Real-Time Smart Attendance System using Face Recognition Techniques

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***Abstract*—The management of the attendance can be a great burden on the teachers if it is done by hand. To resolve this problem, smart and auto attendance management system is being utilized. But authentication is an important issue in this system. The smart attendance system is generally executed with the help of biometrics. Face recognition is one of the biometric methods to improve this system. Being a prime feature of biometric verification, facial recognition is being used enormously in several such applications, like video monitoring and CCTV footage system, an interaction between computer & humans and access systems present indoors and network security. By utilizing this framework, the problem of proxies and students being marked present even though they are not physically present can easily be solved. The main implementation steps used in this type of system are face detection and recognizing the detected face.**

This paper proposes a model for implementing an automated attendance management system for students of a class by making use of face recognition technique, by using Eigenface values, Principle Component Analysis (PCA) and Convolutional Neural Network (CNN). After these, the connection of recognized faces ought to be conceivable by comparing with the database containing student's faces. This model will be a successful technique to manage the attendance and records of students.

Keywords— ***facial recognition, attendance management system, Convolutional Neural Network, Principle Component Analysis.***

I. INTRODUCTION

To verify the student attendance record, the personnel staff ought to have an appropriate system for approving and maintaining the attendance record consistently. By and large, there are two kinds of student attendance framework,
i.e. Manual Attendance System (MAS) and Automated Attendance System (AAS). Practically in MAS, the staff may experience difficulty in both approving and keeping up every student's record in a classroom all the time [1]. In a classroom with a high teacher-to-student ratio, it turns into an extremely dreary and tedious process to mark the attendance physically and cumulative attendance of each student. Consequently, we can execute a viable framework which will mark the attendance of students automatically via face recognition. AAS may decrease the managerial work of its staff. Especially, for an attendance system which embraces Human Face Recognition (HFR), it normally includes the students' facial images captured at the time he/she is entering the classroom, or when everyone is seated in the classroom to mark the attendance [1].

Generally, there are two known methodologies to deal with HFR, one is the feature-based methodology and the other is the brightness-based methodology. The feature-based methodology utilizes key point features present on the face, called landmarks, of the face, for example, eyes, nose, mouth, edges or some other unique attributes, as shown in fig.1. In this way, out of the picture that has been extricated beforehand, just some part is covered during the calculation process. Then again, the brightness-based methodology consolidates and computes all parts of the given picture [1]. It is also called holistic-based or image-based methodology. Since the overall picture must be considered, the brightness-based methodology takes longer handling time and is likewise more complicated [1].

There are different advances that are done during the process of this face recognition framework, yet the essential steps of these are face detection and face recognition. Firstly, to mark the attendance, the images of students' faces will be required. This image can be captured from the camera, which will be installed in the classroom at a position from where the entire classroom is visible. This image will be considered as an input to the system. For efficient face identification, the picture should be upgraded by utilizing some image processing methods like grayscale conversion and histogram equalization. After image quality upgrade, the image will be passed to perform face detection. The face identification process is trailed by face recognition process. There are different strategies accessible for face recognition like Eigen face, PCA and LDA hybrid algorithm. In the Eigen face, when faces are identified, they are trimmed from the picture [2]. With the assistance of the element extractor, different face highlights are extracted. Utilizing these faces as Eigen features, the student is recognized and by coordinating with the face database, their attendance is marked [2]. Developing the face database is required with the end goal of comparison.

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Fig. 1. 68 landmarks present on the face

II. Literature Review

The main objective of this paper is to develop a smart attendance management system using facial recognition that will take care of the problems which are being faced in other automated systems which are in operation in today's modern-day world. The main approach which needs to be followed is to tally a fairly recent image of a student to that of some images which taken deliberately and stored in a database, which further be used to mark the attendance if the images in database match to the real-time image. A model as specified by Naveed et al [4], which is linked with two databases. One for the faces and the other one is used for marking the attendance. The image before the detection and recognition phase, the camera is used to click the face image of the student and performs background and noise removal.

In another implementation of a similar system, Kawaguchi et al [5], proposed a model in which the faces are compared to the images in a database along with the fixed seating positions. This is a method of continuous examination which uses video streaming camera to sense the presence of the students in the class. They even estimated the seating arrangements using several different types of calculations. It is a very common architecture, which implemented using two different cameras, one is used to sense and the other one is used to capture images. MuthuKalyani et al [6] proposed a different approach to this, by using Android Devices to accomplish this task. This was done by the linkage of the android phone to the CCTV camera. After the picture being captured in the camera, it was then exposed to 3D modeling and canonical techniques were used on the pictures for the comparison.

