Facial Recognition and Machine Learning-based Student Attendance Monitoring System

Abstract:

AI-based student monitoring system provides an innovative approach that enables schools and institutions to monitor student attendance performance and behavior. By utilizing cutting-edge technologies like face recognition, the system makes it easier for teachers to keep track of students' attendance while also giving administrators useful information. The technology automatically logs student attendance, doing away with the necessity for manual human attendance taking. Each student's attendance rate is determined, and the attendance analysis is made available. Administrators can more easily identify students with strong or poor attendance records thanks to the visualization module of the system, which presents attendance data as a graphical representation. Administrators can use this function to ensure that students attend classes on a regular basis. Additionally, the system notifies students and their parents through email when a particular level of attendance is not met, encouraging students to improve their attendance by taking appropriate action and fostering accountability. The AI-based student monitoring system is a useful tool for teachers and students. It helps to raise academic attainment by promoting an accountability and attendance culture in organizations and institutions. The system also provides administrators with useful data and minimizes the effort for educators.

SECTION I.

Introduction

Attendance monitoring is an essential task in educational institutions, and it plays a crucial role in student management. Manual attendance taking can be a tedious and time-consuming task for teachers, which can hinder their focus on teaching.

Our AI-based student monitoring system is designed to simplify this task and provide valuable insights to school administrators. With the help of face recognition technology, our system automatically records student attendance, eliminating the need for manual attendance taking. The use of mobile and web applications is said to be more effective and efficient because of the ease in accessing and retrieving information.[5]

The system calculates the attendance percentage of each student and generates subject-wise attendance reports, providing administrators and teachers with a quick and easy overview of attendance patterns in their institution. The attendance reports can be used for further analysis, enabling teachers to identify students who may be at risk of falling behind academically due to poor attendance.

The visualization module provides a graphical representation of attendance data, making it easier for administrators to identify students who have good or poor attendance records. By analyzing the attendance patterns, school administrators can take corrective actions to promote a culture of attendance and accountability among students.

The system sends alerts to students and their parents via email when their attendance falls below a certain threshold, promoting responsibility and accountability among students. The alerts ensure that students are aware of their attendance records and take corrective actions to improve their attendance. The system not only helps to improve academic performance but also promotes a culture of attendance and accountability in organizations and schools.

Technology Stack/Face Recognition And Analysis

A. Face detection and recognition

The AI-based student monitoring uses machine learning algorithms to analyze Student Attendance and Face-recognition Based Attendance. Based on the analysis, the system provides actionable insights to educators and administrators to help them better understand their students and identify any potential issues. The AI-based student monitoring system was developed using the haarcascade_frontalface_alt.xml and haarcascade_frontalface_default.xml classifiers for face recognition. Haar classifiers are used in camera capture images to train [2],[3]. The haarcascade_frontalface_default.xml and haarcascade_frontalface_alt.xml are both pre-trained classifiers in the OpenCV library that are used for detecting faces in images or video frames. These classifiers use a machine learning algorithm called Haar cascades, which analyses the pixel values in an image and identifies patterns that resemble human faces.

In a AI-based student monitoring, these classifiers are used to detect the face of the student in the image captured by the camera during the attendance marking process. LBPH stands for Local Binary Patterns Histograms. The LBPH algorithm is a method which is used to recognize a face [1]. It is a simple yet effective face recognition algorithm that uses local binary patterns to represent the texture of the image and a histogram of these patterns to encode the face. Once the face is detected, the system can then use a trained model to recognize the student and mark their attendance.

B. Student Analysis

For the analysis module, We use Flask, a micro web framework, to develop the system's web interface, which allows the admin to view attendance analysis generated by the system's face recognition module. The attendance data is analysed using the pandas library, which is a popular data manipulation and analysis library in the data science community. Additionally, we use matplotlib, base64, and BytesIO libraries to visualize the data in an easy-to-understand format.

C. Email Notification

To notify students and parents of low attendance, we use the email.mime.multipart and email.mime.text libraries to send email notifications. These notifications are sent using the Google email service and are triggered when the attendance data falls below a certain threshold. Overall, the AI-based student monitoring system uses a variety of technologies to provide accurate attendance tracking and academic progress monitoring while also ensuring effective communication with students and parents.

Attendance Systems

A. Existing System

1. Roll call: One of the most common attendance systems is the roll call method, where teachers or other personnel take attendance by calling out each student's name and recording whether they are present or absent. It can be time-consuming and prone to errors. Teachers may mishear or misspell student names, and students may respond incorrectly or not at all, leading to inaccurate attendance records.

2. Sign-in sheets: Another traditional attendance system involves using sign-in sheets, where students physically sign their names to indicate their presence in a classroom or other learning environment. Passing an attendance sheet from one student to the other to sign takes time as well as causes distraction [4]. In addition, sign-in sheets can be lost or damaged, leading to lost attendance records.

3. Hand raising: In some cases, teachers may simply ask students to raise their hands to indicate their presence in class. Relying on hand raising to take attendance can be subjective and prone to errors, particularly if a large number of students are present in the classroom. Students may not raise their hands consistently, or teachers may not accurately count the number of students who raise their hands.

4. Classroom door monitoring: In this traditional attendance system, teachers or other personnel monitor the entrance to a classroom to record which students enter or exit the room. This method can also be prone to errors, particularly if students enter or exit the room without being seen by the person monitoring the door. In addition, this method may not be feasible for larger classes or for classes held in multiple locations.

5. Barcode scanning: Some traditional attendance systems involve using barcode scanners or other types of scanners to scan student IDs. While barcode scanning can be a more efficient way to take attendance than some of the other traditional methods, it can be costly to implement and may require additional equipment or software. In addition, barcode scanning may not be feasible for all types of student IDs or other identification documents.

B. Issues faced with manual attendance system

Manual student attendance systems have been used in educational institutions for many years, but they are not without their issues. Here are some of the issues with manual student attendance systems:

1. Time-consuming: Taking attendance manually is a time-consuming task for teachers, as they have to call out the names of each student, wait for them to respond, and then mark their attendance in a register or on a sheet of paper. This process can take up valuable class time and distract from teaching and learning.

2. Human error: Manual attendance systems are prone to errors due to the possibility of human error. Teachers may accidentally mark a student present when they are absent or vice versa, leading to inaccurate attendance records.

3. Inefficiency: Manual attendance systems can be inefficient, especially in large classes or schools. Teachers may struggle to keep track of attendance for all students, leading to incomplete records or errors.

