A Project Report

On

FAMS Facial Recognition Attendance Management System

Submitted in partial fulfillment of the

requirement for the award of the degree of

BACHELOR OF TECHNOLOGY

GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

DEGREE

Session 2023-24
in

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Under the guidance of
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GALGOTIAS UNIVERSITY, GREATER NOIDA

INDIA

Feb, 2024

SCHOOL OF COMPUTING SCIENCE AND ENGINEERING

GALGOTIAS UNIVERSITY, GREATER NOIDA

CANDIDATE'S DECLARATION

I/We hereby certify that the work which is being presented in the project, entitled **"FAMS Face Recognition Attendance Management System"** in partial fulfillment of the requirements for the award of the B. Tech. (Computer Science and Engineering) submitted in the School of Computing Science and Engineering of Galgotias University, Greater Noida, is an original work carried out during the period of February, 2024 to May 2024, under the supervision of Prof. Ajay Shankar , Department of Computer Science and Engineering, of School of Computing Science and Engineering , Galgotias University, Greater Noida.

The matter presented in the thesis/project/dissertation has not been submitted by me/us for the award of any other degree of this or any other places.

Prakhar Bansal 20SCSE1180072

This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

Ajay Shankar

Associate Professor

CERTIFICATE

This is to certify that Project Report entitled “FAMS Facial Recognition Attendance Management System” which is submitted by Prakhar Bansal in partial fulfillment of the requirement for the award of degree B. Tech. in Department of ..... of School of Computing Science and Engineering Department of Computer Science and Engineering

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Signature of Examiner(s) **Signature of Supervisor(s)**

Signature of Program Chair **Signature of Dean**

Date: Feb, 2024

Place: Greater Noida

ACKNOWLEDGEMENT

It gives us a great sense of pleasure to present the report of the B. Tech Project undertaken during B. Tech. Final Year. We owe special debt of gratitude to Professor Ajay Shankar Department of Computer Science & Engineering, Galgotias University, Greater Noida, India *for his constant support and guidance throughout the course of our work. His/Her sincerity, thoroughness and perseverance have been a constant source of inspiration for us. It is only his cognizant efforts that our endeavors have seen light of the day.*

We also take the opportunity to acknowledge the contribution of Professor (Dr.) ……., Head, Department of Computer Science & Engineering, Galgotias University, Greater Noida, India *for his full support and assistance during the development of the project.*

We also do not like to miss the opportunity to acknowledge the contribution of all faculty members of the department for their kind assistance and cooperation during the development of our project. Last but not the least, we acknowledge our friends for their contribution in the completion of the project.

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ABSTRACT

The Face Recognition Attendance Management System utilizes CCTV cameras to automate attendance tracking. It employs advanced facial recognition technology to identify and record individuals as they enter a premises. This system eliminates the need for manual attendance records and provides real-time data. Users simply need to show their faces to the CCTV camera, which then matches their identity with the database. The system ensures accuracy and minimizes errors, improving overall efficiency. It offers a convenient and contactless solution, making attendance management swift and hassle-free. This system is highly beneficial for schools, businesses, and institutions looking for a modern, secure, and efficient way to monitor attendance. By revolutionizing attendance tracking, this technology streamlines record-keeping, enhances security, and advances administrative processes. It also solves issues like fake attendance that are done by the students. The model is relatively fast as compared to the manual attendance taken by the teachers.

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LIST OF ABBREVIATIONS

GPU	Graphical Processing Unit
CSS	Cascading Style Sheet
API	Application Programming Interface

CHAPTER 1

INTRODUCTION

1.1 Introduction

In today's fast-paced and increasingly technology-driven world, attendance management systems have become an integral part of various institutions, including schools, businesses, and other organizations. The utilization of cutting-edge facial recognition technology, seamlessly integrated with CCTV cameras, offers a promising solution to streamline attendance tracking. This approach eliminates the cumbersome process of manual attendance record-keeping, providing real-time data that enhances accuracy and overall efficiency. Moreover, the contactless nature of this innovative system makes it both convenient and secure, aligning with the modern needs of a society constantly seeking to optimize administrative processes and improve security measures.

Organizations are continuously working to improve operational efficiency and streamline procedures in the fast-paced business environment of today. Conventional techniques for managing attendance, such human roll calls and swipe cards, frequently fall short of expectations because they are laborious, prone to mistakes, and unable to reliably track each person's attendance patterns. Facial recognition technology has become a game-changing attendance management tool in response to these drawbacks.

Systems for managing attendance using facial recognition and CCTV footage have several advantages over traditional approaches. By doing away with the necessity for manual data entry, these technologies reduce the possibility of human mistake and free up employees to work on other worthwhile projects Furthermore, facial recognition technology has the amazing capacity to recognize people precisely from different angles and in difficult lighting, guaranteeing thorough and trustworthy attendance records.

The use of facial recognition attendance management systems through CCTV cameras has the potential to significantly transform attendance tracking in a variety of contexts, such as access control environments, businesses, and educational institutions. This paper explores the fundamental elements, features, and several advantages of face recognition attendance management systems, going deep into their detailed intricacies.

1.2 Motivation

The development of a face recognition attendance management system using CCTV cameras is driven by several compelling motivations that address the limitations of traditional attendance tracking methods. These motivations include:

Enhanced Efficiency and Accuracy: Traditional attendance methods, such as manual roll calls and swipe cards, are often time-consuming and prone to errors. Manual roll calls can be disrupted by distractions and interruptions, leading to inaccurate attendance records. Swipe cards can be easily lost, stolen, or misused, further compromising attendance data integrity.

Face recognition attendance management systems eliminate the need for manual data entry, significantly reducing the time required to track attendance. The system automatically identifies individuals based on their facial features, ensuring accurate and reliable attendance records.

Lower Labor Costs: Employees can concentrate on more fruitful activities because facial recognition technology automates labor-intensive manual attendance tracking, freeing up staff time. This resource redistribution may result in lower labor expenses and increased productivity.

Removal of Proxy Attendance: People who sign in on behalf of others are able to use traditional attendance systems, which are vulnerable to proxy attendance. The integrity of the attendance system may be jeopardized by this approach, which can also skew attendance data.

Attendance management systems that utilize face recognition technology efficiently eradicate the need for proxy attendance by authenticating individuals through their distinct facial characteristics. This guarantees that each person's presence is appropriately reflected in the attendance records.

Enhanced Security and Access Control: By prohibiting unauthorized people from entering restricted locations, face recognition technology improves security measures for access control. To offer an extra degree of security, the system can be linked with already-installed security systems.

Simplified Attendance Analysis: Face recognition attendance management solutions make it easier to analyze attendance patterns, which helps businesses see trends, gauge employee happiness, and decide how best to manage their staff.

Decreased Environmental Impact: Face recognition attendance management solutions help to make attendance tracking more ecologically friendly by doing away with the requirement for paper-based attendance records.

Possibility of Integration with Other Systems: To increase data consistency and expedite administrative procedures, face recognition attendance management systems can be combined with other programs, including payroll and human resource management.

Enhanced Access and Security

Better Attendance Reporting: Individual attendance records, timeliness, and general attendance patterns are all included in the thorough attendance reports that face recognition attendance management systems offer. Making data-driven decisions and identifying areas for development are both possible with these reports.

Enhanced Employee Convenience: By doing away with the need for employees to carry and maintain physical cards or badges, face recognition attendance management systems offer a simple, frictionless way for them to report their attendance.

1.3 Scope of the project

In a comprehensive perspective of the Automated Attendance Management through CCTV-Based Face Recognition System, it is important to consider the system's broader implications and advantages within various contexts. Here are three long points that can be included

1. **Technological Advancements in Attendance Tracking**: The integration of facial recognition technology with CCTV cameras represents a significant stride in automating attendance management. By harnessing the power of artificial intelligence, the system can accurately identify individuals in real time. This technology offers a major departure from traditional manual attendance methods and aligns with the broader trend of digital transformation and automation in various industries.
2. **Enhanced Efficiency and Error Reduction:** One of the most notable advantages of this system is its ability to enhance efficiency and minimize errors in attendance tracking. By eliminating manual data entry, the system mitigates common issues

associated with human errors, ensuring accurate and up-to-date attendance records. This improved efficiency is of paramount importance in sectors such as education and business, where timely and precise attendance data is crucial for decision-making and operational processes.

3. **Security and Contactless Interaction:** Security considerations are paramount in today's environment. This system not only automates attendance management but also offers an added layer of security. Furthermore, the contactless nature of the system, particularly relevant in the context of a global health crisis, reduces the risk of physical contact and transmission of illnesses, making it an ideal choice for environments where safety is a concern. Using cameras that recognize faces and high-tech attendance systems not only make things easier but also make places more secure **.** With facial recognition, these systems can tell exactly who's coming in, which is super accurate. This helps make things safer and keeps people who shouldn't be there out. Plus, they don't need you to touch anything, which is great when there are sicknesses going around. This means you're less likely to get sick, and it also follows the rule of keeping some space between people.

This system revolutionizes attendance tracking by seamlessly integrating facial recognition with CCTV cameras. It eliminates manual record-keeping, ensuring accuracy and efficiency. It enhances security, as it precisely identifies individuals in real-time, and stops the fake attendance. Furthermore, the system's contactless approach, particularly in health-conscious times, reduces physical contact, minimizing illness transmission. This multifaceted innovation streamlines attendance management, boosts security, and aligns with evolving safety requirements, making it invaluable for modern institutions and businesses. This system offers a user-friendly interface that simplifies attendance monitoring for administrators and users. The real-time data it provides assists in informed decision-making, and its adaptability ensures its relevance in various environments. Its comprehensive capabilities extend beyond conventional attendance tracking, making it a versatile and indispensable tool for organizations striving for efficiency, security, and adaptability in today's dynamic world.

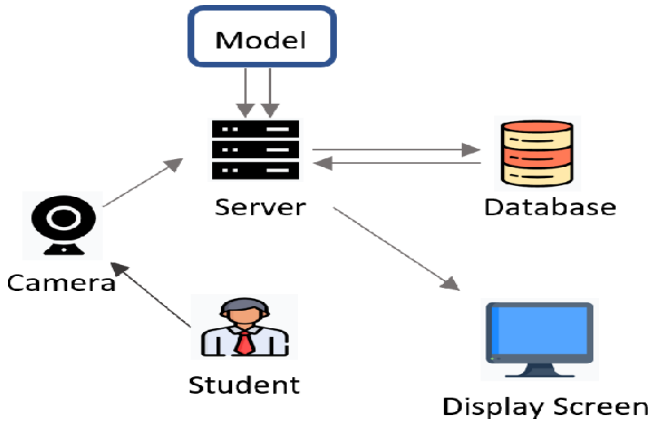


Figure 1 Overview of Smart Attendance System

CHAPTER 2

LITERATURE SURVEY

2.1 Literature Survey

[1] Abhilash Bhise, Radhika Khichi, Anmol Korde Attendance System Using NFC Technology with Embedded Camera on Mobile Device. According to research paper The enhancement of the attendance system is achieved through the utilization of NFC technology and a mobile application. As detailed in the research paper, each student is provided with an NFC tag containing a unique identification number during their college enrollment. To record attendance for each class, students are required to touch or move these tags against the lecturer's mobile phone. The phone's embedded camera captures the student's face, and all the data is transmitted to the college server for validation and verification. This method offers the advantage of user-friendliness and rapid connection establishment, significantly expediting the attendance recording process. However, it has limitations, such as the inability to automatically detect violations when the NFC tag is not used by the rightful owner. Additionally, the system's reliance on a lecturer's personal mobile phone for NFC reading can be inconvenient, especially if the lecturer forgets to bring their phone to work. Furthermore, due to privacy concerns, most lecturers may be hesitant to use their personal smartphones in this manner. Therefore, it is proposed that genuine student-specific information, such as biometrics or facial recognition, be employed as a replacement for NFC tags to ensure that attendance is accurately attributed to the correct student.

