A SCHEMATIC APPORCH ON DIFFERENT ARTIFICIAL INTELLIGENCE NETWORKS MODELS FOR FACE RECOGNITION

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Abstract:
Face recognition is one of the biometric methods that is used to identify any given face using the main features of this face. In this research, a face recognition system was suggested based on four Artificial Neural Network (ANN) models separately. Artificial neural networks (ANN) have been used in the field of face processing and pattern recognition. There is lack of literature surveys which give overview about the studies and researches related to the using of ANN in face detection. Therefore, this research includes a general review of face detection studies and systems which based on different ANN approaches and algorithms. The strengths and limitations of these literature studies and systems were included also. The performance results of these models were compared according to mean square error and recognition rate to identify the best ANN model. Comparison results showed that TrainLM was the best training algorithm for the face recognition system.

Keywords: *Face Detection, Face Recognition, Artificial Neural Networks*

1.0 INTRODUCTION: Human Face represents complex, multidimensional, meaningful visual motivation. It is difficult to develop a computational model for face recognition. Building good computer system similar to human ability to recognize faces and overcome humans' limitations is regarded as a great challenge. The human ability to recognize faces has several difficulties such as: similarity between different faces; dealing with large amount of unknown human faces; expressions and hair can change the face; and also face can be viewed from number of angles in many situations. A good face recognition system must be robust to overcome these difficulties and generalize over many conditions to capture the essential similarities for a given human face. A general face recognition system consists of many processing stages: face detection; facial feature extraction; and face recognition. Face detection and feature extraction phases could run simultaneously. In the recent years, artificial neural networks (ANN) were used largely for building intelligent computer systems related to pattern recognition and face processing. The most popular ANN model is the back propagation neural network (BPNN) which can be trained using back propagation training algorithm (BP). Many literatures related to face recognition system which based on different approaches such as: Geometrical features; Template matching; Graph matching; and ANN approaches. The obtained recognition rates from these studies are different and based on: used approach; used database; and number of classes. Different ANN models were used widely in face recognition and many times they used in combination with the above mentioned methods. ANN simulates the way neurons work in the human brain. This is the main reason for its role in face recognition. Many researches adopted different ANN models

for face recognition with different recognition rates and mean square error (MSE). Therefore, there is a need to identify the ANN model for face recognition systems with best recognition results. Artificial Neural Network (ANN) are used to detection of face for video surveillance, in which ANN is trained with multilayer back propagation neural networks (BPNN) for the purpose to achieve a balance between network ability to respond and the ability of given input reasonable response that is similar, but not identical to the one used in the training. They used face processing techniques such as normalization, rotation and position, light conditions improvement to improve the efficiency of detection in comparison with traditional ANN.

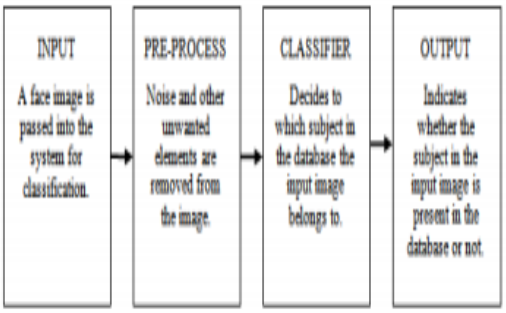
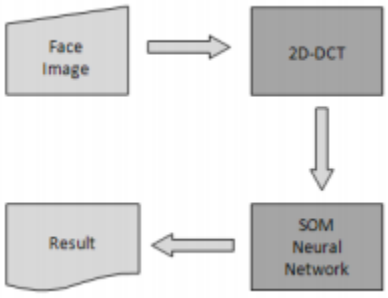


Figure shows Generic representation of a face recognition system



Proposed technique for face recognition system

Face Preprocessing:

- Uniform illumination conditions
- Light color background
- Faces in upright and frontal position
- Tolerance for tilting and rotation up to 20 degrees

