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Face Recognition based Student Attendance System

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A B S T R A C T

Face recognition is a fast growing, challenging and interesting area in various real time applications.Face detection and face recognition is the two topics is the system uses combination of techniques live acquired images without any application is performed in the face detection. Three major steps are contains in a generic facial authentication i.e Facial edge detection, facial features extraction and face recognition. The primary objective of this research work is to automatic student attendance system using face recognition technique. Initially in this work stored student information and theirphoto in the template database. Each classroom have cameras for capturing the students face while entering the class room. In this research work proposed Espy face recognition technique for recognize the face and it compared with template database.If the system matched the studentface, the attendance becomes generated immediately.Finally the attendance report was generated and stored in the attendance database. The proposed Espy technique is compared with existing PCA techniques.From this experimental results theproposed Espy technique providesgood results of storing attendance based on face recognition with higher accuracy and less execution time.

Keywords: Face Recognition, Face Detection, Biometrics, Feature Extraction, Correlation, PCA

1. Introduction

A face recognition system is a process of extractingan important pattern from large facial dataset. Face recognition system is widely used for security purposes, though there is increasing interest in other areas of use. It is one of the biometric software application it is particularly identifying or verifying a personthere are different face recognition techniques are available for detecting the facial features. Most of the face recognition systems are performed based on the different nodal points of a human face. A number of facial expression are used for facial identification, there are more than 2,50,00 facial expressions and 44 facial muscles used. Face recognition system is a one of the difficult research problem in pattern recognition. The distances between important points where used to recognize known faces, measuring the distance between the eyes or other important points or measuring different angles of facial components. Facial images are taken from different types of application such as biometric authentication surveillance human computer interaction and multimedia managementFace recognition is a task that humansperform routinely and effortlessly in their daily lives. Face recognition involves capturing face image from a surveillance camera. A face recognition process is a process of extracting valid patterns from images. Faces are real projector panels of the mechanism, which govern emotional and social behavior. The captured images are matched with the stored database and then the report is generated for particular student's attendance. Face biometrics is a challenging field of research with various limitations imposed for a machine face recognition like variations in head pose, change in illumination, facial expression, aging, occlusion due to accessories. Biometric based face recognition system is trained a well-known images, then known classes are classified and stored in the template database. After the given facial input image is compared with this existing template database. Nowadays Biometric software is very popular, it is using fro security purpose. There are different face recognition techniques are available for detecting the facial features from large amount of data. Most of the face recognition systems are performed based on the different nodal points on a human face. The values measured against the variable associated with points of a person's face help in uniquely identifying or verifying the person. These techniques are used to captured images from different faces can accurately and fast identify target individuals Face recognition techniques are quickly developing with new approaches such as 3-D modeling, helping to overcome issues with existing techniques.

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The remaining portion of the paper is organized as follows. Section 2 presents the related works. Methodology used in face recognition system is discussed in Section 3. Section 4 describes the experimental results. This paper concluded in Section 5.

2. Related Works

Kim, et.al[10] proposed a Kernel based PCA method for face feature extraction. To compute the facial pattern of input pixels in this method usedpolynomial kernel principal components. This work used ORL facial database for the analysis, and compared PCA with SVM method utilized to recognized facial features. Their proposed PCA based method achieved acceptable accuracy than the existing methods.

El Traboulsi, et.al[11]analyzed the semi-supervised discriminant embedding, which is extension of semi-supervised Local Discriminant Embedding (LDE). Generally this method handled high dimensional data. The classic solution to this issue is to reduce the size of dimension of the original data, the reduced collection of features is less than the number of samples.

Wright J, et.al [12] presented feature selection in face recognition on sparse representation perspective. They examined the role of feature selection in face recognition by using conventional features such as Eigen faces and facial parts. The authors proved that the proposed algorithm has achieved much higher recognition accuracy on face images with variation in expression and found the differences in performance between different features.

Gan, et.al[14] proposed a technique for normalization method for class room attendance system. They compared with traditional PCA method and the result becomes more acceptable with different class and same class. This method gave correct recognition of face and better efficiency than PCA method.

Timotius, et.al[15] proposed Kernel Principal Component Analysis (KPCA) method for feature extraction and SVM method for classification for facial input images. These method was compared with existing commonly used face recognition methods. The combination of proposed Kernel Principal Component Analysis (KPCA) and SVM method gives higher accuracy for face recognition.

