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# A Prototype of Automated Attendance System Using Image Processing

**Prof. Sumita Chandak[1], Mansi Patange[2], Himani Deshpande[3], Saifina Maredia[4], Prathmesh Bagwe[5]**

Lecturer, Information Technology, Atharva College of Engineering, Mumbai, India[1]

Student, Information Technology, Atharva College of Engineering, Mumbai, India[2,3,4,5]

**Abstract**: Conventionally, student record keeping is done manually by teachers through roll calling or by passing an attendance sheet in the class. These methods are time consuming, prone to errors and proxy attendance. Moreover, digital assimilation of records is tedious since teachers need to fill in the details in the database by themselves to generate reports. Consistency in manual and digital records also needs to be maintained. In the recent years, automated systems that have evolved use standard biometrics like fingerprint and iris recognition. These systems are intrusive in nature and require expensive gadgetry. Also deploying them on a large scale is detrimental to the project budget. Thus our project design makes use of facial detection and recognition algorithms like Viola Jones and PCA to identify the student and mark their attendance using a dynamic web camera. As the student stands in from of the system detects the face and compares it to the student image database for recognition phase. Daily attendance automatically gets updated in the database thereafter. This system solves the problem of redundancy in manual records and makes attendance keeping a convenient task.[8]

**Keywords**: Automated Attendance System, Face Detection, Face Recognition, PCA (Principal Component Analysis), Viola Jones, Camera, OpenCV.

## I. INTRODUCTION OF TITLE

Automated attendance monitoring using image processing is an upcoming technology which is widely used in factories for storing the attendance of the workers. However, the system used in these factories are expensive. This project proposes a prototype which can be used in Coaching Classes for student's attendance keeping. It is cost effective solution compared to the existing systems such as RFID tags and readers used in these classes.

## II. LITERATURE SURVEY

Mashhood Sajid et al [1] proposed a conceptual model that addresses concerns that if the student comes in the class, show up and marks his attendance once after image is captured the student can leave the class and be marked as present. They produced a solution of taking the attendance randomly three times in a lecture so that it could be made sure that the student attends the particular lecture and is present in the class actually rather than being marked as present. Their proposed model captured the image from a fixed camera in the classroom. The noise from the image is reduced and Gabor Filters or jets are used for extracting the facial fiducially points of every detected face. Calculated facial measurements are matched or verified with the data stored in the database. This all computation will be headed on the server. Humans have a diverse set of facial expressions which can reduce the accuracy of facial recognition software. Janarthany Nagendrarajah[2] proposed a model to overcome this dilemma, where Principal Component Analysis (PCA) is used to extract a set of Eigen-images known as Eigen faces and weights of this representation are used for recognition. This system stores only one image of the individual during enrolment phase since it is inconvenient to store more than one image of an individual from a commercial point of view (e.g. Immigration office ). During this phase, the individuals are required to maintain a neutral expression and the hair is tied away from their face. The model is tested using a database of images of diverse nations like images of Chinese faces and English faces. This security system was accurate in recognizing enrolled individuals when they had spectacles on. However, this project is yet to recognize real occluded images.

Steven Fernandes et al [3] analysed and reviewed the current face recognition algorithms in order to deduce a new and robust algorithm. They used ORL and SHEFFIELD database for analysing the performance of combination of appearance-based methods like Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA). PCA works better when the images are capture with no disturbance. The paper inferred that PCA is better than LDA at recognizing individuals even with background disturbance, since it took shorter time span for recognition. Thus, PCA and its variants are the best facial recognition algorithms.

Harshit Srivastava suggested about usingEmgu CV which is a cross platform .NET wrapper to the OpenCV image processing library. It allows OpenCV functions to be called from .NET compatible languages such as C#, VB, VC++, Iron Python etc. [4] the software proposed here

