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Biometric System Based on Off-Line Signatures

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Abstract*:* Biometrics not only authenticates an individual's identity but is also a process that applies security measures to various systems such as bank check verification, authentication of legal documents etc. Handwriting is one of the unique and widely acceptable modes of authorizing an individual. This paper discusses all the steps to be carried out in achieving the desired objective i.e to determine whether the signature is original or forged. This paper also explains the procedure required for alignment and binarization of signatures. The entire process is covered in four stages: Image acquisition, Pre-processing, Feature extraction and Verification. Out of the four, this paper lays stress on first two stages. The work has been tagged appropriate after undergoing various stages of testing.

Keywords: Average error rate (AER), Feature Extraction, Image acquisition, Off-line signature verification, Support vector machine (SVMs)

I. INTRODUCTION

Offline signature recognition and verification system (SRVS) is the most widely acceptable form because handwriting of an individual differentiates him from other individual. It not only authenticates a person but also validates the documents. One does not need to use any traditional form of protection from forgeries because an individual's signature acts as a password in every authentication mode. The signature is a behavioural biometrics, and is therefore inherently dependent on the changing activity pattern of the signer and the signing process [1].

Signatures are composed of special character; therefore, usually they are not readable. The objective of signature recognition is to recognize the writer [2]. According to the available input, signature recognition and verification process is classified in two parts: Static signature recognition technique which is helpful in automatic signature recognition found on documents and Dynamic signature recognition technique that lays emphasis on dynamic properties of signature.

Offline signature recognition systems are more difficult than online recognition systems because the information like duration, flow, velocity is lost, in case of offline signatures [2]. But, on the other hand, the advantage is that they do not need any special gadgets to traverse them. Other advantages are: collection of signatures does not require special instruments, No special training is required for data collection.

Generally, the signature is a word with which a person identifies him/her, and as such will have a greater personal significance than any other words him /her writes [4]. Thus, it is an ideal method to secure your legal as well as personal documents.

This paper aims at giving the brief idea about the process to be carried out to achieve the desired aim.
It also covers first two stages of the process: Image acquisition and Pew-processing which further consists of various stages which are explained in detail in implementation part of this paper.

II. RELATED WORK

A lot of work has already been done in this field and there is a scope of lot more as well. A brief review is presented as follows:

M. Nasiri and A. Javaheri [1], proposed a fuzzy approach for automatic off-line signature verification. They used fuzzy approach to overcome the variability issue in signature's shape and size of the same writer. In this, four types of local features: distance, angle, proportion, and distance to centre of gravity are specified.

Vu Nguyen and Michael Blumenstein [3], proposed an investigation of the performance of a feature set consisting of 33 feature values. Use of global features in this work reduced the error rate significantly. Support vector machine (SVMs) is used giving an average error rate (AER) of 16.80% with a low false acceptance rate (FAR) for random forgeries of 0.19%.

R.K.Bharathi and B.H.Shekar [4], proposed to combine the transform based approach with dimensionality reduction technique for off-line signature verification. In the feature extraction phase, Discrete Cosine Transform (DCT) is applied on the signature. Afterwards, features are subjected to Linear Discriminant Analysis (LDA) for further reduction. The support vector machine (SVMs) is used as a classifier. CEDAR, GPDS-160 and MUKOS datasets are used in carrying out this work. According to the two authors, the work proposed is simple and easy to implement and is computationally efficient.

S. A. Angadi, Smita Gour and Gayatri Bajantri [5] proposed a novel approach for off-line signature recognition system making use of local radon features. The process was carried out in three stages: Pre-processing stage which further compromised of 3 stages; gray scale conversion, binarisation and fitting boundary box for efficient feature extraction process. Feature extraction stage; where 16 radon transform based projection features are extracted. Finally an efficient back propagation

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technique is used for signature recognition process. A training set of 10-40 persons was used. The accuracy achieved ranges from 87%-97%.

Srikanta Pal, Umapada Pal and Michael Blumenstein [6], proposed a study of off-line signature verification using Hindi signatures. The gradient feature, Zernike moment features and SVMs were considered for verification. An accuracy of 90.69% was obtained. The database used consisted of 2400(100 × 24) genuine signatures and 3000 (100 × 30) forgeries. SVM is used as classifier. 2400 (100 × 24) genuine signatures and 3000 (100 × 30) forgeries. According to this work, it is seen that gradient feature work well than that of Zernike moment feature. An accuracy of 90.69% was obtained using gradient feature.

Moises Diaz-Cabrer, Marta Gomez-Barrero, Aythami Morales, Miguel A. Ferrer and Javier Galbally [7], proposed a novel approach of overcoming the challenge of absence of large databases by generating the fully synthetic signature database. The performance of synthetic signatures is very similar to that of the real signatures. The system used a combination of LS-SVM classifiers for the evaluation of the real and synthetic signatures. LS-SVM system works with signatures that contain pen-up information. Database BiosecurID and MVYT are used. In experiment 1 where the comparative performance of real and synthetic signature is calculated giving an EER of 17%for mono-session and 15% for multi session. In the second experiment, the feasibility of synthetically increasing the enrolment set is analysed. Here, EER achieved is 14% and 8%.

R.K.Bharathi and B.H.Shekar [8], used MLP (Multi-layer perceptrons) based approach for off-line signature verification. In the feature extraction phase, Discrete Cosine Transform (DCT) is applied on the signature. Afterwards, features are subjected to Linear Discriminant Analysis (LDA) for further reduction. The proposed approach covers the benefit of two domains. MLP here is used as classifier. CEDAR, GPDS-160 and MUKOS datasets are used in carrying out this work..

