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Yap et al.

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(54) **APPARATUS AND METHOD FOR REALTIME VISUALIZATION USING USER-DEFINED DYNAMIC, MULTI-FOVEATED IMAGES**

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(*) Notice: Under 35 U.S.C. 154(b), the term of this patent shall be extended for 0 days.

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(52) **U.S. Cl.** **709/203**; 709/246
(58) **Field of Search** 709/217, 219, 709/246, 247, 203; 707/10; 382/103, 233, 235, 232, 240, 302

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,622,632	11/1986	Tanimoto .
5,341,466	8/1994	Perlin .
5,481,622 *	1/1996	Gerhardt et al. 382/103
5,568,598 *	10/1996	Mack et al. .... 382/302 X
5,710,835 *	1/1998	Bradley 382/233
5,724,070 *	3/1998	Denninghoff et al. .... 382/235 X
5,861,920 *	1/1999	Mead et al. .... 382/232 X
5,880,856 *	3/1999	Ferriere .... 382/240 X
5,920,865 *	7/1999	Ariga 707/10

OTHER PUBLICATIONS

Tams Frajka et al., Progressive Image Coding with Spatially Variable Resolution, IEEE, Proceedings International Conference on Image Processing 1997, Oct. 1997, vol. 1, pp. 53–56.*

E. C. Chang et al., "Realtime Visualization of Large . . . " Mar. 31, 11997, pp. 1–9, Courant Institute of Mathematical Sciences, New York University, N.Y. U.S.A.

E. C. Chang et al., "A Wavelet Approach to Foveating Images", Jan. 10, 1997, pp. 1–11, Courant Institute of Mathematical Sciences, New York University, N.Y. U.S.A.

S.G. Mallat, "A Theory for Multiresolutional Signal Decomposition . . . ", IEEE Transactions on Pattern Analysis and Machine Intelligence, pp. 3–23, Jul. 1989, vol. 11, No. 7, IEEE Computer Society.

News Release, "Wavelet Image Features", Summus' Wavelet Image Compression, Summus 14 pages.

R.L. White et al., "Compression and Progressive Transmission of Astronomical Images", SPIE Technical Conference 2199, 1994.

(List continued on next page.)

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(57) **ABSTRACT**

A client apparatus which enables a realtime visualization of at least one image. The client apparatus includes a storage device which stores first data corresponding to a multifoveated representation of an original image, and a user input device which providing second data corresponding to at least one visualization command of at least one user. In addition, the client apparatus includes a processing arrangement which generates third data corresponding to a multi-foveated image using the first data, the second data and a foveation operator.

8 Claims, 6 Drawing Sheets
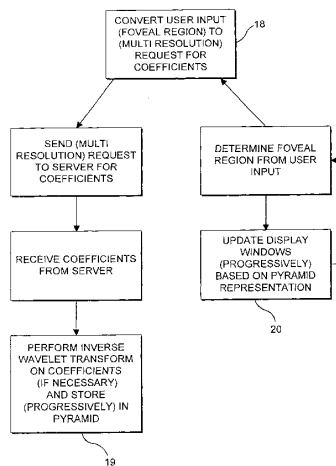
OTHER PUBLICATIONS

E.L. Schwartz, "The Development of Specific Visual . . . " Journal of Theoretical Biology, 69:655–685, 1977.

F.S. Hill Jr. et al.,"Interactive Image Query . . . " Computer Graphics, 17(3), 1983.

T.H. Reeves et al., "Adaptive Foveation of MPEG Video", Proceedings of the 4th ACM International Multimedia Conference, 1996.

R.S. Wallace et al., "Space–variant image processing". Int'l. J. of Computer Vision, 13:1(1994) 71–90.

E.L. Schwartz A quantitative model of the functional architecture: Biological cybernetics, 37(1980) 63–76.

P. Kortum et al., "Implementation of a Foveated Image . . . " Human Vision and Electronic Imagining, SPIE Proceedings vol. 2657, 350–360, 1996.

