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(54) **VERIFICATION METHOD FOR DETERMINING AREAS WITHIN AN IMAGE CORRESPONDING TO MONETARY BANKNOTES**

(75) Inventors: **Xu-Hua Liu**, Los Angeles, CA (US); **Byung-Tae Oh**, Los Angeles, CA (US); **Young-Min Kwak**, Gardena, CA (US); **Chung-Chieh Kuo**, Taipei (TW); **Tzu-Hung Cheng**, Taipei (TW)

(73) Assignee: **Primax Electronics Ltd.**, Neihu, Taipei (TW)

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G06K 9/00 (2006.01)

(52) **U.S. Cl.** **382/135**

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See application file for complete search history.

(56) **References Cited**

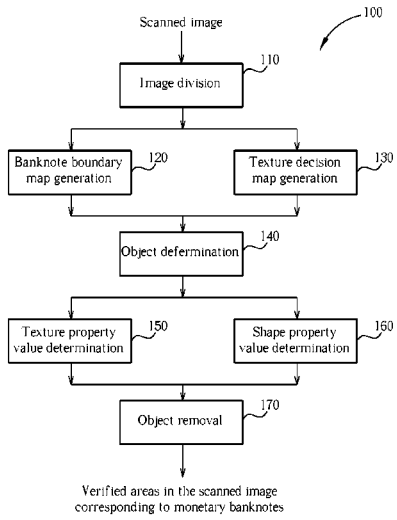
U.S. PATENT DOCUMENTS

5,533,144 A 7/1996 Fan
5,638,496 A 6/1997 Sato
6,026,186 A 2/2000 Fan
6,067,374 A 5/2000 Fan et al.
6,181,813 B1 1/2001 Fan et al.
6,256,412 B1 7/2001 Miyazawa et al.
6,317,524 B1 11/2001 Wu et al.
6,343,204 B1 1/2002 Yang
6,473,202 B1 * 10/2002 Kanata et al. 358/2.1
6,515,764 B1 2/2003 Knox et al.
6,516,078 B1 2/2003 Yang et al.
6,542,629 B1 4/2003 Wu et al.
6,574,366 B1 6/2003 Fan
6,580,820 B1 * 6/2003 Fan 382/135
6,731,784 B2 5/2004 Yang
RE38,716 E * 3/2005 Caspi et al. 382/141
2002/0146167 A1 10/2002 Imamura
2004/0247169 A1 12/2004 Ross
2005/0100204 A1 * 5/2005 Afzal et al. 382/135

* cited by examiner

Primary Examiner—Vu Le
Assistant Examiner—Claire Wang
(74) *Attorney, Agent, or Firm*—Winston Hsu

(57) **ABSTRACT**

Verification of areas within an image corresponding to banknotes includes dividing the image into a plurality of image sections; generating a banknote boundary map having border sections corresponding to a boundary of monetary banknotes within the image; generating a texture decision map having texture sections within a valid range according to a valid monetary banknote; determining a number of objects in the texture decision map by removing texture sections in the texture decision map that correspond to the border sections in the banknote boundary map; calculating a texture property value for each object; calculating a shape property value for each object; and further removing texture sections from the texture decision map corresponding to objects that do not have the texture property value within a first predetermined range and the shape property value within a second predetermined range.

21 Claims, 11 Drawing Sheets