An Automated Recognition of Counterfeit Currency Note Using SVM with Note to Coin Exchanger

Swati V. Walke[1], Prof. Dr. D.M. Chandwadkar [2]
Department of Electronics and Telecommunication Engineering
Karmaveer Kakasaheb Wagh Institute of Engineering Education and Research,
Nashik, India.

***Abstract*—**The average citizen is the worst-hit as fake banknotes have become so deeply embedded in the Indian economy that even bank branch and ATMs are disbursing counterfeit currency. From local vegetable vender to the petrol pumps, everybody is worried of accepting bank notes in denomination of Rs.100, Rs.500 and Rs.1000 as a majority of the fake Indian currency note are almost impossible to differentiate from genuine bank notes. In order to deal with such types of problems, an automated Recognition of currency notes is introduced with the help of feature Extraction, classification based in support vector machine (SVM). SVM classifies the segments using its datasets. This technique is considered with the machine vision where all the processing with the image is done by machine. As well as Requirement of coins is increasing at places like bus stand, railway station, mall and park. The main motive behind the project is to designing an efficient and simple machine counterfeit currency recognition which will fulfil need of coins for transactions so that people will not face problem of coins. This project is to provide coins for genuine note, for this purpose we have developed mechanical coin dispensing model in which camera takes picture of note. After that it's find out its value using image processing technique and then according to the value equivalent number of coins is dispense.

***Keywords*—** *Counterfeit currency; support vector machine(SVM); image processing ;coin dispensing model.*

I. INTRODUCTION

Fake currency is imitation currency produced without the legal sanction of the state or government producing or using fake currency is a form of fraud or forgery. The Reserve bank of India estimates that there is at least Rs.2 trillion of fake rupees note in circulation throughout India. RBI (Reserve bank of India) faces problem of Counterfeit Currency notes or destroyed notes in every year. The bank staffs are specially trained to detect counterfeit notes but problem begins once such notes are infiltrated into the market and circulated through common people. Even receiving counterfeit notes from ATM counters have also been reported at some places. As a result of the great technology come advances in color printing and scanning counterfeiting problems become increases from the past few years. In the previous, only the printing house has the ability to make paper currency, but today not only printing house but also any person can print counterfeit bank notes simply by using a computer and a laser printer at house. Therefore to stop these issue automatic Fake currency detection system has become more and more important [11]. The fake currency detection system is developed to detect the fake currency by applying different techniques and methods on currency note. Fake currency detection system can be used in places such as banks counter, shops and automated teller machine, auto seller machines etc. It is an important task to classify the paper currencies at banks or large shops quickly and correctly. So far, many different approaches have been proposed to solve the problem of paper currency recognition and verification.

Automatic fake note inspection system is a best comparator to human vision inspection Including image processing, computer technology and pattern recognition, Embedded System, NN, SVM, all these systems can provide reliable, objective and smooth performance on fake note detection. Our goal is, therefore, to study the problem of fraud in banks and its resolution by the SVM techniques. SVM classify the segments using its datasets. This SVM technique is considered with the computer vision where all processing with the image is done by machine.

The machine is fitted with a I-Ball C8.0 camera which will scan the image of the currency note considering the dimensions of the banknote and software will process the image segments with the help of SVM and character recognition methods. In this project we have made fake currency note detection technique using MATLAB and feature extraction with other applications of image processing. MATLAB is the computational tool of choice for research, development and analysis. Characteristic extraction of images is challenging work in digital image processing. It involves extraction of some invisible visible and features of Indian currency notes. In the project setup, note is placed in front of camera to check whether it is fake or genuine [12]. Camera take the pictures of notes and analyzed by MATLAB program installed on computer and check Indian currency notes. The project is meant to check Indian currency notes of 10, 20, 50, 100, 500 and 1000 rupees. If the note is genuine, then respective message is appeared on the screen and vice-versa. After that, according to the user input equivalent number of coins will dispense.

II. LITERATURE REVIEW

Currently, there are a number of methods for paper currency recognition [1][2][3]. Using the properties of the HSV (Hue, Saturation and Value) color space with emphasis

on the visual perception of the variation in Hue, Intensity and Saturation values of an image pixel [1]. In this technique, Fitting tool of Neural Network is used for the purpose of paper currency verification and recognition. Critical features from Indian banknotes were extracted by image processing and experimented on Neural Network classifier. In other research work, a simple statistical test is used as the verification step, where only one random variable of Gaussian distribution is employed [2].

