IoT Based Smart Attendance System (SAS) Using RFID

Soumil Nitin Shah
Department of Computer Science and Engineering.
The University of Bridgeport,
Bridgeport, USA
soushah@my.bridgeport.edu

Abdelshakour Abuzneid
Department of Computer Science and Engineering
The University of Bridgeport,
Bridgeport, USA
abuzneid@bridgeport.edu

***Abstract*—This work introduces a new paradigm of monitoring student attendance using Radio Frequency Identification (RFID) based on the Internet of Thing (IoT). Educational institutes are concerned about student irregular attendance. Truancy can affect a student's overall academic performance. The traditional method of taking attendance by calling names or signing on paper is very time consuming and inefficient. RFID based attendance system using IoT system is one of the solutions to handle the problem. The proposed work comprises of two most popular trend in technology research; IoT and RFID.**

Keywords; – Internet of Things (IoT), Radio frequency identification (RFID), attendance system

I. INTRODUCTION

The concept "Internet of Things" (IoT) has recently attracted growing attention from both academia and industry. IoT is a scenario where devices (even animals or people) are provided with unique identifiers and the ability to automatically transmit data over a network without requiring human-to-computer interaction [1, 2]. RFID forms an essential block of IoT where RFID devices are wireless microchips used for tagging objects for automated identification [3]. RFID systems consist of a reading device called a reader, and one or many tags. The frequency band in which each RFID system operates can be low, high or ultra-high frequency. The low-frequency band (LF) covers frequencies from 30 KHz to 300 KHz. Regularly LF RFID systems work at 125 KHz [4]. The high band (HF) ranges from 3 to 30 MHz. Most HF RFID systems work at 13.56 MHz with reading ranges between 10 cm and 1 m. The ultra-high frequency band (UHF), recurrence band, covers the reach from 300 MHz to 3 GHz [5]. The reader is a powerful device with a lot of memory and computational resources which could be connected to Raspberry Pi. The tags are usually of two major types; active or passive. In the active RFID systems, each tag has its own transmitter and power source. In most cases, the source of power is a battery. Active RFID systems frequently operate in the ultra-high recurrence (UHF) band and offer a range of up to 100 m [5]. Passive RFID system doesn't have a power source where it gets in power from the reader when the tag chip is brought close to it. Passive RFID systems can work in the low recurrence (LF), high recurrence (HF) or ultra-high recurrence (UHF) radio groups. RFID technology can help to identify and to monitor items (products, people, student, etc.) wirelessly within a specified distance (a few centimeters to hundreds of meters). In this paper, we describe the proposed Smart Attendance System (SAS) using RFID technology. Our framework utilizes RFID tags which allow school/college to monitor the student attendance in and out of the class, upload the data on Google Spreadsheet, send alert to parents using SMS/email and generate a report quickly. When RFID tags pass through the read-range zone of the RFID reader, the system will record data from the RFID tags to the database system which could be a central server at the school. In Addition to schools, SAS is an automatic integrated system used to assist in taking attendance in any organization. SAS provides organization, efficiency, and convenience utilizing the trending technologies of IoT. The ultimate benefits of this system to schools and organizations is to automate the attendance system and save time. It will prevent students from bunking classes through SMS sending feature to parents if they subscribe to the service. The framework will generate reports of student's attendance in a click. It is a low cost, and portable IoT enabled RFID reader. The power supply system designed will automatically switch to batteries power if the AC power was removed. The size of the device is small. These two features make the system portable and easily packed and carried to the classroom or other places. In section 2, we provide some related work. In section 3, we describe the proposed framework. In section 4, we present the design of the framework. In section 5, we provide the conclusion and future work.

