A Minor Project Proposal Report On

AttendanceGuru - AI-powered Attendance Management Application

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Abstract

AttendanceGuru is an innovative attendance system designed to revolutionize the way colleges manage student attendance. It leverages the power of face recognition technology and artificial intelligence to automate the attendance process and eliminate the need for manual tracking. Using cctv footage, AttendanceGuru captures live images of students in each period. These images are processed using computer vision technology to detect and extract faces using the OpenCV library. The real magic happens through deep learning, where a custom-built model is trained to recognize the faces of individual students based on a dataset of their images and names. When a face is recognized, AttendanceGuru updates the attendance database in real-time, marking the student as present for the specific period. The centralized database stores and manages the attendance records, providing authorized personnel with easy access to up-to-date information. The system ensures accuracy and reliability, even in varying lighting conditions and facial expressions.

AttendanceGuru offers a user-friendly interface for administrators to effortlessly manage attendance records. It also provides a user-friendly interface for students, parents and teacher to view the attendance report. It prioritizes privacy and data security, implementing encryption and access controls to protect sensitive information. By replacing the traditional handpaper attendance system, AttendanceGuru streamlines the process, reducing administrative workload, and enhancing overall efficiency. It simplifies attendance tracking, improves record-keeping accuracy, and enables valuable time and resource allocation for the college department facility.

With AttendanceGuru, colleges can embrace cutting-edge technology to automate attendance, paving the way for a more streamlined and intelligent educational environment.

Keywords : *OpenCV , deep learning , centralized database , real-time*

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1 Introduction

The maintenance of attendance records plays a crucial role in the efficient functioning and analysis of any organization, including educational institutes. Traditional methods of marking attendance, such as manual paper-based systems, are time-consuming, prone to errors, and lack proper security measures. To overcome these challenges, we propose the development of a face recognition attendance system [1] using modern technologies.

Our goal is to create a desktop application that automates the process of capturing live images of students, detecting and recognizing their faces, and updating the attendance records in a centralized database. By leveraging face detection [2] and recognition techniques, we aim to provide an accurate, efficient, and secure solution for attendance management in educational institutions.

The proposed system will utilize computer vision algorithms and deep learning models to detect and extract faces from live video feeds obtained from CCTV cameras. We will employ popular open-source libraries such as OpenCV [3] for image processing, face detection, and face recognition [4]. The captured images will be processed in real-time, allowing for immediate attendance marking.

With the implementation of our face recognition attendance system, we seek to replace the traditional paper-based attendance system used in college departments. This modern approach will not only save valuable class time but also eliminate the possibility of attendance manipulation or loss of records. Additionally, the system will provide convenience to students and parents, as they will have access to view their attendance records through the web application.

2 Problem Statement

Traditional attendance system in universities relies on using paper and manual methods. This leads to problems such as mistakes, delays, and inefficiencies in keeping track of students' attendance. It takes a lot of time and effort for teachers and staff to record attendance manually for each student, and the process is prone to errors. Additionally, the existing system lacks a centralized database, making it difficult to access and manage attendance records easily. Students and parents also face inconvenience in tracking and viewing their attendance records. Furthermore, the manual system lacks proper security measures, making it vulnerable to tampering or loss of attendance records.

1. Inefficient and error-prone manual attendance system.
2. Lack of centralized database and difficulty in accessing and managing attendance records.
3. Vulnerability to tampering and loss of attendance records due to inadequate security measures.

3 Problem Objectives

The objective of our project is to develop an automated attendance system using face recognition technology that eliminates manual processes, reduces errors, and improves efficiency. Our goal is to create a user-friendly system that accurately tracks and records attendance in real-time, replaces the traditional paper-based system, and provides secure access to attendance data for teachers, students, parents and administrators. The main aim of the project is:

1. To develop an automated attendance system using face recognition technology.
2. To eliminate manual processes, reduce errors, and improve efficiency.
3. To create a user-friendly system for real-time attendance tracking, replacing traditional paper-based methods, and ensuring secure access to attendance data.

4 Scope and Limitations

4.1 Scope

The scope of this project is to ease the attendance process in real-time through AI-powered desktop application with the help of deep learning and computer vision. Our system provides the following scope:

1. Development of a desktop application for administrators to manage the attendance system, including adding classrooms, assigning teachers, registering new students, and generating attendance reports.

2. Creation of a web application for students, parents, and teachers to view their attendance records, providing easy access to attendance information.