takes images from a CCTV camera instead of using still images database. Most of the web cameras face the problem of non-uniform lightning since they are dependent on the natural light and cannot have an artificial lighting source. The grayscale images from the camera must be of the same size so as to equalize the histograms. This equalization is crucial for better performance during natural lighting. Bhagyashri Ujagare et al [5] proposed facial recognition software based on Android platform so that it can be used as another security feature. The proposed model used Content based image retrieval (CBIR) method which is used for storing the images on the basis of similarities among the low level visual features like colour, texture, shape and other specific information. The image descriptor module of this model has typically two primary functions. First is an extraction process that encodes the image into feature vectors, and second is to find a similarity measure that compares two images. Only a feature extraction method would produce an inefficient outcome. Hence, clustering algorithm for grouping of similar images and Haar wavelets for texture feature extraction and average RGB for colour feature extraction are combined for more accuracy and efficiency.
It is usually difficult to compute the attendance with precision by utilizing each result of individual facial recognition because the face detection rate will be reduced. Yohei Kawaguchi et al [6] proposed an application where the attendance is monitored by continuous observation. Continuous observation is the method of using video streaming so that the students sitting position, presence, status and other information is collected. Active Student Detecting (ASD) approach is used to estimate the existence of a student sitting on the seat by using the background subtraction and inter-frame subtraction of the image from the sensing camera on the ceiling.

Yugandhara M. Bhoge et al [7] gave a basic idea of how the facial detection and facial recognition algorithms actually work. Viola Jones and PCA (i.e Principal Component Analysis) are the most efficient and accurate face detection and face recognition algorithms respectively. PCA does not work on the images directly it works on the matrices created from these images. It reduces the original image face database into a reduced database. This reduced database has lower dimensions which reduces the time for matrix computation. This reduction is possible due to the extraction of the characteristic feature or dominant feature images called Eigenfaces. The detection of faces is possible due to Viola Jones algorithm which does not take into account the pixel intensity but uses the deviation between the pixels of the rectangular boxes. It uses the Haar object classifier which is in the Haarcascade.xml file.

## III.IMPLEMENTATION

The scope of the proposed system is limited to a user friendly institutional level application existing in a 3 layered hierarchical structure for having role based access:

1.Admin level - Here the admin has the access, read, write, manipulation, deletion permissions of all the student records in the database. The admin has sole responsibility for creation of professor's profile.
2.Faculty/Staff level- The Teacher has the same set of permissions for the students' database but cannot create any new profiles.
3.Student level- The system will generate a monthly report of the student's attendance which will be sent to them via email. Also, notification will be sent to their parents in case they are in the defaulters list.

Implementation steps:

*A. Interface*

1)When the application is executed, a pop-up window appears asking for the login details. We need to select the type of user i.e. Admin or faculty. Unlike a Faculty user, Admin has the rights to create another faculty. The username and password is to be entered accordingly.
2)Login as Admin is made where the correct username and password needs to be entered for authentication. The system validates the login form. Also a query is executed to verify if the username and password are by the correct user.
3)The Admin is authenticated. The admin is authorized to create new faculty users. Hence after verification a window appears as shown. The menu bar shows three options. They are Add Faculty, which is used to create a new user. View faculty is used in order to view the database table which stores the username and password of all the users. Logout is for logging out of the system. These three privileges are granted only to the admin.
4)The Admin creates new faculty user by clicking on the "Add Faculty" button provided on the menu bar. A pop-up window appears which asks for the Username and Password of the newly created user.
5) The Username and Password is entered into the pop-up window. After entering the required fields, the data is securely verified and stored into the database by clicking the "Save" button.
6)After saving the username and password into the database, a message box appears showing that the transaction has been successful.
7)The View Faculty option on the menu bar is clicked by the Admin to view the Table in which the username and password of all the users are stored. This privilege is granted only to the Admin. No other user will be able to access this table in the database. Another window appears which shows the database table.

*B. Faculty/Staff Login*

1)The User type which is going to login is Faculty user. The user needs to select the correct user type from the drop-down list otherwise the user will not be authenticated even if he/she has entered the correct username and password.
2)After the validation and authentication of the new user. The "Face Detection and recognition" form appears on the screen. The user need to click on the "Detect and recognize" button in order to open the camera application.

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*C. Detection and Enrolment*

1)If the student is not enrolled into the system, he/she can be enrolled by training the system. The student need to sit in front of the camera. Their face image will be extracted by the system and the user need to fill up the appropriate details given in the form. The "Add face" button is clicked. It stores all the student details into the database.

2)If the student is already enrolled. Then after clicking on the "Detect and recognize" button the system will detect and extract a new image of the student. It will recognize the user by using the algorithm and the image database used during enrolment.

