and image recovery aspect of these approaches have certair shortcomings. In this paper, a novel ...
Keywords: Authentication, BCH coding, Embedding and extraction, Huffman Coding, Integer Discrete Cosine Transform (IDCT), Integer Wavelet Transform (IWT), Watermarking, self-recovery and tamper localization

12 Foveation image coding with fuzzy-based joint parameter selection
Wuttipong Kumwilaisak
October 2008 **Journal of Visual Communication and Image Representation** , Volume 19 Issue 7
Publisher: Academic Press, Inc.
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count:

This paper presents a novel method of the foveation image coding based on the fuzzy-based joint parameter selection. Our objective is to maximize foveated wavelet image quality index (FWQI) of the reconstructed image With the foveated visual sensitivity ...

Keywords: Discrete wavelet transform, Foveated wavelet image quality index, Foveation image coding, Fuzzy logic system, Joint parameter selection, List significant pixel, SPIHT codec, Scaling down factor

13 Video encoder optimization implementation on embedded platform
Meng Qinglei, Yao Chunlian, Li Bo
September 2006 **ICNC'06: Proceedings of the Second international conference on Advances in Natural Computation - Volume Part II** , Volume Part II
Publisher: Springer-Verlag
Full text available: Publisher Site
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count:

To satisfy the requirement of embedded video encoder in various scenarios, an embedded universal video codin system based on embedded processors is proposed in this paper, which combines the advantages of multi processors in single architecture. According ...

14 Combinatorial Systems Evolution: Example of Standard for Multimedia Information
Mark Sh. Levin, Oleg Kruchkov, Ofer Hadar, Evgeny Kaminsky
December 2009 **Informatica** , Volume 20 Issue 4
Publisher: IOS Press
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count:

The article addresses the issues of combinatorial evolution of standards in transmission of multimedia informati including the following: (a) brief descriptions of basic combinatorial models as multicriteria ranking, knapsack-li problems, clustering, ...

Keywords: combinatorial optimization, decision making, expert judgment, heuristics, multimedia information, standard, system evolution, technological trajectories

15 Multiple description video coding using coefficients ordering and interpolation
Nicola Conci, Francesco G. B. De Natale
March 2007 **Image Communication** , Volume 22 Issue 3
Publisher: Elsevier Science Inc.
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count:

A Multiple Description Video Codec is presented, suitable for high-quality digital video transmission. The methoc works in the DCT domain, and associates to each descriptor two data sources: a subset of the original transforn coefficients, and side information ...

Keywords: Error resilience, Multiple description coding, Video streaming

16 Implementation of Real-Time MPEG-4 FGS Encoder
Yen-Kuang Chen, Wen-Hsiao Peng
December 2002 **PCM '02:** Proceedings of the Third IEEE Pacific Rim Conference on Multimedia: Advances in Multimedia Information Processing
Publisher: Springer-Verlag
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count:

While computers become faster than they used to be, software implementation of the latest video codec in real time is still a challenging topic. This paper presents our techniques in optimizing the speed of MPEG-4 Fine Granularity Scalability (FGS) video ...

17 A novel multi-view image coding scheme based on view-warping and 3D-DCT
M. Zamarin, S. Milani, P. Zanuttigh, G. M. Cortelazzo
July 2010 **Journal of Visual Communication and Image Representation** , Volume 21 Issue 5-6
Publisher: Academic Press, Inc.
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count:

Efficient compression of multi-view images and videos is an open and interesting research issue that has been attracting the attention of both academic and industrial world during the last years. The considerable amount of information produced by multi-camera ...
Keywords: 3D spatial prediction, 3D warping, 3D-DCT, 3DTV, Disparity compensation, Hole filling, Multi-view image coding, Multi-view plus depth

18 Technologies for 3D mesh compression: A survey
Jingliang Peng, Chang-Su Kim, C. -C. Jay Kuo
December 2005 **Journal of Visual Communication and Image Representation** , Volume 16 Issue 6
Publisher: Academic Press, Inc.
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count:

Three-dimensional (3D) meshes have been widely used in graphic applications for the representation of 3D objects. They often require a huge amount of data for storage and/or transmission in the raw data format. Sinc most applications demand compact ...

Keywords: 3D mesh compression, MPEG-4, Progressive mesh coding, Single-rate mesh coding

19 KL-sense secure image steganography
Guoqi Luo, K. P. Subbalakshmi
January 2011 **International Journal of Security and Networks** , Volume 6 Issue 4
Publisher: Inderscience Publishers
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count:

In this paper, we propose a computationally-efficient data hiding method which achieves Cachin's security criterion: zero Kullback-Liebler (KL) divergence. To preserve statistical properties of the cover medium, we swa pixels rather than modify ...

20 Temporal error concealment for H.264 using optimum regression plane
Shih-Chia Huang, Sy-Yen Kuo
January 2008 **MMM'08:** Proceedings of the 14th international conference on Advances in multimedia modeling
Publisher: Springer-Verlag
Bibliometrics: Downloads (6 Weeks): n/a, Downloads (12 Months): n/a, Downloads (Overall): n/a, Citation Count:

Highly compressed video bitstreams transmitted over error-prone communications networks can suffer from packet erasures. In order to avoid error-catalyzed artifacts from producing visible corruption of affected video frames, the use of error concealment ...

Keywords: H.264, temporal error concealment

Result page: **1** 2 3 4 5 6 next

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/377,617	02/16/2009	Se-Yoon Jeong	CU-7298 WWP

CONFIRMATION NO. 8176

PUBLICATION NOTICE

OC000000044457480

26530
LADAS & PARRY LLP
224 SOUTH MICHIGAN AVENUE
SUITE 1600
CHICAGO, IL 60604

Title:APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

Publication No.US-2010-0284459-A1
Publication Date:11/11/2010

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

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Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

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U.S. APPLICATION NUMBER NO.	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
12/377,617	Se-Yoon Jeong	CU-7298 WWP

26530
LADAS & PARRY LLP
224 SOUTH MICHIGAN AVENUE
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CHICAGO, IL 60604

INTERNATIONAL APPLICATION NO.	
PCT/KR07/01433	
I.A. FILING DATE	PRIORITY DATE
03/23/2007	08/17/2006

CONFIRMATION NO. 8176
371 ACCEPTANCE LETTER

OC000000042897844

Date Mailed: 08/05/2010

NOTICE OF ACCEPTANCE OF APPLICATION UNDER 35 U.S.C 371 AND 37 CFR 1.495

The applicant is hereby advised that the United States Patent and Trademark Office in its capacity as a Designated / Elected Office (37 CFR 1.495), has determined that the above identified international application has met the requirements of 35 U.S.C. 371, and is ACCEPTED for national patentability examination in the United States Patent and Trademark Office.

The United States Application Number assigned to the application is shown above and the relevant dates are:

02/16/2009	02/16/2009
DATE OF RECEIPT OF 35 U.S.C. 371(c)(1), (c)(2) and (c)(4) REQUIREMENTS	DATE OF COMPLETION OF ALL 35 U.S.C. 371 REQUIREMENTS

A Filing Receipt (PTO-103X) will be issued for the present application in due course. **THE DATE APPEARING ON THE FILING RECEIPT AS THE " FILING DATE" IS THE DATE ON WHICH THE LAST OF THE 35 U.S.C. 371 (c)(1), (c)(2) and (c)(4) REQUIREMENTS HAS BEEN RECEIVED IN THE OFFICE. THIS DATE IS SHOWN ABOVE.** *The filing date of the above identified application is the international filing date of the international application (Article 11(3) and 35 U.S.C. 363).* Once the Filing Receipt has been received, send all correspondence to the Group Art Unit designated thereon.

The following items have been received:

- Indication of Small Entity Status
- Copy of the International Application filed on 02/16/2009
- Copy of the International Search Report filed on 02/16/2009
- Copy of IPE Report filed on 02/16/2009
- Information Disclosure Statements filed on 02/18/2009
- Oath or Declaration filed on 02/16/2009
- Small Entity Statement filed on 02/16/2009
- Request for Immediate Examination filed on 02/16/2009
- U.S. Basic National Fees filed on 02/16/2009
- Assignment filed on 02/16/2009
- Priority Documents filed on 02/16/2009

Applicant is reminded that any communications to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above (37 CFR 1.5)

PATRICIA A BOOKER

Telephone: (703) 756-1409

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
12/377,617	02/16/2009		600	CU-7298 WWP	20	4

CONFIRMATION NO. 8176

FILING RECEIPT

OC000000042897843

26530
LADAS & PARRY LLP
224 SOUTH MICHIGAN AVENUE
SUITE 1600
CHICAGO, IL 60604

Date Mailed: 08/05/2010

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

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Dae-Yeon Kim, Seoul, KOREA, REPUBLIC OF;
Dong-Kyun Kim, Seoul, KOREA, REPUBLIC OF;

Power of Attorney: The patent practitioners associated with Customer Number 26530

Domestic Priority data as claimed by applicant

This application is a 371 of PCT/KR07/01433 03/23/2007

Foreign Applications

REPUBLIC OF KOREA 10-2007-0008247 01/26/2007
REPUBLIC OF KOREA 10-2006-0077851 08/17/2006

If Required, Foreign Filing License Granted: 08/04/2010

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 12/377,617**

Projected Publication Date: 11/11/2010

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****
Title

APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

Preliminary Class

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Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

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Title 37, Code of Federal Regulations, 5.11 & 5.15

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PCT

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(PCT Rule 92*bis*.1 and Administrative Instructions, Section 422)

To:

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ID Tower #601, Jungdaero 105
(99-7 Garak-dong)
Songpa-gu
Seoul 138-805
RÉPUBLIQUE DE CORÉE

Date of mailing *(day/month/year)* 17 August 2007 (17.08.2007)	
Applicant's or agent's file reference P07E1129PCT	**IMPORTANT NOTIFICATION**
International application No. PCT/KR2007/001433	International filing date *(day/month/year)* 23 March 2007 (23.03.2007)

1. The following indications appeared on record concerning:

☐ the applicant ☐ the inventor ☒ the agent ☐ the common representative

Name and Address	State of Nationality	State of Residence
SHINSUNG PATENT FIRM 2-3f, Line Bldg., 823-30 Yeoksam-dong Kangnam-ku Seoul 135-080 Republic of Korea	Telephone No. 82-2-2009-6100 Facsimile No. 82-2-2009-6200 Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☒ the name ☒ the address ☐ the nationality ☐ the residence

Name and Address	State of Nationality	State of Residence
SHINSUNG INTERNATIONAL PATENT & LAW FIRM ID Tower #601, Jungdaero 105 (99-7 Garak-dong) Songpa-gu Seoul 138-805 Republic of Korea	Telephone No. 82-2-2009-6100 Facsimile No. 82-2-2009-6200 Teleprinter No.	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

☒ the receiving Office
☐ the International Searching Authority
☐ the International Preliminary Examining Authority
☐ the designated Offices concerned
☐ the elected Offices concerned
☐ other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. +41 22 338 82 70	Authorized officer Blanc Veronique e-mail Veronique.Blanc@wipo.int Telephone No. +41 22 338 96 66

Form PCT/IB/306 (October 2005) 1/DCT7R44V27

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

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NOTIFICATION CONCERNING SUBMISSION OR TRANSMITTAL OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

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SHINSUNG PATENT FIRM
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Kangnam-ku
Seoul 135-080
RÉPUBLIQUE DE CORÉE

Date of mailing *(day/month/year)* 23 April 2007 (23.04.2007)	
Applicant's or agent's file reference P07E1129PCT	**IMPORTANT NOTIFICATION**
International application No. PCT/KR2007/001433	International filing date *(day/month/year)* 23 March 2007 (23.03.2007)
International publication date *(day/month/year)* **Not yet published**	Priority date *(day/month/year)* 17 August 2006 (17.08.2006)
Applicant ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE et al	

1. By means of this Form, which replaces any previously issued notification concerning submission or transmittal of priority documents, the applicant is hereby notified of the date of receipt by the International Bureau of the priority document(s) relating to all earlier application(s) whose priority is claimed. Unless otherwise indicated by the letters "NR", in the right-hand column or by an asterisk appearing next to a date of receipt, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).

2. *(If applicable)* The **letters "NR"** appearing in the right-hand column denote a **priority document which, <u>on the date of mailing of this Form</u>, had not yet been received by the International Bureau** under Rule 17.1(a) or (b). Where, under Rule 17.1(a), the priority document must be submitted by the applicant to the receiving Office or the International Bureau, but the applicant fails to submit the priority document within the applicable time limit under that Rule, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

3. *(If applicable)***An asterisk (*)** appearing next to a date of receipt, in the right-hand column, denotes a **priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b)** (the priority document was received after the time limit prescribed in Rule 17.1(a) or the request to prepare and transmit the priority document was submitted to the receiving Office after the applicable time limit under Rule 17.1(b)). Even though the priority document was not furnished in compliance with Rule 17.1(a) or (b), the International Bureau will nevertheless transmit a copy of the document to the designated Offices, for their consideration. In case such a copy is not accepted by the designated Office as the priority document, Rule 17.1(c) provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

Priority date	Priority application No.	Country or regional Office or PCT receiving Office	Date of receipt of priority document
17 August 2006 (17.08.2006)	10-2006-0077851	KR	11 April 2007 (11.04.2007)

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. +41 22 338 82 70	Authorized officer Philippe Becamel Facsimile No. +41 22 338 82 70 Telephone No. +41 22 338 74 12

Form PCT/IB/304 (October 2005) 1/C75JIEVD0

PATENT COOPERATION TREATY

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NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92*bis*.1 and Administrative Instructions, Section 422)

To:

SHINSUNG PATENT FIRM
ID Tower #601, Jungdaero 105
(99-7 Garak-dong)
Songpa-gu
Seoul 138-805
RÉPUBLIQUE DE CORÉE

Date of mailing *(day/month/year)* 13 May 2008 (13.05.2008)	
Applicant's or agent's file reference P07E1129PCT	**IMPORTANT NOTIFICATION**
International application No. PCT/KR2007/001433	International filing date *(day/month/year)* 23 March 2007 (23.03.2007)

1. The following indications appeared on record concerning:

☐ the applicant ☐ the inventor ☒ the agent ☐ the common representative

Name and Address	State of Nationality	State of Residence
SHINSUNG INTERNATIONAL PATENT & LAW FIRM ID Tower #601, Jungdaero 105 (99-7 Garak-dong) Songpa-gu Seoul 138-805 Republic of Korea	Telephone No. 82-2-2009-6100 Facsimile No. 82-2-2009-6200 Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☒ the name ☐ the address ☐ the nationality ☐ the residence

Name and Address	State of Nationality	State of Residence
SHINSUNG PATENT FIRM ID Tower #601, Jungdaero 105 (99-7 Garak-dong) Songpa-gu Seoul 138-805 Republic of Korea	Telephone No. 82-2-2009-6100 Facsimile No. 82-2-2009-6200 Teleprinter No.	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

☒ the receiving Office
☐ the International Searching Authority
☐ the International Preliminary Examining Authority
☒ the designated Offices concerned
☐ the elected Offices concerned
☐ other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. +41 22 338 70 90	Authorized officer Claveri Sebastien e-mail pt12.pct@wipo.int Telephone No. +41 22 338 74 12

Form PCT/IB/306 (October 2005) 1/DNJ4UO3D0

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

To:

SHINSUNG PATENT FIRM
ID Tower #601, Jungdaero 105
(99-7 Garak-dong)
Songpa-gu
Seoul 138-805
RÉPUBLIQUE DE CORÉE

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92*bis*.1 and Administrative Instructions, Section 422)

Date of mailing *(day/month/year)* 02 June 2008 (02.06.2008)	
Applicant's or agent's file reference P07E1129PCT	**IMPORTANT NOTIFICATION**
International application No. PCT/KR2007/001433	International filing date *(day/month/year)* 23 March 2007 (23.03.2007)

1. The following indications appeared on record concerning:

☒ the applicant ☐ the inventor ☐ the agent ☐ the common representative

Name and Address	State of Nationality	State of Residence
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☒ the person ☐ the name ☐ the address ☐ the nationality ☐ the residence

Name and Address	State of Nationality	State of Residence
KWANGWOON UNIVERSITY RESEARCH INSTITUTE FOR INDUSTRY COOPERATION 447-1, Wolgye-dong Nowon-gu Seoul 139-701 Republic of Korea	KR	KR
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

3. Further observations, if necessary:
The person identified in Box 2 has been added to the record as applicant for all designated States except the United States of America

4. A copy of this notification has been sent to:

☒ the receiving Office
☐ the International Searching Authority
☐ the International Preliminary Examining Authority
☒ the designated Offices concerned
☐ the elected Offices concerned
☐ other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. +41 22 338 70 90	Authorized officer Appave Jose e-mail pt12.pct@wipo.int Telephone No. +41 22 338 74 12

Form PCT/IB/306 (October 2005) I/DOCQLO9X0

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92*bis*.1 and Administrative Instructions, Section 422)

To:

SHINSUNG PATENT FIRM
ID Tower #601, Jungdaero 105
(99-7 Garak-dong)
Songpa-gu
Seoul 138-805
RÉPUBLIQUE DE CORÉE

Date of mailing *(day/month/year)* 02 June 2008 (02.06.2008)	
Applicant's or agent's file reference P07E1129PCT	**IMPORTANT NOTIFICATION**
International application No. PCT/KR2007/001433	International filing date *(day/month/year)* 23 March 2007 (23.03.2007)

1. The following indications appeared on record concerning:

☒ the applicant ☐ the inventor ☐ the agent ☐ the common representative

Name and Address	State of Nationality	State of Residence
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☐ the name ☐ the address ☐ the nationality ☐ the residence

Name and Address	State of Nationality	State of Residence
INDUSTRY-ACADEMIA COOPERATION GROUP OF SEJONG UNIVERSITY 98, Gunja-dong Gwangjin-gu Seoul 143-747 Republic of Korea	KR	KR
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

3. Further observations, if necessary:
The person identified in Box 2 has been added to the record as applicant for all designated States except the United States of America

4. A copy of this notification has been sent to:

☒ the receiving Office
☐ the International Searching Authority
☐ the International Preliminary Examining Authority
☒ the designated Offices concerned
☐ the elected Offices concerned
☐ other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. +41 22 338 70 90	Authorized officer Appave Jose e-mail pt12.pct@wipo.int Telephone No. +41 22 338 74 12

Form PCT/IB/306 (October 2005) 1/DOCQMECA0

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter I of the Patent Cooperation Treaty)

(PCT Rule 44*bis*)

Applicant's or agent's file reference P07E1129PCT	**FOR FURTHER ACTION**	See item 4 below
International application No. PCT/KR2007/001433	International filing date *(day/month/year)* 23 March 2007 (23.03.2007)	Priority date *(day/month/year)* 17 August 2006 (17.08.2006)
International Patent Classification (8th edition unless older edition indicated) See relevant information in Form PCT/ISA/237		
Applicant ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE		

1. This international preliminary report on patentability (Chapter I) is issued by the International Bureau on behalf of the International Searching Authority under Rule 44 *bis*.1(a).

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   In the attached sheets, any reference to the written opinion of the International Searching Authority should be read as a reference to the international preliminary report on patentability (Chapter I) instead.

3. This report contains indications relating to the following items:

☒	Box No. I	Basis of the report
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☒	Box No. VIII	Certain observations on the international application

4. The International Bureau will communicate this report to designated Offices in accordance with Rules 44*bis*.3(c) and 93*bis*.1 but not, except where the applicant makes an express request under Article 23(2), before the expiration of 30 months from the priority date (Rule 44*bis* .2).

	Date of issuance of this report 17 February 2009 (17.02.2009)
The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Philippe Becamel
Facsimile No. +41 22 338 82 70	e-mail: pt12.pct@wipo.int

Form PCT/IB/373 (January 2004)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:
SHINSUNG PATENT FIRM

2-3F, Line Bldg., 823-30, Yeoksam-dong, Kangnam-ku Seoul
135-080 Republic of Korea

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing *(day/month/year)*	**29 JUNE 2007 (29.06.2007)**
Applicant's or agent's file reference: P07E1129PCT	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/KR2007/001433	**23 MARCH 2007 (23.03.2007)**	17 AUGUST 2006 (17.08.2006)

International Patent Classification (IPC) or both national classification and IPC

H04N 7/30(2006.01)i

Applicant

ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE et al

1. This opinion contains indications relating to the following items:
   - ☒ Box No. I Basis of the opinion
   - ☐ Box No. II Priority
   - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - ☐ Box No. IV Lack of unity of invention
   - ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - ☐ Box No. VI Certain documents cited
   - ☐ Box No. VII Certain defects in the international application
   - ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**
   If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

   If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.
   For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/KR	Date of completion of this opinion	Authorized officer
Korean Intellectual Property Office 920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	29 JUNE 2007 (29.06.2007)	LEE, Beaung Woo Telephone No.82-42-481-8227

Form PCT/ISA/237 (cover sheet) (April 2007)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/KR2007/001433

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of :

   ☒ the international application in the language in which it was filed

   ☐ a translation of the international application into ________________________, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of:

   a. type of material
      - ☐ a sequence listing
      - ☐ table(s) related to the sequence listing

   b. format of material
      - ☐ on paper
      - ☐ in electronic form

   c. time of filing/furnishing
      - ☐ contained in the international application as filed.
      - ☐ filed together with the international application in electronic form.
      - ☐ furnished subsequently to this Authority for the purposes of search.

4. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additioanl copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Form PCT/ISA/237 (Box No. I)(April 2007)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/KR2007/001433

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-20	YES
	Claims	NONE	NO
Inventive step (IS)	Claims	1-20	YES
	Claims	NONE	NO
Industrial applicability (IA)	Claims	1-20	YES
	Claims	NONE	NO

2. Citations and explanations :

Reference is made to the following documents:

D1: JP2004-348741 A
D2: JP2003-006643 A

D1 discloses an image processing technique using DCT coefficients to determine the similarity between images for eliminating the need for an operation to decode the DCT-encoded images in such cases as performing a pixel comparison in the space domain. The image comparison method comprises comparison of DCT coefficients for a pair of image regions to determine the similarity between the image regions, wherein the comparison involves at least one AC coefficient and the influence of at least one AC coefficient is weighted in the determination of similarity.

D2 discloses a technique for a image processing. An initial similarity candidate calculating part calculates similarity between the first and second images on the basis of the first and second image feature expressed by quantized DCT coefficients. A coefficient converting processing part applies coefficient converting processing to at least one of first and second image feature amounts. A similarity calculating part calculates the similarity between the first and second images on the basis of the image feature amount obtained. Then, the similarity between the first and second images is determined out of a calculated similarity group.

I. Novelty and Inventive Step

Claim 1: The subject matter of claim 1 relates to an encoding apparatus using DCT scanning, comprising: a mode selecting unit for optimal mode of intra-prediction, an intra-prediction unit, a DCT and quantizing unit, an entropy encoding unit encoding the quantized DCT coefficients using scaning mode decided by pixel similarity of coefficient residues.

The difference of claim 1 from D1-D2 is that D1-D2 do not disclose nor teach an entropy encoding unit encoding the quantized DCT coefficients using scaning mode decided by pixel similarity of coefficient residues. Moreover, the difference is not obvious for a person skilled in the art even with any combinations of D1-D2. Therefore, claim 1 is considered to be novel(PCT Article 33(2)) and to involve an inventive step(PCT Article 33(3)).

Claims 2-8: Claims 2-8, which are dependent on claim 1, also comply with PCT Article 33(2) and PCT Article 33(3) as they are dependent claims.

(continued on the Supplemental sheet)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/KR2007/001433

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claims 1, 3, 11, 13 do not meet the requirements of PCT Article 6 in that the terms "optimal", "high similarity", "similar similarity" have technically-unclear meaning.

Claims 1, 8, 18 do not meet the requirements of PCT Article 6 in that the terms "the said quantized DCT coefficient", "the said second multiplying factor" are not found in claims 1, 8, 18, and are not found in any claims on which the claims 8, 18 depend.

Form PCT/ISA/237 (Box No. VIII) (April 2007)

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of :

(Box No. V)

Claim 9: The subject matter of claim 9 relates to an decoding apparatus using DCT scanning, comprising: an entropy decoding unit for encoded image, a scanning decision unit deciding scanning mode for decoded image from the entropy decoding unit, an image restoring unit according the scanning mode decided.

The difference of claim 9 from D1-D2 is that D1-D2 do not disclose nor teach an entropy decoding unit for encoded image, a scanning decision unit deciding scanning mode for decoded image from the entropy decoding unit. Moreover, the difference is not obvious for a person skilled in the art even with any combinations of D1-D2. Therefore, claim 9 is considered to be novel(PCT Article 33(2)) and to involve an inventive step(PCT Article 33(3)).

Claim 10: Claim 10, which is dependent on claim 9, also complies with PCT Article 33(2) and PCT Article 33(3) as it is dependent claim.

Claim 11: The subject matter of claim 11 relates to an encoding method using DCT scanning, comprising: a mode selecting step for optimal mode of intra-prediction, an intra-predicting step, a DCT and quantizing step, a similarity deciding step for deciding pixel similarity of coefficient residues, an entropy encoding step for encoding the quantized DCT coefficients using scaning mode decided by the similarity deciding step.

The difference of claim 11 from D1-D2 is that D1-D2 do not disclose nor teach a similarity deciding step deciding pixel similarity of coefficient residues, an entropy encoding step encoding the quantized DCT coefficients using scaning mode decided by the similarity deciding step. Moreover, the difference is not obvious for a person skilled in the art even with any combinations of D1-D2. Therefore, claim 11 is considered to be novel(PCT Article 33(2)) and to involve an inventive step(PCT Article 33(3)).

Claims 12-18: Claims 12-18, which are dependent on claim 11, also comply with PCT Article 33(2) and PCT Article 33(3) as they are dependent claims.

Claim 19: The subject matter of claim 19 relates to an decoding method using DCT scanning, comprising: an entropy decoding step for decoding an encoded image, a scanning mode deciding step for deciding scanning mode of decoded image from the entropy decoding step, an image restoring step for restoring the image according the scanning mode decided at the scanning mode deciding step.

The difference of claim 19 from D1-D2 is that D1-D2 do not disclose nor teach an entropy decoding step for decoding an encoded image, a scanning mode deciding step for deciding scanning mode of decoded image from the entropy decoding step. Moreover, the difference is not obvious for a person skilled in the art even with any combinations of D1-D2. Therefore, claim 19 is considered to be novel(PCT Article 33(2)) and to involve an inventive step(PCT Article 33(3)).

Claim 20: Claim 20, which is dependent on claim 19, also complies with PCT Article 33(2) and PCT Article 33(3) as it is dependent claim.

II. Industrial Applicability

The industrial applicability of claims 1-20 is self-evident in the sense of PCT Article 33(4) because the subject matter claimed can be made or used in industry.

Patricia Booker

PATENT APPLICATION FEE DETERMINATION RECORD
Effective December 8, 2004

Application or Docket Number: 12377617

CLAIMS AS FILED - PART I

SMALL ENTITY TYPE ☑ OR OTHER THAN SMALL ENTITY

U.S. NATIONAL STAGE FEES	(Column 1)	(Column 2)	SMALL ENTITY RATE	SMALL ENTITY FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY FEE
BASIC FEE			BASIC FEE	165	OR	BASIC FEE	
EXAMINATION FEE			EXAM. FEE	215		EXAM. FEE	
SEARCH FEE			SEARCH FEE	110		SEARCH FEE	
FEE FOR EXTRA SPEC PGS	minus 100 =	/ 50 =	X $ 125 =			X $ 250 =	
TOTAL CHARGEABLE CLAIMS	20 minus 20 =	*	X $ 25 =		OR	X $ 50 =	
INDEPENDENT CLAIMS	4 minus 3 =	* 1	X $ 100 =	110	OR	X $ 200 =	
MULTIPLE DEPENDENT CLAIM PRESENT ☐			+ $ 180 =		OR	+ $ 360 =	
			TOTAL	600	OR	TOTAL	

* If the difference in column 1 is less than zero, enter "0" in column 2

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE	ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	ADDITIONAL FEE
Total	*	Minus	**	=	X $ 25 =		OR	X $ 50 =	
Independent	*	Minus	***	=	X $ 100 =		OR	X $ 200 =	
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐					+ $ 180 =		OR	+ $ 360 =	
					TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE	ADDITIONAL FEE	OR	RATE	ADDITIONAL FEE
Total	*	Minus	**	=	X $ 25 =		OR	X $ 50 =	
Independent	*	Minus	***	=	X $ 100 =		OR	X $ 200 =	
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐					+ $ 180 =		OR	+ $ 360 =	
					TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than "20", enter "20"
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than "3", enter "3"
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1

FORM PTO-875 (Rev. 03/2005)

Patent and Trademark Office - U.S. DEPARTMENT OF COMMERCE

Patricia Booker

MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET (FOR USE WITH FORM PTO-875)	SERIAL NO. 12377617	FILING DATE
	APPLICANT(S)	

CLAIMS

	AS FILED		AFTER 1st AMENDMENT		AFTER 2nd AMENDMENT	
	IND.	DEP.	IND.	DEP.	IND.	DEP.
1	1					
2		1				
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TOTAL IND.	4	↓		↓		↓
TOTAL DEP.	16	←		←		←
TOTAL CLAIMS	20					

	AS FILED		AFTER 1st AMENDMENT		AFTER 2nd AMENDMENT	
	IND.	DEP.	IND.	DEP.	IND.	DEP.
51						
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TOTAL IND.		↓		↓		↓
TOTAL DEP.		←		←		←
TOTAL CLAIMS						

INFORMATION DISCLOSURE STATEMENT (IDS) BY APPLICANT	Application Number	12/377,617
	Filing Date (YYYY-MM-DD)	2009-02-16
	First Named Inventor	Se-Yoon JEONG et al.
	Art Unit	
	Examiner Name	
	Attorney Docket Number	CU-7298

REMARKS

This IDS including Form PTO-1449 (Modified) is submitted for the examiner's review and acknowledgement. The filing of this IDS shall not be construed as an admission against interest in any manner. The filing of this IDS shall not be construed as a representation that a search has been made, an admission that the information cited is, or is considered to be, material to patentability or that no other material information exists.

☒ International Search Report or ☐ European Search Report or ☐ a full translation of the office action of a corresponding foreign patent application or ☐ others [*type the details of "others" here, if any*] (whichever marked in the box) is/are enclosed to satisfy the requirement for a translation or concise explanation of any non-English reference cited therein, as provided in MPEP §609 A(3).

DEPOSIT ACCOUNT: The Commissioner is authorized to charge Deposit Account No. 12-0400 any fees required in connection with filing of this IDS or others related to the present application.

☒ This IDS is being filed within (3) months of the filing date of the application or date of entry into the national stage of an international application or before the mailing date of the first office action on the merits since the filing date of the application or an RCE previously filed on ___-__-___(YYYY-MM-DD), which event occurs last. 37 CFR 1.97(b).

☐ This IDS is being filed with an RCE after the mailing date of a final office action or a notice of allowance. Please charge the requisite fee($) for filing the RCE to Deposit Account No. 12-0400.

☐ This IDS is being filed before the mailing date of a final office action or a notice of allowance but after the mailing date of the first office action on the merits and after (3) months of the filing date of the application. No IDS fee is required in view of the certification statement under 37 C.F.R. §1.97(e) below.

☐ This IDS is being filed before the mailing date of a final office action or a notice of allowance but after the mailing date of the first office action on the merits and after (3) months of the filing date of the application. Please charge the requisite IDS fee ($) to Deposit Account No. 12-0400.

☐ This IDS is being filed after the mailing date of a final office action or a notice of allowance, whichever occurs first, but before, or simultaneously with, the payment of the issue fee. The certification under 37 CFR 1.97(e) is below. Please charge the IDS fee ($) to Deposit Account No. 12-0400.

☐ This IDS is being filed after payment of the issue fee but before a patent issuance, together with an RCE and a petition for withdrawal of application from issue. Please charge the requisite fee ($) for RCE and the petition being filed herewith to Deposit Account No. 12-0400.

☐ This IDS is being filed after payment of the issue fee in order to be placed in the application file. MPEP 609(III)B(4).

CERTIFICATION STATEMENT

☐ Each item of information contained in the IDS was first cited in any communication from a foreign patent office in a counterpart foreign application not more than (3) months prior to the filing of the IDS. 37 CFR 1.97(e)(1).

☐ No item of information contained in the IDS, to the knowledge of the person signing the certification after making reasonable inquiry, was known to any individual designated in § 1.56(c) more than (3) months prior to the filing of the IDS. 37 CFR 1.97(e)(2). The applicant/inventor below, if signed, is making this certification instead of the attorney signing at the bottom.

____
Signature of the applicant/inventor

____
Signing person's name typed/printed

Signature		Date (YYYY-MM-DD)	2009-02-18
Name/Print	Woochoon William Park	Registration Number	55,523
Address	Ladas & Parry LLP | 224 South Michigan Avenue | Chicago Illinois 60604 | Tel. No. (312) 427-1300		

INFORMATION DISCLOSURE STATEMENT (IDS) BY APPLICANT (FORM PTO-1449 Modified)		
	Application Number	12/377,617
	Filing Date (YYYY-MM-DD)	2009-02-16
	First Named Inventor	Se-Yoon JEONG et al.
	Art Unit	
	Examiner Name	
	Attorney Docket Number	CU-7298

U.S. PATENTS

EXAMINER INITIAL	U.S. PATENT NUMBER	ISSUE DATE (YYYY-MM-DD)	PATENTEE	CLASS	SUB-CLASS	FILING DATE (YYYY-MM-DD)

U.S. PATENT APPLICATION PUBLICATIONS

EXAMINER INITIAL	U.S. PATENT APPLICATION PUBLICATION NUMBER	PUBL. DATE (YYYY-MM-DD)	PATENTEE	CLASS	SUB-CLASS	FILING DATE (YYYY-MM-DD)
	2003/0007698 A1	2003-01-09	Govindaswamy et al			

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	FOREIGN PATENT DOCUMENT NUMBER	COUNTRY CODE	KIND CODE	PUBL. DATE (YYYY-MM-DD)	NAME OF PATENTEE OR APPLICANT OF THE CITED DOCUMENT	TRANSLATION YES	NO
	2003-006643	JP	A	2003-01-10	Canon Inc		
	2004-348741	JP	A	2004-12-09	Mitsubishi Electric Information Technology Centre Europa BV		
	10-0180173	KR	B1	1998-11-30	Daewoo Electronics Co Ltd		

NON-PATENT LITERATURE DOCUMENTS

EXAMINER INITIAL	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial symposium catalog, etc.) date, page(s), volume-issue number(s), publisher, city and/or country where published.	TRANSLATION YES	NO
	"Proceedings of the 2006 Korean Signal Processing Conference" Held on September 23, 2006 (Saturday) at Hanyang University Ansan Campus.		
	International Search Report: mailed 29 June 2007; PCT/KR2007/001433		

EXAMINER	DATE CONSIDERED

EXAMINER: Initial citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

(Form PTO-1449)
02-18-09.

PATENT ABSTRACTS OF JAPAN

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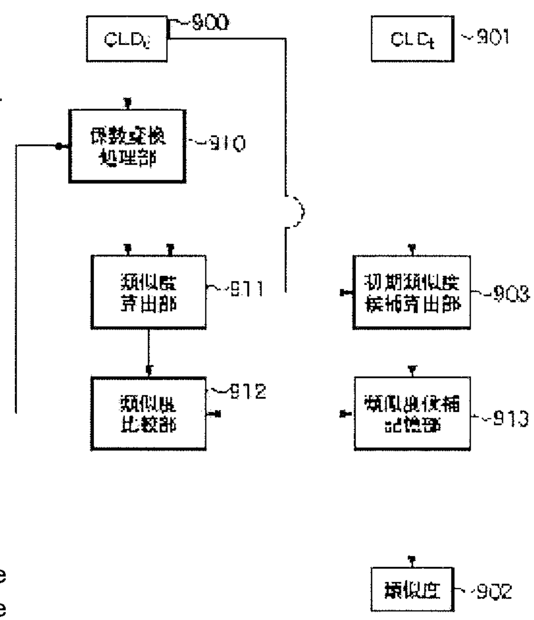
(54) DEVICE AND METHOD FOR PROCESSING IMAGE AND PROGRAM

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a device for processing a image and a program that can decide the image becoming similar when it is rotated or when mirror conversion is applied to it, which has been conventionally unable to decide as the similar image, as a similar image, and to provide a method for processing the image and program.
SOLUTION: On the basis of the first and second image feature amounts of respective first wand second images expressed by quantized DCT coefficients at least, an initial similarity candidate calculating part 903 calculates similarity between the first and second images. A coefficient converting processing part 910 applies coefficient converting processing to at least one of first and second image feature amounts. On the basis of the image feature amount obtained thereby, a similarity calculating part 911 calculates the similarity between the first and second images. Then, the similarity between the first and second images is determined out of a calculated similarity group.



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審査請求　未請求　請求項の数９　ＯＬ　（全 14 頁）

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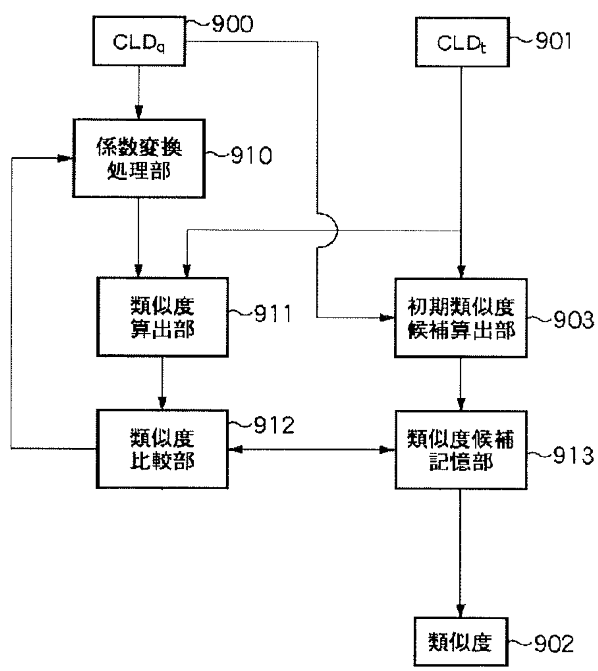
(54)【発明の名称】　画像処理装置及びその方法、プログラム

(57)【要約】

【課題】　従来、類似画像と判定することができなかった回転すると類似する画像や鏡面変換すると類似する画像を、類似画像として判定することができる画像処理装置及びその方法、プログラムを提供する。

【解決手段】　初期類似度候補算出部９０３は、少なくとも量子化ＤＣＴ係数で表現される第１及び第２画像それぞれの第１及び第２画像特徴量に基づいて、該第１及び第２画像間の類似度を算出する。係数変換処理部９１０は、第１及び第２画像特徴量の少なくとも一方に対して、係数変換処理を施す。その得られる画像特徴量に基づいて、類似度算出部９１１は、第１及び第２画像間の類似度を算出する。そして、算出された類似度群から第１及び第２画像間の類似度を決定する。



【特許請求の範囲】

【請求項１】　画像間の類似度を算出する画像処理装置であって、
少なくとも量子化ＤＣＴ係数で表現される第１及び第２画像それぞれの第１及び第２画像特徴量に基づいて、該第１及び第２画像間の類似度を算出する第１算出手段と、
前記第１及び第２画像特徴量の少なくとも一方に対して、係数変換処理を施す係数変換手段と、
前記係数変換手段によって得られる画像特徴量に基づいて、前記第１及び第２画像間の類似度を算出する第２算出手段と、
前記第１及び第２算出手段で算出された類似度群から前記第１及び第２画像間の類似度を決定する決定手段とを備えることを特徴とする画像処理装置。

【請求項２】　前記係数変換処理は、前記画像特徴量に含まれる量子化ＤＣＴ係数に対して、該量子化ＤＣＴ係数をＵ－Ｖ座標系に配置した場合のＵ＝Ｖに対する対称変換処理及び該量子化ＤＣＴ係数の一部に対する正負反転変換処理の内の少なくとも１つを含むことを特徴とする請求項１に記載の画像処理装置。

【請求項３】　前記決定手段は、前記第１及び第２算出手段で算出された類似度群の内、所定値に一番近い値の類似度を前記第１及び第２画像間の類似度として決定することを特徴とする請求項１に記載の画像処理装置。

【請求項４】　前記第１及び第２画像は、対応する第１及び第２原画像それぞれを８×８画素の画像に変倍した画像であることを特徴とする請求項１に記載の画像処理装置。

【請求項５】　画像間の類似度を算出する画像処理方法であって、
少なくとも量子化ＤＣＴ係数で表現される第１及び第２画像それぞれの第１及び第２画像特徴量に基づいて、該第１及び第２画像間の類似度を算出する第１算出工程と、
前記第１及び第２画像特徴量の少なくとも一方に対して、係数変換処理を施す係数変換工程と、
前記係数変換工程によって得られる画像特徴量に基づいて、前記第１及び第２画像間の類似度を算出する第２算出工程と、
前記第１及び第２算出工程で算出された類似度群から前記第１及び第２画像間の類似度を決定する決定工程とを備えることを特徴とする画像処理方法。

【請求項６】　前記係数変換処理は、前記画像特徴量に含まれる量子化ＤＣＴ係数に対して、該量子化ＤＣＴ係数をＵ－Ｖ座標系に配置した場合のＵ＝Ｖに対する対称変換処理及び該量子化ＤＣＴ係数の一部に対する正負反転変換処理の内の少なくとも１つを含むことを特徴とする請求項５に記載の画像処理方法。

【請求項７】　前記決定工程は、前記第１及び第２算出工程で算出された類似度群の内、所定値に一番近い値の類似度を前記第１及び第２画像間の類似度として決定することを特徴とする請求項５に記載の画像処理方法。

【請求項８】　前記第１及び第２画像は、対応する第１及び第２原画像それぞれを８×８画素の画像に変倍した画像であることを特徴とする請求項５に記載の画像処理方法。

【請求項９】　画像間の類似度を算出する画像処理をコンピュータに機能させるためのプログラムであって、
少なくとも量子化ＤＣＴ係数で表現される第１及び第２画像それぞれの第１及び第２画像特徴量に基づいて、該第１及び第２画像間の類似度を算出する第１算出工程のプログラムコードと、
前記第１及び第２画像特徴量の少なくとも一方に対して、係数変換処理を施す係数変換工程のプログラムコードと、
前記係数変換工程によって得られる画像特徴量に基づいて、前記第１及び第２画像間の類似度を算出する第２算出工程のプログラムコードと、
前記第１及び第２算出工程で算出された類似度群から前記第１及び第２画像間の類似度を決定する決定工程のプログラムコードとを備えることを特徴とするプログラム。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、画像間の類似度を算出する画像処理装置及びその方法、プログラムに関するものである。

【０００２】

【従来の技術】画像を変倍し、生成された変倍画像に対して公知の離散コサイン変換（ＤＣＴ）処理と量子化処理を行い、その結果、得られたＤＣＴ係数のうち低周波成分側から幾つかのＤＣＴ係数を取り出し、取り出したＤＣＴ係数を原画像の画像特徴量とし、これを、例えば、画像検索に用いるデータとする方式が知られている（ISO/IEC JTC1/SC29/WG11/N3522 "MPEG-7 Visual Working Draft 4.0"（以下、[VWD4.0]）、あるいはISO/IEC JTC1/SC29/WG11/N3522 "MPEG-7 Visual part of eXperimentation Model Version 7.0" （[VXM7.0]））。

【０００３】以下、[VWD4.0]もしくは[VXM7.0]に記載されている「Color Layout descriptor」における画像特徴量抽出処理について、図１１～図１５を用いて説明する。

【０００４】図１１は[VWD4.0]もしくは[VXM7.0]に記載されている「Color Layout descriptor」における画像特徴量抽出処理を説明するための図である。また、図１２はその画像特徴量処理を示すフローチャートである。

【０００５】原画像１０００１をＲＧＢ色成分毎に８×８画素の画像に変倍する画像変倍処理を行う（ステップＳ１０４０１）。次に、生成した各色成分毎の８×８画

素の画像１００１１、１００１２、１００１３の各画素をＹＣｂＣｒ色空間の各色成分データ１００２１、１００２２、１００２３に変換する色変換処理を行う（ステップＳ１０４０２）。次に、ＹＣｂＣｒ色空間の各色成分データ１００２１、１００２２、１００２３に対してＤＣＴ処理を行い、各色成分のＤＣＴ係数１００３１、１００３２、１００３３を取得する（ステップＳ１０４０３）。

【０００６】尚、画像変倍処理、色変換処理、ＤＣＴ処理は、公知のものでよい。

【０００７】次に、ＤＣＴ係数１００３１、１００３２、１００３３に対して量子化処理を行う（ステップＳ１０４０４）。

【０００８】量子化処理は、例えば、[VWD4.0]によれば、以下のプログラムコード１００００～１０００３に示すような処理で実現することができる。プログラムコード１００００～１０００３は、公知のＣ言語を用いて記述されている。[VWD4.0]によれば、量子化処理は、Ｙ成分とＣｂ／Ｃｒ成分それぞれについて、ＤＣ成分とＡＣ成分で異なる処理を施すので、量子化処理として、４通りの処理を実現するプログラムコード１００００～１０００３が用意されている。

【０００９】プログラムコード１００００：Ｙ係数のＤＣ成分に対する量子化処理

【００１０】

```
Int quant_Y_DC(int i) {
   int j;
   i = i/8;
   if(i>192) j=112+(i-192)/4;
   else if(i>160) j=96+(i-160)/2;
   else if(i>96) j=32+i-96;
   else if(i>64) j=16+(i-64)/2;
   else j=i/4;
   return j>>1;
}
```

プログラムコード１０００１：Ｃｂ／Ｃｒ係数のＤＣ成分に対する量子化処理

【００１１】

```
Int quant_CbCr_DC(int i) {
   int j;
   i = i/8;
   if(i>191) j=63;
   else if(i>160) j=56+(i-160)/4;
   else if(i>144) j=48+(i-144)/2;
   else if(i>112) j=16+I-112;
   else if(i>96) j=8+(i-96)/2;
   else if(i>64) j=(i-64)/4;
   else j=i/0;
   return j;
}
```

プログラムコード１０００２：Ｙ係数のＡＣ成分に対する量子化処理

【００１２】

```
Int quant_Y_AC(int i) {
   int j;
   i = i/2;
   if(i>255) I=255;
   if(i<-256) I=-256;
   if(abs(i)>127) j=64+abs(i)/4;
   else if(abs(i)>63) j=32+abs(i)/2;
   else j=abs(i);
   j = (i<0)?-j:j;
   return (int)trunc(((double)j+128.0)/8.0+0.5);
}
```

プログラムコード１０００３：Ｃｂ／Ｃｒ係数のＡＣ成分に対する量子化処理

【００１３】

```
Int quant_CbCr_AC(int i) {
  int j;
  if(i>255) I=255;
  if(i<-256) i=-256;
  if(abs(i)>127) j=64+abs(i)/4;
  else if(abs(i)>63) j=32+abs(i)/2;
  else j=abs(i);
  j = (i<0)?-j:j;
  return (int)trunc(((double)j+128.0)/8.0+0.5);
}
```

プログラムコード１００００、１０００１による量子化処理の結果、ＹもしくはＣｂ／Ｃｒ成分の量子化されたＤＣＴ係数（以下、量子化ＤＣＴ係数）は、０～６３の値になる。また、プログラムコード１０００２、１０００３による量子化処理の結果、ＹもしくはＣｂ／Ｃｒ成分の量子化ＤＣＴ係数は、０～３１の値となる。従って、量子化ＤＣＴ係数のＤＣ成分は符号無し６ｂｉｔ、ＡＣ成分は符号無し５ｂｉｔで表現することができる。

