Implementation of Attendance Management System Utilizing Fingerprint, QR Code, and GPS Technology in Educational Institutions

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Abstract: *For any educational institute, the task of managing the attendance of students is a very important part of the academic work. The teachers are required to take class attendance of the students regularly and the attendance report of the students is required during the time of term exam. Currently, this task is done manually in most of the institutes of the developing countries. The manual system of taking attendance has many disadvantages. It is a very time-consuming task if the class contains a large number of students and the possibility of false attendance may also appear. Many types of techniques have been proposed to make the attendance system automated by using different types of biometrics of the students and storing the attendance record in the database. If the class information and the location of the student can be added with the biometric information of the student at the time of taking attendance then the attendance system will be more accurate. The way of implementing an attendance management system app that will use the QR code of the particular class, the fingerprint of the student, and the location of the student through GPS technology has been proposed in this paper.*

Keywords: attendance, QR code, education, fingerprint, GPS technology

1. Introduction

Implementing an attendance management system in a high school setting can have a significant impact on student attendance and academic performance. A well-functioning attendance management system is not only expected by parents to stay updated on their child's academic progress, but it also plays a crucial role in maintaining the quality of education and student performance [1]. Proper tracking of attendance is not limited to student attendance alone; it also extends to employee attendance, as poor tracking can contribute to problems in the quality of education [1]. By implementing an attendance management system, schools can improve student attendance and subsequently enhance academic performance [1]. Automation plays a key role in this process, as it significantly improves the speed, efficiency, and effectiveness of attendance processes [1]. An attendance management system is considered crucial for effective student management in educational institutions at all levels [1]. One of the benefits of implementing an attendance tracking system is that it provides valuable data that reveals interesting trends, such as delays in student arrival or teachers failing to meet teaching goals and engage students [2]. Schools can use this data to learn from their attendance patterns and make necessary improvements [2]. Furthermore, an automated attendance management system can shift the focus from penalizing missing students to incentivizing attendance, creating a more positive and encouraging environment for students [2]. It is important to recognize that low levels of attendance may indicate that a student is struggling to engage in their learning, which could be due to negative experiences at school or challenges faced at home [3]. Consistent attendance is crucial, as inconsistent attendance can negatively impact a student's overall performance [3]. Research has shown a direct correlation between higher levels of attendance and higher grades, as well as a higher likelihood of completing a program of study [3]. Jonathan Sandling emphasizes the importance of attendance in student performance, further highlighting the positive correlation between attendance and academic success [3]. Therefore, implementing an effective attendance management system can greatly contribute to improving student attendance and ultimately enhancing their academic performance.

Effectiveness of different automated Attendance Management Systems in Educational Institutes:

Attendance Management using QR code:
QR Code attendance management systems have gained popularity in educational institutions for their effectiveness in monitoring and recording student attendance. The implementation of these systems has shown promising results, as researchers have concluded that they are effective in easing up the process of checking and recording attendance [4]. One of the major advantages of QR Code-based systems is their ability to eliminate errors and problems encountered in manual attendance systems [4]. With the implementation of QR Code attendance systems, the recording and monitoring of student attendance becomes more efficient, timely, convenient, and accurate [4]. These systems have already been successfully used in various settings such as events-related ticketing and security, as well as employee check-in systems [5]. In educational institutions, QR Code attendance management systems are being increasingly adopted in school and college classrooms, providing an efficient and streamlined method of tracking attendance [5]. The use of QR Codes in attendance management is considered to be a reliable and effective solution for educational institutions seeking to improve their attendance-tracking processes [5].

