OFFLINE SIGNATURE VERIFICATION USING NN, KNN and SURF

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ABSTRACT

Signature is one of the most popular and widely accepted bio-metric for authentication and identification of a person. 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. There are diverse techniques in the course of which one can categorize the signature as accurate or fictitious. As Major documents such as demand drafts, property papers are generally subjectedto malpractices. Hence prerequisite of automatic signature verification becomes unavoidable as the degree of processing and locating the individuals augmented several fold in legal and financial transaction. Thus an automated signature verification system is mandatory. 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 Different techniques give different figures for measurement of FAR (False Rate), FRR (False Rejection Rate),EER(Equal Error Rate)which were evaluated further.

Biometricsthe automatic recognition of an individual based on his/her physiological or behavioral uniqueness. This method of verification is favored over classical methods including passwords and PIN numbers for its exactness and case sensitivity. A biometric system is generally a pattern detection system which makes a personal identification by seminal the genuineness of a specific physiological or behavioral characteristic infatuated by the user. These characteristics are quantifiable and unique. These characteristics should not be forged. An important issue in conniving a system is to decide how aperson features are identified.Finger print and thumb scanning, eye scan or scanning of retina, or iris, body scanning of a person does not match with any other in the database. So it enhances the security. Biometrics means Voice, hand, Eye, Fingerprint, Facial recognition and more.An Offline method generally does 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.Data collection is done by scanning individual handwritten signature. Features are extraction from signature image and used for signature verification.

INTRODUCTION

Signaturedepicts 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 categorizedon the basis of Biometric authentication where a user's identity is established by means of physical trait or certain behavioral characteristics. There are twodifferent categories of verification system based on the mode ofsignature acquisition one is*Online* in which the signature is captured during the writing process and making the dynamic information available, and other being *Offline* for which the signature is acquired after the writing process and, therefore, only static information is available. Signature facilitate us

enforce security in many such cases for e.g. Transactions at banks, wills, assets, government documents etc. As Major documents such as drafts, property papers are generally subjectedto malpractices. Hence prerequisite of automatic signature verification becomes unavoidable as the degree of processing and locating the individuals augmented several fold in legaland financial transaction. Thusan automated signature verification system is mandatory. 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 isgenuine 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 habitual resolutions of images which can be used for the signature recognition and validation has improved in later years for the purpose of avoiding the risk of fraud. A dilemma of personal verification and identification is an actively essential area of research. The methods are plentiful and are based on different personal characteristics; face geometry, , lip and hand movement,voice,hand geometry, face, odor, gait, iris, eye, retina and fingerprint are the most commonly used authentication methods. The driving force in this field is over all the growing importance of the internet and other electronic transfers in our modern society. Therefore substantialapplications are determined in thisarea. 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 oforiginal and forgery signature image is a challenging part of signature verification.

Biometrics

The word "biometrics" is derived from the Greek words bio which means life and metric which means to measure. Biometrics thus means the automatic recognition of an individual based on his/her physiological or behavioral uniqueness. This method of verification is favored over classical methods including passwords and PIN numbers for its exactness and case sensitivity. A biometric system is generally a pattern detection system which makes a personal identification by seminal the genuineness of a specific physiological or behavioral characteristic infatuated by the user. These characteristics are quantifiable and unique. These characteristics should not be forged. An important issue in conniving a system is to decide how aperson features are identified.

Advantages of biometric systems

Biometric systems are incorporated with certain advantages. Some of them are enlisted below

- Finger print and thumb scanning, eye scan or scanning of retina, or iris , body scanning of a person does not match with any other in the database. So it enhances the security.
- Biometrics means Voice, hand, Eye, Fingerprint, Facial recognition and more. Hence once identity of an individual gets secured.

Disadvantages of biometric systems

Biometric have certain disadvantages that can be illustrated as:

- The scanning (thumb) of the workers who are working in (say)Chemical industries are often affected . Therefore these companies do not favor using finger print as a means of authentication.
- It is known that with age, the voice and other physical features of a person changes. Also when the person has flu or throat infection his/her voice changes or too much noise in the environment also makes this method work incorrectly. Therefore this method of verification is not feasible all situations and circumstances.

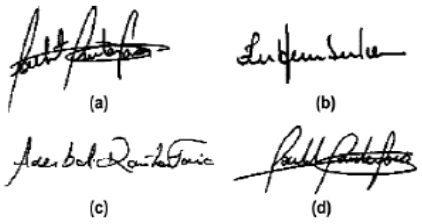
- For those citizens, who affected with diabetes, the eyes often get affected resulting in differences also other medical problem which may lead to complicatedness in identification process.
- Biometrics is quite expensive identification solution.