II. RELATED WORK

The proposed solution for monitoring attendance using barcode by Suda Lakshmi et al. [2] has several disadvantages over the RFID system. RFID is a better and more efficient way to identify objects than manual systems or barcode systems used since the 1970s. Besides, passive RFID tags (those without a battery) can be read if they are passed close enough

to an RFID reader. It is not necessary to "show" the tag to the reader device, as we do with a barcode. In other words, it does not require line of sight to "see" an RFID tag, the tag can be read inside a case, carton, box or another container, and unlike barcodes, RFID tags can be read in tens or hundreds at a time. Barcodes can only be read one at a time. Most importantly, we can apply security, authentication, and privacy for RFID-based systems. Gordon's solution [6] for monitoring attendance with automatic door units is unique in comparison with traditional barcode scanner attendance systems [2, 6]. The whole system has been designed with Microsoft Visual Studio. In his work, the authors developed two separate databases for visitors and users. Instead of developing two separate databases, one database with multiple tables has been implemented in our solution. To increase the efficiency of the software, we have used MySQlite version instead of commercial SQL DBMS. The approach to solving attendance monitoring software was a good attempt; however it lacks features like SMS updates to parent when a student is absent, and instead of using a local database, a cloud-based database is used. Singhal[7] proposed a solution to monitor student attendance using GSM technology. He has developed good software interface which has SMS notification using GSM module. However, the system can be implemented in software using Twilio API [8] which would save the cost of the device. Generating an automated report using Python could be a possible implementation which saves time and paper which was used in the traditional attendance monitoring system. The proposed SAS system advances existing traditional attendance monitoring systems which are time-consuming and inefficient. Reducing the rates of student truancy and absenteeism has been and continues to be an important management goal of every level of school and college systems. Our system utilizes the RFID-integrated ID cards which will mark the attendance of the student using a low-cost IoT enabled RFID reader. SAS will mark the student attendance on the college attendance database. Once data is collected momently into the attendance database, many services could be designed such as email notification to parents. The report of attendance of any student can be generated about student's attendance for any period. SMS alerts also can be received by the instructor or parents. The traditional method of uploading data on the database, whether manually or using barcodes, might be affected by SQL injection attacks or other cyber attacks. In our experimental system, we use the Google cloud server to log the attendance. Our system provides a perfect solution to all the challenges we have discussed above [2, 6, 7].

III. PROPOSED SOLUTION

As IoT and the RFID are relatively new fields, there is a handful of prior relevant work that employs IoT attendance monitoring system. This proposal introduces a new paradigm of IoT for RFID attendance framework. The proposal advances the existing time-consuming traditional attendance monitoring system. Reducing the truancy and absenteeism of students has been and continues to be an important management objective for all schools**.** The process of Attendance: The ID of a student/staff will fall in the range of the RFID reader installed in the classroom (or workplace). Receiving the data at the reader will fire to the server where the complete raw data is processed. Once the data is stored in the database, later on, it can be retrieved by the application to generate a report about attendance. The software can generate a report by the specific name of the student or by a specific date or over a range of dates. Initially, data is saved on an Excel Sheet on the computer. The system can send a notification to the professor with just a click of a button and also log the data on a cloud server and Google spreadsheet. SMS could be sent to each parent's mobile. This system integrates the attendance system which gives the facility that they can view daily attendance report. This system can help college administration to improve retention which is becoming a major issue in many universities.

IV. DESIGN FRAMEWORK

Figure 1 shows the basic design block diagram of SAS. The entire system comprises hardware and software. The function of the hardware is to identify the tag ID by reading a signal generated by the tag. The tag information will be sent out to the database and then to the software application for further data analysis and processing. The software is responsible for performing the task concerning the database, processing of data and providing output in the form of reports and graphs. Once data is collected and stored in the database, lots of services could be used.

