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Title: **FAKENOTE DETECTION USING IMAGE PROCESSING**

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FAKENOTE DETECTION USING IMAGE PROCESSING

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ABSTRACT

It is difficult for people to recognize currencies from different countries. The main aim is to help people solve this problem. However, currency recognition systems that are based on image analysis entirely are not sufficient. The proposed system is based on image processing and makes the process automatic and robust. Here the use of SEK and Chinese RMB as examples to illustrate the technique. Color and shape information are used in the given algorithm.

Keywords: currency recognition, image processing

I. INTRODUCTION

There are approximately 50 currencies all over the world, with each of them looking totally different. For instance the size of the paper is different, the same as the colour and pattern. The staffs who work for the money exchanging (e.g. Forex Bank) have to distinguish different types of currencies and that is not an easy job. They have to remember the symbol of each currency. For bank staffs, there is a "Currency Sorting Machine" helps them to recognize different kinds of currencies. The main working processes of "Currency Sorting Machine" are image acquisition and recognitions. It is a technique named "optical, mechanical and electronic integration", integrated with calculation, pattern recognition (high speed image processing), currency anti-fake technology, and lots of multidisciplinary techniques. It is accurate and highly-efficient. But for most

staffs, they have to keep a lot of different characteristics and anti-fakes label for different commonly-used currencies in their mind. However, each of them has a handbook that about the characteristics and anti-fakes labels of some less commonly-used currencies. Even for that, no one can ever be 100 per cent confident about the manual recognition. Image segmentation is defined as the process of partitioning of a digital image into multiple Segments (sets of pixels) [5]. The main aim in segmentation is to simplify and change the representation of an image into the more meaningful and very easy to analyze. Generally Image segmentation is used to locate objects and boundaries in images. Segmentation algorithm for images generally is based on one of the two basic properties which are given below.

- 1) Similarity: Based on partitioning an image into regions that are similar according to a set of predefined criteria
- 2) Discontinuity: Based on sudden changes in intensity such as edges in an image.

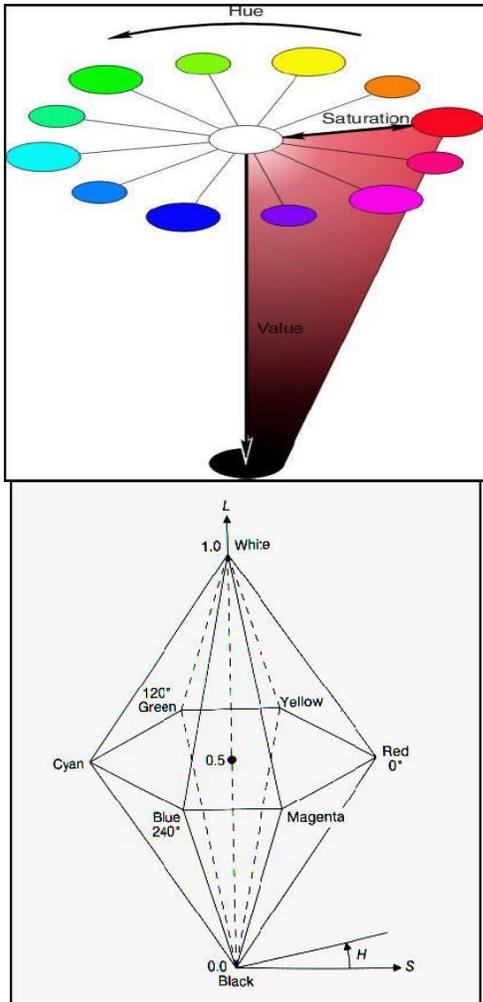


Figure 1: HSV model

HSV model (as shown by Figure 4, HSV model) is one of several color systems used by people to select colors from a color wheel or palette. This color model is considerably closer than the RGB model in the way how humans experience and describe color sensations. [8] HSV is abbreviated to Hue, Saturation and Value.

