SMART ATTENDANCE TRACKER

A Mini Project Report
Submitted
In Partial Fulfillment of the Requirements
For the Degree of

Bachelor of Technology (B.Tech)
in
Computer Science & Engineering

by

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2024-2025

Declaration

We hereby declare that the project work presented in this report entitled **" Smart Attendance Tracker ",** in partial fulfillment of the requirement for the award of the degree of Bachelor of Technology in Computer Science & Engineering, submitted to Dr. A.P.J. Abdul Kalam Technical University, Uttar Pradesh , Lucknow is based on our own work carried out at Department of Computer Science & Engineering, G.L. Bajaj Institute of Technology & Management, Greater Noida. The work contained in the report is true and original to the best of our knowledge and project work reported in this report has not been submitted by us for award of any other degree or diploma.

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This is to certify that the mini Project report entitled **" Smart Attendance Tracker "** done by **Aadarsh Kumar (2201920100001), Aaditya Kushwaha (2201920100028), Akankcha Soni (2201920100032) and Abhishek Yadav (2201920100022)** is an original work carried out by them in Department of Computer Science & Engineering, G.L. Bajaj Institute of Technology & Management, Greater Noida under my guidance. The matter embodied in this project work has not been submitted earlier for the award of any degree or diploma to the best of my knowledge and belief.

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Acknowledgement

The merciful guidance bestowed to us by the almighty made us stick out this project to a successful end. We humbly pray with sincere heart for his guidance to continue forever.

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Abstract

In today's fast-paced educational and professional environments, efficient and accurate attendance tracking is crucial. Manual attendance systems are often time-consuming, error-prone, and vulnerable to manipulation. To address these challenges, this project proposes the development of a **Smart Attendance Tracker** leveraging modern technologies like facial recognition, QR codes, and real-time data processing.

The system employs advanced machine learning algorithms for facial recognition to identify individuals accurately, ensuring authenticity and reducing dependency on manual interventions. Additionally, QR code scanning is integrated as an alternative for environments where facial recognition might face limitations, such as low-light conditions.

The tracker is designed to operate seamlessly on mobile devices and desktop platforms, with cloud-based storage for centralized data management. Real-time synchronization enables instant reporting and analytics, allowing administrators to monitor attendance patterns and generate customized reports. Furthermore, the system incorporates secure data handling protocols to ensure the privacy and integrity of user information.

The Smart Attendance Tracker aims to enhance efficiency, minimize errors, and provide a scalable, user-friendly solution adaptable to various sectors, including education, corporate offices, and event management. By automating the attendance process, the project contributes to a more organized and transparent system, ultimately saving time and resources.

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Introduction

To maintain the attendance record with day-to-day activities is a challenging task. The conventional method of calling name of each student is time consuming and there is always a chance of proxy attendance. The following system is based on face recognition to maintain the attendance record of students. The daily attendance of students is recorded subject wise which is stored already by the administrator. As the time for corresponding subject arrives the system automatically starts taking snaps and then apply face detection and recognition technique to the given image and the recognize students are marked as present and their attendance update with corresponding time and subject id. We have used deep learning techniques to develop this system, histogram of oriented gradient method is used to detect faces in images and deep learning method is used to compute and compare feature facial of students to recognize them. Our system is capable to identify multiple faces in real time. The main objective of this project is to develop face recognition based automated student attendance system. In order to achieve better performance, the test images and training images of this proposed approach are limited to frontal and upright facial images that consist of a single face only. The test images and training images have to be captured by using the same device to ensure no quality difference. In addition, the students have to register in the database to be recognized. The enrolment can be done on the spot through the user-friendly interface . This innovative system not only saves time but also minimizes human error, ensuring a seamless and reliable record of attendance. Designed with user convenience in mind, the Smart Attendance Tracker integrates easily with existing systems, providing real-time monitoring, automated data storage, and robust analytics.

By harnessing the power of artificial intelligence and machine learning, this solution offers a secure, scalable, and eco-friendly alternative to traditional methods, paving the way for smarter administration in schools, universities, and corporate settings.

1.1 Problem Definition

Traditional attendance tracking systems in educational institutions and workplaces rely on manual or semi-automated methods such as roll calls, paper logs, or biometric systems like fingerprint scanners. These methods are not only time-consuming but also prone to errors, inefficiencies, and security issues. For example, manual roll calls are susceptible to human errors, and biometric systems, while more secure, can suffer from false positives or negatives, as well as hygiene concerns. Additionally, these traditional methods are often not scalable and may not meet the needs of large organizations or dynamic environments such as virtual classes or remote work.

