

Automated System for Attendance Tracking and Management Using Face Recognition

Abhijeet More^{1,*}, Anushka Kadam², Aditi Bhopale², Siddhant Kamble², Sumit Nalawade²

Abstract

A camera is used by an attendance tracking system that uses facial recognition to snap photos of people. After that, a computer program analyzes these images and uses facial feature analysis to identify specific individuals. Subsequently, the system can ascertain whether or not the identified individuals are present, by comparing the identified individuals to a database that already has information about known individuals. This technology can be used to expedite the process of collecting attendance and reduce the likelihood of errors resulting from human error in a variety of settings, including offices, industries, and educational institutions. A more complete outcome for overseeing participation might be gotten by joining facial acknowledgment with different innovations, for example, time and participation observing programming. It recognizes deep learning algorithms and utilizes the newest technologies to make attendance more intelligent. This outcomes in the production of a framework that can distinguish and perceive the essences of the understudies signed up for the class. The area of the individual's head that is situated in the frontal region first is the face. Specifically, it is the region that encompasses the top of the head, the bottom of the jawline, and the area between the ears. Facial recognition is one of the biometric measurements that should be required for this system. This concept allows it to do all the tasks of a sophisticated attendance tracking system in half the time it would take a human to complete them. This idea predicts that student data and attendance tracking technology will be successful.

Keywords: Attendance, face identification, openCV, training and recognition, database

INTRODUCTION

Any educational or business setting needs to use attendance tracking as a crucial procedure to keep track of students' or employees' punctuality and presence. Conventional methods for attendance tracking like swiping cards, can be error-prone as well as time-consuming. Technology has progressed to the point that attendance tracking using facial recognition is now possible. With the help of technology, the "Smart Face Recognition Attendance Monitoring System" can easily keep a track of attendance by recognizing individuals by their facial traits.

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Every institution needs a reliable and consistent mechanism to keep track of its students' attendance. Additionally, every institution uses a different approach. For example, biometric equipment like RFID card, fingerprinting are almost nonexistent and are utilized on a daily basis, despite the fact that many took a help of attendance records to physically keep a track of attendance [1]. Using the traditional

method to personally call each student by name takes time. Despite the fact that RFID based card provide every student a distinct recognition, there is a chance of misplacing a card or handled inappropriately by unapproved people, which could result in phony attendance. When it comes to other biometrics, like recognizing voice [2], or fingerprinting [3], it is not 100% accurate.

It is possible to recognize or verify the identification of a person by using the face recognition method, which can be applied to a digital image. Face recognition systems operate in a few different ways, but they all function by differentiating between data that is selected about an individual based on their face and data that is supplied as that person's face in a database. Face recognition is the most efficient and intelligent time and attendance management system currently available and is the primary method for controlling the display of time and attendance [4]. Compared to other methods, face recognition [5] is faster and lessens the need for proxies, as shown in Figure 1 [6].

BACKGROUND

Punch cards and manual roll calls are two examples of traditional attendance management methods that have long been beset by problems with accuracy, efficiency, and manipulation. These techniques are prone to human mistake and demand a lot of administrative work, which could result in fraudulent activity and erroneous data. With the development of technology came the introduction of electronic systems such as biometric fingerprint scanners and swipe cards, which increased accuracy but still had drawbacks including card loss and hygienic issues [7].

Face recognition software has become the best option for managing attendance in recent years. Face recognition provides a quick, easy, and non-intrusive way to track attendance by using sophisticated algorithms to identify people based on distinctive facial features. Several of the flaws in earlier methods are addressed by this technology, which offers a streamlined and dependable method of guaranteeing correct attendance records. Facial recognition-based smart attendance systems are getting more advanced because to the rising integration of AI and machine learning. These systems offer improved security, scalability, and user experience in a variety of settings, including corporate settings and educational institutions.

MOTIVATION

The manual tracking of attendance is the standard practice in the field of education; yet, this method has a number of significant limitations. It is problematic because it is prone to errors, which can result in inaccurate records, and it wastes valuable class time and resources from the faculty. Real-time access to attendance data is not available, which makes it difficult to make decisions quickly. Additionally, security problems, including proxy attendance, continue to be a worry. Clearly, there is a requirement for a contemporary answer.

