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# Automatic Attendance Management System Using Face Recognition

**Jomon Joseph[1], K. P. Zacharia[2]**

[1]M.Tech (By Research) Scholar, Anna University, Coimbatore, Jothipuram, Coimbatore, India

[2]Professor, Department of Electronics & Communication Engineering, Saintgits College of Engineering, Pathamuttom P.O., Kottayam-686532, Kerala, India

**Abstract:** ***Being one of the most successful applications of the image processing, face recognition has a vital role in technical field especially in the field of security purpose. Human face recognition is an important field for verification purpose especially in the case of student's attendance. This paper is aimed at implementing a digitized system for attendance recording. Current attendance marking methods are monotonous & time consuming. Manually recorded attendance can be easily manipulated. Hence the paper is proposed to tackle all these issues.***

**Keywords:** Image processing, Face recognition, PCA, Eigen Face, Microcontroller, MATLAB and Camera

## 1. Introduction

Facial recognition or face recognition as it is often referred to as, analyses characteristics of a person's face image input through a camera. It measures overall facial structure, distances between eyes, nose, mouth, and jaw edges. These measurements are retained in a database and used as a comparison when a user stands before the camera. One of the strongest positive aspects of facial recognition is that it is non-intrusive. Verification or identification can be accomplished from two feet away or more, without requiring the user to wait for long periods of time or do anything more than look at the camera.

Traditionally student's attendance is taken manually by using attendance sheet, given by the faculty member in class. The Current attendance marking methods are monotonous & time consuming. Manually recorded attendance can be easily manipulated. Moreover, it is very difficult to verify one by one student in a large classroom environment with distributed branches whether the authenticated students are actually responding or not. Hence the paper is proposed to tackle all these issues [1].

The proposed system consists of a high resolution digital camera to monitor the classroom or office room. It is embedded on a micro-controller based motor system which enables it to rotate in left & right directions. The data or images obtained by the camera are sent to a computer programmed system for further analysis. The obtained images are then compared with a set of reference images of each of the employees or students & mark the corresponding attendance. The system also provides for continuous monitoring of the classroom by an operator if needed. The camera module can be a wireless or wired system.

## 2. System Overview

1) MATLAB section- The MATLAB section consists of the face recognition module. Face Recognition module- Initially the images of each of the users is provided for the MATLAB & generate a set of facial features using of the feature extraction methods viz. PCA (Principal Component Analysis) –Thus we create a feature set for each of the images provided in the database. During real time, the images of human face may be extracted from a USB camera. This involves MATLAB's Image Acquisition Toolbox, using which a camera is configured, accessed & brought one frame at a time into MATLAB's workspace for further processing using MATLAB's Image Processing Toolbox. This method uses eigen face approach for face recognition which was introduced by Kirby and Sirovich in 1988 at Brown University. The method works by analyzing face images and computing eigenface which are faces composed of eigenvectors. The comparison of eigenface is used to identify the presence of a face and its identity. There is a five step process involved with the system developed byTurk and Pentland [1]. First, the system needs to be initialized by feeding it a set of training images of faces. This is used to define the face space which is set of images that are face like. Next, when a face is encountered it calculates an eigenface for it. By comparing it with known faces and using some statistical analysis it can be determined whether the image presented is a face at all.

2) Micro-controller based embedded hardware system- For this project PIC micro-controller along with as servo motor mechanism is used. The name PIC initially referred to "Peripheral Interface Controller". PICs are popular with both industrial developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability. Servomotors:- A servomotor (servo) is an electromechanical device in which a PWM input determines the position of the armature of a motor. A servomotor is a rotary actuator that allows for precise control of angular position. It consists of a motor coupled to a sensor for position feedback, through a reduction gearbox. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servomotors are used in applications such as robotics, CNC machinery or automated manufacturing. The camera is embedded on this system,

which enables it to rotate in left & right directions. The data or images obtained by the camera are sent to a computer programmed system for further analysis. The obtained images are then compared with a set of reference images of each of the employees or students & mark the corresponding attendance.