M.H. Gross et al., "Efficient triangular surface . . . ", IEEE Trans on Visualization and Computer Graphics, 2(2) 1996.
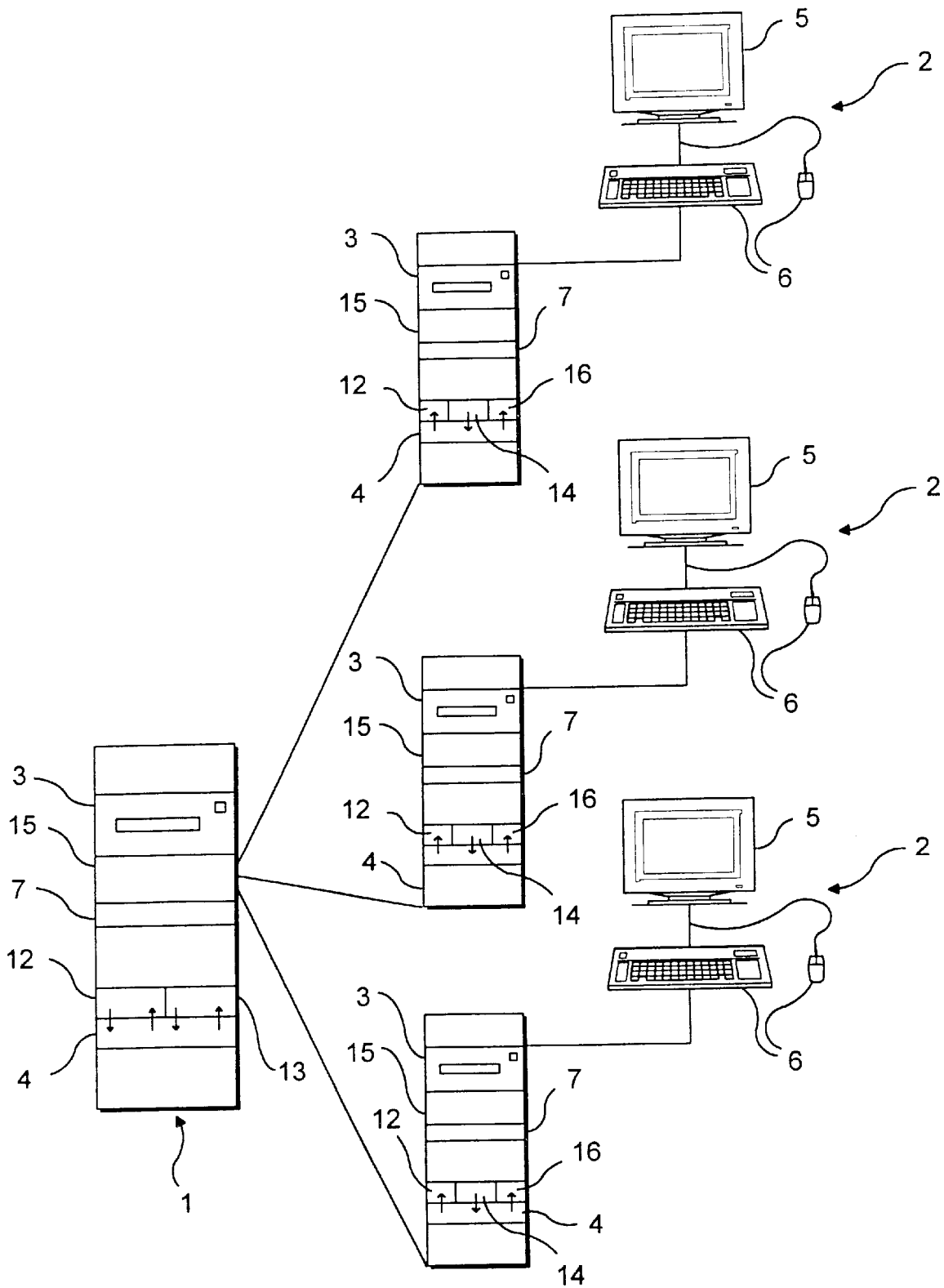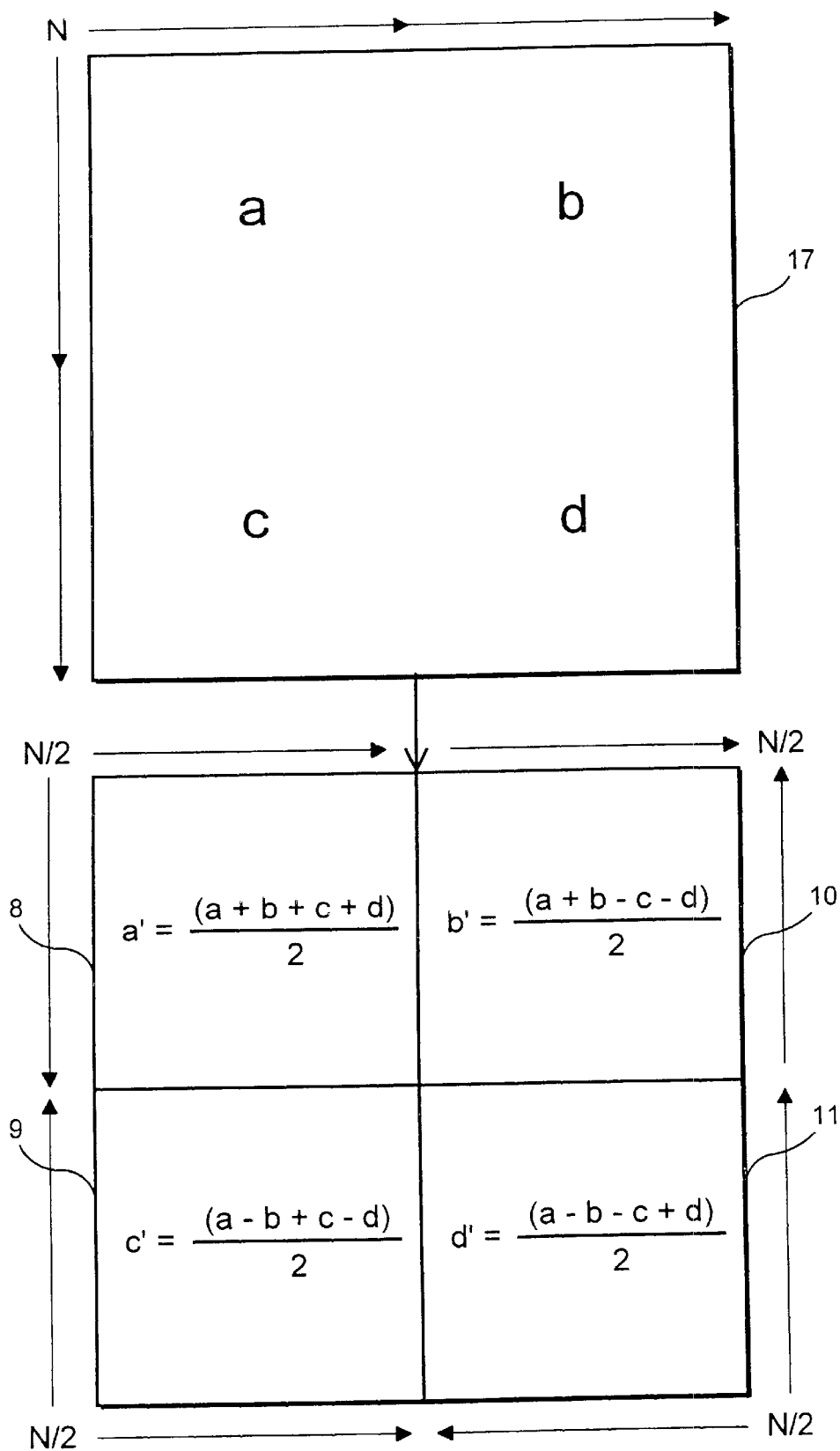
* cited by examiner

