Attendance Monitoring System using Facial Recognition with Audio Output and Gender Classification

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Abstract— Maintaining and taking log of attendance in a class is not much effective through manual process. Since bunking the classes or giving proxies for the absentees become fun and fantasy among the current generation students. Manual entering of attendance in logbooks becomes a difficult task and it can be easily manipulated. Therefore, this paper aims in presenting an automated attendance System - AUDACE. This system automatically detects the student in the class room and marks the attendance by recognizing their face.. This system is developed by capturing real time human faces in the class. The detected faces are matched against the reference faces in the dataset and marked the attendance for the attendees. Finally the absentee lists are said aloud through voice conversion system for confirmation. Secondly, the system is trained to classify the gender of the students present in the class.

Keywords— Face Recognition; Principal Component Analysis; Voice Conversion; Gender classification.

I. INTRODUCTION

Traditional way of marking attendance involves a typical situation of students sitting in a classroom and the teacher calling out the names of the students individually to mark their attendance. The attendance is usually marked using hard resources - pen and paper. The huge attendance records that maintained are then used for later references.

The traditional attendance system has the following disadvantages:

- It is cumbersome to maintain a huge set of records. As and when the class strength increases, the number of records also keeps increasing. Maintaining it continuously over a period of time makes it even more difficult.
- It is time consuming. Every time, the teacher in-charge has to take time out from his/ her class to mark attendance, thereby consuming time other than knowledge transfer.
- Error-prone - It is not foolproof. A teacher may miss out on marking the attendance of a student or may even tend to mark attendance wrongly for a person who is absent due to the various malpractices the students indulge in.
- It leads to wastage of resources- A lot of paper work is involved. It is difficult to maintain large records. There is also the threat of the records getting lost, stolen or damaged.

Hence, our proposed system aims to mark attendance automatically by means of face recognition. The teacher can mark the attendance of the students with just the click of a button. The names of the absentees are called out by voice conversion using speech technology. Hence the teacher can easily mark the attendance of the absentees.

The paper is organized as follows: Section 2 gives the details of previous works and Section 3 presents the design of the proposed system. Section 4 analyses the results obtained from the proposed system and Section 5 provides the conclusion for the above work.

II. PREVIOUS WORK

Nowadays, biometrics traits has become very popular in playing a vital role in security related aspects from lower to higher grade such as, attendance system, physical and digital data entry access, login control, passport, national identity card, border line, etc. Biometric is a physiological or behavioral feature of an individual used to identity or verify his/her identity in an efficient manner. With regard to this existence and development of this research field, every manual system is taking an evolution converting into an automated digital world to reduce the manual errors and obtaining the work effortlessly. In such case, in reducing manual entry and hard resources, with less time consumption, attendance system is transforming into an biometric application for an efficient task of teacher to mark attendance for the students of class using fingerprint or face recognition methods.

Various research works had been attempted in developing an automated attendance system using biometric traits in recent years [1-4]. Henceforth, this paper is presenting a proposed work of an automated attendance system with audio output using image processing techniques and voice conversion methods. This work is experimented in a class room with students sitting in columns with various postures, gestures and accessories.

Gender classification is another promising area where biometrics dealt with. Gender classification have been experimented by various researchers in different aspects using image processing techniques like classification

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methods, fuzzy rules, genetic algorithms, etc [5-9]. But improvements are expected to increase its efficiency of classification. This paper also had took an initial step in gender classification in order to count of number of male and female present in the class during lecture hours.

III. PROPOSED SYSTEM

The Proposed system contains three different modules namely, Attendance through Face Recognition, Voice Converted Output and Gender classification Module. Each module is described below in detail.

A. Attendance through Face Recognition

In this module of work, the system is designed to mark attendance for the students present in the class, whose flow diagram is depicted in Fig 1 and explained below.

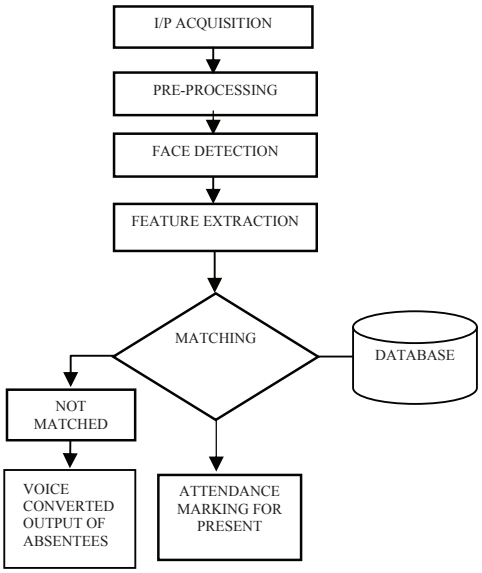

Fig.1. Flow Diagram of the Attendance Marking System

1) Image Acquisition

The images of students with different variations were captured using digital cameras. Different set of students were made to sit in 2 columns and 1 camera is used to capture images of 1 column, thereby resulting in two non-intersecting sets. Sample input images are shown in Fig 2. Rules of acquisition are explained in experimental section.

