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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/823,273	08/11/2015	Se-Yoon Jeong	022096.0037C2C2	7328

89980 7590 10/11/2019
NSIP LAW
P.O. Box 65745
Washington, DC 20035

EXAMINER	
FIELDS, COURTNEY D	

ART UNIT	PAPER NUMBER
2436	

NOTIFICATION DATE	DELIVERY MODE
10/11/2019	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

PTOL-90A (Rev. 04/07)

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
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In re Patent No. 9,736,484	:	
Issue Date: August 15, 2017	:	
Application No. 14/823,273	:	NOTICE
Filed: August 11, 2015	:	
Attorney Docket No. 022096.0037C2C2	:	

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

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.

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

This patent file is no longer entitled to small entity status. Accordingly, all future fees paid in this patent file must be paid at the undiscounted rate.

Telephone inquiries concerning this decision should be directed to Jonya Smalls, Paralegal Specialist at 571-272-1619.

/JONYA SMALLS/
Jonya Smalls
Paralegal Specialist, OPET

United States Patent and Trademark Office

Office of the Chief Financial Officer

Document Code:WFEE

User :C41722

Sale Accounting Date:10/08/2019

Sale Item Reference Number	Effective Date
14823273	03/21/2019

Document Number	Fee Code	Fee Code Description	Amount Paid	Payment Method
I201908808408394	1461	1.28(C) SUBMISSIONS - APPLIC FILE FEE	$1,510.00	Deposit Account

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY.DOCKET NO./TITLE	REQUEST ID
14/823,273	08/11/2015	Electronics and Telecommunications Research Institute	022096.0037C2C2	84164

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:

☒ 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

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Patent of:

Se-Yoon Jeong et al.

Patent No. 9,736,484 | Issued: August 15, 2017

Application No. 14/823,273 | Art Unit: 2436

Confirmation No. 7328

Filed: August 11, 2015 | 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 small-entity status was established in error at the time the application was filed. Accordingly, on March 21, 2019, the law firm indicated below changed the entity status of this patent 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 $1,510 for all of the small-entity fees that were paid in the application, and any small-entity fees that have been paid in the patent.

Pursuant to 37 CFR 1.28(c)(2)(ii)(A)-(C), the table following this paragraph itemizes the total deficiency payment of $1,510 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	
Basic filing fee - Utility	1011	300	1	300	4011	70	1	70	08/11/2015	230
Utility Search Fee	1111	660	1	660	2111	300	1	300	08/11/2015	360
Utility Examination Fee	1311	760	1	760	2311	360	1	360	08/11/2015	400
Statutory disclaimer, including terminal disclaimer	1814	160	1	160	2814	160	1	160	03/29/2017	0
Utility issue fee	1501	1,000	1	1,000	2501	480	1	480	07/11/2017	520
TOTAL				**2,880**				**1,370**		**1,510**

Pursuant to 37 CFR 1.28(c)(2), please charge the total deficiency payment of $1,510 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: February 1, 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:	35490677
Application Number:	14823273
International Application Number:	
Confirmation Number:	7328
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:	022096.0037C2C2
Receipt Date:	21-MAR-2019
Filing Date:	11-AUG-2015
Time Stamp:	13:42:07
Application Type:	Utility under 35 USC 111(a)

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_0220960037C2C2_PetitionAcceptPaymentDeficiencyOwed_Patent_LostBeforeFiling.pdf	20245 4fd83bdc9f10578d444f2b321cb69fb53b5d31b7	no	2

Warnings:

Information:	
Total Files Size (in bytes):	20245

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

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.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/823,273	08/15/2017	9736484	022096.0037C2C2	7328

89980 7590 07/26/2017

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 0 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, Daejeon, KOREA, REPUBLIC OF;
Electronics and Telecommunications Research Institute, Daejeon, KOREA, REPUBLIC OF;
Hae-Chul Choi, Daejeon, KOREA, REPUBLIC OF;
Kwangwoon University Research Institute for Industry Cooperation, Seoul, KOREA, REPUBLIC OF;
Jeong-Il Seo, Daejeon, KOREA, REPUBLIC OF;
Industry-Academia Cooperation Group of Sejong University, Seoul, KOREA, REPUBLIC OF;
Seung-Kwon Beack, Seoul, KOREA, REPUBLIC OF;
In-Seon Jang, Gunpo-si, KOREA, REPUBLIC OF;
Jae-Gon Kim, Daejeon, KOREA, REPUBLIC OF;
Kyung-Ae Moon, Daejeon, KOREA, REPUBLIC OF;
Dae-Young Jang, Daejeon, KOREA, REPUBLIC OF;
Jin-Woo Hong, Daejeon, KOREA, REPUBLIC OF;
Jin-Woong Kim, Daejeon, KOREA, REPUBLIC OF;

IR103 (Rev. 10/09)

Substitute for form 1449/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	~~New Application~~ 14/823,273
(Use as many sheets as necessary)				Filing Date	Concurrently Herewith
				First Named Inventor	Se-Yoon Jeong
				Art Unit	~~Not Yet Assigned~~ 2436
				Examiner Name	~~Not Yet Assigned~~ C.Fields
Sheet	1	of	2	Attorney Docket Number	022096.0037C2C2

Substitute for PTO/SB/08a/b

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
	A	4,821,119 A	04-11-1989	Gharavi	
	B	7,817,718 B2	10-19-2010	Wang et al.	
	C	7,933,334 B2	04-26-2011	Kanehara	
	D	7,995,654 B2	08-09-2011	Boon et al.	
	E	8,107,532 B2	01-31-2012	Gaedke	
	F	8,199,819 B2	06-12-2012	Seo et al.	
	G	8,548,060 B2	10-01-2013	Jeong et al.	
	H	2003/0007698 A1	01-09-2003	Govindaswamy et al.	
	I	2003/0081850 A1	05-01-2003	Karczewicz et al.	
	J	2005/0074062 A1	04-07-2005	Sung et al.	
	K	2006/0002466 A1	01-05-2006	Park	
	L	2007/0274385 A1	11-29-2007	He	
Change(s) applied to document, /C.H.J./ 4/24/2017	M	2013/0343452 A1	12-26-2013	~~Electronics and Telecommunications Research Institute et al.~~	Jeong et al.
	N	2014/0037000 A1	02-06-2014	~~Electronics and Telecommunications Research Institute et al.~~	Jeong et al.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.F./

Examiner Signature	/Courtney Fields/	Date Considered	09/15/2016

*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).

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.
14/823,273	08/11/2015	Se-Yoon Jeong	022096.0037C2C2	7328

TITLE OF INVENTION:

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0	$0	$480	07/12/2017

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	Daejon, 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 /Charles Y. Park/ Date July 11, 2017

Typed or printed name Charles Y. Park Registration No. 50,709

Electronic Patent Application Fee Transmittal

Application Number:	14823273
Filing Date:	11-Aug-2015
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:	Charles Y. Park/Mark Gambriel
Attorney Docket Number:	022096.0037C2C2

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

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:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
UTILITY APPL ISSUE FEE	2501	1	480	480
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**480**

Electronic Acknowledgement Receipt

EFS ID:	29743171
Application Number:	14823273
International Application Number:	
Confirmation Number:	7328
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:	Charles Y. Park/Mark Gambriel
Filer Authorized By:	Charles Y. Park
Attorney Docket Number:	022096.0037C2C2
Receipt Date:	11-JUL-2017
Filing Date:	11-AUG-2015
Time Stamp:	11:02:33
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$480
RAM confirmation Number	071117INTEFSW11050100
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

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)	NOA20170412_0220960037C2C2_IFTransmittalForm.pdf	119392 56b1575f7281f59ab98d80203e24c66e4b332e87	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	32515 3757aabbab2c6c1ac1a4fe669bd67c65baba47d3	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	151907	

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.

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UNITED STATES DEPARTMENT OF COMMERCE
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Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/823,273	08/11/2015	Se-Yoon Jeong	022096.0037C2C2	7328

7590 05/15/2017

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

EXAMINER	
FIELDS, COURTNEY D	

ART UNIT	PAPER NUMBER
2436	

NOTIFICATION DATE	DELIVERY MODE
05/15/2017	ELECTRONIC

NOTICE OF NON-COMPLIANT INFORMATION DISCLOSURE STATEMENT

An Information Disclosure Statement (IDS) filed 05.08.17 in the above-identified application fails to meet the requirements of 37 CFR 1.97(d) for the reason(s) specified below. Accordingly, the IDS will be placed in the file, but the information referred to therein has not been considered.

The IDS is not compliant with 37 CFR 1.97(d) because:

- ☑ The IDS lacks a statement as specified in 37 CFR 1.97(e).
- ☐ The IDS lacks the fee set forth in 37 CFR 1.17(p).
- ☐ The IDS was filed after the issue fee was paid. Applicant may wish to consider filing a petition to withdraw the application from issue under 37 CFR 1.313(c) to have the IDS considered. See MPEP 1308.

N4B

for 571-272-4200 or 1-888-786-0101
Application Assistance Unit
Office of Data Management

FORM PTOM327-B (Rev. 02/08)

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	14/823,273
				Filing Date	August 11, 2015
				First Named Inventor	Se-Yoon Jeong
				Art Unit	2436
				Examiner Name	FIELDS, COURTNEY D
Sheet	1	of	1	Attorney Docket Number	022096.0037C2C2

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]
	a	WO 2012/161444 A2	11-2012	KWON JAE CHEOL		

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]
	1	Habli, Haitham, et al. "Optimizing off-chip memory access costs in low power MPEG-4 decoder." Proceedings of the 3rd International Conference on Information and Communication Systems. ACM, April 2012.	
	2	"Proceedings of the 2006 Korean Signal Processing Conference" Held on September 23, 2006 (Saturday) at Hanyang University Ansan Campus.	

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).

Electronic Acknowledgement Receipt

EFS ID:	29145356
Application Number:	14823273
International Application Number:	
Confirmation Number:	7328
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:	Charles Y. Park/Mark Gambriel
Filer Authorized By:	Charles Y. Park
Attorney Docket Number:	022096.0037C2C2
Receipt Date:	08-MAY-2017
Filing Date:	11-AUG-2015
Time Stamp:	16:04:54
Application Type:	Utility under 35 USC 111(a)

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	Transmittal Letter	IDS20170417_0220960037C2C2_Stmt.pdf	19687 494e52e6be5e9fdbdca8a74434ddd6613bc48c1a	no	2

Warnings:

Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	IDS20170417_0220960037C2C2_IDS.pdf	32743 dfeae35f481b407955445e69c1457615b6a10fa8	no	1
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
		Total Files Size (in bytes):	52430		

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.

<u>New Applications Under 35 U.S.C. 111</u>
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.
<u>National Stage of an International Application under 35 U.S.C. 371</u>
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.
<u>New International Application Filed with the USPTO as a Receiving Office</u>
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.

Attorney Docket No.: 022096.0037C2C2

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

INVENTORS: Se-Yoon Jeong et al. **CONFIRMATION NO.:** 7328

APPLICATION NO.: 14/823,273 **GROUP ART UNIT:** 2436

FILING DATE: August 11, 2015 **EXAMINER:** FIELDS, COURTNEY D

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

NOTICE TO THE PUBLIC REGARDING REFERENCE CONSIDERED BY THE OFFICE

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 April 12, 2017. The Issue Fee has not yet been paid.

This application is a continuation of Application No. 13/975,251, filed on August 23, 2013, now U.S. Patent No. 9,225,982 which is a continuation of Application No. 12/377,617 filed on February 16, 2009, now U.S. Patent No. 8,548,060, which is a U.S. National Stage application of International Application No. PCT/KR2007/001433 filed on March 23, 2007.

Attached hereto is a List of Information Considered in Prior Applications listing the following 3 references: (1 Foreign Patent Documents and 2 Non-Patent Literature Documents, see attached PTO SB08)

All of the 3 references were considered by the Office in parent Application No. 13/975,251, and grandparent Application No. 12/377,617 as indicated by the listings of these references in the "References Cited" section of U.S. Patent No. 9,225,982 that issued from parent Application No. 13/975,251.

MPEP 609.02(A)(2) states as follows on MPEP pages 600-190 and 600-191 (emphasis added):

> The examiner will consider information which has been considered by the Office in a parent application when examining: (A) a continuation application filed under 37 CFR 1.53(b), (B) a divisional application filed under 37 CFR 1.53(b), or (C) a continuation-in-part application filed under 37 CFR 1.53(b). A listing of the information need not be resubmitted in the continuing application unless the applicant desires the information to be printed on the patent.
>
> If resubmitting a listing of the information, applicant should submit a new listing that complies with the format requirements in 37 CFR 1.98(a)(1).

Accordingly, all of the 3 references considered by the Office in parent Application No. 13/975,251 have been considered by the Office in this application. Since the Office has allowed the pending claims it is submitted that the Office has determined that the pending claims are patentable over these references and the other art of record.

Pursuant to 37 CFR 1.97(i), it is respectfully requested that this Information Disclosure Statement be placed in the file of the present application.

Respectfully submitted,

Date: May 8, 2017

/Charles Y. Park /

Charles Y. Park
Registration. No. 50,709

CYP/mag

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

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

NOTICE OF ALLOWANCE AND FEE(S) DUE

89980 7590 04/12/2017

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

EXAMINER	
FIELDS, COURTNEY D	
ART UNIT	PAPER NUMBER
2436	

DATE MAILED: 04/12/2017

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/823,273	08/11/2015	Se-Yoon Jeong	022096.0037C2C2	7328

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	$480	$0	$0	$480	07/12/2017

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 04/12/2017
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.
14/823,273	08/11/2015	Se-Yoon Jeong	022096.0037C2C2	7328

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	$480	$0	$0	$480	07/12/2017

EXAMINER	ART UNIT	CLASS-SUBCLASS
FIELDS, COURTNEY D	2436	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 credits 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
- ❑ Applicant asserting small entity status. See 37 CFR 1.27
- ❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

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.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature ______________________________ Date ______________________________

Typed or printed name ______________________________ Registration No. ______________________________

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/823,273	08/11/2015	Se-Yoon Jeong	022096.0037C2C2	7328

89980 7590 04/12/2017

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

EXAMINER	
FIELDS, COURTNEY D	
ART UNIT	**PAPER NUMBER**
2436	

DATE MAILED: 04/12/2017

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

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

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.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B 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.

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.

Examiner-Initiated Interview Summary	**Application No.** 14/823,273	**Applicant(s)** JEONG ET AL.	
	Examiner COURTNEY FIELDS	**Art Unit** 2436	

All participants (applicant, applicant's representative, PTO personnel):

(1) COURTNEY FIELDS. (3)_____.

(2) ATTORNEY JOSEPH D. PARISH. (4)_____.

Date of Interview: 27 March 2017.

Type: ☒ Telephonic ☐ Video Conference
☐ Personal [copy given to: ☐ applicant ☐ applicant's representative]

Exhibit shown or demonstration conducted: ☐ Yes ☒ No.
If Yes, brief description: _____.

Issues Discussed ☐101 ☐112 ☐102 ☐103 ☒Others
(For each of the checked box(es) above, please describe below the issue and detailed description of the discussion)

Claim(s) discussed: 1, 5, and 6.

Identification of prior art discussed: n/a.

Substance of Interview
(For each issue discussed, provide a detailed description and indicate if agreement was reached. Some topics may include: identification or clarification of a reference or a portion thereof, claim interpretation, proposed amendments, arguments of any applied references etc...)

Examiner Fields contacted the Applicant's representative and presented proposed amendents by adding the word "hardware" to overcome the 112 f, and amend claim 5 by incorporating the last limitation recited in claim 1 and suggested that an eTD be filed in order to place the application in condition for an allowance. The proposed amendments and eTD was submitted and approved on March 29, 2017.

Applicant recordation instructions: It is not necessary for applicant to provide a separate record of the substance of interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

☒ Attachment

/COURTNEY FIELDS/
Examiner, Art Unit 2436

Notice of Allowability	Application No. 14/823,273	Applicant(s) JEONG ET AL.	
	Examiner COURTNEY FIELDS	Art Unit 2436	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 *27 December 2016*.
   ☐ 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 and 5*. 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: _____.

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 *3/27/2017* .
5. ☒ Examiner's Amendment/Comment
6. ☒ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

DETAILED ACTION

1. The present application is being examined under the pre-AIA first to invent provisions.

2. This communication is in response to Applicant's amendment filed on 27 December 2016. Claims 4 and 6 have been canceled. Claims 1-3 and 5 have been amended. Claims 1-3 and 5 remain pending.

EXAMINER'S AMENDMENT

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in an interview with Attorney Joseph D. Parish, Reg. No. 69,949 on 27 March 2017.

The application has been amended as follows:

Please amend the following claims:

Claim 1 (**Currently Amended**) A decoding apparatus comprising:

an entropy decoding hardware processor configured to perform entropy decoding of an encoded video information in a bitstream to obtain transform coefficients;

a scanning decision hardware processor configured to select a scanning mode for the transform coefficients of a current block; and a video recovery <u>hardware</u> processor configured to scan the transform coefficients based on the selected scanning mode;

wherein the scanning decision <u>hardware</u> processor is further configured to select the scanning mode based on an intra prediction mode of the current block, and

the scanning decision <u>hardware</u> processor is further configured to select a horizontal scanning mode as the scanning mode when the intra prediction mode is a vertical intra prediction mode, and select a vertical scanning mode as the scanning mode when the intra prediction mode is a horizontal intra prediction mode.

Claim 2 (**Currently Amended**) The decoding apparatus of claim 1, wherein the scanning decision <u>hardware</u> processor is further configured to select the scanning mode based on the intra prediction mode that was used to perform intra prediction of the current block to obtain difference values that were encoded to obtain the encoded video.

Claim 5 (**Currently Amended**) A non-transitory computer-readable storage medium storing instructions that, when executed by a processor, cause the processor to perform a method of decoding, the method comprising:

performing entropy decoding of encoded video information in a bitstream to obtain transform coefficients for a current block;

selecting a scanning mode for the transform coefficients; and

scanning the transform coefficients based on the selected scanning mode;

wherein the selecting of a scanning mode comprises: ~~selecting the scanning mode based on an intra prediction mode of the current block~~

selecting a horizontal scanning mode in response to the intra prediction mode being a vertical intra prediction mode; and

selecting a vertical scanning mode in response to the intra prediction mode being a horizontal intra prediction mode.

Claim 6 (**Canceled**)

Terminal Disclaimer

2. The terminal disclaimer filed on 29 March 2017 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of prior patent numbers 8,548,060 and 9,225,982 has been reviewed and is accepted. The terminal disclaimer has been recorded.

Allowable Subject Matter

3. Claims **1-3 and 5** are allowed.

4. The following is an examiner's statement of reasons for allowance: The present invention is directed towards an apparatus for encoding decoding image using adaptive

DCT coefficient scanning based on pixel similarity and method therefor. Claims 1 and 5 identifies the uniquely distinct features “**wherein the scanning decision hardware processor is further configured to select the scanning mode based on an intra prediction mode of the current block, and the scanning decision hardware processor is further configured to select a horizontal scanning mode as the scanning mode when the intra prediction mode is a vertical intra prediction mode, and select a vertical scanning mode as the scanning mode when the intra prediction mode is a horizontal intra prediction mode**”.

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 wherein the scanning decision hardware processor is further configured to select the scanning mode based on an intra prediction mode of the current block, and the scanning decision hardware processor is further configured to select a horizontal scanning mode as the scanning mode when the intra prediction mode is a vertical intra prediction mode, and select a vertical scanning mode as the scanning mode when the intra prediction mode is a horizontal intra prediction mode.

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 wherein the scanning decision hardware processor is further configured to select the scanning mode based on an intra prediction mode of the current block, and the scanning decision hardware processor is further configured to select a horizontal scanning mode as the scanning mode when the intra prediction mode is a vertical intra prediction mode, and select a vertical scanning mode as the scanning mode when the intra prediction mode is a horizontal intra prediction mode.

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 wherein the scanning decision hardware processor is further configured to select the scanning mode based on an intra prediction mode of the current block, and the scanning decision hardware processor is further configured to select a horizontal scanning mode as the scanning mode when the intra prediction mode is a vertical intra prediction mode, and select a vertical scanning mode as the scanning mode when the intra prediction mode is a horizontal intra prediction mode.

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 wherein the scanning decision hardware processor is further configured to select the scanning mode based on an intra prediction mode of the current block, and the scanning decision hardware processor is further configured to select a horizontal scanning mode as the scanning mode when the intra prediction mode is a vertical intra prediction mode, and select a vertical scanning mode as the scanning mode when the intra prediction mode is a horizontal intra prediction mode.

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 wherein the scanning decision hardware processor is further configured to select the scanning mode based on an intra prediction mode of the current block, and the scanning decision hardware processor is further configured to select a horizontal scanning mode as the scanning mode when the intra prediction mode is a vertical intra prediction mode, and select a vertical scanning mode as the scanning mode when the intra prediction mode is a horizontal intra prediction mode.

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 wherein the scanning decision hardware processor is further configured to select the scanning mode based on an intra prediction mode of the current block, and the scanning decision hardware processor is further configured to select a horizontal scanning mode as the scanning mode when the intra prediction mode is a vertical intra prediction mode, and select a vertical scanning mode as the scanning mode when the intra prediction mode is a horizontal intra prediction mode.

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 wherein the scanning decision hardware processor is further configured to select the scanning mode based on an intra prediction mode of the current block, and the scanning decision hardware processor is further configured to select a horizontal scanning mode as the scanning mode when the intra prediction mode is a vertical intra prediction mode, and select a vertical scanning mode as the scanning mode when the intra prediction mode is a horizontal intra prediction mode.

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 wherein the scanning decision hardware processor is further configured to select the scanning mode based on an intra prediction mode of the current block, and the scanning decision hardware processor is further configured to select a horizontal scanning mode as the scanning mode when the intra prediction mode is a vertical intra prediction mode, and select a vertical scanning mode as the scanning mode when the intra prediction mode is a horizontal intra prediction mode.

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 wherein the scanning decision hardware processor is further configured to select the scanning mode based on an intra prediction mode of the current block, and the scanning decision hardware processor is further configured to select a horizontal scanning mode as the scanning mode when the intra prediction mode is a vertical intra prediction mode, and select a vertical scanning mode as the scanning mode when the intra prediction mode is a horizontal intra prediction mode.

5. Therefore, **claims 1 and 5** and the respective **dependent claims 2-3** 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. 8:00 - 4:30 pm; IFP.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shewaye Gelagay can be reached on (571) 272-4219. 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 FIELDS/
Examiner, Art Unit 2436
March 31, 2017

/SHEWAYE GELAGAY/
Supervisory Patent Examiner, Art Unit 2436

Examiner-Initiated Interview Summary	**Application No.** 14/823,273	**Applicant(s)** JEONG ET AL.	
	Examiner COURTNEY FIELDS	**Art Unit** 2436	

All participants (applicant, applicant's representative, PTO personnel):

(1) *COURTNEY FIELDS*. (3)_____.

(2) *ATTORNEY JOSEPH D. PARISH*. (4)_____.

Date of Interview: *27 March 2017*.

Type: ☒ Telephonic ☐ Video Conference
☐ Personal [copy given to: ☐ applicant ☐ applicant's representative]

Exhibit shown or demonstration conducted: ☐ Yes ☒ No.
If Yes, brief description: _____.

Issues Discussed ☐101 ☐112 ☐102 ☐103 ☒Others
(For each of the checked box(es) above, please describe below the issue and detailed description of the discussion)

Claim(s) discussed: *1, 5, and 6*.

Identification of prior art discussed: *n/a*.

Substance of Interview
(For each issue discussed, provide a detailed description and indicate if agreement was reached. Some topics may include: identification or clarification of a reference or a portion thereof, claim interpretation, proposed amendments, arguments of any applied references etc...)

Examiner Fields contacted the Applicant's representative and presented proposed amendents by adding the word "hardware" to overcome the 112 f, and amend claim 5 by incorporating the last limitation recited in claim 1 and suggested that an eTD be filed in order to place the application in condition for an allowance. The proposed amendments and eTD was submitted and approved on March 29, 2017.

Applicant recordation instructions: It is not necessary for applicant to provide a separate record of the substance of interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

☒ Attachment

/COURTNEY FIELDS/
Examiner, Art Unit 2436

Notice of References Cited	Application/Control No. 14/823,273	Applicant(s)/Patent Under Reexamination JEONG ET AL.	
	Examiner COURTNEY FIELDS	Art Unit 2436	Page 1 of 1

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*	B	US-7,933,334 B2	04-2011	Kanehara; Fumikazu	H04N19/197	375/240.12
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	I	US-				
	J	US-				
	K	US-				
	L	US-				
	M	US-				

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	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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	V	
	W	
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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
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(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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(54) **Title**: METHOD AND APPARATUS FOR INTRA TRANSFORM SKIP MODE

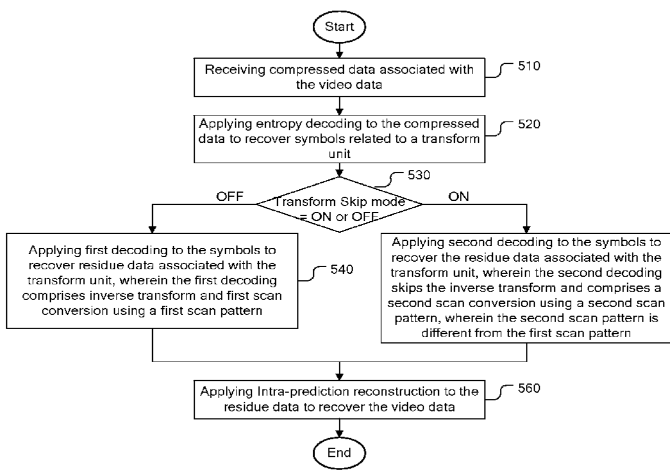

Fig. 5

(57) **Abstract**: A method and apparatus for video coding including an Intra transform Skip mode is disclosed. When the transform Skip mode is ON for a transform unit, embodiments according to the present invention apply different coding processes to the transform unit. The coding process with the transform Skip mode ON uses a different scan pattern from the coding process with the transform Skip mode OFF. According to various embodiments, the transform Skip mode is enabled when the transform unit size is 4x4, the prediction unit and the transform unit having the same size, or the prediction unit uses an INTRA_NxN mode. When the transform Skip mode is enabled, a flag can be signaled in the bitstream to indicate the transform Skip mode selection. Furthermore, the flag can be incorporated in a picture level, a slice level or a sequence level of the video bitstream.

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METHOD AND APPARATUS FOR INTRA TRANSFORM SKIP MODE

CROSS REFERENCE TO RELATED APPLICATIONS

The present invention claims priority to PCT Patent Application, Serial No. PCT/CN2012/076581, filed June 7, 2012, entitled "Improved Intra Transform Skip". The PCT Patent Applications is hereby incorporated by reference in its entirety.

FIELD OF INVENTION

The present invention relates to video coding system. In particular, the present invention relates to method and apparatus for video coding system incorporating a transform Skip mode for Intra-predicted transform unit.

BACKGROUND OF THE INVENTION

Motion estimation is an effective inter-frame coding technique to exploit temporal redundancy in video sequences. Motion-compensated inter-frame coding has been widely used in various international video coding standards The motion estimation adopted in various coding standards is often a block-based technique, where motion information such as coding mode and motion vector is determined for each macroblock or similar block configuration. In addition, intra-coding is also adaptively applied, where the picture is processed without reference to any other picture. The inter-predicted or intra-predicted residues are usually further processed by transformation, quantization, and entropy coding to generate compressed video bitstream. During the encoding process, coding artifacts are introduced, particularly in the quantization process. In order to alleviate the coding artifacts, additional processing has been applied to reconstructed video to enhance picture quality in newer coding systems. The additional processing is often configured in an in-loop operation so that the encoder and decoder may derive the same reference pictures to achieve improved system performance.