【００１４】続いて、量子化処理の結果によって得られた量子化ＤＣＴ係数１００４１、１００４２、１００４３の内、低周波数成分側から幾つかの係数を選択する係数選択処理を行う（ステップＳ１０４０５）。

【００１５】図１１の場合は、例として、Ｙ成分の量子化ＤＣＴ係数に関しては６個、Ｃｂ／Ｃｒ成分の量子化ＤＣＴ係数に関しては３個ずつ選択している例である。係数選択処理は、実際は、図１３に示すようなジグザグスキャン処理によって、８×８と二次元に配置された量子化ＤＣＴ係数を一次元に並び替え、その先頭から幾つかを選択することによって実現される。図１３の１０１０１は、ジグザグスキャンを表す図であり、８×８ブロックの各ブロックに記述されている１から６４の数字は、一次元に並びかえられた後にその量子化ＤＣＴ係数が先頭から何番目に配置されるかを示す数字である。

【００１６】そして、得られた量子化ＤＣＴ係数の低周波成分側から幾つかの量子化ＤＣＴ係数を取得する。[VWD4.0]によれば、ここで取得する量子化ＤＣＴ係数の数は、１、３、６、１０、１５、２１、２８、６４のいずれかである。また、量子化ＤＣＴ係数の数は、Ｃｂ成分の量子化ＤＣＴ係数とＣｒ成分の量子化ＤＣＴ係数に関しては同数であるが、Ｙ成分の量子化ＤＣＴ係数の数とＣｂ／Ｃｒ成分の量子化ＤＣＴ係数の数には別々の数を設定可能である。また、デフォルトではＹ成分の量子化ＤＣＴ係数に関して６個、Ｃｂ／Ｃｒ成分の量子化ＤＣＴ係数に関しては３個を選択する。図１１では、例として、このデフォルト時の係数選択である、Ｙ成分の量子化ＤＣＴ係数に関して６個（１００５１）、Ｃｂ／Ｃｒ成分の量子化ＤＣＴ係数に関しては３個（１００５２、１００５３）を選択している。

【００１７】この選択された量子化ＤＣＴ係数１００５１、１００５２、１００５３を、原画像１０００１の画像特徴量、即ち、Color Layout descriptorとする。

【００１８】また、[VWD4.0]によれば、このColor Layout descriptorは、図１４や図１５に示すようなバイナリ構造で格納される。図１４の１０２０１や図１５の１０３０１において、各ブロックは１ｂｉｔを表現している。また、１０２０１や１０３０１では、便宜上、フィールド毎に区切っているが、実際は、同図の破線矢印で示しているような順序で連続して格納されている。

【００１９】図１４はColor Layout descriptorがデフォルトの場合、即ち、Ｙ成分の量子化ＤＣＴ係数６個、Ｃｂ／Ｃｒ成分の量子化ＤＣＴ係数が各３個の場合のバイナリ構造を表す図である。この場合、先頭の拡張フラグには「０」が格納されている。さらに、それに後続して、Ｙ成分の量子化ＤＣＴ係数が６個、Ｃｂ成分の量子化ＤＣＴ係数が３個、Ｃｒ成分の量子化ＤＣＴ係数が３個の順に格納されている。量子化ＤＣＴ係数は、ＤＣ成分については符号無し６ｂｉｔ、ＡＣ成分については符号無し５ｂｉｔで表現できるので、ＤＣ成分については６ｂｉｔ、ＡＣ成分については５ｂｉｔの領域に格納される。

【００２０】一方、図１５はColor Layout descriptorがデフォルトでない場合のバイナリ構造を表す図である。この場合、先頭の拡張フラグには「１」が格納されている。それに後続して、３ｂｉｔのフィールドが２つ後続する。この３ｂｉｔのフィールドは、それぞれＹ成分の量子化ＤＣＴ係数の数、Ｃｂ／Ｃｒ成分の量子化ＤＣＴ係数の数を表すのに用いられる係数指定フィールドである。例えば、その数を示すビットパターンと量子化ＤＣＴ係数の数との対応を示すと、以下のような表になる。

【００２１】

ビットパターン	量子化 DCT 係数の数
000	1
001	3
010	6
011	10
100	15
101	21
110	28
111	64

【００２２】さらに、この２つの３ｂｉｔの係数指定フィールドに、後続してＹ、Ｃｂ、Ｃｒ成分の順に量子化ＤＣＴ係数が格納される。Ｙ、Ｃｂ、Ｃｒ成分の係数の数は、係数指定フィールドで指定した係数の数である。図１５の１０３０１では、例として、Ｙ成分の量子化ＤＣＴ係数が６個、Ｃｂ／Ｃｒ成分の量子化ＤＣＴ係数がそれぞれ６個の場合を示している。

【００２３】また、この画像特徴量として選択した量子化ＤＣＴ係数による画像間の類似度については、[VXM7.0]によれば、以下の類似度算出式により算出される。例えば、２つのColor Layout descriptor、ＣＬＤ1（YCoeff, CbCoeff, CrCoeff）とＣＬＤ2（YCoeff', CbCoeff', CrCoeff'）の間の類似度Ｄは、以下の類似度算出式で算出される。

【００２４】

$$D=\sqrt{\sum_{i=0}^{Max\{NumberOfYCoeff\}-1}\lambda_{Yi}(YCoeff[i]-YCoeff'[i])^2}+\sqrt{\sum_{i=0}^{Max\{NumberOfCCoeff\}-1}\lambda_{Cbi}(CbCoeff[i]-CbCoeff'[i])^2}+\sqrt{\sum_{i=0}^{Max\{NumberOfCCoeff\}-1}\lambda_{Cri}(CrCoeff[i]-CrCoeff'[i])^2}$$

【００２５】類似度算出式において、λは各量子化ＤＣＴ係数に関する重み付けであり、[VXM7.0]には、以下の表に示すような重み付け値が示されている。尚、表の空欄部分の重み付け値は１である。

【００２６】

	係数の順序					
	1	2	3	4	5	6
Y	2	2	2	1	1	1
Cb	2	1	1			
Cr	4	2	2			

【００２７】また、２つのColor Layout descriptorの持つ量子化ＤＣＴ係数の数が異なる場合には、少ない量子化ＤＣＴ係数に合わせて類似度算出式を適用するか、あるいは不足している量子化ＤＣＴ係数は１６をその値として補い、多い量子化ＤＣＴ係数に合わせて類似度算出式を適用するということが示されている。

【００２８】

【発明が解決しようとする課題】しかしながら、[VXM7.0]による画像類似度算出式だけでは、

・画像の回転

・画像の鏡面変換

のいずれかもしくは両方を施したものを同一視することができないという問題がある。

【００２９】このことは、人間の認識においては、ある画像と別の画像が、左右が逆であるが似ている、あるいは９０度回転したら似ている、というような判断を容易に行えるのに対し、[VXM7.0]に示されているColor Layout descriptorの類似度算出式では、同様の判断を行うことが困難であった。

【００３０】本発明は上記の課題を解決するためになされたものであり、従来、類似画像と判定することができなかった回転すると類似する画像や鏡面変換すると類似する画像を、類似画像として判定することができる画像処理装置及びその方法、プログラムを提供することを目的とする。

【００３１】

【課題を解決するための手段】上記の目的を達成するための本発明による画像処理装置は以下の構成を備える。即ち、また、好ましくは、画像間の類似度を算出する画

像処理装置であって、少なくとも量子化ＤＣＴ係数で表現される第１及び第２画像それぞれの第１及び第２画像特徴量に基づいて、該第１及び第２画像間の類似度を算出する第１算出手段と、前記第１及び第２画像特徴量の少なくとも一方に対して、係数変換処理を施す係数変換手段と、前記係数変換手段によって得られる画像特徴量に基づいて、前記第１及び第２画像間の類似度を算出する第２算出手段と、前記第１及び第２算出手段で算出された類似度群から前記第１及び第２画像間の類似度を決定する決定手段とを備える。

【００３２】また、好ましくは、前記係数変換処理は、前記画像特徴量に含まれる量子化ＤＣＴ係数に対して、該量子化ＤＣＴ係数をＵ－Ｖ座標系に配置した場合のＵ＝Ｖに対する対称変換処理及び該量子化ＤＣＴ係数の一部に対する正負反転変換処理の内の少なくとも１つを含む。

【００３３】また、好ましくは、前記決定手段は、前記第１及び第２算出手段で算出された類似度群の内、所定値に一番近い値の類似度を前記第１及び第２画像間の類似度として決定する。

【００３４】また、好ましくは、前記第１及び第２画像は、対応する第１及び第２原画像それぞれを８×８画素の画像に変倍した画像である。

【００３５】上記の目的を達成するための本発明による画像処理方法は以下の構成を備える。即ち、画像間の類似度を算出する画像処理方法であって、少なくとも量子化ＤＣＴ係数で表現される第１及び第２画像それぞれの第１及び第２画像特徴量に基づいて、該第１及び第２画像間の類似度を算出する第１算出工程と、前記第１及び第２画像特徴量の少なくとも一方に対して、係数変換処理を施す係数変換工程と、前記係数変換工程によって得られる画像特徴量に基づいて、前記第１及び第２画像間の類似度を算出する第２算出工程と、前記第１及び第２算出工程で算出された類似度群から前記第１及び第２画像間の類似度を決定する決定工程とを備える。

【００３６】上記の目的を達成するための本発明によるプログラムは以下の構成を備える。即ち、画像間の類似度を算出する画像処理をコンピュータに機能させるためのプログラムであって、少なくとも量子化ＤＣＴ係数で表現される第１及び第２画像それぞれの第１及び第２画像特徴量に基づいて、該第１及び第２画像間の類似度を算出する第１算出工程のプログラムコードと、前記第１及び第２画像特徴量の少なくとも一方に対して、係数変換処理を施す係数変換工程のプログラムコードと、前記係数変換工程によって得られる画像特徴量に基づいて、前記第１及び第２画像間の類似度を算出する第２算出工程のプログラムコードと、前記第１及び第２算出工程で算出された類似度群から前記第１及び第２画像間の類似度を決定する決定工程のプログラムコードとを備える。

【００３７】

【発明の実施の形態】以下、図面を参照して本発明の好適な実施形態について詳細に説明する。

【００３８】図１は本発明の実施形態の画像処理装置の構成を示すブロック図である。

【００３９】データ入出力部１０５００は、静止画像データと動画像データの両方を入出力可能な画像入力装置である。具体的には、スチル撮影可能なデジタルビデオ装置がある。また、メモリーカード、ＰＣカード等の外部記憶装置からＵＳＢ等の通信インタフェースを介して、画像データを読み込むことも可能である。更に、ＣＤ－ＲＯＭ装置やフロッピー（登録商標）ディスク装置等の記憶媒体を着脱可能な記憶装置から画像データを入力する構成であってもよい。加えて、イーサネット（登録商標）カードやモデム、無線通信等の通信路制御装置によるネットワーク接続等の通信路を介して画像データを入力する構成であってもよい。一方、データ入出力部１０５００は、画像データを、例えば、メモリーカードへ書き込むことも行う。

【００４０】入力部１０５０１は、ユーザからの指示やデータを入力する装置であり、キーボードやポインティング装置を含む。尚、ポインティング装置としては、マウス、トラックボール、トラックパッド、タブレット等が挙げられる。

【００４１】蓄積部１０５０２は、画像データや後述する画像特徴量抽出処理によって得られる画像特徴量データを蓄積する装置であり、通常は、ハードディスク等の大容量記憶媒体が用いられるが、この他でも、例えば、ＣＤ－ＲＯＭ、ＣＤ－Ｒ／ＲＷ等の光／光磁気ディスクであってもよい。さらには、メモリーカード、ＰＣカード等の記憶媒体であってもよい。概念上、蓄積部１０５０２とデータ入出力部１０５００を区別して説明しているが、実際の装置においてはこれらが同一のものであっても構わない。

【００４２】表示部１０５０３は、ＧＵＩ（グラフィックユーザインタフェース）等の画像を表示する装置であり、一般的には、ＣＲＴや液晶ディスプレイ等が用いられる。

【００４３】ＣＰＵ１０５０４は、上述の各構成要素を制御する。ＲＯＭ１０５０５とＲＡＭ１０５０６は、ＣＰＵ１０５０４が実行する処理に必要な制御プログラム、データ、作業領域等をＣＰＵ１０５０４に提供する。また、後述する各実施形態で説明するフローチャートで示される画像特徴抽出処理を実現する制御プログラムは、例えば、蓄積部１０５０２に格納されていても、ＲＯＭ１０５０５に記憶されていても良い。特に、ＲＯＭ１０５０５に格納されている場合は、一旦、ＲＡＭ１０５０６上に、その制御プログラムを読み込んでから実行される。

【００４４】１０５０７は、画像処理部であり、以下に詳述する画像類似度算出処理を含む各種画像処理を実行

する。

【００４５】バス１０５０８は、上述の各構成要素を相互に接続する。

【００４６】尚、以下に説明する各実施形態で説明するフローチャートの各処理は、ＣＰＵ１０５０４によって制御される画像処理部１０５０７で実現されるものとするが、後述する画像処理部１０５０７の各機能を実現する専用プログラムによって実現されても良い。更には、各処理のすべて／一部を専用ハードウェアと専用プログラムの任意の組み合わせによって実現しても良い。

【００４７】本実施形態の画像類似度算出処理を説明する前に、一般的なＤＣＴ係数の変換処理と、その原画像の画素の関係について説明する。

【００４８】尚、以下の説明において、Ｙ、Ｃｂ、Ｃｒ成分の量子化ＤＣＴ係数がそれぞれｘ、ｙ、ｚ個であるColor Layout descriptorを、便宜上、ｘ／ｙ／ｚ descriptorと略する。また、本実施形態では、図１４及び図１５で説明した[VWD4.0]もしくは[VXM7.0]に記載されているColor Layout descriptorのデータ格納方式のデータを例に挙げて説明しているが、本発明は、これにに限定されるものではなく、量子化ＤＣＴ係数の幾つかを保持して、これを画像特徴量とするデータ格納方式であれば適用することができる。

【００４９】図２に示されるように、８×８画素の原画像（ｆ(x,y)）に対して、二次元ＤＣＴ変換を施すことにより、ＤＣＴ係数（Ｆ(U,V)）が得られる。Ｕ、Ｖはそれぞれ原画像のｘ方向、ｙ方向の変化と対応する。二次元ＤＣＴ変換は次式で与えられる。

【００５０】

$$F(U,V)=\frac{1}{4}C_U C_V\sum_{x=0}^{7}\sum_{y=0}^{7}f(x,y)\cos\frac{(2x+1)U\pi}{16}\cos\frac{(2y+1)V\pi}{16} \qquad 式(1)$$

$$C_U,C_V=\begin{cases}\dfrac{1}{\sqrt{2}} & (U,V=0)\\ 1 & (else)\end{cases}$$

【００５１】図３は本発明の実施形態の一次元ＤＣＴ変換の基底波形を示す図である。

【００５２】図３における各波形は、図２におけるＶ＝０であるときの、Ｕ＝０～７の９つの基底波形を二次元平面に投射した図に相当する。Ｖについても同様であり、一般的なＤＣＴ係数Ｆ(a, b)は、原画像における、Ｕ＝ａ、Ｖ＝ｂの基底波形を二次元的に合成した空間波形成分の大きさを表している。

【００５３】また、図３において、Ｕが偶数の場合の基底波形は左右対称であり、Ｕが奇数の場合の基底波形は点対称、即ち、１８０度回転することで元の波形と重なりあう波形をしている。このことは、Ｖについても同様であり、Ｖが偶数の場合は左右対称、Ｖが奇数の場合は点対称である。

【００５４】図４は本発明の実施形態のＤＣＴ係数の入替処理と原画像の関係を説明する図である。

【００５５】図４に示すように、ＤＣＴ係数３０１をＵ＝Ｖに対して線対称となるように入れ替えた場合、入れ替え後のＤＣＴ係数に逆ＤＣＴ変換を施して得られた画像は、原画像３０２をｘ＝ｙに対して線対称に入れ替えたものと同じものになる。これは、原画像に対して左９０度回転処理を施して、さらに垂直方向に鏡面処理を施したものと同じなので、以下、図４による変換処理を左９０度回転垂直鏡面変換と呼ぶこととする。

【００５６】図５は本発明の実施形態のＤＣＴ係数でＶが奇数である場合の符号反転処理と原画像の関係を説明する図である。

【００５７】図５において、ＤＣＴ係数４０１の内、ハッチング部分はＶが奇数であるＤＣＴ係数である。このＤＣＴ係数の符号を反転したＤＣＴ係数に逆ＤＣＴ変換を施して得られた画像は、原画像４０２を垂直方向に鏡面処理を施したものと同じになる。以下、図５による変換処理を垂直鏡面変換と呼ぶこととする。

【００５８】図６は本発明の実施形態のＤＣＴ係数でＵが奇数である場合の符号反転処理と原画像の関係を説明する図である。

【００５９】図６において、ＤＣＴ係数５０１のうち、灰色で示される部分はＵが奇数であるＤＣＴ係数である。このＤＣＴ係数の符号を反転したＤＣＴ係数に逆ＤＣＴ変換を施して得られた画像は、原画像５０２を水平方向に鏡面処理を施したものと同じになる。以下、図６による変換処理を水平鏡面変換と呼ぶこととする。

【００６０】図７は本発明の実施形態の原画像とそれに対して回転変換もしくは鏡面変換を施した画像の一覧を示す図である。

【００６１】ここまで説明したように、これらの変換は、ＤＣＴ係数に図４～図６を用いて説明した左９０度回転垂直鏡面変換、垂直鏡面変換、水平鏡面変換の組み合わせを施すことによりＤＣＴ係数上で変換することが可能である。例えば、図７の６０２～８０６に相当するＤＣＴ係数は、原画像のＤＣＴ係数に対してそれぞれ

６０２：水平鏡面変換

６０３：左９０度回転垂直鏡面変換＋垂直鏡面変換

６０４：左９０度回転垂直鏡面変換＋垂直鏡面変換＋水平鏡面変換

６０５：垂直鏡面変換＋水平鏡面変換

６０６：垂直鏡面変換

６０７：左９０度回転垂直鏡面変換＋水平鏡面変換

６０８：左９０度回転垂直鏡面変換
といった変換パターンに従う変換処理を施すことによって実現される。ここで示した処理手順は、６０２～６０８を表すＤＣＴ係数を得るための手順の例であって、図４～図６で示した３つの処理によって、６０２～６０８に対応するＤＣＴ係数が得られることを示している。従って、他の組み合わせ、処理順序によって６０２～６０８に対応するＤＣＴ係数を得るのであってもよい。

【００６２】尚、Color Layout descriptorは、従来技術で説明したように、量子化ＤＣＴ係数を図１３で示したジグザグスキャン順に並び替え、先頭の低周波成分側から幾つかの量子化ＤＣＴ係数を選択して取り出して格納する。従って、図４～図６で説明したような係数変換処理を行う場合に、必ずしも６４個全ての量子化ＤＣＴ係数に対して係数変換処理を施すのではなく、Color Layout descriptorが有する量子化ＤＣＴ係数部分にのみ処理を施すことになる。

【００６３】図８は本発明の実施形態の６／３／３ descriptorにおける係数変換処理の例を示す図である。

【００６４】但し、従来例で説明した通り、Color Layout descriptorでは、ＤＣＴのＡＣ成分は、げたばき表現によって５ｂｉｔ符号なし整数で表現されている。従って、Color Layout descriptorに対する符号反転処理では、量子化前のＤＣＴ係数が０であることと対応する、１６に対する反転表現となる。即ち、元の量子化されたＡＣ係数がａであった場合、反転後の値ａ'は、

$$a' = 16 - (a - 16) = 32 - a \qquad \text{式（2）}$$

で得られる。尚、式（２）では、ａの値が０であった場合、ａ'の値は３２となるが、その場合は３１に丸める等すればよい。

【００６５】次に、画像処理部１０５０７の詳細構成について、図９を用いて説明する。

【００６６】図９は本発明の実施形態の画像処理部の詳細構成を示す図である。

【００６７】図9において、９００、９０１は類似度算出対象の２つのColor Layout descriptorデータ、ＣＬＤq及びＣＬＤtである。実施形態２では、ＣＬＤq（９００）のみを係数変換処理部９１０に入力しているが、ＣＬＤt（９０１）の両方を係数変換処理部９１０に入力し、双方に対して係数変換処理を実行する構成であってもよい。また、その際に、係数変換処理部を複数設けて実現してもよい。

【００６８】係数変換処理部９１０は、入力されたＣＬＤq（９００）に、上述の図４～図６で説明した変換処理を施す。尚、この変換処理は、無変換を含む変換処理である。

【００６９】初期類似度候補算出部９０３は、ＣＬＤq（９００）とＣＬＤt（９０１）の類似度を算出し、これをＣＬＤq（９００）とＣＬＤt（９０１）間の類似度候補データとして類似度候補記憶部９１３に記憶する。この類似度算出で用いる類似度算出式は任意のものであってよいが、ここでは、例えば、従来技術で説明した類似度算出式を用いるとする。

【００７０】距離算出部９１１は、変換処理部９１０の出力とＣＬＤt（９０１）との間の類似度を算出する。この類似度算出で用いる類似度算出式は、初期類似度候補算出部９０３で用いたものと同一である。

【００７１】類似度算出部９１１から算出される類似度は、類似度比較部９１２によって類似度候補記憶部９１３に保持されている類似度候補データと比較する。類似度比較部９１２は、これら２つの類似度値から、より類似していると判断される類似度値を選択し、その類似度値を類似度候補記憶部９１３が保持する類似度候補データとして更新する。本実施形態では、類似度算出式として、従来技術で説明した類似度算出式を用いているので、類似度値が小さいものを類似度候補記憶部９１３に保持する。尚、類似度候補記憶部９１３が保持する類似度候補データは、従来技術で説明した類似度算出式を用いたＣＬＤq（９００）とＣＬＤt（９０１）間の類似度としたが、処理の開始時に適当な値、あるいは十分に大きな値などで初期化するようにしても良い。これは、本実施形態では、類似度算出式として、従来技術で説明した類似度算出式を用いているので、類似度算出式の数値が小さいほど類似していると判断されるためである。

【００７２】この係数変換処理部９１０から、類似度候補記憶部９１３が保持する類似度候補データの処理は、必要回数繰り返され、また、その度に係数変換処理部９１０は異なった変換、つまり、図7の６０１～６０８の変換パターンの内、必要なものに相当する係数変換処理を行う。

【００７３】最後に、全ての変換パターンについて処理が終わった時点で類似度候補記憶部９１３が保持する類似度候補データを最終的なＣＬＤq（９００）とＣＬＤt（９０１）間の類似度９０２として出力し、処理を終了する。

【００７４】尚、上記の構成では、変換パターンに応じた係数変換処理を係数変換処理部９１０で繰り返すことに各変換パターンによる係数変換処理を実現しているが、これに限定されない。例えば、個々の変換パターンによる係数変換処理を実現する係数変換処理部を必要数配置し、それらにそれぞれＣＬＤq（９００）を入力し、各係数変換処理部から得られるＤＣＴ係数に基づく類似度同士を比較して、最も適切な類似度を選択する構成であってもよい。この場合、類似度候補記憶部９１３は省略することが可能である。

【００７５】次に、本実施形態の画像処理部１０５０７によって実行される画像類似度算出処理について、図１０を用いて説明する。

【００７６】図１０は本発明の実施形態の画像類似度算

出処理を示すフローチャートである。

【００７７】尚、本実施形態では、２つのColor Layout descriptor，ＣＬＤｑとＣＬＤｔの間の類似度判定処理を行うものとする。また、図７で示した原画像と７つの変換パターン全てについて類似度判定を行うものとする。但し、これは本発明の適用先の要求に応じて、例えば、回転のみを行い鏡面については考慮に入れない、ということにするのであってもよい。

【００７８】また、上述したように、本画像類似度算出処理は、画像処理部１０５０７でハードウェア的に実現されるが、専用プログラムによってその処理の全部／一部がソフトウェア的に実現されても良い。

【００７９】まず、ステップＳ８０１で、初期類似度候補算出部９０３は、ＣＬＤｑとＣＬＤｔの間の類似度を算出し、最小類似度候補Ｄmin（類似度候補データ）に代入して、Ｄminの初期化を行い、類似度候補記憶部９１３に記憶する。尚、ここでの類似度算出は、上述したように、従来技術で説明した類似度算出式を用いる。また、この類似度算出式による類度値は、類似度は正の値で、０に近いほど類似している度合が高いと判定される。

【００８０】次に、ステップＳ８０２で、係数変換処理部９１０は、ＣＬＤｑに対して変換処理を施し、ＣＬＤｑ[1]～ＣＬＤｑ[7]の７通りの変換パターンを生成する。ここで、７通りとなっているのは、上述の図７の７つの変換パターンを用いるという前提から生じるものである。

【００８１】ステップＳ８０３で、以下のステップＳ８０４～ステップＳ８０８の繰り返し処理の制御のための変数ｉの初期化として、係数変換処理部９１０は、ｉ＝１に設定する。

【００８２】ステップＳ８０４で、係数変換処理部９１０は、その繰り返し判定の終了判定処理を行う。具体的には、変数ｉが７以下であるか否かを判定する。変数ｉが７より大きい場合（ステップＳ８０４でＮＯ）、類似度候補記憶部９１３に記憶されている最小類似度候補Ｄminを最終的なＣＬＤｑ[i]とＣＬＤｔ間の類似度として出力し、処理を終了する。一方、変数ｉが７以下である場合（ステップＳ８０４でＹＥＳ）、ステップＳ８０５に進む。

【００８３】ステップＳ８０５で、類似度算出部９１１は、ＣＬＤｑ[i]とＣＬＤｔ間の類似度Ｄの算出を行う。この類似度算出は、ステップＳ８０１で用いた類似度算出式を用いる。

【００８４】ステップＳ８０６で、類似度算出部９１１は、類似度候補記憶部９１３に記憶されている最小類似度候補Ｄminと算出した類似度Ｄの比較を行う。具体的には、ＤminがＤ以上であるか否かを判定する。ＤminがＤ未満である場合（ステップＳ８０１でＮＯ）、ステップＳ８０６に進む。一方、ＤminがＤ以上である場合（ステップＳ８０１でＹＥＳ）、ステップＳ８０７に進み、最小類似度候補Ｄminを類似度Ｄとして更新する。

【００８５】そして、ステップＳ８０８で、係数変換処理部９１０は、変数ｉを１インクリメントする。

【００８６】尚、ステップＳ８０６における不等号の向きは、類似度算出式では、類似度は正の値で０に近いほど類似していると判定されることによる。従って、仮に、類似度算出式の値が大きいほど類似していると判定される場合には、この不等号の向きは逆になる。

【００８７】また、本実施形態で用いた類似度算出式では、類似度の最小値は０である。従って、このような場合には、ステップＳ８０１における初期類似度候補算出部９０３で算出された類似度候補である最小類似度候補Ｄminが理論最小値（この場合は「０」）であるかどうかの判断処理を、ステップＳ８０１の後に設けて、理論最小値である場合にはステップＳ８０２～ステップＳ８０８の処理を全て省略し、理論最小値でない場合には、ステップＳ８０２以下の処理を行う構成であっても良い。この場合、特に、理論最小値である場合には、処理の効率化が図れる。

【００８８】更に、本実施形態では、変換パターンとの比較で、ループを用いて逐次的に処理を行ったが、例えば、これを並列処理して実現するようにしても良い。

【００８９】以上説明したように、本実施形態によれば、画像間の類似度算出において、画像の回転や鏡面変換を考慮した類似度を算出し、これを画像間の類似判定に用いることで、従来、類似画像と判定することができなかった回転すると類似する画像や鏡面変換すると類似する画像を、類似画像として判定することができる。

【００９０】尚、本発明は、複数の機器（例えばホストコンピュータ、インタフェース機器、リーダ、プリンタなど）から構成されるシステムに適用しても、一つの機器からなる装置（例えば、複写機、ファクシミリ装置など）に適用してもよい。

【００９１】また、本発明の目的は、前述した実施形態の機能を実現するソフトウェアのプログラムコードを記録した記憶媒体を、システムあるいは装置に供給し、そのシステムあるいは装置のコンピュータ（またはＣＰＵやＭＰＵ）が記憶媒体に格納されたプログラムコードを読出し実行することによっても、達成されることは言うまでもない。

【００９２】この場合、記憶媒体から読出されたプログラムコード自体が前述した実施形態の機能を実現することになり、そのプログラムコードを記憶した記憶媒体は本発明を構成することになる。

【００９３】プログラムコードを供給するための記憶媒体としては、例えば、フロッピディスク、ハードディスク、光ディスク、光磁気ディスク、ＣＤ－ＲＯＭ、ＣＤ－Ｒ／RW、ＤＶＤ－ＲＯＭ／ＲＡＭ、磁気テープ、不揮発性のメモリカード、ＲＯＭなどを用いることができ

る。

【００９４】また、コンピュータが読出したプログラムコードを実行することにより、前述した実施形態の機能が実現されるだけでなく、そのプログラムコードの指示に基づき、コンピュータ上で稼働しているＯＳ（オペレーティングシステム）などが実際の処理の一部または全部を行い、その処理によって前述した実施形態の機能が実現される場合も含まれることは言うまでもない。

【００９５】更に、記憶媒体から読出されたプログラムコードが、コンピュータに挿入された機能拡張ボードやコンピュータに接続された機能拡張ユニットに備わるメモリに書込まれた後、そのプログラムコードの指示に基づき、その機能拡張ボードや機能拡張ユニットに備わるＣＰＵなどが実際の処理の一部または全部を行い、その処理によって前述した実施形態の機能が実現される場合も含まれることは言うまでもない。

【００９６】本発明を上記記憶媒体に適用する場合、その記憶媒体には、先に説明したフローチャートに対応するプログラムコードが格納されることになる。

【００９７】

【発明の効果】以上説明したように、本発明によれば、従来、類似画像と判定することができなかった回転すると類似する画像や鏡面変換すると類似する画像を、類似画像として判定することができる画像処理装置及びその方法、プログラムを提供できる。

【図面の簡単な説明】

【図１】本発明の実施形態の画像処理装置の構成を示すブロック図である。

【図２】本発明の実施形態の二次元ＤＣＴ変換を説明するための図である。

【図３】本発明の実施形態の一次元ＤＣＴ変換の基底波形を示す図である。

【図４】本発明の実施形態のＤＣＴ係数の入替処理と原画像の関係を説明する図である。

【図５】本発明の実施形態のＤＣＴ係数でＶが奇数である場合の符号反転処理と原画像の関係を説明する図である。

【図６】本発明の実施形態のＤＣＴ係数でＵが奇数である場合の符号反転処理と原画像の関係を説明する図である。

【図７】本発明の実施形態の原画像とそれに対して回転変換もしくは鏡面変換を施した画像の一覧を示す図である。

【図８】本発明の実施形態の６／３／３ descriptorにおける係数変換処理の例を示す図である。

【図９】本発明の実施形態の画像処理部の詳細構成を示す図である。

【図１０】本発明の実施形態の画像類似度算出処理を示すフローチャートである。

【図１１】[VWD4.0]もしくは[VXM7.0]に記載されている「Color Layout descriptor」における画像特徴量抽出処理を説明するための図である。

【図１２】[VWD4.0]もしくは[VXM7.0]による画像特徴抽出処理を示すフローチャートである。

【図１３】ジグザグスキャン処理を説明するための図である。

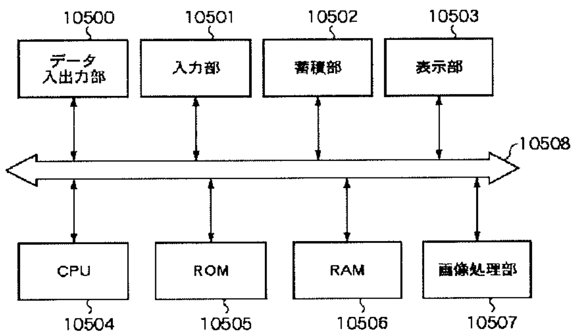
【図１４】[VWD4.0]もしくは[VXM7.0]に記載されているColor Layout descriptorのバイナリ構造を示す図である。

【図１５】[VWD4.0]もしくは[VXM7.0]に記載されているColor Layout descriptorのバイナリ構造を示す図である。

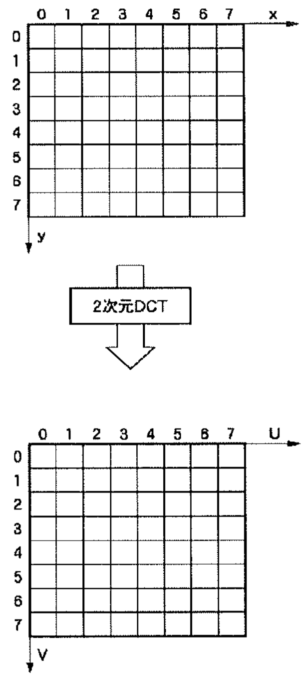
【符号の説明】

１０５００　データ入出力部
１０５０１　入力部
１０５０２　蓄積部
１０５０３　表示部
１０５０４　ＣＰＵ
１０５０５　ＲＯＭ
１０５０６　ＲＡＭ
１０５０７　画像処理部
９０３　初期類似度候補算出部
９１０　係数変換処理部
９１１　類似度算出部
９１２　類似度比較部
９１３　類似項候補記憶部

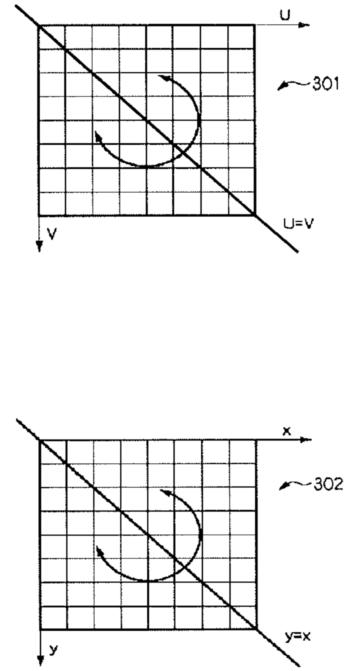
【図１】



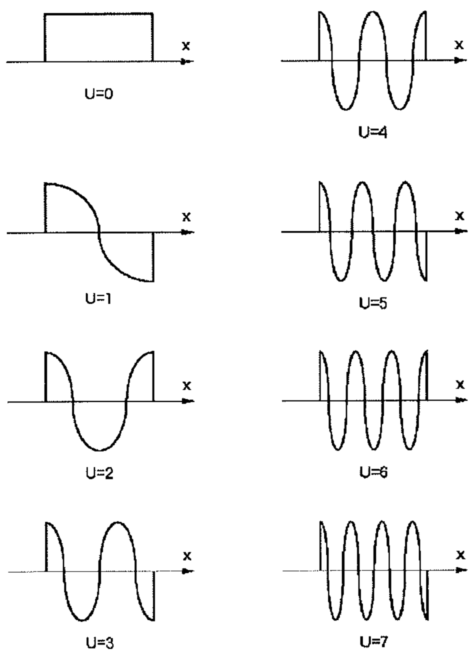
【図２】



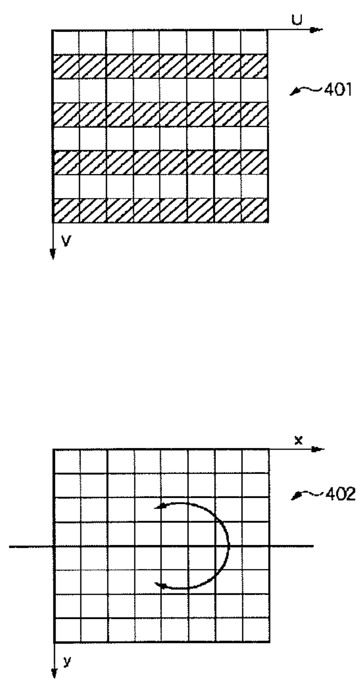
【図４】



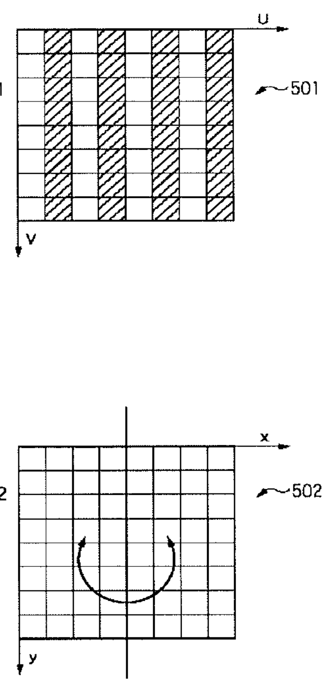
【図３】



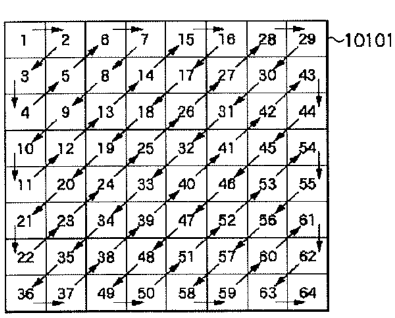
【図５】



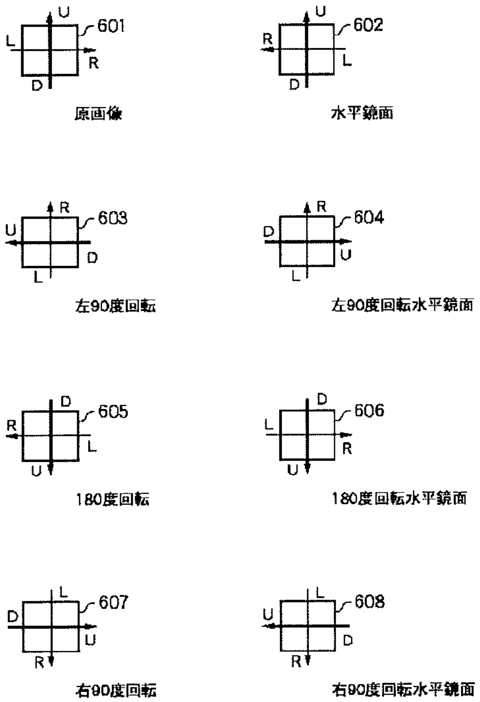
【図６】



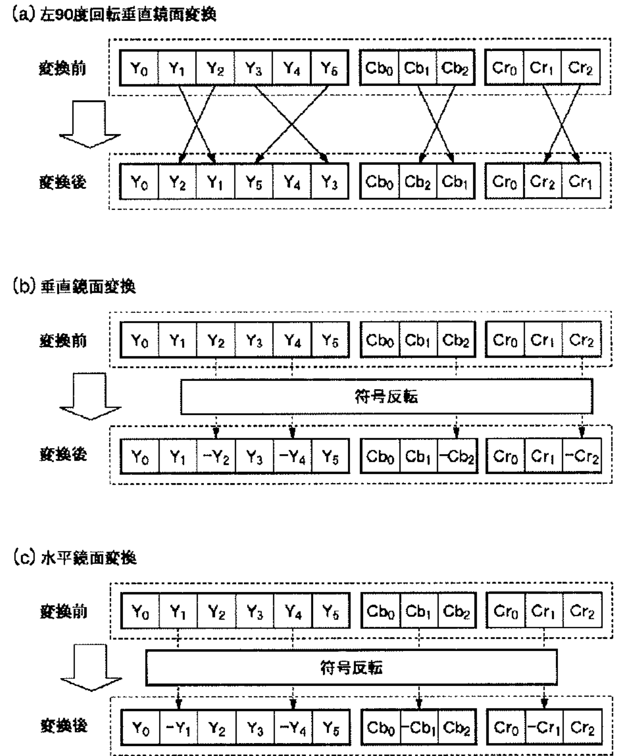
【図１３】



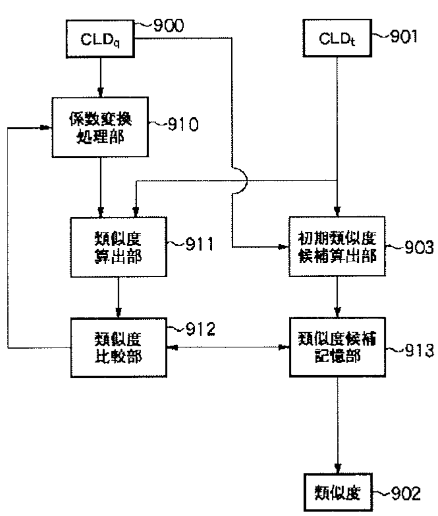
【図７】



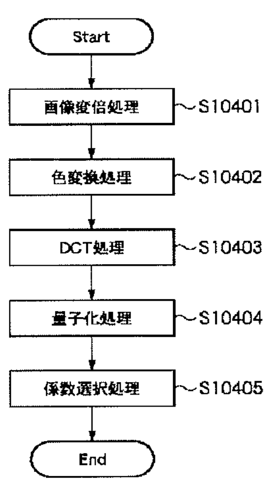
【図８】



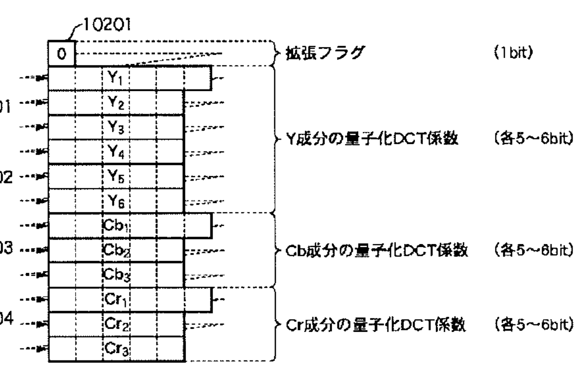
【図９】



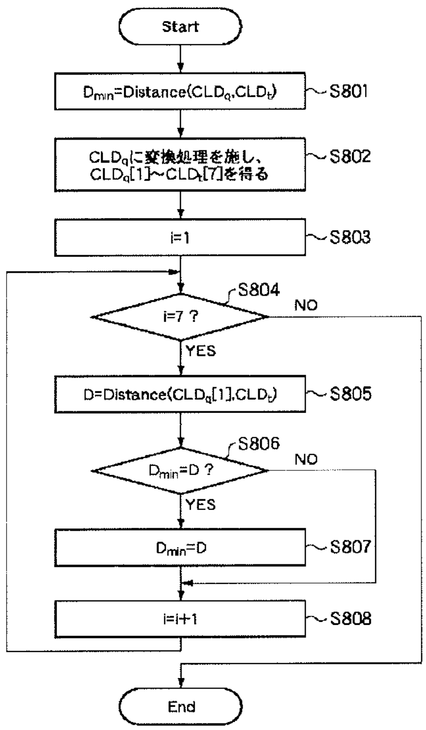
【図１２】



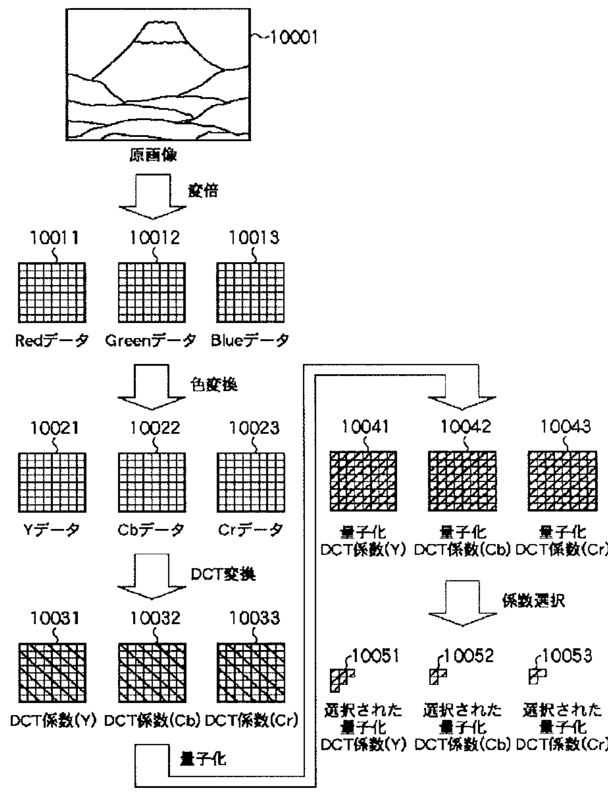
【図１４】



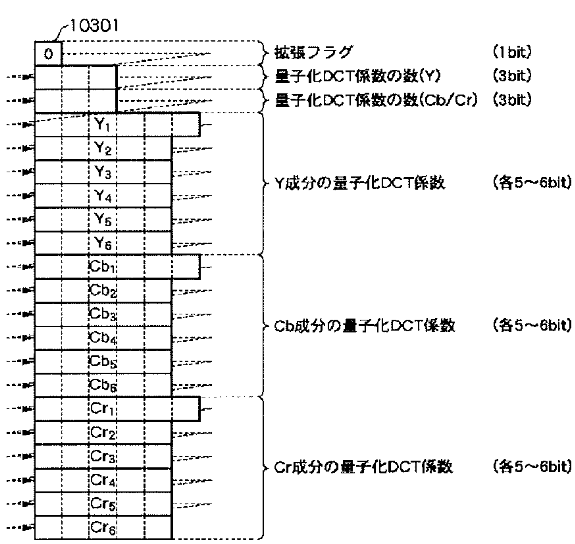
【図１０】


Start
D_{min}=Distance(CLD_q,CLD_t)
S801
CLD_qに変換処理を施し、CLD_q[1]〜CLD_t[7]を得る
S802
i=1
S803
S804
i=7 ?
NO
YES
D=Distance(CLD_q[1],CLD_t)
S805
S806
D_{min}=D ?
NO
YES
D_{min}=D
S807
i=i+1
S808
End

【図１１】


10001
原画像
変倍
10011
10012
10013
Redデータ
Greenデータ
Blueデータ
色変換
10021
10022
10023
Yデータ
Cbデータ
Crデータ
DCT変換
10031
10032
10033
DCT係数(Y)
DCT係数(Cb)
DCT係数(Cr)
量子化
10041
10042
10043
量子化DCT係数(Y)
量子化DCT係数(Cb)
量子化DCT係数(Cr)
係数選択
10051
10052
10053
選択された量子化DCT係数(Y)
選択された量子化DCT係数(Cb)
選択された量子化DCT係数(Cr)

【図１５】


10301
0
拡張フラグ (1bit)
量子化DCT係数の数(Y) (3bit)
量子化DCT係数の数(Cb/Cr) (3bit)
Y_1
Y_2
Y_3
Y_4
Y_5
Y_6
Y成分の量子化DCT係数 (各5〜6bit)
Cb_1
Cb_2
Cb_3
Cb_4
Cb_5
Cb_6
Cb成分の量子化DCT係数 (各5〜6bit)
Cr_1
Cr_2
Cr_3
Cr_4
Cr_5
Cr_6
Cr成分の量子化DCT係数 (各5〜6bit)

フロントページの続き

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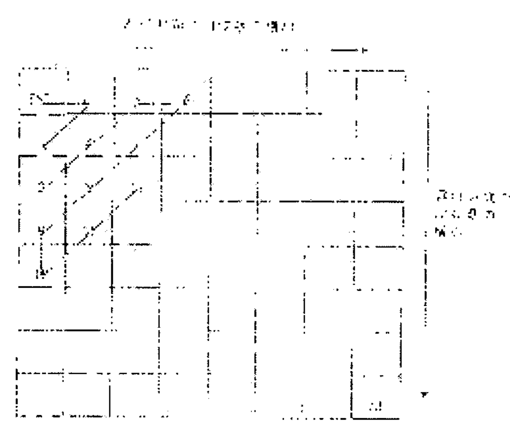
(54) IMAGE COMPARISON METHOD, COMPUTER READABLE STORAGE MEDIUM FOR STORING PROGRAM FOR EXECUTION OF THE METHOD, AND DEVICE FOR EXECUTION OF THE METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an image comparison method using DCT coefficients.
SOLUTION: Using DCT coefficients to determine the similarity between images eliminates the need for an operation to decode the DCT-encoded images in such cases as performing a pixel comparison in the space domain. The image comparison method comprises comparison of DCT coefficients for a pair of image regions to determine the similarity between the image regions, wherein the comparison involves at least one AC coefficient and the influence of at least one AC coefficient is weighted in the determination of similarity.