## 3. System Implementation

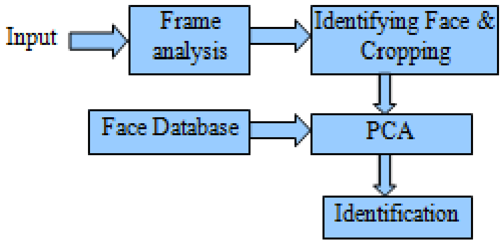


**Figure 1:** Block diagram Full

### 3.1 Face Recognition using Principal Component Analysis

In this paper we have reviewed a face recognition method based on feature extraction. By using extensive geometry, it is possible to find the contours of the eye, eyebrow, nose, mouth, and even the face itself. Principal component analysis for face recognition is based on the information theory approach. Here, the relevant information in a face image extracted and encoded as efficiently as possible.

In mathematical terms, the principal components of the distribution of faces or the eigenvectors of the covariance matrix of the set of face images, treating an image as a point (vector) in a very high dimensional face space is sought. Here principal component analysis method will be presented in more detail. The proposed system is based on an information theory approach that decomposes face images into a small set of characteristic feature images called „Eigen faces", which are actually the principal components of the initial training set of face images. Recognition is performed by projecting a new image into the subspace spanned by the Eigen faces („face space") and then classifying the face by comparing its position in the face space with the positions of the known individuals. The Eigen face approach gives us efficient way to find this lower dimensional space. Eigen faces are the Eigenvectors which are representative of each of the dimensions of this face space and they can be considered as various face features. Any face can be expressed as linear combinations of the singular vectors of the set of faces, and these singular vectors are eigenvectors of the covariance matrices.

### 3.2 Eigen faces for Recognition

We have focused our research toward developing a sort of unsupervised pattern recognition scheme that does not depend on excessive geometry and computations like deformable templates. Eigenfaces approach seemed to be an adequate method to be used in face recognition due to its simplicity, speed and learning capability. A previous work based on the eigenfaces approach was done by M. Turkand A. Pentland, in which, faces were first detected and then identified. In this thesis, a face recognition system based on the eigenfaces approach, similar to the one presented by M. Turk and A. Pentland, is proposed.

The scheme is based on an information theory approach that decomposes face images into a small set of characteristic feature images called eigenfaces, which may be thought of as the principal components of the initial training set of face images. Recognition is performed by projecting a new image onto the subspace spanned by the Eigen faces and then classifying the face by comparing its position in the face space with the positions of known individuals. Actual system is capable of both recognizing known individuals and learning to recognize new face images. The Eigenfaces approach used in this scheme has advantages over other face recognition methods in its speed, simplicity, learning capability and robustness to small changes in the face image. FACE-PRO, the actual face recognition software based on the Eigen faces approach was developed in C programming language on a personal computer. Although no optimizations were performed for matrix operations, during the tests on a Intel 80486 based personal computer, it was remarkable that the system could build a training set that had 14 members with 7 eigen faces over a 58 member demo face library by updating all the feature vectors of the library members in around one minute. Once the training set has been built, recognitions were done near real time over this demo face library in less than one second. Much of the previous work on automated face recognition has ignored the issue of just what aspects of the face stimulus are important for face recognition. This suggests the use of an information theory approach of coding and decoding of Face images, emphasizing the significant local and global features. Such features may or may not be directly related to our intuitive notion of face features such as the eyes, nose, lips, and hair. In the language of information theory, the relevant information in a face image is extracted, encoded as efficiently as possible, and then compared with a database of models encoded similarly. A simple approach to extracting the information contained in an image of a face is to somehow capture the variation in a collection of face images, independent of any judgment of features, and use this information to encode and compare individual face images. In mathematical terms, the principal components of the distribution of faces, or the eigenvectors of the covariance matrix of the set of face images, treating an image as point (or vector) in a very high dimensional space is sought. The eigenvectors are ordered, each one accounting for a different amount of the variation among the face images.