The model proposed by Marko Arsenovic et al. [7] makes use of the topmost advancements; Convolutional Neural Networks cascade to implement face detection and Convolutional Neural Networks for the face embeddings. CNNs accomplish the best outcomes for bigger datasets, or, in other words, case underway condition, the primary test was applying these strategies on small datasets. The general precision was 95.02% on a little dataset of the first face pictures of workers in the ongoing condition.

The facial detection model proposed by Kruti Goyal et al. [8], is a facial detection model which is built using different types of algorithms like AdaBoost, Haar Cascades. This model uses MATLAB and OpenCV for its implementation. Extraction of facial features is done as a localization of the face which is performed using pattern recognition.

Nusrat Mubin Ara et.al [3] in their paper have discussed about the developments in the field of technology they used, such as face detection, normalization, face recognition, and neural networks. The authors also wrote about the methodology in which face detection is done using History of Oriented Gradients, Face Alignment using face landmark estimation, extracting features using Convolutional Neural Network and lastly generating embedding. Although their system found some false predictions, they achieved an accuracy of more than 95%. Samuel Lukas et.al [1] in their Student Attendance system integrated the recognition system with Discrete Wavelet Transform (DWT), Discrete Cosine Transforms (DCT) and Radial Basis Function Network (RBFN), along with their respective mathematical equations. They have represented the system design of their proposed framework with the help of a block diagram to show the process flow. According to their experiment result, they attained an accuracy of 82% as some students were recognized as others.

Priyanka Wagh et.al [2] discussed about the various face recognition techniques like Principle Component Analysis (PCA), Eigenface, Support Vector Machines (SVM) and Neural Networks and compared them based on their success rate. The authors also wrote about system architecture, step-by-step methodology and supported it with its algorithm. They have also provided a mathematical model using mathematical concepts and language.

Abhishek Jha et al. [10] proceeded further to a superior system for the recognition process by utilizing statistical methods PCA and LDA in addition to likewise comparing the picture taken and the saved images for marking the attendance. They suggested to the extensive and blunder inclined procedure of participation making which whenever bargained may influence the understudy definitely. They proposed a framework for figuring the pictures in a specific procedure with the goal that matches scoring should be possible. While it very well may be accomplished by utilizing certain calculations, like color detection, PCA and LDA. They made many extractions of facial features from the picture for instance framework of face, nose, and eyes and so on. The PDA and LDA make use of the Eigen Values for students' attendance to be marked accurately.

III. Proposed Methodology

A. Architecture

The automated attendance management system has a very simple and easy to implement the architecture. The system consists of two databases, a student database, and an attendance database. The student database is for storing the details of the student in a particular class. On the other hand, the attendance database, as the name suggests, is for marking

and maintaining the attendance records of students attending a particular lecture.

For the accomplishment of marking attendance, this system will have a high-definition camera installed outside the classroom. Students will avail the access to enter the classroom, by scanning their faces in that camera. Another camera will be installed inside the classroom in such a way that every student in the class will be visible to the lens of the camera. Facial detection and recognition algorithms will be applied to both the cameras to analyze the faces and mark their attendance accordingly.

B. Methodology

To develop the smart attendance management system, some steps are required to be followed for accomplishing this task successfully. The steps can be defined in the following ways:

- Enrolment
- Face Detection
- Face Recognition
- Confirmation by the class camera
- Attendance Marking

Enrollment

In this step, the student is enrolled in the student database. General information like Name, Enrolment Number, Class, and Section is stored in the database. Along with all this information, pictures of the student's face appearing in the camera window are also stored in the student database.

With the help of all the images stored in the student database, facial recognition can be performed for all the students are coming to attend a lecture.

Face Detection

For detecting the faces, we will be referring to the above mentioned 68 landmarks present on a person's face. Based on these landmarks of the face, the Viola and Jones algorithm [9] will be used for face bounding box detection and constrained Local Model-based face tracking and face landmark identification algorithm. It can also be cited as AdaBoost algorithm for face detection. Once the detection part is successfully completed, we will be moving on to the next phase. The next phase in this system is Face Recognition.

Face Recognition

To implement the facial recognition in this model, we will make use of the Principle Component Analysis (PCA). PCA is a methodology utilized for lessening the quantity of variables which are used in face recognition. In PCA, each picture in the training dataset is represented as a linearly weighted eigenvector called eigenfaces. This methodology change faces into a small arrangement of basic qualities, eigenfaces, which are the principal parts of the underlying arrangement of learning pictures. Recognition is implemented by anticipating another picture in the eigenface subspace, after which the individual is arranged by contrasting its current position in eigenface space and the position of known people. The main benefits of using PCA for facial recognition is ease of use, speed and not changing its judgment based on changes on the human face. The students, appearing on the camera present outside the class, will have their face recognized in order to get access to enter the classroom.

