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NEURAL NETWORK CORRELATION BASED SIMILARITY EVALUATION WITH ZERNIKE MOMENTS FOR THE POSE-INVARIANT FACE RECOGNITION

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ABSTRACT

Human face recognition is best application in pattern recognition for identification and recognition. Development of face recognition system is increasing day by day in market and research organizations. Different parameters and methods are used for face recognition. In this research project, we will discuss about the different algorithms used for face recognition that are Zernike Moments (ZMs) and correlation classification (CC) etc and compare these algorithms with proposed algorithm Z_CC (Zernike with Correlation Classification).The angular information or rotation of the face is calculated by using the Zernike moments (ZM) to obtain the degree or radian of face rotation from the frontal view. The robust combination of angle-invariant and scale-invariant features with the combination of Zernike moments and correlation classification has been proposed with the neural network classification. The experiments will be performed on the variety of datasets. The multi-object dataset has been combined by collection the samples with faces rotated in the training samples. Z_NN (Zernike with neural network) algorithm provide best recognition rate for human face recognition 90%. In this algorithm we use Zernike Moments and correlation for global feature extraction and after that these features are compared by using neural network.

KEYWORDS: Face recognition, neural network, angle invariant, pose invariant, robust classification.

INTRODUCTION

Face is the unique identity of every person by which we can recognize each other, this is the most commonly method of every person to recognize other person at first look [2]. Basically face recognition is a method to search other image of face with matching features of one image. This technique was started to identify the criminals and authorized person for any secure entry [3]. Now this system is common in schools, colleges and industries for attendance purposes. This is a cheap technology for restriction to unauthorized person. This technology is used to stop fake identification and driver's fake licenses. Yet face recognition is a good and fast growing technology in computer vision but it has many challenges to find a right person against different poses, makeup, wearing glass, light effects and different moods. This would be most useful technology of the world for easy recognition [12].

STEPS FOR FACE RECOGNITION

Facial recognition is counting five steps to finish their process.

Step1: Acquiring an image for recognition, there are two ways to acquire an image either from database or direct take from camera.

Step2: Find the location of face in that image [4].

Step3: Withdraw feature from picture that can be local or global [7].

Step4: Compare the withdraw features with the help of software that we are using for recognition [9].

Step5: Decision will generated if the face is recognised then provide the identity of that face otherwise that face is unknown.

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1.1 Techniques

i. Holistic Matching Methods
ii. Feature-based (structural) Methods
iii. Hybrid Methods

Holistic Matching Methods: In this technique, the whole part face is taken into account as input data into face catching system [10]. Eigen faces is the best example of holistic methods that is the most extensively used technique for face recognition, Principal Component Analysis (PCA) is example of this technique, If the input image's weight is greater than given threshold then the image is not known, otherwise identity of image will be shown [14].

Feature-based (structural) Methods: This method is a type in which local features are extracted and forward there features to the classifier. [5] Many problems can occurs there due to the variations in feature extraction method cause of lights, poses etc. Distinguishes between three different extricate methods (procedures): [1]

1) Generic procedures based on edges, lines, and curves.
2) Feature-template-based procedures.
3) Structural matching procedures that take into deliberation geometrical check on the features.

Hybrid Methods: Hybrid method for face recognition systems use amalgamation of both holistic and feature extricate procedures. Hybrid methods are mainly used for 3D images [6].

1.2 Zernike moments: Zernike Moments is a feature extrication method from an image by which we can extricate global features like amplitude and angle [4]. The set of orthogonal Zernike moments for image analysis was first introduced by Teague. It is a set of complex orthogonal functions with a simple rotational invariant quality which forms a complete orthogonal basis over the class of square integrals functions named as Zernike polynomials which are defined over the unit circle [10]. Zernike moments have rotational invariance, and can be made scale and translational invariant, making them fit for many applications. Zernike moments are correct descriptors even with relatively few data points. Rebuild of Zernike moments can be used to decide the amount of moments necessary to make an accurate descriptor.

