OCCLUSION VERIFICATION IN FACE DETECTION AND AGE ESTIMATION USING LOCAL BINARY PATTERN AND DTOD CLASSIFIER USING MORPH DATASET

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Abstract

The purpose of this research work is focused on occlusion conditions in the face like wearing sunglasses and scarf in the eyes and mouth positions of the facial image. The proposed work has three stages. The first stage was based on Decision Tree Induction C5.0 algorithm to classify the occluded part and non occluded part in the facial image. The Second stage was face verification using Local Binary Pattern method. The third stage carried out the estimation of human age using Back Propagation Neural Network. The results of the proposed work having high accuracy of identification of face using decision tree and local binary pattern method using non occluded part of the facial image as the feature. Also the age can be identified using Back Propagation Neural Network algorithm using winkles as a feature and the gender can be classified using the Posteriori and Priori probability values. Compared to the existing work the occluded part was efficiently classified using Decision Tree method and the age can be classified into minimum age intervals like 0-2, 3-5, 6-9 instead of 0-9 in the existing work.

***Key words**: Decision Tree C5.0, Local Binary Pattern, Back Propagation Neural Network, Face Identification. Face Verification.*

1. Introduction

The purpose of research work is to use of local binary pattern, Decision Tree Occlusion Deduction to detect the occluded face. Occluded faces consists of wearing sunglasses, masks, rotation and illumination conditions Change. The individual classifier result is combined using LDA(Linear Discriminent Analysis) and Decision tree methods. This method is suitable for eye occluded faces and mouth occluded faces for face detection. The calculation speed is high compared with the existing methods using AdaBoost Classifier. Principal Component Analysis and Local Binay Pattern are used for pre-processing and feature extraction. The Back Propagation Neural Network play a vital role in this paper and it is used to makes the algorithm to perform better. The Face Recognition Algorithm first study the set of images and to identify the matching of a given image. Neural Network based face recognition algorithm is an advanced approach. The proposed system is to study the small windows of the image and to find the distance between the given points. We use Local Binary Pattern system to arbitrate between the different types of Networks in order to improve the performance over single network. Age-Progression in human faces have two angles. The first is to model the Gradient Orientation Pyramid to identify the facial features. The Second one is to build the Automatic age estimation and age based classification from facial images. The face angle and wrinkles are the main features that can be combined with specific transformations. In verification, we must find out whether the two images come from the same person, as opposed to recognition. The input image is compared with the large number of individual image. The passport renewal task is the main application in which the passport dataset has been taken into account and the newly submitted image have compared with the old one to make sure that the input request is valid or not. In each subject having many images but in the proposed work there is no need of many images in each subject.

2. Related Work

Human Face Verification can be identified with the reference paper [1], [2], [3], [4], [5] and [6]. Using paper [1], LBP operator is used to find the features of the pair of image. Apply AdaBoost to find discriminative features to represent the image pair. A strong Classifier is built for classification. Performance improvement is achieved with smaller age gaps between image pairs and it stabilizes as the age gap increases using Morph

Dataset. Using Paper [2], LBP operator is used to find the features of the pair of image. Proposing to Extract LBP histogram from edge map rather than gray image. Proposing to combine edge map the LBP histogram and the elastic matching for face recognition. In Paper [3], The conventional LBP approach is extended to the advanced LBP in both the intensity and gradient maps to ensure reliable acquisition of the major pattern information. The Tsallis entropy is used to extract the low and mid-frequency texture features of the face image Discriminating global appearance features are extracted by null-space LDA. Then these three kinds of features are combined to represent the characteristics of the face image.

In Paper[4], Discuss on Psychophysics and human perception. Age estimation, facial appearance modeling, face verification across aging etc., Current facial aging databases used in different studies.Structural Invariant consist of Cardioidal strain, Affine Shear. Geometric Invariants in facial growth. In paper [5], GOP approach. Wrinkles as features. Calculate the EER Skin Color is also a feature based on Hemoglobin and melanin The difficulty of face recognition algorithms saturated after the age gap is larger than four years. In paper[6], The Image pair is mapped into the feature space. Feature vector identification. GOP calculation. Calculate the Kernel between GOP,SVM is used to divide the feature space into two classes. Separate the boundary. Calculate the CRR(Correct Reject Rate). Calculate the CAR(Correct Accept Rate). Calculate EER(Equal Error Rate).