Pamudurthy, et.al[16]analyzed nearest neighbor classifier for face recognition, in this work used skin correlation algorithm for feature extraction. Theresults suggested that the high degree of disguise variation was more challenging to address compared to variation in pose, expression and illumination and has high accuracy results than compared to existing algorithm.

Masrath Begum, et.al[17] proposed new modified PCA algorithm for face recognition. In modified PCA was compared with LDA algorithm. From their experimental analysis shown that the LDA is gave higher accuracy than PCA in face recognition. They using synthetic database, which is contains 100 images of different persons. PCA recognizes 89 persons out of 100 and LDA recognizes 97 persons out of 100.

3. Methodology for Face Recognition

Face Recognition system is a process of extracting important pattern from large image dataset attendance of students in the classroom is very important. The main objective of the project is to describe the efficient algorithm that automatically marks the attendance without human intervention. This system consists of four preprocessing, edge detection, feature extraction, face recognition and marking attendance. Figure 1 shows the system architecture of the proposed system.

3.1 Pre-processing

Preprocessing is used to enhance the raw input images and bringing the image into proper layout. This involves preparing/cleaning the data set by resolving problems like missing data, indeterminate data, unrelated fields, removal of distant points, format conversion etc. Several operations such as noise filtering, feature enhancement, image segmentation, object description and classification, image compression, image re-sampling, operations such as noise filtering, feature enhancement, image segmentation, object description and classification, image compression, image re-sampling, noise removal which intensify or reduce certain image details enable an easier or faster evaluation. In this research work, the median filter, linear filter, adaptive filter and predefined filters are used. These filters performance are analyzed and found that the Weiner filter efficiency is better than other filters [1] [3] [4].

3.1.1 Median filter

Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise.Median filter is a non linear filter used in image processing for impulse noise removal. An image containing this type of noise will have dark pixels in bright regions and bright pixels in dark regions. Median Filter processes the corrupted images by detecting the impulse noise. It is a kind of smoothing technique and removes noise in smooth regions. In this filtering is done with an averaging filter and it is best in removing noise with less blurring of edges [4].

3.1.2 Average Filter

Average filtering is done using IM filter. This filtering function provides several kinds of average filters in form of correlation filters. The un-sharp masking filters have effect of masking edges more crisp. It works by smoothing averaging and with a Gaussian to find a derivative. Gaussian gives a good model of window of pixel centered at the images using average filters [4]

3.1.3 Gaussian Filter

Gaussian filtering is used for removing random noise and correcting unequal illuminations. It forms a new image whose pixels are a weighted sum of original pixel values using the same set of weights at each point. This filtering is used for reducing random noise and sharpening the edges, correcting unequal illuminations. The Output is a shift-invariant function of the input same at each image location. Smoothing reduces pixel noise of each row shows smoothing with Gaussians of different width each column shows different amounts of Gaussian noise [3].

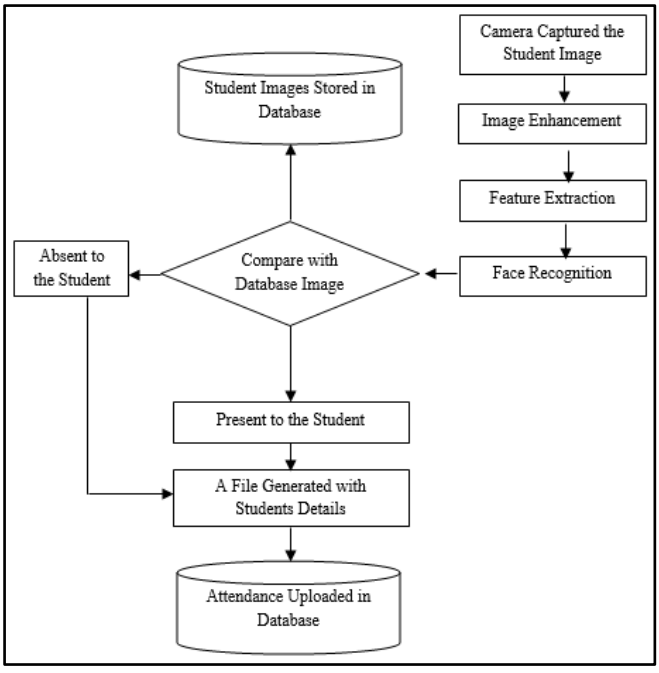


Figure 1 System Architecture

3.1.4 Weiner Filter

Weiner filtering is done by applying this filter to an image. Wiener performs little smoothing. It is more selective in preserving edges. It requires more computation time than median filtering. The true color image is converted into grayscale. Then Gaussian noise is added to the image and image is displayed. First noise is removed and then motion blurred images are converted with less blurring and finally blurred image is sharpened using wiener function.

