valid monetary banknotes in verification of its location within the image. The types of currencies can include, but are not limited to United States of America currency and Japanese denomination currencies.

The method can be applied for use in the detection of counterfeit currency. The scanned image can provide the sample monetary banknote with an arbitrary rotational axis and shift alignment within the image. Additionally, the scanned image can contain the sample monetary banknote while superimposed onto any arbitrary background, can contain multiple isolated or independent banknotes, or have overlapping banknotes. The method can be used in conjunction with basic stand-alone scanners, copiers, stand-alone printers, and other related detection and scanning hardware.

The verification method described in this present invention makes use of new innovations not introduced by the prior art. This not only provides an increased means of security measures when used in application for counterfeit banknote detection, it also provides ease of integration with common hardware devices and a viable low cost approach. Accurate detection rates, and low false alarm rates can therefore be attained. It is also robust and flexible enough to be applied to different image types and conditions.

Prior to a concise description of the present invention color processing method, it is important to understand that certain terms used throughout the following description and claims will refer to particular processes or steps. As one skilled in the art will appreciate, designers may refer to such processes by different names. This document does not intend to distinguish between items that differ in name but not function. In the following discussion and in the claims, the terms "including" and "comprising" are used in an open-ended fashion, and thus should be interpreted to mean "including, but not limited to . . . ".

An overview of a verification method for determining areas within an image corresponding to monetary banknotes according to the present invention is illustrated with reference to FIG. **1**. The method **100** first comprises receiving a scanned image, possibly containing a sample monetary banknote. Upon receiving the scanned image, image division **110** is performed to separate the image into multiple image sections. Banknote boundary map generation **120** is subsequently performed to create a banknote boundary map having border sections chosen from the image sections. The border sections correspond to a boundary of monetary banknotes within the image. At the same time, texture decision map generation **130** operates to create a texture decision map having texture sections chosen from the image sections. The texture sections are image sections possessing a texture value within a valid range according to a valid monetary banknote.

Object determination **140** manages to isolate and count objects in the texture decision map. An object ideally corresponds to a monetary banknote, but may include other identified items in the texture decision map. Each object is separated from each other by removing texture sections in the texture decision map that correspond to the border sections in the banknote boundary map.

Following object determination **140** are texture property determination **150**, and shape property determination **160**, each performed on identified objects in the prior step. Texture property determination **150** calculates a texture property value for each object according to a texture feature map having a texture feature value for each image section. Shape property determination **160** calculates a shape property value for each object.

Finally, based on the results of texture property determination **150** and shape property determination **160**, object removal **170** operates in 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. The resulting texture decision map displays verified areas corresponding to monetary banknotes in the scanned image.

A detailed description for each of the above identified process steps in FIG. **1** will be discussed below, including relevant figures and diagrams for each section.

Image Division

The goal of image division **110** is to divide a scanned image into multiple image sections for computational efficiency. Each image section can then be processed individually, as opposed to an entire image, to provide for a greater resolution in related calculations and processes. The size and shape of the image sections can vary according to various embodiments of the present invention, and the examples provided below are in no way meant to be limiting. FIG. **2** illustrates an exemplary embodiment of a scanned image divided into a plurality of image sections **210**. The plurality of image sections **210** comprises several individual image sections **214**. Although FIG. **2** illustrates the image divided into a fitted manner, other embodiments may employ an overlapping distribution, such as shown in FIG. **3**. This exemplary embodiment illustrates where the plurality of image sections are overlapping, to provide an even greater resolution for following calculations and procedural steps.

Banknote Boundary Map Generation

Banknote boundary map generation **120** focuses on the creation of a banknote boundary map. FIG. **4** illustrates this step. The banknote boundary map **420** is derived from a scanned image **410** containing monetary banknotes. Border sections **430**, which correspond to a boundary of monetary banknotes within the scanned image **410**, are selected and identified. Thus the banknote boundary map **420** highlights the perimeter boundary areas of monetary banknotes if they are included in an original image scan.

The exact implementation for discerning the border sections **430** from the original scanned image **410** can vary according to a number of embodiments. One embodiment involves comparing color histogram data of image sections **214** of the scanned image **410** to color histogram data corresponding to boundaries of valid monetary banknotes. Another embodiment involves comparing texture data of the image sections **214** to texture data corresponding to boundaries of valid monetary banknotes. The exact implementation of the banknote boundary map is intermediate, as long as the banknote boundary map suffices in identifying border sections from the image sections corresponding to a boundary of monetary banknotes within the scanned image.

Texture Decision Map Generation

Texture decision map generation **130** produces a binary texture decision map based on the scanned image. Texture values for each image section of the scanned image are first calculated, and then compared to texture values of a valid monetary banknote. Texture sections are then selected from the image sections having texture values within a valid range of a valid monetary banknote.

FIG. **5** illustrates generation of the texture decision map **520** from a scanned image **510**. Upon performing the above described process, texture sections **530** are identified accordingly from the image sections of the scanned image **510**.

The texture values utilized in discerning the texture sections **530** can vary according to a number of embodiments. One embodiment involves utilizing gray levels as the texture value, and comparing gray levels of image sections to gray