WORK DONE

A dataset is taken of 6660 images of 90 different persons in different angles from -90 degree to +90 degree. Test image provide manually from dataset by user. Images in dataset are in jpg format. System will find the features of testing image using Zernike Moments and Correlation. After feature extraction data will go for comparison to the feed forward neural network. In the above system two feature extraction methods are used, one is Zernike Moments which extract features as angle and amplitude of image and other is correlation which provides the histogram at every pixel. These features are stored in data set for further use. Implementation of neural network is done in MATLAB 2013a, the feed Forward Neural Network is used to execute the system. In the implementation of Feed Forward Neural Network one input layer with 74 neurons, 10 hidden layers and one output layer with one neuron. Pattern net is a feed forward network which helps to classify input data according to the target data. Testing of neural network is done by using different functions like performance, error histogram, confusion matrix and ROC curve. Results are calculated with the help of proposed algorithm provide most accurate result. Testing is done on Face Pix Database which contains 6660 face images of 90 different people, 74 different images for every person. Proposed algorithm is based on combination of Zernike Moments and Feed Forward Neural Network In this we have take a data set of n images and apply Zernike Moments on this data set to find out global features. After that we apply correlation on the data set collect from the Zernike Moments. After that this feature vector set goes to feed forward neural network. If the features are matched then image is matched otherwise check further. The threshold value will be change if image is not match and process will repeat. Pseudo code of proposed algorithm is as follows.

Algorithm 1: Zernike Moments based Face Recognition

i. Initialize T_{set-i}
ii. (i-1, 2,3 …….n)
  a. for (T_{set-i} =1, T_{set-i}< =$T_{set(n)}$, $T_{set(i)}$++)
    i. Extract $F_{vector(K)}T_{set(i)}$
    ii. $Z_{vector(K)}$=1, $Z_{vector(K)}$<= $F_{vector(last)}$, Z_{vector}++
    iii. Apply correlation
iii. For given threshold and last feature vector set
  a. $C_{vector\ (i)}$,C_{vector}=$F_{vector(last)}$, C_{vector} ++
    i. $C_{set(i)}$ = $T_{set(i)}$+ $Z_{vector(K)}$
iv. Initialize F_{NN}
  a. Iterate, T_{seti}=1, $F_{NN\ (j)}$ =1, T_{set-}<$T_{set(n)}$, $T_{set(i)}$++, $F_{NN\ (j)}$ ++
    i. If ($C_{set(i)}$ = $T_{set(j)}$)
    ii. Image match
    iii. exit(1)
    iv. else
    v. Change threshold and repeat

RESULT ANALYSIS

In this section, the results of the proposed model has been obtained and evaluated from the above implementation of the algorithm design. The neural network based implementation has been evaluated for the classification results obtained after testing of the proposed model.

Fig. 3.1: Neural Network generated

- **Neural Network Generated**: In this network we have one input layer having 74 neurons, 10 hidden layers and one output layer with one neuron. Max epochs we have taken are 1000. Features which we have already extracted are stored in data set, now we provide that features to input layer of FFNN and data will processed for classification in hidden layers, after that output layer will produce the result image and identity according

to the target value. Results are calculated using performance plot, training state plot, error histogram and Confusion Matrix. Snapshot and description of these plots are as shown in the figure 3.1.

- **Performance plot:** This graph provides performance of our system and show the Mean Square Error (mse) of training, testing and validation. In following figure training is shown in blue color, testing in red color and validation in green color line. Best match in this figure meet at 11thepoch. Lowest mean square error indicates the best validation performance.