3. Implementation of face recognition technology to capture live images of students using CCTV footage, detect and recognize their faces, and update the attendance database in real-time.

4.2 Limitations:

Due to time and resource constraints, our application might have the following limitations:

1. The system may have limitations in terms of hardware and software resources, which may limit the number of students it can handle simultaneously.

2. The system may require additional training data to improve the accuracy of the face recognition technology.

3. The system may face challenges in terms of privacy and data protection regulations.

4. The system may not work effectively in low-light conditions or if the students are wearing face masks.

5 Significance of the study

The proposed attendance system using face recognition technology brings several important benefits to the college department facility:

- **Improved Efficiency:** By automating the attendance process, the system eliminates the need for manual paperwork and reduces the time and effort required to record and manage attendance. This frees up valuable resources for faculty members and administrative staff to focus on other important tasks.

- **Accurate and Real-time Attendance Tracking:** The face recognition technology ensures accurate attendance tracking by matching students' faces with the existing database. The system updates attendance records in real-time, providing up-to-date information for teachers, students, and administrators.

- **Convenience for Students:** With the new system, students no longer need to physically shout their names, making the process more convenient and less disruptive during class time. It also provides a reliable means of tracking attendance across different periods and classes.

- **Centralized Database and Easy Access:** The attendance system stores all attendance records in a centralized database, enabling easy access and management for authorized personnel. Generating reports, analyzing attendance patterns, and identifying students with poor attendance become more efficient and streamlined processes.

- **Enhanced Security and Integrity:** The automated system ensures the security and integrity of attendance data. With manual systems, there is a risk of tampering or loss of attendance records, but the proposed system minimizes such concerns through secure and reliable digital storage.

6 Literature Review

6.1 Similar works

Safepro AI Video Research Labs Pvt Ltd provides cognitive integrated smart security & video analytics solutions for smart cities, smart platforms for railways and other public transport agencies, law enforcement, defence, critical infrastructure, highways, traffic management, industries, retail & homes in India.

NeoFace by NEC is a facial recognition algorithm that quickly and accurately identifies people, even in difficult situations. It is effective regardless of a person's age, ethnicity, or gender, and can handle factors such as lighting and headwear. It also has privacy safeguards and retention tools.

6.2 Similar concepts

Amazon Rekognition is a popular facial recognition software that offers various features, including facial analysis, facial search, object and scene recognition, and content moderation. It also provides custom labeling and PPE detection services.

Betaface specializes in image and video analysis, facial recognition, identification, and verification. It offers facial recognition SDKs, custom software development services, and hosted web services, and can recognize emotions, ethnicity, and facial features.

BioID provides biometrics-as-a-service through cloud-based FRS services that can be accessed using APIs. Its solutions include a web service, liveness detection, and PhotoVerify, and it caters to industries like finance, healthcare, and online exams.

Cognitec offers scalable and customizable FRS solutions through its open system architecture called FaceVacs. Its solutions include FaceVACS-VideoScan ES Live, catering to various industries such as law enforcement and border control.

7 Proposed Methodology

The use diagram for our proposed system is shown below:

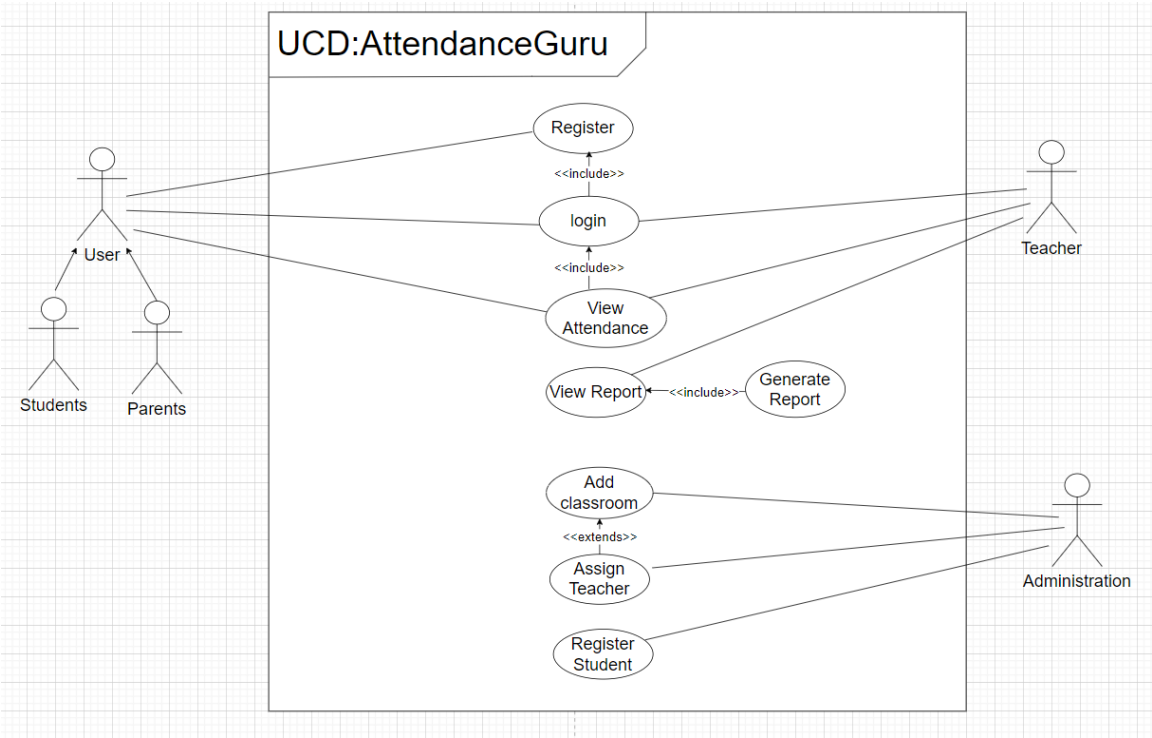

Figure 1: Use Case Diagram

The E-R diagram for our proposed system is shown below:

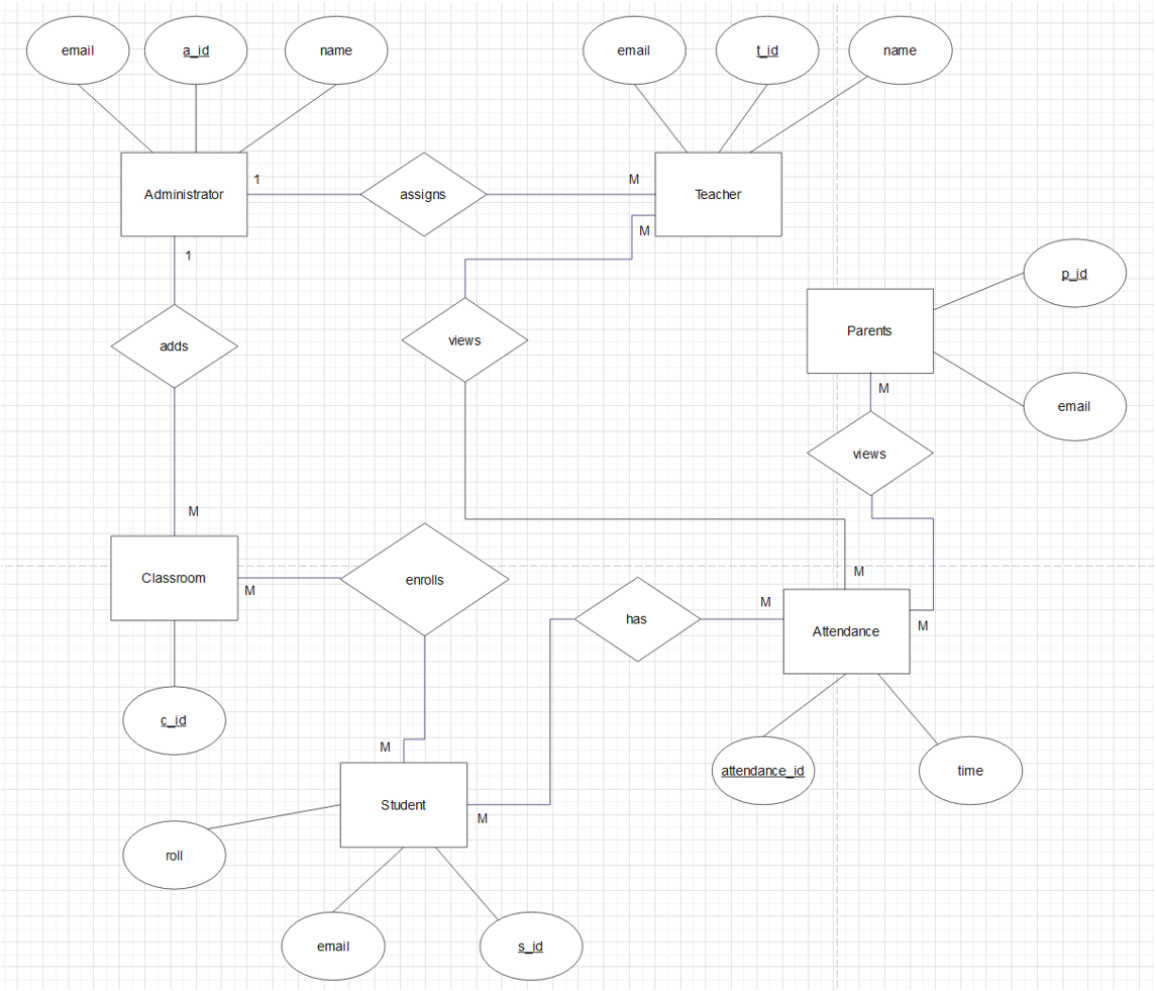

Figure 2: E-R Diagram

We will follow an incremental approach to develop the attendance system using face recognition. The project will be divided into several increments, each focusing on a specific functionality or component of the system. This approach allows us to build and test the system incrementally, ensuring continuous progress and feedback throughout the development process.

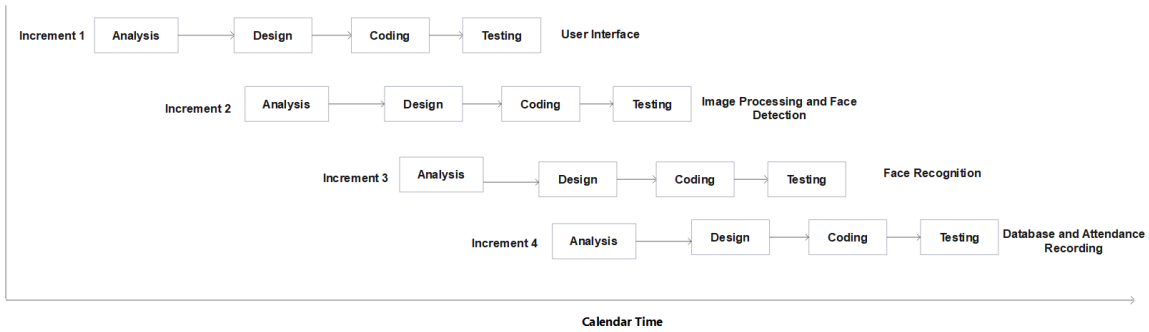

Figure 3: Increment Model

Project Initiation:

- Define the overall project goals and objectives.
- Identify the key stakeholders and gather their requirements.
- Create the project vision and define the initial scope.

7.1 Increment Model

1. **Increment 1:**User Interface
   In final increment, we will
   - Develop a user-friendly desktop application interface for authorized personnel to manage attendance records and generate reports.
   - Develop a user-friendly web-app for end users and teachers view the attendace reports.

- Test the integration of the database and user interface functionality to ensure seamless usability.

2. **Increment 2:** Image Processing and Face Detection
   In this increment, we will
   - Gather the images of students for image processing and face detection.
   - Develop the image processing module using OpenCV to detect and extract faces from captured images.
   - Test and validate the opencv functionality.

3. **Increment 3:** Face Recognition
   In second increment, we will
   - Develop the deep learning model for face recognition, trained on a dataset of student images and names.
   - Implement the face recognition model and test its accuracy and reliability.

4. **Increment 4:** Database and Attendance Recording
   In third increment, we will
   - Design and implement the centralized attendance database.
   - Integrate the attendance recording functionality, marking students as present in real-time.

7.2 Technology and Frameworks

Overleaf

Overleaf is an online collaborative writing and publishing platform that allows users to create, edit, and share LaTeX documents. It provides a user-friendly interface with real-time collaboration features, making it easy for multiple authors to work together on a document simultaneously.We will be using using overleaf to prepare reports and documentation for the project.

Git

We will be using an open source distributed version control system called Git through- out the project development process. It helps us in tracking changes in programs and coordinating work on those programs among the project team members.

LibreDraw

LibreDraw is a free and open-source software application that allows you to create and edit various types of graphical illustrations and diagrams. It provides a user-friendly interface with a wide range of tools and features for creating UML diagrams. These diagrams will be published in the final report and documentation.

Python

Python is a programming language that is easy to read and write. It is widely used for various tasks, including working with computer vision and machine learning. We will use Python to write code for libraries like OpenCV and TensorFlow, which will help us process images and build machine learning models for tasks like face recognition. Python's simplicity and object-oriented nature make it a suitable choice for these projects.