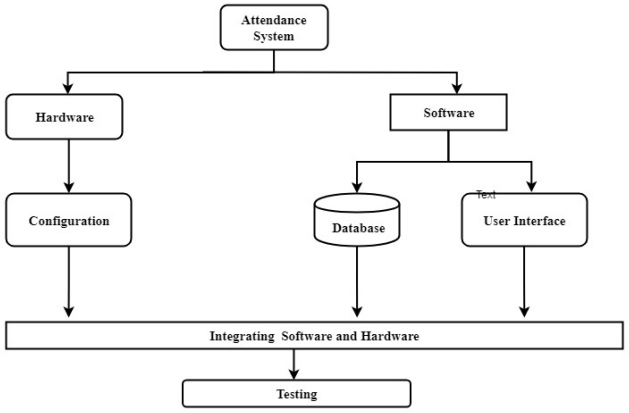

Figure 1 System Block Diagram

*A. **Hardware Implementation***

In RFID systems, a tag is a tiny silicon chip plus an antenna. The tag can be mobile or static. It is scanned by stationary or mobile readers using radio waves. The microcontroller is an integrated circuit or a chip with a processor and other support devices like data memory, I/O ports, a serial communication interface, etc. which all integrated into one board [9]. We use MFRC522 RFID [10] reader to interface with Atmega328P [9, 10,11].

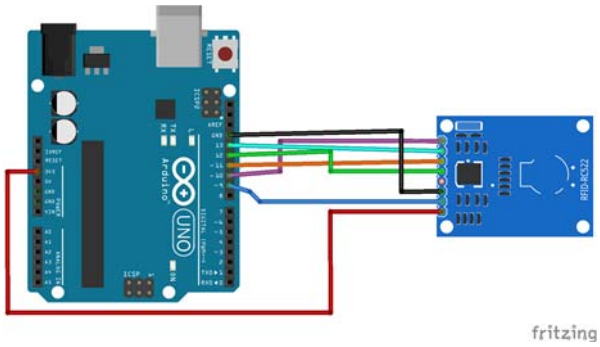

Figure 2: The Hardware Interface

Figure 2 shows the hardware interface of Atmega328P Microcontroller and MFRC522 RFID Reader. Figure 3 shows the flow chart for reading the tag and sending it to the server.

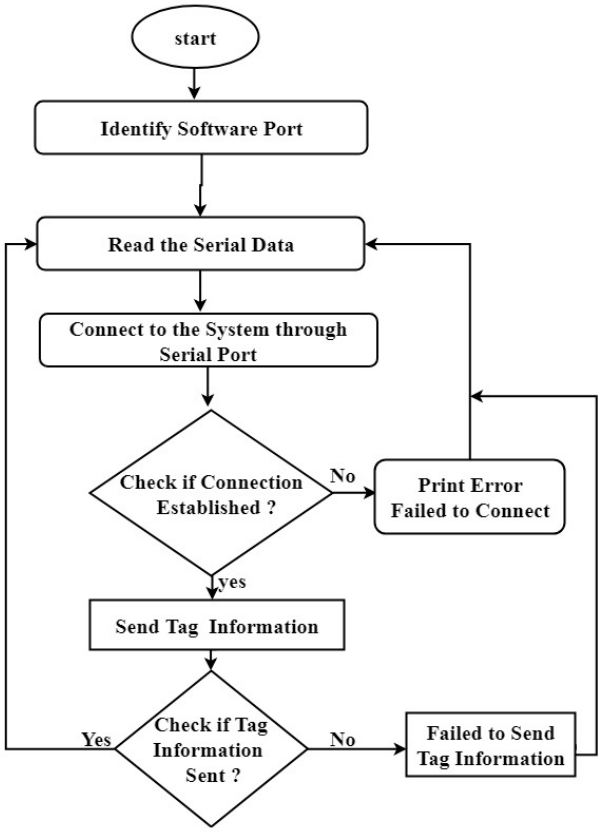

Figure 3: The Flow Chart of Hardware Block

B. Software Implementation

The front end of the software is developed using the Tkinter Module in Python. The backend is developed using MySQLite3 and open source cloud API. The proposed framework will include aspects of engineering from data collection and aggregation, analysis, data processing, profiling, classification, to hardware modeling, simulation, and integration.

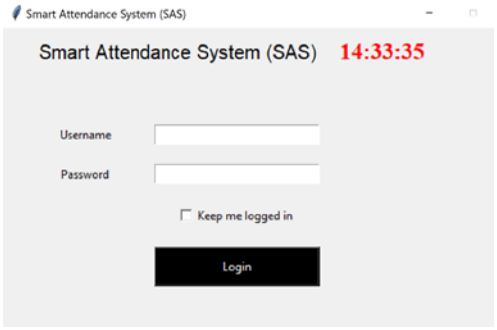

Figure 4: Login Page

Figure 4 shows the login page of the software which is designed in Python Tkinter GUI. When a registered user enters their credentials which will take them to Admin Page and if the credentials are incorrect, a dialog box appears saying incorrect credentials were entered. Figure 5 shows the flow chart of the Login Page.