Hue is pure color and is measured by degrees or percentage. Saturation is the radius in the circle. Value ($V = 1$ or 100%) corresponds to pure white ($R = G = B = 1$) and to any fully saturated color. Gray describes the colors ranging from black to white. Gray paints are created by mixing the two colors. A gray scale image is the value of each pixel which is a single sample [6]. That means it carries only intensity information.

II. METHOD

All the currencies that are to be tested are taken from the scanner. The resolution is set to 600 DPI (Dots Per Inch). DPI means that the number of pixels per unit area, that is a scan precision. The smaller dpi is the lower-resolution scans perform. Otherwise higher-resolution scans perform. As know the size of A4 paper is 21cm \times 29.7cm, 600 dpi means that each inch contains 600 pixels. So after scanning, the size of the image is 7016 \times 4961 pixels. In order to decrease the computation, the system will reset the original image to size 1024 \times 768 pixels. This work is done in pre-processing. The system will ask the user to take the image of currency when launching. After that, the system tries to recognize the currency. When the recognition processing starts, the system inside will do some image processing with the image (pre-processing, segmentation, edge detection and so on) [9]. If the image exhibit information loses such as surface damage, noise level, sharpness issues and so on, the recognition may fail and the user has to do the processing again.

III. FLOW CHART

When the image from a scanner is seen, the size of the image is so big. In order to reduce the calculation, the size is decreased to 1024×768 pixels.

STEP 1: The system can read not only JPEG (JPG) format but others. The image was obtained from a scanner. As mentioned before, the resolution is set to 600 DPI. But this will make the image a big size. So after reading in the image, the system will reset the image to size 1024 by 768 pixels and this work will refer to image pre-processing.

STEP 2: The aim of image pre-processing is to suppress undesired distortions or enhance some image features that are important for further processing or analysis. Image pre-processing includes these parts:

- Image adjusting
- Image smoothening (removing noise).

STEP 3: After observing, each currency has one or more unique patterns. So these unique patterns can be used to distinguish different types of currencies. Because the position of the pattern is aptotic, so the segment is taken proportionally and finally gets what is desired. The scales are set for each side of the image, after that, the pattern is segmented.

STEP 4: When performing smoothing process on a pixel, the neighbor of the pixel is used to do some transforming. After that a new value of the pixel is created. The neighbor of the pixel is consisting with some

other pixels and they build up a matrix, the size of the matrix is odd number, the target pixel is located on the middle of the matrix.

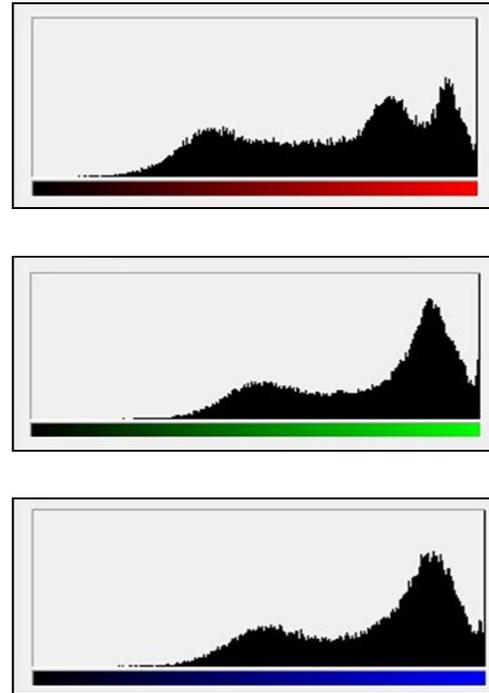


Figure3: RGB Histogram

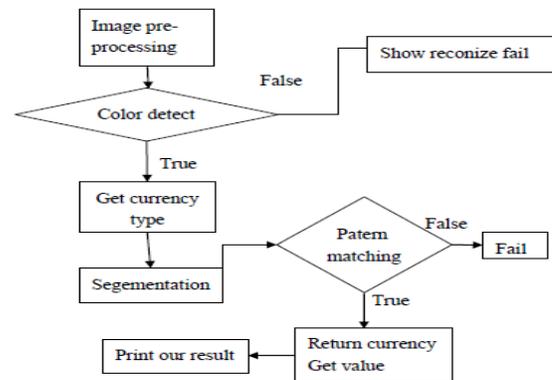


Figure 2: Flow chart

STEP 5: When the filter is centered over the pixel with the border, some parts of it will be outside the edge the image. There are some techniques to handle these situations. The original image and the template image do not need to be of the same size. Each