3.2 Edge Detection

Edge detection is an important task in face recognition system. It is used to extract the edge pointsfrom facial images. Four edge detection techniques are used to extract the edge points from facial images. They are Roberts, Prewitt, Sobel and Canny edge detectors.The performance of these edge detection techniques are analyzed and compared. The canny edge detection method has produced better result than other three techniques [6].

3.2.1 Canny Edge detection

It is a standard edge detection algorithm in image processing. The canny edge detector to be canny saw the edge detection problem as a signal processing optimization problem so he builds up an objective function to be optimized. Following steps are used in the canny edge detection.

Smooth the image with a two dimensional Gaussian computation of a two dimensional Gaussian is costly in most cases so it is estimated by two one dimensional Gaussians one in the y direction and other in the x direction

Non maximal suppression edges will occur at points where the gradient is at a maximum to facilitate this direction of the gradient is computed at each pixel and the magnitude.

Every pixel verify if the magnitude of the gradient is greater at one pixel's distance away in positive or negative direction to the gradient. If the pixel is not larger than both, suppress it.

3.2.2 Prewitt Edge Detection

A variety of edge detectors are available for detecting the edges in digital images. However, each detector has its own improvements and weakness. The basic concept behind edge detection is to find locations in an image where the intensity changes rapidly.

3.2.3 Robert Edge Detection

The Roberts Cross operator executes a simple, quick to compute, 2D spatial gradient measurement on an image. In its most common usage, the input to the operator is a grayscale image, as is the output. Pixel values at every point in the output represent the estimated absolute magnitude of the spatial gradient of the input image at that point.Roberts Cross convolution kernel are designed to retort maximally to edges running at 45° to the pixel grid, one kernel for each of the two vertical orientations. One kernel is simply and the other rotated by 90°. The angle of orientation of the edge giving rise to the spatial gradient relative to the pixel grid orientation an approximate magnitude is computed using: $|G| = |GX| + |GY|$.

3.2.4 Sobel Edge Detection

Sobel edge detection algorithm is a method to discover the edge pixels in a facial image. It is a gradient approach in edge detection. Edges are pixels which hold important information in an image. Sobel edge detector make the use of change in intensity with respect to neighboring pixels. An edge is a

pixel with high intensity contrast with its neighbors. The Sobel edge detector uses a pair of 3x3 convolution masks, one evaluating the gradient in the x-direction (columns) and the other evaluating the gradient in the y-direction (rows). A convolution mask is generally much smaller than the actual image. Thus, the mask is slid over the image, controlling a square of pixels at a time.

3.3 Feature Extraction

Feature extraction is done for extracting features from facial images. The facial image features are color, shape and texture. Texture is described in various terms as smooth uniform flat coarse grainy even uneven and random shape is used as edge detection to extract features Shapes are used to determine the edges of the faces that has been detected as image contour and it is experimented on image database feature extraction is done for extracting features like eyes eyebrows and lips Feature extraction is used to extract the important features from facial images in this project work using existing correlation technique for extracting the features from facial images

3.3.1 Correlation Technique

Correlation technique is used to extract features from facial images.This technique is used for identifying feature points using edges and corners. The feature extraction is done for eyes, eyebrows and lips. Facial features like eyes, eyebrows and lips are different for individual person. Moreover, facial features change when people change their facial expression. This technique is uses an efficient approach for the recognition on the basis of some extracted features. This system follows a step by step procedure that comprises face detection and feature extraction. Once face detection is performed, feature of regions like lips, eyebrows and eyes are extracted. The results are obtained after implementation and this result gives accurate performance for the feature extraction using correlation algorithm.

Steps Involved in Correlation Algorithm

Input the captured images.

Convert the images into binary converter.

Find the 2-d convolution of the target and template image.

Find the mean and variance of the template image.

Find the pixel value from the search region having the values of convolution.

Draw the bounding rectangles by using the values of the convolution technique.

The bounding rectangles form around the matched template which is used to deduce the value of top-left corner pixel from the rectangles by using width and height of the template size.

