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Face Recognition for Smart Classroom Attendance Management System using Computer Vision

Shaif Jawed
Department of Electronics & Telecommunication, Universal College of Engineering, Mumbai, India

Abstract— Classroom attendance is one of the most challenging task for a teacher since its time consuming and burdensome. It plays an important role for the students as well as the institution to ensure that the students are attending school/college regularly. Nowadays teachers are obligated to take attendance via roll call or by signing the attendance sheet which ends up wasting a tiny fraction of time during the teaching process, not to mention there are always possibilities of proxy. The proposed system presents an automatic classroom attendance system which is used to mark attendance through video face recognition using computer vision to reduce wastage of time between teachings and manage the records of students automatically and effectively.

Keywords— Face recognition, class attendance, smart classroom, OpenCV, machine learning, image processing

I. INTRODUCTION

In a classroom environment, keeping records of student's attendance is a crucial part especially for students in higher studies such as high school or college. Traditional methods involve signing of attendance sheet or calling students according to their roll number which becomes quite a long and tedious process if the class has a larger strength, not to mention students tend to mark proxy attendance which makes it unfair for students who attend regularly. Nowadays minimum of 75% attendance is compulsory for all college students so that they won't get cut off from their regular studies. In organizations there are biometric systems capable of recording attendance, but still they are time consuming when there are large number of students and the process is tiresome. It is quite difficult for a teacher to maintain student's attendance records for every week/month since the data is recorded manually in logbook which makes it cumbersome to maintain and manage. So, in this paper we've proposed a system which counters the traditional method of conducting attendance. The system is capable of carrying out attendance automatically through a webcam using face recognition technique eliminating conventional use of pen and paper. The key solution used in our proposed system are as follows:

• Taking attendance automatically in real time by recognizing the facial features in order to mark attendance with higher accuracy which reduces manual human effort and eliminates the need of maintaining redundant logbook. Moreover this system also facilitates with better proof against identity of the students rather than signatures.

• Managing student's attendance details in daily records and making it more hassle free and effective by automatically creating an excel database which provides precise details of an individual student with date and time unlike current method of attendance where date and time has to be filled each and every day which is quite bothersome.

II. RELATED MODELS

Till now, there are numerous models which were proposed in order to improve the quality of attendance system which emphasizes on the related /existing model. The related models are as follows:

[1] Lin Zhi-heng" proposed a methodology which uses installed camera in the classroom for real time face recognition and data acquisition. The collected video information is first divided into multiple static frames and depending upon the clarity and visuals of the image, several pictures are selected and then fed for final recognition results.

[2] Sujit Kumar Gupta" proposed a Computer Vision based Unobtrusive Classroom Attendance Management System which consists of a rotating camera for recognizing the faces of the students in real time. So, it detects the faces of students in a classroom at multiple angles i.e. with various pose variations. It uses Max Margin Face Detection Technique for face detection and is trained using Inception-V3 CNN technique for student's identification.

[3] Wenxian Zeng" combined the idea of deep learning to improve AlexNet convolutional neural network and for improving network training, WebFace data set is used. In order to make the system more effective and stable, an RFID technology is combined with the face recognition technique to develop a smart classroom attendance system capable of working effectively at various angles.

[4] Md. Sajid Akbar" introduced a system which was a combination of both face recognition and RFID technology capable of recognizing students getting in and out of the classroom. The system keeps records of every registered student for a specific semester and provides data if necessary. By using both of these technologies, the proposed model is more user friendly, accurate and organized. Alongside with attendance system, IR modules are also installed to turn the lights On/Off automatically by detecting someone's presence.

[5] Adrian Rhesa Septian Siswanto" talked about various face recognition techniques which includes facial feature extraction, facial algorithm improvements, facial recognition implementations etc. The proposed model compared the Receiver Operating Characteristics and applied it in the attendance system. The proposed model proves that Eigenface is better than Fisherface when it comes to training set.

