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Signature Verification Technique using Artificial Neural Network and SURF Algorithm

Sadia Ahmed[1], Navjot kaur[2], P.K Bansal[3]

Research Scholar, Dept of ECE, PEC, Mouli, Barwala, Haryana Kurukshetra University, Kurukshetra, India[1]

Asst Professor, Dept of ECE, PEC, Mouli, Barwala, Haryana, Kurukshetra University, Kurukshetra, India[2]

Professor, Dept of ECE, PEC, Mouli, Barwala, Haryana, Kurukshetra University, Kurukshetra, India[3]

Abstract: In today's world Signature plays a crucial role. It depicts a person name graphically or in handwritten form. It is the best form of recognition of an individual. Other attributes also plays a big role in recognition but signature is best feature among them. In order to permit a check or it is a mark as well as mark made by an individual to execute a document and signify knowledge, acceptance, or obligation. A signature is also categorized on the basis of Biometric authentication where a user's identity is established by means of physical trait or certain behavioural characteristics. . Signature facilitate us enforce security in many such cases for e.g. transactions at banks, wills, assets, government documents etc .We investigated the impact using artificial neural network (ANN) and Surf algorithm. The EER (equal error rate) is achieved as 14.64.

Keywords: Biometry, ANN, signature verification, FRR (False Rejection Rate), FAR (False Acceptance Rate), Forgery, image processing, SURF.

I. INTRODUCTION

The principal objective of the signature verification system is to make out the exclusive characteristics of personal styles of writing. Basically signature recognition deals with identifying a person whereas verification deals with detecting whether the signature is genuine or fake. The inevitable side-effect of the signatures is that they can be misused for the purpose of the faking a data genuineness. Hence, the prerequisite for the examination in well-organized regular resolutions for the signature recognition and validation so that there is avoidance of the risk or fraud. Personal verification and identification is an actively essential area of research. The methods are plentiful and are based on different personal characteristics; face geometry, voice, lip movement, hand geometry, odour, eye, iris, thumb impression, iris scan and fingerprint are the most commonly used methods for authentication.

Above all the mounting importance of the internet and other electronic transfers in our modern society is a driving force in this field. Therefore substantial applications are determined in this area. Signature verification is a very complicated task due to some challenges like dissimilarity in different shapes and parts of each signature signed by same person, difference in size and orientation of signature images, noises contained by original input image etc. Separation of original and forgery signature image is a challenging part of signature verification.

Broadly there are two types of techniques involved. These are explained below.

1. Offline Verification (static): Offline methods generally do not want any particular acquirement of hardware, just a pen or pencil and a paper, they are therefore less persistent and most user friendly as compared to online signature verification.
2. Online Verification: In an online system, special devices are used like digital pen, digitizer for data acquisition. It generates dynamic information such as location, pen pressure, velocity, coordinate values and speed of signature. Here the verification is performed in real-time.

The main objective of verification is to differentiate between real and imitate signatures and to avoid imitation. Broadly there are three different types of imitation.

1. Random Forgery: Person who doesn't grasp the shape of original signature. A person who just creates a signature with his own style by just knowing the name of a person.
2. Unskilled Forgery: The person who is a observant and creates a signature once or twice without any past experience.
3. Skilled Forgery: A Person having knowledge of original signature and have the sense of copy signature. He copies a signature after obtaining a good observance over it. He/she can be an expert in coping signature. Such signatures are most difficult to detect.

II. LITERATURE REVIEW

This block described the research work that has been done in recent years. Image compression is the ultimate favourable field of research in which assemble the interest of all analysts. A literature review goes beyond the inquiry of report or knowledge and it relates the recognition and connection of relationships among the literature and research field.

L.Basavaraj and R.D Sudhaker Samuel [1] introduced offline signature verification technique which was based on four speed stroke angle. It extracted the dynamic features of static signature image. It was based on the idea that intensity is directly comparative to the speed of the stroke. This method achieved FAR of 13.78% and FRR of 14.25%.

Shashi Kumar , R. K Chhotaray, D R K B Raja and Sabyasachi Pattanaik [2] introduced Off-line Signature Verification which was Based on Fusion of Grid and Global Features Using Neural Networks. The Fusion of global and grid features were used to generate dominant feature set and neural networks are used as classifier. FAR achieved was 4.16% whereas FRR was 7.51%.

