Design and Simulation of Bluetooth Smart Attendance with SMS Alert

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Abstract

The objective of this research is to design and simulate a portable student attendance system used in educational institutions as well as to design a user-friendly attendance mechanism, especially for the lecturer, which incorporates security criteria for the stored data. When the system is powered on, it will first show the SD card on the system by displaying "SD card is OK", then the title of the project will be displayed also. The time, date, and year are also displayed. Each of the students is assigned a certain identification number starting from 01 to 09... If a student with 01 is called and you see him, you will press 01 from your system or android serial monitor with the help of the Bluetooth device used in the system of your phone to indicate the student is present and at the same time you will press send from your system. The message will be sent to the registered phone number with the help of the GSM module. Also, the students present in the class will also be saved on the SD card for future use.

Keywords: Student Attendance System; Security System; GSM Module; Arduino, Bluetooth Module

INTRODUCTION

Most countries' universities or other institutions have attendance systems that can be easily manipulated. As a proof of this fact, imagine if in each class, a lecturer had to pass the attendance list, which is printed on paper, to the students to record their attendance. In this situation, the student only needs to fill out the attendance with their signature. However, some of the students might imitate their friends' signatures even though they are absent from school. Most universities have barring procedures which exclude students from taking the examination if their attendance record is less than 75%. One of the solutions is to call out the students' names to mark their attendance. Nevertheless, this approach is very time-consuming. Hence, a new system to record attendance should be implemented to replace the current method. Thus, by introducing a portable classroom attendance system based on Android, the aforementioned problem would be solved.
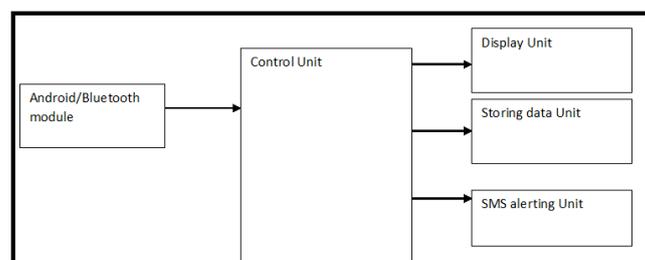