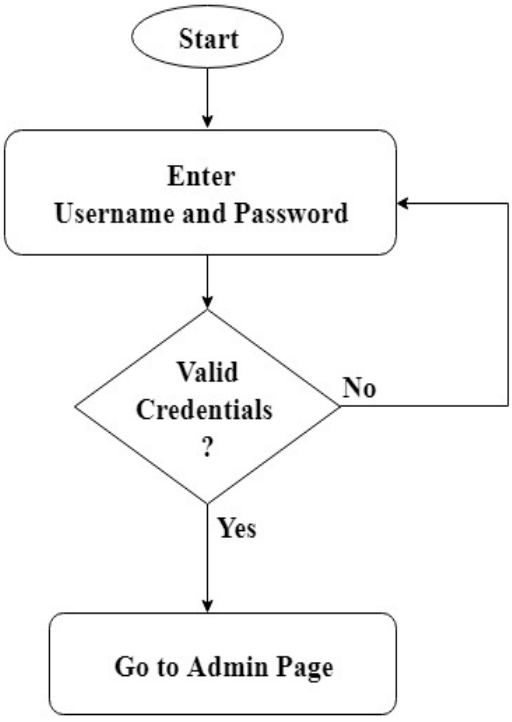

Figure 5: Flow Chart of Login Page

Figure 6 Show the interface for the Admin Page. The user can add, delete and, view students. The necessary actions would be performed on the database, and the result is displayed on the screen. When the attendance button is pressed, it takes the user to the Attendance Page as shown in Figure 8. We have used threading programming in Python to enhance the execution performance of the software.

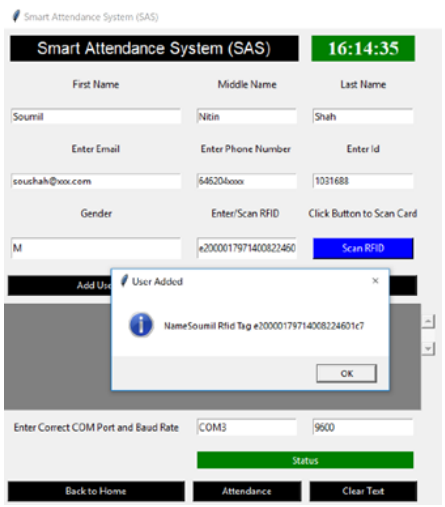

Figure 6: Admin Interface

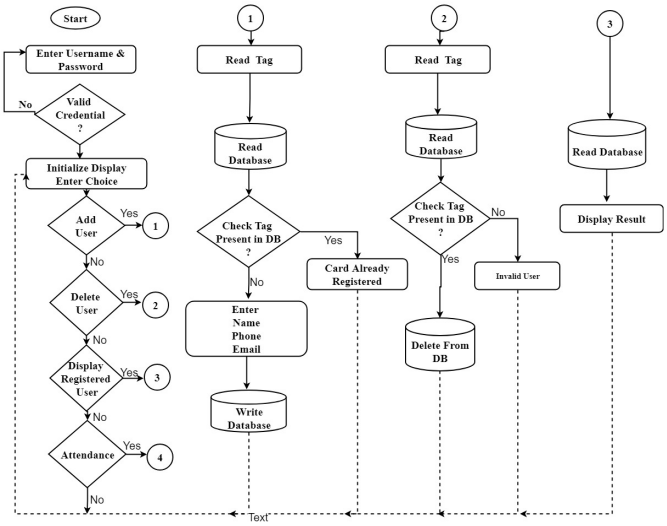

Figure 7: Flow Chart for the Admin Page

Figure 7 shows the algorithm for the Admin Page. After entering correct credentials as shown in Figure 4, it will direct the user to the Admin Page where Students can be added or deleted as shown in Figure 6. Whenever Add User button is pressed, the user needs to assign RFID card to the student. The user places the card on the reader and presses the scan button. It will add an entry for the card in the Database. To delete a user from the database, the card has to be scanned, and then the Delete button is activated to confirm the deletion.