kernel coefficient in turn and multiplied by a value from the neighborhood of the image lying under the kernel when convolution is applied. Top-left corner of the kernel is multiplied by the value at the bottom-right corner of the neighborhood the kernel is applied in such a way.

1. Zero padding: all filter values outside the image are set to 0.
2. Wrapping: all filter values outside the image are set to its "reflection" value.
3. Start convolution in second row and column.
4. The unfiltered rows and columns will be copied to the resulting image.

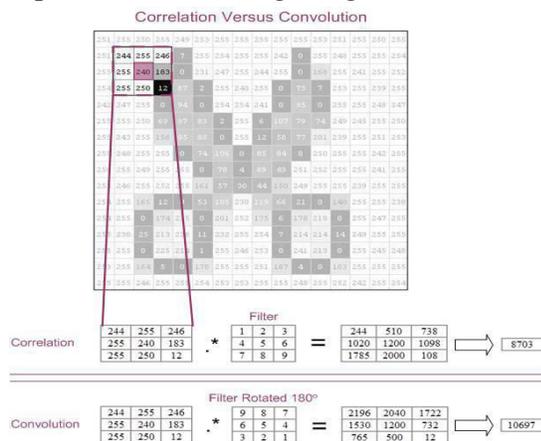


Figure 3: Correlation and Convolution

IV. RESULTS

The most important part of this system is pattern matching. Based on edge detection algorithm, the system performs pattern matching.

When some error occurs, the system will emerge some exception, which may cause the exceptions like "the image not complete", "failed recognition", etc.

	SEK 100	SEK 500	CNY 100	Total
Quantity	5	5	2	12
Success	5	5	2	12
Error	0	0	0	0
Unknown	0	0	0	0
Accuracy (%)	100	100	100	100

Table 1 Banknote classification results

Table 1 illustrates the accuracy that the classification different currency, as example, the test for Swedish Kronor and Chinese RMB. As the results shown from Table 2, the correct rate is pretty high. Take few images for testing, and the entire images are all from the scanner. These means the light conditions are similar, the images are high quality. Take digital image from camera, this good performing will be changed. That's because it's hard to distinguish color when in different light condition. However it's very hard to realize a 100% correct recognition. There is some delimitation. For instance, the quality of the image, the light condition, the old level of the currency, these are the important characters for recognition.

	SEK 100	SEK 500	Other image
Success	5	5	5
Fail	0	0	0

Table 2 Distinguish between currency and other image

Table 2 also shown pretty good results. The system distinguishes if the image is a currency. The other different images are considered, such as the images of cartoon, car or some words. However, this test is check if the system can distinguish the currency or not. As similar as last test, all the images are getting from the scanner. The quality is pretty high. Through these two results, with some delimitation, the system performs pretty well. The correct rate is quite high but trying to modify the proposing algorithm to overcome this delimitation, these are the challenges as of now.

V. CONCLUSION AND DISCUSSION

Here the format of the input image used is JPEG (JPG). There are two types of image format that can be received from the scanner, JPEG and TIF. As is known, TIF contains more details, and high definition, but the restriction is the capacity of TIF image is too large. For JPEG image, the restriction is the details losing, and less details contains, but even for that, those details is enough for the system, the better thing is the capacity is small. As in comparison, even the same resolution, the capacity of TIF image is several times larger than JPEG image, and in details, the details in JPEG image it's not plain to see any markedly different to TIF image. So think it more efficient that to use JPEG instead of TIF.

VI. REFERENCES

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