Fig. 1: System block diagram

LITERATURE REVIEW

Radio frequency identification (RFID) technology has been used for several years. The groundwork of this method was laid in the 1940s and was deployed by the British Army to help in identifying enemy aircraft [1-4]. Furthermore, in 1945, Leon Theremin designed a surveillance tool for the Soviet Union that helped in transmitting radio waves that contained audio information. This tool has a diaphragm, which is vibrated due to sound waves, which alter the shape of the resonator. However, this device was not an identification tag but was a sneaky listening device, and therefore it was considered a prototype of the RFID technology because the device was acting as a passive device that was energized by electromagnetic waves (EM) generated by an external source [5]. Likewise, in 1915, the identification-of-friend-or-foe (IFF) transponder was designed to help in identifying aircraft in World War II. Furthermore, in 1948, Harry Stockman explored the RFID technology in his paper titled "Communication employing reflected power". In the late 1960s, the nuclear material safety and security issues caused the further development of RFID, like the invention of the compact disc, which was visualized in the 1960s but did not get enough popularity until the 1980s. In 1973, Mario Cardullo claimed that his passive radio transponder with memory was the first true predecessor of today's RFID system [6]. Furthermore, in 1973, the first demonstration of RFID tags was done at the Los Alamos Scientific Laboratory [7]. The major progress in RFID tracking was made in the 1980s and 1990s. The Compaq computers started using RFID to track components through production assembly in the 1980s. The developments in the compactness of chips and improvements in the computer speed with complex topologies of computer networks have broadly contributed to the increasing momentum of the RFID system. Most significantly, the standards are benchmarked during this development epoch to ensure that users can enjoy the ease of function and compatibility of this technology [8]. The awaiting storms of potentially distracting technology have found ways to bring comfort in our lives by using the evolution of technology in different ways. Smart tags are interchangeable monikers for this technology. This modern technology is what we refer to as RFID technology. The RFID tag is usually contained within or fixed on a person or product for identification, detection, and traceability purposes using radio waves. The RFID reader can read the data that is stored in the radio RFID tags. Our privacy can be achieved by the use of this modern technology that has an impact on our personal lives nowadays. The RFID technology is an emergent technology that is used in a wide range of applications. It is a member of the family of automatic identification and data capture, which is referred to as the automatic identification and data capture (AIDC) technologies. This is the fastest and most reliable means or method of identifying an object or thing. The RFID consists of two main components: the interrogator, which is referred to as the RFID reader, and the transponder, which is referred to as the RFID tag. The interrogator, which is the RFID reader, usually transmits and receives the signal while the transponder RFID tag is attached to the object. In the RFID system, an RFID reader interrogates the RFID tags. This tag reader generates a radio frequency interrogation, which communicates with the tags registered in the system. This reader likewise has a receiver that captures a reply signal generated from the tags and decodes the signal. This reply signal from the tags reflects the tag's information content. An RFID tag usually consists of an antenna and a tiny microchip [1]. RFID alone has various applications, but when it is combined with an Arduino, its limitations are magnified more. The developments in RFID technology continue to produce larger memory capacities, faster processing, and wider reading ranges. There is a high tendency that the technology can replace barcodes even with the expected reduction in raw materials together with economies of scale; the integrated circuit (IC) in a radio frequency (RF) tag can never be as expensive as a bar code label. Nevertheless, RFID will continue to rise in its recognized places where barcodes or other optical technologies are less effective. Attendance or daily attendance of employees or students in an institution, organization, or place of work has turned into a vivacious assessment viewpoint in the current scheme in institutions, organizations, schools, and universities. The unoriginal attendance-monitoring scheme has a few obstructions with the development of the latest technology. For example, giving out the everyday attendance sheet to a gigantic number of employees, students in a class or an organization, industries, and places of work is extremely risky and it hinders the consideration of the students or people in that particular class or organization [2]. This is considered a waste of time and energy as students or individuals can intentionally register individuals who are not present in the class or places of work in the attendance sheet. If the lecturer or organization mistakenly loses these documents, all the important attendance records will be lost without hesitation. The RFID novelty has a great chore to carry out in the completion of the vision of connecting objects around us to the internet. These items extend from huge structures, planes, modern plants, vehicles, any sort of merchandise, and explicit pieces of a bigger framework to people, animals, plants, and even obvious body portions of them. The idea driving all this is called the internet of things (IoT) [3]. Designed and implemented a wireless fingerprint-based attendance system to obtain and record the attendance information using fingerprints, known as biometric [9]. Designing a time management and access monitoring system using a microprocessor card to monitor students' and staff's movements with the data that is kept in the database for administrator reference in the campus, office, or a certain area. Headmasters, teachers, and parents could access all the information captured by this system by fully utilizing Mykad features via the internet and intranet facilities [10]. A system that was capable of recording students' attendance using interactive input, viewing students' and lecturer profiles, generating reports, and providing students with timetables the system records the attendance using a barcode scanner [11]. In another spectrum, RFID technology for checking in and checking out at parking areas without the need to stop cars avoids traffic jams during the parking hours. This type of system is usually used in identifying vehicles through internet facilities by