In the existing research work from Reference is used to find the face verification and age progression of the image using GOP and discriminative method using FG-NET database. The images were retrieved from the passport database of different subjects such as illumination, facial expression etc are uncontrolled in this dataset. The Recognition Rate in the existing work will be very slow also the error rate is high compared with the proposed work. In Paper “Facial expression recognition using advanced Local Binary Patterns,Tsallia entropies and Global appearance Features” Shu Liao1'2. Wei Fan2, Albert C. S. Chung1'2 and Dit-Yan Yeung2, The conventional LBP approach is extended to the advanced LBP in both the intensity and gradient maps to ensure reliable acquisition of the major pattern information. The Tsallis entropy is used to extract the low and mid-frequency texture features of the face image. Discriminating global appearance features are extracted by null-space LDA.

3. Proposed System

The proposed work stages

- Image Preprocessing
- Occlusion Detection using DTOD classifier
- Feature extraction using PCA for Non occluded part
- Face verification and Recognition using Maximum likelihood classifier and Local Binary Pattern
- Age Estimation using ANN classifier and BPNN .

3.1 Image Preprocessing

Color Conversion: Three dimensional face image is converted to two dimensional gray scale image for easy processing of face image.

Noise Reduction: A filtering function is used to remove the noise in the image and works

Edge detection method: Canny Edge Detection

3.2 Occlusion Detection Using DTOD classifier

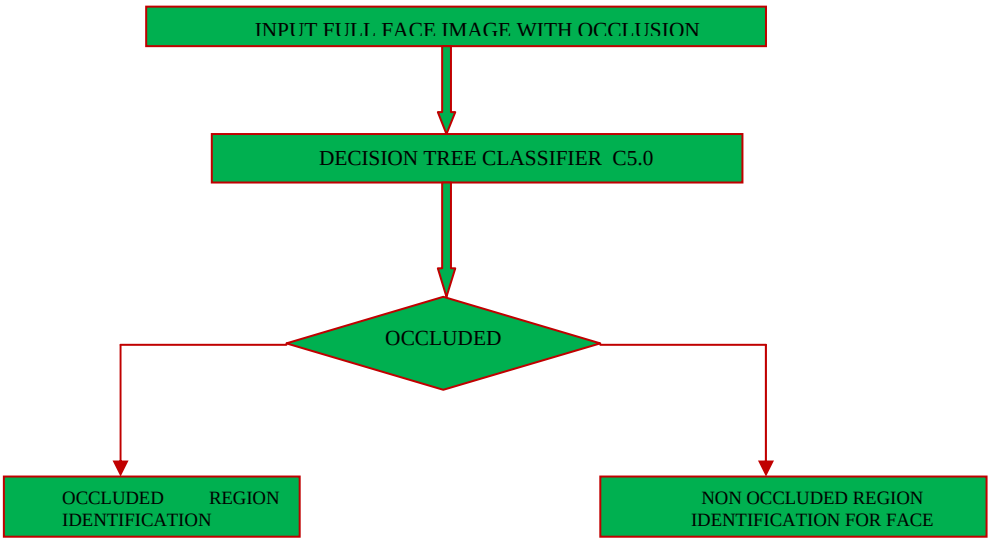

Fig 1: Occlusion Classification

3.2.1 Decision Tree Based Occlusion Detection Algorithm(CLASSIFIER)

1. Acquisition of input image
2. whole face classifier scan the input image and find the confidence measure
3. individual face part classifier is also scanned and find the confidence measure
4. integrate step 2 and 3 to find a face or non face

   A) step 4: the adaboost and lda is used for integration

lda stage h(x)= $\begin{cases} 1 & \sum_{i=0}^{i=N-1}(e_i h_i(x)) \geq T \\ -1 & \text{otherwise} \end{cases}$

$h_i(x)$ is the output value for the i th classifier. T is threshold and e_i is the projection weight.