Fig. 1A illustrates an exemplary system block diagram for an video encoder using adaptive Inter/Intra prediction. For Inter-prediction, Motion Estimation (ME)/Motion Compensation (MC) 112 is used to provide prediction data based on video data from other picture or pictures. Switch 114 selects Intra Prediction 110 or Inter-prediction data and the selected prediction data is supplied to Adder 116 to form prediction errors, also called residues. The prediction error is then processed by Transformation (T) 118 followed by Quantization (Q) 120. The transformed and quantized residues are then coded by Entropy Encoder 122 to form a video bitstream corresponding to the compressed video data. The bitstream associated with the transform coefficients is then packed with side information such as motion, mode, and other information associated with the image area. The side information may also be subject to entropy coding to reduce required bandwidth. Accordingly, the data associated with the side information are provided to Entropy Encoder 122 as shown in Fig. 1A. When an Inter-prediction mode is used, a reference picture or pictures have to be reconstructed at the encoder end as well. Consequently, the transformed and quantized residues are processed by Inverse Quantization (IQ) 124 and Inverse Transformation (IT) 126 to recover the residues. The residues are then added back to prediction data 136 at Reconstruction (REC) 128 to reconstruct video data. The reconstructed video data may be stored in Reference Picture Buffer 134 and used for prediction of other frames.

As shown in Fig. 1A, incoming video data undergoes a series of processing in the encoding system. The reconstructed video data from REC 128 may be subject to various impairments due to a series of processing. Accordingly, various in-loop processing is applied to the reconstructed video data before the reconstructed video data are stored in the Reference Picture Buffer 134 in order to improve video quality. In the High Efficiency Video Coding (HEVC) standard being developed, Deblocking Filter (DF) 130 has been developed to enhance picture quality. The in-loop filter information may have to be incorporated in the bitstream so that a decoder can properly recover the required information.

A corresponding decoder for the encoder of Fig. 1A is shown in Fig. 1B. The video bitstream is decoded by Video Decoder 142 to recover the transformed and quantized residues and other system information. At the decoder side, only Motion Compensation (MC) 113 is performed instead of ME/MC. The decoding process is similar to the reconstruction loop at the encoder side. The recovered transformed and quantized residues and other system information are used to reconstruct the video data. The reconstructed video is further processed by DF 130 to produce the final enhanced decoded video.

In the High Efficiency Video Coding (HEVC) standard, three block concepts are introduced, i.e., coding unit (CU), prediction unit (PU), and transform unit (TU). The overall coding structure is characterized by the various sizes of CU, PU and TU. Each picture is divided into largest CUs (LCUs) or Coding Tree Blocks (CTBs). Each LCU is then recursively divided into smaller CUs until leaf CUs or smallest CUs are reached. After the CU hierarchical tree is done, Inter or Intra prediction is applied to prediction units (PUs) according to partition type. Each PU may be partitioned into one or more smaller blocks (i.e., PUs), such as 2Nx2N, 2NxN, Nx2N and NxN. Asymmetric partition for prediction units is also allowed. Residues are formed for each PU after applying Inter or Intra prediction. Furthermore, residues are partitioned into transform units (TUs) and two-dimensional transform is applied to the residue data to convert the spatial data into transform coefficients for compact data representation.

The adaptive Inter/Intra prediction shown in Figs. 1A-B has been widely used in various coding standards. As mentioned above, the residues from the adaptive Inter/Intra prediction are further processed by a two-dimensional transform to exploit the remaining redundancy within the residues. Nevertheless, for some residue data, the two-dimensional transform may not help to improve compression efficiency. An Intra transform skipping scheme is disclosed by Lan et al. for a 4x4 transform unit ("Intra transform skipping", Joint Collaborative Team on Video Coding (JCT-VC) of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11, 9th Meeting: Geneva, CH, 27 April – 7 May 2012, Document: JCTVC-I0408). The transform Skip mode for a 4x4 Intra TU by Lan et al. uses the same Intra prediction to form Intra prediction residues. When the transform Skip mode is selected for an underlying block (i.e., 4x4 TU), two-dimensional transform is skipped (i.e., bypassed) for the underlying block on the encoder side. Accordingly, the inverse transform is skipped for the underlying block. Furthermore, the same dequantization process is used as if the block was inverse transformed. In order to use the same dequantization process, the inverse transform-skipped block is scaled down by a factor of 32 for the 4x4 TU. A flag for each 4x4 intra TU is sent to indicate if transform is bypassed or not. Two contexts are added to code the flag for Y, U and V TUs. Another flag in the SPS (Sequence Parameter Set) is used to indicate whether transform skipping is enabled or not.

While the transform Skip mode by Lan et al. demonstrates some performance improvement over a conventional coding system that doesn't support transform skipping, it is desirable to further improve the performance by taking into account the characteristics of the Intra prediction residues.

SUMMARY OF THE INVENTION

A method and apparatus for video coding including an Intra transform Skip mode is disclosed. When the transform Skip mode is ON for a transform unit, embodiments according to the present invention applies different coding process to the transform unit from the coding process for a transform unit with the transform Skip mode OFF. The coding process with the transform Skip mode ON uses a different scan pattern than the coding process with the transform Skip mode OFF. In one embodiment, the transform Skip mode is enabled for the transform unit (TU) size of 4x4. In another embodiment, the transform Skip mode is enabled for the prediction unit (PU) and the transform unit (TU) having the same size. In yet another embodiment, the transform Skip mode is enabled for the prediction unit (PU) using an INTRA_NxN mode. When the transform Skip mode is enabled, a flag can be signaled in the bitstream to indicate whether the transform Skip mode is ON or OFF. Furthermore, the flag can be incorporated in a picture level, a slice level or a sequence level of the video bitstream.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1A illustrates an exemplary adaptive inter/intra video encoder system.

Fig. 1B illustrates an exemplary adaptive inter/intra video decoder system.

Fig. 2 illustrates scan patterns for a 4x4 transform unit according to the High Efficiency Video Coding (HEVC) standard.

Fig. 3 illustrates scan patterns for a 4x4 transform unit when the transform Skip mode is ON according to an embodiment of the present invention.

Fig. 4 illustrates a flowchart for an exemplary video encoding system incorporating a transform Skip mode according to an embodiment of the present invention.

Fig. 5 illustrates a flowchart for an exemplary video decoding system incorporating a transform Skip mode according to an embodiment of the present invention.

DETAILED DESCRIPTION

In a video coding system, two dimensional transform is often applied to residues from Inter/Intra prediction to exploit the redundancy within the residue data. The two-dimensional transform coefficients are converted to one-dimensional data using a selected scan pattern. The one-dimensional transform data is processed by quantization to generate symbols to be compressed by entropy coding. The scan pattern is designed to conveniently convert the two-dimensional data into one-dimensional data and also to achieve good compression performance for the subsequent entropy coding. In the HEVC (High Efficiency Video Coding) system, three scan patterns are used for 4x4 and 8x8 TUs as shown in Fig. 2, where scan pattern 210 corresponds to diagonal scan in the direction from upper right to lower left, scan pattern 220 corresponds to horizontal scan from right to left, and scan pattern 230 corresponds to vertical scan from bottom to top. The scan patterns start from locations indicated by open circles (212, 222, and 232) and end at locations indicated by solid circles (214, 224 and 234). In the transform domain, the energy usually concentrates in the lower frequency region. The scan patterns (i.e., 210, 220 and 230) in Fig. 2 scan from a lower energy region to a higher energy region. The subsequent entropy coding is designed according to the statistics of the scanned-quantized coefficients.

Embodiments according to the present invention use different scan patterns from the conventional scan patterns for a block with the transform Skip mode ON. It is observed that the characteristics of the residue data are different from the transform coefficients. If the same scan patterns for transform coefficients are applied to the residue data, the resulting scanned-quantized data may have high entropy. Furthermore, the resulting scanned-quantized data may not fit into the statistical model that the entropy coding is designed for. For example, when the intra prediction mode uses the diagonal scan, the diagonal scan pattern (210) will be applied to the prediction residual when the transform Skip mode is OFF according to the conventional approach. When the underlying block is two-dimensional transformed, the energy will be concentrated at the upper left corner (i.e., the corner corresponding to lower spatial frequencies). The diagonal scan pattern (210) will likely cause longer zero-runs and result in lower entropy. Nevertheless, for the Intra prediction residues, the residue data usually is larger at the lower right corner and decreases along the direction from lower right to upper left. The larger Intra prediction residues at the lower right corner is mostly due to the longer prediction distance since Intra prediction is based on neighbor pixels adjacent to the top block boundary and the left block boundary. The low-to-high energy distribution for the Intra prediction residues is from upper left corner to the lower right corner. On the other hand, the low-to-high energy distribution for the transform coefficients is from the lower right corner to the upper left corner of the transform unit. In other words, the energy distributions between the transform coefficients and the Intra prediction residues are reversed. Accordingly, an embodiment according to the present invention uses a reverse diagonal scan pattern for the transform unit when the transform Skip mode is ON for an underlying transform unit. The normal diagonal scan pattern (i.e., scan pattern 210) would have been applied to the transform unit if the transform Skip mode were OFF for the transform unit. A reverse diagonal scan pattern (310) corresponding to the diagonal scan pattern (210) is shown in Fig. 3.

When transform Skip mode is ON and the Intra prediction mode uses horizontal scan, the prediction residues usually are larger at the bottom region and decrease toward the top of the transform unit since the prediction distance is larger for the bottom region. Therefore, the energy distribution for the Intra prediction residues with the transform Skip mode ON is reversed compared to the two-dimensional transform coefficients when the transform Skip mode is OFF. Therefore, in another embodiment of the present invention, inversed horizontal scan 320 is used as shown in Fig. 3 when transform Skip mode is ON for an underlying transform unit. The underlying transform unit would have used normal horizontal scan pattern

220 if the transform Skip mode were OFF for the transform unit.

When transform Skip mode is ON and the Intra prediction mode uses vertical scan, the prediction residues usually are larger at the right region and decrease toward the left boundary of the block since the prediction distance is larger for the right region. Therefore, the energy distribution for the transform unit with the transform Skip mode ON is reversed compared to the two-dimensional transform coefficients with the transform Skip mode OFF. In another embodiment of the present invention, reversed vertical scan 330 is used as shown in Fig. 3 when the transform Skip mode is ON. The underlying transform unit would have used normal vertical scan pattern 230 if the transform Skip mode were OFF for the transform unit.

As shown above, embodiments according the present invention use reversed diagonal, horizontal and vertical scans when the transform Skip mode is ON. One way to implement the reversed scan patterns is to add the reversed scan patterns as additional scan patterns to the conventional scan patterns. Accordingly, there will be six scan patterns for a system with transform Skip mode enabled. An alternative way to implement the reversed scan order is to store the Intra prediction residues associated with the transform unit in a reversed order. Usually in a system using block-based processing, a block from a current processing stage is buffered for the next stage processing. The processing stage may correspond to transform, scan conversion or quantization on the encoding side, or inverse transform, inverse scan conversion or dequantization on the decoding side. Therefore, the Intra prediction residues can be stored in a reversed scan order if the transform Skip mode is ON for the block. Accordingly, regular scan pattern can be applied to the block stored in the reversed order as if it were a transformed block.

An exemplary pseudo codes to implement a reverse diagonal scan is shown as follows:

Original diagonal scan: $r_{ij} = (d_{ij} + (1 << (\text{shift} - 1))) >> \text{shift}$ (1)

Reverse diagonal scan: $r_{ij} = (d_{(nW-1-i)(nH-1-j)} + (1 << (\text{shift} - 1))) >> \text{shift}$ (2)

In equations (1) and (2), scaling the residue is achieved using shifting by a specified factor, where d_{ij} is the residue before scaling and r_{ij} is the scaled residue. If a scaling factor of 32 is desired, the scaling can be implemented by right shifting by 5 bits, i.e., shift = 5. For the reverse scan, the indices of the residue before scaling is mapped to the indices of the residue to be stored according to (nW-1-i)(nH-1-j) => ij, where nW is the block width and nH is the block height.

In another embodiment, the transform Skip mode is constrained in order to reduce complexity as well as to save some bits. For example, the transform Skip mode is enabled only when the PU and TU are the same. In this case, the PU and TU are associated with the same video data. This is also equivalent to the PU and TU having the same size. Other conditions for enabling transform Skip mode include the case that the TU size is 4x4 and the case that the partition mode is Intra_NxN. A flag to signal the transform Skip mode is transmitted only when the transform Skip mode is enabled. The flag can be incorporated in the sequence level (e.g., Sequence Parameter Set, SPS), the picture level (e.g., Picture Parameter Set, PPS) or the slice level of the bitstream.

Fig. 4 illustrates an exemplary flowchart of an encoding system incorporating a transform Skip mode according to an embodiment of the present invention. The system receives video data to be encoded as shown in step 410. The video data may be received from storage such as a computer memory, buffer (RAM or DRAM) or other media. The encoding system illustrated in Fig. 4 may be implemented in hardware, software, or both hardware and software. In a software based implementation, the video data may be stored in a data space allocated by a program or a subroutine for the video encoder. The video data may also be received from a processor such as a controller, a central processing unit, a digital signal processor or electronic circuits that produce the video data. The processor may perform some processing to prepare the input video data for the encoding system. For example, the original video data may be in a raw RGB format and is converted to a luminance/chrominance format for subsequent encoding process. The processor may also perform noise reduction to improve coding efficiency. Other type of processing may also be performed to prepare the video data for subsequent coding. Intra prediction is then applied to the video data to form residue data as shown in step 420. A decision is performed in step 430 regarding whether the transform Skip mode is ON or OFF for a transform unit. If the transform Skip mode is OFF, a first encoding process is applied to the residue data associated with the transform unit to generate symbols associated with the transform unit as shown in step 440, wherein the first encoding process comprises transform and first scan conversion using a first scan pattern. If the transform Skip mode is ON, a second encoding process is applied to the residue data to generate the symbols associated with the transform unit as shown in step 450, wherein the second encoding process skips the transform and comprises a second scan conversion using a second scan pattern, and wherein the second scan pattern is different from the first scan pattern. Entropy coding is then applied to the symbols to generate compressed data as shown in step 460.

Fig. 5 illustrates an exemplary flowchart of a decoding system incorporating a transform Skip mode according to an embodiment of the present invention. The system receives compressed data associated with the video data as shown in step 510. The compressed data may be received from storage such as a computer memory, buffer (RAM or DRAM) or other media. The decoding system illustrated in Fig. 5 may be implemented in hardware, software, or both hardware and software. In a software based implementation, the compressed data may be stored in a data space allocated by a program or a subroutine associated with the video decoder. The compressed data may also be received from a processor such as a controller, a central processing unit, a digital signal processor or electronic circuits that produce the first data. The processor may perform some processing to prepare the compressed data for the decoding system. For example, the compressed data may be extracted from a multiplexed media stream corresponding to multiple audio/video channels. The processor may receive the compressed data from a transmission channel or through internet. The processor may also perform error correction on the compressed data if the compressed data is susceptible to transmission errors. Other type of processing may also be performed to prepare the compressed data for subsequent decoding. Entropy decoding is applied to the compressed data to recover symbols related to a transform unit as shown in step 520. A decision is performed in step 530 regarding whether the transform Skip mode is ON or OFF for a transform unit. If the transform Skip mode is OFF, a first decoding process is applied to the symbols to recover residue data associated with the transform unit as shown in step 540, wherein the first decoding process comprises inverse transform and first scan conversion using a first scan pattern. If the transform Skip mode is ON, a second decoding process is applied to the symbols to recover the residue data associated with the transform unit, wherein the second decoding process skips the inverse transform and comprises a second scan conversion using a second scan pattern as shown in step 550, wherein the second scan pattern is different from the first scan pattern. Intra-prediction reconstruction is then applied to the residue data to recover the video data as shown in step 560.

The flowcharts shown above are intended to illustrate exemplary encoder and decoder incorporating a transform Skip mode incorporating an embodiment of the present invention. A person skilled in the art may modify each step, re-arranges the steps, split a step, or combine steps to practice the present invention without departing from the spirit of the present invention.

The above description is presented to enable a person of ordinary skill in the art to practice the present invention as provided in the context of a particular application and its requirement. Various modifications to the described embodiments will be apparent to those with skill in the art, and the general principles defined herein may be applied to other embodiments. Therefore, the present invention is not intended to be limited to the particular embodiments shown and described, but is to be accorded the widest scope consistent with the principles and novel features herein disclosed. In the above detailed description, various specific details are illustrated in order to provide a thorough understanding of the present invention. Nevertheless, it will be understood by those skilled in the art that the present invention may be practiced.

Embodiment of the present invention as described above may be implemented in various hardware, software codes, or a combination of both. For example, an embodiment of the present invention can be a circuit integrated into a video compression chip or program code integrated into video compression software to perform the processing described herein. An embodiment of the present invention may also be program code to be executed on a Digital Signal Processor (DSP) to perform the processing described herein. The invention may also involve a number of functions to be performed by a computer processor, a digital signal processor, a microprocessor, or field programmable gate array (FPGA). These processors can be configured to perform particular tasks according to the invention, by executing machine-readable software code or firmware code that defines the particular methods embodied by the invention. The software code or firmware code may be developed in different programming languages and different formats or styles. The software code may also be compiled for different target platforms. However, different code formats, styles and languages of software codes and other means of configuring code to perform the tasks in accordance with the invention will not depart from the spirit and scope of the invention.

The invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described examples are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

CLAIMS

1. A method for decoding video data, the method comprising:

receiving compressed data associated with the video data;

applying entropy decoding to the compressed data to recover symbols related to a transform unit (TU);

if transform Skip mode is OFF for the transform unit,

applying a first decoding process to the symbols to recover residue data associated with the transform unit, wherein the first decoding process comprises inverse transform and first scan conversion using a first scan pattern;

if the transform Skip mode is ON for the transform unit,

applying a second decoding process to the symbols to recover the residue data associated with the transform unit, wherein the second decoding process skips the inverse transform and comprises a second scan conversion using a second scan pattern, and wherein the second scan pattern is different from the first scan pattern; and

applying Intra-prediction reconstruction to the residue data to recover the video data.

2. The method of Claim 1, wherein said applying the second decoding process comprises storing the residue data according to the second scan pattern before said applying Intra-prediction reconstruction to the residue data.

3. The method of Claim 1, wherein the second scan pattern corresponds to a reverse scan of the first scan pattern.

4. The method of Claim 1, wherein the transform unit corresponds to a 4x4 TU.

5. The method of Claim 1, wherein said applying Intra-prediction reconstruction applies the Intra-prediction reconstruction to the residue data associated with a prediction unit (PU) to recover the video data associated with the prediction unit, and wherein the transform Skip mode is enabled if the prediction unit and the transform unit having a same size.

6. The method of Claim 1, wherein said applying Intra-prediction reconstruction applies the Intra-prediction reconstruction to the residue data associated with a prediction unit (PU) to

recover the video data associated with the prediction unit, and wherein the transform Skip mode is enabled if the prediction unit uses an INTRA_NxN partition mode.

7. The method of Claim 1, wherein a flag signaling the transform Skip mode is incorporated in a bitstream associated with the video data if the transform Skip mode is enabled.

8. The method of Claim 7, wherein the flag is incorporated in a picture level, a slice level or a sequence level of the bitstream.

9. A method for encoding video data, the method comprising:

receiving video data;

applying Intra prediction to the video data to form residue data;

if transform Skip mode is OFF for a transform unit (TU),

applying a first encoding process to the residue data associated with the transform unit to generate symbols associated with the transform unit, wherein the first encoding process comprises transform and first scan conversion using a first scan pattern;

if the transform Skip mode is ON for the transform unit,

applying a second encoding process to the residue data to generate the symbols associated with the transform unit, wherein the second encoding process skips the transform and comprises a second scan conversion using a second scan pattern, and wherein the second scan pattern is different from the first scan pattern; and

applying entropy coding to the symbols to generate compressed data.

10. The method of Claim 9, wherein the transform unit corresponds to a 4x4 TU.

11. The method of Claim 9, wherein said applying the second encoding process comprises storing the residue data using the second scan pattern before said applying Intra-prediction reconstruction to the residue data.

12. The method of Claim 9, wherein said applying Intra prediction applies the Intra prediction to the video data associated with a prediction unit (PU), and wherein the transform Skip mode is enabled if the prediction unit and the transform unit are having a same size.

13. The method of Claim 9, wherein said applying Intra prediction applies the Intra prediction to the video data associated with a prediction unit (PU), and wherein the transform Skip mode is enabled if the prediction unit uses an INTRA_NxN partition mode.

14. The method of Claim 9, wherein the second scan pattern corresponds to a reverse scan of the first scan pattern.

15. The method of Claim 9, wherein a flag signaling the transform Skip mode is incorporated in a bitstream associated with the video data if the transform Skip mode is enabled.

16. The method of Claim 15, wherein the flag is incorporated in a picture level, a slice level or a sequence level of the bitstream.

17. An apparatus for decoding video data, the apparatus comprising:

circuit, wherein the circuit is configured to

receive compressed data associated with the video data;

apply entropy decoding to the compressed data to recover symbols related to a transform unit (TU);

if transform Skip mode is OFF for the transform unit,

apply a first decoding process to the symbols to recover residue data associated with the transform unit, wherein the first decoding process comprises inverse transform and first scan conversion using a first scan pattern;

if the transform Skip mode is ON for the transform unit,

apply a second decoding process to the symbols to recover the residue data associated with the transform unit, wherein the second decoding process skips the inverse transform and comprises a second scan conversion using a second scan pattern, wherein the second scan pattern is different from the first scan pattern; and

apply Intra-prediction reconstruction to the residue data to recover the video data.

18. An apparatus for encoding video data, the apparatus comprising:

circuit, wherein the circuit is configured to

receive video data;

apply Intra prediction to the video data to form residue data;

if transform Skip mode is OFF for a transform unit, apply a first encoding process to the residue data associated with the transform unit to generate symbols associated with the transform unit, wherein the first encoding process comprises transform and first scan conversion using a first scan pattern;

if the transform Skip mode is ON for the transform unit,

apply a second encoding process to the residue data to generate the symbols associated with the transform unit, wherein the second encoding process skips the transform and comprises a second scan conversion using a second scan pattern, and wherein the second scan pattern is different from the first scan pattern; and

apply entropy coding to the symbols to generate compressed data.

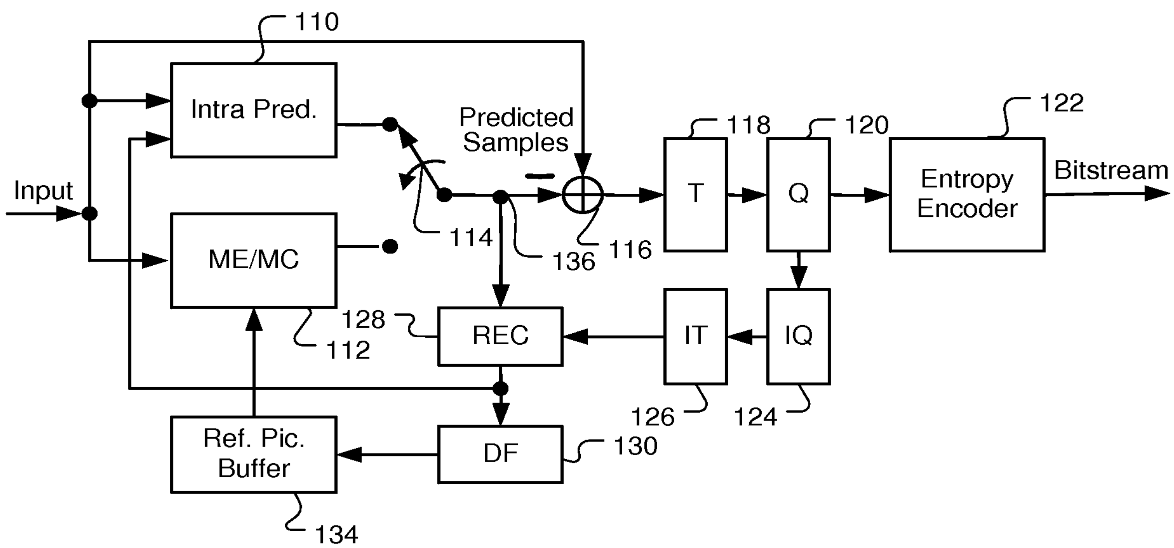
110
Intra Pred.
Predicted
Samples
118
120
122
Entropy
Encoder
Bitstream
T
Q
Input
ME/MC
114
136
116
128
REC
IT
IQ
112
126
124
Ref. Pic.
Buffer
DF
130
134

Fig. 1A

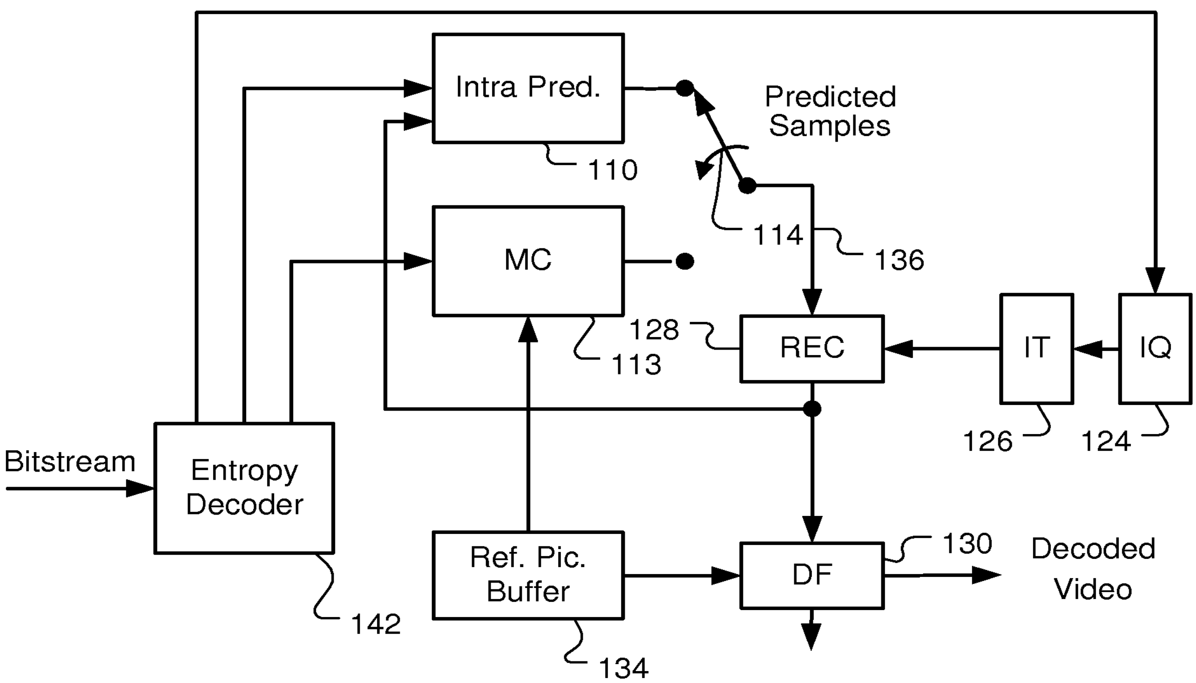
Intra Pred.
110
Predicted Samples
114
136
MC
128
113
REC
IT
IQ
126
124
Bitstream
Entropy Decoder
142
Ref. Pic. Buffer
134
DF
130
Decoded Video

