ISSN 2395-1621

Analysis and Recognition of Currency Notes

[#1]Shahbaj Khan, [#2]Yogesh Vadekar, [#3]Shardul Sant, [#4]Mahesh Jadhav

[1]shahbaz.khan1430@gmail.com
[2]yogeshvadekar@gmail.com
[3]shardulsant@gmail.com

[#1234]BE, Computer Engineering,Sinhgad College of Engineering, Vadgaon, Pune

ABSTRACT

Automated paper currency recognition system can be a very good utility in banking systems and other field of commerce. Since many years counterfeiting of paper currency challenges the financial system of every country in different sectors, India is also one of them. In current project, recognition of paper currency with the help of digital image processing techniques is described. Three characteristics of Indian paper currency is selected for counterfeit detection included identification mark, security thread and watermark. The characteristics extraction is performed on the image of the currency and it is compared with the characteristics of the genuine currency. Paper currency recognition with good accuracy and high processing speed has great importance for banking system. The proposed method has advantages of simplicity and high speed.

***Keywords*—** ARCN, HSV, POI, UML

ARTICLE INFO

Article History

Received :1st April 2016

Received in revised form :

3rd April 2016

Accepted : 4th April 2016

Published online :

6th April 2016

I. INTRODUCTION

Modernization of the financial system is a milestone in protecting the economic prosperity, and maintaining social harmony. Automatic machines capable of recognizing banknotes are massively used in automatic dispensers of a number of different products, ranging from cigarettes to bus tickets, as well as in many automatic banking operations. The needs for automatic banknote recognition systems encouraged many researchers to develop corresponding robust and reliable techniques. Processing speed and recognition accuracy are generally two important targets in such systems. Paper currency recognition with good accuracy and high processing speed has great importance for banking system. This proposed system describes an approach for verification of Indian currency banknotes. The currency will be verified by using image processing techniques.For the purpose of recognition, we are taking the image of a particular currency note as an input to the system and we are analyzing this image using some image processing techniques. Here we are using some useful algorithms like template matching and ORB algorithm. The template matching algorithm finds out if a smaller image (patch) is present there in a larger image or not. Similarly, ORB algorithm is used to recognize different objects inside the image. We are also going to be performing different operations on the input image like Gray-scale conversion, Edge detection, Image segmentation and Characteristic Extraction. Finally after the completion of these processes, we'll be getting the status of given currency note as "Original" or "Duplicate".

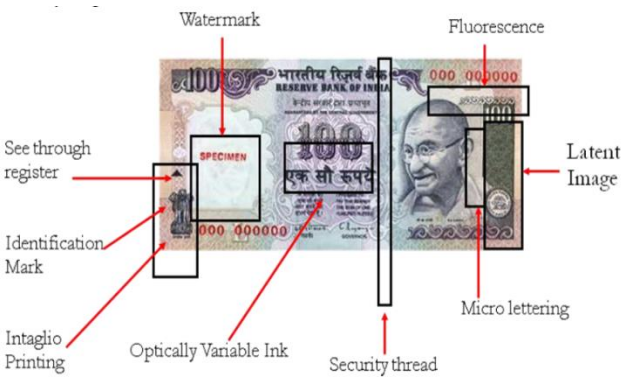

Figure 1. Security features of Indian currency notes

I. 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.

II. Latent Image –

An inscription of the value of denomination is seen on the right side of Mahatma Gandhi's image when held against the light at an angle of 45 degrees.

III. 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.

IV. 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.

V. Fluorescence –

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

VI. 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.

VII. 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. Micro Lettering RBI letters are printed on Rs. 10 note and on other notes, their denominations are printed

VIII. See Through Register

It is a floral design. This design is printed on both (front and back) sides of the notes which are perfectly overlapping each other. The denomination number can be viewed when the note is held against normal bright light.

II. BRIEF DESCRIPTION

1. Abbreviation and Acronyms:

- ARCN – Analysis & Recognition of Currency Notes
- GUI – Graphical User Interface
- HSV – Hue Saturation Value
- HTTP – Hype Text Transfer Protocol
- JDK – Java Development Kit
- POI – Point of Interest
- SDK – Software Development Kit
- UML – Unified Modelling Language

2. Template Matching Overview –

This technique is used in digital image processing for finding small parts of an image which match a template image (patch). This can be used for locating a small image in a bigger image. We can use feature based approach if the template in image has strong features. For templates without strong features the template image constitutes the matching image, a template-based approach would be effective.

This is a brute force algorithm for object recognition. It does pixel by pixel matching of template with the image to be scanned. Then it finds the pixel giving maximum match using a similarity, like normalized cross correlation. A basic method uses a convolution mask technique which can be easily performed on grey images. The convolution output will be highest at places where the image structure matches mask structure. Improvements can be made to the matching method by using more than one template.

