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Automated Cloud Based Attendance System Using Principal Component Analysis

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Abstract

Every educational institute needs attendance marking to keep a daily track on students' performance. Conventional marking is time-consuming and banal for both students and teachers. To overcome this problem, proposed system using face recognition and integrate data on the cloud so that all records are easily available and maintained by the server and to minimize the errors. The model is deployed on the cloud so that faculty and students can access it. Eigen face detection techniques are used for marking the attendance of the students. The concepts of Image processing as well as Face detection and Recognition are used.

Keywords: *Face Recognition, Cloud database, Eigen face, Eigenvectors.*

1. INTRODUCTION

Face recognition technique can be considered as effective for face detection .The attendance of the students can be managed by the system which can be effectively utilized in educational field.

In the world there are many education systems where many students are learning and enrolling for variety of courses .Classrooms contains 80 to 100 students at a time for course. To maintain the records and attendance of such a huge group of students is a very time consuming and inexpedient task. Daily attendance of the students is the essential part, so to maintain the manual attendance and record for such a huge number of the students is grim task as well as it is monotonous and time overwhelming task. To check whether student being present in the class an effective system can be implemented. By recognizing the faces of the students, it will automatically mark the attendance Therefore it is desideratum to implement an effective system.

System is divided into various modules.

1. Face recognition
2. Face detection

Database of the students need to be created for marking the student's attendance. To recognize face student database is created. To mark attendance student's images are captured using android smart phone. To identify the correct image, it needs to capture the multiple images of the all students. These images will be provided to the system as input parameter. The images need to be enhanced for effective face detection using image processing techniques such as gray scale conversion. Image quality is enhanced and then variety of techniques are applied. Some of the available approaches are Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA). In view of the class having sixty to seventy students, mark the attendance is essential for every student present in the class. To spot the attendance of last bench, student must be identified. So for the histogram, equalization of the images must be done. After enhancing the quality of

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the images, it is ready for face detection. In present paper Eigen Face technique is proposed using PCA. Faces are cropped from images after faces are detected using Eigen Face Technique. Then different features such as nose-line, face-outline, distance between eyes, etc. are extracted. The student is identified based on these different features. The extracted features are compared with stored database feature on cloud and then only the student will get their attendance marked. For comparison, we should have a database of all the faces required. Students can enrol themselves in the database along with maintaining other information such as name, roll number, division, attendance and photo for the identification. The teacher can generate monthly and yearly report of the attendance for the respective class. The system can also send mail to the students based on the report generated.

2. LITERATURE SURVEY

There are some drawbacks in the in the biometric systems used for attendance marking. Most of the systems have just 40% accuracy and it works by capturing the image through camera after every 20 minutes. Voila Jones approach is best suitable and was proposed by Jayant et al [1]. It is possible to improve the performance of attendance management systems.

Using MATLAB platform, a system useful for face recognition and detection was proposed by Owayjan.et.al [2]. The proposed system first detects and crop the face. These images are then converted into gray scale. Smoothing filter was applied further to enhance. Finally, with the help of Artificial Neural Networks, the features of image were extracted and cross checked with the database for the match.

For making the system time efficient and more accurate, a different idea of using video streaming to detect the faces was proposed by Santana et.al [3]. Only face detection was achieved using this approach which was the basic idea behind it.

Soetedjo et.al [4] proposed a system by using Kalman Filter tracking and Cam Shift tracking together. Face detection and recognition technologies are used together. The execution time and accuracy was not so great but the detection rate was pretty efficient.

Researchers [5][6] modelled automated attendance management system using face recognition.
Tiwari et al [7] used Harr features based techniques for face detection. Researchers [8][9] worked on attendance system using face recognition techniques. Ravibabu et al [10] proposed face recognition mechanism using android mobile. Many Researchers [11] [12] used facial recognition using smartphones.

3. FLOW DIAGRAM

Fig 1. Shows flow diagram of modeled attendance management system. It uses android smartphone to capture the set of images of individual student. From this set, facial features of students are extracted and data is stored on cloud.