[2] Devendra Yadav, Shashank Pujari, Sumit Singh, Pragyan Mishra Fingerprint Based Attendance System Using Microcontroller and LabView. Their proposal involves implementing a fingerprint-based attendance tracking solution. This system employs two microcontrollers to handle the fingerprint recognition process. Initially, a fingerprint sensor collects the fingerprint pattern, which is then transmitted to the first microcontroller. Subsequently, the first

microcontroller transfers this information to the second microcontroller for cross-referencing with the database it holds. Upon identifying a match with a student's data, the details are conveyed to a PC via serial communication for display. This design offers the advantage of expediting development, preserving design adaptability, and simplifying testing. However, a drawback is its tethering to a PC, rendering it non-portable. Moreover, the database information is not readily accessible, making it inconvenient for parents who wish to monitor their child's attendance. To enhance accessibility for authorized individuals, the solution suggests uploading the student's information to a web server for convenient access. Access control can be enforced through a login screen to maintain data security.

[3]Jasem Malgheet, Noridayu Manshor, Iris Recognition Development Techniques: A Comprehensive Review. This research report tells about the recognition of the person based on the iris of eye. It consists of various steps like taking image from eye, preprocessing it for further analysis, Iris segmentation, Iris normalization, feature extraction, feature selection, classification/matching. It also explain how the algorithm run and works. It Requires specific hardware that is a iris reader sensor. The drawback of this is it is costly, consumes a lot of time, not possible to use it in school, college for attendance, may cause health issues in eyes.

[4] Elima Hussain, Priyanka Dugar, Abdul Hannan, Vaskar Deka, RFID Based Student Attendance System. The proposed solution bears a resemblance to the initial research journal, which also utilized RFID technology to enhance the existing attendance system. In this system, a combination of a tag and a reader is once more employed to monitor student attendance. The primary distinction from the initial research lies in the accessibility of attendance information via a web portal, offering a more convenient means of retrieving data. However, this system has its shortcomings. Firstly, it lacks portability as the RFID reader relies on a connection to a PC for operation. Secondly, the RFID tag does not provide genuine, unique identification for students, leading to inaccuracies in the recorded attendance data.

CHAPTER 3

SOFTWARE REQUIREMENT SPECIFICATION

3.1 System Interfaces

There are two primary components to the system interfaces of a face recognition attendance management system that uses CCTV cameras:

3.1.1 Hardware Interfaces

Two basic hardware interfaces are needed for a face recognition attendance management system that uses CCTV cameras. These are as follows:

1. CCTV cameras:

Having CCTV cameras of the highest caliber is necessary to get precise and comprehensive facial images of people. The resolution of the cameras should be adequate to guarantee that facial features are visible in a variety of lighting and distance situations. In order to capture people's faces as they enter or leave designated areas, the cameras should also be placed strategically.

2 Infrastructure for Networking and Communication:

High-speed network connectivity for cameras, servers, and storage devices is provided by an Ethernet network. Fiber Optic Network: High-bandwidth links for redundancy and long-distance data transfer. Communication Protocols: For data encryption and protection, use secure communication protocols like SSH and HTTPS.

3.1.2 Software Interfaces

In order to collect, process, and manage attendance data, software interfaces are necessary for face recognition attendance management systems that use CCTV cameras. These interfaces can be divided roughly into three primary parts.

1. Interface for Acquiring Images:

In order to record and broadcast live video feeds, this interface communicates with the CCTV cameras. It should ensure real-time data transfer and low latency while managing a variety of camera protocols, frame rates, and image resolutions.

2. Interface for Face Detection and Recognition:

This interface uses the captured video frames to identify people using face detection and recognition algorithms. It should be able to effectively recognize faces, extract their characteristics, and cross-reference them with a database of enrolled faces. For accurate attendance tracking, this interface's speed and accuracy are essential.

3. Interface for Attendance Management:

The enrollment of people, the recording of attendance timestamps, the generation of attendance reports, and system integration are all handled by this interface. Administrators should be able to handle attendance data and guarantee data integrity with ease thanks to its intuitive interface.

Depending on the particular needs and features of the face recognition attendance management system, different software interfaces may be used. For example, more advanced face recognition algorithms and stringent data security protocols might be needed for a system built for high-security settings.

3.2 System Requirements

Mentioned below are the System requirements for the Client or the end user as well as the server on which the application will run.

3.2.1 Client Side System Requirements

Below mentioned are the client side requirements that include software and hardware requirements.

Software Requirements

The client or the user must have any device that runs on any Operating System like Android, IOS, Mac, Linux Windows and it should have a web browser that supports HTML CSS and JavaScript like Chrome, Edge, Firefox etc. With these the browser should also support cookies for the security and the user sessions. Also the device should have a Graphical Processing Unit for better speed and consistency.

Hardware Requirements

The client or the user must use a device that have a Graphical Processing Unit with proper hardware that can support a browser without any lag or delay. The Devices can be any like Mobile, Laptop, Desktop, Tablet etc.

3.2.2 Server Side System Requirements

Software Requirements

1. Linux Preferable Ubuntu version 18.04 above
2. SQLite
3. Python Pip with necessary dependencies

Hardware Requirements Minimum

1. 4 GB RAM
2. 10 GB Storage Preferable SSD
3. Good Processor Quad core and above
4. Good GPU with 2 GB video memory
5. High Resolution CCTV cameras for effective working
6. Optical Fiber Internet Connectivity

3.3 Dependencies

Mentioned Below are the required dependencies for the application to execute.

blinker==1.6.3

cachelib==0.10.2

certifi==2023.11.17

charset-normalizer==3.3.2

click==8.1.7

dlib==19.24.2

dominate==2.9.0

et-xmlfile==1.1.0

face-recognition==1.3.0

face-recognition-models==0.3.0

Flask==3.0.0

Flask-Bootstrap==3.3.7.1

Flask-Login==0.6.3

Flask-Session==0.5.0

Flask-SQLAlchemy==3.1.1

Flask-WTF==1.2.1

greenlet==3.0.1

idna==3.6

itsdangerous==2.1.2

Jinja2==3.1.2

joblib==1.3.2

MarkupSafe==2.1.3

numpy==1.26.1

opencv-contrib-python==4.8.1.78

openpyxl==3.1.2

pandas==2.1.1

pickle5==0.0.11

Pillow==10.1.0

python-dateutil==2.8.2

pytz==2023.3.post1

requests==2.31.0

scikit-learn==1.3.2

scipy==1.11.3

six==1.16.0

SQLAlchemy==2.0.22

threadpoolctl==3.2.0

typing_extensions==4.8.0

tzdata==2023.3

urllib3==2.1.0

visitor==0.1.3

Werkzeug==3.0.0

WTForms==3.1.1

3.4 Product Functions

1. Student Registration

A student can be registered on the portal in which necessary information needs to be entered with proper image with clear face so that the Model can be trained easily and efficiently.

2. Marking Attendance

The application will take the attendance precisely in real time when the student will enter in the classroom.

3. Updating Attendance

The teacher can update the attendance manually if there is anything wrong done like incorrect attendance or a student is not recognized.

4. Downloading attendance:

The teacher can download the attendance in the form of excel file for their own purposes.

