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Design and Implementation of Fake Currency Detection System

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Abstract: In recent years, a lot of illegal counterfeiting rings manufacture and sell fake coins and at the same time fake note currency is printed as well, which have caused great loss and damage to the society. Thus it is imperative to be able to detect fake currency. We propose a new approach to detect fake Indian notes using their images. A currency image is represented in the dissimilarity space, which is a vector space constructed by comparing the image with a set of prototypes. Each dimension measures the dissimilarity between the image under consideration and a prototype. In order to obtain the dissimilarity between two images, the local key points on each image are detected and described. Based on the characteristics of the currency, the matched key points between the two images can be identified in an efficient manner. A post processing procedure is further proposed to remove mismatched key points. Due to the limited number of fake currency in real life, SVM is conducted for fake currency detection, so only genuine currency are needed to train the classifier.

Keywords—*Fake currency, fake currency detection, currency image representation, dissimilarity space, class learning.*

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I. INTRODUCTION

Currency duplication also known as counterfeit currency is a vulnerable threat on economy. It is now a common phenomenon due to advanced printing and scanning technology. Bangladesh has been facing serious problem by the increasing rate of fake notes in the market. To get rid of this problem various fake note detection methods are available around the world and most of these are hardware based and costly. Automatic recognition of fake Indian currency note is important in many applications such as automated goods seller machine and automated goods tellers machine. This system is used to detect the valid Indian currency note. The system consists of eight steps including image acquisition, grey scale conversion, edge detection, feature extraction, image segmentation, comparisons of images and output [1]. Automatic machine more helpful in banks because bank face the problem of counterfeit currency notes or destroyed notes. Therefore involving machine makes note recognition process simpler and systematic. Automatic machine is more important to detect fake currency note in every country. The system designed to check the Indian currency note 200, 500 and 2000 rupees. The system will display currency is genuine or fake and currency denomination. The Reserve bank of India estimates that there is at least Rs.2 trillion of fake rupees note in circulation throughout India. 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. With development of modern banking services, automatic methods for currency recognition become important in many applications such as in ATM and Automatic Goods Seller Machines.

1.1 Commonly Used Methods to Detect Fake Notes

i. See Through Register: The small floral design is printed in the middle of the vertical band and next to watermark. The floral designed on the front is hollow and in back is filled up. The floral design has back to back registration. The design will see as one floral design when seen against the light [1].

ii. Water marking: The mahatma Gandhi watermark is present on the bank notes. The mahatma Gandhi watermark is with a shade effect and multidirectional lines in watermark [5].

iii. Optically Variable Ink: Optically variable ink is used for security feature; this type of feature is in the Rs.200, 500, and Rs. 2000 bank note. Optically variable ink as security feature for bank note is introduced in Nov.2000. The denomination value is printed with the help of optical variable ink. The color of numerical 2000 or 500 appear green, when note is flat but change the color to blue when is held in an angle [4].

iv. Fluorescence: Fluorescent ink is used to print number panels of the notes. The note also contains optical fiber. The number panel in fluorescent ink and optical fiber can be seen when exposed to UV light.

v. Security Thread: The security thread is in 2000 and 500 note, which appears on the left of the Mahatma Gandhi's portrait. In security thread the visible feature of "RBI" and "BHARAT". When note is held

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against the light, the security thread can be seen as one continuous line [4].

vi. Latent Image: The latent image shows the respective denomination value in numerical. On the observe side of notes, the latent image is present on the right side of Mahatma Gandhi portrait on vertical band. When the note is held horizontally at eye level then the latent image is visible.

vii. Micro Lettering: The micro letter's appears in between the portrait of Mahatma Gandhi and vertical band. Micro letter's contains the denomination value of bank note in micro letters. The denomination value can be seen well under magnifying glass.

viii. Identification Mark: Each note has its special identification mark. There are different shapes of identification mark for different denomination (Rs.200-H, Rs.500-circle and Rs.2000- Square). The identification mark is present on the left of water mark [1].