4. Lack of real-time information: With a manual attendance system, attendance information is only available after it has been recorded, making it difficult for administrators to access real-time information about student attendance. This can make it challenging to identify patterns or trends in attendance and to intervene when necessary.
5. Difficulty in analysis: Manual attendance systems make it difficult to analyze attendance data. For instance, it can be challenging to identify which students are consistently absent, which classes have high or low attendance rates, or which teachers have better attendance records.
6. Data security: Manual attendance systems are susceptible to data breaches and security risks. Attendance records may be lost, stolen, or misused, leading to privacy and security concerns. Students can potentially forge signatures, or staff members may falsify attendance records for personal reasons or to manipulate statistics. There were many cases of student making false attendance by asking their college to sign on their behalf.[6]

Beneficiaries

A. Teachers/Administrators

Oftentimes, Teachers are required to manually take attendance be it by calling out their names, signature recording, maintaining records etc which is a tasking job. Managing student attendance data can be challenging, and the existing solutions are often complex and difficult to use . The AI-based student monitoring system aims to address these problems and provide a more efficient, secure, and user-friendly solution for tracking student attendance like displaying graphical representation of student attendace record, showing subject wise attendance etc. It also provides a more accurate and up-to-date record of student attendance, reducing the risk of error, By providing analysis of students attendance and sending email notification, most of the work is efficiently wrapped.

B. Students

Students no doubt lead a busy life and it is a possibility, they might lose track of their attendance. Thus, by providing them a means to be kept up to date by sending them email notification whenever their attendance is low helps in maintenance of each student's attendance and thus improving academic achievement.

C. Parents

There can be times when parents are left out of loop when it comes to their wards attendance so, To keep the parents up to date and encourage more parent engagement, This system provides with a way for them to keep informed of their child’s attendance by sending them an email every time attendance of their child is not up to a certain criteria.

Flow Of Modules/Methodology/Proposed Solution

The proposed model is a Flask application for marking students’ attendance and a web system enabling administrators to access the student’s attendance analysis and allowing them to send mail to the defaulters.

1. Face Recognition Module: This module would be responsible for capturing images of students as they enter the classroom and comparing them with the preexisting database of student images to mark attendance.

2. Attendance Management Module: This module would store attendance data for each student for each subject, along with the corresponding date and time stamp.
3. Analysis Module: This module would perform analysis on the attendance data collected for each subject, such as calculating the percentage of attendance for each student, identifying students who are frequently absent, and generating reports on subject-wise attendance.
4. Overall Attendance Analysis Module: This module would provide an overview of the attendance data collected across all subjects, such as the overall attendance percentage of the attendance.
5. Visualization Module: This module would provide visual representations of the attendance data, such as graphs and charts, to help teachers and administrators quickly identify patterns and trends in student attendance.
6. Email Functionality Module: This module would enable teachers and administrators to send automated emails to students and their parents notifications about poor attendance.