III. PROPOSED METHODOLOGY

The block diagram for the proposed methodology is depicted in Figure 1. There are two cases which exists before starting the attendance [5]. The first stage involves collecting data of the student's faces individually i.e. registration of their identity. By doing this, data can be recorded for multiple students in a real time environment. The second stage involves verification of their true identity which will is done by comparing their current identity with the registered database of overall students. Certain factors are to be taken under consideration during registration or tracking of a student's attendance such as the amount of light intensity in the background or the number of students registering at a time. Having varying light intensity falling on the webcam each and every time a student is checking in might affect the overall accuracy as well as the clarity of the image. In these cases it's better to close the window curtains or sit in front of a black background which will reduce the light's reflection. Another point which should be kept in mind is to make sure that multiple students are not registering at the same time because later while checking in, the system might get confused with the real identity of the person sitting in front of him with someone else.

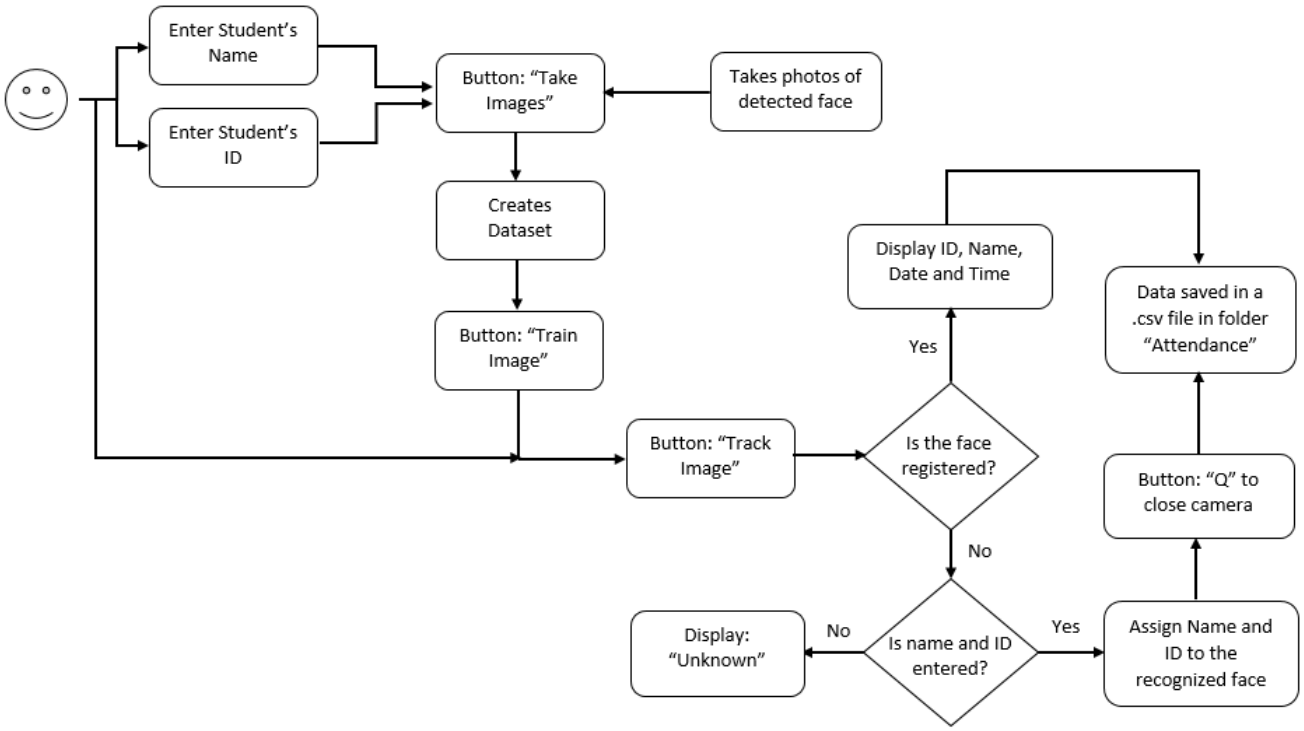

Figure 1. Functional block diagram of the proposed system

The proposed system uses webcam from a desktop to capture images in real time of the attendee. Suppose the student is signing up for the first time, he/she would be asked to enter Name and Identification number for their registration process in the corresponding entry slot. The Label and Entry widgets were used for creating the Labels with default texts and entry boxes for entering data. Once the details are entered, the system will check whether the entered data is in correct format or not i.e. the name should be alphabetical and the ID in numeric form. If the details are entered correctly, the video capture screen will pop up. Here the image of the attendee is captured frame by frame when pressed on the "Take Images" button. The argument for the object VideoCapture ( ) depends if we want to display a video file or capture image in real time where the device's index name is mentioned. The process of detection of face is done using Haar cascade classifiers which uses classification and regression to detect the frontal part of the face. Next, the captured frames are converted into greyscale and then operation on each frame is performed. It's not like the whole image is used for the operation because a rectangular box is created around the face which captures 61 iterating images in almost same dimensions. This leads to the ending of the training process of the captured images. The 61 sampled images are then saved in the folder named "TrainingImage".

