



Indian Currency Recognition and Verification System Using Image Processing

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Abstract— Automated paper currency recognition system can be a very good utility in banking systems and other field also. Fake notes in India in denominations of Rs.100, 500 and 1000 are being flooded into the system. Over the past few years, as results of the great technological advances in colour printing, duplicating, and scanning, counterfeiting problems have become more and more serious. In this article, recognition of paper currency with the help of digital image processing techniques is described. Two characteristics of Indian paper currency is selected for counterfeit detection included identification mark and currency serial number. The identification mark also decides the currency denomination. The characteristics extraction is performed on the image of the currency and it is compared with the characteristics of the genuine currency. The Sobel operator with gradient magnitude is used for characteristic extraction. . The currency will be verified by using image processing techniques. The approach consists of a number of components including image processing, edge detection, image segmentation, characteristic extraction, comparing images.

Keywords: Paper currency recognition, Counterfeit detection, Sobel operator with gradient magnitude, feature extraction

I. INTRODUCTION

Automatic methods for paper currency recognition become important in many applications such as automated teller machine and automated goods seller machines. This system is designed to recognize and verify the Indian paper currency. The approach consists of a number of steps including image acquisition, gray scale conversion, edge detection, feature extraction, image segmentation and comparison of images [1]. This is a challenging issue to system designers. Every year RBI (Reserve bank of India) face the counterfeit currency notes or destroyed notes [2]. Handling of large volume of counterfeit notes imposes additional problems. Therefore, involving machines (independently or as assistance to the human experts) makes notes recognition process simpler and efficient.

Automatic method for detection of fake currency note is very important in every country. In this approach we extract the general attributes of the paper currency like identification mark and serial numbers of currency. The identification marks helps to know the denomination of currency [7]. The serial number of currency helps to detect fake or genuine. The system is designed to check Indian currency notes of 100, 500 and 1000 rupees. The system will display currency denomination and either currency is genuine or fake.

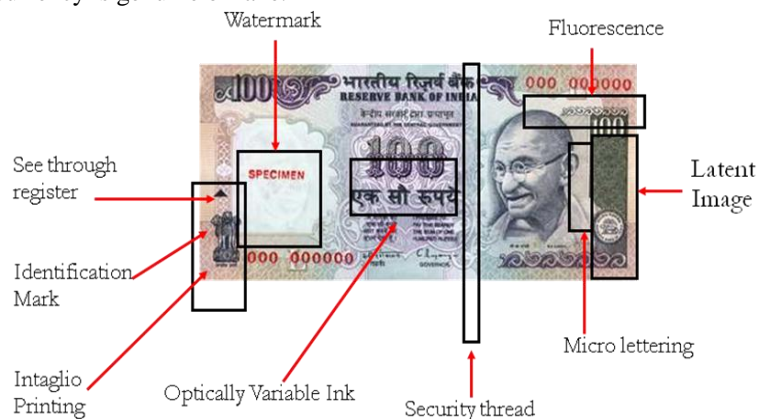


Fig. 1 Security features of indian curreny notes [4],[5]

1. Identification mark

A symbol with intaglio prints which can be felt by touch, helps the visually impaired to identify the denomination. In 100 denominations the identification mark is a triangle, In 500 denominations the identification mark is a circle and In 1000 denominations the identification mark is a diamond [1].

2. Currency serial number

The serial numbers are currency Issuance numbers, which are used as the identifiers (IDs) of the banknotes. Each sheet has its own serial numbers and the same numbers cannot be used more than once.

3. Water marking

The Mahatma Gandhi Series of banknotes contain the Mahatma Gandhi watermark with a light and shade effect and multi-directional lines in the watermark window.

4. Optically variable ink

This is a new feature included in the Rs.1000 and Rs.500 notes with revised color scheme introduced in November 2000. The numeral 1000 and 500 on the obverse of Rs.1000 and Rs.500 notes respectively is printed in optically variable ink viz., a color-shifting ink. The colour of the numeral 1000/500 appears green when the note is held flat but would change to blue when the note is held at an angle.

5. Fluorescence

Number panels of the notes are printed in fluorescent ink. The notes also have optical fibers. Both can be seen when the notes are exposed to ultra-violet lamp.

6. Security thread

The Rs.500 and Rs.100 notes have a security thread with similar visible features and inscription 'Bharat' (in Hindi), and 'RBI'. When held against the light, the security thread on Rs.1000, Rs.500 and Rs.100 can be seen as one continuous line. The Rs.5, Rs.10, Rs.20 and Rs.50 notes contain a readable, fully embedded windowed security thread with the inscription 'Bharat' (in Hindi), and 'RBI'. The security thread appears to the left of the Mahatma's portrait.

