

A Web Enabled Secured System for Attendance Monitoring and Real Time Location Tracking Using Biometric and Radio Frequency Identification (RFID) Technology

Srinidhi MB, Romil Roy
Indian Institute of Technology, Kharagpur, India
E-Mail : mb.srinidhi@gmail.com, romilroy@gmail.com

Abstract—Automated Information Systems has played a major role in the growth, advancement, and modernization of our daily work processes. The main purpose of this paper is to develop a safe and secure web based attendance monitoring system using Biometrics and Radio Frequency Identification (RFID) Technology based on multi-tier architecture, for both computers and smartphones. The system can maintain the attendance records of both students and teachers/staff members of an institution. The system can also detect the current location of the students, faculties, and other staff members anywhere within the domain of institution campus. With the help of android application one can receive live feeds of various campus activities, keep updated with the current topics in his/her enrolled courses as well as track his/her friends on a real time basis. An automated SMS service is facilitated in the system, which sends an SMS automatically to the parents in order to notify that their ward has successfully reached the college. Parents as well as student will be notified via e-mail, if the student is lagging behind in attendance. There is a functionality of automatic attendance performance graph in the system, which gives an idea of the student's consistency in attendance throughout the semester.

Keywords—Radio Frequency Identification Technology, RFID, Attendance Monitoring, Biometric, Four-Tier Architecture, Auto- mated System, Web Based System, Information System, Android

I. INTRODUCTION

Attendance of students has become an important evaluation aspect in the current educational system in both colleges and schools. The traditional attendance monitoring system has several disadvantages. For example, passing the daily attendance sheet to a huge number of students in a class is very problematic and it hampers the attention of the students in the class [5]. A roll-call is an unnecessary waste of time. Also, a student can intentionally register fake attendance record in the daily attendance sheet. If the teacher loses these documents, all the relevant attendance records are lost [7] [9]. Since the attendance record of the students is maintained on paper, it can be easily tampered. While analyzing the attendance, the teacher

has to work-out a lot of calculations, which is pretty gruesome and time consuming.

As an alternative to the traditional system, we propose a system which records the attendance of students, teachers and other institutional staff, without any human interventions using Biometrics and Radio Frequency Identification (RFID) technology and an extension to this is provided by the Android application module which uses the installed system to track the RFID cardholders anywhere inside the campus. The registered users need to flash their RFID tag embedded identity card in front of the RFID reader as well as scan their fingerprint in the Biometric fingerprint scanner in order to confirm their original identity. The Biometric fingerprint scanner is included in the system to stop the fake attendance registered by the students. Once the fingerprint and the unique RFID tag number is matched with the record saved in the database of a particular individual, the attendance of the individual for the event is stored in the database automatically [13]. Whenever a student enters or leaves the campus, an SMS is automatically sent to their parents mobile, informing them of the same. The system is provided with the feature of tracking any individual having the RFID tag embedded identity card anywhere inside the campus, using the installed RFID readers across the campus. The system can also calculate the percentage of attendance of students automatically. Parents are notified via e-mail, if their ward is lagging behind the minimum requirement of attendance. As mentioned earlier, students' attendance record is very sensitive and has a high risk of being manipulated and keeping this in mind, the proposed system has been made totally safe, secure and the system is protected from all kinds of unauthorized user access. The security feature of the system has been designed by following the four-tier architecture. An

android application for the students has also been developed, along with the web based system, through which the system can be accessed remotely from anywhere. This new feature helps our system to stand out among the rest of the attendance monitoring system. Another important feature of our system is the attendance performance graph which is generated for each individual, including students, teachers and other institutional staff depending on the individual's attendance in a semester, in order to get a visual idea. Both desktop and android smart- phone version prototype of the system have been developed. These RFID tags will not only serve the purpose of identity card but also library cards, mess cards and other authorization cards required for various events and purposes within and outside the campus.

