Fake currency detection using image processing

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Fake currency detection using image processing

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Abstract. The advancement of color printing technology has increased the rate of fake currency note printing and duplicating the notes on a very large scale. Few years back, the printing could be done in a print house, but now anyone can print a currency note with maximum accuracy using a simple laser printer. As a result the issue of fake notes instead of the genuine ones has been increased very largely. India has been unfortunately cursed with the problems like corruption and black money .And counterfeit of currency notes is also a big problem to it. This leads to design of a system that detects the fake currency note in a less time and in a more efficient manner. The proposed system gives an approach to verify the Indian currency notes. Verification of currency note is done by the concepts of image processing. This article describes extraction of various features of Indian currency notes. MATLAB software is used to extract the features of the note. The proposed system has got advantages like simplicity and high performance speed. The result will predict whether the currency note is fake or not.

1. Introduction

Technology is growing very fast these days. Consequently the banking sector is also getting modern day by day. This brings a deep need of automatic fake currency detection in automatic teller machine and automatic goods seller machine. Many researchers have been encouraged to develop robust and efficient automatic currency detection machine [1-5]. Automatic machine which can detect banknotes are now widely used in dispensers of modern products like candies, soft drinks bottle to bus or railway tickets. The technology of currency recognition basically aims for identifying and extracting visible and invisible features of currency notes. Until now, many techniques have been proposed to identify the currency note. But the best way is to use the visible features of the note [1]. For example, color and size. But this way is not helpful if the note is dirty or torn. If a note is dirty, its color characteristic are changed widely. So it is important that how we extract the features of the image of the currency note and apply proper algorithm to improve accuracy to recognize the note.

We apply here a simple algorithm which works properly. The image of the currency note is captured through a digital camera. The hidden features of the note are highlighted in the ultraviolet light. Now

processing on the image is done on that acquired image using concepts like image segmentation, edge information of image and characteristics feature extraction[2-3]. MATLAB is the perfect tool for computational work, and analysis. Feature extraction of images is challenging task in digital image processing. It involves extraction of invisible and visible features of Indian currency notes. This approach consists of different steps like image acquisition, edge detection, gray scale conversion, feature extraction, image segmentation and decision making [4-5]. Acquisition of image is process of creating digital images, from a physical scene. Here, the image is captured by a simple digital camera such that all the features are highlighted. Image is then stored for further processing.

1.1.Process of Edge detection

It is a basic tool in image processing. It is widely used in area of feature detection and extraction. This process aim at identifying point in digital image at which image brightness sharply changes.

1.2 *Process of Image segmentation*

This process sub divides image into it sub regions. The level of division depends on the problem. Segmentation algorithm for images which are monochromatic is based on properties of images like discontinuity and similarity [6].

2. Methodology

The system proposed here work here on the image of currency note under ultraviolet light acquired by a digital camera. The algorithm which is applied here is as follows

1. Acquisition of image of currency note under ultraviolet light by simple digital camera or scanner.
2. Image acquired is RGB image and now is converted to grayscale image.
3. Edge detection of whole gray scale image.
4. Now characteristics features of the paper currency will be cropped and segmented.
5. After segmentation, characteristics of currency note are extracted.
6. Intensity of each feature is calculated.
7. If the condition is satisfied, then the currency note is said as original otherwise fake.

In this method, characteristics of currencies are employed which are used by common people for differentiating for different banknote denomination. The characteristics that can be used to check the authentication of currency note are

A. Security Thread

It is a 3mm windowed security thread with inscriptions of India in Hindi, RBI and 2000/500 on banknotes with color shift. Color of the thread changes from green to blue when the note is tilted.

B. Serial Number

Serial number panel with banknote number growing from small to big on the top left side and bottom right side.

C. Latent image

A vertical band on front side of denomination at right hand size. It contains latent image showing numeral of denomination when banknote is held horizontally at eye level.