Fig. 1B

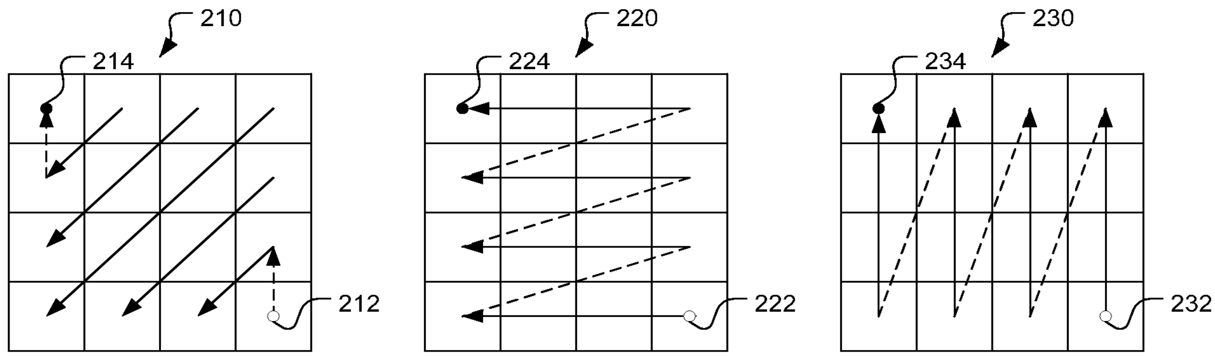

Fig. 2

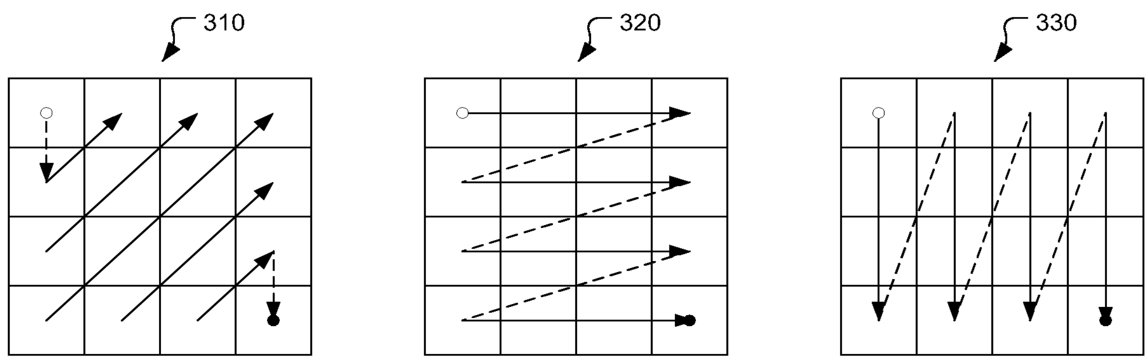

Fig. 3

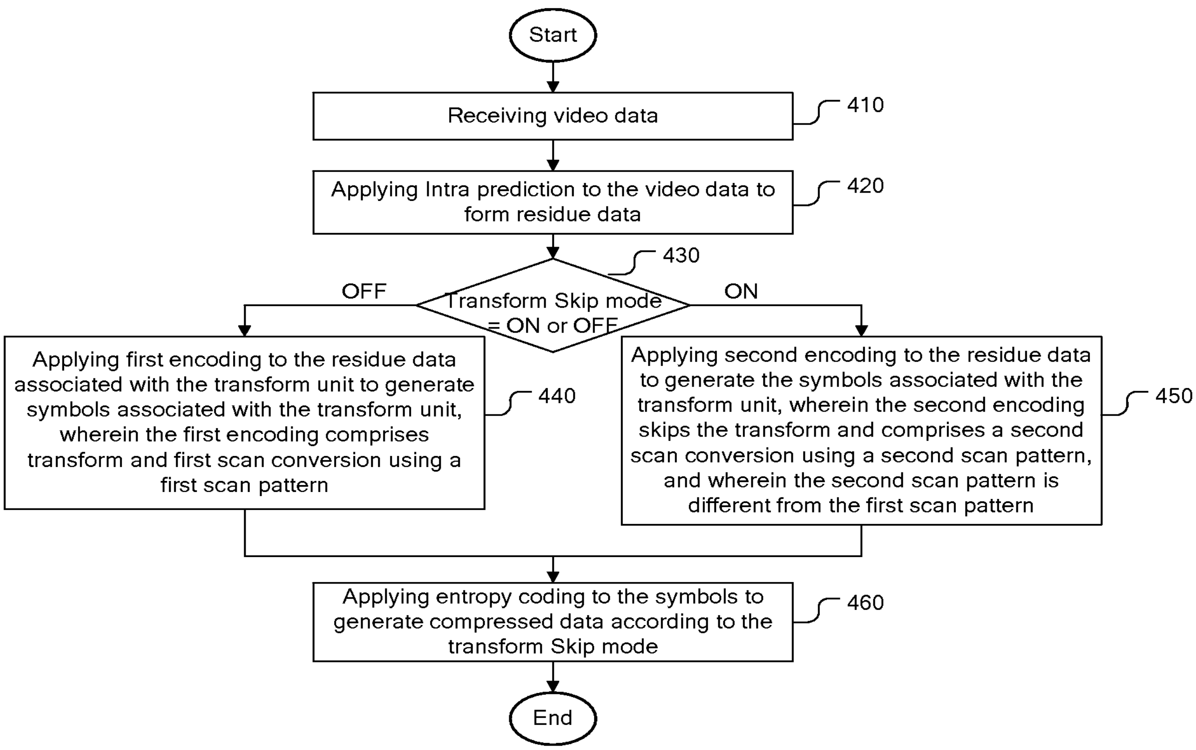
Start
Receiving video data
410
Applying Intra prediction to the video data to form residue data
420
430
OFF
Transform Skip mode = ON or OFF
ON
Applying first encoding to the residue data associated with the transform unit to generate symbols associated with the transform unit, wherein the first encoding comprises transform and first scan conversion using a first scan pattern
440
Applying second encoding to the residue data to generate the symbols associated with the transform unit, wherein the second encoding skips the transform and comprises a second scan conversion using a second scan pattern, and wherein the second scan pattern is different from the first scan pattern
450
Applying entropy coding to the symbols to generate compressed data according to the transform Skip mode
460
End

Fig. 4

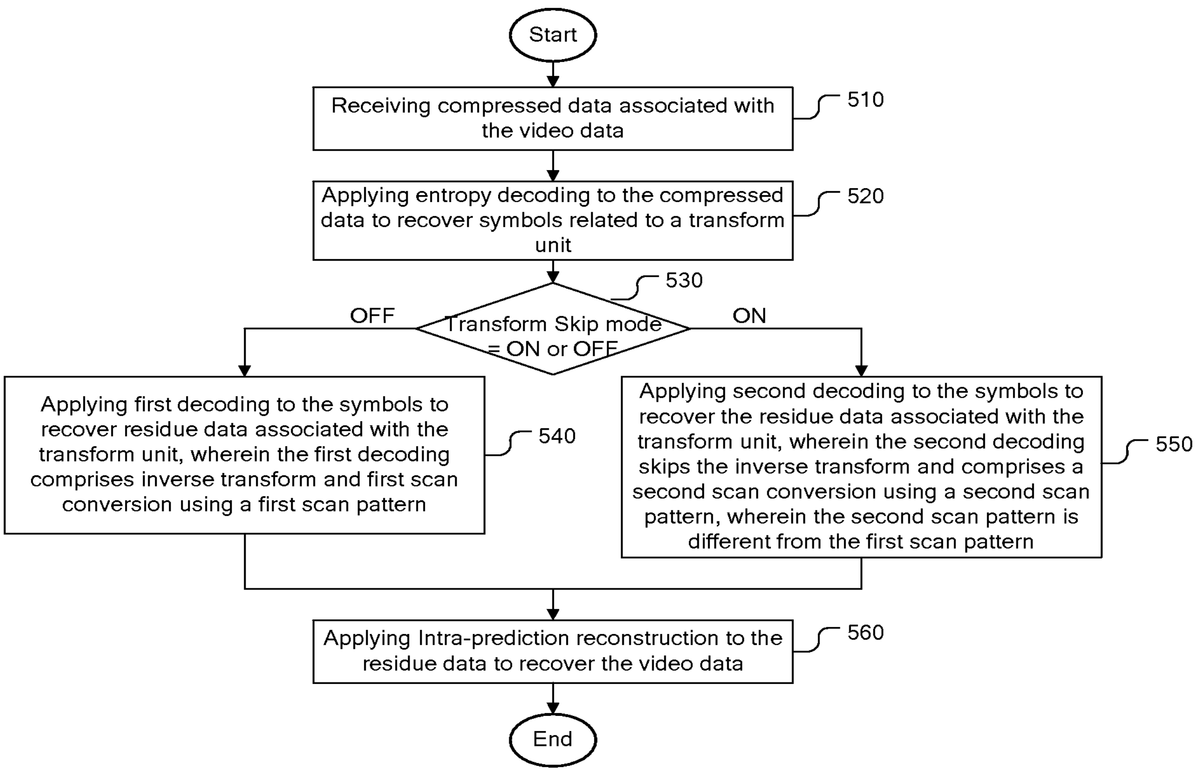
Start
Receiving compressed data associated with the video data
510
Applying entropy decoding to the compressed data to recover symbols related to a transform unit
520
530
OFF
Transform Skip mode = ON or OFF
ON
Applying first decoding to the symbols to recover residue data associated with the transform unit, wherein the first decoding comprises inverse transform and first scan conversion using a first scan pattern
540
Applying second decoding to the symbols to recover the residue data associated with the transform unit, wherein the second decoding skips the inverse transform and comprises a second scan conversion using a second scan pattern, wherein the second scan pattern is different from the first scan pattern
550
Applying Intra-prediction reconstruction to the residue data to recover the video data
560
End

Fig. 5

INTERNATIONAL SEARCH REPORT	International application No. PCT/CN2013/075237

A. CLASSIFICATION OF SUBJECT MATTER

H04N 7/50 (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)

IPC: H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT, CNKI, EPODOC, WPI, IEEE: encoding, decoding, entropy, skip mode, residue, inverse transform, scan conversion, scan pattern, intra prediction

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2011/0007820 A1 (SAMSUNG ELECTRONICS CO., LTD.) 13 January 2011 (13.01.2011) description, paragraphs [0113]-[0115], and figure 5	1-18
A	US 2010/0061447 A1 (MICROSOFT CORPORATION) 11 March 2010 (11.03.2010) the whole document	1-18
A	CN 101159873 A (INSTITUTE OF COMPUTING TECHNOLOGY CHINESE ACADEMY OF SCIENCES) 09 April 2008 (09.04.2008) the whole document	1-18

☐ 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 another 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
01 July 2013 (01.07.2013)	**15 Aug. 2013 (15.08.2013)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer ZHENG, Hao Telephone No. (86-10)62413554

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2013/075237

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
US 2011/0007820 A1	13.01.2011	EP 2276256 A1	19.01.2011
		KR 20110005093 A	17.01.2011
US 2010/0061447 A1	11.03.2010	WO 2010/027637 A2	11.03.2010
		EP 2319241 A2	11.05.2011
		CN 102144391 A	03.08.2011
		INCHENP 201101092 E	02.12.2011
		HK 1159383 A	27.07.2012
CN 101159873 A	09.04.2008	None	

Form PCT/ISA /210 (patent family annex) (July 2009)

DERWENT-ACC-NO: 2013-W73039

DERWENT-WEEK: 201527

TITLE: Decoding method of video data using transform skip mode for intra-predicted transform unit, by applying intra-prediction reconstruction to residue data associated with transform unit to recover video data

INVENTOR: AN J; GUO X ; LEI S ; LEI S M ; ZHAO L

PATENT-ASSIGNEE: MEDIATEK SINGAPORE PTE LTD[MTEK]

PRIORITY-DATA: 2012WO-CN076581 (June 7, 2012)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE
WO 2013181979 A1	December 12, 2013	EN
CA 2876017 A1	December 12, 2013	EN
KR 2015027788 A	March 12, 2015	KO
CN 104380734 A	February 25, 2015	ZH
EP 2859726 A1	April 15, 2015	EN

DESIGNATED-STATES: AE AG AL AM AO AT AU AZ BA BB BG BH BN BR BW BY BZ CA CH CL CN CO CR CU CZ DE DK DM DO DZ EC EE EG ES FI GB GD GE GH GM GT HN HR HU ID IL IN IS JP KE KG KM KN KP KR KZ LA LC LK LR LS LT LU LY MA MD ME MG MK MN M W MX MY MZ NA NG NI NO NZ OM PA PE PG PH PL PT QA RO RS RU RW SC SD SE SG SK SL SM ST SV SY TH TJ TM TN TR TT TZ UA UG US UZ VC VN ZA ZM ZW AL AT BA BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK S M TR

APPLICATION-DATA:

PUB-NO	APPL-DESCRIPTOR	APPL-NO	APPL-DATE
WO2013181979A1	N/A	2013WO-CN075237	May 7, 2013
CA 2876017A1	N/A	2013CA-2876017	May 7, 2013
CN 104380734A	N/A	2013CN-80029926	May 7, 2013
EP 2859726A1	N/A	2013EP-800677	May 7, 2013

CA 2876017A1	PCT Application	2013WO-CN075237	May 7, 2013
KR2015027788A	PCT Application	2013WO-CN075237	May 7, 2013
CN 104380734A	PCT Application	2013WO-CN075237	May 7, 2013
EP 2859726A1	PCT Application	2013WO-CN075237	May 7, 2013
KR2015027788A	N/A	2015KR-700361	May 7, 2013

CPC-CURRENT:

CPC-INVENTIVE:

TYPE	CPC	DATE
CPCI	H04N19/12	20141101
CPCI	H04N19/127	20141101
CPCI	H04N19/159	20130101
CPCI	H04N19/176	20130101
CPCI	H04N19/70	20130101

INT-CL-CURRENT:

TYPE	IPC	DATE
CIPP	H04N19/159	20140101
CIPP	H04N19/59	20140101
CIPP	H04N7/50	20060101
CIPS	H04N19/12	20140101
CIPS	H04N19/122	20140101
CIPS	H04N19/127	20140101
CIPS	H04N19/129	20140101
CIPS	H04N19/159	20140101
CIPS	H04N19/176	20140101
CIPS	H04N19/61	20140101
CIPS	H04N19/70	20140101
CIPS	H04N19/70	20140101
CIPS	H04N19/91	20140101

RELATED-ACC-NO: 2013-W73228

ABSTRACTED-PUB-NO: WO 2013181979 A1

BASIC-ABSTRACT:

NOVELTY - The method involves applying (520) entropy decoding to compressed data associated with the video data to recover symbols related to a transform unit. If a transform skip mode is OFF for the transform unit, a first decoding process (540) is applied to the symbols to recover residue data associated with the transform unit. If the transform skip mode is ON for the transform unit, a second decoding process (550) is applied to the symbols to recover the residue data associated with the transform unit. Intra-prediction reconstruction (560) is

applied to the residue data to recover the video data.

DESCRIPTION - The first decoding process comprises inverse transform and first scan conversion using a first scan pattern. The second decoding process skips the inverse transform and comprises a second scan conversion using a second scan pattern. The second scan pattern is different from the first scan pattern. INDEPENDENT CLAIMS are also included for the following:

(1) a method for encoding video data;

(2) an apparatus for encoding video data; and

(3) an apparatus for decoding video data.

USE - Decoding method of video data using transform skip mode for intra-predicted transform unit.

ADVANTAGE - The transform Skip mode is constrained in order to reduce complexity as well as to save some bits. Decoding performance is improved by taking into account the characteristics of the intra-prediction residues.

DESCRIPTION OF DRAWING(S) - The drawing illustrates a flowchart for a video decoding system incorporating a transform skip mode.

Compressed data receiving step (510)

Entropy decoding process (520)

First decoding process (540)

Second decoding process (550)

Intra-prediction reconstruction (560)

CHOSEN-DRAWING:	Dwg.5/5
TITLE-TERMS:	DECODE METHOD VIDEO DATA TRANSFORM SKIP MODE INTRA PREDICT UNIT APPLY RECONSTRUCT RESIDUE ASSOCIATE RECOVER

DERWENT-CLASS: W04

EPI-CODES: W04-P01A4;

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14823273	JEONG ET AL.
	Examiner	**Art Unit**
	COURTNEY FIELDS	2436

CPC					
Symbol				**Type**	**Version**
H04N	19	/	159	F	2014-11-01
H04N	19	/	91	I	2014-11-01
H04N	19	/	182	I	2014-11-01
H04N	19	/	13	I	2014-11-01
H04N	19	/	18	I	2014-11-01
H04N	19	/	176	I	2014-11-01
H04N	19	/	129	I	2014-11-01
H04N	19	/	61	I	2014-11-01
H04N	19	/	11	I	2014-11-01
H04N	19	/	103	I	2014-11-01
H04N	19	/	136	I	2014-11-01
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CPC Combination Sets							
Symbol				**Type**	**Set**	**Ranking**	**Version**
		/					
		/					

/COURTNEY FIELDS/ Examiner.Art Unit 2436 (Assistant Examiner)	03/31/2017 (Date)	**Total Claims Allowed:** 4
/SHEWAYE GELAGAY/ Supervisory Patent Examiner.Art Unit 2436 (Primary Examiner)	04/03/2017 (Date)	O.G. Print Claim(s): 1 / O.G. Print Figure: 1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14823273	JEONG ET AL.
	Examiner	**Art Unit**
	COURTNEY FIELDS	2436

US ORIGINAL CLASSIFICATION		INTERNATIONAL CLASSIFICATION	
CLASS	SUBCLASS	CLAIMED	NON-CLAIMED
		G 0 6 F 21 / 00 (2013.01.01)	H 0 4 N 7 / 50 (2006.01.01)
		H 0 4 L 29 / 06 (2006.01.01)	H 0 4 N 19 / 44 (2014.01.01)

CROSS REFERENCE(S)

CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				

/COURTNEY FIELDS/ Examiner.Art Unit 2436 (Assistant Examiner)	03/31/2017 (Date)	**Total Claims Allowed:** 4	
/SHEWAYE GELAGAY/ Supervisory Patent Examiner.Art Unit 2436 (Primary Examiner)	04/03/2017 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

U.S. Patent and Trademark Office Part of Paper No. 20170331

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14823273	JEONG ET AL.
	Examiner	**Art Unit**
	COURTNEY FIELDS	2436

☐ 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														
2	2														
3	3														
	4														
4	5														
	6														

/COURTNEY FIELDS/ Examiner.Art Unit 2436 (Assistant Examiner)	03/31/2017 (Date)	**Total Claims Allowed:** 4
/SHEWAYE GELAGAY/ Supervisory Patent Examiner.Art Unit 2436 (Primary Examiner)	04/03/2017 (Date)	O.G. Print Claim(s): 1 / O.G. Print Figure: 1

Search Notes	Application/Control No. 14823273	Applicant(s)/Patent Under Reexamination JEONG ET AL.
	Examiner COURTNEY FIELDS	Art Unit 2436

CPC- SEARCHED

Symbol	Date	Examiner
H04N 19/159	3/31/2017	CDF
H04N 19/18	3/31/2017	CDF
H04N 19/13	3/31/2017	CDF
H04N 19/91	3/31/2017	CDF
H04N 19/182	3/31/2017	CDF
H04N 19/129	3/31/2017	CDF
H04N 19/61	3/31/2017	CDF
H04N 19/136	3/31/2017	CDF
H04N 19/176	3/31/2017	CDF
H04N 19/11	3/31/2017	CDF
H04N 19/103	3/31/2017	CDF

CPC COMBINATION SETS - SEARCHED

Symbol	Date	Examiner

US CLASSIFICATION SEARCHED

Class	Subclass	Date	Examiner

SEARCH NOTES

Search Notes	Date	Examiner
EAST Search (USPAT, USPGPUB, DERWENT, EPO, JPO, IBM)	3/31/2017	CDF
Assignee Search	3/31/2017	CDF
Inventorship/Double Patenting Search	3/31/2017	CDF
Interference Search (USPGPUB)	3/31/2017	CDF
NPL Search (Google Scholar, IEEE, ACM)	3/31/2017	CDF
"Every claim has been reviewed for 35 USC non-statutory subject matter"	3/31/2017	CDF
Consulted with SPE Gelagay	3/27/2017	CDF
H04N 19/159	3/31/2017	CDF
H04N 19/18	3/31/2017	CDF

SEARCH NOTES

Search Notes	Date	Examiner
H04N 19/13	3/31/2017	CDF
H04N 19/91	3/31/2017	CDF
H04N 19/182	3/31/2017	CDF
H04N 19/129	3/31/2017	CDF
H04N 19/61	3/31/2017	CDF
H04N 19/136	3/31/2017	CDF
H04N 19/176	3/31/2017	CDF
H04N 19/11	3/31/2017	CDF
H04N 19/103	3/31/2017	CDF

INTERFERENCE SEARCH

US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
	General Interference and Search of Claims (USGPUB)	3/31/2017	CDF

Index of Claims	Application/Control No. 14823273	Applicant(s)/Patent Under Reexamination JEONG ET AL.
	Examiner COURTNEY FIELDS	Art Unit 2436

✓	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	09/15/2016	03/31/2017							
1	1	✓	=							
2	2	✓	=							
3	3	✓	=							
	4	✓	-							
4	5	✓	=							
	6	✓	-							

Displaying results 1-25 of 3,875 for (((decoding) AND entropy) AND scanning) »

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Content Type

- Conference Publications (2,273)
- Journals & Magazines (1,442)
- Books & eBooks (95)
- Standards (34)
- Early Access Articles (31)

Year

Single Year | Range

1950 2017

From 1950 To 2017

Author

Affiliation

Publication Title

Publisher

Supplemental Items

Conference Location

Standard Status

Standard Type

Medical image compression using advanced coding technique
K. V. Sridhar; K. S. R. Krishna Prasad
2008 9th International Conference on Signal Processing
Year: 2008
Pages: 2142 - 2145, DOI: 10.1109/ICOSP.2008.4697570
Cited by: Papers (1)
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Abstract (158 Kb)

Lossy-to-lossless screen content coding using an HEVC base-layer
Geert Braeckman; Shahid Mahmood Satti; Heng Chen; Steven Delputte; Peter Schelkens; Adrian Munteanu
2013 18th International Conference on Digital Signal Processing (DSP)
Year: 2013
Pages: 1 - 6, DOI: 10.1109/ICDSP.2013.6622843
Cited by: Papers (2)
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Abstract (713 Kb)

Model-Based Coding of 3D Head Sequences
L. Granai; T. Vlachos; M. Hamouz; J. R. Tena; T. Davies
2007 3DTV Conference
Year: 2007
Pages: 1 - 4, DOI: 10.1109/3DTV.2007.4379442
IEEE Conference Publications

Abstract (425 Kb)

Semantic Diversity Accounts for the "Missing" Word Frequency Effect in Stroke Aphasia: Insights Using a Novel Method to Quantify Contextual Variability in Meaning
Paul Hoffman; Timothy T. Rogers; Matthew A. Lambon Ralph
Journal of Cognitive Neuroscience
Year: 2011, Volume: 23, Issue: 9
Pages: 2432 - 2446, DOI: 10.1162/jocn.2011.21614
MIT Press Journals

Abstract (398 Kb)

Two-scale transmission of DCT-coded video over lossy packet networks
L. R. Mendes; R. Togni del Pietro; M. H. M. Costa
Telecommunications Symposium, 1998. ITS '98 Proceedings. SBT/IEEE International

Standards Dictionary Terms

channel
authentication
authorization
link
encapsulation
mp
pc
ds
md
sm
broadcast address
big endian
little endian
unlink

Browse »

Year: 1998, Volume: 2
Pages: 510 - 515 vol.2, DOI: 10.1109/ITS.1998.718446
Cited by: Patents (3)
IEEE Conference Publications

Abstract (408 Kb)

Context-Based Distributed Wavelet Video Coding
Marco Grangetto; Enrico Magli; Gabriella Olmo
2005 IEEE 7th Workshop on Multimedia Signal Processing
Year: 2005
Pages: 1 - 4, DOI: 10.1109/MMSP.2005.248682
Cited by: Papers (4)
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Abstract (4290 Kb)

Fast Frame-Based Scene Change Detection in the Compressed Domain for MPEG-4 Video
Jens Brandt; Jens Trotzky; Lars Wolf
2008 The Second International Conference on Next Generation Mobile Applications, Services, and Technologies
Year: 2008
Pages: 514 - 520, DOI: 10.1109/NGMAST.2008.39
Cited by: Papers (1)
IEEE Conference Publications

Abstract (445 Kb)

On the error probability for a class of binary recursive feedback strategies
J. Schalkwijk; K. Post
IEEE Transactions on Information Theory
Year: 1973, Volume: 19, Issue: 4
Pages: 498 - 511, DOI: 10.1109/TIT.1973.1055047
Cited by: Papers (14)
IEEE Journals & Magazines

Abstract (1960 Kb)

A shape feature based image retrieval in DCT compressed-domain
Zhang Xihuang; Bian Guochun; Xu Wenbo
The Fifth International Conference on Computer and Information Technology (CIT'05)
Year: 2005
Pages: 629 - 633, DOI: 10.1109/CIT.2005.50
Cited by: Papers (2)
IEEE Conference Publications

Abstract (344 Kb)

Directed Information, Causal Estimation, and Communication in Continuous Time
Tsachy Weissman; Young-Han Kim; Haim H. Permuter
IEEE Transactions on Information Theory
Year: 2013, Volume: 59, Issue: 3
Pages: 1271 - 1287, DOI: 10.1109/TIT.2012.2227677
Cited by: Papers (9)
IEEE Journals & Magazines

Abstract (4370 Kb)

Overview of the H. 264/AVC **video** coding standard

T Wiegand, GJ Sullivan… - … and systems for video …, 2003 - ieeexplore.ieee.org

… compensation utilizes reference fields rather than reference frames; • the zig-zag **scan** of **transform** … MBAFF frame, the methods that are used for zig-zag **scanning**, **prediction** of motion … **intra**-frame sample **prediction**, deblocking filtering, and context modeling in **entropy** coding are …

Cited by 8615 Related articles All 59 versions Cite Save

The H. 264/AVC advanced **video** coding standard: Overview and introduction to the fidelity range extensions

GJ Sullivan, PN Topiwala… - … , the SPIE 49th …, 2004 - proceedings.spiedigitallibrary.org

… field **mode**, the **scanning** order of the **coefficients** is modified to be more efficient for field **scanning** as shown … chroma DC, and 2x4 for 4:2:2 chroma DC), the same basic concepts apply, with **scan** orders specified … The steps in the CABAC **entropy** coding scheme are depicted in Fig …

Cited by 693 Related articles All 15 versions Cite Save

Intra-macroblock DC and AC **coefficient prediction** for interlaced digital **video**

RO Eifrig, X Chen, A Luthra - US Patent 5,974,184, 1999 - Google Patents

… of the DCT is performed to concentrate the **coefficient** distribution around zero so that **entropy** coding can … ST indicates a horizontal or **vertical scan** order … For example, while the invention was discussed in connection with DCT **transform coefficients**, the invention may be adapted …

Cited by 134 Related articles All 2 versions Cite Save

H. 263+: **Video** coding at low bit rates

G Cote, B Erol, M Gallant… - … and systems for video …, 1998 - ieeexplore.ieee.org

… Annex E): Baseline H.263 employs variable-length coding as a means of **entropy** coding. … Three **scanning** patterns are used: the basic zigzag **scan** for DC only **prediction**, the alternate … as in MPEG-2) for horizontally **predicted** blocks, or the alternate-horizontal **scan** for **vertically** …

Cited by 583 Related articles All 18 versions Cite Save

Video coder providing implicit **coefficient prediction** and **scan** adaptation for image coding and **intra** coding of **video**

BG Haskell, A Puri, RL Schmidt - US Patent 6,341,144, 2002 - Google Patents

… No block is horizontally adjacent to block Y in the **scanning** direction. … Additional bandwidth efficiencies are obtained, in a preferred embodiment, by tying a **scan** direction of the variable … The encoder **scans** blocks of **coefficients** to generate run-level events that are VLC coded. …

Cited by 34 Related articles All 2 versions Cite Save

Video compression-from concepts to the H. 264/AVC standard

GJ Sullivan, T Wiegand - Proceedings of the IEEE, 2005 - ieeexplore.ieee.org

… Using FMO, a picture can be split into many macroblock **scanning** patterns such as interleaved slices … 6) **Entropy** Coding: In H.264/AVC, two alternatives for **entropy** coding are supported … except MCP uses reference fields rather than reference frames, the zigzag **scan** for **transform** …

Cited by 718 Related articles All 21 versions Cite Save

Optimized **scanning** of **transform coefficients** in **video** coding

A Puri - US Patent 5,500,678, 1996 - Google Patents

… These pairs are **entropy** encoded in a variable length encoder 190. … The output of inverse **scan** 1040 are a normally ordered two-dimensional DCT **coefficient** blocks and are input to … Optimal **scanning** method for **transform coefficients** in coding/**decoding** of image and **video**. …

Cited by 75 Related articles All 2 versions Cite Save

Adaptive coding and **decoding** of frames and fields of **video**

A Puri, R Aravind - US Patent 5,227,878, 1993 - Google Patents

… the **transform coefficients** into the order they had in the quantizer 19 prior to being **scanned** by the … by which the inverse **scan** selector 28 is able to use the correct inverse **scanning** sequence. … 1. The inverse **scan** selector 64 directs the **coefficients** it receives in inverse order to a …

Cited by 294 Related articles All 2 versions Cite Save

Video coding with H. 264/AVC: tools, performance, and complexity

J Ostermann, J Bormans, P List… - IEEE Circuits and …, 2004 - ieeexplore.ieee.org

… tude equal to 1, so-called trailing 1's (T1), is observed at the end of the **scan**. … in the sec- ond step, sign and level value of significant **coefficients** are encoded by **scanning** the list of … A total number of 32 different VLCs are used in CAVLC **entropy** coding **mode**, where, however, the …

Cited by 1202 Related articles All 22 versions Cite Save

A high-definition H. 264/AVC **intra**-frame codec IP for digital **video** and still camera applications
CW Ku, CC Cheng, GS Yu, MC Tsai… - … and Systems for Video …, 2006 - ieeexplore.ieee.org
... adopts the ping-pong architec- ture such that the coding loop and **entropy** coding stage **...** The encoder can be divided into two parts: **scanning** process and encoding process, which are **...** During encoding, the **transform coefficients** are first reordered in the zigzag **scan** order and **...**
Cited by 81 Related articles All 12 versions Cite Save

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), (Cancelled), (Withdrawn), (Previously Presented), (New), and (Not Entered).