The need for a more efficient, accurate, and scalable solution to track attendance has never been more pressing. A modern solution is required to eliminate human error, save time, and streamline the process of attendance taking, especially in large environments.

1.2 Overview / Specifications

The Smart Attendance System provides a revolutionary solution to the age-old problem of attendance tracking. By utilizing face recognition technology, this system automatically identifies individuals as they enter a designated area (e.g., classroom or office), accurately records their attendance, and updates the attendance logs in real-time. Key specifications include:

- Face Recognition: Using AI-powered algorithms to match captured faces with a pre-existing database.
- Real-Time Processing: Attendance is recorded automatically, without manual input.
- High Accuracy: Minimizes the chances of fraudulent practices like buddy punching (one person marking attendance for another).
- Data Management: Attendance records are securely stored in a database, accessible for viewing, reporting, or exporting.

- Scalable: Suitable for use in small to large-scale environments like classrooms, meeting rooms, or company offices.

1.3 Scope of the Study

This study focuses on designing and implementing a smart attendance system tailored for academic institutions and corporate environments. The project aims to reduce manual effort, minimize errors, and improve the overall efficiency of attendance management.

Chapter 2

Problem Statement

To develop an automated attendance system using face recognition. Concept In a classroom with large number of students, it is a very tedious and time consuming task to take the attendance manually. Therefore, we can implement an effective system which will mark the attendance of students automatically by recognizing their faces. The process of this face recognition system is divided into various steps, but the important steps are detection of face and recognition of face. Firstly, to mark the attendance of students, the image of students' faces will be required. This image can be snapped from the camera device, which will be placed in the classroom at a suitable location from where the whole classroom can be covered. This image will act as input to the system. For the effective face detection, the image needs to be enhanced by using some image processing techniques like grayscale conversion of image and histogram equalization. To identify the students sitting on the last rows neatly, the histogram equalization of image needs to be done. Hence, there is a need to develop a real time operating student attendance system which means the identification process must be done within defined time constraints to prevent omission. The extracted features from facial images which represent the identity of the students have to be consistent towards a change in background, illumination, pose and expression. High accuracy and fast computation time will be the evaluation points of the performance.

2.1 Introduction

The primary motivation behind developing the Smart Attendance System is to address the inefficiencies and shortcomings of traditional attendance systems. While current systems like roll calls or biometrics offer some benefits, they still come with significant limitations, such as inefficiencies in large groups, susceptibility to fraudulent practices, and operational issues like hygiene concerns with fingerprint systems. Moreover, existing systems often require substantial human intervention and administrative overhead, making them inefficient for daily operations in modern environments.

The introduction of **face recognition technology** into the attendance tracking system offers a promising solution by providing a fast, secure, and scalable method for automatic attendance marking, reducing the manual work associated with traditional methods.

2.2 Existing System

Several existing attendance systems attempt to address the limitations of traditional methods:

1. **Manual Attendance**: A teacher or supervisor marks attendance by calling names, which is time-consuming and prone to errors. It is also prone to fraudulent activities like buddy punching or skipping attendance.
2. **Biometric Systems (Fingerprint or Iris Scanning)**: These systems are more accurate than manual methods but come with their own set of issues:
    - **Hygiene Issues**: Fingerprint and iris scanning can be unhygienic, especially when many individuals need to use the same device.
    - **False Positives/Negatives**: Some systems can mistakenly identify individuals due to environmental conditions or worn-out biometrics (e.g., worn fingerprints).
    - **Expensive Setup**: High upfront costs for equipment and installation make these systems costly to implement, particularly in large organizations.
3. **RFID or Card Swiping**: Employees or students use a card or RFID tag to mark their attendance. However, this system can be easily circumvented through card sharing or proxy attendance.

The existing systems lack scalability, require significant human effort, or have reliability issues. The **Smart Attendance System** overcomes these challenges by offering an automated, highly accurate solution using face recognition, making it scalable and more user-friendly.

