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NEURAL NETWORK BASED BIOMETRIC TECHNOLOGY FOR FINGERPRINT CLASSIFICATION

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Abstract

Fingerprints are widely used for the identification purpose in the fields of data and information, mobile applications, mobile security, automatic locks and guards as it is one of the unique features of a person and security is ensured. No two humans have the same fingerprints and this set up the pathway for researchers to innovate applications and usages of this unique human asset. Due to the reliable nature of this asset, there is an urge to use this feature in a very high security demanding fields like military, secure transactions, secret missions, very confidential information storage and retrieval of nation's concern. For effective retrieval, the fingerprints should be matched with an authenticated user fingerprints. To implement this Fuzzy Neural networks plays a key role. In this paper and efficient algorithm is developed that recognises the fingerprints of the corresponding users accurately.

Keywords: Fuzzy Neural Network, Fingerprint classification.

1. Introduction

For identifying a person as a part of security constraints, identification of fingerprints is widely used in several applications

In most recent couple of years recognizable proof of fingerprint is generally utilized as a part of numerous applications like ID of individual. Fingerprint arrangement is the procedure of partitioning a lot of unique finger impression database inside which the information fingerprint is initially decided and after that an order is done to watch the arrangement of same class. A database as a rule contains various fingerprints with various number of individual components.

The recognizable proof of information unique mark inside this database turns into a to a great degree long process. Hence arrangement of fingerprint can expand the rate of distinguishing proof. The info fingerprint is characterized among the arrangement of classes of unique finger impression database. In this manner every fingerprint is just need to

coordinate against the comparing class contained in database. Numerous fingerprint order techniques have been proposed till now like introduction field stream bends strategy and quality based technique. Few of them shows chart based representation and few of them shows basic representation. Some method utilizes a standard fingerprint database to order fingerprint pictures into six classes curve, tented curve, right circle, left circle, and whorl and twin circle utilizing back spread.

This paper manages the execution of an example coordinating calculation to coordinate and confirm fingerprints. The calculation utilizes Neural Network ideas to perform powerful example coordinating to recognize fingerprints. The idea depends on picture preparing strategies to find the fingerprints highlights utilizing unique finger impression investigation by minute. fingerprints handling must give back the match of each of these elements. In spite of the fact that any pair of relating highlight qualities might be same for two people, the mix of all the qualities may never be the same. Consequently a powerful and novel ID parameter is found for every person. A fingerprints is a graphical example of edges and valleys on the surface of a human finger. Because of the uniqueness and lastingness of fingerprints, they are among the most solid human attributes that can be utilized for individual distinguishing proof. The execution of a programmed unique finger impression distinguishing proof framework depends vigorously on the fingerprints impression picture quality which can be influenced by a few elements, for example, the nearness of scars, varieties of the weight between the finger and procurement sensor, worn ancient rarities, and the natural conditions amid the obtaining procedure. For developing a powerful fingerprints recognizable proof framework, a successful upgrade calculation is fundamental. Directional conduct is a conspicuous trademark in a fingerprints impression picture brought about by the constant stream of fingerprints impression edges whose introductions are gradually changing in the finger impression design. Edges and valleys in a nearby neighbourhood frame a sinusoidal formed

wave, which has an all around characterized recurrence and introduction. The edge introductions and also the edge time frame are kept up verging on consistent inside a little neighbourhood. The essential thought for improving a unique mark is to first distinguish the introductions of the edges, and afterward a smoothing operation is performed along the edge bearings to evacuate the commotion. Edge introductions can be assessed straightforwardly from a dim scale picture utilizing inclination strategies and others require a twofold fingerprints picture. With the introduction data accessible, the smoothing operation is normally done by versatile channels sensitive to the comparing introduction and edge period in neighbourhood districts. Hong et al. utilized Gabor channels as soble channels to evacuate the commotion and hold genuine edge and valley structures, and highpass channel that is utilized to improve the picture. The traditional phases of upgrade and edge identification are binarization, improvement, highlight extraction, preparing and coordinating. The essential major strides of these frameworks are picture securing, pre-preparing division, upgrade and highlight extraction, coordinating alongside order through databases. Confirmation or check frameworks validate the individual's character by looking at the own biometric template(s) put away in database (One-to-One correlation). A distinguishing proof framework is perceived by a person via seeking the whole formats in database for match (One-to-Many Comparison).

