



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

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(54) **TEXTURE INFORMATION ASSIGNMENT METHOD, OBJECT EXTRACTION METHOD, THREE-DIMENSIONAL MODEL GENERATING METHOD, AND APPARATUS THEREOF**

(58) **Field of Classification Search** 345/581, 345/582, 586, 589, 606, 623-626, 629-630, 345/640, 643, 655, 682; 348/578, 580-581, 348/584-585, 586-590; 382/173, 282-283, 382/284-286, 295; G09G 5/00; G06K 9/00, G06K 9/20

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See application file for complete search history.

(73) Assignee: **Sanyo Electric Co., Ltd.**, Moriguchi (JP)

(56) **References Cited**

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 473 days.

U.S. PATENT DOCUMENTS

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4,982,438 A	1/1991	Usami et al.	
5,475,507 A *	12/1995	Suzuki et al.	358/500
5,483,066 A *	1/1996	Sadjadi et al.	250/338.1
5,687,249 A *	11/1997	Kato	382/104
5,724,493 A	3/1998	Hosoya et al.	
5,832,134 A *	11/1998	Avinash et al.	382/257
5,862,508 A *	1/1999	Nagaya et al.	701/207
5,864,640 A	1/1999	Miramonti et al.	
5,892,853 A *	4/1999	Hirani et al.	382/280
6,118,552 A *	9/2000	Suzuki et al.	382/166
6,151,424 A *	11/2000	Hsu	382/294
6,215,914 B1 *	4/2001	Nakamura et al.	382/284
6,229,578 B1 *	5/2001	Acharya et al.	348/607
6,246,804 B1 *	6/2001	Sato et al.	382/284
6,356,272 B1 *	3/2002	Matsumoto et al.	345/582
6,445,833 B1 *	9/2002	Murata et al.	382/285
6,556,210 B1 *	4/2003	Yamamoto et al.	345/418
2001/0005204 A1 *	6/2001	Matsumoto et al.	345/418
2002/0048399 A1 *	4/2002	Lee et al.	382/165

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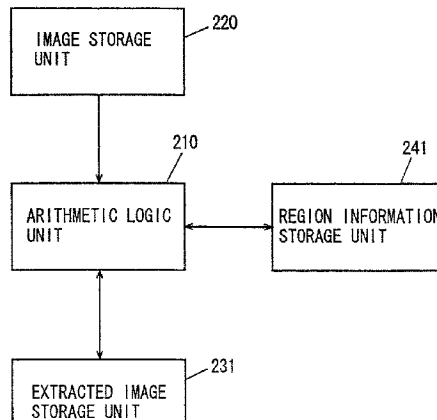
FOREIGN PATENT DOCUMENTS

EP	735 512 A2	10/1996
JP	61-138377	6/1986
JP	5-135155	6/1993
JP	6-258048	9/1994
JP	06-309023	11/1994
JP	06-311405	11/1994
JP	06-337998	12/1994
JP	07-287756	10/1995
JP	7-109626	11/1995
JP	07-320035	12/1995
JP	07-336694	12/1995
JP	8-14858	1/1996
JP	08-014858 A	1/1996
JP	8-147494	6/1996
JP	08147494 A	6/1996

(51) **Int. Cl.**

G09G 5/00 (2006.01)
G06K 9/00 (2006.01)
G06K 9/20 (2006.01)

(52) **U.S. Cl.** **345/640; 345/643; 382/173; 382/282**



JP 8-331607 12/1996
JP 09-231369 9/1997

OTHER PUBLICATIONS

“Shape Measurement and Description of Curved Objects” by Yukio Sato and Hiroichi Fujita, *Denshi Tsushin Gakkai*, '79/1 vol. J62-D No. 1.

“Recovering 3D Models from Silhouette Sequence and Detecting Unexposed Regions” by Jiang Yu Zheng and Fumio Kishino, *Denshi Joho Tsushin Gakkai*, '93/6 vol. J76-D-11 No. 6.

“Fundamental Study of Input Method of 3D digital Image” by Yoshiaki Usami and Misato NIO, *Computer Vision* 37-2, Jul. 18, 1985.