CHAPTER 4

SYSTEM DESIGN

4.1 Architecture diagram

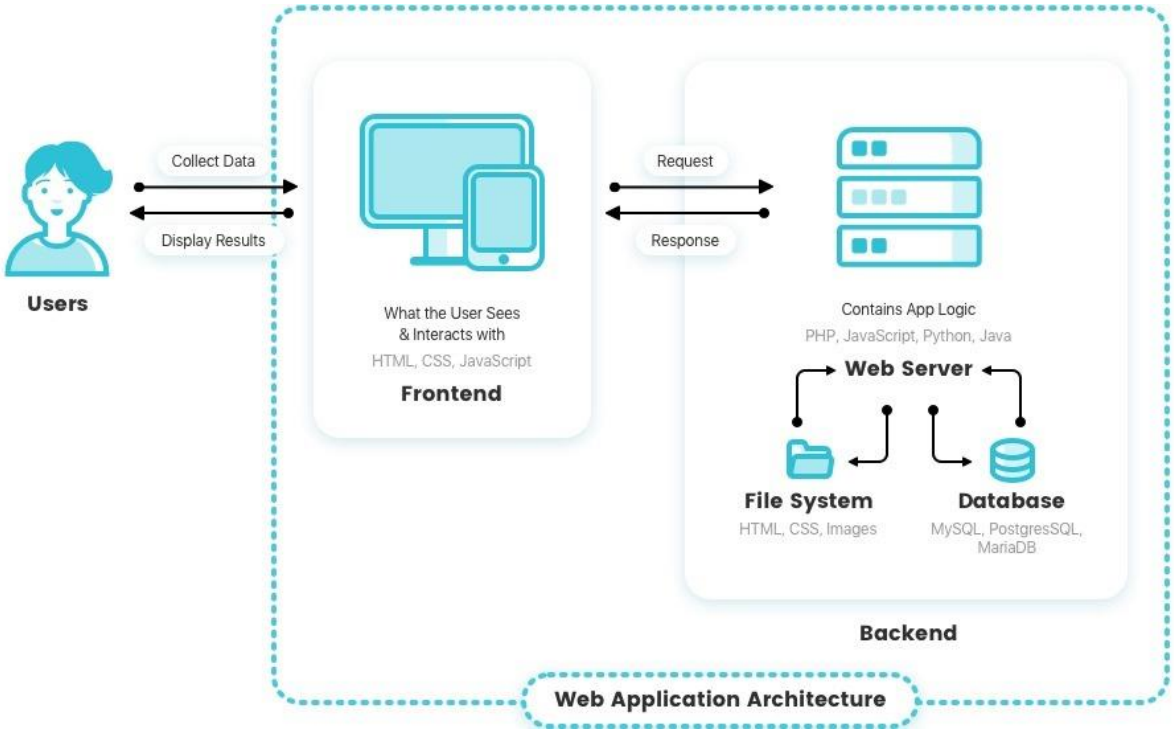


Figure 2 web Architecture

4.2 Database Schema Diagram

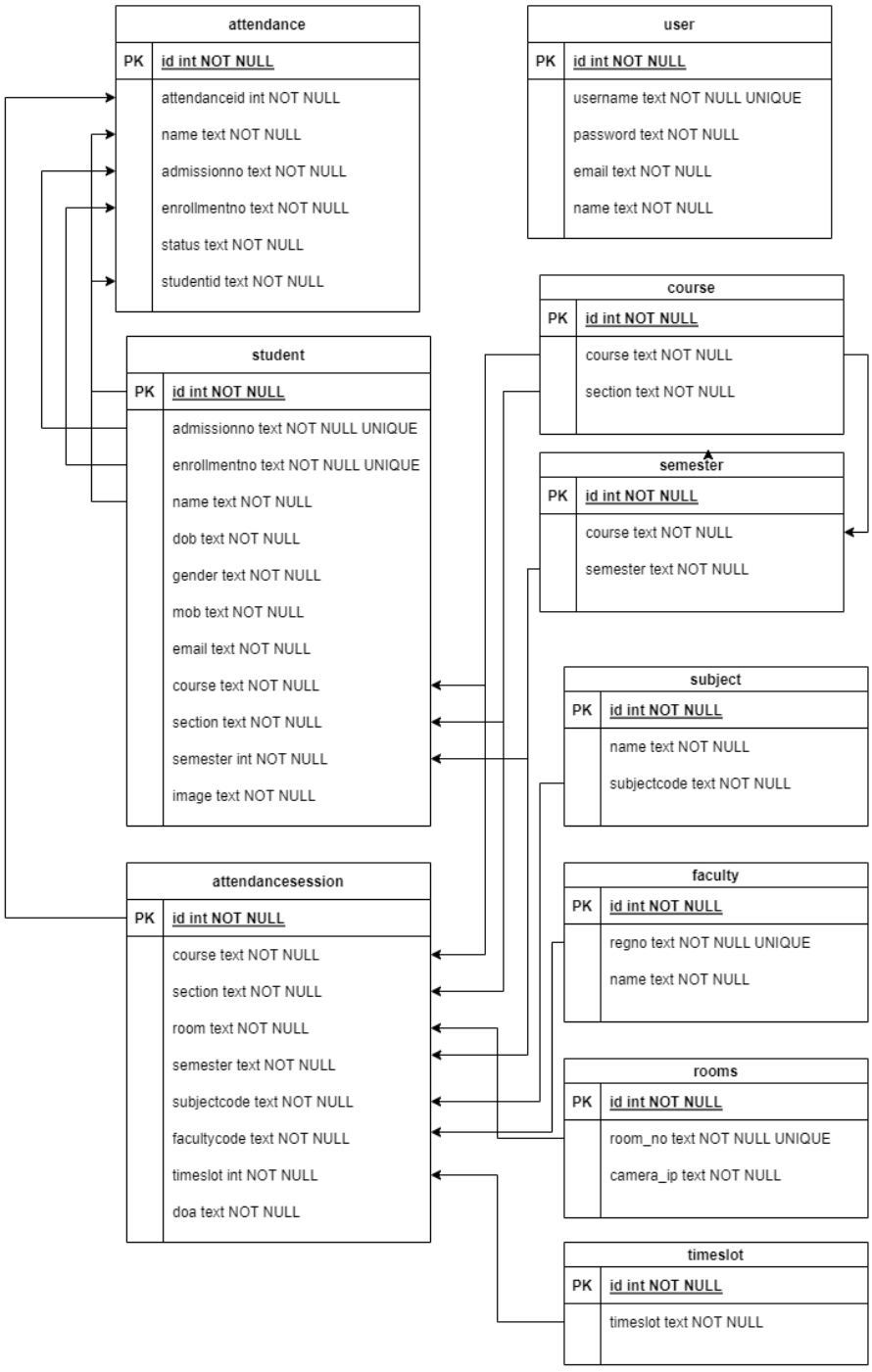


Figure 3 Database Schema Diagram

4.3 Activity Diagrams

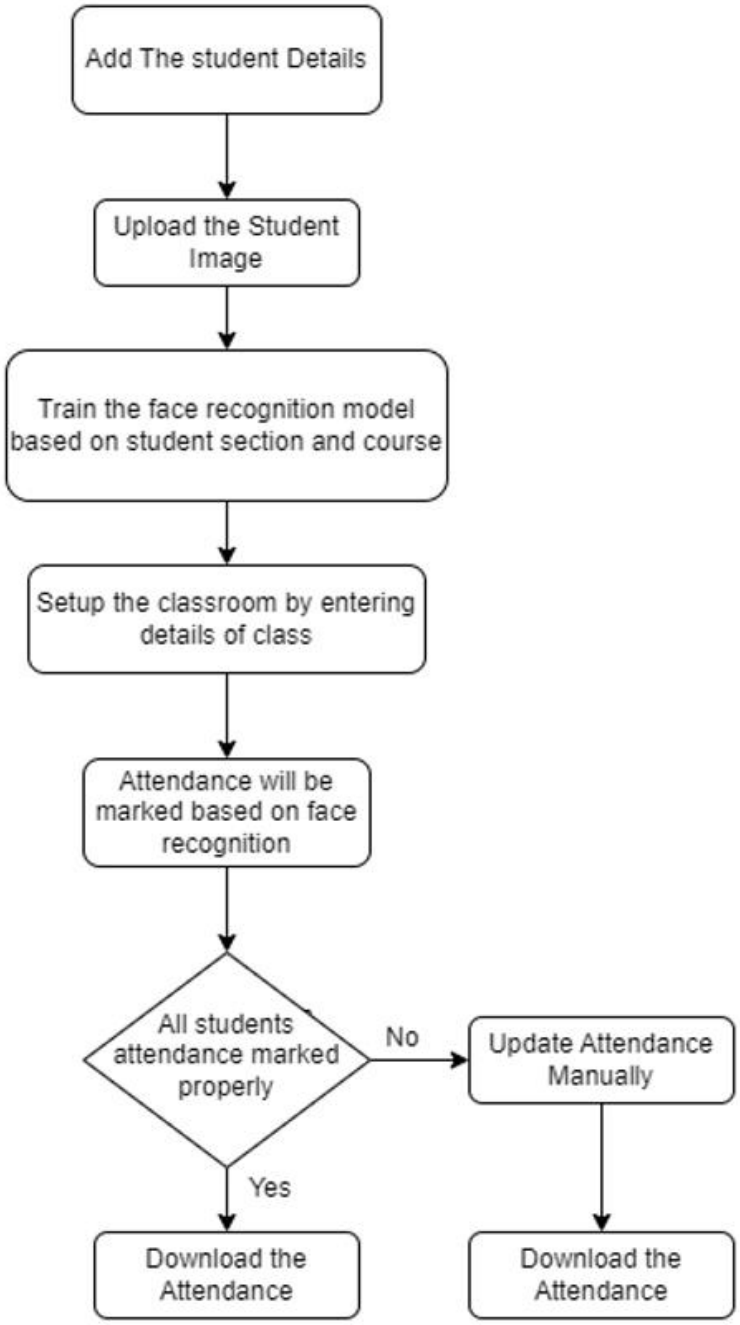


Figure 4 System Activity Diagram

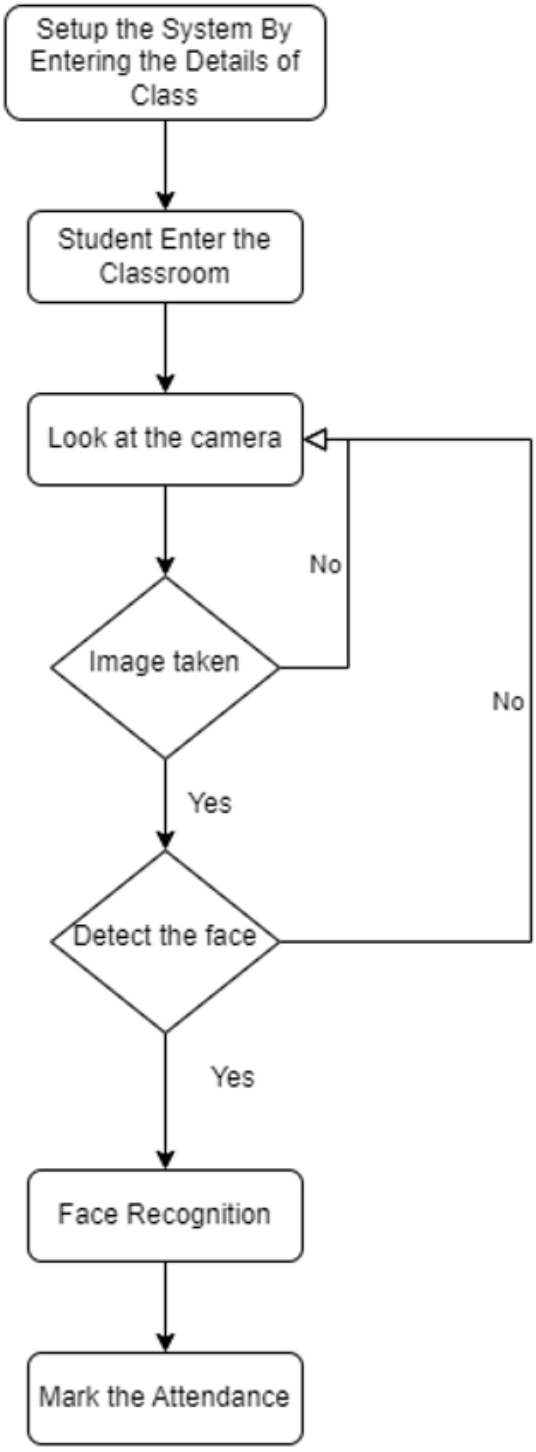


Figure 5 Take Attendance activity diagram

CHAPTER 5

IMPLEMENTATION AND RESULTS

5.1 Software and Hardware Requirements

Software Requirements

1. Linux Preferable Ubuntu version 18.04 above
2. SQLite
3. Python Pip with necessary dependencies

Hardware Requirements Minimum

1. 4 GB RAM
2. 10 GB Storage Preferable SSD
3. Good Processor Quad core and above
4. Good GPU with 2 GB video memory
5. High Resolution CCTV cameras for effective working
6. Optical Fiber Internet Connectivity

5.2 Assumptions and dependencies

1. **Face_recognition:**

   The Face Recognition library is a powerful and versatile tool that has gained popularity for its ability to perform facial recognition tasks. This library offers a wide array of functions and features, making it a valuable resource for developers and researchers working in fields like computer vision, biometrics, and security. With the ability to detect and identify faces in images and videos, it has applications in various

domains, from enhancing security and access control to enabling facial authentication in user-friendly applications. The Face Recognition library leverages sophisticated algorithms and deep learning techniques to accurately recognize faces, making it a valuable asset for businesses and organizations seeking to implement facial recognition technology. Researchers and developers continue to explore its potential and contribute to its growth, pushing the boundaries of what's possible with facial recognition technology.

It is the main library that is used to capture the face from the image and learn the features of the face and recognize the face.

2. **Dlib:**

Dlib is an open-source software library that is widely recognized for its versatility and power in the field of machine learning and computer vision. Developed by Davis King, this C++ library offers a wide range of tools and algorithms for tasks such as face detection, facial landmark recognition, object tracking, and image classification. Dlib's strength lies in its efficiency, which allows it to be seamlessly integrated into various applications and research projects, making it a popular choice among developers and researchers in the domain of computer vision and machine learning.

