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Forensic Detection of Signature Alteration in Bank Cheques using GLCM

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Abstract: Everyone chooses signature as an authorization tool from the beginning till now. Each and every businessman uses bank cheques for most of his transactions. Even though banks are computerized, verification of signature in cheques is done manually which consumes time and even misleads sometimes. This is how signature verification system originated. Verification of signatures can be done on-line or off-line depending upon the application. In this study, a Neural Network model is designed for the signature verification and testing using the Offline Bank Cheque Signature Verification System. The acquired signature from the bank cheque is pre-processed and the Gray Level Co-occurrence Matrix (GLCM) features of the signature are extracted. The extracted features are used to train a Feed Forward Back Propagation Neural Network (FFBPNN). The signature features, to be tested, are fed to the trained neural network to find whether the signature is genuine or a forged one.

I. INTRODUCTION

Signature is the cheapest way to authenticate a person. Every document has the signature on it to identify the signer. A signature verification system is badly needed for every document processing platforms. Today all banks are almost computerized but even then, the signature of the account holder, found in the cheque is verified manually. This gave birth to the automation of the signature verification systems. The system accepts signature as input and classifies it into genuine or forged. The system modeled will verify the signature with maximum accuracy and in minimum time using less computational resources.

Signature is a scanned image with a pattern which differs for each person. A person's signature is constant, unique and also difficult for others to imitate. His/her handwriting may vary due to aging factor, sickness, unusual conditions but the width-height ratio of the signature does not vary. In case a signature is forged, one can find it out by using certain basic things. If a signature is forged, the density of the ink will be high at the point where the forger stops for verification with the original one. After the pause, the beginning stroke will be heavier. There are three types of signature forgeries, random, skilled and simple.

In Random forgery, the forger has not seen the signature before and but by simply knowing the name, he signs randomly. But in Simple forgery, the forger has seen the signature once or twice in a document previously and tries to sign. In skilled forgery, forger has the copy of the signature in hand and tries to imitate the signature. As the banking area plays a major role in our day today life. Here are some examples of cheque and signature.

There are two types of signature verification systems. One is On-line and the other is Off-line. On-line signature verification is easy since the signature is scanned online and various dynamic features like velocity of the pen, pressure applied at a point, time taken to sign, acceleration, sequence of strokes, etc can be recorded easily for the verification process. It also needs the equipments like digital pad and stylus. Whereas in offline signature verification, it requires only a scanner to scan the signature and convert into digital format and by using various digital image processing techniques signatures are verified.

II. EXISTING SYSTEM

Verification of signatures can be done on-line or off-line depending upon the application. In this study, a Neural Network model is designed for the signature verification and testing using the Offline Bank Cheque Signature Verification System. The acquired signature from the bank cheque is pre-processed and the extracted features are used to train a Feed Forward Back Propagation Neural Network (FFBPNN). The signature features, to be tested, are fed to the trained neural network to find whether the signature is genuine or a forged one.

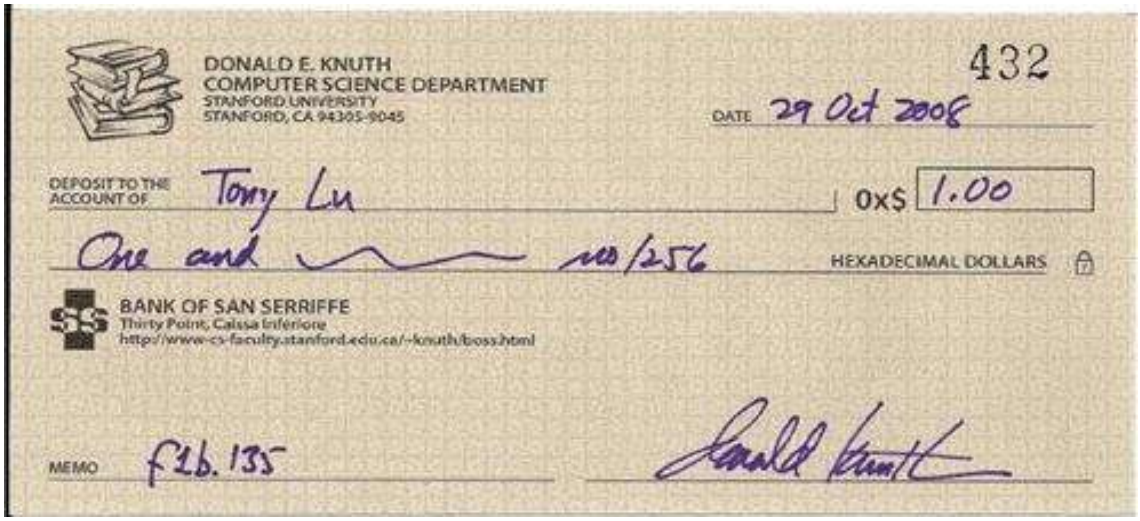

Fig.1. Sample cheque

The signature features, to be tested, are fed to the trained neural network to find whether the signature is genuine or a forged one. After the extraction stage , the signatures are fed into a neural network model and tested. The following figure shows the verification process of signature using neural network. Some of the signature samples that are fed to the network model are as follows. To train the network with the features extracted a feed forward back propagation network type is used. The signature samples are fed to neural network .Verification process of signature using neural network and the samples of signature are shown below.

