

A New Approach based on Image Processing Techniques for Automatic Attendance System with Audio Output

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Abstract— The traditional way of taking attendance in a classroom becomes a difficult task and also it is time consuming. In order to overcome such difficulties a new approach is proposed for automatic attendance system. This automatic attendance system detects the student face automatically in the class room and mark the attendance by recognizing the face of student. The proposed approach consists of 3 phases. In phase 1, face is detected using Viola-Jones algorithm. In phase 2, features are extracted by applying principal component analysis. Phase 3, is face recognition process which recognizes the face by finding Euclidean distance between extracted features of detected face in input image with the features of face images in database by using K-Nearest Neighbor. The attendance of student is marked based on the output of phase 3. The absentees list is said loudly through voice conversion system. Experiments are conducted for different input images. The results obtained shows that face detection accuracy is 89 % and for face recognition accuracy is 72%.

Index Terms— Digital image, Face detection, Face recognition, Principal component analysis, KNN, Voice conversion system.

I. INTRODUCTION

Manually entering of attendance which 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 marked using pen and paper. The attendance of the student record are maintained and used for further process [1]. Maintaining the attendance is very much important in all the institutes for checking the presence of students. Every institute has its own method in this regard. Some are taking attendance manually using the traditional pen and paper or file based approach [2].

Now a day's biometric is more usage they are finger print recognition, facial recognition, iris scanning recognition etc [3]. An automatic attendance system will provide many advantages to institute. There was a time when the attendance of the students was marked on registers and kept safely. Such an attendance monitoring system is developed for maintaining the attendance of the student on the daily basis in the school/collage. Here the teacher's, who are handling the subjects, are responsible to mark the attendance of

the students. Manually recorded attendance can be easily manipulated. Moreover, it is very difficult to verify one by one student in a large classroom environment [4]. Maintaining a large set of records in log book which is also a difficult task. Here some of the students were bunking the classes or also giving proxies for the absentee's student which had become a fun and fantasy among the current generation students. Calculating a student attendance manually which is another task and may cause errors. Sometimes the attendance sheet may become lost. To overcome such difficulties it is essential to evolve an automatic attendance management system. When it comes to schools, colleges or universities, the automatic attendance monitoring system is a very much helpful for both teachers as well as parents. Parents are never uninformed of the dependability of their children in the class. With the monitoring system in place, the information which related to attendance can easily be printed or a soft copy can be sent directly to parents to their personal mobile phones or email accounts. An automatic attendance management system aims at solving the issues of manual method of existing system [5]. The main aim of the proposed work is to mark the attendance automatically by recognizing the faces of students. The names of the absentees are said loud through voice conversion system using speech technology.

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

II. LITERATURE SURVEY

Rahib H. Abiyev [6] proposed a work on facial feature extraction technique for recognition of face. The design of face recognition system includes two basic steps. In first step is the extraction of face features using 3 algorithm as Principal Component Analysis (PCA), Fisher Linear Discriminant Analysis (FLD) and Fast Pixel Based Matching (FPBM). In second step is the classification of features using SVM classifier. The feature extraction algorithm of principal component analysis obtained face recognition accuracy as 94.5%, Fisher discriminant analysis obtained face recognition accuracy as 95.5%. Fast Pixel Based matching obtained face recognition accuracy as 62.5%.

Deep Mehta et al.,[7] proposed a work on automated attendance monitoring system using facial recognition. There are three stage of mechanism. In first stage involves face detection process using Viola-Jones algorithm. In second stage feature extraction for training using principal component analysis based on Eigen values. In third stage face recognition system is processed using appropriate linear binary pattern histogram algorithm (LBPH). After recognizing the face with the database the attendance list will be retrieved.

Ms. Pooja et al.,[8] proposed a method for automatic attendance using face recognition. In this method the first step is that, face is detected using viola jones algorithm. Next step is the features extraction for both trained and test face image using principal component analysis. Eigen values are computed for both trained and test set images. Then, testing image Eigen values are compared with the training face images Eigen values. Based on the Eigen values face image is recognized, then attendance registered for matched face images. Finally, the attendance details of the student are send to staff and parent through E-mail.

Ajinkya Patil and Mrudang Shukla[10] proposed a work on attendance system. This system has two step mechanisms such as face detection and face recognition. Viola-Jones algorithm is used for face detection which was tested for different images with different face positions and lighting conditions and then algorithm was applied to the detect faces in real time video. In second step face feature extraction they have used hybrid algorithm of principal component analysis and linear discriminant analysis. The Raspberry pi module is used for face detection & recognition for marking the attendance.