Attendance Management using fingerprint:
The implementation of a fingerprint attendance management system in educational institutions has been proven to enhance attendance accuracy and efficiency. Biometric

systems, which rely on unique physiological or behavioral characteristics, have been widely utilized for identification purposes [6]. The goal of this project is to track student attendance using a biometric fingerprint sensor in educational institutions [6]. By combining fingerprint scanning with recognition technology, the system ensures accurate tracking of student attendance [6]. This project utilizes the Raspberry Pi as the controller, along with an Arduino and a camera module [6]. The main objective of the fingerprint attendance management system is to create a transparent attendance system that provides real-time data and reports [6]. This system aims to replace the outdated paper-based attendance recording system and improve accuracy and efficiency [6]. Fingerprint sensors are considered one of the most secure biometric solutions and are commonly used for tracking attendance in organizations [6]. In educational institutions, the use of fingerprint attendance management systems has been shown to improve attendance accuracy and efficiency [7]. These systems not only accurately mark the presence of students and staff but also enhance security measures by quickly identifying individuals on campus [7][8]. Moreover, they effectively monitor student attendance to prevent unauthorized access to classes and eliminate instances of "buddy-punching" among students [8]. The utilization of biometrics, specifically fingerprints, guarantees accuracy in attendance data collection [8][9]. Compared to traditional methods of attendance tracking, such as badges or ID cards, fingerprint attendance management systems are recognized for their superior accuracy and efficiency in educational institutions [8]. Overall, the use of a fingerprint attendance management system is an effective solution for improving attendance accuracy and efficiency in educational institutions [8].

Attendance Management using face recognition:
Face recognition technology has emerged as an effective solution for attendance management systems, offering numerous advantages for both employers and employees. By utilizing face recognition technology, organizations can improve the accuracy and efficiency of their attendance tracking processes [10]. One of the key benefits of face recognition technology in attendance management is the elimination of manual tracking, as it automates the attendance recording process [10]. This not only saves time and resources but also reduces the potential for human error [10]. Face recognition attendance systems have gained popularity in various industries, including small and large businesses, due to their effectiveness in managing attendance [11]. The use of facial recognition enables automatic identification and confirmation of an individual's identity based on their facial features [11]. This eliminates the need for manual check-ins or physical identification cards, simplifying the attendance tracking process [12]. Moreover, face recognition technology ensures increased accuracy and accountability in recording attendance data [12]. The unique aspects of an individual's face are used to accurately identify and verify their identity, making it a reliable method of tracking attendance [13]. Additionally, face recognition attendance systems offer a non-contact approach to managing employees, which is particularly beneficial for those who are out in the field [11]. These systems also provide an additional layer of protection to the workplace by preventing unauthorized access to company

data and resources [11]. Overall, the effectiveness of face recognition technology lies in its ability to accurately identify individuals and streamline the attendance management process, making it a valuable tool for organizations in various industries.

Attendance Management Systems using RFID:
The implementation of RFID-based attendance management systems in educational institutions has proven to have a positive impact on efficiency and accuracy. These systems utilize RFID technology to track the attendance of both students and faculty/staff, simplifying the payroll management procedure [14]. For instance, MasterSoft's RFID Attendance Management System is specifically designed to track attendance in multiple locations within an educational institute, such as classrooms, libraries, laboratories, hostels, mess halls, or administrative offices spread across the campus [14]. Students are provided with RFID tags, which they use to mark their presence on an RFID reader [14]. The recorded attendance data can then be utilized by faculty members for various purposes [14]. The use of RFID-based attendance systems results in high accuracy and efficiency in recording attendance data, with real-time recording and notification features helping to identify and address any irregularities in attendance [14][15]. Additionally, these systems offer online accessibility, allowing lecturers to easily keep track of their students' attendance from anywhere and at any time [16]. By eliminating the manual process of taking attendance, which consumes a significant amount of time and can lead to errors, RFID-based attendance management systems contribute to improved efficiency and accuracy in educational institutions [17]. Overall, the implementation of these systems can enhance the quality of teaching, monitor student performance, and benefit academic management staff in maintaining student records and progress monitoring [16].