III. PROPOSED SYSTEM

Everyone chooses signature as an authorization tool from the beginning till now. Each and every businessman uses bank cheques for most of his transactions. Even though banks are computerized, verification of signature in cheques is done manually which consumes time and even misleads sometimes. This is how signature verification system originated. Verification of signatures can be done on-line or off-line depending upon the application. In this study, a Neural Network model is designed for the signature verification and testing using the Offline Bank Cheque Signature Verification System. The acquired signature from the bank cheque is pre-processed and the Gray Level Co-occurrence Matrix (GLCM) features of the signature are extracted.

The extracted features can be easily verified by the numerals obtained after the extraction .The system modelled is checked with 120 genuine and 120 forged signatures. The system is found to have an accuracy of 92.08% with sensitivity of 93.25% and specificity of 91.12%.

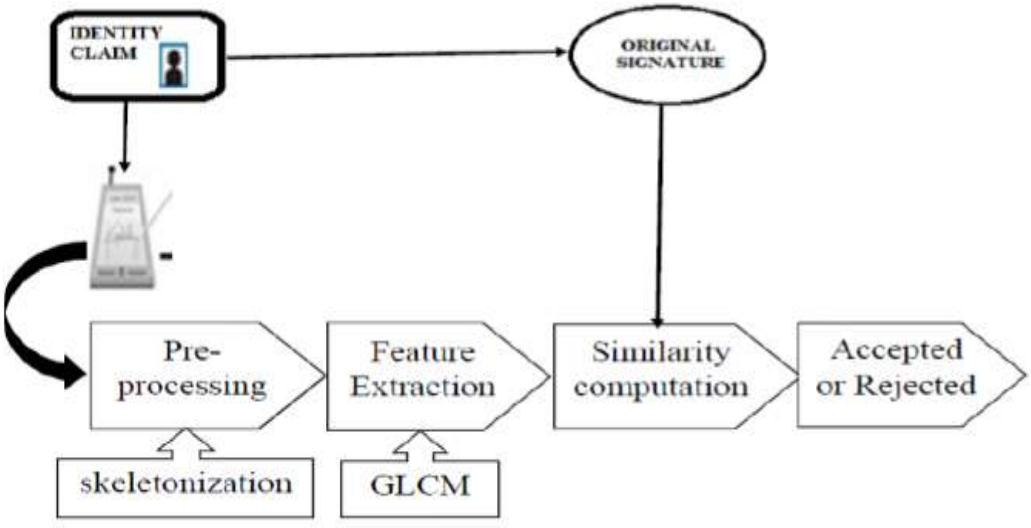

Fig .2. Block diagram of proposed system

A. IMAGE ACQUISITION

The process of selecting the image and giving to the system as input is called image acquisition. Signatures can be captured by a camera or it can be scanned by a scanner. Camera uses Megapixels (MP) format and scanner uses Dots per inches (DPI) format and so scanning the signature by using a scanner will give more accurate results. The scanner helps to digitize, analyse and process an image

B. IMAGE PRE-PROCESSING

Pre-processing is done to enhance the quality of the scanned signature. The acquired image is binarised to convert the image into black and white pixels of 0's and 1's. Then skeletonization is done to reduce the signature into one-pixel width for reducing the memory and computational time for processing it. After that, the image is filtered from noise. The noise may arise due to the scanned image standards, background dots, design and lines or even dust.

C. FEATURE EXTRACTION

After the pre-processing steps, feature extraction is performed to collect similar unique properties of a signature. Various methods are available for creating features from the signature image. All these methods can be classified into direct and indirect methods. Direct methods use feature values from image pixels like grid based information, gray-level information and pixel density. Whereas in indirect methods, transformations like Fourier, Wavelet and Radon are applied. For this study, the direct method is used. There are three types of features. They are global, grid and texture features. Selection of the features depends upon the application. Texture feature plays a vital role in image classification. In off-line signature verification, various features like height, width, curvature, stroke, peaks, aspect ratio, etc are considered.