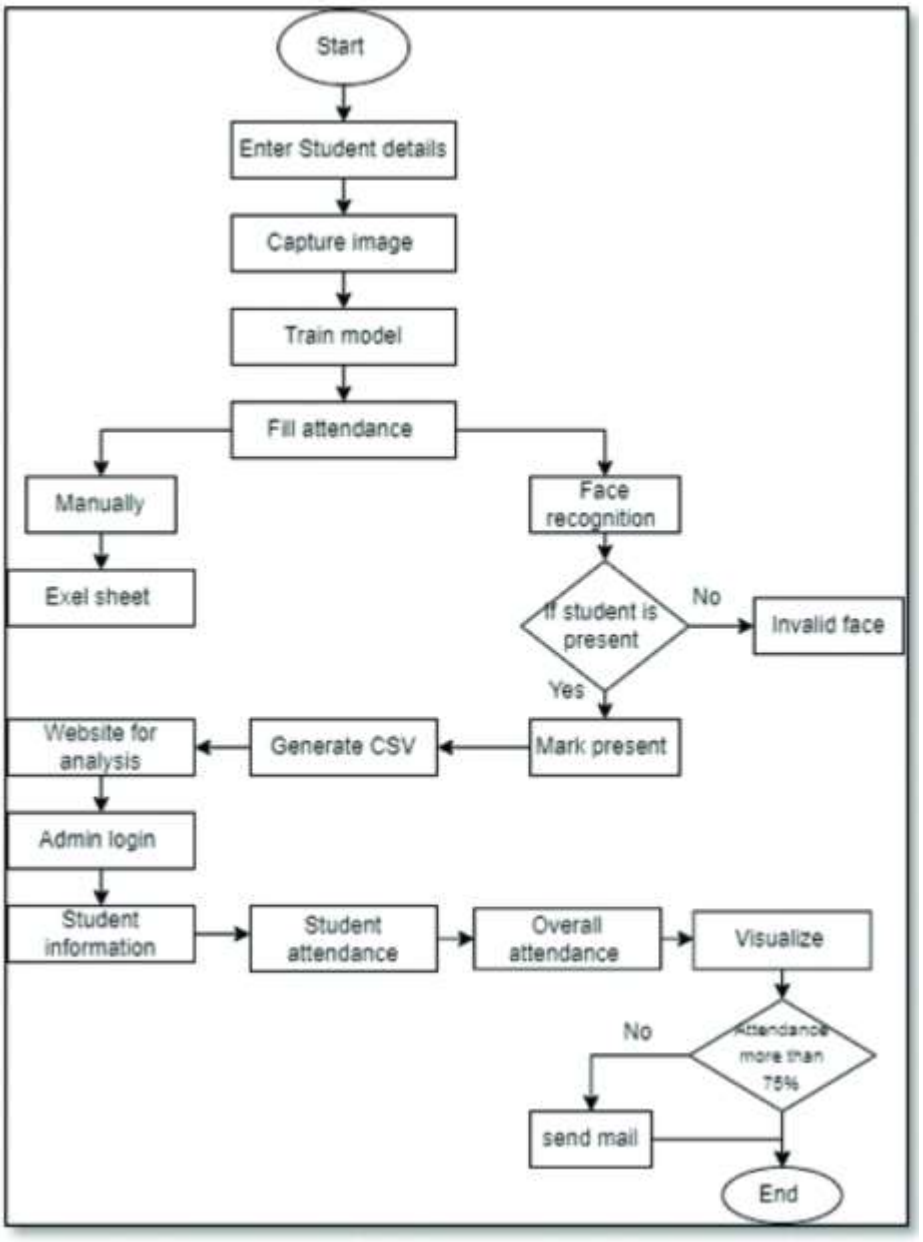


Fig. 1. Activity Diagram

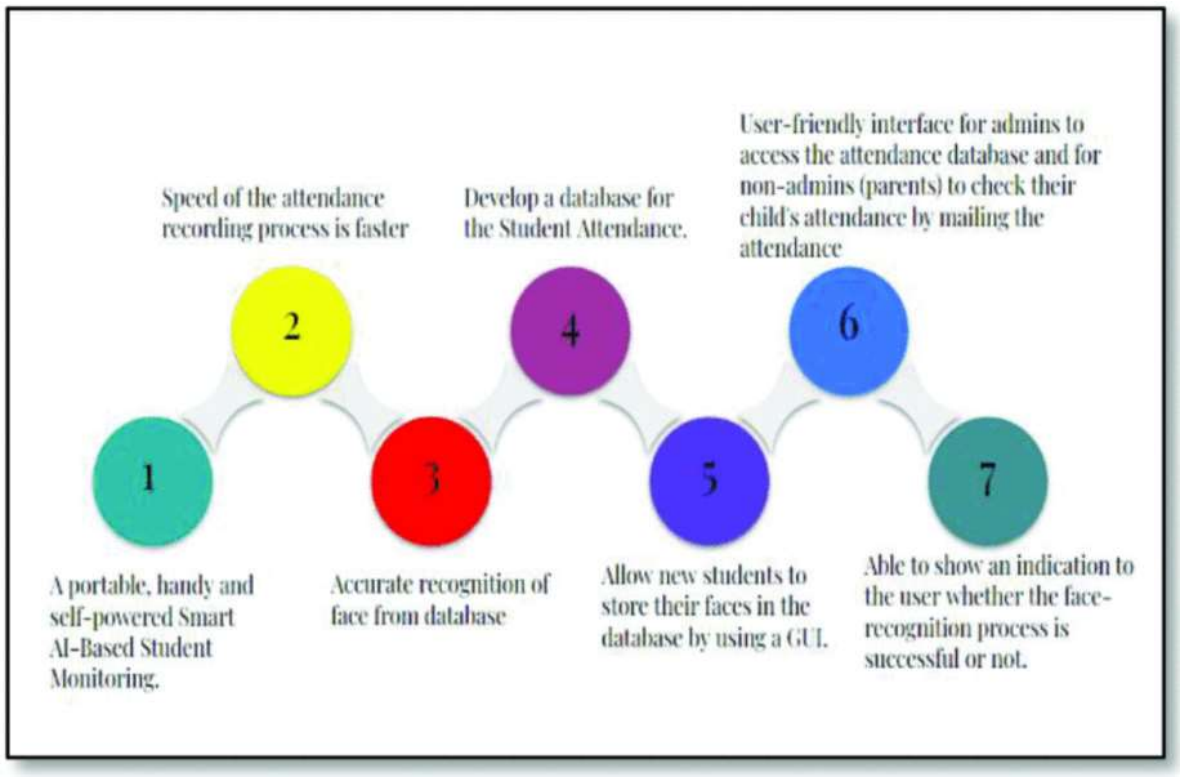


Fig. 2. Flow Of Modules

The above diagram displays an outline for the flow of modules implemented in our project.

Result Analysis

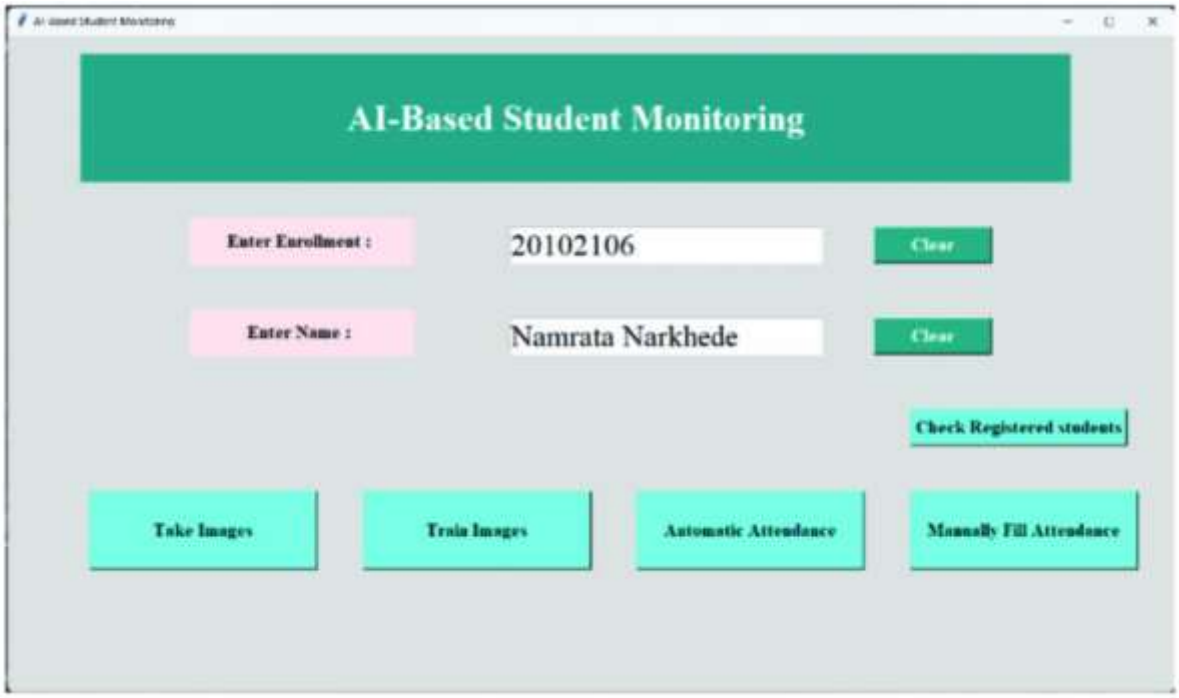


Fig. 3. Register Student

Here, we are registering the students by adding their name and Enrollment no.

Fig. 4. Take Image

Here we are taking the image of the student and then training the model.