The propose using the probability density formed by a multivariable Gaussian function. In that input data space is transferred to a lower dimensional subspace. Due to the overall structure of this model, the total processing system is acts as a hybrid neural network. Another study describes an approach to digit recognition for the serial numbers on the Chinese currency banknotes [3]. Three characteristics of paper currencies including color, size and texture are used in the recognition. By using image histogram, plentitude of different colors in a paper currency is computed and compared with the one in the reference paper currency. Built on the traditional local binary pattern method, an improved local binary pattern algorithm, called block-LBP algorithm, is used for characteristic extraction [5]. LBP is a powerful tool for texture description. This method has advantage of simplicity and great speed.

A Neural Network based recognition scheme is used for Bangladeshi banknotes [6]. The Marcov chain concept is used to model the texture of paper currencies as random process. Ensemble neural network (ENN) is used for the recognition system. The individual neural networks in an Ensemble neural network are skilled via negative correlation learning. The perseverance of using negative correlation learning is to skill the individuals in an ensemble on different parts or portion of input patterns. The technique is proposed to improve the recognition ability and the transaction speed to classify the Japanese and U.S. paper currency [8]. This paper compare two types of data sets, Fourier power spectra and time series data are used in this study. In both cases, they are used as inputs to the neural network. We also refer a new evaluation method of recognition ability.

III. TECHNIQUES FOR DETECTING COUNTERFEIT CURRENCY

a) Varied-Density Watermarks

By varying the density of the paper a banknote is printed on in a controlled manner, thin watermarks can be applied. These all are observable when a bright light shines onto the rear of banknote, and the varied paper density causes varying intensities of light to pass through it, causing the watermarked image is appear on the other side of the note.

b) Ultraviolet Fluorescence

Embedding fluorescent fibre into the paper, or printing by ultra- violet ink on to the paper, creates a form of optical verification easily used at counters. By exposing the note to ultra-violet light, the ink or fibre fluoresce, revealing a colored pattern not visible under natural light

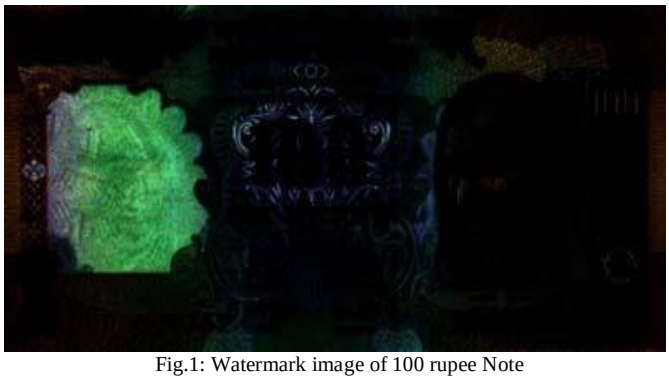

Fig.1: Watermark image of 100 rupee Note

c) Intaglio Printing

The note is subjected to a high-pressure printing process that strengthens and slightly raises the paper's surface structure. Using different alignment of line printed in this manner, a *latent image* can be produced which is changes the appearance depending on the angle at which the note is viewed.

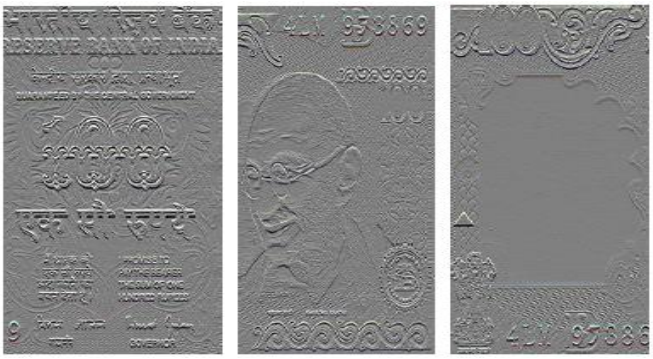

Fig.2: Intaglio and Identification Mark

d) Microtext

Text printed at smaller than 1 point size, readable only with the magnifying glass. It provides additional security to coupons, invoices, and other fraud-sensitive applications. Compatible with monochrome, color and highlight color devices.

IV. MODELING APPROACH

A. Software Desinging

1) I-Ball C8.0 camera: We are using I-ball USB camera for image acquisition with High Quality CMOS sensors, 8 M pixels still image resolution, 4 M pixels video resolution, High quality 5G wide angle lens, USB 2.0 Interface, 4x Digital zoom, Video Format: RGB 24 bit, Video Resolution: 640x480, 1600x760,1280x960, 1280x1024,1600x1200, 2304x1728 and Frame Rate of 30 Frames per second.The images are taken under no occlusion or shadowing is there and image is taken in a clear environment. Distance of camera is nearly fixed from the object and within a small range of variation. The orientation of the currency notes was such that the sufficient amount of data required for further processing of

even a single face was at least visible. The currency notes are of good quality i.e. they are not very much full of stains.