For marking the attendance, classroom photo is captured. From this photo, faces are extracted by Eigen face algorithm. The features are extracted from cropped images after undergoing preprocessing. These features are compared with database stored on cloud. If match found then the corresponding attendance of the student is marked as present, otherwise the student is absent in the excel sheet.

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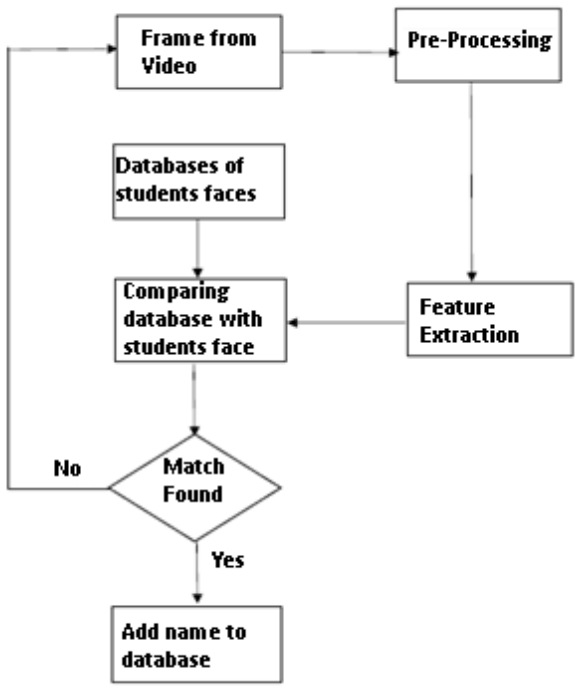

Fig. 1.*Flow Diagram of System*

4. PROPOSED METHODOLOGY

In facial recognition all the images of should be discriminated. All object that can be extracted from the image may be noisy due to conflicting lighting condition, pose etc. Objects are extracted from the original images called as Eigen faces. Every original image of the training dataset can be transformed into corresponding Eigen faces using PCA. By combining the Eigen faces from training dataset can be reconstruct any original image using PCA which is most of the important feature of that. Adding of the Eigen faces into precise proportion helps to maintain the accuracy of the image. Higher degree or lower degree Eigen faces are present in the original image. Actual image is reconstructed by considering weighted sum. The Existence of the feature in considered image is at larger extent then the share of the specific Eigen faces should be grater in the sum of Eigen faces. In contrast, Eigen faces should contribute a smaller proportion to the sum of Eigen faces when particular feature not present in the actual image.

Video Processing- In this step, camera or video of the class is captured and processed by Java CV library. It detects the faces and compares with the database stored on cloud.

Feature Extraction- The original RGB image is converted into grey scale image and further various operations like contrast stretching, histogram equalization, filtering is accomplished.

Storing- Cloud is used for storing the database of students and attendance can be accessed from any location

5. SYSTEM ARCHITECTURE

Fig.2 shows the system architecture consists of two parts such as enrollment and recognition. Enrollment process consists of three modules namely Image Capture, Face Detection and pre- processing .After completion of these processes; generated data is stored in the database of faces. These datasets are used for extraction of features. Recognition module also requires all these processes for classification. Extracted and classified feature shows matching name of recognized person which are to be matched in the classification.

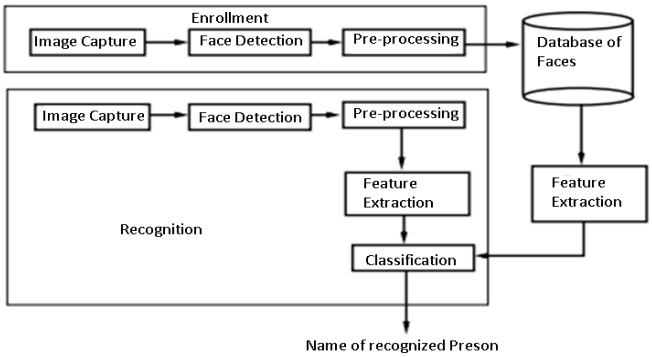

Fig. 2. System Architecture

6. ALGORITHM DEVELOPMENT

A. Face Recognition

Algorithm used for face recognition is Eigen face recognition [7] Fig 3.shows the bitmap image in vector.

