International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 05 | May 2020 www.irjet.net p-ISSN: 2395-0072

INDIAN FAKE CURRENCY DETECTION USING COMPUTER VISION

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Abstract - *This paper developed a computer vision based approach for Indian paper currency detection. In this approach, extract currency feature and develop an own datasets used for the currency detection. By using feature extraction method of front and back side Rs. 200 denomination security feature of Indian currency note. The mainly use ORB (Oriented FAST and Rotated BRIEF) and Brute-Force matcher approach to extract the feature of paper currency, so that can more accurately detection the denomination of the banknote both obverse and reverse. Our main contribution is through using ORB and BF matcher in OpenCV based, the average accuracy of detection is up to 95.0% and tested this method on different denominations of Indian banknote.*

Key Words: Feature Extraction, ORB Algorithm, Edge Detection, Computer Vision, OpenCV.

1. INTRODUCTION

Today, the technology is very fast growing in the word. This increasing of technology the every year government or bank sector faces the problem of fake currency. This problem is very serious issue in India now a day. Similarly the government is also improving day to day but using high printing technology counterfeit circulates the fake banknote in the Indian market [1]. The Reserve Bank of India (RBI) in its latest annual report said that the during 2017-2018, 17,929 pieces of Rs 2,000 notes were detected in 2017-2018 while only 638 counterfeit notes of the same denomination had been detected the year before. In the past, people detecting of counterfeit banknote only manual or a hardware machine which is not easy available in market [3]. The technology of currency detection system basically used for identification and extraction the features of bank note [2].

The main objective of this paper is to get familiar with the new security feature which is provided by the government of India so that they can differentiate between the fake and real note. Detecting of fake note some module including image acquisition, Image per-processing, Image adjusting, Gray-scale conversion, Edge detection, Segmentation, Feature extraction classification every step required algorithm for which using OpenCV library (open source computer vision library) [3]. Acquisition of image is process of capture a digital image from camera such that all features are highlighted. In the project we proposed a novel approach for the detection and classification of duplication in currency note using ORB (Oriented FAST and Rotated BRIEF) and Brute-Force matcher in OpenCV.

2. LITERATURE REVIEW

Over the year a lot of researchers have made several contributions in this field of currency note detection. The researchers have done detection based on security feature, texture, color etc. In this section, we review previous work in currency detection techniques.

Deshpande and Shrivastava [1], the propose a recognition and authentication system using image processing which can be a good for recognition the fake currency note. In this methodology, extract the security features with Multi-spectral imaging. They are so many feature extract in this process is Mahatma Gandhi portrait, watermark, RBI watermark , 2000 watermark, electrotype watermark of 2000 denomination note.

Y. Neeraja et.al. [2], describe a fake currency detection using k-nn technique. In this methodology, the feature extraction process by k-nn technology is a robust and versatile classifier that is often used as a benchmark for more complex classifiers such as support vector machines (SVM).

Sawant and More [3], introduce an approach to detect fake note using minimum distance classifier technique. In this paper, the extract an ID mark and latent image and compute the Euclidean distance between the test sample and train sample. The Fourier descriptor is used for the describe the note boundary. The experimental setup is done on rupees 20, 50, 100,500 and 1000.The average success rate achieved is 90.0%.

K. B. Zende et.al. [4], describe a fake note detection system automatic recognition of Indian currency security feature based on MATLAB system. They are so many step including in this process is feature extraction, image segmentation, edge detection, bit plane slicing and comparison of image. In this paper extract some many feature watermark Detection, Security Thread Detection, checking currency series number, identification mark and sees through register. Here, they propose a GUI platform to check the currency is fake or real.

Li Liu et al. [5], introduce an approach to detect fake coins using digital images. In this paper, represented in the dissimilarity space, which is a vector space constructed by comparing the image with a set of prototypes. To recognized key points they used DOG and SIFT detector.