3.4 Face Recognition

Face recognition is a post processing step and/or recognition face to detect the facial features and the extracted features are compared with template database. If the system recognizes the features, the corresponding face is recognized and the name of the recognized person is displayed on the screen. The extracted features are compared with the faces stored in the database during face recognition using existing PCA technique and proposed Espy technique. The proposed Espy technique has produced better result than PCA technique. If the system recognizes faces, the attendance gets marked immediately of recognized faces.

3.4.1 Principle Component Analysis (PCA)

Principle Component analysis (PCA) is a widely used to emphasize variation and capture strong patterns in a data set.PCA approaches used in face recognition systems is the so-called eigen face approach. It is a statistical procedure that uses an orthogonal transformation, to convert a set of observations into a set of values of linearly uncorrelated variables. PCA is the simplest of the true Eigen vector-based multi variant analyses. It supply the user with a lower-dimensional picture, a projection of this object can be viewed from its most informative viewpoint.

Pseudo code for Principle Component analysis (PCA)

1. Start to capture the images.
2. Place the circular masks around the pixels.
3. Apply circular masks to extract features.
4. Points = PCA (I, m size, mask) using masking technique.
5. Extract features as eyes, lips and eyebrows.
6. Corner points = point (points>S max/4).
7. Convert binary values as (0 and 1).
8. Calculate the values by training and testing the images.
9. End.

3.4.2 Proposed Espy Technique

In the traditional way of student attendance system was manually taken by faculty and marked in the attendance sheet. After that the faculty update the attendance in the database for the purpose of student eligibility for attending examination. It is a crucial and time consuming process for maintaining the above mentioned process manually. For overcome this problem biometric system was introduced. In this system initially stored human individual physiological features like fingerprint, iris and face detection. In fingerprint and iris biometric are taking time because of student are standing in queue to touch their thumb on the biometric device. Hence face detection is used in this research work for automatic attendance system. Initially the student

information and their face images are stored in the database. In this database several student images are stored as well as the extracted features from the student photo are stored into the template database. After extracting the feature of each face through feature extraction, the last step is to recognize the identities of these faces from the database. The camera fixed in the class room for capturing the face of the students while entering the class room.When the student image is captured through camera,then the feature extraction and face detection are performed on it. In this research work proposed Espy face recognition technique for recognize student face. Then extracted features are compared with student template database. If the student face are matched to a database the attendance becomes marked immediately.The proposed Espy technique is removed valuable features that discriminate one person from the others. Finally the student attendance was generated and stored in the attendance database.

Pseudo code for Espy Algorithm

1. Start to capture the images.
2. Im2bw for binary image.
3. Read the database images.
4. Apply affine moment invariants for the images.
5. Convert vector into features for face recognition.
6. Gray co matrix (image, 'all') for extract texture features of images in the matrix.
7. Extract features as eyes, mouth and nose.
8. Train the images and then test it.
9. Calculate the values by training and testing the images.
10. End.

3. Experimental Result

This work is implemented in MATLAB tool. It provides the required image mining functions and methodologies. The Genius WideCam F100 camera model fixed in the class room and it connected into student database. The proposed ESPY technique is used for face recognition, it compared input captured student image and existing student database.

4.1 Preprocessing

In preprocessing step, four preprocessing techniques are used for removing the noise from facial images. They are Median filter, Average filter, Gaussian filtering and Weiner filtering.

4.1.1 Performance Analysis

PSNR (Peak Signal to Noise Ratio) is used for performance analysis. From the performance measure, it is observed that Weiner filter achieved high PSNR (Peak Signal to Noise Ratio) ratio and less execution time compared with other three techniques. Other filters take more time and removal of noise is not as best as Weiner filter.

Table 1 Filtering Accuracy

Filters	**Accuracy (PSNR Values)**
Average Filter	40%
Median Filter	38%
Gaussian Filter	38%
Weiner Filter	53%

From the table 1 it shows that Weiner filter with 53% gives best results with lesser noise and with higher PSNR values by the amount of de-noise images with the comparison of noisy images.

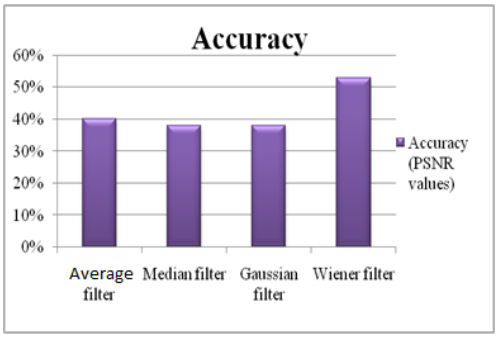


Figure 2 Filtering Accuracy

From the above figure 2 it is showed that Weiner filter performs better than other filters by their accuracy values with PSNR values.

