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OFFLINE SIGNATURE RECOGNITION SYSTEM USING RADON TRANSFORM WITH GENETIC ALGORITHM

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ABSTRACT

Hand handwritten signatures are generally acknowledged as a method for archive confirmation, approval and individual check. For legitimateness most archives like bank checks, travel visas and scholastic declarations need to have approved handwritten signatures. In modern world where extortion is widespread, there is the requirement for a programmed HSV (Handwritten signature verification) framework to supplement visual confirmation. Automated signature verification is as vital as other programmed distinguishing proof frameworks; however they vary from different frameworks that depend on ownership of keys and so forth or learning of particular individual data like passwords. So, in this proposed work signature recognition will be done using Radon Transform, GA and Neural network. The proposed work has divided into 2 panels: training and testing panel. In training panel training will be done using neural network. Then in testing panel testing is done using Radon Transform and GA. In the end performance has been evaluated using FAR, FRR and accuracy in MATLAB 7.10 simulation. From the results it has been calculated that neural network works much better as compared to existing technique.

KEYWORDS: Offline Signature Recognition; Radon Transform; Back Propagation Neural Network (BPNN) and Genetic Algorithm.

INTRODUCTION

An extensive variety of systems require dependable individual recognition schemes to either confirm or decide the identity of an entity requesting their services. The reason of such schemes is to make sure that the render services are access only by a rightful user, and not anyone else. Example of such applications includes secure access to buildings, computer systems, laptops, cellular phones and ATMs. In the nonexistence of strong personal recognition schemes, these systems are susceptible to the wiles of an impostor [1, 2]. Biometric recognition, or just biometrics, refers to the mechanical recognition of persons based on their physiological and behavioral individuality. Most of the existing biometric systems developed were based on single biometric features (fingerprint, ear, face, iris and so on). Each biometric trait has its own strength and weakness.

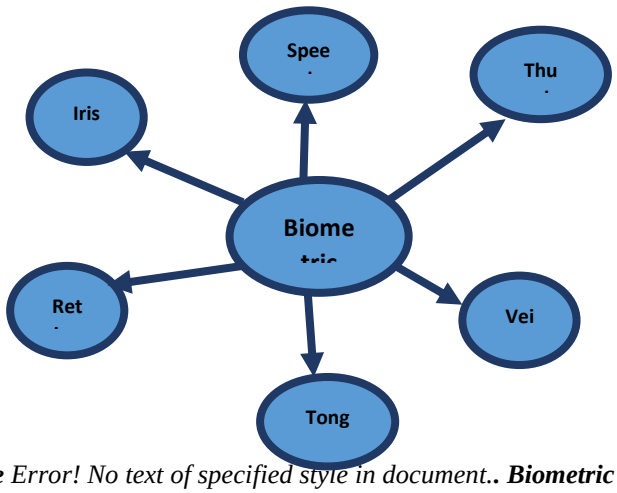

Figure** Error! No text of specified style in document.. **Biometric Traits

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Some of the problem with fingerprint recognition system is fingerprint images have been observed to have poor ridge details. Similarly, face recognition system fails due to variation in facial expression. Hence while developing biometric systems the choice of biometric traits is important in order to achieve better performance. Multimodal systems available are face and ear, face and fingerprint, palm print and face, etc [10, 11].

Deng et.al [4] developed a system that uses a closed contour tracing algorithm to represent the edges of each signature with several closed contours. The curvature data of the traced closed contours are decomposed into multi resolution signals using wavelet transforms. The zero crossings corresponding to the curvature data are extracted as features for matching. A statistical measurement is devised to decide systematically which closed contours and their associated frequency data are most stable and discriminating. Based on these data, the optimal threshold value which controls the accuracy of the feature extraction process is calculated. Matching is done through dynamic time warping.