Thus signature identification is need of hour.

Types of Verification Systems

Even though the handwritten signature identification andverification has been extensively studied in some last decadesand with the best methodologies functioning at higheraccuracy rates, there are still lots of questions to be answered.Overall, signature verification systems is categorized asoffline (static) and online (dynamic).

a) OFFLINE VERIFICATION: It is obtained from a piece of writing paper which is with as an input image and mostly found on documents concerning to signature and bank checks. 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.Data collection is done by scanning individual handwritten signature. Features are extraction from signature image and used for signature verification. Since, the scanned image will be used for the signature verification only.



Offline (static) verification technique.

b) 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. On the other hand, online signature verification uses all dynamic properties of the signature (pen ups and pen down signature trajectory, time stamping, pen pressure, etc. which are captured by a pen based tablet or device., 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. In background, the verification is performed in real-time.

Online (dynamic) signature verification

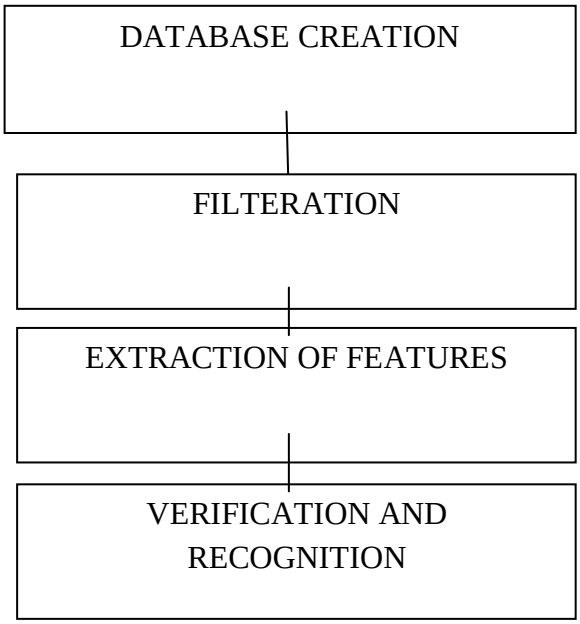
Why Offline Verification Systems

They are more unique, exclusiveand difficult to imitate and imitate than their counterparts. The biometric systems may have noise due to its scanning counter parts.Most physiological characteristics remain reasonably stable over the period of time, whilebehavioral features are in control of theSubject (Person) and changes over the short and long terms due to changes in our body or health, physiological state and due to aging. While physiological biometrics characteristics may bepassably represented by just a single sample, behavioralbiometrics requires some samples due to theirvariability, for example signatures vary many timesdepending on mental, fatigue and physical state, and writing position.

Advantages of Offline Verification Systems

Of all this biometric technologies, handwritten signaturerecognition and verification is simple, inexpensive and acceptable in society for authenticating varioustransactions, acts of volition, civil law contracts and one's identity. This is mainly due to the ageold and more practice ofhandwritten signatures as a resource of personal or humanidentification and its freedom from anyprivacy leakage or intrusion related issues. Thus research is developingin various systems which can enhance theexactness of these handwritten signature verification continuesto be of very most important interest to date. Signature enable us enforce security in many such cases for eg. Transactions at banks, wills, assets, government documents etc. As Majordocuments such as cheques, property papers are generally subjectedto malpractices

Block Diagram of Offline Verification System



Block diagram of signature verification

Offline signature verification is requisite to achieve a sequence of operation for getting authentic results. The major verification steps and discussed briefly about these steps.

A. Database creation*:*

The authentication system is requisite digital image format. We have collected paper based signature and then converted it into digital by scanning.

B. Filtering of signature*:*

Signature preprocessing involves first background removal step and background noise then filtering of background noise is performed after that, normalization of the width of the signature is performed. Thinning step is also performed on the signature.

Certain steps are involved in preprocessing:

*1)*Background removal*:*Background elimination step is performed to take out the characteristics of signatures. Certain thresholding methods are used to haul out signature from the background. In thresholding method all pixels of the signature are convertedinto “1” and other pixels those are fit in to background of signature are convertedinto “0”.

2) Noise elimination and subtraction:Background noise reduction filter to the binary signature to used get rid of the background noise. This filter removes the single black pixels on the white background. If the number of white pixels are lesser than number of black pixels the chosen pixel will be white or else black.

3) Width resize: The normalization is used to resize and used it for proper dimensions.

4) Thinning feature: Thinning eliminates the thickness differences that may take place because of different pens.

C. Extraction of features:
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 aperson'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.