4.1.2 Execution Time for Filters

Table 2 Execution Time

Filters	Time Taken (Milliseconds)
Average Filter	440
Median Filter	260
Gaussian Filter	160
Weiner Filter	140

From the table 2 proved that Weiner filter takes less execution time compares with other filtering techniques. Table 3 shows the Filtering results.

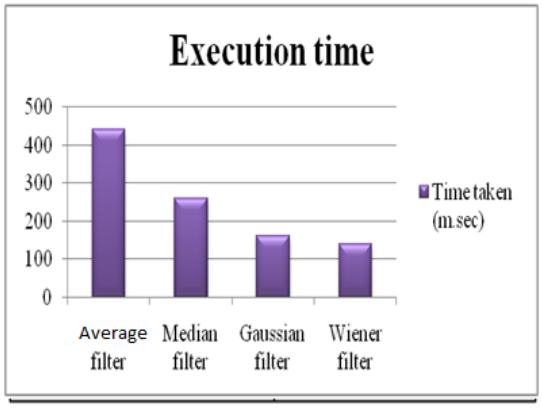
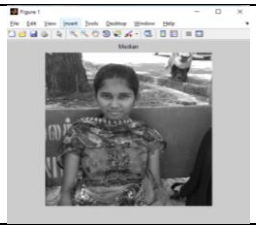
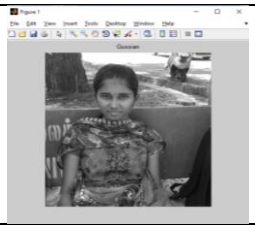
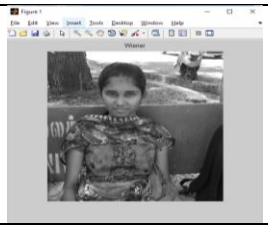


Figure 3 Execution Time for Filters

Table 3 Filtering Results

Average Filter Result	Median Filter Result	Gaussian Filter Result	Wiener Filter Result
			

4.2 Edge Detection

Four edge detection techniques are used fro extract the edge points from facial images. They are Roberts, Prewitt, Sobel and Canny edge detectors.The performance of these edge detection techniques are analyzed and compared. The canny edge detection method has produced better result than other three techniques.

4.2.1 Performance Analysis

PSNR (Peak Signal to Noise Ratio) is used for performance analysis. From the performance measure, it is proved that canny edge detector performs better than other detectors with its highest accuracy values by using PSNR ratio.

Table 4 Accuracy Measures for Edge detection

Edge Detection	Accuracy (PSNR)
Sobel	86%
Prewitt	85%
Robert	81%
Canny	91%

From the table 4 accuracy measure it is proved that canny edge detector performs better than other detectors with its highest accuracy values by using PSNR (Peak Signal to Noise Ratio). By calculating PSNR it is showed by comparing the edge detection images with original images. It is showed the best edge detector by smoothing and detecting the edges accurately.

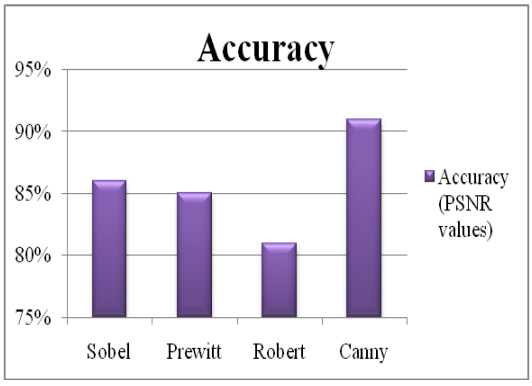


Figure 4Edge detection Accuracy

From the above figure 4 it is showed that Canny edge detection performs better than other filters by their accuracy values with PSNR values.

