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Automated Attendance System Based on Face Recognition Using Opencv

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***Abstract*—Effective attendance is essential to the education process. Teachers and school administrators need to know how much time each student spends in the classroom. Because of this, many schools use automated attendance systems (AASs). These systems save time and space by enabling schools to register and track students without the need for physical identification cards or teachers. To keep track of students, teachers can use smart cards that monitor attendance records. Biometric technology allows schools to verify student attendance by comparing their biographical data to student identification card entries. A good attendance system helps school administrators maintain proper attendance records for each child. However, no system works effectively when only some required IDs are present among the school's student population. Implementing AASs requires proper planning and implementation- but it will undoubtedly save time and space in your school's classroom when properly executed and utilized.**

Keywords—Attendance System, Face Recognition, Machine Learning, AASs, Automated Attendance

I. Introduction

Face recognition is a technology that enables computers to identify people based on their facial features. A face recognition system uses a camera to capture images of faces and compares them to stored images of known individuals. If the computer finds a match, it can then determine who is present at the time of image capture. A smart attendance system combines both face recognition and an attendance system. It works similarly to a traditional attendance system, except that it can recognize students' faces instead of manually logging their attendance. The system can send out reminders to students if they fail to appear for a class. This is one way we can ensure students attend class.

This software can be used to record the attendance of students in class automatically. It does this by scanning the faces of students in the classroom and comparing them to a database of recorded attendance. This method is ideal because it eliminates the need for teachers to write down student attendance manually. It also eliminates the risks associated with collecting handwritten records. Plus, it reduces the amount of time required to verify student attendance. Institutions can save money and time by implementing an automated system for recording student attendance.

Doing so frees up administrative staff to focus on more important tasks, such as grading assignments and filing paperwork. Furthermore, face recognition software helps schools identify repeat absentees. This allows them to provide individualized treatment to children who consistently miss class. Over time, this could reduce problematic absenteeism behavior among specific demographics of students.

It has several uses in schools and colleges, primarily as an absenteeism management tool and a discipline strategy tool. In the first case, it helps teachers identify absent students in a timely manner. It can also notify teachers when absent students return to class so they can give them extra attention and feedback. As a discipline strategy tool, face recognition is used in schools to enforce uniform behavior among students. For example, it can be used to track whether a child attends school or not, what they do while at school, and whom they hang out with while at school. All this information is gathered so officials can keep an eye on troublesome child behavior. [1]

II. Literature Review

There are many different parts that need to be thought out before designing a system. Creating the architecture, designing modules and interfaces, and selecting adequate components - all these things require some knowledge and experience. The design process would work like systems theory as seen usually in product development. The proposed automated attendance system consists of 5 main components. The process is described in detail in the following sections.

A. Image Capture

The camera is right in front of the students so that it can capture the frontal images of the students. The camera is always in focus and does not need to be manually

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adjusted for each student. Moreover, the lighting in the room should be bright enough so that the facial features of the students are clearly visible. It's recommended that the student faces the camera during the capturing process.

In order to capture an accurate image of each student, we recommend standing at least 3 feet away from the student and making sure that their entire face is within the frame. Once they have positioned themselves correctly, press the capture button on the app to take a picture. The picture is then saved and used later for face recognition and marking their attendance.

B. Face Detection

A proper face detector improves the performance of any face recognition system. Such algorithms can be based on Face geometry or can be invariant to how we change our features through aging or changes in appearance. Approaches such as Machine Learning are often useful [2]. Attendance flow diagram is shown in Fig. 1.