D. Watermark

The portrait of Mahatma Gandhi, and multidirectional lines and a mark showing the denominational numeral appear which can be viewed when held against light.

E. Identification Mark A mark with intaglio print which can be felt by touch, helps blind person to identify the denomination. In 500 denomination the mark is of five lines while in 2000 line the mark is of seven lines.

The flow diagram of the process to be followed in the proposed system is as follows:-

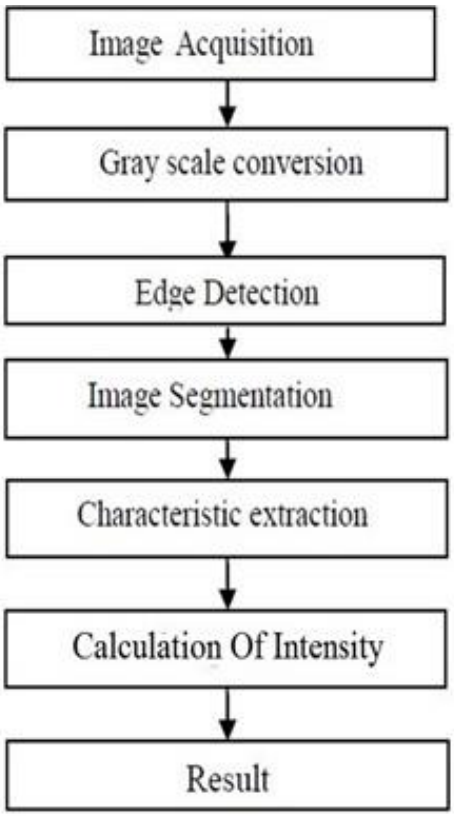

Figure 1. Flow diagram of process.

1) Image acquisition:
The image is kept under ultraviolet light and the image is captured through a simple digital camera

Figure 2. Acquired image.

2) **Image preprocessing:**
It involves the operations required prior to data analysis and information extraction. Here image resizing is done.

3) **Gray scale conversion and edge detection:**
The acquired image is obtained as RGB image which is now converted into gray scale image since it carries intensity information. This image is further processed and edges of gray scale images are detected.

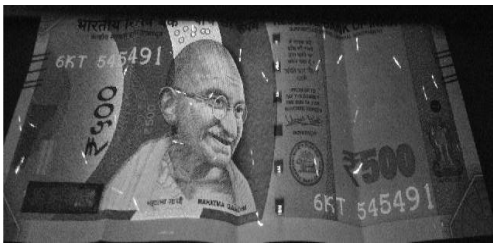

Figure 3. Gray scale image

4) **Image segmentation:**
It's the process of dividing image into multiple parts by cropping it.
5) **Feature extraction:**
Now the features are extracted using edge based segmentation.

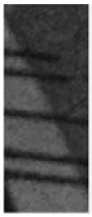

Figure 4. Identification mark

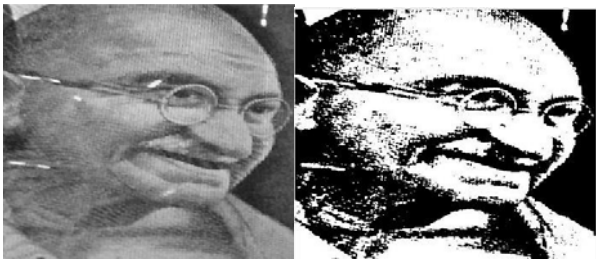

Figure 5. Edge based segmentation of Mahatma Gandhi portrait.

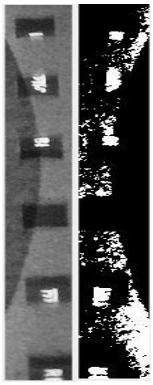

Figure 6. Edge based segmentation of security thread.