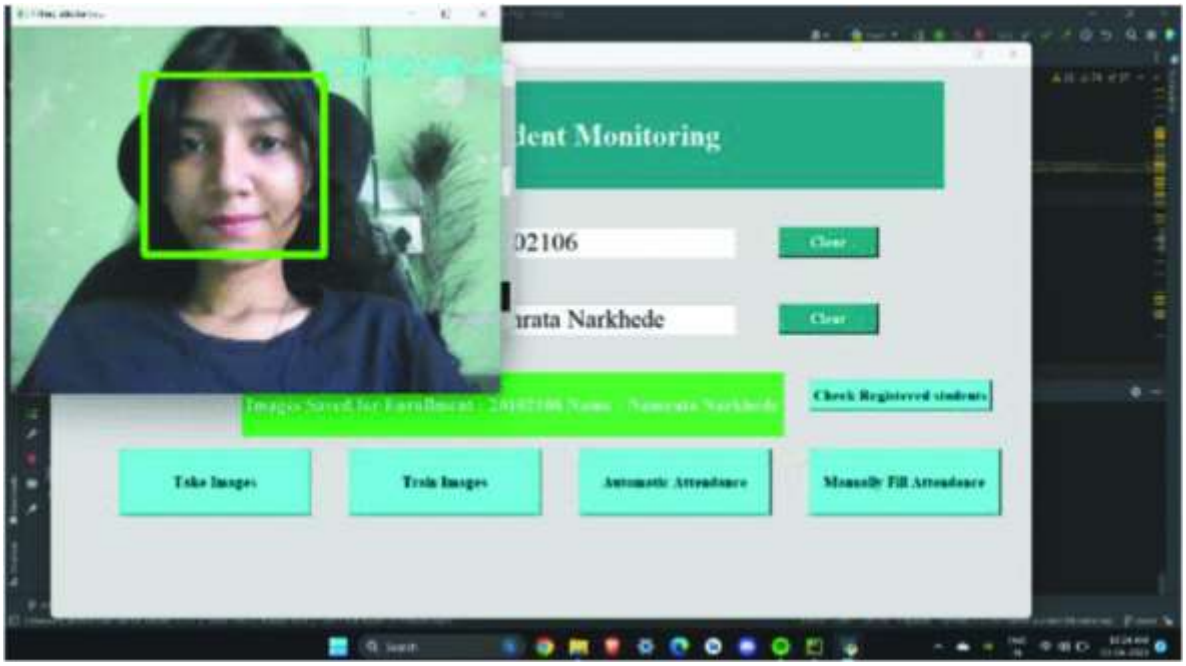


Fig. 5. Face Recognition Module

Then the image is stored in the database. Now by clicking automatic attendance, the students face is detected, and their attendance is marked for particular subject entered. Attendance can also be marked manually.

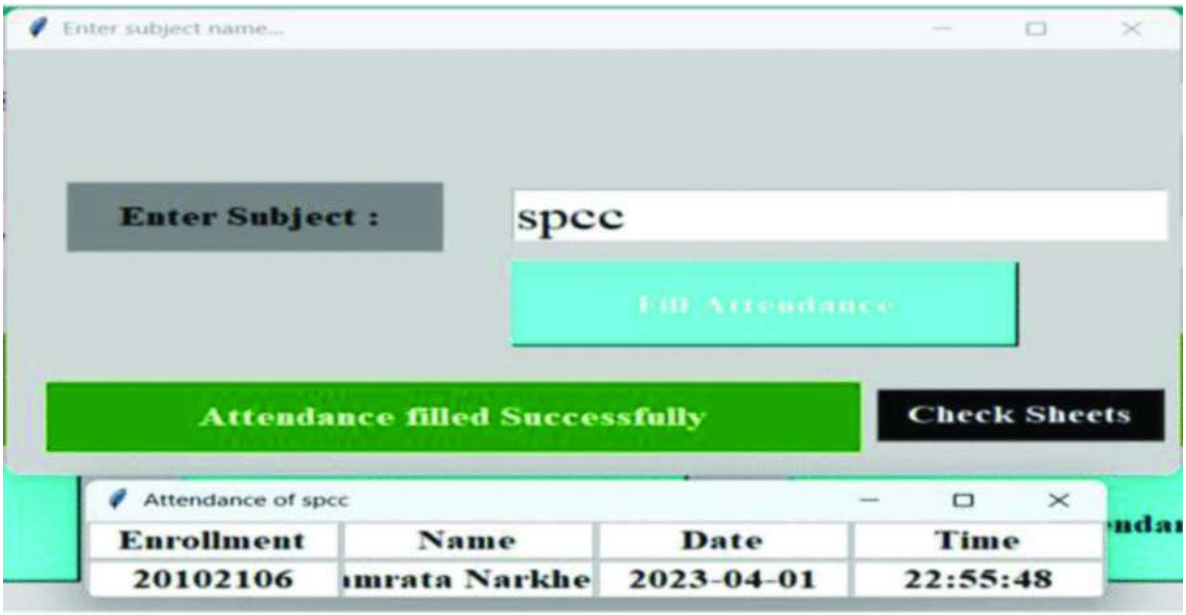


Fig. 6. Attendance Management

Teacher enters subject name and take the attendance by clicking on Fill Attendance then the window will be pop up for face recognition for detecting the face of student and mark their attendance.

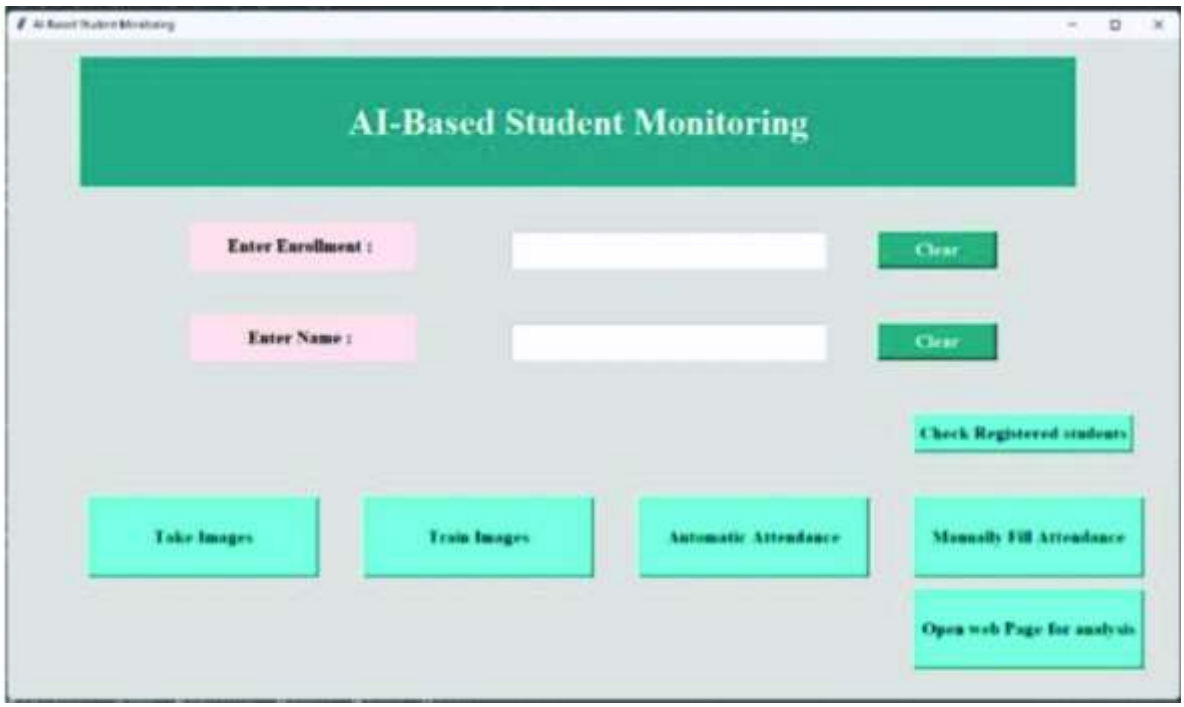


Fig. 7. Button for Accessing Website

By clicking on this button the Teacher/Admin would be routed to the website.