II. LITERATURE SURVEY

Li Liu et al. [1], introduce a new approach to detect fake coins using their images. A coin image is represented in the dissimilarity space, which is a vector space constructed by comparing the image with a set of prototypes. Each dimension measures the dissimilarity between the image under consideration and a prototype. To recognized key points they used DOG and SIFT detector.

Ying Li Tian [2], describes an Effective Component-based Banknote Recognition for the Blind. In this methodology, for the detection of forged notes it needs to identify the denomination every time they use the device which consists of ultraviolet light. The bank employees keeps the paper currency note on the device and try to find whether the watermark identification, serial number and other characteristics of the notes are proper to get the denomination and check its authentication

Author Bo Tang, Steven Kay, Fellow, and Haibo [3] ,describes a novel shape feature—angle-distance methodology. Automated feature selection is important for text categorization to reduce the feature size and to speed up the learning process of classifiers. A common feature reduction approach for text categorization is feature selection that this paper concentrates on, where only a subset of original features are selected as input to the learning algorithms.

Author study an automatic recognition method for ancient Roman coins. The proposed method exploits the structure of the coin by using a spatially local coding method. Results show that the proposed method outperforms traditional rigid spatial structure models such as the spatial pyramid [5].

Mohammad H Alshayeji [6], elaborates a technique to Detection Method for Counterfeit Currency Based on Bit-Plane Slicing Technique. A new approach is discovered in this paper using the bit plane slicing technique to extract the most significant data from counterfeit banknote images with the application of an edge detector algorithm.

Nayana Susan Jose and Shermin Siby [7], introduce an Android Based Currency Recognition System for Blind people .In this methodology is mainly built to support them and make them easier to get used to the currencies. Here, they propose an android based application for recognizing currencies of different countries and also their denominations mainly for visually impaired people.

Mirza and Nanda [8], describe an automated paper currency recognition system which can be a very good utility in banking systems and other field of commerce. In this methodology, recognition of paper currency with the help of digital image processing techniques is described. The characteristics extraction is performed on the image of the currency and it is compared with the characteristics of the genuine currency. The sobel operator with gradient magnitude is used for characteristic extraction.

III. PROPOSED APPROACH

In the proposed work, we will develop a system to detect fraud currency for Indian Notes. First take the input of the given image and preprocessed the given image and convert the RGB image into the gray scale image. After preprocessing, apply sobel algorithm for extraction of the inner as well as outer edges of the image. Clustering will be done using k-means algorithm. In which it forms the clustering of feature one by one. After that recognized the input image as a 200, 500, or 2000 and compare the features of the image and classified it as original or fake with the help of SVM algorithm.

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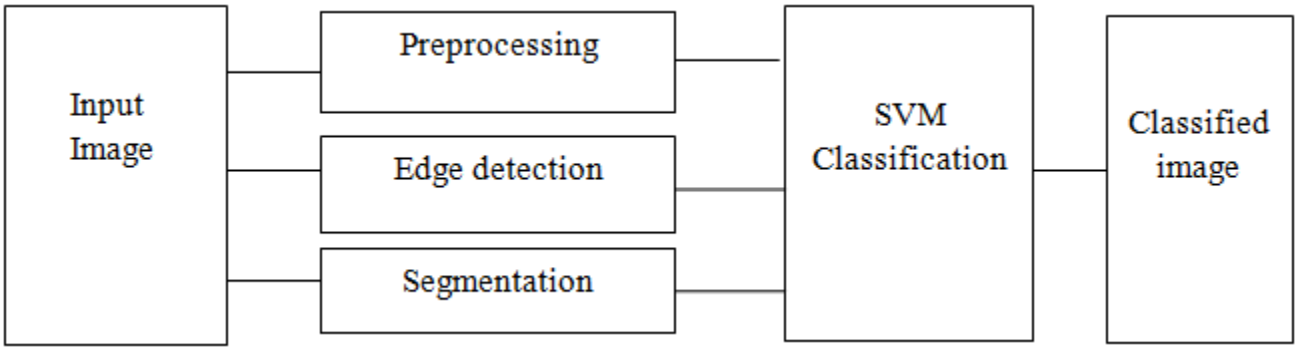

Fig 1: System Architecture

K-means Algorithm: Means algorithm is an unsupervised clustering algorithm that classifies the input data points into multiple classes based on their inherent distance from each other. The k-means method aims to minimize the sum of squared distances between all points and the cluster centre. The algorithm has a loose relationship to the k-nearest neighbor classifier, a popular machine learning technique for classification that is often confused with k-means because of the k in the name. One can apply the 1-nearest neighbor classifier on the cluster centers obtained by k-means to classify new data into the existing clusters. This is known as nearest centroid classifier or Rocchio algorithm.