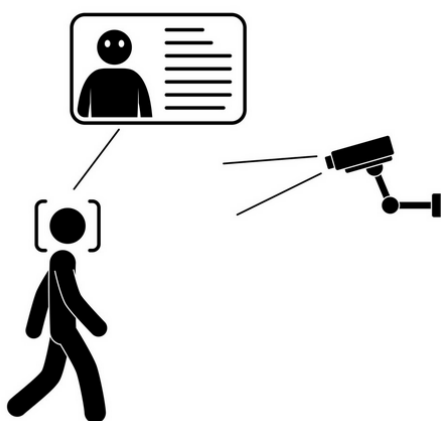


Figure 1. Smart attendance system.

Step forward the Intelligent Attendance System

In order to guarantee accuracy and safety, it makes use of cutting-edge technology such as facial detection and digital attendance tracking. Not only does this lessen the demands of administration, but it also promotes transparency and accountability, giving students the chance to examine their attendance records and encouraging them to take responsibility for their actions [8].

To ensure that students have a more enjoyable educational experience, it is imperative to develop the Smart Attendance System. Through the utilization of cutting-edge technology, it is able to automate the tracking of attendance, so maintaining accuracy while simultaneously minimizing the amount of administrative work required. Its elements of transparency and accountability empower students and enable data-driven decision-making, revealing light on attendance trends and the effects those trends have on student achievement. The ultimate objective is to create a strong system that tackles the problems that now exist, thereby paving the way for an educational environment that is more effective, accountable, and data-driven, which will eventually be to the benefit of both teachers and students.

FUNDAMENTAL CONCEPTS

This project's main objective is to develop a smart attendance system that uses face recognition technology to increase attendance management's precision and effectiveness.

Literature Review of the Research Papers

IoT-enabled Attendance Monitoring System

This paper presents an IoT-enabled system for automating attendance tracking and providing real-time analytics. The system leverages the Internet of Things (IoT) to streamline the attendance process and deliver timely insights into attendance patterns.

Advantages:

- Automation of attendance tracking; and
- Real-time analytics for attendance monitoring.

Limitations:

- Network connectivity issues; and
- Maintenance of IoT infrastructure.

Machine Learning Approach to Attendance Prediction

In order to provide early interventions for possible absentees, investigate the application of machine learning approaches to predict attendance. The approach adapts to diverse datasets, offering robust predictive capabilities.

Advantages:

- Predictive analysis for early intervention; and
- Adaptive to diverse datasets.

Limitations:

- Not suitable for large datasets; and
- Complexity in handling noisy data.

BLE-based Smart Attendance System

Using Bluetooth Low Energy (BLE) technology, create a sophisticated attendance system. The system is noted for its low infrastructure requirements and real-time tracking capabilities, making it a practical solution for various environments.

Advantages:

- Low infrastructure requirements; and
- Real-time tracking capabilities.

Limitations:

- Limited range of BLE technology; and
- Dependency on user's device compatibility.

RFID Technology for Attendance Tracking

The application of RFID technology in attendance tracking. This method improves accuracy and efficiency and is non-intrusive for users, making it a user-friendly option.

Advantages:

- Improved accuracy and efficiency; and
- Non-intrusive for users.

Limitations:

- Initial setup cost; and
- Requires RFID tags for each user.

EXISTING SYSTEMS**Conventional Approaches and Their Drawbacks**

Conventional attendance techniques, including sign-in sheets and manual roll calls, have long been rife with errors and inefficiencies. These techniques take a lot of time, and they can be manipulated and subject to human mistake. Although there is a minor increase in accuracy with punch cards and swipe cards, problems like buddy punching and card loss still exist. Higher security is offered by biometric systems that use fingerprint or iris scans, but they also need physical touch, which can be cumbersome and uncomfortable for users and create hygienic concerns [9].

Existing Attendance Systems Based on Facial Recognition

The drawbacks of conventional techniques have been addressed by a number of sophisticated systems that use face recognition technology to automate attendance tracking. Megvii's Face++ cloud-based service, which delivers high-accuracy face detection and recognition, is one such example [10]. Because of its scalability and real-time processing capabilities, this system is frequently utilized; nevertheless, because it depends on internet access and raises privacy concerns surrounding cloud data storage, it is not without controversy as shown in Figure 2.