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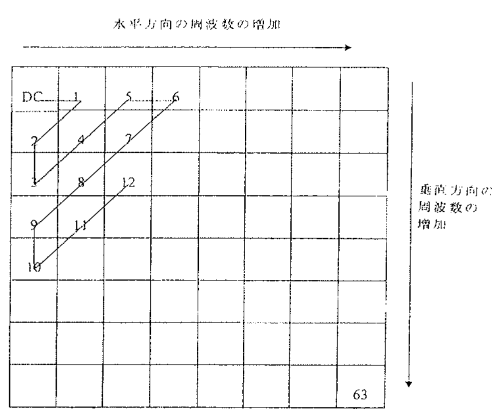
(54)【発明の名称】画像の比較方法、方法を実行するためのプログラムを記憶するコンピュータ可読記憶媒体、および方法を実行する装置

(57)【要約】
【課題】　ＤＣＴ係数を用いた画像の比較方法を提供する。
【解決手段】　ＤＣＴ係数を用いて画像間の類似度を判定することにより、空間ドメインで画素の比較を行うときなどに、ＤＣＴ符号化された画像を復号化する操作を不要とする。本方法は、画像領域ペアのＤＣＴ係数を比較することであって、それによって画像領域間の類似度を判定する、比較することを含み、この比較は少なくとも１つのＡＣ係数を含み、類似度の判定における少なくとも１つのＡＣ係数の影響が重み付けされる。
【選択図】　図３



【特許請求の範囲】
【請求項１】
画像領域ペアのＤＣＴ係数を比較することであって、それによって前記画像領域間の類似度を判定する、比較することを含む、
画像の比較方法であって、
前記比較は少なくとも１つのＡＣ係数を含み、
前記類似度の前記判定における少なくとも１つのＡＣ係数の影響が重み付けされる、
画像の比較方法。
【請求項２】
前記画像領域ペアの対応するＡＣ係数の少なくとも１つのペアの間の差を計算することと、
前記差を重み付けすることと
を含む請求項１に記載の画像の比較方法。
【請求項３】
前記画像領域ペアのＤＣＴ係数の複数の対応するペアの重み付けした差を計算することを含み、さらに、
前記重み付けした差を総和すること
を含む請求項２に記載の画像の比較方法。
【請求項４】
重み付けした差または重み付けした差の総和を閾値と比較することであって、それによって類似度を判定する、比較することを含む請求項２または請求項３に記載の画像の比較方法。
【請求項５】
画像領域ペアのＤＣＴ係数を比較することであって、それによって前記画像領域間の類似度を判定する、比較することを含む、
画像の比較方法であって、
第１の画像領域の第１のＤＣＴ係数が第２の画像領域の対応するＤＣＴ係数と比較され、
前記第１の画像領域の第２のＤＣＴ係数が前記第２の画像領域の第２のＤＣＴ係数と比較され、
前記比較の各々の結果が前記類似度の判定に個別に用いられる、
画像の比較方法。
【請求項６】
ひとつのＡＣ係数を含む少なくとも１つの比較の影響が前記類似度の判定において重み付けされる請求項５に記載の画像の比較方法。
【請求項７】
対応するＡＣ係数の少なくとも１つのペアの間の差を計算することと、
前記差を閾値と比較することと
を含む請求項１、請求項５または請求項６に記載の画像の比較方法。
【請求項８】
対応するＤＣＴ係数の複数のペアの差を計算することと、
前記差の各々をそれぞれの閾値と比較することと
を含む請求項７に記載の画像の比較方法。
【請求項９】
少なくとも１つのＡＣ係数には複数の閾値が関連付けられている請求項７または請求項８に記載の画像の比較方法。
【請求項１０】
ＤＣＴ係数の閾値の選択が別のＤＣＴ係数の閾値との前記比較の結果に応じて行われる請求項９に記載の画像の比較方法。
【請求項１１】

ＡＣ係数の閾値の選択がＤＣ係数の閾値との前記比較の結果に応じて行われる請求項１０に記載の画像の比較方法。

【請求項１２】

類似度が多数決により、１つまたは複数のＤＣＴ係数の前記閾値との前記比較の結果を用いて判定される請求項７ないし１１のいずれか１項に記載の画像の比較方法。

【請求項１３】

複数のＡＣ係数を含み、

前記複数のＡＣ係数は、ＤＣＴ配列の左上から右下への対角線上の係数のみを含むか、

または、前記ＤＣＴ配列の前記左上から右下への対角線に直交する１つまたは複数の斜めの線上の全ての係数を含む

ことによって、ＤＣＴ周波数ドメインにおいてバランスが取られている、請求項１ないし１２のいずれか１項に記載の画像の比較方法。

【請求項１４】

請求項１ないし１３のいずれか１項に記載の方法を実行するためのプログラムを記憶するコンピュータ可読記憶媒体。

【請求項１５】

請求項１ないし１３のいずれか１項に記載の方法を実行するように適合した装置。

【請求項１６】

データプロセッサと、請求項１４に記載の記憶媒体とを備える請求項１５に記載の装置。

【請求項１７】

画像データソースを備える請求項１５または請求項１６に記載の装置。

【請求項１８】

ビデオ監視システムである請求項１５ないし１７のいずれか１項に記載の装置。

【発明の詳細な説明】

【技術分野】

【０００１】

本発明は、画像処理方法に関し、より具体的には画像間または画像の領域間の類似度を判定する方法に関する。本方法は例えば、動きの検出またはビデオを構成する画像のシーケンスにおけるシーン変化の検出に特に有用である。本発明はまた、これに対応する装置に関する。

【背景技術】

【０００２】

動きの検出が重要である用途の例にビデオ監視システムがある。例えば、ビデオ監視システムのカメラは、常態では動きのないシーンに向けられる場合があり、そのシステムでは、動きの検出が関心の対象となる。カメラが取り込んだ画像は通常、早期の段階で符号化される。これは、圧縮された画像データをシステムの他の部分に転送すれば効率が良くなるためである。

【０００３】

ＪＰＥＧやＭＰＥＧなどの一般的な符号化技法は、高いデータ圧縮比を実現することにより記憶および転送要件を低減する離散コサイン変換（以下ＤＣＴ）の使用を伴う。

【０００４】

画像間の変化を検出する既知の方法は、画像ペアの間で画素毎に差の計算を行うものである。しかしながら、例えば上述のようなＤＣＴを伴う技法を用いて画像が符号化されている場合、画素の比較を実行する前にまず画像を復号化する必要がある。復号化、特に逆ＤＣＴと、画素の比較を伴う動き検出アルゴリズムとはどちらも計算集約的(computationally intensive)であるため、利用可能な処理パワーに対する要求は高くなる。

【０００５】

検索や取り出しのためにビデオなどの画像シーケンスに索引を付けるには、画像シーケンスを、例えば１シーンまたは１回のカメラ動作（パンなど）に対応する「ショット」に

分割することが有用である場合がある。こうした分割を行うための様々な技法が既知であり、通常は画像ペアの間の類似度を検出し、小さい類似度をシーンまたはショット変化の表れとして解釈することを伴う。

【０００６】

論文「一般化したシーケンストレースを用いたビデオシーンの変化の検出（C. TaskiranおよびE. J. Delp著、Video scene change detection using the generalized sequence trace）」（Proceedings of IEEE Int'l Conference on Acoustic, Speech and Signal Processing, May 1998 pp. 2961-2964）は、ＭＰＥＧシーケンスにおける１フレームのＤＣＴのＤＣ係数を用いて、連続するフレームペアを比較し、よってシーン変化を検出する方法を開示している。より具体的には、ペアのフレームの各々についてｄｃ画像（１フレームのＤＣＴのＤＣ係数により形成される画像）と、各ｄｃ画像の輝度ヒストグラムとを得る。輝度ヒストグラムに基づく計算を用いて特徴ベクトルを導き出し、この特徴ベクトルを次のフレームペアの対応する特徴ベクトルと比較する。

【０００７】

論文「ビデオの解析、検索および閲覧：統合的かつコンテントベースの解決策（Video parsing, retrieval and browsing: An integrated and content-based solution）」（Zhang、Low、SmoliarおよびWu著、Proceedings ACM Multimedia '95）もまた、連続したカメラショット間の境界の検出を伴う画像シーケンスの時間的なセグメント化について記載しており、コンテントの比較およびセグメント化のためのＤＣＴ係数および動きベクトルの使用に言及している。

【０００８】

論文「圧縮データを用いたビデオの解析および閲覧（Video parsing and browsing using compressed data）」（Zhang、LowおよびSmoliar著、Multimedia Tools and Applications, Vol. 1 - 1995, pages 89-111）は、フレーム間の差、したがってショット境界を検出するためのＤＣＴ係数の使用を論じている。第１のアルゴリズムは、フレーム中のブロックのサブセットのＤＣＴ係数のサブセットを用いて各フレームのベクトル表現を作成する。次に、そのような２つのベクトル表現の内積を伴う差の評価尺度（metric）を用いてフレームペアを比較する。第２のアルゴリズムは、連続するビデオフレームの対応するブロックのＤＣＴ係数（全部で６４個の係数）間の差の総和を出し、その結果を閾値と比較する。この結果が閾値を上回る場合、そのブロックは２つのフレーム間で変化したと言える。ブロックの全てのＤＣＴ係数を用いるのではなく、係数およびブロックのサブセットのみを用いる。

【発明の開示】

【発明が解決しようとする課題】

【０００９】

上述の論文のいくつかのように、ＤＣＴ係数を用いて画像間の類似度を判定することにより、空間ドメインで画素の比較を行うときなどに、ＤＣＴ符号化された画像を復号化する必要がなくなる。

【００１０】

本発明は既知の技法に改良を施す。

【課題を解決するための手段】

【００１１】

本発明の態様を、本明細書に付随する請求項に示す。

【００１２】

概して、本発明の第１の態様は、それぞれの画像領域について少なくとも１つのＡＣ係数を含むＤＣＴ係数を比較し、画像領域間の類似度を判定することによって画像領域を比較する。類似度を判定する際のあるＡＣ係数の影響は、他のＤＣＴ係数（ＤＣ係数や他のＡＣ係数など）の影響とは異なる。言い換えれば、類似度の判定においてそのＡＣ係数、ＡＣ係数の一部または全部の影響を重み付けする。この重み付けは、例えば特定のＡＣ係数に関連する重みによって、あるいは閾値によって行うことができる。類似度の比較は、

１つのＡＣ係数またはいくつかのＡＣ係数を伴う可能性があり、ＤＣ係数を伴っても伴わなくてもよい。またＤＣ係数は、重み付けしてもしなくてもよい。重み付けは、類似度を検出する際のそれぞれの係数の信頼度を反映する。この信頼度は例えば実験によって判定することができる。

【００１３】

本発明の１実施形態によれば、画像領域間の類似度の計算は、画像領域ペアの対応するＤＣＴ係数ペアの間の差の、少なくとも１つのＡＣ係数を含む複数のＤＣＴ係数にわたる重み付き総和に基づく。重み付き総和の結果を１つまたは複数の閾値と比較する。

【００１４】

別の実施形態によれば、画像領域ペアの対応するＤＣＴ係数ペアの間の差を、少なくとも１つのＡＣ係数を含む複数のＤＣＴ係数について計算する。これらの差の各々を、それぞれのＤＣＴ係数に関連するそれぞれの閾値と比較する。係数の一部は複数の閾値と関連しており、この閾値の選択は別の係数の閾値比較の結果に応じて行う。

【００１５】

上記の実施形態を組み合わせてもよい。

【００１６】

本発明の別の態様では、類似度の判定において、画像領域のＤＣＴ係数を個別にすなわち互いに独立して比較する。例えば、１つの領域の１つのＤＣＴ係数を別の領域の対応するＤＣＴ係数と比較して評価し、この第１の評価とは別に、第１の領域の別のＤＣＴ係数を第２の領域の対応するＤＣＴ係数と比較して評価する。全体的な評価または類似度の判定では第１および第２の評価（ならびに任意の他の評価）の結果を併せて考えることができる。

【００１７】

本発明の１実施形態による方法は例えば、画像シーケンスにおいて動きを検出するために用いるか、または、シーケンスにおける変化（ショット変化またはシーン変化など）を検出することによって画像シーケンスを時間的にセグメント化するため、あるいは動きを含む領域と動きを含まない領域とを分けるために用いることができる。

【００１８】

本発明の１実施形態による方法はコンピュータなどの適当な装置により、画像データに対応する信号を処理することによって実施される。

【００１９】

本明細書において、画像領域という用語は、画素のグループなどの画像の領域を意味し、画像全体または画像の一部分に相当する場合がある。比較される画像領域は同一画像のものであっても別の画像のものであってもよい。

【発明の効果】

【００２０】

本発明における、画像間または画像の領域間の類似度を判定する方法は、例えば、動きの検出またはビデオを構成する画像のシーケンスにおけるシーン変化の検出に特に有用である。

【発明を実施するための最良の形態】

【００２１】

次に添付図面を参照して本発明の実施形態を説明する。

【００２２】

図１は、本発明の実施形態による方法を実施する、本発明の１実施形態による装置の概略図である。

【００２３】

図１の装置は、モニタ２と、プロセッサ４と、２つの記憶手段６および８とを含むコンピュータの形態である。キーボードやマウスなどの他の標準的な構成要素（図示せず）も含まれる。

【００２４】

一方の記憶手段６は、本発明の１実施形態による方法を実施するコンピュータプログラムを記憶する。他方の記憶手段８は画像データを記憶する。２つの別個の記憶手段を設ける必要はなく、その代わりに例えば単一の記憶手段を使用してもよい。記憶手段は、ハードディスク、フロッピー（登録商標）ディスクまたはＤＶＤなどの任意の既知のタイプの記憶装置であってよい。プログラムは、ソフトウェアの形態で実施する必要はなく、その代わりに例えば専用チップなどのハードウェア形態であってもよい。

【００２５】

プロセッサ４は後述のように、記憶手段６に記憶されているプログラムを用いて、記憶手段８に記憶されている画像データを操作する。

【００２６】

この実施形態において、画像データは空間ドメインに記憶される。言い換えれば、各画像は、複数の画素を表すデータの形態で記憶され、各画素はその色を表す値をＲＧＢ、ＨＳＶ、ＹＵＶなどの既知の形式で有する。これを図２に示す。図２は、画素２０に分割された画像１０（ビデオシーケンスのフレームまたはフィールドなど）を示す。代替的な実施形態では、画像データをＤＣＴドメインに記憶してもよい（以下を参照）。

【００２７】

図２に示すような空間ドメインの画像データは、ＤＣＴを用いて周波数ドメインに変換される。ＤＣＴは様々な技法（ＪＰＥＧやＭＰＥＧなど）における画像データの圧縮でよく知られているため、詳細な説明は行わない。しかしながら、簡単に概略を述べる。

【００２８】

ＤＣＴを行うために、画像の画像データは画素ブロックに分割される。この実施形態において、画像は図２に示すような８×８画素ブロックに分割される。他のサイズのブロック（Ｍ×Ｎ）を用いてもよい。

【００２９】

各ブロックにＤＣＴ変換を施す。その結果、そのブロックについて、ブロックを周波数ドメインで表す複数のＤＣＴ係数が得られる。より具体的には、ＤＣＴの結果、ブロックにおける画素の平均値に実質的に対応する１つのＤＣ係数と、６３個のＡＣ係数とが得られる。ＤＣＴ係数は通常、図３に示すような配列の形式で表され、この配列は、左から右に向かって水平方向の周波数の増加に相当し、上から下に向かって垂直方向の周波数の増加に相当する。図３に示すように、係数にはジグザグの順番で番号を付ける。以下では、図３に示すような画像領域のＤＣＴ係数の配列をＤＣＴブロックとして説明する。画像領域のＤＣＴブロックペアに対応するＤＣＴ係数は、配列において同じ位置を占めるＤＣＴ係数を意味する。

【００３０】

次に、ＤＣＴを用いて符号化した画像ペアを後述のように比較する。

【００３１】

次に画像領域ペアのＤＣＴブロックを比較して、原画像領域間の類似度を判定する。この実施形態において、画像中の１つの位置（例えば左上の角）にある画像領域のＤＣＴブロックを、同じ画像領域の別の位置にあるＤＣＴブロックと比較する。この比較は、動きの検出、または画像領域における著しい変化（ビデオなどの画像シーケンスにおけるシーン変化を示す可能性がある）の検出などの様々な理由で有用である可能性がある。

【００３２】

しかしながら、本発明は異なる画像中の領域の比較に限定されず、用途によっては同じ画像中の別の領域の比較に有用である可能性がある。

【００３３】

本実施形態では、現画像と基準画像からなる画像ペアにおける対応する画像領域のＤＣＴブロックを、以下に式（１）で示す重み付き総和を用いて比較する。

【００３４】

【数１】

$$D_1 = \sum_{i=0}^{n} w_i \left| C_i^C - C_i^R \right| \qquad (1)$$

【００３５】
ここで、Ｗ$_i$ は係数ｉの重みであり、
【００３６】
【数２】

$$C_i^C$$

【００３７】
は、現画像の領域のｉ番目の係数の値であり、
【００３８】
【数３】

$$C_i^R$$

【００３９】
は、基準画像の領域のｉ番目の係数の値であり、
ｎは、用いる係数の個数である。
【００４０】
インデックスＩはｉ番目のＤＣＴ係数を示し、ｉ＝０はＤＣ係数に相当する。
【００４１】
重み付き総和の結果は以下のように閾値と比較される。
【００４２】
【数４】

$$\begin{aligned} D_1 &> T_1 \\ D_1 &\le T_1 \end{aligned} \qquad (2)$$

【００４３】
Ｄが$Ｔ_1$ を上回る場合、それは画像領域が非類似であることの表れであり、この場合は動きの表れとして解釈する。Ｄが$Ｔ_1$ 以下である場合、それは画像領域が類似していること、言い換えれば動きがないことを示す。
【００４４】
ｎを変化させると、ある一定の個数（例えば２５個）までのＡＣ係数のみを重み付き総和に用いることができる。好ましくはｎ＝２、５または９である。特定の値のｉについてＷ$_i$ をゼロに設定すると、ＤＣＴ係数の他のサブセットを用いることができる。例えば、Ｗ$_0$ をゼロに設定するとＤＣ係数が除外される。しかしながら、総和にはそれぞれ少なくとも１つのＡＣ係数が含まれる。
【００４５】
好ましくは、右上から左下へ向かう、ある斜めの線上にあるＡＣ係数のいずれかが重み付き総和に関係する場合、周波数成分に関してバランスを取るために（for balance）、その斜めの線上のＡＣ係数全てを含める。例えば図３を参照して、６番目から９番目までのＡＣ係数のいずれかを含める場合、その全てを含める。あるいは図４に示すように、左上から右下への対角線上にある全てのＤＣＴ係数、すなわちＤＣ係数とＡＣ係数４、１２、２４、３９、５１、５９および６３を含め、他のＡＣ係数は全て除外してもよい。

【００４６】
類似度を判定する際の各係数の信頼度を示す重みは、実験に基づいて事前に決められるのが好ましい。通常、ＤＣ係数および低い（lower）ＡＣ係数の信頼度が最も高く、好ましくは、低いＡＣ係数の一部または全てを総和に含める。
【００４７】
重みおよび閾値は用途、あるいは解析中の画像データのタイプに応じて変えることができる。
【００４８】
次に本発明による方法の第２の実施形態を説明する。
【００４９】
第１の実施形態と同様に、画像ペア（現画像と基準画像）のブロックのＤＣＴ係数を得る。
【００５０】
現画像と基準画像における対応する画像領域のＤＣＴブロックを比較する。
【００５１】
まず最初にＤＣＴブロックペアのＤＣ係数を比較する。より具体的には、上記で説明した表記を用い、以下の式（３）を用いてＤＣ係数の値の差の絶対値を得る。
【００５２】
【数５】

$$D_{d.c} = \left| C_0^C - C_0^R \right| \tag{3}$$

【００５３】
同様に、ＤＣＴブロックペアの１番目のＡＣ係数の値の差の絶対値、ならびに２番目のＡＣ係数の値の差の絶対値も得る。
【００５４】
【数６】

$$\begin{aligned} D_{a.c.1} &= \left| C_1^C - C_1^R \right| \\ D_{a.c.2} &= \left| C_2^C - C_2^R \right| \end{aligned} \tag{4}$$

【００５５】
これにより次の３つの値が得られる。
$D_{d.c.}$、$D_{a.c.1}$、$D_{a.c.2}$
【００５６】
初めに、以下の式（５）を用いて$D_{d.c.}$を所定の閾値Ｔ２と比較する。
【００５７】
【数７】

$$\begin{aligned} D_{d.c.} &> T_2 \\ D_{d.c.} &\le T_2 \end{aligned} \tag{5}$$

【００５８】
これは実質的に、サブサンプリングした画像の差を計算することに等しい。
【００５９】
$D_{d.c}$が閾値より大きい場合、それは画像領域ＤＣ係数間の差の程度が高いことを示

す。$D_{d.c}$が閾値より小さい場合、それは画像領域が類似していることを示す。

【００６０】

$D_{a.c.1}$と$D_{a.c.2}$もそれぞれ閾値と比較する。しかしながら、ＤＣ係数と異なり、各ＤＣ係数$D_{a.c.1}$および$D_{a.c.2}$はそれぞれ２つの閾値$T_{1.1}$、$T_{1.2}$および$T_{2.1}$、$T_{2.2}$と関連付けられる。閾値の選択は上記の式（５）の結果に応じて行われる。

【００６１】

より具体的には、ＤＣ係数の比較が、画像領域が類似していること（$D_{d.c} \leqq T_2$）を示した場合、ＡＣ係数の比較には高いほうの閾値を用いる。言い換えれば、ＤＣ係数が既に類似を示している場合、非類似を示すためにＡＣ係数にはより厳密でより厳しいテストが用いられる。同様に、$D_{d.c} > T_2$であり、画像領域が相違していることを示す場合、ＡＣ係数には低いほうの閾値が用いられ、したがって類似を証明するためのより厳しいテストが用いられる。

【００６２】

１番目のＡＣ係数についてより詳しく言えば、$D_{a.c.1}$は２つの閾値$T_{1.1}$および$T_{1.2}$を有し、ここで$T_{1.1} < T_{1.2}$である。$D_{d.c} \leqq T_2$である場合は$D_{a.c.1}$を$T_{1.2}$と比較するが、$D_{d.c} > T_2$である場合は$D_{a.c.1}$を$T_{1.1}$と比較する。同様に、$D_{a.c.2}$は２つの閾値$T_{2.1}$および$T_{2.2}$を有し、$D_{d.c} \leqq T_2$である場合は$D_{a.c.2}$を$T_{2.2}$と比較するが、$D_{d.c} > T_2$である場合は$D_{a.c.2}$を$T_{2.1}$と比較する。

【００６３】

$D_{a.c.1} > T_{1.2}$である場合、$T_{1.2}$が高い閾値であることを考えると、それは、ＤＣ係数間の類似度にもかかわらず、画像領域が実際にはかなり相違している可能性があることを示す。

【００６４】

各比較の結果は、「相違」または「類似」のいずれかに分類することができる。

【００６５】

この例で、$D_{d.c} \leqq T_2$であると仮定すると、結果は「類似」となる。

【００６６】

次に、ＡＣ係数１には閾値$T_{1.2}$を選択し、ＡＣ係数２には閾値$T_{2.2}$を選択する。

$D_{a.c.1} > T_{1.2}$である場合、比較結果は「相違」である。
$D_{a.c.1} \leqq T_{1.2}$である場合、結果は「類似」である。　（６）
$D_{a.c.2} > T_{2.2}$である場合、結果は「相違」である。
$D_{a.c.2} \leqq T_{2.2}$である場合、結果は「類似」である。　（７）

【００６７】

次に式（５）、（６）および（７）の結果を組み合わせる。この例では、３つの係数の各々の決定に基づいて多数決を取る。

【００６８】

この例で、式（５）および（７）の結果が「類似」であって式（６）の結果が「相違」であると仮定すると、総合的な結果は「類似」となる。

【００６９】

この例で使用する係数は３つだけであり、それらは最初の３つの係数であるが、任意の係数および任意数の係数（偶数であれ奇数であれ）を使用してよい。好ましくは、第１の実施形態に関して説明したように、選択される係数は配列に関してバランスが取れている。上記の例において、ＤＣ係数を含む係数は全て多数決に用いられる。あるいは、例えば奇数個のＡＣ係数がある場合、多数決はＡＣ係数の結果を用いて行ってもよい。例えば、単純な場合では、ＤＣ係数比較の結果が１番目のＡＣ係数の比較の閾値を決め、１番目のＡＣ係数の比較の結果が類似度を示すものとして用いられる（１つのＡＣ係数に基づく多数決）。ＡＣ係数についての多数決の結果は、任意選択で、ＤＣ係数テストの結果と比較

してもよい。第１の実施形態と同様に、係数の信頼度（すなわちテストにおける係数の有用性）は実験によって判定することができる。同様に、閾値も実験によって求めることができる。この例では２つの閾値のみを用いるが、各係数について２つより多いかまたは２つより少ない閾値があってもよい。上記の例の変形において、係数の一部または全部は関連する閾値を１つしか持たないものであってもよい。全ての係数が閾値を１つしか持たない場合、単純な多数決となる。上記の例において、ＡＣ係数の閾値は全てＤＣ係数の結果に基づいて求める。しかしながら、例えば他の係数の一部または全部（（ＤＣＴ配列に関して）先行するＡＣ係数全てなど）の比較結果を用いて、より複雑な方法で閾値を求めてもよい。

【００７０】

上記の画像領域の比較方法は、画像全体を比較するために、画像ペアの画像ブロックの一部または全部について実施してもよい。画像全体の間の類似度の決定は領域間の類似度に基づいて、例えば同じく多数決を用いて行うことができる。類似している領域よりも相違している領域のほうが多い場合、それは画像どうしが相違していることを示し、また逆の場合も同じである。別法として、所定数の領域が相違している場合（例えば１個または２個）、それは差を示すものとして解釈してもよい。これは例えば、精度が重要であるビデオ監視システムにおける動きの検出に有用である可能性がある。ビデオなどの画像シーケンスにおける、索引付けの目的でビデオをショットにセグメント化するためのシーン変化の検出などの他の用途では通常、シーン変化を示すには１つまたは２つよりも多い領域が相違している必要がある。上記の例において、各比較の結果は「相違」または「類似」である。別法として、結果には例えば数値を与え、次に総合的な決定におけるそれぞれの係数の重要度に従って重み付けすることができる。

【００７１】

本発明の実施形態を実施する装置の別の実施形態を図５に示す。この装置は図１の装置と同様であるが、画像を取り込むためのカメラ１２も含む。このカメラは送信機１４を含み、取り込んだ画像を、受信機１６を含むコンピュータに送信する。受信機は、取り込んだ画像を画像データ記憶手段６に送る。

【００７２】

この実施形態において、カメラ１２は、画像を取り込み、ＤＣＴを伴うＪＰＥＧまたはＭＰＥＧなどの技法を用いて画像を符号化し、続いてさらなる符号化を行ってから、符号化したデータをコンピュータへ送信する。符号化されたデータは記憶手段６に記憶されてから、プロセッサによって処理される。この実施形態において、プロセッサは、送信されてきたデータストリームを復号化してＤＣＴ係数を得た後で、カメラが生成したＤＣＴ係数を操作する。言い換えれば、プロセッサは、以前の例のような画像の画素データではなく既に生成されたＤＣＴ係数を操作する。これにより処理速度を上げることができる。画像領域ペアを比較するためのＤＣＴ係数の操作は上記の通りである。

【００７３】

図５に示す装置の用途の例には、ビデオ監視システムにおけるものがある。

【図面の簡単な説明】

【００７４】

【図１】本発明の１実施形態による装置の概略図である。

【図２】画像の表現である。

【図３】ＤＣＴ係数の配列を示す図である。

【図４】別のＤＣＴ係数の配列を示す図である。

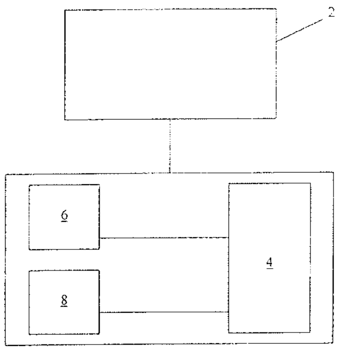
【図５】本発明の１実施形態による別の装置の概略図である。

【符号の説明】

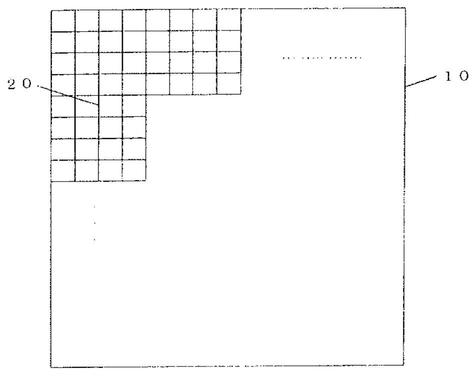
【００７５】

２　モニタ、４　プロセッサ、６および８　記憶手段、１０　画像、１２　カメラ、１４　送信機、１６　受信機、２０　画素。

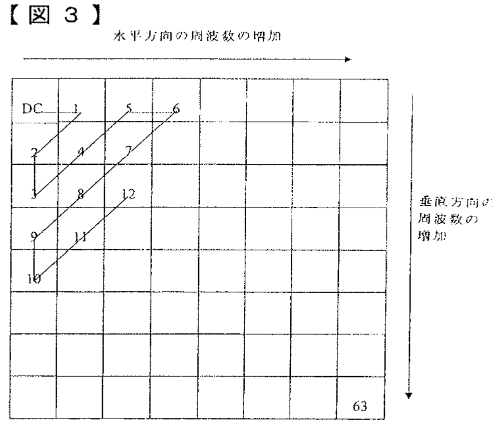
【図１】


2
6
8
4

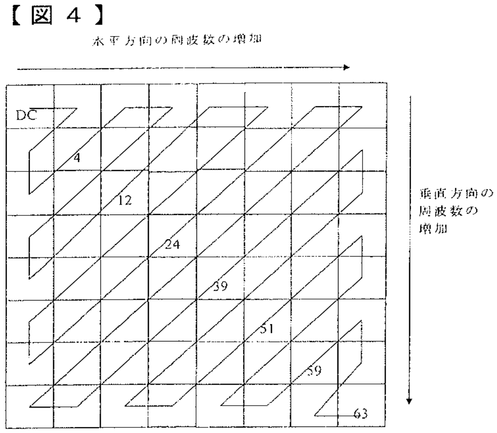
【図２】


２０
１０

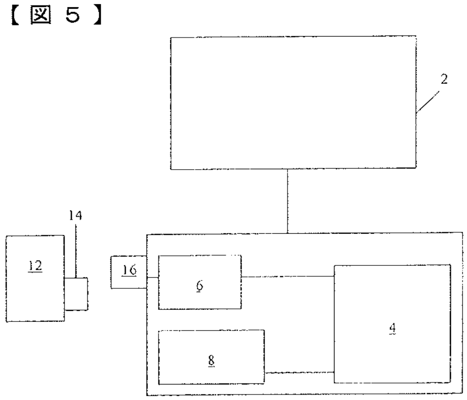
【図３】


水平方向の周波数の増加
垂直方向の周波数の増加
DC
1
5
6
2
4
7
3
8
12
9
11
10
63

【図４】


水平方向の周波数の増加
垂直方向の周波数の増加
DC
4
12
24
39
51
59
63

【図５】


2
14
12
16
6
4
8

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(54) OBJECT ENCODER

(57) Abstract:

PURPOSE: An object encoder is provided to reduce the amount of image data by scanning with an appropriate scanning direction selected according to an edge direction of an object after DCT(Discrete Cosine Transforming) processing a contour of the blocked object. CONSTITUTION: An image separator (10) blocks a contour of an object into an 8X8 pixel block. A DCT unit(20) transforms the 8X8 pixel block into an 8X8 frequency coefficient block. A zigzag scanning unit(30), a vertical scanning unit(40) and a horizontal scanning unit(50) run-length-codes the 8X8 frequency coefficient block. In case that an edge of the object is an oblique line, a selector(70) selects a run-length-coded code language outputted by zigzag-scanning after DCT. In case of a vertical line, the selector selects a run-length-coded code language outputted by horizontally scanning. In case of a horizontal line, the selector selects a run-length-coded code language outputted by vertically scanning.

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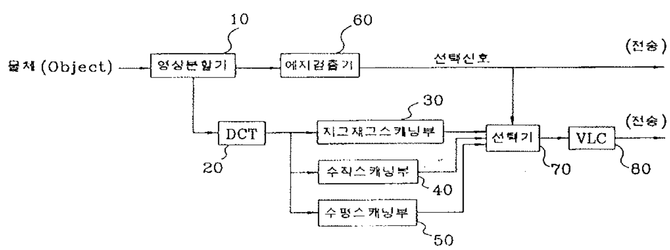
요약

본 발명은 물체 부호화기에 관한 것으로서, 물체의 윤곽 부위를 8×8 화소블록으로 블럭화하는 영상분할부(10)와; 상기 8×8 화소블럭을 8×8 주파수 계수블럭으로 변환하는 DCT부(20)와; 상기 8×8 주파수 계수 블럭을 지그재그 스캐닝하여 런 렝스 부호화하여 출력하는 지그재그 스캐닝부(30)와; 상기 8×8 주파수 계수 블럭을 수직 스캐닝하여 런 렝스 부호화하여 출력하는 수직 스캐닝부(40)와; 상기 8×8 주파수계수 블럭을 수평 스캐닝하여 런 렝스 부호화하여 출력하는 수평 스캐닝부(50)와; 상기 8×8 화소블럭으로 블거화된 물체의 에지를 검출하고, 상기 에지의 방향에 따라 스캐닝 선택신호를 출력하는 에지검출부(60)와; 상기 스캐닝 선택신호에 따라 상기 지그재그 스캐닝부(30), 상기 수직 스태닝부(40) 및 상기 수평 스캐닝부(50) 중 하나의 출력을 선택하여 출력하는 선택부(70)를 푸함하여 구성되어, 블럭화된 물체의 윤곽 부위를 DCT한 다음 물체의 에지 방향에 따라 적합한 스캐닝 방향을 선택하여 스캐닝을 수행하기 때문에 영상 데어터이량을 감소시킬 수 있는 효과가 있다.

대표도



명세서

[발명의 명칭]

물체 부호화기

(An object coder)

[도면의 간단한 설명]

제1도는 물체의 윤곽(contour)을 블록화한 상태를 도시한 도면.

제2도는 본 발명에 따른 물체 부호화기의 계통도.

제3도는 본 발명에 따른 스캐닝 방법을 도시한 개략도이다.

* 도면의 주요부분에 대한 부호의 설명

10 : 영상분할기	20 : DCT부
30 : 지그재그 스캐닝부	40 : 수직 스캐닝부
50 : 수평 스캐닝부	60 : 에지검출기
70 : 선택기	80 : 가변길이부호기(VLC)

[발명의 상세한 설명]

본 발명은 물체 부호화기에 관한 것으로서, 특히 물체의 윤곽 부위를 블럭화한 다음 DCT(Discrete Cosine Transform)를 수행하여 만들어진 주파수 계수를 물체의 에지(edge) 방향에 따라 여러 가지 방향으로 스캐닝하여 영상 데이터량을 감소시키는 물체 부호화기에 관한 것이다.

현재, 컴퓨터와 통신 및 방송 등의 다중매체가 결합, 통합된 다중미디어 환경이 다양하게 발전하여 금세기 말부터는 정보 통신 분야의 꽃이라 할 수 있는 멀티미디어 시대가 열릴 것이다. 이러한 멀티미디어를 지원해주는 핵심 요소 기술로는 디지털화와 디지털 영상 압축 기술이 있다.

이러한 디지털 영상 압축 기술의 필요성을 간단히 논하자면 현재의 NTSC 방식의 텔레비전(TV) 신호는 초당 180Mbit의 데이터량을 갖고 있는데. 이를 CD(Compact Disk, 용량 : 약 6.25Gbit) 한장에 담으면 약 35초의 분량이 되므로 이 정도의 정보 저장 능력으로는 충분한 길이의 동영상 데이터를 저장할 수 없게 된다. 따라서, CD 한장에 많은 영상 데이터를 저장하기 위한 기술이 개발되었는데, 이것이 바로 디지털 영상 압축 기술이다.

상기 디지털 영상 압축을 한마디로 요약하면 영상이 갖는 공간적, 시간적 중복성을 제거함으로써 영상을 표시하는데 필요한 데이터량을 줄이는 것이다.

한편, MPEG-2 비디오 압축 방법은 두 가지 기본 기술을 바탕으로 한다.

첫 번째로 시간 중복성(Temporal redundancy)을 줄이기 위하여 블럭 단위의 움직임 추정 및 보상(MOtion estimation and compensation)을 이용하고, 두 번째로 공간 중복성(Spatial redundancy)을 줄이기 위하여 DCT 압축 기법을 이용한다.

즉, MPEG-2에서 규정하는 픽쳐 타입(picture type)에는 1,P,B-픽쳐의 세 가지가 있으며, 그중 I(Intra coded) 픽쳐는 움직임 보상을 이용하지 않고 단순히 그 픽쳐만을 DCT해서 코딩하는 것이고, P(Predicted coded) 픽쳐에서는 I 또는 다른 P-픽쳐를 기준으로 삼아 움직임 보상을 한 후 나머지 차분을 DCT 코딩한다. 또한, B(Bidirectionally predicted coded) 픽쳐에서는 P-픽쳐처럼 움직임 보상을 사용하지만 P-픽쳐와는 달리 시간축상에서 앞뒤에 있는 두개의 프레임으로부터 움직임 보상을 한다.

이러한 움직임 보상은 16×16 블럭을 기본 단위로 한다.

그리고, 상기 DCT 코딩은 고속 알고리즘을 갖는 직교 변환(Orthogonal transform)으로 많은 종류의 영상들에 대해서 최적에 가까운 성능을가질 뿐만아니라, DCT 기본 함수가 시각 특성기준의 효과적인 이용을 매우 용이하게 하는 장점이 있어 공간 중복성을 줄이기 위하여 이용되고 있다.

이러한 DCT는 8 8 블럭을 기본 단위로 한다.

그러나, 상기와 같이 영상의 수학적 통계 특성을 이용한 블럭 또는 매크로 블럭 단위로 처리하는 기존의 부호화 방법은 비트율이 낮아질수록 즉, 압축률이 높아질수록 블럭화 형상 및 경계의 흐림 현상(blurring) 등이 더욱 심하게 발생하여 시각적으로 거슬리게 된다.

따라서, 인간의 시각이 경계에 민감하다는 점을 감안하여 영상을 물체 위주로 분할하여 부호화하는 물체 코딩(object coding) 방법이 발전되어 왔다.

이러한 종래의 물체 코딩 방법은 외형이 불규칙적은 물체의 윤관(contour)을 코딩하고 그 물체 내의 그레이 레빌(gray level)은 DCT 등의 방법으로 따로 고딩한다.

이 때, 제1도에 도시된 바와 같이 DCT를 수행하기 전에 물체 이외의 여백 부분을 어떤 값으로 채워주는 것이 필요하며, 보통은 여백부분을 '0'으로 채워준 후에 DCT를 수행하게 된다.

그러나, 상기와 같이 여백부분을 '0'으로 채운 다음 DCT를 수행하면 높은 주파수 계수(frequency coefficients)가 발생됨에 따라 이 주파수 계수를 코딩하기 위해서는 많은 비트 수가 필요하게 되는 문제점이 있었다.

이에, 본 발명은 상기와 같은 문제점을 해결하기 위하여 안출된 것으로서, 물체의 윤곽 부위를 블럭화한 다음 DCT를 수행하여 만들어진 주파수 계수를 물체의 에지 방향에 따라 다른 방향으로 스캐닝함으로써 영상 데이터량을 감소시킬 수 있는 물체 부호화기를 제공하는데 그 목적이 있다.

상기와 같은 목적을 달성하기 위하여 본 발명에 의한 물체 부호화기는 물체의 윤곽 부위를 8× 8 화소블럭으로 블럭화하는 영상분할부와; 상기 8×8 화소블럭을 8×8 주파수 계수 블럭으로 변환하는 DCT부와; 상기 8×8 주파수 계수 블럭을 지그재그(zig zag) 스캐닝하여 런 렝스(run length) 부호화하여 출력하는 지그재그 스캐닝부와; 상기 8×8 주파수 계수 플럭을 수직 스캐닝하여 런렝스 부호화하여 출력하는 수직 스캐닝부와; 상기 8×8 주파수 계수 블럭을 수평 스캐닝하여 런 렝스 부호화하여 출력하는 수평 스캐닝부와; 상기 물체의 에지를 검출하여 에지의 방향이 사선일 경우 상기 지그재그 스캐닝부의 출력이, 에지의 방향이 수평일 경우 상기 수직 스캐닝부의 출력이, 에지 방향이 수직일 경우 상기 수평 스캐닝부의 출력이 각각 선택되도록 하는 스캐닝 선택신호를 출력하는 에지검출부와; 상기 스캐닝 선택신호에 따라 상기 지그재그 스캐닝부, 상기 수직 스캐닝부 및 상기 수평 스캐닝부 중 하나의 출력을 선택하여 출력하는 선택부를 포함하여 구성된 것을 특징으로 한다.

이하, 본 발명의 바람직한 실신예를 첨부된 도면을 참조하여 상세하게 설명한다.

제2도는 본 발명에 따른 물체 부호화기의 계통도로서, 상기 물체 부호화기는 물체의 윤곽 부위를 8×8 화소블럭으로 블럭화하는 영상분할기(10)와; 상기 8×8 화소블럭을 8×8 주파수 계수 블럭으로 변환하는 DCT부(20)와; 상기 8×8 주파수 계수 블럭을 지그재그 스캐닝하여 런 렝스 부호화하여 출력하는 지그재그 스캐닝부(30)와; 상기 8×8 주파수 계수 블럭을 수직 스캐닝하여 런 렝스 부호화하여 출력하는 수직 스캐닝부(40)와; 상기 8×8 주파수 계수 블럭을 수평 스캐닝하여 런 렝스 부호화하여 출력하는 수평 스캐닝부(50)와; 상기 8×8 화소 블럭으로 블럭화된 물체의 에지를 검출하고, 검출된 에지의 방향에 따라 스캐닝

선택신호를 출력하는 에지검출기(60)와; 상기 스캐닝 선택신호에 따라 상기 지그재그 스캐닝부(30), 상기 수직 스캐닝부(40) 및 상기 수평 스캐닝부(50) 중 하나의 출력을 선택하여 출력하는 선택기(70)와; 상기 선택기(70)에서 출력되는 런 렝스 부호화된 부호어에 대해 발생활률이 높은 부호어들에 대하서는 부호당 짧은 비트를 할당하고, 발생확률이 낮은 부호어들에 대해서는 부호당 긴 비트를 할당하여 부호의 평균길이를 엔트로피에 가깝도록 통계적 중복성을 제거한 후 수신측(도시하지 않음)으로 전송하는 가변길이부호기(VLC, 80)를 포함하여 구성된다.

상기 에지검출기(60)는 물체의 에지를 검출하여 에지의 방향이 사선일 경우 지그재그 스캐닝부(30)의 출력이, 에지의 방향이 수평일 경우 수직 스캐닝부(40)의 출력이, 에지 방향이 수직일 경우 수평 스캐닝부(50)의 출력이 각각 선택되도록 하는 스캐닝 선택신호를 선택기(70)로 출력한다.

상기와 같이 구성된 본 발명에 따른 물체 부호화기의 작용 및 효과를 보다 상세하게 설명하면 다음과 같다.

먼저, 영상분할기(10)가 불체의 윤곽 부위를 8×8 화소블럭으로 블럭화하여 DCT부(20)로 출력하면, 상기 DCT부(20)는 입력받은 8×8 화소블럭을 8×8 주파수 계수 블럭으로 변환하여 지그재그 스캐닝부(30), 수직 스캐닝부(40) 및 수평 스캐닝부(50)로 각각 출력한다.

상기 지그재그 스캐닝부(30), 수직 스캐닝부(40) 및 수평 스캐닝부(50)는 각각 입력받은 8×8 주파수 계수 블록을 런 렝스 부호화하여 선택기(70)로 출력한다.

상기 선택기(70)는 어제검출기(60)가 제공하는 스캐닝 선택신호에 따라 지그재그 스캐닝부(30), 수직 스캐닝부(40) 및 수평 스캐닝부(50) 중 하나에서 출력되는 런 렝스 부호화된 부호어들을 선택하여 가변길이부호기(80)로 출력한다.

즉, 상기 선택기(70)는 제3도에 도시된 바와 같이 물체의 에지가 사선일 경우에는 DCT 수행 후 지그재그 스캐닝되어 출력되는 런 렝스 부호화된 부호어를 선택하여 출력하고, 물체의 에제가 수직선일 경우에는 DCT 수행 후 수평 스캐닝되어 출력되는 런 렝스 부호화된 부호어를 선택하여 출력하고, 물체의 에지가 수평선일 경우에는 DCT 수행 후 수직 스캐닝되어 출력되는 런 렝스 부호화된 부호어를 선택하여 출력한다.

예를 들어, DCT된 주파수 계수가 아래 표1과 같고,

표 1

276	59	89	39	7	-13	-12	-7
137	-94	-35	4	17	16	7	2
51	25	-42	-20	-14	1	5	7
-12	40	-8	-16	-4	-4	-5	-5
-8	3	17	-13	-4	0	-1	0
2	14	14	5	-7	0	-1	0
-1	-3	-2	12	0	-4	-2	1
-6	2	-6	6	8	-5	-1	0

첫 번째로 8×8 블럭화된 물체의 윤곽 에지가 사선일 경우에는 (276, 137, 59, 89, -94, 51, -12, 25, -35, 39 ...) 순으로 지그재그 스캐닝하여 런 렝스 부호화된 부호어를 선택하여 출력하고, 두 번째로 8×8 블럭회된 물체의 윤곽 에지가 수직선일 경우에는 (276, 59, 89, 39, 7, -13, -12, -7, 137 ...) 순으로 수평 스캐닝하여 런 렝스 부호화된 부호어를 선택하여 출력하고, 세 번째로 8×8 블럭화된 물체의 윤곽 에지가 수평선일 경우에는 (276, 137, 51, -12, -8, 2, 1, -1, -6, 59 ...) 순으로 수직 스캐닝하여 런 렝스 부호화된 부호어를 선택하여 출력한다.

이 때, 물체 이외의 여백부분을 '0'으로 채운 다음 DCT를 수행하면 높은 주파수 계수가 발생되어 이 주파수 계수를 코딩하기 위해서는 많은 비트수가 필요하게 되나, 상기와 같이 물체의 에지 방향에 따라 스캐닝 방향을 달리하면 영상 데이터량을 감소시킬 수 있다.

한편, 상기와 같이 선택적으로 스캐닝된 런 렝스 부호화된 부호어들은 가변길이부호기(70)에서 발생확률이 높은 부호어들에 대해서는 부호당 짧은 비트가 할당되고, 발생확률이 낮은 부호어들에 대해서는 부호당 긴 비트를 할당되어 부호의 평균길이를 엔트로피에 가깝도록 통계적 중복성이 제거된 후 수신측(도시하지 않음)으로 전송된다.