OpenCV

OpenCV, also known as Open Source Computer Vision Library, is a freely available software library for computer vision and machine learning. It offers a comprehensive set of tools and algorithms that enable tasks such as image and video processing, object detection and recognition, and feature extraction. We will be utilizing OpenCV in our project to leverage its powerful capabilities for tasks related to computer vision and image processing, specifically for our face recognition implementation.

Figma

Figma is a cloud-based design and prototyping tool that allows users to create and collaborate on user interface (UI) designs. It provides a range of features such as real-time

collaboration, vector editing, design components, and interactive prototyping. Figma is widely used in the design industry for creating visually appealing and interactive UI/UX designs. We will be using Figma in our project to create and refine the user interface design for our desktop application.

ElectronJS

ElectronJS is a framework that allows developers to build cross-platform desktop applications using web technologies such as HTML, CSS, and JavaScript. It provides a runtime environment that combines the Chromium rendering engine and Node.js, allowing developers to create desktop applications that can run on Windows, macOS, and Linux operating systems. We will be using ElectronJS in our project to develop the user interface and handle the frontend of our face recognition attendance system.

ReactJS

ReactJS is a JavaScript library used for building user interfaces. It allows developers to create reusable UI components and efficiently manage the state of an application. We will be utilizing ReactJS in our project to develop the frontend of our face recognition attendance system, enabling us to create dynamic and interactive user interfaces for a seamless user experience.

MySQL

MySQL is a popular open-source relational database management system. It allows users to store, organize, and manage structured data efficiently. We will be using MySQL as the backend database for our project to store and retrieve data related to attendance records, student information, and other relevant data.

Spring

Spring Java is a popular framework for building enterprise-level Java applications. It provides a robust infrastructure for developing scalable and modular applications, simplifying the development process and promoting good programming practices. We will be using

Spring Java in our project to leverage its features and benefits, such as dependency injection, aspect-oriented programming, and easy integration with other frameworks and libraries. It will help us develop a reliable and maintainable backend system for our face recognition attendance application.

8 Tasks Done so far

1. **Increment 1:** User Interface

    - A user-friendly web application has been created for end users and teachers to easily view attendance reports.
    - The web app provides a responsive and accessible interface for end users and teachers to access and analyze attendance data.
    - Integration testing has been conducted to ensure smooth functionality between the database and the user interface.
    - The integration of the database and user interface has been successfully implemented, resulting in a seamless and user-friendly experience for managing attendance records and generating reports.

2. **Increment 2:** Image Processing and Face Detection

    - The image processing module for face detection using OpenCV has been completed.
    - A collection of student images has been gathered for the purpose of testing and validation.
    - The OpenCV module has been successfully applied to the student images to detect and extract faces.
    - Rigorous testing has been conducted to validate the accuracy and reliability of the face detection functionality.
    - The results of the tests indicate that OpenCV effectively detects and extracts faces from the captured student images.
    - The functionality of the OpenCV module has been thoroughly validated and deemed suitable for further use in face detection tasks.

3. **Increment 3:** Face Recognition

    - Discussion has been done to select the best pretrained face recognition.