The rest of the paper is organized in the following manner. A brief idea regarding Radio Frequency Identification (RFID) technology and Biometric is described in Section II and Section III respectively. Section IV deals with the system architecture. The functional description of the system is explained in the Section V. Section VI talk about the different features comes with the android application. Finally, Section VII includes a summerized conclusion from the proposed research work.

II. RADIO FREQUENCY IDENTIFICATION (RFID) TECHNOLOGY

A wireless technology of communication of electromagnetic waves between the RFID reader and the RFID tag in order to automatically collect the stored information, uniquely identify and trace the RFID tag is known as Radio Frequency Identification Technology [4] [6]. There are three types of RFID tags- active, passive and semi-passive. The main difference between these tags is that active and semi-passive tags require an internal battery to work but the passive tags do not. Passive tags acquire the required power from the RFID reader. In the proposed system we have used passive RFID tags only. Each and every RFID tag has unique ID stored in it. Different frequencies of RFID readers available are shown in the table I. In our prototype we have used a high frequency RFID reader with frequency range from 3 MHz to 30 MHz, as shown in the figure 1.

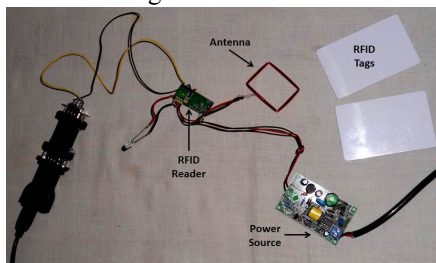


Figure. 1. The RFID reader and tag.

In order to communicate, it is not necessary to have a line of sight. The RFID readers can easily read the RFID tags from a significant distance. The readers are capable of reading multiple tags at a time. As the RFID tags are enclosed in hard casing, it is difficult to tamper them [10]. If a cardholder loses his card, he can easily track it online and trace it back to its location.

III. BIOMETRICS

The process by which human identification is carried out based on their traits or characteristics is known as Biometrics [1]. Biometric identifiers are unique, determinable typical features applied to identify and depict an individual's identity.

TABLE I
Different types of available RFID reader based upon their frequencies.

		Range	Frequency Used
LF	Low Frequency	3kHz - 300kHz	125kHz
HF	High Frequency	3MHz - 30MHz	13.56MHz
VHF	Very High Frequency	30MHz - 300MHz	Not used in RFID
UHF	Ultra High Frequency	300MHz - 1GHz	866MHz, 915MHz

IV. SYSTEM ARCHITECTURE

The attendance records are very important and sensitive. They are highly prone to manipulation, as a student is allowed to attend semester examinations depending on the student's attendance percentage. The monthly salary of the teachers and other institutional staff is decided depending on their daily attendance. To make the system safe and secure, we have implemented the four-tier architecture, considering the security of both the attendance records stored in the database and also the system itself [8]. The four-tier architecture solves the the problem of security of the system and all the data stored in the database is protected from unauthorized users and hackers. The four-tier architecture mainly consists of four layers- Database Layer, Business Logic Layer, Presentation Layer and Web Proxy Layer. The Database Layer, Business Logic Layer, Presentation Layer are the three most important layers of the four-tier architecture and are kept behind the firewall. These layers are known as Private Layers or Internal Layers. The last and the outmost layer is the Web Proxy Layer which resides outside the firewall.

V. FUNCTIONAL DESCRIPTION

In this section of the paper, we will be discussing the different functional aspects of the system. The data flow diagram of the system is shown in the figure 2. In the subsequent sub-sections, we will be discussing the important features of the system which include student

registration, recording attendance, SMS & E-mail module, automated tracking system and automated student's attendance record graph module briefly.

A. Student Registration

At the time of admission of a student in a college, they will be provided with a registration form to register into the system and at the same time they will be issued a RFID tag whose unique code will be saved into the database respective to their name. The student also needs to undergo through the biometric fingerprint scanner where a template of their fingerprint will be saved in the database respective to their names at the same time.