“Recent Tendency in Image Processing Algorithm” by Naokazu Yokoya, pp. 227-233, *Shin Gijutsu Communications*, O Plus E, Nov. 1986, edited by Takagi et al.

“3.4 Range Information From Geometry” pp. 88-93, *Computer Vision* edited by Dana H. Ballard and Christopher M. Brown.

“An Iterative Procedure for the Polygonal Approximation of Plane Curves” by Urs Ramer, pp. 244-256, *Computer Graphics and Image Processing* (1972) I.

“Estimation of Shape and Color from Bi-directional Voting Using a Sequence of Color Frames” by Hisayoshi Zaima and Tsuyoshi Yamamoto, *Joho Shori Gakkai* (1996).

Photorealistic Scene Reconstruction by Voxel Coloring by Steven M. Seitz and Charles R. Dyer, pp. 1067-1073, 1997 IEEE.

English translation of the Notice of Ground of Rejection received from the Japanese Patent Office dated Apr. 27, 2004 for the corresponding Japanese Patent Application No. 9-217550.

English translation of the Notice of Ground of Rejection received from the Japanese Patent Office dated Jun. 22, 2004 for the corresponding Japanese Patent Application No. 09-232617.

Takahiro Muraki et al. “Study on Virtual Viewpoint Image Generation Using Multi ViewPoint Image Selection Method” (in Japanese with English language translation), 1996 Proceedings of the Institute of Electronics, Information and Communication Engineers of Japan, Information—System 2, Aggregate Corporation Institute of Electronics, Information and Communication Engineers of Japan, Mar. 28, 1996, p. 228.

English translation of the Notice of Ground of Rejection received from the Japanese Patent Office dated Aug. 3, 2004 for the corresponding Japanese Patent Application No. 09-234829 (cited previously).

English translation of the Notice of Ground of Rejection received from the Japanese Patent Office dated Aug. 3, 2004 for the corresponding Japanese Patent Application No. 09-234829.

English translation of the Notice of Ground of Rejection received from the Japanese Patent Office dated Aug. 3, 2004 for the corresponding Japanese Application No. 09-217550.

* cited by examiner

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(57)

ABSTRACT

The present method represents a three-dimensional shape model by polygons according to a plurality of object images information picked up by rotating a real object for every arbitrary angle to assign texture information on each polygon from object image information having the largest projection area of the relevant polygon. In order to improve the color continuity between adjacent polygons, the object image information having correspondence between a polygon of interest and an adjacent polygon thereof is selected so as to be the object image information approximating the shooting position and the shooting direction. An alternative method divides an object image into a plurality of regions, obtains difference between an object image and a background image in region level, outputs a mean value of the absolute value of difference in the region level, and detects the region having the mean value of absolute values of difference equal to or greater than a threshold value as the object portion. Another further method obtains a plurality of object images by shooting only a background of an object of interest and by shooting the object of interest during each rotation. A silhouette image is generated by carrying out a difference process between the object image and the background image. A voting process is carried out on the voxel space on the basis of the silhouette image. A polygon is generated according to the three-dimensional shape obtained by the voting process. The texture obtained from the object image is mapped to the polygon.