Now that the images are trained and saved in the database, the next task is to track the image. Tracking of the image can be used in 2 ways as mentioned in the flowchart. If a person is already registered, then he/she won't have to go through the process of registering again, just click on track image and see if there name and ID are displayed or not. But if the person has just registered, the tracking process follows a few technical steps which are as follows:

- Get the path of all the files in the folder
- Create an empty face list
- Create an empty ID list
- Loop through all the image paths and load the IDs and the images
- Load the image and convert it into gray scale

- Convert the PIL image into numpy array
- Get the ID from the image
- Extract the face from the training image sample

Now following the flowchart, once the "Track Image" button is pressed, there might be chances that the person has already registered or if it's going to be his/her first time. If the face is registered, then a pop up cam window displays the name and ID of the attendee and the details will be saved in an excel sheet in the folder named "Attendance". If the person is registering for the first time, then there face won't be counted as a registered attendee. Therefore the chosen name and ID will be allotted to the attendee as per his/her entered details. Once the details are allotted, a pop up cam window opens focusing on the face of the attendee in a rectangular box along with the name and ID and finally the details will be saved in the excel file as mentioned before. There might be cases where a person who has never registered before came to mark attendance for someone else, in that case the face won't match with anyone in the student's database and the face of that person will be labelled as "Unknown". As for security purpose, the students labelled as "Unknown" will be sent to the "ImagesUnknown" folder which can be viewed along with their date and time.

IV. EXPERIMENTAL RESULTS

The real time face detection and recognition was tested on a desktop with a processor of AMD Radeon R5 Graphics, 2.20 GHz, 4 GB RAM, 64-bit Operating System type and a webcam of 8 MP. Figure 2 shows the GUI of the proposed model which was created using tkinter on Python 3.7. As it can be observed from the Interface, the name and ID of the student is already entered. Once the "Take Image" button is pressed, a cam video pops up to read the frontal part of the face which can be observed in figure 3. After detecting the face for a few seconds, the cam window closes automatically. The next process involves training of the image which is done by pressing the "Train Image" button. Once the training is over, the student can track and see if his face is registered or not by clicking on the "Track Image" button just like in figure 4. The cam window displayed now shows the name and ID of the student at the bottom, this indicates that the student is a registered member so after pressing the button "Q" the cam window closes and the data including student's name, ID, date and time are saved in the excel sheet in the "Attendance" folder.