5. The Decision Tree Stage

   Output from the classifier

Lda Stage:
if output is >threshold and <threshold take right eye, the right eye will be the root
if output is >0 or output is <0
Right Eye-lefteye-left:
if lefteye.output > 0 then take lip
else
occlusion on left.
if lipoutput is >0 then take non face
else
output is<0 then occlusion on mouth.

right eye : left eye-right

if left eye. output is >0 then occlusion on right side
else
output is <0 then take nose
if nose.output>0 then occluded on right side
else non face

3.3 Feature extraction using LBP for Non occluded part

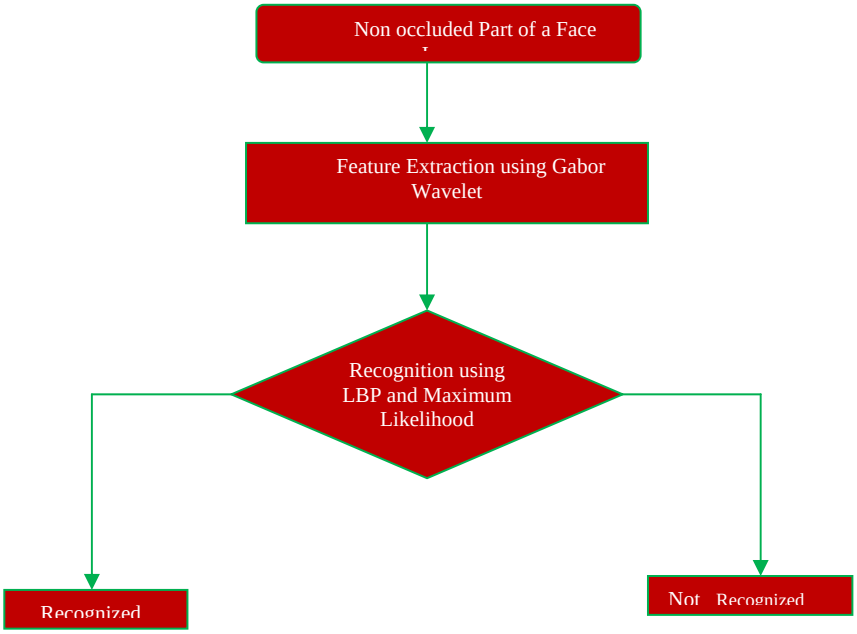

Fig 2: Face Recognition

3.3.1 Feature extraction using Gabor Wavelet Transform

Gabor wavelet is used to find the feature extraction in the facial image for the non occluded part. The Features are extracted and then the output is taken into consideration for the recognition and verification process. Texture based features are extracted using Gabor wavelet Transform in MATLAB7.9. The Daisy Petal Filter is which gives the domain response function .

```
K = Kmax/f^nu * exp(1i*mu*pi/8);
Kreal = real(K);
Kimag = imag(K);
NK = Kreal^2+Kimag^2;
```

