Verification of Signatures on Bank Cheques

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***Abstract*— In this paper, a methodology is proposed for extraction of signature features from a bank cheque and then comparing them with the stored features to analyze whether the signature is of the verified person or not. This system is developed to avoid the forgeries taking place in the banking environment. The signature is extracted for its features from the bank cheque. Features are extracted using principle component analysis method. The extracted features are then matched with the ones stored in database. If the signature matches then whole data of the customer with whom the signature has matched is displayed onto the screen. After matching, the cheque can be sent for clearance.**

***Index Terms*— Binary image, covariance matrix, cropped image, offline signature verification, PCA.**

I. Introduction

Signature has been a distinguishing part or a feature for personal identification. It is one of the most important and world adopted means of identification. It can be used anywhere to give our personal identity. It can also be used in places where we need to give our consent or authorization. For financial transactions signature plays an important role. Many times we sign cheques for the purpose of money retrieval. Our signature is also needed in places where our agreement or any consent is required. But many a times our signatures are on the pin point of frauds. Many times our signatures are misused for money. Some people imitate our signatures with intent to make money. Even though this is a punishable offence we need to curb it. Whenever we want to retrieve money from bank we use cheques for that purpose. Usually the cheque is taken in the back room and then it is verified manually by a person present over there using our previous documents which are signed and stored. This is called manual verification.

Although our sign can be digitally processed and verified, banks have adopted the paper filling process. Whenever a cheque comes for clearance, it is taken for verification of signature in the back room, for manual signature verification. But again when manual verification comes into account the question of accuracy arises. The accuracy of manual verification depends on the skill and experience of the bank personnel. In order to increase the accuracy, a system is designed to process the handwritten signatures and verify for its correctness.

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The verification system can be online verification system or offline verification system. The online system makes use of special pen called the stylus pen. The customer usually signs using this pen or he can make use of touchpad. Online data records the motion of stylus while signing. The dynamic features of the signatures are extracted in online system. The dynamic features comprises of pressure exerted while signing, the speed of signing, acceleration velocity, etc. These features are then stored in the database and compared while verifying. In offline systems the static features of the signatures are taken into consideration. Here firstly the image of signature is captured and then it is processed for feature extraction. The extracted features are stored in database and then evaluated and compared while verifying.

Offline systems are more complex to design than the online system. It is hard to distinguish the stylish strokes of signature as there are different writing styles. Processing offline signatures is more complex due to absence of stable dynamic characteristics in signature. Here a system is designed for offline verification of the signatures on the bank cheques. Offline system is designed because the banks have adopted the paper filling method even though they can use electronic systems for verification. The features are extracted using the PCA method.

II. Literature Review

In the referred paper, a system was developed to verify the signatures using offline systems. Following was the block diagram of the system proposed in the referred paper. [1]

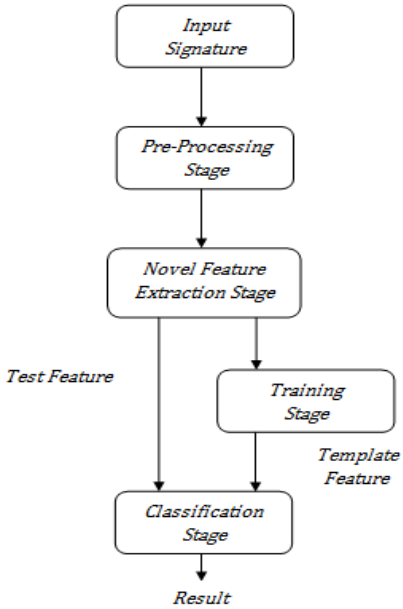

Fig. 1 Offline verification system

The system was designed to work in five stages. First stage comprises of taking signature image as an input. It comprises of collecting signature samples as input. Second stage

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comprises of the pre-processing stage. Here the signature is pre-processed to remove all the noises like the salt pepper noise, thresholding, etc to enhance the signature image. Third stage is to extract the novel features. Here feature extraction is done using splitting of signature image. The centre of gravity of signature is used for splitting the image. The signature image is partitioned into rectangular cells at moderate resolution. It is done in such a way that gradient information of strokes of signature is acquired. The extracted features are able to capture invariant characteristics at local, intermediate and global level. The next stage is training and thresholding stage. Here a threshold value for each registered user is calculated independently. The threshold value is calculated by taking five signatures from each user. The mean of all signatures is calculated and then the threshold value is determined. These values are stored in template and evaluated while verifying the signature. [1]

