Signature Verification System using Neural Networks

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***Abstract*— In today's era of digitalization, digital signatures are most widely used in various fields of documentation activities for authorization of identity of any human, we also know that handwritten signature verification system are mainly based on manual verification, in which a person looks and compare the given signature with the test signature, so a better system is required which can be computer based classification, so in this paper an online signature verification is proposed which is based on the dynamic features of the signature using artificial neural network as classifier, the proposed system uses the User database for acquisition of the signature and extract the dynamic features of the signature i.e., x,y coordinate of the signature along with the velocity component and these dynamic features are then considered and a feature feed forward neural network is trained for classification.**

Keywords—Digitalization; artificial neural network; graphical user interface; feed forward neural network;

I. INTRODUCTION

Signature is an identification mark that a person writes on documents or texts. The signature is the primary mechanism both for authentication and authorization.The signature verification can be done either by online or offline. This signature verification is natural and intuitive. In the offline approach the signature is usually handwritten and the verification process using extracted features from the scanned image of the handwritten signature. online approach signature is taken using digital pen and the signature data is then stored in database which is later used for verification process.Some features like x-y coordinates,pressure,time are considered which is used for forge detection.These dynamic features are functions of time and static features are time independent. Even a skilled forger would not not be able to put in the same pressure as the user. Hence these dynamic features help to detect forgery. Since signature for different individuals vary with the variation of individuals, so it is a very robust biometric to authenticate a user. Signature verification is a very difficult pattern recognition problem. Since intra class variations occur, even experts get difficulty to recognize the forgery signature. There are three types of forgeries which are related to signature detection they are: 1) Random forgery 2) unskilled forgery 3) skilled forgery. Random Forgery is a type, where the person who want to forge the sign only knows about the name of the person to whom which he want to forge the signature but does not know about the sign of that person. Unskilled Forgery is a type of forge where the person who want to copy the genuine signature are known about the way how a genuine signature was sign but does not able reproduce exactly. Skilled Forgery is a type where the person who want to copy the sign knows very well about the way and different variation of genuine signature and the copy is very well match with the signature.

II. PROBLEM STATEMENT

The signatures of the same person can vary with time and state of mind. Our main aim is to verify whether the acquired signature is genuine or forged one.

III. OBJECTIVE

- The main objective is implementation of Signature Verification for Document Fraud Detection.
- To collect handwritten signature via the user databse which can provide very useful dynamic features.
- To Derive a set of features from parametric based approach i.e x-y coordinates and velocity component .
- To Measure the similarity of signature using a NN algorithm.
- To Perform classification using feed forward neural networks and implementing it in MATLAB IDE.
- To Evaluate performance by comparing reference signatures with test signatures.

IV. LITERATURE SURVEY

[1] Babita P : "Online Signature Recognition Using Neural Network" : Authentication of user is becoming very important to do business transactions, accessing data and for security purpose. Automatic signature authentication is now becoming popular in research areas because of its acceptance in legal and social areas and its widespread use for authentication purpose. The main objective of this work is to construct a signature recognition system using some feature values so that to get a maximum accuracy label. To do this, some features were extracted and formed pattern from them. The features acts as an input pattern to the neural network and corresponding targets are constructed. In neural network, the patterns are trained according to the target, where weights are updated to get a minimum error. When a stopping condition is reached the iteration stops. In neural network training, many times trial and error is done to get satisfactory neural network architecture.

[2] Abdelâali Hassaïne, Somaya Al-ma'adeed : "An Online Signature Verification System for Forgery and Disguise Detection" : Signature verification is a very active research field. It consists in comparing a questioned signature with a set of one or several reference signatures. This paper presented a new system for online signature verification which deals with both forgeries and disguised signatures. This system extracts several features of the signatures and compares them at the histogram level and the signal level.Several classifiers have been tested for combining these features, with neural networks and random forests generally preferred. It is planned to study new methods of matching these features using dynamic time warping as well as extending this method for the case of multiple reference signatures.

[3] Manish Trikha, Maitreyee Dutta : "Online Signature Verification Using Normalized Dynamic Feature With Artificial Neural Network Classification" : An automatic signature verification system can either be online or offline. The online approach in which the user sign on digital tablet using digital pen and the dynamic data has been captured in real time and saved as database, then from this dynamic data like x,y coordinate, pressure, time etc. In this paper an online signature verification system is proposed which is based on artificial neural network based classification. This system 10 signatures of 5 different persons are taken on digital tablet using digital pen and from that a database of x, y coordinate and pressure values at different points are extracted, from which 11 different specific feature set is calculated, which is used to train a neural network using MATLAB software.

