



An Automatic recognition system of fake Indian currency notes detection using Image processing analysis

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Abstract:

Fake currency notes are increasing day by day. For detecting the fake currency note is done by counting the number of interruptions in the thread line. For predicting the note is real or fake on the basis of number of interruptions. If the number of interruptions is zero, if it is real note otherwise it is fake. And also, we calculate the entropy of the currency notes for the efficient detection of fake currency note. 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. 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.

Keywords: *Image processing, Currencies, Real and fake authentication, Classifier, Feature extraction.*

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1. Introduction

Fake currency detection is a serious issue worldwide, affecting the economy of almost every country including India. Currency duplication also known as counterfeit currency is a vulnerable threat on economy [1-2]. It is now a common phenomenon due to advanced printing and scanning technology. The possible solutions are to use either chemical properties of the currency or to use its physical appearance. The approach presented in this paper is based upon physical appearance of the Indian currency. Image processing algorithms have been

adopted to extract the features such as security thread, intaglio printing (RBI logo) and identification mark, which have been adopted as security features of Indian currency. Hence, we propose a more user friendly and portable solution to this problem in form of a mobile app coupled with cloud storage. The Reserve bank is only one which has the sole authority to issue bank notes in India. Reserve bank, like other central banks the world over, changes the design of bank notes from time to time. Traditionally, anticounterfeiting measures involved including fine detail with raised intaglio printing on bills which allows non-experts to easily spot forgeries [3-4].

On coins, milled or marked with parallel grooves edges are used to show that none of the valuable metal has been scraped off. Reserve bank uses several techniques to detect fake currency. Manual testing of all notes in transactions is very time consuming and untidy process and also there is a chance of tearing while handing notes [5-8]. Technology is growing in no time lately. Consequently, the banking sector is additionally obtaining modern-day by day. This brings a deep would like of automatic faux currency detection in the machine and automatic product merchant machine [9-11]. Several researchers are inspired to develop strong and economical automatic currency detection machine. An automatic machine which might notice banknotes are currently widely employed in dispensers of a contemporary product like candies, soft drinks bottle to bus or railway tickets [12-15]. The technology of currency recognition essentially aims for distinctive and extracting visible and invisible options of currency notes.

Until now, several techniques are planned to spot the currency note. However, the most effective approach is to use the visible options of the note [16-19]. For instance, color and size. However, this manner isn't useful if the note is dirty or torn. If a note is dirty, its color characteristic is modified wide. Therefore, it's vital that however, we tend to extract the options of the image of the currency note and apply the correct algorithmic rule to enhance accuracy to acknowledge the note [20-24]. We tend to apply here a straightforward algorithmic rule that works properly. Manual testing of all notes in transactions is very time consuming and untidy process and also there is a chance of tearing while handing notes. Therefore Automatic methods for bank note recognition are required in many applications such as automatic selling goods and vending machines. Extracting sufficient monetary characteristics from the currency image is essential for accuracy and robustness of the automated system [25-28]. This is a challenging issue to system designers. Every year RBI (Reserve bank of India) face the counterfeit currency notes or destroyed notes. 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 [29-34]. Counterfeit money is imitation currency produced without the legal sanction of the state or government. Producing or using counterfeit money is a form of fraud or forgery. Counterfeiting is almost as old as money itself. Plated copies have been found of Lydian coins which are thought to be among the first western coins. Before the introduction of paper money, the most prevalent method of counterfeiting involved mixing base metals with pure gold or silver [35-37]. A form of counterfeiting is the production of documents by legitimate printers in response to fraudulent instructions.

Counterfeit money is imitation currency produced without the legal sanction of the state or government. Producing or using this fake money is a form of fraud or forgery. Counterfeiting is as old as money itself, and is sufficiently prevalent throughout history that it has been called "the world's second oldest profession. This has led to the increase of corruption in our country hindering country's growth [38-41]. Common man became a scapegoat for the fake currency circulation, let us suppose that a common man went to a bank to deposit money in bank but only to see that some of the notes are fake, in this case he has to take the blame.

The image of the currency note is captured through a camera. The hidden options of the note are highlighted within the actinic radiation [42-45]. Currently, process on the image is completed thereon non-inheritable image exploitation ideas like image segmentation, edge data of image and characteristics feature extraction. MATLAB is that the excellent tool for procedure work, and analysis [46-49].