Jesus F. Vargas and Mioguel A.Ferrer [3] proposed Offline Signature Verification which was Based on Pseudo-Cepstral Coefficients. This technique included from gray-scale images, its histogram was calculated and used as "spectrum" which further calculated the pseudo-spectral coefficients. Finally, the unique minimum-phase sequence was estimated and was used as feature vector for signature verification. Here the optimal number of pseudo-coefficients was expected for best system performance and FAR and FRR were 7.35 and 5.05 respectively

Ashwini Pansare and Shalini Bhatia [4].They extracted set of geometric features from a signature image which includes center of mass, area of signature, surface features, six fold surface features etc .FAR and FRR were reported to be 14.66% and 20% respectively.

Paigwar Shikha and Shukla Shailja [5] highlighted their method for Multilayer perception, modular neural network and the collaboration with feed-forward networks and Self Organizing Map group's neural network comparison for absolute study process. Over here they found that multilayer perception was better for having multilayer networks because it is more reliable to solve complicated problems rather than single layer perceptions. They used small database as a pilot project basis and do not consider the big database and to evaluate robustness and signature verification problems. They reduced the False Rates Rejection, (FRR), False Acceptance Rate (FAR) and Total error rate (TER).

Abikoye, O. C., M. A. Mabayoje, and R. Ajibade [6] proposed a scheme for signature verification and recognition for Artificial Neural network. They have given more specification which would carry far more in signature verification. They were given one of these modelled of verification and them also, and extracted the procedure of their work. They consider a small database and took few peoples signature and forged signature as well. The main aim of this paper was the utility of signature verification helps in detecting the exact person and more accuracy in verifying signatures for implementation.

Radmehr, Anisheh, Nikpour and Yaseri [7] developed an offline signature recognition system based on Radon transform, fractal dimension (FD) and SVMs. Experimental result of the proposed method achieved true positive rate (TPR) consisting of 92.5% and false positive rate (FPR) resulted in 10% using polynomial kernel for 5 classes in their proposed method. For comparison, they evaluated the performance using a linear kernel and a radial basis function kernel as well. The scope of our work in contrast covered up to 30 classes with improved accuracies in classification employing multilayer ANN and SVM RBF kernel.

III. METHODOLOGY USED

The problem of signature verification and identification is a vigorously mounting area of research. There are a variety of techniques and they can be assorted on the basis of various characteristics such as voice, shape, lip movement, face geometry, hand symmetry, gait, odour, eye, iris, retina, body and fingerprint are the most regularly used for substantiation.

These psychological as well as behavioural features are known as biometrics. The pouring feature of the progress in this area is above all, the growing importance of the internet and electronic usage in our modern society. There are numerous applications is in the area of electronic commerce and electronic banking systems where the use of signature verification in inevitable.

A. Objectives

To make an improved offline signature recognition system by using Neural Network and Surf. System of human identification using signature recognition algorithm is range independent and distributed for different types of images. To use surf feature for matching in signature recognition system.

The results of FRR (False Rejection Rate), FAR (False Acceptance Rate) and EER (Equal Error Rate) are improved as we use Neural network with surf feature technique for recognition.

Better improved quality of signature and matching results are obtained. The following steps are involved in obtaining a verified image.

Step1: choose the desired image from the database which is having variety of stored images. The Code is implemented such that images for database are stored in a mat file. Firstly we establish a particular GUI for its execution. After that code is developed for loading the signature image from the database of the images.

Step2: Code is used to carry out pre-processing step on the input image which is obtained from the database of the images.

Step3: The Code composed is used for ruling the features by performing feature extraction on input image using SURF Technique.

Step4: After the extraction process code is implemented for Neural Network classification and code for matching and recognition of signature is finally developed by using the surf and neural network functions and commands present in MATLAB.

Step5: Finally code for comparing a variety of parameters like FRR, ERR and FAR with base paper is developed.

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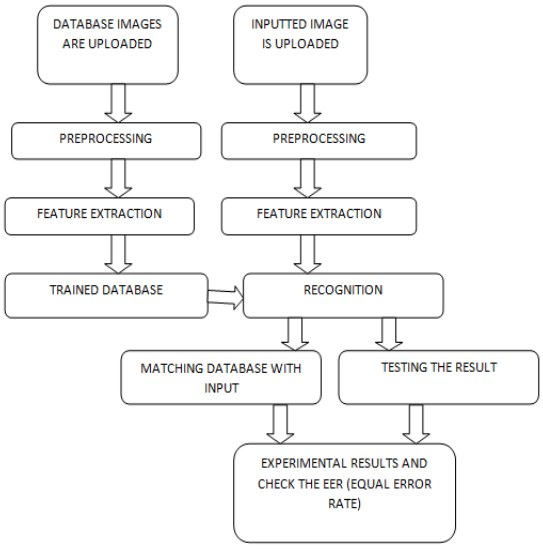

Fig.1. Block diagram of proposed work

B. Block Diagram Explanation

The accuracy and precision of any work performed is judged by the results obtained. There are various parameters which are involved in any system and on this basis the method is either accepted or rejected. When a system runs on different datasets then only its effectiveness is determined. Using different parameters the value of datasets and after using SURF and ANN we obtained a verified image. When a system runs on different datasets then only its effectiveness is determined.