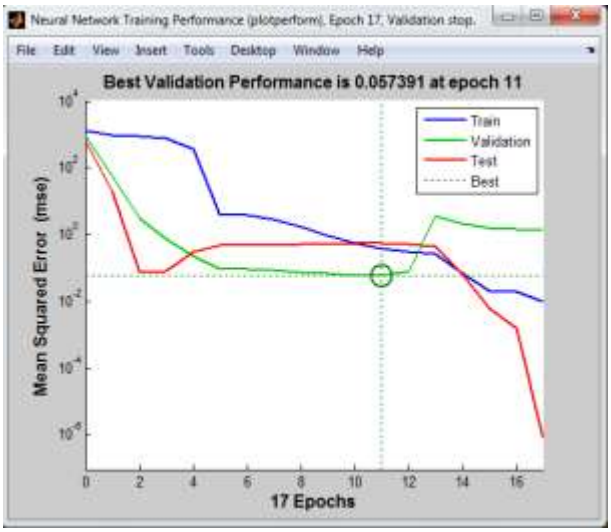

Fig 3.2:Performance plot

- **Confusion matrix:** this matrix is about the actual and predicted values of the network and tells about the overall performance of this system for training, testing and validation. In above matrix green squares contain high number of correct response and red squares contains low no of incorrect response. Blue Square at the right bottom contains overall performance.

Fig:3.3: Confusion matrix

- **ROC Curve:** The ROC curve in the figure 4.9 describes the realization of the results determined after classification. The neural network algorithm has been evaluated as the adaptable method for the classification of the rotation invariant face recognition. The following figure 4.9 describes the TPR (true positive rate) against the FPR (false positive rate), which gives the rate of accurate results and false results respectively. Both of the values has been recorded at 100%, which shows the robust performance of the neural network.

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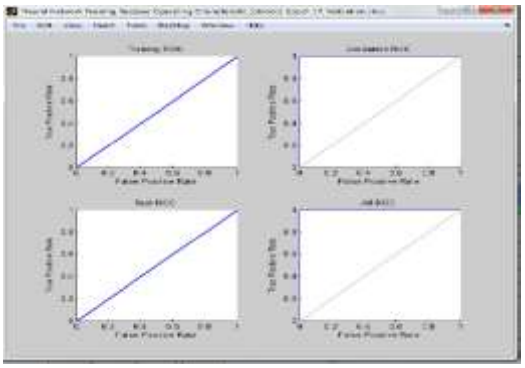

Fig. 3.4: ROC curve

- **Training state:** It shows the gradient value of back propagation at each iteration. Gradient value shows the very closest point of goal. Validation fails iterations are those iterations whose Mean Square Error values are increased. MATLAB automatically stops after 6 regular validation fails.

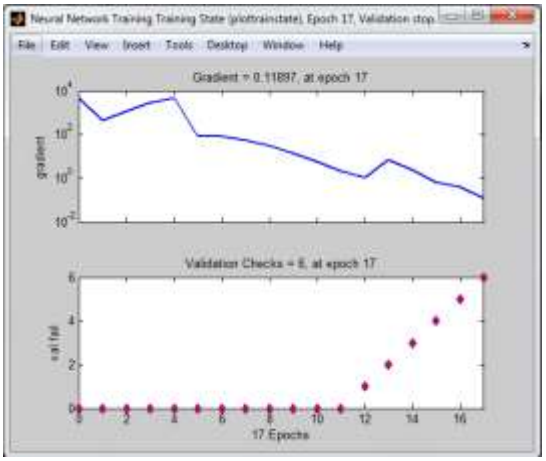

Fig. 3.5: training state

- **Error Histogram:** This plot shows training in blue color, testing in red color and validation in green color. This plot shows the errors at first bin are both training and testing errors. One training error lies at 7th bin and validation error lies at last bin.