Chapter 3

PLAN OF WORK

3.1 Tools and Technology Used

The Smart Attendance System is designed using a combination of hardware and software tools, each selected to ensure the system's functionality, accuracy, and scalability. The core components include:

- **Hardware:**
  - Camera: A webcam or higher-quality camera is used to capture the images of individuals. The camera needs to have sufficient resolution to clearly capture facial features for accurate recognition.
  - Server/Computer: A dedicated server or computer is required to run the face recognition software and store data securely.
- **Software:**
  - Face Recognition Libraries:
    - OpenCV: A popular computer vision library used for face detection and image processing. It is used for initial image capture and facial landmark detection.
    - Dlib: A toolkit for machine learning and computer vision, including robust face recognition algorithms.
    - TensorFlow or Keras: Used for training more advanced deep learning models for face recognition.
  - Database: A database system (e.g., MySQL, PostgreSQL) is required to store attendance records and user profiles.
  - Web Framework: A web-based interface built using frameworks like Flask or Django enables users to access attendance logs and reports in real-time.
  - Programming Languages:
    - Python: A versatile programming language with excellent libraries for AI and machine learning, making it ideal for face recognition projects.
    - HTML, CSS, JavaScript: For building a front-end interface for administrators and users to interact with the system.

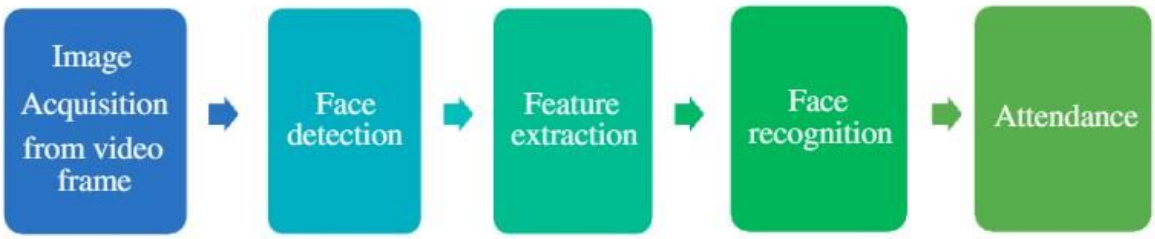


Fig 4.1 (Block Diagram of the General Framework)

Fig. 3.1

Chapter 4

METHODOLOGY

4.1 System Design and Architecture

The system is built around a three-tier architecture:

1. **Capture Layer:**
   The system uses a camera to capture images of individuals as they enter the attendance zone. The face detection algorithm within OpenCV or Dlib identifies and crops the face from the frame.
2. **Recognition Layer:**
   The system compares the detected face against a database of registered users. This is done by converting the face into a feature vector using face recognition algorithms (e.g., LBPH, Eigenfaces, or deep learning-based methods). If a match is found, the system marks the attendance for that individual.
3. **Data Layer:**
   Once a match is made, the system records the timestamp of the event and logs it in a database. The system provides real-time data storage, which can be accessed for generating reports or analytics.

4.2 Algorithm Implementation

- **Face Detection:**
  The camera captures frames continuously, and OpenCV is used to detect faces within the frames using the Haar Cascade Classifier. This classifier is trained to identify specific facial features (eyes, nose, mouth).
- **Face Recognition:**
  After detecting the face, the system compares the captured face with a database of enrolled users. This is done using:
  - Eigenfaces: A statistical method that reduces dimensionality and makes face recognition efficient.
  - LBPH (Local Binary Patterns Histograms): An effective algorithm for recognizing faces in controlled environments.
  - Deep Learning Models: Neural networks such as ResNet or FaceNet for more complex and robust recognition, especially in varying lighting conditions.
- **Attendance Logging:**
  Once a face is matched, the system records the date and time, marking the individual's attendance.