Ali and Manzoor [6], describe a Recognition System for Pakistani Paper Currency system. In this methodology, the scan an image and classifier used Knn. They are extract the currency feature area, height, width, and aspect ratio. They

proposed the system used the different feature of the currency for detection currency and a low cost machine. The experimental setup is done 100 Pakistani currency notes 20 each on rupees Rs. 10, 20, 50, 100, 500 and 1000.The average success rate achieved is 98.57%.

Bhagat and Patil [7], proposed a fast binary descriptor based ob BRIEF, called ORB, Which resistant to noise. In this paper, proposed the system on both side of currency feature. The recognized samples for conditions as illumination changes, rotation and scale change. The experimental setup is done 210 Indian currency notes sample 15 each on rupees Rs. 5, 10, 20, 50, 100, 500 and 1000.The average success rate achieved is 97.14%.

Yanyan Qin et.al. [8], proposed systems provide by SIFT (Scale-Invariant Feature Transform). Initially, the scale spaces were built for the detection of stable extreme points, and then the detected stable extreme points were considered to be feature points which has scale in variance. Secondly, ORB descriptor is used to describe the currency feature points. This finally generated the binary descriptors with scale and rotation in variance. The ORB is 65.28 times faster than SIFT. The experimental setup is done 20 images and achieves accuracy 92.53%.

3. METHODOLOGY

The system proposed here work on the image of Indian currency note acquired by a digital camera. The method which is applied here is as follows

a. Acquisition of image of Indian currency note by simple digital camera or scanner.

b. Image acquired is RGB image and converted to Gray-scale image.

c. Edge detection of whole gray scale image.

d. Now Indian currency features of the paper currency both observe and reverse will be cropped and segmented.

e. After segmentation, feature of Indian currency note are extracted.

f. BF matcher match that database features with test images note then the test note is said as original otherwise fake.

3.1 Security Features of New Indian Currency Note

1. See through Register: The small floral design printed both on the observer side (hollow) and reverser side (filled up) with note colour. The denomination numeral of note is written horizontally along bottom the motif on the right side (reverse side) and above the latent image on the lift side (observer side). The design looks like a single floral design when seen against the light.

2. Bleed line: The bleed line printed on the obverse in both, the upper left and the right hand edge of the notes to aid the visually impaired. The bleed line is printed only 2000,500,200,100 notes.

3. Water marking: The water marks see in the new MG series note of Mahatma Ghandi and denominational value on the centre of the note. The portrait of Mahatma Gandhi is displayed in raised manner as compared to the old currency note.

4. Security Thread: The security thread is different in the denomination. In 2000 denomination currency note is a 3mm wide strip and usually 6 windowed and similar visible features and inscription “Bharat” (in Hindi), “RBI” and “2000”. The 500, 200, 100, 50, 20, 10 denomination security thread inscription “Bharat” (in Hindi) and “RBI”. The security thread changes from green to blue when the note tilted. The security thread appears between the Mahatma's portrait and guarantee clause, Governor’s signature panel.

5. Intaglio Printing: The portrait of Mahatma Gandhi printed in centre, the Reserve Bank seal, guarantee and promise clause printed after security thread, Ashoka Pillar Emblem on the right and RBI Governor's signature are printed in intaglio. Inscription printed using the Intaglio printing or raised printing can be felt by touch.

6. Latent image: On the obverse side of Rs.2000, Rs.500, Rs.200, Rs. 100, Rs.50 and Rs.20 and Rs. 10 notes, a vertical band on the left side of the currency note. It is visible only when the note is held horizontally at eye level.

7. Micro lettering: The Micro lettering is written on the inside of the frame of the spectacles of Mahatma Gandhi. It always contains the word “Bharat” (in Hindi) and “India. On the Indian currency note contain the denominational value of the notes in micro letters. This feature can be read under a microscope or by using a hand magnifying glass.

8. Identification Mark: Each currency note has a unique mark of it. Identification marks are made for identify the denomination of note with a visually impaired. A special feature in intaglio has been introduced on above the Ashoka Pillar Emblem in right side. The identification marks only appear 2000, 500, 200,100 denomination notes.

