United States Patent [19]

Kim et al.

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[54] **IMAGE COMPRESSION ENCODING AND DECODING METHOD AND APPARATUS THEREFOR**

[75] Inventors: **Yong-Kyu Kim**, Seoul, Rep. of Korea; **Tianmin Liu**, Lawrenceville; **Steven T. Jaffe**, Freehold, both of N.J.; **Christopher H. Strolle**, Glenside, Pa.

[73] Assignee: **SamSung Electronics Co., Ltd.**, Kyungki-do, Rep. of Korea

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Related U.S. Application Data

[63] Continuation of Ser. No. 851,019, Mar. 13, 1992, abandoned.

[51] **Int. Cl.^{6}** **H04N 7/12**; G06K 9/36

[52] **U.S. Cl.** **382/232**; 348/403; 348/422; 358/433

[58] **Field of Search** 382/56; 348/403, 348/422; 358/430, 429, 431, 432, 433, 262.1

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,845,559	7/1989	Labit et al.	358/133
5,047,852	9/1991	Hanyu	358/141
5,051,840	9/1991	Watanabe et al.	382/56
5,121,216	6/1992	Chen et al.	382/56
5,122,875	6/1992	Rachaudhuri et al.	358/141

OTHER PUBLICATIONS

R. M. Gray, "Vector Quantization", Apr. 1984, pp. 4–26 IEEE ASSP Magazine, 1, No. 2.

Lee et al., "A study on New DCT–Based Bit Rate Reduction Algorithm and Variable Speed Playback for a Home–Use Digital VCR", Aug. 1992, pp. 236–242.

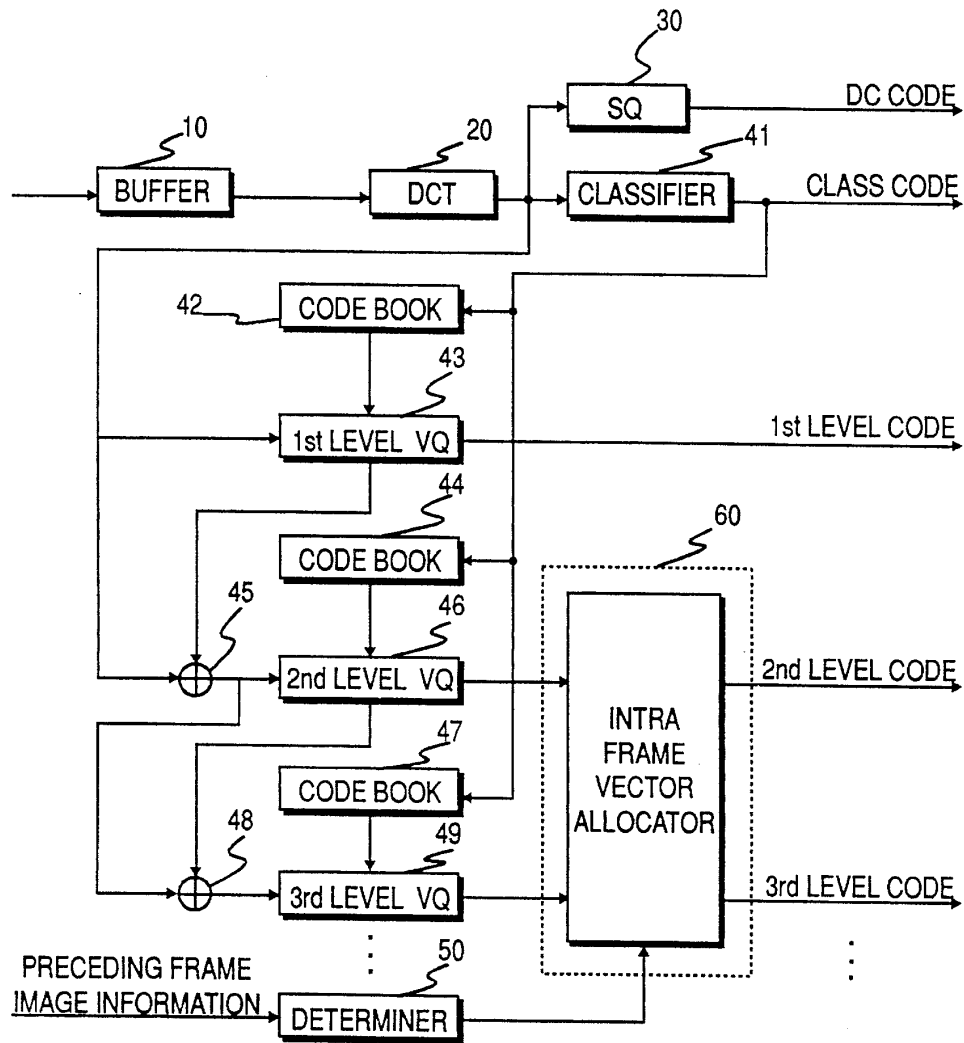Yashima et al., "HDTV/Standard TV Compatible Coding Based on DCT", 1990.

