# SEAL DETECTION SYSTEM AND METHOD

## FIELD OF THE INVENTION

This invention is generally related to electronic image recognition techniques and, more particularly, to a seal detection system and method that detects and authenticates seals in complex images.

## BACKGROUND OF THE INVENTION

The ability to detect seal patterns in an image can be useful in copier machines or scanners for the purpose of authenticating documents or preventing counterfeiting. The challenge of incorporating such a method in current copier or scanning technology is the difficulty with detecting seals patterns in a rotation or shift invariant manner. Specifically, the pattern could be of any orientation and at any location of the image. The orientation and the location of the seal can be relatively simple to estimate in the case of a single seal within a plain background; however, it becomes a major obstacle when the seals are embedded in some complicated image background.

Prior anti-counterfeiting or pattern detection methods are presented by the following patents:

U.S. Pat. No. 4,153,897

Yasuda, et. al.

Issued May 8, 1979

U.S. Pat. No. 5,216,724

Suzuki, et. al.

Issued Jun. 1, 1993

U.S. Pat. No. 5,291,243

Heckman, et. al.

Issued Mar. 1, 1994

U.S. Pat. No. 5,533,144

Fan

Issued July 1996

Yasuda et al. discloses a pattern recognition system where similarities between unknown and standard patterns are identified. Similarities are detected at first in respective shifting conditions where the unknown and standard patterns are relatively shifted from each other over the first limited extent, including the condition without shift. The maximum value of these similarities is then detected. The similarities are further detected in respective shifting conditions where the unknown and standard patterns are relatively shifted from each other over the second extent larger than the first limited extent, when the shifting condition which gave the maximum value is that without relative shift.

Suzuki et al. discloses an apparatus for image reading or processing that can precisely identify a particular pattern, such as banknotes or securities. A detecting unit detects positional information of an original image and a discriminating unit extracts pattern data from a certain part of the original image to discriminate whether the original image is the predetermined image based on the similarity between the pattern data and the predetermined pattern.



Heckman et al. discloses a system for printing security documents which have copy detection or tamper resistance in plural colors with a single pass electronic printer, a validating signature has two intermixed color halftone patterns with halftone density gradients varying across the signature in opposite directions, but different from the background.

Fan discloses an anti-counterfeit detector and method which identifies whether a platen image portion to be photocopied contains one or several note patterns. The detection is performed in a rotation and shift invariant manner. Specifically, the pattern can be of any orientation and at any location of the image and can be embedded in any complicated image background. The image to be tested is processed block by block. Each block is examined to see if it contains an "anchor point" by applying an edge detection and orientation estimation procedure. For a potential anchor point, a matching procedure is then performed against stored templates to decide whether the pre-selected monetary note patterns are valid once detected.

All of the references cited herein are incorporated by reference for their teachings.

## SUMMARY OF THE INVENTION

A detection system and method that detects distinctive marks, such as seals or other patterns, in images for purposes of authentication or to defeat counterfeiting is presented. This detection method has the ability to identify whether an image contains one or several pre-selected distinctive marks.

A detector is first trained off-line with examples of the distinctive marks of interest to be detected during operation. The distinctive marks are each stored as templates. After training, to detect marks, a four step procedure consisting of binarization, location estimation, orientation estimation and template matching is performed. Binarization extracts a binary bitmap from the input image. A pixel in the bitmap is set to be "1" if the color of the corresponding pixel in the input image is close to the color of the template to be matched to the input image. Location estimation detects the "suspects", or the potential mark patterns, and estimates their location. The relative orientation of the suspects and the template is then evaluated, so they can be aligned (this method is rotation and shift invariant). Finally, after orientation, the suspect and template are compared and analyzed to verify if suspect is legitimate. A suspect mark can be in any orientation and at any location within an image.

The method can be summarized as follows:

- a detector is trained off-line with distinctive marks resulting in templates which are generated and recorded for each of the distinctive marks;
- sample images bearing suspect marks are received by the detector and the location and orientation of the suspect marks are identified;
- the templates are rotated and shifted for alignment of he templates to the suspect marks;
- the templates and the suspects marks are compared to determine whether there is a match.

The method can be carried out in a system comprising a microprocessor programmed to become familiarized with a plurality of seals through training and to analyze and detect distinctive marks within tested documents. A memory is used to store the marks of interest. A scanner may be used during training and detection to accept training marks and images bearing suspect marks, and transmits the captured