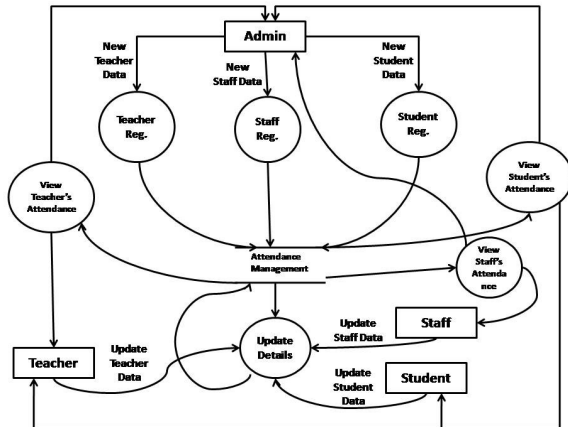


Figure. 2. Data Flow Diagram of the system.

Same procedure is followed in order to register a teacher/lecturer or other institutional staff into the system. They can search for a particular student either by their name or their roll number. The teachers can also check the attendance percentage of each student which is calculated automatically. The teachers can also view their own attendance record for a semester on monthly basis. It will be mandatory for the teachers to update the ongoing topics in their courses on a regular basis. The institutional staff can only update their profile, view their own attendance record and information regarding their leaves.

Another important functionality introduced in the system is that the students registered in different semesters can view their daily class routine and the ongoing topics in their enrolled courses. The administration can regularly monitor the professors' performance by calculating the student turnout corresponding to each topic. Similarly the teachers also can view the schedule of their classes, students' attendance, their leave details.

B. Recording Attendance and Real Time Tracking

In the proposed system, the daily attendance registering of students, teachers and other institutional staff

is fully automatic. The RFID readers are installed at different entrance and exit gates of the campus and also at different campus 'hotspots'. Whenever a student is entering the campus, the RFID reader automatically reads the unique code of the RFID passive tag from their identity card and is passed on the server and is saved into the database. When a student attends their respective class, the reader reads the unique code of the tag and checks the respective class information of the student saved in the database like semester number, subject code, classroom student has to scan his fingerprint on to the scanner, after which the template of the fingerprint is moved to the server for processing where it is matched with the template saved in the database. If the match is found, then the attendance of the student for that particular subject's class is marked present. The optical fingerprint scanner device does not remain active for all the time. It gets activated about five minutes before the scheduled time of a class, and it remains activated till five minutes past of the scheduled time of a class. If a student is late, he/she would be allowed to enter in the class but will not be getting any attendance for the class, as a penalty for being late. The flowchart of the whole attendance recording process is shown in the figure 3.

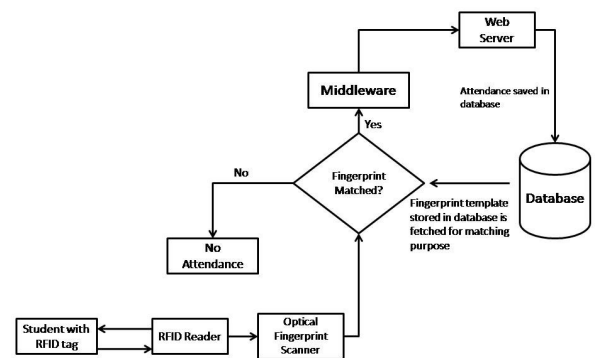


Figure. 3. Flowchart of attendance recording process.

C. SMS & E-mail Module

Whenever a student enters the institution campus, an SMS (short message service) is sent to their parents mobile number informing them that their ward has entered the college campus. The message includes the date and timestamp at which the student has entered the campus. Similarly, when the student will leave the campus again a SMS will be sent to their parents mobile informing them that their ward has left the campus along with the date and timestamp. Keeping in mind the costing of the system, we did not use any GSM modem to deliver the SMS, instead we used a free API provided by a bulk SMS service

company [2] for a trial period. Along with the SMS service, e-mails are sent to the parents email ID regarding the attendance performance of their ward at the end of each month.