4.2.2 Execution Time for Edge Detection

Table 5 Edge Detection – Execution Time

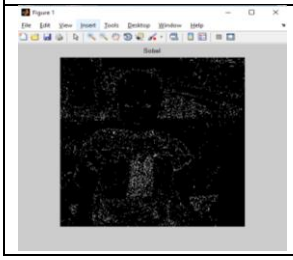
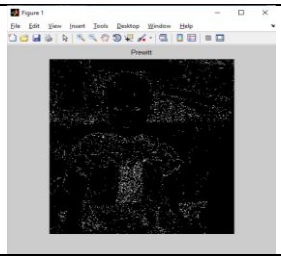
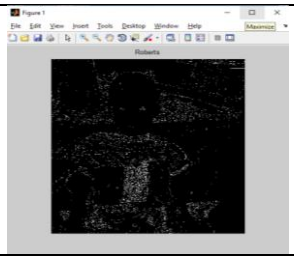
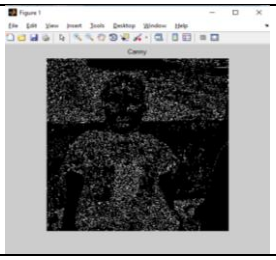
Edge Detection	**Time Taken (Milliseconds)**
Sobel	560
Prewitt	540
Robert	560
Canny	420

From the table 5 it is proved that canny edge detector performs better than other filter with its less time taken compared to other filters.

Figure 5 Execution Time for Edge detection

From the above figure 5 shown that the canny edge detector performs less time when compared with other detectors.

Table 6 Edge Detection Results

Sobel Edge Detection Result	**Prewitt Edge Detection Result**	**Robert Edge Detection Result**	**Canny Edge Detection Result**
			

From the above experimental results it is proved that canny is the best detector by its outline of edge detection, accuracy and timing.

4.3 Feature Extraction

In feature extraction, the performance of Correlation algorithm is used for feature extraction. Figure 6 presents the features extracted from the facial images are eyes, nose and lips. In face part detection bounding box is used for feature extraction. Table 7given the bounding box extracts two eyes, nose and lips and it is extracted using convolution technique for all the images.

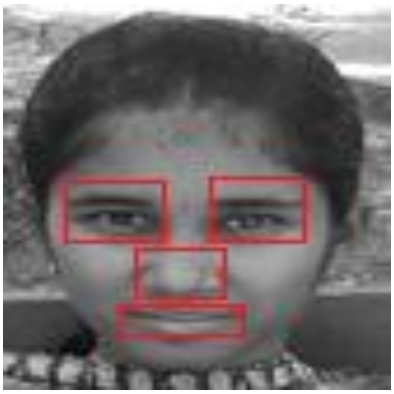
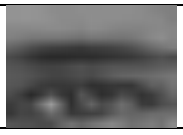
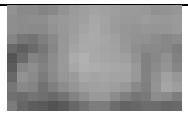


Figure 6 Features are extracted using correlation algorithm

Table 7 Feature Extraction Results

			
Right Eye	Left Eye	Nose	Lip

The extracted features are compared with the faces stored in the database during face recognition using existing PCA technique and proposed Espy technique. This espy technique has produced better result than PCA technique. If the system recognizes faces, the attendance gets marked immediately of recognized faces.