9. Optically variable Ink: The denominational numeral of a note with rupee symbol in the Mahatma Gandhi watermark window. The optically variable Ink printed on the observer side. The numeral changing the colour green to blue on bottom side.

3.2 Proposed Method to Detect Fake Currency

The design flow of fake Indian currency detection system includes following stages:

1. Image acquisition
2. Pre-processing
3. Gray scale conversion
4. Binarization Image
5. Edge detection
6. Image segmentation
7. Feature extraction
8. Comparison
9. Result

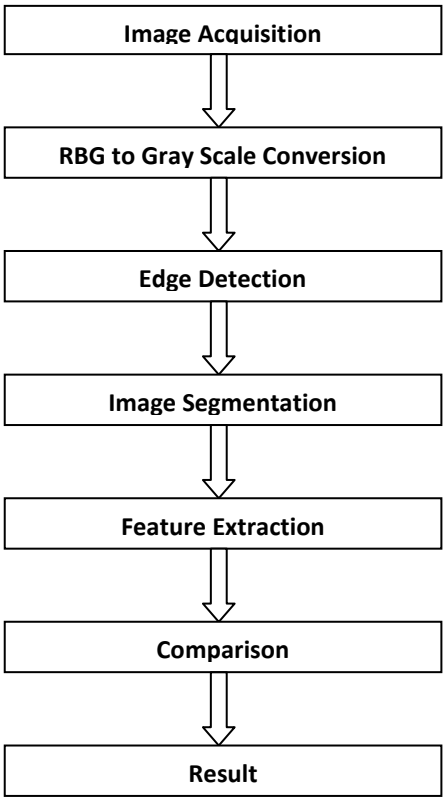


Fig -1: Block diagram of Indian Currency Detection System

The proposed system is works on two modules, one is the extract the Indian currency security feature and creates a datasets and other is the test currency dataset image on which authentication is too performed.

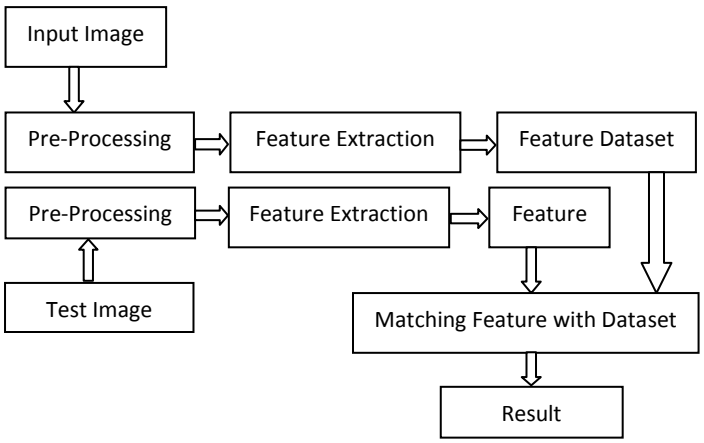


Fig -2: Proposed Detection System

1. Image Acquisition: Fig 3 shows the acquisition image. In this process, first image by using various ways to acquire image such as with the help of camera or scanner. This part is very impartment for extraction and detection of a currency.

Fig-3: Input Test Image

2. Pre-Processing: Image pre-processing is required prior to the main dataset and extraction of information and performs different operation for any currency verification. It includes

Image Adjusting: When we get the image from a camera, Fig 3 is capture in big size. Fig 4 shows reduce the calculation and decrease size of an image. These will also removing the background form the image also helping in reducing the size of the image [6].

Fig-4: Resize Image

3. RGB to Gray-Scale Conversion: The capture image acquired is in RGB colour. This image is heavy and has more noise. Fig 5 shows by converting into gray scale, it reduces the size of the image and also the intensity information which is easy to process instead of processing three components R (Red), G (Green), B (Blue).