Other methods are also available for pattern matching such as 'Stereo matching', 'Image registration' and 'Scale-invariant feature transform'.

III.ORB OVERVIEW

Feature matching is at the base of many computer vision problems, such as object recognition or structure from motion. Current methods rely on costly descriptors for detection and matching. In this paper, we propose a very fast binary descriptor based on BRIEF, called ORB, which is rotation invariant and resistant to noise. We demonstrate through experiments how ORB is at two orders of magnitude faster than SIFT, while performing as well in many situations. The efficiency is tested on several real-world applications, including object detection and patch-tracking on a smart phone.

As usual, we have to create an ORB object with the function, **cv2.ORB()** or using feature2d common interface. It has a number of optional parameters. Most useful ones are nFeatures which denotes maximum number of features to be retained (by default 500), scoreType which denotes

whether Harris score or FAST score to rank the features (by default, Harris score) etc. Another parameter, WTA_K decides number of points that produce each element of the oriented BRIEF descriptor. By default, it is two, i.e. selects two points at a time. In that case, for matching, NORM_HAMMING distance is used. If WTA_K is 3 or 4, which takes 3 or 4 points to produce BRIEF descriptor, then matching distance is defined by NORM_HAMMING2.

IV. PROPOSED METHOD

The project is about the currency recognition system how and the customer can make best use of the application according to his/her point of interest. The system provides currency note authentication for different types of denominations. Customer just needs to feed the image of the currency to the system and the system will provide the customer with the result.This system provides a cheaper and efficient means for banknote authentication than the existing systems. The existing systems are way expensive and hence prove difficult for usage. This system can be further improved to authenticate banknotes for different countries. Classification of banknotes according to their denomination can also be made possible.

Block Diagram of Currency Recognition System

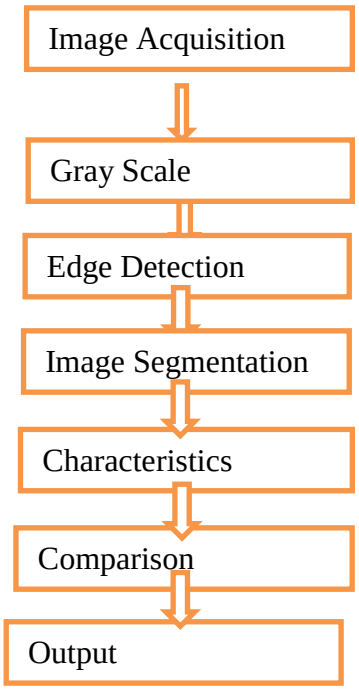

Figure 2 Block Diagram of Currency Recognition System

1. Image Acquisition

Image is acquired by digital camera or scanner for 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.

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.

3. 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.

4. 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.

5. 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.

6. Output

The output will be either “The note is Genuine” or “The note is fake” based on number of components matched will be display.

V. EXPERIMENTAL AND RESULTS

Below are the figures which shows results of our application.

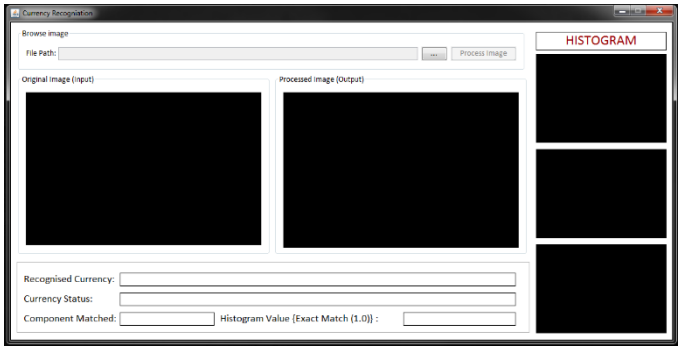

Figure 3. Panel of software application

Fig.3 shows front panel of software application which is main GUI windows containing various options like Browse image using Browse button, Original image (Input), Processed image (Output), "Process Image" button, Histogram panel showing Histogram1, Histogram2, Histogram3, a panel at the bottom giving status about input image like Currency Status, Components Matched, Recognised Currency and Histogram Value.

