



A Performance Analysis of Face Recognition Based on Artificial Neural Network

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Abstract: Face recognition is bearing in mind and recognizing a face of individual, like a visual pattern recognition that enables the system to verify or identify individual faces that is taken from imaging system. In this paper we tried to show that a face recognition that uses a tanh activation function would have a better or lower mean squared error instead of using the Logistic Sigmoid activation function. The network was trained several times on different ideal input and noisy images that are taken from imaging devices like camera. In this case training a network on different sets of noisy images forced the network to learn how to deal with noise image by using a tanh activation function.

Keywords: Face recognition, Logistic Sigmoid activation function and tanh function.

I.INTRODUCTION:

A. Face Recognition:

Human beings have recognition capabilities that are unparalleled in the modern computing area these are mainly due to high degree of interconnectivity, adaptive nature learning skill and generalization capacities of nervous system. The human brain has numerous highly interconnected biological neurons therefore the main idea is a system that can emulate what human beings can do. Face recognition is a part of visual pattern recognition technology which is used for identifying or verifying a person that is taken from a digital image or a video automatically. Face recognition has always been a very challenging task for the researches its applications may be very useful for personal verification and recognition. It is typically used in security systems like biometrics such as fingerprint, eye iris recognition systems, facial patterns and others although we can find many other identification and verification techniques, the main motivation for face recognition is because it is considered as a passive, no intrusive system to verify and identify people.

The way to carry out face recognition is to look at the major features of the face that is taken from digital image or video and compare these features to the same features on other faces. For example, the image that is taken from digital image or video then the face recognition system may analyze the relative position, size, and/or shape of the eyes, nose, lip, jaw and others

these features are used to search for other images with matching features.

Face recognition starts from the moment that machine started to become more and more intelligent or help the lack of human abilities and senses. Darwin includes analysis of the different facial expressions due to different emotional states for instance sadness or happiness of a person, where as Galton studied facial profiles. The first real attempts regarding to face recognition is to develop semi-automated facial recognition systems began in the late 1960's and early 1970's, based on geometrical information and the features were placed on photographs locating the major facial features, such as eyes, ears, noses, and mouth. After placing feature on photographs relative distances and angles were computed from the located features on the photograph to a common reference point and compared to reference data therefore the first stages of facial recognition focused on the automatic detection of individual facial features.

Recently face recognition is attracting much attention in the society of network multimedia information access. Areas such as network security, content indexing and retrieval, and video compression benefits from face recognition technology. Face recognition is nothing but the ability of machine to successfully categorize a set of image based on certain discriminatory features. Basically face recognition is used in security and face systems like biometrics such as fingerprint, eye iris recognition systems, facial patterns and others. Face is the most common biometric used by humans and its application range from static, mug-shot verification to a dynamic uncontrolled face identification in a cluttered background. The average adult working in a large business has at least 12 passwords to remember and spends nearly a week in every year logging in to a system. They are very useful when we need an active identification system the fact that a person has to expose their faces to some digital device makes people being scanned and then the scanned images are identified.

A neural network is a powerful data modeling tool that is able to capture and represent complex input/output relationships. Neural network can be considered as an artificial system that could perform an intelligent task

similar to those performed by the human brain for example recognizing some ones at the first sight.

II. ARTIFICIAL NEURAL NETWORKS:

Computer plays an important role in day to day's life and in the society. With the enhancing technology, human being becomes more and more affected with computers as the leader of this technological age. Technological revolution has taken place all over the world based on this enhancement. Computer vision plays a vital role in our life for the purpose of security of the systems. The problem in face recognition is to find the best match of an unknown image against a database of face models or to determine whether it does not match any of them well. An artificial neural network is to be designed and trained to recognize the persons of the database that is taken from imaging system however, the imaging system is not perfect and the faces may suffer from noise i.e. if the imaging system is at a fixed distance the image is clear but when the distance is varied the image became more and more noise due to this problem it is difficult to recognize the image that is taken from the imaging system.



When the image is suffered from noise it is difficult to recognize the person.



In this paper is to design a system that is a capable of recognize and identify noisy individual faces which consisting of a large set of images of different people.

III. PRESENT SYSTEM:

The authors state that they used a back propagation with both adaptive learning rate and momentum. Back propagation, which is frequently used in Neural Network training, often takes a great deal of time to converge on an acceptable solution. Momentum is a standard technique that is used to speed up convergence and maintain generalization performance.

