



US009736484B2

(12) **United States Patent**
Jeong et al.

(10) **Patent No.:** **US 9,736,484 B2**

(45) **Date of Patent:** ***Aug. 15, 2017**

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

(71) Applicants: **Electronics and Telecommunications Research Institute**, Daejeon (KR); **Kwangwoon University Research Institute for Industry Cooperation**, Seoul (KR); **Industry-Academia Cooperation Group of Sejong University**, Seoul (KR)

(72) Inventors: **Se-Yoon Jeong**, Daejeon (KR); **Hae-Chul Choi**, Daejeon (KR); **Jeong-Il Seo**, Daejeon (KR); **Seung-Kwon Beack**, Seoul (KR); **In-Seon Jang**, Gunpo-si (KR); **Jae-Gon Kim**, Daejeon (KR); **Kyung-Ae Moon**, Daejeon (KR); **Dae-Young Jang**, Daejeon (KR); **Jin-Woo Hong**, Daejeon (KR); **Jin-Woong Kim**, Daejeon (KR); **Yung-Lyul Lee**, Seoul (KR); **Dong-Gyu Sim**, Seoul (KR); **Seoung-Jun Oh**, Seongnam-si (KR); **Chang-Beom Ahn**, Seoul (KR); **Dae-Yeon Kim**, Seoul (KR); **Dong-Kyun Kim**, Seoul (KR)

(73) Assignees: **Electronics and Telecommunications Research Institute**, Daejeon (KR); **Kwangwoon University Research Institute For Industry Cooperation**, Seoul (KR); **Industry-Academia Cooperation Group of Sejong University**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days. This patent is subject to a terminal disclaimer.

(21) Appl. No.: **14/823,273**

(22) Filed: **Aug. 11, 2015**

(65) **Prior Publication Data**

US 2015/0350658 A1 Dec. 3, 2015

Related U.S. Application Data

(63) Continuation of application No. 13/975,251, filed on Aug. 23, 2013, now Pat. No. 9,225,982, which is a (Continued)

(30) **Foreign Application Priority Data**

Aug. 17, 2006 (KR) 10-2006-0077851
Jan. 26, 2007 (KR) 10-2007-0008247

(51) **Int. Cl.**
G06F 21/00 (2013.01)
H04L 29/06 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC **H04N 19/159** (2014.11);
(Continued)

(58) **Field of Classification Search**
CPC H04N 19/159; H04N 19/18; H04N 19/13;
(Continued)

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,821,119 A * 4/1989 Gharavi H04N 19/129
375/240
(Continued)

FOREIGN PATENT DOCUMENTS

CN WO 2013181979 A1 * 12/2013 H04N 19/44
(Continued)

OTHER PUBLICATIONS

Chih-Hung Li, Chih-Chieh Chen, Wei-Chi Su, Ming-Jiun Wang, Wen-Hsiao Peng, Tihao Chiang, Gwo-Giun Lee; "A unified systolic architecture for combined inter and intra predictions in H.264/AVC decoder"; Jul. 2006; IWCMC '06: Proceedings of the 2006 international conference on Wireless communications and mobile computing; Publisher: ACM; pp. 73-78.*

(Continued)

Primary Examiner — Shewaye Gelagay

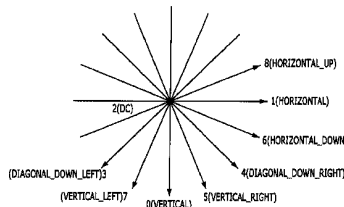
Assistant Examiner — Courtney Fields

(74) *Attorney, Agent, or Firm* — NSIP Law

(57) **ABSTRACT**

The present invention discloses an encoding apparatus using a Discrete Cosine Transform (DCT) scanning, which includes a mode selection means for selecting an optimal mode for intra prediction; an intra prediction means for performing intra prediction onto video inputted based on the mode selected in the mode selection means; a DCT and quantization means for performing DCT and quantization

(Continued)



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.