7. Intaglio printing

The portrait of Mahatma Gandhi, the Reserve Bank seal, guarantee and promise clause, Ashoka Pillar Emblem on the left, RBI Governor's signature are printed in intaglio i.e. in raised prints, which can be felt by touch, in Rs.20, Rs.50, Rs.100, Rs.500 and Rs.1000 notes.

II. PROPOSED SYSTEM

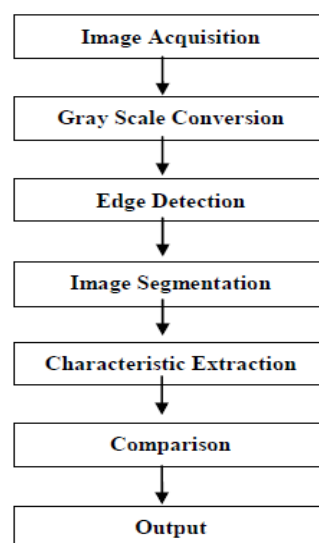


Fig. 2 Block diagram for automatic recognition of genuine and fake Indian notes [2]

1. Image Acquisition

Image is acquired by digital camera by applying the white backlighting against the paper currency so that the hidden attributes are able to appear on the image of the currency.

2. Gray-scale conversion

The image acquired is in RGB color. It is converted into gray scale because it carries only the intensity information which is easy to process instead of processing three components R (Red), G (Green), B (Blue). Image is acquired in step 1 is large to continue process and colour information is not needed, except the colour index. First, RGB image is converted to pixel values and then to gray scale [10].

3. Edge detection

It is the fundamental tool in image processing, which aim at identifying points in digital image at which the image brightness changes sharply or has discontinuities. There are many ways to perform edge detection. . Edges are detected

of the gray scale image of paper currency using Sobel operator. It smoothes the image and calculate the gradient of the image. Edge detection is one of the fundamental steps in image processing, image analysis, image pattern recognition, and computer vision techniques.

4. Image segmentation

Segmentation is the process of partitioning a digital image into multiple segments. It is typically used to distinguish objects from backgrounds. Here edge based segmentation is performed on the image. Image segmentation sub divides the image into its constituent regions or objects [8].

5. Feature extraction

Now the features are extracted using edge based segmentation and objects and background are separated. It is a challenging work in digital image processing. In any currency recognition system, feature extraction is one of the most challenging tasks. Here, the aim is to analyze and identify the unique and distinguishing features of each denomination under various challenging conditions such as old notes, worn out notes, also under different illumination and background.

6. Comparison

Lastly the extracted features are compared with the extracted features of original currency by calculating the number of black pixels of segmented image. If the pixels of segmented image of test currency are approximately equal to the pixels of segmented image of original currency then the currency is found to be genuine otherwise counterfeit.

7. Output

The output will be currency denomination and either “The note is Genuine” or “The note is fake” at a time anyone will be display.

III. EXPERIMENTAL AND RESULTS

Below figure shows the MATLAB Results:

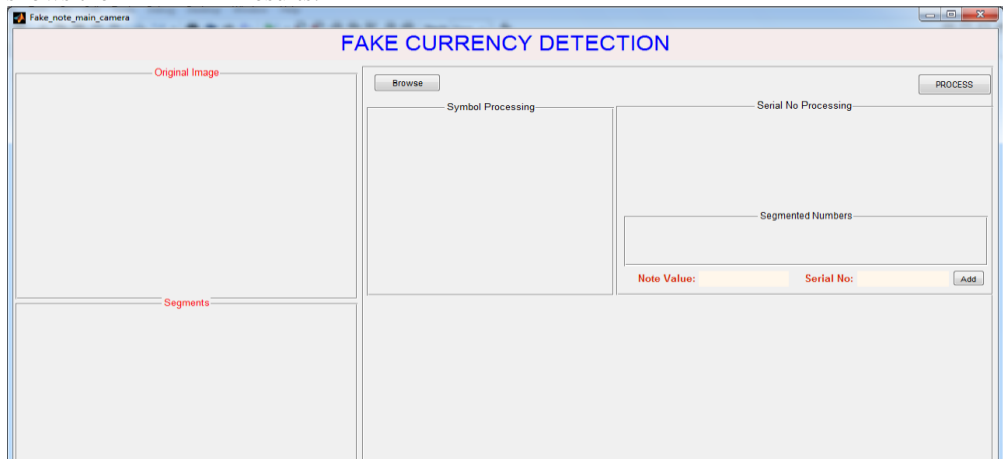


Fig. 3 Front panel of software application

Fig.3 shows front panel of software application which is main GUI windows containing various options like original image,segments,browse,symbol processing, serial no processing, segmented numbers, note value, serial no., process and add buttons.