이상에서 살펴본 바와 같이 본 발명에 의한 물체 부호화기는 블럭화된 물체의 윤곽 부위를 DCT한 다음 물체의 에지 방향에 따라 적합한 스캐닝 방향을 선택하여 스캐닝을 수행하기 때문에 영상 데이터량을 감소시킬 수 있는 효과가 있다.

(57) 청구의 범위

청구항 1

물체의 윤곽 부위를 8×8 화소 블럭으로 블럭화하는 영상분할부(10)와; 상기 8×8 화소블럭을 8×8 주파수 계수 블럭으로 변환하는 DCT부(20)와;

상기 8×8 주파수 계수 블럭을 지그재그(zig zag) 스캐닝하여 런 렝스(run length) 부호화하여 출력하는 지그재그 스캐닝부(30)와;

상기 8×8 주파수 계수 블럭을 수직 스캐닝하여 런 렝스 부호화하여 출력하는 수직 스캐닝부(40)와;

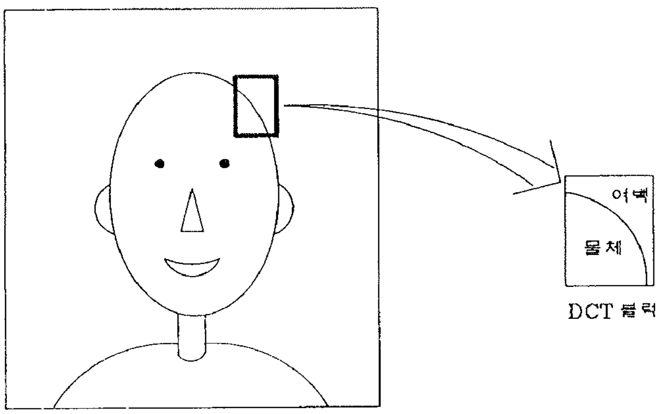
상기 8×8 주파수 계수 블럭을 수평 스캐닝하여 런 렝스 부호화하여 출력하는 수평 스캐닝부(50)와;

상기 물체의 에지를 검출하여 에지의 방향이 사선일 경우 상기 지그재그 스캐닝부(30)의 출력이, 에지의 방향이 수평일 경우 상기 수직 스캐닝부(40)의 출력이, 에지 방향이 수직일 경우 상기 수평 스캐닝부(50)의 출력이 각각 선택되도록 하는 스캐닝 선택신호를 출력하는 에지검출부(60)와;

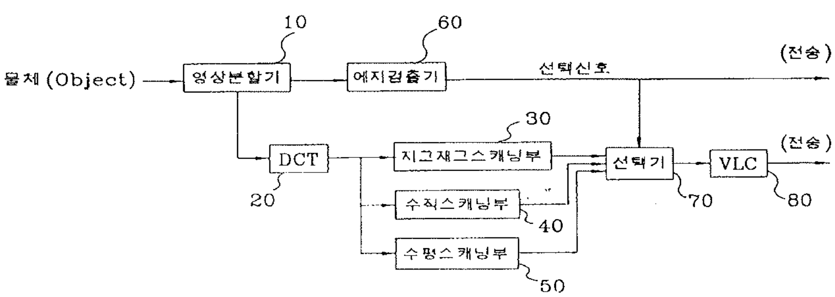
상기 스캐닝 선택신호에 따라 상기 지그재그 스캐닝부(30), 상기 수직 스캐닝부(40) 및 상기 수평 스캐닝부(50) 중 하나의 출력을 선택하여 출력하는 선택부(70)를 포함하여 주성된 것을 특징으로 하는 물체 부호화기.

도면

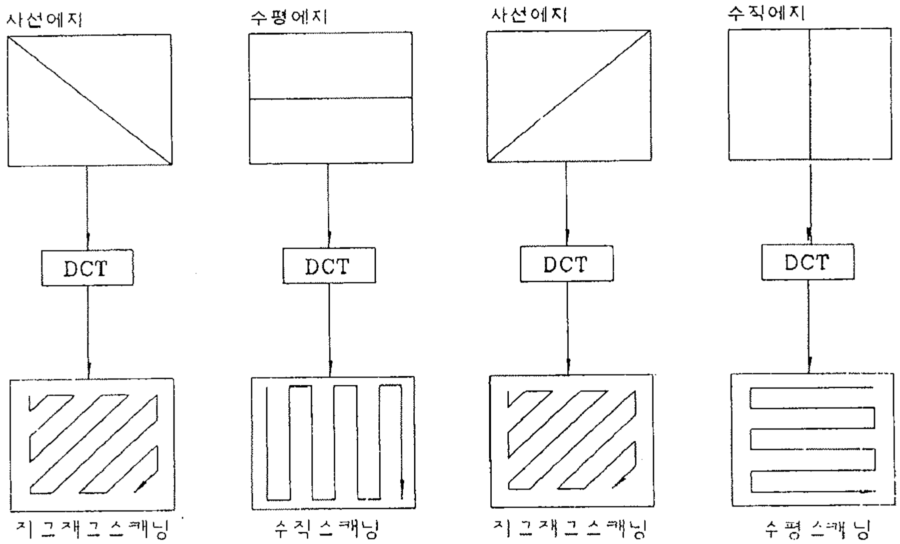
도면1



도면2



도면3


사선에지
수평에지
사선에지
수직에지
DCT
DCT
DCT
DCT
지그재그스캐닝
수직스캐닝
지그재그스캐닝
수평스캐닝

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2007/001433

A. CLASSIFICATION OF SUBJECT MATTER

H04N 7/30(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC8: H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models since 1975
Japanese Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKIPASS(KIPO internal) "predict, similarity, DCT, coefficient"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP2004-348741 A (MITSUBISHI ELECTRIC EUROPA BV.) 9 December 2004 see abstract, claims 1-5, 14-18, figures 1, 3-5	1-20
A	JP2003-006643 A (CANON INC.) 10 January 2003 see abstract, claims 1, 5, 9, figures 1, 9-12	1-20

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 JUNE 2007 (29.06.2007)	**29 JUNE 2007 (29.06.2007)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office 920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer LEE, Beaung Woo Telephone No. 82-42-481-8227

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2007/001433

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP16348741	09.12.2004	EP01480170A1	24.11.2004
		EP1480170A1	24.11.2004
		JP16348741	09.12.2004
		JP2004348741A2	09.12.2004
		US20050002569A1	06.01.2005
		US2005002569AA	06.01.2005
JP15006643	10.01.2003	JP15006643	10.01.2003
		JP2003006643A2	10.01.2003
		US20030081678A1	01.05.2003
		US2003081678A1	01.05.2003
		US2003081678AA	01.05.2003
		US7079689BB	18.07.2006

Form PCT/ISA/210 (patent family annex) (April 2007)

Electronic Acknowledgement Receipt

EFS ID:	4816185
Application Number:	12377617
International Application Number:	
Confirmation Number:	8176
Title of Invention:	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR
First Named Inventor/Applicant Name:	Se-Yoon JEONG
Customer Number:	26530
Filer:	Woochoon William Park/Louise Johnson
Filer Authorized By:	Woochoon William Park
Attorney Docket Number:	CU-7298 WWP
Receipt Date:	18-FEB-2009
Filing Date:	
Time Stamp:	16:50:24
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		IDSCU7298.pdf	1637794 aeca64f8d22c1e84bf04ced39e13cc4858bf8fc6	yes	2

	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Information Disclosure Statement Letter		1	1	
	Information Disclosure Statement (IDS) Filed (SB/08)		2	2	
Warnings:					
Information:					
2	Foreign Reference	JP2003-006643.pdf	909317 ea9f4a4e7f6718a7d03becde168913bf6d4ab6c9	no	15
Warnings:					
Information:					
3	Foreign Reference	JP2004-348741.pdf	628901 bf0bf46de4f11e5e2c460da9607394cfee4045e9	no	13
Warnings:					
Information:					
4	Foreign Reference	KR10-0180173B1.pdf	278993 caee73edee4b65c9b9ea58ae4f60c96984eb5b94	no	6
Warnings:					
Information:					
5	NPL Documents	NPLPROCEEDINGS.pdf	715049 c4a1fd67f4ceee337eaf91233799d981e63b1d28	no	9
Warnings:					
Information:					
6	NPL Documents	ISR.pdf	82938 a7410d3e8cd29ae3044077540f48ff93c4a54430	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	4252992		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A SUBMISSION UNDER 35 U.S.C. 371		ATTORNEY'S DOCKET NUMBER CU-7298 WWP U.S. APPLICATION NO. (If known, see 37 CFR 1.5)
INTERNATIONAL APPLICATION NO. PCT/KR2007/001433	INTERNATIONAL FILING DATE 23 March 2007	PRIORITY DATE CLAIMED 17 August 2006
TITLE OF INVENTION APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING...		
APPLICANT(S) FOR DO/EO/US Se-Yoon JEONG et al		

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☑ This is a **FIRST** submission of items concerning a submission under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a submission under 35 U.S.C. 371.
3. ☑ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☐ The US has been elected (Article 31).
5. ☑ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☐ is attached hereto (required only if not communicated by the International Bureau).
   b. ☑ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☐ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☑ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☑ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☑ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☐ A preliminary amendment.
14. ☑ An Application Data Sheet under 37 CFR 1.76.
15. ☐ A substitute specification.
16. ☐ A power of attorney and/or change of address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13*ter*.3 and 37 CFR 1.821- 1.825.
18. ☐ A second copy of the published International Application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
	PCT/KR2007/001433	CU-7298 WWP

20. Other items or information:

*Published PCT International Application (WO2008/020672)

The following fees have been submitted				CALCULATIONS	PTO USE ONLY
21. ☑ Basic national fee (37 CFR 1.492(a))........ $330				$ 330.00	
22. ☑ Examination fee (37 CFR 1.492(c)) If the written opinion prepared by ISA/US or the international preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4)........ $0 All other situations........ $220				$ 220.00	
23. ☑ Search fee (37 CFR 1.492(b)) If the written opinion of the ISA/US or the International preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4)........ $0 Search fee (37 CFR 1.445(a)(2)) has been paid on the international application to the USPTO as an International Searching Authority........ $100 International Search Report prepared by an ISA other than the US and provided to the Office or previously communicated to the US by the IB........ $430 All other situations........ $540				$ 430.00	
TOTAL OF 21, 22 and 23 =				980.00	
☐ Additional fee for specification and drawings filed in paper over 100 sheets (excluding sequence listing in compliance with 37 CFR 1.821(c) or (e) in an electronic medium or computer program listing in an electronic medium) (37 CFR 1.492(j)). The fee is **$270** for each additional 50 sheets of paper or fraction thereof.					
Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof (round **up** to a whole number)	RATE		
- 100 =	/50 =		x $270	$	
Surcharge of **$130.00** for furnishing any of the search fee, examination fee, or the oath or declaration after the date of commencement of the national stage (37 CFR 1.492(h)).				$	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	$	
Total claims	20 - 20 =	0	x $ 52	$ 0.00	
Independent claims	4 - 3 =	1	x $220	$ 220.00	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $390	$	
TOTAL OF ABOVE CALCULATIONS =				$ 1200.00	
☑ Applicant claims small entity status. See 37 CFR 1.27. Fees above are reduced by ½.				600.00	
SUBTOTAL =				$ 600.00	
Processing fee of **$130.00** for furnishing the English translation later than 30 months from the earliest claimed priority date (37 CFR 1.492(i)). +				$	
TOTAL NATIONAL FEE =				$ 600.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	
TOTAL FEES ENCLOSED =				$ 600.00	
				Amount to be refunded:	$
				Amount to be charged	$

a. ☐ A check in the amount of $ ____________ to cover the above fees is enclosed.

b. ☑ Please charge my Deposit Account No. 12-0400 in the amount of $ 600.00 to cover the above fees.

c. ☑ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 12-0400.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038. The PTO-2038 should only be mailed or faxed to the USPTO. However, when paying the basic national fee, the PTO-2038 may NOT be faxed to the USPTO.

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February 16, 2009

/Woochoon W. Park/
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A SUBMISSION UNDER 35 U.S.C. 371		ATTORNEY'S DOCKET NUMBER CU-7298 WWP U.S. APPLICATION NO. (If known, see 37 CFR 1.5)
INTERNATIONAL APPLICATION NO. PCT/KR2007/001433	INTERNATIONAL FILING DATE 23 March 2007	PRIORITY DATE CLAIMED 17 August 2006
TITLE OF INVENTION APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING...		
APPLICANT(S) FOR DO/EO/US Se-Yoon JEONG et al		

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☑ This is a **FIRST** submission of items concerning a submission under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a submission under 35 U.S.C. 371.
3. ☑ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☐ The US has been elected (Article 31).
5. ☑ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☐ is attached hereto (required only if not communicated by the International Bureau).
   b. ☑ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☐ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☑ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☑ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☑ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☐ A preliminary amendment.
14. ☑ An Application Data Sheet under 37 CFR 1.76.
15. ☐ A substitute specification.
16. ☐ A power of attorney and/or change of address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13*ter*.3 and 37 CFR 1.821- 1.825.
18. ☐ A second copy of the published International Application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
	PCT/KR2007/001433	CU-7298 WWP

20. Other items or information:
*Published PCT International Application (WO2008/020672)

The following fees have been submitted	CALCULATIONS	PTO USE ONLY
21. ☑ Basic national fee (37 CFR 1.492(a)) $330	$ 330.00	
22. ☑ Examination fee (37 CFR 1.492(c)) If the written opinion prepared by ISA/US or the international preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4) .... $0 All other situations $220	$ 220.00	
23. ☑ Search fee (37 CFR 1.492(b)) If the written opinion of the ISA/US or the International preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4) .... $0 Search fee (37 CFR 1.445(a)(2)) has been paid on the international application to the USPTO as an International Searching Authority .... $100 International Search Report prepared by an ISA other than the US and provided to the Office or previously communicated to the US by the IB .... $430 All other situations $540	$ 430.00	
TOTAL OF 21, 22 and 23 =	980.00	
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CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	$	
Total claims	20 - 20 =	0	x $ 52	$ 0.00	
Independent claims	4 - 3 =	1	x **$220**	$ 220.00	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$390**	$	

TOTAL OF ABOVE CALCULATIONS =	$ 1200.00	
☑ Applicant claims small entity status. See 37 CFR 1.27. Fees above are reduced by ½.	600.00	
SUBTOTAL =	$ 600.00	
Processing fee of **$130.00** for furnishing the English translation later than 30 months from the earliest claimed priority date (37 CFR 1.492(i)). +	$	
TOTAL NATIONAL FEE =	$ 600.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +	$	
TOTAL FEES ENCLOSED =	$ 600.00	
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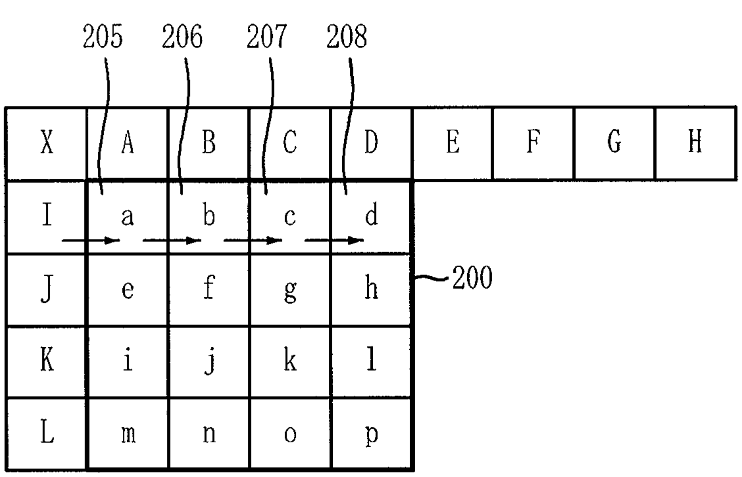
[Continued on next page]

(54) Title: APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR



(57) Abstract: The present invention discloses an encoding apparatus using a Discrete Cosine Transform (DCT) scanning, which includes: a mode selection means for selecting an optimal mode for intra prediction; an intra prediction means for performing intra prediction onto video inputted based on the mode selected in the mode selection means; a DCT and quantization means for performing DCT and quantization onto residual coefficients of a block outputted from the intra prediction means; and an entropy encoding means for performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided based on pixel similarity of the residual coefficients.

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DESCRIPTION

APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

TECHNICAL FIELD

The present invention relates to an encoding/decoding apparatus and method using an adaptive Discrete Cosine Transform (DCT) coefficient scanning based on pixel similarity. More particularly, the present invention relates to an encoding/decoding apparatus and method which performs intra prediction onto input video, predicts pixel similarity based on pixel similarity information of coefficients to be encoded that is acquired from adjacent pixels in the intra-predicted video, and performs a most effective scanning, e.g., Discrete Cosine Transform (DCT) coefficient scanning, according to the predicted pixel similarity.

BACKGROUND ART

According to video compression standards for encoding/decoding video data, a frame is divided into a plurality of macro blocks and a macro block may be divided into a plurality of sub-blocks. The encoding/decoding is performed on the basis of a macro block unit or a sub-block unit based on temporal prediction and spatial prediction.

Herein, the temporal prediction is to predict motion of macro blocks or sub-blocks of a current frame by referring to blocks of adjacent frames.

The spatial prediction is to predict motion of macro blocks or sub-blocks of a current frame to be encoded by using boundary pixels of already recovered adjacent blocks.

The spatial prediction is also called intra prediction. The intra prediction takes advantage of a characteristic that when a pixel is predicted, pixels adjacent to it are highly likely to have similar values.

H.264/Advanced Video Coding (AVC) standard technology can compress video about twice as high as Moving Picture Experts Group 2 (MPEG-2) and about one and a half times as high as MPEG-4 by using such technique as intra prediction encoding, 1/4-based variable block motion prediction and compensation, Context-Based Adaptive Variable Length Coding (CAVLC), and Context-Based Adaptive Binary Arithmetic Coding (CABAC).

The H.264/AVC standard predicts pixel values of a current block by using prediction modes of 9 directivities.

Fig. 1 illustrates 9 prediction modes used for intra prediction of 4 x 4 blocks.

As illustrated in Fig. 1, the 9 prediction modes used for intra prediction of 4 x 4 blocks include a vertical mode (mode 0), a horizontal mode (mode 1), a direct current (DC) mode (mode 2), a diagonal_down_left mode (mode 3), a diagonal_down_right mode (mode 4), a vertical_right mode (mode 5), a horizontal_down mode (mode 6), a vertical_left mode (mode 7), and a horizontal_up mode (mode 8).

Herein, in the DC mode (mode 2), intra prediction is performed using a mean value of adjacent pixels. The arrows indicate prediction directions.

Meanwhile, intra 16 x 16 prediction encoding includes a total of four modes, which are a vertical mode, a horizontal mode, a DC mode, and a plane mode.

Also, intra 8 x 8 prediction encoding includes a total of 9 modes, just like the intra 4 x 4 prediction encoding. As for color difference signals, intra 8 x 8 prediction encoding is performed, and the intra 8 x 8 prediction encoding includes a DC mode, a vertical mode, a horizontal mode, and a plane mode and so on.

Hereinafter, prediction methods in the vertical and horizontal modes for intra prediction of 4 x 4 blocks will be described with reference to Figs. 2 and 3.

Fig. 2 exemplarily illustrates a pixel prediction method in a vertical direction.

As shown in Fig. 2, pixel a 201, pixel b 202, pixel i 203, and pixel m 204 are predicted based on an adjacent pixel A in the vertical direction.

Also, pixels b, f, j and b are predicted based on an adjacent pixel B in the vertical direction, and pixels c, g, k and o are predicted based on an adjacent pixel C in the vertical direction. Pixels d, h, l and p are predicted based on an adjacent pixel D in the vertical direction.

Fig. 3 exemplarily illustrates a pixel prediction method in a horizontal direction.

As illustrated in Fig. 3, pixel a 205, pixel b 206, pixel c 207, and pixel d 208 are predicted based on an adjacent pixel I in a horizontal direction.

Also, pixels e, f, g and h are predicted based on an adjacent pixel J in the horizontal direction, and pixels i, j, k and l are predicted based on an adjacent pixel K in the horizontal direction. Pixels m, n, o and p are predicted based on an adjacent pixel 1 in the horizontal direction.

An encoder performs Discrete Cosine Transform (DCT) and quantization onto residual signals (which are of a pixel area) acquired by differentiating the predicted pixels and a current pixel. Subsequently, the encoder performs zigzag scanning and entropy encoding onto the transformed coefficients obtained from DCT and quantization.

Herein, although the zigzag scanning takes advantage of an energy compaction characteristic of a transformed coefficient that energy converges onto low frequency and energy appears little in high frequency, the energy compaction after intra prediction is not always effective.

In short, the zigzag scanning is a method of scanning a transformed coefficient from low frequency components to high frequency components. When distribution of transformed coefficients appears more in the low frequency components, the zigzag scanning is effective. However, when spatial prediction having directivity is used, the distribution of transformed coefficients is influenced by the direction of prediction. Therefore, it is ineffective to apply the zigzag scanning to the prediction of all directions.

DISCLOSURE

TECHNICAL PROBLEM

An embodiment of the present invention, which is devised to overcome the above problems, is directed to providing an encoding/decoding apparatus and method which performs intra prediction onto input video, predicts pixel similarity based on pixel similarity information of coefficients to be encoded acquired from adjacent pixels in the intra-predicted video, and performs a most effective scanning, e.g., DCT coefficient scanning, according to the predicted pixel similarity.

Other objects and advantages of the present invention can be understood by the following description, and become apparent with reference to the embodiments of the present invention. Also, it is obvious to those skilled in the art of the present invention that the objects and advantages of the present invention can be realized by the means as claimed and combinations thereof.

TECHNICAL SOLUTION

In accordance with an aspect of the present invention, there is provided an encoding apparatus using a Discrete Cosine Transform (DCT) scanning, which includes: a mode selection means for selecting an optimal mode for intra prediction; an intra prediction means for performing intra prediction onto video inputted based on the mode selected in the mode selection means; a DCT and quantization means for performing DCT and quantization onto residual coefficients of a block outputted from the intra prediction means; and an entropy encoding means for performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided based on pixel similarity of the residual coefficients.

In accordance with another aspect of the present invention, there is provided a decoding apparatus using a DCT scanning, which includes: an entropy decoding means for performing entropy decoding onto encoded video; a scanning decision means for deciding a scanning mode for the video decoded in the entropy decoding means; and a video recovery means for recovering the video based on the scanning mode decided in the scanning decision means.

In accordance with another aspect of the present invention, there is provided an encoding method using a DCT scanning, which includes the steps of: selecting an optimal mode for intra prediction; performing intra prediction onto video inputted based on the mode selected in the mode selection step; performing DCT and quantization onto residual coefficients of a block outputted from the intra prediction step; deciding pixel similarity of the residual coefficients; and performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided in the pixel similarity decision step.

In accordance with an aspect of the present invention, there is provided a decoding method using a DCT scanning, which includes the steps of: performing entropy decoding onto encoded video; deciding a scanning mode for the video decoded in the entropy decoding step; and recovering the video based on the scanning mode decided in the scanning decision step.

According to an embodiment of the present invention, a luminance block may go through an intra 4 x 4 luminance encoding mode of H.264/Advanced Video Coding (AVC), which includes a vertical mode, a horizontal mode, a diagonal_down_left mode, a diagonal_down_right mode, a vertical_right mode, a horizontal_down mode, a vertical_left mode, and a horizontal_up mode, and an intra 16 x 16 luminance encoding mode of H.264/AVC, which includes a vertical mode, a horizontal mode, a plane mode, and a DC mode.

Also, according to an embodiment of the present invention, a chrominance block may go through an intra M x N chrominance encoding mode of H.264/AVC, which includes a vertical mode, a horizontal mode, a plane mode and a DC mode.

ADVANTAGEOUS EFFECTS

As described above, the present invention can improve a compression rate of intra encoding by applying a most effective scanning method according to pixel similarity in order to encode/decode video.

Also, the present invention can improve a video compression rate by being applied to a video compression technology using intra prediction, which will be developed in future.

Also, the present invention can reduce a need for an additional module by applying the same similarity information to both encoder and decoder.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates 9 prediction modes used for intra prediction of 4 x 4 blocks according to H.264/AVC.

Fig. 2 exemplarily illustrates a pixel prediction method in a vertical mode.

Fig. 3 exemplarily illustrates a pixel prediction method in a horizontal direction.

Fig. 4 is a block view showing an encoding apparatus using an adaptive DCT coefficient scanning based on pixel similarity in accordance with an embodiment of the present invention.

Fig. 5 exemplarily illustrates a zigzag scanning method used in the present invention.

Fig. 6 exemplarily illustrates a horizontal scanning method used in the present invention.

Fig. 7 exemplarily illustrates a vertical scanning method used in the present invention.

Fig. 8 illustrates a method for predicting pixel similarity in vertical and horizontal directions in accordance with an embodiment of the present invention.

Fig. 9 is a flowchart describing an adaptive scanning method based on pixel similarity in a vertical intra prediction mode in accordance with an embodiment of the present invention.

Fig. 10 is a flowchart describing an adaptive scanning method based on pixel similarity in a horizontal intra prediction mode in accordance with an embodiment of the present invention.

Fig. 11 is a block view showing a decoding apparatus using an adaptive DCT coefficient scanning based on pixel similarity in accordance with an embodiment of the present invention.

BEST MODE FOR THE INVENTION

The advantages, features and aspects of the invention will become apparent from the following description of the embodiments with reference to the accompanying drawings, which is set forth hereinafter. When it is considered that detailed description on a related art may obscure a point of the present invention, the description will not be provided herein. Hereinafter, specific embodiments of the present invention will be described in detail with reference to the accompanying drawings.

Fig. 4 is a block view showing an encoding apparatus using an adaptive DCT coefficient scanning based on pixel similarity in accordance with an embodiment of the present invention.

As illustrated in Fig. 4, the encoding apparatus based on DCT coefficient scanning adaptive to pixel similarity includes a mode selection unit 10, an intra prediction unit 20, a DCT and quantization unit 30, and an entropy encoding unit 40.

The mode selection unit 10 selects an optimal mode among several available prediction modes for intra prediction. In other words, it selects one among a plurality of possible encoding modes when 4 x 4, 16 x 16, or 8 x 8 intra prediction is performed. Generally, the mode selection unit 10 selects one mode according to a rate-distortion optimization method for reducing a rate-distortion.

The intra prediction unit 20 receives a video, and performs 4 x 4 intra prediction for pixels of luminance blocks and 8 x 8 intra prediction for pixels of chrominance blocks based on a mode selected in the mode selection unit 10.

The DCT and quantization unit 30 performs DCT and quantization onto difference values outputted from the mode selection unit 10, that is, onto residual coefficient blocks indicating differences between pixel values of macro blocks of a current frame to be encoded and predicted pixel values, and transmits resulting coefficients to the entropy encoding unit 40.

The entropy encoding unit 40 arrays DCT coefficients obtained in the DCT and quantization unit 30 by using an adaptive DCT coefficient scanning based on pixel similarity, performs entropy encoding onto the arrayed DCT coefficients, and outputs the result.

Herein, the entropy encoding is an encoding technique for enhancing a compression rate by allocating small bits to data highly likely to occur and many bits for data that are not likely to occur. Examples of the entropy encoding used in the present invention include Context Adaptive Variable Length Coding (CAVLC) or Context-Based Adaptive Binary Arithmetic Coding (CABAC).

With reference to Figs. 8 to 10, described hereafter are a method of predicting pixel similarity in vertical and horizontal directions in the entropy encoding unit 40, and a scanning method in vertical and horizontal intra prediction modes.

Fig. 5 exemplarily illustrates a typical zigzag scanning method used in the present invention. Fig. 6 exemplarily illustrates a typical horizontal scanning method used in the present invention. Fig. 7 exemplarily illustrates a typical vertical scanning method used in the present invention.

As shown in Fig. 5, the zigzag scanning method used in the present invention is devised in consideration that low frequency components of transformed coefficient acquired from the DCT and quantization are highly likely to be positioned in the upper left part on a two-dimensional plane. It takes advantage of a transformed coefficient energy compaction characteristic that coefficients after DCT collectively appear in low frequencies, whereas coefficients after DCT less appear in high frequencies.

The zigzag scanning method may be more efficient when pixel similarity in the horizontal direction is similar to the pixel similarity in the vertical direction.

However, when intra prediction encoding, particularly, vertical or horizontal intra prediction, is performed, the similarity of the residual coefficients in the vertical direction shows much difference from the similarity in the horizontal direction. Thus, the above-described coefficient distribution is not always effective. Therefore, it is inefficient to apply the zigzag scanning to prediction of all directions.

To describe an example of the vertical prediction mode, the vertical prediction mode is selected as an optimal mode in a rate-distortion process, when the pixel similarity in the vertical direction is high. Herein, significant coefficients are distributed in the first row. Therefore, the horizontal scanning shown in Fig. 6 is more efficient than the typical zigzag scanning.

Meanwhile, to describe an example of the horizontal prediction mode, the horizontal prediction mode is selected as an optimal mode, when the pixel similarity in the horizontal direction is high. Herein, significant coefficients are distributed in the first column. Therefore, the vertical scanning shown in Fig. 7 is more efficient.

However, since the pixel similarity before intra prediction is different from pixel similarity of residual coefficients after the intra prediction, it is inefficient to simply use the scanning method of Fig. 6 or Fig. 7 according to the intra prediction mode.

Therefore, if pixel similarities in the vertical and horizontal directions of blocks around a block to be encoded are predicted based on similarity information among adjacent block boundary pixels which are already recovered and an adaptive scanning method according to the prediction result is used, the encoding efficiency can be increased.

Fig. 8 illustrates a method for predicting pixel similarity in vertical and horizontal directions in accordance with an embodiment of the present invention.

As illustrated in Fig. 8, pixels A, B, C and D are positioned in the upper part of a current block to be encoded, whereas pixels E, F, G and H are positioned in the left part of the current block to be encoded.

Herein, when vertical prediction encoding is performed, vertical-directional pixel similarity of the pixels a, e, i and m are positioned in a first row of the current block to be encoded is the same as the vertical-directional pixel similarity of residual coefficients a-A, e-A, i-A, and m-A after vertical prediction. This is because the residual coefficients a-A, e-A, i-A, and m-A are differentiated by the same prediction pixels as the pixels a, e, i and m and thus the correlation does not change.

As described above, the vertical-directional pixel similarity of pixels in 2, 3 and 4 rows of a block is the same as the vertical-directional pixel similarity of residual coefficients after vertical prediction.

However, the horizontal-directional pixel similarity of the 1-row pixels a, b, c and d of the current block to be encoded is different from the horizontal-directional pixel similarity of residual coefficients a-A, b-B, c-C, and d-D after vertical prediction. Also, horizontal-directional pixel similarity before vertical prediction becomes higher than the horizontal-directional pixel similarity after the vertical prediction. Thus, it becomes similar to or higher than the vertical-directional pixel similarity.

Likewise, in case of the horizontal prediction encoding, horizontal-directional pixel similarity of the pixels a, b, c and d in a first row of a block is the same as the horizontal-directional pixel similarity of residual coefficients a-E, b-E, c-E, and d-E after horizontal prediction. Also, the horizontal-directional pixel similarity of the pixels in 2, 3 and 4 rows of the bock is the same as the horizontal-directional pixel similarity of the residual coefficients after horizontal prediction.

However, the vertical-directional pixel similarity of the 1-row pixels a, e, i and m of the block is different from the vertical-directional pixel similarity of residual coefficients a-E, e-F, i-G, and m-H after horizontal prediction. Also, the vertical-directional pixel similarity before horizontal prediction becomes higher than the vertical -directional pixel similarity after the horizontal prediction. Thus, it becomes similar to or higher than the horizontal-directional pixel similarity.

As described above, when the pixel similarities in the vertical and horizontal directions become similar, a general zigzag scanning method is more efficient than the horizontal and vertical scanning methods.

Therefore, when the vertical intra prediction mode is performed and the vertical-directional pixel similarity of residual coefficients is high and their horizontal-directional pixel similarity is low, it is more efficient to use the horizontal scanning.

Meanwhile, when the horizontal intra prediction mode is performed and the horizontal-directional pixel similarity of residual coefficients is high and their vertical-directional pixel similarity is low, it is more efficient to use the vertical scanning.

When vertical-directional pixel similarity of recovered 8 pixels A, B, C, D, E, F, G and H of Fig. 8 is referred to as S_VER and their horizontal-directional pixel similarity is referred to as S_HOR, the pixel similarities for increasing the efficiency of 4 x 4 prediction encoding can be calculated as the following Equation 1.

Equation 1

$$S\_VER = \frac{1}{Variance(E,F,G,H)}$$

$$S\_HOR = \frac{1}{Variance(A,B,C,D)}$$

where Variance() denotes a dispersion; E, F, G and H DENOTE pixels adjacent to the left part of the current block to be endoed; and A, B, C and D denote pixels adjacent to the upper part of the current block to be encoded.

When the vertical prediction mode is carried out, a value obtained by multiplying S_HOR by a multiplication factor α ($\alpha \geq 1$) is used as a horizontal-directional pixel similarity prediction value of residual coefficients of the current block. Herein, the α value is fixed at 2 in an experiment. The S_VER as it is is used as a vertical-directional pixel similarity prediction value of the residual coefficients of the current block.

When the horizontal prediction mode is carried out, a value obtained by multiplying S_VER by a multiplication factor β ($\beta \geq 1$) is used as a vertical-directional pixel similarity prediction value of the residual coefficients of the current block. Herein, the β value is fixed at 2 in an experiment. The S_HOR as it is is used as a horizontal-directional pixel similarity prediction value of the residual coefficients of the current block.

The vertical and horizontal-directional pixel similarity prediction values acquired in the above methods are compared to each other to decide a scanning method.

Although the example of 4 x 4 intra prediction mode is described in the above, the present invention is not limited to the mode and the present invention can be applied to an M x N intra prediction mode, too.

Hereinafter, a method of selecting a scanning method in the vertical and horizontal prediction modes will be described in detail with reference to Figs. 9 and 10.

Fig. 9 is a flowchart describing an adaptive scanning method based on pixel similarity in a vertical intra prediction mode in accordance with an embodiment of the present invention.

In case of a vertical intra prediction mode in step S601, an S_VER value and a value of α x S_HOR are compared in step S602. When the S_VER value is greater than the value of α x S_HOR, a horizontal scanning method is used in step S603. When the S_VER value is smaller than the value of α x S_HOR, a zigzag scanning method is used in step S604.

Herein, when a vertical-directional pixel similarity of the current block to be encoded based on similarity of adjacent pixels is predicted higher than the horizontal-directional pixel similarity thereof, transformed coefficients obtained after DCT and quantization are highly likely to be distributed in a direction horizontal to a first row of the block. Therefore, the horizontal scanning method can bring about a high encoding efficiency.

Fig. 10 is a flowchart describing an adaptive scanning method based on pixel similarity in a horizontal intra prediction mode in accordance with an embodiment of the present invention.

In case of a horizontal intra prediction mode in step S701, an S_HOR value and a value of β x S_VER are compared in step S702. When the S_HOR value is greater than the value of β x S_VER, a vertical scanning method is used in step S703. When the S_HOR value is smaller than the value of β x S_VER, a zigzag scanning method is used in step S704.

Herein, when a horizontal-directional pixel similarity of the current block to be encoded based on similarity of adjacent pixels is predicted higher than the vertical-directional pixel similarity thereof, transformed coefficients obtained after DCT and quantization are highly likely to be disposed in a direction vertical to a first row of the block. Therefore, the vertical scanning method can bring about a high encoding efficiency.

Fig. 11 is a block view showing a decoding apparatus using an adaptive DCT coefficient scanning based on pixel similarity in accordance with an embodiment of the present invention.

As shown in Fig. 11, the decoding apparatus using an adaptive DCT coefficient scanning based on pixel similarity includes an entropy decoding unit 50, a scanning decision unit 60, and a video recovery unit 70.

The entropy decoding unit 50 receives video bitstream encoded in the encoding apparatus using an adaptive DCT coefficient scanning based on pixel similarity and decodes it through an entropy decoding method such as CAVLC or CABAC. Then, the entropy decoding unit 50 transmits the entropy-decoded video bitstream to the scanning decision unit 60.

The scanning decision unit 60 decides a scanning method for the coefficients decoded in the entropy decoding unit 50 according to an intra prediction mode, as described in the above with reference to Figs. 8 to 11.

The video recovery unit 70 finally recovers the coefficients by using the scanning method decided in the scanning decision unit 60 to recover the video.

An experiments was carried out for diverse test videos by using Joint Model 86 (JM86), which is H.264/AVC Reference Codec, according to the above-described methods. The result of increase in compression efficiency was as follows. In the experiment, video recommended by H.264/AVC as test video was used. The following Table 1 shows conditions of the experiment.

Table 1

Video	News (QCIF)	Container (QCIF)	Coast (QCIF)	Paris (QCIF)	Coast (CIF)
Entire Frame	300 (30 Hz)	300 (30 Hz)	300 (30 Hz)	300 (35 Hz)	300 (30 Hz)
Conditions	CAVLC, Intra only, QP(18,22,26,40), rate-distortion optimization				

As shown in Table 1, five pieces of video with different sizes were used for the experiment.

The following Table 2 presents video compression rates when the test videos were compressed using a conventional compression method, which is a zigzag scanning method of H.264/AVC, and the compression method of the present invention, which is the adaptive scanning method according to intra prediction mode under the same conditions as the Table 1.

Table 2

Sequence	QP	H.264/AVC		Method of the Present Invention		Bit Saving rate (%)
		PSNR (dB)	Bit rate (Kbps)	PSNR (dB)	Bit rate (Kbps)	
News (QCIF)	18	45.64	2370.65	45.64	2344.75	1.51%
	22	43.06	1714.99	43.05	1692.69	1.67%
	26	40.32	1221.96	40.32	1206.02	1.51%
	30	37.50	872.65	37.49	860.23	1.49%
Container (QCIF)	18	44.84	874.63	44.84	857.75	1.93%
	22	41.71	643.42	41.7	630.5	2.01%
	26	38.61	451.07	38.61	441.54	2.11%
	30	35.77	317.36	35.76	309.93	2.34%
Coast (QCIF)	18	44.18	2200.99	44.13	2152.15	2.22%
	22	40.61	1631.56	40.59	1592.37	2.40%
	26	37.13	1139.76	37.12	111.02	2.52%
	30	34.00	765.52	33.99	746.77	2.45%
Paris (CIF)	18	44.72	4360.41	44.71	4271.09	2.05%
	22	41.57	3334.22	41.56	3259.84	2.23%
	26	38.25	2450.69	38.24	2391.77	2.40%
	30	35.04	1780.73	35.03	1736.21	2.50%
Coast (CIF)	18	44.34	4068.4	44.33	4015.7	1.30%
	22	40.8	2989.5	40.8	2950.65	1.30%
	26	37.32	2074.47	37.32	2045.89	1.38%
	30	34.21	1388.07	34.22	1369.23	1.36%

The Table 2 shows that the result of video compression using the adaptive scanning method according to the intra prediction mode, which is suggested in the present invention, is superior to that of video compression using only the conventional zigzag scanning method of H.264/AVC.

The method of the present invention described above may be realized as a program and stored in a computer-readable recording medium such as CD-ROM, RAM, ROM, floppy disks, hard disks, magneto-optical disks and so fourth. Since the process can be easily implemented by those skilled in the art to which the present invention pertains to, further description on it will not be provided herein.

While the present invention has been described with respect to certain preferred embodiments, it will be apparent to those skilled in the art that various changes and modifications may be made without departing from the scope of the invention as defined in the following claims.

WHAT IS CLAIMED IS

1. An encoding apparatus using a Discrete Cosine Transform (DCT) scanning, comprising:

a mode selection means for selecting an optimal mode for intra prediction;

an intra prediction means for performing intra prediction onto video inputted based on the mode selected in the mode selection means;

a DCT and quantization means for performing DCT and quantization onto residual coefficients of a block outputted from the intra prediction means; and

an entropy encoding means for performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided based on pixel similarity of the residual coefficients.

2. The encoding apparatus of claim 1, wherein the scanning mode is any one among a horizontal-directional scanning, a vertical-directional scanning, and a zigzag scanning.

3. The encoding apparatus of claim 2, wherein the entropy encoding means:

performing encoding using a horizontal-directional scanning, when vertical-directional pixel similarity of the residual signals is high;

performing encoding using a vertical-directional scanning, when horizontal-directional pixel similarity of the residual signals is high; and

performing encoding using a zigzag scanning, when vertical and horizontal-directional pixel similarities of the residual signals are similar.

4. The encoding apparatus of claim 3, wherein the entropy encoding means decides that the vertical-directional pixel similarity is high, when a vertical-directional pixel similarity value is greater than a value obtained by multiplying a horizontal-directional pixel similarity value by a first multiplication factor.

5. The encoding apparatus of claim 3, wherein the entropy encoding means decides that the horizontal-directional pixel similarity is high, when a horizontal-directional pixel similarity value is greater than a value obtained by multiplying a vertical-directional pixel similarity value by a second multiplication factor.

6. The encoding apparatus of claim 4, wherein the vertical-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to a left part of a currently encoded block.

7. The encoding apparatus of claim 5, wherein the horizontal-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to an upper part of a currently encoded block.

8. The encoding apparatus of claim 6, wherein the first and second multiplication factors are natural number 2.

9. A decoding apparatus using a DCT scanning, comprising:

an entropy decoding means for performing entropy decoding onto encoded video;

a scanning decision means for deciding a scanning mode for the video decoded in the entropy decoding means; and a video recovery means for recovering the video based on the scanning mode decided in the scanning decision means.

10. The decoding apparatus of claim 9, wherein the decided scanning mode is any one among a horizontal-directional scanning, a vertical-directional scanning, and a zigzag scanning.

11. An encoding method using a DCT scanning, comprising the steps of:

selecting an optimal mode for intra prediction;

performing intra prediction onto video inputted based on the mode selected in the mode selection step;

performing DCT and quantization onto residual coefficients of a block outputted from the intra prediction step;

deciding pixel similarity of the residual coefficients; and

performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided in the pixel similarity decision step.

12. The encoding method of claim 11, wherein the decided scanning mode is any one among a horizontal-directional scanning, a vertical-directional scanning, and a zigzag scanning.

13. The encoding method of claim 12, wherein the entropy encoding step includes the steps of:

performing encoding using a horizontal-directional scanning, when vertical-directional pixel similarity of the residual signals is high;

performing encoding using a vertical-directional scanning, when horizontal-directional pixel similarity of the residual signals is high; and

performing encoding using a zigzag scanning, when vertical and horizontal-directional pixel similarities of the residual signals are similar.

14. The encoding method of claim 13, wherein the vertical-directional pixel similarity is decided high in the entropy encoding step, when a vertical-directional pixel similarity value is greater than a value obtained by multiplying a horizontal-directional pixel similarity value by a first multiplication factor.

15. The encoding method of claim 13, wherein the horizontal-directional pixel similarity is decided high in the entropy encoding step, when a horizontal-directional pixel similarity value is greater than a value obtained by multiplying a vertical-directional pixel similarity value by a second multiplication factor.

16. The encoding method of claim 14, wherein the vertical-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to a left part of a currently encoded block.

17. The encoding method of claim 15, wherein the horizontal-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to an upper part of a currently encoded block.

18. The encoding method of claim 16, wherein the first and second multiplication factors are natural number 2.

19. A decoding method using a DCT scanning, comprising the steps of:

performing entropy decoding onto encoded video;

deciding a scanning mode for the video decoded in the entropy decoding step; and

recovering the video based on the scanning mode decided in the scanning decision step.

20. The decoding apparatus of claim 19, wherein the decided scanning mode is any one among a horizontal-directional scanning, a vertical-directional scanning, and a zigzag scanning.