Fang et.al [5] proposed two methods for the detection of skilled forgeries using template matching. One method is based on the optimal matching of the one-dimensional projection profiles of the signature patterns and the other is based on the elastic matching of the strokes in the two-dimensional signature patterns. Given a test signature to be verified, the positional variations are compared with the statistics of the training set and a decision based on a distance measure is made. Both binary and grey-level signature images are tested. The average verification error rate of 18.1% was achieved when the local peaks of the vertical projection profiles of grey-level signature images were used for matching and with the full estimated covariance matrix incorporated.

Fang et. al [6] Verification performance is affected by the variation of signature stroke widths and a registered signature selected from a set of reference samples in off-line signature verification using a pattern matching. There are inevitable variations in the signature patterns written by the same person. The variations can occur in the shape or in the relative positions of the characteristic features. This paper proposed two methods based on projections and strokes.

The remainder of this paper is organized as the following. At first, in Section II we illustrate the various components of our proposed technique to offline signature verification. Further, in Section III we present some key experimental results and evaluate the performance of the proposed system. At the end we provide conclusion of the paper in Section IV and state some possible future work directions.

PROPOSED TECHNIQUE

This section illustrates the overall technique of our proposed signature verification. In our proposed work we present “Offline Signature Recognition System using Radon Transform with Genetic Algorithm”. In previous purposed work, the signature verification work is proposed with neural network without optimization. So we proposed signature verification system with the optimization technique and we use the Genetic Algorithm for feature optimization. The main objective of our proposed work is given below:

1. Use Genetic Algorithm for the feature reduction and optimization purpose.
2. The average recognition accuracy from 90% to 99%.
3. We can use training set of 100–150 persons.

SIGNATURE BIOMETRICS

Handwritten signatures are generally acknowledged as a method for archive confirmation, approval and individual check. For legitimateness most archives like bank checks, travel visas and scholastic declarations need to have approved handwritten signatures. Biometrics can be arranged into two sorts; physiological and behavioral. Physiological biometrics measure some physical elements of the subject like fingerprints, iris, hand and finger geometry which are steady after some time. Behavioral biometrics measures client activities like talking, composition and strolling which are influenced by wellbeing, age and physiological elements. A mark is a behavioral biometric described by behavioral quality that an essayist learns and obtains over a span of time and turns into his novel character. HSV frameworks are suited for fraud identification as they are shoddy and non-intrusive and give an immediate connection between the author's character and the exchange. The target of signature verification is to separate in the middle of unique and manufactured mark, which are identified with intra-individual and between individual variability. Intra-individual variety is variety among the marks of the same individual and between individual is the variety between the firsts and the imitations. We make a qualification between signature recognition and signature verification.

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RADON TRANSFORM

The radon function computes projections of an image matrix along specified directions. A projection of a two-dimensional function f(x, y) is a set of line integrals. The radon function computes the line integrals from multiple sources along parallel paths, or beams, in a certain direction. The beams are spaced 1 pixel unit apart. To represent an image, the radon function takes multiple, parallel-beam projections of the image from different angles by rotating the source around the center of the image. The following figure shows a single projection at a specified rotation angle.

The radon transform is projections of an image matrix along specified directions. The Radon Transformation is a fundamental tool which is used in various applications such as radar imaging, geophysical imaging, non-destructive testing and medical imaging. A projection of a two-dimensional function f(x, y) is a set of line integrals. The radon transform computes the line integrals from multiple sources along parallel paths, or beams, in a certain direction. The beams are spaced 1 pixel unit apart. To represent an image, the radon transform takes multiple, parallel-beam projections of the image from different angles by rotating the source around the center of the image. Projections can be computed along any angle. In general, the Radon transform of f(x, y) is the line integral of f parallel to the y´-axis.