Another notable arrangement is Microsoft Purplish blue Face Programming interface, which is a piece of Microsoft's Mental Administrations portfolio. It offers strong facial recognition capabilities, such as age and mood detection in addition to face detection, verification, and identification. Though it might be expensive for large-scale use and requires technical know-how for integration, Azure Face API is commended for its thorough support and dependability.

Truein is a facial recognition attendance system that is intended only for use in businesses and educational settings. It provides staff and guest administration, touchless attendance marking, and simple deployment on mobile and tablet devices. Truein is easy to use and offers comprehensive attendance metrics, but its performance is dependent on certain hardware and it offers few customization choices.

Another noteworthy technology is NCheck Bio Attendance, which enables multi-modal biometric verification through the use of iris, fingerprint, and facial recognition. This solution improves security with multi-biometric support and provides real-time attendance tracking and comprehensive reporting. However, some firms may find it difficult to manage various biometric systems because to the increased setup and maintenance costs.

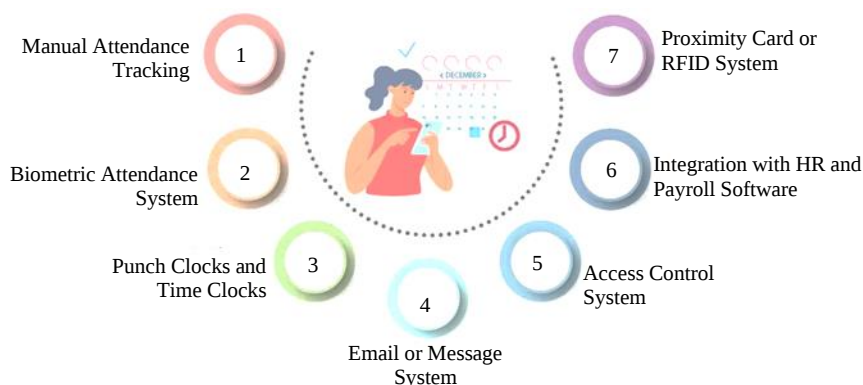


Figure 2. Types of attendance management.

Within its larger HR toolkit, Zoho People is an HR management software that offers face recognition for attendance tracking. This integrated solution offers seamless interaction with other HR functions and facilitates the use of mobile apps. Although Zoho People provides a complete HR administration package, its primary focus is on HR management rather than specialist attendance monitoring, and it may contain features that are redundant for those looking for a more specialized solution.

PROBLEM STATEMENT

The majority of the systems that are currently used to track attendance at educational institutions are manual, which results in inefficiencies, inaccuracies, and a lack of access to data in real time. This antiquated method uses up valuable resources and time, diverting them away from instructional activities and providing room for problems such as students defaulting on their assignments and a lack of accountability. In order to address these challenges, there is an urgent requirement for the development and implementation of a smart attendance system. This system should make use of advanced technologies such as online attendance and real-time face detection in order to automate the process of tracking attendance, improve accuracy, and provide real-time data. Ultimately, this will result in educational institutions becoming more efficient and effective.

IMPLEMENTED SYSTEM

Facial recognition technology is used in the proposed smart attendance system to automate and speed up the procedure of attendance tracking of students. This system offers a more dependable and user-friendly alternative to standard attendance techniques, thereby addressing their inefficiencies and errors.

Teachers and administrators can easily use the system because of its simple operation. Every new student's facial data is first gathered and used to train the algorithm. This entails taking several pictures of every pupil and utilizing them to build a distinct facial recognition profile. Python is used in the training process in conjunction with libraries like OpenCV for image processing and Haar Cascade for face identification, which guarantees great accuracy in identifying faces in a variety of settings.

After the training phase is over, the system is prepared for recording daily attendance. Every class period, the instructor uses a smartphone or digital camera to take a picture of the entire classroom. After that, the algorithm analyzes the picture to find and recognize the students' faces. The identified faces are compared to the training profiles by the OpenCV-powered face recognition system. Pupils who are recognized in the picture are tagged as present by default.

Python tools like Pandas and Numpy, which provide effective data processing and manipulation, are used to manage the attendance data. Because the attendance records are recorded straight into an Excel sheet, instructors may easily access and analyze attendance data. This integration guarantees the system's speed and lowers the possibility of errors related to manual data entering.

The system has a tool to identify defaulters in order to make sure that students maintain a suitable level of attendance. A 75% attendance criterion is established, and any student who does not meet this barrier is considered a defaulter. With the help of this function, educators and administrators may make sure that students fulfill the necessary attendance requirements by promptly identifying and addressing attendance-related concerns.