27 Claims, 43 Drawing Sheets

FIG.1
PRIOR ART

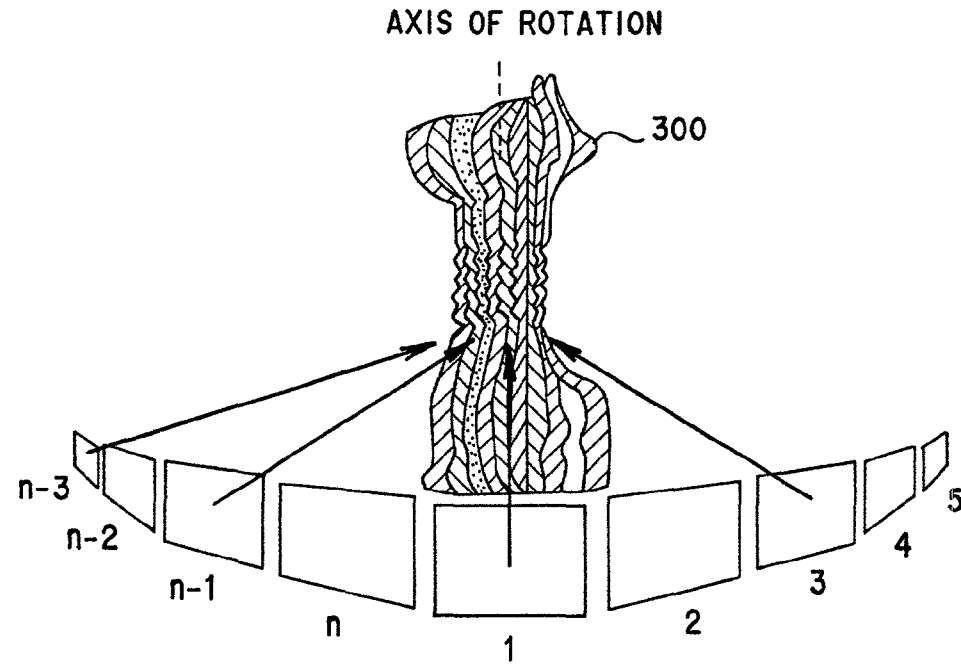


FIG.2

