

METHOD AND APPARATUS FOR DETECTING PHOTOCOPIER TRACKING SIGNATURES

BACKGROUND OF THE INVENTION

The present invention relates to the color image processing arts. It finds particular application in conjunction with detecting photocopier tracking signatures placed on documents that are reproduced by color photocopiers, and will be described with particular reference thereto. However, it should be appreciated that the present invention may also find application in conjunction with other types of imaging systems and applications where detecting hidden information in an image or document is desirable.

Photocopier technology, in particular color photocopier technology, has advanced to the point that highly accurate copies of an original color document can be produced. Such accurate color document reproduction capabilities have brought about the potential for illicit photocopying of valuable color documents such as currency, stock and bond certificates, bank notes, and other negotiable instruments, etc.

Various methods have been developed to make such valuable documents resistant to photocopying. Some known methods involve the use of a special ink composition; a particular printed pattern; minute gradations in the thickness of the printed image; or some combination of these methods, all of which result in making the document either wholly or partially resistant to photocopying. One such solution is disclosed in U.S. Pat. No. 5,510,199, which describes a method of making a photocopy-resistant document.

Other known solutions focus on providing photocopiers with document rejection capabilities. Typically, these solutions prevent a color copier from reproducing an original document when the copier detects one or more specific landmarks or features on the original document. One such solution is disclosed in U.S. Pat. No. 5,515,451, which describes an image processing system for selectively reproducing documents.

Notwithstanding these known countermeasures, valuable color documents can sometimes be photocopied with enough accuracy to somewhat appear as an original document. Thus, known color photocopiers are provided with a further countermeasure that prints substantially-latent, photocopier-specific information on each output document that is produced. One such color photocopier signature tracking system is discussed in the above-mentioned U.S. Pat. No. 5,515,451.

For example, copier-specific information, in the form of a repeating yellow dot pattern having areas and/or densities that are below the threshold of visual perception, is printed on every output document generated by the photocopier. The use of yellow toner for the dot pattern is preferred because most people are not able to visually detect yellow as well as other colors. Photocopier-specific information can include the photocopier manufacturer, photocopier serial number, photocopier model number, etc. This alphanumeric information can be converted to numeric code, and the numeric code can then be represented as a pattern of dots that are repeated across an output document. For example, Xerox Corporation can be assigned a manufacturer's code of 50_{10} , which can be represented as 00110010_2 . The binary 1's can be represented as the yellow dots and binary 0's can be represented as spaces.

FIGS. 1 and 2 show an exemplary output document **10** on which a copied image **12** and latent copier-specific infor-

mation are printed. The copier-specific information is in the form of repeating blocks of code data **14** that are arrayed across the output document. In this example, one byte of code data forms a single row **16** of the block, and each dot position **18** in the row represents a single bit of a code data byte. The dot pattern for each bit can consist of two yellow pixels in the fast scan direction and one yellow pixel in the slow scan direction. This extremely small yellow dot pattern is below the threshold of visual perception for most people.

Latent copier-specific information can sometimes be detected by viewing the counterfeit document through a blue filter and a magnifier. This maximizes the contrast of the photocopier-signature if the filter is chosen to be the complement of the colored dot pattern. When such a dot pattern is detected, the photocopier-specific information can be decoded and then used by law enforcement agencies to track down counterfeiting perpetrators. However, in the case where the copied image **12** and/or the plain document substrate **10** has a yellow color component, it can be very difficult to detect the yellow dot pattern with conventional methods. That is, this known method of detecting copier-specific information works as long as the background information does not significantly lower the visual contrast of the photocopier signature.

Accordingly, it has been considered desirable to develop a new and improved method and apparatus for detecting photocopier tracking signatures placed on documents produced by color photocopiers, which meets the above-stated needs and overcomes the foregoing difficulties and others while providing better and more advantageous results.

SUMMARY OF THE INVENTION

In accordance with one aspect of the present invention, a method of detecting a latent photocopier tracking signature printed on a document produced by a color photocopier. The method includes generating a plurality of color separations that digitally represent the document wherein each of the plurality of color separations are defined by a plurality of pixel values; generating an output image based on differences between corresponding pixel values of at least two of the plurality of color separations; and displaying the output image to view the photocopier tracking signature.

In accordance with another aspect of the present invention, an image processing system is disclosed. The image processing system includes an input terminal that supplies digital image data representing an input document produced by a color photocopier. The digital image data includes a plurality of pixel values grouped together to form a plurality of color separations that represent the input document, and the input document has a latent photocopier tracking signature printed thereon. The system also includes an image processing unit that generates an output image based on the digital image data, the image processing unit generating the output image based on differences between corresponding pixel values of at least two of the plurality of color separations. The system further includes an output terminal for displaying the output image to view the photocopier tracking signature.

One advantage of the present invention is the provision of a method for detecting copier tracking signatures printed on a photocopier-generated document.

Another advantage of the present invention is the provision of a method for detecting information printed on a photocopier-generated document that is below a threshold of visual perception.

A still further advantage of the present invention is the provision of a method for authenticating a photocopier-generated document.