1. Input Image: The first stage of the offline signature recognition system includes the input image where a image is taken as a input.GUI is created and the images which are stored in the database are obtained and using the Matlab software the Preprocessed. Here input image is transformed into greyscale using software and various steps are performed for further operation

2. Pre processing: The background subtraction process is the first method of pre-processing. It is a technique which implements the difference between the current image and the image in the background used to detect the signature region. A typical methodology is to perform subtraction, after converting image is pre-processed. It is a method that allows feature extraction to be operated in image easily. Background Subtraction calculation is simple and easy to implement. The subtraction of background helps in delineating the foreground from background in the images.

$$Ek(x,y)\{1 \text{ if} |Fk(x,y)-Bk-1(x,y)|>T \} 0 \quad \text{otherwise}$$

where Ek (x,y) is the resultant difference, Fk (x,y) is the current frame and Bk-1(x,y) is the background initialized frame and T defines the threshold which restrain the shadow ehich rekon upon the value assigned.After background subtraction, median filtering is used to remove noise. Median filter perform 2d average sifting. The Median Filter block supersede the central value of an M-by-N neighborhood with its median value.

Fig.2.Original signature Fig. 3. Preprocessed signature

3. Feature extraction: Feature extraction techniques are an important and are used to get better the accuracy of signature. Same characters of a signature are called features of that particular signature and precisely extracting these features called extraction. This process identifies and separates a person's signature from any other. This process is based on dissimilar type features such as local features, global features , texture features geometric features, face features and grid features.

4. Matching: Moving target characterization calculation is utilized separate person (i.e., passerby) from other closer view objects (viz., vehicles). Surf feature is used in this system for matching .which has not been used till date in the hand gesture recognition systems, these concentrated quirk vectors are usual to seeing single individual. Surf Feature is utilized for perceiving persons on the premise of stride. The matching of these features are done by SURF algorithm. Surf feature is used for matching in this method. it is a robust local quality detector that can be used in computer visualization tasks like object detection or 3D renovation. Interest points are elected at distinctive locations in the image, such as bolbs, corners, and T-junctions. The significant property of a interest point detector is its repeatability

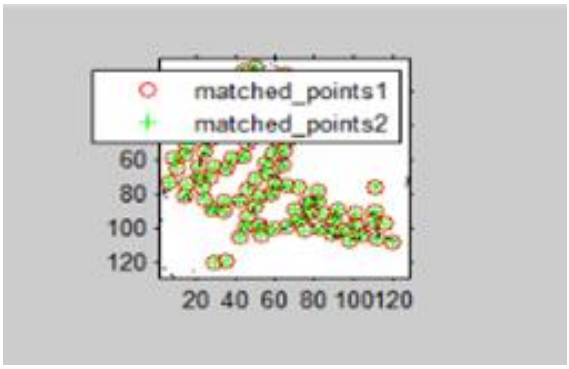

Fig.4. Matching of points.

5. Testing: In case of signatures are same result will be match successful. After that result are analyzed using NN tools. It is performed by using Neural Network (NN), which is defined as a set of interconnected neurons which used for universal approximation. Artificial neural networks are poised of interconnecting artificial neurons (imitate the properties of biological neurons). Good performance or human error pertaining to pattern can then be used as one source of evidence towards underneath the supposition that the abstraction really apprehend something noteworthy from the stance of information

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processing in the brain. Delta Rule algorithm as well as NNstart tool is used. The occurrence of accuracy Is not the only condition for the effective performance of this systems.

C. Result Analysis

The accuracy and precision of any work performed is judged by the results obtained. There are various parameters which are involved in any system and on this basis the method is either accepted or rejected. When a system runs on different datasets then only its effectiveness is determined. Using different parameters the value of datasets are obtained and recorded

Parameters used for signature verification are as follows.
1. FRR (False Rejection Rate).
2. FAR (False Rejection Rate).
3. ERR (Equal Error Rate).