$R(x') = f(x'\cos\alpha - y'\sin\alpha, x'\sin\alpha + y'\cos\alpha)dy'\ \alpha$

GENETIC ALGORITHM

Genetic algorithm modifies the new population and generates new solutions until best solution has not been reached. From large set of population, genetic algorithm uses the random chromosomes to make it parent then make it to produce children. The repetition goes on until good solutions have not been achieved on the basis on the fitness function. Firstly, we load all extracted feature point for the feature reduction process. Before applying Genetic Algorithm we need to initialize the GA basic function using 'optimset' function like population size, mutation function, crossover etc. After that we use 'GA' function for feature reduction according to the fitness function. We set fitness function according to our requirement like which type of feature we can use for classification purpose. Genetic algorithm (GA) is a method for solving both constrained and unconstrained optimization problems based on a natural selection procedure with the purpose of mimic biological evolution. The algorithm repeatedly modifies a population of entity solutions. At every stage, the genetic algorithm randomly selects individuals from the feature vector. The fitness function value must be for feasible solution must high than the in-feasible solution. Fitness function is vital to the performance of GA. In our approach, fitness function is defined by a two-step process. During the first step, the optimized change is used to verify the global consistency between two sets of feature. In the second step, local properties of the feature are used to verify the detailed matching. In proposed work, Fs is the current selected feature and Ft is the threshold value of feature points. On the basis of given condition we check the fit value which can exist in new feature set.

$$f(fit) = \begin{cases} 1, & fs < ft \\ 0, & fs \geq ft \end{cases}$$

Where f(fit) is fit value according to the fitness function. According to fitness function of GA, we have optimized the feature point and we got more appropriate feature value according to fitness function. Here 1 (true) and 0 (false) represent the feature value, if Fs is less than Ft then selected value is true and store, if Fs doesn't satisfy the condition then selected feature value Fs is false and not store as optimized features.

NEURAL NETWORK

Machine learning algorithms facilitate a lot in decision making and neural network has performed well in categorization purpose in medical field. Most popular techniques among them are neural network. Neural networks are those networks that are the collection of simple elements which function parallel. A neural network can be trained to perform a particular function by adjusting the values of the weights between elements. When we extract the optimized feature using GA then we train data using Neural Network for the classification purpose. The initialization is done using the syntax "newff" in MATLAB. It accepts three parameters, the first one is the training the data, second one is the group to which each element of the data belongs to and the third is the number of hidden neurons in one hidden layer.

RESULT & EVALUATION

To verify the effectiveness (qualities and robustness) of the proposed Offline Signature Recognition System using Radon Transform with Genetic Algorithm. We conduct several experiments with this procedure on several signature images. There are some steps of our proposed technique are given below:

Step1. Upload signature images database and it is called training section for proposed work.

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Step2. Find the feature vector for database images and generate the code for genetic algorithm to optimize the feature vector according to the fitness function of genetic algorithm and save all optimized feature vector.
Step3. Initiate the Neural Network and provide the extracted and optimized feature set to neural network as the input of neural network and train feature data and save into different categories according to the feature.
Step4. After the training section we develop the code for classification purpose and firstly upload the test signature image.
Step5. Find the feature of test signature image and use feature optimization using GA according to the fitness function and simulate with save neural network structure and find the classification result.
Step6. After that at the last of proposed work we the parameters metrics like FAR, FRR and Accuracy.

Flow Diagram of proposed work:

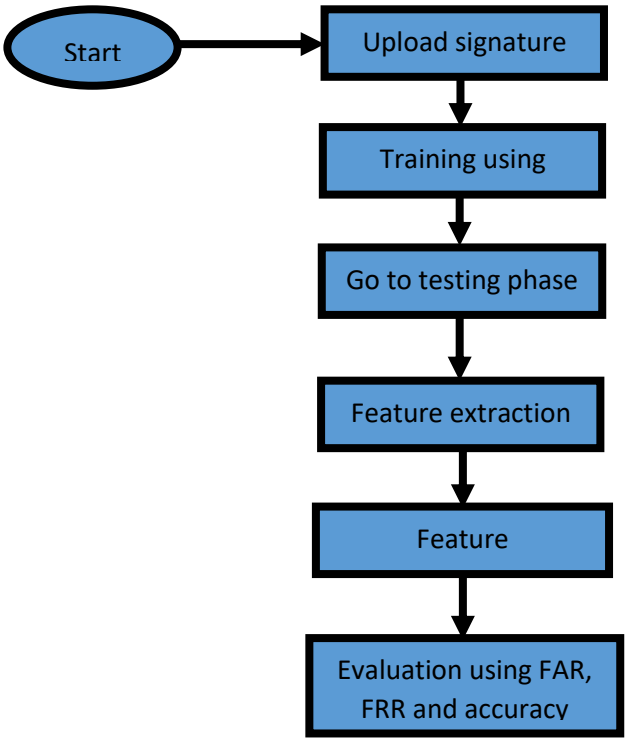

Figure: 2. Flow chart of proposed method

RESULT

When we simulate our implementation then we got these result which more accurate than previous work:

Figure 3. Woking Panel

The whole simulation has been taken place in MATLAB environment 2012a using GA and Neural Network.

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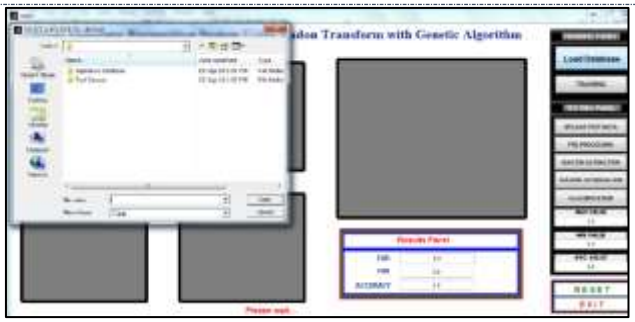

Figure 4. Biometric Authentication Main GUI

In above figure, we have displayed the main GUI of our proposed work. In this we have three panels which are traing and testing panel with a parameter panel also.
In training panel, we have given button for training.
In testing panel, we have given for buttons in which: first upload test image of signature, feature extracion using Radon Transform, feature optimization using GA.
In third panel, parameters used are shown with their values which are False Acceptance Rate, False Rejection Rate, and Accuracy values.

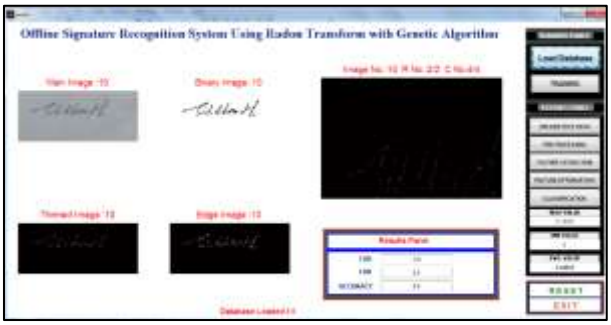

Figure 5 Signature GUI and Upload signature image

When we click on signature button a signature GUI will appear in different dialog box. In which we upload the image, then convert it into grey scale image as shown in above figure.

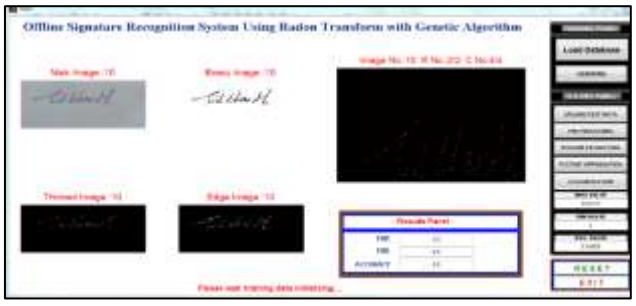

Figure 6. Training using NN

Above figure shows the Training using NN being processed.

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Figure 7 Uploading of Test Image

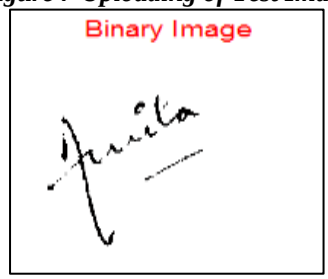

Figure 8 Pre-Processing of image

Figure 9 Feature Extraction

Above figure shows the feature extraction process using Radom algorithm in which feature points has been saved.