SVM Algorithm: In machine learning, support vector machines (SVMs, also support vector networks) are supervised learning models with associated learning algorithms that analyze data used for classification and regression analysis. Given a set of training examples, each marked as belonging to one or the other of two categories, an SVM training algorithm builds a model that assigns new examples to one category or the other, making it a non-probabilistic binary linear classifier (although methods such as Platt scaling exist to use SVM in a probabilistic classification setting).

Fig 2 shows the fake currency detection system. In this system user need to take an input image which he or she want to check as an original or fake. After taking it as input image the given image is preprocessed it as RGB to gray and removing all unwanted outlier of that image and apply sobel algorithm for the extraction of features of that image and extracting each and every feature one by one and compared it with dataset using svm algorithm.

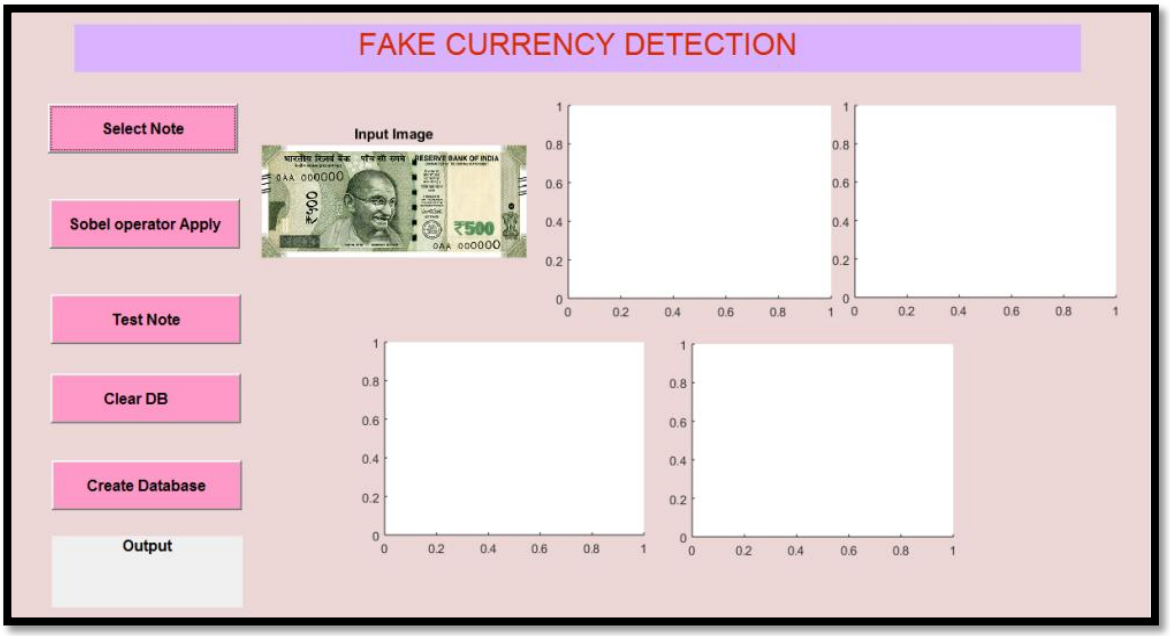

Fig 2: Taking Input Image and Preprocessed Image

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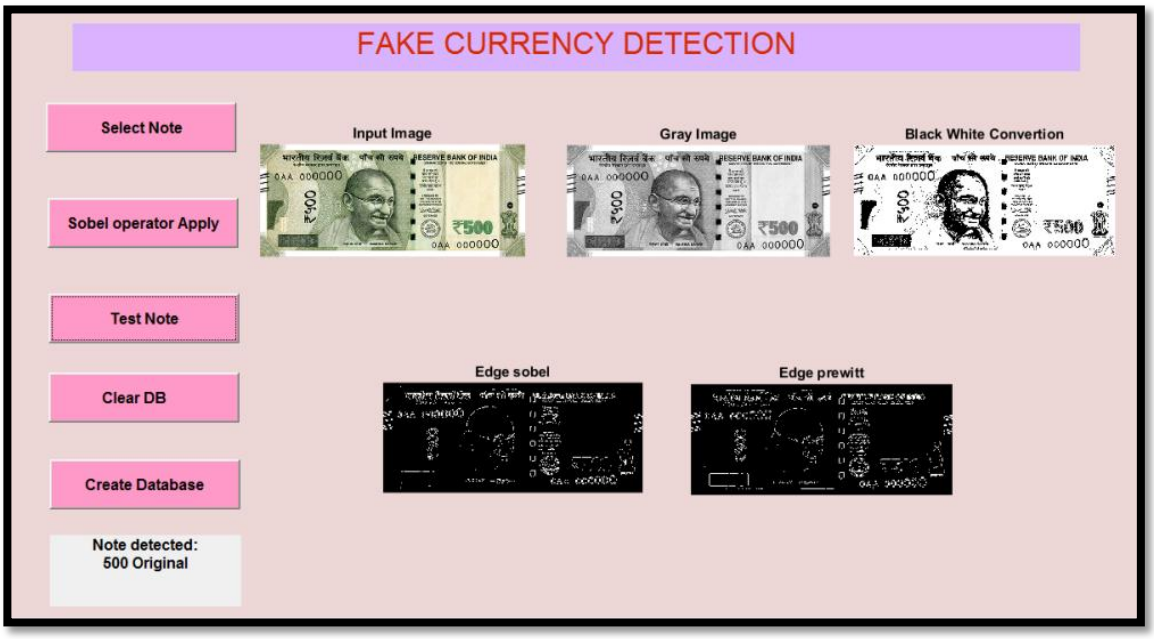

Fig 3: Detection of Original notes

Fig 3 shows the detection of notes in which the clustered feature of the given image is compared with the dataset of the image and classified it as an original image.