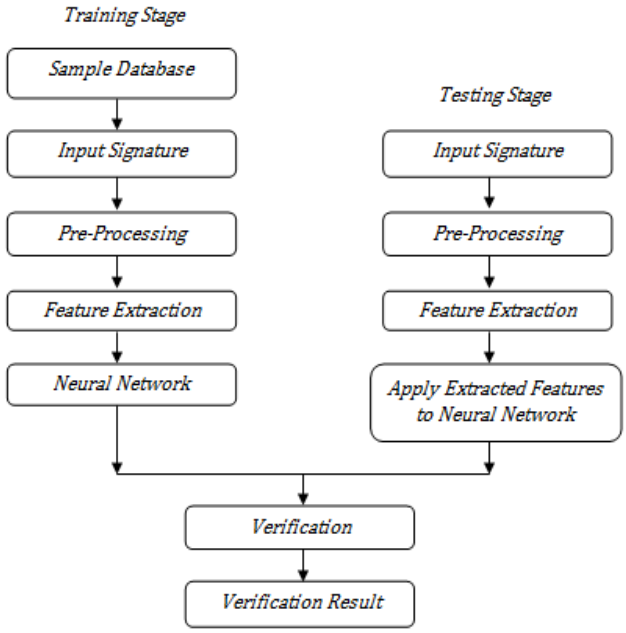

Fig. 2 System flow using Neural Networks

The proposed system in [2] uses Neural Networks for feature extraction and matching purpose. Fig. 2 shows the flow of the proposed system. The use of neural networks shows it's widespread and eases of using this methodology. First of all, the samples of signatures from different users are extracted for its features. Later, using the features the neural network is trained, whenever the testing signature comes at the input of neural networks, the verification is done whether a match occurs or not. The features that are extracted comprises o the aspect ratio of signature, the centre of mass, normalised area, etc. Using these features and neural; networks, the matched signature is found out and testing signature is verified.

In yet another paper, a system was developed which would verify the signatures using two processes. First stage was the recognition process, which used the K-nearest neighbour algorithm. The next process was verification process which used the neural networks for verification. [3]

In other paper, a system was developed which could analyse using the grid features. Simply a rectangular array of cells was prepared upon the signature. Now, in whichever cell even a small part of signature was present was marked as '1' and rest were marked as '0'. This template was saved in database. Whenever a test signature was input to the system, its grid was prepared and matched with the ones stored in database. With every match the signature was verified. Here global features like the pure width, the pure height, baseline, etc. were also taken into consideration. [4]

Other system which was developed was a trace copy forgery system. Here forgery was done by tracing the signature by keeping a blank paper on the already signed paper and then copying it. This forgery was the most difficult to trace as it was very much alike to the real signature. The system was designed using two approaches. Firstly the Wen's approach was used. Here an online system was prepared to analyse the tremors occurring while doing the signature. This approach had several drawbacks. First was that the system was designed to analyse only the Chinese signatures. Thus the system was not applicable to English signatures. The second drawback was that it was only applicable for online method. It could not be used for offline systems. Thus, another system was prepared which made use of the Deng's approach. This system could now analyse the signatures in online as well as the offline modes. Also the signatures that it took into account were both in Chinese as well as in English language. Thus the drawbacks of Wen's approach were overcome. [5]

An Auto-SIG system was also developed in other paper for signature verification purpose. The system comprised of a camera for capturing the image of signature, then an image compression module to compress and store the signature, image decompression module, image displayer, verifier module for verification purpose, etc. [6]

III. Overview Of Proposed System

I have designed an offline verification system to verify the signatures present on bank cheques. The image of signature is captured using a webcam. Later on the image is communicated to computer for further processing.