The back propagation technique is used as a means of reducing error in the network's classification, by initially calculating this error and the propagating it back through the network for reduction. Inputs are propagated to the first layer of hidden units, whose output is calculated and propagated to the next hidden later. This process is repeated until the output layer is

reached. Each output layer unit calculates the activation, from the sum of weighted inputs from previous layers. The error on the initial output is computed and propagated back to the first hidden layer, where the weight matrix is updated. This process is repeated until the error is minimized as far as possible. The back propagation learning technique can use the Logistic Sigmoid activation function or the tanh activation function at each classification unit. The logistic sigmoid activation function is mathematically defined by the following function:

$$Y = \frac{1}{1 + e^{-v}}$$

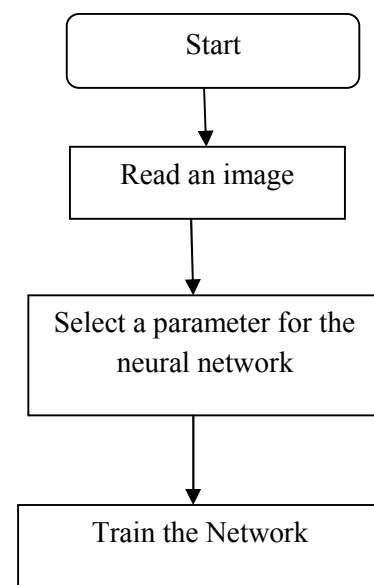
Where Y is activation function. It was decided that the Logistic Sigmoid would be a suitable activation function because of it is easier to implement and modify the logistic sigmoid function.

The aim is to train the network to achieve a balance between the ability to respond correctly to the input patterns that are used for training and the ability to provide good response to the input that are similar

IV. BACK PROPAGATION ALGORITHM:

As in the case with most neural networks, the aim is to train the network to achieve a balance between the network's ability to respond and the ability to give a reasonable response to the input that is similar, but not identical to the one used in the training.

During feed forward, each input neuron receives an input a signal and broad casts it to the each hidden neuron, which in turn computes the activation and passes it on to its output unit, which again computes the activation to obtain the net output.