Primary Examiner—Stephen Chin
Assistant Examiner—Timothy J. May
Attorney, Agent, or Firm—Robert E. Bushnell

[57] **ABSTRACT**

Television images to be digitally recorded are divided into blocks and the discrete cosine transform DCT of each block is taken. The DC coefficient of each DCT block is scalar-quantized, and its AC coefficients are classified-vector-quantized (CVQ). The square of the value that part or all the AC coefficients among horizontal AC coefficients including a first AC coefficient and vertical AC coefficients including a second AC coefficient, according to the zigzag scanning sequence of DCT block, are subtracted from a representative value of a preset reference class. Using a multilevel compression method, lowest level codes are vector-partitioned by P-units at equal intervals with respect to each classified DCT block, and code books of representative vectors corresponding to the partitioned vectors are provided. Indices of corresponding representative vectors in respective code books are taken as encoding data corresponding to AC coefficients to keep a constant number of bits in the lowest level codes. Then, errors created in a preceding level are corrected. Code books of S-units of representative vectors corresponding to the errors are provided again, and corresponding indices and parity data in the respective code books are provided. Here, codes are output in which an image is more compactly compressed in lower levels, and higher levels have more elaborate picture quality. During tape recording, the codes descriptive of the scalar quantized DC term, the classification of the AC terms and the lowest-level vector-quantization index for each successive DCT block are grouped together for recording in a respective one of regularly spaced equal-length segments of the recording tracks. Decoding is performed in the reverse sequence of encoding. During a high speed search, only lowest level codes having a constant number of bits are decoded regardless of the complexity of the picture, so that picture quality is good enough to discern the nature of the images.

20 Claims, 4 Drawing Sheets

FIG. 1

DC

AC

	X 01	X 02	X 03	X 04	X 05	X 06	X 07
	0	4	5	13	14	26	27
Y 10 1	3	6	12	15	25	28	41
Y 20 2	7	11	16	24	29	40	42
Y 30 8	10	17	23	30	39	43	52
Y 40 9	18	22	31	38	44	51	53
Y 50 19	21	32	37	45	50	54	59
Y 60 20	33	36	46	49	59	58	60
Y 70 34	35	47	48	56	57	61	62

FIG. 2
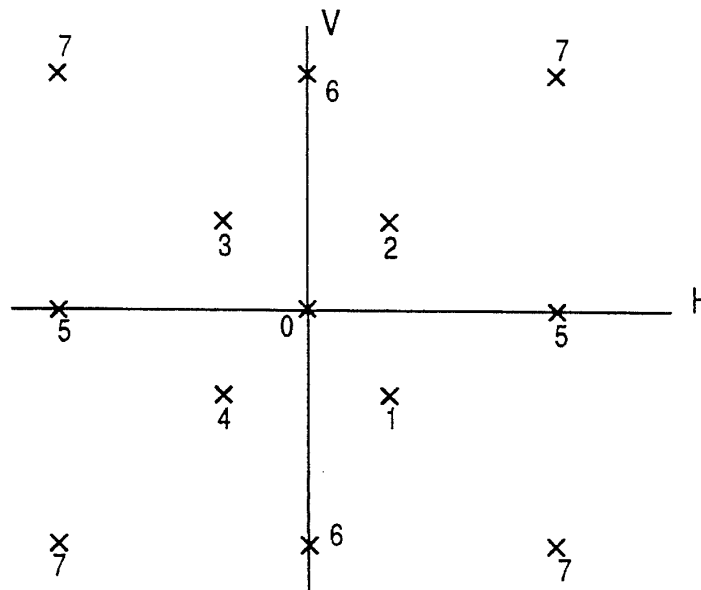
FIG. 3
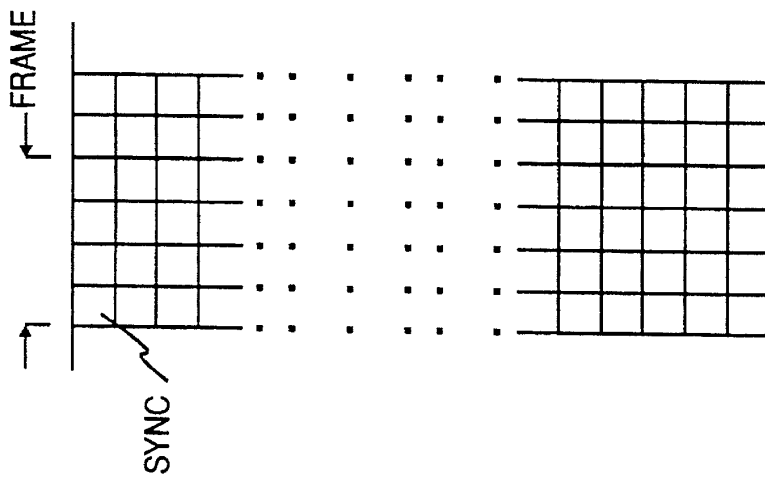
SYN	ID	IDC	ECC	DDC	ECC
2	2	24	6	104	8

