

Smart Attendance System Using Face Recognition with OpenCV

Divyanshu Bhardwaj^{1,*}, Nikita², Vernika¹, Aarush Gupta¹, Tanya Chauhan²

Abstract

In the past, the conventional method of recording student attendance relied heavily on teachers manually marking entries in a physical register. While simple, this approach is not only time-consuming but also highly vulnerable to errors such as accidental omissions, incorrect entries, or even malpractice in the form of proxy attendance. Moreover, traditional registers lack real-time accessibility, making it difficult to analyze or monitor data instantly. To address these limitations, modern systems have introduced biometric solutions such as fingerprint scanning, iris recognition, and other unique identifiers. However, these often require physical contact or specialized devices, which may not always be practical in large classrooms. The proposed project introduces a smart attendance system based on facial recognition technology to overcome these challenges. By capturing classroom images and applying advanced face recognition algorithms through OpenCV, the system can automatically detect and identify students. Attendance is then marked instantly and stored securely. To enhance usability, a Google API is integrated with a Flask-based web application, ensuring real-time database management and easy accessibility through a website. This automated framework not only eliminates the possibility of proxy attendance but also provides a fast, reliable, and scalable solution for educational institutions. The system ultimately aims to simplify attendance management while improving accuracy, efficiency, and transparency.

Keywords: Facial recognition, OpenCV, Google API, Flask framework, smart attendance system, biometric authentication, real-time database management

INTRODUCTION

Traditional attendance marking system involved physically marking attendance calling out each student name which at minimum takes up to 5 min of each lecture every day. It was also an extra burden on the faculty to mark and maintain attendance records for each student, each class and each lecture. Also, there is chances of proxy attendance marking and errors while marking (missing a student or mark

someone else for someone's name). Considering all these problems, this proposed model provides a single answer 'Face recognition'. Face recognition is getting really popular nowadays, being used in phone security, surveillance and tracking people etc. Use of facial recognition can help in identifying students and mark attendance in real-time. The purpose of this system is to automate attendance marking using face recognition techniques. Here face of the individual is used to mark attendance of each student.

*Author for Correspondence

Divyanshu Bhardwaj
E-mail: div.kri.bhardwaj2204@gmail.com

¹Student, Department of Computer Science & Engineering,
Echelon Institute of Technology, Faridabad, Haryana, India

²Assistant Professor, Department of Computer Science &
Engineering, Echelon Institute of Technology, Faridabad,
Haryana, India

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Many other biometric systems are used to mark attendance in different institutes like finger print, iris recognition and radio frequency tags, but most of

these are used for faculty as it is much harder to use these methods for each and every student with new students coming in every year. Face recognition makes it much easier to monitor student attendance without much need of time, money or equipment. This method just needs a camera, face recognition software and a database of students. Face recognition involves two parts: Face Recognition and Face Identifications. (1) Face Recognition is used to recognize faces of students and capture them; and (2) Face Identification is used to identify students individually and match them from database provided. Using these techniques marks attendance and makes it visible for students on a website.

LITERATURE SURVEY

In 2014, Face Detection System for Attendance of Class Students [1]

Fuzail *et al.* proposed a method of attendance marking by using computer vision and a rotating camera mounted at the entrance of the class which would capture image of students entering the class. Each class would have individual cameras and store data to a common web server and detect students and mark attendance for all classes at once. This system has three modules: (1) image capturing, (2) face detector, and (3) face recognizer. First the camera captures the images of students in the class and faces are detected of each student and then faces from web server are used to identify students and mark them present. This paper has some security issues which can be improved with some popular methods like encrypting and passwords.

In 2018, Automated Attendance System Using Image Processing [2]

Hapani *et al.* proposed a model to use facial recognition methods to build a contactless worker attendance marking method during the COVID-19 pandemic. It proposed a model which involved training data to detect and differentiate faces from background, and marking attendance without any manual interventions of any kind. 45% face detection accuracy was achieved using this system which used Viola-Jones algorithm and about 50% accuracy for facial recognition using Fisher Face algorithm. This study concluded that traditional methods were time consuming and produced a lot of paper waste.