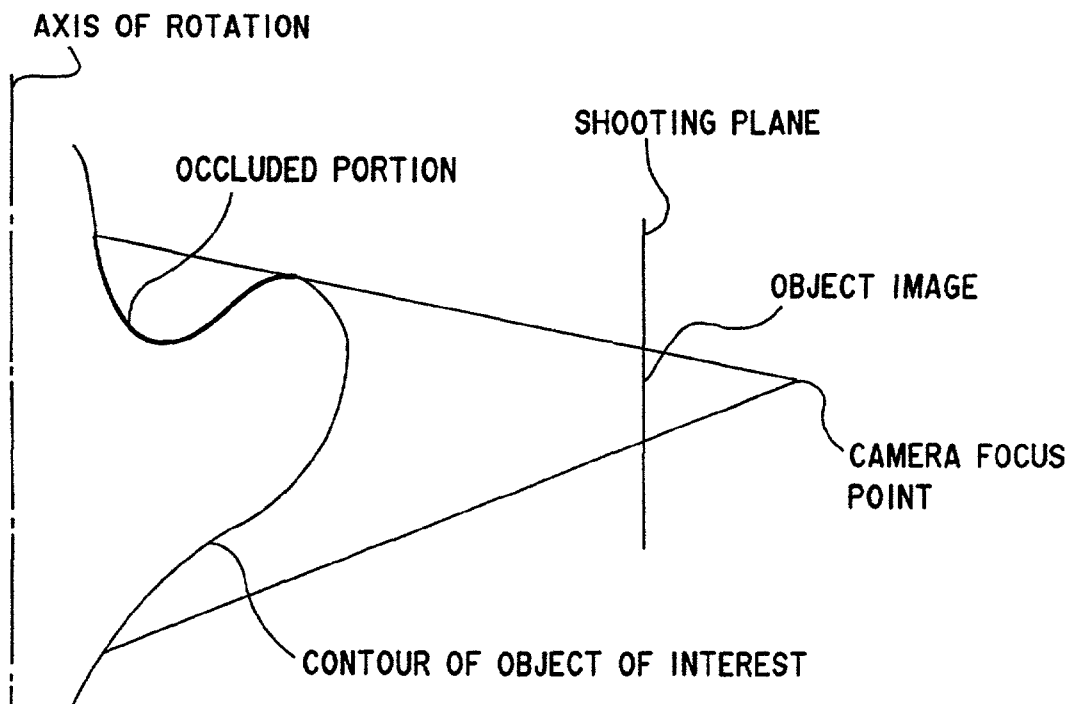


FIG. 3

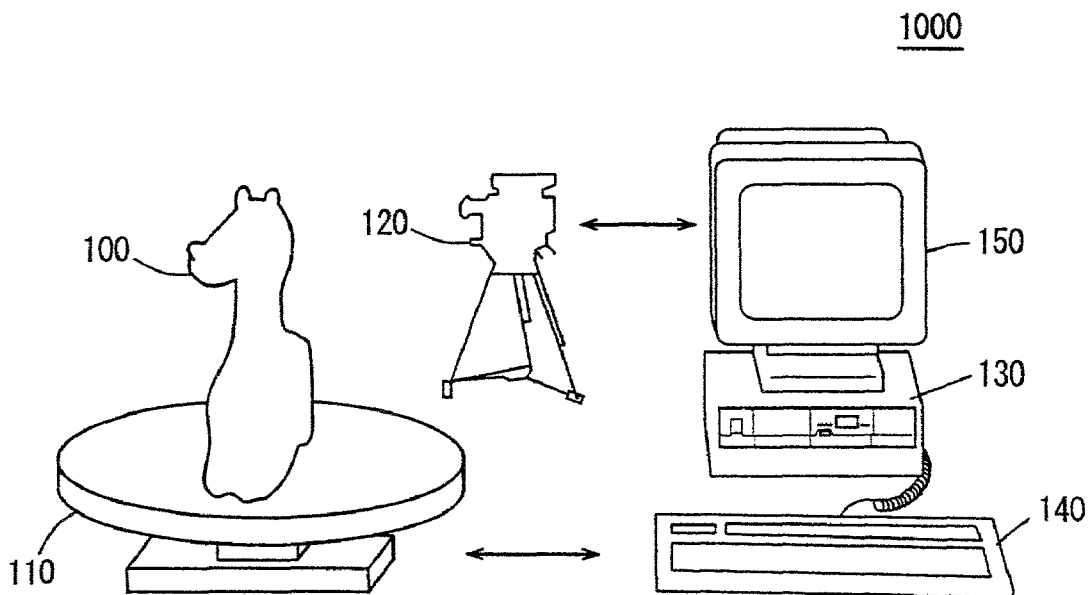


FIG. 4

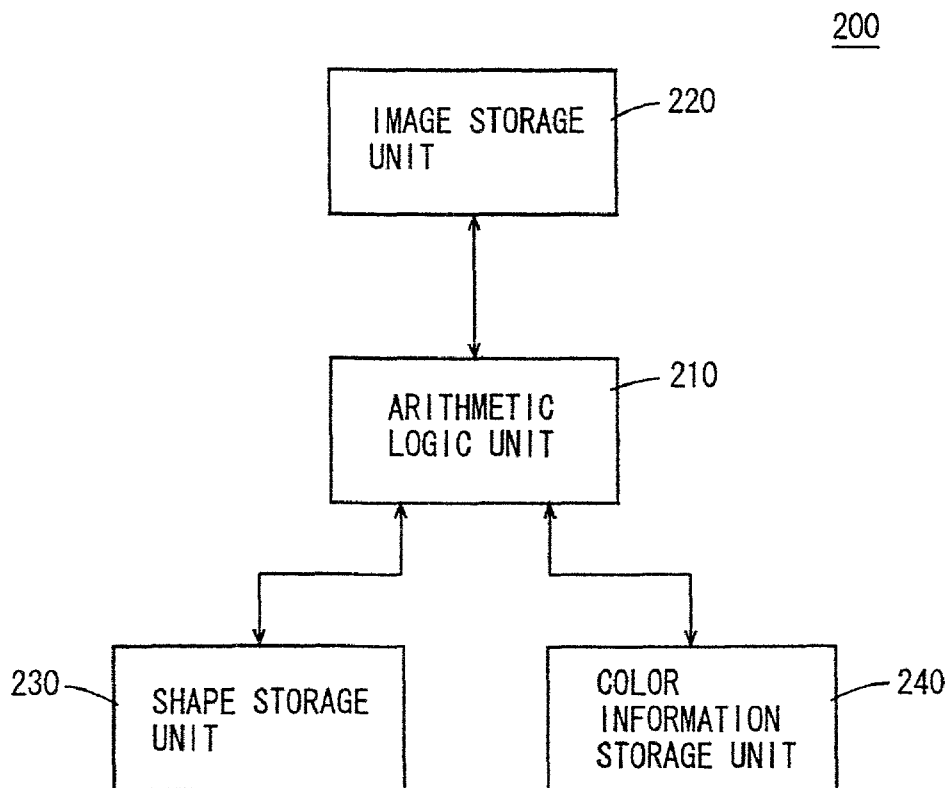