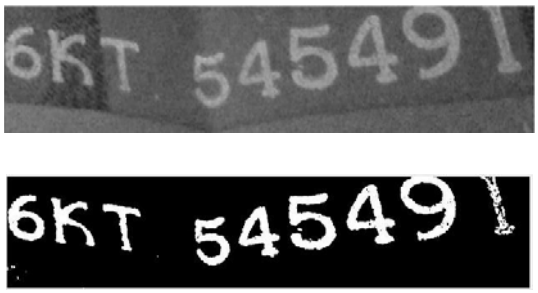

Figure 7. Edge based segmentation of serial number

6) Now the process of calculation of intensity of each extracted feature is done. If the calculated intensity is greater than the threshold of 70%, then it is classified as original note otherwise it is considered as fake one.

7) The final decision depends upon the intensities of all extracted features.

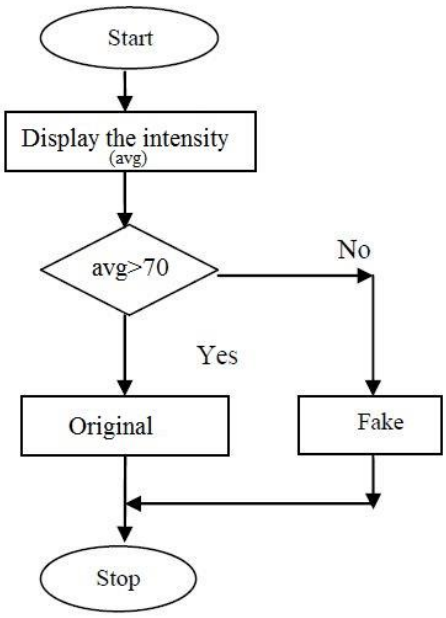

Figure 8. Flow chart for decision making

3. Experimental results

The results are shown in a GUI made in MATLAB which shows extracted features like security thread and serial number.

Figure 9. Testing a 500 denomination note.

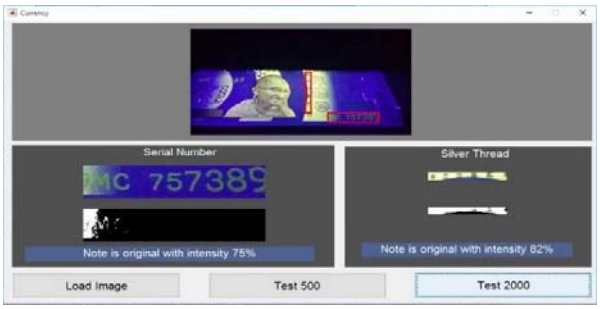

Figure 10. Testing a 2000 denomination note.

Intensities of all remaining features were also calculated for different notes of 500 and 2000.

Table 1. Results for 500-1 note

Features	**Intensity**
Serial number	93%
Security thread	82%
Mahatma Gandhi portrait	83%
Identification mark	80%

Table 2. Results for 500-2 note

Features	**Intensity**
Serial number	76%
Security thread	73%
Mahatma Gandhi portrait	60%
Identification mark	68%

Table 3. Results for 2000 note

Features	**Intensity**
Serial number	75%
Security thread	82%
Mahatma Gandhi portrait	86%
Identification mark	73%

From the above results it was observed clearly that an original currency note's extracted features displays minimum intensity of 70%, it is seen that the 500-2 note displays intensity less than 75% for some features hence it is considered as fake note.

4. Conclusion

The fake currency detection using image processing was implemented on MATLAB. Features of currency note like serial number, security thread, Identification mark, Mahatma Gandhi portrait were extracted. The process starts from image acquisition to calculation of intensity of each extracted feature. The system is capable of extracting features even if the note has scribbles on it. The algorithm processed here works suitably for the newly introduced 500 and 2000 denomination.. Hardware implementation of the proposed system can also be done using suitable processor so that to increase the speed of detection. An automatic railway ticket booking system can also be proposed which includes currency detection as one of its part.

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