*D.*Verification and recognition*:*
For verification we are using ANN along with SURF algorithm. These algorithms are explained below:
Artificial Neural network (ANN):
It is set of interconnected neurons which usedfor universal approximation. Artificial neural networks are poised of interconnecting artificial neurons (mimic the properties ofbiological neurons). Artificial neural networks can be eitherused to gain an understanding of biological neuralnetworks, or for solving artificial intelligence problems .The real biological nervous system is extremelycomplex: artificial neural network algorithms attempt toevaluate this complexity and focus on what mayhypothetically matter most from an information. Good performance or human error pertaining to pattern can then be usedas one source of evidence towards underneath thesupposition that the abstraction really apprehend somethingimportant from the point of view of information processingin the brain.

SURF algorithm:
SURF (Speeded up Robust Features) is defined as a stout local feature detector, first presented in the year 2006. In SURF, a descriptor vector of length 64 is built with a histogram of gradient orientations in the local neighborhood around key point customized SURF (Speeded up Robust Features) is one of the renowned feature-detection algorithms. By using Hessian matrix-based measure for the identifier and allocation-based descriptor and by simplifying this methodology to it is essential. This leads to amalgamation of novel detection, matching steps and description. Speeded up Robust Feature is performing scale- and turning-invariant point detector and descriptor.

k-nearest neighbors (KNN)

The k-Nearest Neighbors (KNN) family of classification algorithms and regression algorithms is often referred to as memory-based learning or instance-based learning. Sometimes, it is also called lazy learning. These terms correspond to the main concept of KNN. The concept is to replace model creation by memorizing the training data set and then use this data to make predictions.

The KNN algorithm uses a majority voting mechanism. It collects data from a training data set, and uses this data later to make predictions for new records. For each new record, the k-closest records of the training data set are determined. Based on the value of the target attribute of the closest records, a prediction is made for the new record. The basic nearest neighbor (NN) algorithm makes classification predictions or regression predictions for an arbitrary instance. To this purpose, the NN algorithm identifies a training instance that is closest to the arbitrary instance. Then, the NN algorithm returns the class label or target function value of the training instance as the predicted class label or target function value for the arbitrary instance.

The KNN algorithm expands this process by using a specified number k≥1 of the closest training instances instead of using only one instance. Typical values range from 1 to several dozens. The output depends on whether you use the KNN algorithm for classification or regression.

- In KNN classification, the predicted class label is determined by the voting for the nearest neighbors, that is, the majority class label in the set of the selected k instances is returned.
- In KNN regression, the average value of the target function values of the nearest neighbors is returned as the predicted value.

By using a specified number k≥1, you can control the tradeoff between over fitting prevention and resolution. Overfitting prevention might be important for noisy data. Resolution might be important to get different predictions for similar instances. The KNN algorithm can compete with the most accurate models because it makes highly accurate predictions. Therefore, you can use the KNN algorithm for applications that require high accuracy but that do not require a human-readable model. The quality of the predictions depends on the distance measure. Therefore, the KNN algorithm is suitable for applications for which sufficient domain knowledge is available. This knowledge supports the selection of an appropriate measure.

The KNN algorithm is a type of lazy learning, where the computation for the generation of the predictions is deferred until classification. Although this method increases the costs of computation compared to other algorithms, KNN is still the better choice for applications where predictions are not requested frequently but where accuracy is important

Problem Formulation:

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

The biometrics have a noteworthy advantage over conventional authentication methods generally passwords, id proof, PIN numbers, smart cards etcz* have no significance in recent era as they lag security and due to this fact signature verification is gaining a dominant importance as characteristics of the individual are not simply transportable and are often unique for every individual and cannot be misplaced, stolen or broken down. The biometric solutions depend on several factors which include:

- User reception
- Cost and execution time
- Level of security needed
- precision

The technique of signature verification observed in this paper is advantageous to potential customers. The exercise of the signature has an extensive history which goes to the manifestation of writing itself. Operation of the signature as an authentication and certification method has already become a custom in today time. As we know the signature of an individual is an established proof of identity and any work say transaction performed by a person needs proper security. Hence the users are more expected to support such computerized authentication and validated method.