Hussain Rangoonwala et al., [12] proposed a method of text to speech conversion. In this system the text is retrieved from image and then to speech. The processing of image is done by extracting mechanical text from image which will later convert to speech. The various method as pre-processing, Unicode Conversion, Segmentation, Concatenation, Prosody and Smoothing, then will combine as an application. The main aim is to develop this system by combing various modules by using modular approach. The text-to-speech will converts an inputted text to speech and then read using voice database by Microsoft SAPI.

Sathyanarayana N et al.,[14] proposed a work on automatic student attendance management system using facial Recognition. This system describe about the some of the algorithms which are used in the automated attendance system they are Viola & Jones algorithm which is used for face detection process and face can be recognized by calculating mean square error. Mean square error calculates pixels of both live and reference face image. If mean square is greater than threshold, then that student face will be identified and extract USN from the database and update the attendance sheet.

III. PROPOSED WORK

For automatic attendance monitoring system, an approach is proposed using two major modules namely, Attendance through Face Recognition and Voice Converted Output. Each module has been described below in detail.

A. Attendance through face recognition

This module is designed to mark the attendance by recognizing the student faces. Fig 1 shows the block diagram of various steps in face recognition. This module comprises 3 phases. In phase 1, image pre-processing and face detection are carried out. In phase 2, feature extraction of detected face image is performed. In phase 3, matching of detected face image with reference images in database is carried out. In phase 4, attendance is recorded. All these phases are explored below in detail.

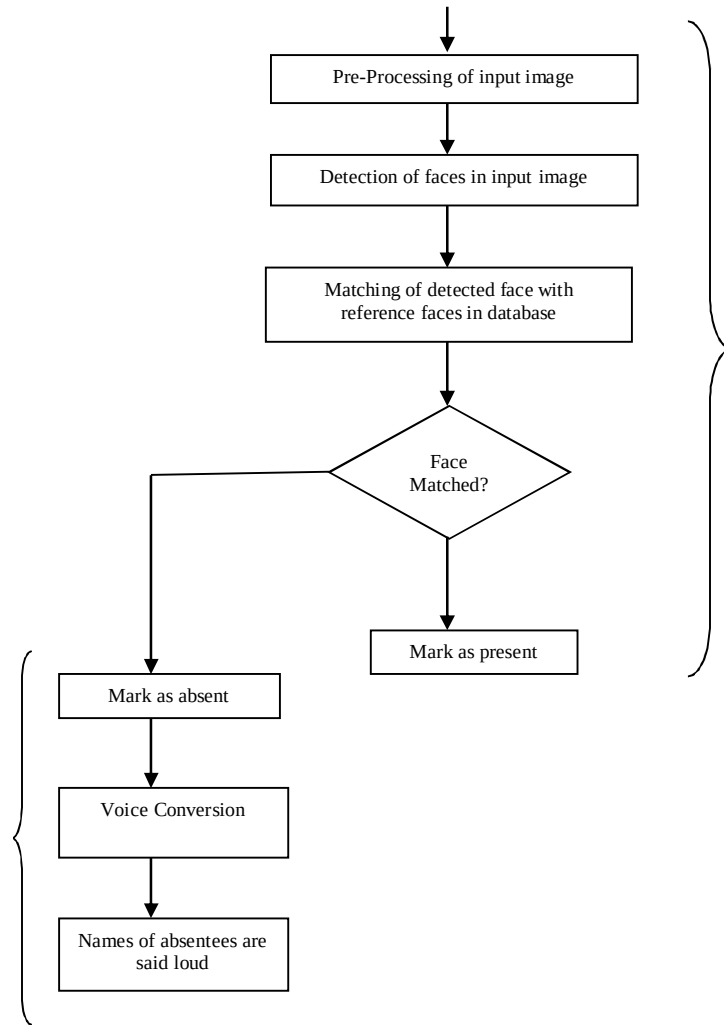


Figure 1. Block diagram of attendance system

The image acquisition of sample input of number of the students in the classroom is taken with different variations like with/without spectacles and images are captured using mobile cameras. Fig 2 shows the sample input image.