The present status of the issue is that quantities of fingerprints are gathered in order to check whether the framework is knowledgeable to recognize the fingerprints of the same client and recognize the fingerprints of various clients. A dataset is gathered and put to preparing so that the framework figures out how to which client this specific specimen has a place. Different other particulars subtle elements like the structure of particulars and other internal points of interest are put to study to prepare the framework.

A unique finger impression is the component example of one finger. Every individual has his own fingerprints with the perpetual uniqueness. Because of the uniqueness and perpetual quality of fingerprints, they are among the most solid human attributes that can be utilized for individual distinguishing proof. Various techniques are utilized to obtain fingerprints. Among them, the inked impression technique remains the most well known one. Inkless unique mark scanners are additionally present disposing of the middle of the road digitization process. Unique mark quality is critical since it influences specifically the particulars extraction calculation. The span of the examined fingerprints that are utilized as a part of this exploration is 188x240 pixels. The pictures are taken in this size with a specific end goal to facilitate the computational weight. This paper puts the usage of Artificial Neural Networks to give a proficient coordinating calculation to unique finger impression validation. Utilizing the Feed-Forward strategy, the calculation

attempts to match nine unique mark parameters and relate them to an interesting number accommodated each approved client. After coordinating, the calculation ought to give back the best match for the given unique mark parameters.

The system experiences procedure of preparing, consistently in an iterative way it figures yield from every layer, extricating the mean square blunder and spreading it in reverse on the off chance that it is not drawing nearer targets. Because of this retrogressive mistake spread, blunder signal for every neuron is ascertained. This truth be told is utilized for neuron weight overhauling. On the off chance that its drawing nearer targets then preparing is viewed as done. The procedure of preparing these pictures is done, in which preparing bend is drawing nearer its objective through correction of weights and predispositions. The reaction of the Neural Network is needy upon weights, inclinations and initiation capacities. The actuation capacities utilized as a part of the food forward back proliferation neural system are Tangent sigmoid (tansig) utilized as a part of concealed layer and purelin utilized as a part of yield layer. These capacities goes about as summation intersection and computes the yield from the inputs introduced. After the preparation stage is finished, the ID procedure must be executed keeping in mind the end goal to assess the proposed framework. The assessment procedure is proficient by testing the framework with known and recently fingerprints pictures. New pictures for testing are connected to the prepared neural system alongside effectively prepared pictures for ascertaining the rate of precision and mistake. An arrangement of unique mark tests are utilized to test the proposed framework.

The whole source code has been composed in Matlab. This work manages acknowledgment unique mark utilizing low determination pictures through Neural Networks. In the proposed strategy picture resizing is connected to a bound together picture size for all unique mark tests. Keeping in mind the end goal to achieve unique finger impression acknowledgment errand, a solitary neural system is joined. Usage is separated into two stages. The pre-handling stage and the neural preparing stage. In Pre-handling stage time compelling pre-preparing is performed keeping in mind the end goal to make picture information best fit for neural system info. Unique finger impression Identification System has 9 qualities from every unique mark. The framework prepared 30X150 image as contribution for database utilizing the proposed system and looked at their execution.

2. Related Work

The utilization of unique mark in biometric distinguishing proof has been the most broadly utilized confirmation framework. The uniqueness of the unique mark for each human gives every one of us we requirement for impeccable ID. In any case, amid the unique mark filtering process, the picture produced by the scanner might be marginally

diverse amid every output. This paper puts the usage of Artificial Neural Networks to give a proficient coordinating calculation to unique mark verification. Utilizing the Back-Propagation strategy, the calculation attempts to match twelve unique mark parameters and relate them to a novel number accommodated each approved client. After coordinating, the calculation gives back the best match for the given unique mark parameters.