2.0 LITERATURE REVIEW:

- **W. Zhao, et al (2000)** presented face recognition system with incremental learning ability that has one-pass incremental learning and automatic generation of training data. They adopted Resource Allocating Network with Long-Term Memory (RANLTM) as a classifier of face faces.
- **Turk M & Pentland A (1991)**developed a face authentication system based on: preprocessing, principal component analysis (PCA), and ANN for recognition. Normalization illumination, and head orientation were done in preprocessing stage. PCA is applied to find the aspects of face which are important for identification.
- **Phil Brimblecombe (2002)**suggested a face recognition algorithm based on gray-scale. They applied ANN to the pattern recognition phase rather than to the feature extraction phase to reduce complexity of ANN training. Also developed BPNN model to extract the basic face of the human face faces. The eigenfaces is then projecting onto human faces to identify unique features vectors. This BPNN uses the significant features vector to identify unknown face. They used ORL database.

- **P. Viola & M.J. Jones (2001)**used BPNN for face recognition to detect frontal views of faces. The PCA is used to reduce the dimensionality of face face. They used Yale database and calculated acceptance ratio and execution time as a performance metrics.
- **Bouchra Abboud, et al (2004)**used single layer feed forward ANN approach with PCA to find the optimum learning rate that reduces the training time. They used variable learning rate and demonstrate its superiority over constant learning rate. They test the system's performance in terms of recognition rate and training time. They used ORL database.
- **Ming-Hsuan Yan, et al (2002)**proposed a face recognition system using PCA with BPNN. The system consists of three steps: detecting face face using BPNN; extraction of various facial features; and performing face recognition. Performed face recognition by 3D facial recognition system using geometrics techniques with two types of ANN (multilayer perceptron and probabilistic). At the end, he proposed face recognition method using PCA with BP algorithm. The feature is extracted using PCA and the BPNN is used for classification
- **Minyoung Kim, et.al (2008)**Principal component analysis (PCA) is used with linear projection to recognized faces in a real-time video stream. It not only reduces the dimensionality of the face, but also some of the variations in face data. After performing the PCA, the hidden layer neurons of the radial basis function neural networks have been modeled by considering intra-class discriminating characteristics of the training faces, This help the RBF neural networks to acquire wide variation in the lower input space and improve its generalization capabilities.
- **Brunelli R & Poggio T (1993)**regression classification algorithms are used to identify the facial expression in pattern recognition .linear regression using a concept of single object class lie on linear subspace. Linear model take the faces as a linear combination of class specific galleries, which used a standard database for handle the faces

3.0 RESEARCH METHODOLOGY:

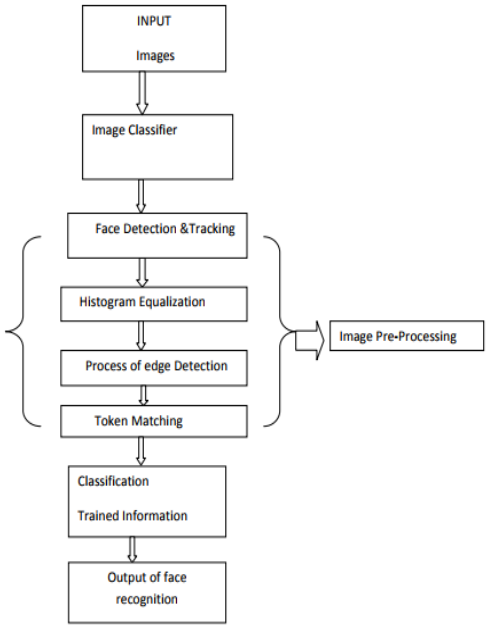
Neural Net-Works for Face Detection and Recognition:

MATLAB tends for matrix laboratory. It is the power software tool for solving various types of problem in mathematics, science and engineering, having 40 toolboxes for different subjects of studies. In which we work with simulink model and generate the code, integrate the generated code with existing system and validate the simulation and executable results. It has a very expensive library of predefined function or programs which design to help to solve their problem in a minimum timestamp. The Neural