9 Outcomes

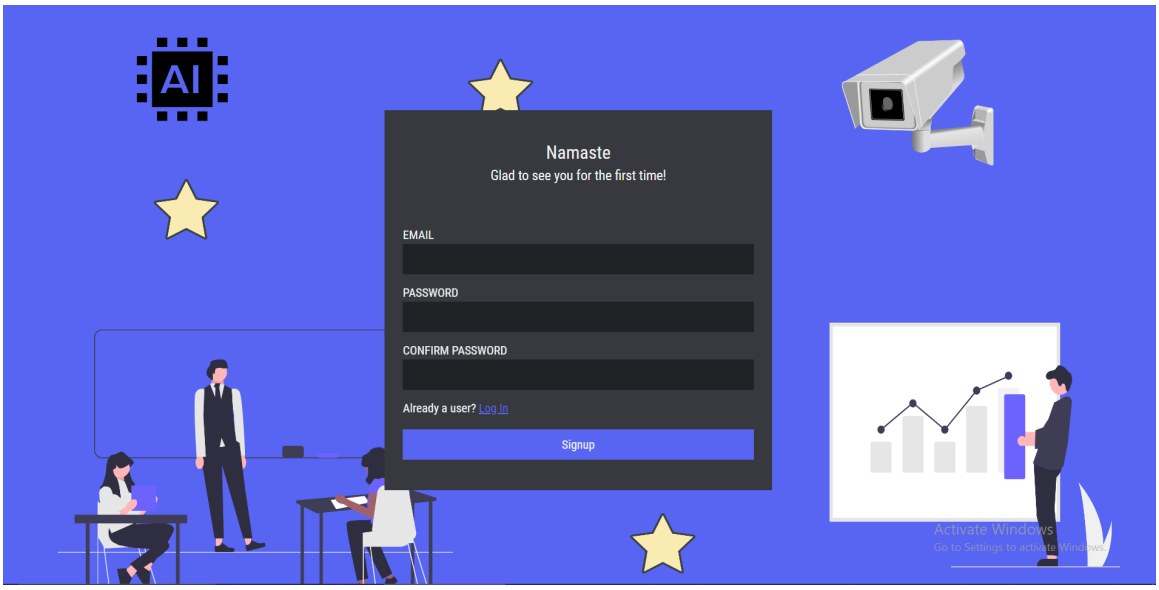

Figure 4: Signup

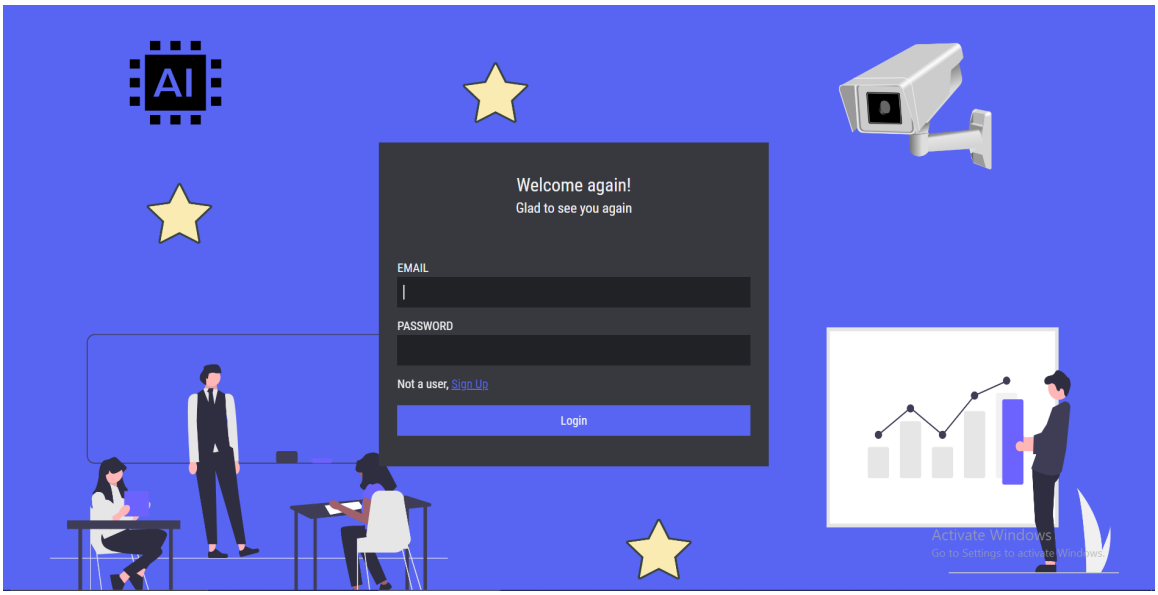

Figure 5: Login

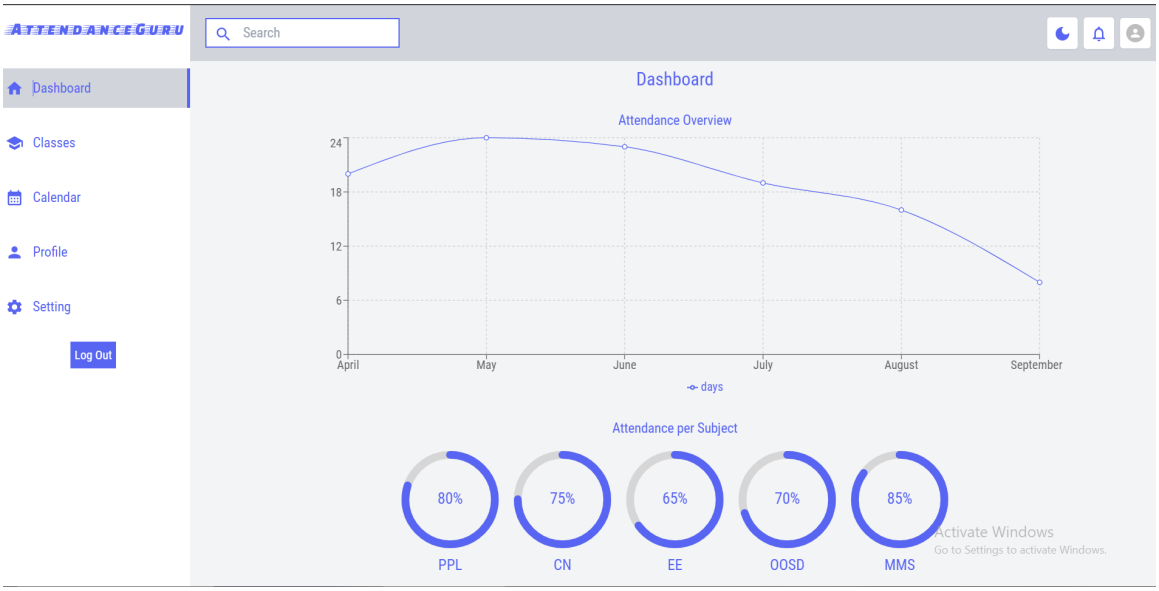

Figure 6: Dashboard

Figure 7: FaceDetection

10 Tasks Remaining

1. **Increment 3:** Face Recognition

    - The deep learning model for face recognition, trained on a dataset of student images and names is yet to be developed.
    - The face recognition model and test its accuracy and reliability is yet to be implemented.

2. **Increment 4:** Database and Attendance Recording

    - The centralized attendance database is yet to be designed and implemented.
    - The attendance recording functionality, marking students as present in real-time is yet to be integrated.

11 Proposed Performance Analysis Methodology

11.1 System Test Case:

Test Case Name: Attendance Capture and Recognition

Test Case Description: This test will verify the system's ability to capture live images, detect faces, and recognize them accurately for attendance marking.

Test Steps:

1. Provide a live video feed to the system. Verify that the system captures frames from the video feed. Ensure that the system detects faces in the captured frames.

2. Validate that the system accurately recognizes the detected faces. Verify that the attendance is marked correctly based on the recognized faces.

Expected Result: The system should successfully capture images, detects faces, recognizes them accurately, and marks attendance correctly.

11.2 Model Test Case:

Test Case Name: Face Recognition Accuracy

Test Case Description: This test will evaluate the performance of the machine learning model used for face recognition in the attendance system. The objective is to assess the precision, recall, and overall accuracy of the model and generate metrics such as the confusion matrix, ROC curve, and AUC score.

Test Steps:

- Prepare a labeled dataset of face images, with ground truth identities.

- Train the machine learning model using the labeled dataset.

- Evaluate the model's performance using a separate test dataset.