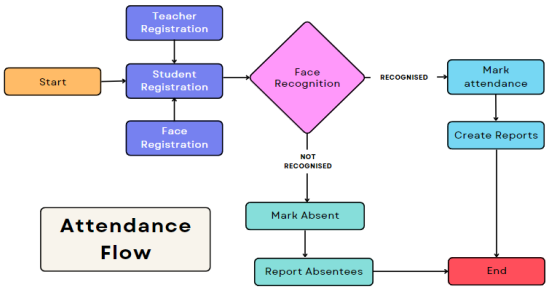

Fig. 1. Attendance Flow Diagram

C. Pre-Processing

The detected faces will be processed in order to make them easier to detect and identify. Facial recognition is a difficult task due to the many pre-processing steps required. Algorithms are required to detect objects in an image, track, align and finally identify faces. These steps are: 1) image enhancement, 2) face matching, 3) matching with previously stored data, and 4) recognition of facial expressions. After pre-processing is completed, the detected face may be decomposed into various parts for recognition. These pieces are the eyes, nose, and mouth. They each have a certain probability associated with them that depends on how well the data is pre-processed. For example, if much more data was used to detect the eyes than the nose and mouth, then there is a high probability that this person's face may include only their eyes. The calculation of probabilities for the filters before any analysis can be performed computationally complex, so for most systems; it is simplified by considering certain attributes. [3]

D. Database Development

We have decided to use a storage level database to store the face models for each student as well as to store the recorded attendance. JPEGs are one of the most popular image formats and provide a lossy compression technique. It stores the pre-processed images for further processing and results in a smaller file size. We have used MongoDB to store this information. We want the application to provide the student with an option to display the name and photo of their classmate or teacher on their profile page. We will do this by using a MongoDB query that returns all documents for each attendee; then, for each document, we will return a One-to-one relationship that connects it to a Face model in our level database

E. Post-Processing

Post-processing is a technique that is used in many different fields, including computer graphics and image processing. It is the process of manipulating images after they are captured or generated. In face detection, post-processing can be used to remove unwanted features from the image. A common example of post-processing in the field of face detection would be removing an object from a photo, such as a hat or sunglasses. Faces detected with the proposed system are matched with the names in the database. The frontend report that is displayed is generated by exporting this data from a database. The database can also generate monthly and weekly attendance reports. These records can be sent out to parents or guardians if needed, and the final list of students will be shown at the end of class. This allows students whose faces are not recognized correctly to shape the system and make it more accurate and stable. The face recognition system needs to be able to identify a face correctly for it to be able to match with a database. This means that the more people who use the system, the more accurate and stable it will become. Sending out well-timed notifications is one of the easiest ways to increase engagement with the students and staff. The reporting system also uses email APIs, which allows you to communicate with every authorized member of staff.

The system sends out email updates on a daily basis to every authorized staff member. Push notifications are also available; they can be sent out to both staff and students. Push notifications are handy for keeping you up to date with events happening at school in real time [4].

III. Working Principle

INPUT: Faces of students sitting in a classroom.

OUTPUT: Automatic marking of attendance.

PROBLEM DESCRIPTION: Recognizing the faces and marking attendance of present students accordingly.

Step I: Start

Step II: To facilitate easy verifications, students are encouraged to enroll their personal details in the student database.

Step III: Install a webcam in the classroom. Students can be seen on it.

Step IV: Face Detection using OpenCV.

Step V: The face recognition algorithm uses a binary code of how dark pixels are distributed in an image.

Step VI: If the student's face is present in the database, Proceed.

Step VII: If a person is recognized and matched, mark them present; otherwise, mark them as absent.

Step VIII: Receive attendance data and record the information in our system.

Step IX: End.

IV. Proposed Methodologies

The tools and methodology to implement and evaluate face detection and tracking are listed below.

A. OpenCV

Intel's OpenCV Library is an open source framework of programming functions that incorporate real-time computer vision, and it can run on various platforms. It can run on Windows, Linux, Mac OS X, Android, iOS, Raspberry Pi, and others. It is cross-platform, meaning that it works on any operating system without having to install additional software. It is also free to use. The OpenCV library was initially created in the C programming language, and the C interface lets OpenCV be portable to certain systems. For example, OpenCV can be ported to digital signal processors. OpenCV 2.0 includes two interfaces: the traditional C interface and the C++ interface. The C++ interface is designed to make it easier to use OpenCV in C++ programs. It uses templates to automatically manage memory allocation and deallocation. In addition, the C++ interface allows programmers to create custom classes that inherit from the cv::Mat class. These custom classes can be used to store data in memory without having to worry about memory management. It supports many programming languages, including C, C++, Python, Java, Matlab, Perl, PHP, Ruby, Tcl, and others. OpenCV is used in many fields, including image processing, video analysis, machine learning, robotics, autonomous navigation, augmented reality, biometrics, and medical imaging.