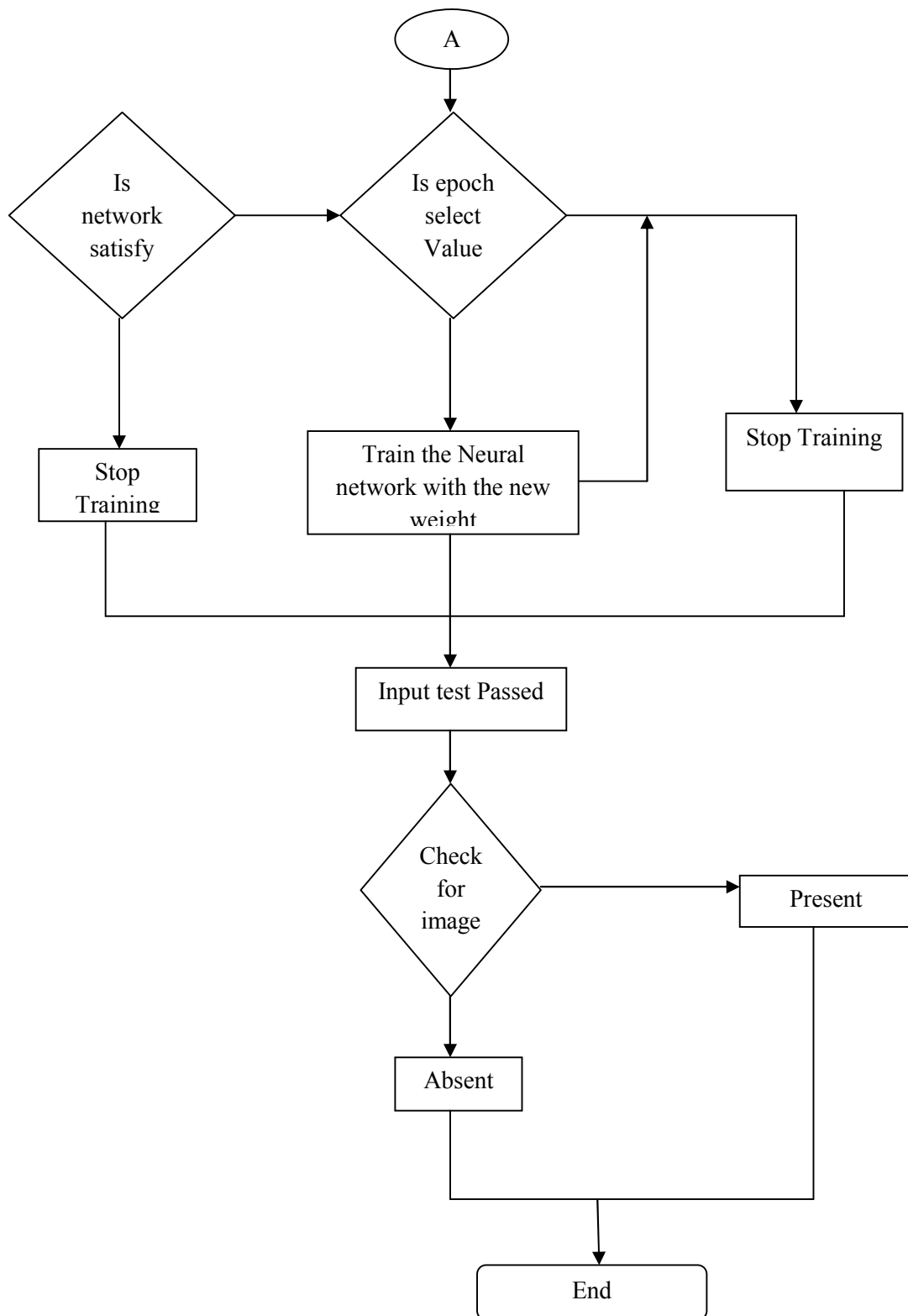


Figure 1: Back propagation algorithm

A. Neuron Model:

The neuron model that they applied is a three-layer log sigmoid/log sigmoid network i.e. input layer, hidden layer and output layer are used. The log-sigmoid transfer function was picked because its output range (0 to 1) is perfect for learning to output Boolean values. The nodes of the input layer are passive, meaning they do not modify the data. They receive a single value on their input, and

duplicate the value to their multiple outputs. On the other hand, the nodes of the hidden and output layer are active. This means they modify the data. As shown in the figure below the image 32*30 passes to the input layer as it is to hidden and output layer the node in the hidden and output layer will process the data and produce either 0 or 1

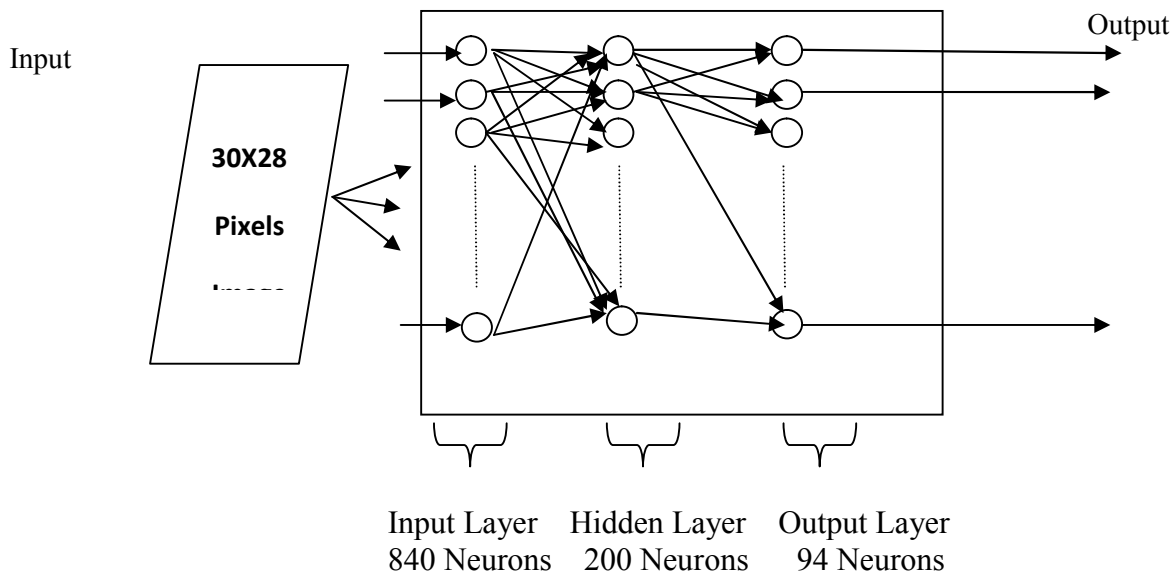


Figure 2: Neuron Model

The neural network needs 960 inputs and 94 neurons in its output layer to identify the faces. The hidden layer has 200 neurons. This number was picked by guesswork and experience. If the network has trouble of learning capabilities, then neurons can be added to this layer. Each value from the input layer is duplicated and sent to all of the hidden nodes. This is called a fully interconnected structure. As shown in the above figure, the values entering a hidden node are

multiplied by weights, a set of predetermined numbers stored in the program. The weighted inputs are then added to produce a single number. Before leaving the node, this number is passed through a nonlinear mathematical function called a sigmoid. This is an "s" shaped curve that limits the node's output. That is, the input to the sigmoid is a value between $-\infty$ and $+\infty$, while its output can only be between 0 and 1.

