

Institute Attendance management system

IAMS - software development project

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Abstract—As students seek to find ways to go around the system, the difficulty of having an effective attendance monitoring system is a never-ending problem. This study describes a relatively failsafe and moderately cost effective system for managing attendance in institutes that uses cameras and a face detection algorithm.

Index Terms—attendance, camera, mobile application, face detection, facial recognition

I. INTRODUCTION

Professors and institutes use attendance at schools and colleges to determine a student's dedication and interest in classes. It's also crucial because it allows teachers to observe the students' constancy and establish a rapport with them. Attendance can sometimes be a useful tool in detecting any mental health concerns that a student is experiencing.

These are some of the reasons why most colleges stress upon the necessity for 75% compulsory attendance [1]. Many studies have demonstrated that a student's attendance percentage correlates with their exam success rate and grades.

Despite the fact that attendance is critical in a student's life, students from all fields and universities around the world have discovered ways to work around the system. Because a professor's goal is to teach and enlighten the class, there must be a strict and foolproof attendance control system in place to ensure that all students are awake, active, and present in order for the class to be successful.

In order to plan for potential future leaves, such a system should also tell pupils about their present attendance %. In this approach, students should also be given the opportunity to submit a valid cause for their absence. More significantly, the system should ensure that the class is not disrupted and that the professor can continue teaching without interruptions or a dramatic decline or spike in student numbers. For a system to be adopted on a big scale in all of an institution's classrooms, it must be relatively cost effective. [12].

II. LITERATURE REVIEW

In a classroom, the attendance procedure is complicated since it requires correct attendance labelling for each student against their role numbers. When considering an attendance management system, one of the primary issues is the time and resources spent on the procedure. A great deal of research has gone into the hunt for such a system, which uses a variety of technologies such as barcode scanning, RFID tagging, bio-metric systems, facial detection, and others. This section provides a quick overview of these strategies, as well as their benefits and downsides.

A. Paper-based attendance control

This is one of the oldest and most often used methods of maintaining attendance at many academic institutions. In this system, a person, generally the instructor, has a list of the students for the specific course, and when the names are called out, the names are marked present. Although this is an effective method of attendance because it ensures the authenticity of the student's presence, it is not only time consuming for both students and professors, but it also disrupts the flow of the class and necessitates manual effort in centralising the data, which leads to human errors.

B. Fingerprint based attendance system

The attendance of the pupils is noted in this method by a gadget that recognises the student's fingerprint, so registering the attendance [4]. This approach is relatively successful since it lowers phoney attendance and assures student participation in class. [3]. The drawbacks of this system are

- It is time consuming as a large number of the student require a significant amount of time on the fingerprint device and it can result in the distraction of students from the class.
- There is chance that students can give attendance by their fingerprints and then later leave the class.
- It can also be costly as many such devices are needed to record the fingerprints.

C. Face detection based attendance system

This technology of recognising students' faces during class using software that recognises faces from a photo shot with a high-definition camera is an effective method since it assures

students' attendance in class. [6]. One of the minor limitations of this system is that it requires a powerful algorithm to support it. It also occasionally fails to accurately register faces, resulting in absenteeism for pupils who are present in class. [13].

D. Iris based attendance system

The irises of kids are scanned to register attendance in this attendance control system. The benefit of this technique is that it prevents phoney attendance and is simply recorded and preserved. [5]. The drawbacks of this system are

- This system is a very expensive one and needs a lot of infrastructure in order to work.
- It can be time consuming as students might have to wait in long queues to mar attendance.
- There is chance that students can give attendance and then later leave the class.

E. Mobile based attendance system

During the lesson, pupils are given a unique id in this system to track their attendance. The pupils then type this code into the programme, and accurate code entry guarantees that the attendance is recognised. [7]. This method is successful since it is based on a centralised system, does not require costly hardware installation, and is not time demanding. The main disadvantage of this approach is the possibility of fraudulent attendance, since students may pass on the code to friends who are not present in class.