It is the library on top of which face_recognition is built.

3. **OpenCV:**

OpenCV, an acronym for Open Source Computer Vision Library, is a potent open-source software library dedicated to computer vision and machine learning. Originally developed by Intel and later backed by Willow Garage, OpenCV finds extensive utility across diverse applications, including robotics, image and video processing, object detection, facial recognition, and more. Notable for its versatility, OpenCV is compatible with various programming languages such as Python, C++, and Java. This characteristic makes it an inclusive tool accessible to a broad spectrum of developers. Its rich assortment of functions and tools equips developers to engage in tasks like

image manipulation, object tracking, and the creation of sophisticated computer vision applications.

OpenCV is used in many places like reading the live data from the CCTV cameras, display the video on to the web, image processing etc.

4. **Pandas**

Pandas is a widely-used Python library essential for data manipulation and analysis. It offers a versatile set of tools and data structures for efficiently handling structured data, such as tables or spreadsheets. The central data structure in Pandas is the DataFrame, which can be likened to a two-dimensional array, enabling users to work with data organized in rows and columns.

It is widely used in processing the data. In this system the attendance will be exported to a csv or an excel file. That can be done with the help of pandas

5. **Flask:**

Flask stands out as a highly regarded web framework within the Python ecosystem, celebrated for its elegant simplicity and unparalleled flexibility when it comes to crafting web applications. Its origins trace back to the skilled hands of Armin Ronacher, who conceived Flask to provide a minimalist, yet incredibly potent toolkit for the creation of web services and applications. Flask's innovative micro-framework design empowers developers to cherry-pick and seamlessly integrate diverse components, facilitating the development of tailored applications that meet specific project requirements.

Flask is used as a web framework to render all the HTML pages and provides the working of the system.

6. **SQLite:**

SQLite is a lightweight and self-contained relational database management system that is widely used in various software applications. It is known for its simplicity and efficiency, making it an excellent choice for embedded database solutions, mobile

applications, and desktop software. SQLite stores data in a single, cross-platform file, eliminating the need for a separate server process, which simplifies its deployment and usage. This open-source database engine supports standard SQL syntax and offers features such as transactions, indexing, and views, making it a versatile and powerful tool for developers looking to integrate a database into their projects. Its small memory footprint and high performance have made it a popular choice for applications where resources are limited, and it has gained widespread adoption in both commercial and open-source projects.

SQLite is used to store the student information and the attendance that can be further exported to the csv or excel files.

7. **Pickle:**

The pickle library is a Python module that offers a convenient method for serializing and deserializing Python objects. This process involves saving and loading Python objects, making it particularly beneficial for preserving complex data structures such as lists, dictionaries, and custom objects. By pickling, which is the act of converting a Python object into a byte stream, you can save the object to a file or transmit it over a network. Conversely, unpickling allows you to retrieve the object from the byte stream and restore it to its original state.

Here the pickle files are used to store the different face encodings based on different classes

8. **NumPy:**

The NumPy library is a fundamental and highly influential Python package, renowned for its capabilities in numerical computing and data manipulation. It empowers developers and scientists to work with large, multi-dimensional arrays and matrices efficiently, making it a cornerstone of various scientific and data analysis tasks. NumPy facilitates operations such as mathematical, logical, and statistical computations, enhancing the performance and readability of Python code. This library

also serves as a foundation for numerous other scientific libraries and data analysis tools, contributing significantly to the Python ecosystem's robustness and versatility. Its array-oriented programming approach streamlines tasks involving data storage and manipulation, making it an invaluable resource for a wide range of applications, from machine learning to scientific research and more.

Here the NumPy is used to store the face encodings in the form of NumPy array.

9. **Flask-Login:**

"Flask-Login serves as a valuable extension tailored for Flask, a renowned Python web framework, with the primary goal of simplifying user authentication and session administration within online applications. Crafted meticulously for effortless integration into Flask-driven projects, it serves as a streamlined solution for managing user sessions, ensuring authentication, and regulating access control.

Flask-Login excels in simplifying user authentication by encapsulating fundamental tasks such as login procedures, session management, and logout functionalities. It effectively verifies user credentials, maintains user sessions seamlessly, and offers straightforward mechanisms to control access to specific routes or views based on user-defined roles or permissions.

One of Flask-Login's standout attributes is its adaptability to accommodate diverse user models. It seamlessly embeds user authentication within applications, providing tailored callbacks for loading and retrieving users, facilitating effortless integration with various user data models.

Furthermore, Flask-Login greatly aids in implementing pivotal security measures. This includes safeguarding routes that require authentication, ensuring secure management of session cookies, and overseeing user sessions effectively. Its additional utilities extend to managing sessions, monitoring login statuses, and streamlining user-related functionalities within Flask routes or views.

The extension's meticulously organized documentation and strong community support empower developers to seamlessly implement user authentication and session handling

within Flask applications. Flask-Login stands out as a dependable and user-centric solution due to its adaptability and simplicity, making it an indispensable asset for effectively managing user authentication and access control in Flask-based web applications."

10. **Flask Session**

The Flask web framework has a strong extension called Flask-Session that makes managing user sessions easier. It makes it easy for developers to store, retrieve, and delete session data, guaranteeing that user data is kept consistent throughout the user's interactions with the program. Flask-Session's extensive feature set enables developers to manage session data storage across filesystem, database, and Redis, guaranteeing the best possible data storage solutions. It also makes data serialization and deserialization more efficient, ensuring data transfer that is smooth and compatible with the selected storage backend. Flask-Session uses secure storage techniques and encrypts session cookies to protect sensitive user data in order to improve security. Furthermore, it works in unison with Flask-Login to allow for the storing and retrieval of user-specific session data, supporting strong authentication and access control protocols. Because of Flask-Session's adaptability, developers can personalize how sessions are handled, adjusting session behavior to suit particular application needs and integrating with external session management systems. All things considered, Flask-Session is a vital tool for developing scalable, secure web applications that require effective session management.

11. **Flask-SQLAlchemy**

The Flask web framework has a powerful extension called Flask-SQLAlchemy that transforms how developers work with databases. It easily combines with Flask to streamline the process of creating table mappings, connecting to databases, and utilizing an object-oriented interface to interact with database data. The extensive feature set of Flask-SQLAlchemy enables developers to effortlessly manage database schema migrations, carry out object-oriented queries, perform CRUD operations, and handle database transactions. Web application templates can easily access database data thanks

to its integration with Flask and Jinja2. Due to Flask-SQLAlchemy's flexibility, developers can integrate with third-party database tools, modify certain aspects of database interactions, and adapt data access patterns to particular application requirements. Essentially, Flask-SQLAlchemy is a vital tool for developing web applications that require transparent and effective database management.

12. Flask-WTF

A Flask extension called Flask-WTF makes handling and integrating web forms in Flask-based applications easier. It provides an easy-to-use method for creating, validating, and processing web forms in Flask projects and is based on the WTForms library. By offering a smooth interface that enables developers to define forms using Python classes, Flask-WTF simplifies the process of creating forms and reduces the likelihood of errors in form handling.

By abstracting away common tasks involved in working with web forms, like form generation, validation, and rendering, this extension greatly reduces the complexity of form handling. Developers can create cleaner, more manageable codebases by using Flask-WTF to define form fields, apply validation rules, and generate HTML forms directly from their Python code.

Moreover, Flask-WTF easily integrates with Flask's request handling, simplifying the form submission and user input validation processes. It improves web form security by default and has built-in defense against Cross-Site Request Forgery (CSRF) attacks.

Support for intricate form structures, including managing file uploads, custom field types, and form composition, is another advantageous feature of Flask-WTF. Because of this flexibility, developers can design a wide range of feature-rich forms that are customized to meet the needs of individual applications.

13. Jinja2

A popular and potent Python templating engine, Jinja2 was created especially to produce dynamic content for web applications. It is well-known for being adaptable, straightforward, and simple to use and comes pre-installed in the widely-used web

framework Flask. With Jinja2, developers can incorporate dynamic content and logic into HTML or other text-based files to create templates that specify the structure of web pages. Because of its similar syntax to Python, the templating engine is easy for Python developers to work with. Jinja2 templates have placeholders, also called template variables or expressions, that can have dynamic content added to the output by enclosing them in double curly braces {{{ }}}.

Furthermore, Jinja2 allows developers to incorporate logic within templates to generate dynamic content based on changing conditions or data by supporting control structures like loops, conditionals, and filters.

Jinja2's capacity to isolate presentation (HTML) from application logic improves code readability and maintainability, which is one of its main advantages. Templates can be reused across multiple pages, promoting code reusability and consistency in web application design.

Moreover, Jinja2 allows for template inheritance, which enables programmers to design base templates that share common components among several pages. This feature reduces redundancy, encourages a more organized code structure, and makes it possible to create modular and maintainable templates, all of which speed up the development process.

Jinja2 is an excellent option for developing dynamic web applications because of its comprehensive documentation and broad acceptance in the Python web development community. Because of its versatility, robust feature set, and easy integration with web frameworks like Flask, it's a vital tool for Python developers who want to build scalable, dynamic web applications.

14. Pillow

The library for Python Opening, modifying, and saving a wide variety of image file formats is possible with Pillow, a robust image processing library. It enables users to carry out a number of tasks, including basic editing operations, image enhancement, and filtering.

You can work with a variety of image formats with Pillow, including JPEG, PNG, TIFF, BMP, and more. It can perform simple image manipulation operations like cropping, resizing, and rotating images as well as more complex ones like applying filters, switching between color spaces, and manipulating image metadata.

One noteworthy feature of Pillow is that it is accessible to both novice and seasoned developers due to its extensive documentation and ease of use. The library's extensive collection of techniques and features enables users to effectively complete a wide range of image processing tasks.

15. Werkzeug

Werkzeug is a robust and all-inclusive Python WSGI (Web Server Gateway Interface) utility library. Werkzeug is a set of tools for creating web applications and managing HTTP requests and responses, developed by the same people who created Flask. It provides the fundamental structure for many web frameworks, including Flask.

This library provides many necessary elements, including secure cryptography operations, HTTP request and response handling, routing, and debugging tools. With the help of Werkzeug's routing system, programmers can create URL patterns and associate them with particular tasks, resulting in neat and structured URL structures for online applications.

The integrated development server, which helps with testing and debugging Flask applications during the development stage, is one of its standout features. Furthermore, Werkzeug comes with a strong debugger that offers comprehensive information about exceptions, assisting developers in quickly locating and fixing problems.

Additionally, Werkzeug enhances the security features of web applications by incorporating secure password hashing and authentication functionalities. Its compatibility with HTTP utilities makes handling a variety of HTTP-related tasks easier by facilitating the manipulation of request and response data.

Because of the library's well-organized, modular design, which encourages reusability and extensibility, developers can use its parts to build reliable web applications. Furthermore, Werkzeug is a useful tool for web developers creating Python-based web

applications because of its widespread use in the Python web development community, active maintenance, and updates that guarantee support and the integration of new features.