Please AMEND claims 1-3, and 5-6 and CANCEL claim 4 without prejudice or disclaimer in accordance with the following:

1. (Currently Amended) A decoding apparatus comprising:

an entropy decoding hardware processor configured to perform entropy decoding of an encoded video information in a bitstream to obtain transform coefficients;

a scanning decision hardware processor configured to select a scanning mode for the transform coefficients of a current block; and

a video recovery hardware processor configured to scan the transform coefficients based on the selected scanning mode;

wherein the scanning decision hardware processor is further configured to select the scanning mode based on an intra prediction mode of the current block, and

the scanning decision hardware processor is further configured to select a horizontal scanning mode as the scanning mode when the intra prediction mode is a vertical intra prediction mode, and select a vertical scanning mode as the scanning mode when the intra prediction mode is a horizontal intra prediction mode.

2. (Currently Amended) The decoding apparatus of claim 1, wherein the scanning decision hardware processor is further configured to select the scanning mode based on the intra prediction mode that was used to perform intra prediction of the current block to obtain difference values that were encoded to obtain the encoded video.

3. (Previously Presented) The decoding apparatus of claim 1, wherein the intra prediction mode is one of the vertical intra prediction mode and the horizontal prediction mode.

4. (Canceled)

5. (Currently Amended) A non-transitory computer-readable storage medium storing instructions that, when executed by a processor, cause the processor to perform a method of decoding, the method comprising:

performing entropy decoding of encoded video information in a bitstream to obtain transform coefficients for a current block;

selecting a scanning mode for the transform coefficients; and

scanning the transform coefficients based on the selected scanning mode;

wherein the selecting of a scanning mode comprises: ~~selecting the scanning mode based on an intra prediction mode of the current block~~

selecting a horizontal scanning mode in response to the intra prediction mode being a vertical intra prediction mode; and

selecting a vertical scanning mode in response to the intra prediction mode being a horizontal intra prediction mode.

6. (Canceled)

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L8	22	(entropy) and (decoding) and (scan) and (video) and (intra adj prediction)	FPRS; EPO; JPO; DERWENT	OR	ON	2017/04/02 04:33
L7	0	(entropy) and (decoding) and (scan) and (video) and (recovery)	FPRS; EPO; JPO; DERWENT	OR	ON	2017/04/02 04:33
L6	180	(entropy) and (decoding) and (scan) and (video)	FPRS; EPO; JPO; DERWENT	OR	ON	2017/04/02 04:33
L5	0	(entropy) and (decoding) and (scan) and (video adj recovery)	FPRS; EPO; JPO; DERWENT	OR	ON	2017/04/02 04:33
L4	0	(entropy) and (decoding) and (scan) and (video adj recovery) and (intra) and (prediction) and (coefficients) and (pixel adj values)	FPRS; EPO; JPO; DERWENT	OR	ON	2017/04/02 04:32
L3	0	(entropy) and (decoding) and (scan) and (video adj recovery) and (intra adj prediction) and (coefficients) and (pixel adj values)	FPRS; EPO; JPO; DERWENT	OR	ON	2017/04/02 04:32
L2	0	(entropy) and (decoding) and (scanning) and (video adj recovery) and (intra adj prediction) and (coefficients) and (pixel adj values)	FPRS; EPO; JPO; DERWENT	OR	ON	2017/04/02 04:32
L1	0	(entropy adj decoding) and (scanning) and (video adj recovery) and (intra adj prediction) and (coefficients) and (pixel adj values)	FPRS; EPO; JPO; DERWENT	OR	ON	2017/04/02 04:31
S209	11	(entropy adj decoding) and (scanning) and (video adj recovery) and (intra adj prediction) and (coefficients) and (pixel adj values) and (H04N19/159 or H04N19/18 or H04N19/13 or H04N19/91 or H04N19/182 or H04N19/129 or H04N19/61 or H04N19/136 or H04N19/176 or H04N19/11 or H04N19/103).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/09/15 22:33
S208	11	(entropy adj decoding) and (scanning) and (video adj recovery) and (intra adj prediction) and (H04N19/159 or H04N19/18 or H04N19/13 or H04N19/91 or H04N19/182 or H04N19/129 or H04N19/61 or H04N19/136 or H04N19/176 or H04N19/11 or H04N19/103).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/09/15 22:32
S207	96780	(H04N19/159 or H04N19/18 or H04N19/13 or H04N19/91 or	US-PGPUB; USPAT;	OR	ON	2016/09/15 22:30

		H04N19/182 or H04N19/129 or H04N19/61 or H04N19/136 or H04N19/176 or H04N19/11 or H04N19/103).cpc.	USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
S199	29	"entropy decoding" and "video" and "pixel values"	FPRS; EPO; JPO; DERWENT	OR	ON	2015/09/16 16:31
S198	10	"entropy decoding" same "video" and "pixel values"	FPRS; EPO; JPO; DERWENT	OR	ON	2015/09/16 16:31
S197	9	"entropy decoding" same "video" same "pixel values"	FPRS; EPO; JPO; DERWENT	OR	ON	2015/09/16 16:30
S196	373	"entropy decoding" same "video"	FPRS; EPO; JPO; DERWENT	OR	ON	2015/09/16 16:30
S195	61229	(entropy decoding) and (video)	FPRS; EPO; JPO; DERWENT	OR	ON	2015/09/16 16:29
S194	12	"entropy decoding" and "scanning" and "intra prediction" and "horizontal intra prediction" and "vertical intra prediction" and "coefficients" and "encoded video"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/05/28 12:34
S193	24	"entropy decoding" and "scanning" and "intra prediction" and "horizontal intra prediction" and "vertical intra prediction" and "coefficients"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/05/28 12:34
S192	26	"entropy decoding" and "scanning" and "intra prediction" and "horizontal intra prediction" and "vertical intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/05/28 12:34
S191	29	"entropy decoding" and "scanning" and "intra prediction" and "horizontal intra" and "vertical intra"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/05/28 12:33
S190	0	"entropy decoding" and "scanning" and "intra prediction" and "horizontal intra" and "vertial intra"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2015/05/28 12:33
S189	30	"entropy decoding" and "scanning" and "intra prediction" and "horizontal intra"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	OFF	2015/05/28 12:33

			DERWENT; IBM_TDB			
S188	1161	"entropy decoding" and "scanning" and "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2015/05/28 12:33
S187	2	"7995654".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2015/01/24 23:28
S186	26	"2006002466"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2015/01/24 23:12
S185	53	"entropy decoding" and "encoded video" and "coefficients" and "vertical scanning" and "intra prediction" and "horizontal scanning" and "pixel values"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/01/24 22:39
S184	72	"entropy decoding" and "video" and "encoding" and "coefficients" and "vertical scanning" and "intra prediction" and "horizontal scanning" and "pixel values"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/01/24 22:39
S183	73	"entropy decoding" and "video" and "encoding" and "coefficients" and "vertical scanning" and "intra prediction" and "horizontal scanning"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/01/24 22:39
S182	78	"entropy decoding" and "video" and "encoding" and "coefficients" and "vertical scanning" and "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/01/24 22:39
S181	80	"entropy decoding" and "video" and "encoding" and "coefficients" and "vertical scanning"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/01/24 22:38
S180	4305	"entropy decoding" and "video" and "encoding" and "coefficients"	US-PGPUB; USPAT; USOCR;	OR	ON	2015/01/24 22:38

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S179	4	(H04N19/00218 and H04N19/159 and H04N19/136 and H04N19/61 and H04N19/129 and H04N19/103 and H04N19/11 and H04N19/176).CPC. and "entropy decoding" and "video" and "encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/01/24 22:37
S178	24	(H04N19/00218 and H04N19/159 and H04N19/136 and H04N19/61 and H04N19/129 and H04N19/103 and H04N19/11 and H04N19/176).CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/01/24 22:33
S170	105	375/240.2.ccls. and "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 14:08
S169	291	375/240.2.ccls. and "entropy"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 14:08
S168	1000	375/240.2.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 14:07
S167	0	375/240.20.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 14:07
S166	0	375/240.200.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 14:06
S165	0	375/240.2.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 14:06
S164	0	375/240.200.ccls. and "entropy	US-PGPUB;	OR	OFF	2013/05/13

		encoding" same "optimal" same "intra prediction" same "coefficients"	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			14:06
S163	4	"20070274385" "20050074062"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 13:09
S162	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
S161	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
S160	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
S159	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
S158	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
S157	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
S156	0	375/240.20.ccls. and "entropy encoding" same "optimal" same "intra prediction" same "coefficients"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	2013/05/13 12:38

			IBM_TDB			
S146	24	encoder and decoder and "intra prediction" and "entropy"	EPO; JPO; DERWENT	OR	OFF	2013/05/13 12:21
S145	152	encoder and decoder and "intra prediction"	EPO; JPO; DERWENT	OR	OFF	2013/05/13 12:18
S144	1	S139 and S143	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:17
S143	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
S142	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
S141	1	"video recovery" near5 "scanning mode"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:15
S140	3134865	"video recovery" near5 scanning mode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:14
S139	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
S138	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
S137	13	"entropy encoding" same "optimal" same "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	2013/05/13 12:07

			IBM_TDB			
S136	4	"entropy encoding" near5 "zigzag" same "horizontal"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 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;	OR	OFF	2012/11/07 19:07

			JPO; DERWENT; 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;	OR	OFF	2012/11/07 18:33

			USOCR; FPRS; EPO; 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 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
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	US-PGPUB; USPAT; USOCR;	OR	OFF	2012/11/07 18:11

		"zigzag" and "intra prediction" and "video" and "entropy encoding" and "DCT" and "quantization"	FPRS; EPO; JPO; 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	US-PGPUB;	OR	OFF	2012/11/07

		"DCT" with "quantization" with "9 prediction modes" with (entropy encod$3)	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			17:57
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;	OR	OFF	2012/08/16 16:51

			IBM_TDB			
S85	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
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;	OR	OFF	2012/08/16 16:46

			JPO; DERWENT; 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"	US-PGPUB; USPAT;	OR	OFF	2012/08/16 16:43

		and "intra"	USOCR; FPRS; EPO; 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; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:42
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;	OR	OFF	2012/08/15 16:30

			DERWENT; IBM_TDB			
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;	OR	OFF	2012/03/18 13:40

			FPRS; EPO; JPO; 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	US-PGPUB;	OR	OFF	2012/03/18

		prediction"	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			13:34
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;	OR	OFF	2012/03/18 13:31

			IBM_TDB			
S24	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
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;	OR	OFF	2012/03/18 13:28

			JPO; DERWENT; 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;	OR	OFF	2012/03/18 13:26

			USOCR; FPRS; EPO; 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

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L12	0	((video adj recovery) near2 (hardware adj processor) near5 (transform) near2 (coefficients) near5 (selected) near5 (scanning adj mode)).CLM.	US-PGPUB	OR	ON	2017/04/02 04:46
L11	0	((scanning adj decision) near2 (hardware adj processor) near5 (transform) near2 (coefficients) near5 (current adj block) near5 (scanning adj mode)).CLM.	US-PGPUB	OR	ON	2017/04/02 04:46

L10	0	((scanning adj decision) near2 (hardware adj processor) near5 (selecting) near2 (horizontal) near2 (scanning mode) near2 (vertical) near2 (intra prediction)).CLM.	US-PGPUB	OR	ON	2017/04/02 04:45
L9	0	((scanning adj decision) near2 (hardware adj processor) near "5" (selecting) near2 (horizontal) near2 (scanning mode) near2 (vertical) near2 (intra prediction)).CLM.	US-PGPUB	OR	ON	2017/04/02 04:44
S206	0	((selecting) near2 (horizontal) near2 (scanning mode) near2 (vertical) near2 (intra prediction)).CLM.	US-PGPUB	OR	ON	2015/09/16 16:50
S205	2	((selecting) near2 (scanning mode) near2 (intra prediction) near2 (difference values) near2 (predicted pixel values)).CLM.	US-PGPUB	OR	ON	2015/09/16 16:49
S204	2	((selecting) near2 (scanning mode) near2 (intra prediction) near2 (difference values) near2 (pixel values)).CLM.	US-PGPUB	OR	ON	2015/09/16 16:48
S203	5	((selecting) near2 (scanning mode) near2 (intra prediction) near2 (difference values)).CLM.	US-PGPUB	OR	ON	2015/09/16 16:48
S202	2	((selecting) near2 (scanning mode) near2 (transform) near2 (coefficients)).CLM.	US-PGPUB	OR	ON	2015/09/16 16:46
S201	2	((entropy decoding) near2 (encoded video) near2 (information) near2 (transform) near2 (coefficients)).CLM.	US-PGPUB	OR	ON	2015/09/16 16:45
S200	754	((entropy decoding) near2 (encoded video) near2 (information)).CLM.	US-PGPUB	OR	ON	2015/09/16 16:45
S177	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	OR	OFF	2013/05/13 14:43
S176	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	OR	OFF	2013/05/13 14:40
S175	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	OR	OFF	2013/05/13 14:39
S174	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	OR	OFF	2013/05/13 14:38
S173	109	encoding AND mode AND selection AND optimal AND intra AND prediction AND video AND difference AND values AND transformation AND quantization AND	US-PGPUB	OR	OFF	2013/05/13 14:38

		coefficients.CLM.				
S172	67	encoding AND mode AND selection AND optimal AND intra AND prediction AND video AND difference AND values AND transformation.CLM.	US-PGPUB	OR	OFF	2013/05/13 14:37
S171	572	encoding AND mode AND selection AND optimal AND intra AND prediction.CLM.	US-PGPUB	OR	OFF	2013/05/13 14:37

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

This application is a CON of 13/975,251 08/23/2013 PAT 9225982
which is a CON of 12/377,617 02/16/2009 PAT 8548060
which is a 371 of PCT/KR2007/001433 03/23/2007

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

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

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Foreign Priority claimed ☑ Yes ☐ No 35 USC 119(a-d) conditions met ☑ Yes ☐ No ☐ Met after Allowance Verified and Acknowledged /COURTNEY D FIELDS/ Examiner's Signature CDF Initials	KOREA, REPUBLIC OF	6	~~6~~ 4	2

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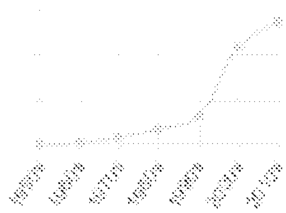

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1 Algorithm and hardware design of a fast intra-frame mode decision module for h.264/AVC encoders

Daniel Palomino, Guilherme Corrêa, Claudio Diniz, Sérgio Bampi, Luciano Agostini, Altamiro Susin

August 2011 SBCCI '11: Proceedings of the 24th symposium on Integrated circuits and systems design

Publisher: ACM

Bibliometrics: Citation Count: 1
Downloads (6 Weeks): 1, Downloads (12 Months): 4, Downloads (Overall): 78

Full text available: PDF

In the Rate-Distortion Optimization (RDO) technique for video encoding, the process of choosing the best prediction mode is performed through exhaustive executions of the whole encoding process, which increases significantly the encoder computational complexity. Considering H.264/AVC intra-frame prediction there are several modes to encode each macroblock (MB). In order to ...

Keywords: mode decision, h.264/avc, intra prediction, video coding

[result highlights]

2 A Low-Area and High-Throughput Intra Prediction Architecture for a Multi-Standard HEVC and H.264/AVC Video Encoder

Marcel Corrêa, Marcelo Porto, Bruno Zatt, Luciano Agostini

August 2015 SBCCI '15: Proceedings of the 28th Symposium on Integrated Circuits and Systems Design

Publisher: ACM

Bibliometrics: Citation Count: 0
Downloads (6 Weeks): 3, Downloads (12 Months): 27, Downloads (Overall): 49

Full text available: PDF

This paper describes a low-area and high-throughput hardware architecture for the intra prediction coding of today's most important video coding standards---the state of the art HEVC and its predecessor H.264/AVC. In order to reduce control complexity, memory accesses and total area, our design works with a subset of the prediction ...

Keywords: H.264/AVC, Intra prediction, HEVC, Video coding, Hardware architecture

[result highlights]

3 Power reduction in an H.264 encoder through algorithmic and logic transformations

Maria G. Koziri, George I. Stamoulis, Ioannis X. Katsavounidis

October 2006 ISLPED '06: Proceedings of the 2006 international symposium on Low power electronics and design

Publisher: ACM

Bibliometrics: Citation Count: 2
Downloads (6 Weeks): 1, Downloads (12 Months): 2, Downloads (Overall): 357

Full text available: PDF

The H.264 video coding standard can achieve considerably higher coding efficiency than previous video coding standards. The keys to this high coding efficiency are the two prediction modes (Intra & Inter) provided by H.264. Unfortunately, these result in a considerably higher encoder complexity that adversely affects speed and power, which ...

Keywords: low-power implementation, intra prediction, motion estimation, H.264 encoder

[result highlights]

4 Performance enhancement of H.264/AVC intra frame prediction hardware using efficient 4-2 and 5-2 adder-compressors

Cláudio Machado Diniz, João Altermann, Eduardo Costa, Sergio Bampi

August 2010 SBCCI '10: Proceedings of the 23rd symposium on Integrated circuits and system design

Publisher: ACM

Bibliometrics: Citation Count: 0
Downloads (6 Weeks): 1, Downloads (12 Months): 3, Downloads (Overall): 99

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Full text available: PDF

Adder compressors have already been proved as efficient structures to reduce the critical path of adder-tree circuits with large number of input values. Our recently proposed intra-frame prediction hardware architecture for H.264/AVC video encoder employs adder-tree circuits for SAD (Sum of Absolute Difference) calculation and for the intra prediction itself. ...

Keywords: H.264/AVC, intra-frame prediction, adder-compressors, sad

[result highlights]

5 High throughput architecture for H.264/AVC motion compensation sample interpolator for HDTV

Bruno Zatt, Altamiro Susin, Sergio Bampi, Luciano Agostini

August 2008 SBCCI '08: Proceedings of the 21st annual symposium on Integrated circuits and system design

Publisher: ACM

Bibliometrics: Citation Count: 2
Downloads (6 Weeks): 0, Downloads (12 Months): 1, Downloads (Overall): 204

Full text available: PDF

This work presents a new sample interpolator architecture for the motion compensation in H.264/AVC. The proposed solution saves hardware resources through a simplified filters organization, still reaching the needed throughput to real time decoding of HDTV 1920x1080 bi-predictive H.264/AVC video sequences. The new luma interpolator organization uses 4 vertical and ...

Keywords: video coding, H.264/AVC, hardware architectures, motion compensation

[result highlights]

6 Fast mode decision algorithm for intra prediction in HEVC

Tiancai Ye, Dongming Zhang, Feng Dai, Yongdong Zhang

August 2013 ICIMCS '13: Proceedings of the Fifth International Conference on Internet Multimedia Computing and Service

Publisher: ACM

Bibliometrics: Citation Count: 0
Downloads (6 Weeks): 9, Downloads (12 Months): 39, Downloads (Overall): 304

Full text available: PDF

The High Efficiency Video Coding (HEVC) standard achieves much better efficiency than previous video coding standards. One contributor to this improvement is the large set of intra prediction modes that it supports. While resulting in the better Rate-Distortion (R-D) performance compared to the H.264/AVC equivalent predictor, it suffers from heavier ...

Keywords: HEVC, mode decision, intra prediction, video coding

[result highlights]

7 Fine-grained CUDA-based Parallel Intra Prediction for H.264/AVC

Wenbin Jiang, Min Long, Hai Jin, Pengcheng Wang

March 2014 NOSSDAV '14: Proceedings of Network and Operating System Support on Digital Audio and Video Workshop

Publisher: ACM

Bibliometrics: Citation Count: 0
Downloads (6 Weeks): 0, Downloads (12 Months): 12, Downloads (Overall): 86

Full text available: PDF

Recently, the power of the Graphics Processing Unit (GPU) has largely increased, whereas previous works of intra prediction on the GPU could not efficiently exploit the massive parallel opportunity. The related work only achieves frame-level, slice-level or block-level parallelism. It is a challenge to implement fine-grained parallelism on the Compute ...

Keywords: CUDA, Fast Mode Decision, GPU, H.264/AVC, Parallel Intra Prediction

[result highlights]

8 Transforms and quantization design targeting the H.264/AVC intra prediction constraints

Robson Dornelles, Felipe Sampaio, Daniel Palomino, Luciano Agostini

August 2009 SBCCI '09: Proceedings of the 22nd Annual Symposium on Integrated Circuits and System Design: Chip on the Dunes

Publisher: ACM

Bibliometrics: Citation Count: 2
Downloads (6 Weeks): 0, Downloads (12 Months): 7, Downloads (Overall): 141

Full text available: PDF

This paper presents an architecture for a dedicated transforms and quantization loop targeting the Intra Prediction of the H.264/AVC video coding standard. The transforms and quantization loop is a bottleneck for the Intra Prediction, since the prediction process cannot start before the transforms and quantization loop finishes the reconstruction of ...

Keywords: video coding, H.264/AVC, IQ modules, T, VLSI design, intra-prediction, low latency, Q, IT, high performance

[result highlights]

9 [A parallel approach for high performance hardware design of intra prediction in H.264/AVC video codec]

Muhammad Shafique, Lars Bauer, Jörg Henkel

April 2009 DATE '09: Proceedings of the Conference on Design, Automation and Test in Europe

Publisher: European Design and Automation Association

Bibliometrics: Citation Count: 1
Downloads (6 Weeks): 1, Downloads (12 Months): 2, Downloads (Overall): 62

Full text available: PDF

The H.264/AVC Intra Frame Codec (i.e. all frames are coded as I-frames) targets high-resolution/high-end encoding applications (e.g. digital cinema and high quality archiving etc.), providing much better compression efficiency at lower computational complexity compared to MJPEG2000. Moreover, in case of video coding of very high motion scenes, the number of ...

[result highlights]

10 [Real-Time Architecture for HEVC Motion Compensation Sample Interpolator for UHD Videos]

Wagner Penny, Guilherme Paim, Marcelo Porto, Luciano Agostini, Bruno Zatt

August 2015 SBCCI '15: Proceedings of the 28th Symposium on Integrated Circuits and Systems Design

Publisher: ACM

Bibliometrics: Citation Count: 0
Downloads (6 Weeks): 4, Downloads (12 Months): 34, Downloads (Overall): 55

Full text available: PDF

This paper presents a high throughput architecture for a Motion Compensation (MC) sample interpolator targeting the High Efficiency Video Coding (HEVC) standard. Real-time operation and low power dissipation in video coding systems have become important research challenges, especially in mobile devices with limited computational resources and battery availability. The Fractional ...

Keywords: sample interpolator, video coding, HEVC decoder, hardware architectures, Motion compensation

[result highlights]

11 [A novel hardware architecture design for binary arithmetic decoder engines based on bitstream flow analysis]

Dieison Antonello Deprá, Vagner Santos da Rosa, Sergio Bampi

August 2008 SBCCI '08: Proceedings of the 21st annual symposium on Integrated circuits and system design

Publisher: ACM

Bibliometrics: Citation Count: 2
Downloads (6 Weeks): 1, Downloads (12 Months): 3, Downloads (Overall): 172

Full text available: PDF

This paper presents the design and implementation of a dedicated hardware architecture for binary arithmetic decoder (BAD) engines of CABAD, as defined in the H.264/AVC video compression standard. The BAD is the most important CABAD process, which is the main entropy encoding method defined by the H.264/AVC standard. The BAD ...

Keywords: CABAD, H.264/AVC, entropy coding, CABAC, hardware dedicated architecture

[result highlights]

12 [A unified systolic architecture for combined inter and intra predictions in H.264/AVC decoder]

Chih-Hung Li, Chih-Chieh Chen, Wei-Chi Su, Ming-Jiun Wang, Wen-Hsiao Peng, Tihao Chiang, Gwo-Giun Lee

July 2006 IWCMC '06: Proceedings of the 2006 international conference on Wireless communications and mobile computing

Publisher: ACM

Bibliometrics: Citation Count: 0
Downloads (6 Weeks): 0, Downloads (12 Months): 4, Downloads (Overall): 327

Full text available: PDF

This paper presents a unified systolic architecture for inter and intra predictions in H.264/AVC decoder. To increase hardware utilization and minimize cost, we combine inter and intra predictions by a reprogrammable FIR filter, which is further implemented using systolic array. For intra prediction, the boundary pixels are reshuffled before feeding ...

Keywords: intra prediction, H.264, motion compensation

[result highlights]

13 [Improving the memory behavior of vertical filtering in the discrete wavelet transform]

Asadollah Shahbahrami, Ben Juurlink, Stamatis Vassiliadis

May 2006 CF '06: Proceedings of the 3rd conference on Computing frontiers

Publisher: ACM

Bibliometrics: Citation Count: 3
Downloads (6 Weeks): 1, Downloads (12 Months): 4, Downloads (Overall): 228

Full text available: PDF

The discrete wavelet transform (DWT) is used in several image and video compression standards, in particular JPEG2000. A 2D DWT consists of horizontal filtering along the rows followed by vertical filtering along the columns.

It is well-known that a straightforward implementation of vertical filtering (assuming a row-major layout) induces many ...

Keywords: cache, memory hierarchy, discrete wavelet transform, performance

[result highlights]

14 An H.264 Quad-FullHD low-latency intra video encoder

Muhammad Usman Karim Khan, Jan Micha Borrmann, Lars Bauer, Muhammad Shafique, Jörg Henkel

March 2013 DATE '13: Proceedings of the Conference on Design, Automation and Test in Europe

Publisher: EDA Consortium

Bibliometrics: Citation Count: 1
Downloads (6 Weeks): 3, Downloads (12 Months): 7, Downloads (Overall): 40

Full text available: PDF

Video applications are moving from Full-HD capability (1920x1080) to even higher resolutions such as Quad-FullHD (3840x2160). The H.264 Intra-mode can be used by embedded devices to trade off the better encoding efficiency of H.264 temporal prediction (Inter-mode) against savings in area and power as well as saving the massive computational ...

[result highlights]

15 A VLSI architecture design of an edge based fast intra prediction mode decision algorithm for h.264/avc

Shen Li, Xianghui Wei, Takeshi Ikenaga, Satoshi Goto

March 2007 GLSVLSI '07: Proceedings of the 17th ACM Great Lakes symposium on VLSI

Publisher: ACM

Bibliometrics: Citation Count: 4
Downloads (6 Weeks): 1, Downloads (12 Months): 3, Downloads (Overall): 379

Full text available: PDF

The intra-frame coding in H.264/AVC has made significant contribution to the enhancement of coding efficiency. However it brings about a heavy computation burden in the rate distortion based (RD) mode decision (MD) process. Although the real-time encoding of 1280-720p signals is realized in recent works with existing algorithms, for higher ...