F. Bluetooth based attendance system

The attendance is taken by the teacher using an electronic device such as a cell phone or computer in this attendance management system. In such electronic equipment, a Bluetooth-based programme queries the students' mobile phones and certifies the students' attendance in class. [2]. This system is moderately effective as it ensures the students being present in the class throughout the lecture. Some of the drawbacks of this system are

- The range of Bluetooth might not be sufficient for large halls
- There is a chance of students working around the system by placing their phones in the classroom and leaving the class, thus being ineffective in ensuring the presence of students throughout the class.
- Students might genuinely have Bluetooth connectivity issues, and might lose valuable attendance due to such issues.

III. SYSTEM ARCHITECTURE

In this paper, the method of face detection and mobile app based attendance systems are going to be combined to form an INSTITUTE ATTENDANCE MANAGEMENT SYSTEM (IAMS) that is foolproof, effective and gives scope for the students to track their attendance.

A. Workflow

- In the classroom, rotating cameras will be aimed at the kids. For a big classroom, two cameras are ideally positioned by calculating the optimal placement to ensure that all faces are recorded. The number of cameras, their orientation, and placements might change over time, and these cameras are placed in discrete locations known only to a few key persons.
- The camera will be connected directly to a server
- In order for the administrative office to coordinate the attendance management system, the server will hold class schedules, a list of classrooms, faculty names, and a list of courses.
- The camera is switched on at the starting of the class and it records the pictures of the class at random times and uploads into the server
- The camera takes the pictures of the class at 5 different times during the class randomly.
- the server identifies the faces in the pictures using face detection algorithms or software like YOLO or Face-net and stores the information in a secure format.
- The server has pre-stored faces and facial features of the students which are recorded in the beginning of the use of IAMS.

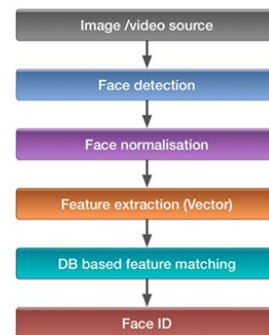


Fig. 1. Face detection algorithm

- Once the faces in the class are identified and compared against the existing database, the output is stored as a binary value. A binary value is where the output is 1 if the face is detected and 0 if the face is not detected.
- Every student's facial features are associated with a unique id (like the roll number), and the value of 1 and 0 are assigned to it for the five times.
- As there is a chance that the faces of students might not be recorded correctly in some of the pictures taken, the attendance is calculated a 3 out of 5 logic, that is, if the student's face is detected in 3 of the 5(similar to the 2 out of 3 analogy [14]) pictures, then he/she is marked as present.
- If the overall output is 1, then the student is marked present for that particular class.
- In the mobile application, every students registers for the courses using their roll number and a password.

TABLE I
VISUAL REPRESENTATION OF THE TABLE STORED IN SERVER

| Roll number | Binary values | | | | | overall value 3 out of 5 |
|-------------|---------------|-----|-----|-----|-----|-----------------------------|
| | 1st | 2nd | 3rd | 4th | 5th | |
| 202XXXXXX | 0 | 1 | 1 | 0 | 1 | 1 |