Python is used to implement the system; it is a strong and flexible programming language. The following important libraries and tools were utilized in this project:

- *OpenCV*: for face recognition and picture processing.
- *Haar Cascade*: To effectively identify faces.
- *Pandas*: For managing and manipulating data.
- *Numpy*: For data processing and numerical operations.

This set of instruments and technology guarantees that the suggested method is reliable, effective, and able to meet the needs of actual classroom settings.

Compared to conventional attendance techniques, the suggested smart attendance system with facial recognition offers a notable improvement. This solution improves the overall effectiveness of attendance management by automating the attendance process, lowering administrative workload, and supplying reliable, real-time data. Better academic performance and accountability are also encouraged by the capacity to detect defaulters based on a predetermined threshold, which guarantees that student attendance is effectively monitored as shown in Figure 3.

METHODOLOGY

The face recognition approach for creating the smart attendance system includes multiple crucial stages: preprocessing and data collecting, system training, attendance marking, data administration, and defaulter identification. The specific steps are outlined in the following order:

Gathering and preprocessing data

Data Collection

- *Student Registration*: Every new student is entered into the system at the start of the term. To ensure powerful face identification, multiple photos of each student are taken in various lighting situations and angles.
- *Image Capture*: To ensure excellent resolution and clarity, images are taken with a digital camera or smartphone.

Prior to Processing

- *Face Detection*: OpenCV and Haar Cascade are used to identify faces in the photos that are taken. In order to precisely identify face regions in the images, the Haar Cascade classifier is trained on a big collection of faces.
- *Normalization*: To standardize the input for the recognition algorithm, detected face photos are shrunk and transformed to grayscale.

System Training

Extracting Features

- OpenCV's face recognition module is used to extract facial features from the preprocessed face images. Each student has a feature vector created specifically for them using these particular features.

Model Training

- An algorithm for facial recognition is trained using the retrieved feature vectors. With the use of supervised learning approaches, this model is trained to increase accuracy in facial recognition.