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Prerequisite: Images (of size N*N) are considered as a matrix of dimension [N2 X 1]

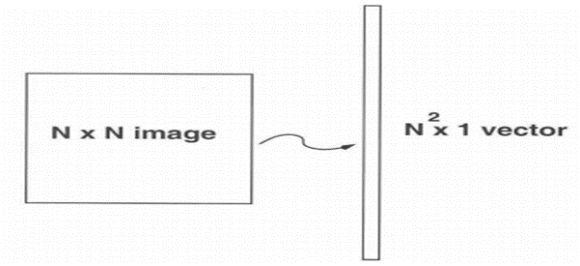

Fig 3. *Bitmap image in Vector*

The simplest approach is representing pattern matching problem:

- In the a very high dimensional space problem arise when performing face recognition
- At initial stage data is mapped into lower dimensionality for significant improvement
- Image (I) is represented as Γ is [$N^2 \times 1$] vector = [N×N].
- Signify Γ (Φ= Γ- mean face)
  Φ − mean = w1u1 + w2u2 + ... w_K u_K ……. (1)

Where ($K<<N^2$)

B. Flow chart of Eigen Face Recognition

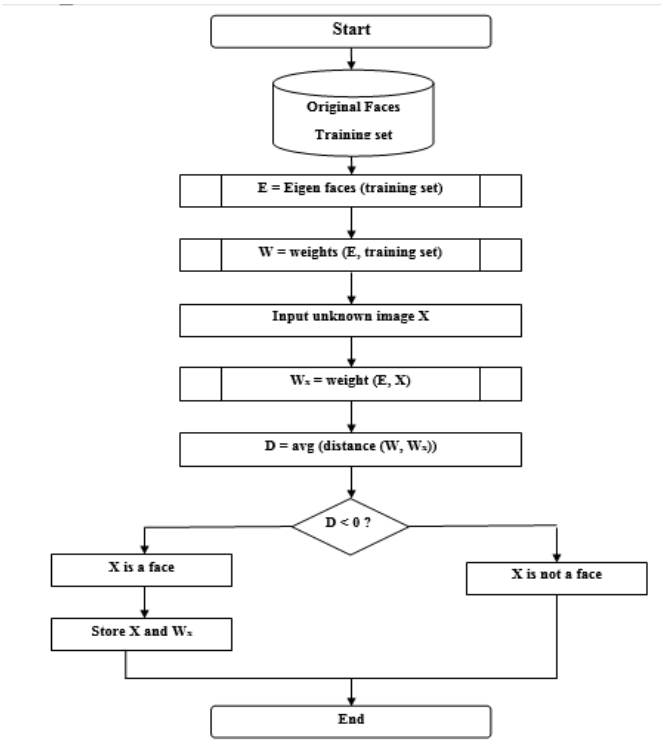

Fig 4*. Eigen Face Recognition*

6.1 ALGORITHM

1. The set of images are obtained as I_1 , I_2 , ..., I_M
   (Similar size and centered images are considered)

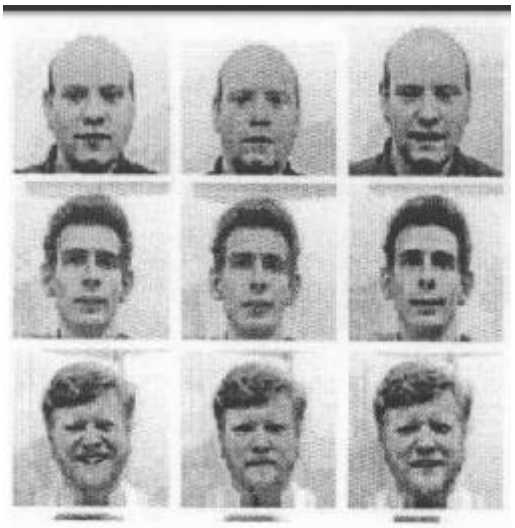

Fig. 5*. Training Dataset*

2. Image I_i is denoted by vector Γ_i

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3. Calculate Face vector average (Ψ)

$$\Psi = \frac{1}{M}\sum_{i=1}^{M} \Gamma i \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