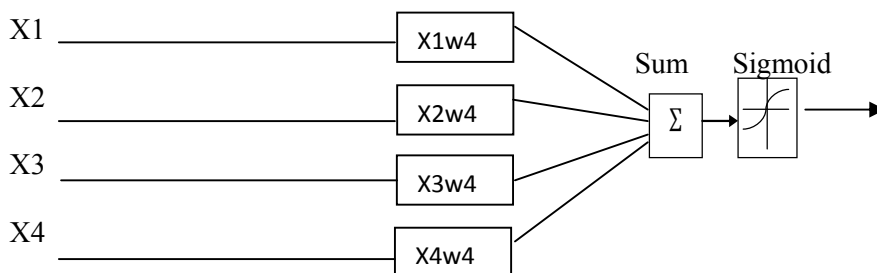


Figure 3: Sigmoid transfer function

V. TRAINING:

After preparing all the things the network is ready to be trained. To start this process the initial weights are chosen randomly. Then, the training, or learning, begins. To create a neural network that can handle noisy input images it is best to train the network on both ideal and noisy images. In order to do this the network will first be trained on ideal images until it has a low sum-squared error. Then the network will be trained on 10 sets of ideal and noisy images. The network is trained on two copies of the noise free images at the same time as it is trained on noisy images. The two copies of the noise free images are used to maintain the network's ability to classify ideal input images. Therefore, the network will again be trained on just ideal images. This ensures that the network will respond perfectly when presented with an ideal face. All training is done using back propagation with both adaptive learning rate and momentum.

A. Training without noise:

The network will initially be trained on just ideal images or without noisy image that is taken from an imaging system for a maximum of 10,000 epochs or until the network sum-squared error falls below 0.1. Before the network has been trained with noise it makes sense to train it without noise this is because of once more to ensure that ideal input images are always classified correctly.



B. Training with noise:

In order to train the network we tried to train with two ideal copies and two noisy copies of the images. This forces the neurons of network to learn how to properly identify noisy faces



Figure 4: Training

VI. PROPOSED SYSTEM:

Back propagation with both adaptive learning rate and momentum uses gradient based methods and this method are one of the most widely used error minimization methods used to train back propagation networks. The back propagation algorithm has been the most popular and most widely implemented for training these types of neural network. even though the general success of back propagation network in the learning process. Several major deficiencies are still needed to be solved. The convergence rate of back propagation is very low. This is highly because the designer is required to arbitrarily select parameter such as the network topology, initial weights and biases, a learning rate value, the activation function, and a value for the gain in the activation function before the training. Improper selection of any of these parameters can result in slow convergence or even network paralysis where the training process comes to a virtual standstill. Another weakness is that the back propagation learning technique can use the Logistic Sigmoid activation function or the tanh activation function at each classification unit. It was decided that the Logistic Sigmoid would be a suitable activation function because of it is easier to implement and modify the logistic sigmoid function. The logistic sigmoid activation function is mathematically defined by the following function:

$$Y = \frac{1}{1 + e^{-v}}$$

Where Y is the activation function.

The tanh function is an alternative for the activation function, and is mathematically defined by the following:

$$\tanh(X) = \frac{e^x - e^{-x}}{e^x + e^{-x}}$$

Where tanh(X) is the activation function.

VII. RESULTS:

The tanh function has a greater range than the Logistic Sigmoid. In terms of real numbers, this range is equivalent to double that of the Sigmoid, or $[-1, +1]$. The range of the Sigmoid function is $[0, 1]$. Therefore, the tanh function is far more sensitive to a change in

learning rate, which also ensures that weight changes have a greater range. The two functions are compared to one another.