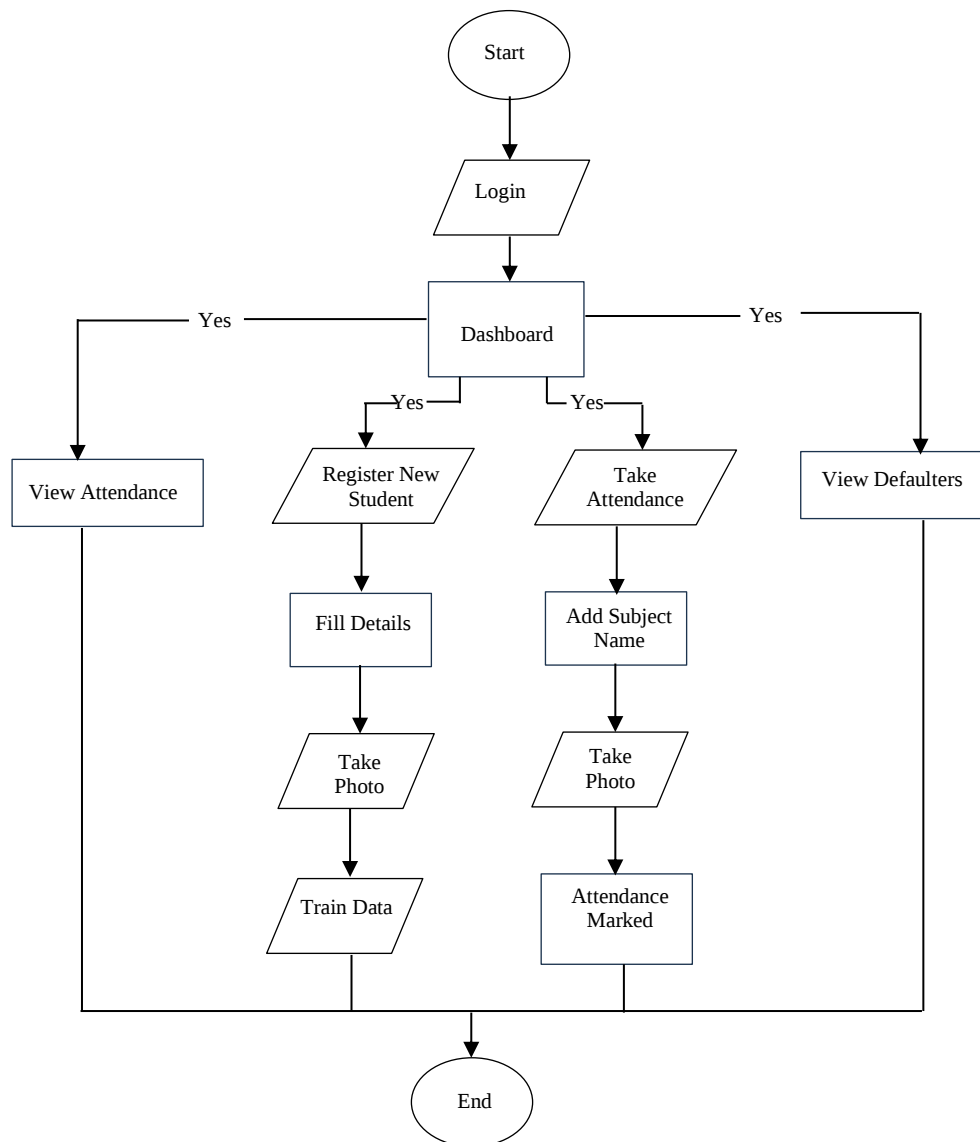


Figure 3. System Flowchart.

Marking Attendance

Take Images in the Classroom

- Every class period, the instructor takes a picture of the whole classroom.

Recognition and Detection of Faces

- OpenCV is used to process the class image that was taken and identify every face in the picture.
- To determine which students are present, the detected faces are compared to the trained facial recognition model.

Attendance Recording

- The identifiable faces are cross-referenced with the student database, and the attendance record of every identified student is updated to 'present' within the system.

Data Management

Data Entry

- The Pandas library is used to record the attendance data in an Excel sheet. This guarantees that attendance records are readily available and neatly arranged.

Analysis of Data

- Periodically, attendance records are examined to track trends in student attendance. This study aids in the early detection of trends and possible problems.

Identification of Defaulters

Threshold Configuration

- There is a defined threshold of 75% attendance. Students who do not meet this requirement for attendance are deemed defaulters.

Report Generation

- Using the attendance data, the system automatically creates a list of defaulters. Teachers and administrators utilize this report to make the required decisions.

Tools for Implementation

Language of Programming

- Python is used to implement the system because of its large library and user-friendliness as shown in Figure 4.

Figure 5 shows the starting page of the system which has two main features.

This is sign up page for authentication of faculty and student. Only registered faculty can use the smart attendance system as shown in Figure 6.

Dashboard displayed buttons for different features like generating defaulter list, attendance etc. (Figure 7).

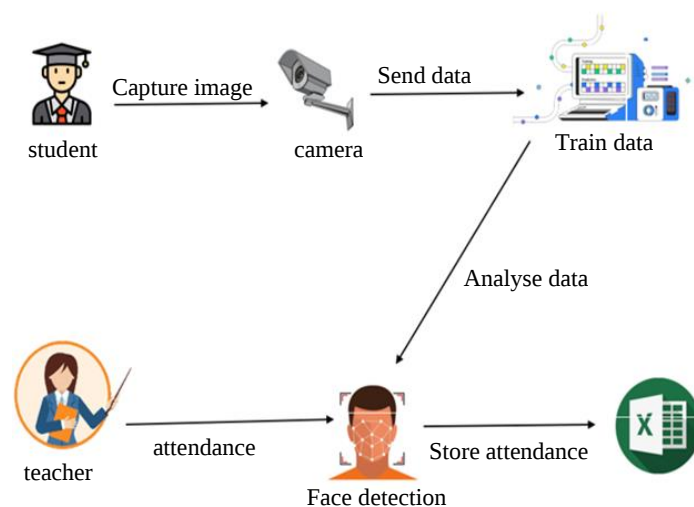


Figure 4. Implemented system.