16. Requests

Making HTTP requests and managing responses is made easier with the help of the Python'requests' library, which is a flexible and intuitive HTTP library. Because of its user-friendly and Pythonic interface, developers frequently choose it to communicate with web services and APIs. Requests, which are based on urllib3, make it easier to send a variety of HTTP requests, such as GET, POST, PUT, DELETE, and more, while offering extensive customization and response handling capabilities.

This library offers a higher-level API that makes it simple for developers to carry out HTTP operations by abstracting away the complexity of working directly with sockets and HTTP connections. Users can effortlessly manage authentication, handle cookies, add custom headers, and handle file uploads with requests.

Additionally, the ability to handle responses for requests makes it easier to extract data from HTTP responses, supporting common data formats like HTML, XML, and JSON. Additionally, the library offers practical functions for managing timeouts and error responses, guaranteeing the stability of online interactions.

Because of its clear and expressive syntax, extensive documentation, and vibrant user base, requests are a viable option for developers of all experience levels. Despite being simple, the library is very versatile because it can handle synchronous and asynchronous requests, meeting the needs of different kinds of applications.

17. Scikit learn

Scikit-learn, also known as sklearn, is a well-liked and extensive Python machine learning library. It is intended to offer an intuitive user interface and effective application of different machine learning algorithms for a range of tasks, including dimensionality reduction, clustering, regression, and classification. Built on top of other Python libraries for scientific computing, including NumPy, SciPy, and matplotlib, scikit-learn is an open-source library that provides smooth integration with these resources.

Its simplicity of use and well-documented, consistent API are among its main advantages, as they enable both novice and seasoned machine learning practitioners to utilize it. Support vector machines (SVMs), random forests, k-nearest neighbors (KNN), decision trees, and many more algorithms are available in Scikit-learn, along with tools for data preprocessing, model evaluation, and parameter tuning.

Additionally, the library offers a number of feature extraction and selection tools that let users efficiently prepare and work with datasets. To help create reliable and effective machine learning models, scikit-learn also provides functions for model evaluation, such as tools for metrics computation, cross-validation, and hyperparameter optimization.

With its focus on readability and consistency of code, comprehensive documentation, and a sizable user and contributor community, scikit-learn is a top option for Python machine learning experimentation, prototype, and implementation. As a result of its continuous development and support, it remains current with machine learning's most recent developments, securing its place as an essential tool for both practitioners and researchers.

18. Openpyxl

A popular and robust Python library for handling Excel files (.xlsx) is called Openpyxl. Using Python code, it enables users to read, write, and edit Excel spreadsheets. Because Openpyxl offers an easy-to-use interface for interacting with Excel files, it's a well-liked option for automating processes linked to data management, report creation, and analysis. With the aid of the library, users can add or remove sheets, create new Excel files, format cells, write data to particular cells, apply styles, and carry out a variety of programmatic operations on Excel worksheets. It offers extensive capabilities for manipulating Excel files and supports a wide range of Excel features, such as formulas, charts, images, conditional formatting, and merging cells.

Users can work with the most recent versions of Excel files thanks to Openpyxl's compatibility with the.xlsx file format, which also enables seamless integration with Excel files created by different Excel applications. In addition, the library's

documentation is thorough and up to date, providing precise instructions and examples for completing various tasks so that users of different skill levels can utilize it.

Openpyxl is constantly developing and adding new features and improvements thanks to its vibrant user community. It is an essential tool for people and organizations working with Excel-based data operations and analysis within Python environments because of its capacity to handle Excel files through Python code, which streamlines complicated Excel-related tasks and automates data processing workflows.

5.3 Frontend Dependencies

1. HTML

HTML (Hypertext Markup Language) stands as the foundational language for crafting web pages across the internet. It serves as a structural framework, defining the elements and layout within a webpage.

Using a system of markup tags enclosed in angle brackets, HTML identifies various elements within a webpage. These tags, forming opening and closing pairs (e.g., <tag> and </tag>), denote different components like headings, paragraphs, images, links, lists, forms, and more.

A typical HTML document consists of the root element <html>, housing two primary sections: <head> and <body>. The <head> section contains metadata such as the page title, character encoding, and references to external resources like stylesheets and scripts. On the other hand, the <body> section holds the visible content displayed on the webpage.

HTML offers a diverse set of elements to structure content and determine its appearance and functionality. These elements may encompass attributes that modify their behavior or visual presentation. For instance, the <a> tag generates hyperlinks and may include attributes like href to specify the destination URL.

HTML often collaborates with CSS (Cascading Style Sheets) for styling and layout, along with JavaScript for adding interactivity and dynamism to web pages. The latest iteration, HTML5, has introduced new elements, attributes, and APIs, augmenting the capabilities for developing modern web applications.

Proficiency in HTML is crucial for web developers as it forms the fundamental building block for crafting web pages and serves as a cornerstone for creating dynamic, engaging, and interactive websites online.

2. CSS

CSS (Cascading Style Sheets) is an essential technology in web development used to define the visual presentation and layout of HTML and XML documents. It plays a critical role in determining how web elements appear on a webpage, including aspects such as color, layout, typography, spacing, and more.

By employing CSS, developers can separate the content and structure of a webpage, handled by HTML, from its stylistic presentation. This separation allows for better organization, easier maintenance, and consistent styling across multiple pages or a website.

CSS operates through a set of rules that specify how specific HTML elements should be styled. These rules consist of selectors targeting HTML elements and declarations that define the styling properties and their respective values.

Selectors in CSS aid in identifying which elements or groups of elements should receive particular styles. They can target specific HTML tags, classes, IDs, or other attributes to apply styles more precisely.

The functionalities of CSS encompass a wide range, including defining layout structures, adjusting typography and colors, managing spacing and alignment, creating responsive designs adaptable to different screen sizes, and enabling animations and transitions for interactive elements.

With CSS3 being the latest version, it introduces various new features and enhancements that empower developers and designers with advanced tools to craft visually appealing, responsive, and modern web layouts and interfaces.

CSS remains an integral part of web development, allowing for the consistent and appealing presentation of web content across different devices and screen sizes.

Bootstrap

Bootstrap is a popular front-end framework used in web development to create responsive and mobile-first websites and web applications. Developed by Twitter, Bootstrap offers a collection of pre-designed templates, components, and styles built with HTML, CSS, and JavaScript.

The framework simplifies and expedites the process of building user interfaces by providing a set of reusable and customizable components, such as navigation bars, buttons, forms, carousels, modals, and more. These components follow a consistent design language and are responsive by default, ensuring they adapt well to various screen sizes and devices.

Bootstrap's grid system is a fundamental feature that enables developers to create responsive layouts easily. It's based on a 12-column grid system, allowing for the creation of complex and flexible page structures. This grid system, along with utility classes, facilitates the arrangement and alignment of content across different screen sizes.

Moreover, Bootstrap includes CSS classes and JavaScript plugins that enhance the user experience by adding interactive elements and functionality. For instance, its JavaScript components provide features like tooltips, modals, carousels, and dropdowns, contributing to the overall interactivity of web interfaces.

The framework encourages consistency and efficiency in development by providing a robust set of documentation, examples, and starter templates. Developers can customize Bootstrap components using its extensive set of variables and mixins, allowing for the creation of unique and branded designs while leveraging Bootstrap's underlying structure and functionality.

Bootstrap's widespread adoption, active community support, and continuous updates make it a go-to choice for developers seeking to build modern, responsive, and visually appealing websites or applications efficiently, particularly when focusing on responsive design and rapid prototyping.

3. JavaScript

JavaScript stands as a versatile programming language primarily utilized in web development to add interactivity and dynamic functionalities to web pages. It's instrumental in creating responsive user interfaces and facilitating interactions within web browsers.

Functioning predominantly on the client-side, JavaScript allows for the manipulation and modification of HTML elements, facilitating the creation of dynamic content and enhancing user experiences without requiring a complete page reload.Its capabilities include:

1. DOM Manipulation: JavaScript enables the modification of HTML elements, their attributes, and styles dynamically, allowing developers to create and alter webpage content in real-time.

2. Event Handling: Through event listeners, JavaScript can respond to various user interactions, such as clicks, mouse movements, and keyboard inputs, triggering actions or functions accordingly.

3. AJAX: JavaScript empowers the retrieval and updating of data from servers asynchronously, enhancing web pages by providing seamless data updates without reloading the entire page.

4. Animations and Effects: It supports the creation of animations and effects, enhancing user interface elements and creating engaging visual experiences on web pages.

5. Front-end Development Frameworks: JavaScript forms the foundation of several front-end frameworks and libraries like React, Angular, and Vue.js, offering additional tools and structures for efficient web development.

JavaScript has evolved over time, introducing modern features and functionalities through ECMAScript standards. This evolution includes advancements like asynchronous programming patterns, arrow functions, modules, and classes, enabling developers to build complex and efficient web applications.

JavaScript plays a crucial role in modern web development, empowering developers to create interactive, user-centric web experiences across various platforms and devices.

AJAX

AJAX, short for Asynchronous JavaScript and XML, is a technique used in web development to send and retrieve data from a server asynchronously without needing to reload the entire web page. It leverages a combination of technologies, including JavaScript, XML (though JSON is commonly used instead), HTML, and CSS, to create more dynamic and interactive web applications.

With AJAX, web pages can make requests to the server in the background, allowing for data retrieval, data posting, and updating content without requiring the user to navigate away from the current page. This asynchronous nature of AJAX enhances the user experience by providing smoother and more responsive interactions.

JavaScript plays a significant role in AJAX by facilitating the interaction with the server-side through XMLHttpRequest (XHR) objects or by using modern Fetch API. Developers use

JavaScript to create these requests, define actions upon receiving responses, and update the content on the webpage accordingly.

5.4 Implementation Details

5.4.1 Snapshots Of Interfaces

1. Login Page

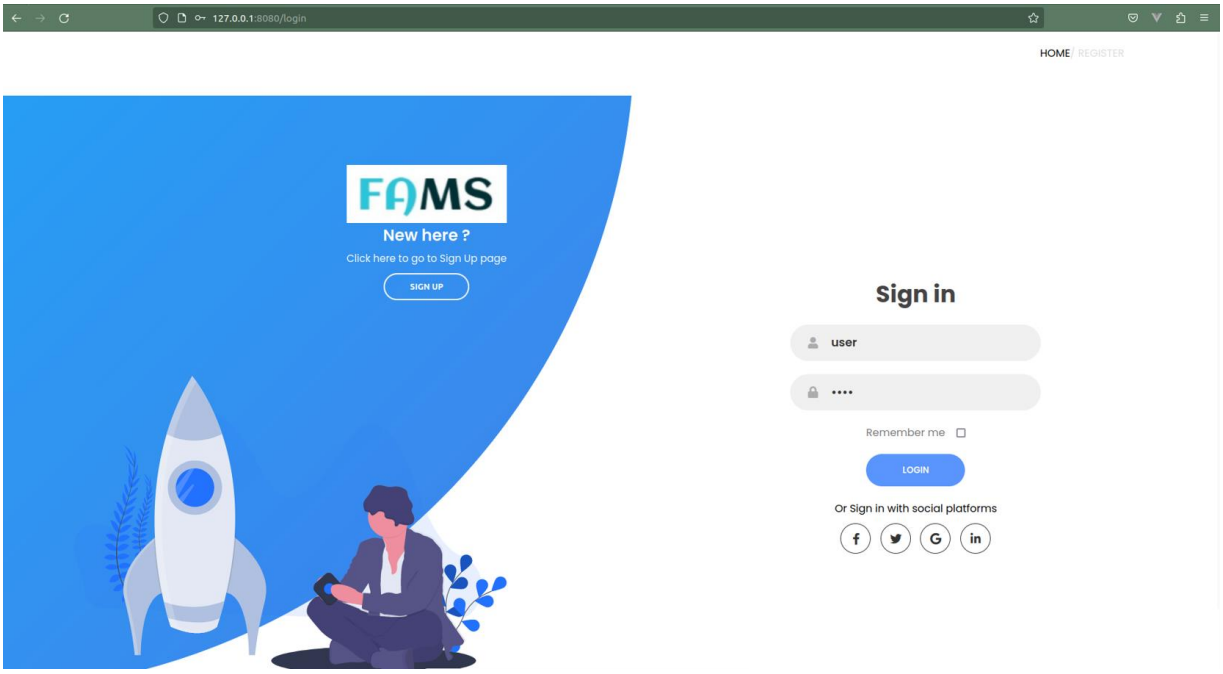


Figure 6 Login Page

The login page where the teacher or faculty has to login into the portal.