2. Literature Review

Ms. Monali Patil, Prof. Jayant Adhikari, Prof. Rajesh Babu they proposed a system which uses image processing to distinguishes between features of a real note and a fake note [50-52]. They used K-means algorithm for feature clustering and SVM algorithm to train their data model. Mayadevi A. Gaikwad, Vaijinath V. Bhosle Vaibhav D Patil in their research paper they have suggested a methodology of detecting fake currency from the real by comparing their visual features such as distance between Gandhijis portrait and other notations [53-58]. This methodology can be useful for a system purely based on software processing. Renuka Nagpure, Shreya Sheety, Trupti Ghotkar, they have proposed a system which uses the floral designs on the notes provided by RBI to distinguish between real and fake notes [59-63]. Neeru Rathee, Arun Kadian, Rajat Sachdeva, Vijul Dalel, Yatin Jaie in their paper they have suggested image processing along with supervised machine learning to learn the distinguishing feature of a real note from fake one which will increase the precision of this method [64-67]. Akanksha Upadhyaya Research Scholar, Vinod Shokeen Associate

Professor, Garima Srivastava. In their study they have proved that image processing along with logistic regression gives an accuracy of above 99%. Amol A. Shirsat, S.D. Bharkat have proposed a Paper Currency Recognition System [68-71]. This system mainly consists of three parts. The image of interest is first processed and extracting the feature by applying toolbox MATLAB. The second part is currency recognition where classifier such as neural network is used. Deborah. Soniya Prathap has proposed a paper Detection of Fake currency using Image Processing [72-74]. Choose the image and apply preprocessing. In pre-processing the image to be crop, smooth and adjust. Convert the image into gray color. With significant advances in printing and production equipment, the production and circulation of inauthentic currency notes have become increasingly sophisticated. Although there are advanced detection and analysis methods for counterfeit currency notes and artifacts, most require expensive laboratory bench-top equipment that require detailed training, and are usually slow to collect and analyze data. Some of these need elaborate sample handling and positioning, and frequently cannot be taken into the field [75-76]. This technical note presents a simple fluorescence-based hyper spectral-imaging method of detecting and analyzing the quality or authenticity of currency notes and artifacts using 365 nm Ultraviolet (UV) Bulb. All the image and spectral data are collected by capturing snapshot via camera.

Indian Banknote Recognition using Convolution Neural Network: Independent Scholar 2C-126, Vasundhara Ghaziabad, Uttar Pradesh This paper presents a deep learning-based method for identification of denominations of Indian Currency Rupee notes from their colour images [77-79]. A classification framework has been implemented using the concept of transfer learning where a large convolution neural network pre-trained on millions of natural images is employed for classification of images from new classes. An image dataset of four banknote denominations is prepared by preprocessing and augmentation of real-bank note images acquired in different viewpoints and lighting conditions via Smartphone camera. A new top layer upon the convolutional base of a pre-trained Mobile Net model is trained for a few epochs upon a portion of the dataset to achieve an agreeable accuracy upon validation subset.

Automatic Recognition of Fake Indian Currency Note: 2016 International Conference on Electrical Power and Energy Systems (ICEPES) Maulana Azad National Institute of Technology, Bhopal, India. Dec 14-16, 2016 in this paper, the automatic system is designed for identification of Indian currency notes and check whether it is fake or original. The automatic system is very useful in banking system and other field also. In India increase in the counterfeit currency notes of 100, 500 and 1000 rupees. As there are increases in the technology, like scanning, colour printing, and duplicating, there is increase in counterfeit

problem [80-82]. In this paper, recognition of fake Indian currency notes is done by using image processing technique. In this paper, recognition of fake Indian currency notes is done by using image processing technique. In this technique first the image acquisition is done and applies pre-processing to the image. In pre-processing crop, smooth and adjust then convert the image into grey colour after conversion apply the image segmentation then extract features and reduce, finally comparing image.

4. Aim and Objective

The main objective of our proposed work is to propose a currency note recognition system under hyper spectral imaging mode with different lights under different wavelengths and the comparison of features by using image processing algorithms.

3. Proposed System and Algorithm

We propose a system in which the recognition of currency notes can be done automatically based on the combination of enhancement, segmentation and feature extraction method under image processing. First, we acquire the images under hardware setup which consists of camera mounted inside the box with the arrangement of UV light, Normal LED light along with multicolor LED's. The hardware setup is interfaced with the PC using USB port of web-camera. Once the power supply on, the images are captured using webcam software by placing the different currency notes inside the box setup. The acquired images are given as the input for the program created in the MATLAB software. Aspect Ratio is calculated initially. Based on the AR, it is classified that the given note is 100, 500 or 2000. Entropy and Mean act as the main feature extraction technique which is applied for all the images and the values are collected. After running the program, we will get the results such that the graph is plotted between the real note and the fake note under different modes and wavelengths. Therefore, we can able to obtain the threshold value which act as the center between real notes and fake notes. The utility of low-resolution images of currency notes acquired from camera is examined to ascertain the performance.