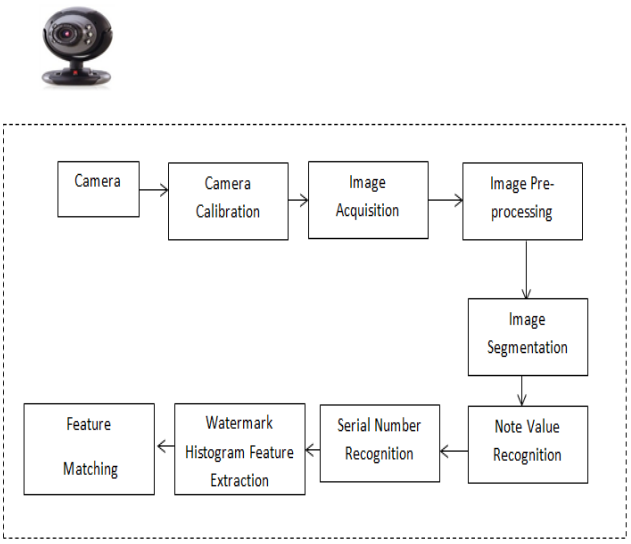

Fig.3. Block Diagram Of Counterfeit Currency Detection

2) Image acquisition: The first stage of any vision system is the image acquisition. After the image has been obtained and various methods of processing can be applied to the image to perform the many different vision tasks. However, if the image has not been acquired properly then the intended tasks may not be achievable even with the aid of some form of image enhancement. In this system image acquisition is done using camera. Few inbuilt functions of MATLAB are used to acquire image.

3) Image pre-processing: Pre-processing is done to increase the quality of image to be processed. In this stage noise reduction is done using inbuilt functions of MATLAB. This is essential for further processing on image. Also histogram adjustment is done in this stage. Histograms is a graphical representation, it is similar to a bar chart in structure that organizes a group of data points into user-defined ranges. The histogram condenses a data series into an easily interpreted visual by taking many data points and grouping them into logical ranges or bins. Histogram adjustment is done to increase the clarity of image.

4) Segmentation: Image segmentation is the process of Partitioning a digital image into multiple segments. The goal of image segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is used to locate boundaries objects and in images. Image Segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics. The result of it is a set of segments that collectively cover the entire image. Each of the pixels in this region is similar with respect to some characteristic and computed property, such as intensity, texture and color. Adjacent regions are significantly different with respect to the same characteristic. Segmentation means to divide image into regions. Out of different regions the region of interest is selected for processing.

5) Note Value Recognition: After segmentation different regions are selected for processing to extract the features of notes. Extracting the features of middle region and using symbol recognition note value is determined.

6) Serial number recognition: After segmentation serial number on the upper right corner of the note is recognized. Serial number is also determined using symbol recognition.

7) Watermark histogram feature extraction: Watermark is a recognizable image or pattern in paper that appears as various shades of lightness/darkness when viewed by transmitted light caused by thickness or density variations in the paper. Watermarks have been used on currency, postage stamps and other government documents to discourage counterfeiting. There is watermark of Mahatma Gandhi on currency note. So it is identified after segmentation. Watermark histogram features are extracted to match the watermark with Gandhi's portrait.

8) Features matching using SVM (Support Vector Machine): SVM is a new statistical learning technique that can be seen as a new method for training classifiers based on radial basis functions, splines, neural networks, polynomial functions or other functions. SVM uses a hyper-linear separating plane to create a classifier. For problems that cannot be linearly separated in the input space, the machine will offers a possibility to find a solution by making a non-linear transformation of the original input space into a high dimensional feature space, so that optimal separating hyper plane can be found[9]. Those separating plane is optimal, that means a maximal margin classifier with respect to the training data set can be obtained. Here support vector machines (SVM) are used aiming at determining the location of decision boundaries that produce the optimal separation of classes. The whole sample set consisting of genuine as well as duplicate samples is divided into few subsets. A fourfold test is conducted so that each subset appears at least once as in validation, training, and testing.