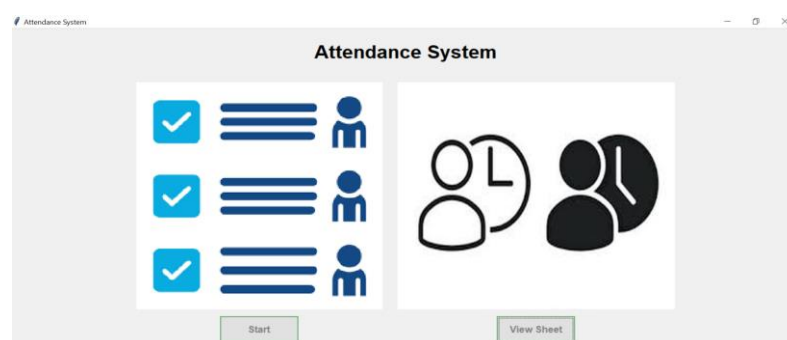


Figure 5. Starting page.

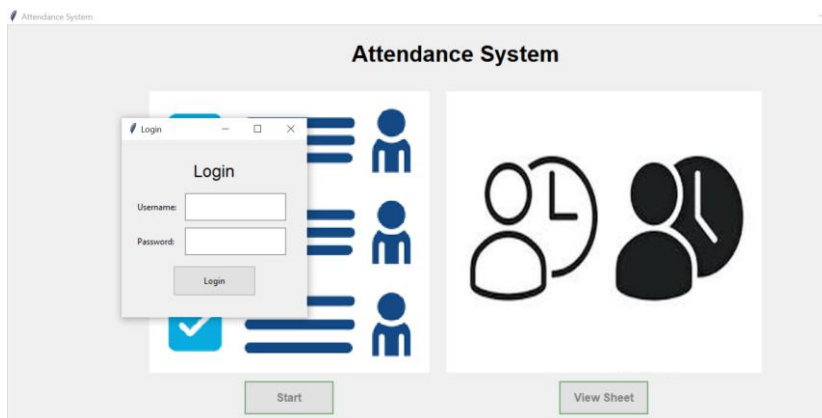


Figure 6. Login Page.

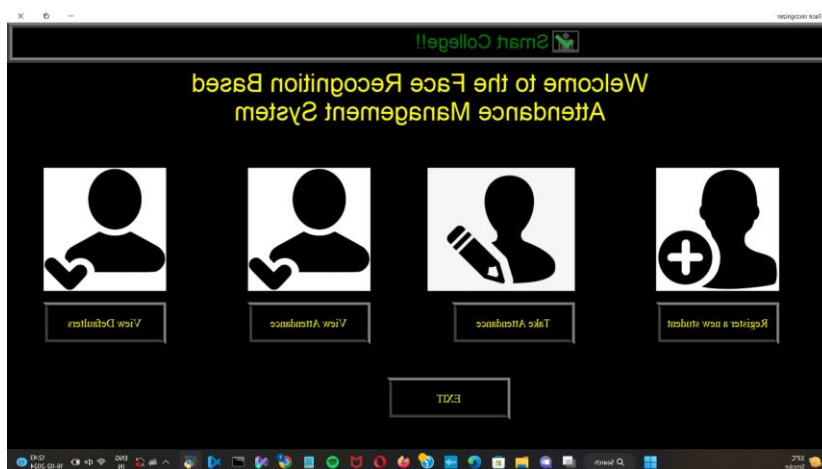


Figure 7. Dashboard.