- Once they login, there is a dashboard with the list of courses. For every course, the total attendance is shown at the top and the attendance is shown in a tabular format date-wise.
- Whenever the student is absent for a class, they get a notification in the app informing them about their absence.
- The students then have the provision of entering the reason of absence in 120 words or applying for a recheck stating that the algorithm did not detect their faces.
- The recheck option is only accessible twice every semester per course, and if the student's face is recorded at least once in the photo of the five times (with at least 1/5 score in the binary table), they are listed as present, otherwise they are marked absent.
- This method of attendance can also ensure that the students who refrain from sleeping during the classes are only marked present.
- False positives and false negatives are also concerns with facial detection. The first occurs when the algorithm believes there is a positive match between two face photos when there is none. The second occurs when the algorithm reports that there is no match when there should be. These difficulties must also be considered while using this strategy in IAMS. [8]
- As the server gets more and more data, the algorithm betters itself due to the amount of training data, which can be compared to a 6σ accuracy(99.999%) and many other such factors [11]
- The accuracy of facial detection algorithm depends on the type of algorithm used and the distance of the face from the camera. More information about the facial detection algorithm can be found in [9]
- As the cameras take pictures at random times, there is no way to predict when it happens. This can ensure that students do not leave or enter the class for attendance
- In the same mobile application, when a professor enters his/her unique id and password, they are taken to a slightly different version of the application.
- After login, the dashboard of professor shows the list of courses.
- For every course, the overall number of classes and the average attendance is shown on the top of the page.
- In this section, there is a list of the dates given and the attendance of the specific day is given in a tabular.
- Every row upon clicking will redirect to a list of students who were present on that particular day.

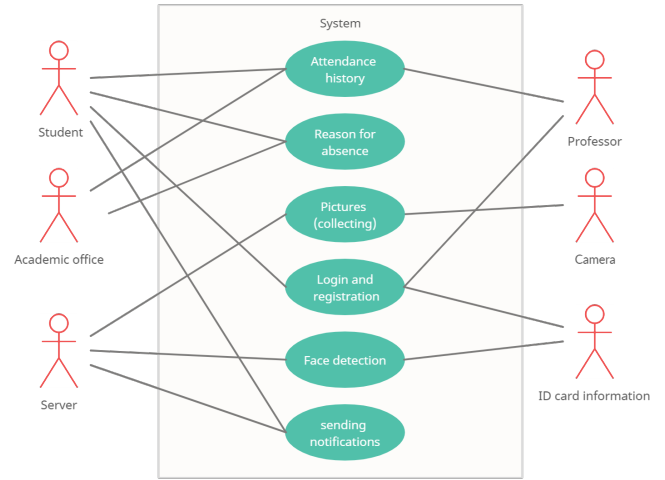


Fig. 2. UML use case diagram

B. Requirements

1) Functional requirements

- Login and registration: All the users, professors and students should be able to create new accounts using their unique ID (like roll numbers for students) and the account should be verified using the institute mail ID's.
- Attendance history: The attendance history of the student is the information of the attendance against the dates of the classes for the particular course. This attendance history is also available to the academic office to ensure a mandatory 75% attendance. The professor also gets a copy of the attendance history to observe the attendance of his/her courses.
- Reason of absence: This requirement gives the student, the provision of appealing to the institute about the reason behind his absence in 120 words. The academic office can check the reason out and send out a mail if they think the reason is genuine.
- Pictures: The camera takes pictures of the class randomly during the time period of the class and uploads them to the server for further analysis
- Face detection: Once the pictures are uploaded to the server, the server runs the face detection algorithm and compares the faces against the database of faces in the database and fills the binary tables according to the outputs.
- Sending notifications: The notifications are sent to the student's account directly from the server once the student is marked absence. In this notifications feature, there is also an option of appealing for a recheck of the attendance.

2) Non-functional requirements

- Security : It is preferred that the server should use a 128 bit encryption to ensure that the server is secure. This is to make sure that the information

of attendance and the facial features of the students are available only to the proper authorities.

- Privacy: The faces in the data-set can be stored as features using feature extraction [11] in order to avoid privacy issues.
- Avoiding false positives: The algorithm's false positives percentage can be reduced by continuing the previous form of attendance along with the IAMS to ensure that the algorithm works accurately or to identify the mistake in the algorithm.