B. Hardware Designing

The entire system is based on communication between the PC with MATLAB and the processor. Fig.4 shows PC with MATLAB, which is used for image processing and to implement User Interface runs on the PC. Communication with the processor is done using serial communication. Processor is used to control the process. The work of processor is to interpret data from fake note detection unit to check if currency is fake, control and synchronize the note to coin exchanger mechanism. Control functions are performed

by LPC 2138 and image processing by MATLAB. Pc with matlab is provided the information that note place by the user is genuine or fake note. Once the note is under the camera, data will be sent serially to MATLAB to start capturing the image of the note and do the image processing in MATLAB. The image acquired is RGB image and then it will be converted into gray scale than Edge detection of the whole gray scale image will be performed. After detecting edges, characteristics of the paper currency will be cropped and segmented. After that, the characteristics of the paper currency will be extracted. The characteristics of test image are compared with the original image (pre-store) in the system. If the test image match with the pre-stored image then the currency is genuine otherwise it is counterfeit currency. If note is place by user is genuine, the respective message is appeared on the graphical user interface (GUI) and vice-versa. According to the requirement user can give the input through matlab. USB to serial converter is used for user to machine communication.

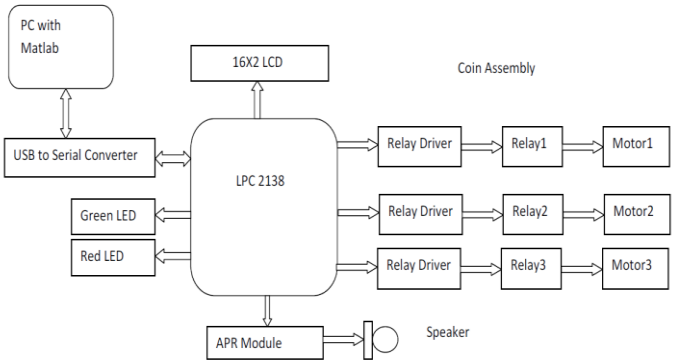

Fig.4. Block Diagram of Note to Coin Exchanger with counterfeit note detection

Processor development board to control overall working of project. Processor controls all motor operation and it communicates with MATLAB running on computer. Coin Container unit consists of relays to drive the motors and motor is let out the coins to the user. Incase of mix coins, the controller is checked for availability of coins in the coin container and then as per the wants of the user from the buttons the mix coins is let out to the user. If the coins as per the need of the user are not present in the coin container then "INSUFFICIENT COINS" message is displayed on the LCD screen.

V. EXPERIMENTAL RESULT

In this section, we test the performance of the proposed method on a set of some Indian banknotes. In this banknotes some are genuine and some are forged. We randomly choose few genuine notes and few forged note for testing. Fig. 4. Shows the technique for detecting Indian currency. This technique uses four characteristics of currency including identification mark, watermark, note size, serial number of the note. One's the note is detected as genuine note, as per further requirement of the user, process can be stop or it can be continued for dispensing of coins.

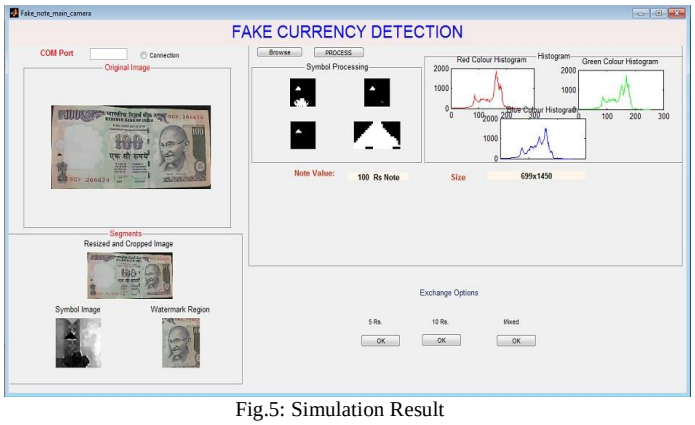

Fig.5: Simulation Result

VI. CONCLUSION

The main motive behind this is to present the system based on recognition of counterfeit currency banknotes to avoid frauds. The note value is identified by using database. After that, Identification Mark, Note Size, Serial Number and Watermarked region is extracted by using segmentation method and RGB histogram is plotted for the watermarked region. The proposed system will be helpful in day to day life of every common man where people have to suffer for change at many public places.

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Swati V. Walke pursued her Bachelor of Engineering in Electronics from Rajeev Ganghi College of Engineering Research and Technology, Chandrapur, which is affiliated to Rashtrasant Tukadoji Maharaj Nagpur University. she is currently pursuing Masters of Engineering in Electronics and Telecommunication, with specialization as VLSI and Embedded Systems from K. K. Wagh Institute of Engineering Education and Research, Nashik. This paper is published as a part of the research work done for the fulfillment of degree of Masters.

Prof. Dr. D. M. Chandwadkar is working as Head of Department – Electronics & Telecommunication Engineering, in Karmaveer Kakasaheb Wagh Institute of Engineering Education and Research, Nashik, since last 25 years. He pursued his Ph. D. from College of Engineering, Pune. His areas of interest include Power Electronics and image Processing.