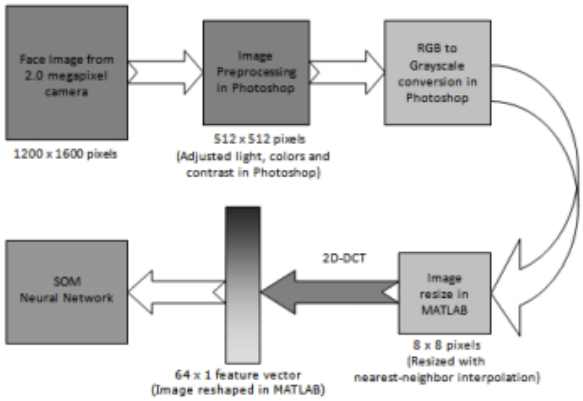
Network toolbox is present in MATLAB. Artificial Neural Network is a set of interconnect links that have weight associated them. The concept of Artificial Neural Network was derived from biological neural network, in which set of interconnected units broadly categorized into three layers that is input layer, output layer and hidden layer. Neural networks are composed of simple elements operating in parallel. As in nature, the connections between elements largely determine the network function. Neural Network can train to perform a particular function by adjusting the values of the connections (weights) between elements.

Artificial neural network can be used in face detection and recognition because these models can simulate the way neurons work in the human brain.

- In the gesture recognition arrangement each box treated as one module. First uses the web-cam, digital camera or scanner to capture the faces and gives to the input block for classification of the faces.
- The face area provided to the pre-processing block which contains a combination of four modules such as face detection and tracking, histogram equalization, process of edge detection and token matching to remove the unwanted noise and also zed the face
- The output of face pre-processing block is provided to classification trainer module to trains the face and decides whether the face belongs to the face class
- Finally it will provide the information about the recognition of face and generate the output



Representation in Face Detection Arrangements

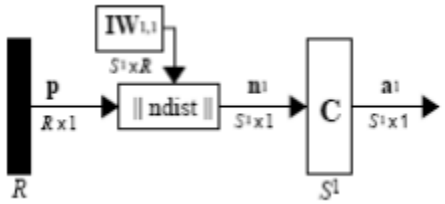


Face image fabrication process:

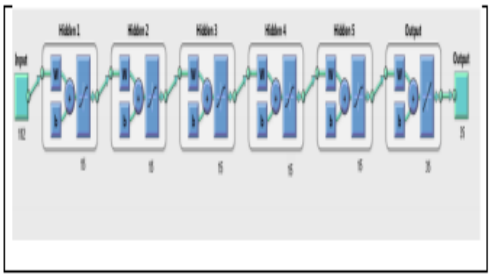
2D-DCT Face Compression Nearest-neighbor interpolation is performed using the MATLAB Face Processing Toolbox to resize preprocessed faces from size 512 × 512 pixels to face blocks of size 8 × 8 pixels as shown in Figure above

Network Architecture:

SOMs can be one-dimensional, two-dimensional or multidimensional maps. The number of input connections in a SOM network depends on the number of attributes to be used in the classification