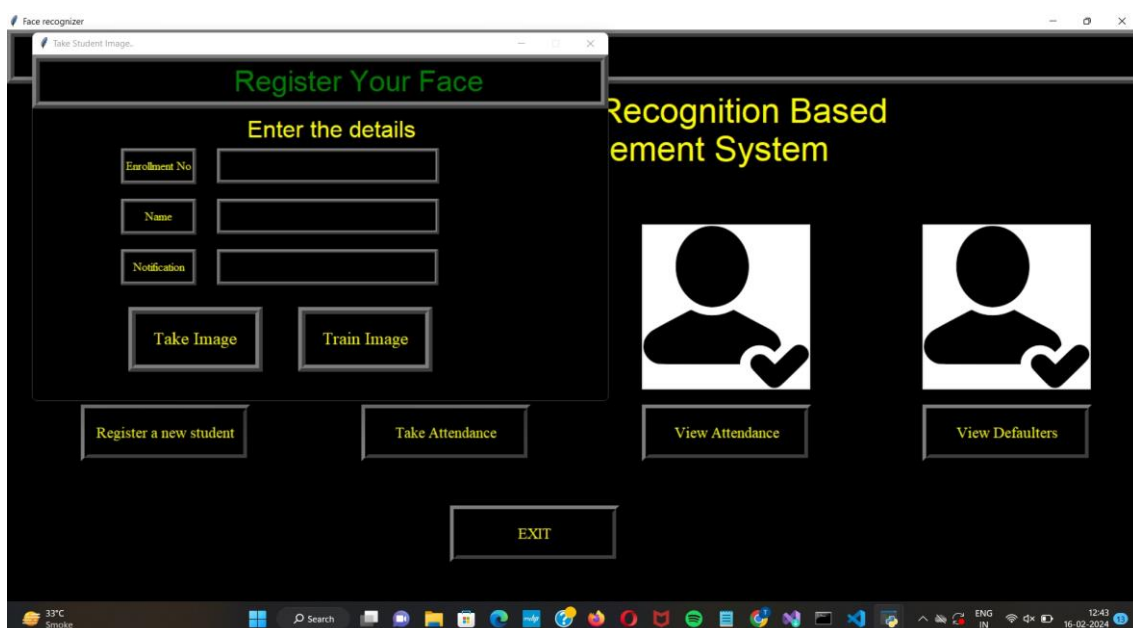


Figure 8. Registration of new student.

Figure 8 shows the page to 'Register' a new student's data along with their roll number and image, and this data is used to train the details of student.

Figure 9 shows taking attendance by clicking photo, it automatically marks the attendance of present students.

Figure 10 shows, 'Enter the name of subject, of which you want to check attendance sheet'.

Figure 11 shows 'Display of defaulter list of students as per their attendance'.

Figure 12 shows the main excel sheet after merging all the attendance sheets.

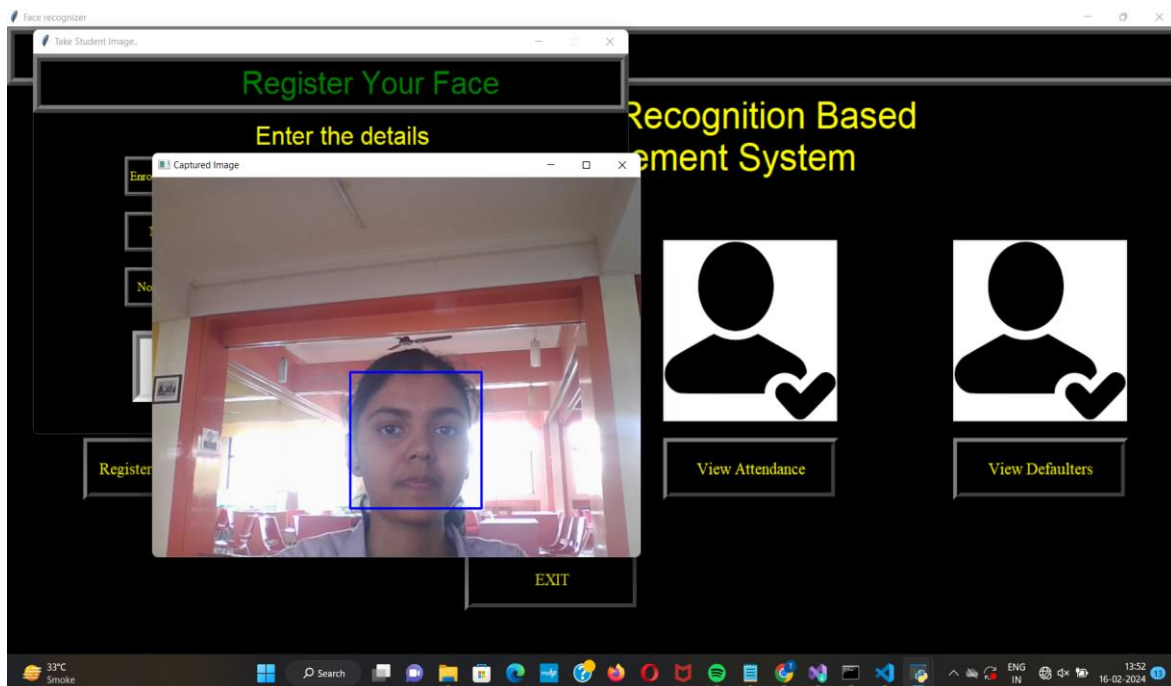


Figure 9. Marking attendance.