4 Claims, 6 Drawing Sheets

Related U.S. Application Data

continuation of application No. 12/377,617, filed as application No. PCT/KR2007/001433 on Mar. 23, 2007, now Pat. No. 8,548,060.

- (51) **Int. Cl.**
H04N 19/159 (2014.01)
H04N 19/91 (2014.01)
H04N 19/182 (2014.01)
H04N 19/13 (2014.01)
H04N 19/18 (2014.01)
H04N 19/176 (2014.01)
H04N 19/129 (2014.01)
H04N 19/61 (2014.01)
H04N 19/11 (2014.01)
H04N 19/103 (2014.01)
H04N 19/136 (2014.01)
H04N 7/50 (2006.01)
H04N 19/44 (2014.01)
- (52) **U.S. Cl.**
CPC **H04N 19/103** (2014.11); **H04N 19/11** (2014.11); **H04N 19/129** (2014.11); **H04N 19/13** (2014.11); **H04N 19/136** (2014.11); **H04N 19/176** (2014.11); **H04N 19/18** (2014.11); **H04N 19/182** (2014.11); **H04N 19/61** (2014.11); **H04N 19/91** (2014.11)
- (58) **Field of Classification Search**
CPC H04N 19/91; H04N 19/182; H04N 19/129; H04N 19/61; H04N 19/136; H04N 19/176; H04N 19/11; H04N 19/103
See application file for complete search history.

(56)

References Cited

U.S. PATENT DOCUMENTS

7,817,718	B2 *	10/2010	Wang	H04N 19/105 348/699
7,933,334	B2 *	4/2011	Kanehara	H04N 19/197 375/240.12
7,995,654	B2 *	8/2011	Boon	H04N 19/619 375/240.12
8,107,532	B2 *	1/2012	Gaedke	H04N 19/105 375/240.01
8,199,819	B2	6/2012	Seo et al.	
8,548,060	B2	10/2013	Jeong et al.	
2003/0007698	A1	1/2003	Govindaswamy et al.	
2003/0081850	A1 *	5/2003	Karczewicz	H04N 19/176 382/247
2005/0074062	A1 *	4/2005	Sung	H04N 19/176 375/240.2
2006/0002466	A1 *	1/2006	Park	H04N 19/196 375/240.03
2007/0274385	A1 *	11/2007	He	H04N 19/51 375/240.12
2013/0343452	A1	12/2013	Jeong et al.	
2014/0037000	A1	2/2014	Jeong et al.	

FOREIGN PATENT DOCUMENTS

EP	0 230 632	A2	8/1987
EP	2 207 359	A2	7/2010
JP	2003-6643	A	1/2003
JP	2004-348741	A	12/2004
KR	10-0180173	B1	5/1999
KR	2002-0006149	A	1/2002
KR	2002-0081342	A	10/2002
WO	WO 2008/020672	A1	2/2008

OTHER PUBLICATIONS

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, Sep. 23, 2006, Hanyang University Ansan Campus, Ansan, Republic of Korea (in Korean, including English abstract).
International Search Report and Written Opinion of the International Searching Authority issued on Jun. 29, 2007, in counterpart International Application No. PCT/KR2007/001433.
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 Apr. 20-24, 2009, Nice, France, ISBN 978-3-9810801-5-5.