F I G. 1

N

a   b

17

c   d

N/2   N/2

8

$$a' = \frac{(a + b + c + d)}{2}$$ $$b' = \frac{(a + b - c - d)}{2}$$

10

9

$$c' = \frac{(a - b + c - d)}{2}$$ $$d' = \frac{(a - b - c + d)}{2}$$

11

N/2   N/2

F I G. 2A

$$a = \frac{a' + b' + c' + d'}{2} \qquad b = \frac{a' + b' - c' - d'}{2}$$

17

$$c = \frac{a' - b' + c' - d'}{2} \qquad d = \frac{a' - b' - c' + d'}{2}$$

8

$$a' = \frac{(a + b + c + d)}{2} \qquad b' = \frac{(a + b - c - d)}{2}$$

10

9

$$c' = \frac{(a - b + c - d)}{2} \qquad d' = \frac{(a - b - c + d)}{2}$$
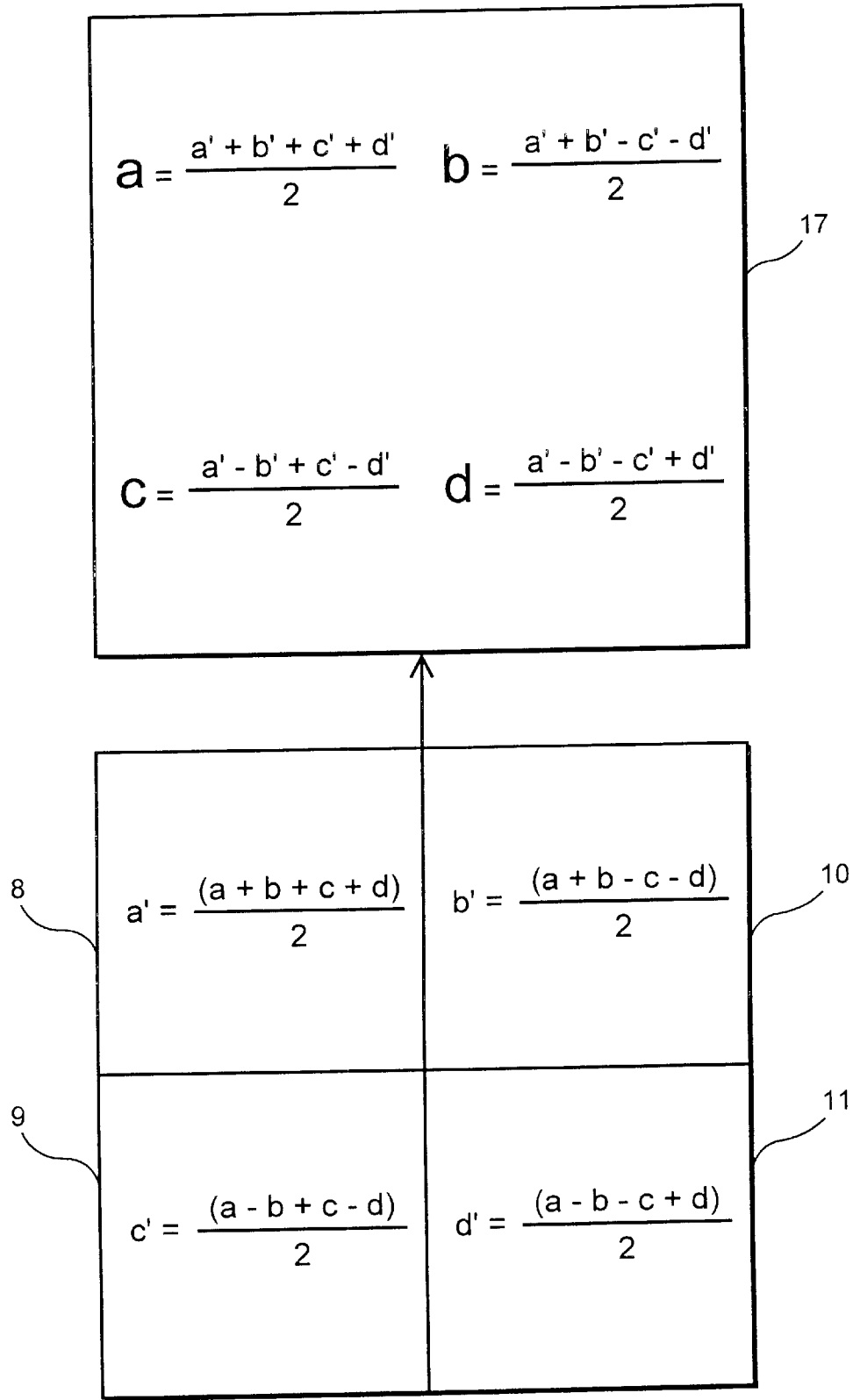
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F I G. 2B

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