[4] Mohd Hafizuddin Mohd Yusof, Vamsi Krishna Madasu : "Signature Verification and Forgery Detection System" : In this work a signature verification and forgery detection system is modeled by TS model is designed, which involves structural parameters in its exponential membership function. The features consisting of angles are extracted using box approach. Each feature yields a fuzzy set when its values are gathered from all samples because of the variations in handwritten signatures. In this formulation, a single feature constitutes each rule. The efficacy of this system has been tested on a large database of signatures. The verification system is able to detect all types of forgeries: random, unskilled and skilled with utmost precision.

[5] Vahab Iranmanesh,Sharifah Mumtazah Syed Ahmad:"Online Handwritten Signature Verification Using Neural Network Classifier Based on Principal Component Analysis" : A new approach for feature selection in verification and recognition of online handwritten signatures is presented in this paper. Utilizing PCA for feature extraction on Malaysian handwritten signatures, proposed to extract 50 prominent features to represent each individual signature. Afterwards, a MLP is implemented to classify the signatures as either forged or genuine. The verification result shows the effectiveness of the proposed technique, as it attained 93.1% accuracy on 200 users and 8,000 signatures consisting of genuine and skill-forged signatures.

[6] **Mohammad Hajizadeh Saffar, Mohsen Fayyaz, Mohammad Sabokrou, Mahmood Fathy : "Online Signature Verification Using Deep Representation" :** Authentication has been known as an intrinsic part of social life. Recent years have seen a growing interest toward personal identity authentication. Increasing security requirements have placed biometrics at the center of so much attention. Biometric technology has become an important field in verifying people and has been used in people identification and authentication. The term biometric refers to individual recognition based on a person's distinguishing characteristics.

V. METHODOLOGY

The flowchart for the methodology for signature verification is as shown in fig1. This can be done by acquiring the Dynamic signature through the designed graphical user interface or through the user database which is followed by enhancement of the signature by pre-processing and data acquisition.

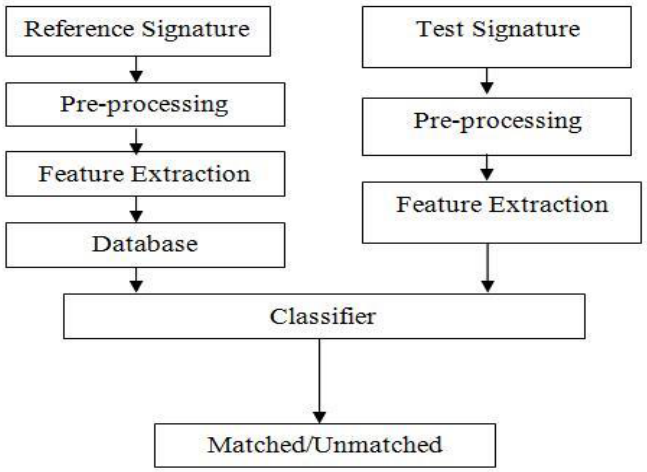

Fig.1: Flow chart of the proposed signature verification system

1) Average value of X-coordinates(Xavg): It is the average value of the X-coordinates used in acquisition of signature.

$$Xavg = (1/N) \sum Xk$$

2) Average value of Y-coordinates(Yavg): It is the average value of the Y-coordinates used in acquisition of signature.

$$Yavg = (1/N) \sum Yk$$

3) Area of signature (A): It is the total area on the GUI screen acquired by signer during acquisition of the signature

$$A = [(Xfinal - Xinitial) * (Yfinal - Yinitial)]$$

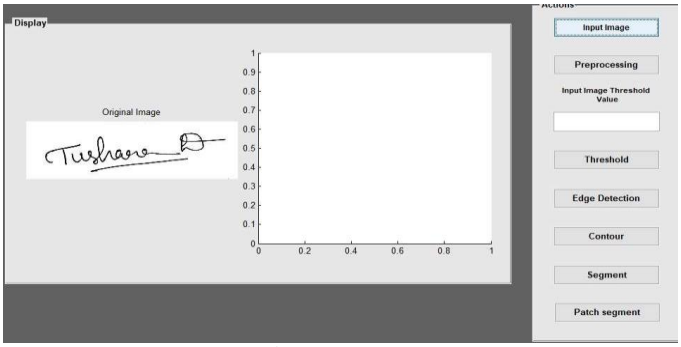

Fig.2 : Output screen for test signature preprocessing phase

So using this data many of the features can be extracted but for this paper only few features are calculated. These are given below.