Fig. 3 shows the hardware block diagram of the proposed system. Hardware is to be prepared to bring the cheque inside the box for capturing the image of cheque using a webcam. After the image is captured the cheque is again brought outside. Here there is a requirement of PIC controller to drive the stepper motors. The PIC controller that will be used is a PIC18F52 controller which is a 40-pin controller IC. Two stepper motors are required to drive the tray in and out of the box on which the cheque is placed. Also there is requirement of MAX232 for the communication with computer.

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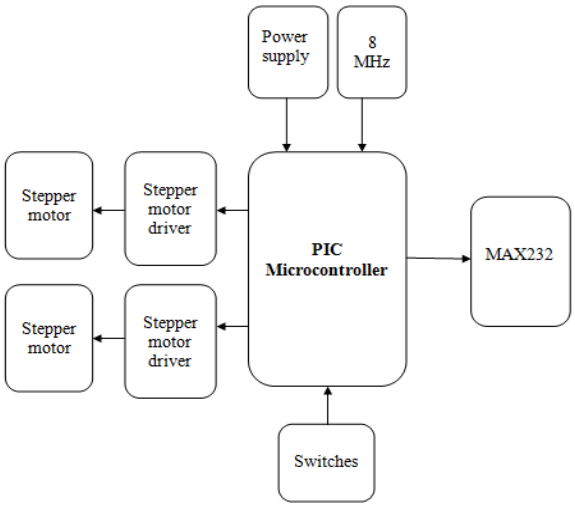

Fig. 3 Hardware block diagram

Thus, after the image is captured from the webcam, it is communicated to the computer and the further processing of the image is done in computer using MATLAB software.

IV. System Software

The system software comprises of five main steps. Those are input cheque image, pre-processing, cropping region of interest, feature extraction, recognition.

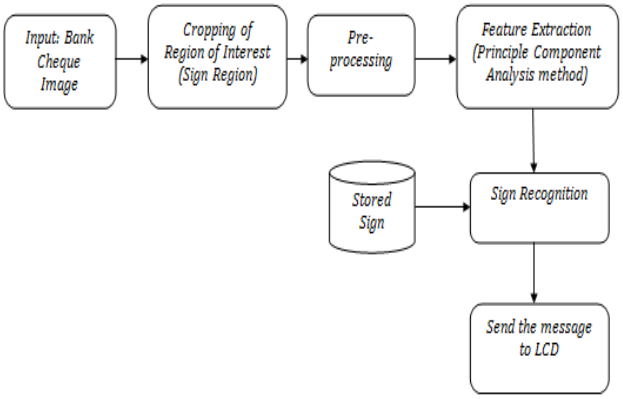

Fig. 4 Software flow

Description of each block is given below:

A. Input Image:

The signature image captured using webcam is input to the system. The image is stored in computer and can be further sent for pre-processing.

B. Cropping Region of Interest:

The whole cheque is not required or processing. Requirement is only of the signature. Thus the region of signature is cropped from the cheque. Automatic cropping is used here. This is done using MATLAB.

C. Pre-processing:

The image is then sent for pre-processing. Pre-processing is very much essential to enhance the quality of image and also to enhance the features of the image which are to be extracted. Firstly the captured image is a colour image so it is converted to gray-scale. Later on the image is converted to binary image. Binary image is the representation of the whole image information in just two values. This image is later on sent for feature extraction.

D. Feature Extraction and Recognition:

Feature extraction is the most important step. Features are extracted from the binary image. The extracted features are stored in the database. Later on whenever a test signature image is input to the system, its features are extracted and compared with the stored features in database. The signature with which the features match, whole information of that customer is displayed onto the screen. Principle component analysis method is used for feature extraction purpose.

V. Feature Extraction

For the purpose of feature extraction, principle component analysis (PCA) is used. PCA is one of the most powerful tools used for feature reduction. But it can also be used for feature extraction. It is powerful tool for analysing data.
Steps for feature extraction:

A. For database

[1] First of all collect at least 8 samples of signature from each customer.
[2] Convert the image into binary image.
[3] Now get the pixel values of each signature image and store the values in row and column matrix.
[4] Now convert the row and column matrix into a column matrix.
[5] Get the column matrix of each sample signature of the customer.
[6] Now calculate the mean of all samples of the customer.
[7] After calculation of mean find the standard deviation and variance.
[8] The matrix which we get is called as the co-variance matrix.
[9] Store this co-variance matrix of the customer in the database with all the information of the customer.