The quick, solid, and automated grouping and coordinating of unique mark pictures is a surprising issue in example acknowledgment that has not, to this date, got a complete arrangement. Mechanized unique finger impression acknowledgment frameworks could on a fundamental level have a to a great degree extensive variety of utilizations, well past the customary spaces of criminal equity and, for occasion, render the utilization of locks and distinguishing proof cards outdated. Our motivation here is to give a brief record of our preparatory results on the use of neural system thoughts to the issue of unique finger impression coordinating. Specifically, we might depict the engineering, preparing, and testing of a neural system calculation that, when given two unique mark pictures, yields a likelihood p that the two pictures start from the same finger. There are a few motivations to suspect that neural system methodologies might be amazingly appropriate for unique finger impression issues. To start with, fingerprints shape a certain class of examples with exceptionally impossible to miss flavor and measurable attributes. Hence the relating design acknowledgment issues appear to be all around restricted and obliged, maybe significantly more so than in other example acknowledgment issues, for example, the acknowledgment. Neural Computation 5,402-418 (1993) @ 1993 Massachusetts Institute of Technology Neural Networks for Fingerprint Recognition 403 of written by hand characters, where neural systems have as of now been connected with sensible achievement. Second, neural systems could maintain a strategic distance from a portion of the pitfalls natural to other more routine methodologies. It has been known for over a century that sets of unique mark pictures can be coordinated by human administrators on the premise of minutia and/or edge introductions. Details are specific sorts of discontinuities in the edge examples, for example, bifurcations, islands, and endings. There is regularly of the request of 50 to 150 details on a complete unique mark picture. Ten coordinating details or so are normally evaluated as adequate to dependably build up personality. To be sure, it is this methodology in view of minutia location and coordinating that has been embraced in a large portion of the past endeavors to discover robotized arrangements. The minutia-based methodology has two clear shortcomings: it is delicate to clamor (particularly with inked fingerprints, little irritations can make counterfeit minutia or camouflage existing ones) and computationally costly since it is basically a chart coordinating issue. Third, neural systems are strong, versatile, and trainable from cases. This is especially essential since unique finger impression pictures can

incorporate a few distinctive wellsprings of misshapening and clamor running from the fingers and their situating on the gathering gadget (interpretation, move, turn, weight, skin condition) to the accumulation gadget itself (ink/optical). Moreover, watch that the prerequisites as far as pace, processing power, likelihood of false acknowledgment and false dismissal, memory and information base size can differ extensively relying upon the application considered. To get to a private living arrangement or private auto, one needs a little monetary framework with a little modifiable information base of a couple people and a reaction time of at most a few moments. Then again, criminological applications can require quick ventures through vast information bases of a huge number of records utilizing substantial PCs and a reaction time that can be longer. Neural systems can be custom-made and prepared contrastingly to fit the specific necessity of particular applications. Unique mark coordinating is a standout amongst the most prevalent and dependable biometric procedures utilized as a part of programmed individual identification. There are two principle applications including fingerprints: fingerprint verification and fingerprint identification. While the objective of fingerprint verification is to check the personality of a man, the objective of fingerprint identification is to set up the character of a man. Specifically,fingerprint identification includes coordinating an inquiry fingerprint against a fingerprint database to build up the personality of a person. To lessen seek time and computational many-sided quality, fingerprint classification is typically utilized to decrease the pursuit space by part the database into littler parts. Coordinating is typically in view of lower level components dictated by singularities in the finger edge design known as details. Give the details representation of fingerprints, fingerprint coordinating can basically be seen as a point coordinating issue. In this setting, coordinating two fingerprints infers finding a subset of details in the first fingerprint that best match to a subset of particulars in the second fingerprint through a geometric change in an ideal sense (i.e., minimum squares). Other than coordinating two fingerprints together, the fundamental issue when managing substantial fingerprint databases is the manner by which to choose the most comparable fingerprints to the inquiry fingerprint from the database.

Both of these issues seem all the time in PC vision, especially, in item acknowledgment. Therefore, techniques for article acknowledgment have much just the same as fingerprint identification strategies.

In most recent couple of years ID of unique mark is broadly utilized as a part of numerous applications like recognizable proof of individual. Unique mark arrangement is the procedure of partitioning a lot of unique mark database inside which the information finger impression is initially decided and afterward a characterization is completed to watch the arrangement of same class. A database for the most part contains various fingerprints with

various number of individual components. The ID of information unique mark inside this database turns into a to a great degree long process. In this way order of unique mark can build the velocity of ID. The information unique mark is arranged among the arrangement of classes of unique mark database. Along these lines every unique mark is just need to coordinate against the comparing class contained in database. Numerous unique mark grouping strategies have been proposed till now like introduction field stream bends technique and quality based strategy.

Few of them shows diagram based representation and few of them shows auxiliary representation. In some system utilized a standard unique finger impression database to arrange unique finger impression pictures into six classes curve, tented curve, right circle, left circle, whorl and twin circle utilizing back proliferation calculation.