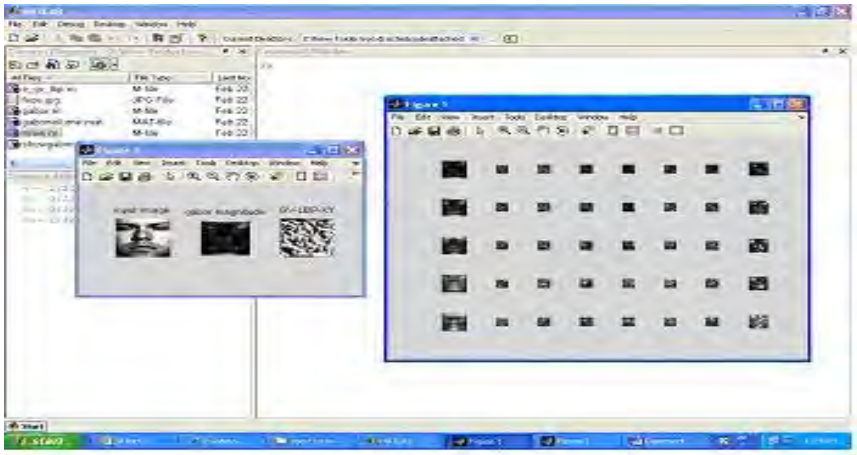

Fig 4: The Gabor Wavelet output for a given image after extraction

3.3.2 Elastic matching

A human face is treated as a combination of a sequence of small and flat Facets adopt an even distribution of feature points and a uniform block size, and all of the blocks employ square structure. Adjacent blocks also allowed overlapping. After the image is divided into blocks, the next step is calculating the distance between two blocks. Blocks to be compared will not be accurate in the same position because of some partial distortion. Such as a side face, or a face with expression or the key points (such as the eyes) are not located precisely, then there will exist translation of some face parts. And these translations will bring about a certain negative impact to face recognition. So, in order to reduce these effects, we employ elastic matching to compare two blocks.

3.4 Face verification using Maximum likelihood classifier

The text block is compared with the neighborhood in the training set and to estimate the best match. The block with the minimum distance was considered. Considering the computational speed and performance measure the size is reduced to 64*64. image and 21*21 grid level. The distance between the block levels is 3 and the size of the block is 5*5. For recognition the model likelihood value can be calculated using the maximum likelihood function. The highest log likelihood is identified as a face. To check whether the face is in the training set or database the Euclidean distance was used.

Fig 5: Testing Data Set

Fig 6: Training Data Set

Figure 5,6 are the ORL Dataset of 200 images with 40 subjectives.

3.5 Age Estimation using ANN classifier and BPN

1. Input : Face Image
2. Output: Gender classification and age estimation
3. Features like, Total number of white pixels, left and right eye end positions for gender classification.
4. Features like wrinkle (forehead, cheek and eye corner) for age identification.
5. Posteriori and Priori probability are calculated to differentiate the male and female.

3.5.1 Age Progression using Feed Forward Neural Network

The following steps summarize the back propagation algorithm:

- Propagate the input forward through the network to the output.
- Propagate the partial derivatives of the error function backward through the network.
- Update the weights and biases of the network.
- Repeat until stop condition is reached.

4 Training and Learning Functions

Training and learning functions are mathematical procedures used to automatically adjust the network's weights and biases. The training function dictates a global algorithm that affects all the weights and biases of a given network. The learning function can be applied to individual weights and biases within a network. Neural Network Toolbox supports a variety of training algorithms, including several gradient descent methods, conjugate gradient methods, the Levenberg-Marquardt algorithm (LM), and the resilient back propagation algorithm (Rprop). The toolbox's modular framework lets you quickly develop custom training algorithms that can be integrated with built-in algorithms. While training your neural network, you can use error weights to define the relative importance of desired outputs, which can be prioritized in terms of sample, time step (for time-series problems), output element, or any combination of these. You can access training algorithms from the command line or via a graphical tool that shows a diagram of the network being trained and provides network performance plots and status information to help you monitor the training process.

4.1 Training

Features extracted from faces of individuals are used to train a model for each face using the algorithm shown in Figure 5. The initial parameter were generated randomly and improved using Baum-Welch re-estimation procedure [15] to get the parameters that optimise the likelihood of the training set observation vectors for the each face. State transition probability (A) is defined as,

parameters that optimise the likelihood of the training set observation vectors for the each face.

State transition probability (A) is defined as,

$$a_{ij} = 0, \qquad j < i$$

$$a_{ij} = 0, \qquad j > i + \Delta$$

where $\Delta = 1$ i.e. the model is not allowed to jump more than a state at a time. Since each face was divided into five sub-images, the resulting matrix is

$$A = \begin{bmatrix} a_{11} & a_{12} & 0 & 0 & 0 \\ 0 & a_{22} & a_{23} & 0 & 0 \\ 0 & 0 & a_{33} & a_{34} & 0 \\ 0 & 0 & 0 & a_{44} & a_{45} \\ 0 & 0 & 0 & 0 & a_{55} \end{bmatrix}$$

$$a_{NN} = p\ ,$$

while $a_{Ni} = 0 \quad for\ i < N\ and\ i > N + 1$

and the initial state probability (π) is defined as

$$\pi_i = [1,0,0,0,0]$$

Maximum number of iteration for the re-estimation is set to 5 or if the error between the initial and present value is less than 10^{-4}, then the model is taken to have converged and the model parameters are stored with appropriate class name or number (A_c, B_c, π_c).