FIG. 1

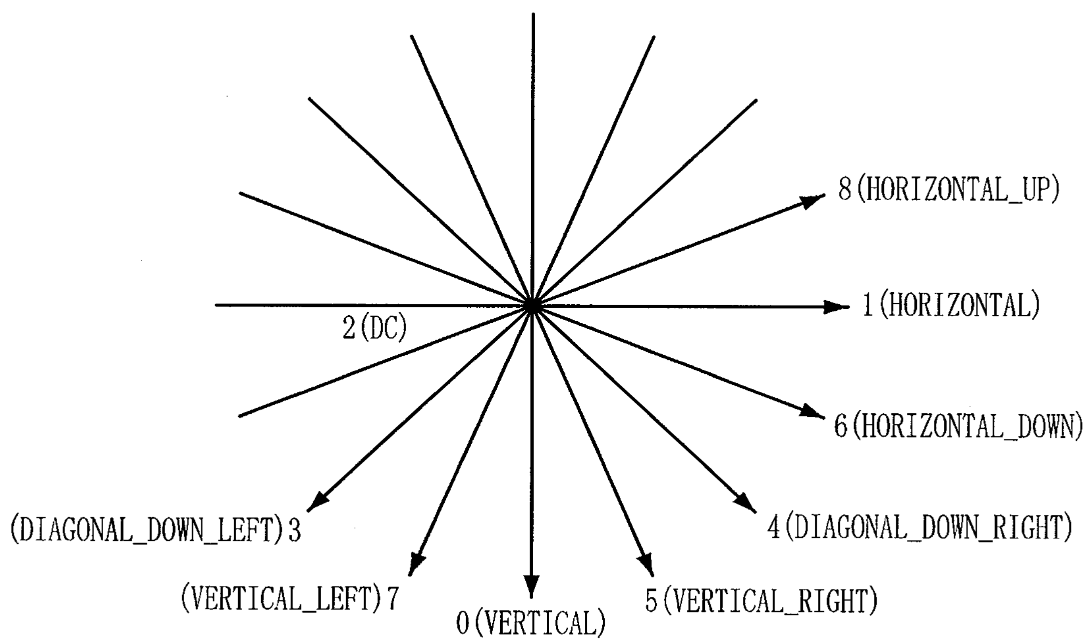
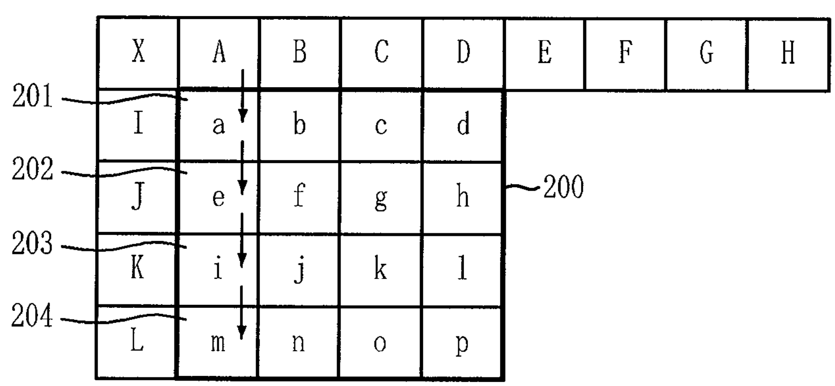

8 (HORIZONTAL_UP)
1 (HORIZONTAL)
2 (DC)
6 (HORIZONTAL_DOWN)
(DIAGONAL_DOWN_LEFT) 3
4 (DIAGONAL_DOWN_RIGHT)
(VERTICAL_LEFT) 7
0 (VERTICAL)
5 (VERTICAL_RIGHT)

FIG. 2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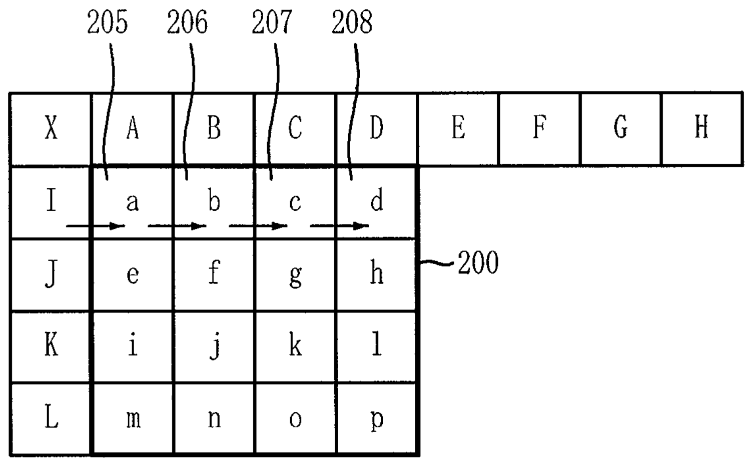
201 I a b c d
202 J e f g h
203 K i j k l
204 L m n o p
200

FIG. 3


205
206
207
208
X
A
B
C
D
E
F
G
H
I
a
b
c
d
J
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f
g
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K
i
j
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l
L
m
n
o
p
200

FIG. 4

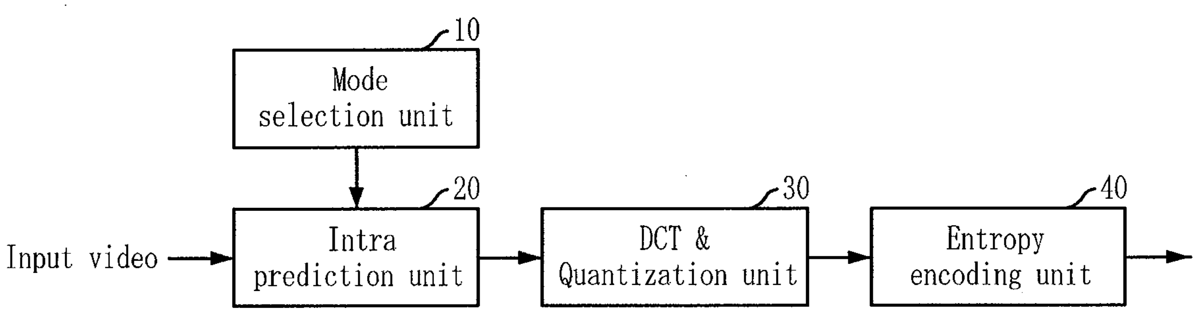

10
Mode selection unit
20
Input video
Intra prediction unit
30
DCT & Quantization unit
40
Entropy encoding unit

FIG. 5

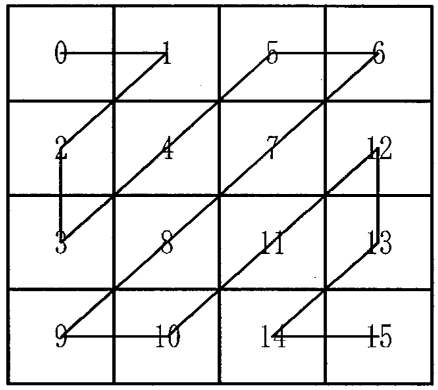


FIG. 6

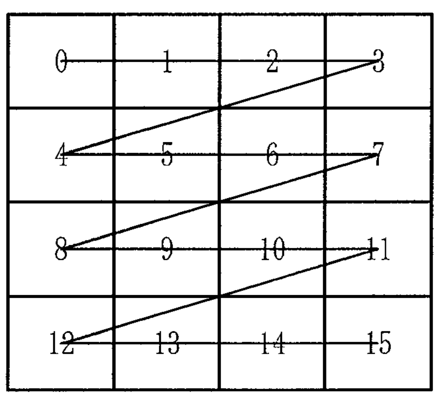


FIG. 7

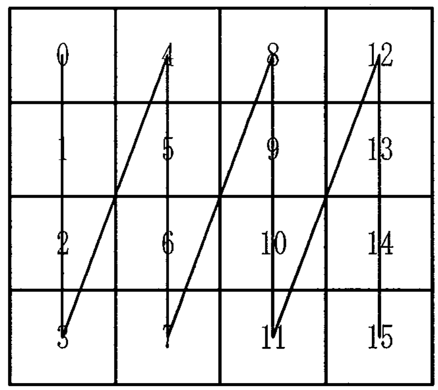


FIG. 8

	A	B	C	D
E	a	b	c	d
F	e	f	g	h
G	i	j	k	l
H	m	n	o	p

FIG. 9

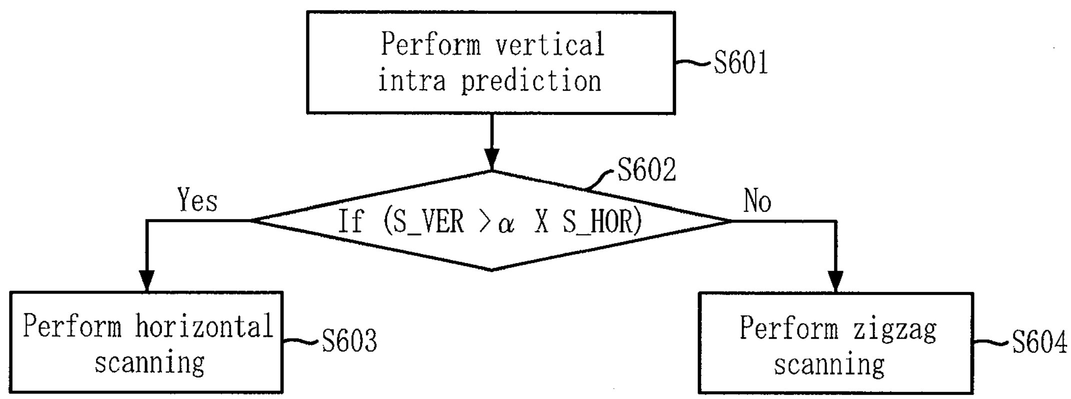

Perform vertical intra prediction
S601
S602
Yes
If (S_VER > α X S_HOR)
No
Perform horizontal scanning
S603
Perform zigzag scanning
S604

FIG. 10

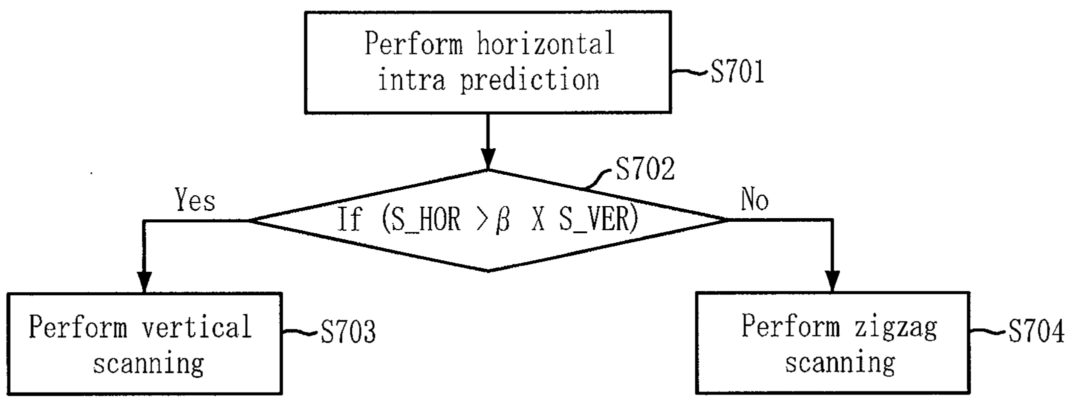
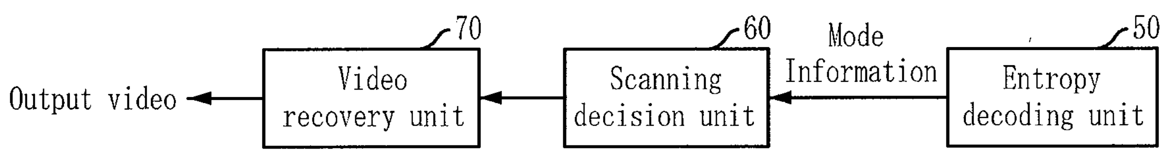

Perform horizontal intra prediction
S701
S702
Yes
No
If (S_HOR > β X S_VER)
Perform vertical scanning
S703
Perform zigzag scanning
S704

FIG. 11


70
60
50
Output video
Video recovery unit
Scanning decision unit
Mode Information
Entropy decoding unit

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2007/001433

A. CLASSIFICATION OF SUBJECT MATTER

H04N 7/30(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC8: H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility models and applications for Utility models since 1975
Japanese Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS(KIPO internal) "predict, similarity, DCT, coefficient"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP2004-348741 A (MITSUBISHI ELECTRIC EUROPA BV.) 9 December 2004 see abstract, claims 1-5, 14-18, figures 1, 3-5	1-20
A	JP2003-006643 A (CANON INC.) 10 January 2003 see abstract, claims 1, 5, 9, figures 1, 9-12	1-20

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

29 JUNE 2007 (29.06.2007)

Date of mailing of the international search report

29 JUNE 2007 (29.06.2007)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
920 Dunsan-dong, Seo-gu, Daejeon 302-701,
Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

LEE, Beaung Woo

Telephone No. 82-42-481-8227

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP16348741	09.12.2004	EP01480170A1	24.11.2004
		EP1480170A1	24.11.2004
		JP16348741	09.12.2004
		JP2004348741A2	09.12.2004
		US20050002569A1	06.01.2005
		US2005002569AA	06.01.2005
JP15006643	10.01.2003	JP15006643	10.01.2003
		JP2003006643A2	10.01.2003
		US20030081678A1	01.05.2003
		US2003081678A1	01.05.2003
		US2003081678AA	01.05.2003
		US7079689BB	18.07.2006

Docket: PATENT

COMBINED DECLARATION AND POWER OF ATTORNEY

(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL, CONTINUATION OR CIP)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type: *(check one applicable item below)*

- ☐ original
- ☐ design
- ☐ supplemental

Note: *If the Declaration is for an International Application being filed as a divisional, continuation or continuation-in-part application, do not check next item; check appropriate one of last three items*

- ☒ national stage of PCT

Note: *If one of the following 3 items apply, then complete and also attach ADDED PAGES FOR DIVISIONAL, CONTINUATION OR CIP*

- ☐ divisional
- ☐ continuation
- ☐ continuation-in-part (CIP)

INVENTORSHIP IDENTIFICATION

WARNING: *If the inventors are each not the inventors of all the claims, an explanation of the facts, including the ownership of all the claims at the time the last claimed invention was made, should be submitted.*

My residence, post office address and citizenship are as stated below, next to my name. I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter that is claimed, and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

SPECIFICATION IDENTIFICATION

the specification of which: *(complete (a), (b) or (c))*

☐ (a) is attached hereto.

☐ (b) was filed on ______________ as ☐ Serial No. ______________ or
☐Express Mail No. *(as Serial No. not yet known)* ____________
and was amended on ______________*(if applicable)*.

Note: Amendments filed after the original papers are deposited with the PTO that contain new matter are not accorded a filing date by being referred to in the Declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental Declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 CFR 1.67.

☒ (c) was described and claimed in PCT International Application No. PCT/KR2007/001433 filed on 23 March 2007.

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information, which is material to patentability as defined in 37, Code of Federal Regulations, § 1.56,

(also check the following items, if desired)

☐ and which is material to the examination of this application, namely, information where there is a substantial likelihood that a reasonable Examiner would consider it important in deciding whether to allow the application to issue as a patent, and

☐ in compliance with this duty, there is attached an information disclosure statement, in accordance with 37 CFR 1.98.

PRIORITY CLAIM (35 U.S.C. § 119(a)-(d))

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)-(d) of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

(complete (d) or (e))

☐ (d) no such applications have been filed.

☒ (e) such applications have been filed as follows.

Note: Where item (c) is entered above and the international application which designated the U.S. itself claimed priority check item (e), enter the details below and make the priority claim.

PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS APPLICATION AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119(a)-(d)

COUNTRY (OR INDICATE IF PCT	APPLICATION NUMBER	DATE OF FILING (day/month/year)	PRIORITY CLAIMED UNDER 35 USC 119
Republic of Korea	10-2006-0077851	17 August 2006	☒ YES NO ☐
Republic of Korea	10-2007-0008247	26 January 2007	☒ YES NO ☐

CLAIM FOR BENEFIT OF PRIOR U.S. PROVISIONAL APPLICATION(S) (35 U.S.C. § 119(e))

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

PROVISIONAL APPLICATION NUMBER	FILING DATE

ALL FOREIGN APPLICATION(S), IF ANY, FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

Note: If the application filed more than 12 months from the filing date of this application is a PCT filing forming the basis for this application entering the United States as (1) the national stage or (2) a continuation, divisional, or continuation-in-part, then also complete ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR CIP APPLICATION for benefit of the prior U.S. or PCT application(s) under 35 U.S.C. § 120.

POWER OF ATTORNEY

I hereby appoint the practitioners associated with **Customer Number 26530** to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

SEND CORRESPONDENCE TO:

DIRECT TELEPHONE CALLS TO:
(Name and telephone number)

Customer Number 26530

Richard J. Streit
c/o Ladas & Parry LLP
224 South Michigan Avenue
Chicago, Illinois 60604

(312) 427-1300

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURE(S)

Note: Carefully indicate the family (or last) name, as it should appear on the filing receipt and all other documents.

Full name of first joint inventor

Se-Yoon (Given Name) — (Middle Initial or Name) — JEONG (Family (or Last) Name)

Inventor's signature [signature]

Date 10. Feb. 2009 **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #101-1203 Geumseong Baekjo Apt., Birae-dong, Daedeok-gu Daejon 306-769, Republic of Korea

Full name of second joint inventor

Hae-Chul (Given Name) — (Middle Initial or Name) — CHOI (Family (or Last) Name)

Inventor's signature [signature]

Date 10-FEB-2009 **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #105-904 Yangji Maeul, Banseok-dong, Yuseong-gu Daejon 305-150, Republic of Korea

Full name of third joint inventor

Jeong-Il (Given Name) | (Middle Initial or Name) | SEO (Family (or Last) Name)

Inventor's signature

Date 10. Feb. 2009 **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #107-801 Sejong Apt., Jeonmin-dong, Yuseong-gu

Daejon 305-728, Republic of Korea

Full name of fourth joint inventor

Seung-Kwon (Given Name) | (Middle Initial or Name) | BEACK (Family (or Last) Name)

Inventor's signature

Date 10. Feb. 2009 **Country of Citizenship** Republic of Korea

Residence Seoul, Republic of Korea

Post Office Address 957-13, Bangbae 2-dong, Seocho-gu

Seoul 137-062, Republic of Korea

Full name of fifth joint inventor

In-Seon (Given Name) | (Middle Initial or Name) | JANG (Family (or Last) Name)

Inventor's signature

Date 10/Feb/2009 **Country of Citizenship** Republic of Korea

Residence Gyeonggi-do, Republic of Korea

Post Office Address #202, 86-46, Sanbon-dong, Gunpo-si

Gyeonggi-do 435-040, Republic of Korea

Full name of sixth joint inventor

Jae-Gon (Given Name) | (Middle Initial or Name) | KIM (Family (or Last) Name)

Inventor's signature

Date 10 Feb, 2009 **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #203-402 Saemmeori Apt., Dunsan-dong, Seo-gu

Daejon 302-120, Republic of Korea

Full name of seventh joint inventor

Kyung-Ae ______________________ MOON
(Given Name) (Middle Initial or Name) (Family (or Last) Name)

Inventor's signature Moon, Kyungae

Date 10. Feb. 2009 **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #9-903 Hanmaru Apt., Dunsan-dong, Seo-gu
Daejon 302-120, Republic of Korea

Full name of eighth joint inventor

Dae-Young ______________________ JANG
(Given Name) (Middle Initial or Name) (Family (or Last) Name)

Inventor's signature

Date 10. Feb. 2009 **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #904-1701 Yeolmae Maeul, Noeun-dong, Yuseong-gu
Daejon 305-768, Republic of Korea

Full name of ninth joint inventor

Jin-Woo ______________________ HONG
(Given Name) (Middle Initial or Name) (Family (or Last) Name)

Inventor's signature

Date 10. Feb. 2009 **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #130-702 Hanbit Apt., Eoeun-dong, Yuseong-gu
Daejon 305-333, Republic of Korea

Full name of tenth joint inventor

Jin-Woong ______________________ KIM
(Given Name) (Middle Initial or Name) (Family (or Last) Name)

Inventor's signature Jinwoong Kim

Date 10. Feb 2009 **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #305-1603 Expo Apt., Jeonmin-dong, Yuseong-gu
Daejon 305-761, Republic of Korea

Full name of eleventh joint inventor

Yung-Lyul		LEE
(Given Name)	(Middle Initial or Name)	(Family (or Last) Name)

Inventor's signature ______________________

Date ______________ **Country of Citizenship** Republic of Korea

Residence Seoul, Republic of Korea

Post Office Address #1-704 Kukdong Apt., Garak-dong, Songpa-gu
Seoul 138-160, Republic of Korea

Full name of twelfth joint inventor

Dong-Gyu		SIM
(Given Name)	(Middle Initial or Name)	(Family (or Last) Name)

Inventor's signature ______________________

Date ______________ **Country of Citizenship** Republic of Korea

Residence Seoul, Republic of Korea

Post Office Address #31-607 Samho Apt., Wolgye-dong, Nowon-gu
Seoul 139-050, Republic of Korea

Full name of thirteenth joint inventor

Seoung-Jun		OH
(Given Name)	(Middle Initial or Name)	(Family (or Last) Name)

Inventor's signature ______________________

Date ______________ **Country of Citizenship** Republic of Korea

Residence Gyeonggi-do, Republic of Korea

Post Office Address #104-1902 I-Park, Jeongja 1-dong, Bundang-gu, Seongnam-si
Gyeonggi-do 463-010, Republic of Korea

Full name of fourteen joint inventor

Chang-Beom		AHN
(Given Name)	(Middle Initial or Name)	(Family (or Last) Name)

Inventor's signature ______________________

Date ______________ **Country of Citizenship** Republic of Korea

Residence Seoul, Republic of Korea

Post Office Address #109-501 Olympic Apt., 89, Bangi-dong, Songpa-gu
Seoul 138-050, Republic of Korea

Full name of fifteen joint inventor

Dae-Yeon (Given Name) | (Middle Initial or Name) | KIM (Family (or Last) Name)

Inventor's signature__________

Date__________ **Country of Citizenship** Republic of Korea

Residence Seoul, Republic of Korea

Post Office Address #204-1203 Life Apt., Gongneung 3-dong, Nowon-gu
Seoul 139-243, Republic of Korea

Full name of sixteen joint inventor

Dong-Kyun (Given Name) | (Middle Initial or Name) | KIM (Family (or Last) Name)

Inventor's signature__________

Date__________ **Country of Citizenship** Republic of Korea

Residence Seoul, Republic of Korea

Post Office Address #106-412 Byeoksan Apt., Sanggye 5-dong, Nowon-gu
Seoul 139-748, Republic of Korea

COMBINED DECLARATION AND POWER OF ATTORNEY

(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL, CONTINUATION OR CIP)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type: *(check one applicable item below)*

- ☐ original
- ☐ design
- ☐ supplemental

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- ☐ divisional
- ☐ continuation
- ☐ continuation-in-part (CIP)

INVENTORSHIP IDENTIFICATION

WARNING: If the inventors are each not the inventors of all the claims, an explanation of the facts, including the ownership of all the claims at the time the last claimed invention was made, should be submitted.

My residence, post office address and citizenship are as stated below, next to my name. I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter that is claimed, and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

SPECIFICATION IDENTIFICATION

the specification of which: *(complete (a), (b) or (c))*

☐ (a) is attached hereto.

☐ (b) was filed on ____________ as ☐ Serial No. ____________ or ☐ Express Mail No. *(as Serial No. not yet known)* ____________ and was amended on ____________ *(if applicable).*

Note: Amendments filed after the original papers are deposited with the PTO that contain new matter are not accorded a filing date by being referred to in the Declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental Declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 CFR 1.67.

☒ (c) was described and claimed in PCT International Application No. PCT/KR2007/001433 filed on 23 March 2007.

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information, which is material to patentability as defined in 37, Code of Federal Regulations, § 1.56,

(also check the following items, if desired)

☐ and which is material to the examination of this application, namely, information where there is a substantial likelihood that a reasonable Examiner would consider it important in deciding whether to allow the application to issue as a patent, and

☐ in compliance with this duty, there is attached an information disclosure statement, in accordance with 37 CFR 1.98.

PRIORITY CLAIM (35 U.S.C. § 119(a)-(d))

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)-(d) of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

(complete (d) or (e))

☐ (d) no such applications have been filed.

☒ (e) such applications have been filed as follows.

Note: Where item (c) is entered above and the international application which designated the U.S. itself claimed priority check item (e), enter the details below and make the priority claim.

PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS APPLICATION AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119(a)-(d)

COUNTRY (OR INDICATE IF PCT	APPLICATION NUMBER	DATE OF FILING (day/month/year)	PRIORITY CLAIMED UNDER 35 USC 119
Republic of Korea	10-2006-0077851	17 August 2006	☒ YES NO ☐
Republic of Korea	10-2007-0008247	26 January 2007	☒ YES NO ☐

CLAIM FOR BENEFIT OF PRIOR U.S. PROVISIONAL APPLICATION(S) (35 U.S.C. § 119(e))

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

PROVISIONAL APPLICATION NUMBER	FILING DATE

ALL FOREIGN APPLICATION(S), IF ANY, FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

Note: If the application filed more than 12 months from the filing date of this application is a PCT filing forming the basis for this application entering the United States as (1) the national stage or (2) a continuation, divisional, or continuation-in-part, then also complete ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR CIP APPLICATION for benefit of the prior U.S. or PCT application(s) under 35 U.S.C. § 120.

POWER OF ATTORNEY

I hereby appoint the practitioners associated with **Customer Number 26530** to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

SEND CORRESPONDENCE TO:

DIRECT TELEPHONE CALLS TO:
(Name and telephone number)

Customer Number 26530

Richard J. Streit
c/o Ladas & Parry LLP
224 South Michigan Avenue
Chicago, Illinois 60604

(312) 427-1300

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURE(S)

Note: Carefully indicate the family (or last) name, as it should appear on the filing receipt and all other documents.

Full name of first joint inventor

Se-Yoon (Given Name) ____ (Middle Initial or Name) JEONG (Family (or Last) Name)

Inventor's signature______

Date______ **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #101-1203 Geumseong Baekjo Apt., Birae-dong, Daedeok-gu
Daejon 306-769, Republic of Korea

Full name of second joint inventor

Hae-Chul (Given Name) ____ (Middle Initial or Name) CHOI (Family (or Last) Name)

Inventor's signature______

Date______ **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #105-904 Yangji Maeul. Banseok-dong, Yuseong-gu
Daejon 305-150, Republic of Korea

Full name of third joint inventor

Jeong-Il (Given Name) | (Middle Initial or Name) | SEO (Family (or Last) Name)

Inventor's signature

Date **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #107-801 Sejong Apt., Jeonmin-dong, Yuseong-gu
Daejon 305-728, Republic of Korea

Full name of fourth joint inventor

Seung-Kwon (Given Name) | (Middle Initial or Name) | BEACK (Family (or Last) Name)

Inventor's signature

Date **Country of Citizenship** Republic of Korea

Residence Seoul, Republic of Korea

Post Office Address 957-13, Bangbae 2-dong, Seocho-gu
Seoul 137-062, Republic of Korea

Full name of fifth joint inventor

In-Seon (Given Name) | (Middle Initial or Name) | JANG (Family (or Last) Name)

Inventor's signature

Date **Country of Citizenship** Republic of Korea

Residence Gyeonggi-do, Republic of Korea

Post Office Address #202, 86-46, Sanbon-dong, Gunpo-si
Gyeonggi-do 435-040, Republic of Korea

Full name of sixth joint inventor

Jae-Gon (Given Name) | (Middle Initial or Name) | KIM (Family (or Last) Name)

Inventor's signature

Date **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #203-402 Saemmeori Apt., Dunsan-dong, Seo-gu
Daejon 302-120, Republic of Korea

Full name of seventh joint inventor

Kyung-Ae (Given Name) | (Middle Initial or Name) | MOON (Family (or Last) Name)

Inventor's signature

Date **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #9-903 Hanmaru Apt., Dunsan-dong, Seo-gu

Daejon 302-120, Republic of Korea

Full name of eighth joint inventor

Dae-Young (Given Name) | (Middle Initial or Name) | JANG (Family (or Last) Name)

Inventor's signature

Date **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #904-1701 Yeolmae Maeul, Noeun-dong, Yuseong-gu

Daejon 305-768, Republic of Korea

Full name of ninth joint inventor

Jin-Woo (Given Name) | (Middle Initial or Name) | HONG (Family (or Last) Name)

Inventor's signature

Date **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #130-702 Hanbit Apt., Eoeun-dong, Yuseong-gu

Daejon 305-333, Republic of Korea

Full name of tenth joint inventor

Jin-Woong (Given Name) | (Middle Initial or Name) | KIM (Family (or Last) Name)

Inventor's signature

Date **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #305-1603 Expo Apt., Jeonmin-dong, Yuseong-gu

Daejon 305-761, Republic of Korea

Full name of eleventh joint inventor

Yung-Lyul (Given Name) | (Middle Initial or Name) | LEE (Family (or Last) Name)

Inventor's signature Lee Yung Lyul

Date Feb. 7, 2009 **Country of Citizenship** Republic of Korea

Residence Seoul, Republic of Korea

Post Office Address #1-704 Kukdong Apt., Garak-dong, Songpa-gu
Seoul 138-160, Republic of Korea

Full name of twelfth joint inventor

Dong-Gyu (Given Name) | (Middle Initial or Name) | SIM (Family (or Last) Name)

Inventor's signature

Date **Country of Citizenship** Republic of Korea

Residence Seoul, Republic of Korea

Post Office Address #31-607 Samho Apt., Wolgye-dong, Nowon-gu
Seoul 139-050, Republic of Korea

Full name of thirteenth joint inventor

Seoung-Jun (Given Name) | (Middle Initial or Name) | OH (Family (or Last) Name)

Inventor's signature

Date **Country of Citizenship** Republic of Korea

Residence Gyeonggi-do, Republic of Korea

Post Office Address #104-1902 I-Park, Jeongja 1-dong, Bundang-gu, Seongnam-si
Gyeonggi-do 463-010, Republic of Korea

Full name of fourteen joint inventor

Chang-Beom (Given Name) | (Middle Initial or Name) | AHN (Family (or Last) Name)

Inventor's signature

Date **Country of Citizenship** Republic of Korea

Residence Seoul, Republic of Korea

Post Office Address #109-501 Olympic Apt., 89, Bangi-dong, Songpa-gu
Seoul 138-050, Republic of Korea

Full name of fifteen joint inventor

Dae-Yeon		KIM
(Given Name)	(Middle Initial or Name)	(Family (or Last) Name)

Inventor's signature

Date Feb. 7, 2009 **Country of Citizenship** Republic of Korea

Residence Seoul, Republic of Korea

Post Office Address #204-1203 Life Apt., Gongneung 3-dong, Nowon-gu
Seoul 139-243, Republic of Korea

Full name of sixteen joint inventor

Dong-Kyun		KIM
(Given Name)	(Middle Initial or Name)	(Family (or Last) Name)

Inventor's signature

Date Feb. 7. 2009 **Country of Citizenship** Republic of Korea

Residence Seoul, Republic of Korea

Post Office Address #106-412 Byeoksan Apt., Sanggye 5-dong, Nowon-gu
Seoul 139-748, Republic of Korea

Docket: PATENT

COMBINED DECLARATION AND POWER OF ATTORNEY

(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL, CONTINUATION OR CIP)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type: *(check one applicable item below)*

- ☐ original
- ☐ design
- ☐ supplemental

Note: If the Declaration is for an International Application being filed as a divisional, continuation or continuation-in-part application, do not check next item; check appropriate one of last three items.

- ☒ national stage of PCT

Note: If one of the following 3 items apply, then complete and also attach ADDED PAGES FOR DIVISIONAL, CONTINUATION OR CIP.

- ☐ divisional
- ☐ continuation
- ☐ continuation-in-part (CIP)

INVENTORSHIP IDENTIFICATION

WARNING: If the inventors are each not the inventors of all the claims, an explanation of the facts, including the ownership of all the claims at the time the last claimed invention was made, should be submitted.

My residence, post office address and citizenship are as stated below, next to my name. I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter that is claimed, and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

SPECIFICATION IDENTIFICATION

the specification of which: *(complete (a), (b) or (c))*

☐ (a) is attached hereto.

☐ (b) was filed on ____________ as ☐ Serial No. ____________ or
☐ Express Mail No. *(as Serial No. not yet known)* ____________
and was amended on ____________ *(if applicable).*

Note: Amendments filed after the original papers are deposited with the PTO that contain new matter are not accorded a filing date by being referred to in the Declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental Declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 CFR 1.67.

☒ (c) was described and claimed in PCT International Application No. PCT/KR2007/001433 filed on 23 March 2007.

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information, which is material to patentability as defined in 37, Code of Federal Regulations, § 1.56,

(also check the following items, if desired)

☐ and which is material to the examination of this application, namely, information where there is a substantial likelihood that a reasonable Examiner would consider it important in deciding whether to allow the application to issue as a patent, and

☐ in compliance with this duty, there is attached an information disclosure statement, in accordance with 37 CFR 1.98.

PRIORITY CLAIM (35 U.S.C. § 119(a)-(d))

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)-(d) of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

(complete (d) or (e))

☐ (d) no such applications have been filed.

☒ (e) such applications have been filed as follows.

Note: Where item (c) is entered above and the international application which designated the U.S. itself claimed priority check item (e), enter the details below and make the priority claim.

PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS APPLICATION AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119(a)-(d)

COUNTRY (OR INDICATE IF PCT	APPLICATION NUMBER	DATE OF FILING (day/month/year)	PRIORITY CLAIMED UNDER 35 USC 119
Republic of Korea	10-2006-0077851	17 August 2006	☒ YES NO ☐
Republic of Korea	10-2007-0008247	26 January 2007	☒ YES NO ☐

CLAIM FOR BENEFIT OF PRIOR U.S. PROVISIONAL APPLICATION(S) (35 U.S.C. § 119(e))

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

PROVISIONAL APPLICATION NUMBER	FILING DATE

ALL FOREIGN APPLICATION(S), IF ANY, FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

Note: If the application filed more than 12 months from the filing date of this application is a PCT filing forming the basis for this application entering the United States as (1) the national stage or (2) a continuation, divisional, or continuation-in-part, then also complete ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR CIP APPLICATION for benefit of the prior U.S. or PCT application(s) under 35 U.S.C. § 120.

POWER OF ATTORNEY

I hereby appoint the practitioners associated with **Customer Number 26530** to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

SEND CORRESPONDENCE TO:

DIRECT TELEPHONE CALLS TO:
(Name and telephone number)

Customer Number 26530

Richard J. Streit
c/o Ladas & Parry LLP
224 South Michigan Avenue
Chicago, Illinois 60604

(312) 427-1300

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURE(S)

Note: Carefully indicate the family (or last) name, as it should appear on the filing receipt and all other documents.

Full name of first joint inventor

Se-Yoon		JEONG
(Given Name)	(Middle Initial or Name)	(Family (or Last) Name)

Inventor's signature__________

Date__________ **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #101-1203 Geumseong Baekjo Apt., Birae-dong, Daedeok-gu Daejon 306-769, Republic of Korea

Full name of second joint inventor

Hae-Chul		CHOI
(Given Name)	(Middle Initial or Name)	(Family (or Last) Name)

Inventor's signature__________

Date__________ **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #105-904 Yangji Maeul. Banseok-dong, Yuseong-gu Daejon 305-150, Republic of Korea

Full name of third joint inventor

Jeong-Il (Given Name) | (Middle Initial or Name) | SEO (Family (or Last) Name)

Inventor's signature ______________________

Date ______________________ **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #107-801 Sejong Apt., Jeonmin-dong, Yuseong-gu
Daejon 305-728, Republic of Korea

Full name of fourth joint inventor

Seung-Kwon (Given Name) | (Middle Initial or Name) | BEACK (Family (or Last) Name)

Inventor's signature ______________________

Date ______________________ **Country of Citizenship** Republic of Korea

Residence Seoul, Republic of Korea

Post Office Address 957-13, Bangbae 2-dong, Seocho-gu
Seoul 137-062, Republic of Korea

Full name of fifth joint inventor

In-Seon (Given Name) | (Middle Initial or Name) | JANG (Family (or Last) Name)

Inventor's signature ______________________

Date ______________________ **Country of Citizenship** Republic of Korea

Residence Gyeonggi-do, Republic of Korea

Post Office Address #202. 86-46, Sanbon-dong, Gunpo-si
Gyeonggi-do 435-040, Republic of Korea

Full name of sixth joint inventor

Jae-Gon (Given Name) | (Middle Initial or Name) | KIM (Family (or Last) Name)

Inventor's signature ______________________

Date ______________________ **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #203-402 Saemmeori Apt., Dunsan-dong, Seo-gu
Daejon 302-120, Republic of Korea

Full name of seventh joint inventor

Kyung-Ae (Given Name) | (Middle Initial or Name) | MOON (Family (or Last) Name)

Inventor's signature ______

Date ______ **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #9-903 Hanmaru Apt., Dunsan-dong, Seo-gu
Daejon 302-120, Republic of Korea

Full name of eighth joint inventor

Dae-Young (Given Name) | (Middle Initial or Name) | JANG (Family (or Last) Name)

Inventor's signature ______

Date ______ **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #904-1701 Yeolmae Maeul, Noeun-dong, Yuseong-gu
Daejon 305-768, Republic of Korea

Full name of ninth joint inventor

Jin-Woo (Given Name) | (Middle Initial or Name) | HONG (Family (or Last) Name)

Inventor's signature ______

Date ______ **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #130-702 Hanbit Apt., Eoeun-dong, Yuseong-gu
Daejon 305-333, Republic of Korea

Full name of tenth joint inventor

Jin-Woong (Given Name) | (Middle Initial or Name) | KIM (Family (or Last) Name)

Inventor's signature ______

Date ______ **Country of Citizenship** Republic of Korea

Residence Daejon, Republic of Korea

Post Office Address #305-1603 Expo Apt., Jeonmin-dong, Yuseong-gu
Daejon 305-761, Republic of Korea

Full name of eleventh joint inventor

Yung-Lyul (Given Name) | (Middle Initial or Name) | LEE (Family (or Last) Name)

Inventor's signature

Date **Country of Citizenship** Republic of Korea

Residence Seoul, Republic of Korea

Post Office Address #1-704 Kukdong Apt., Garak-dong, Songpa-gu
Seoul 138-160, Republic of Korea

Full name of twelfth joint inventor

Dong-Gyu (Given Name) | (Middle Initial or Name) | SIM (Family (or Last) Name)

Inventor's signature

Date 2/9/2009 **Country of Citizenship** Republic of Korea

Residence Seoul, Republic of Korea

Post Office Address #31-607 Samho Apt., Wolgye-dong, Nowon-gu
Seoul 139-050, Republic of Korea

Full name of thirteenth joint inventor

Seoung-Jun (Given Name) | (Middle Initial or Name) | OH (Family (or Last) Name)

Inventor's signature

Date 2/ 9/2009 **Country of Citizenship** Republic of Korea

Residence Gyeonggi-do, Republic of Korea

Post Office Address #104-1902 I-Park, Jeongja 1-dong, Bundang-gu, Seongnam-si
Gyeonggi-do 463-010, Republic of Korea

Full name of fourteen joint inventor

Chang-Beom (Given Name) | (Middle Initial or Name) | AHN (Family (or Last) Name)

Inventor's signature

Date 2/9/2009 **Country of Citizenship** Republic of Korea

Residence Seoul, Republic of Korea

Post Office Address #109-501 Olympic Apt., 89, Bangi-dong, Songpa-gu
Seoul 138-050, Republic of Korea

Full name of fifteen joint inventor

Dae-Yeon		KIM
(Given Name)	(Middle Initial or Name)	(Family (or Last) Name)

Inventor's signature____________________

Date____________ **Country of Citizenship** Republic of Korea

Residence Seoul, Republic of Korea

Post Office Address #204-1203 Life Apt., Gongneung 3-dong, Nowon-gu
Seoul 139-243, Republic of Korea

Full name of sixteen joint inventor

Dong-Kyun		KIM
(Given Name)	(Middle Initial or Name)	(Family (or Last) Name)

Inventor's signature____________________

Date____________ **Country of Citizenship** Republic of Korea

Residence Seoul, Republic of Korea

Post Office Address #106-412 Byeoksan Apt., Sanggye 5-dong, Nowon-gu
Seoul 139-748, Republic of Korea

PTO/SB/14 (07-07)
Approved for use through 06/30/2010. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	CU-7298 WWP
	Application Number	
Title of Invention	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Applicant Information:

Applicant 1 Remove

Applicant Authority	◉ Inventor	○ Legal Representative under 35 U.S.C. 117	○ Party of Interest under 35 U.S.C. 118	
Prefix	**Given Name**	**Middle Name**	**Family Name**	**Suffix**
	Se-Yoon		JEONG	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Daejon	**Country Of Residence** i	KR
Citizenship under 37 CFR 1.41(b) i	KR		
Mailing Address of Applicant:			
Address 1	#101-1203 Geumseong Baekjo Apt., Birae-dong,		
Address 2	Daedeok-gu		
City	Daejon	**State/Province**	
Postal Code	306-769	**Country** i	KR

Applicant 2 Remove

Applicant Authority	◉ Inventor	○ Legal Representative under 35 U.S.C. 117	○ Party of Interest under 35 U.S.C. 118	
Prefix	**Given Name**	**Middle Name**	**Family Name**	**Suffix**
	Hae-Chul		CHOI	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Daejon	**Country Of Residence** i	KR
Citizenship under 37 CFR 1.41(b) i	KR		
Mailing Address of Applicant:			
Address 1	#105-904 Yangji Maeul, Banseok-dong, Yuseong-gu		
Address 2			
City	Daejon	**State/Province**	
Postal Code	305-150	**Country** i	KR

Applicant 3 Remove

Applicant Authority	◉ Inventor	○ Legal Representative under 35 U.S.C. 117	○ Party of Interest under 35 U.S.C. 118	
Prefix	**Given Name**	**Middle Name**	**Family Name**	**Suffix**
	Jeong-Il		SEO	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Daejon	**Country Of Residence** i	KR

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	CU-7298 WWP
	Application Number	

Title of Invention	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

Citizenship under 37 CFR 1.41(b) i	KR		
Mailing Address of Applicant:			
Address 1	#107-801 Sejong Apt., Jeonmin-dong, Yuseong-gu		
Address 2			
City	Daejon	**State/Province**	
Postal Code	305-728	**Country**i	KR

Applicant 4 Remove

Applicant Authority	◉Inventor	○Legal Representative under 35 U.S.C. 117	○Party of Interest under 35 U.S.C. 118	
Prefix	**Given Name**	**Middle Name**	**Family Name**	**Suffix**
	Seung-Kwon		BEACK	
Residence Information (Select One)	○ US Residency	◉ Non US Residency	○ Active US Military Service	
City	Seoul	**Country Of Residence**i	KR	
Citizenship under 37 CFR 1.41(b) i	KR			
Mailing Address of Applicant:				
Address 1	957-13, Bangbae 2-dong, Seocho-gu			
Address 2				
City	Seoul	**State/Province**		
Postal Code	137-062	**Country**i	KR	

Applicant 5 Remove

Applicant Authority	◉Inventor	○Legal Representative under 35 U.S.C. 117	○Party of Interest under 35 U.S.C. 118	
Prefix	**Given Name**	**Middle Name**	**Family Name**	**Suffix**
	In-Seon		JANG	
Residence Information (Select One)	○ US Residency	◉ Non US Residency	○ Active US Military Service	
City	Gyeonggi-do	**Country Of Residence**i	KR	
Citizenship under 37 CFR 1.41(b) i	KR			
Mailing Address of Applicant:				
Address 1	#202, 86-46, Sanbon-dong, Gunpo-si			
Address 2				
City	Gyeonggi-do	**State/Province**		
Postal Code	435-040	**Country**i	KR	

Applicant 6 Remove

Applicant Authority	◉Inventor	○Legal Representative under 35 U.S.C. 117	○Party of Interest under 35 U.S.C. 118	
Prefix	**Given Name**	**Middle Name**	**Family Name**	**Suffix**
	Jae-Gon		KIM	
Residence Information (Select One)	○ US Residency	◉ Non US Residency	○ Active US Military Service	
City	Daejon	**Country Of Residence**i	KR	
Citizenship under 37 CFR 1.41(b) i	KR			

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	CU-7298 WWP
	Application Number	

Title of Invention	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

Mailing Address of Applicant:

Address 1	#203-402 Saemmeori Apt., Dunsan-dong, Seo-gu		
Address 2			
City	Daejon	**State/Province**	
Postal Code	302-120	**Country** i	KR

Applicant 7 Remove

Applicant Authority ◉Inventor ○Legal Representative under 35 U.S.C. 117 ○Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Kyung-Ae		MOON	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Daejon	**Country Of Residence** i	KR
Citizenship under 37 CFR 1.41(b) i	KR		

Mailing Address of Applicant:

Address 1	#9-903 Hanmaru Apt., Dunsan-dong, Seo-gu		
Address 2			
City	Daejon	**State/Province**	
Postal Code	302-120	**Country** i	KR

Applicant 8 Remove

Applicant Authority ◉Inventor ○Legal Representative under 35 U.S.C. 117 ○Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Dae-Young		JANG	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Daejon	**Country Of Residence** i	KR
Citizenship under 37 CFR 1.41(b) i	KR		

Mailing Address of Applicant:

Address 1	#904-1701 Yeolmae Maeul, Noeun-dong, Yuseong-gu		
Address 2			
City	Daejon	**State/Province**	
Postal Code	305-768	**Country** i	KR

Applicant 9 Remove

Applicant Authority ◉Inventor ○Legal Representative under 35 U.S.C. 117 ○Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Jin-Woo		HONG	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Daejon	**Country Of Residence** i	KR
Citizenship under 37 CFR 1.41(b) i	KR		

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	CU-7298 WWP
	Application Number	

Title of Invention	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

Mailing Address of Applicant:

Address 1	#130-702 Hanbit Apt., Eoeun-dong, Yuseong-gu		
Address 2			
City	Daejon	**State/Province**	
Postal Code	305-333	**Country** i	KR

Applicant 10 Remove

Applicant Authority ◉Inventor ○Legal Representative under 35 U.S.C. 117 ○Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Jin-Woong		KIM	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Daejon	**Country Of Residence** i	KR
Citizenship under 37 CFR 1.41(b) i	KR		

Mailing Address of Applicant:

Address 1	#305-1603 Expo Apt., Jeonmin-dong, Yuseong-gu		
Address 2			
City	Daejon	**State/Province**	
Postal Code	305-761	**Country** i	KR

Applicant 11 Remove

Applicant Authority ◉Inventor ○Legal Representative under 35 U.S.C. 117 ○Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Yung-Lyul		LEE	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Seoul	**Country Of Residence** i	KR
Citizenship under 37 CFR 1.41(b) i	KR		

Mailing Address of Applicant:

Address 1	#1-704 Kukdong Apt., Garak-dong, Songpa-gu		
Address 2			
City	Seoul	**State/Province**	
Postal Code	138-160	**Country** i	KR

Applicant 12 Remove

Applicant Authority ◉Inventor ○Legal Representative under 35 U.S.C. 117 ○Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Dong-Gyu		SIM	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Seoul	**Country Of Residence** i	KR
Citizenship under 37 CFR 1.41(b) i	KR		

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	CU-7298 WWP
	Application Number	

Title of Invention	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

Mailing Address of Applicant:

Address 1	#31-607 Samho Apt., Wolgye-dong, Nowon-gu		
Address 2			
City	Seoul	**State/Province**	
Postal Code	139-050	**Country** i	KR

Applicant 13 Remove

Applicant Authority ◉ Inventor | ○ Legal Representative under 35 U.S.C. 117 | ○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Seoung-Jun		OH	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Gyeonggi-do	**Country Of Residence** i	KR
Citizenship under 37 CFR 1.41(b) i	KR		

Mailing Address of Applicant:

Address 1	#104-1902 I-Park, Jeongja 1-dong, Bundang-gu,		
Address 2	Seongnam-si		
City	Gyeonggi-do	**State/Province**	
Postal Code	463-010	**Country** i	KR

Applicant 14 Remove

Applicant Authority ◉ Inventor | ○ Legal Representative under 35 U.S.C. 117 | ○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Chang-Beom		AHN	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Seoul	**Country Of Residence** i	KR
Citizenship under 37 CFR 1.41(b) i	KR		

Mailing Address of Applicant:

Address 1	#109-501 Olympic Apt., 89, Bangi-dong, Songpa-gu		
Address 2			
City	Seoul	**State/Province**	
Postal Code	138-050	**Country** i	KR

Applicant 15 Remove

Applicant Authority ◉ Inventor | ○ Legal Representative under 35 U.S.C. 117 | ○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Dae-Yeon		KIM	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Seoul	**Country Of Residence** i	KR
Citizenship under 37 CFR 1.41(b) i	KR		

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	CU-7298 WWP
	Application Number	

Title of Invention	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

Mailing Address of Applicant:			
Address 1	#204-1203 Life Apt., Gongneung 3-dong, Nowon-gu		
Address 2			
City	Seoul	**State/Province**	
Postal Code	139-243	**Country**i	KR

Applicant 16 Remove

Applicant Authority ◉Inventor ○Legal Representative under 35 U.S.C. 117 ○Party of Interest under 35 U.S.C. 118

Prefix	**Given Name**	**Middle Name**	**Family Name**	**Suffix**
	Dong-Kyun		KIM	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Seoul	**Country Of Residence**i	KR
Citizenship under 37 CFR 1.41(b) i	KR		

Mailing Address of Applicant:			
Address 1	#106-412 Byeoksan Apt., Sanggye 5-dong, Nowon-gu		
Address 2			
City	Seoul	**State/Province**	
Postal Code	139-748	**Country**i	KR

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	26530	
Email Address		Add Email Remove Email

Application Information:

Title of the Invention	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR		
Attorney Docket Number	CU-7298 WWP	**Small Entity Status Claimed**	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Suggested Class (if any)		**Sub Class (if any)**	
Suggested Technology Center (if any)			
Total Number of Drawing Sheets (if any)	6	**Suggested Figure for Publication (if any)**	

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	CU-7298 WWP
	Application Number	

Title of Invention	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Enter either Customer Number or complete the Representative Name section below. If both sections are completed the Customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	26530		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78(a)(2) or CFR 1.78(a)(4), and need not otherwise be made part of the specification.

Prior Application Status		Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	a 371 of international	PCT/KR2007/001433	2007-03-23

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim benefit of foreign priority and to identify any prior foreign application for which priority is not claimed. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(a).

			Remove
Application Number	Country i	Parent Filing Date (YYYY-MM-DD)	Priority Claimed
10-2006-0077851	KR	2006-08-17	◉ Yes ○ No

			Remove
Application Number	Country i	Parent Filing Date (YYYY-MM-DD)	Priority Claimed
10-2007-0008247	KR	2007-01-26	◉ Yes ○ No

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	CU-7298 WWP
	Application Number	

Title of Invention	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

Assignee Information:

Providing this information in the application data sheet does not substitute for compliance with any requirement of part 3 of Title 37 of the CFR to have an assignment recorded in the Office.

Assignee 1 Remove

If the Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee Data may be generated within this form by selecting the **Add** button. Add

Signature:

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 10.18. Please see 37 CFR 1.4(d) for the form of the signature.