In 2018, Face Recognition and RFID Verified Attendance System [3]

Another model was proposed by Akbar *et al.* using face recognition for attendance management. This paper used face recognition and RFID tags for identification and attendance management. This module had three major parts: face recognition, RFID tagger, and student counter. Face recognition and RFID tagger work together to recognize, identify and manage attendance of each student precisely whereas student counter is used to count the number of students present and entering in the classroom. This paper involved use of RFID tags which improved the accuracy of the student identification significantly.

In 2017, Design and Implementation of a Student Attendance System Using Iris Biometric Recognition [4]

Okokpujie *et al.* proposed automated attendance management system using iris biometric recognition method. This paper used a method to create a model which would use iris of each and every student to identify and mark attendance. It was a web-based project in which each attendee has to register their details and their unique iris template. This data would be used to identify each student by capturing iris image of each student and matching it from the database.

In 2017, Automated Attendance System Using Machine Learning Approach [5]

Rathod *et al.* proposed a system using algorithms like Viola-Jones and histogram of Oriented Gradients (HOG) along with Support Vector Machines (SVM) classifiers. Authors also used real-time scenarios such as scaling, occlusions and illuminations. Also, peak signal to noise ratio values were used for quantitative analysis. The entire project was made on MATLAB GUI.

In 2014, Implementation of Face Recognition Algorithm for Biometrics Based Time Attendance System [6]

Siswanto *et al.* used algorithms like Eigenface and Fisher face provided by OpenCV to implement an attendance system by comparing them to Receiver Operating Characteristics curve. Based on the project, the eigenface algorithm provides about 70–90% accuracy.

In 2016, Student Attendance System in Classroom Using Face Recognition Technique [7]

Lukas *et al.* proposed a model which used Discrete Wavelet Transforms (DWT) and Discrete Cosine Transform (DCT) algorithms to make an attendance system. These algorithms were used for face detection and recognition and Radial Basis Function (RBF) was further used for classification of facial objects. The model achieved 82% accuracy as proclaimed by the authors.

In 2012, Facial Recognition Using OpenCV [8]

Emami and Suciu tested face recognition techniques using OpenCV with Haar cascade classifiers. Author tested these technologies to test face recognition by first using single human face then increasing number of faces in a single picture and also tested it for non-human faces like animals. These algorithms were able to identify human faces easily but failed if the face was not exposed completely, and also it identifies a monkey image too as they are also a part of primate family like humans.

In 2020, Student Attendance System Using Face Recognition [9]

Dev and Patnaik used Haar-cascade classifiers to make a face recognition attendance system. The model proposed creates a dataset of all the students including details and pictures for identification. A video camera is set in the classroom which uses live video tracking and capturing student faces which are identified from the dataset and attendance is marked. At the end of the session, name of the students who were absent in the class are emailed to the teacher.

In 2023, Student Attendance with Face Recognition (LBPH or CNN): Systematic Literature Review [10]

Budiman *et al.* proposed a system which used face recognition for student attendance management with Haar-cascade. This system has a database with student details and at least one picture of each student for face recognition. A webcam would take a picture of the classroom; this picture would then be used to detect and identify students in the class. The students present will be marked 'present' on google sheet and absent students will be marked 'absent' in the sheet.

In 2024, Face Recognition Based Attendance System Using Group Photos [11]

Jagneet *et al.* introduced a face recognition-based attendance system. In this system the images of students get processed to mark them as present. It has used a python flask-based web for attendance management system. A login page is provided for placation of the image administration. Email will be sent at the end of each month by triggering a single button via Yagmail library for students below 50% attendance. It offers a user-friendly interface which is easy to track.

In 2018, Smart Attendance Management System Using Face Recognition [12]

Bhatti *et al.* focused to streamline attendance taking in schools, offices and factories. The face gets captured with the help of a camera and then the computer identifies the individuals based on their unique features. After that, a comparison is done in between the image which is captured and the pre-existing database to determine their attendance. It used deep learning algorithm to detect and recognize the face in smart and effective way.

In 2021, Face Recognition Smart Attendance System Using Deep Transfer Learning [13]

Alhanaee *et al.* proposed a smart attendance system based on deep learning convolutional neural network (CNN). The authors researched that facial recognition is the most effective and secure way to get an accurate outcome. The authors also mentioned about different biometric ways of identifying an individual but chose to use face recognition as it is contactless. This research has used deep learning transfer technology for face recognition. It is based on the three networks which shows very high-performance training time as well as high accuracy.