2) Preprocessing

Preprocessing involves converting the color image to gray scale and passing it through a Gaussian Filter and Median Filter for image enhancement. In image processing, a Gaussian blur is the result of blurring an image by a Gaussian function. It is a used to reduce image noise and reduce detail. The median filter is a nonlinear digital filtering technique, used to remove salt and pepper noise and to sharpen the edges.

Fig.2. Sample Input Images

3) Face Detection and Extraction

The preprocessed images are subjected to the Viola Jones algorithm for the face detection process [10]. The face detected images are shown in Fig 3. The detected faces are then cropped and stored in a folder. This is the folder that contains the image to be used for testing. The images (faces) are numbered automatically and saved in a folder. The features are then extracted from the set of cropped faces and stored. The algorithm used for feature extraction is PCA-Principal Component Analysis for the set of training images. Training set contains individual face images of students taken with variations like with/without spectacles, these are used for comparison during face recognition phase.

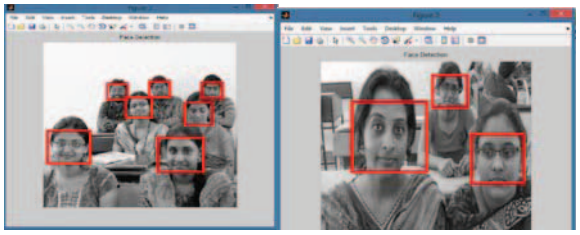

Fig.3. Face Detected Images

4) Matching

The images (faces) that are in the testing set are then compared one by one, with all the images (faces) in the training set. The ones for which a match was found, i.e. the ones that are recognized with the training set are taken to be present. The PCA- Principal Component Analysis algorithm is used for face recognition [11-13]. This is done for all

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images (faces) in the testing set. The matched images are marked as present in the class.

B. Voice Conversion Module

After matching, the names of the matched images are retrieved from an Excel Spreadsheet and rest of the students is considered to be absent. The names of the absentee are converted to voice using Microsoft Speech API. This can serve as a cross check to ensure that the attendance is marked correctly.

C. Gender Clssification Module

Gender classification is an essential task used in immense number of applications like passive surveillance, control in smart buildings (restricting access to certain areas based on gender) and supermarkets, gender advertising, security investigation. So far detection of gender using facial features is done by using the methods like Gabor wavelets, artificial neural networks and support vector machine. In this work, facial distance measure is used as a progenitor to achieve the gender classification. The proposed approach performs gender classification using mathematical operations on the frontal pose face images using Matlab. This work can be further evaluated in future by using different databases with various poses other than the frontal pose. The gender classification problem can be solved by a 3-step process. The first is to pre-process an image second step is to extract features and third is to classify gender. Similar to the face detection task, the gender classification task also considered as a binary classification but now with the result being male or female instead of face or non-face. Essentially, gender classification consists of 3 main steps: (1) preprocessing (2) geometric based feature extraction, (3) classification.

1) Preprocessing

Pre-processing of a face image will undergo several processes in order to attain a transformed face image which in turn enhances the quality of the face image by holding noticeable features of the visual quality. Color conversion, Noise reduction, and Edge detection are applied here.

2) Geometric Feature Extraction

Roytatsu Iga et al., [14] proposed an algorithm to classify gender and age using SVM classifier considering the features like geometric arrangement and luminosity of facial images. Referring to his work, this paper have utilized geometric-based facial features are considered for gender classification. Geometric based features, also called as local features, represents high-level face descriptors like distances between nose, eyes and mouth, face width, face length, eyebrow thickness and so on. For extracting the facial features consider the facial image then divide into four equal parts. At each part find the centroid by using the region properties. Compute the distances between the centroids by using the distance formula. Thereby, locate the eyes at upper right and left parts and then locate lips. Chin and nose are located by adding +45 and -30 to the centroid value of lips respectively.

Facial Features to Be Considered

- Inter-ocular distance: The distance between the midpoint of right eye and midpoint of left eye in the face image.

$$\text{Ratio 1} = \frac{\text{Left eye to Right eye distane}}{\text{Eye to Nose distance}}$$

- Lips to Nose: The distance between nose tip and the midpoint of the lips pixel in the facial image.

$$\text{Ratio 2} = \frac{\text{Eye to Nose distance}}{\text{Eye to Chin distance}}$$

- Nose to Eyes: The distance between Nose tip to interocular distance in the facial image.

$$\text{Ratio 3} = \frac{\text{Left eye to Right eye distance}}{\text{Eye to Chin distance}}$$

- Lips to Eyes: The distance between lips midpoint to interocular in the facial image.

$$\text{Ratio 4} = \frac{\text{Eye to Nose distance}}{\text{Eye to Lip distance}}$$

Ratios of male and female are calculated and based on these four ratios set the threshold value by observing number of images and decides whether the given image is a male or a female [14-15].