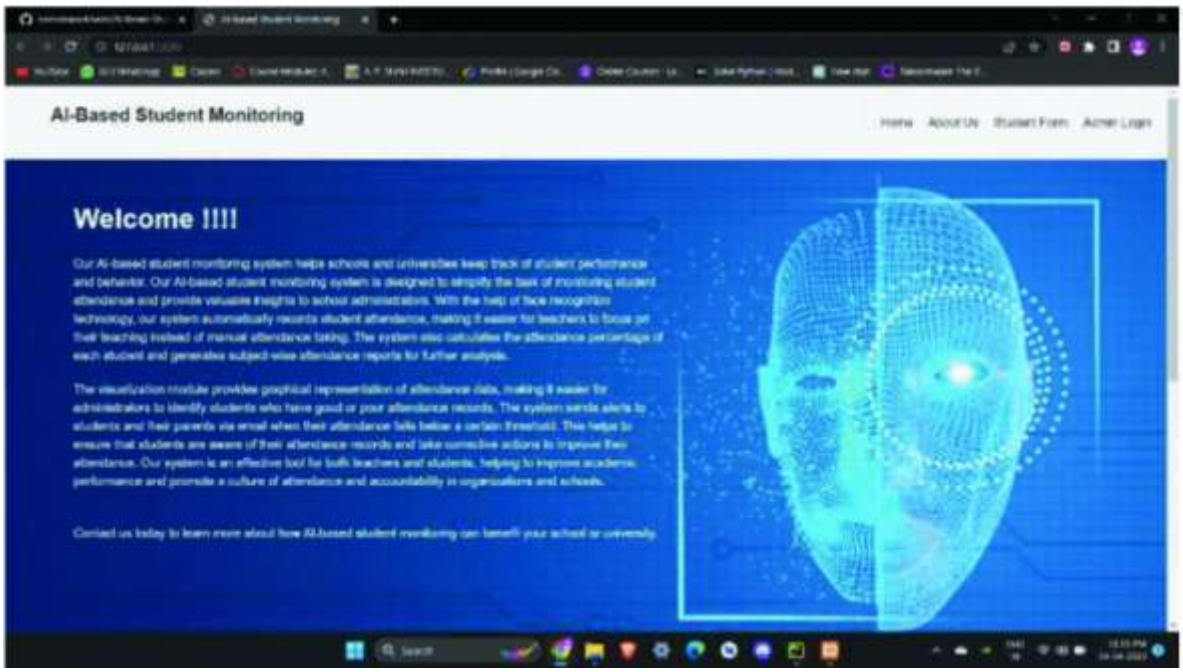


Fig. 8. Homepage

This is our website to show students attendance analysis.

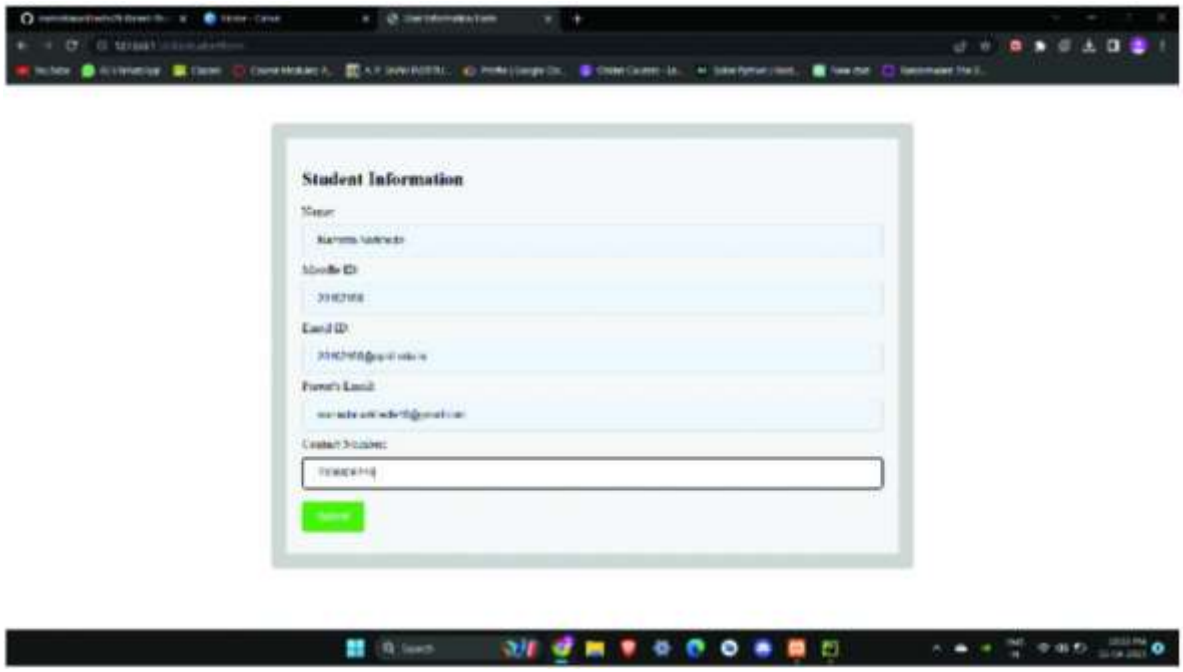


Fig. 9. Student Information Form

Here the information of students is to be submitted by admin.