3) Classes

- Student:** The student class is primarily identified by the student_ID and it contains a password as an attribute. This class is used for functions like registering for the mobile app, Logging into the app using ID and password as well as logout.
- Professor:** The professor class is primarily identified by the professor_ID and it contains a password as an attribute. This class is used for functions like registering for the mobile app, Logging into the app using ID and password as well as logout.
- Camera:** Every camera has an ID according to the class it has been installed in. The camera takes pictures of the class at random times during the class and uploads them to the server.
- Pictures:** The pictures are time and date stamped along with the camera ID that has taken the picture and the course ID of the course during which the picture was taken.
- Server:** The server is secured using an encryption key. It receives the pictures, identifies the faces the ID card database and uses the face recognition algorithm to upload the attendance of students. If the student is marked absent, then the account with that particular ID number is sent a notification of absence. The server also relays the rechecks and reasons requests and updates the status of rechecks.
- Academic office:** The academic office has an authentication key to access the server and selective database information. The academic office consolidates the attendance history of students. It also evaluates rechecks and reasons and sends their reply to the server to relay.
- Notifications:** The notifications are sent by the server when the student is absent. The notifications can be identified by the student Id they were sent to, the date of absence mentioned and the course ID. The notifications have two features of recheck and reason of absence.
- Recheck:** The recheck class is used by the students in the notifications tab to apply for a recheck of their absence. Every request can be uniquely identified by the student ID they were sent from and the date of absence. They have a status of Apply, Accepted or Rejected.

- Course:** Every course has a course ID and is associated with a professor ID. The course has information about the total number of classes and the classes schedule of which classrooms would be used.
- Reason of absence:** The reason of absence is associated with the student id and the date of absence is sent to the academic office through the server
- ID card database:** In this database, every card has an ID number. They also have the faces of the students saved. These pictures are uploaded into the server for facial recognition.

4) UML class diagrams

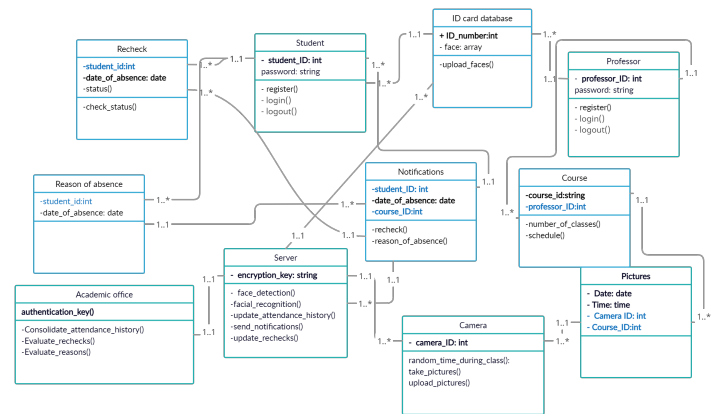


Fig. 3. UML class diagram

C. Working

1) *Registering to the app:* The registering into the app begins with the student/professor entering their unique ID. The value they reach the server, the server then sends the data into the id card database to confirm the ID card number. Once the ID card number is confirmed, it is relayed back onto the server to take the input of password and confirms the password. If both the values match perfectly, then the registration is successful and the values are updated into the database. Otherwise it is treated invalid and the password option is shown once again to reenter the correct values.

- Sequence diagram

D. Marking attendance

The camera takes the pictures and the five set of pictures are sent to the server. The server then detects the faces in the pictures using the id card database. Then the server recognises the photos and marks the values in the tables, thus updating the attendance history.

Once the attendance history is updated by the server, the value of the attendance history is shown in the application. The student then can view the attendance history in the application.

If the attendance history shows the student as absent on a particular day, then there is a notification sent on the application for that particular day.