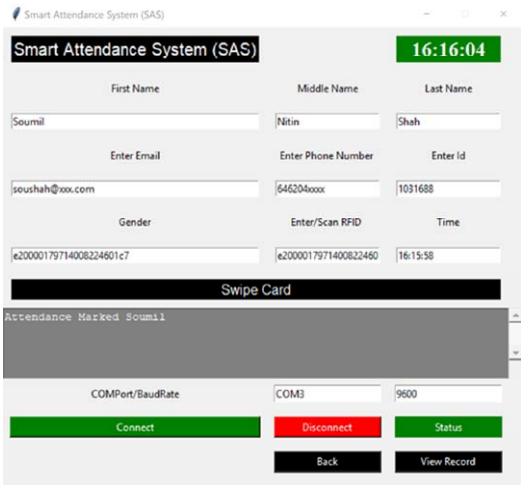

Figure 8: The Attendance Page

Figure 8 shows the attendance module before taking attendance. It is necessary for the user to enter the correct baud rate and the appropriate communication port. If the user enters an incorrect baud rate or communication port, a message would be displayed with some guidance and details. This also can be hardcoded for a default value. Once the details are entered correctly, and after the connect-button is pressed as shown in figure 8, the status will change to green color to show that the system is ready and attendance of student can be taken. At this point, the system is ready to scan students' IDs. A student swipes the ID card, and the ID number will automatically appear in the entry field after it is stored on the database.

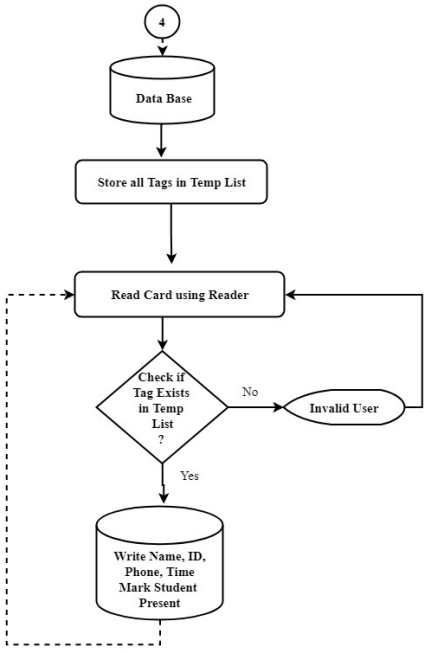

Figure 9: Flowchart for the Attendance Page

Figure 9 shows the flowchart of the Attendance Page. Once the correct communication port and baud rate is entered, the status changes to green which means the system is ready to take attendance. When a student swipes his or her ID over the reader, it reads the ID of the student and stores in a temporary variable to checks against the database.

Figure 10 shows the report module of the attendance monitoring software. The user can generate a report based on the Name or ID. The user could specify the date or a span of dates for attendance. The report will be fetched from the database and presented in Excel file format. Figure 11 shows the flowchart of the Reporting Module.