2. Home Page

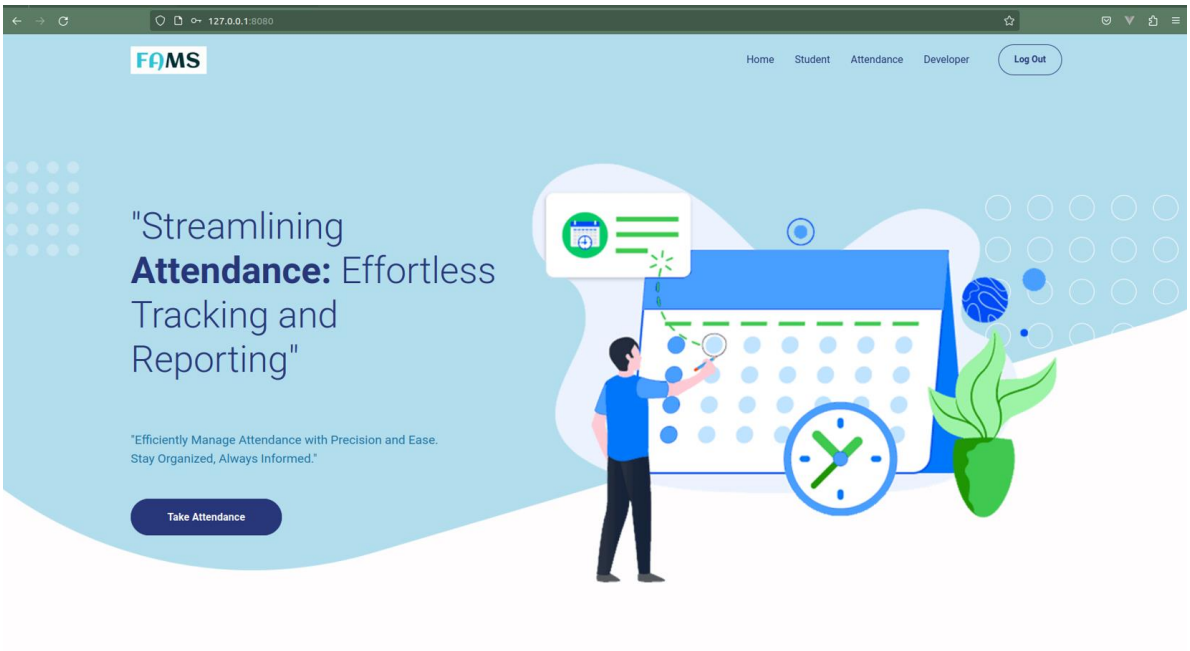


Figure 7 Home Page

Home page of the application.

3. Student page

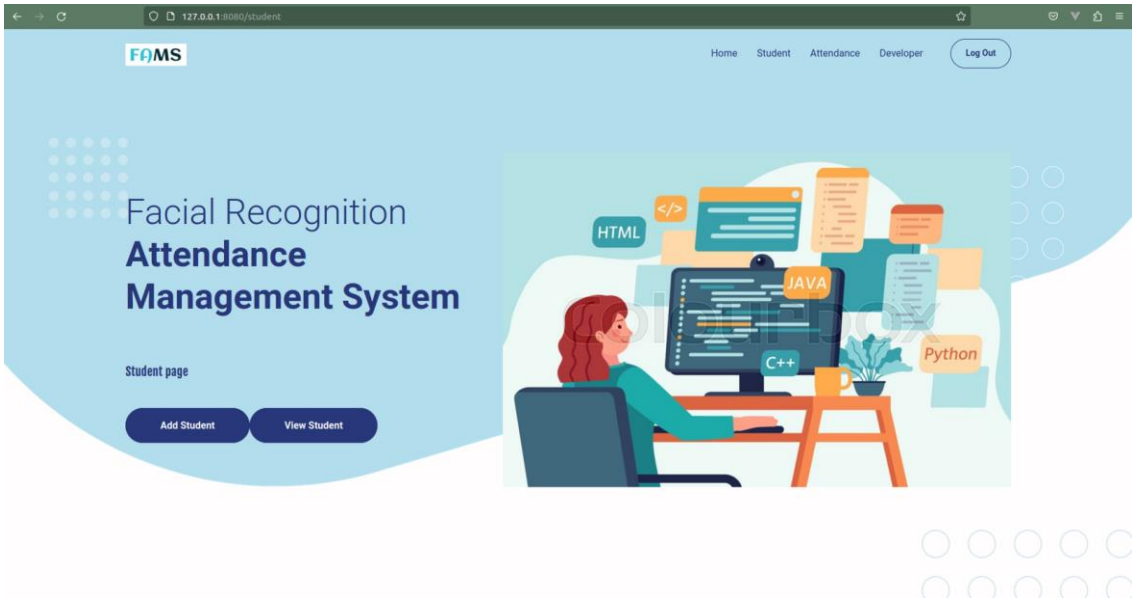


Figure 8 Student Page

Student page where the user can add or view the details of the student.

4. Add Student page

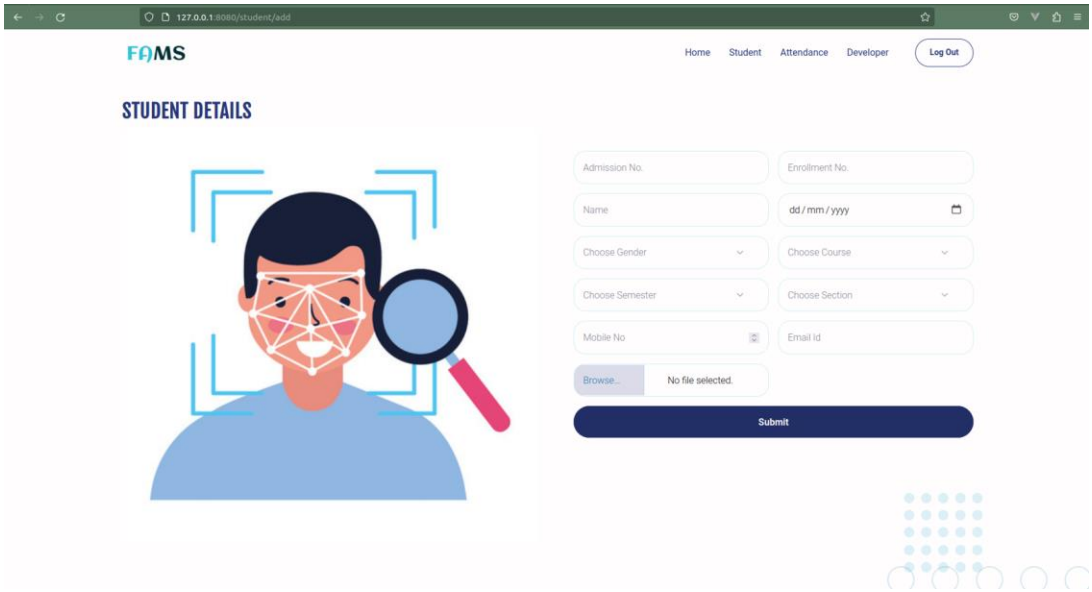


Figure 9 Add Student Page

The students can be added in the FAMS application by giving the details like admission no, enrollment no, date of birth etc. with one photo of the student that will be used for model training.

5. View Student page

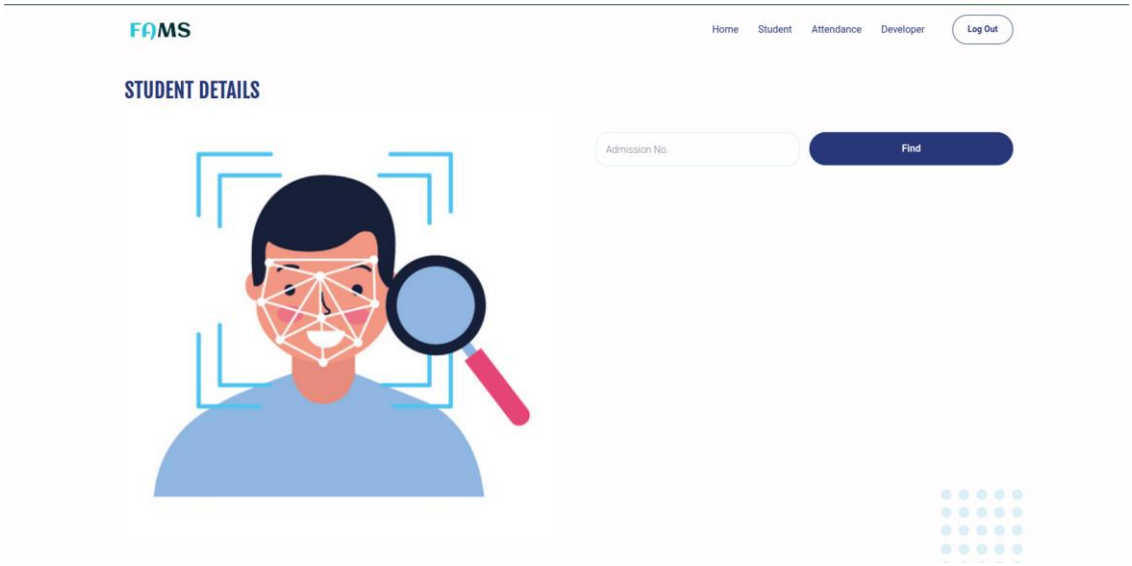


Figure 10 View Student

User will be able to view and update the details of the student by giving the admission no.