3)The students name will appear on the edge of the frame. The student details appear on the results box. The student need to select the appropriate date and then click on the "Attendance" button. A message box appears which shows that the students attendance is marked in the database.

4)When we click on the "View" button, another window appears which displays the attendance database table in which the students' attendance is marked.

5)When "Generate Report" button is clicked. A window appears which has a drop-down list for selecting the month and the year of which a report is to be generated. It shows a message box "Done" if the report generation is completed.

The technologies and algorithms to be used in achieving this goal are explained in the next section.

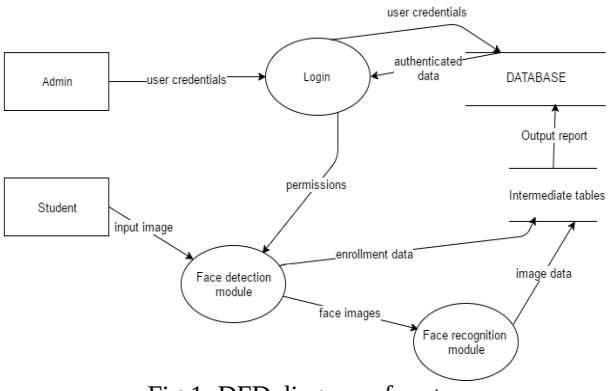


Fig 1: DFD diagram of system

## IV. METHODOLOGIES

*A. Viola-Jones Algorithm*

The Viola–Jones object detection framework is the first object detection framework to provide competitive object detection rates in real-time proposed in 2001 by Paul Viola and Michael Jones. Although it can be trained to detect a variety of object classes, it was motivated primarily by the problem of face detection.

•Extremely fast feature computation
•Efficient feature selection
•Scale and location invariant detector
•Instead of scaling the image itself (e.g. pyramid-filters), we scale the features.
•Such a generic detection scheme can be trained for detection of other types of objects (e.g. cars, hands)

```
//Face Detector
MCvAvgComp[][] facesDetected = gray.DetectHaarCascade(
face,
1.2,
10,
Emgu.CV.CvEnum.HAAR_DETECTION_TYPE.DO_CANNY_PRUNING,
new Size(20, 20));

//Action for each element detected
foreach (MCvAvgComp f in facesDetected[0])
{
    TrainedFace = currentFrame.Copy(f.rect).Convert<Gray, byte>();
    break;
}

//resize face detected image for force to compare the same size with the
//test image with cubic interpolation type method
TrainedFace = result.Resize(100, 100, Emgu.CV.CvEnum.INTER.CV_INTER_CUBIC);
trainingImages.Add(TrainedFace);
string user_data;
user_data = textBox1.Text + ";" + textBox2.Text + ";" + textBox3.Text+";"+txtPhone.Text;
```

Fig 2: Code for Haar cascades

*B. PCA*

Principal component analysis (PCA) is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. The number of principal components is less than or equal to the number of original variables. PCA is a linear Dimensionality Reduction Technique which searches patterns for reduction of dataset with minimal loss of information and data. It cannot directly operate on the images so it needs to convert them into matrices for computation. This transformation is defined in such a way that the first principal component has the largest possible variance (that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance possible under the constraint that it is orthogonal to the preceding components. PCA is sensitive to the relative scaling of the original variables.

•Lack of redundancy of data given the orthogonal components.
•Reduced complexity in images' grouping with the use of PCA.
•Smaller database representation since only the trainee images are stored in the form of their projections on a reduced basis.
•Reduction of noise since the maximum variation basis is chosen and so the small variations in the background are ignored automatically.

```
/// <summary>
/// An object recognizer using PCA (Principle Components Analysis)
/// </summary>
[Serializable]
public class EigenObjectRecognizer
{
   private Image<Gray, Single>[] _eigenImages;
   private Image<Gray, Single> _avgImage;
   private Matrix<float>[] _eigenValues;
   private string[] _labels;
   private double _eigenDistanceThreshold;

   /// <summary>
   /// Get the eigen vectors that form the eigen space
   /// </summary>
   /// <remarks>The set method is primary used for deserialization, do not attemps to set it unless you know what you are doing</remarks>
   public Image<Gray, Single>[] EigenImages
   {
      get { return _eigenImages; }
      set { _eigenImages = value; }
   }

   /// <summary>
   /// Get or set the labels for the corresponding training image
   /// </summary>
   public String[] Labels
   {
      get { return _labels; }
      set { _labels = value; }
   }
```