There are two main phase of the proposed signature verification system. They are:

- Training Phase
- Testing Phase

During the Training Phase 10 number of signatures are taken as input and stored. Then extract the dynamic properties of the signature i.e., x, y coordinates of signatures and velocity. During testing phase a signature is taken as input through the GUI screen or through the user data base and extract the same dynamic features as in Training phase. Then, make a database of the extracted features of Training and Testing are trained using SVM classifier algorithm in MATLAB and then a judgement is made whether the signature is matched or unmatched.

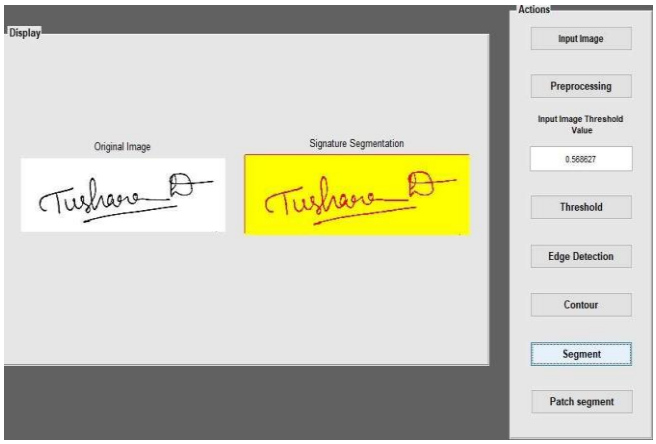

Fig 3: Preprocessing of input signature

Support vector Machine Algorithm:

Support vectors are a learning algorithm directed under machine learning and are used for both classification and regression functions [13]. But mostly a vector is used for classification, so this will be what we focus on in this paper. The vector machine is based on the idea of finding a hyperplane that divides the data set into two classes in the best way, as shown in Figure

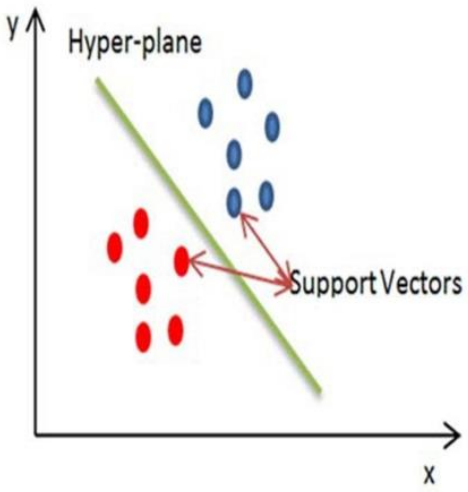

Fig 8:Support Vector Machine

Supporting vectors are the data points closest to the super plane, which are points that, if removed from the data set, will change the location of the super plane that divides the data. Therefore these points can be considered as the important elements in the dataset . The distance between the super plane and the nearest point to any of the data sets is known as the margin. The goal is to choose a super level with the largest margin between it and any point in the training data set to increase the likelihood that any new data will be classified correctly.

For each test enrolled signature x, an SVM classifier outputs a score that is determined by the distance of x to the hyperplane learned for separating accepted from rejected enrolled signatures. The probability of different enrolled patterns is calculated to determine the threshold value. The results above the threshold value are accepted, whether the results below are rejected. We used a trial and error approach to determine the threshold value. The ROI can be defined as the most important region that contains the most significant information for the pattern. Like in fingerprint the ROI is the core of the fingerprint by which the sensor needs this part to identify the fingerprint of the person.

Signature is different because it depends on the behavioral characteristics of each person. Therefore, the need of MRoI ensures high accuracy for signature recognition. The MRoI images are convoluted to one pattern as a feature vector required for classification using SVM.

System Requirement Specification :

1. Hardware Requirements

   PC with below configurations

   - OS : Windows XP and above
   - RAM : 2GB
   - Memory : 20 GB
   - Processor : Dual core and above
   - Processor Speed : 3GHZ

2. Software Requirements

Matlab Tool 7.0 and above – It is a proprietary multi-paradigm programming language and numeric computing environment developed by MathWorks. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages.

