ANTI-COUNTERFEIT PATTERN DETECTOR AND METHOD

BACKGROUND OF THE INVENTION

The present invention relates to an anti-counterfeit detector and method for identifying whether an image to be photocopied contains one or several pre-selected monetary note patterns.

Preventing color copiers from being misused for counterfeiting has currently drawn more and more attention. In determining whether a color copier is being used for counterfeiting, a detector compares a known currency image with an image being copied. A problem arises in that it is difficult to detect the patterns in a rotation and shift invariant manner. Specifically, the pattern could be of any orientation and at any location on the image. The orientation and the location of the note can be relatively simple to obtain in the case of a single note with a plain background. However, it is difficult to obtain orientation and location if multiple notes are involved and/or the notes are embedded in some complicated image background.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an anti-counterfeit pattern detector that detects patterns in a rotation and shift invariant manner.

It is a further object of the present invention to provide greater accuracy and lower analysis time for the currency detection and orientation detection process.

The present invention achieves these and other objects and advantages by providing a memory for storing a plurality of templates, each of the plurality of templates comprising at least one predetermined anchor point; examining structure for examining a portion of the image to be photocopied and for determining whether the portion contains a detected anchor point; orientation determining structure for determining an orientation of the detected anchor point; and matching structure for comparing the plurality of templates to the portion in accordance with the orientation of the detected anchor point.

A method is also disclosed.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects of the present invention will become apparent from the following detailed description of preferred embodiments when taken in conjunction with the accompanying drawings, in which:

FIGS. **1**A–D illustrate matching a template to a detected sample;

FIG. **2** is a block diagram of the system of the invention;

FIG. **3** is a flowchart illustrating the operation in the invention; and

FIG. **4** is a flowchart illustrating orientation estimation according to the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The following detailed description of preferred embodiments is applicable to numerous detection and imaging systems as would be contemplated by those of ordinary skill.

The invention will be described with general reference to FIG. **3**.

In order to detect whether a color copier is being used for counterfeiting, the detector **1** is first trained off-line with example notes. A template is created by an initial sampling of currencies (hereinafter template) suspected of being photocopied and counterfeited. Conventional sampling is preferably performed in a low resolution.

The training includes sampling the templates and selecting one or several anchor points. Only those pixels on relatively straight edges, preferably long straight edges, are qualified to be anchor points. Anchor points are used to determine the edge orientation of the unknown document or documents and orient the template accordingly (discussed below). There is no set limit as to the number of possible anchor points in each template. The greater the number of preselected anchor points, the higher the detection accuracy, but the more time of analysis.

One-dollar bills may be sampled at 16 dpi and 32 dpi, respectively. That resolution is sufficient to make a positive determination of the presence of currency when the template is compared with the image being photocopied. The template is stored in a computer memory **26** (FIG. **2**) for future image comparison with the unknown document.

The detecting of currency notes placed on a platen will now be described. A digital color copier contains functionally a scanning part **20** and a printing part **28** as indicated in FIG. **2**. The currency detector **1** is placed in parallel to the normal video pass **30**. A data processor (CPU) **22** performs the functions of the detector **1**.

When an image of the platen (platen image) containing the unknown document is scanned by the scanning part of the copier, the signal is also sent to the detector **1**. The image is sampled using conventional means and at the resolution of the template (FIG. **3**, step **S1**), and stored into the image buffer **21**.

The information of a scanned color image is typically organized into three or four channels. The most commonly used sets of channels, or color spaces, are RGB and CIELAB. In RGB, three channels carry red (R), green (G), and blue (B) signals, respectively, while in CIELAB, L* channel represents luminance information, and a* and b* channels represent chromanance information. If RGB space is used, all three channels will be sampled at the same resolution of 16 dpi or 32 dpi. If L*a*b* space is used, a* and b* channels are sampled at a resolution that is half of that of the L* channel. Specifically, L* is sampled at 16 dpi or 32 dpi, and a* and b* are sampled at 8 dpi or 16 dpi.

After sampling, the color image of the platen is smoothed (FIG. **3**, step **S2**). The process of smoothing entails the averaging of the value of pixels within a given area and reassigning the averaged value to the center pixel. For example, a block area of 3×3 pixels may contain pixels of different value. An average value is obtained for the nine pixels, and is assigned to the center pixel. The reassigned value produces a new version of the platen image providing less prominent fine texture patterns that could otherwise confuse edge detection and orientation estimation (see below).

The smoothed platen image is examined block by block, with a typical block size of 8×8 pixels. The blocks can be overlapping. Each block is examined by the data processor **22** (FIG. **2**) to see if it possibly contains a pixel intensity orientation that corresponds to a preselected anchor point on the template. The "quiet blocks" containing little pixel variation, can be initially discarded as an edge is not present within the block (FIG. **3**, step **S3**). For remaining blocks, the orientation of the edges contained in the block is estimated.