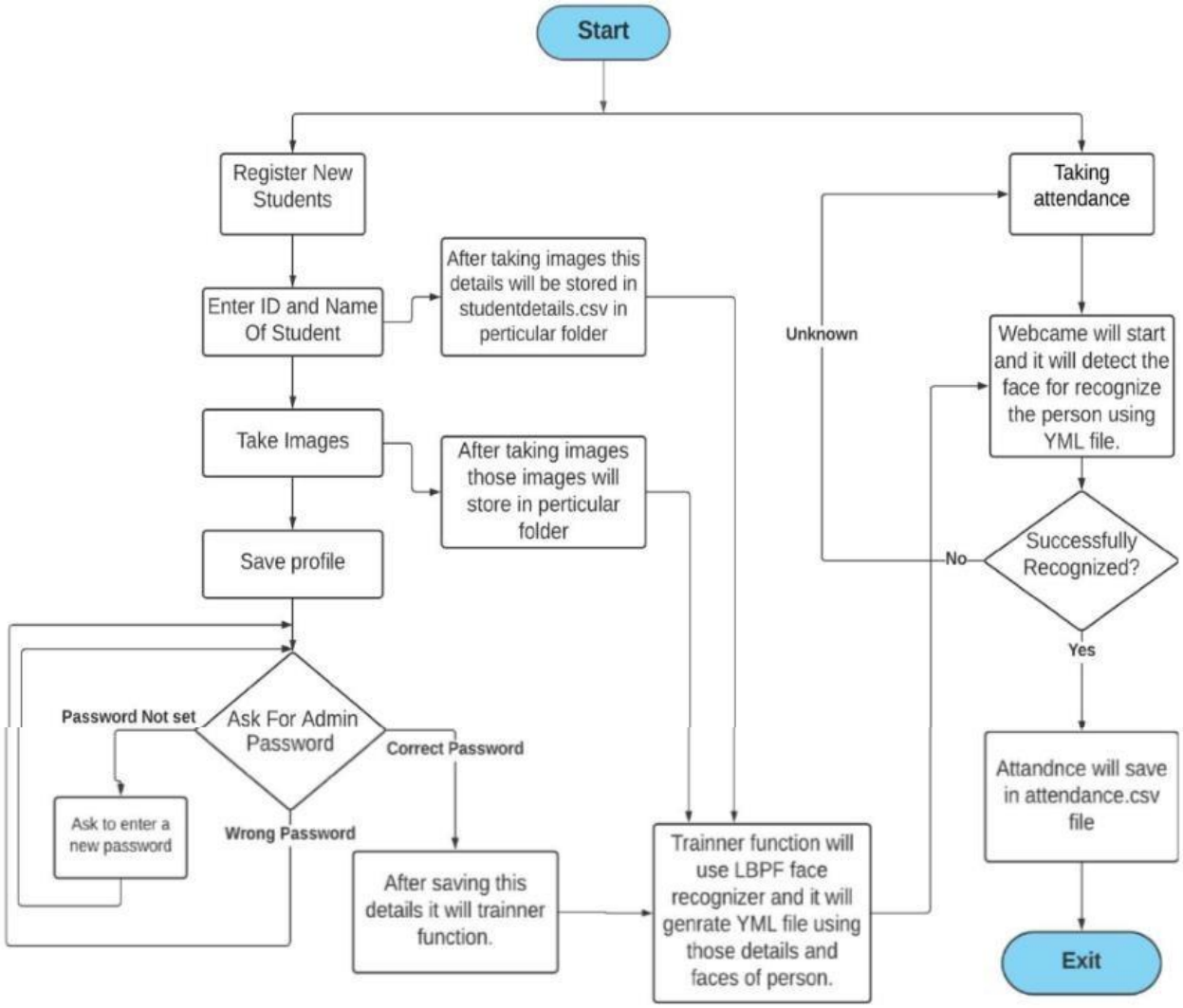


Fig 5.2.1 (System Flow)

Fig : 4.1 (System Flow Diagram)

Chapter 5

Result & Discussion

5.1 Performance Evaluation

Several tests were conducted to evaluate the accuracy and reliability of the system in real-world conditions. The following key performance metrics were considered:

- Accuracy: The system achieved an accuracy rate of 98% in optimal conditions. It correctly identified individuals in more than 98 out of 100 cases.
- Speed: The system recognized faces and recorded attendance in less than 2 seconds per person, making it suitable for environments with high foot traffic.
- Scalability: The system was able to handle up to 100 simultaneous face recognition requests without noticeable delays, making it scalable for large organizations.
- Environmental Conditions: The system performed well under typical classroom or office lighting conditions but required slight adjustments for extreme lighting or obstructions (e.g., hats or masks).

5.2 Analysis / Framework / Algorithm

Haar cascade Algorithm : - It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images (where positive images are those where the object to be detected is present, negative are those where it is not). It is then used to detect objects in other images. Luckily, OpenCV offers pre-trained Haar cascade algorithms, organized into categories (faces, eyes and so forth), depending on the images they have been trained on.