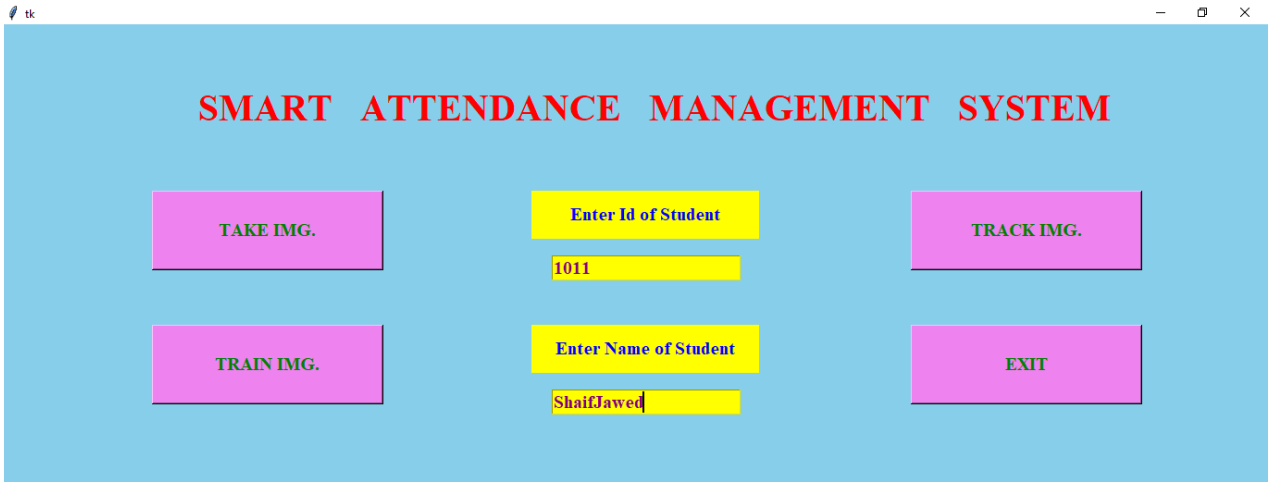

Figure 2. Interface of the proposed model created on Python 3.7

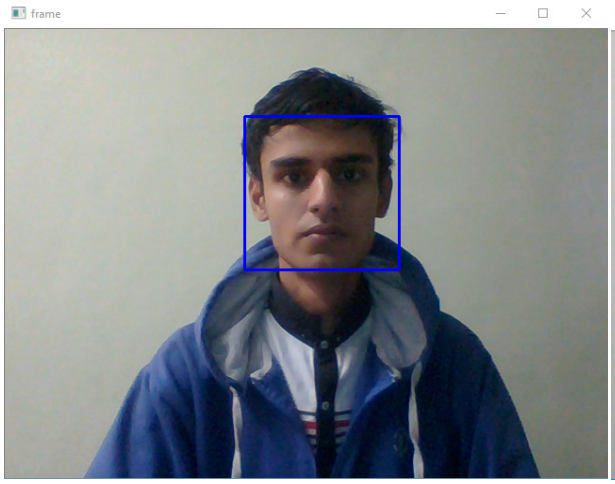

Figure 3. Face Detection

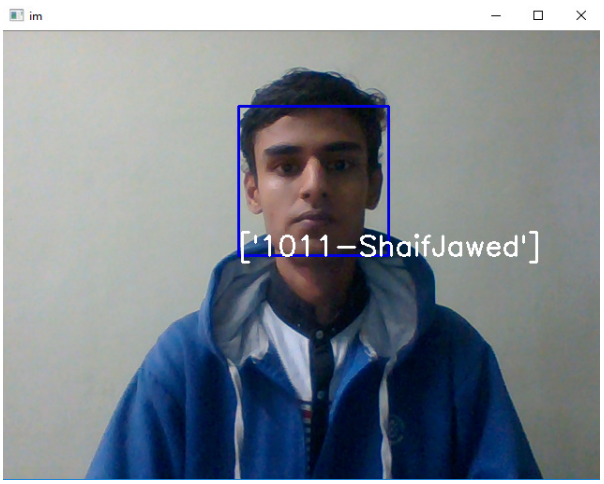

Figure 4. Face Recognition

V. CONCLUSION

In this paper, the proposed model for automatic and smart attendance in real time was used in order to overcome the old and traditional method of manually using roll call or logbook. The proposed model uses the concept of face detection technique for signing up the students according to their name and Identification number, and face recognition technique for logging in the students who have registered for the attendance. This system can't detect faces from different angles since it's designed to recognize only the frontal part of face using haarcascade_frontalface classifier. The accuracy of the system can be further enhanced by increasing the number of images captured during training.

VI. FUTURE SCOPE

The important factor required for the future scope of this project is magnitude/scale. If multiple students could be registered and recognized at the same time, then it'll require less number of turns and the time required would be lesser compared to the previous technique. Surveillance cameras with higher resolution can be used for achieving higher degree of security, therefore installing this system might also help in attaining better records for incoming and outgoing students in class. There are various methods introduced for detection of an object, frontal face is just the tip of an iceberg. This method can also be used to detect other body parts such as nose, mouth, left eye, right eye, lower body, full body etc. By increasing the number of classifiers, security can be doubled for the identification process.

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