IV. EXPERIMENTAL RESULTS

a) Datasets and its Assumptions:

The students were made to sit in the classroom and their images were taken using cameras. We have taken into consideration a class of strength fourteen students. Eight students were seated and a non-intersecting image was captured, while 3 students were seated facing the camera and 3 other students were seated without facing the camera. Students were asked to pose in different ways such as, with/without spectacles, wearing a veil to cover their heads, with/without a moustache/beard, with/without a hand on cheeks/chin gesture.

As well the students are not allowed with following assumptions such as, wearing a helmet, fully covered face, half covered face, lying down on the bench, completely turning away from the camera. The set of images (faces) that are saved in the testing folder are compared one by one against the all the images (faces) used for training (Fig 5).

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The correct match of the face gives attendance for the student in the class. Rest of the non-matched faces in the training set are considered as absent which are reconfirmed through audio output by generating a voice output listing the absentees.

Fig.4. Sample Acquired Image

Fig. 5. Sample Images in Traning Set

The system is measured using Genuine Acceptance Rate (GAR). Few of the cases tested are shown in Table 1. Similarly, more comparisons were made between the testing images and the training images. The testing images were compared one by one against 30 training images. And 25 were recognized correctly. Hence the accuracy of the module built is found to be 83.33 %

TABLE I: GAR for Face Recognition system

Student Name	Attendance	Recognition Correct/Incorrect
Nandu	Absent	Incorrect
Poojetha	Present	Correct
Aishwariya Nair	Absent	Incorrect
Vaishali	Present	Correct
Noorjahan	Present	Correct
Gokul	Absent	Correct
Manoj	Present	Correct
Dhanish	Present	Correct
Aishwariya	Present	Correct
Aishwariya Nair	Present	Correct
Varshini	Present	Correct
Varalakshmi	Present	Correct
Manoj	Present	Correct
Dhanish	Present	Correct
Aishwariya	Present	Correct
Aishwariya Nair	Present	Correct
Varshini	Present	Correct
Varalakshmi	Present	Correct
Jenitha	Absent	Incorrect

In Gender classification module, four ratios for the facial features are computed and the threshold values are set through observation for male and female of the training set.

The threshold values for female are obtained as,

((Ratio1>=1.1000)&&(Ratio2>=0.7450))
|| ((Ratio3<=1.3714)&&(Ratio4>=0.6404))

For male,

((Ratio1<=1.09)&&(Ratio2<=0.7440))
|| ((Ratio3>=1.3714)&&(Ratio4<=0.640))

Finally, if all these values satisfy the above conditions then the given image can be a male or a female. Face images of students were captured with different poses and fed to the gender recognition module. The testing image set consisted of faces of 44 students (girls and boys), out of which gender of 31 images were identified correctly. Hence the accuracy of the module is 70.45% and the sample outputs are shown in Fig 6.

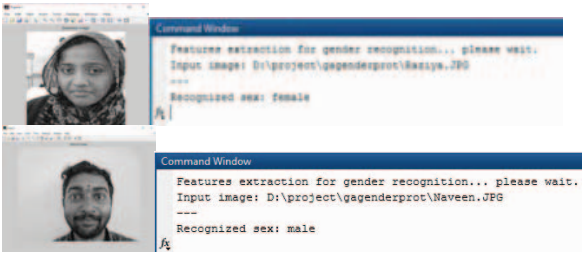

Fig. 6. Sample Gender classification output

V. CONCLUSION

This paper focuses on developing an automated attendance system with audio output in lecture or classroom session by which the lecturer or faculty can record student's attendance. It saves time and effort, especially if it is a lecture with huge number of students. This attendance system shows the use of facial recognition technique for the purpose of student attendance and for the further process this record of student can be used in exam related issues. It is not possible to identify faces having similar facial features. For example, twin faces and heavy variance in pose like 90 degree rotation of face. Background details of the input image are not considered. The face detection

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module's accuracy can be improved by integrating results from viola jones face detection and skin color detection algorithms in order to improve the accuracy.

The system can be extended to respond to the presence of newcomers in the classrooms. Also, means to mark attendance without the intervention of teachers in a classroom i.e. automatically marking attendance at the beginning of every hour can be implemented. It can be extended to video surveillance to detect frauds at crowded areas such as bus stands, theatres, railway stations wherein by face recognition techniques, the identity of the culprits can be found. As well, Gender Classification can be improved further by considered few more features and advanced classification algorithm.

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