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(54) **INTRA PREDICTION APPARATUS**

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H04N 11/02   (2006.01)
H04N 11/04   (2006.01)
H04N 9/12   (2006.01)
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(52) **U.S. Cl.** **375/240.16**; 375/240.08; 375/240.24; 375/240.26; 382/236; 348/392

(58) **Field of Classification Search** 375/240.16, 375/240.26, 240.24, 240.08; 382/236; 348/392
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,654,420	B1 *	11/2003	Snook	375/240.16
6,859,559	B2	2/2005	Boon et al.	
7,778,331	B2 *	8/2010	Sato et al.	375/240.26
2003/0223645	A1	12/2003	Sun et al.	
2004/0136458	A1	7/2004	Dahlhoff et al.	

FOREIGN PATENT DOCUMENTS

JP   2004-304724   10/2004

OTHER PUBLICATIONS

"Advanced video coding for generic audiovisual services" H.264 Series H: Audiovisual and Multimedia Systems Infrastructure of audiovisual services—Coding of moving video.
Japanese Office Action issued in Japanese Patent Application No. JP 2005-321566 dated Jul. 20, 2010.

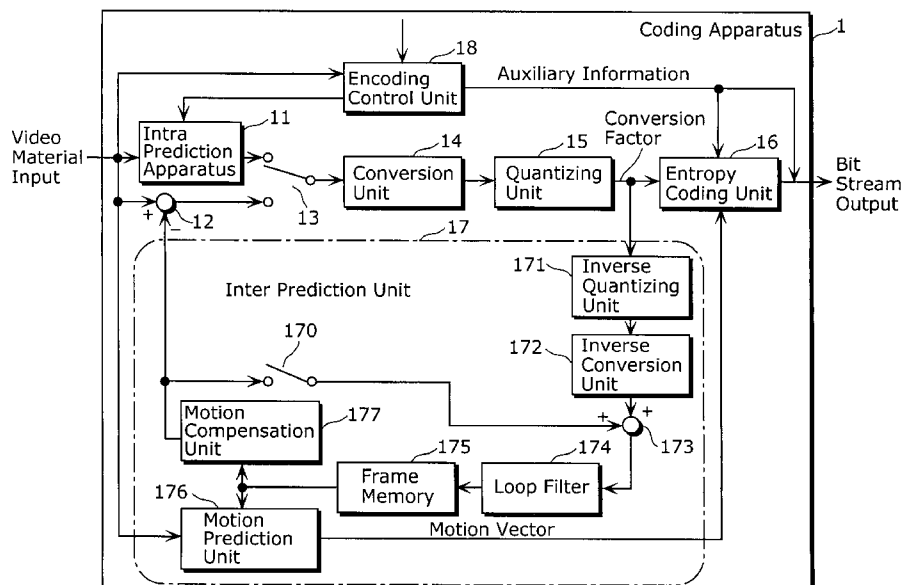* cited by examiner

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(57) **ABSTRACT**