Signature	/Woochoon W. Park/			Date (YYYY-MM-DD)	2009-02-16
First Name	Woochoon W.	Last Name	Park	Registration Number	55523

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

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Title of Invention:	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR
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1	Transmittal of New Application	cu7298pto_1390_transmittal.pdf	237400 c056b9504299ad85aa1aabddd380ec25d78a45ed	no	4
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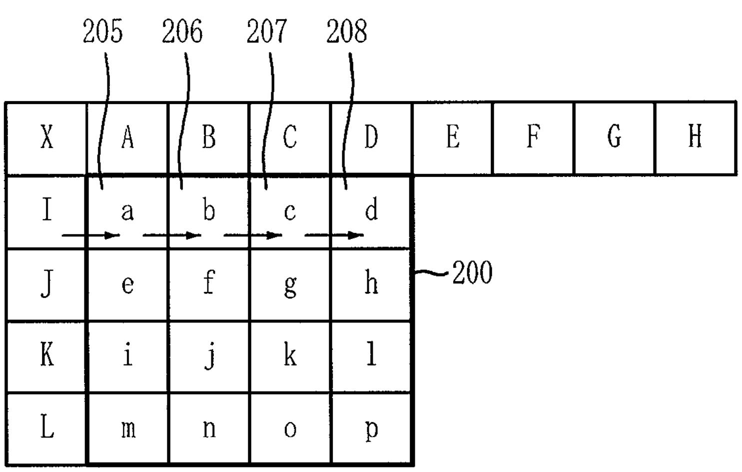
(54) **Title:** APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR



(57) Abstract: The present invention discloses an encoding apparatus using a Discrete Cosine Transform (DCT) scanning, which includes: a mode selection means for selecting an optimal mode for intra prediction; an intra prediction means for performing intra prediction onto video inputted based on the mode selected in the mode selection means; a DCT and quantization means for performing DCT and quantization onto residual coefficients of a block outputted from the intra prediction means; and an entropy encoding means for performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided based on pixel similarity of the residual coefficients.

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DESCRIPTION

APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

TECHNICAL FIELD

The present invention relates to an encoding/decoding apparatus and method using an adaptive Discrete Cosine Transform (DCT) coefficient scanning based on pixel similarity. More particularly, the present invention relates to an encoding/decoding apparatus and method which performs intra prediction onto input video, predicts pixel similarity based on pixel similarity information of coefficients to be encoded that is acquired from adjacent pixels in the intra-predicted video, and performs a most effective scanning, e.g., Discrete Cosine Transform (DCT) coefficient scanning, according to the predicted pixel similarity.

BACKGROUND ART

According to video compression standards for encoding/decoding video data, a frame is divided into a plurality of macro blocks and a macro block may be divided into a plurality of sub-blocks. The encoding/decoding is performed on the basis of a macro block unit or a sub-block unit based on temporal prediction and spatial prediction.

Herein, the temporal prediction is to predict motion of macro blocks or sub-blocks of a current frame by referring to blocks of adjacent frames.

The spatial prediction is to predict motion of macro blocks or sub-blocks of a current frame to be encoded by using boundary pixels of already recovered adjacent blocks.

The spatial prediction is also called intra prediction. The intra prediction takes advantage of a characteristic that when a pixel is predicted, pixels adjacent to it are highly likely to have similar values.

H.264/Advanced Video Coding (AVC) standard technology can compress video about twice as high as Moving Picture Experts Group 2 (MPEG-2) and about one and a half times as high as MPEG-4 by using such technique as intra prediction encoding, 1/4-based variable block motion prediction and compensation, Context-Based Adaptive Variable Length Coding (CAVLC), and Context-Based Adaptive Binary Arithmetic Coding (CABAC).

The H.264/AVC standard predicts pixel values of a current block by using prediction modes of 9 directivities.

Fig. 1 illustrates 9 prediction modes used for intra prediction of 4 x 4 blocks.

As illustrated in Fig. 1, the 9 prediction modes used for intra prediction of 4 x 4 blocks include a vertical mode (mode 0), a horizontal mode (mode 1), a direct current (DC) mode (mode 2), a diagonal_down_left mode (mode 3), a diagonal_down_right mode (mode 4), a vertical_right mode (mode 5), a horizontal_down mode (mode 6), a vertical_left mode (mode 7), and a horizontal_up mode (mode 8).

Herein, in the DC mode (mode 2), intra prediction is performed using a mean value of adjacent pixels. The arrows indicate prediction directions.

Meanwhile, intra 16 x 16 prediction encoding includes a total of four modes, which are a vertical mode, a horizontal mode, a DC mode, and a plane mode.

Also, intra 8 x 8 prediction encoding includes a total of 9 modes, just like the intra 4 x 4 prediction encoding. As for color difference signals, intra 8 x 8 prediction encoding is performed, and the intra 8 x 8 prediction encoding includes a DC mode, a vertical mode, a horizontal mode, and a plane mode and so on.

Hereinafter, prediction methods in the vertical and horizontal modes for intra prediction of 4 x 4 blocks will be described with reference to Figs. 2 and 3.

Fig. 2 exemplarily illustrates a pixel prediction method in a vertical direction.

As shown in Fig. 2, pixel a 201, pixel b 202, pixel i 203, and pixel m 204 are predicted based on an adjacent pixel A in the vertical direction.

Also, pixels b, f, j and b are predicted based on an adjacent pixel B in the vertical direction, and pixels c, g, k and o are predicted based on an adjacent pixel C in the vertical direction. Pixels d, h, l and p are predicted based on an adjacent pixel D in the vertical direction.

Fig. 3 exemplarily illustrates a pixel prediction method in a horizontal direction.

As illustrated in Fig. 3, pixel a 205, pixel b 206, pixel c 207, and pixel d 208 are predicted based on an adjacent pixel I in a horizontal direction.

Also, pixels e, f, g and h are predicted based on an adjacent pixel J in the horizontal direction, and pixels i, j, k and l are predicted based on an adjacent pixel K in the horizontal direction. Pixels m, n, o and p are predicted based on an adjacent pixel l in the horizontal direction.

An encoder performs Discrete Cosine Transform (DCT) and quantization onto residual signals (which are of a pixel area) acquired by differentiating the predicted pixels and a current pixel. Subsequently, the encoder performs zigzag scanning and entropy encoding onto the transformed coefficients obtained from DCT and quantization.

Herein, although the zigzag scanning takes advantage of an energy compaction characteristic of a transformed coefficient that energy converges onto low frequency and energy appears little in high frequency, the energy compaction after intra prediction is not always effective.

In short, the zigzag scanning is a method of scanning a transformed coefficient from low frequency components to high frequency components. When distribution of transformed coefficients appears more in the low frequency components, the zigzag scanning is effective. However, when spatial prediction having directivity is used, the distribution of transformed coefficients is influenced by the direction of prediction. Therefore, it is ineffective to apply the zigzag scanning to the prediction of all directions.

DISCLOSURE

TECHNICAL PROBLEM

An embodiment of the present invention, which is devised to overcome the above problems, is directed to providing an encoding/decoding apparatus and method which performs intra prediction onto input video, predicts pixel similarity based on pixel similarity information of coefficients to be encoded acquired from adjacent pixels in the intra-predicted video, and performs a most effective scanning, e.g., DCT coefficient scanning, according to the predicted pixel similarity.

Other objects and advantages of the present invention can be understood by the following description, and become apparent with reference to the embodiments of the present invention. Also, it is obvious to those skilled in the art of the present invention that the objects and advantages of the present invention can be realized by the means as claimed and combinations thereof.

TECHNICAL SOLUTION

In accordance with an aspect of the present invention, there is provided an encoding apparatus using a Discrete Cosine Transform (DCT) scanning, which includes: a mode selection means for selecting an optimal mode for intra prediction; an intra prediction means for performing intra prediction onto video inputted based on the mode selected in the mode selection means; a DCT and quantization means for performing DCT and quantization onto residual coefficients of a block outputted from the intra prediction means; and an entropy encoding means for performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided based on pixel similarity of the residual coefficients.

In accordance with another aspect of the present invention, there is provided a decoding apparatus using a DCT scanning, which includes: an entropy decoding means for performing entropy decoding onto encoded video; a scanning decision means for deciding a scanning mode for the video decoded in the entropy decoding means; and a video recovery means for recovering the video based on the scanning mode decided in the scanning decision means.

In accordance with another aspect of the present invention, there is provided an encoding method using a DCT scanning, which includes the steps of: selecting an optimal mode for intra prediction; performing intra prediction onto video inputted based on the mode selected in the mode selection step; performing DCT and quantization onto residual coefficients of a block outputted from the intra prediction step; deciding pixel similarity of the residual coefficients; and performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided in the pixel similarity decision step.

In accordance with an aspect of the present invention, there is provided a decoding method using a DCT scanning, which includes the steps of: performing entropy decoding onto encoded video; deciding a scanning mode for the video decoded in the entropy decoding step; and recovering the video based on the scanning mode decided in the scanning decision step.

According to an embodiment of the present invention, a luminance block may go through an intra 4 x 4 luminance encoding mode of H.264/Advanced Video Coding (AVC), which includes a vertical mode, a horizontal mode, a diagonal_down_left mode, a diagonal_down_right mode, a vertical_right mode, a horizontal_down mode, a vertical_left mode, and a horizontal_up mode, and an intra 16 x 16 luminance encoding mode of H.264/AVC, which includes a vertical mode, a horizontal mode, a plane mode, and a DC mode.

Also, according to an embodiment of the present invention, a chrominance block may go through an intra M x N chrominance encoding mode of H.264/AVC, which includes a vertical mode, a horizontal mode, a plane mode and a DC mode.

ADVANTAGEOUS EFFECTS

As described above, the present invention can improve a compression rate of intra encoding by applying a most effective scanning method according to pixel similarity in order to encode/decode video.

Also, the present invention can improve a video compression rate by being applied to a video compression technology using intra prediction, which will be developed in future.

Also, the present invention can reduce a need for an additional module by applying the same similarity information to both encoder and decoder.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates 9 prediction modes used for intra prediction of 4 x 4 blocks according to H.264/AVC.

Fig. 2 exemplarily illustrates a pixel prediction method in a vertical mode.

Fig. 3 exemplarily illustrates a pixel prediction method in a horizontal direction.

Fig. 4 is a block view showing an encoding apparatus using an adaptive DCT coefficient scanning based on pixel similarity in accordance with an embodiment of the present invention.

Fig. 5 exemplarily illustrates a zigzag scanning method used in the present invention.

Fig. 6 exemplarily illustrates a horizontal scanning method used in the present invention.

Fig. 7 exemplarily illustrates a vertical scanning method used in the present invention.

Fig. 8 illustrates a method for predicting pixel similarity in vertical and horizontal directions in accordance with an embodiment of the present invention.

Fig. 9 is a flowchart describing an adaptive scanning method based on pixel similarity in a vertical intra prediction mode in accordance with an embodiment of the present invention.

Fig. 10 is a flowchart describing an adaptive scanning method based on pixel similarity in a horizontal intra prediction mode in accordance with an embodiment of the present invention.

Fig. 11 is a block view showing a decoding apparatus using an adaptive DCT coefficient scanning based on pixel similarity in accordance with an embodiment of the present invention.

BEST MODE FOR THE INVENTION

The advantages, features and aspects of the invention will become apparent from the following description of the embodiments with reference to the accompanying drawings, which is set forth hereinafter. When it is considered that detailed description on a related art may obscure a point of the present invention, the description will not be provided herein. Hereinafter, specific embodiments of the present invention will be described in detail with reference to the accompanying drawings.

Fig. 4 is a block view showing an encoding apparatus using an adaptive DCT coefficient scanning based on pixel similarity in accordance with an embodiment of the present invention.

As illustrated in Fig. 4, the encoding apparatus based on DCT coefficient scanning adaptive to pixel similarity includes a mode selection unit 10, an intra prediction unit 20, a DCT and quantization unit 30, and an entropy encoding unit 40.

The mode selection unit 10 selects an optimal mode among several available prediction modes for intra prediction. In other words, it selects one among a plurality of possible encoding modes when 4 x 4, 16 x 16, or 8 x 8 intra prediction is performed. Generally, the mode selection unit 10 selects one mode according to a rate-distortion optimization method for reducing a rate-distortion.

The intra prediction unit 20 receives a video, and performs 4 x 4 intra prediction for pixels of luminance blocks and 8 x 8 intra prediction for pixels of chrominance blocks based on a mode selected in the mode selection unit 10.

The DCT and quantization unit 30 performs DCT and quantization onto difference values outputted from the mode selection unit 10, that is, onto residual coefficient blocks indicating differences between pixel values of macro blocks of a current frame to be encoded and predicted pixel values, and transmits resulting coefficients to the entropy encoding unit 40.

The entropy encoding unit 40 arrays DCT coefficients obtained in the DCT and quantization unit 30 by using an adaptive DCT coefficient scanning based on pixel similarity, performs entropy encoding onto the arrayed DCT coefficients, and outputs the result.

Herein, the entropy encoding is an encoding technique for enhancing a compression rate by allocating small bits to data highly likely to occur and many bits for data that are not likely to occur. Examples of the entropy encoding used in the present invention include Context Adaptive Variable Length Coding (CAVLC) or Context-Based Adaptive Binary Arithmetic Coding (CABAC).

With reference to Figs. 8 to 10, described hereafter are a method of predicting pixel similarity in vertical and horizontal directions in the entropy encoding unit 40, and a scanning method in vertical and horizontal intra prediction modes.

Fig. 5 exemplarily illustrates a typical zigzag scanning method used in the present invention. Fig. 6 exemplarily illustrates a typical horizontal scanning method used in the present invention. Fig. 7 exemplarily illustrates a typical vertical scanning method used in the present invention.

As shown in Fig. 5, the zigzag scanning method used in the present invention is devised in consideration that low frequency components of transformed coefficient acquired from the DCT and quantization are highly likely to be positioned in the upper left part on a two-dimensional plane. It takes advantage of a transformed coefficient energy compaction characteristic that coefficients after DCT collectively appear in low frequencies, whereas coefficients after DCT less appear in high frequencies.

The zigzag scanning method may be more efficient when pixel similarity in the horizontal direction is similar to the pixel similarity in the vertical direction.

However, when intra prediction encoding, particularly, vertical or horizontal intra prediction, is performed, the similarity of the residual coefficients in the vertical direction shows much difference from the similarity in the horizontal direction. Thus, the above-described coefficient distribution is not always effective. Therefore, it is inefficient to apply the zigzag scanning to prediction of all directions.

To describe an example of the vertical prediction mode, the vertical prediction mode is selected as an optimal mode in a rate-distortion process, when the pixel similarity in the vertical direction is high. Herein, significant coefficients are distributed in the first row. Therefore, the horizontal scanning shown in Fig. 6 is more efficient than the typical zigzag scanning.

Meanwhile, to describe an example of the horizontal prediction mode, the horizontal prediction mode is selected as an optimal mode, when the pixel similarity in the horizontal direction is high. Herein, significant coefficients are distributed in the first column. Therefore, the vertical scanning shown in Fig. 7 is more efficient.

However, since the pixel similarity before intra prediction is different from pixel similarity of residual coefficients after the intra prediction, it is inefficient to simply use the scanning method of Fig. 6 or Fig. 7 according to the intra prediction mode.

Therefore, if pixel similarities in the vertical and horizontal directions of blocks around a block to be encoded are predicted based on similarity information among adjacent block boundary pixels which are already recovered and an adaptive scanning method according to the prediction result is used, the encoding efficiency can be increased.

Fig. 8 illustrates a method for predicting pixel similarity in vertical and horizontal directions in accordance with an embodiment of the present invention.

As illustrated in Fig. 8, pixels A, B, C and D are positioned in the upper part of a current block to be encoded, whereas pixels E, F, G and H are positioned in the left part of the current block to be encoded.

Herein, when vertical prediction encoding is performed, vertical-directional pixel similarity of the pixels a, e, i and m are positioned in a first row of the current block to be encoded is the same as the vertical-directional pixel similarity of residual coefficients a-A, e-A, i-A, and m-A after vertical prediction. This is because the residual coefficients a-A, e-A, i-A, and m-A are differentiated by the same prediction pixels as the pixels a, e, i and m and thus the correlation does not change.

As described above, the vertical-directional pixel similarity of pixels in 2, 3 and 4 rows of a block is the same as the vertical-directional pixel similarity of residual coefficients after vertical prediction.

However, the horizontal-directional pixel similarity of the 1-row pixels a, b, c and d of the current block to be encoded is different from the horizontal-directional pixel similarity of residual coefficients a-A, b-B, c-C, and d-D after vertical prediction. Also, horizontal-directional pixel similarity before vertical prediction becomes higher than the horizontal-directional pixel similarity after the vertical prediction. Thus, it becomes similar to or higher than the vertical-directional pixel similarity.

Likewise, in case of the horizontal prediction encoding, horizontal-directional pixel similarity of the pixels a, b, c and d in a first row of a block is the same as the horizontal-directional pixel similarity of residual coefficients a-E, b-E, c-E, and d-E after horizontal prediction. Also, the horizontal-directional pixel similarity of the pixels in 2, 3 and 4 rows of the bock is the same as the horizontal-directional pixel similarity of the residual coefficients after horizontal prediction.

However, the vertical-directional pixel similarity of the 1-row pixels a, e, i and m of the block is different from the vertical-directional pixel similarity of residual coefficients a-E, e-F, i-G, and m-H after horizontal prediction. Also, the vertical-directional pixel similarity before horizontal prediction becomes higher than the vertical -directional pixel similarity after the horizontal prediction. Thus, it becomes similar to or higher than the horizontal-directional pixel similarity.

As described above, when the pixel similarities in the vertical and horizontal directions become similar, a general zigzag scanning method is more efficient than the horizontal and vertical scanning methods.

Therefore, when the vertical intra prediction mode is performed and the vertical-directional pixel similarity of residual coefficients is high and their horizontal-directional pixel similarity is low, it is more efficient to use the horizontal scanning.

Meanwhile, when the horizontal intra prediction mode is performed and the horizontal-directional pixel similarity of residual coefficients is high and their vertical-directional pixel similarity is low, it is more efficient to use the vertical scanning.

When vertical-directional pixel similarity of recovered 8 pixels A, B, C, D, E, F, G and H of Fig. 8 is referred to as S_VER and their horizontal-directional pixel similarity is referred to as S_HOR, the pixel similarities for increasing the efficiency of 4 x 4 prediction encoding can be calculated as the following Equation 1.

Equation 1

$$S\_VER = \frac{1}{Variance(E,F,G,H)}$$

$$S\_HOR = \frac{1}{Variance(A,B,C,D)}$$

where Variance() denotes a dispersion; E, F, G and H DENOTE pixels adjacent to the left part of the current block to be endoed; and A, B, C and D denote pixels adjacent to the upper part of the current block to be encoded.

When the vertical prediction mode is carried out, a value obtained by multiplying S_HOR by a multiplication factor α ($\alpha \geq 1$) is used as a horizontal-directional pixel similarity prediction value of residual coefficients of the current block. Herein, the α value is fixed at 2 in an experiment. The S_VER as it is is used as a vertical-directional pixel similarity prediction value of the residual coefficients of the current block.

When the horizontal prediction mode is carried out, a value obtained by multiplying S_VER by a multiplication factor β ($\beta \geq 1$) is used as a vertical-directional pixel similarity prediction value of the residual coefficients of the current block. Herein, the β value is fixed at 2 in an experiment. The S_HOR as it is is used as a horizontal-directional pixel similarity prediction value of the residual coefficients of the current block.

The vertical and horizontal-directional pixel similarity prediction values acquired in the above methods are compared to each other to decide a scanning method.

Although the example of 4 x 4 intra prediction mode is described in the above, the present invention is not limited to the mode and the present invention can be applied to an M x N intra prediction mode, too.

Hereinafter, a method of selecting a scanning method in the vertical and horizontal prediction modes will be described in detail with reference to Figs. 9 and 10.

Fig. 9 is a flowchart describing an adaptive scanning method based on pixel similarity in a vertical intra prediction mode in accordance with an embodiment of the present invention.

In case of a vertical intra prediction mode in step S601, an S_VER value and a value of α x S_HOR are compared in step S602. When the S_VER value is greater than the value of α x S_HOR, a horizontal scanning method is used in step S603. When the S_VER value is smaller than the value of α x S_HOR, a zigzag scanning method is used in step S604.

Herein, when a vertical-directional pixel similarity of the current block to be encoded based on similarity of adjacent pixels is predicted higher than the horizontal-directional pixel similarity thereof, transformed coefficients obtained after DCT and quantization are highly likely to be distributed in a direction horizontal to a first row of the block. Therefore, the horizontal scanning method can bring about a high encoding efficiency.

Fig. 10 is a flowchart describing an adaptive scanning method based on pixel similarity in a horizontal intra prediction mode in accordance with an embodiment of the present invention.

In case of a horizontal intra prediction mode in step S701, an S_HOR value and a value of β x S_VER are compared in step S702. When the S_HOR value is greater than the value of β x S_VER, a vertical scanning method is used in step S703. When the S_HOR value is smaller than the value of β x S_VER, a zigzag scanning method is used in step S704.

Herein, when a horizontal-directional pixel similarity of the current block to be encoded based on similarity of adjacent pixels is predicted higher than the vertical-directional pixel similarity thereof, transformed coefficients obtained after DCT and quantization are highly likely to be disposed in a direction vertical to a first row of the block. Therefore, the vertical scanning method can bring about a high encoding efficiency.

Fig. 11 is a block view showing a decoding apparatus using an adaptive DCT coefficient scanning based on pixel similarity in accordance with an embodiment of the present invention.

As shown in Fig. 11, the decoding apparatus using an adaptive DCT coefficient scanning based on pixel similarity includes an entropy decoding unit 50, a scanning decision unit 60, and a video recovery unit 70.

The entropy decoding unit 50 receives video bitstream encoded in the encoding apparatus using an adaptive DCT coefficient scanning based on pixel similarity and decodes it through an entropy decoding method such as CAVLC or CABAC. Then, the entropy decoding unit 50 transmits the entropy-decoded video bitstream to the scanning decision unit 60.

The scanning decision unit 60 decides a scanning method for the coefficients decoded in the entropy decoding unit 50 according to an intra prediction mode, as described in the above with reference to Figs. 8 to 11.

The video recovery unit 70 finally recovers the coefficients by using the scanning method decided in the scanning decision unit 60 to recover the video.

An experiments was carried out for diverse test videos by using Joint Model 86 (JM86), which is H.264/AVC Reference Codec, according to the above-described methods. The result of increase in compression efficiency was as follows. In the experiment, video recommended by H.264/AVC as test video was used. The following Table 1 shows conditions of the experiment.

Table 1

Video	News (QCIF)	Container (QCIF)	Coast (QCIF)	Paris (QCIF)	Coast (CIF)
Entire Frame	300 (30 Hz)	300 (30 Hz)	300 (30 Hz)	300 (35 Hz)	300 (30 Hz)
Conditions	CAVLC, Intra only, QP(18,22,26,40), rate-distortion optimization				

As shown in Table 1, five pieces of video with different sizes were used for the experiment.

The following Table 2 presents video compression rates when the test videos were compressed using a conventional compression method, which is a zigzag scanning method of H.264/AVC, and the compression method of the present invention, which is the adaptive scanning method according to intra prediction mode under the same conditions as the Table 1.

Table 2

Sequence	QP	H.264/AVC		Method of the Present Invention		Bit Saving rate (%)
		PSNR (dB)	Bit rate (Kbps)	PSNR (dB)	Bit rate (Kbps)	
News (QCIF)	18	45.64	2370.65	45.64	2344.75	1.51%
	22	43.06	1714.99	43.05	1692.69	1.67%
	26	40.32	1221.96	40.32	1206.02	1.51%
	30	37.50	872.65	37.49	860.23	1.49%
Container (QCIF)	18	44.84	874.63	44.84	857.75	1.93%
	22	41.71	643.42	41.7	630.5	2.01%
	26	38.61	451.07	38.61	441.54	2.11%
	30	35.77	317.36	35.76	309.93	2.34%
Coast (QCIF)	18	44.18	2200.99	44.13	2152.15	2.22%
	22	40.61	1631.56	40.59	1592.37	2.40%
	26	37.13	1139.76	37.12	111.02	2.52%
	30	34.00	765.52	33.99	746.77	2.45%
Paris (CIF)	18	44.72	4360.41	44.71	4271.09	2.05%
	22	41.57	3334.22	41.56	3259.84	2.23%
	26	38.25	2450.69	38.24	2391.77	2.40%
	30	35.04	1780.73	35.03	1736.21	2.50%
Coast (CIF)	18	44.34	4068.4	44.33	4015.7	1.30%
	22	40.8	2989.5	40.8	2950.65	1.30%
	26	37.32	2074.47	37.32	2045.89	1.38%
	30	34.21	1388.07	34.22	1369.23	1.36%

The Table 2 shows that the result of video compression using the adaptive scanning method according to the intra prediction mode, which is suggested in the present invention, is superior to that of video compression using only the conventional zigzag scanning method of H.264/AVC.

The method of the present invention described above may be realized as a program and stored in a computer-readable recording medium such as CD-ROM, RAM, ROM, floppy disks, hard disks, magneto-optical disks and so fourth. Since the process can be easily implemented by those skilled in the art to which the present invention pertains to, further description on it will not be provided herein.

While the present invention has been described with respect to certain preferred embodiments, it will be apparent to those skilled in the art that various changes and modifications may be made without departing from the scope of the invention as defined in the following claims.

WHAT IS CLAIMED IS

1. An encoding apparatus using a Discrete Cosine Transform (DCT) scanning, comprising:

a mode selection means for selecting an optimal mode for intra prediction;

an intra prediction means for performing intra prediction onto video inputted based on the mode selected in the mode selection means;

a DCT and quantization means for performing DCT and quantization onto residual coefficients of a block outputted from the intra prediction means; and

an entropy encoding means for performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided based on pixel similarity of the residual coefficients.

2. The encoding apparatus of claim 1, wherein the scanning mode is any one among a horizontal-directional scanning, a vertical-directional scanning, and a zigzag scanning.

3. The encoding apparatus of claim 2, wherein the entropy encoding means:

performing encoding using a horizontal-directional scanning, when vertical-directional pixel similarity of the residual signals is high;

performing encoding using a vertical-directional scanning, when horizontal-directional pixel similarity of the residual signals is high; and

performing encoding using a zigzag scanning, when vertical and horizontal-directional pixel similarities of the residual signals are similar.

4. The encoding apparatus of claim 3, wherein the entropy encoding means decides that the vertical-directional pixel similarity is high, when a vertical-directional pixel similarity value is greater than a value obtained by multiplying a horizontal-directional pixel similarity value by a first multiplication factor.

5. The encoding apparatus of claim 3, wherein the entropy encoding means decides that the horizontal-directional pixel similarity is high, when a horizontal-directional pixel similarity value is greater than a value obtained by multiplying a vertical-directional pixel similarity value by a second multiplication factor.

6. The encoding apparatus of claim 4, wherein the vertical-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to a left part of a currently encoded block.

7. The encoding apparatus of claim 5, wherein the horizontal-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to an upper part of a currently encoded block.

8. The encoding apparatus of claim 6, wherein the first and second multiplication factors are natural number 2.

9. A decoding apparatus using a DCT scanning, comprising:

an entropy decoding means for performing entropy decoding onto encoded video;

a scanning decision means for deciding a scanning *mode for the video decoded in the entropy decoding means;* and a video recovery means for recovering the video based on the scanning mode decided in the scanning decision means.

10. The decoding apparatus of claim 9, wherein the decided scanning mode is any one among a horizontal-directional scanning, a vertical-directional scanning, and a zigzag scanning.

11. An encoding method using a DCT scanning, comprising the steps of:

selecting an optimal mode for intra prediction;

performing intra prediction onto video inputted based on the mode selected in the mode selection step;

performing DCT and quantization onto residual coefficients of a block outputted from the intra prediction step;

deciding pixel similarity of the residual coefficients; and

performing entropy encoding onto DCT coefficients acquired from the DCT and quantization by using a scanning mode decided in the pixel similarity decision step.

12. The encoding method of claim 11, wherein the decided scanning mode is any one among a horizontal-directional scanning, a vertical-directional scanning, and a zigzag scanning.

13. The encoding method of claim 12, wherein the entropy encoding step includes the steps of:

performing encoding using a horizontal-directional scanning, when vertical-directional pixel similarity of the residual signals is high;

performing encoding using a vertical-directional scanning, when horizontal-directional pixel similarity of the residual signals is high; and

performing encoding using a zigzag scanning, when vertical and horizontal-directional pixel similarities of the residual signals are similar.

14. The encoding method of claim 13, wherein the vertical-directional pixel similarity is decided high in the entropy encoding step, when a vertical-directional pixel similarity value is greater than a value obtained by multiplying a horizontal-directional pixel similarity value by a first multiplication factor.

15. The encoding method of claim 13, wherein the horizontal-directional pixel similarity is decided high in the entropy encoding step, when a horizontal-directional pixel similarity value is greater than a value obtained by multiplying a vertical-directional pixel similarity value by a second multiplication factor.

16. The encoding method of claim 14, wherein the vertical-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to a left part of a currently encoded block.

17. The encoding method of claim 15, wherein the horizontal-directional pixel similarity is calculated by performing dispersion onto pixels adjacent to an upper part of a currently encoded block.

18. The encoding method of claim 16, wherein the first and second multiplication factors are natural number 2.

19. A decoding method using a DCT scanning, comprising the steps of:

performing entropy decoding onto encoded video;

deciding a scanning mode for the video decoded in the entropy decoding step; and

recovering the video based on the scanning mode decided in the scanning decision step.

20. The decoding apparatus of claim 19, wherein the decided scanning mode is any one among a horizontal-directional scanning, a vertical-directional scanning, and a zigzag scanning.

FIG. 1

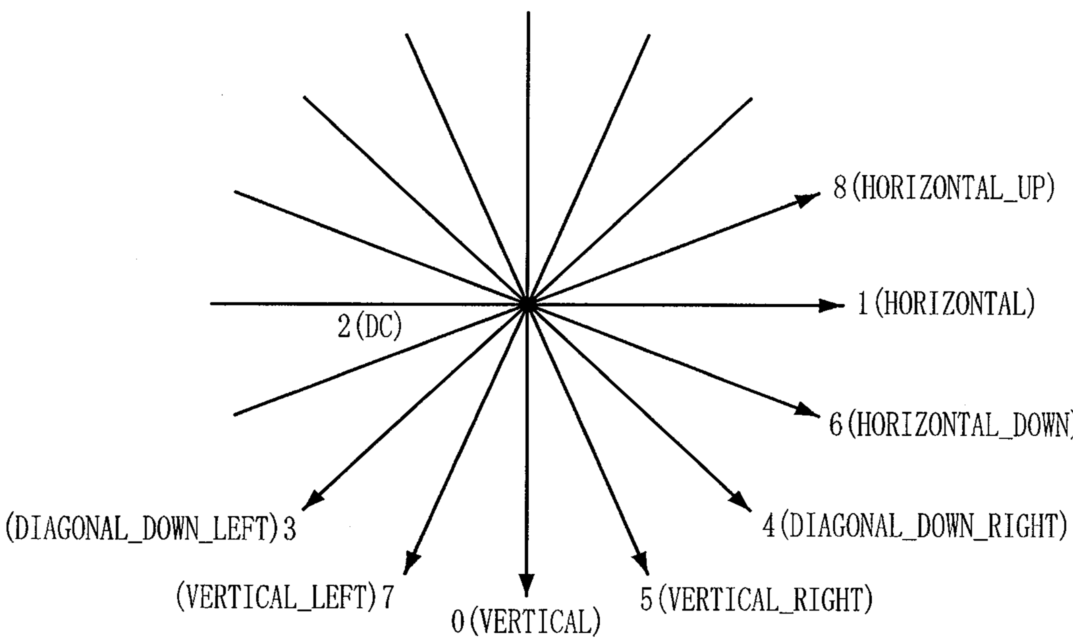
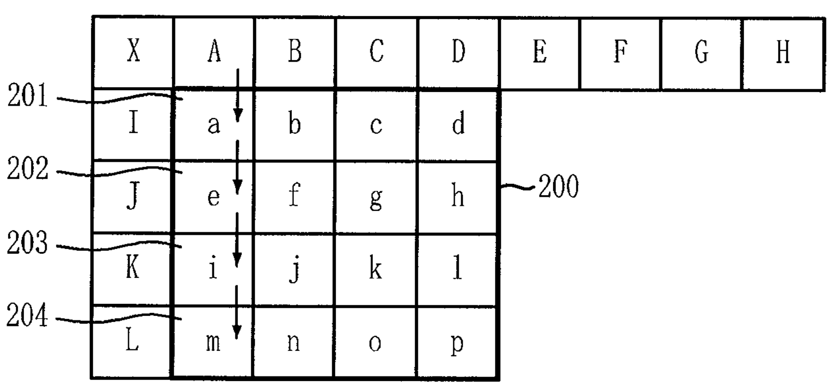

8 (HORIZONTAL_UP)
1 (HORIZONTAL)
2 (DC)
6 (HORIZONTAL_DOWN)
(DIAGONAL_DOWN_LEFT) 3
4 (DIAGONAL_DOWN_RIGHT)
(VERTICAL_LEFT) 7
0 (VERTICAL)
5 (VERTICAL_RIGHT)

FIG. 2


X
A
B
C
D
E
F
G
H
201
202
203
204
I
a
b
c
d
J
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f
g
h
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l
L
m
n
o
p

FIG. 3

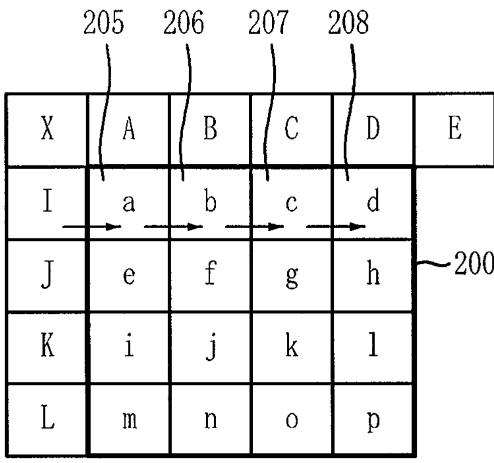

205
206
207
208
X
A
B
C
D
E
F
G
H
I
a
b
c
d
J
e
f
g
h
K
i
j
k
l
L
m
n
o
p
200

FIG. 4

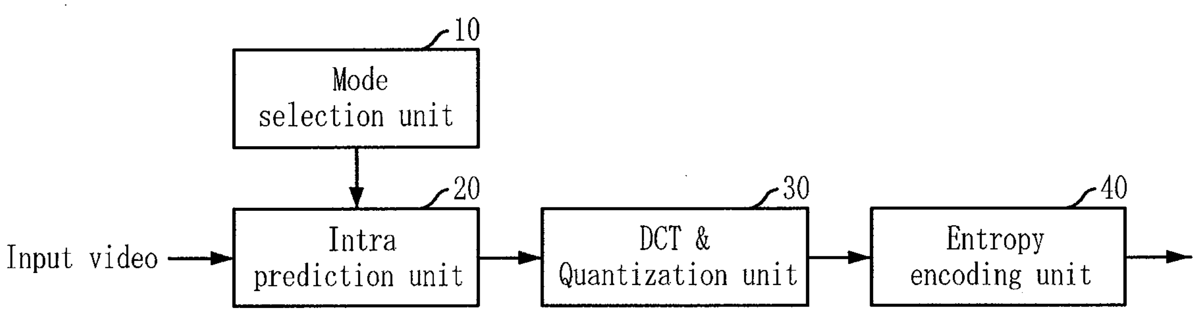

10
Mode selection unit
20
Input video
Intra prediction unit
30
DCT & Quantization unit
40
Entropy encoding unit

FIG. 5

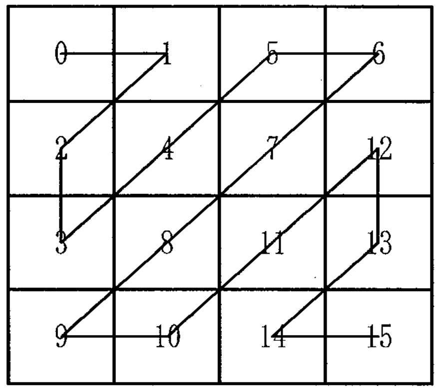


FIG. 6

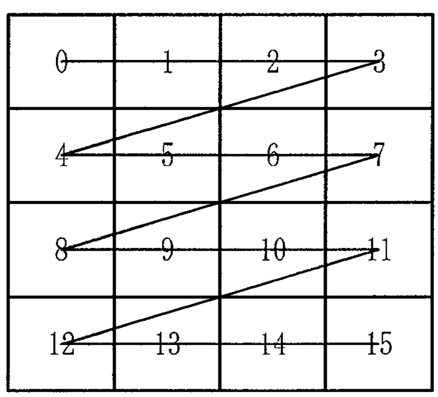


FIG. 7

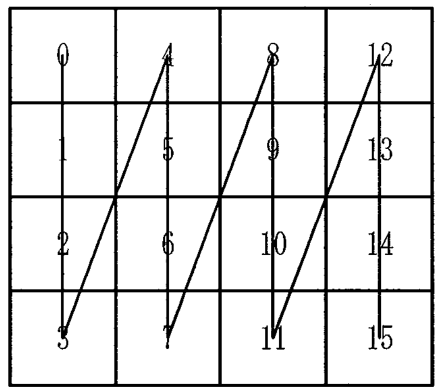


FIG. 8

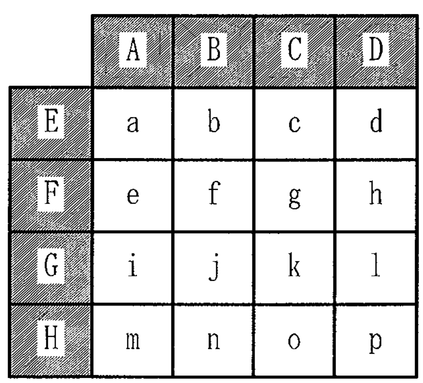


FIG. 9

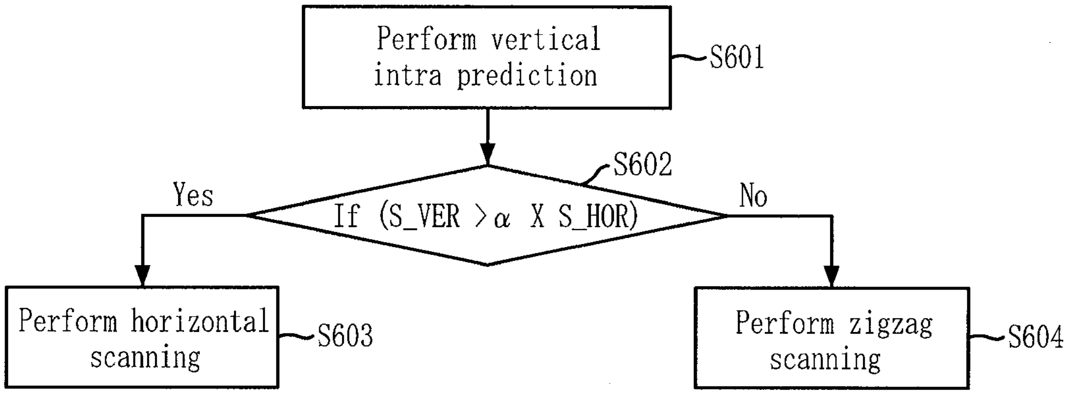

Perform vertical intra prediction
S601
S602
Yes
If (S_VER > α X S_HOR)
No
Perform horizontal scanning
S603
Perform zigzag scanning
S604

FIG. 10

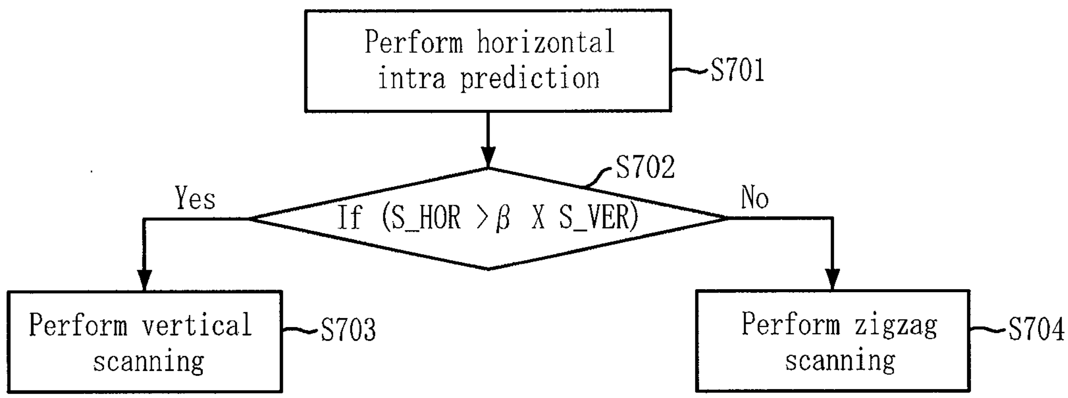
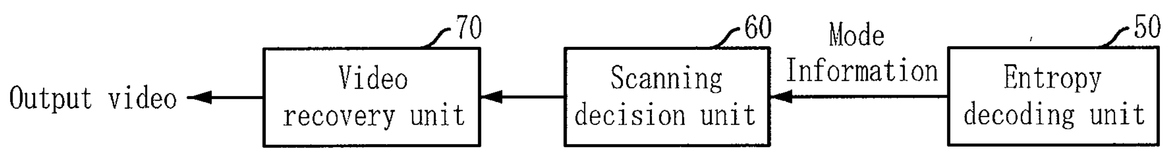

Perform horizontal intra prediction
S701
S702
If (S_HOR > β X S_VER)
Yes
No
Perform vertical scanning
S703
Perform zigzag scanning
S704

FIG. 11


Output video
70
Video recovery unit
60
Scanning decision unit
Mode Information
50
Entropy decoding unit

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출 원 인 : 한국전자통신연구원 외 2 명
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2007 년 04 월 04 일

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【발명의 국문명칭】	화소 유사성에 따라 적응적인 D C T 계수 스캐닝을 이용한 부호화/복호화 장치 및 그 방법
【발명의 영문명칭】	Apparatus of encoding and decoding using adaptive scanning of DCT coefficients according to the pixel similarity, and it method
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【우편번호】 139-050

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【취지】 특허법 제42조의 규정에 의하여 위와 같이 출원합니다.

대리인 특허법인 신성 (인)

【수수료】

【기본출원료】	0	면	38,000	원
【가산출원료】	23	면	0	원
【우선권주장료】	0	건	0	원
【심사청구료】	0	항	0	원
【합계】	38,000 원			
【감면사유】	정부출연연구기관			
【감면후 수수료】	19,000 원			

【첨부서류】 1.전담조직임을 증명하는 서류_2통 2.위임장[추후제출]_2통

【요약서】

【요약】

1. 청구범위에 기재된 발명이 속한 기술분야

본 발명은 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 부호화/복호화 장치 및 그 방법에 관한 것임.

2. 발명이 해결하려고 하는 기술적 과제

본 발명은 소정 크기의 블록에 대한 인트라 예측 수행 후, 현재 블록의 변환계수에 대한 적응적인 스캐닝을 적용하기 위하여, 이미 복원된 주변 블록 경계 화소(수평 및 수직 화소)들 간의 유사성 정보를 이용, 잔차 신호의 수평 및 수직 유사성을 예측하여 그 정보에 따라 지그재그 스캐닝, horizontal 스캐닝, vertical 스캐닝을 이용하여 압축률을 높이기 위한, 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 부호화/복호화 장치 및 그 방법을 제공하는데 그 목적이 있음.

3. 발명의 해결방법의 요지

본 발명은, 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 부호화/복호화 장치에 있어서, 소정 크기의 블록에 대한 인트라 예측 수행 후, 현재 블록의 변환 계수에 대한 적응적인 스캐닝을 적용하기 위하여, 이미 복원된 주변 블록 경계 화소(수평 및 수직 화소)들 간의 유사성 정보를 이용, 잔차 신호의 수평 및 수직 유사성을 예측하여 그 정보에 따라 지그재그 스캐닝, horizontal 스캐닝, vertical 스캐닝을 이용하여 압축률을 높이는데 특징이 있음.

4. 발명의 중요한 용도

본 발명은 DCT 계수 스캐닝을 이용한 부호화/복호화 장치 등에 이용됨.

【대표도】

도 1

【색인어】

DCT 계수, 부호화, 복호화, 스캐닝, 화소 유사성

【명세서】

【발명의 명칭】

화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 부호화/복호화 장치 및 그 방법{Apparatus of encoding and decoding using adaptive scanning of DCT coefficients according to the pixel similarity, and it method}

【도면의 간단한 설명】

<1> 도 1은 H.264/AVC에서의 4x4 블록에 대한 인트라 예측모드의 일실시예 설명도,

<2> 도 2a는 인트라 vertical 모드에서의 화소 예측 방법에 대한 일실시예 설명도,

<3> 도 2b는 인트라 horizontal 모드에서의 화소 예측 방법에 대한 일실시예 설명도,

<4> 도 3은 본 발명에 따른 부호화 장치의 일실시예 구성도,

<5> 도 4는 기존의 지그재그(Zig-zag) 스캐닝 방법에 대한 일실시예 설명도,

<6> 도 5는 vertical과 horizontal 방향의 화소 유사성 예측 방법에 대한 일실시예 설명도,

<7> 도 6a는 horizontal 스캐닝 방법에 대한 일실시예 설명도,

<8> 도 6b는 vertical 스캐닝 방법에 대한 일실시예 설명도,

<9> 도 7a는 인트라 vertical 예측 모드에서의 화소 유사성에 따른 적응적인 스

캐닝 장치의 일실시예 구성도,

<10> 도 7b는 인트라 horizontal 예측 모드에서의 화소 유사성에 따른 적응적인 스캐닝 장치의 일실시예 구성도,

<11> 도 8은 본 발명에 따른 복호화 장치의 일실시예 구성도이다.

【발명의 상세한 설명】

【발명의 목적】

【발명이 속하는 기술분야 및 그 분야의 종래기술】

<12> 본 발명은 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 부호화/복호화 장치 및 그 방법에 관한 것으로, 더욱 상세하게는 소정 크기의 블록에 대한 인트라 예측 수행 후, 현재 블록의 변환 계수에 대한 적응적인 스캐닝을 적용하기 위하여, 이미 복원된 주변 블록 경계 화소(수평 및 수직 화소)들 간의 유사성 정보를 이용, 잔차 신호의 수평 및 수직 유사성을 예측하여 그 정보에 따라 지그재그 스캐닝, horizontal 스캐닝, vertical 스캐닝을 이용하여 압축률을 높일 수 있는, 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 부호화/복호화 장치 및 그 방법에 관한 것이다.

<13> 동영상 데이터를 부호화하고 복호화하기 위해 마련된 영상 압축 표준에 따르면 하나의 프레임에 포함된 복수 개의 매크로 블록, 또는 매크로 블록을 더 작은 블록들로 나누어 얻어진 서브 블록 단위로 부호화 및 복호화를 수행한다. 부호화

및 복호화 방법은 시간적 예측과 공간적 예측을 기반으로 이루어진다. 시간적 예측은 현재 프레임에서 매크로 블록 내의 블록(매크로 블록 또는 매크로 블록보다 작은 서브 블록들)들의 움직임을 예측하는데 있어서 인접한 프레임의 블록을 참조하여 예측을 수행하는 것을 말하고, 공간적 예측은 부호화하고자 하는 현재 프레임의 매크로 블록 내의 블록을 현 프레임 내에서 이미 복원된 인접한 블록의 경계 화소를 이용하여 예측을 수행하는 것을 말한다.

