A Smart Attendance System for Imam Abdulrahman Bin Faisal University Using Facial Recognition

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Abstract. Students’ attendance is one of the methods used to ensure students success by making sure that a student does not miss many classes. The most dominant method used nowadays in the Saudi universities such as, Imam Abdulrahman Bin Faisal University (IAU), is the traditional method where the instructors are the ones responsible for taking student’s attendance. Developing new and effective methods is critical to improve the traditional way and minimise their errors. A proposed facial recognition based attendance system is one efficient method that can substitute the traditional methods. Installing cameras in classrooms where it detects faces and recognise each face for attendance registration is more competent. The system can also track students’ attendance and warn them if they exceeded the permitted absences rate. The proposed system facilitates the attendance registration process and reduces the time and effort for both students and instructors.

1. Introduction

Taking attendance of the students is one of the major processes which comes into any faculty member’s mind when he/she prepares for a lecture. The traditional attendance systems are becoming a main issue in some educational entities. Using a printed paper containing a list of the students to check every one by calling names or IDs is no longer efficient while we are living within an era of technology and digital transformation environments. Even entering the attendance electronically after calling the names is also considered as a semi-automated way which requires a human interaction leads into time consumption and possible number of mistakes, so that’s also considered as an old school approach nowadays. Since we know that humans can make mistakes, these approaches are suffering from lack of accuracy as human interaction factor is playing a major role in that old school approaches. Also, passing the attendance paper between the students and the students writes their names, can cause disturbance, noise, and mess in the classroom. If the lecturer tried to do it the other way, which is calling everyone by his name, the disturbance will be solved but by consuming much more of time. Even the electronic system entry method is still suffering from the problem of wasting time. We are aiming in this paper to eliminate complicity and time consumption which is going to be done through the full automation of the process.

This paper proposes an effective smart attendance system for Imam Abdulrahman Bin Faisal University (IAU) using face recognition to automatically catch the attendance with the minimum
amount of human interaction. Calling the educational entities here to look into the benefits of automating this non-adding value process and start taking advantage of the technology as it is available and affordable to most entities nowadays. The system works basically by installing a camera inside the classroom, and this camera will automatically recognise students through support of specific algorithms to recognise faces. The aims of implementing the proposed system are to reduce the burden on the lecturers since this technology will handle it. Saving lecture time, being more efficient, and accuracy. In somehow, lecturers will have more time delivering valuable knowledge to the students rather than wasting the time taking attendance.

This paper is structured as follows. Section 2 presents the related work on the student attendance systems. Section 3 describes the current attendance system and Section 4 describes the proposed attendance system. Section 5 presents the expected results. Section 6 draws the conclusion and future work.

2. Related Work
In [1], the authors have considered the issues of the traditional student attendance system and proposed an intelligent attendance system to increase the efficiency. The system used a liquid crystal display (LCD) screen to provide a visual feedback, a fingerprint sensor for a biometric input, an "Arduino Uno" ship to handle the student’s fingerprint impression which was recorded using a unique identification number, and a Bluetooth was used for wireless data transmission. The main result is that the system could save more time about 11:53 per minute, and for this reason, 30:287 minutes per week is saved, which can be used in the education process rather than in taking attendance.

In [2], the authors have considered the problem of manual attendance system that maintaining the class environment regularly during attendance and checking each student’s record, maintaining time and calculating the average attendance for each student. The main findings are the system recognises 121 images out of 142, which means that the percentage of successful recognition of faces is 82%.

In [3], the authors have developed a Smart Attendance Management System (SAMS). The system uses face print recognition, that uses a video running based methodology to recognise any pre-stored face print and match it with the best possible identities to provide the student with a scroll-down list ranked by the most accurate in order for student to confirm. The used methodology is safe in terms of minimising the need of hand touching or finger prints so that will not spread viruses or diseases for instance, also, it saves time as well. In addition, it reduces the disturbance of the class. In contrast to [4], this methodology saves more time by allowing the student to interact with the system directly, unlike in [4] where the instructor is the one to enter every student ID in the application to mark there presence.

In [4], The authors have developed a semi-automated solution to reduce the time consumed during the attendance registration process. An application-based solution is used to serve instructors while taking attendance. It allows instructors to enter students’ IDs to the system and mark them as a present. Even though when using the proposed method, while taking the attendance, reduced the time remarkably, fully automating the process would be more efficient. In contrast to [3], the fully automation has given the advantage of expediting the process. In [4], the focus was to eliminate the paperwork which has been achieved and reducing the time which was not up to the best they could do.

In [5], the system was built using a camera installed in each semester. Researchers used more than one algorithm for face detection. The researchers took pictures of everyone. After saving attendance data in the database, the results showed that the new system has become more effective, faster, and more accurate.

In [6], researchers have addressed the problem of the traditional student attendance that consumes time and effort. To address this problem, an automatic attendance management
system based on face recognition was proposed. In this system, a camera was installed to take pictures of students, faeces are detected and then stored in the database from different angles and different locations.