- Calculate the precision and recall of the model by comparing the predicted identities with the ground truth labels.

- Generate a confusion matrix to assess the model's accuracy in correctly classifying different identities.
- Plot the ROC curve and calculate the AUC to measure the model's ability to distinguish between positive and negative samples.

Expected Result: : The face recognition model should exhibit high precision, indicating that the majority of correctly recognized faces are indeed correct. The model should also demonstrate high recall, indicating that it can correctly identify a significant portion of the faces in the dataset.

12 Proposed Deliverable

1. **Desktop Application for Administrators:**

    - Development of a user-friendly desktop application for administrators to manage the attendance system.
    - Functionality to generate comprehensive attendance reports.
    - Capability to view and analyze attendance data for different classrooms and time periods. Intuitive user interface for easy navigation and interaction.

2. **Web Application for Students, Parents, and Teachers:**

    - Creation of a web application accessible to students, parents, and teachers for viewing attendance reports.
    - Secure login and personalized access to individual attendance records.
    - User-friendly interface for easy browsing and retrieval of attendance data. Compatibility with different devices, allowing convenient access from desktops, laptops, tablets, and smartphones.

3. **Face Recognition Model:**

    - Integration of a trained face recognition model into the web application.
    - Accurate detection and recognition of faces from live images or video frames.
    - Utilization of CCTV footage for capturing images and facilitating face recognition.

4. **Centralized Attendance Database:**

    - Implementation of a centralized database for storing and managing attendance records.
    - Real-time updating of attendance data in the database.
    - Secure storage of attendance records and convenient retrieval and analysis of data.