In 2019, Smart Attendance System Using Face Recognition [14]

Al-Muhaidhri and Hussain proposed a research paper with the idea of automatic attendance system with Raspberry pi 3B+ and OpenCV/Python libraries. This method is proposed to aid the traditional

attendance method which is time taking and increases the chances of proxy. This method is introduced to overcome these challenges and cooperate at large scale which saves a lot of time. It is said to be a greatest solution for colleges and universities to mark attendance.

In 2021, A Review Paper on Attendance Management System Using Face Recognition [15]

Soundarya *et al.* proposed a system in which a camera is set up to capture the image after which it gets matched with the database to mark the attendance. This system works on automated facial recognition concept which helps in detecting students in any professional environment employees to recognize and mark their attendance in a very less time-consuming way.

In 2019, Face recognition based attendance system [16]

Mekala *et al.* proposed a method on video streaming and OpenCV to extract the frames of the video to further detect the students using dlib. Then the faces get recognized to mark the attendance in a successful and efficient manner. This method is used to reduce the risk of proxy and the need of manual attendance.

In 2024, Automatic Attendance System, Using Face Detection and Machine Learning [17]

Khalkar *et al.* did the research with the help of convolutional neural network (CNN) powered deep learning methodologies to analyze facial features of the individuals with accuracy. The face gets matched with pre-established repository of individuals. This method is resistant to all the possible limitations such as bad lightning conditions, minor variations in posing and facial expressions. This research also provides precise attendance which will be accurate.

In 2024, Smart Campus: Smart Attendance Management System using Face Recognition [18]

According to Singh *et al.*, the study aims to eliminate the traditional method of manual attendance which is prone to error. This method is proposed to make critical task of attendance taking to be accurate and efficient. It involves computer vision as well as deep learning techniques which further helps in identifying the individuals. In short, the face gets recognized using facial algorithms which gets captured. Then it gets matched with the records existing in the database to mark the attendance.

In 2022, Attendance Monitoring System Using Face Recognition [19]

Jain *et al.* have designed and implemented an attendance marking system without any physical contact due to COVID-19 pandemic. After the pandemic, fingerprint or any other mode of biometric attendance requires physical contact which was not possible. This research was done to provide a contactless and secured way of identification of an individual. This system works on Face Recognition Grand Challenge (FRGC) with up to 95% accuracy and preciseness. This system detects the face, matches with the pre-processed data and the face gets recognized to mark the attendance. In case, there may occur a possibility that the students can manipulate the attendance by showing fake image in the mobile phones or any other device. In this case, the system will display a warning message with a beep sound. This research truly makes the face recognition highly secure, accurate and efficient.

In 2020, Face Recognition Based Smart Attendance System [20]

Raj *et al.* proposed Principal Component Analysis (PCA) approach in MATLAB platform. This automated attendance is created with the MATLAB platform to get the best facial recognition algorithm (Eigenfaces). With the PCA approach, the photos are tested and trained to mark the attendance. If identified, it will be marked as present. The attendance automatically gets updated in an Excel sheet in which a proper record is maintained. The Excel sheet formed not only put an end to the high risk of error but also saves the time of the lecture.

In 2018, Face Recognition based Smart Attendance System Using IoT [21]

Patel *et al.* did this research to propose smart attendance system using IoT tool to recognize the face of the students. A Raspberry pi system will be able to recognize the faces of the students accurately. Calling out the name of each student is truly a time-consuming method which can have a lot of human error. This method detects face in no time making it time efficient. The face gets detected after this

process. when it gets recognized, only then it will be marked as present which gets updated simultaneously with their corresponding name, time and register number. Deep learning tool has also been used for the development of this project.

In 2020, Face Recognition based Attendance Management System [22]

Pavithra and Afshin proposed a system model of an automated attendance taking system which is based on facial recognition using Haar cascade and Local Binary Pattern Histogram algorithm. The system is designed to provide a non-invasive and contactless attendance system. This research consists of four phases, i.e. database creation, face detection, face-recognition and attendance updation. Attendance will also be mailed to the respective teachers at the end of each lecture.

In 2021, Automated Smart Attendance System using Face Recognition [23]

Preethi and Vodithala used CNN, OpenCV and LBPH in this study. It ensures precise face detection by leveraging advanced facial recognition technology. This work has used computer vision and machine learning to give accurate attendance and real-time analysis. Results have shown to give effortless attendance taking system with minimal human effort.