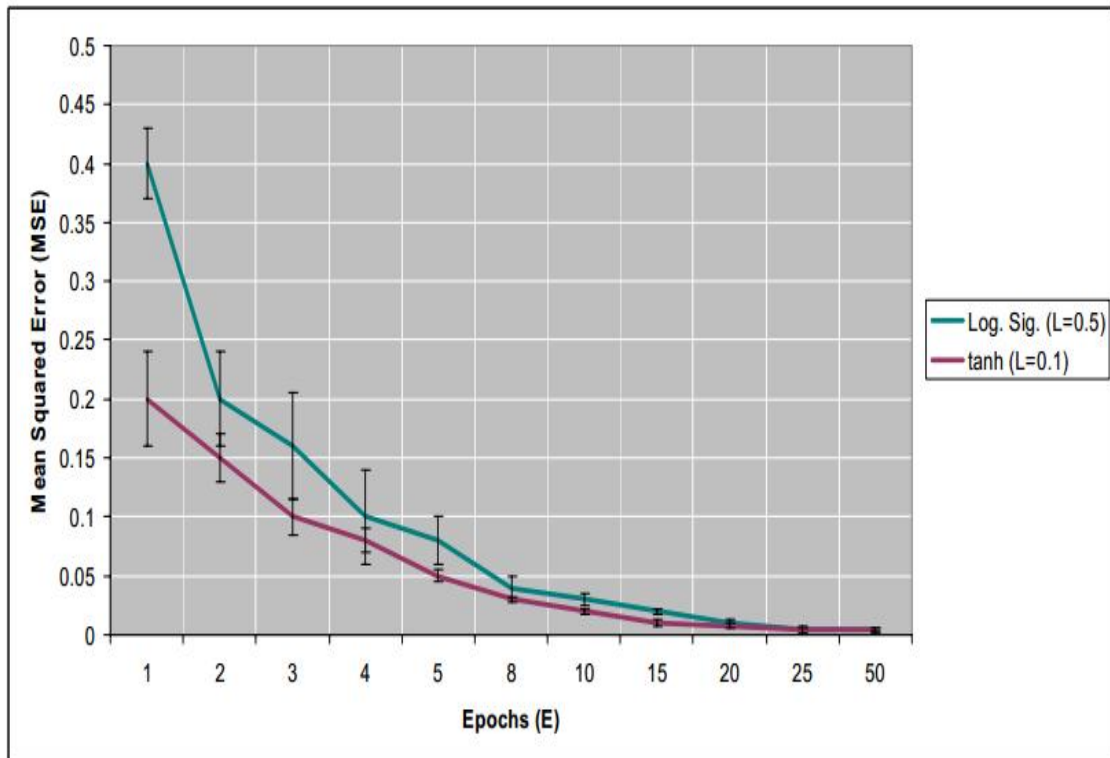


Figure 5: Logistic Sigmoid VS Tanh activation function

As shown in the graph above i.e. Figure 6 after approximately 20 epochs, the two functions converge and give similar results. But as epochs increased to 50 the tanh activation function is more accurate than the Logistic Sigmoid activation function. The activation functions that is used analyzing a neural network trained in back propagation as showed in fig 6 that the tanh

function would probably yield more accurate results than the Logistic Sigmoid function i.e. after 50 epochs the mean square error for the function tanh is 0.1 but when we see the Logistic Sigmoid it is 0.5 therefore if they used the tanh instead of using logistic sigmoid function they can achieve a better result.

Architecture of Neural network	Training and Testing	Time of training	Recognition Rate			
			Logistic Sigmoid activation function		Tanh activation function	
			Image without Noise	Image with noise	Image without noise	Image with noise
Artificial Neural Network	Web Faces	1 hr 56 min 08 sec	100 %	98.81	100 %	98.96

Table 1: Recognition Rate for logistic sigmoid activation function and Tanh activation function.

VIII.CONCLUSION:

Face recognition is a technology just reaching sufficient maturity for it to experience a rapid growth in its practical applications. Much research effort around the world is being applied to expanding the accuracy and capabilities of this biometric domain, with a consequent broadening of it s application in the near future. we have demonstrated how a face recognition system can be

designed by artificial neural network with a low mean squared error. The network was trained several times on various input ideal and noisy images of faces. In this case training a network on different sets of noisy images forced the network to learn how to deal with noise a common problem in the real world.

IX.REFERENCES:

- [1] Henry A. Rowley, ShumeetBaluja, and Takeo Kanade. Neural Network-Based Face Detection (PAMI, January 1998)
- [2] Omaira N. A. AL-Allaf, AbdelfatahArefTamimi, Mohammad A. Alia. "Face recognition System Based on Different Artificial Neural Networks Models and Training Algorithms", International Journal of Advanced Computer Science and Applications, Vol. 4, No. 6, 2013
- [3] A. S. Tolba, A.H. El-Baz, and A.A. El-Harby. Face Recognition: A Literature Review, International Journal of Information and Communication Engineering 2:2 2006
- [4] Face recognition home page: <http://www.face-rec.org/>
- [5] Dr. Peter Tino. Analyzing a Neural network trained by back propagation. School of Computer Science. The University of Birmingham
- [6] Md. Iqbal Quraishi, J Pal Choudhury, MallikaDe. Image Recognition and Processing Using Artificial Neural Network
- [7] AdjoudjRéda, DrBoukelifAoued. Artificial Neural Network-Based Face Recognition

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