6. Attendance Home page

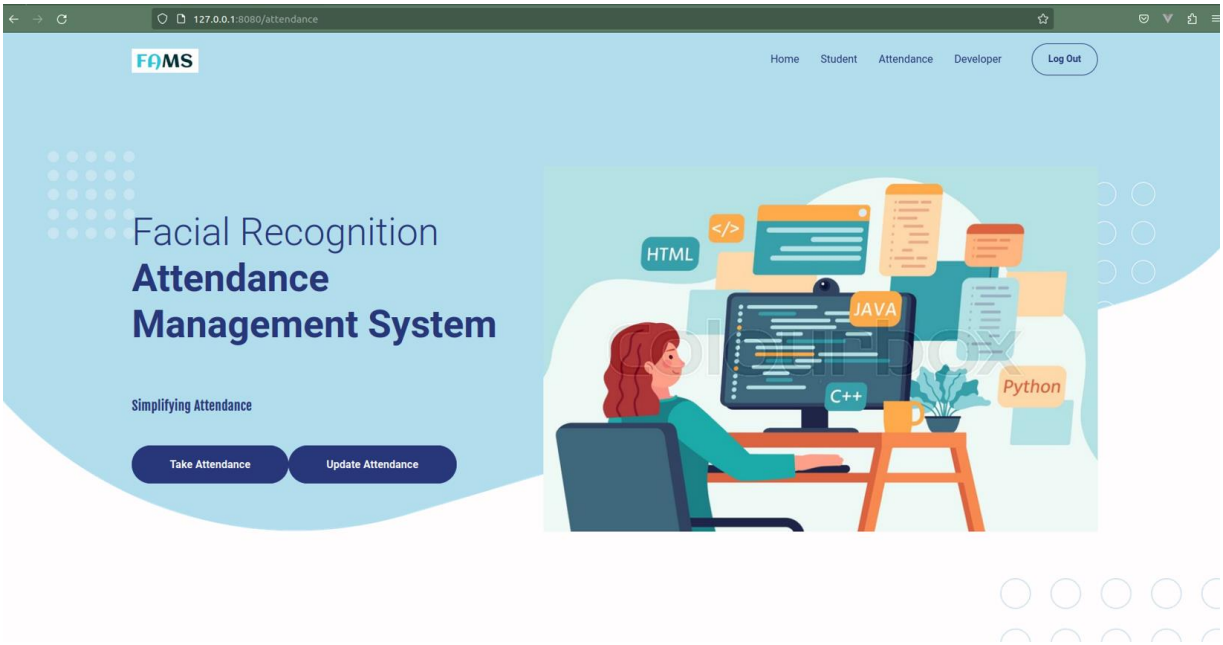


Figure 11 Attendance Home page snapshot

Here the teacher can take attendance or update the previously taken attendance.

7. Attendance detail page

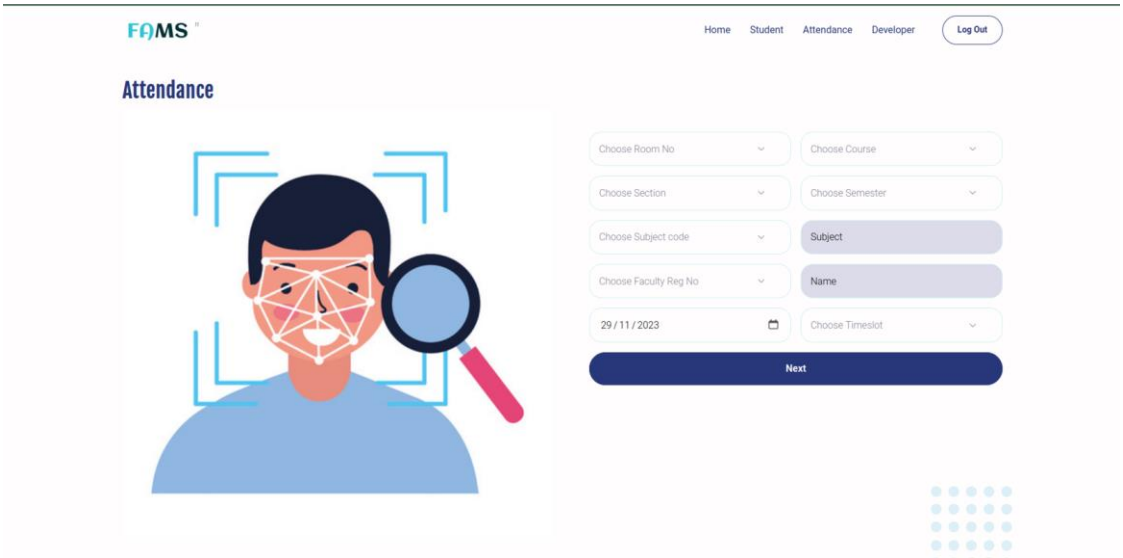


Figure 12 Attendance Details snapshot

The faculty has to fill the details mentioned like room no, course, semester etc. From the room no the CCTV camera of that particular room will open and with the help of course, semester and section the trained model will open accordingly as for each class there is different model for students.

8. Taking Attendance page

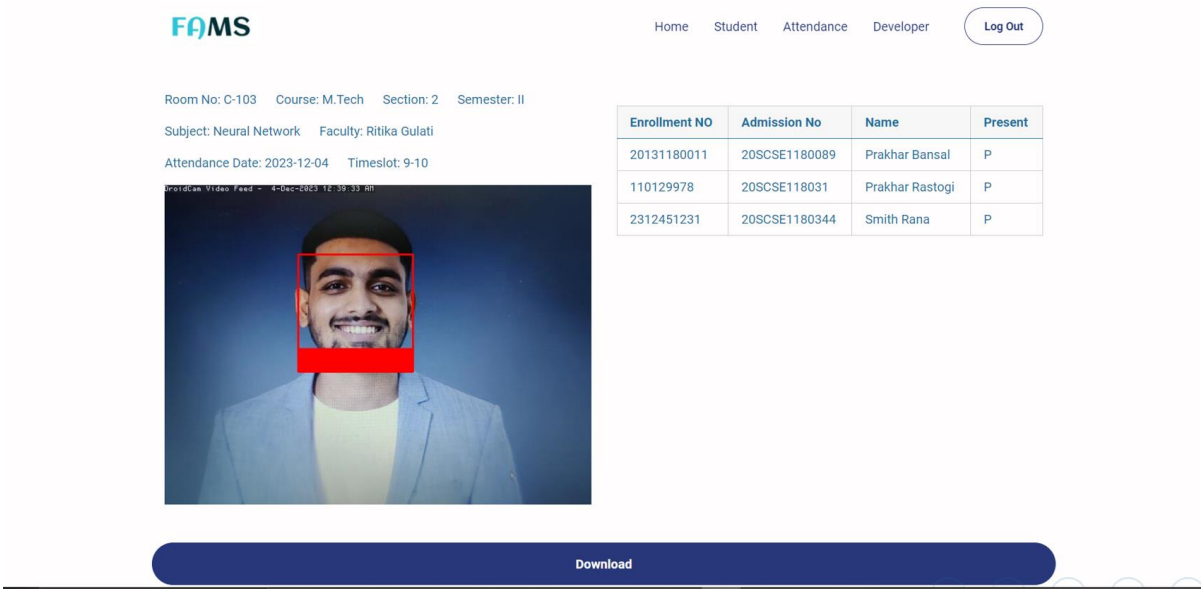


Figure 13 Taking Attendance page snapshot

The CCTV camera of that particular classroom will open in the left side and as soon as the student come In front of CCTV camera his or her name will come in the table present in the right side.

9. Update Attendance home page

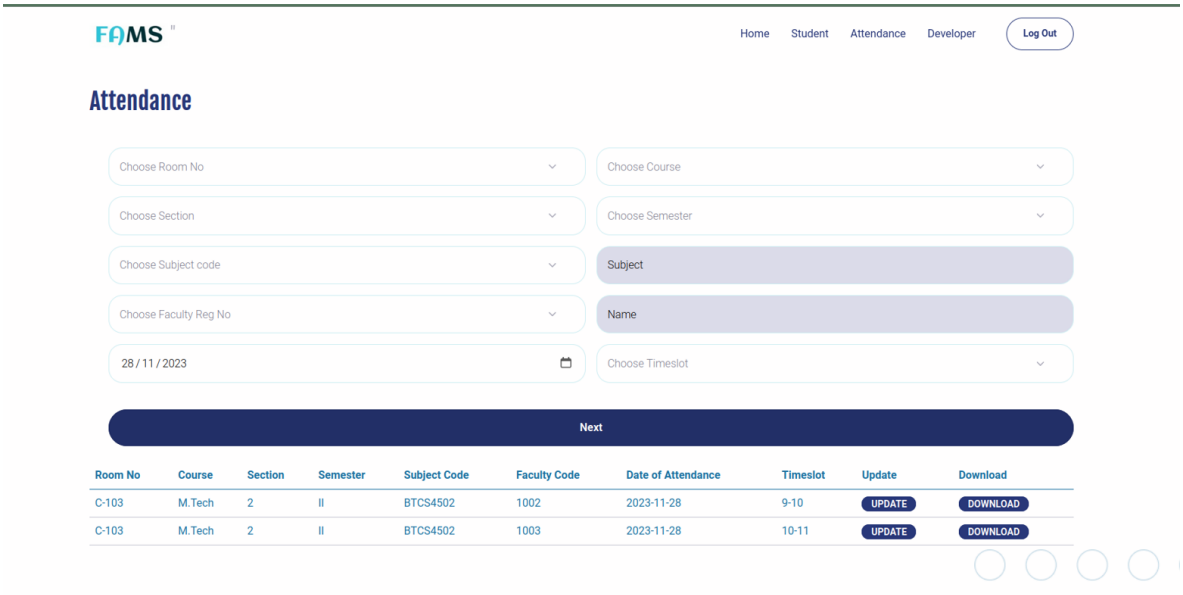


Figure 14 Update Attendance Home Page Snapshot

There might be possibility of incorrect attendance like a student may be left then the teacher can update the attendance manually by filling the details above. If the teacher does not fill all the details then all the rows will be fetched by values which are mentioned.