B. For test image

[1] Whenever a cheque image is input to the system it is first cropped to get the signature region and then converted to binary image.
[2] Then its pixel values are stored in row and column matrix.
[3] Later on the row and column matrix is converted to column matrix.
[4] Then the mean of all pixels is obtained and the standard deviation and variance is calculated.
[5] Now this covariance matrix is compared to the covariance matrix in the database and its Euclidean distance is calculated with each matrix in database.
[6] Whichever matrix its Euclidean distance is minimum is considered as a perfect match.
[7] After the best match is obtained the data of the customer with which the match has occurred, is displayed on the screen.

This way a best match is obtained and the signature is verified for the verified customer. This way the percentage of

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fraud can be avoided and it can help to increase the security in banking systems.

VI. FLOWCHART

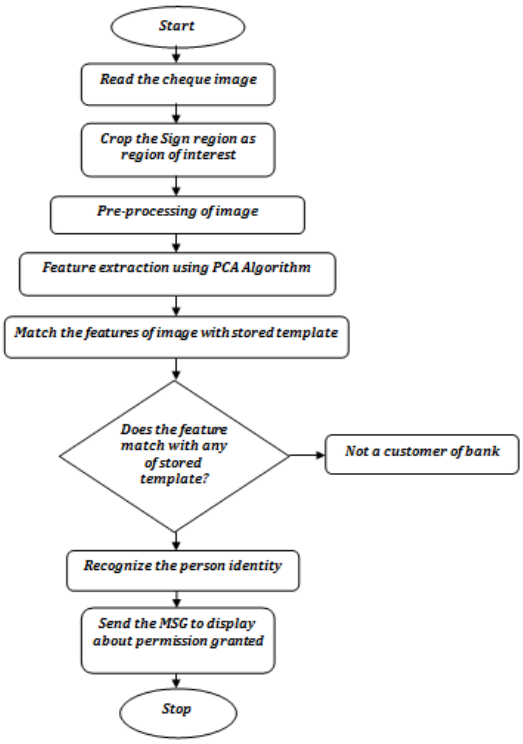

Fig. 5 Flow chart of Proposed System

Fig. 5 shows the flowchart of the proposed system. Firstly the system reads the cheque image. Then crop the signature and convert them to binary image. Then extract the features from the image using PCA. After extracting the features match them with the stored templates, when there is a match the person's identity is displayed on screen.

VII. RESULT

Following are the results of the proposed systems.

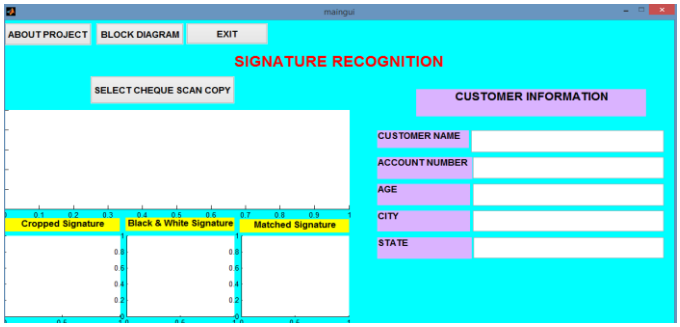

Fig. 6 GUI of Proposed System

For selection of the cheque the GUI in Fig. 6 is displayed on the screen. There are various buttons on the GUI using which we can select the copy of the cheque. Also depending upon the other button we can get the information about the block diagram and the system information. After the selection of the cheque, the features of the signatures are extracted and they are matched with the features in database. Simultaneously the cropped signature of the cheque and its black and white i.e. the binary image is also displayed on the GUI. After a match is obtained the matched signature is also displayed on the screen in GUI. Also the customer with whom the signature is matched, his details are also displayed on the screen.

VIII. CONCLUSION

This type of system is very essential in the banking environment. This system is essential in banks so that the major frauds in the banks related in terms of money can be avoided. PCA which is used for feature extraction is a simple and very effective method for feature extraction. This way the system can be very useful for curbing the frauds in banking environment.

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