3. Methodology

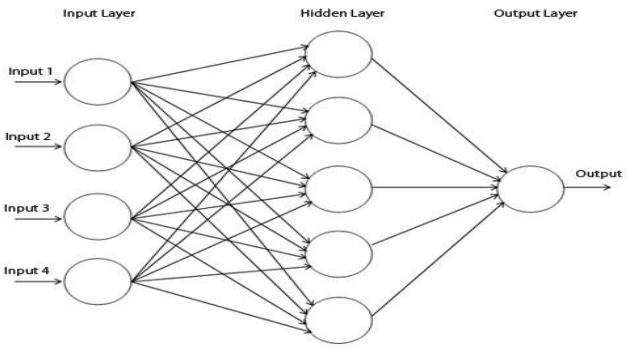
3.1.1 Neural Network

Neural network is system which has the same analogy as the biological neural system. The neural network consists of set of inputs (x_1, $x_2 \ldots x_n$) which is multiplied by multiple weights (w_1, $w_2 \ldots w_n$) which gives us output. The weights are included in the hidden layers of neural network. A neural system is a computational structure propelled by the investigation of biological neural processing. There are a wide range of sorts of neural systems, from moderately easy to extremely perplexing, pretty much as there are numerous hypotheses on how biological neural systems functions [6-9]. A layered feed forward neural system has layers, or subgroups of preparing components. A layer of preparing components makes autonomous calculations on information that it gets and passes the outcomes to another layer. The following layer may make its autonomous calculations and go on the outcomes to yet another layer. At last, a subgroup of one or additionally handling components decides the output from the system. Every handling component makes its calculation based upon a weighted entirety of its inputs [10,11]. The main layer is the info layer and the last the yield layer. The layers that are set between the first and the last layers are the hidden layers. The handling components are seen as units that are like the neurons in a human mind, and subsequently, they are alluded to as cells, neuromimes, or artificial neurons. An edge function is once in a while used to qualify the output of a neuron in the output layer. Neurotransmitters between neurons are alluded to as associations, which are spoken to by edges of a coordinated diagram in which the hubs are the fake neurons. Nets comprise of little units called cells, and these are associated with each other in a manner that they can pass signs to each other. The weights utilized on the associations between various layers have much importance in the working of the neural system and the portrayal of a system. The accompanying activities are conceivable in a neural system:

1. Begin with one arrangement of weights and run the system. (No Training)

2. Begin with one arrangement of weights, run the system, and change a few or all the weights, and run the system again with the new arrangement of weights. Rehash this procedure until some foreordained objective is met. (Preparing) The associations have certain qualities or weights. The net begins off with these association qualities set arbitrarily. The system is presented to different inputs and the qualities modify them as indicated by some scientific arrangement. This is the thing that we call preparing and after it, the system can perceive info designs or, in any event, accomplish something sensible - whatever it has been prepared to do. The data is in this way put away in the qualities of the associations, pretty much as it is in the human cerebrum.

3.1.2 Architecture



Neural Network Architecture characterizes its structure including number of hidden layers, number of hidden nodes, number of output nodes and activation function

i. Number of hidden layers: The hidden layer(s) give the system its capacity to sum up. In principle, a neural system with one hidden layer with adequate number of hidden neurons is equipped for approximating any nonstop capacity. In practice, neural system with one and occasionally two hidden layers are broadly utilized and need to perform extremely well.

ii. Number of hidden hubs: There is no enchantment recipe for selecting the ideal number of hidden neurons. Be that as it may, some thumb guidelines are accessible for ascertaining number of hidden neurons. A harsh guess can be acquired by the Kolmogorov theorem. For a three-layer system with n input, the hidden layer would have 2n+1 neurons.

iii. Number of output nodes: Neural system with numerous outputs, particularly if these outputs are broadly divided, will deliver second rate results when contrasted with system with a single output.

iv. Activation Function: Activation functions are scientific formulae that decide the output of a processing node. Every unit takes its net input and applies activation to it. Non liner functions have been utilized as activation

functions, for example, logistic, tanh. The motivation behind the transfer function is to keep output from achieving huge quality which can paralyze neural systems and in this way repress preparing. transfer functions, for example, sigmoid are usually utilized on the grounds that they are nonlinear and constantly differentiable which are attractive for system learning.