* cited by examiner

FIG. 1

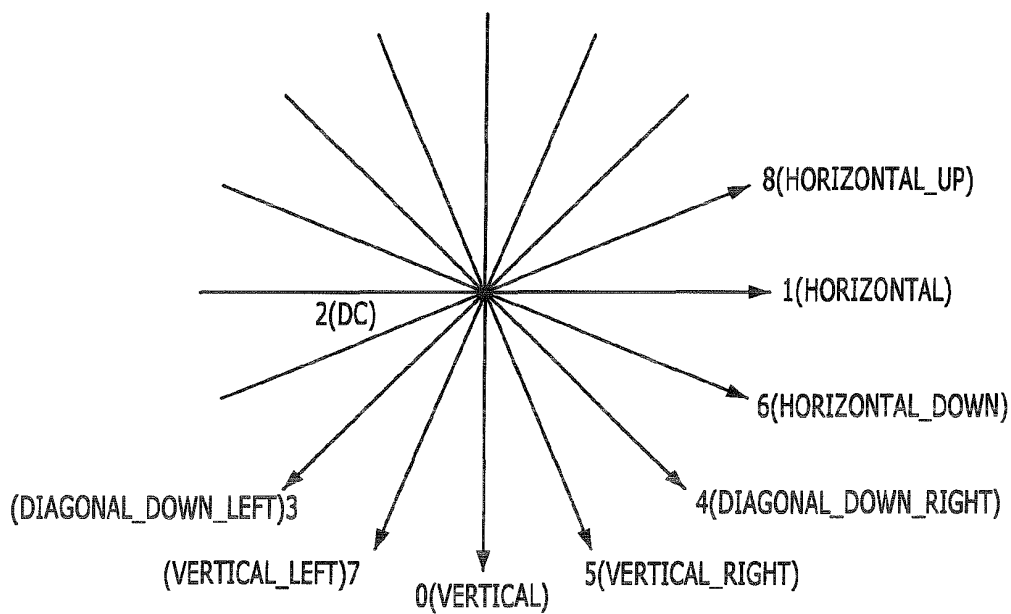


FIG. 2

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

FIG. 3

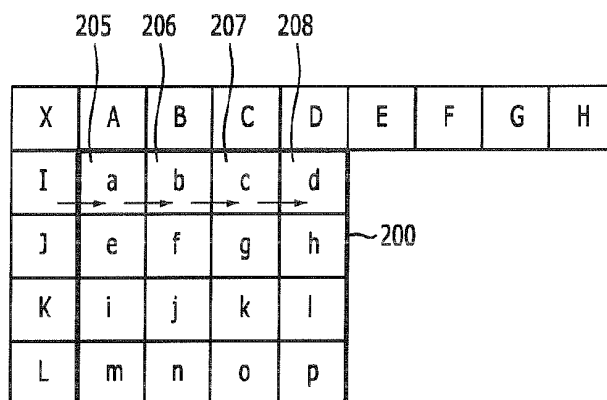


FIG. 4

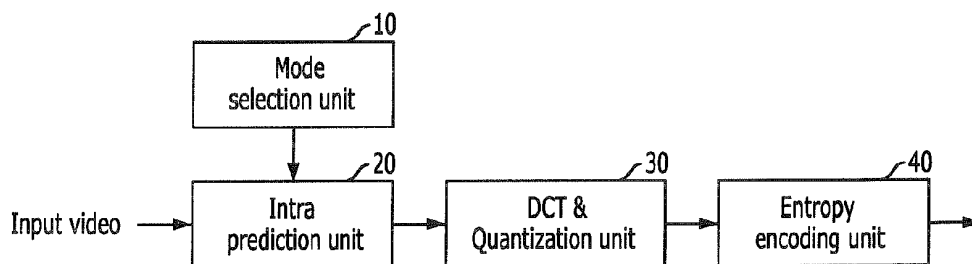


FIG. 5

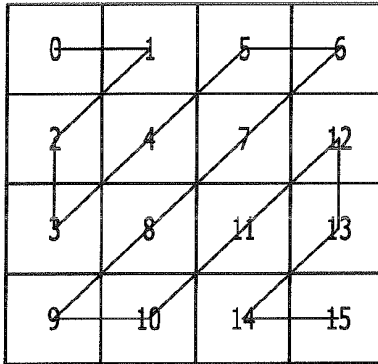
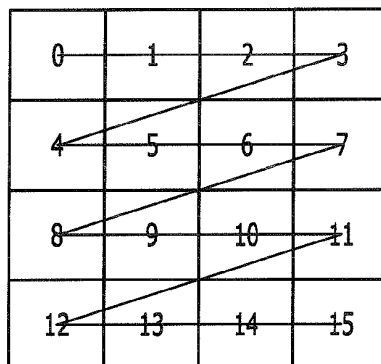


FIG. 6



Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.