In [7], the authors have considered the problem of the traditional student attendance system, the instructor’s entire responsibility is costing a lot of time and effort, and a smart attendance system, which is based on facial recognition technology has been proposed to avoid these problems. In this system, attendance is recorded for students in a classroom automatically via a camera at the entry areas. The student stands in front of it and preserves a distance of 50 cm. His image is taken and stored in the system and compared to the stored images, then the attendance is confirmed.

In [8], the authors have examined the problem of the traditional system of manual preparation for students or systems based on the fingerprint as they have little effectiveness. The attendance system based on Android using a “face recognition” technique has been proposed. A quick response code contains chapter information at the front of the classroom, each student used his Android smartphone to scan the QR code and photograph his face and then send the image to the university’s server. The results showed that the accuracy of recognising the faces was up to 97.29%.

3. The Current Attendance System in IAU

In traditional students attendance systems, the course instructor takes the student’s attendance manually by using an attendance sheet containing a list of the students’ names. In IAU, the attendance is done by checking each student separately. Then, the instructor fills the Student Information System (SIS) online as shown in Figure 1.

![Figure 1. The SIS in IAU - Instructors preview.](image)

However, this process is time and effort consuming, where the instructor takes part in the lecture time. In addition, it is difficult to verify all students in a large classroom one by one specially when students are not responding. Furthermore, the system may be unreliable for many reasons. So, there is no guarantee of no error occurred during the attendance, the instructor may be checked a student as an absent student by mistake, even though he was attended. On the opposite, it may be possible to take attendance to a student who is not in the classroom. Moreover, students need to check the SIS every time they want to know about their absence rates as shown in Figure 2. Hence, this attendance system lacks the alert messages sent to students when they are closed to exceed the allowance absence limit.
The proposed attendance system consists of three main phases. The flowchart of the proposed attendance system is shown in Figure 3.

4.1. Faces Detection and Recognition Phase
Contrary to what other attendance systems did, the camera was installed outside the classroom near of the door. However, in our proposed system, a high-resolution camera device is installed in a suitable location within the classroom, which is in the middle of the front wall as shown in Figure 4. The benefit of this installation position is to easily identify faces. The angle of view of the camera is clear and flexible until it scan all aspects of the students at the same moment and more efficiently as shown in Figure 5. Meanwhile, students are satisfied with only sitting on their seats, their task is limited to sitting only. The location of the camera gave him a lot of time, unlike if the camera was at the front of the door, there would be a crowd and a long waiting line and a waste of time. When capturing images from the camera, machine-learning algorithm is implemented to identify the faces. After this phase, the identification process is successfully completed, and we have a clear, specific image that can help us in the next phase.

4.2. Image Comparison and Verification in Databases Phase
After the face detection and recognition phase, images are entered as an input to the system. When creating an IAU database, students’ images must be added to the basic data to compare the image entered to the system with the image saved in the IAU database and check whether it is identical or not. The goal of matching images is whether the students are enrolled in this course or not on the same day and time, in case the images do not match, i.e. students are enrolled in this course but not on this day nor at the same time. Hence, the system brings the student information and sends it to the instructor. Thus, the decision is made for the instructor whether to consider the attendance or not.

4.3. Attendance Verification Phase
After the comparison of the images entered with the images stored in the IAU database is completed, the system confirms the attendance of the student by registering the time he entered the class in the attendance field for the course in the IAU system as shown in Figure 6. Then,
Figure 3. The flowchart of the proposed attendance system.

Figure 4. The position of a camera in classroom.
the system sends a text message to the student mobile number. This message contains details of the attendance verification process such as the course name, date, time and the classroom. Also, the system sends a text message when the permitted absence rate exceeds, this warning message contains the absence rate and a reminder of the approaching this percentage exceeding. Figure 7 is shown the examples of alert messages.

5. Expected Results
The attendance process that done by the face recognition system is having many properties that lead to the success of the system. One of the most important results which we are aiming for is that students and instructors will deal with the system easily and smoothly, by allowing the system to take the attendance automatically without human interference. We expect that the time and effort will noticeably be reduced, and the instructors and students will take all the time to be focusing on the educational benefits and activities. Also, the system is playing a major role in reducing the mistakes and keeps the students automatically having feedback about their percentage of attendance to take attention about denial if a student is about to, they will get it by notification messages sent to the student’s mobile immediately. We expect that to have a secure, highly efficient, fast and usable system.

Figure 5. Face detection process.

Figure 6. Adding a new column ”Time” to the SIS in IAU - Student preview.
6. Conclusion
The face recognition system has proven effective in improving and speeding up the university attendance process and making the process more reliable and more efficient. Therefore, we have tried to develop this process to become more effective and because we believe it deserves attention and deserves development and adoption. We have tried to make the system work more quickly and is linked directly to the IAU system. Our own opinion is that the results will be very effective because we have relied on developing a system that solves realistic and existing problems such as that the instructor takes part in the lecture time to enter attendance information. We suggest that the rest of the researchers look more in this field to develop an effective system that makes educational institutions and others have a desire to adopt their ideas.

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