B. Local Server

The attendance system should also have a backup copy of the web pages where you can see all attendance information updates. This requires a server that can host the website. The "Attendee Management System" website was developed to provide a platform to review attendance. This website is developed in the server-side scripting language - ExpressJS and style sheet language - CSS, which is used to search and format a document written in a markup language. This website uses the MongoDB database, which is the most widely used database solution in the world.

C. Face Detection

This system can recognize faces from HD video collected images for the purpose of studying and detecting the face. Face from Section IV above, face detection detects where a face is in a picture, and it is accomplished by scanning the various picture scales and detecting the face by extracting the precise patterns. The A Haar-Like Feature function is used to build the prototype. Haar classifier facial detection is used in OpenCV to build a search window that scrolls over images and checks if a certain section of a picture resembles a face or not.

D. Feature Extraction

Face detection feature extraction involves locating the features of face components in an image. This process is done using a series of mathematical operations. First, the image is converted into grayscale. Then, the pixels are divided into blocks. Each block contains a small area of the image. Next, the image is examined for changes in color intensity. These changes indicate the presence of a face. Finally, the location of the face is determined by comparing the size and shape of the face to a pre-defined template. This process is used in many applications, including face detection, facial expression recognition, and human activity recognition. This process is divided into identification and verification. This solution focuses on two terms: identification to detect the face in real-time video and verification application for facial recognition. The greatest matching score obtained in the previous stage is declared in the final phase of face detection. The configuration will define how the application should act.

E. Attendance Marking

Attendance marking is the final step of the system procedures; in this stage, mark the attendance of the student; if the overall above development is done and recognize a copy adequately, then it will mark as a current in the system server; else, it will mark as absent. The database also stores the student's name, as well as the day and time of attendance. This information is then utilized to compile a student's cumulative attendance reports. The student is also notified if their attendance falls below a specific level. Feature selection for face detection is shown in Fig. 2.

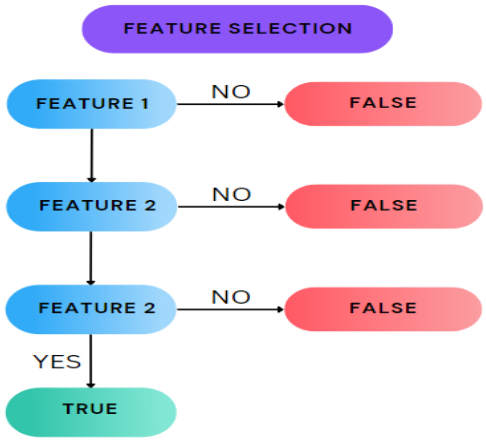

Fig. 2. Feature Selection for Face Detection

F. Report Generation

After the attendance is marked, visual reports and summaries can be viewed from the attendance records for any particular student. Bulk reports are also available to download from the dashboard and can be exported to an Excel sheet.

V. Result

The attendance management system using facial recognition is very easy to use and works smartly in less time. This is an automatic system. Once an administrator has created a student profile in the database, it is automatically used in the facial recognition and recognition process. To initialize this system, the administrator first creates all student profiles with their

name, roll number, department, and other educational details. The Login page of the management portal is shown in Fig. 3.