comparing the previous data in the database [12]. A system called the RFID-based automatic attendance system was developed. The attendance system software is developed using Visual Basic.NET (VB.NET) and a database (Microsoft Access). Each of the employees or students has an RFID tag attached to their identification (ID) card. There is a serial connection between the computer and the RFID reader and the computer system. The RFID reader is placed at the lecture hall door or entrance door of the organization. Whenever students or employees enter the lecture hall or organization, the RFID reader reads the RFID tags, and it stores all data (entry time, name, etc.) of the employee or students into the database via a serial connection and maintains the system. Here, the admin of this system can view all the documents using the software interface by retrieving the data from the database without any hitches, not like the traditional system of writing names on the attendance sheet or piece of paper [13]. Design and implement an attendance system with the combination of RFID and a web-based system. This system uses the RFID tag and the RFID reader to get the student's attendance and read the particulars of the student. Then this reader connects with Arduino, which serves as the brain of the whole research because all instructions are given from there. It then passes the RFID reader response to the web server by the use of the Arduino shield. Finally, the attendance of students can be stored on the web server by using PHP and MySQL. The admin of the implemented system can now view all the student's documents by logging into this particular web-based application and can view all the student's details registered or stored using liquid crystal display (LCD) [14]. A system that uses RFID and pose invariant face verification for an automatic attendance system. The system works under two-factor verification. In the first step, the students need to use the RFID tag that is read by the RFID reader. If the first step is successful, then it moves to the second step of verification. If not, the student becomes unrecognized. The second step is face verification. If the face matches with the particular registered in the RFID tag, then it marks the student's attendance that is in the database. The system will detect fraudulent students automatically. This two-factor automatic system reduces the misuse of identity theft for getting attendance because they are not registered in the system database [15]. In a student attendance management system based on RFID and fingerprint reader applications, the system also works as a two-factor verification system. The RFID reader is linked with the computer, and the computer has specific software that is used to measure the automatic attendance of the students, which is developed by Microsoft Visual Basic Studio and structured query language (SQL). In the first place, the entire student must register his or her RFID tag and fingerprints, and they are stored in the database of the system. Once the students enter the classroom, they need to use the RFID tag, and this will be read by the RFID reader, which will then check the database of the system to see if the tag is registered. If it is registered or correct, then he moves to the next verification step. In the second step, the fingerprint of the student is then verified. If it matches the information of the student registered, he or she then the attendance of the student will be stored on the server. Besides, the lecturers or teachers have authentication to use the system. They can also act as admins of the entire system [16]. An SD card module with an RFID tag, which carries different voice codes, is used in the system development. The tag identification card and the code for the voice greeting are stored in the SD card module. When the student enters the classroom door, his or her RFID tag is read. If the identification card of the student matches with the stored data in the SD card, then the particulars of the student or person need to use the voice greeting. If it matches, then the door will be open and the attendance of the student will be stored in the excel sheet. The students can view their attendance details using the LCD used in the research. In the research, the Arduino connects the liquid crystal display, the RFID reader, the SD card module, and the rest of the components used in the research. Likewise, the system has very simple schematics compared to another system because of the very simple components it uses and the design of the whole system. Also, you can get fast responses and accurate results [17]. A model system called the microcontroller-based attendance system using the RFID system and global system for mobile phones (GSM) was designed. The system consists of three ATmega16 microcontrollers placed in between the RFID reader, the global system for mobile modem, and the computer. Each of the microcontrollers used has its purpose. The system will start whenever a lecturer or teacher uses his or her RFID tag to enter the lecture room or classroom, and then the students will enter the classroom by swapping their RFID tags within five minutes. The RFID reader reads the RFID tag, sends the signal to the first microcontroller, which will analyze the signal from the RFID reader and open the classroom door using an infrared ray (IR) signal, which is influenced by a motor. This signal is temporarily stored in the microcontroller. When the lecturer or teacher finishes his or her class, he or she must swap the RFID tag again to the RFID reader and the system will decide automatically that the class is finished. Therefore, the microcontroller will pass the temporarily stored signal to the computer database as the attendance. If a student is absent, the signal will pass to the global system for mobile phones and modems, and it will send this message to the parents of the students who were not present during the lectures or lessons in the lecture room or the classroom. If any of the students goes out before the lecturer or teacher, the system will not count the student present in the lecture room or classroom. The system itself is an added advantage and a reliable security system. As a result, students cannot defraud the administration or their parents [18]. A system that will use RFID technology, as well as a global system for mobile phones in their research, they used a microcontroller as a middleman between global systems for mobile modules and RFID technology. Whenever the students enter the lecture room or classroom, they need to make use of their tag, which is read by the RFID reader, which sends it to the global system for the mobile module. If the identification card of the student or individual tag does not match with the stored information of the database, he or she is considered an unapproved person. If it accepts the tag, then the global system for the mobile module will send a message to the administration and the students' parents that the students attended lectures or lessons [19]. A system that uses web-based attendance using a four-tier architecture with the use of RFID and