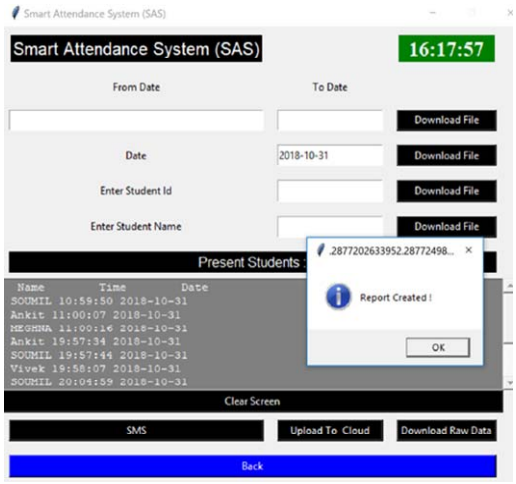

Figure 10: The Reporting Page

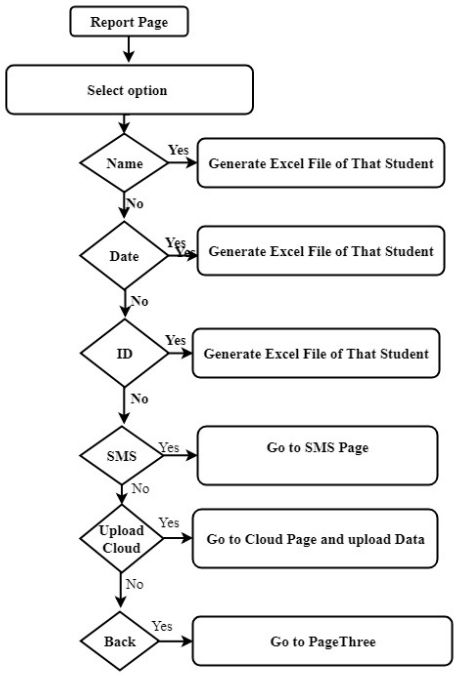

Figure 11: Flowchart of the Reporting Module

Figure 11 shows the software implementation of the Report Page. The user can generate reports based on name, date, or ID. When a name is entered, and the button is pressed, the system fetches the data in the SQlite3 database. The data is written into an Excel file. An example of SQLite3 query is shown below.

```
c.execute(""" SELECT fname,time,date from my_student
WHERE fname =?""",(e_name_v,))
```

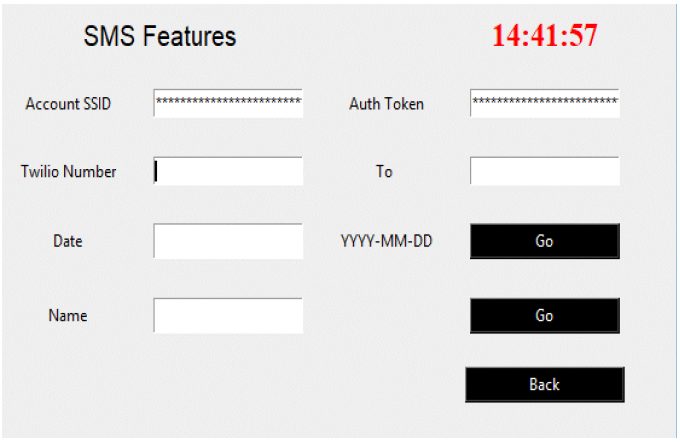

Figure 12: Shows SMS Page

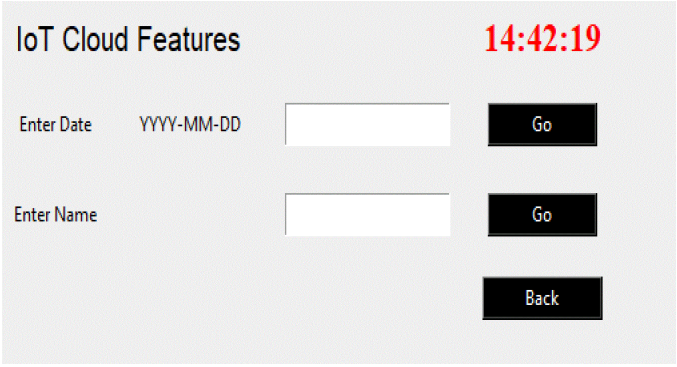

Figure 12: Shows Cloud Page

Figure 12 shows the notification using SMS. With just a click of a button, it can send an SMS to parents of the absent students. Truancies can affect the students overall academic performance. The traditional method of taking attendance by calling names or signing on paper is very time consuming and inefficient. When the user clicks a button to upload to the cloud, it will direct him to the Cloud Module shown in figure 12. By entering the name or date, the user can log all data on a cloud server such as Google Spreadsheets. The entire tedious process is automated using Python and Google Cloud API.