RESEARCH PROBLEM

Biometric identification is getting popular for attendance marking, but technologies like fingerprints need physical contact which is effective but is not safe as the world learned during COVID-19 outbreak. Face recognition technology can provide better solution to this problem. Face recognition can be an easy and effective way for maintaining student attendance although, it is not yet perfect. Problems like system's inability to identify faces because of masks and specs, students arriving a little late in class resulting in missing out from the attendance snapshot, can occur in the systems. Also, data integrity is important for secure attendance management and proper monitoring. Face recognition technology can sometimes identify non-human things [8]. Also, in the existing models if the data is uploaded it cannot be changed at all even if the teacher wants it to due to certain reasons (like student participating in college events, industrial visits, participation in external events (sports, tech, etc.)). Classes are held in a specific time slots throughout the day and it is stored in timetable and these face recognition systems do not integrate the timetable and scheduling. There is a need to propose a model which can improve and overcome these limitations while providing more scopes and reliability on face recognition for attendance management systems, with solving scheduling problems too.

NEED FOR THE RESEARCH

To resolve the issues of existing researches, the proposed model is supposed to provide much safer and more accurate face detection methods. The proposed system will take multiple pictures in a single lecture to identify students in class without missing anyone including late comers, students out of camera angle for a few minutes, or covered faces for a moment. The system will take up the best case for easier and accurate marking. Deep learning algorithms like CNN have been used to identify masks and specs in the pictures. The proposed model also provides a website as a platform for students to check their attendance and cross check if they are marked absent for a class they attended. Login passwords and encryption are the most common methods for improving data integrity which will be followed in this project to provide safer data management without and risks of data loss or unauthorized manipulation. Faculty has the permission to manipulate the data in case a special case occurs and a student is to be marked present for the lecture or day. Finally, the model will provide a much safer, reliable, easier to use and friendly system.

PROPOSED METHOD

The proposed system uses face recognition to authenticate and identify students and mark their attendance on a website in real-time. As we know, use of face recognition is gaining popularity day-by-day, and enhancing technology. Face lock in mobile phones, identification and tracking people are few common uses of face recognition. This model uses face recognition techniques to automate attendance marking of students. In the proposed model, cameras will capture snapshots of a classroom in every 10 min, these snapshots will then be used by face recognizers to detect student faces and identify them

from the database, then the model will check for lecture time and name from the uploaded timetable and mark present on a google sheet and display it on a website. If a student is detected in 60% of the total snapshots taken, he/she will be marked present. Also, if a student is falling under the minimum attendance requirements, then an alert will be generated and sent to the teacher and the student so they can get cautious before it is too late. The attendance will be marked according to the timetable and will be displayed on a website so the students can login and check their attendance. Also, for added security, the website will have login passwords and only teachers will have access to the entire data and google sheets for data management and authentication (Figures 1–6).

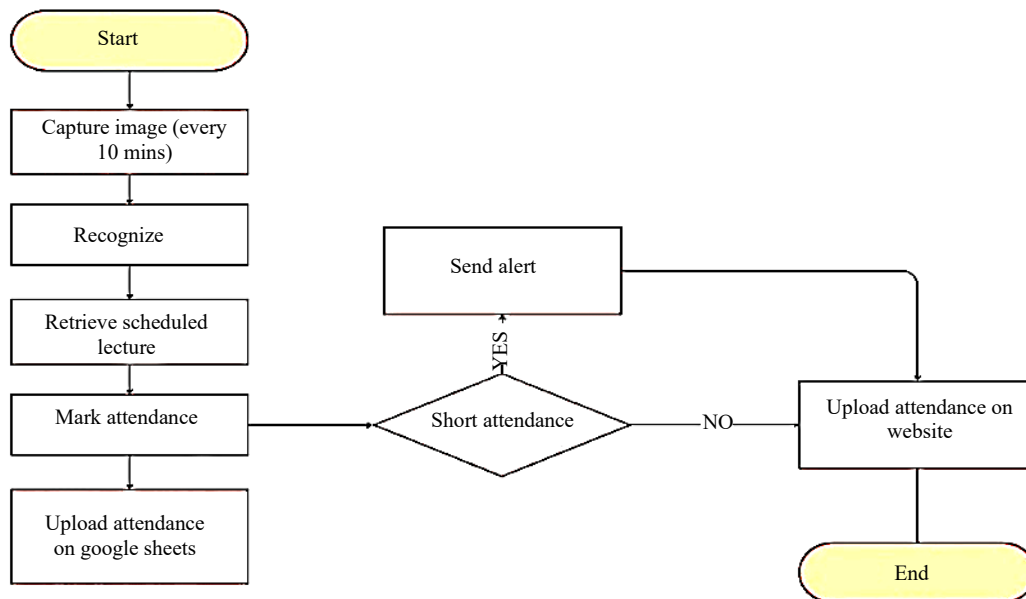


Figure 1. System flowchart.