biometrics in their system, the students, lecturers, or teachers' RFID have a unique code, which will be stored in the database of the institution or school. The RFID reader and the fingerprint device are placed at the entrance door of the lecture room or classroom. Whenever the students want to enter the classroom, they need to use the RFID tag, which will be read by an RFID reader and validate the identity of the students by comparing it with the information stored in the database to determine whether the tag matches or not. The second stage of verification will be allowed if and only if the first stage of verification is successful. The verification with the fingerprint is the second stage of the system, and if the student's fingerprint matches with the data in the database, then the attendance will be marked and stored in the database, but if he or her record is not stored or captured in the database, then there will be no attendance for that student. The fingerprint verification takes merely ten minutes, including five minutes before and after the scheduled class starting time. If anyone is late, then it will deny providing attendance to that particular student that is late, but the student can stay at the lectures and learn but will not have attendance for that class. Lastly, a short message service (SMS) will be sent to the students' parents if the students are present in the lecture room or classroom [20]. The prototype of the attendance management system with the placement of a larger number of RFID readers is placed in the room, and there is a server application maintained through a laptop. The radio frequency identification reader and the laptop or personal computer (PC) are connected with the help of a wireless router or local area network (LAN) connection. Whenever a student or person enters the classroom or lecture room, he or she needs to use the RFID tag, which is read by the RFID reader and passes the student's attendance to the server through wireless or LAN connection. Since many of the RFID readers are placed, more than one person can get the attendance simultaneously and get a higher efficiency than the traditional method or using a single radio frequency identification reader [16]. In addition, he proposed a system that works with the RFID technology and Telegram messenger application. In their system, the students need to meet their lecturers or teachers for the tapping of their RFID tags. If the tags match with the tag information stored in the database, then it will send the attendance to the management of the institution or principal in the form of an excel sheet as well as send a message to the specific student's parent via Telegram messenger. Meanwhile, facial verification costs are comparably average to other biometric verification. It could also be considered for a better system for developing an automatic attendance system. The RFID technology with a fingerprint system is very comparable to the RFID system with a facial system. Each characteristic of the table provides similar ideas except for their cost. Fingerprint biometric systems provide a very lower cost compared to the retina and iris. Meanwhile, software, which makes use of Visual Studio and SQL, costs a great deal. Eventually, the system is considered a high-cost system with a higher eminence [17]. A low-cost portable smartcard-based attendance system uses the combination of RFID with fingerprint biometric technology to enhance the safety level and integrity of the records. This design system does not merely make the system design simpler but, likewise, improves the efficiency of the institution both in terms of manpower and time. This system does not merely abridge the method of taking attendance but decreases the rate of errors and permits faster verification of student attendance, all with minimal human interaction [18]. The Smart Attendance Monitoring System (SAMS) is a face recognition-based attendance system for the classroom environment. This system was developed by the integration of omnipresent components to make a portable device for managing the student's attendance using face recognition technology [19]. A radio frequency identification (RFI)-based attendance system with short message service (SMS) backup. This project seeks to address means of automatically registering the student's recorded attendance, saving students' information on the PC as well as backing their information via the global system for mobile communication, and finally making a decision on the worthiness of a student to sit for an examination course or attend the lectures [20–21].

MATERIAL AND METHODS

3.1. The materials used in this research are shown in Table I below.

Table I: materials used in this research

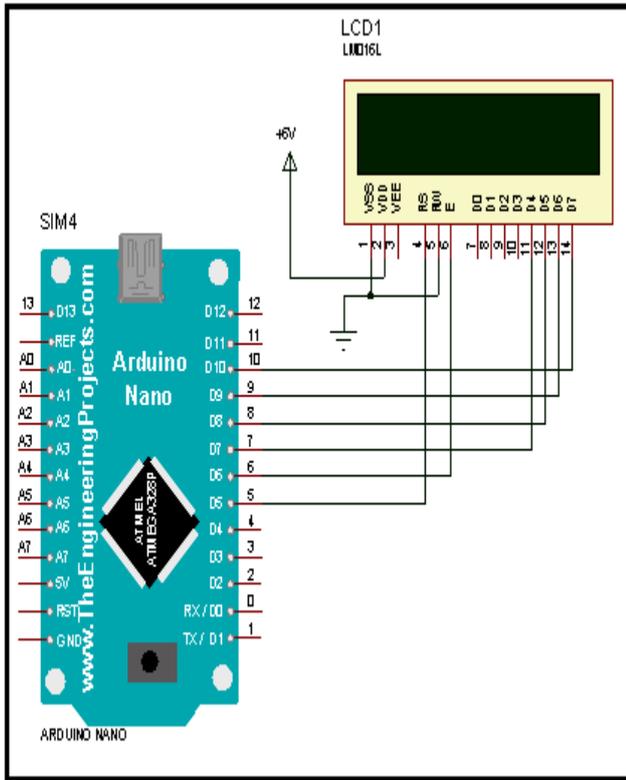| S/N	Name of components	Number used
1	Arduino Nano	1
2	Bluetooth Module	1
3	Liquid Crystal Display	1
4	Jumper wires	12
5	Resistor	2
6	Number of connections	24
7	Light Emitting Diodes	1
8	SD Card	1
9	GSM Module	1