Keywords: VLSI architecture, H.264, fast intra prediction mode decision

[result highlights]

16 Motion driven adaptive transform based on wavelet transform for enhanced video coding

Nikola Sprljan, Marta Mrak, Ebroul Izquierdo

September 2006 MobiMedia '06: Proceedings of the 2nd international conference on Mobile multimedia communications

Publisher: ACM

Bibliometrics: Citation Count: 1
Downloads (6 Weeks): 0, Downloads (12 Months): 2, Downloads (Overall): 70

Full text available: PDF

Spatial wavelet transform in video coding has traditionally been applied in a non-adaptive fashion. However, since motion compensation introduces specific structure into video frames, adaptive spatial transform can introduce additional coding gain. As the structure introduced by motion compensation depends on applied motion parameters, the same motion information can be ...

Keywords: adaptive wavelet transform, intra coding, scalable video coding

[result highlights]

17 Efficient hardware solution for practical intra h.264/SVC video encoder implementation

Ronaldo Husemann, Altamiro Amadeu Susin, Valter Roesler, José Valdeni de Lima

August 2011 SBCCI '11: Proceedings of the 24th symposium on Integrated circuits and systems design

Publisher: ACM

Bibliometrics: Citation Count: 0
Downloads (6 Weeks): 2, Downloads (12 Months): 10, Downloads (Overall): 107

Full text available: PDF

The emergent standard H.264/SVC (scalable video coding) combines distinct complex techniques in order to allow efficient data compression considering data among consecutive layers. In practice, a complete implementation of this scalable encoder is not trivial, since the global complexity increases proportionally with the number of layers involved. Considering that, this ...

Keywords: fpga, h.264/svc, hardware design, scalable video coding, programmable logic

[result highlights]

18 Exploiting horizontal and vertical concurrency via the HPSm microprocessor

Wen-mei W. Hwu, Yale N. Patt

August 1988 ACM SIGMICRO Newsletter: Volume 19 Issue 3, Sept. 1988

Publisher: ACM

Bibliometrics: Citation Count: 0

Downloads (6 Weeks): 1, Downloads (12 Months): 1, Downloads (Overall): 21

Full text available: Pdf

HPSm is a single-chip microarchitecture designed and implemented at the University of California to achieve high performance. The approach is to exploit both vertical and horizontal concurracy in the microarchitecture. Experiments have been conducted to demonstrate the effectivenese of HPSm as compared is a popular single-chip microarchitecture, the Berkeley RISC/SPUR. ...

[result highlights]

19 A complexity-utility framework for modeling decoding complexity towards optimizing subjective quality of video for mobile devices

Özgür Deniz Önür, A. Aydın Alatan

October 2010 MoViD '10: Proceedings of the 3rd workshop on Mobile video delivery

Publisher: ACM

Bibliometrics: Citation Count: 0
Downloads (6 Weeks): 2, Downloads (12 Months): 4, Downloads (Overall): 40

Full text available: Pdf

In this paper, the complexity of decoding a video clip on a resource constrained mobile device is modeled in terms of content properties and hardware capabilities. It is discussed that the decoding complexity basically depends on specialized hardware that are utilized during the decoding process. A utility-based prediction framework that ...

Keywords: subjective utility, complexity-utility framework, decoding complexity

[result highlights]

20 SoftHV: a HW/SW co-designed processor with horizontal and vertical fusion

Abhishek Deb, Josep Maria Codina, Antonio González

April 2011 CF '11: Proceedings of the 8th ACM International Conference on Computing Frontiers

Publisher: ACM

Bibliometrics: Citation Count: 3
Downloads (6 Weeks): 1, Downloads (12 Months): 4, Downloads (Overall): 129

Full text available: PDF

In this paper we propose SoftHV, a high-performance HW/SW co-designed in-order processor that performs horizontal and vertical fusion of instructions. SoftHV consists of a co-designed virtual machine (Cd-VM) which reorders, removes and fuses instructions from frequently executed regions of code. On the hardware front, SoftHV implements HW features for efficient ...

Keywords: micro-op fusion, co-designed virtual machine

[result highlights]

Result 1 - 20 of 122,246 Result page: **1** 2 3 4 5 6 7 8 9 10 >>

Doc Code: DIST.E.FILE **Document Description: Electronic Terminal Disclaimer - Filed**	PTO/SB/26 U.S. Patent and Trademark Office Department of Commerce

Electronic Petition Request	**TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT**
Application Number	14823273
Filing Date	11-Aug-2015
First Named Inventor	Se-Yoon Jeong
Attorney Docket Number	022096.0037C2C2
Title of Invention	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR

☒ Filing of terminal disclaimer does not obviate requirement for response under 37 CFR 1.111 to outstanding Office Action

☒ This electronic Terminal Disclaimer is not being used for a Joint Research Agreement.

Owner	Percent Interest
INDUSTRY-ACADEMIA COOPERATION GROUP OF SEJONG UNIVERSITY 98, GUNJA-DONG, GWANGJIN-GU SEOUL, KOREA, REPUBLIC OF 143-747	100%
KWANGWOON UNIVERSITY RESEARCH INSTITUTE FOR INDUSTRY COOPERATION 447-1, WOLGYE-DONG, NOWON-GU SEOUL, KOREA, REPUBLIC OF 139-701	100%
ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE 161, GAJEONG-DONG, YUSEONG-GU DAEJON, KOREA, REPUBLIC OF 305-350	100%

The owner(s) with percent interest listed above in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of prior patent number(s)

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9225982

as the term of said prior patent is presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the prior patent, "as the term of said prior patent is presently shortened by any terminal disclaimer," in the event that said prior patent later:
- expires for failure to pay a maintenance fee;
- is held unenforceable;
- is found invalid by a court of competent jurisdiction;
- is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321;
- has all claims canceled by a reexamination certificate;
- is reissued; or
- is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

◉ Terminal disclaimer fee under 37 CFR 1.20(d) is included with Electronic Terminal Disclaimer request.

○ I certify, in accordance with 37 CFR 1.4(d)(4), that the terminal disclaimer fee under 37 CFR 1.20(d) required for this terminal disclaimer has already been paid in the above-identified application.

Applicant claims the following fee status:

◉ Small Entity

○ Micro Entity

○ Regular Undiscounted

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.

THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES

I certify, in accordance with 37 CFR 1.4(d)(4) that I am:

◉ An attorney or agent registered to practice before the Patent and Trademark Office who is of record in this application

Registration Number 69949

○ A sole inventor

○ A joint inventor; I certify that I am authorized to sign this submission on behalf of all of the inventors as evidenced by the power of attorney in the application

○ A joint inventor; all of whom are signing this request

Signature	/Joseph D Parish/
Name	Joseph D Parish

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

Electronic Patent Application Fee Transmittal

Application Number:	14823273
Filing Date:	11-Aug-2015
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:	Joseph D. Parish
Attorney Docket Number:	022096.0037C2C2

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
STATUTORY OR TERMINAL DISCLAIMER	2814	1	160	160
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	160

Doc Code: DISQ.E.FILE
Document Description: Electronic Terminal Disclaimer – Approved

Application No.: 14823273

Filing Date: 11-Aug-2015

Applicant/Patent under Reexamination: Jeong

Electronic Terminal Disclaimer filed on March 29, 2017

☒ APPROVED

This patent is subject to a terminal disclaimer

☐ DISAPPROVED

Approved/Disapproved by: Electronic Terminal Disclaimer automatically approved by EFS-Web

U.S. Patent and Trademark Office

Electronic Acknowledgement Receipt

EFS ID:	28772181
Application Number:	14823273
International Application Number:	
Confirmation Number:	7328
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:	Joseph D. Parish
Filer Authorized By:	
Attorney Docket Number:	022096.0037C2C2
Receipt Date:	29-MAR-2017
Filing Date:	11-AUG-2015
Time Stamp:	14:06:12
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$160
RAM confirmation Number	033017INTEFSW14061000
Deposit Account	505113
Authorized User	Joseph Parish

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Electronic Terminal Disclaimer-Filed	eTerminal-Disclaimer.pdf	36210 af971e58734b9da06c1a0d9f7f18832b1da6ceb7	no	3
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30759 d5b73d1679af6a2cadc5252ee5a1296c2aa34479	no	2
Warnings:					
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			Total Files Size (in bytes):	66969	

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. 022096.0037C2C2

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Se-Yoon Jeong et al.

Application No. 14/823,273 Art Unit: 2436

Confirmation No. 7328

Filed: August 11, 2015 Examiner: FIELDS, COURTNEY D

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

AMENDMENT UNDER 37 C.F.R. §1.111

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

Sir:

This is in response to the Office Action mailed September 27, 2016.

The following amendments and remarks are respectfully submitted. Reconsideration of the pending application is respectfully requested in view of the amendments and the following remarks.

A listing of the claims 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 underlining and deleted text with ~~strikethrough~~. The status of each claim is listed with one of (Original), (Currently Amended), (Cancelled), (Withdrawn), (Previously Presented), (New), and (Not Entered).

Please AMEND claims 1-3, and 5-6 and CANCEL claim 4 without prejudice or disclaimer in accordance with the following:

1. (Currently Amended) A decoding apparatus comprising:

an entropy decoding processor~~unit~~ configured to perform entropy decoding of an encoded video information in a bitstream to obtain transform coefficients;

a scanning decision processor~~unit~~ configured to select a scanning mode for the transform coefficients of a current block; and

a video recovery processor~~unit~~ configured to scan the transform coefficients based on the selected scanning mode;

wherein the scanning decision processor~~unit~~ is further configured to select the scanning mode based on an intra prediction mode of the current block ~~used to obtain difference values encoded to obtain the encoded video information~~, and

the scanning decision processor is further configured to select a horizontal scanning mode as the scanning mode when the intra prediction mode is a vertical intra prediction mode, and select a vertical scanning mode as the scanning mode when the intra prediction mode is a horizontal intra prediction mode.

2. (Currently Amended) The decoding apparatus of claim 1, wherein the scanning decision processor is further configured to select the scanning mode based on the intra prediction mode that was used to perform intra prediction of the current block to obtain difference values that were encoded to obtain the encoded video~~the difference values are differences between pixel values and predicted pixel values~~.

3. (Currently Amended) The decoding apparatus of claim 1, wherein the intra prediction mode is one of ~~a~~ the vertical intra prediction mode and ~~a~~ the horizontal prediction mode.

4. (Canceled)

5. (Currently Amended) A non-transitory computer-readable storage medium storing ~~a program for controlling a computer~~ instructions that, when executed by a processor, cause the processor to perform a method of decoding, the method comprising:

performing entropy decoding of encoded video information in a bitstream to obtain transform coefficients for a current block;

selecting a scanning mode for the transform coefficients; and

scanning the transform coefficients based on the selected scanning mode;

wherein the selecting of a scanning mode comprises selecting the scanning mode based on an intra prediction mode of the current block~~that was used to obtain difference values between pixel values and predicted pixel values~~.

6. (Original) The storage medium of claim 5, wherein the selecting of the scanning mode based on an intra prediction mode comprises:

selecting a horizontal scanning mode in response to the intra prediction mode being a vertical intra prediction mode; and

selecting a vertical scanning mode in response to the intra prediction mode being a horizontal intra prediction mode.

REMARKS

At the outset, the Office is thanked for the review and consideration of the pending application. The Office Action mailed September 27, 2016 (Office Action) has been received and its contents reviewed.

In accordance with the foregoing, claims 1-3, and 5-6 are pending, with claims 1 and 5 being independent. Applicant has amended claims 1-3, and 5 to advance prosecution and canceled claim 4 without prejudice or disclaimer. Support for the amendments is found in Applicant's Specification as originally filed. No new matter is presented in this Amendment.

Applicant has amended the claims solely to further prosecution for a disclosed embodiment, and not based on the merits of the outstanding rejections. Applicant reserves the right to prosecute broader claims or embodiments, including the original claims, in a continuing application.

Preliminary Remarks

a) Drawings:

The Office is thanked for acknowledging that the drawings filed on August 11, 2015 have been accepted.

b) Foreign Priority:

The Office is thanked for acknowledging Applicant's claim for foreign priority and that all of the certified copies of the priority document(s) have been received.

c) Information Disclosure Statement(s):

Applicant further thanks the Office for considering the Information Disclosure Statement(s) filed on August 11, 2015.

Double Patenting Rejections

Claims 1-6 were rejected on the ground of nonstatutory obviousness-type double patenting as being obvious over claims 1-2 of US Pat. 9,225,982 ('982) and claims 1-2 of US Pat 8,548,060 ('060).

Applicant has amended claim 1 to recite the feature of "perform entropy decoding of an encoded video information in a bitstream[1]" and "select a scanning mode for the transform

[1] Emphasis of claim language by highlighting, underlining, bold, or otherwise is done only to facilitate the Office's understanding and not to imply importance of one claim element over another.

coefficients <u>of a current block</u>." The '982 and '060 patents do not claim video information in a bitstream or transform coefficients of a current block. Applicant submits that the claims of the current Application differ in scope and are patentably distinct from the claims of the '982 and '060 patents.

In the Office Action, the Office states as follows:

> 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 performing entropy decoding of encoded video information to obtain transform coefficients and selecting of the scanning mode based on an intra prediction mode. The only difference between the claims is the omission of "between pixel values and predicted pixel values" or "based on an intra prediction mode". This omission does not change the scope of the claims because both the issued application and the instant application perform entropy decoding of encoded video to obtain transform coefficients and scanning based on intra prediction to obtain difference values.
>
> Claims 1-2 of US Patent No. 9,225,982 and US Patent No. 8,548,060 contains every element of claims 1-6, of the instant application and as such anticipates claims 1-6 of the instant application.

Office Action, at pp. 3-4. MPEP 804(II)(B)(1) stipulates as follows:

> Any obviousness-type double patenting rejection should make clear:
>
> (A) The <u>differences</u> between the inventions defined by the conflicting claims — a claim in the patent compared to a claim in the application; and
>
> (B) The <u>reasons why</u> a person of ordinary skill in the art would conclude that the invention defined in the claim at issue is anticipated by, or would have been an obvious variation of, the invention defined in a claim in the patent.

Applicants respectfully submit that the Office has failed to explain the differences between the inventions defined by the conflicting <u>claims</u>. That is, the differences between <u>claims</u> 1 and 2 of the '982 and '060 patents compared to <u>claims</u> 1-6 in the instant application.

The Office has also provided no reason why a person of ordinary skill in the art would conclude that the invention defined in the claims at issue is anticipated by, or would have been an obvious variation of, the invention defined in the claims of the '982 and '060 patents.

The Office's rationale for the Double Patenting rejection is that, the claims "are not patentably distinct from each other because the scope of the claims is the same for the instant application and the issued application" and "both the issued application and the instant application perform entropy decoding of encoded video to obtain transform coefficients and scanning based on intra prediction to obtain difference values." See Office Action, at pp.3-4.

However, a proper Double Patenting rejection must focus upon the claims. In asserting that both the issued application and the instant application *perform* entropy decoding of encoded video to obtain transform coefficients and scanning based on intra prediction to obtain difference values, the Office fails to consider a comparison of the claims of the issued patent and the pending application. A Double Patenting rejection does not compare "performance" of both the issued application and the instant application but necessarily instead focuses upon the claims.

The Office even recognizes that there are differences. Notably, the Office also states, "the conflicting claims are not identical." Office Action, at p. 3. The Office recognizes that "between pixel values and predicted pixel values" or "based on an intra prediction mode" are missing from the claims. If the Office recognizes that the claims are not identical, then, the Office must provide a reason as to why a person of ordinary skill in the art would deem the claims to be obvious variants. The Office provides no reason(s) as to why a person of ordinary skill in the art would deem the claims to be obvious variants.

Applicants submit therefore that the Office did not meet the Office's burden of establishing a proper Double Patenting rejection.

> "[T]he examiner bears the initial burden, on review of the prior art or on any other ground, of presenting a *prima facie* case of unpatentability. If that burden is met, the burden of coming forward with evidence or argument shifts to the applicant.... If examination at the initial stage does not produce a *prima facie* case of unpatentability, then without more the applicant is entitled to grant of the patent." See also *Fregeau v. Mossinghoff*, 776 F.2d 1034, 227 USPQ 848 (Fed. Cir. 1985) (applying *prima facie* case law to 35 U.S.C 101; *In re Piasecki*, 745 F.2d 1468, 223 USPQ 785 (Fed. Cir. 1984).

The Office has not provided a detailed rationale. *See* MPEP § 707.07(f) ("[w]here the applicant traverses any rejection, the examiner should, if he or she repeats the rejection, take note of the applicant's argument and answer the substance of it.") (emphasis added). Furthermore, MPEP § 707.07(f), however, incorrectly states that an examiner "should" answer all material traversed; rather, it is a statutory "must." Like all other decisions of all other federal agencies, the Administrative Procedure Act (APA) requires "[a]t a minimum, [an agency decision must] 'examine the relevant data and articulate a satisfactory explanation for its action including a rational connection between the facts found and the choice made." *Tourus Records Inc. v. Drug Enforcement Admin.*, 259 F.3d 731, 736–37 (D.C. Cir. 2001) (*citing Motor Vehicle Mfrs. Ass'n of United States, Inc. v. State Farm Mutual Auto. Ins. Co.*, 463 U.S. 29, 43 (1983)); 5 U.S.C. § 555(e) (agency must give a "brief statement of grounds").

In the event that the Office maintains the nonstatutory obviousness-type double patenting over claims 1-2 of copending '982 and '060 patents, Applicants respectfully request the Office to provide a detailed rationale addressing the specific features of instant claims 1-6 **so that the Applicants have the opportunity to fully respond**.

Claim Interpretation under 35 U.S.C. §112, sixth paragraph

The Office has interpreted claim elements "entropy decoding unit configured to", "scanning decision unit configured to" and "video recovery unit configured to" as invoking 35 U.S.C. §112, sixth paragraph. Applicant respectfully traverses this interpretation.

Without conceding the propriety of the Office's interpretation of the claims, Applicant has amended claims 1 and 2 top recite a processor. Because a processor is recognized as a structural element, Applicant submits that the claims do not invoke 35 U.S.C. §112, sixth paragraph. Applicant respectfully requests that the Office reconsider the interpretation of Applicants claims under 35 U.S.C. §112, sixth paragraph.

Claim Rejections Under 35 U.S.C. §102 and §103

Claims 1-3 and 5 were rejected under 35 U.S.C. §102(e) as being anticipated by US Pub. 2006/0002466 to Park (Park). Claims 4 and 6 were rejected under 35 U.S.C. §103(a) as being obvious over Park in view of US Pat. 7,995,654 to Boon et al. (Boon). Applicant respectfully traverses these rejections.

As described in the Specification, Park describes a prediction encoder including a prediction encoding unit which starts prediction from an origin macroblock of an area of interest of a video frame, continues prediction in a direction of ripple scanning with respect to a square ring that includes macroblocks and surrounds the origin macroblock, and encodes video by performing intra-prediction in 8×8 block units using information about a macroblock that has been just coded in a present 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 previous square ring which is inner square ring adjacent to the present square ring. Park further describes that the prediction encoding unit may predict a DCT coefficient of each block of the macroblock to be coded using a DCT coefficient of each block of the origin macroblock or a DCT coefficient of each block of the macroblock A, when the macroblock to be coded is a first macroblock after completion of encoding of the origin macroblock or there exist two reference macroblocks of the macroblock to be coded, wherein the two reference macroblocks includes a macroblock A that is included in the present square ring and has been just coded and a macroblock D that is included in the present square ring and is adjacent to the macroblock to be coded. See paragraphs [0026] – [0027]. Park further describes that the intra-prediction mode uses information of a predetermined scanning order. See paragraph [0179], [0187] – [0188].

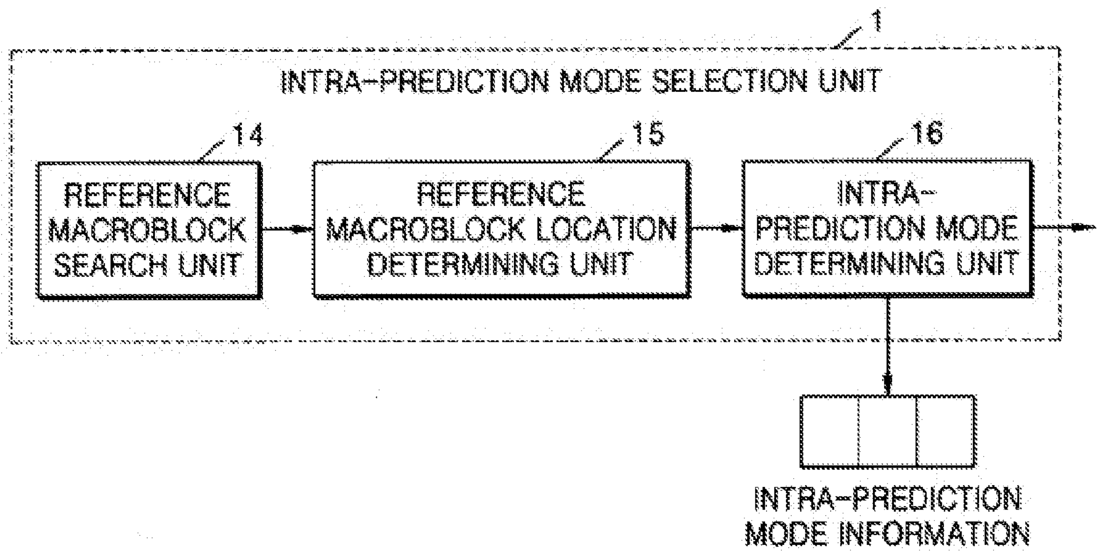
Independent Claims 1 and 5

However, Park fails to describe each and every feature of independent claim 1, **because Park does not describe or suggest**, at least, “wherein the scanning decision processor is further configured to select the scanning mode based on an intra prediction mode of the current block," as instantly claimed by Applicants.

In rejecting claim 1, the Office asserts that Park discloses a **selecting the scanning mode based on an intra prediction mode used to obtain difference values encoded to obtain the encoded video information in paragraphs [0187]-[0189].** Applicants respectfully disagree that Park discloses selecting the scanning mode **based on an intra prediction mode.**

Instead, Park describes that an intra-prediction mode determining unit determines a mode having a minimum sum of absolute differences between a macroblock to be coded and each predicted macroblock in an intra-prediction mode according to a **predetermined scanning order**. See paragraphs [0179] and [0187]. In other words, Park describes that the scanning order is already chosen and fixed, and not selected.

Paragraph [0165] of Park discloses "a ripple scan unit 8" and paragraph [0173] discloses "These coefficients X are ripple scanned by the ripple scan unit 8 and are then entropy encoded by the entropy encoding unit 9." Park, at ¶ [0173]. Thus, it appears the predetermined scanning order is a ripple scan. Therefore, Applicants submit that Park fails to disclose selecting a scanning mode based on an intra prediction mode. In fact, Park discloses that a scanning mode is **already predetermined** and thus not selected based on any criteria, contrary to Applicants' instant claim 1.



Park describes that the intra-prediction mode determining unit (16) determines a mode according to an already **predetermined** scanning order, rather than selecting a scanning order as recited in Applicants' claim 1.

Because Park fails to disclose or suggest "select[ing] the scanning mode based on an intra prediction mode," Applicants submit that Park fails to disclose all of the features of claim 1. For at least the foregoing reasons, it is respectfully requested that claim 1 is in condition for allowance.

Applicant has amended claim 1 to recite "the scanning decision processor is further configured to select a horizontal scanning mode as the scanning mode when the intra prediction mode is a vertical intra prediction mode, and select a vertical scanning mode as the scanning mode when the intra prediction mode is a horizontal intra prediction mode," which was previously recited in claim 4. Claim 4 has been canceled. The Office relies on Boon to teach this element.

Contrary to the Office's assertions, Boon fails to disclose that the scanning mode is selected to be a horizontal scanning mode when the selected intra prediction mode is a vertical intra prediction mode, and the scanning mode is selected to be a vertical scanning mode when the selected intra prediction mode is a horizontal intra prediction mode. Rather, Boon describes a prediction method capable of generating prediction image data of a spatial region, and mentions sequences of a horizontal scan, a vertical scan, and a zigzag scan. See column 42 lines 41-45, FIGS. 27-29. However, Boon fails to mention any connection between a scanning mode and an intra prediction mode, much less that "the scanning mode is selected to be a horizontal scanning mode when the selected intra prediction mode is a vertical intra prediction mode, and the scanning mode is selected to be a vertical scanning mode when the selected intra prediction mode is a horizontal intra prediction mode," as instantly claimed in claim 1.

Fig.27

0	1	2	3	10	11	12	13
4	5	8	9	17	16	15	14
6	7	19	18	26	27	28	29
20	21	24	25	30	31	32	33
22	23	34	35	42	43	44	45
36	37	40	41	46	47	48	49
38	39	50	51	56	57	58	59
52	53	54	55	60	61	62	63

Horizontal Scanning

Fig.28

0	4	6	20	22	36	38	52
1	5	7	21	23	37	39	53
2	8	19	24	34	40	50	54
3	9	18	25	35	41	51	55
10	17	26	30	42	46	56	60
11	16	27	31	43	47	57	61
12	15	28	32	44	48	58	62
13	14	29	33	45	49	59	63

Vertical Scanning

Fig.29

0	1	5	6	14	15	27	28
2	4	7	13	16	26	29	42
3	8	12	17	25	30	41	43
9	11	18	24	31	40	44	53
10	19	23	32	39	45	52	54
20	22	33	38	46	51	55	60
21	34	37	47	50	56	59	61
35	36	48	49	57	58	62	63

Zigzag Scanning

Boon fails to mention any connection between a scanning mode and an intra prediction mode, contrary to Applicants' claimed invention.

Accordingly, reconsideration of the rejection and allowance of claim 1 is respectfully requested.

Independent claim 5, which has its own scope, recites similar features to claim 1, and therefore, the arguments above apply to claim 5 as well as claim 1.

For at least the reasons stated above, the cited references, taken alone or in combination, fail to disclose or suggest each of the elements recited in claims 1 and 5, and therefore, the present rejection of claims 1 and 5 should be withdrawn.

The dependent claims 2-3 and 6 depend from their respective allowable independent claims. Therefore, the rejections of claims 2-3 and 6 should be withdrawn for at least the reasons discussed above and for the additional features recited that are not disclosed in the cited references.

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.

In the event this paper is not being timely filed, the Applicant respectfully petitions for an appropriate extension of time. Any fees for such an extension together with any additional fees only associated with the processing of this Response and any other documents filed concurrently with this Response may be charged to Counsel's Deposit Account 50-5113.

Respectfully submitted,

Date: December 27, 2016

/Joseph D Parish/

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Electronic Acknowledgement Receipt

EFS ID:	27908016
Application Number:	14823273
International Application Number:	
Confirmation Number:	7328
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:	Joseph D. Parish
Filer Authorized By:	
Attorney Docket Number:	022096.0037C2C2
Receipt Date:	27-DEC-2016
Filing Date:	11-AUG-2015
Time Stamp:	16:34:54
Application Type:	Utility under 35 USC 111(a)

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		OA20160927_0220960037C2C2_20161227RespasFiled.pdf	329565 42e31c16b3cfef1a9e22058a1a4705d2facacd37	yes	12

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	3
	Applicant Arguments/Remarks Made in an Amendment	4	12

Warnings:

Information:

Total Files Size (in bytes):	329565

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 14/823,273	Filing Date 08/11/2015	☐ 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	12/27/2016	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))	* 5	Minus	** 20	= 0	x $40 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	***3	= 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	**0**

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
CORALIA BETANCOURT

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/823,273	08/11/2015	Se-Yoon Jeong	022096.0037C2C2	7328

89980 7590 09/27/2016
NSIP LAW
P.O. Box 65745
Washington, DC 20035

EXAMINER
FIELDS, COURTNEY D

ART UNIT	PAPER NUMBER
2496	

NOTIFICATION DATE	DELIVERY MODE
09/27/2016	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)

Office Action Summary	Application No. 14/823,273	Applicant(s) JEONG ET AL.	
	Examiner COURTNEY FIELDS	Art Unit 2436	AIA (First Inventor to File) Status No

-- 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* MONTHS 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 *11 August 2015*.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

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) *1-6* 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) *1-6* 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 *11 August 2015* 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).