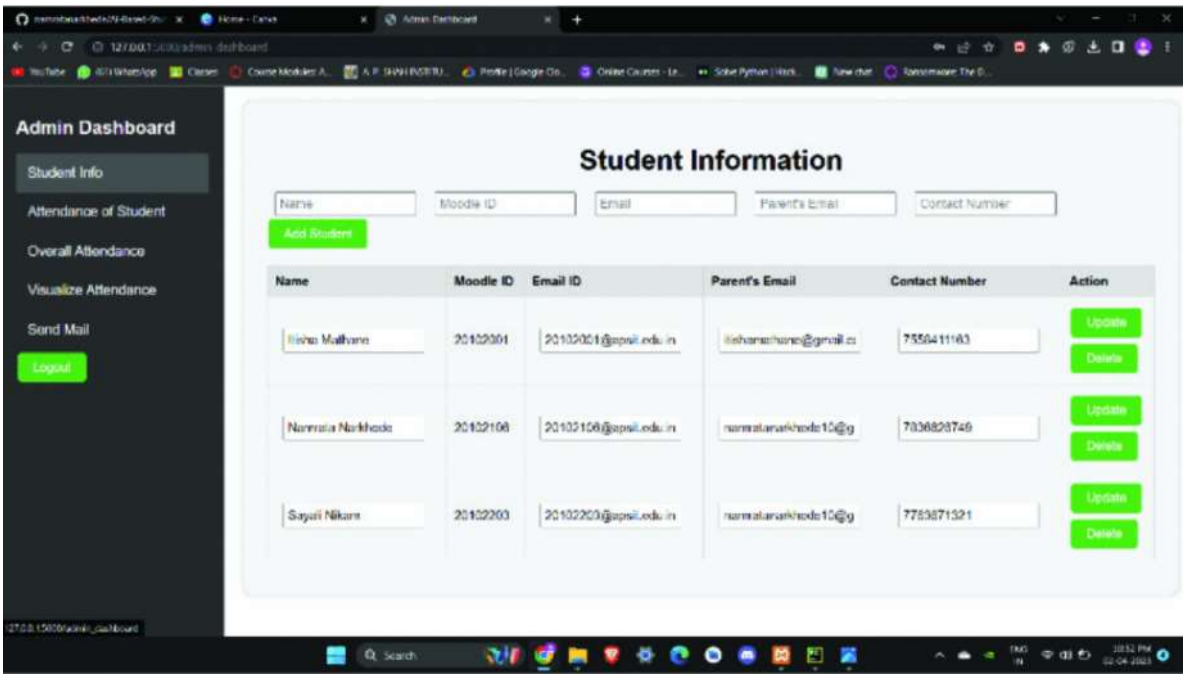


Fig. 10. Student Information

The student information will be visible in the student info section in tabular format.

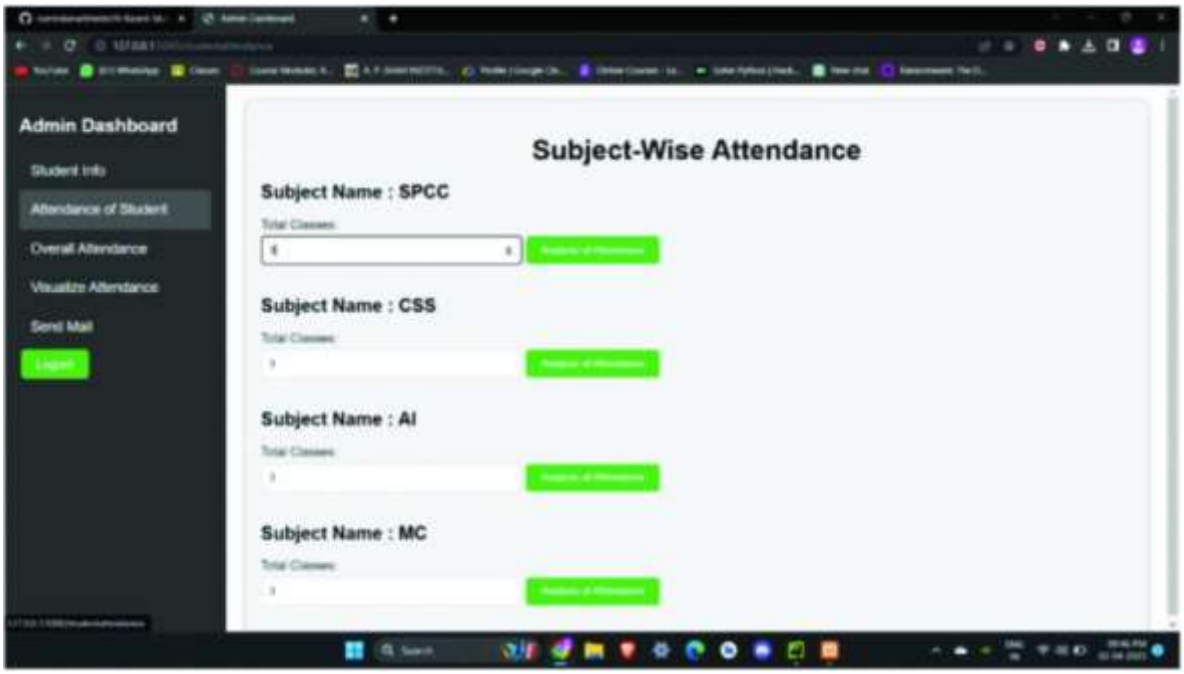


Fig. 11. Subject-Wise Attendance

Here in attendance of Student after entering total number of classes of any subject we can see the attendance count and percentage of each student individually.

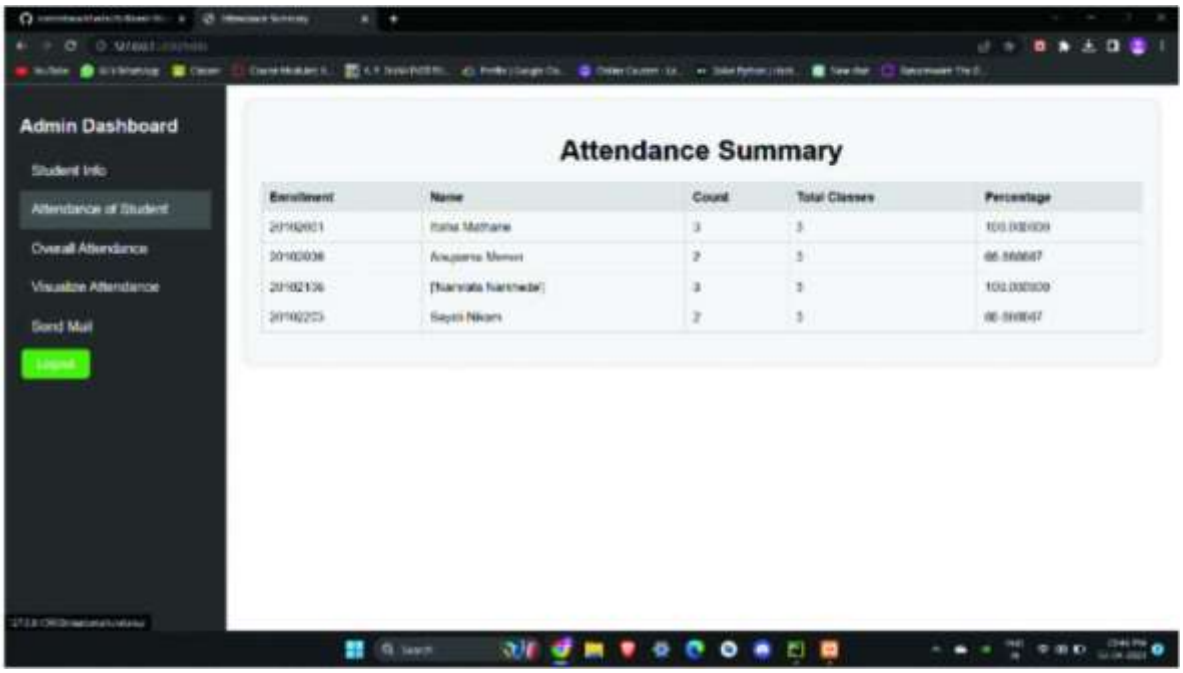


Fig. 12. Attendance Summary

Here for the particular subject the attendance and analysis is displayed.