3.2. Experimental Setup

Hardware: 4GB RAM,

i3 processor,

128GB HDD

Windows 10

Software: MATLAB 2013

Dataset requirements:

- **150 samples of each user**
- **Details of minutiae should be clearly visible**
- **Fuzzified dataset**

Fuzzification of Input:

The initial step is to take the inputs and decide the extent to which they have a place with each of the suitable fuzzy sets through membership functions. In Fuzzy Logic programming, the input is dependably a crisp numerical value constrained to the universe of discourse of the input variable (in this case the interval somewhere between 0 and 10) and the output is a fuzzy level of membership in the qualifying phonetic set (dependably the interval somewhere between 0 and 1). Fuzzification of the input adds up to either a table lookup or a function evaluation.

Sample dataset:

Variables - finger_input

finger_input

finger_input <30x150 double>

	1	2	3	4	5	6
1	0.6736	0.2825	0.9171	0.6011	0.2256	0.3898
2	0.2939	0.3918	0.4092	0.9889	0.9966	0.0442
3	0.1421	0.2797	0.8835	0.0746	0.2276	0.0241
4	0.9633	0.5657	0.4776	0.3563	0.2722	0.8719
5	0.5705	0.3770	0.0313	0.2061	0.3484	0.9060
6	0.2049	0.1294	0.9578	0.4032	0.3673	0.3169
7	0.2638	0.1526	0.5529	0.3612	0.5408	0.7609
8	0.0908	0.7074	0.2841	0.7868	0.5488	0.6489
9	0.6785	0.2677	0.3991	0.5454	0.1065	0.8230
10	0.9415	0.8351	0.3199	0.7097	0.4854	0.8515
11	0.1532	0.1707	0.7840	0.5250	0.3752	0.2773
12	0.6673	0.6771	0.0057	0.5840	0.5343	0.1145
13	0.7816	0.2430	0.7348	0.2203	0.7620	0.6093
14	0.9012	0.6474	0.6060	0.6826	0.5708	0.1562
15	0.5092	0.3343	0.6659	0.3342	0.1620	0.0533

3.2. Model

3.2.1Feed Forward Backpropagation Algorithm:

n=1;

initialize **weights** randomly;

while (stopping criterion not satisfied or n <max_iterations)

for each example (**x**,*d*)

- run the network with input x and compute the output y

- update the weights in backward order starting from those of the output layer:

$$w_{ji} = w_{ji} + \Delta w_{ji}$$

with Δw_{ji} computed using the (generalized) Delta rule

end-for

n = n+1;

end-while;