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)).

** 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/08a and/or PTO/SB/08b)
Paper No(s)/Mail Date *11 August 2015*.

3) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.

4) ☐ Other: _____.

DETAILED ACTION

1. The present application is being examined under the pre-AIA first to invent provisions.

2. Claims 1-6 remain pending.

Information Disclosure Statement

3. The Information Disclosure Statement respectfully submitted on 11 August 2015 has been considered by the Examiner.

Continued Prosecution Application

4. This application is a continuation of Serial No. 13/975,251 filed on 23 August 2013 which is now, US Patent No. 9,225,982, issued on 29 December 2015 and Serial No. 12/377,617 filed on 16 February 2009 which is now, US Patent No. 8,548,060, issued on 01 October 2013.

Double Patenting

5. 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).

1. Claims 1-6 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-2 of U.S. Patent No. 9,225,982 and 1-2 of U.S. Patent No. 8,548,060. 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 performing entropy decoding of encoded video information to obtain transform coefficients and selecting of the scanning mode based on an intra prediction mode. The only difference between the claims is the omission of "between pixel values and predicted pixel values" or "based on an intra prediction mode". This omission does not change the scope of the claims because both the issued application and the instant application perform entropy decoding of encoded video to obtain transform coefficients and scanning based on intra prediction to obtain difference values.

4. Claims 1-2 of US Patent No. 9,225,982 and US Patent No. 8,548,060 contains every element of claims 1-6, of the instant application and as such anticipates claims 1-6 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).

35 USC § 112 6th paragraph – Claim Interpretation

Claim limitations “entropy decoding unit configured to”, “scanning decision unit configured to” and “video recovery unit configured to” have been interpreted under 35 U.S.C. 112, sixth paragraph, because it uses a non-structural term “unit configured to” coupled with functional language “perform entropy decoding”, “select a scanning mode”, “scan the transform coefficients”, “select the scanning mode based on an intra prediction mode”, “select 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” without reciting sufficient structure to achieve the function. Furthermore, the non-structural term is not preceded by a structural modifier. A unit configured to is a substitute for means plus function “means for” and is not recognized as the name of the structure.

Since this claim limitation invokes 35 U.S.C. 112, sixth paragraph, claims 1 and 4 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 11, a decoding apparatus is shown to perform the steps of using an adaptive DCT coefficient scanning based on pixel similarity.

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

1. The following is a quotation of the appropriate paragraphs of pre-AIA 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.

2. Claims 1-3 and 5 are rejected under pre-AIA 35 U.S.C. 102(e) as being anticipated by Park (Pub No. 2006/0002466).

Referring to the rejection of claim 1, Park discloses a decoding apparatus comprising: **(See Park, Fig. 9, para. 178)** an entropy decoding unit configured to perform entropy decoding of an encoded video information to obtain transform coefficients; **(See Park, Fig. 9, para. 178)**

a scanning decision unit configured to select a scanning mode for the transform coefficients; **(See Park, para. 179)**

and a video recovery unit configured to scan the transform coefficients based on the selected scanning mode; **(See Park, para. 180-181)**

wherein the scanning decision unit is further configured to select the scanning mode based on an intra prediction mode used to obtain difference values encoded to obtain the encoded video information. **(See Park, para. 187-189)**

Referring to the rejection of claim 2, Park discloses wherein the difference values are differences between pixel values and predicted pixel values. **(See Park, para. 187)**

Referring to the rejection of claim 3, Park discloses wherein the intra prediction mode is one of a vertical intra prediction mode and a horizontal prediction mode. **(See Park, Fig. 13 and para. 222-223)**

Referring to the rejection of claim 5, Park discloses a non-transitory computer-readable storage medium storing a program for controlling a computer to perform a method of decoding, the method comprising: **(See Park, Fig. 9, para. 178)** performing entropy decoding of encoded video information to obtain transform coefficients; **(See Park, para. 178-179)**

selecting a scanning mode for the transform coefficients; **(See Park, para. 179)**

and scanning the transform coefficients based on the selected scanning mode; **(See Park, para. 180-181)**

wherein the selecting of a scanning mode comprises selecting the scanning mode based on an intra prediction mode that was used to obtain difference values between pixel values and predicted pixel values. **(See Park, para. 187-189)**

Claim Rejections - 35 USC § 103

3. The following is a quotation of pre-AIA 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.

2. Claims 4 and 6 rejected under pre-AIA 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 selecting a horizontal scanning mode when the intra prediction mode is a vertical intra prediction mode; and selecting a vertical scanning mode when the intra prediction mode is a horizontal intra prediction mode.

Boon et al. discloses image predictive coding method for storing digital image data of an image which is a static image or dynamic image into a recording medium for transmitting data through a communication line.

Referring to the rejection of claim 4, (Park modified by Boon et al.) 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 selecting a vertical scanning mode when the optimal intra prediction mode is a horizontal intra prediction mode. **(See Boon et al., Figs. 27-29, Col. 42, lines 41-45)**

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 modified with Boon et al.'s image predictive coding method for storing digital image data of an image which is a static image or dynamic image into a recording medium for transmitting data through a communication line. 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 claim 6, (Park modified by Boon et al.) wherein the selecting of the scanning mode based on an intra prediction mode comprises: selecting a horizontal scanning mode in response to the intra prediction mode being a vertical intra prediction mode; and selecting a vertical scanning mode in response to the intra prediction mode being a horizontal intra 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 4.

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 - Fri. 8:00 - 4:30 pm; IFP.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shewaye Gelagay can be reached on (571) 272-4219. 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 FIELDS/
Examiner, Art Unit 2436
September 15, 2016

/SHEWAYE GELAGAY/
Supervisory Patent Examiner, Art Unit 2436

Notice of References Cited	Application/Control No. 14/823,273	Applicant(s)/Patent Under Reexamination JEONG ET AL.	
	Examiner COURTNEY FIELDS	Art Unit 2436	Page 1 of 1

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*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-2006/0002466 A1	01-2006	Park; Gwang-hoon	H04N19/196	375/240.03
*	B	US-7,995,654 B2	08-2011	Boon; Choong Seng	H04N19/619	375/240.12
	C	US-				
	D	US-				
	E	US-				
	F	US-				
	G	US-				
	H	US-				
	I	US-				
	J	US-				
	K	US-				
	L	US-				
	M	US-				

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*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
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	S					
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NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
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APPLICANTS

Electronics and Telecommunications Research Institute, Daejeon, KOREA, REPUBLIC OF;
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** **CONTINUING DATA** *************************

This application is a CON of 13/975,251 08/23/2013 PAT 9225982
which is a CON of 12/377,617 02/16/2009 PAT 8548060
which is a 371 of PCT/KR2007/001433 03/23/2007

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

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

** **IF REQUIRED, FOREIGN FILING LICENSE GRANTED** ** ** SMALL ENTITY **
08/25/2015

		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	6	2

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

TITLE

BIB (Rev. 05/07).

Substitute for form 1449/PTO	Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Application Number	~~New Application~~ 14/823,273
(Use as many sheets as necessary)	Filing Date	Concurrently Herewith
	First Named Inventor	Se-Yoon Jeong
	Art Unit	~~Not Yet Assigned~~ 2436
	Examiner Name	~~Not Yet Assigned~~ C.Fields
Sheet 1 of 2	Attorney Docket Number	022096.0037C2C2

Substitute for PTO/SB/08a/b

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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
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	B	7,817,718 B2	10-19-2010	Wang et al.	
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	I	2003/0081850 A1	05-01-2003	Karczewicz et al.	
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	M	2013/0343452 A1	12-26-2013	Electronics and Telecommunications Research Institute et al.	
	N	2014/0037000 A1	02-06-2014	Electronics and Telecommunications Research Institute et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.F./

Examiner Signature	/Courtney Fields/	Date Considered	09/15/2016

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Substitute for form 1449/PTO	Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Application Number	~~New Application~~ 14/823,273
(Use as many sheets as necessary)	Filing Date	Concurrently Herewith
	First Named Inventor	Se-Yoon Jeong
	Art Unit	~~Not Yet Assigned~~ 2436
	Examiner Name	~~Not Yet Assigned~~ C. Fields
Sheet **2** of **2**	Attorney Docket Number	022096.0037C2C2

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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]
	a	EP 0 230 632 A2	08-05-1987	Nishizawa		
	b	EP 2 207 359 A2	07-14-2010	Ding		
	c	JP 2003-6643 A	01-10-2003	Fukuda		
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	f	KR 2002-0006149 A	01-19-2002	Chun		
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	h	WO 2008/020672 A1	02-21-2008	Electronics and Telecommunications Research Institute et al.		

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	1	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).	
	2	International Search Report and Written Opinion of the International Searching Authority issued on June 29, 2007, in counterpart International Application No. PCT/KR2007/001433.	
	3	H. Zrida et al., "High Level H.264/AVC Video Encoder Parallelization for Multiprocessor Implementation"; *Proceedings of the 2009 Design, Automation & Test in Europe Conference & Exhibition (DATE '09)*, pp. 940-945, conference held April 20-24, 2009, Nice, France, ISBN 978-3-9810801-5-5.	

Examiner Signature	/Courtney Fields/	Date Considered	09/15/2016

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Index of Claims	Application/Control No. 14823273	Applicant(s)/Patent Under Reexamination JEONG ET AL.
	Examiner COURTNEY FIELDS	**Art Unit** 2436

✓	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	09/15/2016								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								

Patents

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SEARCH TERMS

prediction ✕ + Synonym

decoding ✕ + Synonym

entropy ✕ + Synonym

scanning ✕ + Synonym

video ✕ + Synonym

pixel values ✕ + Synonym

+ Search term or CPC

SEARCH FIELDS

Before 2006-08-17 ✕

+ Assignee

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grouped by classification

H04N19/90?

Methods or arrangements for coding, decoding, compressing or decompressing digital video signals using coding techniques not provided for in groups H04N19/10-H04N19/85, e.g. fractals

Variable length coding

Grant US6696993B2 • Marta Karczewicz • Nokia Corporation

Priority 2001-03-23 • Filing 2002-03-22 • Grant 2004-02-24 • Publication 2004-02-24

58. A **decoder** for variable length **decoding** variable length codewords, including means for receiving a stream of variable length codewords representative of data symbols, said data symbols being arranged in a number of sets of data symbols, ...

Search within classification H04N19/90 (3,029 results)

H04N19/147?

Data rate or code amount at the encoder output according to rate distortion criteria

Sub-block transform coding of **prediction** residuals

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Patents

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SEARCH TERMS

prediction ✕ + Synonym

decoding ✕ + Synonym

entropy ✕ + Synonym

scanning ✕ + Synonym

video ✕ + Synonym

pixel values ✕ + Synonym

+ Search term or CPC

SEARCH FIELDS

Before 2006-08-17 ✕

+ Assignee

MORE

Grant US7266149B2 • Thomas W. Holcomb • Microsoft Corporation
Priority 2001-12-17 • Filing 2002-12-17 • Grant 2007-09-04 • Publication 2007-09-04
Techniques and tools for sub-block transform coding are described. For example, a **video** encoder adaptively switches between 8×8, 8×4, and 4×8 DCTs when encoding 8×8 **prediction** residual blocks; a corresponding **video decoder** switches between ...

The H. 264/AVC advanced **video** coding standard: Overview and introduction to the fidelity range extensions

Google Scholar • 212.59.112.227 • Sullivan G • Optical Science and Technology, the SPIE 49th Annual Meeting
Publication 2004
... motion compensation loop) ♦ Coefficient **scanning** o Zig-Zag (Frame) o Field ♦ Lossless **Entropy** coding o ... pictures can be used as references for interframe **prediction** during the **decoding** of later ... It is noteworthy that, unlike in prior standards, pictures that use bi-**prediction** can be ...

Search within classification H04N19/147 (1,782 results)

H04N7/141?

Systems for two-way working between two video terminals, e.g. videophone

Digital **video** coding standards and their role in **video** communications

Google Scholar • www.cs.sfu.ca • Schafer R • Proceedings of the IEEE
Publication 1995
... words are concatenated to form a stream of binary digits (bits), then correct **decoding** by a ... intensity of the component block and is encoded using a differential dc **prediction** method.' The ... of "zig-zag" **scanning** for ordering the coefficients prior to run-length **entropy** coding using ...

Search within classification H04N7/141 (356 results)

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SEARCH TERMS

prediction ✕ + Synonym

decoding ✕ + Synonym

entropy ✕ + Synonym

scanning ✕ + Synonym

video ✕ + Synonym

pixel values ✕ + Synonym

+ Search term or CPC

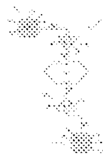
SEARCH FIELDS

Before 2006-08-17 ✕

+ Assignee

MORE

Context adaptive variable length decoding system and method

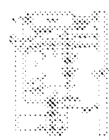


Grant US6646578B1 • James Au • Ub Video Inc.

Priority 2002-11-22 • Filing 2002-11-22 • Grant 2003-11-11 • Publication 2003-11-11

A system and method to perform context-adaptive variable length **decoding** (CAVLC) of transform coefficient levels for block-based motion-compensated **decoding** of moving pictures, corresponding to transform coefficients. The system and method …

Adaptive variable length coding of digital video



Grant US6690307B2 • Marta Karczewicz • Nokia Corporation

Priority 2002-01-22 • Filing 2002-01-22 • Grant 2004-02-10 • Publication 2004-02-10

21. A **decoder** according to claim 19 , provided in a **video decoder**. 22. A **decoder** according to claim 19 , implemented as machine executable code stored on a computer readable storage medium. 23. A **decoder** according to claim 19 , wherein the …

Prediction encoder/decoder, prediction encoding/decoding method, and computer …

Application US20050265447A1 • Gwang-Hoon Park • Industry Academic Cooperation Foundation Kyunghee Univ.

Priority 2004-05-25 • Filing 2005-04-22 • Publication 2005-12-01

A **prediction** encoder/**decoder**, a **prediction** encoding/**decoding** method, and a computer readable recording medium having a program for the **prediction** encoding/**decoding** method recorded thereon. The **prediction** encoder includes a **prediction** …

Video coding using the H. 264/MPEG-4 AVC compression standard

Google Scholar • pdfs.semanticscholar.org • Puri A • Signal processing: Image communication

Publication 2004

Patents

SEARCH TERMS

prediction ✕ + Synonym

decoding ✕ + Synonym

entropy ✕ + Synonym

scanning ✕ + Synonym

video ✕ + Synonym

pixel values ✕ + Synonym

+ Search term or CPC

SEARCH FIELDS

Before 2006-08-17 ✕

+ Assignee

MORE

... to earlier standards and discusses the operation of encoding and **decoding** compliant to ... 3 introduces **prediction** modes such as intra **prediction**, motion compensated **prediction** including multiple ... Section 5, focuses on **entropy** coding techniques such as context adaptive VLC ...

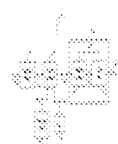
... program, image **decoding** apparatus, image **decoding** method, and image **decoding** ...

Application US20050163216A1 • Choong Boon • Ntt Docomo, Inc.

Priority 2003-12-26 • Filing 2004-12-23 • Publication 2005-07-28

The image encoding apparatus of one embodiment of the present invention comprises a coding mode determination unit, a **prediction** image generation unit, a storage unit, and an encoding unit. The coding mode determination unit determines a ...

Method and system for context-based adaptive binary arithmetic coding



Grant US6856701B2 • Marta Karczewicz • Nokia Corporation

Priority 2001-09-14 • Filing 2001-11-27 • Grant 2005-02-15 • Publication 2005-02-15

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 ...

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S209	11	(entropy adj decoding) and (scanning) and (video adj recovery) and (intra adj prediction) and (coefficients) and (pixel adj values) and (H04N19/159 or H04N19/18 or H04N19/13 or H04N19/91 or H04N19/182 or H04N19/129 or H04N19/61 or H04N19/136 or H04N19/176 or H04N19/11 or H04N19/103).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/09/15 22:33
S208	11	(entropy adj decoding) and (scanning) and (video adj recovery) and (intra adj prediction) and (H04N19/159 or H04N19/18 or H04N19/13 or H04N19/91 or H04N19/182 or H04N19/129 or H04N19/61 or H04N19/136 or H04N19/176 or H04N19/11 or H04N19/103).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/09/15 22:32
S207	96780	(H04N19/159 or H04N19/18 or H04N19/13 or H04N19/91 or H04N19/182 or H04N19/129 or H04N19/61 or H04N19/136 or H04N19/176 or H04N19/11 or H04N19/103).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/09/15 22:30
S199	29	"entropy decoding" and "video" and "pixel values"	FPRS; EPO; JPO; DERWENT	OR	ON	2015/09/16 16:31
S198	10	"entropy decoding" same "video" and "pixel values"	FPRS; EPO; JPO; DERWENT	OR	ON	2015/09/16 16:31
S197	9	"entropy decoding" same "video" same "pixel values"	FPRS; EPO; JPO; DERWENT	OR	ON	2015/09/16 16:30
S196	373	"entropy decoding" same "video"	FPRS; EPO; JPO; DERWENT	OR	ON	2015/09/16 16:30
S195	61229	(entropy decoding) and (video)	FPRS; EPO; JPO; DERWENT	OR	ON	2015/09/16 16:29
S194	12	"entropy decoding" and "scanning" and "intra prediction" and "horizontal intra prediction" and "vertical intra prediction" and "coefficients" and "encoded video"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/05/28 12:34
S193	24	"entropy decoding" and "scanning" and "intra prediction" and "horizontal	US-PGPUB; USPAT;	OR	ON	2015/05/28 12:34

		intra prediction" and "vertical intra prediction" and "coefficients"	USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
S192	26	"entropy decoding" and "scanning" and "intra prediction" and "horizontal intra prediction" and "vertical intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/05/28 12:34
S191	29	"entropy decoding" and "scanning" and "intra prediction" and "horizontal intra" and "vertical intra"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/05/28 12:33
S190	0	"entropy decoding" and "scanning" and "intra prediction" and "horizontal intra" and "vertial intra"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2015/05/28 12:33
S189	30	"entropy decoding" and "scanning" and "intra prediction" and "horizontal intra"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2015/05/28 12:33
S188	1161	"entropy decoding" and "scanning" and "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2015/05/28 12:33
S187	2	"7995654".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2015/01/24 23:28
S186	26	"2006002466"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2015/01/24 23:12
S185	53	"entropy decoding" and "encoded video" and "coefficients" and "vertical scanning" and "intra prediction" and "horizontal scanning" and "pixel values"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/01/24 22:39

S184	72	"entropy decoding" and "video" and "encoding" and "coefficients" and "vertical scanning" and "intra prediction" and "horizontal scanning" and "pixel values"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/01/24 22:39
S183	73	"entropy decoding" and "video" and "encoding" and "coefficients" and "vertical scanning" and "intra prediction" and "horizontal scanning"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/01/24 22:39
S182	78	"entropy decoding" and "video" and "encoding" and "coefficients" and "vertical scanning" and "intra prediction"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/01/24 22:39
S181	80	"entropy decoding" and "video" and "encoding" and "coefficients" and "vertical scanning"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/01/24 22:38
S180	4305	"entropy decoding" and "video" and "encoding" and "coefficients"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/01/24 22:38
S179	4	(H04N19/00218 and H04N19/159 and H04N19/136 and H04N19/61 and H04N19/129 and H04N19/103 and H04N19/11 and H04N19/176).CPC. and "entropy decoding" and "video" and "encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/01/24 22:37
S178	24	(H04N19/00218 and H04N19/159 and H04N19/136 and H04N19/61 and H04N19/129 and H04N19/103 and H04N19/11 and H04N19/176).CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/01/24 22:33
S170	105	375/240.2.ccls. and "entropy encoding"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 14:08
S169	291	375/240.2.ccls. and "entropy"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	OFF	2013/05/13 14:08

			DERWENT; IBM_TDB			
S168	1000	375/240.2.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 14:07
S167	0	375/240.20.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 14:07
S166	0	375/240.200.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 14:06
S165	0	375/240.2.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 14:06
S164	0	375/240.200.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 14:06
S163	4	"20070274385" "20050074062"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 13:09
S162	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
S161	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
S160	2	375/240.16.ccls. and "entropy encoding" same "optimal" same "intra prediction" same "coefficients"	US-PGPUB; USPAT; USOCR;	OR	OFF	2013/05/13 12:38

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S159	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
S158	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
S157	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
S156	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
S146	24	encoder and decoder and "intra prediction" and "entropy"	EPO; JPO; DERWENT	OR	OFF	2013/05/13 12:21
S145	152	encoder and decoder and "intra prediction"	EPO; JPO; DERWENT	OR	OFF	2013/05/13 12:18
S144	1	S139 and S143	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:17
S143	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
S142	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
S141	1	"video recovery" near5 "scanning mode"	US-PGPUB; USPAT; USOCR;	OR	OFF	2013/05/13 12:15

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S140	3134865	"video recovery" near5 scanning mode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/05/13 12:14
S139	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
S138	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
S137	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" same "horizontal"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 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;	OR	OFF	2012/11/07

			USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			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; IBM_TDB	OR	OFF	2012/11/07 19:07
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;	OR	OFF	2012/11/07 18:44

			IBM_TDB			
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; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:33
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;	OR	OFF	2012/11/07 18:30

			JPO; DERWENT; IBM_TDB			
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 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
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	US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	2012/11/07 18:11

		"video" and "entropy encoding" and "DCT" and "quantization" and "coefficients" and "horizontal" and "vertical" and "scanning" and "residual signals"	JPO; DERWENT; IBM_TDB			
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 "DCT" and "quantization"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 18:11
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;	OR	OFF	2012/11/07 18:10

			JPO; DERWENT; IBM_TDB			
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 encod$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/11/07 17:57
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;	OR	OFF	2012/11/07 17:54

			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
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 encoding" and "horizontal" and "zigzag"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 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; IBM_TDB	OR	OFF	2012/08/16 16:46
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;	OR	OFF	2012/08/16 16:44

			DERWENT; IBM_TDB			
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; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/16 16:43
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;	OR	OFF	2012/08/16 16:41

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
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; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/08/15 16:42
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	US-PGPUB;	OR	OFF	2012/08/15

		"quantization" same "intra" and "entropy encoding"	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			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;	OR	OFF	2012/08/15 16:24

			IBM_TDB			
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; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:40
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;	OR	OFF	2012/03/18 13:35

			JPO; DERWENT; IBM_TDB			
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; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:34
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;	OR	OFF	2012/03/18 13:32

			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
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)) same "scanning"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 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; IBM_TDB	OR	OFF	2012/03/18 13:28
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;	OR	OFF	2012/03/18 13:27

			DERWENT; IBM_TDB			
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; JPO; DERWENT; IBM_TDB	OR	OFF	2012/03/18 13:26
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;	OR	OFF	2012/03/18 13:25

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
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

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14823273	JEONG ET AL.
	Examiner	**Art Unit**
	COURTNEY FIELDS	2436

CPC- SEARCHED

Symbol	Date	Examiner
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H04N 19/18	09/15/2016	CDF
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H04N 19/91	09/15/2016	CDF
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H04N 19/129	09/15/2016	CDF
H04N 19/61	09/15/2016	CDF
H04N 19/136	09/15/2016	CDF
H04N 19/176	09/15/2016	CDF
H04N 19/11	09/15/2016	CDF
H04N 19/103	09/15/2016	CDF

CPC COMBINATION SETS - SEARCHED

Symbol	Date	Examiner

US CLASSIFICATION SEARCHED

Class	Subclass	Date	Examiner

SEARCH NOTES

Search Notes	Date	Examiner
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Assignee Search	09/15/2016	CDF
Inventorship/Double Patenting Search	09/15/2016	CDF
NPL Search (Google Patent)	09/15/2016	CDF
Consulted with QAS Swann	09/15/2016	CDF
H04N 19/159 (See Search History)	09/15/2016	CDF
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SEARCH NOTES

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H04N 19/176 (See Search History)	09/15/2016	CDF
H04N 19/11 (See Search History)	09/15/2016	CDF
H04N 19/103 (See Search History)	09/15/2016	CDF

INTERFERENCE SEARCH

US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

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KOREAN INTELLECTUAL PROPERTY OFFICE

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This is to certify that the following application annexed hereto is a true copy from the records of the Korean Intellectual Property Office

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출 원 년 월 일 Filing Date	:	2007년 01월 26일 JAN. 26, 2007
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【서지사항】

【서류명】 특허출원서

【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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【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]_1통 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, 인트라 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 평

면 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 위

한 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 모

드 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 방

법으로는 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 모드

나 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 방향의 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 화

소들(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 유사성은 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 개

의 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】

<76>
$$S\_VER = \frac{1}{Variance(E, F, G, H)}$$

$$S\_HOR = \frac{1}{Variance(A, B, C, D)}$$

<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 화

소 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 $\beta \times$ S_VER 값을 비교하여(702), S_HOR 값이 $\beta \times$ S_VER 값보다 크면 수직(vertical) 스캐닝을 사용하고(703), S_HOR 값이 $\beta \times$ 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 입력 받아 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 같이 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 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%

<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 지그재그 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】

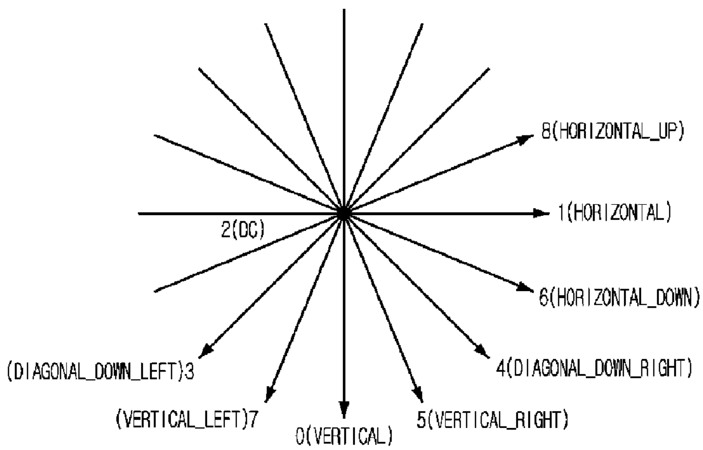
제 19 항에 있어서,

상기 결정된 스캐닝 모드는,

수평 방향 스캐닝 또는 수직 방향 스캐닝 또는 지그재그 스캐닝 중 어느 하나인 것을 특징으로 하는 복호화 방법.