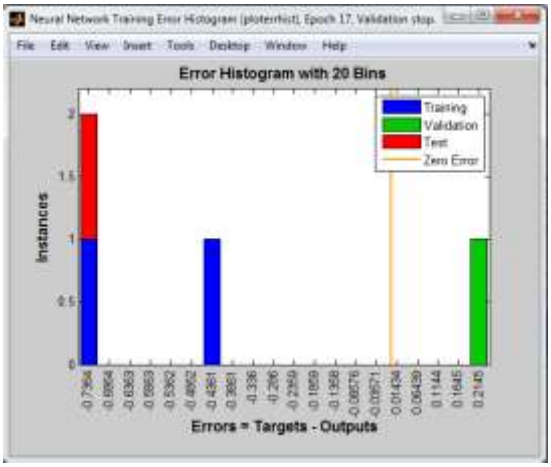

Fig. 3.6: Error Histogram

- **Output:** After performing all tasks explained above we get an output from the system which tells us the identity of the face we test for recognition. This system test on Face Pix Database and provides best result. The feature vectors are obtained from the image to construct the training feature matrix which includes the Zernike moment features (phase, amplitude and moment). The neural network is applied over the feature matrix is then matched against the features described from the input testing sample, which finally generates the output in the form of the matching sample. The multiple input and output layers are programmed to return the final classification results.

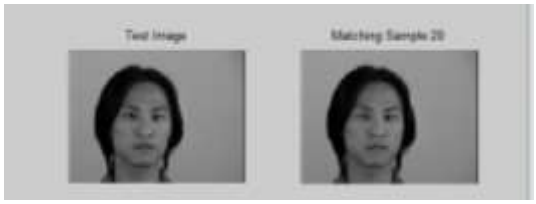

Fig. 3.7: OUTPUT

- **Comparative analysis:** Comparative analysis of proposed algorithm with exiting algorithms is shown as the table. The results of the popular techniques for the feature classification such as Independent component analysis, support vector machine, linear discriminant analysis and principle component analysis has been compared against the proposed model.

Proposed model has been evaluated against the existing schemes for the performance analytical survey. The proposed model has been found way better than all of the existing algorithms, which shows the 97% detection rate against the maximum of 89% offered by the independent component analysis. The proposed model has been programmed to work with the angle invariant samples between the -90 degree to + 90 degree angles of the face samples.

Table no. 3.2: Comparison of different algorithms with proposed model

Index	Method	Dataset	Classification Rate	Merits	Demerits
1	PCA	AR-Faces	70	Reduce dimensionality	Class separability remain same
2	LDA	AR-Faces	88	Reduce dimensionality Increase class separability	N/A
3	ICA	FERET	89	Exploits higher order statistics	N/A
4	SVM	FERET	77-78	N/A	N/A
5	NEURAL	Face Pix Database	97	Pose variations and high performance rate	

CONCLUSION

Face recognition is most important technique of biometrics which contains many local and global features for recognition in case of security. This technique is more helpful and in case of security and authentication as compare to password using or other biometrics techniques because in this technique no one have to remember any password or activity to remind the system. Also no one can copy your face as password or signature. The proposed work is based on face recognition system which will be helpful against poses and different angles of system. In this system two methods are used for feature extraction which is Zernike Moments (ZMs) and Cross Correlation (CC), collect global features of image. Zernike Moments extract angle and amplitude of images and Cross Correlation find similarities of images. We use neural network for pattern classification and recognition with one input, one output and 10 hidden layers. Feature set extracted using ZMs and CC is used as the training set of neural network. Network will produce output for testing image from dataset and show identity of face. Neural network is an automatic system which can

classify the training data according to target data, this classification is done by the hidden layers. When we compare the results of proposed algorithm with existing algorithms we find it performs better. We also use cross correlation in this algorithm to find more similar image. In a paper Zernike Moments is used with SIFT algorithm that also produce good results but cannot perform very well at large dataset. That is the reason we use large dataset for training and testing of proposed system. Proposed algorithm is trained and test on Face Pix database which contains 6660 face image of different 90 persons for face recognition, 74 face images of every person. This data is generated by Arizona State University of US and freely available for researches all over the World. Format of images is in JPEG images.

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