Figure 2. Input Image

Phase 1- Image Pre-processing and Face detection

In this step some of the issues such as noise, blur effect and uneven brightness is introduced during acquisition of input image. In order to reduce such issues and also to improve the image quality the adaptive histogram equalization is used. Fig 3 shows the enhanced image. The output image is further enhanced by applying median filter. Fig 4 shows the output image after applying median filter. The pre-processed images are subjected to face detection process. The detected face which is a computer technology used in many of the application that basically identifies the human faces. Face detection algorithms mainly focus on detection of frontal faces. Here the face is detected from the pre-processed image using the Viola-Jones algorithm which identifies the location and size of the face from the given image. This Viola-Jones algorithm is the most famous algorithm for face detection process. This algorithm is most widely used and an efficient method of detecting faces [9]. Fig 5 shows the output image after face detection phase.



Figure 3. Enhanced Image



Figure 4. Output image after applying Median filter



Figure 5. Image showing detected faces in input Image

Phase 2- Feature extraction

The detected faces are then cropped and extract the feature of cropped face. The cropped face image is scaled to 50*51. The trained set contains the individual face image of each students using with or without spectacles. The both detected input face image and trained set face image is resized into 50*51 and then features are extracted. The algorithm used for face feature extraction is principal component analysis (PCA). Each detected face extract features up to 2550 both in trained images as well as in input image. PCA is a tool to reduce multidimensional data to lower dimensions which retain most of the information. It is a classical feature extraction and data representation technique widely used in face recognition [13].

Fig. 6 shows the sample cropped images of 3 detected faces from the input image. Table I shows the extracted features values of detected input face image shown in fig 6 (a).

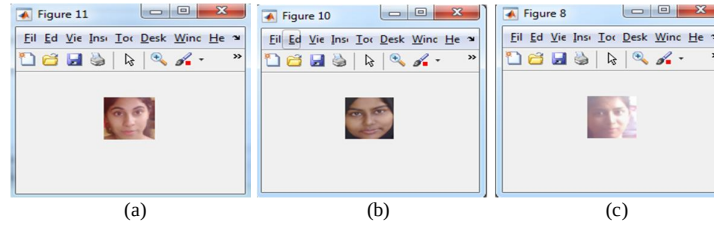


Figure 6. (a)- (c) Sample output images of phase 1 – images after cropping detected faces

TABLE I. EXTRACTED FEATURES OF DETECTED FACE IMAGE

	1	2	3	4	5	6	7	8	9	10	---	2550
1	0.1125	0.1160	0.1190	0.1197	0.1184	0.1218	0.1265	0.1314	0.1369	0.1411	---	0.1874

Table II shows the values of features extracted for trained set of face images in the image database.

TABLE II. EXTRACTED FEATURES VALUES OF FACE IMAGES IN THE IMAGE DATABASE

	1	2	3	4	5	6	7	8	9	10	---	2550
1	0.1155	0.1175	0.1203	0.1239	0.1278	0.1330	0.1372	0.1421	0.1444	0.1420	---	0.0176
2	0.1155	0.1175	0.1203	0.1239	0.1278	0.1330	0.1372	0.1421	0.1444	0.1420	---	0.0176
3	0.1155	0.1175	0.1203	0.1239	0.1278	0.1330	0.1372	0.1421	0.1444	0.1420	---	0.0176
4	0.1182	0.1202	0.1222	0.1234	0.1248	0.1261	0.1278	0.1317	0.1317	0.1414	---	0.0082
5	0.1212	0.1226	0.1237	0.1251	0.1268	0.1290	0.1332	0.1387	0.1428	0.1396	---	1.1226
6	0.1193	0.1211	0.1226	0.1239	0.1252	0.1267	0.1293	0.1336	0.1391	0.1416	---	0.2688
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮		⋮
350	0.0697	0.0725	0.0795	0.0874	0.0977	0.1139	0.1316	0.1431	0.1425	0.1346	---	0.2204

Phase 3- Matching

The feature of each cropped face image has to be matched with feature of trained face image. The K-nearest neighbour (KNN) is used for matching of cropped face from the input image with the each face image in the database. KNN is an algorithm based on machine learning, the computational complexity is average, and the performance is satisfactory [11]. The K-nearest neighbour uses “Eq (1)” to calculate minimum distance between for each detected face from the input image with the each reference face image in database. $\text{Min}(\text{Ed}_{ji})$ is considered as the matched face for the input image 'j'. Fig 7 shows the sample face recognition using the KNN classifier by matching with the nearest value.

$$\text{Ed}_{ji} = \sqrt{\sum_{l=1}^k (x_{ji} - y_{li})^2} \quad (1)$$

Where,

k = 2550

x_{ji} = i^{th} value of extracted feature of j^{th} input face image.

y_{li} = i^{th} value of extracted feature of l^{th} sample faces in training set.

j = 1----n.

l = 1----m.

n = number of faces detected in input image.

m = number of trained faces in image database.