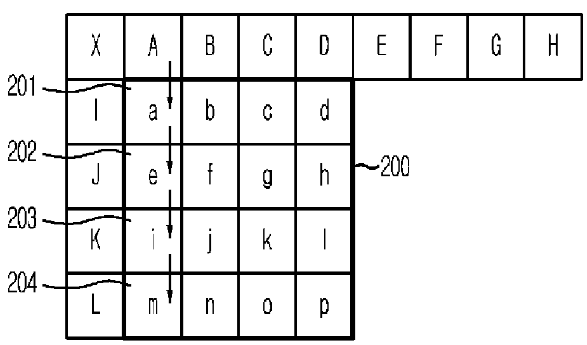
【도면】

【도 1】



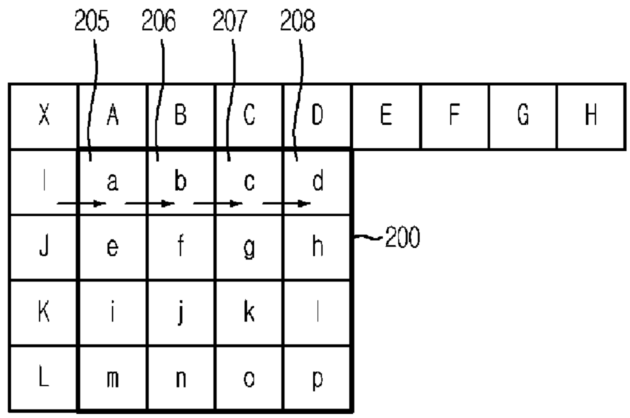
8(HORIZONTAL_UP)
1(HORIZONTAL)
2(DC)
6(HORIZONTAL_DOWN)
(DIAGONAL_DOWN_LEFT)3
4(DIAGONAL_DOWN_RIGHT)
(VERTICAL_LEFT)7
0(VERTICAL)
5(VERTICAL_RIGHT)

【도 2a】

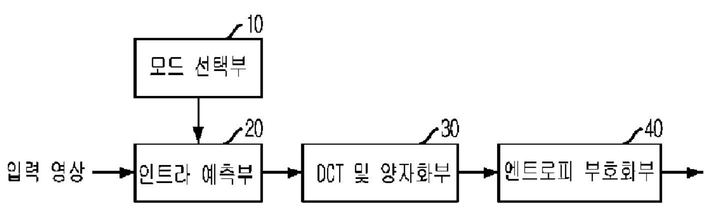


X A B C D E F G H
201 I a b c d
202 J e f g h
203 K i j k l
204 L m n o p
200

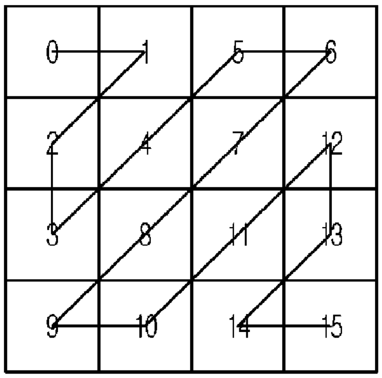
【도 2b】


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

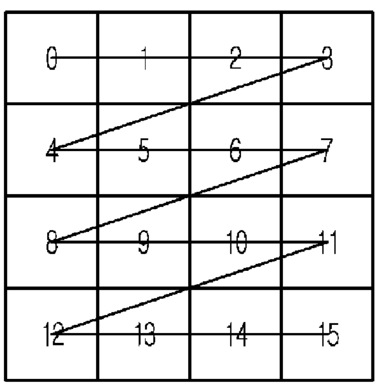
【도 3】


10
모드 선택부
20
30
40
입력 영상
인트라 예측부
DCT 및 양자화부
엔트로피 부호화부

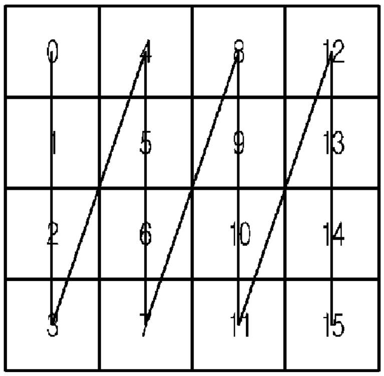
【도 4a】



【도 4b】



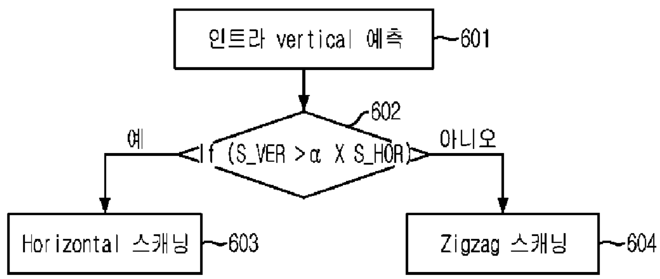
【도 4c】



【도 5】

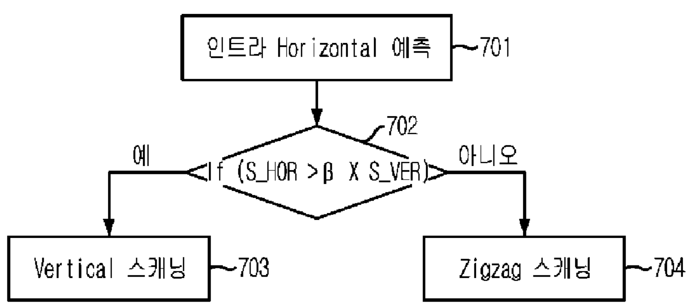
	A	B	C	D
E	a	b	c	d
F	e	f	g	h
G	i	j	k	l
H	m	n	o	p

【도 6】



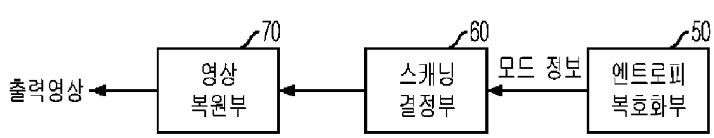
인트라 vertical 예측
601
602
예
If (S_VER > α X S_HOR)
아니오
Horizontal 스캐닝
603
Zigzag 스캐닝
604

【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

대 한 민 국 특 허 청
KOREAN INTELLECTUAL PROPERTY OFFICE

별첨 사본은 아래 출원의 원본과 동일함을 증명함.

This is to certify that the following application annexed hereto is a true copy from the records of the Korean Intellectual Property Office

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출 원 인 : 한국전자통신연구원 외 2명
Applicant(s) Electronics and Telecommunications Research Institute, et al.

2016년 04월 05일

특 허 청
COMMISSIONER

【서지사항】

【서류명】	특허출원서
【권리구분】	특허
【수신처】	특허청장
【제출일자】	2006.08.17
【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
【출원인】	
【명칭】	한국전자통신연구원
【출원인코드】	3-1998-007763-8
【출원인】	
【명칭】	세종대학교산학협력단
【출원인코드】	2-2005-011470-2
【출원인】	
【명칭】	광운대학교 산학협력단
【출원인코드】	2-2004-010265-4
【대리인】	
【명칭】	특허법인 신성
【대리인코드】	9-2000-100004-8
【지정된변리사】	원석희,박해천,최종식,최장식,김연권,김인철,이종근
【포괄위임등록번호】	2000-051975-8
【발명자】	
【성명】	정세윤

【성명의 영문표기】 JEONG,Se Yoon

【주민등록번호】 730322-1XXXXXX

【우편번호】 306-769

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【발명자】

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【성명의 영문표기】 CHOI,Hae Chul

【주민등록번호】 740725-1XXXXXX

【우편번호】 305-150

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【국적】 KR

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【성명의 영문표기】 SEO,Jeong Il

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【국적】 KR

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【성명】 백승권

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【주민등록번호】 620524-2XXXXXX

【우편번호】 302-120

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【국적】 KR

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【주민등록번호】 590415-1XXXXXX

【우편번호】 305-333

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【국적】 KR

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【성명】 김진웅

【성명의 영문표기】 KIM,Jin Woong

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【우편번호】 305-761

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【국적】 KR

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【성명의 영문표기】 LEE,Yung Lyul

【주민등록번호】 611030-1XXXXXX

【우편번호】 138-160

【주소】 서울 송파구 가락동 극동아파트 1-704

【국적】 KR

【발명자】

【성명】 심동규

【성명의 영문표기】 SIM,Dong Gyu

【주민등록번호】 700710-1XXXXXX

【우편번호】 139-050

【주소】 서울 노원구 월계동 삼호아파트 31-607

【국적】 KR

【발명자】

【성명】 오승준

【성명의 영문표기】 OH,Seoung Jun

【주민등록번호】 571107-1XXXXXX

【우편번호】 463-010

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【국적】 KR

【발명자】

【성명】 안창범

【성명의 영문표기】 AHN,Chang Beom

【주민등록번호】 580416-1XXXXXX

【우편번호】 138-050

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【국적】 KR

【발명자】

【성명】 김대연

【성명의 영문표기】 KIM,Dae Yeon

【주민등록번호】 820615-1XXXXXX

【우편번호】 139-243

【주소】 서울 노원구 공릉3동 라이프아파트 204-1203

【국적】 KR

【발명자】

【성명】 김동균

【성명의 영문표기】 KIM,Dong Kyun

【주민등록번호】 800417-1XXXXXX

【우편번호】 139-748

【주소】 서울 노원구 상계5동 벽산아파트 106-412

【국적】 KR

【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 D C T 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 예측

은 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 주

변 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 인트

라 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 스

캐닝 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 이용하

여 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		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%

<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 가능하다. 상기 프로그램을 구성하는 코드들 및 코드 세그먼트들은 당해 분야의 컴퓨터 프로그래머에 의하여 용이하게 추론될 수 있다. 또한, 상기 프로그램은 컴퓨터

가 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】

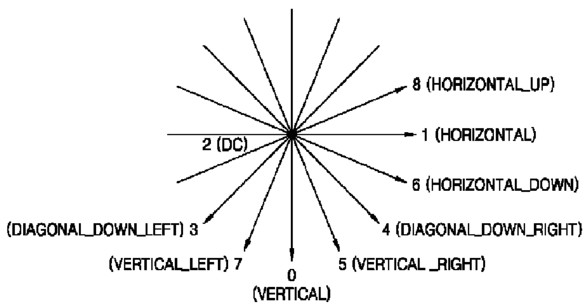
화소 유사성에 따라 적응적인 DCT 계수 스캐닝을 이용한 부호화/복호화 방법에 있어서,

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

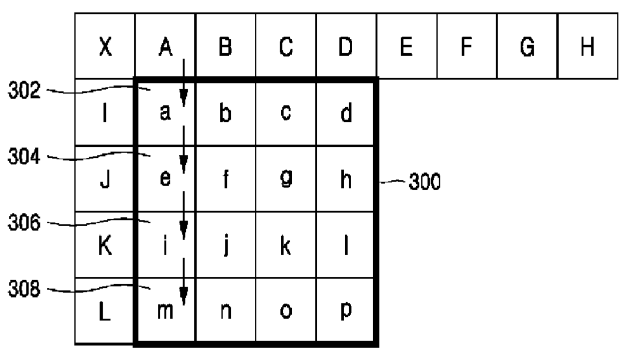
용한 부호화/복호화 방법.

【도면】

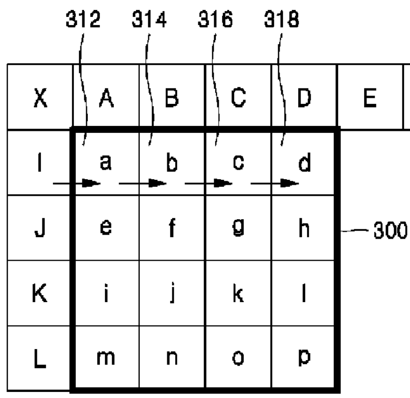
【도 1】


8 (HORIZONTAL_UP)
1 (HORIZONTAL)
2 (DC)
6 (HORIZONTAL_DOWN)
(DIAGONAL_DOWN_LEFT) 3
4 (DIAGONAL_DOWN_RIGHT)
(VERTICAL_LEFT) 7
5 (VERTICAL _RIGHT)
0
(VERTICAL)

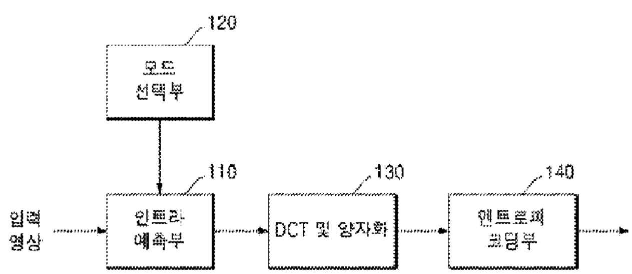
【도 2a】


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

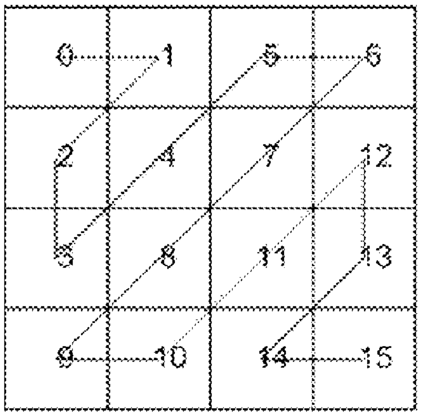
【도 2b】


312
314
316
318
X
A
B
C
D
E
F
G
H
I
J
K
L
a
b
c
d
e
f
g
h
i
j
k
l
m
n
o
p
300

【도 3】


120
모드 선택부
110
입력 영상
인트라 예측부
130
DCT 및 양자화
140
엔트로피 코딩부

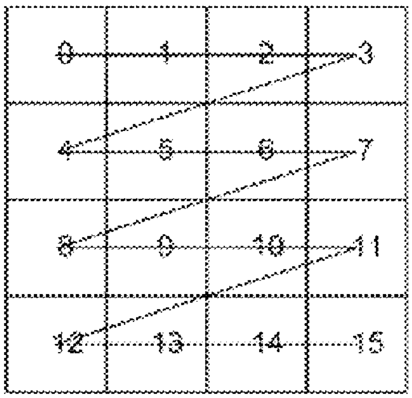
【도 4】



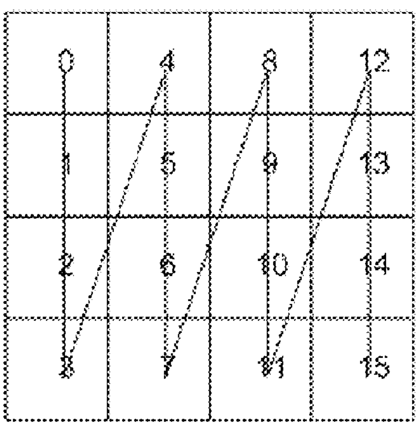
【도 5】

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

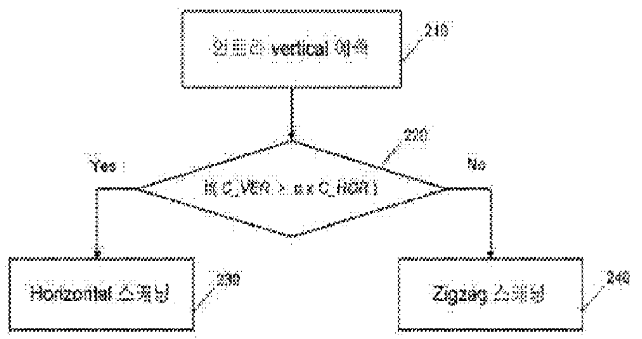
【도 6a】



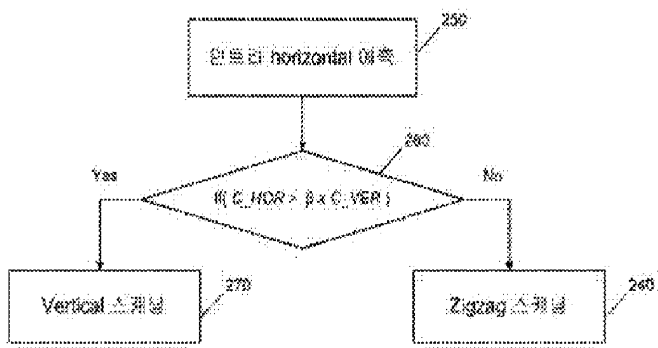
【도 6b】



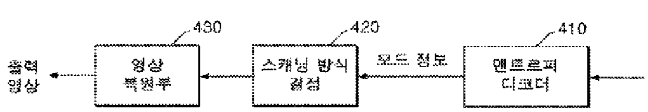
【도 7a】


인트라 vertical 예측
210
220
Yes
No
if(C_VER > α x C_HOR)
Horizontal 스캐닝
230
Zigzag 스캐닝
240

【도 7b】


인트라 horizontal 예측
250
Yes
No
if(C_HOR > β x C_VER)
Vertical 스캐닝
270
Zigzag 스캐닝

【도 8】


430
420
410
출력 영상
영상 복원부
스캐닝 방식 결정
모드 정보
엔트로피 디코더

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
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89980
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P.O. Box 65745
Washington, DC 20035

PUBLICATION NOTICE

OC000000079067048

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

Publication No.US-2015-0350658-A1
Publication Date:12/03/2015

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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.

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 14/823,273

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	70		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	300		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	360		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	6 minus 20 =	*	x 40 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*	x 210 =	0.00			
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).			0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	730		TOTAL	

APPLICATION AS AMENDED - PART II

AMENDMENT A		(Column 1)		(Column 2)	(Column 3)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	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	

AMENDMENT B		(Column 1)		(Column 2)	(Column 3)					
		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	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 found in the appropriate box in column 1.

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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
14/823,273	08/11/2015	2482	730	022096.0037C2C2	6	2

CONFIRMATION NO. 7328

FILING RECEIPT

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

OC000000077071276

Date Mailed: 08/26/2015

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**

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Industry-Academia Cooperation Group of Sejong University, Seoul, KOREA, REPUBLIC OF;

Assignment For Published Patent Application

Electronics and Telecommunications Research Institute, Daejeon, KOREA, REPUBLIC OF
Kwangwoon University Research Institute for Industry Cooperation, Seoul, KOREA, REPUBLIC OF

Industry-Academia Cooperation Group of Sejong University, Seoul, KOREA, REPUBLIC OF

Power of Attorney: The patent practitioners associated with Customer Number 89980

Domestic Priority data as claimed by applicant

This application is a CON of 13/975,251 08/23/2013
which is a CON of 12/377,617 02/16/2009 PAT 8548060
which is a 371 of PCT/KR2007/001433 03/23/2007

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.)
REPUBLIC OF KOREA 10-2006-0077851 08/17/2006
REPUBLIC OF KOREA 10-2007-0008247 01/26/2007

Permission to Access - A proper **Authorization to Permit Access to Application by Participating Offices** (PTO/SB/39 or its equivalent) has been received by the USPTO.

Request to Retrieve - This application either claims priority to one or more applications filed in an intellectual property Office that participates in the Priority Document Exchange (PDX) program or contains a proper **Request to Retrieve Electronic Priority Application(s)** (PTO/SB/38 or its equivalent). Consequently, the USPTO will attempt to electronically retrieve these priority documents.

If Required, Foreign Filing License Granted: 08/25/2015

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/823,273**

Projected Publication Date: 12/03/2015

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

375

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

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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For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	022096.0037C2C2
First Named Inventor	Se-Yoon JEONG
Title	APPARATUS FOR ENCODING ...
Express Mail Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450**

1. [✔] **Fee Transmittal Form** (PTO/SB/17 or equivalent)
2. [✔] **Applicant asserts small entity status.** See 37 CFR 1.27
3. [ ] **Applicant certifies micro entity status.** See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
4. [✔] **Specification** [*Total Pages* 19]
   Both the claims and abstract must start on a new page.
   (See MPEP § 608.01(a) for information on the preferred arrangement)
5. [✔] **Drawing(s)** (35 U.S.C. 113) [*Total Sheets* 6]
6. **Inventor's Oath or Declaration** [*Total Pages* 4]
   (including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))
   a. [ ] Newly executed (original or copy)
   b. [✔] A copy from a prior application (37 CFR 1.63(d))
7. [✔] **Application Data Sheet** ** See note below.*
   See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
8. **CD-ROM or CD-R**
   in duplicate, large table, or Computer Program (*Appendix*)
   [ ] Landscape Table on CD
9. **Nucleotide and/or Amino Acid Sequence Submission**
   (*if applicable, items a. – c. are required*)
   a. [ ] Computer Readable Form (CRF)
   b. [ ] Specification Sequence Listing on:
      i. [ ] CD-ROM or CD-R (2 copies); or
      ii. [ ] Paper
   c. [ ] Statements verifying identity of above copies

ACCOMPANYING APPLICATION PAPERS

10. [ ] **Assignment Papers**
    (cover sheet & document(s))
    Name of Assignee ____________________
11. [ ] **37 CFR 3.73(c) Statement** *(when there is an assignee)* [✔] **Power of Attorney**
12. [ ] **English Translation Document** *(if applicable)*
13. [✔] **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    [ ] Copies of citations attached
14. [ ] **Preliminary Amendment**
15. [ ] **Return Receipt Postcard**
    (*MPEP § 503*) (*Should be specifically itemized*)
16. [ ] **Certified Copy of Priority Document(s)**
    (*if foreign priority is claimed*)
17. [ ] **Nonpublication Request**
    Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
18. [✔] **Other:** Statement Re Certified Copy of Priority Document

***Note**: (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must** be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS

[✔] The address associated with Customer Number: 89980 **OR** [ ] Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone		Email	

Signature	/Jeanne A. Di Grazio/	Date	2015-08-11
Name (Print/Type)	Jeanne A. Di Grazio	Registration No. (Attorney/Agent)	58,633

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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.

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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.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	022096.0037C2C2
	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.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Se-Yoon		Jeong	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

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Mailing Address of Inventor:

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Inventor 2 Remove

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Prefix	Given Name	Middle Name	Family Name	Suffix
	Hae-Chul		Choi	

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Mailing Address of Inventor:

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Postal Code	305-150	**Country** i	KR

Inventor 3 Remove

Legal Name

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	022096.0037C2C2
	Application Number	

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

Prefix	**Given Name**	**Middle Name**	**Family Name**	**Suffix**
	Jeong-Il		Seo	

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Inventor 4 Remove
Legal Name

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

Mailing Address of Inventor:

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City	Seoul	**State/Province**	
Postal Code	137-062	**Country** i	KR

Inventor 5 Remove
Legal Name

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	Gunpo-si	Country of Residence i	KR

Mailing Address of Inventor:

Address 1	#202, 86-46, Sanbon-dong, Gyeonggi-do		
Address 2			
City	Gunpo-si	**State/Province**	
Postal Code	435-040	**Country** i	KR

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	022096.0037C2C2
	Application Number	

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

Inventor 6 Remove

Legal Name

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	Daejeon	Country of Residence i	KR

Mailing Address of Inventor:

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Inventor 7 Remove

Legal Name

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	Daejeon	Country of Residence i	KR

Mailing Address of Inventor:

Address 1	#9-903 Hanmaru Apt., Dunsan-dong, Seo-gu		
Address 2			
City	Daejeon	**State/Province**	
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Inventor 8 Remove

Legal Name

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	Daejeon	Country of Residence i	KR

Mailing Address of Inventor:

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Address 2	

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	022096.0037C2C2
	Application Number	

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

City	Daejeon	State/Province	
Postal Code	305-768	Country i	KR

Inventor 9 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Jin-Woo		Hong	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

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Inventor 10 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
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Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

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Inventor 11 Remove

Legal Name

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

Mailing Address of Inventor:

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	022096.0037C2C2
	Application Number	

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

Address 1	#1-704 Kukdong Apt., Garak-dong, Songpa-gu		
Address 2			
City	Seoul	**State/Province**	
Postal Code	138-160	**Country** i	KR

Inventor 12 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Dong-Gyu		Sim	

Residence Information (Select One) ◯ US Residency ◉ Non US Residency ◯ Active US Military Service

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Mailing Address of Inventor:

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Inventor 13 Remove

Legal Name

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	Seongnam-si	Country of Residence i	KR

Mailing Address of Inventor:

Address 1	#104-1902 I-Park, Jeongja 1-dong, Bundang-gu		
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Inventor 14 Remove

Legal Name

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

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	022096.0037C2C2
	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 Inventor:

Address 1	#109-501 Olympic Apt., 89, Bangi-dong, Songpa-gu		
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Postal Code	138-050	**Country** i	KR

Inventor 15 Remove

Legal Name

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

Mailing Address of Inventor:

Address 1	#204-1203 Life Apt., Gongneung 3-dong, Nowon-gu		
Address 2			
City	Seoul	**State/Province**	
Postal Code	139-243	**Country** i	KR

Inventor 16 Remove

Legal Name

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

Mailing Address of Inventor:

Address 1	#106-412 Byeoksan Apt., Sanggye 5-dong, Nowon-gu		
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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).**

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	022096.0037C2C2
	Application Number	
Title of Invention	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR	

☐ An Address is being provided for the correspondence Information of this application.		
Customer Number	89980	
Email Address	pto@nsiplaw.com	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	022096.0037C2C2	**Small Entity Status Claimed**	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	6	**Suggested Figure for Publication (if any)**	

Filing By Reference :

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country i

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.

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Either enter 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	89980		

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	022096.0037C2C2
	Application Number	
Title of Invention	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR	

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(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.
When referring to the current application, please leave the application number blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation of	13975251	2013-08-23

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13975251	Continuation of	12377617	2009-02-16	8548060	2013-10-01

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
12377617	a 371 of international	PCT/KR2007/001433	2007-03-23

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Application Number	Country i	Filing Date (YYYY-MM-DD)	Access Code i (if applicable)
10-2006-0077851	KR	2006-08-17	

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Application Number	Country i	Filing Date (YYYY-MM-DD)	Access Code i (if applicable)
10-2007-0008247	KR	2007-01-26	

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	022096.0037C2C2
	Application Number	
Title of Invention	APPARATUS FOR ENCODING AND DECODING IMAGE USING ADAPTIVE DCT COEFFICIENT SCANNING BASED ON PIXEL SIMILARITY AND METHOD THEREFOR	

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	022096.0037C2C2
	Application Number	

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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(●) Assignee	( ) Legal Representative under 35 U.S.C. 117	( ) Joint Inventor
( ) Person to whom the inventor is obligated to assign.	( ) Person who shows sufficient proprietary interest	

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	022096.0037C2C2
	Application Number	

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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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	022096.0037C2C2
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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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First Name	Jeanne A.	Last Name	Di Grazio	Registration Number	58633

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	022096.0037C2C2
	Application Number	
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DESCRIPTION

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

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation Application of Applicaton No. 13/975,251 filed on August 23, 2013, which is a continuation Application No. 12/377,617 filed on February 16, 2009, now U.S. Patent No. 8,548,060, which is a U.S. National Stage application of International Application No. PCT/KR2007/001433 filed on March 23, 2007, which claims the benefit of Korean Applications Nos. 10-2006-0077851 filed on August 17, 2006, and 10-2007-0008247 filed on January 26, 2007. The entire disclosures of Application No. 13/975,251, 12/377,617, International Application No. PCT/KR2007/001433, and Korean Application Nos. 10-2006-0077851 and 10-2007-0008247 are incorporated herein by reference for all purposes.

TECHNICAL FIELD

[0002] 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

[0003] 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.

[0004] 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.

[0005] 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.

[0006] 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.

[0007] 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-pixel based variable block motion prediction and compensation, Context-based Adaptive Variable Length Coding (CAVLC), and Context-based Adaptive Binary Arithmetic Coding (CABAC).

[0008] The H.264/AVC standard predicts pixel values of a current block by using prediction modes of 9 directivities.

[0009] Fig. 1 illustrates 9 prediction modes used for intra prediction of 4 x 4 blocks.

[0010] 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).

[0011] Herein, in the DC mode (mode 2), intra prediction is performed using a mean value of adjacent pixels. The arrows indicate prediction directions.

[0012] 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.

[0013] 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.

[0014] 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.

[0015] Fig. 2 exemplarily illustrates a pixel prediction method in a vertical direction in a 4 x 4 block 200.

[0016] As shown in Fig. 2, pixel a 201, pixel e 202, pixel i 203, and pixel m 204 are predicted based on an adjacent pixel A in the vertical direction.

[0017] 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.

[0018] Fig. 3 exemplarily illustrates a pixel prediction method in a horizontal direction in a 4 x 4 block 200.

[0019] 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.

[0020] 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.

[0021] An encoder performs Discrete Cosine Transform (DCT) and quantization onto residual signals (which are of a pixel area) acquired by calculating differences between the predicted pixels and the current pixels. Subsequently, the encoder performs zigzag scanning and entropy encoding onto the transformed coefficients obtained from DCT and quantization.

[0022] Herein, although the zigzag scanning takes advantage of an energy compaction characteristic of a transformed coefficient that energy converges into low frequency components and energy appears little in high frequency components, the energy compaction after intra prediction is not always effective.

[0023] 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

[0024] 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.

[0025] 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

[0026] 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.

[0027] 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.

[0028] 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.

[0029] 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.

[0030] 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.

[0031] 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

[0032] 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.

[0033] 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.

[0034] 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

[0035] Fig. 1 illustrates 9 prediction modes used for intra prediction of 4 x 4 blocks according to H.264/AVC.