4. Mean face subtraction as follows:

$$\Phi_i = F_i - \Psi$$

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

5. Calculation of covariance matric C is obtained as

$$C = \frac{1}{M}\sum_{n=1}^{M} \Phi n(\Phi n)' = AA'$$

$(N^2 \times N^2$ matrix) $\ldots\ldots\ldots\ldots\ldots$ (4)

$$A = [\Phi_1\ \Phi_2 \ldots \Phi_M]$$ ($N^2 \times$ M matrix)

6. Calculate the eigen vectors u_i of AA^T .The matrix AA^T is very huge
   a. Matrix A^T A (M×M matrix)
   b. Calculate eigenvectors v_i of $A^T A$

$$A^T A v_i = \mu_i v_i$$

   c. M best eigenvectors of AA^T : $u_i = Av_i$ Can be Calculate (Normalize u_i such that $||u_i|| = 1$)

7. Consider K eigenvectors

6.1.1 Representing faces based on above steps

Face representation is given by Φi within set of training and is represented in linear format.

$$\Phi i = mean = \sum_{j=1}^{K} Wjuj$$

$(Wj = uTj\Phi i)$ ……..(5)

where, uj eigen faces

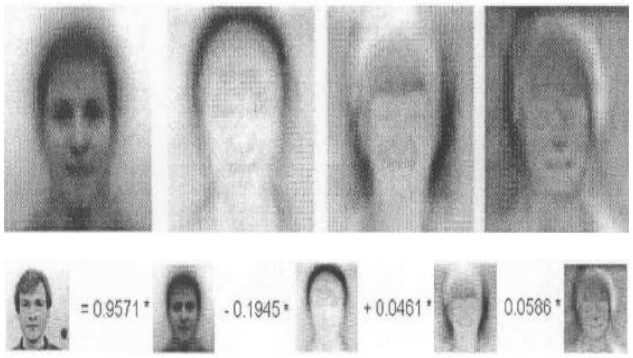

Fig. 6. *Eigen faces*

On the basis of the vector each normalized training face Φi is represented as

$$\Omega i = \begin{matrix} wi1 \\ \ldots \\ wik \end{matrix}, \quad \text{where, } i = 1, 2..., M$$

6.1.2 Recognition of Face Using Eigen faces

Unseen faces are trained by following steps

1. Regularize Γ: Φ = Γ – Ψ
2. Projection on the Eigen space

$$\Phi = K_i = 1\sum_{i=1}^{K} wiui \ (wi = u\,Ti\,\Phi$$

3. Consider Φ as: $\Omega = [w_1, w_2 \ldots W_k]$
4. Compute $e_r = minl\ ||\Omega - \Omega\, l\ ||$
5. If $e_r < T_r$, Γ the face is recognized where, e_r is distance within the face space d_{ifs}

To compute the er , Euclidean distance formulation is used. For the better performance use the Mahalanobis distance formulation is used as follows :

$$||\Omega - \Omega\, k\ || = \Sigma K\ i=1\ 1\ /\lambda i\ (wi - w\ k\ i\ )^2$$

6.1.3 Using Eigen faces Face Detection

Given an unseen image Γ

a. Compute $\Phi = \Gamma - \Psi$

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b. Compute $\Phi = Ki = \sum_{i=1}^{K} wiui\ (wi = uTi\ \Phi)$

c. Compute $ed = ||\Phi - \Phi\hat{}||$

d. If $(ed \leq Td)$, then Γ is a face and (d_{ffs}) is considered (ed)