Phase 4- Attendance recording

Attendance sheet generated using text document to record attendance of the student in the class. A text file is created a text file named as attendance sheet. In Attendance sheet contain only the present student name with system date and time by using the function of date and clock. Table III shows the attendance sheet only for present student names. But the absentee student names are said a loud through voice conversion system using the Microsoft Speech Application Programming Interface.

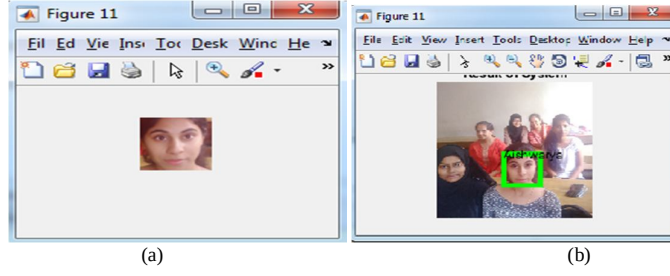


Figure. 7. (a) Recognized face image, (b) Recognized face labelled with student name

TABLE III. ATTENDANCE SHEET

Name	Date	Time	Attendance
Sidra	23-Jun-2019	12:27:15	Present
Archana	23-Jun-2019	12:27:16	Present
Anusha	23-Jun-2019	12:27:17	Present
Fariha	23-Jun-2019	12:27:19	Present
Aishwarya	23-Jun-2019	12:27:20	Present

B. Voice Conversion System

After matching, the names of the matched images are marked as present in the attendance sheet. The remaining absentee's student names are converted to voice using Microsoft Speech API. The speech application programming interface is an API which was developed by Microsoft to allow the use of speech recognition. The Microsoft Speech API has been installed in every windows application. This process is to cross check that the attendance is marked correctly or not.

IV. EXPERIMENTAL RESULTS

The proposed automatic attendance system is implemented using MATLAB tool. For experimental process the student images are collected in the classroom using mobile camera and are stored in the database which represents as test images. The student images are taken with different orientation such as with or without spectacles, hand on cheeks. The proposed method is tested for 10 different class images (input images). The databases of student images are captured using mobile camera with the resolution of 24 mega pixels.

The dataset contain around 50 samples of 7 student face images are collected and stored separately. The total number of faces in training set is 350. Then each student face images are sending for training process. Each faces of student images are trained and matched with input image faces. Fig 8 shows the 2 samples of each student with different orientation of face.

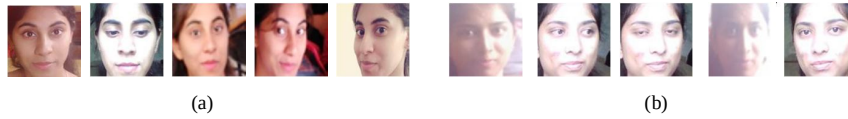


Figure 8. Sample training with different orientation face images - (a) first sample ; (b) second sample

The proper 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 converting a voice output for the absentees.



Figure. 9 : Sample input images

Face detection accuracy=(No. of face detected/Total no. of faces)*100 (2)

Average detection accuracy = Sum of face detection accuracy/ Total number of input image (3)

Face recognition accuracy=(No. of correctly recognized face/Total no. of detected faces)*100 (4)

Average recognition accuracy = Sum of face recognition accuracy/ Total number of input image. (5)

Fig. 9 shows the sample input images. The table IV shows results of face detection and recognition. Each image contains number of students. The “Eq (2)” is used to calculate the face detection accuracy. The “Eq (4)” is used to calculate the face recognition accuracy. Then “Eq (3) & (5)” is used to find out the average accuracy for both face detection and face recognition.

TABLE IV. RESULTS OF FACE DETECTION AND RECOGNITION

Image	No. of Students	No. of Face Detected	Detection Accuracy	No. of face recognized	Recognition Accuracy
1.	6	6	100	5	83.33
2.	3	3	100	2	66.67
3.	5	4	80	3	75
4.	4	4	100	3	75
5.	6	6	100	4	66.67
6.	5	5	100	3	60
7.	6	5	83.33	3	60
8.	4	3	75	2	66.67
9.	5	4	80	3	75
10.	4	3	75	3	100
Average			89.333		72.834

V. CONCLUSIONS

The proposed system mainly focuses on developing an automatic attendance system with audio output for taking attendance in a classroom for recognizing student faces. This system saves time and effort, especially in recording attendance in a class of large number of students. Automatic Attendance system removes the traditional method of taking student attendance. The absent names list are called loud through voice conversion system.

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