If the student's face is present in the respective database, then he is allowed the access to enter the class, else if his face image is not present in the database then the system will ask the student to enrol himself in the student database before gaining access in the classroom.

Confirmation by the classroom camera

After the face of a student is recognized successfully and the student is allowed access to the classroom, in order to confirm that the student is present in the class for the lecture, a second camera installed inside the classroom will be set up in such a way that all the students are visible. This will help in cancelling out the proxies.

Attendance Marking

At the end of the lectures, the camera inside the classroom will be used to provide the list of students present in the classroom. With the help of this, attendance for that lecture will be marked in the attendance database.

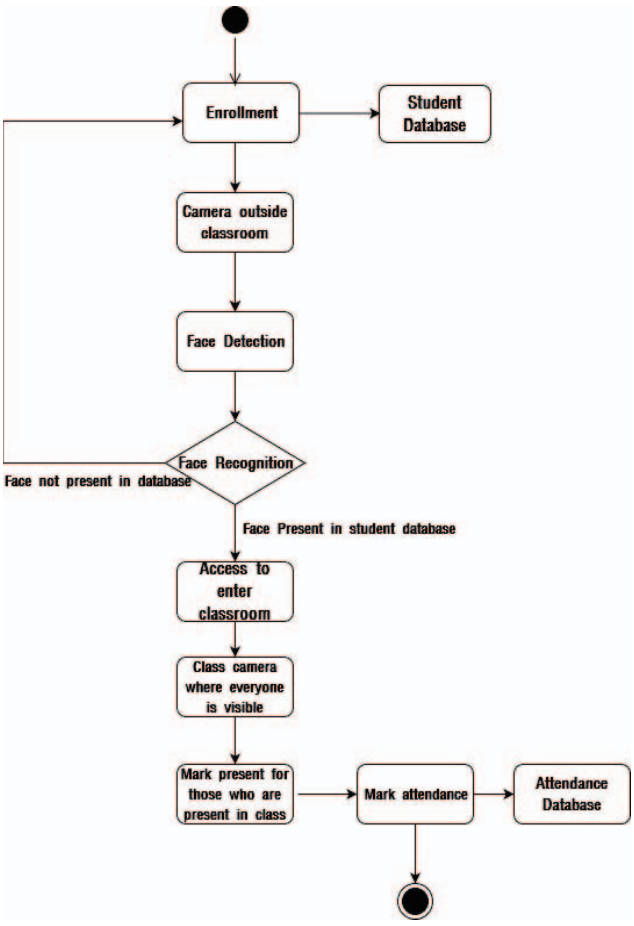

Fig. 2. Activity diagram for the smart attendance system

C. Algorithm

ALGORITHM:
REAL_TIME_SMART_ATTENDANCE_USING_FACE_R RECOGNITION

INPUTS: Faces of students at Entrance, Inside Classroom.

OUTPUT: Automatic Marking of the attendance.

PROBLEM DESCRIPTION: Recognition of faces and marking attendance accordingly.

Step I: Commence

Step II: Enrolment of students' details in the student database.

Step III: Setup a camera outside the classroom. Students' face will appear in the camera.

Step IV: Face Detection

Step V: Face Recognition by comparing the students' face with images in the student database.

Step VI: IF: student is present in database.

Grant access to the classroom

ELSE: Go back to Step 2.

Step VII: Camera installed in the class is used to check the presence of the student in the class.

IF: Faces recognized in step 6 are present, Mark them present.

ELSE: Mark absent.

Step VIII: Mark the attendance in the attendance database.

Step IX: End.

IV. Conclusion

The proposed automated attendance system using face recognition is a great model for marking the attendance of students in a classroom. This system also assists in overcoming the chances of proxies and fake attendance. In the modern world, a large number of systems using biometrics are available. However, the facial recognition turns out to be a viable option because of its high accuracy along with minimum human intervention. This system is aimed at providing a significant level of security. Hence, a highly pro-efficient attendance system for classroom attendance needs to be developed which can perform recognition on multiple faces at one instance. Also, there is no requirement of any special hardware for its implementation. A camera, a PC and database servers are sufficient for constructing the smart attendance system.

V. Future Scope

The proposed system here is only used for classroom attendance for students. However, this system can be improved and enhanced in a way that it can also be used in multi-national companies for maintaining the surveillance of a much larger database, filled with huge amount of entries of the employees working in a particular organization. This will be able to help in maintaining security and also the company will able to keep a track on its workers whether they are completing the desired working hours in a day or not. This can also be implemented in banks. The ATM machines can be equipped with a facial recognition algorithm. The customers will only be able to access their bank accounts, once their faces have been recognized by the ATM machine on comparison with images which are already saved in the database. This can help in preventing money thefts hence increasing the security while operating ATMs.

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