The different Features in the note are detected and extracted based on ROI extraction method by setting the width and height of the ROI portion. The extracted features are compared between real note and fake note. Entropy is applied and the entropy value is compared between the two. Through the difference in entropy values, we can classify that the given note is real note or fake note.

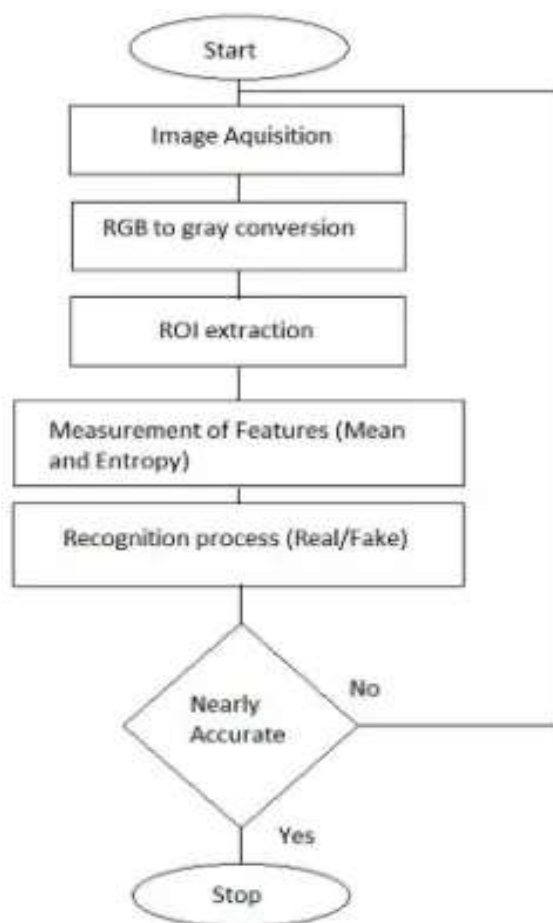


Fig.1: Flowchart of the proposed system

4. Metodology

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. Acquisition of image of currency note under ultraviolet light by simple digital camera or scanner.

Image acquired is RGB image and now is converted to grayscale image.

- Edge detection of whole gray scale image.
- Now characteristics features of the paper currency will be cropped and segmented.
- After segmentation, characteristics of currency note are extracted.
- Intensity of each feature is calculated.
- 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:

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.

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

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.

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

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

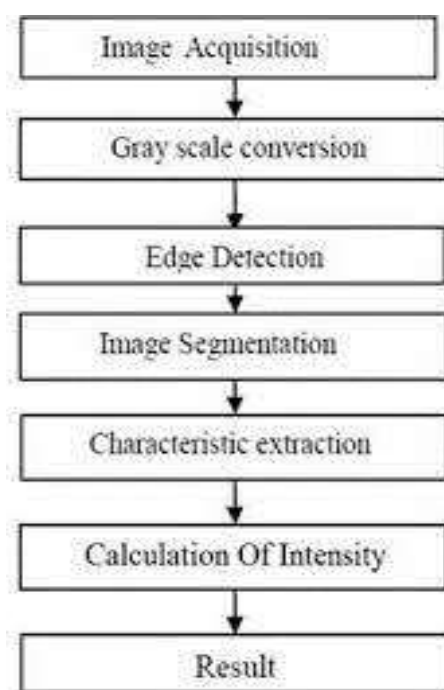


Fig.2: Flow Diagram of Process

Image Acquisition: The image is kept under ultraviolet light and the image is captured through a simple digital camera.



Fig.3: Image Acquisition

Image Preprocessing: Image preprocessing are the steps taken to format images before they are used by model training and inference. This includes, but is not limited to, resizing, orienting, and color corrections. Thus, a transformation that could be an augmentation in some situations may best be a preprocessing step in others. It involves the operations required prior to data analysis and information extraction. Here image resizing is done.