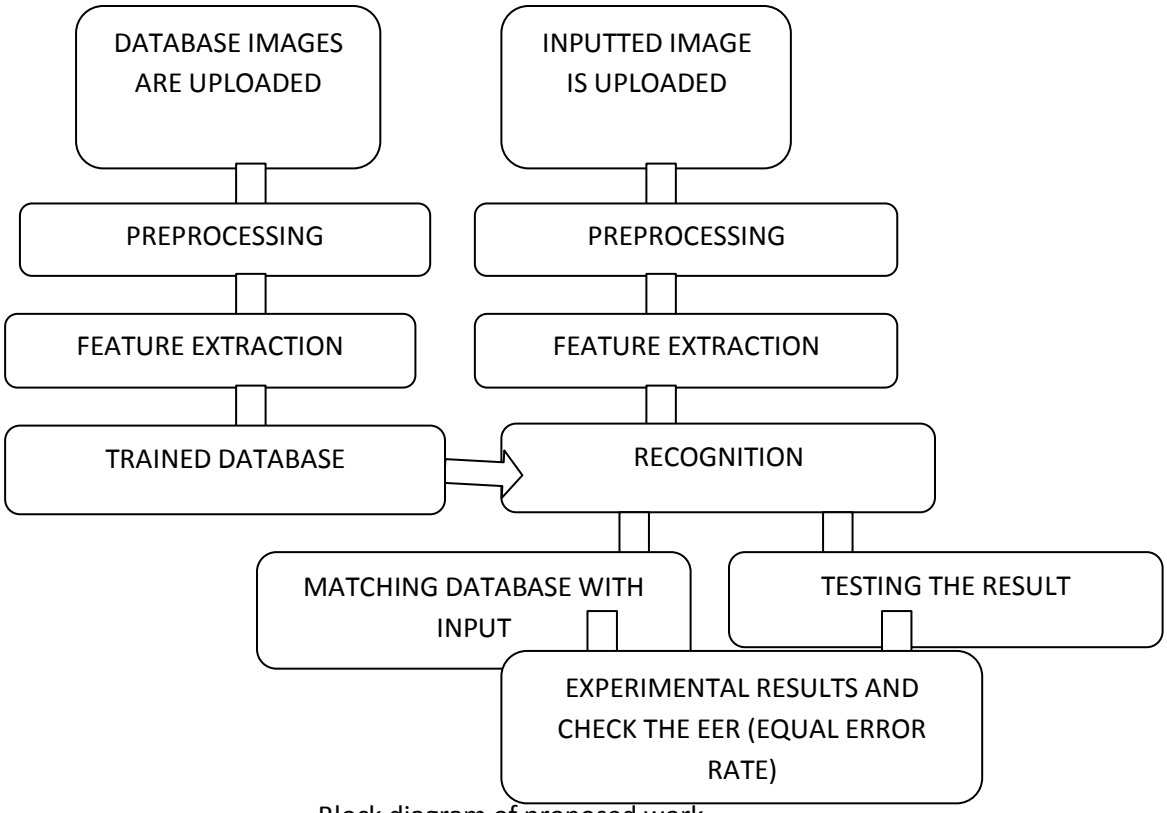
Objectives

- To make an improved offline signature recognition system by using Neural Network and Surf with KNN.
- 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 existing system has some drawbacks their problems are not unique, easy malpractice was possible, easily traceable by intruders, low reliability and no unique identification.

- The features must be reasonably robust to operating conditions and should yield good differences across individuals.
- Several Parameters has been proposed for Signature Recognition previously but there have been always a desire for enhanced parameters to improve recognition and identification.
- The existingFAR (FalseAcceptance Rate), FRR (False Rejection Rate), FAR (FalseAcceptance Rate) and EER (Equal Error Rate) was poor.
- The existing Signature Recognition Technique was less accurate as it used Lib SVM with RBF kernel rather than Neural Network and KNN.
- Many signature verification techniques have been projected previously but they were not protected enough as they get interpose temporary and thus the task was not fulfilled.

Block Diagram of Proposed Work



Block diagram of proposed work

Here, the method of the projected work for the offline signature recognition system is explained. Firstly the phases of the offline signature recognition system were explained and then the algorithms used in the method were mentioned. The following steps were performed in obtaining in recognizing the image.

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 150 handwritten signature images of 10 persons on the network that is trained with another set of 120 images of same subjects. The proposed algorithm is implemented as an practical and helpful for signature verification sand identification system. Then 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. In the proposed work Equal Error Rate (EER) achieved is 14.64 which are better than previous result.

Future Work

Signature Verification is most latent in terms ofsuppleness and execution. There are numerous aspects for e.g. Less execution cost, easy to employ and trouble-free in implementing the system in an association, group, or business .We can also extend our research to work on the different scanned images simultaneously. Also in future moreparameters like by enhancing the number of pixels quality can be considered. As we can alsoextend this work for the infinite number of users. We can further apply new formulas oralgorithm for the enhancement of accuracy in detection of signatures and reducing time forexecution. The proposed algorithm can be implemented on different tools also.

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