VI. RESULTS AND DISCUSSION

Artificial Neural network is a generalization tool. The reason why the neural network approach is chosen amongst the other classification method is that, neural network is very easy to use and can solve complex problems with ease. From this work we find the results of the testing conducted on artificial neural network using features data extracted from the signature. The classifier used here compares trained signatures with test signature and identifies wheather the signature is original or forged signature.

As shown in the fig.6 we get the screen saying wheather the signature is matched or not matched. If the signature is matched then it specifies the respective ID number which defines the respective user. Thus we can determine if the signature is original or forged.

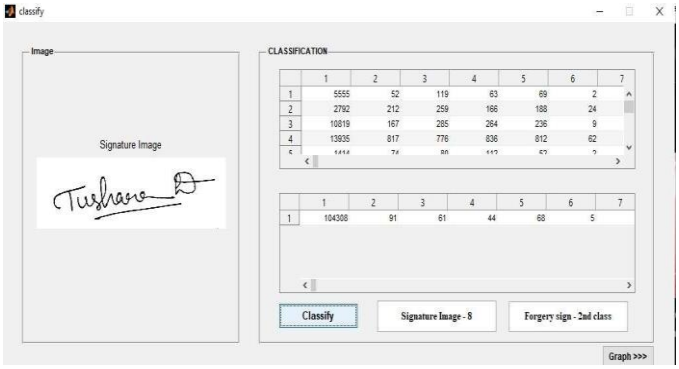

Fig.4 : Final result of the proposed system which determines signature is original or a forgery

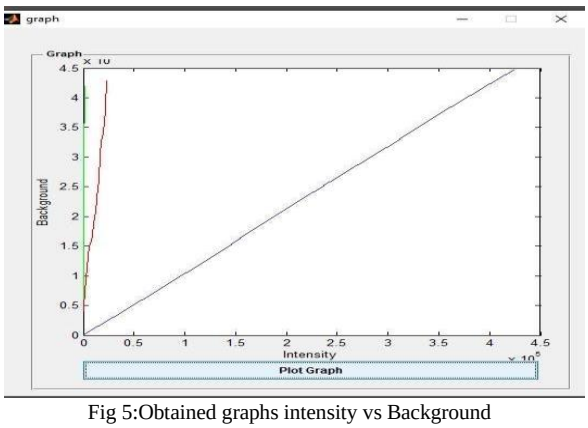

Fig 5:Obtained graphs intensity vs Background

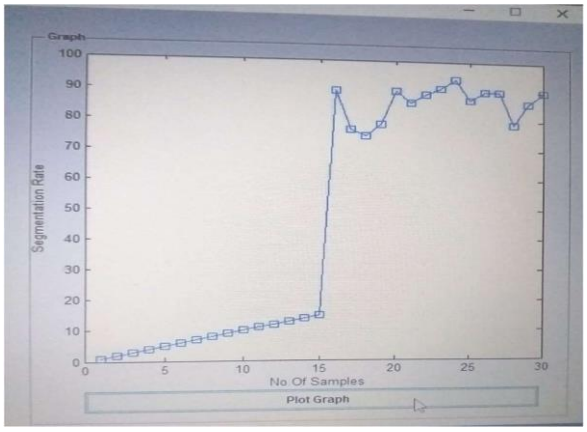

Fig 7: Obtained graph No of samples vs Segmentation rate

VII. APPLICATIONS

- Finance and banking
- Government organizations
- Retail sector
- Online transactions
- Air travel
- Insurance and compliance documents
- Other legal documents

VIII. CONCLUSION AND FUTURE SCOPE

Signature is used in all financial transactions for authorization of identity of human but still these authentication system is based on by comparing the signature with authorized signature manually. So a system is required which is based on the computer based classification . In this paper an online signature verification system is proposed which is based on neural network based classification. This system uses 10 signatures taken from the user database and from that a database of x, y coordinate and velocity values at different points are extracted, from which different specific feature set is calculated, which is used to train a neural network using MATLAB software, the proposed system provide the better result with maximum accuracy. The future work should address the challenges and issues involved in signature verification and there is always a scope for new approach which may be more effective in distinguishing forgeries from genuine signatures. There is a scope for reducing number of signatures required for training the model for reliable authentication.

IX. REFERENCES

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