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. The luminance of a pixel value of a grayscale image ranges from 0 to 255. The conversion of a color image into a grayscale image is converting the RGB values (24 bit) into grayscale value (8 bit). Various image processing techniques and software applications converts color image to grayscale image. Edge detection is an image processing technique for finding the boundaries of objects within images. It works by detecting discontinuities in brightness. Edge detection is used for image segmentation and data extraction in areas such as image processing, computer vision, and machine vision. The purpose of detecting sharp changes in image brightness is to capture important events and changes in properties of the world. Edge detection helps to detect all the edges of the necessary ROI to perform various operations in the latter stages.



Fig.4: Gray scale image

Image Segmentation: Image segmentation is a method in which a digital image is broken down into various subgroups called Image segments which helps in reducing the complexity of the image to make further processing or analysis of the image simpler. Segmentation in easy words is assigning labels to pixels.

Feature Extraction: Feature extraction is a type of dimensionality reduction that efficiently represents interesting parts of an image as a compact feature vector. This approach is useful when image sizes are large and a reduced feature representation is required to quickly complete tasks such as image matching and retrieval. The features are extracted and then used for comparison in further step.

Characteristics Extraction: It is a part of dimensionality reduction process, in which an initial set of raw data is divided and reduced to more manageable groups and image data will extracts some parts of characteristics. It refers to process of transforming raw data into numerical features that can be processed while preserving information in original data set.

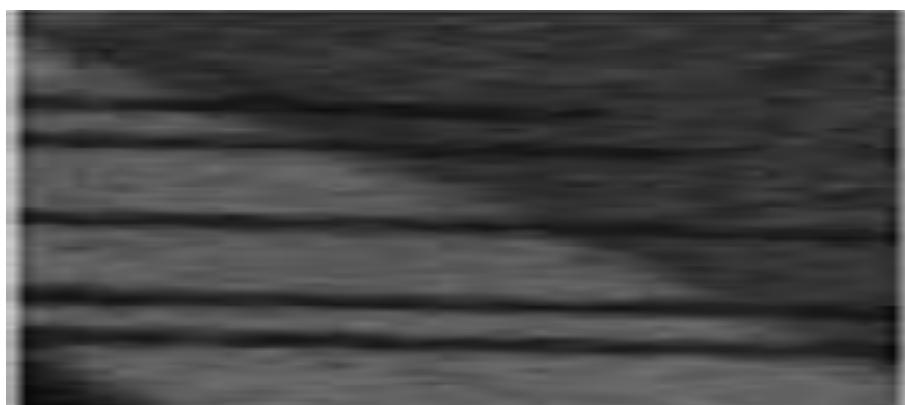


Fig.5: Identification Mark

5. Implementation

The execution stage regarding the task is that the complete aim is essentially changed keen on

running code. Intent regarding the stage is towards interpreting the aim keen on a finest likely result within an appropriate programmed language. In this section, it covers up the execution phase concerning the task, providing particulars regarding the programmed language as well as improvement background employed. The execution phase involves the following tasks.

- Cautious scheduling.
- Examination regarding structure as well as constraints.
- Aim concerning the techniques towards accomplishing the conversion.
- Assessment concerning the conversion technique.
- Accurate judgment about the choosing of the proposal.
- Software Used

The necessary program regarding private PC that comprises configuration as specified as follows:

- Windows 7(64-bit) operating system.
- MATLAB 7.14 Version R2012a

Image Processing Toolbox: Image processing device box permits carrying out image improvement, deblurring of image, characteristic identification, decreasing of noise, image segmentation, arithmetical alteration, as well as registration of image. Image processing device intended for the execution regarding methods proposed are specified below:

- Fundamental import as well as export
- Display

6. Results and Discussions



Fig.6: Input of the real note



Fig.7: Input image of a fake note



Fig 8: Gray Scale Conversion of Real Note



Fig 9: Gray Scale Conversion of Fake Note

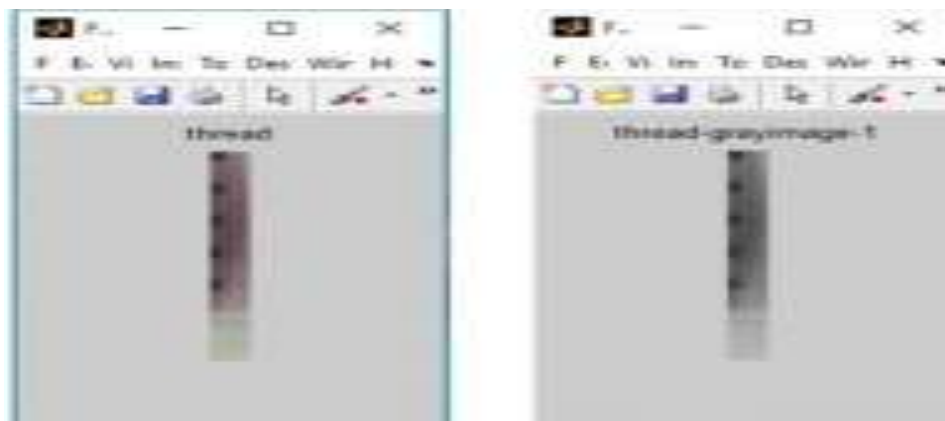


Fig.10: Thread feature of the note



Fig.11: Gandhi security feature of the note

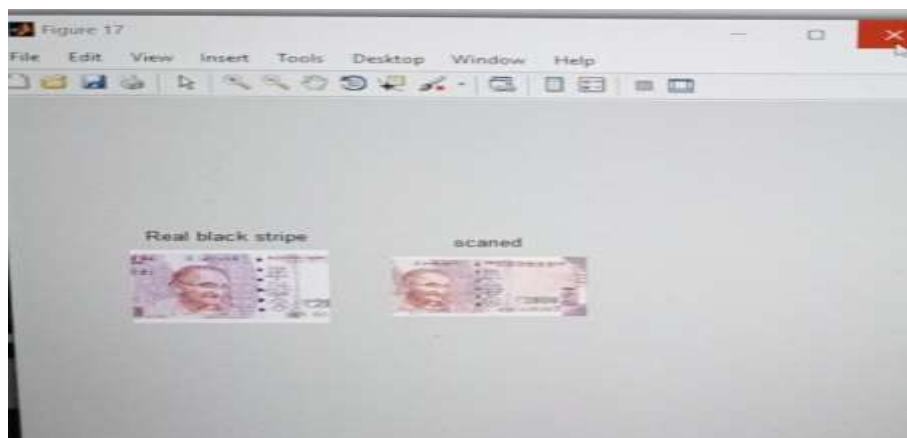


Fig.12: Color and Real black strips of note

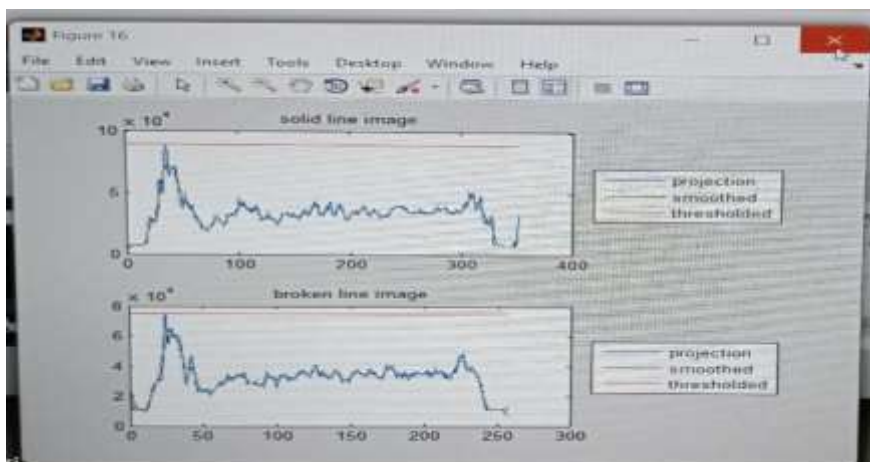


Fig.13: Graph of solid line and broken line



Fig.14: Differences Image for solid and broken line

7. Conclusion

The fake currency detection using image processing was implemented by considering The Features of currency note like serial number, security thread, Identification mark, and 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 parts. By utilizing computerized image processing, examination of Currency picture is increasingly exact just as this strategy is proficient as far as expense and tedious contrasted with existing procedures. The proposed framework is worked adequately for separating highlight of Indian currency image. Separated features of cash picture will use

for currency recognition system just as for its check. Application based framework will be intended to get appropriate outcome whether cash picture is fake or it's real.

8. Future Scope

The main motive behind this project was to make a system for common man who is fast and easy to use. This is a MATLAB based system for automatic recognition for fake and genuine Indian currency. This is a low-cost system, using effective and efficient image processing techniques, provide accurate and reliable results at good throughput as shown by experimental results which are totally done at server's end. The developed MATLAB Code works for detection of all Indian currencies and for fake detection it works with Rs 2000 and Rs 500. Our proposed system could replace the Hardware system in some initial stages of currency verification process. Our system will helpful for regular peoples who are technically not involved in daily life with background process. By using of Image Processing Technique, it was done in an easier and identified by accurately.

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