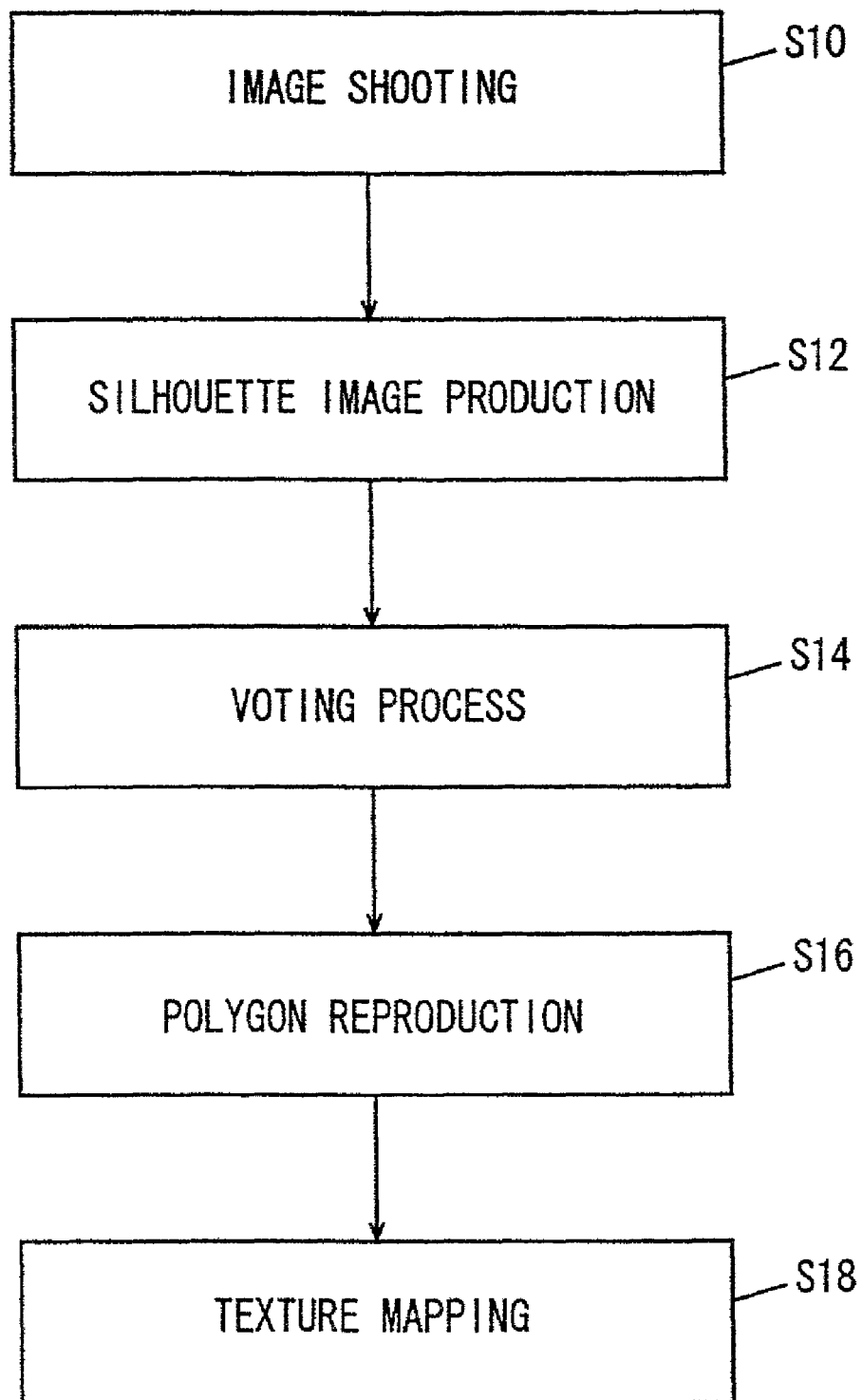


FIG. 5



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