1. False Acceptance Rate: FAR is the likelihood that the system mistakenly authorizes a non-authorized person which is caused due to falsely matching pattern.

$$FAR = \frac{\text{No. of fake signature accepted}}{\text{No. of fake signature tested}} x100$$

2. False Rejection Rate: FRR is the likelihood that the system incorrectly refutes the access to an authorized person which is caused due to falsely matching pattern.

$$FRR = \frac{\text{No. of actual signature accepted}}{\text{No. of actual signature tested}} x100$$

3. Equal Error Rate:
The rate at which both FRR and FAR errors are equal is called EER.

TABLE I Comparison of FAR AND FRR w.r.t Gamma.

GAMMA	FRR(%)	FAR(%)
0.01	28.46	1.14
0.02	27.68	1.92
0.03	27.02	2.58
0.04	26.24	3.36
0.05	25.29	4.30
0.06	24.16	5.44
0.07	22.83	6.76
0.08	21.32	8.28
0.09	19.60	9.99
0.10	17.69	11.90
0.11	15.58	14.01
0.12	13.28	16.32
0.13	10.77	18.82
0.14	8.06	21.53
0.15	5.16	24.43

The results were carried out for the various signature several values of FRR and FAR were noted and the most similar value of both FRR and FAR was noted. This is discussed briefly below. Here we used 15 test signatures for 10 individuals. Here the best results were obtained at FRR= 15.58%, FAR= 14.01% at gamma function having the value of 0.11.Below fig. 5.depicts FAR verses FRR.

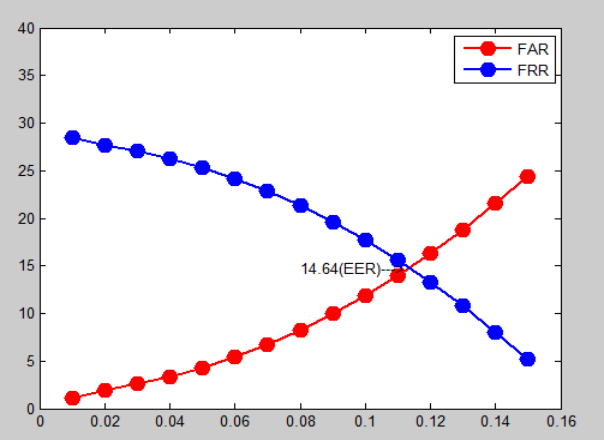

Fig.5. Comparison of graph for FRR and FAR.

Here the intersection of FAR and FRR results in obtaining the value of EER .Here at 0.11 gamma axis we obtain EER =14.64%. Further increase in gamma gives reduction in FRR with the increase in FAR value and finally the FAR and FRR value cross over each other which is called as EER point. It is apparent that a small value of gamma leads to tighter decision boundary and will decline any minor alteration in signature prototype. Consequently even the genuine signature with minor variation are segregated as imitated or fake which results into very large value of FRR but has small FAR value. As the value of gamma increases the model allows some variation in general. As a result FRR will plunge but FAR value will augment as skilled forgeries having small variations will be acknowledged authentic. Additional increase in gamma gives low FRR with increase in FAR value and in conclusion both values (FAR and FRR) cross over each other at a particular point known as EER point. Below is the Graph of comparison of previous work and proposed work on the basis of EER as in [8].

IV. CONCLUSION

The basic advantage of implementing neural networks is that they can extract the most discriminative and representative set of features. We have presented a learning vector quantization neural network architecture based on varying parameters and eliminating redundant hidden layer units or blind neurons that learns the correlation of patterns and recognizes handwritten signatures. The network classifier is trained on the random training samples to perform recognition task on the input signature image. The Empirical results yield an accuracy rate of 98% for a random test set of 15 handwritten signature images of 10 persons on the network that is trained with another set of 12 images of same subjects. The proposed algorithm can be implemented as a useful and effect full for signature verification and identification system. [8] have used low level stroke feature extraction technique which were originally proposed for recognition of a printed Gujarati text .SVM classifier along with RBF

kernel. The EER (%) had values were ranging from 15.12 to 13.72. Thus, EER was having a range of 15±2. The average EER was obtained as 15.59 and Average value of FAR and FRR was 15.86, 15.31 respectively.

The algorithm proposed successfully made rotation invariant by using the rotation of the image. The error rejection rate (ERR) can further be improved by using enhanced techniques for rotation; blurring and thinning.

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