D. GRAY LEVEL CO-OCCURRENCE MATRIX (GLCM)

The features extracted using GLCM are Autocorrelation, Contrast, Correlation, Cluster Prominence, Cluster Shade, Dissimilarity, Energy, Entropy, Homogeneity, Maximum probability, Sum of squares, Variance, Sum average, Sum variance, Sum entropy, Difference variance, Difference entropy, Information measure of correlation, Inverse difference normalized (INN) and Inverse difference moment normalized. First order texture measures are statistics calculated from the original image values, like variance, and do not consider neighbourhood pixel relationships. Second order measures consider the relationship between groups of two (usually neighbouring) pixels in the original image useful for signature verification. The measures require that each GLCM cell contain the probability not the count. It is only an approximate probability value because a true probability would require continuous values but the grey levels are integer values which are discrete. This process is called normalizing the matrix.

IV. EXPERIMENTAL RESULT

The system specifications include the software requirements for the simulation of the project. The project is simulated with the help of a desktop computer or laptop. The development tool used for the simulation of this project is MATLAB 9.0. The input image for the signature verification is as follows:

Fig.3. Input Image

This image is turned into a noisy image to identify the unwanted noise.

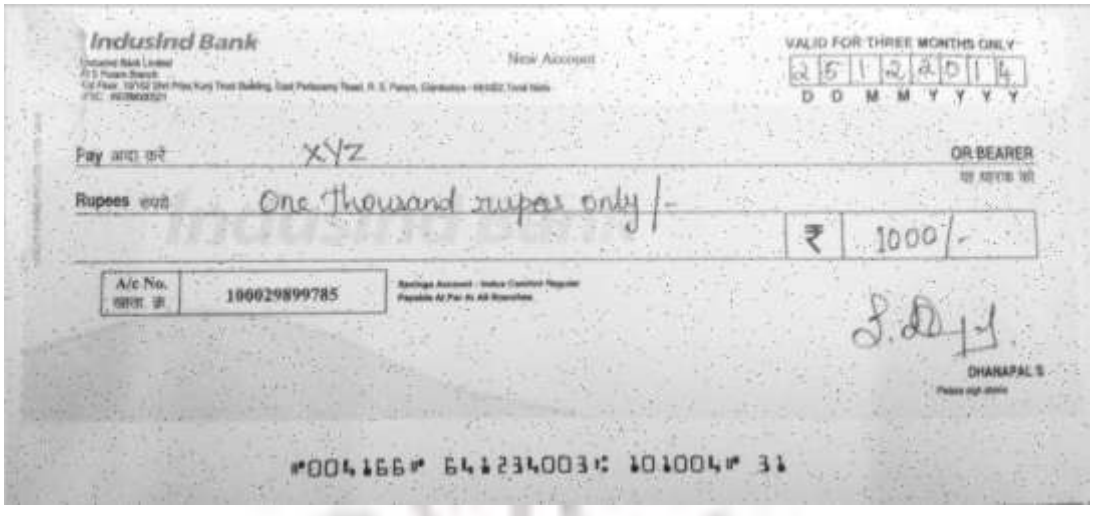

Fig.4. Noisy Image

By passing into the median filter, the noise is removed from the image. The acquired image is binarised to convert the image into black and white pixels of 0's and 1's.