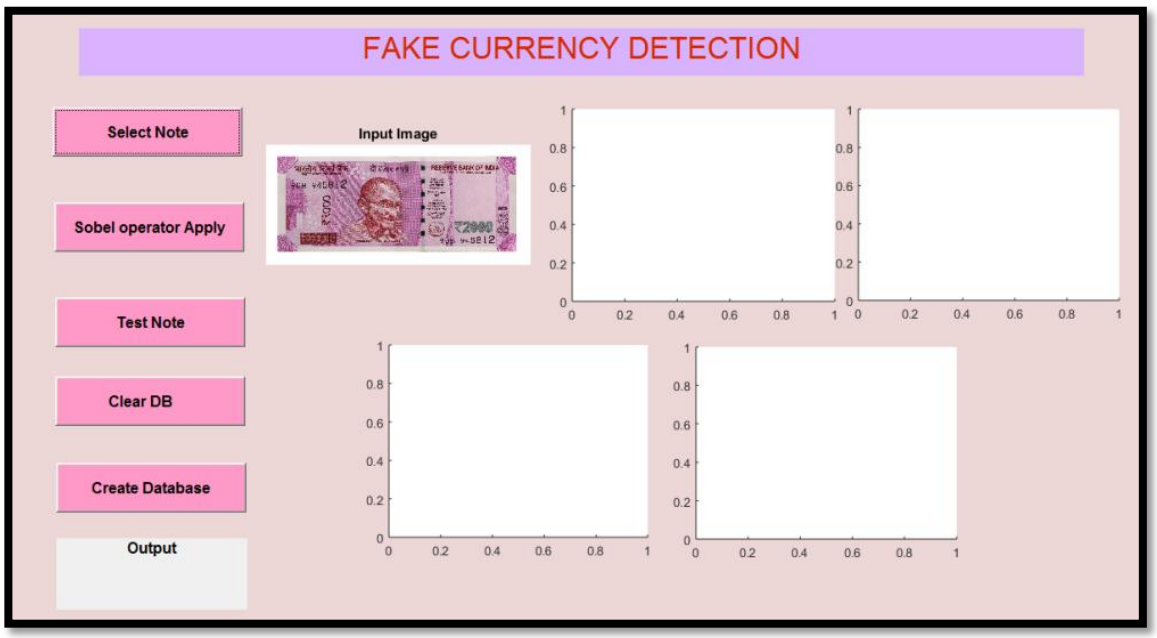

Fig 4: Input as a Fake Note Image

Fig 4 shows the extraction of the fake image from the dataset and performing preprocessing on fake note image. And Fig 5 shows the sobel operator apply on the fake note image. Sobel edge algorithm is applied for the extraction of the inner as well as outer edges of the image and classified it as a fake note.

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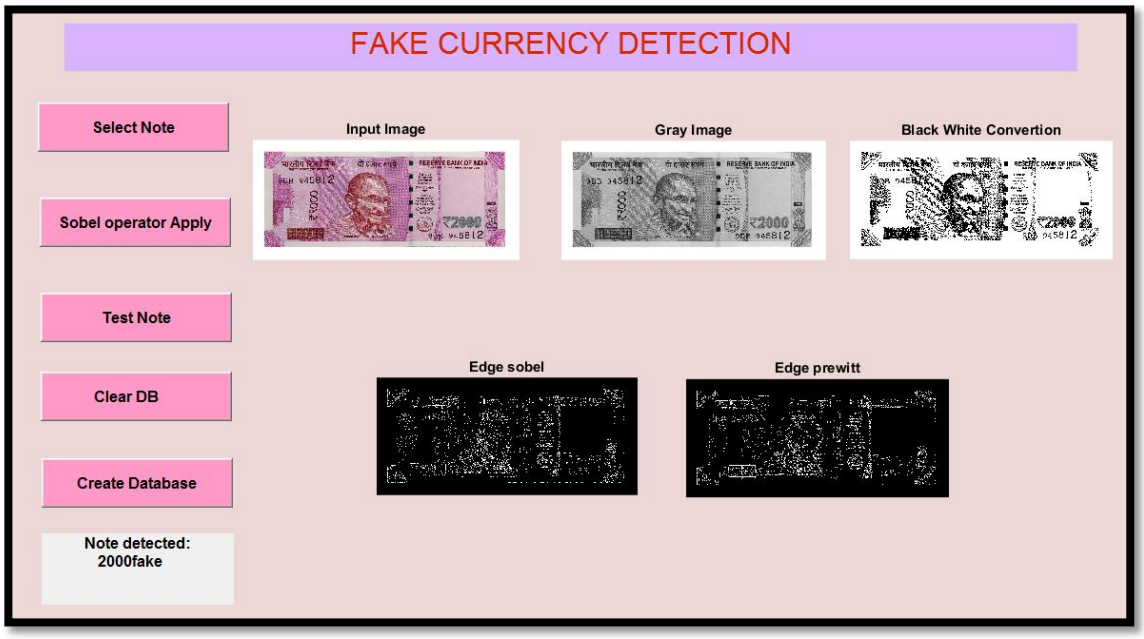

Fig 5: Detection of fake notes

IV. RESULTS AND DISCUSSION

Consider an example, when we take 50 notes on which 35 notes are original and 15 notes are fake. In that 35 notes 34 notes are relevant while in terms of 15 fake notes 14 notes are relevant ,so precision of original notes is 34/35 =0.97 while its recall is 34/50 = 0.68 and precision of fake notes is 14/15 =0.933 while its recall is 14/50 = 0.28 So, in this case, precision is "how useful the results are", and recall is "how complete the results are". The recall, precision and accuracy of a system are calculated from the results taken from the dataset and observing results. These experimental results indicate that use of SVM Algorithm having better performance than KNN Algorithm for accuracy. Figure 6 and 7 shows the comparative graph. The recall, precision and accuracy of a system shows the combination of original and fake notes as 97%. These values are calculated from the taken 50 notes from the database and observing results. Fig 6 shows the result of precision and recall of the original notes of the current system as well as existing system according to the accuracy from the 50 notes which are taken from the dataset.