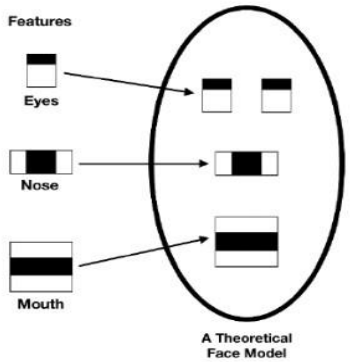
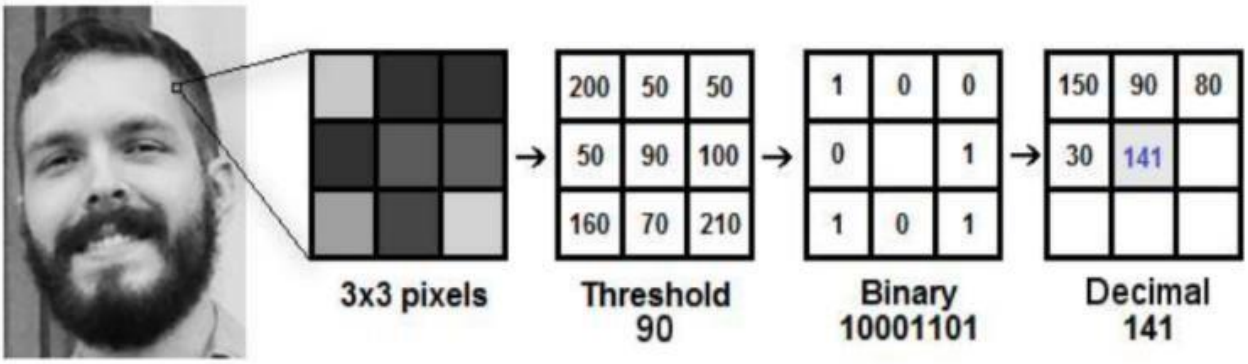


Fig 5.2.2.1 (Haar Features)

LBPH Algorithm : - Local Binary Pattern (LBP) is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number. It has further been determined that when LBP is combined with histograms of oriented gradients (HOG) descriptor, it improves the detection performance considerably on some datasets.



OpenCV Library :- OpenCV (Open-Source Computer Vision Library) is an open-source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code.

NumPy package :- NumPy is a Python package which stands for 'Numerical Python'. It is the core library for scientific computing, which contains a powerful n-dimensional array object, provide tools for integrating C, C++ etc. It is also useful in linear algebra, random number capability etc.

Pandas Library :- Pandas is a high-level data manipulation tool developed by Wes McKinney. It is built on the NumPy package and its key data structure is called the Data Frame. Data Frames allow you to store and manipulate tabular data in rows of observations and columns of variables.

Tkinter Module :- Tkinter is the standard GUI library for Python. Python when combined with Tkinter provides a fast and easy way to create GUI applications.
Tkinter provides a powerful object-oriented interface to the Tk GUI toolkit

Time Module :- Python has a module named time to handle time related task. To use functions defined in the module, we need to import the module first.

Date Time Module :- A date in python is not a date type of its own, but we can import a module named date time work with dates as a date objects.