An intra prediction apparatus includes: a candidate narrowing-down unit which narrows down, from a plurality of intra prediction directions, an intra prediction direction candidate which is applied to a block of multiple pixels that constitutes a video in accordance with a characteristic of the video; and an intra prediction execution unit which executes intra prediction in the intra prediction direction narrowed down by said candidate narrowing-down unit. Through this, computational load can be lightened while contributing to improvement in picture quality and encoding efficiency.
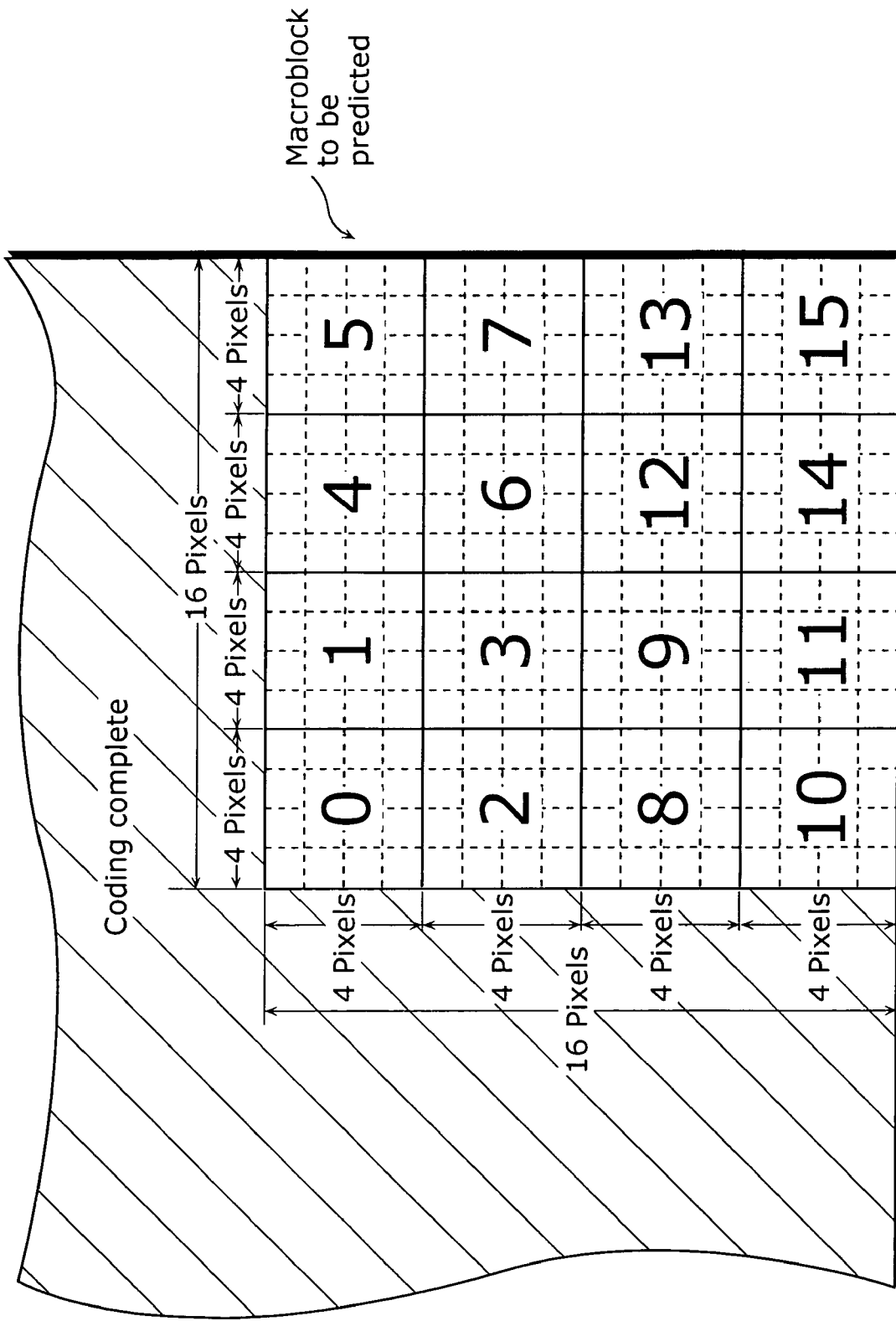
24 Claims, 15 Drawing Sheets

FIG. 1

Macroblock to be predicted

Coding complete

16 Pixels

16 Pixels

4 Pixels

0	1	4	5
2	3	6	7
8	9	12	13
10	11	14	15

FIG. 2

(a)

Prediction Mode 0

(b)

Prediction Mode 1

(c)

Average value

Prediction Mode 2

(d)

Prediction Mode 3

(e)

Prediction Mode 4

(f)

Prediction Mode 5

(g)

Prediction Mode 6

Already-encoded pixels of nearby blocks

Pixels to be encoded

(h)

Prediction Mode 7

(i)

Prediction Mode 8

FIG. 3

(a)

16 Pixels

16 Pixels

Prediction Mode 0
(Vertical Prediction)

(b)

16 Pixels

16 Pixels

Prediction Mode 1
(Horizontal Prediction)

(c)

16 Pixels

16 Pixels

Average value

Prediction Mode 2
(DC Prediction)

(d)

16 Pixels

16 Pixels

Prediction Mode 3
(Plane Prediction)