Rapanjot Kaur and Gagangeet Singh Aujla [9], presented an approach that used neural network and SVM with surf feature based recognition of offline signatures system. Above mentioned classifiers were used because according to the author, these classifiers help in achieving an efficient result.

III. PROPOSED METHODOLOGY

STEPS TO BE INVOLVED IN THE THESIS:

1. Understanding the need and subject of biometrics systems especially signature from the existing literature.
2. Finding the merits and demerits of existing uni-modal systems of biometrics in off-line signature and their level of robustness.
3. Proposing a new uni-modal technique which will be better in performance from existing uni-modal biometric systems.
4. An algorithm will be developed using mat lab and experimental results will be compared with the existing techniques.
5. Modifications will be done to increase the speed and performance of the algorithm.

The proposed methodology follows a sequence of stages to generate the authentication process efficiently. The main steps involved are as follows:

A. *Image Acquisition*

Signatures are taken in different directions from the different users so that a wide range of signatures are covered. The signatures obtained are in jpeg format. Database is created by collecting signatures from various people.

B. *Pre-processing*

This stage is necessary because the processed image, after this, would be subjected to feature extraction process. Various algorithms are used at this stage such as Background elimination, noise reduction, width normalization, skeletonization, thinning, Binarization, Denoising etc.

STEPS INVOLVED IN ALIGNMENT AND BINARIZATION OF SIGNTURES:

Step 1: Collect the signatures from different people in different directions on a white sheet.
Step 2: Scan them in the format which is compatible with the software. Here, the image is scanned in png format. One can use jpg or jpeg as well.
Step 3: After collecting all the images, create a database that could be used further.
Step 4: Load the image into MAT lab from specified location.

FIGURE 1: ORIGINAL IMAGE

Step 5: Convert the original (RGB) image into gray scale image.

FIGURE 2: GRAY SCALE IMAGE

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Step 6: Now, the gray scale image is converted into binary image.

FIGURE 3: BINARY IMAGE

Step 7: Morphological operations like thinning and thickening are applied after the above step.

FIGURE 4: THINNED IMAGE

Step 8: Centroid of image according to signature pixel on x and y direction is calculated.
Step 9: Eigen values in x-direction are calculated.
Step 10: However, Theta is calculated and the binary image is rotated towards horizontal axis according to the theta value.
Step 11: Crop the signature area.
Step 12: The image is aligned and ready for the next stage.

FIGURE 5: ALIGNED IMAGE

C. *FEATURE EXTRACTION*

A number of features could be extracted according to the need of the researcher beause the efficiency of any system depends on this field. Some of the basic features are:

1. Height of signature
2. Width of signature
3. Diagonal distance
4. Aspect ratio
5. Centre of mass
6. Eccentricity
7. Skewness
8. Kurtosis
9. Orientation
10. Foreground information
11. Background information
12. Image area

All the above mentioned features, when applied, gives us the clear and accurate image of the signature image so that we could conclude whether the authorized signatures are being forged or not.

D. *VERIFICATION*

This stage aims at detecting whether the signatures are original or forged. Various classifiers are used before this stage to get better results. This could be better explained through the diagram which is given as follows:

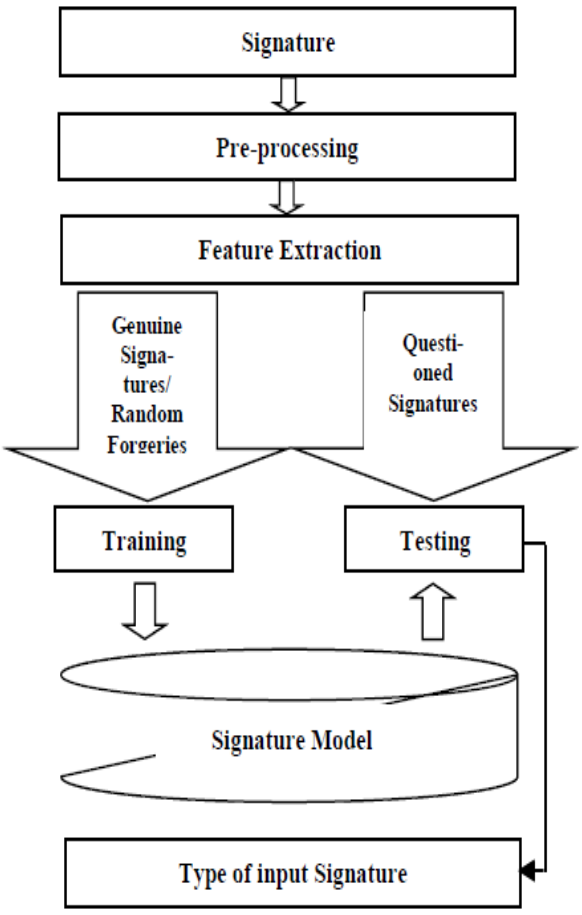

FIGURE 6: SPEAKER VERIFICATION APPROACH

IV. CONCLUSION

Off-line signature verification process covers a wide range of techniques and algorithms to be used.This paper explained the algorithm used in alignment and binarization of signatures. The above stated aim is successfully achieved. The approach used works well and is effective. Despite the result, this paper only laid stress on the two stages of the entire process: Image acquisition and Pre-processing. A lot more work is still to be done to get better results.

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