### 3.3 Calculation of Eigen faces and Weights

Let a face image I(x,y) be a two-dimensional N x N array of 8-bit intensity values. An image may also be considered as a vector of dimension N2 , so that a typical image of size 256 x 256 becomes a vector of dimension 65,536, or equivalently a point in 65,536-dimensional space. An ensemble of images, then, maps to a collection of points in this huge space. Images of faces, being similar in overall configuration, will not be randomly distributed in this huge image space and thus can be described by a relatively low dimensional subspace. The main idea of the principal component analysis (or Karhunen-Loeve expansion) is to find the vectors that best account for the distribution of face images within the entire image space. These vectors define the subspace of face images, which we call "face space". Each vector is of length N2 , describes an N x N image, and is a linear combination of the original face images. Because these vectors are the eigenvectors of the covariance matrix corresponding to the original face images, and because they are face-like in appearance, we refer to them as "eigenfaces". Some examples of eigenfaces are shown in Figure 5.2. An N x N matrix A is said to have an eigenvector X, In linear algebra, the eigenvectors of a linear operator are non-zero vectors which, when operated on by the operator, result in a scalar multiple of them. The scalar is then called the eigenvalue An N x N matrix A is said to have an eigenvector X, In linear algebra, the eigenvectors of a linear operator are non-zero vectors which, when operated on by the operator, result in a scalar multiple of them.

The scalar is then called the eigenvalue $\lambda$ associated with the eigenvector(X). Eigen vector is a vector that is scaled by a linear transformation. It is a property of a matrix. When a matrix acts on it, only the vector magnitude is changed not the direction

$$AX = \lambda X \quad (1)$$

Calculations of eigen values and eigen vectors

$$(A - \lambda I) = 0 \quad (2)$$

Where I is the n x n Identity matrix.We know that a nontrivial solution exists if and only if

$$\det(A - \lambda I) = o \quad (3)$$

Where det () denotes determinant.
If A is n x n, then there are n solutions or n roots of the characteristic polynomial. Thus there are n eigen values of A satisfying the equation Where i=1, 2, 3….n

We assume the training sets of images are $\Gamma_1, \Gamma_{2,} \ldots \Gamma_m$ with each image is I (x, y).Convert each image into set of vectors and new full-size matrix(m×p), where m is the number of training images and p is x × y.
Find the mean face by:

$$\Psi = \frac{1}{m}\sum_{i=1}^{m}\Gamma_i \quad (4)$$

Calculated the mean-subtracted face:

$$\Phi_i = \Gamma_i - \Psi, i = 1,2\ldots m \quad (5)$$

$A = [\phi_1, \phi_2 \ldots \phi_m]$ is the mean-subtracted matrix vector with its size Amp. By implementing the matrix transformations, the vectors matrix is reduced by

$$C_{mn} = A_{mp} \times A_{pm}^T \quad (6)$$

where C is the covariance matrix and T is transpose matrix. Find the eigenvectors, Vmm and eigenvalues from the C matrix using Jacobi method and ordered the eigenvectors by highest eigenvalues. Jacobi's method is chosen because its accuracy and reliability than other

method.Apply the eigenvectors matrix, Vmm and adjusted matrix, These vectors determine linear combinationsof the training set images to form the eigenfaces, Uk by

$$U_k = \sum_{n=1}^{m}\phi_n V_{kn}, k = 1,2\ldots m \quad (7)$$

Instead of using m eigenfaces, m'_<_m which we consider the image provided for training are more than 1 for each individuals or class. m' is the total class used. Based on the eigenfaces, each image have its face vector by:

$$W_k = U_k^T\ (\Gamma - \Psi), k = 1,2\ldots m \quad (8)$$

and mean subtracted vector of size and eigenfaces is Upm'_. The weights form a feature vector

$$\Omega^T = [w_1 w_2 \ldots . w_m ,]$$

A face can be reconstructed by using its feature, vector and previous eigen faces

$$\Gamma = \Psi + \Phi_f \quad (9)$$

Where

$$\Phi_f = \sum_{i=1}^{m} w_i U_i$$

## 4. Experiment

The steps of the experiment process are;

1. Initiate capturing the images through the camera which is able to rotate in all direction in the class room.
2. Pre-process the captured images through and extract face image.
3. Calculate the eigen value of the captured face image and compared with that of the existing face images.
4. If the eigen value does not matches with the existing one,save it as a new face image.
5. If the eigen values matches, then the recognition process will start soon.
6. Using PCA algorithm the following steps would be followed
7. Find the face information of matched face image in the database.
8. Update the log table with corresponding face image and system time that makes completion of attendance for an individual students.
9. This section presents the results of the experiments.