V. Attendance Procedure

The first step would be entering valid username and password as shown in Figure 4. After the user is validated, it will direct the user to the Admin Page as shown in Figure 6. The user can add or delete a student. Figure 6 shows a student is added to the database. Once the student is added to the database, the instructor can go to the Attendance Module by clicking the attendance button on the screen. After entering the correct communication port and baud rate, the system verifies the values and then the status changes to green which indicate that software is ready to take attendance. The students can swipe the cards and attendance is marked on the database as shown in figure 8. After marking the attendance, the instructor can generate the report by pressing the View Record button on the screen which will direct him to the Reporting Page shown in figure 10. After entering all information and once the information is validated, the report is generated and stored in Excel File as shown in Figure 13.

	A	B	C
1	SOUMIL	10:59:50	2018-10-31
2	Ankit	11:00:07	2018-10-31
3	MEGHNA	11:00:16	2018-10-31
4	Ankit	19:57:34	2018-10-31
5	SOUMIL	19:57:44	2018-10-31
6	Vivek	19:58:07	2018-10-31
7	SOUMIL	20:04:59	2018-10-31
8	Ankit	20:05:10	2018-10-31
9	Vivek	20:05:19	2018-10-31
10	Nitin	20:21:15	2018-10-31
11	Ankit	20:21:28	2018-10-31
12	SOUMIL	20:21:34	2018-10-31
13			
14	Total Stud	11	
15			

Figure 13: Shows Report Generated

Figure 14 shows the SMS is sent to parents of the absent student with the click of a button.

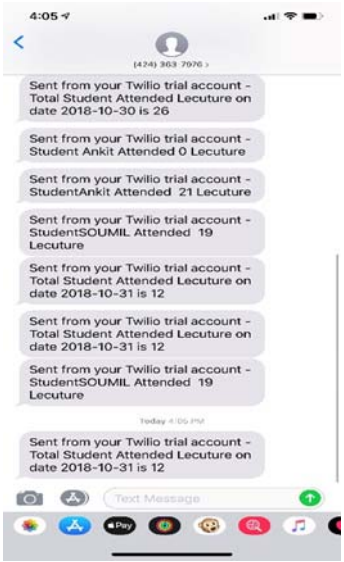

Figure 14: SMS Generation

VI. Conclusion

Our goal is to develop a secure, portable and ready to deploy RFID-based attendance. The system provides a practical and efficient solution for monitoring student attendance on a large-scale. The proposed attendance monitoring system uses the concept of IoT to log and fetch data on the server/cloud and make it available for the user anytime and anywhere. For future work, we would also like to give access to students about their attendance, so they can log in and check their attendance remotely. We would integrate the entire system with a mobile phone application so that all functionality is on the mobile itself. Also, we would like to integrate this system with Canvas or Blackboard using XML interface.

References

1. Kiruthika, J. and S. Khaddaj, *Software Quality Issues and Challenges of Internet of Things*, in *2015 14th International Symposium on Distributed Computing and Applications for Business Engineering and Science (DCABES)*. 2015. p. 176-179.
2. Sudha, K.L., et al., *Barcode based student attendance system.* 2015. **119**(2).
3. Roberts, C.M.J.C. and security, *Radio frequency identification (RFID).* 2006. **25**(1): p. 18-26.
4. Finkenzeller, K., *RFID handbook: fundamentals and applications in contactless smart cards, radio frequency identification and near-field communication*. 2010: John Wiley & Sons.
5. Dobkin, D.M., *The rf in RFID: uhf RFID in practice*. 2012: Newnes.
6. Ononiwu, G., *<RADIO FREQUENCY IDENTIFICATION (RFID) BASED ATTENDANCE SYSTEM WITH AUTOMATIC DOOR UNIT.pdf>.*
7. Singhal, Z. and R.K.J.I.J.o.C.A. Gujral, *Anytime anywhere-remote monitoring of attendance system based on RFID using GSM network.* 2012. **39**(3): p. 37-41.
8. Janarthanam, S., *Hands-On Chatbots and Conversational UI Development: Build chatbots and voice user interfaces with Chatfuel, Dialogflow, Microsoft Bot Framework, Twilio, and Alexa Skills*. 2017: Packt Publishing Ltd.