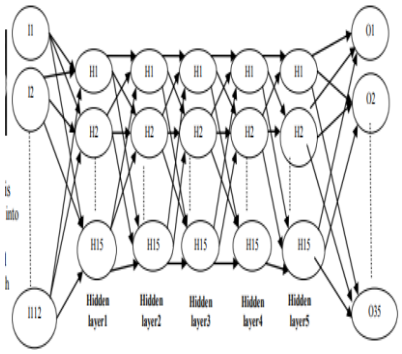
Architecture of a simple SOM



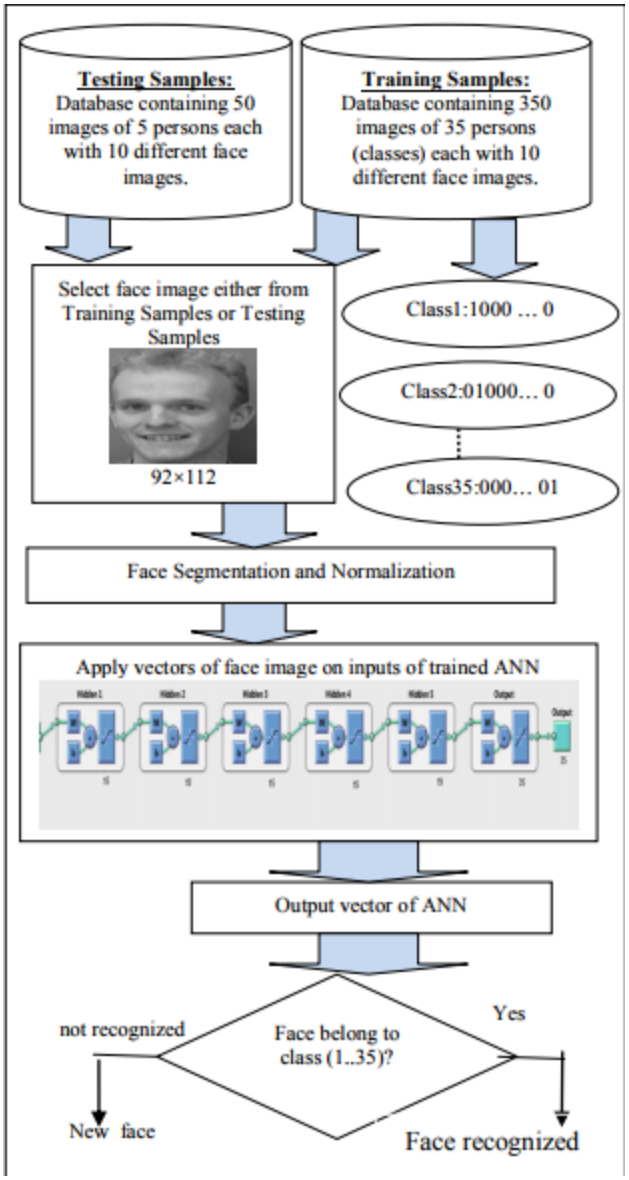
Feed forward network in phases

ANN Architecture:

The architecture of the suggested ANN model for face recognition system and it is consists of 7 layers (input layer, 5 hidden layers each with 15 hidden units and finally output layer). The input layer represents the face sub face (block) as system input. The number of input layer neurons depends on sub face dimensions (8×14) and here it is equal to 112. Finally, the output layer returns the output vector. The number of output layer neurons depends on the problem nature and here it depends on the number of classes used in the face recognition training process. Since 350 faces of 35 different persons were adopted, the number of classes is equal to 35 and hence, this is the number of output layer neurons.

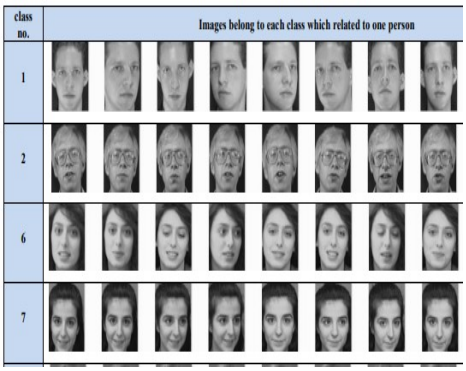


Feed forward with 11 phases



ANN testing face recognization system

4.0 EXPERIMENTAL RESULTS:



Face Database:

A face database was created for the purpose of benchmarking the face recognition system. The face database is divided into two subsets, for separate training and testing purposes. During SOM training, 36faces were used, containing five subjects and each subject having 5 faces with different facial expressions

Training and testing face data base

Validation of Technique:

The preprocessed grayscale faces of size 8 × 8 pixels are reshaped in MATLAB to form a 64 × 1 array with 64 rows and 1 column for each face. This technique is performed on all 5 test faces to form the input data for testing the recognition system.