7. RESULTS:

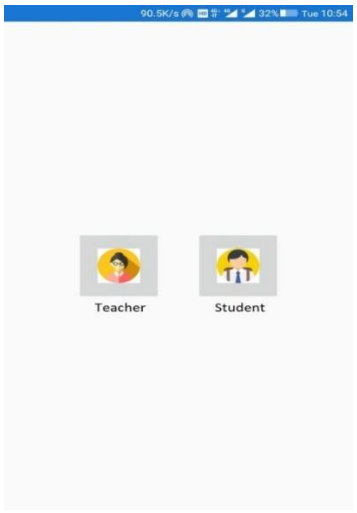

Fig 7. *Student - Teacher login*

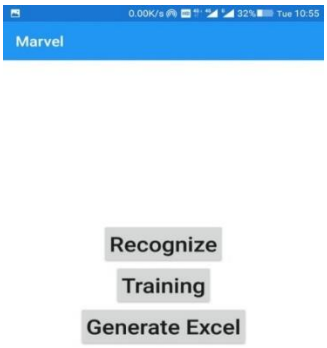

Fig 8. *Generate excel sheet*

Fig 7. Shows the student and the teacher login where the teacher can access all the classes' attendance records and student also check the attendance. Fig 8.illustrate the recognizing the faces from captured images and generate the report in excel format.

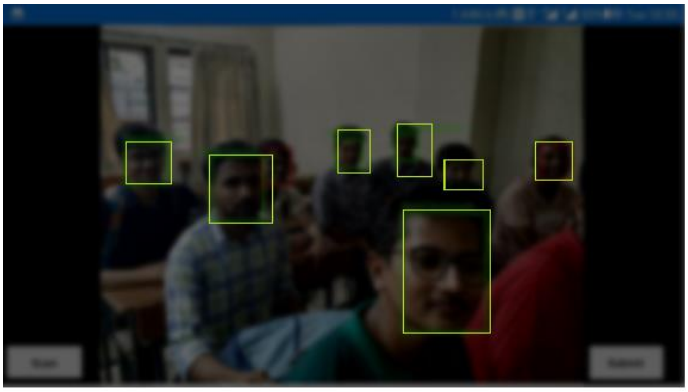

Fig. 9 *Face recognition*

Fig.9 represents face recognition of the students after capturing the image. Based on the features present in the databases it matches with them and identify the student and mark the attendance of each student.

Table 1 .Excel sheet generated

Name	Roll No	01-04-2019
Kanade Sampada	407045	P
Shruti Kulkarni	407077	P
Devendra P	407049	A
Harsh Mahajan	407062	P

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Table 1. shows the attendance record generated at the backend after capturing the images. Report contains the several field such as name of the students, roll number and date wise attendance whether student is present or absent

7.1 OBSERVATIONS

The amount of light can vary the results or conditional observations to a large extent. Best results are tested in two conditions, natural light (i.e. Sunlight) and low light conditions eg. tube light, bulb, flashlight etc.

It was found that if the distance is in between 1 to 1.5 meter, the accuracy of the system found to be satisfactory, whereas for distance greater than 1.5 meter, the performance of the system was degraded. The best result was observed from 0.5 meter to 1 meter. The above-mentioned observations are platform and hardware dependent.

The results obtained from above observations are as shown in Table 2.

Table.2 *Parameter Comparison*

Parameters	No. of Students	Recognized	False Acceptance	False Rejection	% Accuracy
Normal Light	8	8	0	0	100
	10	9	1	0	90
	12	10	4	2	83.3
					Mean = 91.11
Low Light	8	3	2	3	37.5
	10	4	2	4	40
	12	4	3	5	33.33
					Mean = 36.94

Distance	No. of Students	Recognized	False Acceptance	False Rejection	% Accuracy
<1	8	8	0	0	100
	10	9	1	0	90
	12	10	4	2	83.33
					Mean = 91.11
< 1.5	8	5	2	1	62.5
	10	4	2	4	40
	12	4	3	5	33.33
					Mean = 45.27

Table 3. *Distance Comparison*

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Table 3.shows that the as distance between student and camera increases, the accuracy in percentage decreases. Optimum distance for accurate results should be less than or equal to 1 meter.

CONCLUSION

Cloud based attendance management system is used for can be recognized as well organized system. Due to face detection of the students, bogus attendances and proxies can be reduced. Face recognition system has a greatest performance than biometrics techniques .It is possible to implement a consistent as well as proficient attendance system .There is no special hardware requirement to construct the smart attendance system. Database server, Personal Computer and smart phone is sufficient.

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