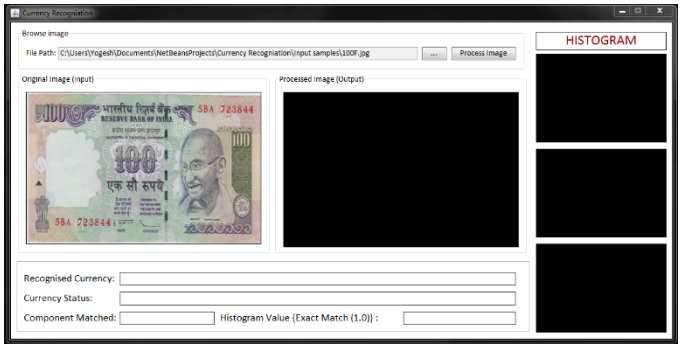

Figure 4. Front panel of software after image is selected

Figure 4 shows front panel of software after an image is selected as input using browse button for carrying out the processing of the currency note.

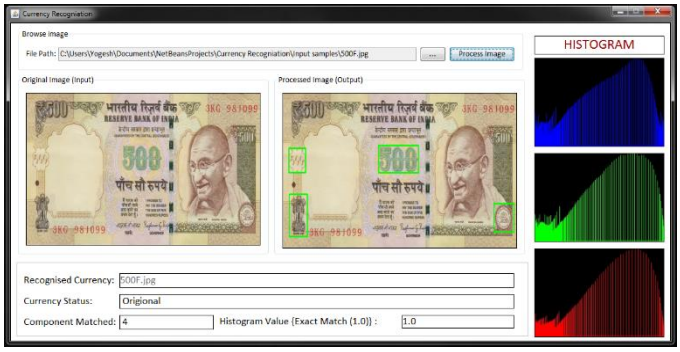

Figure 5. Front panel of software showing the given input image of currency note is "Original"

Figure 5 shows that an image of Rs. 500 note is given as input to the software. The software is giving the result as "Original" currency note after matching the 4 components from the dataset.

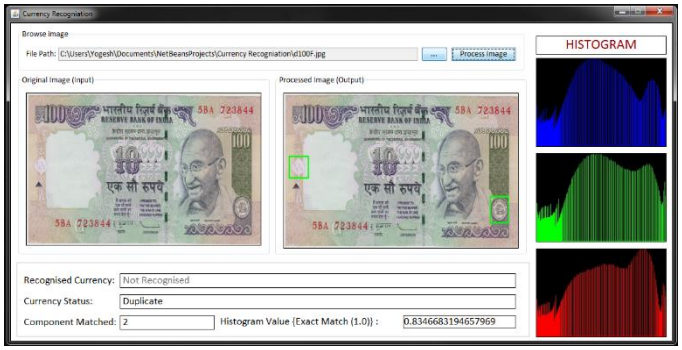

Figure 6. Front panel of software showing the given input image of currency note is "Duplicate"

In above figure 6, it is shown that the given input image of Rs.100 note is duplicate. Only two components from the dataset are found to be matching on the given input image. Thus our software is showing it as a Duplicate currency note.

VI. CONCLUSION

In this technique, the authentication of Paper Currency is described by applying image processing. Basically three features are extracted including Security Thread, Intaglio Printing, Micro Lettering from the image of paper currency. The process begins from image capturing and end at comparison of features. The features are extracted using edge based segmentation 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.

Acknowledgment

We are thankful to Prof. S.D. WABLE for the encouragement and support that they have extended. We are also thankful to our teaching as well as non-teaching faculty members of Computer Department, Sinhgad College of Engineering Vadgaon(BK), Pune - 41 for their valuable contribution & suggestions.

REFERENCES

1. Amol A. Shirsath S. D. Bharkad, "Survey of Currency Recognition System Using Image Processing", IJCER, Vol.3, Issue 7, pp 36-40, July 2013

2. JiheonOk, Chulhee Lee, **"**Fast country classification of Bank notes", IEEE, 2013

3. Ms. Rumi Ghosh, Mr Rakesh Khare, "A Study on Diverse Recognition Techniques for Indian Currency Note", IJESRT, Vol.2, Issue 6, June 2013

4. Ms. Trupti Pathrabe and Dr. N.G. Bawane "Paper Currency Recognition System Using Characteristic Extraction and Negativity Correlated NN Ensemble", Int. Journal of Latest Trends in Computing, 2010

5. R. Bhavani, A. Karthikeyan, "A Novel Method for Counterfeit Banknote Detection", IJCSE, Vol.2, Issue 4, pp 165-167, April 2014

6. Rubeena Mirza, Vinti Nanda "Design and Implementation of Indian Paper Currency Authentication System Based on Feature Extraction by Edge Based Segmentation Using Sobel Operator", IJERD, Vol.-3, Issue-2, pp.41-46, August 2012

7. Vipin Kumar Jain, Dr. Ritu Vijay**, "**Indian Currency Denomination Identification Using Image Processing Technique" IJCSIT, Vol.4, issue 1, pp.126-128, January 2013

8. YaojiaWang, SiyuanLin, "Currency recognition system using image processing", June 2010