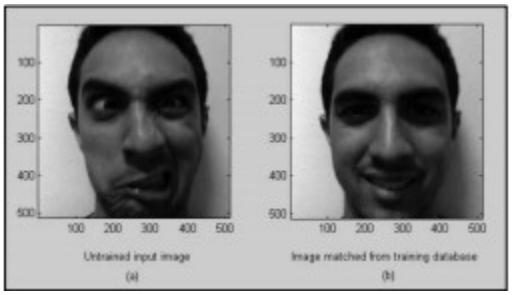


Figure shows Result of face recognition system

The result obtained from this simulation identifies that the subject in the input face The best match face displayed in Figure illustrates that subjects with different facial expressions in the face database can be easily identified. Euclidean distance for DCT-feature vectors for the untrained face database and SOM trained face database

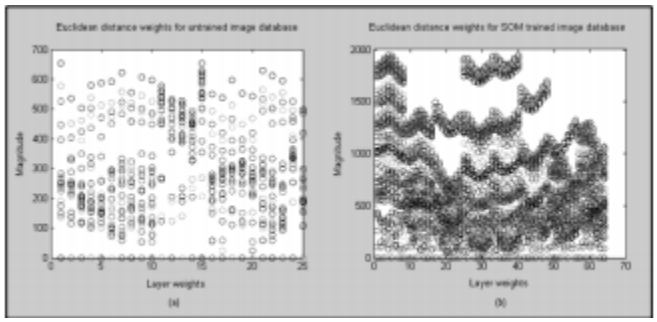


Figure shows Untrained face database and Face database trained with SOM network

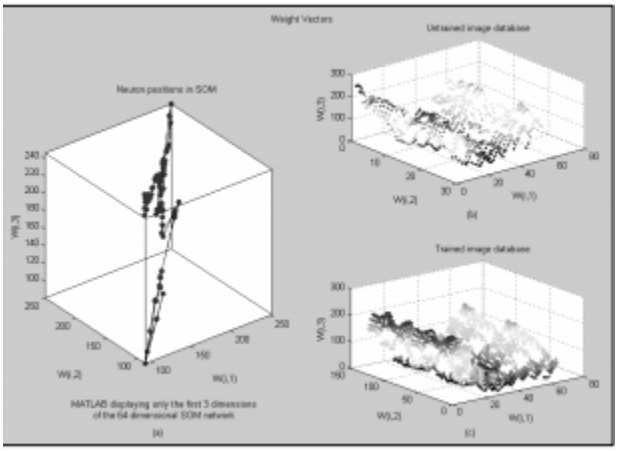


Figure shows Weight vectors of SOM

This experiment demonstrates that good face recognition performance is possible, even with feature vectors that are dramatically reduced in size relative to the usual case for DCTbased analysis

Table Shows Impact of Ann Models On MSE

Algorithm	FFBP	CFBP	FitNet	PatternNet
TRAINLM	0.08	0.09	0.03	0.003
TRAINBFG	0.20	0.15	0.09	0.03
TRAINBR	0.10	0.16	0.1	0.05
TRAINCGF	0.14	0.15	0.09	0.04
TRAINGD	0.25	0.27	0.18	0.09
TRAINGDM	0.34	0.31	0.22	0.11

Also the lowest MSE values were obtained from the Pattern Net model. Also, we calculated the number of iterations needed for training process for each experiment. The ANN model required more number of iterations when we increased the number of hidden layer neurons.

Impact of Algorithms On Number Of Iterations

Algorithm	FFBP	CFBP	FitNet	PatternNet
TRAINLM	65	54	31	21
TRAINBFG	67	59	35	28
TRAINBR	58	71	41	35
TRAINCGF	72	74	58	41
TRAINGD	66	61	36	31
TRAINGDM	73	62	38	35

ANN models require more iteration when they were trained using TRAINLM training algorithm.

CONCLUSIONS:

In this research, we presented a face recognition system using Four feed forward ANN models. The training and testing samples of the suggested face recognition system were taken from The ORL Database of Faces. A set of experiments were conducted to evaluate the performance of the suggested face recognition system by calculating the MSE, number of iterations, recognition rate and PSNR. The system was evaluated in MATLAB using an face database of 36 face faces, containing five subjects and each subject having 6faces with different facial expressions. After training for approximately 850 epochs the system achieved a recognition rate of 90.24% for 10 consecutive trials. A reduced feature space, described for experiment 2 above, dramatically reduces the computational requirements of the method as compared with standard DCTfeature extraction methods. However, it is conceivable that a practical SOM-based face recognition system may be possible in the future.

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