10. Update Attendance page

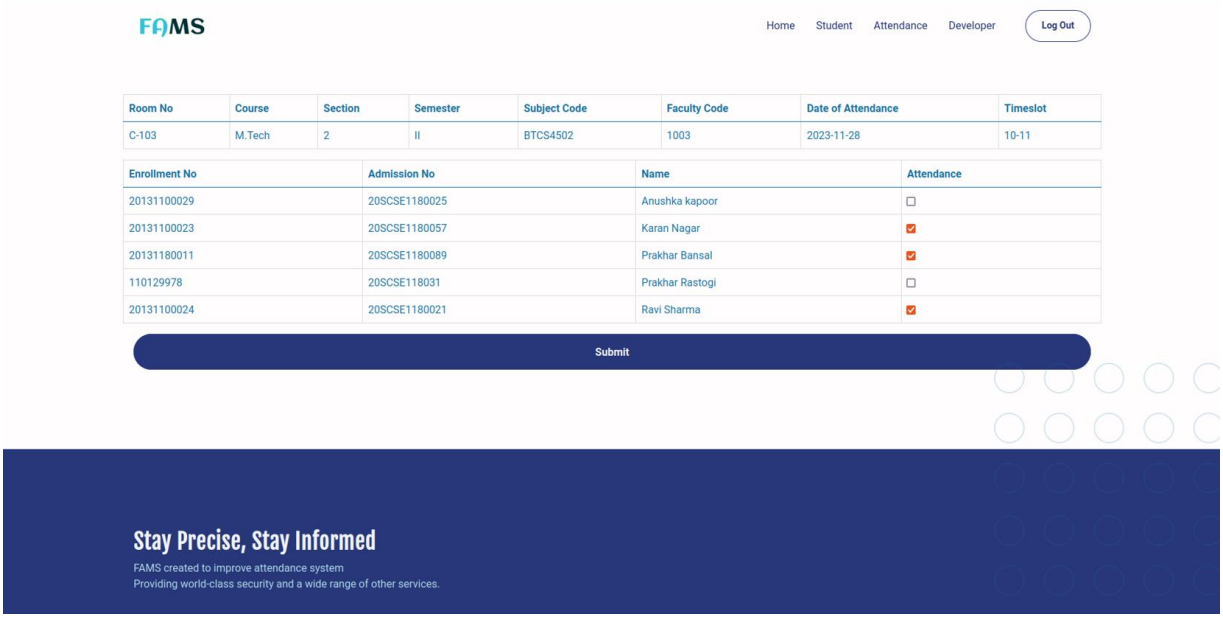


Figure 15 Update Attendance page snapshot

By clicking on the checkbox, the teacher can mark a student absent or present.

11. Download Attendance.

Enrollment No	Admission No	Name	Status
20131100029	20SCSE1180025	Anushka Kapoor	A
20131100023	20SCSE1180057	Karan Nagar	P
20131180011	20SCSE1180089	Prakhar Bansal	P
110129978	20SCSE118031	Prakhar Rastogi	A
20131100024	20SCSE1180021	Ravi Sharma	B

Table 1 Attendance Format

Here is the format of attached Excel file.

5.4.2 List of API's used

/details/room

/details/course

/details/timeslot

/details/faculty

/details/subjectcode

/details/subject

/details/attendance/<id>

/details/attendance/id

/details/coursename

/details/timeslot

/details/student/admission_no

/details/course/coursename

/details/semester/coursename

details/updateapi/room no/course/section/semester/subjectcode/faculty code/date of attendance/timelost

/logout

/student

/student/add

/student/update/room/roomno123/section/section_id

/attendance

/attendance/add/

/attendance/update/id

/attendace/download/id

/developer

/takeattenance/id

/login

/signup

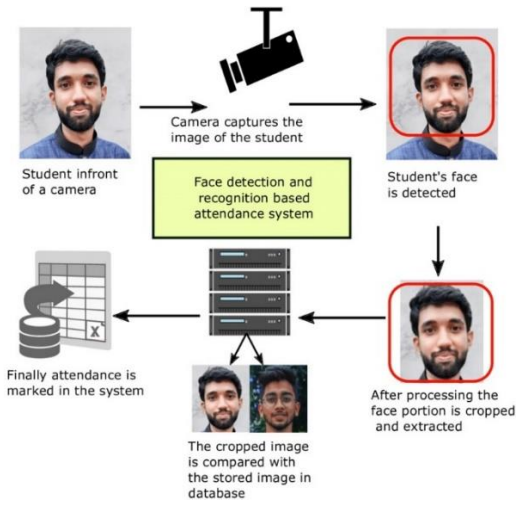


Figure 16 Proposed System

5.4.3 Model working

The "face_recognition" framework is a Python library primarily utilized for facial recognition and the analysis of facial features. It is constructed atop the widely acclaimed computer vision library known as dlib, with the aim of rendering facial recognition tasks more accessible to developers. Below, we present a concise overview of the workings of the "face_recognition" framework:

Face Detection: The framework initiates its operation by employing a pre-trained deep learning model to identify faces within an image or video frame. This process involves pinpointing the precise locations of faces within the input data.

Face Encoding: Following face detection, the framework proceeds to generate a distinctive facial encoding for each detected face. This encoding is essentially a vector composed of numerical values, serving as a numeric representation of an individual's facial characteristics.

Database Establishment: Developers typically construct a database or roster of recognized faces by encoding and storing the facial data of individuals whom they wish to identify. Each entry in this database is linked to a specific label or identifier.

Recognition: When the need arises to recognize faces within a new image or video frame, the framework commences by detecting faces within the input data and subsequently computes their facial encodings.

Comparison: The framework then undertakes a comparison between the freshly computed facial encodings and those residing within the known face database. It quantifies the similarity or dissimilarity between these encodings to ascertain the presence of a match.

Identification: Should a match be established with a known face within the database (signifying that the calculated encoding is sufficiently similar), the framework confers a label or identifier upon the recognized face based on the entries within the known face database.

Visualization or Execution of Actions: The specific application dictates how the framework is employed, which can range from tagging faces in photographs, providing access to a system, to triggering predefined actions upon the detection of a recognized face.

It is worth emphasizing that the "face_recognition" framework streamlines a multitude of intricate tasks within the realms of computer vision and machine learning, thereby simplifying the process of implementing facial recognition in Python applications. This, in turn, enables developers to concentrate on the higher-level aspects of their projects, rather than grappling with the intricacies of face recognition algorithms and data manipulation.

CHAPTER 6

CONCLUSION

The system is a web-based application integrated with a server that facilitates access to individual Closed-Circuit Television (CCTV) cameras designated for specific rooms or classes. Each classroom or designated area is equipped with its own CCTV camera, allowing the system to capture live images of students during class sessions.

To maintain accurate attendance records, the system utilizes face recognition technology, specifically employing the face_recognition framework, which is built on top of Dlib. This framework is selected for its notable accuracy and efficient speed in recognizing faces. Leveraging this technology, the system utilizes pre-stored face encodings associated with each student enrolled in a particular class. These encodings act as a unique identifier for each student's face, significantly reducing recognition errors.

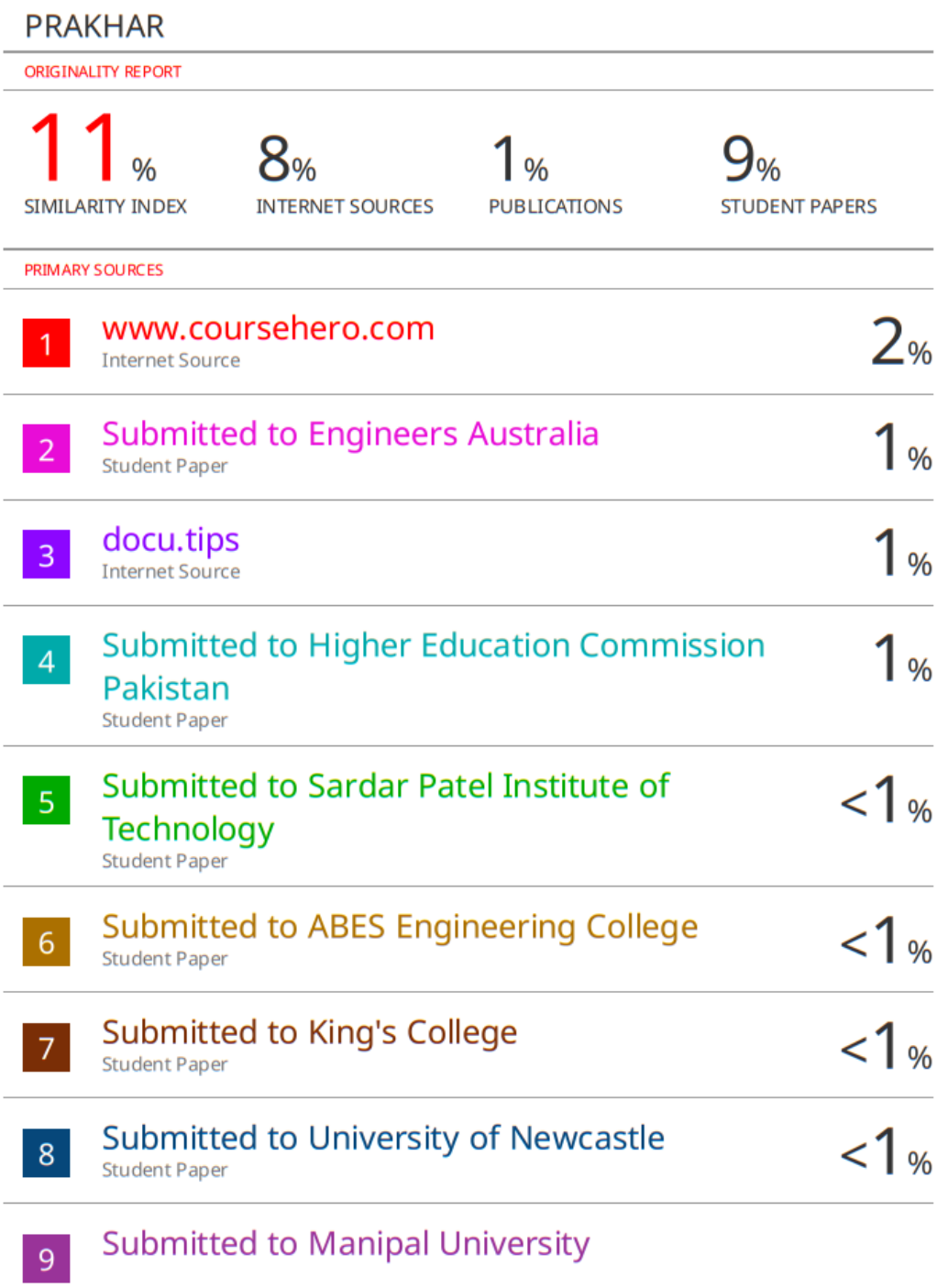
During class sessions, the system captures live images of the students present in the classroom using the CCTV cameras. These live images are then processed through the face recognition framework to match the detected faces against the pre-stored face encodings. This process enables the system to automatically mark the attendance of recognized students accurately.

The attendance records are promptly updated and made available on the students' attendance portal, allowing both students and instructors to track attendance in real-time. The portal displays the list of students present in the class, providing a transparent and easily accessible way to monitor attendance.

In cases where the system fails to automatically mark a student's attendance due to recognition issues or other factors, there is a provision for manual attendance updates. Instructors or designated personnel have the capability to manually update the attendance record for any student who was not accurately marked present during the automated process.

This comprehensive system provides a seamless and efficient method for managing class attendance through the integration of CCTV cameras, face recognition technology, and an accessible web-based portal. Its reliance on accurate face recognition ensures reliable attendance tracking while offering the flexibility for manual updates to maintain accuracy in attendance records.

Appendix A



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References

[1] Abhilash Bhise, Radhika Khichi, Anmol Korde “Attendance System Using NFC Technology with Embedded Camera on Mobile Device”

[2] Devendra Yadav, Shashank Pujari, Sumit Singh, Pragyan Mishra “Fingerprint Based Attendance System Using Microcontroller and LabView.”

[3] Jasem Malgheet, Noridayu Manshor, “Iris Recognition Development Techniques: A Comprehensive Review.”

[4] Elima Hussain, Priyanka Dugar, Abdul Hannan, Vaskar Deka, “RFID Based Student Attendance System.”