4.2 Algorithm for model re-estimation

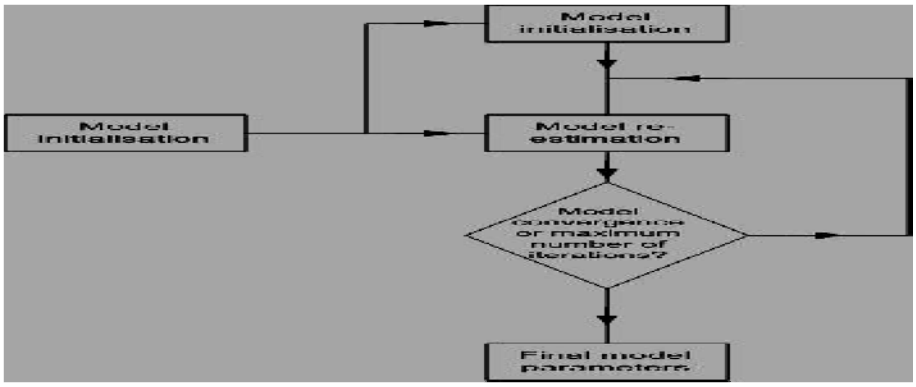

Fig 7: Algorithm for Training

(n is the maximum number of iteration allowed)

k = 1

initialise $\lambda = (A, B, \pi)$

compute $P(O/\lambda^k)$

while $k < n$ do

estimate $P(O/\lambda^{k+1})$

if $|P(O/\lambda^{k+1}) - P(O/\lambda^k)| < error$

quit

else

$P(O/\lambda^k) \Leftarrow P(O/\lambda^{k+1})$

End

6. Conclusions and Future Enhancement

The research work has completed all the above three modules with artificially occluded image. But when the input facial image with masking is the challenging part in the facial recognition technology. The

next step focus on the masked image as the input without artificial occlusion. The Face Verification and estimation of age using Maximum likelihood classifier and Back propagation Neural Network have high accuracy compared with the existing work using discriminative approach. The false occurrence rate is only 0.02%. The recognition rate is 94%. The classification accuracy is 97% compared with existing occlusion methods.