Fig. 4 Front panel of software after image is selected

Fig. 4 shows Fake Currency Detection windows where genuine currency image is browsed from database. Browse image is resized and cropped. The symbol and serial number is cropped as shown in above figure. Symbol image is mainly used to identify Note Value.

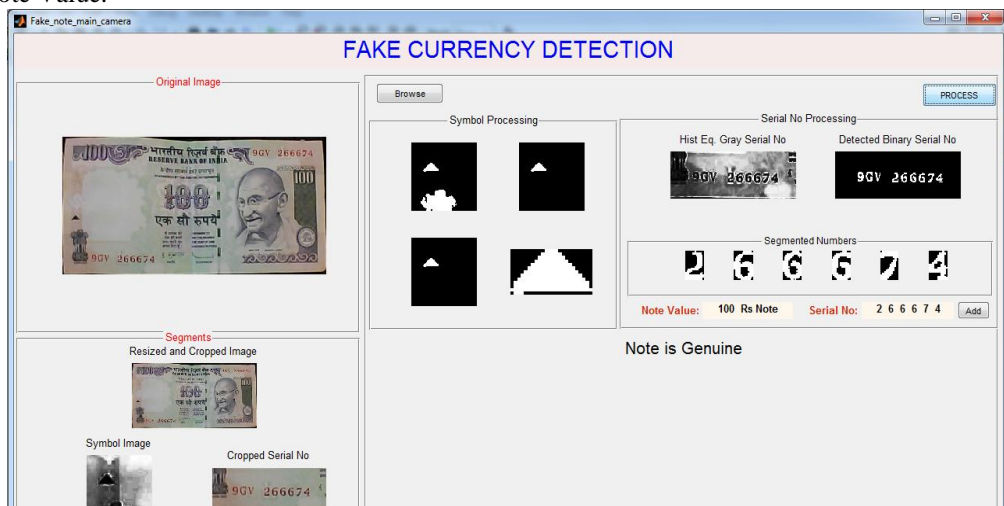


Fig. 5 Front panel of software after image is processed and result is “Note is Genuine”

Fig. 5 shows genuine currency image browsed and processed windows. The resize and cropped image are processed. The various processes like segmentation, edge detection, characteristic extraction and then comparison with securities features of genuine currency of database done. As extracted features matched with database image so note is genuine message displayed. The identification mark (symbol) is triangle so note denomination is Rs.100 as shown in above fig.5.

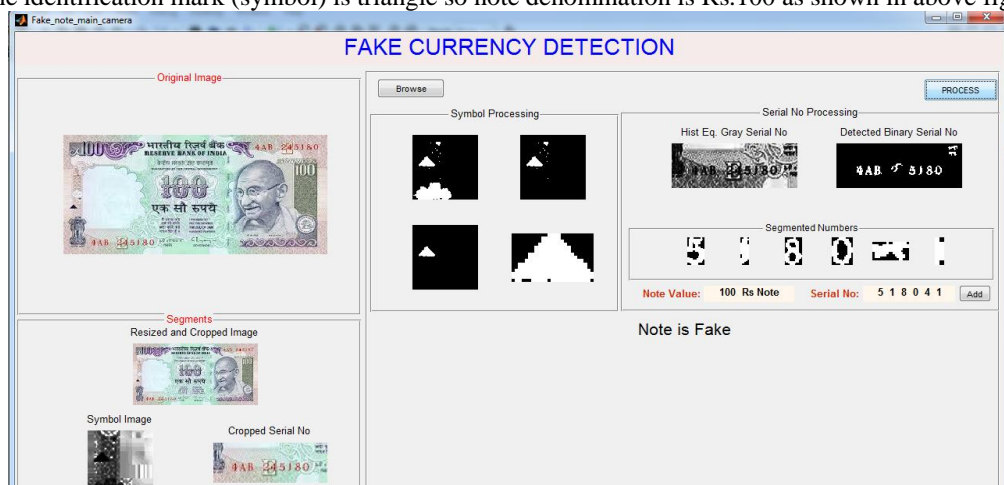


Fig. 6 Front panel of software after image is processed and result is “Note is Fake”

Fig. 6 shows Fake currency image browsed and processed windows. The resize and cropped image are processed. The various processes like segmentation, edge detection, characteristic extraction and then comparison with securities features of genuine currency of database done. As extracted features not matched with database image so note is fake displayed.

IV. CONCLUSION

In this technique, the authentication of Indian paper currency is described by applying image processing. Basically two features are extracted including identification mark and serial no from the image of the currency. The process begins from image acquisition and end at comparison of features. The features are extracted using edge based segmentation by sobel operator and works well in the whole process with less computation time. The complete methodology works for Indian denomination 100, 500 and 1000. The method is very simple and easy to implement. This technique is very adaptive to implement in real time world. Not only in banks, could such type of appliances also be used in shops or some other places.

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