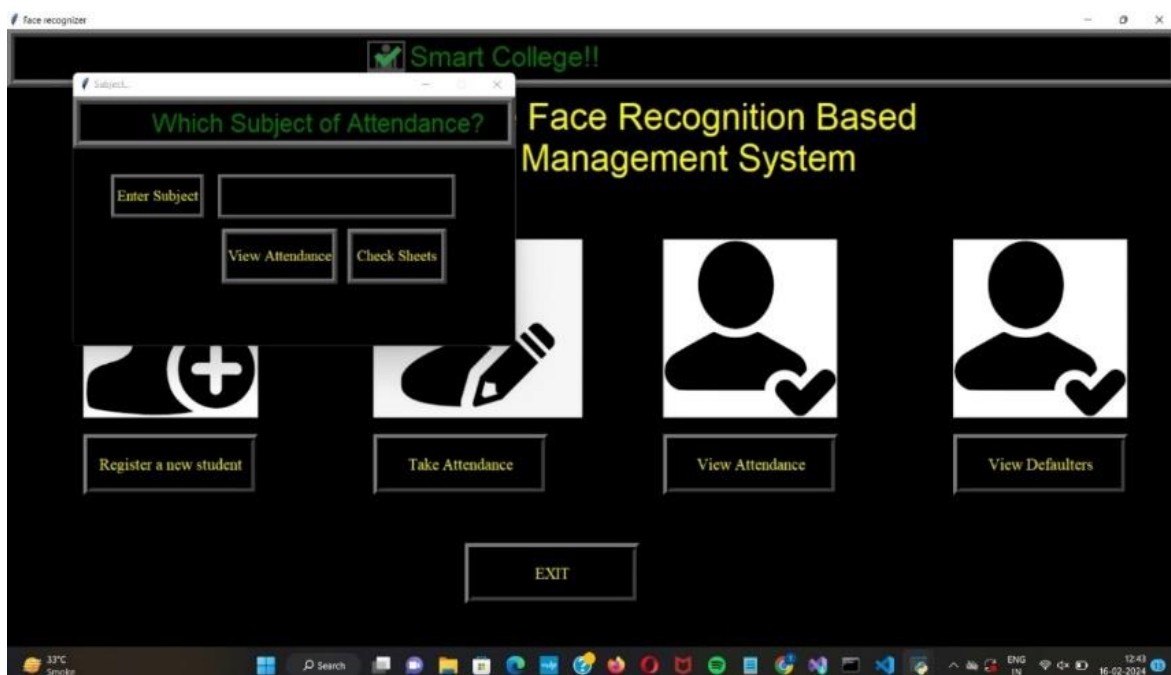


Figure 10. Filling subject details.

Enrollment	Name	11-04-2024
31	vasu	0
32	bhopale	0
33	swastik	0
10	Aditi	0
11	Sumit	0
12	aditib	0
14	swastik	0
45	aditi	1

Figure 11. Main Attendance list.

	A	B	C	D	E	F	G	H	I	J	K	L
1	Name	Rollno	SE	IP	SPCC	Total						
2	Aditi	45	76%	78%	45%							
3	Anushka	56	82%	76%	78%							
4	sumit	78	78%	67%	67%							
5	Siddhant	41	52%	89%	76%							
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Figure 12. Main spreadsheet.

CONCLUSION

The project that we decided to go with was an automated attendance monitoring system. This decision was made after taking into consideration the demands and desires of society on a daily basis. Recent developments in technology have prompted us to think creatively and come up with ideas that have the potential to bring about significant changes in the future. Education is the most essential thing that every individual ought to obtain since it serves as the foundation for a more desirable way of life and will unquestionably improve the quality of life in a society that is currently struggling to survive. Students' participation in their educational institutions, including schools, colleges, and universities, is something that our educational system is lacking. Instead, then engaging in activities such as attending lectures

and studying, they would rather remain absent from the classroom and continue to use these electronic devices. When students have a low attendance rate, it indicates that they are not present to learn the knowledge that they are intended to get. This knowledge is of utmost value to them and has the potential to lead them to a future.

Acknowledgement

Being able to work on this project with Prof. Abhijeet More as our advisor has been a privilege. His insightful recommendations and concepts have been of great assistance to us. We take great pleasure in extending our sincere gratitude to them for their invaluable advice, unwavering support, and tolerance during this project. We also owe our guide for helping us expand the assistance to scholarly publications.

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