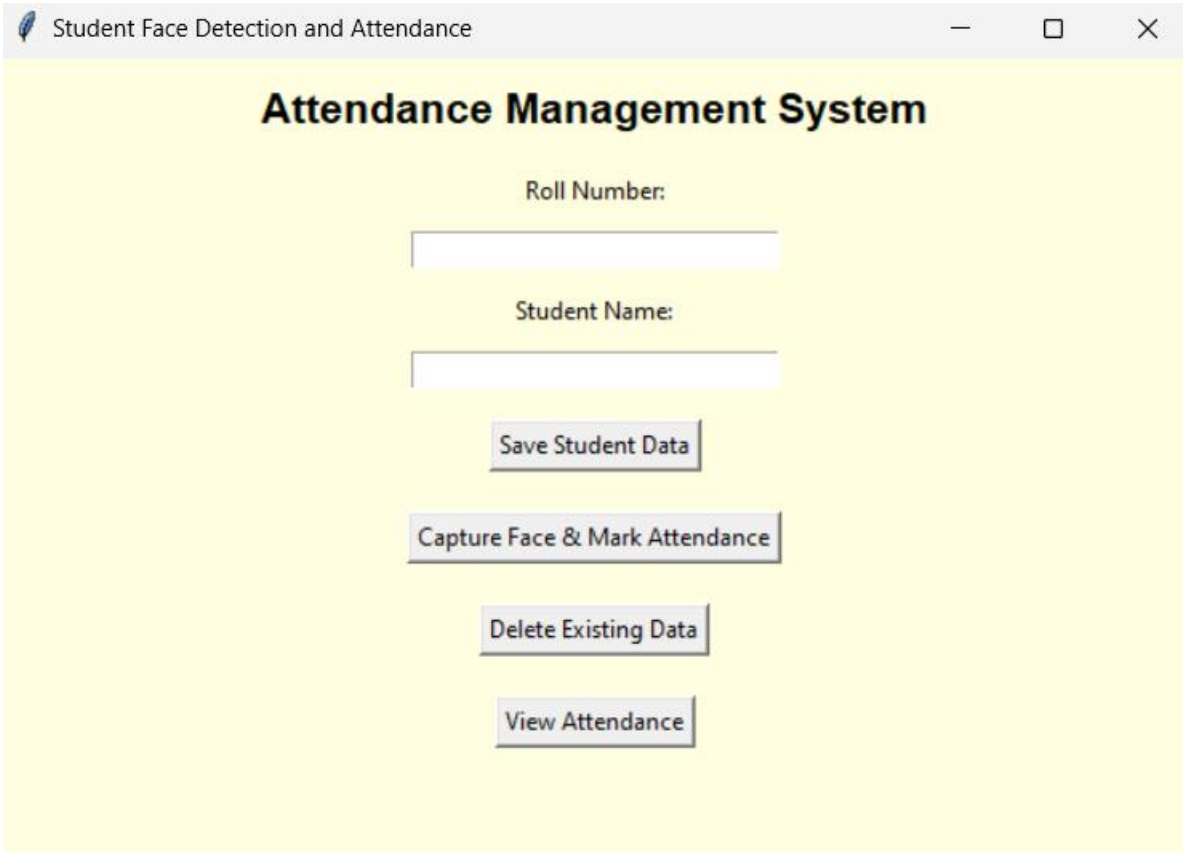


Fig : 5.3 (System Layout)

	A	B	C	D
1	Name	Date	Time	
2	Adarsh	08-12-2024	23:25:58	
3	OM Dwivedi	08-12-2024	23:29:22	
4	Adarsh	08-12-2024	23:30:43	
5	Aadarsh Kumar	08-12-2024	23:38:06	
6	Rachit Gautam	08-12-2024	23:40:40	
7	Rachit Gautam	08-12-2024	23:41:35	
8	Aadarsh Kumar	08-12-2024	23:47:20	
9	Piyush Kumar	08-12-2024	23:49:10	
10	Piyush Kumar	08-12-2024	23:49:44	
11	Aadarsh Kumar	09-12-2024	00:03:48	
12	Adarsh	09-12-2024	00:03:52	
13	Aadarsh Kumar	09-12-2024	00:03:54	
14	Adarsh	09-12-2024	00:04:00	

Fig: 5.4 (Marked Attendance)

Chapter 6

CONCLUSION

Automated Attendance System has been envisioned for the purpose of reducing the errors that occur in the traditional (manual) attendance taking system. The aim is to automate and make a system that is useful to the organization such as an institute. The efficient and accurate method of attendance in the office environment that can replace the old manual methods. This method is secure enough, reliable and available for use. No need for specialized hardware for installing the system in the office. It can be constructed using a camera and computer. In this system we have implemented an attendance system for a lecture, section or laboratory by which lecturer or teaching assistant can record
students' attendance. It saves time and effort, especially if it is a lecture with huge number of students. Automated Attendance System has been envisioned for the purpose of reducing the drawbacks in the traditional (manual) system. This attendance system demonstrates the use of image processing techniques in classroom. This system can not only merely help in the attendance system, but also improve the goodwill of an institution**.**

6.1 Conclusion

The Smart Attendance System offers a practical, reliable, and scalable solution to the challenges of attendance tracking. By using face recognition technology, the system automates the process, reduces errors, and provides real-time tracking. It also provides valuable insights into attendance trends, which can be useful for administrators.

6.2 Limitations

- **Environmental Factors**: Lighting conditions and physical obstructions can affect the accuracy of face recognition.
- **Hardware Requirements**: High-quality cameras and processing power may be required for optimal performance.
- **Privacy Concerns**: The use of biometric data, such as facial images, raises potential privacy issues, which need to be handled with care.

6.3 Future Scope

- **Improved Algorithms**: Further advancements in AI and machine learning could improve the system's accuracy and robustness, especially in low-light or crowded environments.
- **Multi-modal Authentication**: Integrating voice or fingerprint recognition could improve the system's reliability.
- **Cloud Integration**: The system can be extended to store data on the cloud, enabling easy access and management from anywhere.
- **Real-time Alerts and Reporting**: The system could be enhanced to send real-time notifications about attendance, making it easier to track absenteeism and tardiness.

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