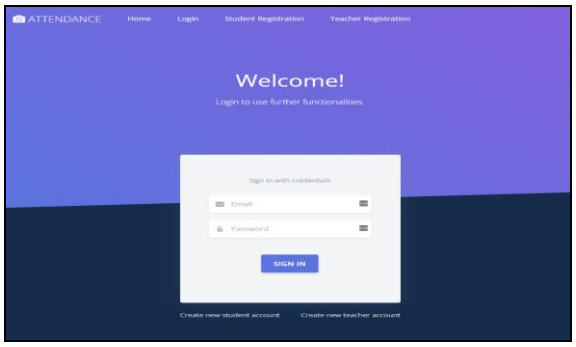

Fig. 3. The Login page of the management portal.

The system has an Authentication System built into it and needs a user ID and Password for access. The system will have two roles Student and Staff. Both Students and Staff have two different Dashboards through which Users can Control and View Attendance Records. The teacher dashboard on the portal is shown in Fig. 4.

Fig. 4. The Teacher dashboard on the portal.

The student and teacher both have their separate dashboards where they can view the attendance reports. The teachers have an additional facility to take attendance for any particular class by going to their classes and clicking the mark attendance button. The Student dashboard on the portal is shown in Fig. 5.

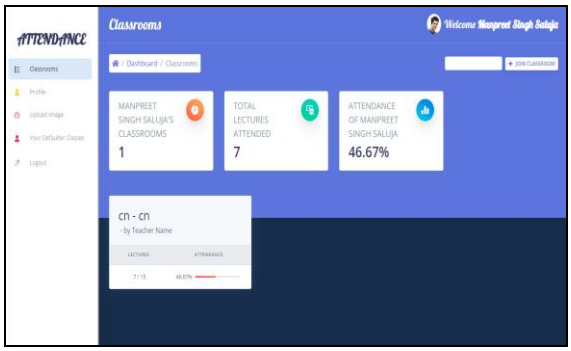

Fig. 5. The Student dashboard on the portal.

When the attendance for a class is to be taken, the teacher will log into their dashboard and click the "take attendance" button. This will then open up the camera module that would automatically start capturing the faces of the people in front of it. If any face matches with any of the students registered in the class, then the attendance for that student will be marked. Attendance being taken in a class is shown in Fig. 6.

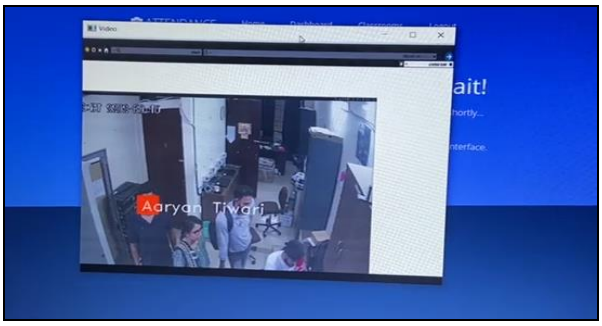

Fig. 6. Attendance being taken in a class

VI. Conclusion

In conclusion, this project will help teachers all over the world and show efficiency in the education sector. Just uploading a class photo to the website and getting an instant attendance report would be helpful for busy teachers. The above method gives the best result. This is achieved using OpenCV for frame extraction and dlib for face detection.

This method has higher accuracy in detecting multiple faces from one frame with a shorter response time.

This project's future scope is very broad. It is possible to use a SQL server to transfer attendance data to the college database, which would make it simpler for teachers to take attendance. We anticipate that many schools will use this and incorporate it into their systems as a result of our initiative. This is an automated system, so if the admin creates a student profile once in the database, then it will automatically use the number of times in the face detection and recognition process. The work of the future is to improve the recognition speed of algorithms when involuntary changes occur in a person, for example, cleaning the head or wearing a scarf or beard. The developed system only recognizes 30-degree angular variations of the face, which needs to be further improved. In addition, a graphical user interface can be made to facilitate access and improve appearance. This includes automatic entry into the database and updating presence when faces are detected, making the entire system automatically. Motion detection can be combined with face detection systems to achieve better system performance. Poor lighting conditions can affect image quality, which indirectly reduces system performance.

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