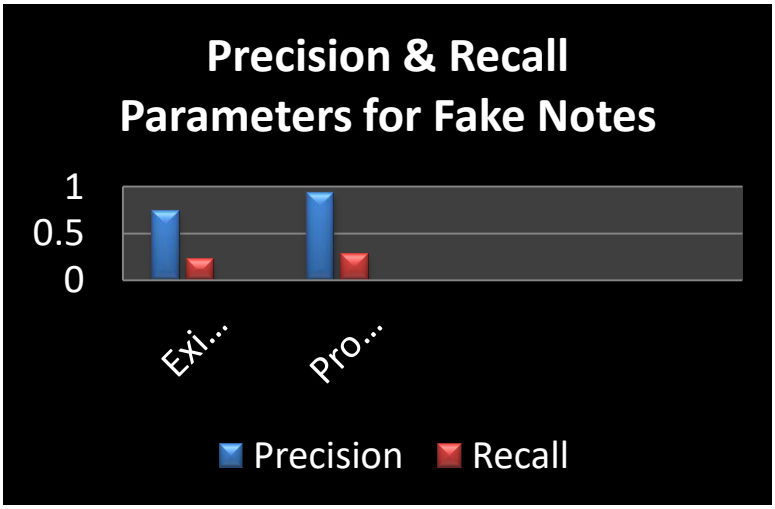

Fig 6: Graph of Precision and Recall for fake notes

Fig 7 shows the precision and recall for original notes of the existing system and proposed system. It shows comparative analysis of existing system as well as proposed system. By the analysis of the proposed system and existing system on the basis of accuracy we find that the proposed system gives better result than existing system. From the graph it is clear that value of Precision and Recall for proposed system is greater than existing one. Thus the accuracy of proposed system is more.

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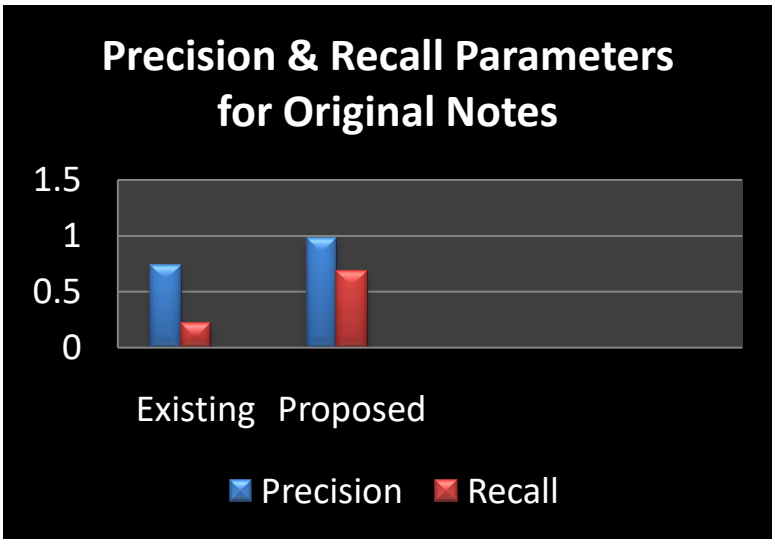

Fig 7: Graph of Precision and Recall for original notes

V. CONCLUSION AND FUTURE SCOPE

By using digital image processing, analysis of Currency image is more accurate as well as this method is efficient in terms of cost and time consuming compared to existing techniques. MATLAB Software is used for this analysis. Day by day research work is increasing in this field and various image processing techniques are implemented in order to get more accurate results. The proposed system is worked effectively for extracting features of Indian currency images. Extracted features of currency image will be using for currency value recognition as well as for its verification.

In Future, Application based system shall be designed to get proper result whether currency image is fake or genuine. The same system can be developed for the remaining Indian currency notes and other country's currency notes. Also the app's interface can be further modified as per the user requirements.

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