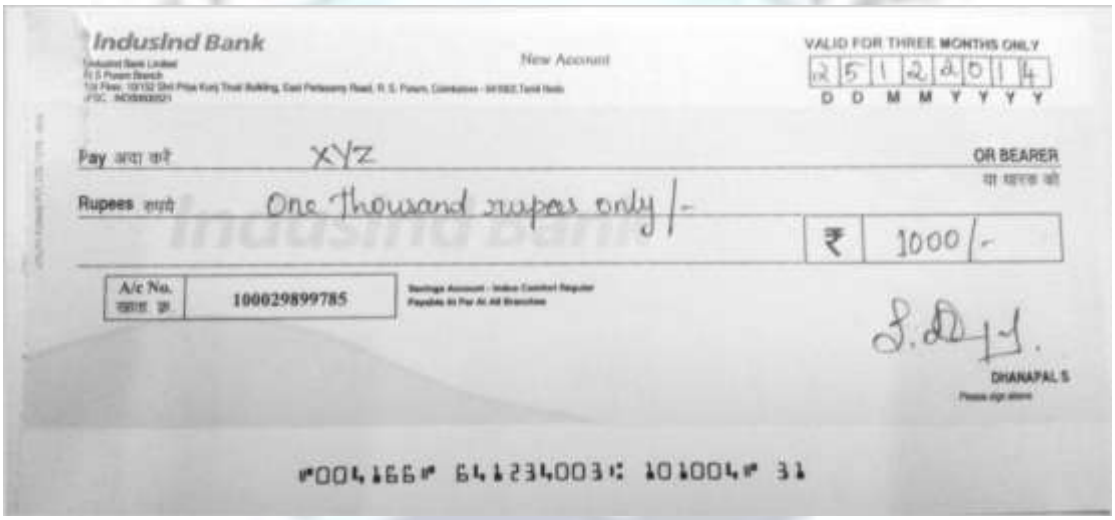

Fig.5. Noise Removed Image

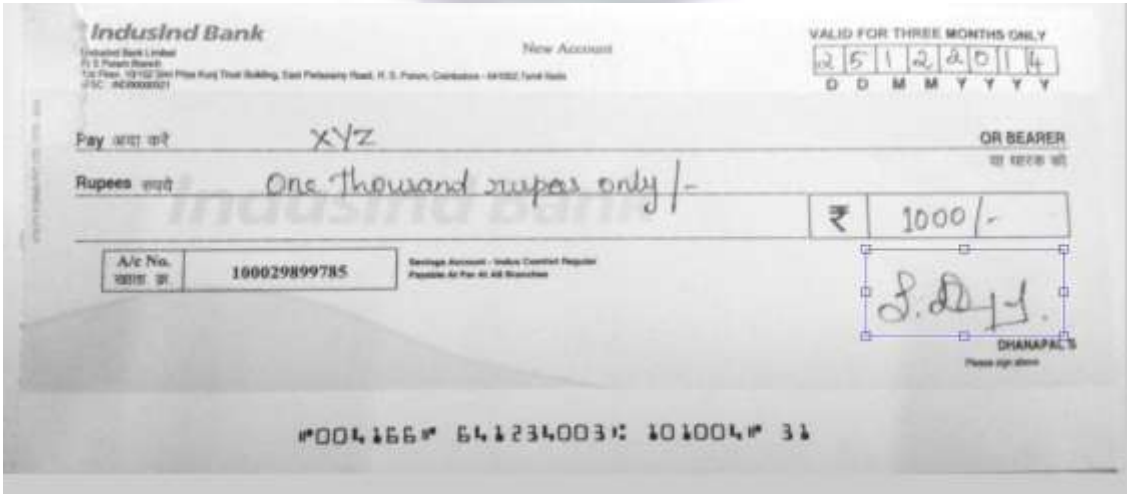

Fig.6. Signature Extraction

Then skeletonization is done to reduce the signature into one-pixel width for reducing the memory and computational time for processing it.

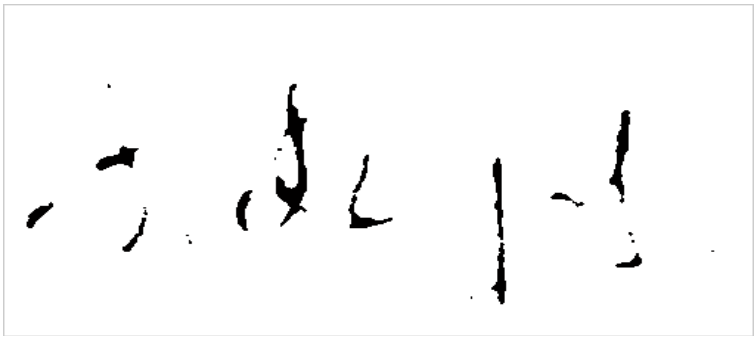

Fig.6. Pre-processed Image

There are more than 13 features can be extracted from one image and these features are compared with the features already obtained from the database signature. The image is processed for feature extraction using GLCM. From the Gray Level Concurrence Matrix only the lower level band is taken for processing signature area.

Table.1. Experimental Results

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FEATURE	ORIGINAL IMAGE	PROPOSED IMAGE
Autocorrelation	3.818039	3.821400
Contrast	4.429926	4.539434
Correlation	5.608080	5.394743
Cluster Prominence	4.283613	4.076784
Cluster Shade	-2.417375	-2.311423
Dissimilarity	4.429926	4.539434
Energy	8.567977	8.581352
Entropy	3.492642	3.469424
Homogeneity	9.778503	9.773028
Maximum probability	9.245799	9.253352
Sum of squares	2.929331	2.929594
Sum average	3.893459	3.896064
Sum variance	1.293734	1.297182
Sum entropy	3.185583	3.155403
Difference variance	4.429926	4.539434
Difference entropy	1.813746	1.847240
correlation1	- 3.211094	- 2.963830
correlation2	3.536497	3.403707
Inverse difference normalized	9.852335	9.848685
Inverse difference moment normalized	9.911401	9.909211

If any five to six features are matched then the signature processed is not a forgeried one.

CONCLUSION

In the model of off-line signature verification on bank cheques are more efficient. The signature on a bank cheque is scanned and pre-processed. Features are extracted using the GLCM. This method is more effective because each and every part of signature features are taken into account for detection, so this will avoid the passing of forgeried cheques.

FUTURE ENHANCEMENT

This project gives the output at an efficiency of more than 85%.In future we can consider only the features which is necessary for the detection. so that the time consuming can be saved. Processing of multiple cheques should be considered.

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