146 BYTE

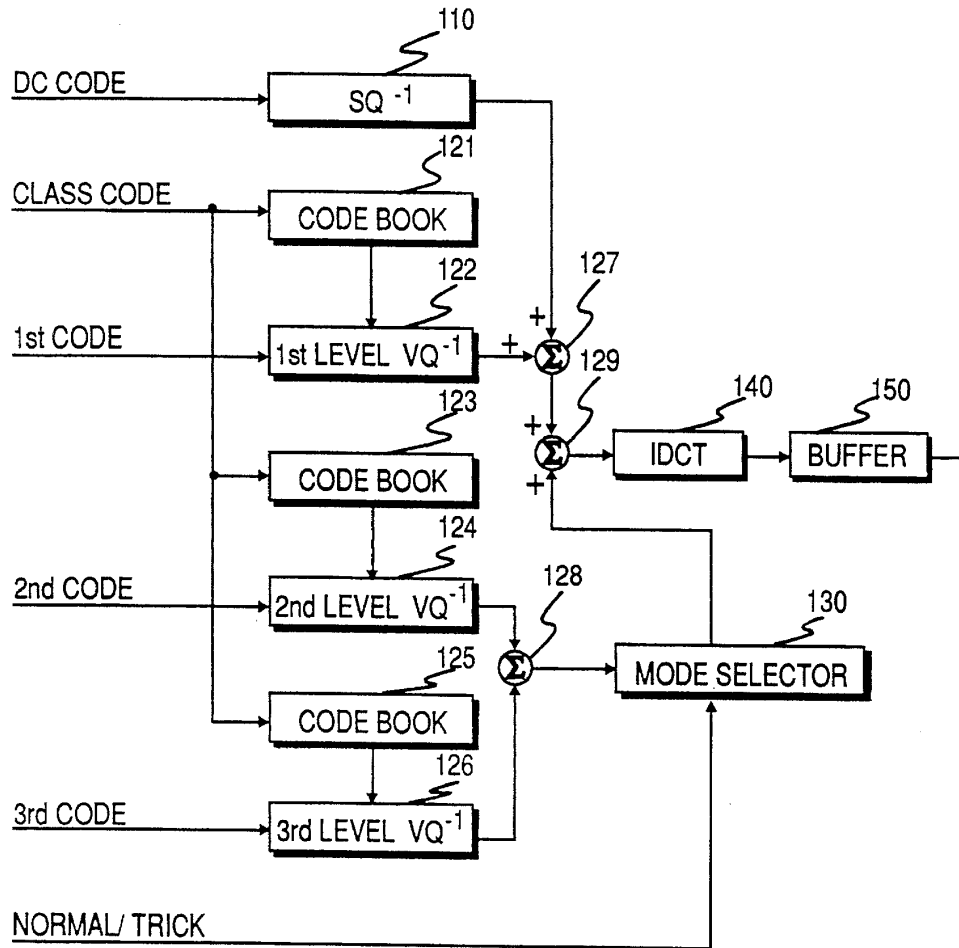*FIG. 4B*

FRAME

SYNC

FIG. 4A

FIG. 5

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