6. Results and Discussions

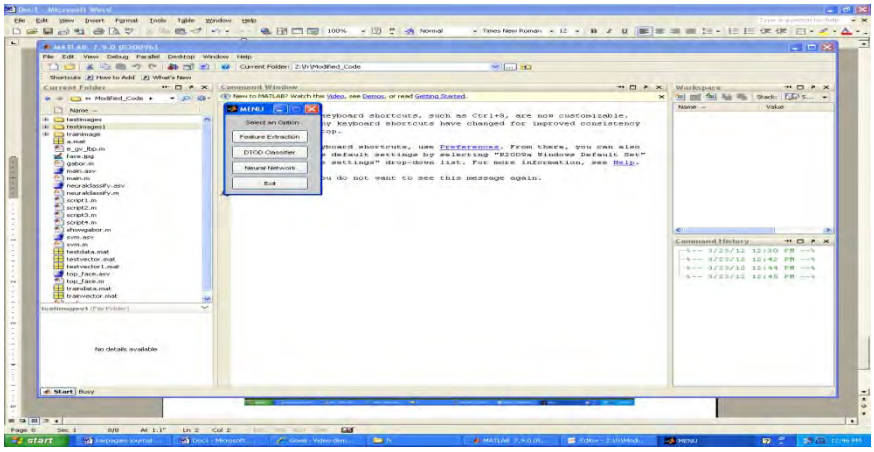

Fig 8: Menu for Classification using DTOD

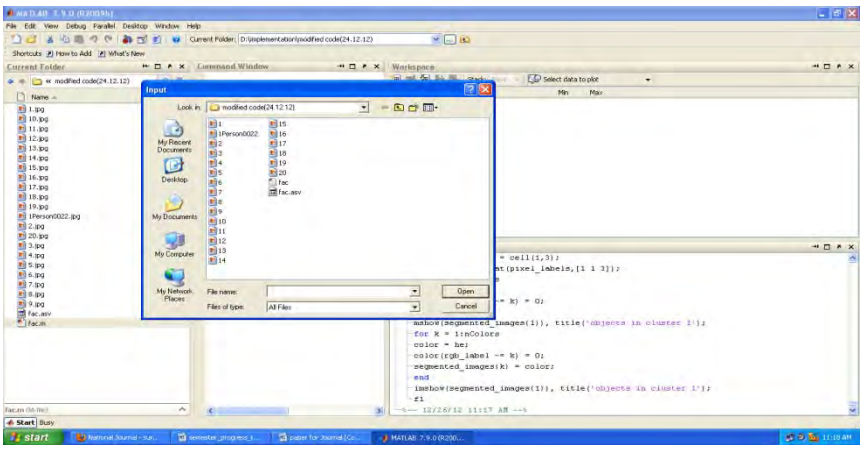

Fig 9. Input taken from the dataset

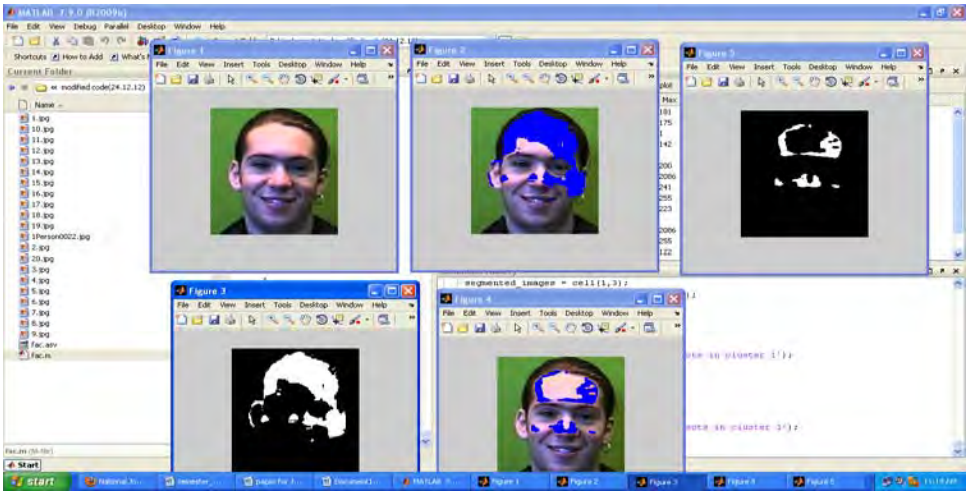

Fig 10. Classification of occluded and non occluded part of the facial image