Fig 3: Eigen Object Recogniser

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## V. RESULTS

### *A. Initial results*

The inception of the project began with the idea of a web application using Bootstrap frameworks but due to CSS usage the application took long time to load which defeated the purpose of easy attendance maintenance. Also uploading the image online was tedious. Thus a shift to desktop application was adopted. Also initially static images were used but a switch to dynamic live capture of images was made since facial dynamics play an important role in the face recognition process, facial dynamics are even more crucial under degraded viewing conditions such as poor illumination, low resolution, and recognition at distance.

### *B. Application results*

The software was initially designed to be for multiple faces, but was giving a high rate of false positives. Occurrence and resolving false positives is difficult and more time consuming than recording a single face. As a result, the prototype uses single face detection method. The following are the Test Cases:

Table 1: Test Cases for Recognition phase

| Description | Test Data | Expected Result | Actual Result | Pass/ fail status |
|---|---|---|---|---|
| 1)Recognizing an existing face image | Detected face image as input | Efficiently recognize the face image and return respective name. | Face image success fully recognized. | Pass |
| 2)Recognizing a face that is not enrolled | Detected face image as input | Not recognized | Falsely recognized | Fail |
| 3)Recognition of dummy Images | Detected dummy Image as input | Not Recognized | Recognized | Fail |

The face detection and recognition results are shown below:

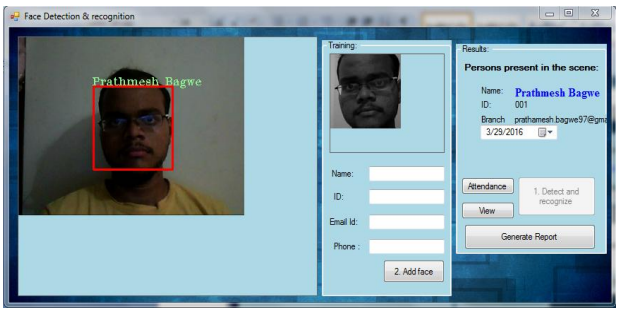


Fig 4: Enrolment phase

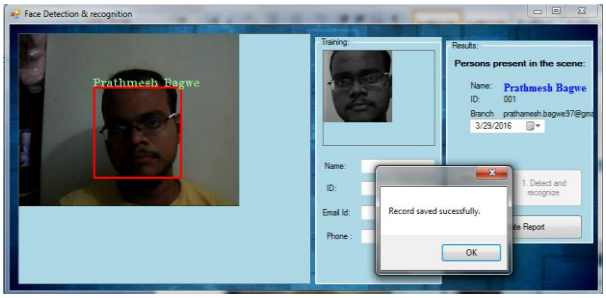


Fig 5: Recognition phase and storage in Database

## VI. CONCLUSION

The Attendance monitoring using image processing is a solution to curb the various inconsistencies in manual record keeping. This project has employed various technologies and their optimisations to achieve this goal. Our project has made this goal cost effective by using open source technologies to create an institutional level project which is easy to use and removes the nuisance of maintaining attendance.

## VII. FUTURE SCOPE

*A.* Android application-The system can be developed on an android platform where instant push notifications can be given. The cost can also be reduced as basic camera of the phone can be used to capture images.

*B.* This prototype can be used in online exam verification instead of hall tickets and QR codes, if the issue of dummy images is resolved.

*C.* Efficient multiple face recognition- This prototype can be improved using 3D and 2D image processing, where multiple faces can be recognized at a given time and can be recorded easily.

*D.* Performance improvement- Image processing algorithms can be used to increase the accuracy and makes attendance monitoring more efficient.

*E.* Security Applications-We can use detection & recognition system to identify culprits on bus stations, railway stations and other public places. This will be helping hand to the police. In this system, we will use GSM module. Suppose if culprit is detected, then detected signal can be transmitted using GSM module to the central control room of police station. With the help of ISDN number of GSM, culprit surviving area will be recognized.

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