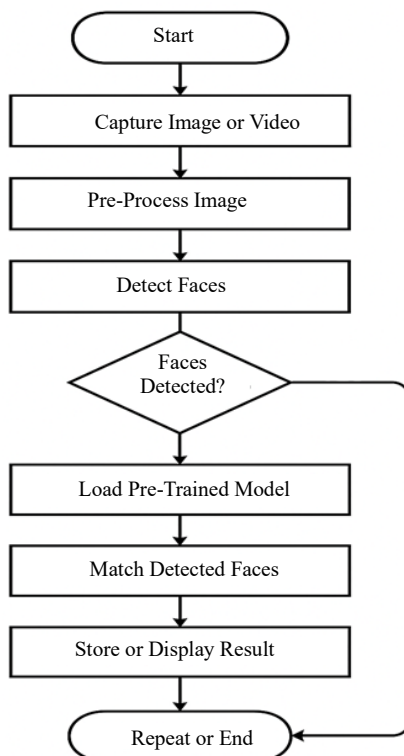


Figure 2. Face recognizer flowchart.

```

1  # auto_snapshot.py
2
3  import cv2
4  import time
5  import datetime
6  import os
7  from backend.face_recognition import load_known_faces, recognize_faces
8  from backend.schedule_api import mark_attendance
9  from backend timetable import get_current_subject
10 import logging
11
12 # Setup logging
13 os.makedirs('logs', exist_ok=True)
14 logging.basicConfig(
15     filename='logs/attendance_log.txt',
16     level=logging.INFO,
17     format='%(asctime)s - %(levelname)s - %(message)s'
18 )
19
20 INTERVAL = 600 # 10 minutes
21 FACE_FOLDER = 'data/faces'
22 TOTAL_STUDENTS = 60
23 ATTENDANCE_THRESHOLD_PERCENT = 10
24
25 # Load known student faces once at start
26 print(f"[INFO] Loading known faces...")
27
28 PS C:\Users\diksha\OneDrive\Desktop> python -i "c:\Users\diksha\OneDrive\Desktop\attendance\auto_snapshot.py"
29 [INFO] Loading known faces...
30 [INFO] Camera initialized. Starting snapshot loop...
31 [INFO] Taking snapshot...
32 [INFO] Running face recognition...
33 [INFO] Recognized roll numbers: ['23cs001']
34 [INFO] Low attendance alert: Only 1.67% present.
35 [INFO] No class scheduled currently. Skipping attendance marking.
36 [INFO] Sleeping for 10 minutes...
    
```

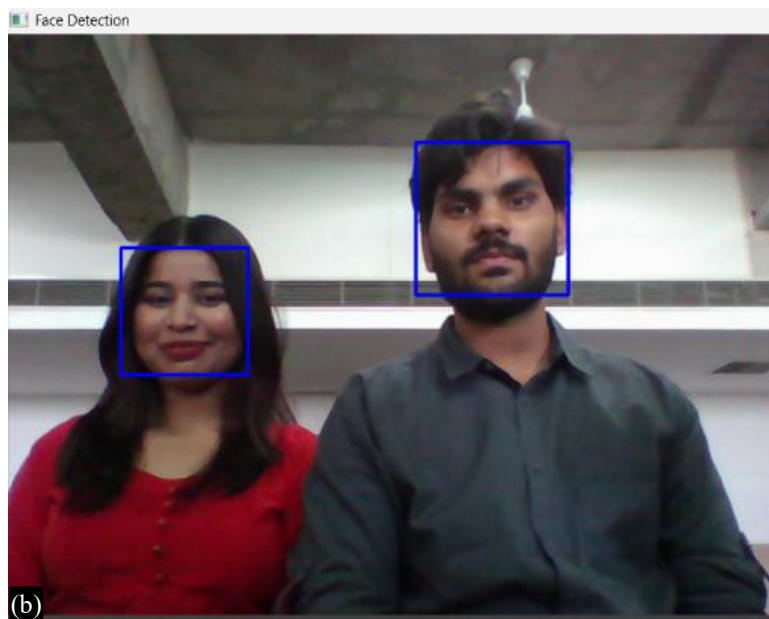


Figure 3. (a and b) Face recognition.