<14> 공간적 예측을 인트라 예측(Intra prediction)이라고도 하는데, 인트라 예측은 어느 화소를 예측하는데 있어 그와 인접한 화소가 유사한 값을 가질 가능성이 많다는 특징을 이용한 것이다. H.264/AVC 표준은 9가지 방향성을 고려한 예측 모드를 이용하여 현재 블록의 화소값을 예측한다. 도 1은 H.264/AVC 표준에서 4x4 블록의 인트라 예측에 사용되는 9가지 예측모드이다. 예측방향에 따라 vertical 모드(모드 0), horizontal 모드(모드 1), DC 모드(모드 2), diagonal_down_left(모드 3), diagonal_down_right(모드 4), vertical_right(모드 5), horizontal_down(모드 6), vertical_left(모드 7), horizontal_up(모드 8)이 존재한다. 화살표는 예측방향을 나타낸다. 이하에서는 4x4 블록을 인트라 예측하는 경우, vertical 모드 및 horizontal 모드에서의 예측방법을 설명한다.

<15> 도 2a는 vertical 모드에서의 화소 예측을 설명하기 위한 도면이다.

<16> 화소 a(302), e(304), i(306), m(308) 는 수직방향으로 인접한 화소 A로부터 예측되고, 이와 같은 방법으로 화소 b, f, j, n 는 화소 B로부터 예측되고, 화소 c, g, k, o 는 화소 C로부터 예측되고, 화소 d, h, l, p 는 화소 D로부터

예측된다.

<17> 도 2b는 horizontal 모드에서의 화소 예측을 설명하기 위한 도면이다.

<18> 화소 a(312), b(314), c(316), d(318) 는 수평 방향으로 인접한 화소 I로부터 예측되고, 이와 같은 방법으로 화소 e, f, g, h 는 화소 J로부터 예측되고, 화소 i, j, k, l 는 화소 K로부터 예측되고, 화소 m, n, o, p 는 화소 L로부터 예측된다.

<19> 한편, 부호화기에서는 상기의 예측된 화소와 현재 화소를 차분한 잔차 신호(화소 영역)를 DCT 및 양자화를 수행한다. 그 후, 변환 계수(transformed coefficient)를 지그재그(zig-zag) 스캐닝하여 엔트로피 부호화한다. 그러나 이러한 지그재그 스캐닝 방법은, 변환 계수의 에너지 컴팩션 특징은, 낮은 주파수에 에너지가 몰리고 높은 주파수에 에너지가 적게 나타나는 특징을 이용한 것이다. 하지만 인트라 예측 수행 후, 이와 같은 에너지 컴팩션이 항상 유효하지 않다는 문제점이 있다.

【발명이 이루고자 하는 기술적 과제】

<20> 본 발명은 상기 문제점을 해결하기 위하여 제안된 것으로, 소정 크기의 블록에 대한 인트라 예측 수행 후, 현재 블록의 변환 계수에 대한 적응적인 스캐닝을 적용하기 위하여, 이미 복원된 주변 블록 경계 화소(수평 및 수직 화소)들 간의 유사성 정보를 이용, 잔차 신호의 수평 및 수직 유사성을 예측하여 그 정보에 따라 지그재그 스캐닝, horizontal 스캐닝, vertical 스캐닝을 이용하여 압축률을 높이

기 위한, 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 부호화/복호화 장치 및 그 방법을 제공하는데 그 목적이 있다.

<21> 본 발명의 다른 목적 및 장점들은 하기의 설명에 의해서 이해될 수 있으며, 본 발명의 실시예에 의해 보다 분명하게 알게 될 것이다. 또한, 본 발명의 목적 및 장점들은 특허청구범위에 나타낸 수단 및 그 조합에 의해 실현될 수 있음을 쉽게 알 수 있을 것이다.

【발명의 구성】

<22> 상기 목적을 달성하기 위한 본 발명은, 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 부호화/복호화 장치에 있어서, 소정 크기의 블록에 대한 인트라 예측 수행 후, 현재 블록의 변환 계수에 대한 적응적인 스캐닝을 적용하기 위하여, 이미 복원된 주변 블록 경계 화소(수평 및 수직 화소)들 간의 유사성 정보를 이용, 잔차 신호의 수평 및 수직 유사성을 예측하여 그 정보에 따라 지그재그 스캐닝, horizontal 스캐닝, vertical 스캐닝을 이용하여 압축률을 높이기 위한, 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 부호화/복호화 장치에 관한 것이다.

<23> 또한, 본 발명은, 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 부호화/복호화 방법에 있어서, 소정 크기의 블록에 대한 인트라 예측 수행 후, 현재 블록의 변환 계수에 대한 적응적인 스캐닝을 적용하기 위하여, 이미 복원된 주변 블록 경계 화소(수평 및 수직 화소)들 간의 유사성 정보를 이용, 잔차 신호의

수평 및 수직 유사성을 예측하여 그 정보에 따라 지그재그 스캐닝, horizontal 스캐닝, vertical 스캐닝을 이용하여 압축률을 높이기 위한, 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 부호화/복호화 방법에 관한 것이다.

<24> 본 발명은 소정 크기의 블록에 대한 인트라 예측 수행 후, DCT와 양자화기를 통하여 생성된 변환 계수(DCT 및 양자화된 계수)에 대한 스캐닝 방법을 화소 유사성 예측을 통한 적응적인 선택을 통해 압축률을 높이는 동영상 부호화 및 복호화 방법 및 장치에 있어서, 본 발명에 따라 인트라 예측 수행 후, 인접 화소로부터 부호화 될 계수의 화소 유사성 정보를 이용, 잔차 신호(residual signal)의 수평 및 수직 유사성을 예측하여 그 정보에 따라 가장 효율적인 스캐닝 방법을 적용함으로써, 엔트로피 부호화의 효율을 높이고 종래의 부호화 방법보다 높은 압축률을 얻을 수 있는 특징을 지니는 압축 부호화 방식이다.

<25> 또한, 본 발명은, 현재 블록의 변환 계수 (quantized DCT 또는 quantized integer transform)에 대한 적응적인 스캐닝을 적용하기 위하여, 이미 복원된 주변 블록의 경계 화소(수평 및 수직 화소, 화소 영역)들 간의 유사성 정보를 이용하여 가장 효율적인 scanning 방식을 선택하여 압축률을 높이는 동영상 부호화 및 복호화 방법에 관한 것이다. 이때, 부호기와 복호기는 같은 유사성 정보를 이용함으로써 새로운 syntax의 추가가 필요없다.

<26> 또한, 본 발명은, 잔차 신호의 수평 및 수직 유사성을 예측하여 그 정보에 따라 지그재그 스캐닝, horizontal 스캐닝, vertical 스캐닝을 이용하여 압축률을 높이는 동영상 부호화 및 복호화 방법에 관한 것이다. 유사성 예측을 위하여 이미

복원된 수평, 수직 경계화소의 variance 정보를 고려하여 효율적 scanning mode를 선택한다. 유사성 예측을 위하여 variance 정보와 유사한 correlation 정도도 사용 가능하다.

<27> 또한, 본 발명은, 4x4 인트라 예측(Intra prediction) 모드 또는 MxN 인트라 예측(Intra prediction) 모드에 마찬가지로 적용가능하다.

<28> 상기 기술적 과제는 본 발명에 따라, 각 블록이 (a) 인트라 부호화시 vertical 예측 모드 및 horizontal 예측 모드로 결정된 경우, (b) 이미 복원된 주변 블록 경계 화소들 간의 유사성 이용하여, 잔차 신호의 수평 및 수직 유사성을 예측하여 그 정보에 따라 지그재그 스캐닝, horizontal 스캐닝, vertical 스캐닝을 선택적으로 이용하는 단계; 및 (c) 선택된 스캐닝 방식에 따라 나열된 계수를 엔트로피 부호화하는 단계를 포함하는 것을 특징으로 하는 동영상 부호화 방법에 의해 달성된다.

<29> 상기 부호화 모드는, 휘도 블록인 경우에는 H.264/AVC의 인트라 4x4 휘도 부호화 모드인 vertical 모드, horizontal 모드, DC 모드, diagonal_down_left, diagonal_down_right, vertical_right, horizontal_down, vertical_left 및 horizontal_up 과 인트라 16x16 휘도 부호화 모드인 vertical 모드, horizontal 모드, plane 모드 및 DC 모드인 것이 바람직하다.

<30> 또한 상기 부호화 모드는, 색도 블록에 대해서는 H.264/AVC 인트라 MxN 색도 부호화 모드인, vertical 모드, horizontal 모드, plane 모드 및 DC 모드인 것이 바람직하다.

<31> 상술한 목적, 특징 및 장점은 첨부된 도면과 관련한 다음의 상세한 설명을 통하여 보다 분명해 질 것이며, 그에 따라 본 발명이 속하는 기술분야에서 통상의 지식을 가진 자가 본 발명의 기술적 사상을 용이하게 실시할 수 있을 것이다. 또한, 본 발명을 설명함에 있어서 본 발명과 관련된 공지 기술에 대한 구체적인 설명이 본 발명의 요지를 불필요하게 흐릴 수 있다고 판단되는 경우에 그 상세한 설명을 생략하기로 한다. 이하, 첨부된 도면을 참조하여 본 발명에 따른 바람직한 일 실시예를 상세히 설명하기로 한다.

<32> 도 1은 H.264/AVC에서의 4x4 블록에 대한 인트라 예측모드를 도시한 도면이다

<33> 도 2a는 인트라 vertical 모드(모드 0)에서의 화소 예측을 설명하기 위한 도면이다.

<34> 도 2b는 인트라 horizontal 모드(모드 1)에서의 화소 예측을 설명하기 위한 도면이다.

<35> 도 3은 본 발명의 바람직한 실시 예에 따른 부호화 장치의 블록도이다.

<36> 영상이 입력되면 인트라 예측부(110)에서 예측을 수행한다. 본 실시 예에서는 휘도(luminance) 블록의 화소에 대해서는 4x4 인트라 예측을 수행하고, 색도(chrominance) 블록의 화소에 대해서는 8x8 인트라 예측을 수행한다. 모드 선택부(120)는 여러 가지 예측 모드 중에서 최적의 모드를 하나 선택한다. 즉, 4x4 인트라 예측, 16x16 인트라 예측 및 8x8 인트라 예측 시에 가능한 여러 가지 부호화 모드 중에서 하나를 선택한다. 일반적으로 율-왜곡(Rate-Distortion)을 가장 줄인 율

-왜곡 최적화(RD Optimization) 방법에 따라 하나의 모드를 선택한다.

<37> DCT 및 양자화(130)는 인트라 예측부(110)에서 출력된 차이값, 즉, 부호화하고자 하는 현재 프레임의 매크로 블록내의 화소값과 예측 화소값의 차이를 나타내는 잔여 계수 블록 대하여 DCT와 양자화하여 엔트로피 부호화부(140)로 전달한다.

<38> 엔트로피 부호화부(140)는 스캐닝을 이용하여 계수를 나열한 후, 엔트로피 부호화하여 출력한다. 엔트로피 부호화는 발생빈도가 높은 데이터에 대해서는 적은 비트를 할당하고, 발생빈도가 낮은 데이터에 대해서는 많은 비트를 할당함으로써 데이터의 압축률을 높인 부호화방법을 말한다. 본 발명에서 사용되는 엔트로피 부호화방법에는 CAVLC(Context Adaptive Variable Length Coding) 또는 CABAC(Context-Based Adaptive Binary Arithmetic Coding) 등이 있다.

<39> 도 4는 기존의 지그재그 스캐닝 방법을 설명하기 위한 도면이다.

<40> 상기 도 4에 따른 기존의 지그재그 스캐닝 방법은, 화소 영역에 대해서 DCT를 수행하였을 경우, 변환 계수의 에너지 컴팩션 특징이 대부분의 경우 낮은 주파수에 에너지가 몰리고 높은 주파수에 에너지가 적게 나타나는 특징을 이용한 것이다. 하지만 방향성을 띈 인트라 예측을 할 경우, 잔차 신호의 수평과 수직 방향의 유사성이 서로 큰 차이를 보이게 되어 DCT의 에너지 컴팩션 특징이 항상 유효하지는 않다. 예를 들어, vertical 예측 모드는 대부분의 경우, 수직 방향의 화소 유사성이 높을 때 율-왜곡 과정에서 최적의 모드로 선택되어 첫 번째 행에 중요 계수가 몰리기 때문에 horizontal 스캐닝이 효율적이다. 하지만 다음과 같은 이유로 지그재그 스캐닝이 효율적인 경우가 발생한다.

<41> 도 5는 본 발명에 따른 vertical과 horizontal 방향의 화소 유사성 예측을 설명하기 위한 도면이다.

<42> 상기 도 5에 표기된 블록 내 1열의 화소(a,e,i,m)들의 수직 방향 유사성은, vertical 예측 후의 잔차 신호(a-A,e-A,i-A,m-A)들의 수직 방향 유사성과 서로 같다(2,3,4열의 경우도 동일). 다시 말해 vertical 예측을 할 경우 수직 방향 유사성은 변하지 않는다. 하지만 블록 내 1행의 잔차 신호(a-A,b-B,c-B,d-D)들의 수평 방향 유사성이 예측 전 보다 높아지게 되어 수직 방향의 유사성과 비슷해지거나 더 커지는 경우에는 지그재그 스캐닝이 효율적일 수 있다(2,3,4행의 경우도 동일).

<43> 따라서 본 발명에서는 인트라 예측 수행 후, 현재 블록의 변환 계수에 대한 적응적인 스캐닝을 적용하기 위하여, 이미 복원된 주변 블록 경계 화소(수평 및 수직 화소)들 간의 유사성 정보를 이용하여 현재 블록 내의 수평 및 수직의 화소 유사성 예측을 통해 스캐닝 방법을 선택적으로 사용한다.

<44> 상기 도 5에 따르면 화소 A, B, C, D는 현재 부호화될 블록의 상단에 위치한 화소들이고, 화소 E, F, G, H는 현재 부호화될 블록의 좌측에 위치한 화소들이다. 상기 8개의 화소들은 복원된 화소들로써, vertical 화소 유사성을 S_VER 이라 하고, horizontal 화소 유사성을 S_HOR 이라 하면, 각각의 화소 유사성은 수학식 1과 같이 계산된다.

【수학식 1】

$$S\_VER = \frac{1}{Variance(E, F, G, H)}$$

<45> $$S\_HOR = \frac{1}{Variance(A, B, C, D)}$$

<46> vertical 예측 모드를 수행하였을 경우, S_HOR 에 factor α(α>=1)를 곱한 값을 현재 블록의 잔차 신호의 수평 유사성 예측 값으로 사용한다. (α값은 실험시 2로 고정하였다) S_VER 은 그 값 그대로 현재 블록의 잔차 신호의 수직 유사성 예측 값으로 사용된다.

<47> horizontal 예측 모드를 수행하였을 경우, S_VER 에 factor β(β>=1)를 곱한 값을 현재 블록의 잔차 신호의 수직 유사성 예측 값으로 사용한다.(β값은 실험시 2로 고정하였다) S_HOR 은 그 값 그대로 현재 블록의 잔차 신호의 수평 유사성 예측 값으로 사용된다.

<48> 위와 같은 방법으로 구한 수직 및 수평 유사성 예측 값을 서로 비교하여 스캐닝 방법을 결정한다.

<49> 도 6a는 본 발명에 따른 horizontal 스캐닝 방법을 설명하기 위한 도면이다.

<50> 도 6b는 본 발명에 따른 vertical 스캐닝 방법을 설명하기 위한 도면이다.

<51> 도 7a는 인트라 vertical 예측 모드에서의 화소 유사성에 따른 적응적인 스캐닝 장치의 블록도이다.

<52> 도 7a에 따르면, 인트라 vertical 예측 모드(210)일 경우 C_VER 값이 α × C_HOR 값보다 크면(220), 본 발명에서 제안한 horizontal 스캐닝(230)을 사용하며, 그 외의 경우에는 기존의 지그재그 스캐닝(240)을 사용한다.

<53> 도 7b는 인트라 horizontal 예측 모드에서의 화소 유사성에 따른 적응적인 스캐닝 장치의 블록도이다.

<54> 도 7b에 따르면, 인트라 horizontal 예측 모드(250)일 경우 C_HOR 값이 β × C_VER 보다 크면, 본 발명에서 제안한 vertical 스캐닝(260)을 사용하며, 그 외의 경우에는 기존의 지그재그 스캐닝(240)을 사용한다.

<55> 도 8는 본 발명의 바람직한 실시 예에 따른 복호화 장치의 블록도이다.

<56> 엔트로피 복호화(410)는 본 발명에 따라 부호화된 비트 스트림을 입력받아 CAVLC(Context Adaptive Variable Length Coding) 또는 CABAC(Context-Based Adaptive Binary Arithmetic Coding) 등과 같은 엔트로피 복호화 방법에 따라 복호화를 수행한다. 복호화 된 인트라 예측 모드에 따라 앞서 기술한 방법을 이용, 현재 복호화 된 계수의 스캐닝 방식을 선택(420)하여 최종적인 계수를 복원(430)한다.

<57> 상술한 방법에 따라 H.264/AVC Reference Codec 인 JM86(Joint Model 86)을 이용하여 여러 가지 테스트 영상에 대하여 실험을 수행한 결과 다음과 같은 압축효율 증가를 가져올 수 있었다. H.264/AVC에서 실험영상으로 권고하는 영상을 이용하여 실험을 수행하였다. 다음 표 1은 실험조건을 설명하기 위한 도면이다.

【표 1】

<58>

영상	News (QCIF)	Container (QCIF)	Coast (QCIF)	Paris (QCIF)	Coast (CIF)
전체 프레임	300 (30 Hz)	300 (30 Hz)	300 (30 Hz)	300 (35 Hz)	300 (30 Hz)
조건	CAVLC, Intra only, QP(18,22,26,40), 율-왜곡 최적화 사용				

<59> 상기 표 1과 같이 크기가 다른 5개의 영상에 대해서 실험 하였다. 다음 표 2는 표 1과 같은 실험조건하에서 종래의 압축방법과 본 발명에 따른 압축방법에 따라 테스트 영상을 압축하였을 때의 압축률을 비교한 도표이다.

【표 2】

<60>

Sequence	QP	H.264/AVC PSNR (dB)	H.264/AVC Bitrates (Kbps)	Proposed Method PSNR (dB)	Proposed Method Bitrates (Kbps)	Bits saving (%)
News (QCIF)	18	45.64	2370.65	45.64	2344.75	1.51%
	22	43.06	1714.99	43.05	1692.69	1.67%
	26	40.32	1221.96	40.32	1206.02	1.51%
	30	37.50	872.65	37.49	860.23	1.49%
Container (QCIF)	18	44.84	874.63	44.84	857.75	1.93%
	22	41.71	643.42	41.7	630.5	2.01%
	26	38.61	451.07	38.61	441.54	2.11%
	30	35.77	317.36	35.76	309.93	2.34%
Coast (QCIF)	18	44.18	2200.99	44.13	2152.15	2.22%
	22	40.61	1631.56	40.59	1592.37	2.40%
	26	37.13	1139.76	37.12	1111.02	2.52%
	30	34.00	765.52	33.99	746.77	2.45%
Paris (CIF)	18	44.72	4360.41	44.71	4271.09	2.05%
	22	41.57	3334.22	41.56	3259.84	2.23%
	26	38.25	2450.69	38.24	2391.77	2.40%
	30	35.04	1780.73	35.03	1736.21	2.50%
Coast (CIF)	18	44.34	4068.4	44.33	4015.7	1.30%
	22	40.8	2989.5	40.8	2950.65	1.30%
	26	37.32	2074.47	37.32	2045.89	1.38%
	30	34.21	1388.07	34.22	1369.23	1.36%

<61> 상기 표 2에 따르면, H.264/AVC 의 지그재그 스캐닝 방식만을 사용하였을 때와 제안된 인트라 예측 모드에 따른 적응적인 스캐닝 방식을 사용하였을 때의 실험 결과를 나타낸다. 제안된 방법의 압축률이 보다 우수함을 알 수 있다.

<62> 한편, 전술한 동영상 부호화 및 복호화 방법은 컴퓨터 프로그램으로 작성 가

능하다. 상기 프로그램을 구성하는 코드들 및 코드 세그먼트들은 당해 분야의 컴퓨터 프로그래머에 의하여 용이하게 추론될 수 있다. 또한, 상기 프로그램은 컴퓨터가 읽을 수 있는 정보저장매체(computer readable media)에 저장되고, 컴퓨터에 의하여 읽혀지고 실행됨으로써 동영상 부호화 및 복호화 방법을 구현한다. 상기 정보저장매체는 자기 기록매체, 광 기록매체, 및 캐리어 웨이브 매체를 포함한다.

<63> 상술한 바와 같은 본 발명의 방법은 프로그램으로 구현되어 컴퓨터로 읽을 수 있는 형태로 기록매체(씨디롬, 램, 롬, 플로피 디스크, 하드 디스크, 광자기 디스크 등)에 저장될 수 있다. 이러한 과정은 본 발명이 속하는 기술 분야에서 통상의 지식을 가진 자가 용이하게 실시할 수 있으므로 더 이상 상세히 설명하지 않기로 한다.

<64> 이상에서 설명한 본 발명은, 본 발명이 속하는 기술분야에서 통상의 지식을 가진 자에게 있어 본 발명의 기술적 사상을 벗어나지 않는 범위 내에서 여러 가지 치환, 변형 및 변경이 가능하므로 전술한 실시예 및 첨부된 도면에 의해 한정되는 것이 아니다.

【발명의 효과】

<65> 상기와 같은 본 발명은, 부호화시의 인트라 부호화의 압축률을 향상시킬 수 있는 효과가 있다.

<66> 또한, 본 발명은 차후 개발될 인트라 예측을 사용하는 비디오 압축 기술에서도 마찬가지로 압축률을 향상시킬 수 있는 효과가 있다.

【특허청구범위】

【청구항 1】

화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 부호화/복호화 장치에 있어서,

소정 크기의 블록에 대한 인트라 예측 수행 후, 현재 블록의 변환 계수에 대한 적응적인 스캐닝을 적용하기 위하여, 이미 복원된 주변 블록 경계 화소(수평 및 수직 화소)들 간의 유사성 정보를 이용, 잔차 신호의 수평 및 수직 유사성을 예측하여 그 정보에 따라 지그재그 스캐닝, horizontal 스캐닝, vertical 스캐닝을 이용하여 압축률을 높이기 위한, 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 부호화/복호화 장치.

【청구항 2】

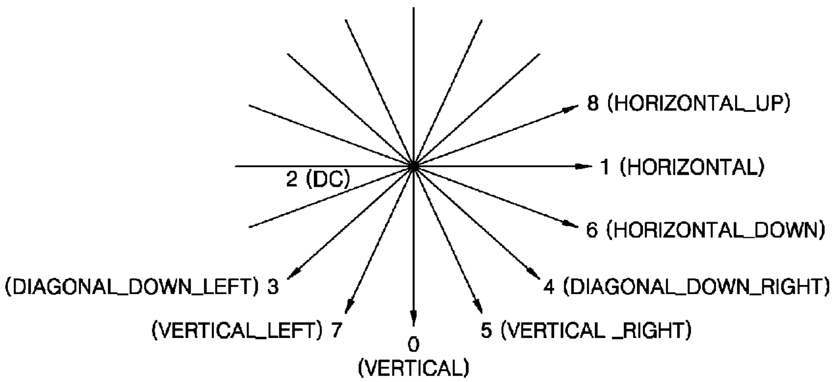
화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 부호화/복호화 방법에 있어서,

소정 크기의 블록에 대한 인트라 예측 수행 후, 현재 블록의 변환 계수에 대한 적응적인 스캐닝을 적용하기 위하여, 이미 복원된 주변 블록 경계 화소(수평 및 수직 화소)들 간의 유사성 정보를 이용, 잔차 신호의 수평 및 수직 유사성을 예측하여 그 정보에 따라 지그재그 스캐닝, horizontal 스캐닝, vertical 스캐닝을 이용하여 압축률을 높이기 위한, 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이

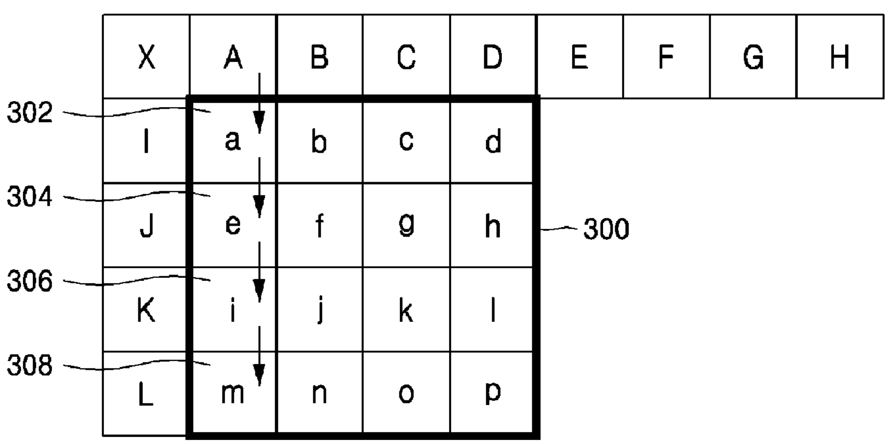
용한 부호화/복호화 방법.

【도면】

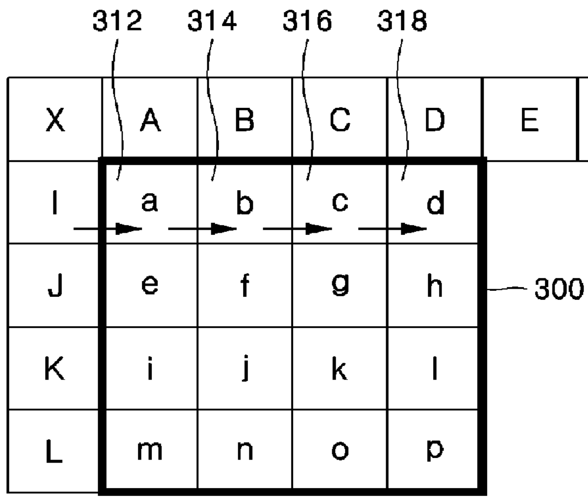
【도 1】


8 (HORIZONTAL_UP)
1 (HORIZONTAL)
2 (DC)
6 (HORIZONTAL_DOWN)
(DIAGONAL_DOWN_LEFT) 3
4 (DIAGONAL_DOWN_RIGHT)
(VERTICAL_LEFT) 7
0
(VERTICAL)
5 (VERTICAL _RIGHT)

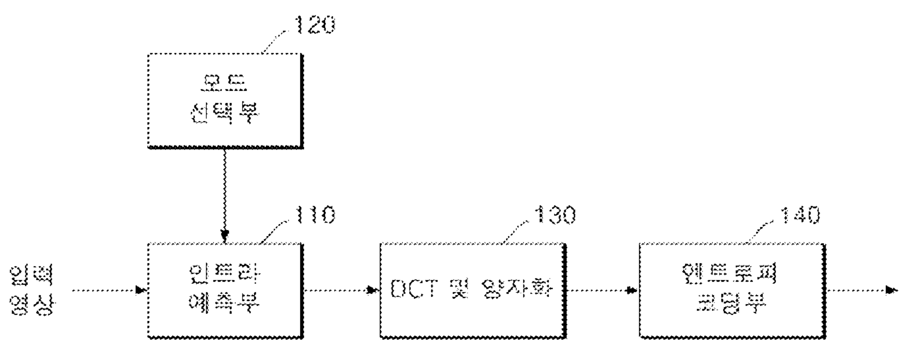
【도 2a】


X A B C D E F G H
302
I a b c d
304
J e f g h
300
306
K i j k l
308
L m n o p

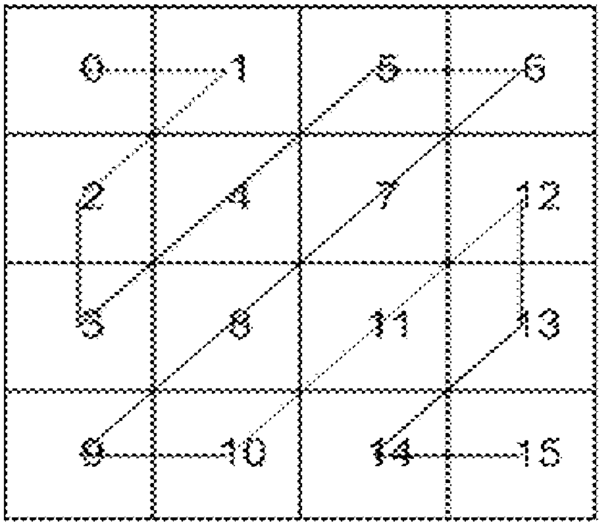
【도 2b】


312
314
316
318
X A B C D E F G H
I a b c d
J e f g h
K i j k l
L m n o p
300

【도 3】


120
모드
선택부
110
130
140
입력
영상
인트라
예측부
DCT 및 양자화
엔트로피
코딩부

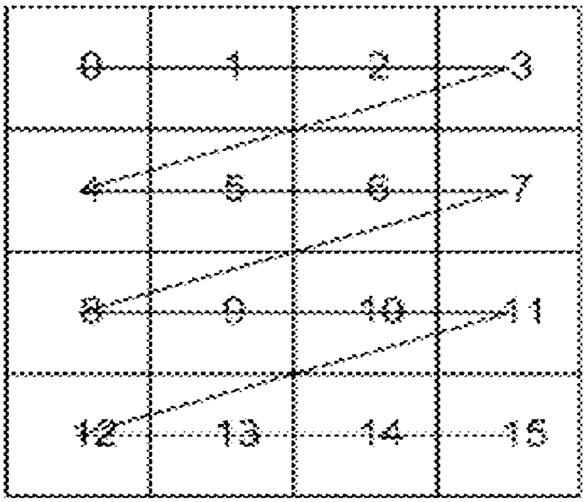
【도 4】



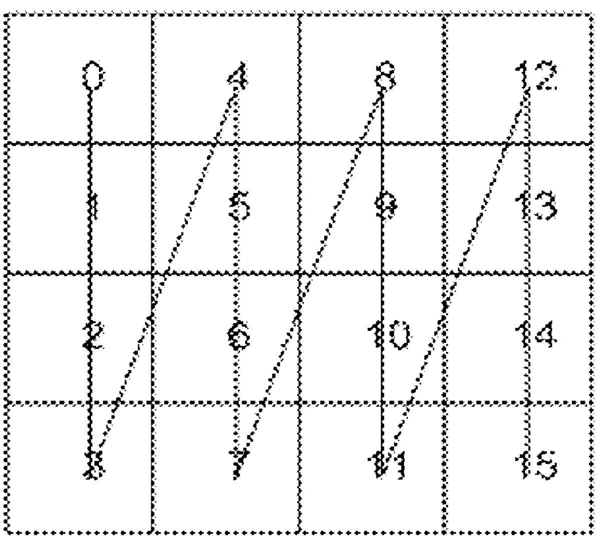
【도 5】

	A	B	C	D
E	a	b	c	d
F	e	f	g	h
G	i	j	k	l
H	m	n	o	p

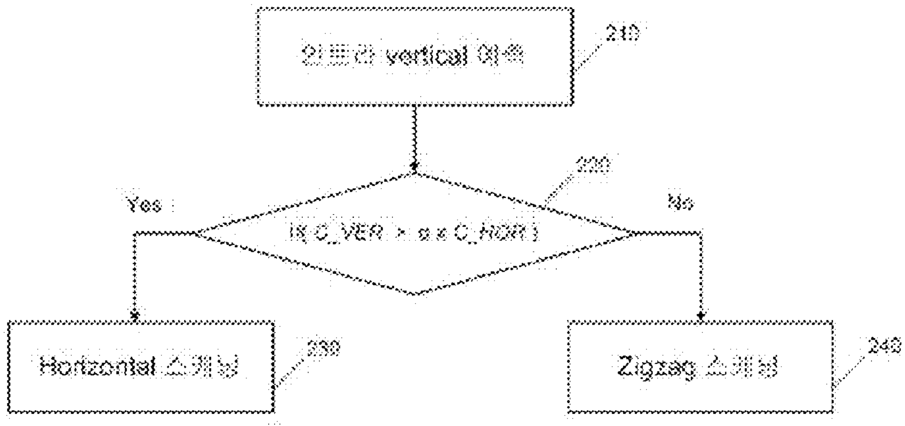
【도 6a】



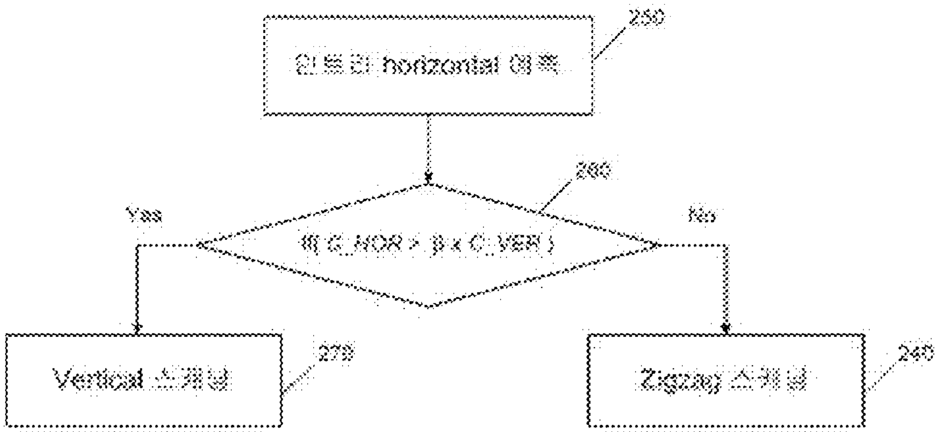
【도 6b】



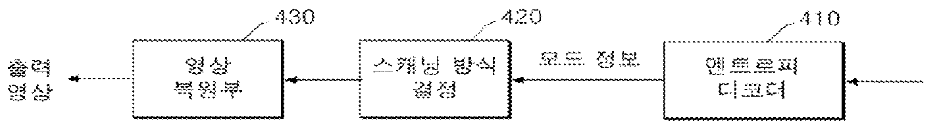
【도 7a】


vertical
210
220
Yes
No
if(C_VER > α x C_HOR)
Horizontal 스캐닝
230
Zigzag 스캐닝
240

【도 7b】


horizontal
250
260
Yes
No
if(C_HOR > β x C_VER)
Vertical 스캐닝
270
Zigzag 스캐닝
240

【도 8】



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Applicant(s) Electronics and Telecommunications Research Institute, et al

2007 년 04 월 04 일

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【권리구분】 특허

【수신처】 특허청장

【제출일자】 2007.01.26

【발명의 국문명칭】 화소 유사성에 따라 적응적인 이산 코사인 변환 계수 스캐닝을 이용한 부호화/복호화 장치 및 그 방법

【발명의 영문명칭】 Apparatus and method of encoding and decoding using adaptive scanning of DCT coefficients according to the pixel similarity

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【포괄위임등록번호】 2000-051975-8

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【성명】 정세윤

【성명의 영문표기】 JEONG,Se Yoon

【주민등록번호】 730322-1150718

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【성명의 영문표기】 CHOI,Hae Chul

【주민등록번호】 740725-1674018

【우편번호】 305-150

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【성명의 영문표기】 SEO,Jeong Il

【주민등록번호】 710204-1726919

【우편번호】 305-728

【주소】 대전 유성구 전민동 세종아파트 107-801

【국적】 KR

【발명자】

【성명】 백승권

【성명의 영문표기】 BEACK,Seung Kwon

【주민등록번호】 741212-1226712

【우편번호】 137-062

【주소】 서울 서초구 방배2동 957-13

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【성명의 영문표기】 JANG,In Seon

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【성명의 영문표기】 KIM,Jae Gon

【주민등록번호】 670726-1788014

【우편번호】 302-120

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【성명】 문경애

【성명의 영문표기】 MOON,Kyung Ae

【주민등록번호】 620524-2401117

【우편번호】 302-120

【주소】 대전 서구 둔산동 한마루아파트 9-903

【국적】 KR

【발명자】

【성명】 장대영

【성명의 영문표기】 JANG,Dae Young

【주민등록번호】 660224-1122115

【우편번호】 305-768

【주소】 대전 유성구 노은동 열매마을 904-1701

【국적】 KR

【발명자】

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【성명의 영문표기】 HONG,Jin Woo

【주민등록번호】 590415-1224318

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【성명의 영문표기】 KIM,Jin Woong

【주민등록번호】 591223-1011621

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【주소】 대전 유성구 전민동 엑스포아파트 305-1603

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【성명의 영문표기】 LEE,Yung Lyul

【주민등록번호】 611030-1047211

【우편번호】 138-160

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【성명】 심동규

【성명의 영문표기】 SIM,Dong Gyu

【주민등록번호】 700710-1182528

【우편번호】 139-050

【주소】 서울 노원구 월계동 삼호아파트 31-607

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【성명】 오승준

【성명의 영문표기】 OH,Seoung Jun

【주민등록번호】 571107-1030124

【우편번호】 463-010
【주소】 경기 성남시 분당구 정자1동 아이파크 104-1902
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【성명의 영문표기】 AHN,Chang Beom
【주민등록번호】 580416-1056715
【우편번호】 138-050
【주소】 서울 송파구 방이동 89번지 올림픽선수기자촌 아파트 109-501
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【발명자】
【성명】 김대연
【성명의 영문표기】 KIM,Dae Yeon
【주민등록번호】 820615-1360511
【우편번호】 139-243
【주소】 서울 노원구 공릉3동 라이프아파트 204-1203
【국적】 KR
【발명자】
【성명】 김동균
【성명의 영문표기】 KIM,Dong Kyun
【주민등록번호】 800417-1030811
【우편번호】 139-748
【주소】 서울 노원구 상계5동 벽산아파트 106-412
【국적】 KR
【우선권 주장】
【출원국명】 KR
【출원종류】 특허

【출원번호】 10-2006-0077851
【출원일자】 2006.08.17
【증명서류】 첨부

【공지예외적용대상증명서류의 내용】

【공개형태】 간행물 발표, 학술단체 서면발표
【공개일자】 2006.09.23

【심사청구】 청구

【취지】 특허법 제42조의 규정에 의한 출원, 특허법 제60조의 규정에 의한 심사청구를 합니다.

대리인 특허법인 신성 (인)

【수수료】

【기본출원료】	0	면	38,000	원
【가산출원료】	35	면	0	원
【우선권주장료】	1	건	20,000	원
【심사청구료】	20	항	749,000	원
【합계】	807,000 원			
【감면사유】	정부출연연구기관			
【감면후 수수료】	413,500 원			

【기술이전】

【기술양도】 희망
【실시권허여】 희망
【기술지도】 희망

【첨부서류】 1.전담조직임을 증명하는 서류[세종대학교산학협력단]_1통
2.전담조직임을 증명하는 서류[광운대학교 산학협력단]_1통
3.위임장[세종대학교산학협력단, 광운대학교산학협력단]_1

통 4.공지예외적용대상(신규성상실의예외, 출원시의특례)규정을 적용받기 위한 증명서류_1통

【요약서】

【요약】

1. 청구범위에 기재된 발명이 속한 기술분야

본 발명은 화소 유사성에 따라 적응적인 이산 코사인 변환 계수 스캐닝을 이용한 부호화/복호화 장치 및 그 방법에 관한 것임.

2. 발명이 해결하려고 하는 기술적 과제

본 발명은 입력된 영상에 인트라 예측을 수행하고, 인트라 예측된 영상에서 인접 화소로부터 부호화될 계수의 화소 유사성 정보를 기반으로 화소 유사성을 예측하며, 예측된 화소 유사성에 따라 가장 효율적인 스캐닝 방법을 적용하기 위한, DCT 계수 스캐닝을 이용한 부호화/복호화 장치 및 그 방법을 제공하는데 그 목적이 있음.

3. 발명의 해결방법의 요지

본 발명은, 이산 코사인 변환 계수(DCT : Discrete Cosine Transform) 스캐닝을 이용한 부호화 장치에 있어서, 인트라 예측 시 최적 모드를 선택하기 위한 모드 선택수단; 상기 모드 선택수단에 의해 선택된 모드를 기반으로 입력된 영상에 대한 인트라 예측을 수행하는 인트라 예측수단; 상기 인트라 예측수단으로부터 출력된 잔차 계수 블럭에 대해 이산 코사인 변환(DCT) 및 양자화를 수행하는 DCT 및 양자화수단; 및 상기 잔차 계수들의 화소 유사성에 따라 결정된 소정의 스캐닝 모드를 이용해 상기 양자화된 DCT 계수를 엔트로피 부호화하기 위한 엔트로피 부호화

수단을 포함함.

4. 발명의 중요한 용도

본 발명은 부호화/복호화 장치 등에 이용됨.

【대표도】

도 3

【색인어】

부호화, 복호화, DCT, 화소 유사성, 인트라 예측, 엔트로피 부호화, 엔트로피 복호화, 적응적인 스캐닝

【명세서】

【발명의 명칭】

화소 유사성에 따라 적응적인 이산 코사인 변환 계수 스캐닝을 이용한 부호화/복호화 장치 및 그 방법{Apparatus and method of encoding and decoding using adaptive scanning of DCT coefficients according to the pixel similarity}

【도면의 간단한 설명】

<1> 도 1 은 H.264/AVC 표준에서 4 × 4 블록의 인트라 예측에 사용되는 9가지 예측 모드를 나타내는 일실시예 설명도,

<2> 도 2a 는 수직 모드(vertical mode)에서의 화소 예측 방법을 나타내는 일실시예 설명도,

<3> 도 2b 는 수평 모드(horizontal mode)에서의 화소 예측 방법을 나타내는 일실시예 설명도,

<4> 도 3 은 본 발명에 따른 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 부호화 장치의 일실시예 구성도,

<5> 도 4a 는 본 발명에 이용되는 지그재그 스캐닝 방법을 나타내는 일실시예 설명도,

<6> 도 4b 는 본 발명에 이용되는 수평(horizontal) 스캐닝 방법을 나타내는 일실시예 설명도,

<7> 도 4c 는 본 발명에 이용되는 수직(vertical) 스캐닝 방법을 나타내는 일실

시예 설명도,

<8> 도 5 는 본 발명에 따른 수직 및 수평 방향의 화소 유사성 예측 방법을 나타내는 일실시예 설명도,

<9> 도 6 은 본 발명에 따른 인트라 수직(vertical) 예측 모드에서의 화소 유사성에 따른 적응적인 스캐닝 방법에 대한 일실시예 흐름도,

<10> 도 7 은 본 발명에 따른 인트라 수평(horizontal) 예측 모드에서의 화소 유사성에 따른 적응적인 스캐닝 방법에 대한 일실시예 흐름도,

<11> 도 8 은 본 발명에 따른 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 복호화 장치의 일실시예 구성도이다.

<12> * 도면의 주요 부분에 대한 부호 설명

<13> 10 : 모드 선택부 20 : 인트라 예측부

<14> 30 : DCT 및 양자화 40 : 엔트로피 부호화부

<15> 50 : 엔트로피 복호화부 60 : 스캐닝 결정부

<16> 70 : 영상 복원부

【발명의 상세한 설명】

【발명의 목적】

【발명이 속하는 기술분야 및 그 분야의 종래기술】

<17> 본 발명은 화소 유사성에 따라 적응적인 이산 코사인 변환(DCT : Discrete Cosine Transform, 이하 'DCT'라 함) 계수 스캐닝을 이용한 부호화/복호화 장치 및 그 방법에 관한 것으로, 더욱 상세하게는 입력된 영상에 인트라 예측을 수행하고, 인트라 예측된 영상에서 인접 화소로부터 부호화될 계수의 화소 유사성 정보를 기반으로 화소 유사성을 예측하며, 예측된 화소 유사성에 따라 가장 효율적인 스캐닝 방법을 적용하는, DCT 계수 스캐닝을 이용한 부호화/복호화 장치 및 그 방법에 관한 것이다.

<18> 동영상 데이터를 부호화 및 복호화하기 위해 마련된 영상 압축 표준에 따르면, 하나의 프레임에 포함된 복수 개의 매크로 블록, 또는 매크로 블록을 더 작은 블록들로 나누어 얻어진 서브 블록 단위로 부호화 및 복호화를 수행한다. 여기서, 부호화 및 복호화 방법은 시간적 예측과 공간적 예측을 기반으로 이루어진다.

<19> 이때, 시간적 예측은 인접한 프레임의 블록을 참조하여 현재 프레임에서 매크로 블록 내의 블록들(즉, 매크로 블록 또는 매크로 블록보다 작은 서브 블록들)의 움직임을 예측하는 것을 의미한다.

<20> 그리고, 공간적 예측은 부호화하고자 하는 현재 프레임의 매크로 블록 내의 블록들(즉, 매크로 블록 또는 매크로 블록보다 작은 서브 블록들)을 현 프레임 내에서 이미 복원된 인접한 블록의 경계 화소를 이용하여 예측을 수행하는 것을 의미한다.

<21> 이때, 공간적 예측을 인트라 예측(Intra Prediction)이라고도 하는데, 인트

라 예측은 어느 화소를 예측하는데 있어 그와 인접한 화소가 유사한 값을 가질 가능성이 많다는 특성을 이용한 것이다.

<22> H.264/AVC(Advanced Video Coding) 표준은 인트라 예측 부호화, 1/4 단위의 가변 블록 움직임 추정 및 보상, CAVLC(Context-Based Adaptive Variable Length Coding) 및 CABAC(Context-Based Adaptive Binary Arithmetic Coding) 등의 기술들을 이용해 MPEG-2(Moving Picture Experts Group-2)의 약 2배의 압축율, MPEG-4(Moving Picture Experts Group-4)의 약 1.5배의 압축율을 보인다.

<23> 이러한, H.264/AVC 표준은 9가지 방향성을 고려한 예측 모드를 이용하여 현재 블록의 화소 값을 예측한다.

<24> 도 1 은 H.264/AVC 표준에서 4 × 4 블록의 인트라 예측에 사용되는 9가지 예측 모드를 나타내는 일실시예 설명도이다.

<25> 도 1에 도시된 바와 같이, H.264/AVC 표준에서 4 × 4 블록의 인트라 예측에 사용되는 9가지의 예측 모드는, 예측 방향에 따라 수직 모드(vertical mode)(모드 0), 수평 모드(horizontal mode)(모드 1), DC 모드(모드 2), 대각선 하단 좌측(diagonal_down_left)(모드 3), 대각선 하단 우측(diagonal_down_right)(모드 4), 수직 우측(vertical_right)(모드 5), 수평 하단(horizontal_down)(모드 6), 수직 좌측(vertical_left)(모드 7) 및 수평 상단(horizontal_up)(모드 8)가 있다.

<26> 여기서, DC 모드(모드 2)의 경우는 주변 화소들의 평균 값을 사용하여 인트라 예측을 수행하게 된다. 이때, 화살표는 예측 방향을 나타낸다.

<27> 한편, 인트라 16 × 16 예측 부호화의 경우는 총 4개의 모드가 존재하며, 그

종류로는 수직 모드(vertical mode), 수평 모드(horizontal mode), DC 모드 및 평면 모드(plane mode) 등이 있다.

<28> 또한, 인트라 8 × 8 예측 부호화의 경우는 인트라 4 × 4 예측 부호화와 동일하게 총 9가지의 모드가 존재한다. 색차 신호의 경우는 인트라 8 × 8 예측 부호화가 존재하며, 그 종류로는 DC 모드, 수직 모드(vertical mode), 수평 모드(horizontal mode) 및 평면 모드(plane mode) 등이 있다.

<29> 이하, 4 × 4 블록을 인트라 예측하는 경우, 수직 모드(vertical mode) 및 수평 모드(horizontal mode)에서의 예측 방법을 도 2a 및 도 2b를 참조하여 살펴보기로 한다.

<30> 도 2a 는 수직 모드(vertical mode)에서의 화소 예측 방법을 나타내는 일실시예 설명도이다.

<31> 도 2a에 도시된 바와 같이, 화소 a(201), e(202), i(203) 및 m(204)는 수직 방향으로 인접한 화소 A로부터 예측이 된다.