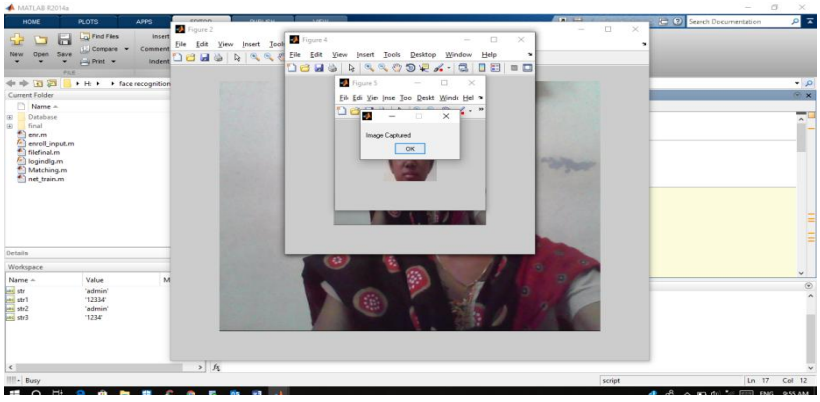


Figure 7 Image for Enrolling

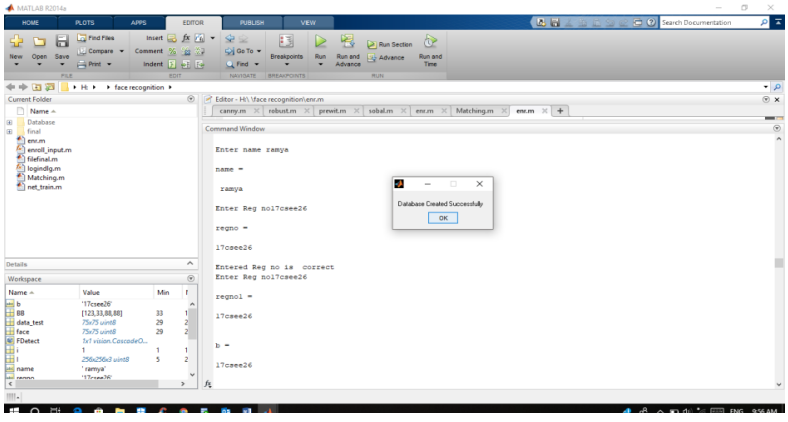


Figure 8 Database Creation

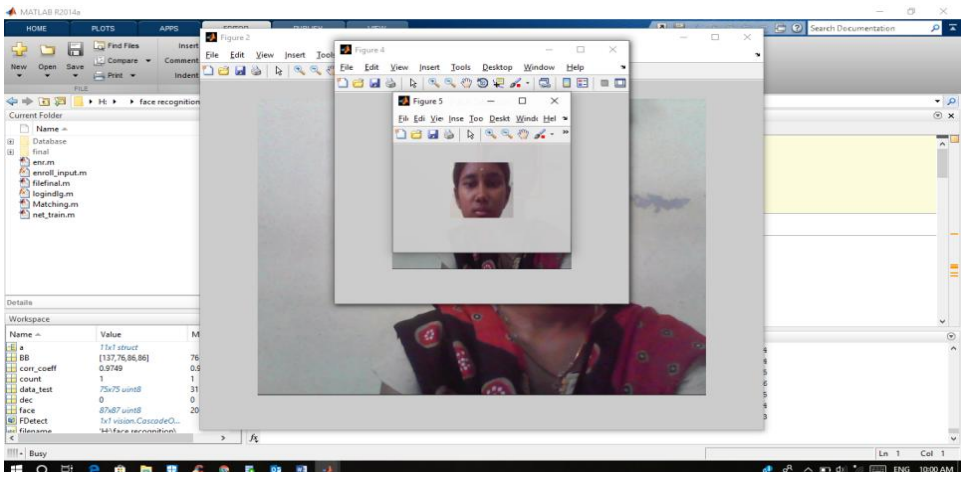


Figure 9 Image matching

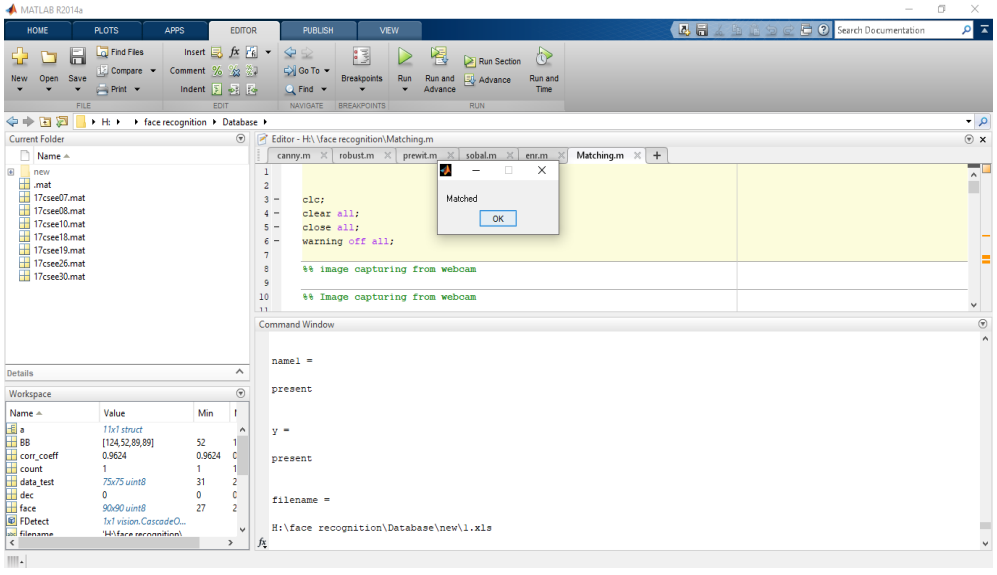


Figure 10 Result of the matched image

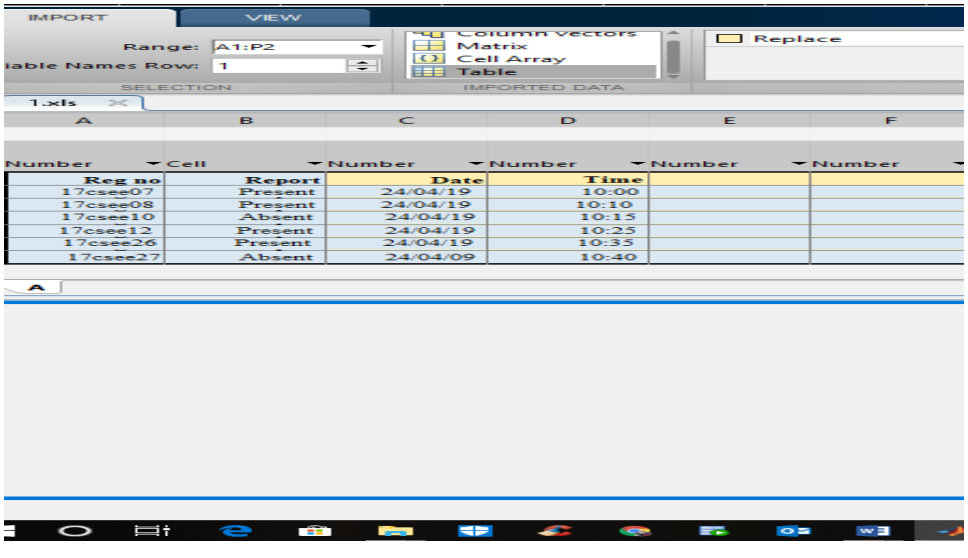


Figure 11 Stored in the Database

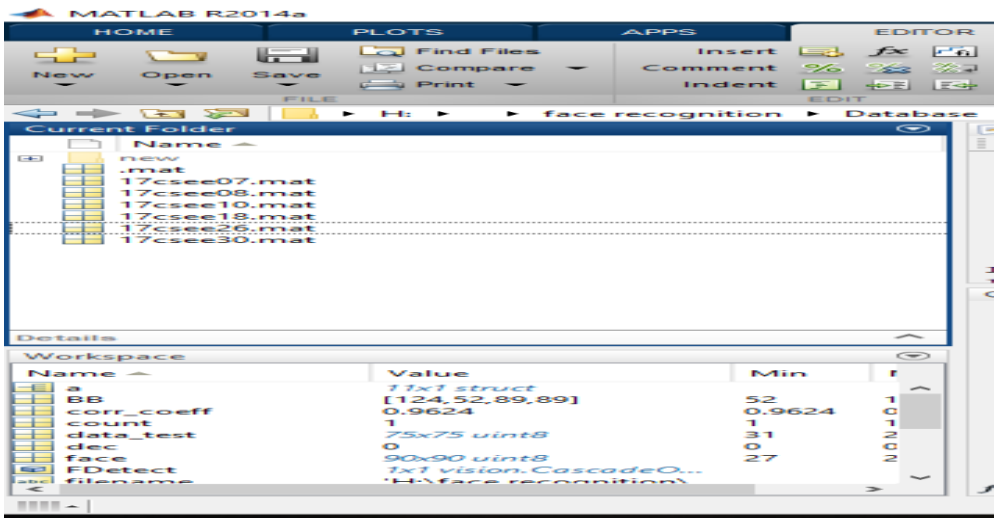


Figure 12 Report Generation

5. Conclusion

The main objective of this research work is to automatic student attendance system using face recognition technique. Initially in this work stored student information and their photo in the template database. Each classroom have cameras for capturing the face of the students while entering the class room and it is matched with the template database. The proposed ESPY face recognition technique is used for recognize the face and compared with template database and automatically mark the attendance. If the system matched the faces, the attendance gets generated immediately and stored in the table.The proposed Espy technique is compared with existing PCA and Correlation techniques.From this experimental results theproposed Espy technique provides complete results of storing attendance based on face detection and recognition with higher accuracy and less execution time. In Future, this work is extended for handling the whole class group image and takes the further preprocessing, edge detection, feature extraction and recognition steps for capturing the images and it stores in the database. It detects individual face from the group image and then match with the database then, it generate the student attendance report.

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