Pixels already encoded
in the above block or
the left block

Pixels to be encoded

FIG. 4

4×4 Block

| Block 0 Execute 9 prediction modes | Block 1 Execute 9 prediction modes | Block 2 Execute 9 prediction modes | Block 3 Execute 9 prediction modes |

| Block 4 Execute 9 prediction modes | Block 5 Execute 9 prediction modes | Block 6 Execute 9 prediction modes | Block 7 Execute 9 prediction modes |

| Block 8 Execute 9 prediction modes | Block 9 Execute 9 prediction modes | Block 10 Execute 9 prediction modes | Block 11 Execute 9 prediction modes |

| Block 12 Execute 9 prediction modes | Block 13 Execute 9 prediction modes | Block 14 Execute 9 prediction modes | Block 15 Execute 9 prediction modes |

16×16 Macroblock

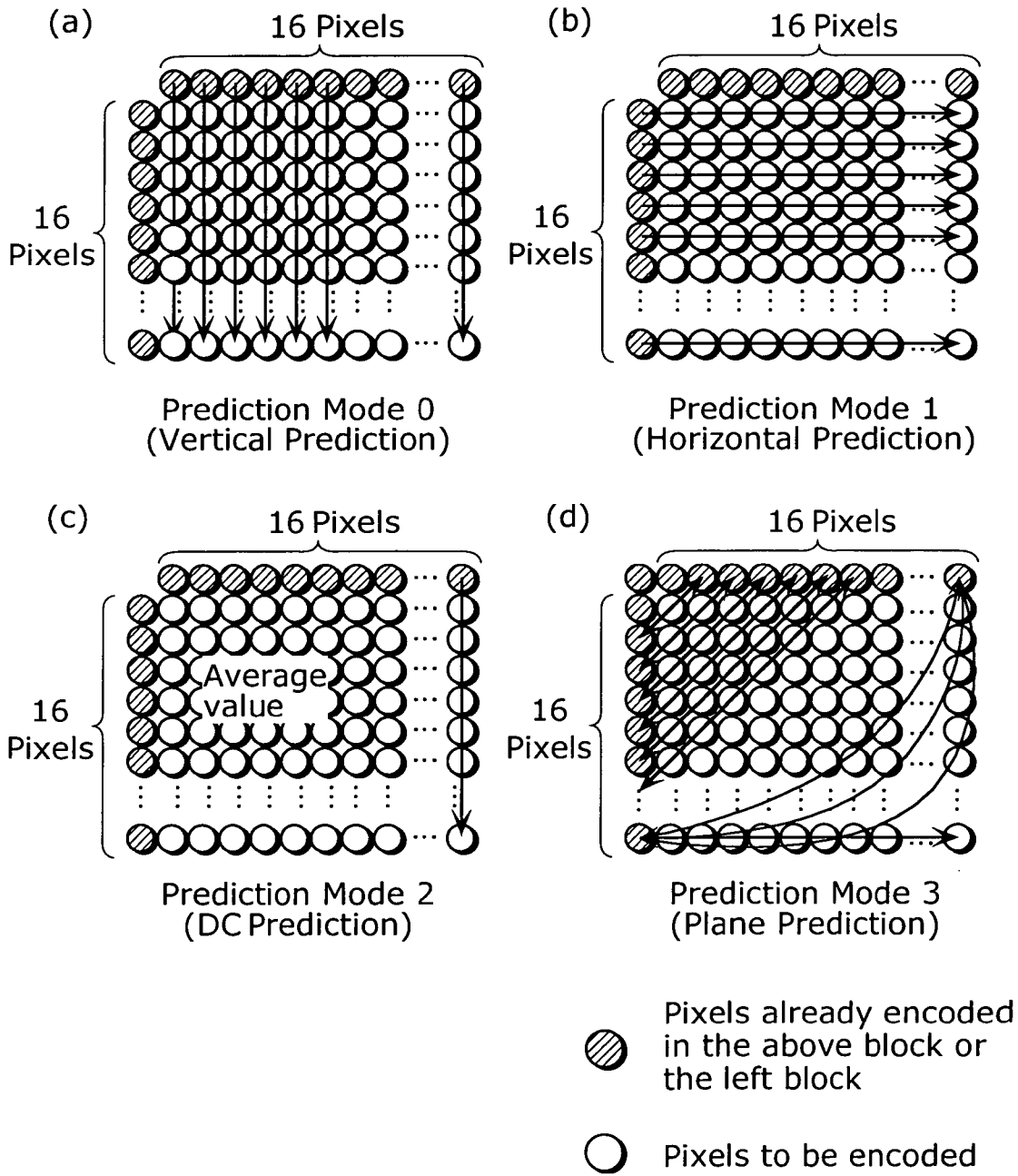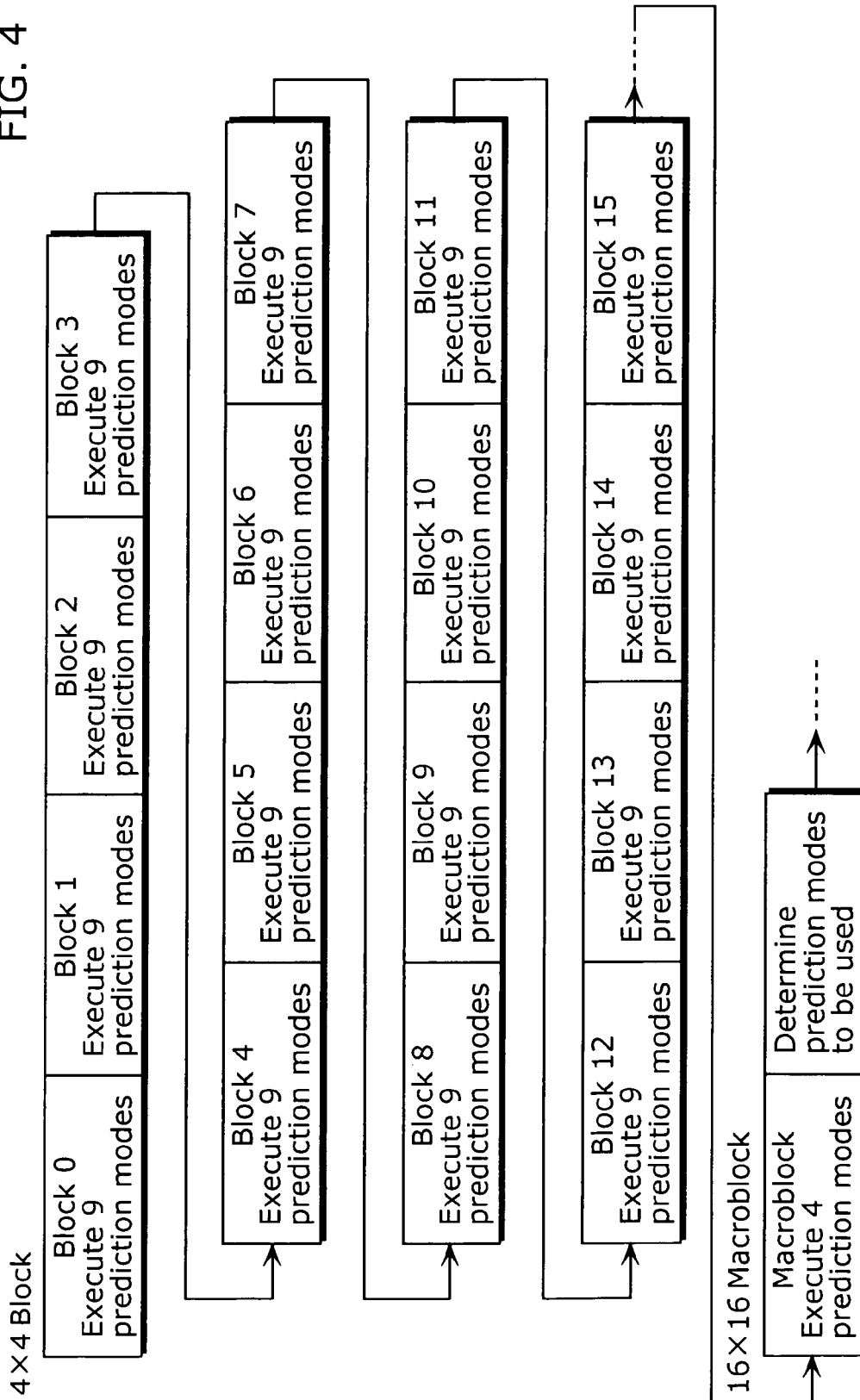| Macroblock Execute 4 prediction modes | Determine prediction modes to be used |

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