<32> 상기와 같이, 화소 b, f, j 및 b는 수직 방향으로 인접한 화소 B로부터 예측이 된다. 또한, 화소 c, g, k 및 o는 수직 방향으로 인접한 화소 C로부터 예측이 된다. 또한, 화소 d, h,l 및 p는 수직 방향으로 인접한 화소 D로부터 예측이 된다.

<33> 도 2b 는 수평 모드(horizontal mode)에서의 화소 예측 방법을 나타내는 일실시예 설명도이다.

<34> 도 2b에 도시된 바와 같이, 화소 a(205), b(206), c(207) 및 d(208)는 수평 방향으로 인접한 화소 I로부터 예측된다.

<35> 상기와 같이, 화소 e, f, g 및 h는 수평 방향으로 인접한 화소 J로부터 예측된다. 또한, 화소 i, j, k 및 l은 수평 방향으로 인접한 화소 k로부터 예측된다. 또한, 화소 m, n, o 및 p는 수평 방향으로 인접한 화소 l로부터 예측된다.

<36> 부호화기는 상기의 예측된 화소와 현재 화소를 차분한 잔차 신호(화소 영역)를 DCT 및 양자화를 수행한다. 그 후, 부호화기는 DCT 및 양자화된 변환 계수(Transformed coefficient)들을 지그재그(zig-zag) 스캐닝하여 엔트로피 부호화한다.

<37> 여기서, 지그재그 스캐닝 방식은 낮은 주파수에 에너지가 집중되고, 높은 주파수에 에너지가 적게 나타나는 변환 계수의 에너지 컴팩션의 특성을 이용한 것이지만, 인트라 예측 수행 후 이와 같은 에너지 컴팩션이 항상 유효한 것은 아니다.

<38> 즉, 지그재그 스캐닝 방식은 저주파 성분에서부터 고주파 성분으로 변환 계수를 스캐닝하는 방식으로, 변환 계수의 분포가 저주파 성분에 많이 나타나는 경우에 효율적이지만, 방향성을 띈 공간적 예측을 사용할 경우에는 변환 계수의 분포가 예측 방향에 영향을 많이 받기 때문에, 모든 방향 예측에 대해서 지그재그 스캐닝을 사용하는 것은 효율적이지 못하다는 문제점이 있다.

【발명이 이루고자 하는 기술적 과제】

<39> 본 발명은 상기 문제점을 해결하기 위하여 제안된 것으로, 입력된 영상에 인트라 예측을 수행하고, 인트라 예측된 영상에서 인접 화소로부터 부호화될 계수의 화소 유사성 정보를 기반으로 화소 유사성을 예측하며, 예측된 화소 유사성에 따라

가장 효율적인 스캐닝 방법을 적용하기 위한, DCT 계수 스캐닝을 이용한 부호화/복호화 장치 및 그 방법을 제공하는데 그 목적이 있다.

<40> 본 발명의 다른 목적 및 장점들은 하기의 설명에 의해서 이해될 수 있으며, 본 발명의 실시예에 의해 보다 분명하게 알게 될 것이다. 또한, 본 발명의 목적 및 장점들은 특허청구범위에 나타낸 수단 및 그 조합에 의해 실현될 수 있음을 쉽게 알 수 있을 것이다.

【발명의 구성】

<41> 상기 목적을 달성하기 위한 본 발명은, 이산 코사인 변환 계수(DCT : Discrete Cosine Transform) 스캐닝을 이용한 부호화 장치에 있어서, 인트라 예측 시 최적 모드를 선택하기 위한 모드 선택수단; 상기 모드 선택수단에 의해 선택된 모드를 기반으로 입력된 영상에 대한 인트라 예측을 수행하는 인트라 예측수단; 상기 인트라 예측수단으로부터 출력된 잔차 계수 블럭에 대해 이산 코사인 변환(DCT) 및 양자화를 수행하는 DCT 및 양자화수단; 및 상기 잔차 계수들의 화소 유사성에 따라 결정된 소정의 스캐닝 모드를 이용해 상기 양자화된 DCT 계수를 엔트로피 부호화하기 위한 엔트로피 부호화수단을 포함한다.

<42> 또한, 본 발명은, 이산 코사인 변환 계수(DCT : Discrete Cosine Transform) 스캐닝을 이용한 복호화 장치에 있어서, 부호화된 영상을 엔트로피 복호화하기 위한 엔트로피 복호화수단; 상기 엔트로피 복호화수단에 의해 복호화된 영상에 대한 스캐닝 모드를 결정하기 위한 스캐닝 모드 결정수단; 및 상기 스캐닝 결정수단에

의해 결정된 스캐닝 모드에 따라 영상을 복원하기 위한 영상 복원수단을 포함한다.

<43> 또한, 본 발명은, 이산 코사인 변환 계수(DCT : Discrete Cosine Transform) 스캐닝을 이용한 부호화 방법에 있어서, 인트라 예측 시 최적 모드를 선택하는 모드 선택 단계; 상기 모드 선택 단계에서 선택된 모드를 기반으로 입력된 영상에 대한 인트라 예측을 수행하는 인트라 예측 단계; 상기 인트라 예측 단계에서 출력된 잔차 계수 블럭에 대해 이산 코사인 변환(DCT) 및 양자화를 수행하는 DCT 및 양자화 단계; 상기 잔차 계수들의 화소 유사성을 판단하는 판단 단계; 및 상기 판단 결과에 따라 결정된 소정의 스캐닝 모드를 이용해 상기 DCT 및 양자화 단계에서 양자화된 DCT 계수를 엔트로피 부호화하는 엔트로피 부호화 단계를 포함한다.

<44> 또한, 본 발명은, 이산 코사인 변환 계수(DCT : Discrete Cosine Transform) 스캐닝을 이용한 복호화 방법에 있어서, 부호화된 영상을 엔트로피 복호화하는 엔트로피 복호화 단계; 상기 엔트로피 복호화 단계에서 복호화된 영상에 대한 스캐닝 모드를 결정하는 스캐닝 모드 결정 단계; 및 상기 스캐닝 결정 단계에서 결정된 스캐닝 모드에 따라 영상을 복원하는 영상 복원 단계를 포함한다.

<45> 본 발명에서 부호화 모드는, 휘도(luminance) 블록인 경우에는 H.264/AVC의 인트라 4 × 4 휘도 부호화 모드인 수직 모드(vertical mode), 수평 모드(horizontal mode), 대각선 하단 좌측(diagonal_down_left), 대각선 하단 우측(diagonal_down_right), 수직 우측(vertical_right), 수평 하단(horizontal_down), 수직 좌측(vertical_left) 및 수평 상단(horizontal_up)과, H.264/AVC의 인트라 16 × 16 휘도 부호화 모드인 수직 모드(vertical mode), 수평 모드(horizontal

mode), 평면 모드(plane mode) 및 DC 모드인 것이 바람직하다.

<46> 또한, 본 발명에서 상기 부호화 모드는, 색도(chrominance) 블록에 대해서는 H.264/AVC의 인트라 M × N 색도 부호화 모드인, 수직 모드(vertical mode), 수평 모드(horizontal mode), 평면 모드(plane mode) 및 DC 모드인 것이 바람직하다.

<47> 상술한 목적, 특징 및 장점은 첨부된 도면과 관련한 다음의 상세한 설명을 통하여 보다 분명해 질 것이며, 그에 따라 본 발명이 속하는 기술분야에서 통상의 지식을 가진 자가 본 발명의 기술적 사상을 용이하게 실시할 수 있을 것이다. 또한, 본 발명을 설명함에 있어서 본 발명과 관련된 공지 기술에 대한 구체적인 설명이 본 발명의 요지를 불필요하게 흐릴 수 있다고 판단되는 경우에 그 상세한 설명을 생략하기로 한다. 이하, 첨부된 도면을 참조하여 본 발명에 따른 바람직한 일 실시예를 상세히 설명하기로 한다.

<48> 도 3 은 본 발명에 따른 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 부호화 장치의 일실시예 구성도이다.

<49> 도 3에 도시된 바와 같이, 본 발명에 따른 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 부호화 장치는, 모드 선택부(10), 인트라 예측부(20), DCT 및 양자화부(30) 및 엔트로피 부호화부(40)를 포함한다.

<50> 여기서, 상기 모드 선택부(10)는 인트라 예측 시 가능한 여러 가지 예측 모드 중에서 최적의 모드를 선택한다. 즉, 상기 모드 선택부(10)는 4 × 4 인트라 예측, 16 × 16 인트라 예측 및 8 × 8 인트라 예측 시에 가능한 여러 가지 부호화 모드 중에서 하나를 선택한다.

<51> 일반적으로, 상기 모드 선택부(10)는 율-왜곡(Rate-Distortion)을 가장 줄이기 위한 율-왜곡 최적화(Rate-Distortion Optimization) 방법에 따라 하나의 모드를 선택한다.

<52> 그리고, 상기 인트라 예측부(20)는 영상을 입력받아, 상기 모드 선택부(10)에 의해 선택된 모드를 기반으로 휘도 블록의 화소에 대해서는 4 × 4 인트라 예측을 수행하고, 색도 블록의 화소에 대해서는 8 × 8 인트라 예측을 수행한다.

<53> 그리고, 상기 DCT 및 양자화부(30)는 인트라 예측부(10)로부터 출력된 차이값 즉, 부호화하고자 하는 현재 프레임의 매크로 블록 내의 화소 값과 예측 화소 값의 차이를 나타내는 잔차 계수 블록에 대하여 DCT 및 양자화를 수행하여 엔트로피 부호화부(40)로 전달한다.

<54> 그리고, 상기 엔트로피 부호화부(40)는 상기 DCT 및 양자화부(30)에 의해 DCT 및 양자화된 계수를 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용하여 DCT 계수를 나열하고, 나열된 DCT 계수를 엔트로피 부호화하여 출력한다.

<55> 이때, 엔트로피 부호화는 발생 빈도가 높은 데이터에 대해서는 적은 비트를 할당하고, 발생 빈도가 낮은 데이터에 대해서는 많은 비트를 할당함으로써, 데이터의 압축률을 높이는 부호화를 의미한다. 본 발명에서 사용되는 엔트로피 부호화 방법으로는 CAVLC(Context Adaptive Variable Length Coding) 또는 CABAC(Context-Based Adaptive Binary Arithmetic Coding) 등이 있다.

<56> 여기서, 상기 엔트로피 부호화부(40)의 수직 및 수평 방향의 화소 유사성 예측 방법과, 인트라 수직(vertical) 및 수평(horizontal) 예측 모드에서의 스캐닝

방법에 대해 도 5 내지 도 7을 참조하여 보다 상세하게 살펴보기로 한다.

<57> 도 4a 는 본 발명에 이용되는 지그재그 스캐닝 방법을 나타내는 일실시예 설명도로서, 종래의 지그재그 스캐닝 방법을 나타낸다. 또한, 도 4b 는 본 발명에 이용되는 수평(horizontal) 스캐닝 방법을 나타내는 일실시예 설명도로서, 종래의 수평(horizontal) 스캐닝 방법을 나타낸다. 또한, 도 4c 는 본 발명에 이용되는 수직(vertical) 스캐닝 방법을 나타내는 일실시예 설명도로서, 종래의 수직(vertical) 스캐닝 방법을 나타낸다.

<58> 도 4a에 도시된 바와 같이, 본 발명에 이용되는 지그재그 스캐닝 방법은, DCT 및 양자화된 변환 계수의 저주파 성분이 2 차원 상에서 좌측 상단에 위치할 가능성이 높다는 것을 고려하여 고안된 방법으로, 낮은 주파수에는 DCT 후의 계수가 집중되어 나타나고, 높은 주파수에는 DCT 후의 계수가 적게 나타나는 변환 계수의 에너지 컴팩션의 특성을 이용한 것이다.

<59> 이러한 지그재그 스캐닝 방법은 수평 방향의 화소 유사성이 수직 방향의 화소 유사성과 비슷한 경우에 보다 효율적일 수 있다.

<60> 그러나, 인트라 예측 부호화를 수행할 경우, 특히 수직(vertical) 예측 모드나 수평(horizontal) 예측 모드의 경우는 잔여 계수의 수직 방향의 유사성 및 수평 방향의 유사성이 서로 큰 차이를 보이게 되는 경우가 많기 때문에, 위와 같은 DCT 후의 계수 분포가 항상 유효하지 않다. 따라서, 모든 방향 예측에 대해 지그재그 스캐닝 방법을 사용하는 것은 효율적이지 못하다.

<61> 여기서, 수직(vertical) 예측 모드의 경우를 예를 들어 살펴보면, 수직 방향

의 화소 유사성이 높을 때 율-왜곡(Rate-Distortion) 과정에서 최적의 모드로 선택되는 특징이 있는데, 이때의 변환 계수는 첫 번째 행에 중요 계수가 분포하는 현상이 생긴다. 이러한 경우에는 종래의 지그재그 스캐닝 방법보다는 도 4b의 수평(horizontal) 스캐닝 방법이 더욱 효율적이다.

<62> 한편, 수평(horizontal) 예측 모드의 경우를 예를 들어 살펴보면, 수평 방향의 화소 유사성이 높을 때 최적의 모드로 선택되며, 이때의 중요 계수는 첫 번째 열에 분포하는 현상이 생긴다. 이러한 경우에는 도 4c의 수직(vertical) 스캐닝 방법이 더욱 효율적이다.

<63> 그러나, 인트라 예측이 수행되기 전의 화소 유사성과 예측이 수행된 후의 잔여 계수의 화소 유사성이 상이하기 때문에, 단순히 인트라 예측 모드에 따라 상기 도 4b 및 상기 도 4c의 스캐닝 방법을 사용하는 것은 효율적이지 못하다.

<64> 따라서, 이미 복원된 주변 블록 경계 화소들(수평 방향의 화소 및 수직 방향의 화소) 간의 유사성 정보를 이용하여 현재 부호화될 블록의 수직 방향의 화소 유사성 및 수평 방향의 화소 유사성을 예측하고, 예측된 결과에 따라 적응적인 스캐닝 방법을 적용한다면 부호화 효율을 높일 수 있다.

<65> 도 5 는 본 발명에 따른 수직 및 수평 방향의 화소 유사성 예측 방법을 나타내는 일실시예 설명도이다.

<66> 도 5에 도시된 바와 같이, 화소 A, B, C 및 D는 현재 부호화될 블록의 상단에 위치한 화소들이고, 화소 E, F, G 및 H는 현재 부호화될 블록의 좌측에 위치한 화소들이다.

<67> 여기서, 수직(vertical) 예측 부호화의 경우, 현재 부호화될 블록 내 1 열의 화소들(a, e, i, m)의 수직 방향 화소 유사성은, 수직(vertical) 예측 후의 잔차 계수들(a-A, e-A, i-A, m-A)의 수직 방향 화소 유사성과 동일하다. 그 이유는 상기 잔차 계수들(a-A, e-A, i-A, m-A)은 화소들(a, e, i, m)과 동일한 예측 화소로 차분되어지므로, 그 상관성이 변하지 않기 때문이다.

<68> 이와 같이, 블록 내 2 열, 3 열 및 4 열의 화소들의 수직 방향 화소 유사성은, 수직(vertical) 예측 후의 각각의 잔차 계수들의 수직 방향 화소 유사성과 동일하다.

<69> 하지만, 현재 부호화될 블록 내 1 행의 화소들(a, b, c, d)의 수평 방향 유사성과 수직(vertical) 예측 후 잔차 계수들(a-A, b-B, c-C, d-D)의 수평 방향 화소 유사성은 서로 상이하다. 그리고, 수직(vertical) 예측 전 수평 방향의 화소 유사성은 수직(vertical) 예측 전보다 높아지게 되어 수직 방향의 화소 유사성과 비슷해지거나 더 커지는 경우가 발생한다.

<70> 이와 마찬가지로, 수평(horizontal) 예측 부호화의 경우, 블록 내 1 행의 화소들(a, b, c, d)의 수평 방향 화소 유사성과 수평(horizontal) 예측 후 잔차 계수들(a-E, b-E, c-E, d-E)의 수평 방향 화소 유사성은 서로 동일하다. 그리고, 블록 내 2 행, 3 행 및 4 행의 화소들의 수평 방향 화소 유사성은, 수평(horizontal) 예측 후의 각각의 잔차 계수들의 수평 방향 화소 유사성과 동일하다.

<71> 하지만, 블록 내 1 열의 화소들(a, e, i, m)의 수직 방향 화소 유사성과 수평(horizontal) 예측 후 잔차 계수(a-E, e-F, i-G, m-H)의 수직 방향 화소 유사성

은 서로 상이하다. 또한, 수평(horizontal) 예측 전 수직 방향의 화소 유사성은 수평(horizontal) 예측 전보다 높아지게 되어 수평 방향의 화소 유사성과 비슷해지거나 더 커지는 경우가 발생한다.

<72> 위와 같이 수직 및 수평 방향의 화소 유사성이 비슷해지게 될 경우, 수평(horizontal) 스캐닝 방법과 수직(vertical) 스캐닝 방법보다는 일반적인 지그재그 스캐닝 방법이 보다 효율적이다.

<73> 따라서, 인트라 수직(vertical) 예측 모드의 경우에는 잔차 계수들의 수직 방향 화소 유사성이 매우 높고, 수평 방향의 화소 유사성이 매우 낮은 경우에 수평 방향(horizontal) 스캐닝 방법을 사용하는 것이 보다 효율적이다.

<74> 한편, 인트라 수평(horizontal) 예측 모드의 경우에는 잔차 계수들의 수평 방향 화소 유사성이 매우 높고 수직 방향의 화소 유사성이 매우 낮은 경우에 수직(vertical) 스캐닝 방법을 사용하는 것이 보다 효율적이다.

<75> 인트라 4 × 4 예측 부호화의 효율을 높이기 위해, 상기 도 5의 복원된 8 개의 화소들(A, B, C, D, E, F, G, H)의 수직 방향의 화소 유사성을 S_VER 이라 하고, 수평 방향의 화소 유사성을 S_HOR 이라 하면, 각각의 화소 유사성은 하기의 [수학식 1]과 같이 계산된다.

【수학식 1】

$$S\_VER = \frac{1}{Variance(E, F, G, H)}$$

<76>
$$S\_HOR = \frac{1}{Variance(A, B, C, D)}$$

<77> 여기서, *Variance()*는 분산을 나타내고, E, F, G, H 는 현재 부호화될 블록의 왼쪽에 인접한 화소들을 나타내며, A, B, C, D 는 현재 부호화될 블록의 위쪽에 인접한 화소들을 나타낸다.

<78> 수직(vertical) 예측 모드를 수행하였을 경우, S_HOR에 곱인자 (multiplication factor) α(α >= 1)를 곱한 값이 현재 블록의 잔차 계수의 수평 방향 화소 유사성 예측 값으로 사용된다(여기서, α 값은 실험시 2로 고정하였다). S_VER 은 그 값 그대로 현재 블록의 잔차 계수의 수직 방향 화소 유사성 예측 값으로 사용된다.

<79> 수평(horizontal) 예측 모드를 수행하였을 경우, S_VER에 곱인자 (multiplication factor) β(β >= 1)를 곱한 값이 현재 블록의 잔차 계수의 수직 방향 화소 유사성 예측 값으로 사용된다(여기서, β 값은 실험시 2로 고정하였다). S_HOR은 그 값 그대로 현재 블록의 잔차 계수의 수평 방향 화소 유사성 예측 값으로 사용된다.

<80> 상기와 같은 방법으로 획득한 수직 및 수평 방향 화소 유사성 예측 값을 서로 비교하여 스캐닝 방법을 결정한다.

<81> 상기에서는 4 × 4 인트라 예측 모드를 예로 들어 설명하였지만, 이에 한정하지 않고 M × N 인트라 예측 모드 등에도 적용 가능하다.

<82> 이하, 인트라 수직(vertical) 및 수평(horizontal) 예측 모드에서의 스캐닝 방식을 선택하는 방법에 대해 도 6과 도 7을 참조하여 보다 상세하게 살펴보기로 한다.

<83> 도 6 은 본 발명에 따른 인트라 수직(vertical) 예측 모드에서의 화소 유사성에 따른 적응적인 스캐닝 방법에 대한 일실시예 흐름도이다.

<84> 인트라 수직(vertical) 예측 모드일 경우(601), S_VER 값과 α × S_HOR 값을 비교하여(602), S_VER 값이 α × S_HOR 값보다 크면 수평(horizontal) 스캐닝을 사용하고(603), S_VER 값이 α × S_HOR 값보다 작으면 지그재그 스캐닝을 사용한다(604).

<85> 여기서, 주변 화소의 유사성을 이용하여 현재 부호화할 블록의 수직 방향 화소 유사성이 수평 방향의 화소 유사성보다 매우 높게 예측될 경우에는 DCT 및 양자화를 거친 변환 계수가 블록 내의 1 행에 수평 방향으로 분포하게 될 확률이 높기 때문에 수평(horizontal) 스캐닝 방법을 사용하면 높은 부호화 효율을 낼 수 있다.

<86> 도 7 은 본 발명에 따른 인트라 수평(horizontal) 예측 모드에서의 화소 유사성에 따른 적응적인 스캐닝 방법에 대한 일실시예 흐름도이다.

<87> 인트라 수평(horizontal) 예측 모드일 경우(701), S_HOR 값과 β × S_VER 값을 비교하여(702), S_HOR 값이 β × S_VER 값보다 크면 수직(vertical) 스캐닝을 사용하고(703), S_HOR 값이 β × S_VER 값보다 작으면 지그재그 스캐닝을 사용한다(704).

<88> 여기서, 주변 화소의 유사성을 이용하여 현재 부호화할 블록의 수평 방향 화소 유사성이 수직 방향 화소 유사성보다 매우 높게 예측될 경우에는 DCT 및 양자화를 거친 변환 계수가 블록 내 1 열에 수직 방향으로 분포하게 될 확률이 높기 때문에 수직(vertical) 스캐닝 방법을 사용하면 높은 부호화 효율을 낼 수 있다.

<89> 도 8 은 본 발명에 따른 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 복호화 장치의 일실시예 구성도이다.

<90> 도 8에 도시된 바와 같이, 본 발명에 따른 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 복호화 장치는, 엔트로피 복호화부(50), 스캐닝 결정부(60) 및 영상 복원부(70)를 포함한다.

<91> 여기서, 상기 엔트로피 복호화부(50)는 상기 화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 부호화 장치에 의해 부호화된 영상(비트 스트림)을 입력받아 CAVLC 또는 CABAC 등과 같은 엔트로피 복호화 방법에 따라 복호화를 수행한다. 또한, 상기 엔트로피 복호화부(50)는 엔트로피 복호화된 영상(비트 스트림)을 상기 스캐닝 결정부(60)로 전달한다.

<92> 그리고, 상기 스캐닝 결정부(60)는 상기 도 5 내지 도 8에서 설명한 바와 같

이 인트라 예측 모드에 따라 상기 엔트로피 복호화부(50)에 의해 복호화된 계수의 스캐닝 방법을 결정한다.

<93> 그리고, 영상 복원부(70)는 상기 스캐닝 결정부(60)에 의해 결정된 스캐닝 방법을 이용하여 계수들을 최종적으로 복원(영상 복원)한다.

<94> 전술한 방법에 따라 'H.264/AVC Reference Codec' 인 JM86(Joint Model 86)을 이용하여 여러 가지 테스트 영상에 대하여 실험을 수행한 결과 다음과 같은 압축 효율 증가를 가져올 수 있었다. H.264/AVC에서 실험 영상으로 권고하는 영상을 이용하여 실험을 수행하였다.

<95> 하기 [표 1]은 상기 실험에 대한 조건을 나타낸다.

【표 1】

<96>

영상	News (QCIF)	Container (QCIF)	Coast (QCIF)	Paris (QCIF)	Coast (CIF)
전체 프레임	300 (30 Hz)	300 (30 Hz)	300 (30 Hz)	300 (35 Hz)	300 (30 Hz)
조건	CAVLC, Intra only, QP(18,22,26,40), 율-왜곡 최적화 사용				

<97> 상기 [표 1]과 같이, 크기가 다른 5개의 영상에 대해서 실험하였다.

<98> 하기 [표 2]는 상기 [표 1]과 같은 실험 조건하에서 종래의 압축 방법

(H.264/AVC의 지그재그 스캐닝 방법)과 본 발명에 따른 압축 방법(인트라 예측 모드에 따른 적응적인 스캐닝 방법)을 이용하여 테스트 영상을 압축하였을 시의 영상의 압축률을 나타낸다.

【표 2】

Sequence	QP	H.264/AVC		Proposed Method		Bits saving (%)
		PSNR (dB)	Bitrates (Kbps)	PSNR (dB)	Bitrates (Kbps)	
News (QCIF)	18	45.64	2370.65	45.64	2344.75	1.51%
	22	43.06	1714.99	43.05	1692.69	1.67%
	26	40.32	1221.96	40.32	1206.02	1.51%
	30	37.50	872.65	37.49	860.23	1.49%
Container (QCIF)	18	44.84	874.63	44.84	857.75	1.93%
	22	41.71	643.42	41.7	630.5	2.01%
	26	38.61	451.07	38.61	441.54	2.11%
	30	35.77	317.36	35.76	309.93	2.34%
Coast (QCIF)	18	44.18	2200.99	44.13	2152.15	2.22%
	22	40.61	1631.56	40.59	1592.37	2.40%
	26	37.13	1139.76	37.12	1111.02	2.52%
	30	34.00	765.52	33.99	746.77	2.45%
Paris (CIF)	18	44.72	4360.41	44.71	4271.09	2.05%
	22	41.57	3334.22	41.56	3259.84	2.23%
	26	38.25	2450.69	38.24	2391.77	2.40%
	30	35.04	1780.73	35.03	1736.21	2.50%
Coast (CIF)	18	44.34	4068.4	44.33	4015.7	1.30%
	22	40.8	2989.5	40.8	2950.65	1.30%
	26	37.32	2074.47	37.32	2045.89	1.38%
	30	34.21	1388.07	34.22	1369.23	1.36%

<99>

<100> 상기 [표 2]에 도시된 바와 같이, 본 발명에 따른 인트라 예측 모드에 따른 적응적인 스캐닝 방법을 사용하여 영상을 압축한 결과가 종래 H.264/AVC의 지그재

그 스캐닝 방법만을 사용하여 영상을 압축한 결과보다 우수함을 알 수 있다.

<101> 상술한 바와 같은 본 발명의 방법은 프로그램으로 구현되어 컴퓨터로 읽을 수 있는 형태로 기록매체(씨디롬, 램, 롬, 플로피 디스크, 하드 디스크, 광자기 디스크 등)에 저장될 수 있다. 이러한 과정은 본 발명이 속하는 기술 분야에서 통상의 지식을 가진 자가 용이하게 실시할 수 있으므로 더 이상 상세히 설명하지 않기로 한다.

<102> 이상에서 설명한 본 발명은, 본 발명이 속하는 기술분야에서 통상의 지식을 가진 자에게 있어 본 발명의 기술적 사상을 벗어나지 않는 범위 내에서 여러 가지 치환, 변형 및 변경이 가능하므로 전술한 실시예 및 첨부된 도면에 의해 한정되는 것이 아니다.

【발명의 효과】

<103> 상기와 같은 본 발명은, 화소 유사성에 따라 가장 효율적인 스캐닝 방법을 적용하여 영상을 부호화 또는 복호화함으로써, 인트라 부호화의 압축률을 향상시킬 수 있는 효과가 있다.

<104> 또한, 본 발명은, 차후 개발될 인트라 예측을 사용하는 비디오 압축 기술에도 적용될 수 있으므로, 비디오 압축률을 향상시킬 수 있는 효과가 있다.

<105> 또한, 본 발명은, 부호화기와 복호화기에 동일한 유사성 정보를 적용함으로써, 새로운 모듈 추가에 대한 불필요함을 줄일 수 있는 효과가 있다.

【특허청구범위】

【청구항 1】

이산 코사인 변환 계수(DCT : Discrete Cosine Transform) 스캐닝을 이용한 부호화 장치에 있어서,

인트라 예측 시 최적 모드를 선택하기 위한 모드 선택수단;

상기 모드 선택수단에 의해 선택된 모드를 기반으로 입력된 영상에 대한 인트라 예측을 수행하는 인트라 예측수단;

상기 인트라 예측수단으로부터 출력된 잔차 계수 블럭에 대해 이산 코사인 변환(DCT) 및 양자화를 수행하는 DCT 및 양자화수단; 및

상기 잔차 계수들의 화소 유사성에 따라 결정된 소정의 스캐닝 모드를 이용해 상기 양자화된 DCT 계수를 엔트로피 부호화하기 위한 엔트로피 부호화수단

을 포함하는 부호화 장치.

【청구항 2】

제 1 항에 있어서,

상기 소정의 스캐닝 모드는,

스평 방향 스캐닝 또는 수직 방향 스캐닝 또는 지그재그 스캐닝 중 어느 하나인 것을 특징으로 하는 부호화 장치.

【청구항 3】

제 2 항에 있어서,

상기 엔트로피 부호화수단은,

상기 잔차 계수들의 수직 방향 화소 유사성이 높은 경우, 수평 방향 스캐닝을 이용해 부호화하고,

상기 잔차 계수들의 수평 방향 화소 유사성이 높은 경우, 수직 방향 스캐닝을 이용해 부호화하며,

상기 잔차 계수들의 수직 및 수평 방향의 화소 유사성이 비슷한 경우에는 지그재그 스캐닝을 이용해 부호화하는 것을 특징으로 하는 부호화 장치.

【청구항 4】

제 3 항에 있어서,

상기 엔트로피 부호화수단은,

수직 방향의 화소 유사성 값이 수평 방향의 화소 유사성 값에 제1 곱인자를 곱한 값보다 크면, 수직 방향의 화소 유사성이 높다고 판단하는 것을 특징으로 하는 부호화 장치.

【청구항 5】

제 3 항에 있어서,

상기 엔트로피 부호화수단은,

수평 방향의 화소 유사성 값이 수직 방향의 화소 유사성 값에 제2 곱인자를 곱한 값보다 크면, 수평 방향의 화소 유사성이 높다고 판단하는 것을 특징으로 하는 부호화 장치.

【청구항 6】

제 4 항에 있어서,

상기 수직 방향의 화소 유사성은,

현재 부호화된 블록의 왼쪽에 인접한 화소들에 대한 분산을 수행하여 계산하는 것을 특징으로 하는 부호화 장치.

【청구항 7】

제 5 항에 있어서,

상기 수평 방향의 화소 유사성은,

현재 부호화된 블록의 위쪽에 인접한 화소들에 대한 분산을 수행하여 계산하는 것을 특징으로 하는 부호화 장치.

【청구항 8】

제 6 항 또는 제 7 항에 있어서,

상기 제1 곱인자 및 상기 제2 곱인자는,

자연수 2인 것을 특징으로 하는 부호화 장치.

【청구항 9】

이산 코사인 변환 계수(DCT : Discrete Cosine Transform) 스캐닝을 이용한 복호화 장치에 있어서,

부호화된 영상을 엔트로피 복호화하기 위한 엔트로피 복호화수단;

상기 엔트로피 복호화수단에 의해 복호화된 영상에 대한 스캐닝 모드를 결정하기 위한 스캐닝 결정수단; 및

상기 스캐닝 결정수단에 의해 결정된 스캐닝 모드에 따라 영상을 복원하기 위한 영상 복원수단

을 포함하는 복호화 장치.

【청구항 10】

제 9 항에 있어서,

상기 결정된 스캐닝 모드는 수평 방향 스캐닝 또는 수직 방향 스캐닝 또는 지그재그 스캐닝 중 어느 하나인 것을 특징으로 하는 복호화 장치.

【청구항 11】

이산 코사인 변환 계수(DCT : Discrete Cosine Transform) 스캐닝을 이용한 부호화 방법에 있어서,

인트라 예측 시 최적 모드를 선택하는 모드 선택 단계;

상기 모드 선택 단계에서 선택된 모드를 기반으로 입력된 영상에 대한 인트라 예측을 수행하는 인트라 예측 단계;

상기 인트라 예측 단계에서 출력된 잔차 계수 블럭에 대해 이산 코사인 변환(DCT) 및 양자화를 수행하는 DCT 및 양자화 단계;

상기 잔차 계수들의 화소 유사성을 판단하는 판단 단계; 및

상기 판단 결과에 따라 결정된 소정의 스캐닝 모드를 이용해 상기 DCT 및 양자화 단계에서 양자화된 DCT 계수를 엔트로피 부호화하는 엔트로피 부호화 단계

를 포함하는 부호화 방법.

【청구항 12】

제 11 항에 있어서,

상기 소정의 스캐닝 모드는 수평 방향 스캐닝 또는 수직 방향 스캐닝 또는 지그재그 스캐닝 중 어느 하나인 것을 특징으로 하는 부호화 방법.

【청구항 13】

제 12 항에 있어서,

상기 엔트로피 부호화 단계는,

상기 잔차 계수들의 수직 방향 화소 유사성이 높은 경우, 수평 방향 스캐닝을 이용해 부호화하고,

상기 잔차 계수들의 수평 방향 화소 유사성이 높은 경우, 수직 방향 스캐닝을 이용해 부호화하며,

상기 잔차 계수들의 수직 및 수평 방향의 화소 유사성이 비슷한 경우에는 지그재그 스캐닝을 이용해 부호화하는 것을 특징으로 하는 부호화 방법.

【청구항 14】

제 13 항에 있어서,

상기 엔트로피 부호화 단계는,

수직 방향의 화소 유사성 값이 수평 방향의 화소 유사성 값에 제1 곱인자를 곱한 값보다 크면, 수직 방향의 화소 유사성이 높다고 판단하는 것을 특징으로 하는 부호화 방법.

【청구항 15】

제 13 항에 있어서,

상기 엔트로피 부호화 단계는,

수평 방향의 화소 유사성 값이 수직 방향의 화소 유사성 값에 제2 곱인자를 곱한 값보다 크면, 수평 방향의 화소 유사성이 높다고 판단하는 것을 특징으로 하는 부호화 방법.

【청구항 16】

제 14 항에 있어서,

상기 수직 방향의 화소 유사성은,

현재 부호화된 블록의 왼쪽에 인접한 화소들에 대한 분산을 수행하여 계산하는 것을 특징으로 하는 부호화 방법.

【청구항 17】

제 15 항에 있어서,

상기 수평 방향의 화소 유사성은,

현재 부호화된 블록의 위쪽에 인접한 화소들에 대한 분산을 수행하여 계산하는 것을 특징으로 하는 부호화 방법.

【청구항 18】

제 16 항 또는 제 17 항에 있어서,

상기 제1 곱인자 및 상기 제2 곱인자는,

자연수 2인 것을 특징으로 하는 부호화 방법.

【청구항 19】

이산 코사인 변환 계수(DCT : Discrete Cosine Transform) 스캐닝을 이용한 복호화 방법에 있어서,

부호화된 영상을 엔트로피 복호화하는 엔트로피 복호화 단계;

상기 엔트로피 복호화 단계에서 복호화된 영상에 대한 스캐닝 모드를 결정하는 스캐닝 모드 결정 단계; 및

상기 스캐닝 결정 단계에서 결정된 스캐닝 모드에 따라 영상을 복원하는 영상 복원 단계

를 포함하는 복호화 방법.

【청구항 20】

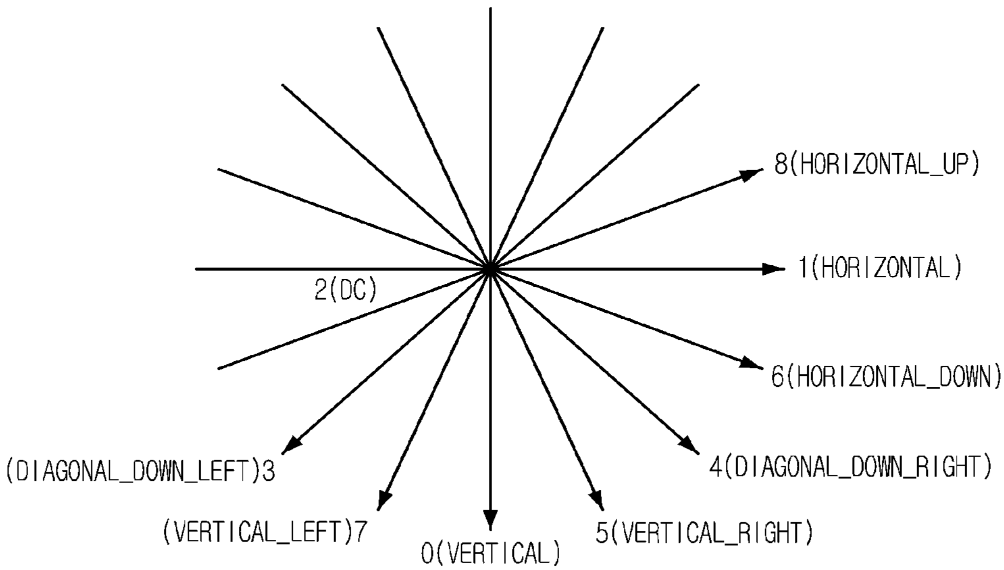
제 19 항에 있어서,

상기 결정된 스캐닝 모드는,

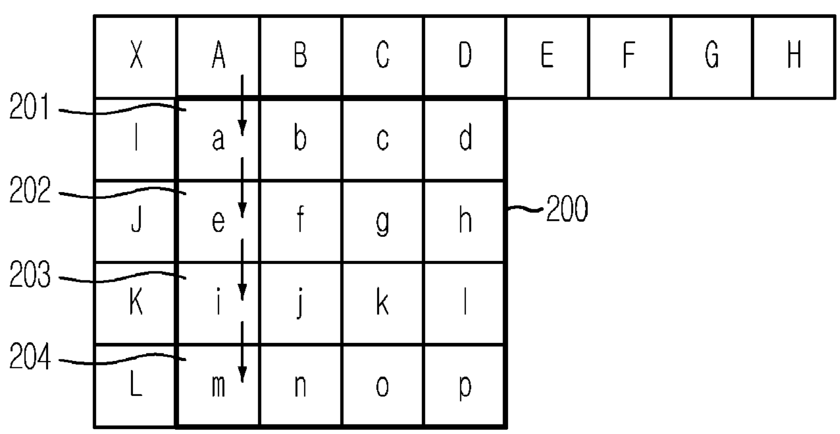
수평 방향 스캐닝 또는 수직 방향 스캐닝 또는 지그재그 스캐닝 중 어느 하나인 것을 특징으로 하는 복호화 방법.

【도면】

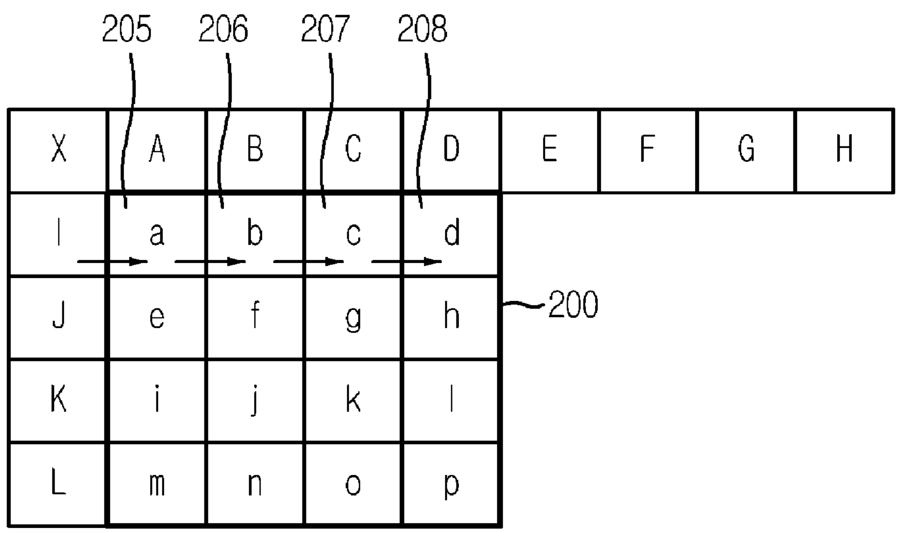
【도 1】


8(HORIZONTAL_UP)
1(HORIZONTAL)
2(DC)
6(HORIZONTAL_DOWN)
4(DIAGONAL_DOWN_RIGHT)
(DIAGONAL_DOWN_LEFT)3
(VERTICAL_LEFT)7
0(VERTICAL)
5(VERTICAL_RIGHT)

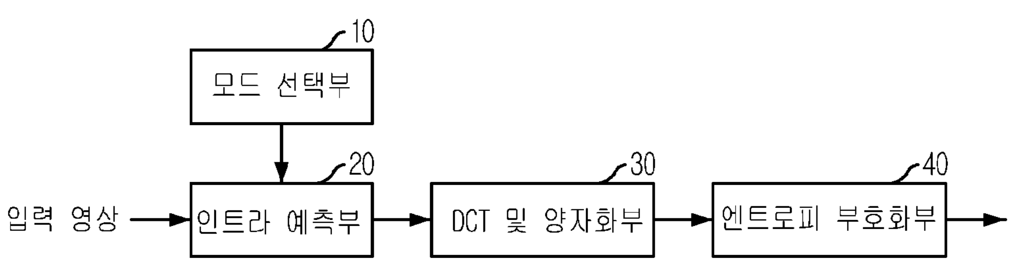
【도 2a】


X A B C D E F G H
201 I a b c d
202 J e f g h
203 K i j k l
204 L m n o p
200

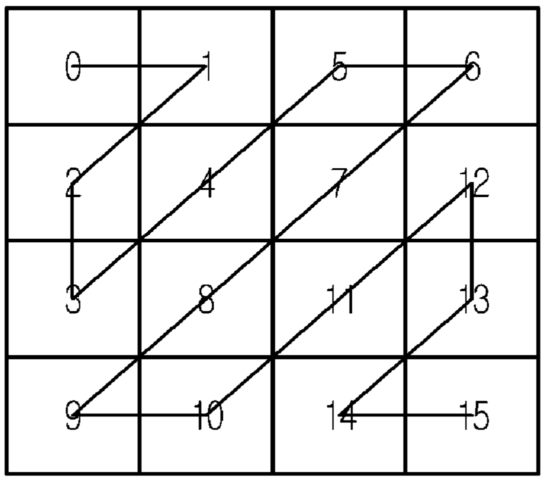
【도 2b】


205
206
207
208
X
A
B
C
D
E
F
G
H
I
a
b
c
d
J
e
f
g
h
200
K
i
j
k
l
L
m
n
o
p

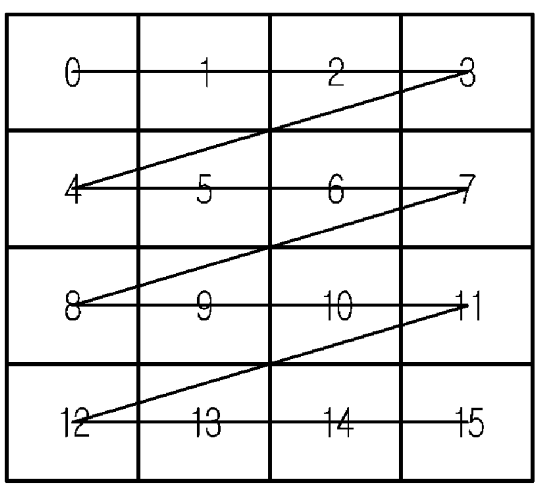
【도 3】


10
모드 선택부
20
30
40
입력 영상
인트라 예측부
DCT 및 양자화부
엔트로피 부호화부

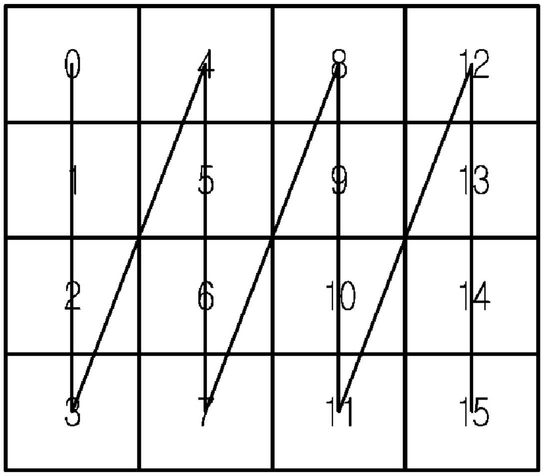
【도 4a】



【도 4b】



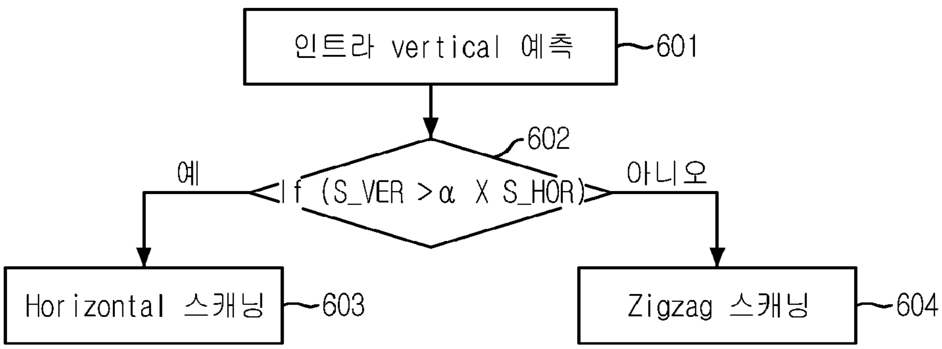
【도 4c】



【도 5】

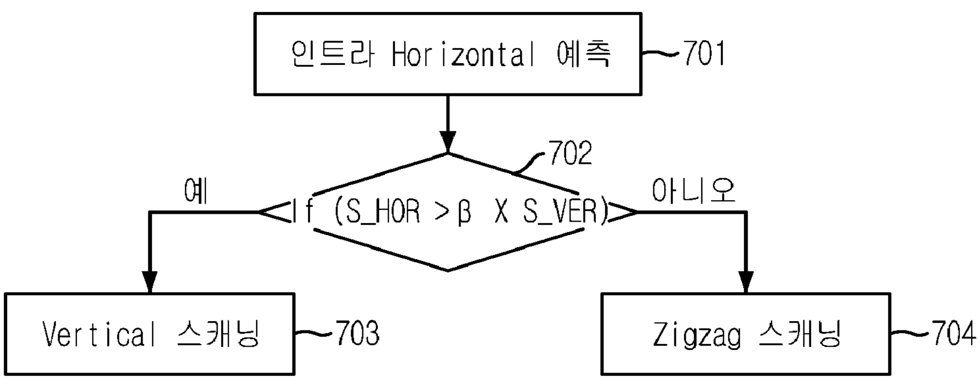
	A	B	C	D
E	a	b	c	d
F	e	f	g	h
G	i	j	k	l
H	m	n	o	p

【도 6】



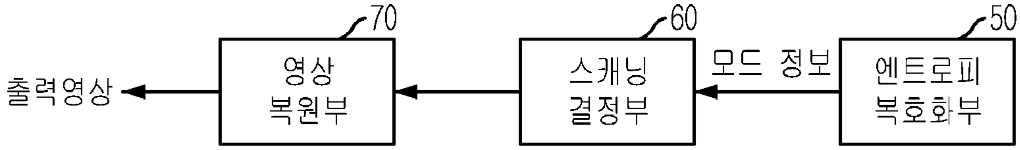
인트라 vertical 예측
601
602
예
If (S_VER > α X S_HOR)
아니오
Horizontal 스캐닝
603
Zigzag 스캐닝
604

【도 7】



인트라 Horizontal 예측
701
702
예
If (S_HOR > β X S_VER)
아니오
Vertical 스캐닝
703
Zigzag 스캐닝
704

【도 8】



70
60
50
출력영상
영상 복원부
스캐닝 결정부
모드 정보
엔트로피 복호화부