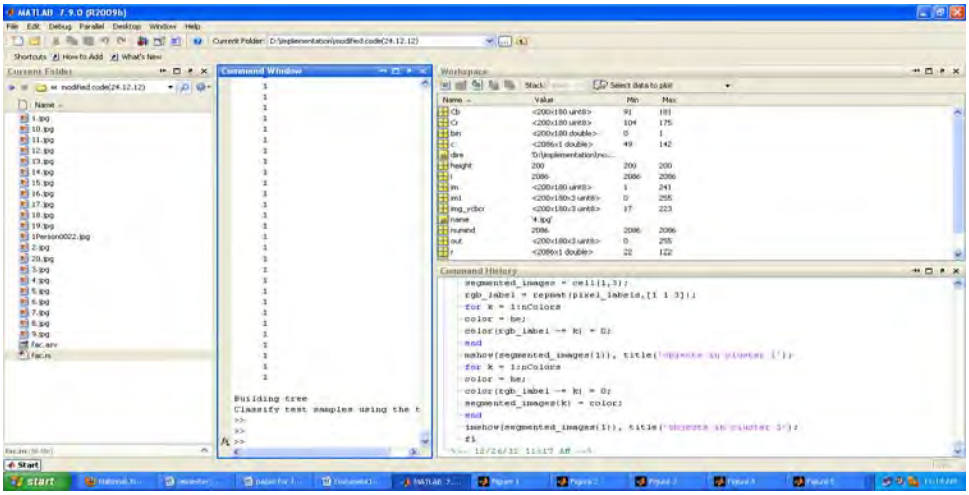

Fig 11.Decision Tree C5.0 algorithm Result

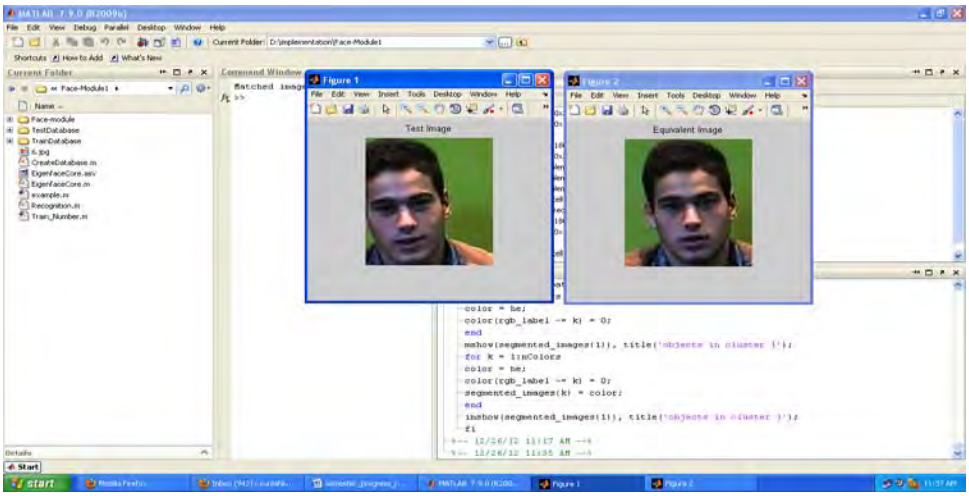

Fig 12. Face Recognition

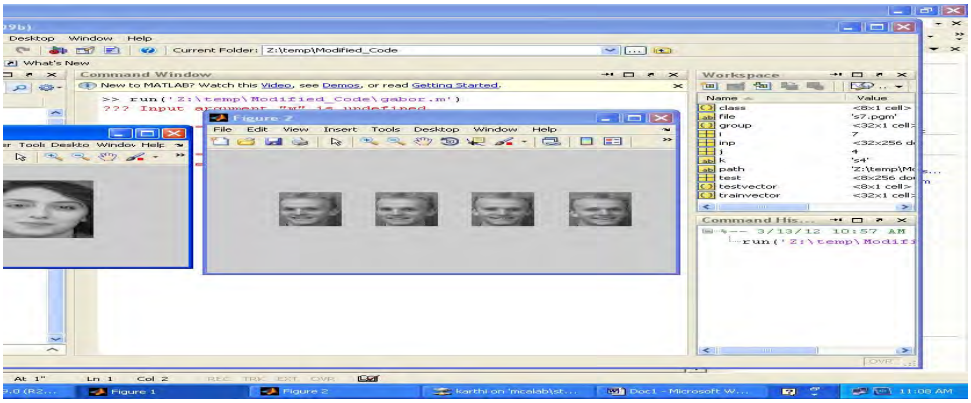

Fig 13. Classification from male to female faces

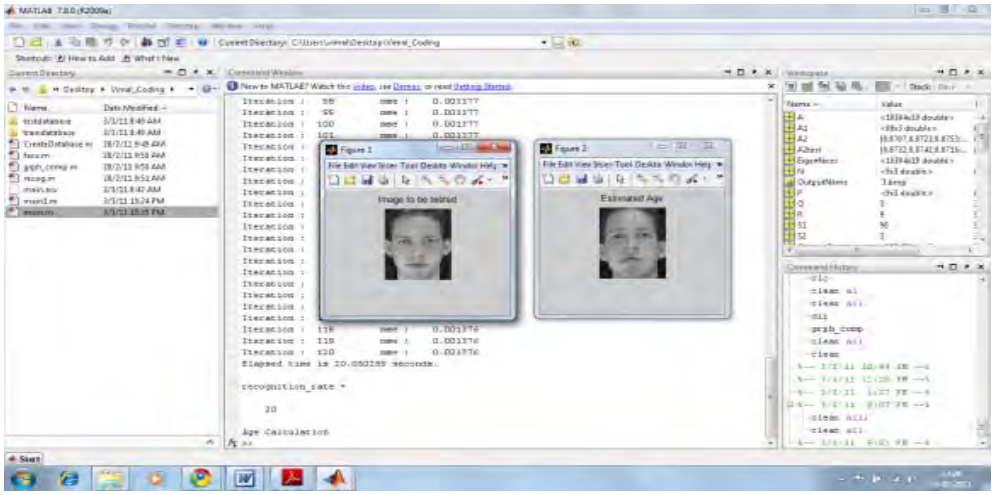