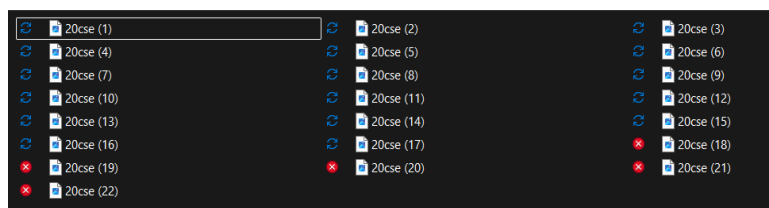


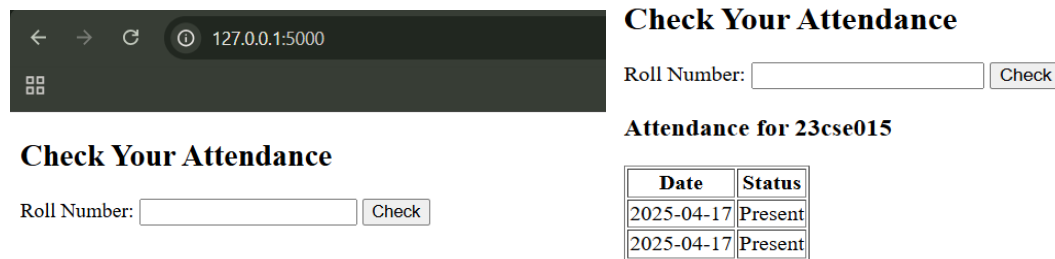
Figure 4. Dataset.

	A	B	C	D	E
1	23cse015	2025-04-17	Present		
2	23cse015	2025-04-17	Present		
3	23cse031	2025-04-17	Present		

Figure 5. Google sheets (attendance sheet).

The working of the model is explained below step-by-step:

1. *Capture image*: cameras in the classroom capture snapshot of the class.
2. *Face recognition*: face recognizer using OpenCV is used to detect and identify each and every student.
3. *Retrieve lecture*: subject name is retrieved from the uploaded timetable and also used to mark attendance on google sheets.
4. *Mark attendance*: In this step, attendance is marked and uploaded on google sheets.
5. *Generating alerts*: if the attendance of a student is less than 70% then a short attendance alert is generated to get attention of student and faculty.
6. *Website*: the marked attendance is uploaded on a website where students can login and check their attendance.



Check Your Attendance

Roll Number:

Attendance for 23cse015

Date	Status
2025-04-17	Present
2025-04-17	Present

Figure 6. Website.

CONCLUSION

The proposed method can automate attendance management system using facial recognition and increase accuracy and reduce errors. It will use webcam to capture images and recognize students. After recognition, it will mark the attendance of the recognized student and update the attendance record in real-time. The model can help save time for marking attendance. This model helps keeping record of attendance on google sheets to maintain record.

Additionally, features like generating alerts for students with low attendance, logging and online website for students provides accessibility and transparency of data (attendance). This project enhances efficiency and reduce chances of errors.

Scope of Research

Such model can be used in educational institutes for student attendance management to mark and maintain student attendance. This model provides a secure and easy way monitor students attendance and regularity in class. Face recognition can be used to identify students attending examinations, seminars and events. This model can also be used in hospitals, offices, factories and industries too.

Scopes of improvement:

1. The facial recognition system can further be developed by including iris detection method which will be helpful if a person is wearing a mask.
2. We will also include privacy preserving features like face data encryption and consent-based scan of the face which also includes unauthorized real-time threat detection.
3. Improve to the most robust systems using 3D face recognition. It will work in the cases if a person is wearing a mask, glasses and even consider changes because of aging.
4. We can also add Infra-Red technology and night vision in cases of low light environments.
5. We will also integrate global cloud-based systems to sync the attendance across branches in educational organizations as well as multinational organizations.

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