Fig. 2: Interfacing the LCD and Arduino

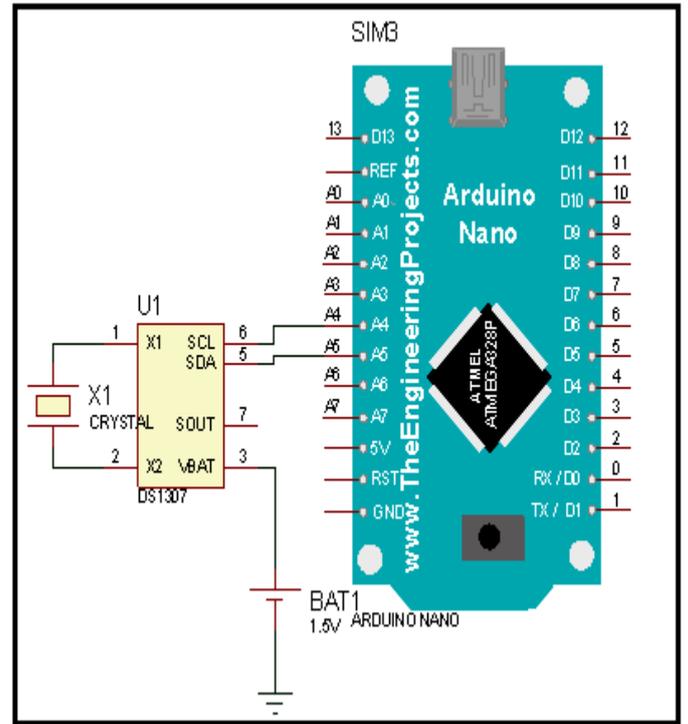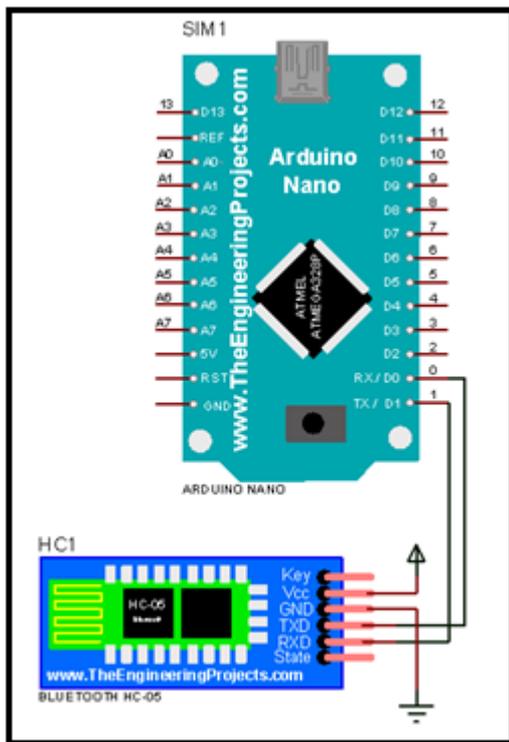Fig. 4Interfacing of the Arduino to a real-time clock