[0036] Fig. 2 exemplarily illustrates a pixel prediction method in a vertical direction.

[0037] Fig. 3 exemplarily illustrates a pixel prediction method in a horizontal direction.

[0038] 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.

[0039] Fig. 5 exemplarily illustrates a zigzag scanning method used in the present invention.

[0040] Fig. 6 exemplarily illustrates a horizontal scanning method used in the present invention.

[0041] Fig. 7 exemplarily illustrates a vertical scanning method used in the present invention.

[0042] Fig. 8 illustrates a method for predicting pixel similarity in vertical and horizontal directions in accordance with an embodiment of the present invention.

[0043] 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.

[0044] 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.

[0045] 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

[0046] 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.

[0047] 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.

[0048] 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.

[0049] 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 an amount of distortion at a given bit rate.

[0050] 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.

[0051] 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.

[0052] 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.

[0053] Herein, the entropy encoding is an encoding technique for enhancing a compression rate by allocating a few bits to data highly likely to occur and many bits to data that are not likely to occur. Examples of the entropy encoding used in the present invention include Context-based Adaptive Variable Length Coding (CAVLC) or Context-based Adaptive Binary Arithmetic Coding (CABAC).

[0054] 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.

[0055] 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.

[0056] As shown in Fig. 5, the zigzag scanning method used in the present invention is devised in consideration that low frequency components of transformed coefficients acquired from the DCT and quantization are highly likely to be positioned in the upper left part 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.

[0057] 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.

[0058] 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.

[0059] 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.

[0060] 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.

[0061] 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.

[0062] Therefore, if pixel similarities in the vertical and horizontal directions of 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.

[0063] Fig. 8 illustrates a method for predicting pixel similarity in vertical and horizontal directions in accordance with an embodiment of the present invention.

[0064] As illustrated in Fig. 8, pixels A, B, C and D are positioned adjacent to the upper part of a current block to be encoded, whereas pixels E, F, G and H are positioned adjacent to the left part of the current block to be encoded.

[0065] Herein, when vertical prediction encoding is performed, the vertical-directional pixel similarity of the pixels a, e, i and m in the first 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 pixel A from the pixels a, e, i and m, and thus the correlation does not change.

[0066] Also, the vertical-directional pixel similarity of the pixels in columns 2, 3 and 4 of the current block to be encoded is the same as the vertical-directional pixel similarity of residual coefficients after vertical prediction.

[0067] However, the horizontal-directional pixel similarity of the 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 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.

[0068] Likewise, in the case of the horizontal prediction encoding, the horizontal-directional pixel similarity of the pixels a, b, c and d in the first row of 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 of the current block to be encoded is the same as the horizontal-directional pixel similarity of the residual coefficients after horizontal prediction.

[0069] However, the vertical-directional pixel similarity of the 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 is higher than the vertical-directional pixel similarity after the horizontal prediction. Thus, it becomes similar to or higher than the horizontal-directional pixel similarity.

[0070] As described above, when the pixel similarities in the vertical and horizontal directions are similar, a general zigzag scanning method is more efficient than the horizontal and vertical scanning methods.

[0071] 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.

[0072] 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.

[0073] 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 using the following Equation 1.

Equation 1

$$S\_VER = \frac{1}{Variance(E, F, G, H)}$$

$$S\_HOR = \frac{1}{Variance(A, B, C, D)}$$

[0074] In Equation 1, Variance() denotes a dispersion; E, F, G and H denote pixels adjacent to the left part of the current block to be encoded; and A, B, C and D denote pixels adjacent to the upper part of the current block to be encoded.

[0075] 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.

[0076] 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.

[0077] The vertical-directional and horizontal-directional pixel similarity prediction values acquired in the above methods are compared to each other to decide a scanning method.

[0078] Although 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.

[0079] 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.

[0080] 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.

[0081] 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.

[0082] 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.

[0083] 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.

[0084] 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.

[0085] 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.

[0086] 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.

[0087] 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.

[0088] 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.

[0089] 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.

[0090] 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.

[0091] An experiment was carried out for diverse test videos 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, videos recommended by H.264/AVC as test 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(18,22,26,30), rate-distortion optimization				

[0092] As shown in Table 1, five test videos with different sizes were used for the experiment.

[0093] 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%

[0094] 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.

[0095] 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 forth. Since the program can be easily implemented by those skilled in the art to which the present invention pertains, further description of the program will not be provided herein.

[0096] 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. A decoding apparatus comprising:

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

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

a video recovery unit configured to scan the transform coefficients based on the selected scanning mode;

wherein the scanning decision unit is further configured to select the scanning mode based on an intra prediction mode used to obtain difference values encoded to obtain the encoded video information.

2. The decoding apparatus of claim 1, wherein the difference values are differences between pixel values and predicted pixel values.

3. The decoding apparatus of claim 1, wherein the intra prediction mode is one of a vertical intra prediction mode and a horizontal prediction mode.

4. The decoding apparatus of claim 1, 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.

5. A non-transitory computer-readable storage medium storing a program for controlling a computer to perform a method of decoding, the method comprising:

performing entropy decoding of encoded video information to obtain transform coefficients;

selecting a scanning mode for the transform coefficients; and scanning the transform coefficients based on the selected scanning mode;

wherein the selecting of a scanning mode comprises selecting the scanning mode based on an intra prediction mode that was used to obtain difference values between pixel values and predicted pixel values.

6. The storage medium of claim 5, wherein the selecting of the scanning mode based on an intra prediction mode comprises:

selecting a horizontal scanning mode in response to the intra prediction mode being a vertical intra prediction mode; and

selecting a vertical scanning mode in response to the intra prediction mode being a horizontal intra prediction mode.

ABSTRACT OF THE DISCLOSURE

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.

FIG. 1

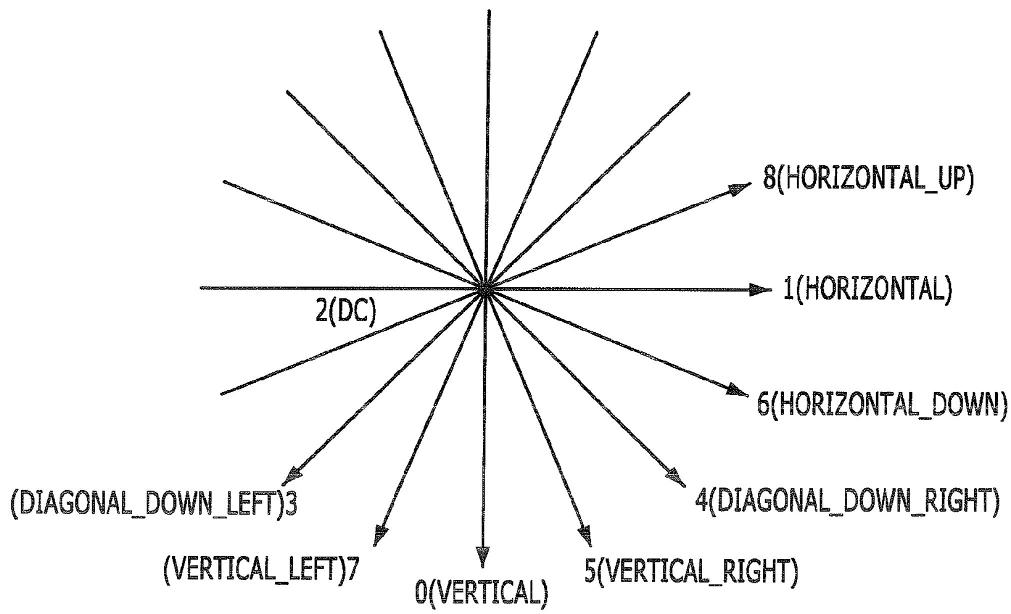
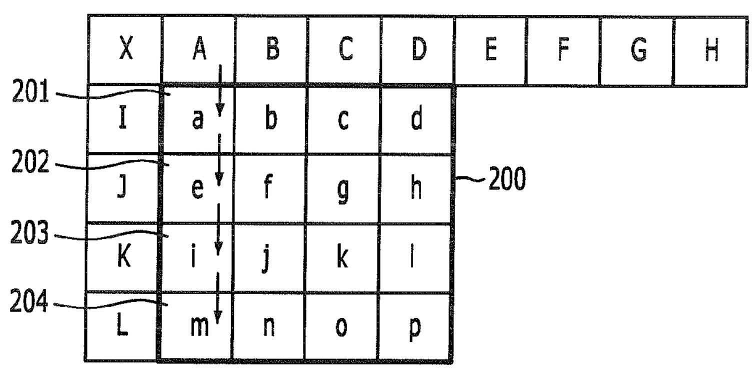

8(HORIZONTAL_UP)
1(HORIZONTAL)
2(DC)
6(HORIZONTAL_DOWN)
(DIAGONAL_DOWN_LEFT)3
4(DIAGONAL_DOWN_RIGHT)
(VERTICAL_LEFT)7
0(VERTICAL)
5(VERTICAL_RIGHT)

FIG. 2


X
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B
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201
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202
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200
203
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204
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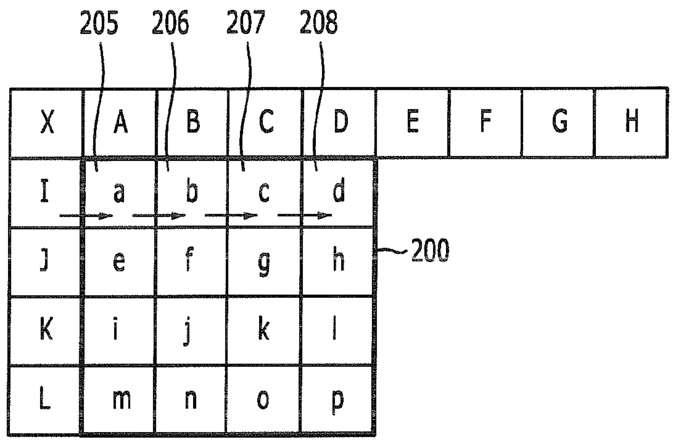
FIG. 3



205
206
207
208
X
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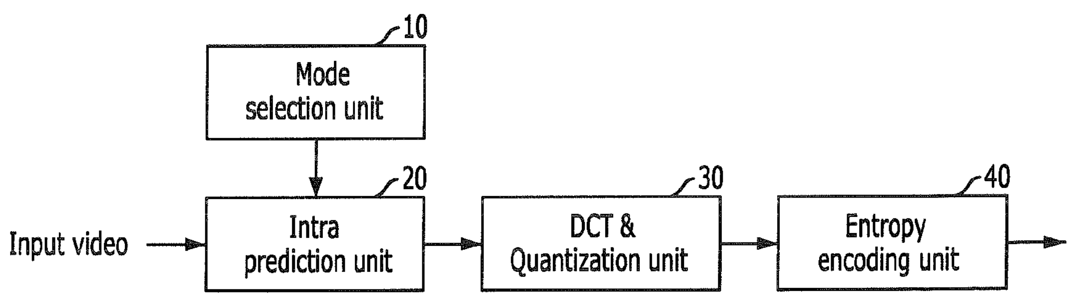
p

FIG. 4



10
Mode selection unit
20
Input video
Intra prediction unit
30
DCT & Quantization unit
40
Entropy encoding unit

FIG. 5

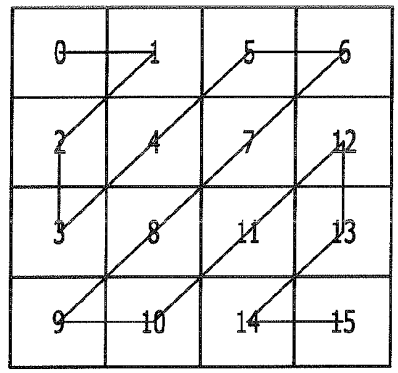


FIG. 6

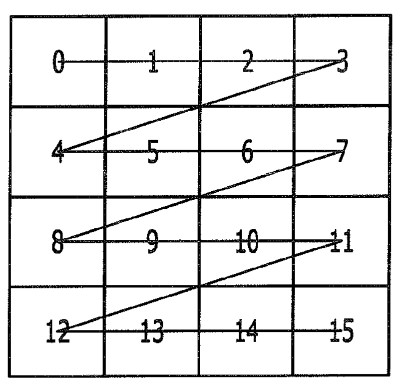


FIG. 7

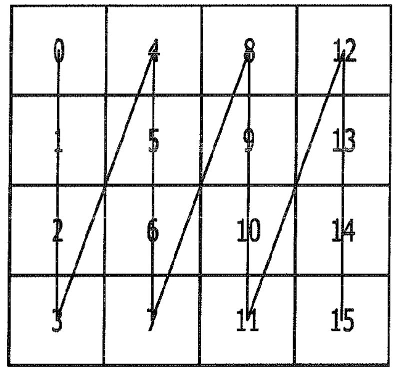


FIG. 8

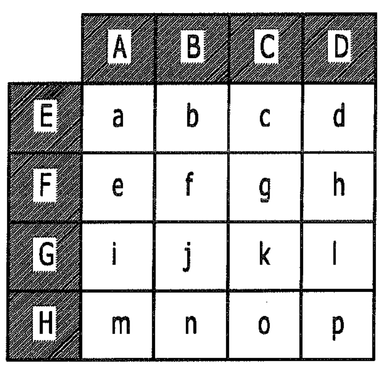
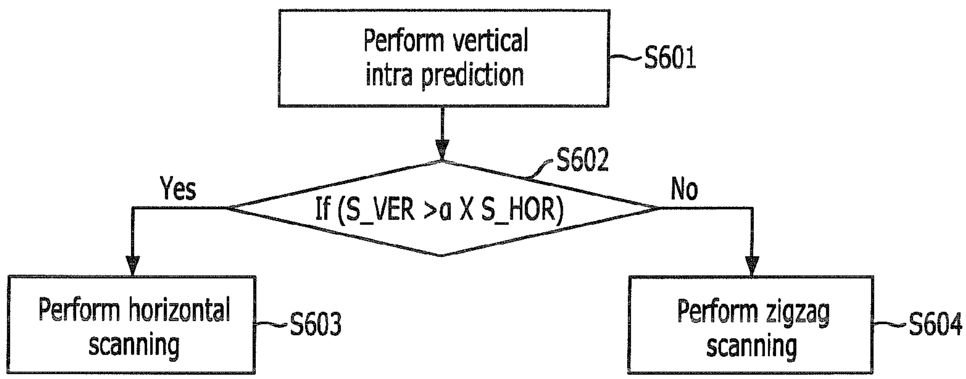


FIG. 9



Perform vertical intra prediction
S601
S602
If (S_VER >α X S_HOR)
Yes
No
Perform horizontal scanning
S603
Perform zigzag scanning
S604

FIG. 10

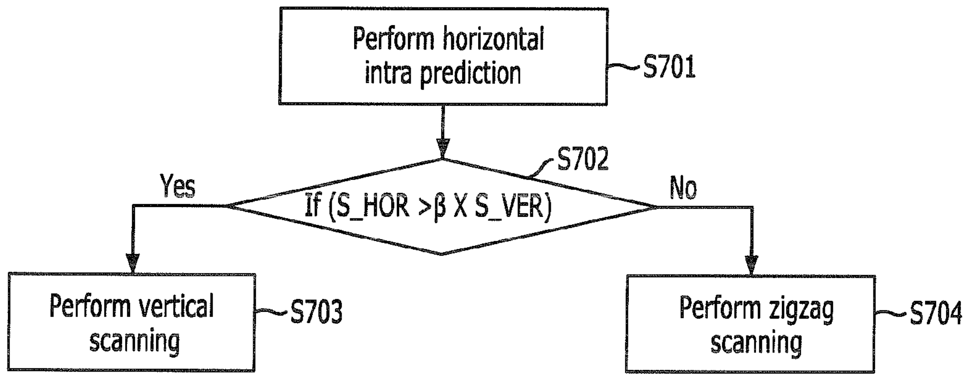
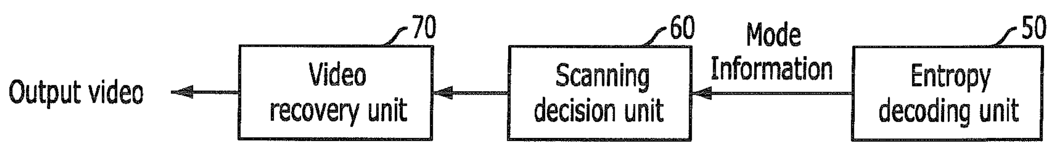

Perform horizontal intra prediction
S701
S702
Yes
If (S_HOR >β X S_VER)
No
Perform vertical scanning
S703
Perform zigzag scanning
S704

FIG. 11


70
60
Mode Information
50
Output video
Video recovery unit
Scanning decision unit
Entropy decoding unit

DECLARATION UNDER 37 CFR 1.63

As a below-named inventor, I hereby declare that this declaration is directed to United States Application Number 13/975,251 filed on August 23, 2013, entitled:

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

The above-identified application was made or authorized to be made by me.

I believe I am the original inventor or an original joint inventor of a claimed invention in the above-identified application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 USC 1001 by fine or imprisonment of not more than five (5) years, or both.

I have reviewed and understand the contents of the above-identified application, including the claims.

I am aware of the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information that became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

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DECLARATION UNDER 37 CFR 1.63

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Substitute for form 1449/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	New Application
				Filing Date	Concurrently Herewith
				First Named Inventor	Se-Yoon Jeong
				Art Unit	Not Yet Assigned
(Use as many sheets as necessary)				Examiner Name	Not Yet Assigned
Sheet	1	of	2	Attorney Docket Number	022096.0037C2C2

Substitute for PTO/SB/08a/b

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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	N	2014/0037000 A1	02-06-2014	Electronics and Telecommunications Research Institute et al.	

Examiner Signature		Date Considered	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	New Application
				Filing Date	Concurrently Herewith
				First Named Inventor	Se-Yoon Jeong
				Art Unit	Not Yet Assigned
(Use as many sheets as necessary)				Examiner Name	Not Yet Assigned
Sheet	2	of	2	Attorney Docket Number	022096.0037C2C2

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]
	a	EP 0 230 632 A2	08-05-1987	Nishizawa		
	b	EP 2 207 359 A2	07-14-2010	Ding		
	c	JP 2003-6643 A	01-10-2003	Fukuda		
	d	JP 2004-348741 A	12-09-2004	Bober et al.		
	e	KR 10-0180173 B1	05-01-1999	Jung		
	f	KR 2002-0006149 A	01-19-2002	Chun		
	g	KR 2002-0081342 A	10-26-2002	Miyata et al.		
	h	WO 2008/020672 A1	02-21-2008	Electronics and Telecommunications Research Institute et al.		

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]
	1	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).	
	2	International Search Report and Written Opinion of the International Searching Authority issued on June 29, 2007, in counterpart International Application No. PCT/KR2007/001433.	
	3	H. Zrida et al., "High Level H.264/AVC Video Encoder Parallelization for Multiprocessor Implementation"; *Proceedings of the 2009 Design, Automation & Test in Europe Conference & Exhibition (DATE '09)*, pp. 940-945, conference held April 20-24, 2009, Nice, France, ISBN 978-3-9810801-5-5.	

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).

Docket No. 022096.0037C2C2

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Se-Yoon Jeong et al.

Application No. Not yet assigned — Art Unit: Not yet assigned

Confirmation No. Not yet assigned

Filed: Concurrently Herewith — Examiner: Not yet assigned

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

STATEMENT RE CERTIFIED COPY OF PRIORITY DOCUMENT

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

Sir:

This application is a continuation application of US Application No. 13/975,251, filed August 23, 2013, which claims the benefit of Korean Applications Nos. 10-2006-0077851 filed on August 17, 2006, and 10-2007-0008247 filed on January 26, 2007 in the Korean Intellectual Property Office.

Certified copies of Korean Applications Nos. 10-2006-0077851 and 10-2007-0008247, were electronically-retrieved by the USPTO on January 12, 2014, and are in the image file wrapper of parent Application No. 13/975,251.

Respectfully submitted,

Dated: August 11, 2015

By: / Jeanne A. Di Grazio /
Jeanne A. Di Grazio Reg. No. 58,633
NSIP Law
P.O. Box 65745
Washington, DC 20035
Tel: (202) 429-0020

CYP/JDG/yrk

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
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:	Jeanne Andrea Di Grazio/Yuri Kang
Attorney Docket Number:	022096.0037C2C2

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility filing Fee (Electronic filing)	4011	1	70	70
Utility Search Fee	2111	1	300	300
Utility Examination Fee	2311	1	360	360
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**730**

Electronic Acknowledgement Receipt

EFS ID:	23175737
Application Number:	14823273
International Application Number:	
Confirmation Number:	7328
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:	Jeanne Andrea Di Grazio/Yuri Kang
Filer Authorized By:	Jeanne Andrea Di Grazio
Attorney Docket Number:	022096.0037C2C2
Receipt Date:	11-AUG-2015
Filing Date:	
Time Stamp:	14:18:40
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$730
RAM confirmation Number	412
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	NewConApp_0220960037C2C2_UtilityTransmittal.pdf	310689 da157f5ec0852cd9af6af5a6cde01482f2dec b9c	no	2
Warnings:					
Information:					
2	Application Data Sheet	NewConApp_0220960037C2C2_ADS.pdf	1820884 173cbbbeba8353254979ca181f89364f236 abd34	no	15
Warnings:					
Information:					
3		NewConApp_0220960037C2C2_AppAsFiled.pdf	81837 32bb56544a33381c3b5b36aeda2c928c981 0520e	yes	19

Multipart Description/PDF files in .zip description

Document Description	Start	End
Specification	1	16
Claims	17	18
Abstract	19	19

Warnings:					
Information:					
4	Drawings-only black and white line drawings	NewConApp_0220960037C2C2_DrawingsAsFiled.pdf	361511 c9945e28910c7441faad347a41e92a70f12f 2256	no	6
Warnings:					
Information:					
5	Oath or Declaration filed	NewConApp_0220960037C2C2_DECExecuted.pdf	114672 6e10e250af4b62de19b391b7732bbe69218 b445d	no	4
Warnings:					
Information:					
6	Power of Attorney	POA_byApplicant_ETRI_Jul2015.pdf	47981 d9cb1d00ccf2fe940f392107e8f385ee49bbf 66a	no	1

Warnings:					
Information:					
7	Power of Attorney	POA_byApplicant_KwangwoonUnivResearchInstForIndCoop.pdf	39773 c2a8fa0eb8a9c59db0093924925f6e4ac17c095a	no	1
Warnings:					
Information:					
8	Power of Attorney	POA_byApplicant_Ind-AcadCoopGroupSejongUniv.pdf	30308 226965e6206df3d5eaa5df6410247ae5eabf944c	no	1
Warnings:					
Information:					
9	Transmittal Letter	NewConApp_0220960037C2C2_Stmt.pdf	18914 ecce1d9e948d275cef8d67a6c40158c3fbb4f236	no	2
Warnings:					
Information:					
10	Information Disclosure Statement (IDS) Form (SB08)	NewConApp_0220960037C2C2_IDS.pdf	91498 ff2738a61a6170213e802db87e968d772581aa0d	no	2
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
11	Miscellaneous Incoming Letter	NewConApp_0220960037C2C2_StmtReCertifiedCopy.pdf	12829 a7d5cba4228ca9d7f07ab29027a880b8e64a73a6	no	1
Warnings:					
Information:					
12	Fee Worksheet (SB06)	fee-info.pdf	35379 ac5b093a344505527f90f40b4461c2463868cacd	no	2
Warnings:					
Information:					
Total Files Size (in bytes):			2966275		

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.

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in the accompanying transmittal letter (form PTO/AIA/15, PTO/SB/16, PTO/AIA/18, PTO/AIA/19, PTO/SB/29, PTO/AIA/50, PTO/AIA/82A, or equivalent).

I hereby appoint the practitioners of NSIP Law associated with the following Customer Number as my attorneys or agents to transact all business in the United States Patent and Trademark Office connected with the application identified in the accompanying transmittal letter:

89980

Please recognize or change the correspondence address for the application identified in the accompanying transmittal letter to the address of NSIP Law associated with the following Customer Number:

89980

I, the below-named Assignee, am the original Applicant (if there is only one Applicant) or an original Applicant (if there is more than one Applicant) of the application identified in the accompanying transmittal letter. The undersigned, whose title is supplied below, is authorized to act on behalf of the Assignee.

Name of Assignee	Electronics and Telecommunications Research Institute		
Address of Assignee	218, Gajeong-ro, Yuseong-gu, Daejeon 34129 Republic of Korea		
Signature	[signature]	Date	28-07-2015
Name	Ickchan Lee		
Title	Director Intellectual Property Management Team		

PTO/AIA/82B Equivalent

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in the accompanying transmittal letter (form PTO/AIA/15, PTO/AIA/16, PTO/AIA/18, PTO/AIA/19, PTO/SB/29, PTO/AIA/50, PTO/AIA/82A, or equivalent).

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89980

Please recognize the address of NSIP Law associated with the following Customer Number as the correspondence address for the application identified in the accompanying transmittal letter:

89980

I, the below-named Assignee, am the original Applicant (if there is only one Applicant) or an original Applicant (if there is more than one Applicant) of the application identified in the accompanying transmittal letter.

Name of Assignee	Industry-Academia Cooperation Group of Sejong University		
Address of Assignee	209, Neungdong-ro, Gwangjin-gu, Seoul 143-747, Republic of Korea		
Signature		Date	July 28, 2014
Name	Sun-Jae Kim		
Title	President		

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

INVENTORS: Se-Yoon Jeong et al.

CONFIRMATION NO.: Not Yet Assigned

APPLICATION NO.: New Application

GROUP ART UNIT: Not Yet Assigned

FILING DATE: Concurrently Herewith

EXAMINER: Not Yet Assigned

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

INFORMATION DISCLOSURE STATEMENT

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

Dear Sir:

Applicant hereby submits the following information in accordance with the duty of disclosure set forth in 37 C.F.R. § 1.56.

MPEP 609.02(A)(2) states as follows (emphasis added):

> The examiner will consider information which has been considered by the Office in a parent application when examining: (A) a continuation application filed under 37 CFR CFR 1.53(b), (B) a divisional application filed under 37 CFR 1.53(b), or (C) a continuation-in-part application filed under 37 CFR 1.53(b). A listing of the information need not be resubmitted in the continuing application unless the applicant desires the information to be printed on the patent.
>
> If resubmitting a listing of the information, applicant should submit a new listing that complies with the format requirements in 37 CFR 1.98(a)(1).

Accordingly, attached hereto is an Information Disclosure Statement complying with the format requirements in 37 CFR 1.98(a)(1) and listing the references cited in parent applications numbers 12/377,617 and 13/975,251. This Information Disclosure Statement is being presented concurrently with the filing of the new application, and therefore no fee is due at this time.

It is respectfully requested that an Examiner-initialed copy of the attached PTO/SB08 form be returned to the undersigned.

Dated: August 11, 2015

By: /Jeanne A. Di Grazio/

Jeanne A. Di Grazio, Reg. No.58,633
NSIP Law
P.O. Box 65745
Washington, DC 20035
Tel: (202) 429-0020

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in the accompanying transmittal letter (form PTO/AIA/15, PTO/AIA/16, PTO/AIA/18, PTO/AIA/19, PTO/SB/29, PTO/AIA/50, PTO/AIA/82A, or equivalent).

I hereby appoint the practitioners of NSIP Law associated with the following Customer Number as my attorneys or agents to transact all business in the United States Patent and Trademark Office connected with the application identified in the accompanying transmittal letter:

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Please recognize the address of NSIP Law associated with the following Customer Number as the correspondence address for the application identified in the accompanying transmittal letter:

89980

I, the below-named Assignee, am the original Applicant (if there is only one Applicant) or an original Applicant (if there is more than one Applicant) of the application identified in the accompanying transmittal letter.

Name of Assignee	Kwangwoon University Research Institute for Industry Cooperation		
Address of Assignee	447-1, Wolgye-dong, Nowon-gu, Seoul 139-701, Republic of Korea		
Signature		Date	April 29, 2013
Name	Jin Joo Choi		
Title	President		