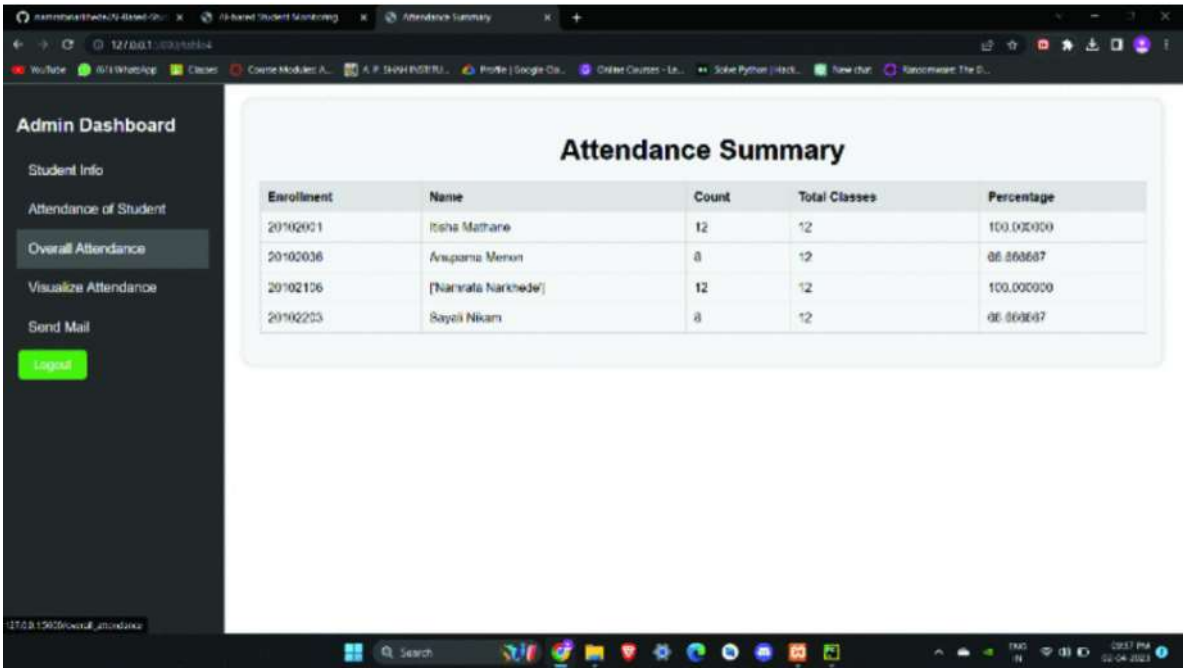


Fig. 13. Overall Attendance Summary

Admin can also check overall attendance for all subjects combined.

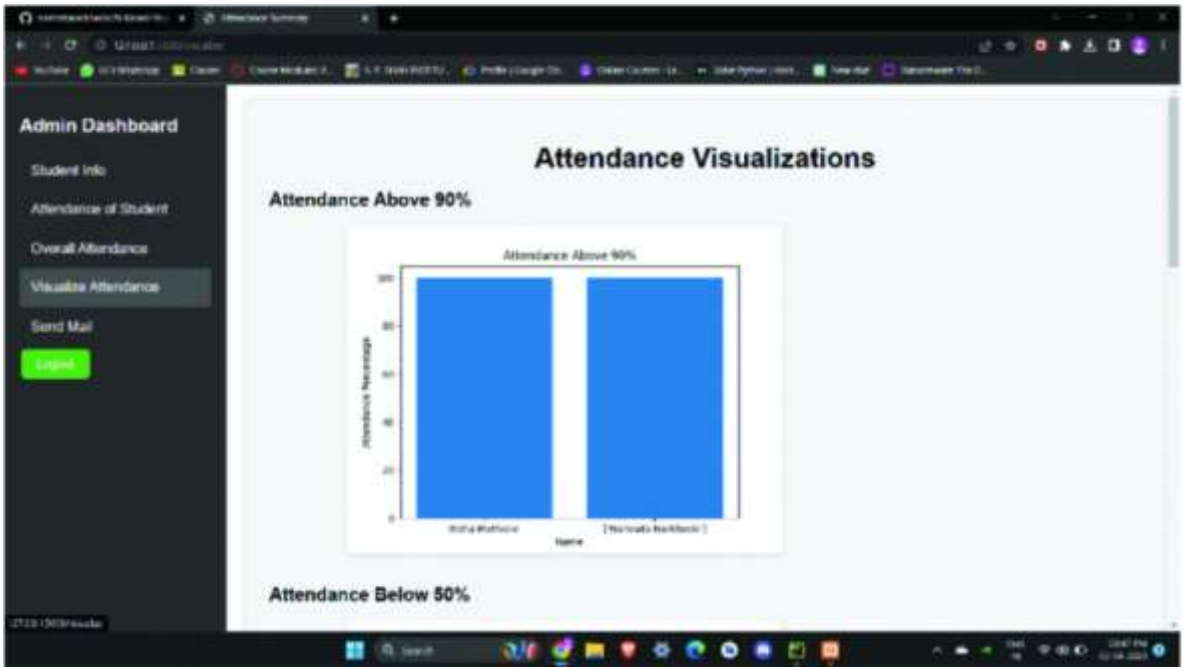


Fig. 14. Attendance Visualization

In the visualize attendance section admin can see a visual representation of percentage of classes attended by each student.