Fig 14. Estimation of Age using BPNN(Back Propagation Neural Network)

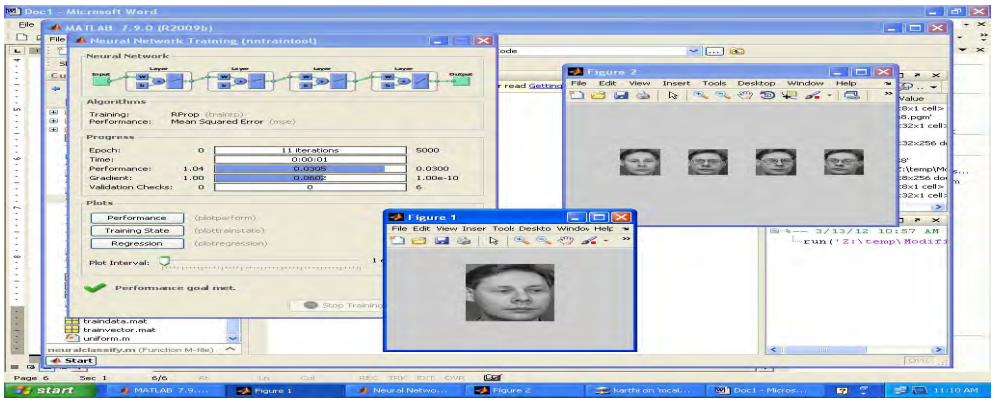

Fig 15. Neural Network Training for recognition

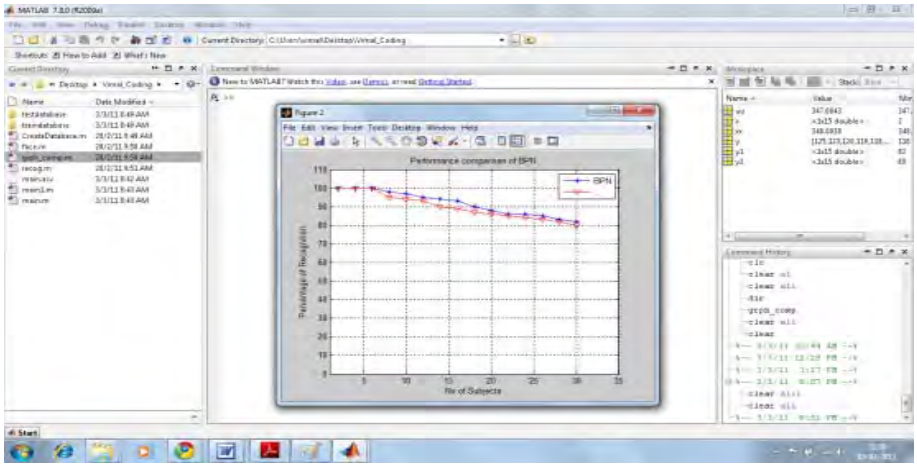

Fig 16. Performance Measurement from Existing and Proposed System

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