Fig-5: RGB to Gray-Scale Image

4. Edge Detection: Edge detection is a tool in computer vision, particularly in the process of feature extraction and detection, which aim at identifying key points in a digital image. To segment an object from capture image, one needs closed region boundaries. Edge detection is one of the processes in image processing, image analysis, image pattern recognition, and computer vision techniques.

5. Image Segmentation: The image segmentation is the process which is divided a digital image into multiple segments, set of pixel. It is also called the image thresholding which threshold is decided and if value of given pixel is

above threshold then is converted into white pixel otherwise converted into black pixel.

6. Feature Extraction: Feature extraction process very important role in image processing and computer vision. In computer vision, feature extraction is the special form of dimensionality reduction. It is method of capturing image for retrieval and indexing. The aim is to extract and identify the unique feature of each Indian denomination under various challenging condition such as rough note, fold condition also under different background.

Fig-6: Observe Side Feature of Indian note

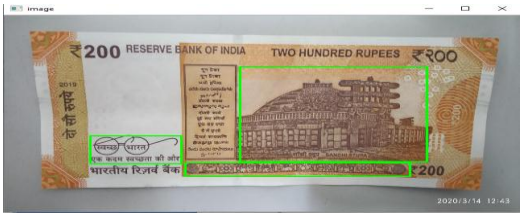


Fig-7: Reserve Side Feature of Indian note

4. RESULTS AND DISCUSSION

The system trained with 50 trained Indian currency note security features and the system is tested 29 testing images of denomination 200 and 500 Indian banknote. The security feature extracts of both side and compare with trained security feature. The accuracy calculated base on the testing image. The Table- I represent the accuracy in %. In denomination 200 testing images pass 29 banknotes out of 30 and the obtain accuracy 96.6%. In denomination 500 testing images pass 28 out of 30 and the obtain accuracy 93.3%. The average accuracy is obtaining 95.0%.

Table -1: Test accuracy (%)

Denomination	Image Datasets	Test Pass	Test Fail	Accuracy
200 Rupee Notes	30 Training and 30 Test Banknote Image	29	01	96.6%
500 Rupee Notes	30 Training and 30 Test Banknote Image	28	02	93.3%
Average Accuracy		**95.0%**		

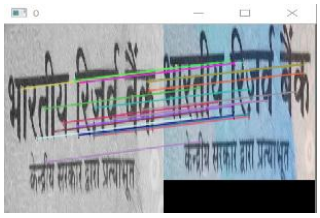
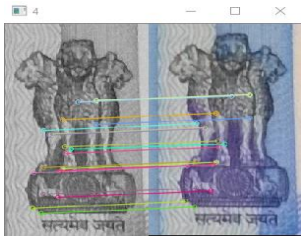


Fig-8: RBI_HIN Matches **Fig-9:** RBI_ENG Matches



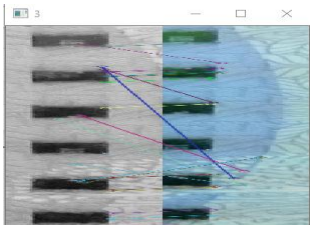


Fig-10: EMBLEM Matches **Fig-11:** SEC_THRE Matches

5. CONCLUSION

In this paper, we proposed ORB (Oriented FAST and Rotated BRIEF) and Brute-Force matcher in OpenCV for Indian currency detection system and currency security feature; everybody has its own centrality. By using said technique we have find that extraordinary results can be complete less time. The paper also includes the study of detailed information about various Indian currency notes. This is an OpenCV based using effective computer vision methods and algorithm which provide accurate and reliable result. At present we are having new MG series Indian currency note Rs. 200 and we can also experiment of notes Rs. 2000, Rs. 500, Rs. 100, Rs.50, Rs.20 and Rs.10. Our experiment shows that this is the low cost system to detection the Indian banknote. We had checked different notes on this system and the result is 95.0% which means that the system is working efficiently. In future, we will develop android app for detection Indian currency.

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