D. Automated Tracking System number and class timing to simulate flawless attendance.

The going through the table of record, they could access the graph and can easily get a visual idea of the total number of classes attended by a student in each and every month. The graph recording the student's attendance is shown in the figure 5.

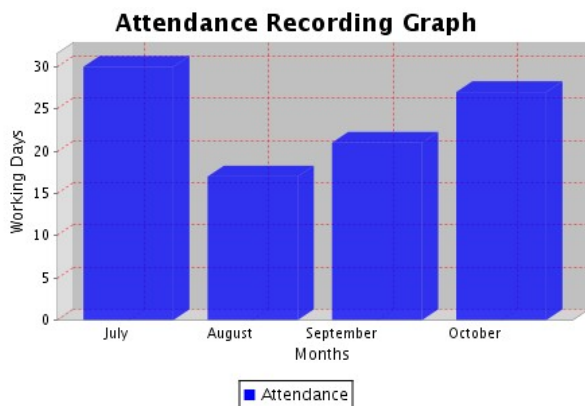


Figure. 5. Automatic student's attendance recording bar graph.

VI. ANDROID SMARTPHONE MODULE

Taking into account the widespread usage of smartphones these days, we propose an android application which is compatible with the wide range of android smartphones. One has to login to this application with the username and password which is given to them at the time of registration in the system, i.e., with the same username and password with which they use while they access it from a desktop or laptop. The android application is also designed by following the four-tier architecture [8]. With the help of this application one can create a private group, where they can add their friends and professors. Students can choose to let their friends track them on a real time basis. Students can also check their attendance record and view their attendance graph record. Another interesting feature which has been introduced in this application is that one can get the live update regarding the different kinds of current campus activities, which is updated regularly in the system to create a lively atmosphere in the campus. The system is capable of recording the exact number of RFID tags in the range of any RFID reader at a given time. This has been effectively implemented in the system. Students can get the live traffic at various campus hotspots (food joints, parks, auditorium, etc.), so the student has a clear idea of the crowd at various places before even visiting the place.

One can also access the log file which stores the history of the various places visited by the individual inside the campus along with the date and timestamp. We have developed an inbuilt route guide system which offers assistance as soon as the student goes to an unknown place inside the campus, which is detected by the RFID reader at that particular place. This feature can also be used by students in order to go from one place to another if the path is not known. This has been developed by integrating the Google Map API in the application, with the help of which one can easily find the route between the source and the destination. Since the real time location of every student is being stored centrally in the database, it is very important to address the issue of Privacy. The issue has been trickily addressed in the 'Track your friend' feature. A student will be allowed to track their friend only if they themselves share their current location with that particular friend. Also, a student can choose to be tracked only by a preset group of individuals in their closed connected group.

VII. CONCLUSION

Recording the attendance of the students, teachers and other institutional staff is a very hectic job in a college environment. A web enabled automated system for the purpose of recording attendance in a college environment is proposed here. A four-tier architecture is implemented here, in order to make the system more secure. The attendance of the students are recorded with the help of biometric device and RFID technology. In the proposed system not only attendance of the students are recorded, but attendance of the teacher and other institutional staff is also recorded. A student can be tracked easily if he/she is present in the institution campus. SMS alerts services are introduced in the system, to inform the parents about the regularity of their child in the college. An automated attendance monitoring graph will be generated in the system which will give a brief idea about the regularity of a student in attending his/her classes. Both desktop version as well as android version compatible with the smartphones have been developed. Both the mentioned versions include the all the above mentioned functionalities. In future we plan to develop a master system which will not only manage the attendance registering of the students, teachers and other staff members of the institution but also will help the institution in storing the marks of all the semester examinations the student will face in his/her college life. The system will be further modified in such a way so that it will be capable of storing the grade cards of the semester examinations of a particular student, storing the payslips of the monthly salary of the teachers and other institutional staff. The Android application module can further be expanded by enabling the students to participate in online group conversations with the people within their campus.

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