5. **User Documentation:**

    - User manuals, installation guides, and system requirements provided.
    - Step-by-step instructions for using the web application.
    - Effective management of attendance records with clear guidance.

6. **Maintenance and Updates:**

    - Ongoing maintenance and updates for the web application, face recognition model, and attendance database.
    - Ensuring optimal performance, security, and compatibility with future technologies.
    - Regular monitoring, bug fixes, and enhancements to improve system functionality and reliability.

13 Project Task and Time schedule

13.1 Project Task

Name	Task	Responsibility
Rikesh Silwal Khatri	Face Detection	To filter the live feed from the cctv and detect the faces for the facial recognition using Computer Vision with the help of OpenCV
	Face Recognition Model Development	To create a CNN model that recognizes the face of students using Deep Learning and Neural Networks
	Desktop Application Development	To create a Desktop Application using Electron JS for the administrators to manage and view the attendance records and generate reports
	Web Application	To create web application using React Js for teachers and students to view records
Arun Bikram Khatri	Face Detection	To filter the live feed from the cctv and detect the faces for the facial recognition using Computer Vision with the help of OpenCV
	Face Recognition Model Development	To create a CNN model that recognizes the face of students using Deep Learning and Neural Networks
	Database Design	To design and maintain the database and tables under that database
	Backend Development	To implement secure user authentication, track attendance based on recognized faces and provide API endpoints for seamless integration with the frontend application
Suman KC	UI Design	To create the design of the Desktop Application using Figma
	System Design	To design Context Diagram, DFD, ER Diagram, Use Case Diagram and Class Diagram
	Data Gathering	To collect photos of students to train the created Deep Learning model and to test the working of facial recognition
	Documentation	To develop documentation of the project

Figure 8: Tasks

13.2 Time Schedule

ID	Task Name	Start	Finish	Duration	Complete
1	Analysis	2023-05-22	2023-05-23	2.0 d.	0.0%
2	Design	2023-05-24	2023-05-26	3.0 d.	0.0%
3	Coding	2023-05-27	2023-06-02	7.0 d.	0.0%
4	Testing	2023-06-03	2023-06-04	2.0 d.	0.0%

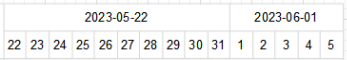

Figure 9: Gantt chart for Increment 1

ID	Task Name	Start	Finish	Duration	Complete
1	Analysis	2023-06-05	2023-06-06	2.0 d.	0.0%
2	Design	2023-06-07	2023-06-09	3.0 d.	0.0%
3	Coding	2023-06-10	2023-06-16	7.0 d.	0.0%
4	Testing	2023-06-17	2023-06-18	2.0 d.	0.0%

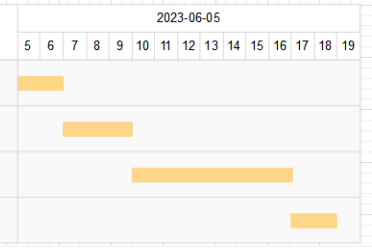

Figure 10: Gantt chart for Increment 2

ID	Task Name	Start	Finish	Duration	Complete
1	Analysis	2023-06-19	2023-06-20	2.0 d.	0.0%
2	Design	2023-06-21	2023-06-23	3.0 d.	0.0%
3	Coding	2023-06-24	2023-06-30	7.0 d.	0.0%
4	Testing	2023-07-01	2023-07-02	2.0 d.	0.0%

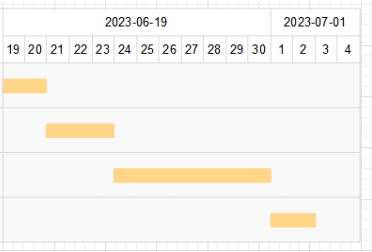

Figure 11: Gantt chart for Increment 3

ID	Task Name	Start	Finish	Duration	Complete
1	Analysis	2023-07-03	2023-07-04	2.0 d.	0.0%
2	Design	2023-07-05	2023-07-07	3.0 d.	0.0%
3	Coding	2023-07-08	2023-07-14	7.0 d.	0.0%
4	Testing	2023-07-15	2023-07-16	2.0 d.	0.0%

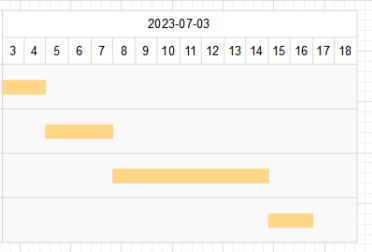

Figure 12: Gantt chart for Increment 4

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