4. Results & Discussion

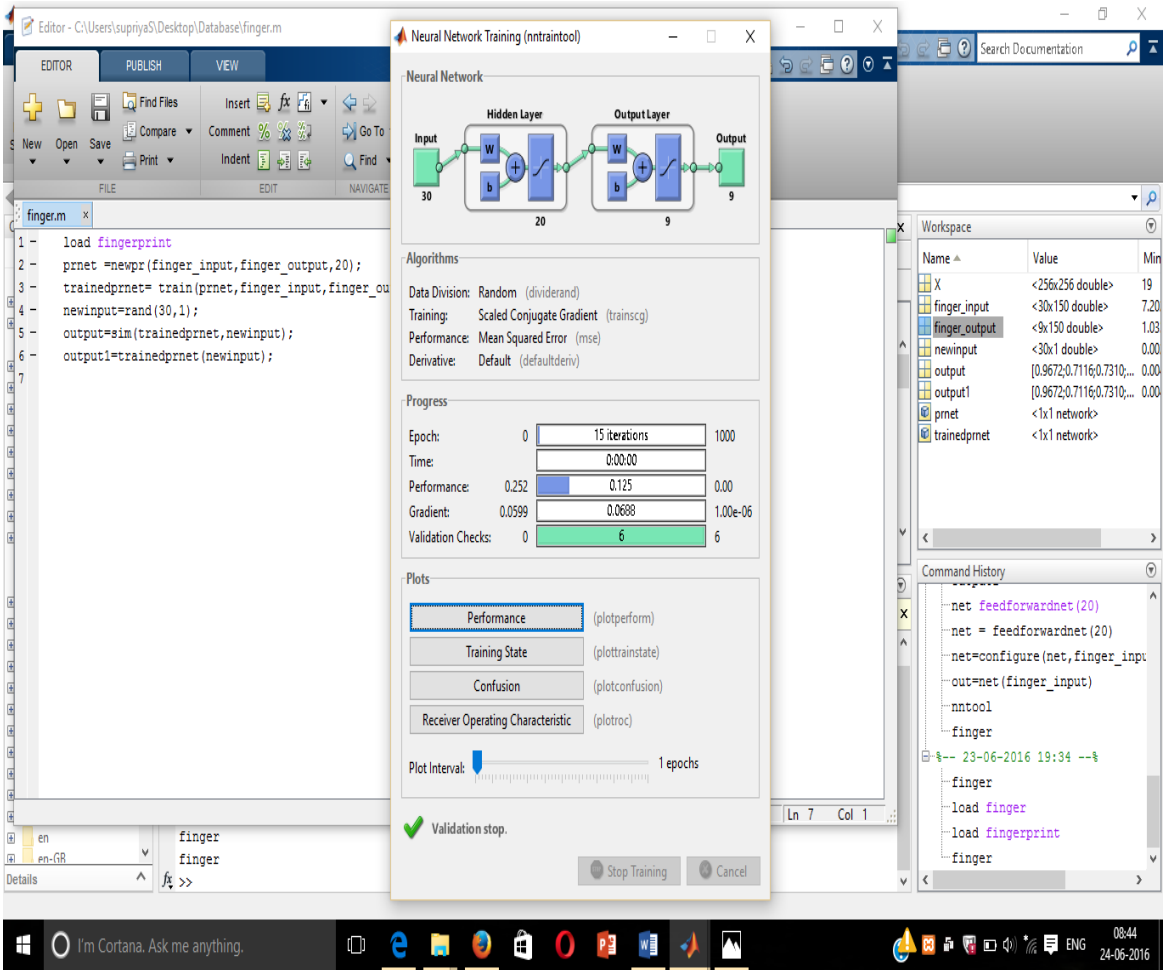


Fig1.Performance.

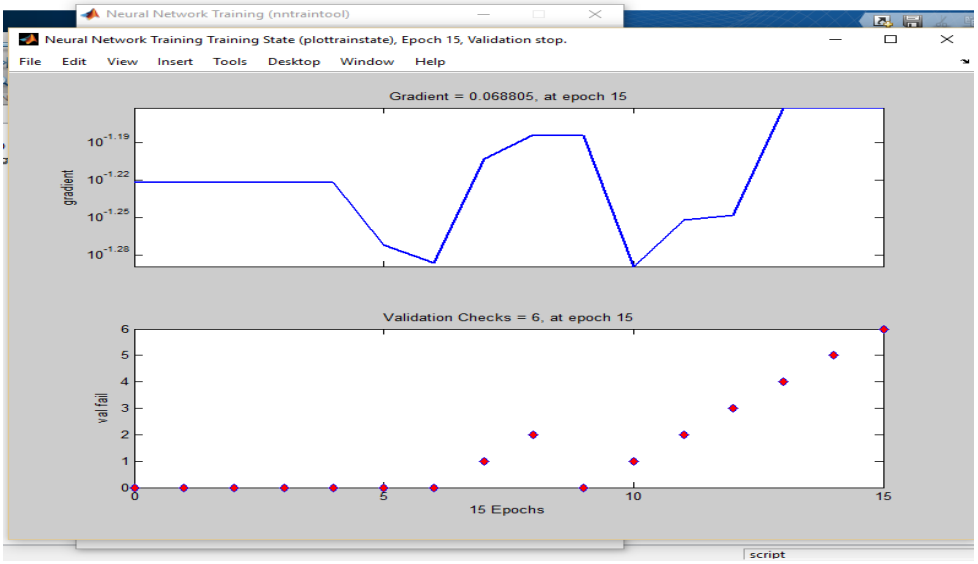


Fig2.Training State.