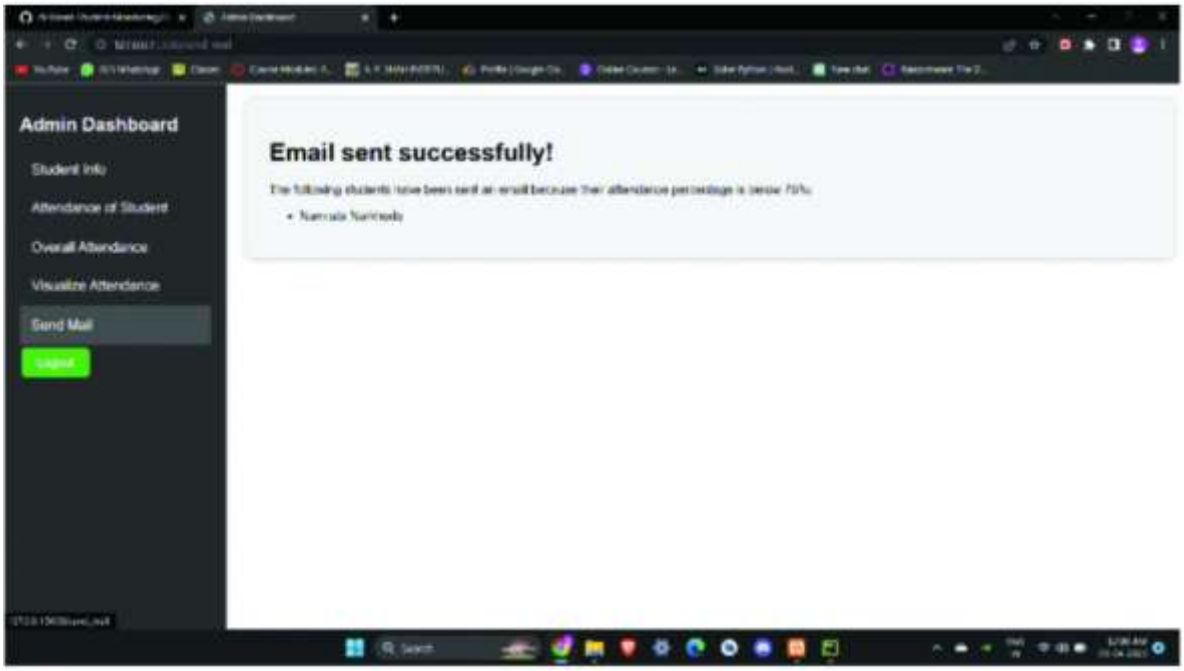
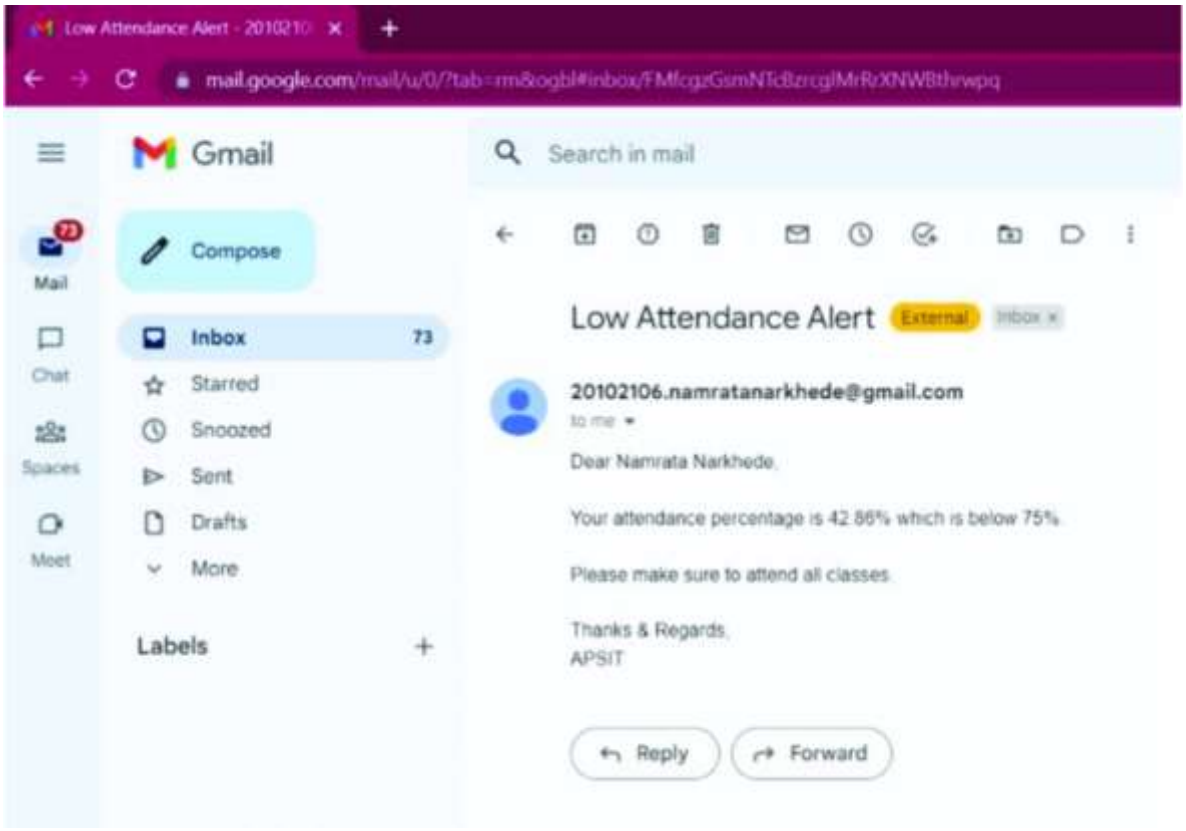


Fig. 15. Send Email Notification

In the send email section admin send email to defaulter.



ig. 16. Email Notification

Email sent to the defaulter student displaying their attendance percentage.

Future Scope

However, as with any technology, there is always room for improvement and enhancement. In terms of future scope, there are several areas where an AI-based student monitoring system can be further enhanced to provide better services and features. One such area is the integration of learning management systems (LMS). LMS is software that allows educational institutions to manage their online and offline learning activities. By integrating the student monitoring system with LMS, educational institutions can provide a more comprehensive view of student progress and engagement. For example, if a student is struggling with a particular subject, the system can provide personalized feedback and support to help the student improve their performance.

Another area where the system can be enhanced is the use of natural language processing (NLP) capabilities. NLP is a technology that allows computers to understand, interpret, and generate human language. By integrating NLP capabilities, the system can provide personalized feedback and support to students based on their learning styles and preferences. For example, the system can use NLP to identify the areas where a student is struggling and provide personalized feedback to help the student improve their performance.

Additionally, the system can be integrated with other school systems such as student information systems, transportation systems, and security systems. By integrating these systems, the system can provide a more holistic view of student activities and behavior. For example, if a student is absent from school, the system can use the transportation system to check if the student has taken the bus to

school. If the student has not taken the bus, the system can alert the school administration to take appropriate action.

Conclusion

In conclusion, the AI-Based student monitoring system can provide significant benefits to educational institutions and their stakeholders. The system's advanced features and functionalities can streamline administrative tasks, reduce errors, and provide timely and accurate data to teachers, administrators, students, and parents. By using facial recognition technology and machine learning algorithms, the system can accurately track student attendance and analyze attendance and academic data to identify trends and patterns. This can help teachers and administrators to proactively address absenteeism and identify areas where students may need additional support or interventions.

Moreover, the system's user-friendly interface allows teachers and administrators to view attendance and academic data in real-time, which can help them make data-driven decisions about student support and interventions. They can easily monitor students' progress, identify areas of concern, and provide targeted support to ensure that students stay on track to meet their academic goals. Additionally, the system can provide a comprehensive view of student engagement and performance, which can help administrators and policymakers make informed decisions about resource allocation and curriculum development.

Furthermore, the system can send timely notifications to students and parents about low attendance and academic progress, which can help improve engagement and performance. Students and parents can receive notifications via email or text messages, which can remind them of upcoming deadlines, assignments, or exams. This can help students stay organized and motivated, and parents can stay informed about their children's academic progress and provide additional support where necessary.