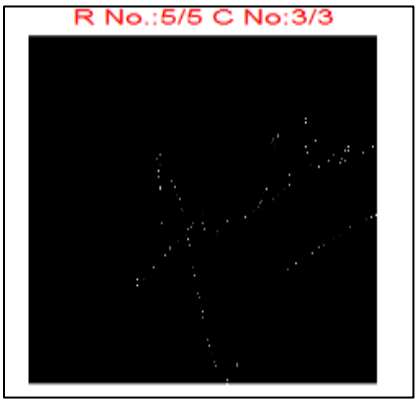

Figure 10 Feature Optimization

Above figure shows the feature optimization process using GA, in which optimization has been done using fitness function.

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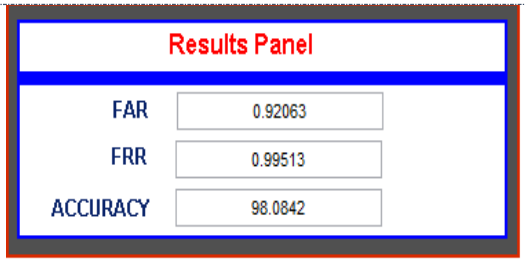

Figure 11 Results Evaluation

In above figure result evaluation has been done using FAR, FRR and accuracy.

Table: Proposed Work Implementation

IMAGE NO.	FAR	FRR	ACCURACY
1	.923963	.995005	98.0831
2	.913697	.995040	98.01263
3	.92051	.995012	98.02938
4	.92214	.995038	98.00748
5	.92191	.995011	98.02798
6	.92439	.995031	98.08530
7	.92968	.995039	98.00998
8	.92214	.995001	98.09785
9	.92310	.995018	98.04672
10	.92513	.995014	98.03473

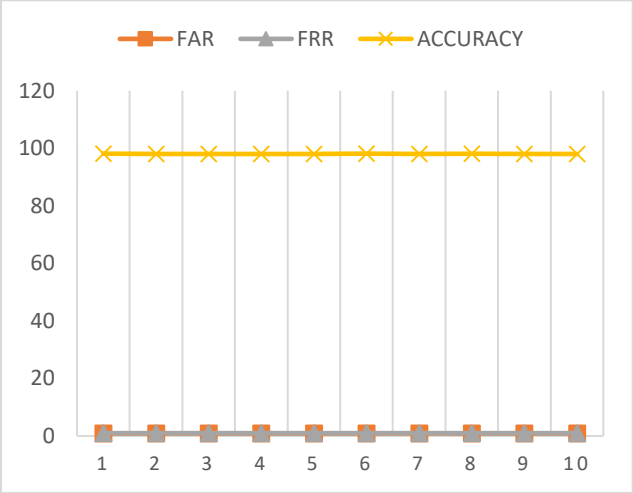

Figure 12 Comparison Graph between Metrics

CONCLUSION

In this paper we "Offline Signature Recognition System using Radon Transform with Genetic Algorithm".
In this work it has been shown that if a signature image of a person is given then the network can recognize the image. The whole work is completed through the following steps:

1. Various signature images have been used for the experiment. Signature images of various persons have been collected by taking different samples of each person.

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2. Each image is converted into grayscale conversion to get the edges of the image.
3. Radon Transform method has been used for feature extraction of Signature samples.
4. Radon Transform method has been used for feature extraction of thumbprint samples.
5. Back Propagation neural network, have been used to train, the network for each part of the image.
6. Output of all samples are collected and set as the new input and a new target is set to train, test and validate the entire parts of each sample.
7. Image division in this work has been done by using a MATLAB tool.
8. Obtained accuracy = 98.03%.

In future we can use genetic algorithm with BFA for more accuracy and to improve the quality of image. The aim of this survey is to provide an overall view of the available signature verification techniques. This will help for the researchers who are willing to develop a new signature verification technique for signature images.

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