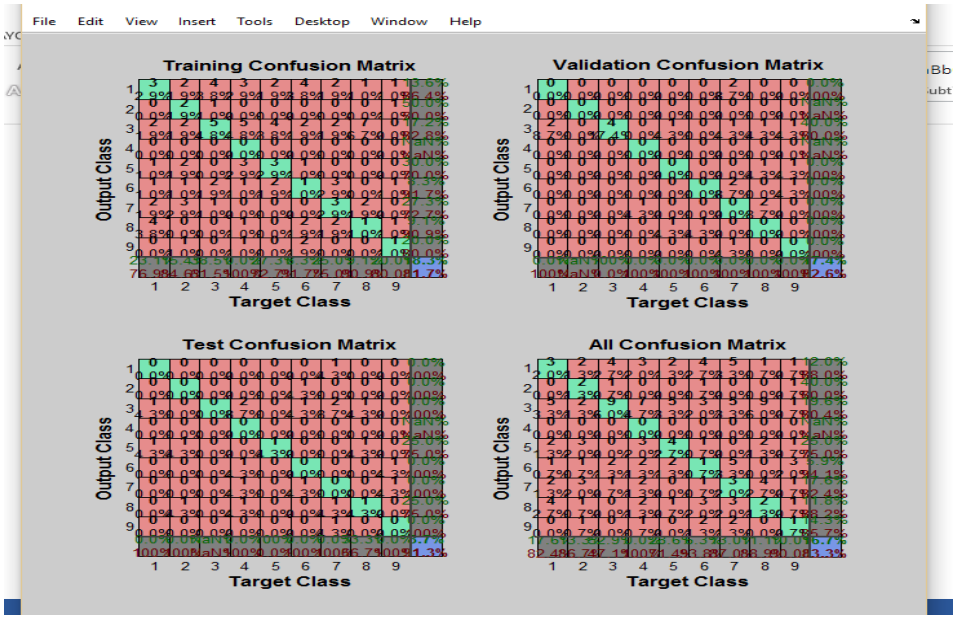


Fig.3.Confusion Matrix.

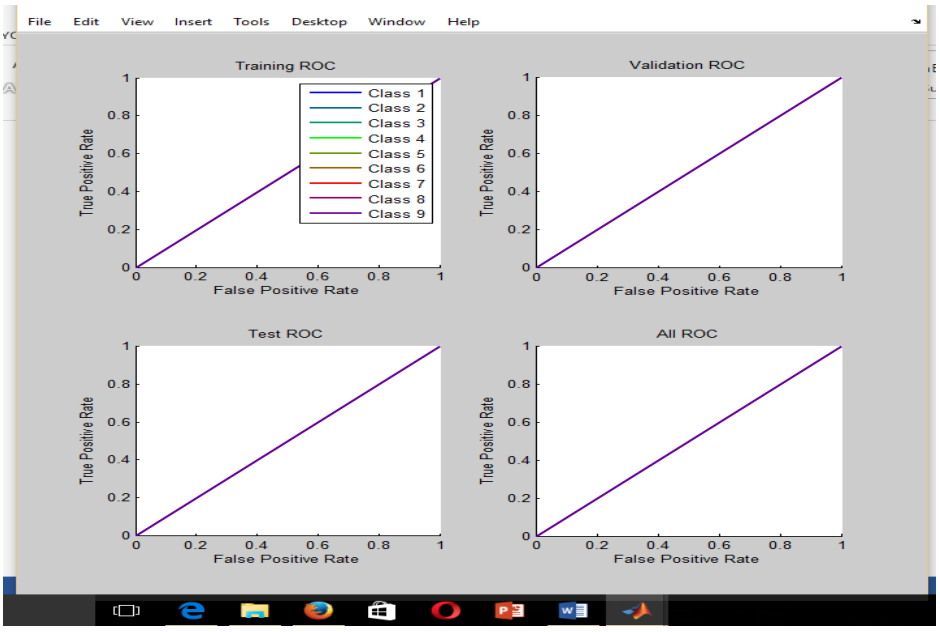


Fig4.Receiver Operating Characteristic [ROC].

5. Conclusion

It is obvious from the work that the neural systems can be utilized to illuminate the "Neural network based biometric technology for fingerprint classification" issue viably. Particularly, the feed forward neural network can be extremely helpful for taking care of the taken issue. We have experimented the feed forward neural network algorithm for recognizing the fingerprints. The inputs are fuzzified features of fingerprints which gives us the benefit of getting the values between 0 to 1. The results obtained here are more accurate having accuracy up to 92% which leads us to recognizing the fingerprint of person. However, for the blur images it is hard to extract the features and because of that fuzzification will produce wrong output so there is scope to work on blur images of the fingerprints.

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