## 5. Results

### 5.1 Test Image

**Figure 2:** Test Image

### 5.2 Result

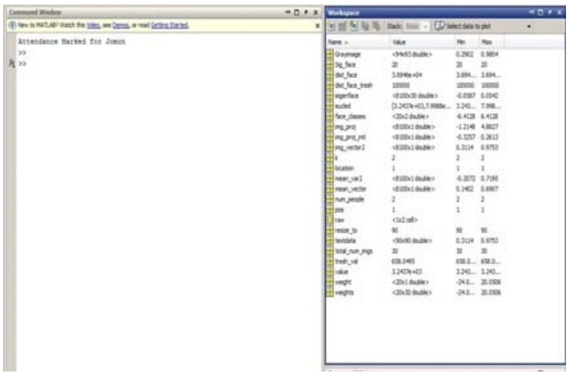


**Figure 3:** Attendance marked for Jomon

### 5.3 Test Result-Excel Report

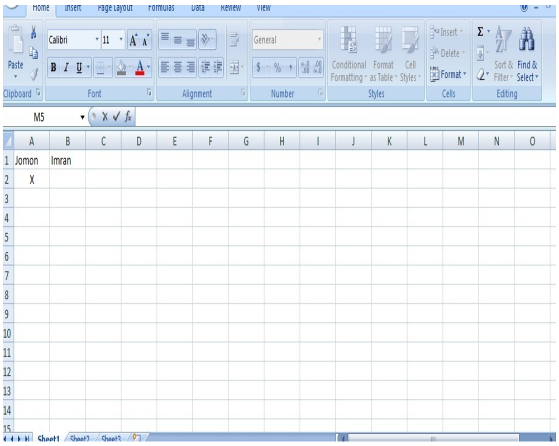


**Figure 4,** Attendance marked for Jomon

## 6. Conclusion

Experimental results have shown that, the proposed face recognition method was very sensitive to face background and head orientations. Changes in the illumination did not cause a major problem to the system. Besides, presence of small detail such as dark glasses or masks was too far from being a real challenge to the system. There exists a trade off between the correct recognition rate and the threshold value. As the threshold value increases, numbers of misses begin to decrease, possibly resulting in misclassifications. On the contrary, when the number of eigenfaces involved in the recognition process increases misclassification rate begins to decrease, possibly resulting in misses. The eigenface method is very sensitive to head orientations, and most of the mismatches occur for the images with large head orientations.

## 7. Future Scope

The current recognition system has been designed for frontal views of face images. A neural network architecture (may be together with a feature based approach) can be implemented in which the orientation of the face is first determined, and then the most suitable recognition method is selected, Also the current recognition system acquires face images only from face files located on magnetic mediums. Camera and scanner support should be implemented for greater flexibility.

## References

[1] M. A. Turk and A. P. Pentland, "Face Recognition Using Eigenfaces,"in Proc. IEEE Conference on Computer Vision and PatternRecognition, pp. 586–591. 1991.

[2] Nirmalya Kar, Mrinal Kanti Debbarma, Ashim Saha, and Dwijen Rudra Pal" Study of Implementing Automated Attendance SystemUsing Face Recognition Technique "International Journal of Computer and Communication Engineering, Vol. 1, No. 2, July 2012.

[3] Goldstein, A. J., Harmon, L. D., and Lesk, A. B., Identification of human faces", Proc. IEEE 59, pp. 748-760, (1971).

[4] M.N.Shah Zainudin., Radi H.R., S.Muniroh Abdullah., Rosman Abd. Rahim., M.Muzafar Ismail," Face Recognition using PCA and LDA", International Journal of Electrical & Computer Sciences

[5] Yohei KAWAGUCHI ,Tetsuo SHOJI ,Weijane LIN ,and Koh KAKUSHO , "Face Recognition-based Lecture Attendance System", Department of Intelligence Science and Technology, Graduate School of Informatics, Kyoto University.

## Author Profile

**Jomon Joseph** received his Bachelor of Technology Degree in Electronics & Communication Engineering from Government Engineering College, Kottayam, Kerala. He worked as an Assistant Professor in the Department of Electronics and Communication at SAINTGITS college of Engineering, Kottayam, Kerala, India. Currently he is doing M. Tech (By Research) at Anna University, Coimbatore, Tamilnadu, India.