Proposed Attendance Management System:

Process of taking attendance:
In this proposed system, the following steps have to be taken to take the attendance of a class more effectively.
a) The teachers and the students will register for the application with the necessary information.
b) Before starting any class, the teacher will log in to the system with his/her credentials and assign a class with the schedule and a particular QR code for that class.
c) The student will log in to the app by using his/her fingerprint which has been provided at the time of registration.
d) After logging in, the student will select the class that he/she wants to attend and scan the QR code of the class that will be published by the teacher.
e) If the student can scan the QR code successfully then the location of the student will be traced by GPS technology.
f) If all the tasks are done by the students successfully then the student's attendance will be counted by the application and stored in the database.
g) At the end of the day attendance record of the particular student will be sent to the student and the parent of the student regularly.

Diagram of the proposed application:
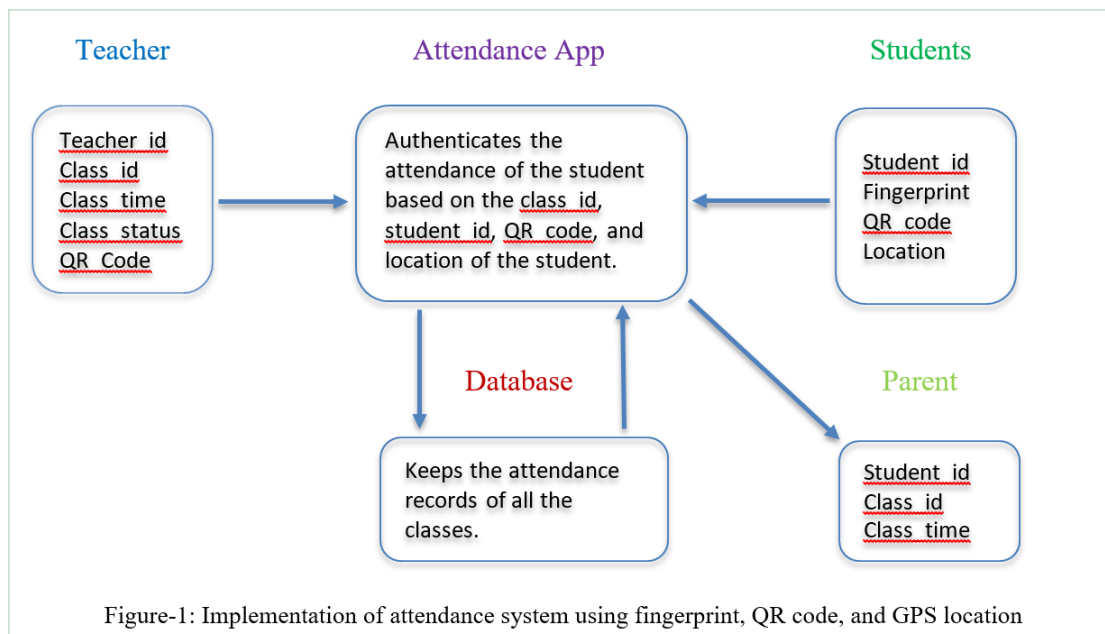The way of taking attendance of a particular class has been shown in the following diagram.

Figure-1: Implementation of attendance system using fingerprint, QR code, and GPS location

Benefits for the teachers:
a) Teachers are not required to maintain a manual attendance system because the developed application will keep the attendance records of all classes.
b) The percentage of attendance for a particular student on a particular subject can be calculated easily by using this application.
c) Teachers can identify the list of the students who are irregular in the class by this application with a single click.
d) The fake attendance can be removed easily.

Benefits for the students:
a) The students will get alert regularly about their low attendance.
b) The students don't need to give their attendance manually and wait for the roll call.

Benefits for the parents:
a) Parents will get notification about their children's presence in the class and take proper action if required.
b) For low attendance, parents can discuss it with the corresponding teacher.

2. Conclusion

The proposed attendance management system can be more beneficial for college or university-level students who can use smart mobile. This type of application can be used for taking attendance of the employees of any company and also by generating a single QR code for each day to give their attendance through the application. But this application can't be used for the schools where the smart device is prohibited for the students.

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