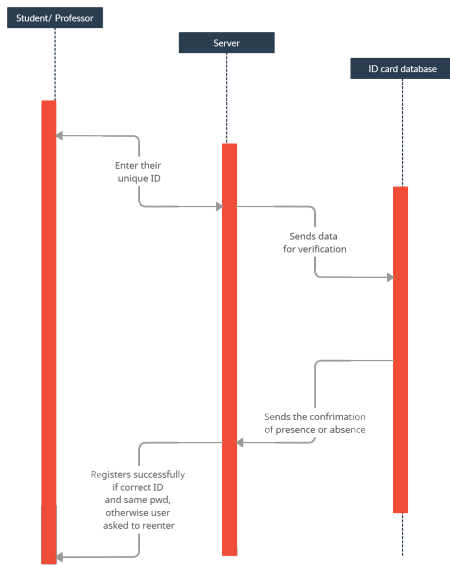


Fig. 4. Sequence diagram for registering

• Sequence diagram

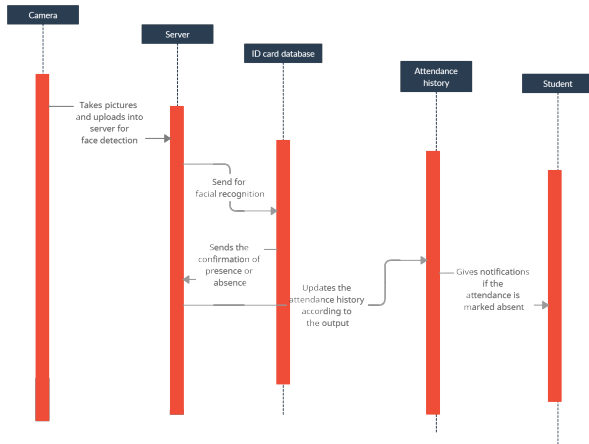


Fig. 5. Sequence diagram for Marking attendance

1) *Applying for recheck*: Once the students applies for recheck, the request is routed to the server. The server then sends the request to the academic office who review the request. The status is then updated to 'Accepted' or 'rejected' according to the response of the academic office. The student then views the changed status in the notifications bar.

• Sequence diagram

2) *Mentioning reason of absence*: When the student is absent, the student gets a chance to appeal to the institution with a reason for absence. The reason is then relayed through the servers to the academic office who consider the reason and can reply to the student via the official mail ID.

• Sequence diagram

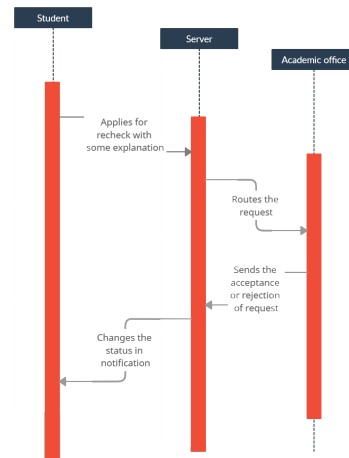


Fig. 6. Sequence diagram for Applying for recheck

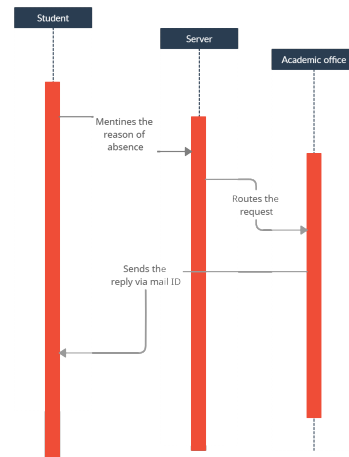


Fig. 7. Sequence diagram for Reason of absence

IV. CONCLUSION AND FUTURE WORKS

IAMS is a foolproof and efficient solution to solve the problem of Attendance management. This system is simple, and can be managed and maintained easily. IAMS mobile app has simple features as mentioned above, which can be efficiently used by students and professors to monitor and regulate the attendance.

A. Future works

This system has a wide scope of improvement in the future

- 1) New and efficient face detection algorithms can be used to make the system more accurate
- 2) Qualitative image analysis using common partners, general seating arrangement, popularity of professor/course, and many more such features can be implemented to increase accuracy.
- 3) The server and the algorithm can be modified to store only the facial features and completely remove the

pictures of camera from the database to improve on privacy.

- 4) Applications for rechecking can be automated.
- 5) The software can be modified to analyse the attendance patterns and give automated reports regularly to the academic office.

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