Fig. 3: Interfacing of the Arduino Nano to the Bluetooth Module
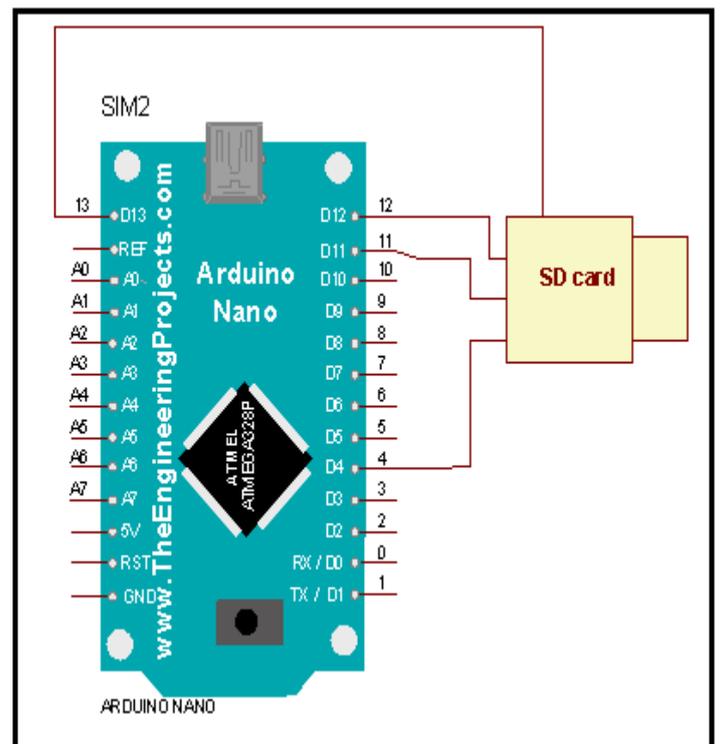
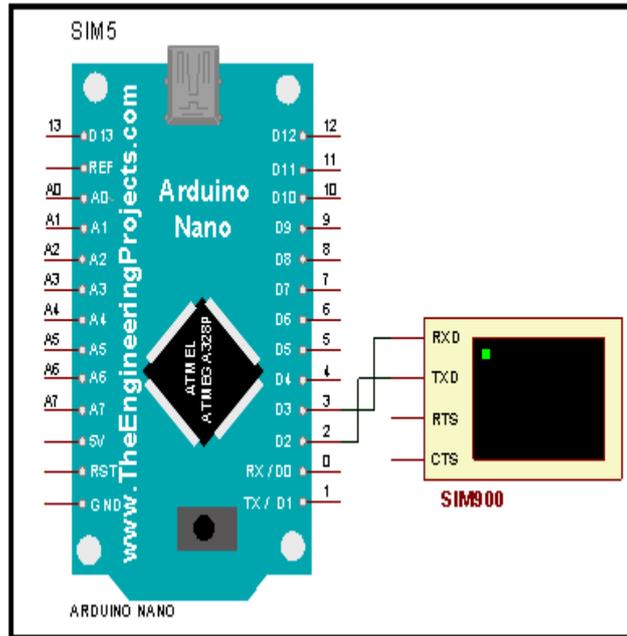Fig. 5: Attendance data storing device (SD Card)

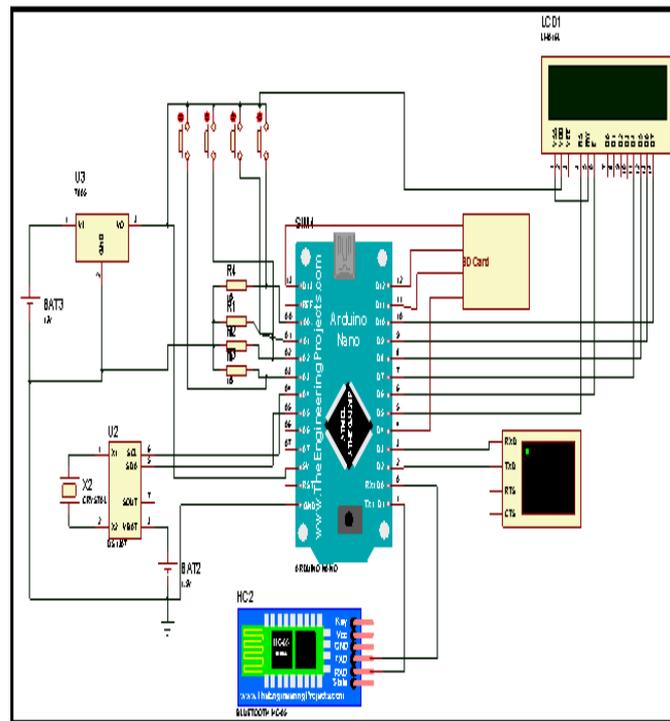Fig. 6: The interfacing of the Arduino to the GSM module

Fig. 7: Interfacing of the whole circuit diagram

METHODS

The objective of this research is to design and simulate a portable student attendance system used in educational institutions as well as to design a user-friendly attendance mechanism, especially for the lecturer, which incorporates security criteria for the stored data. When the system is powered on, it will first show the SD card on the system by displaying "SD card is OK", then the title of the project will be displayed also. The time, date, and year are also displayed. Each of the students is assigned a certain identification number starting from 01 to 09... If a student with 01 is called and you see him, you will press 01 from your system or android serial monitor with the help of the Bluetooth

device used in the system of your phone to indicate the student is present and at the same time you will press send from your system. The message will be sent to the registered phone number with the help of the GSM module. Also, the students present in the class will also be saved on the SD card for future use.

RESULTS

The written and debugged program (HEX-file) was loaded into the microcontroller. After loading the program, it was tested on Proteus software and found to be working successfully.
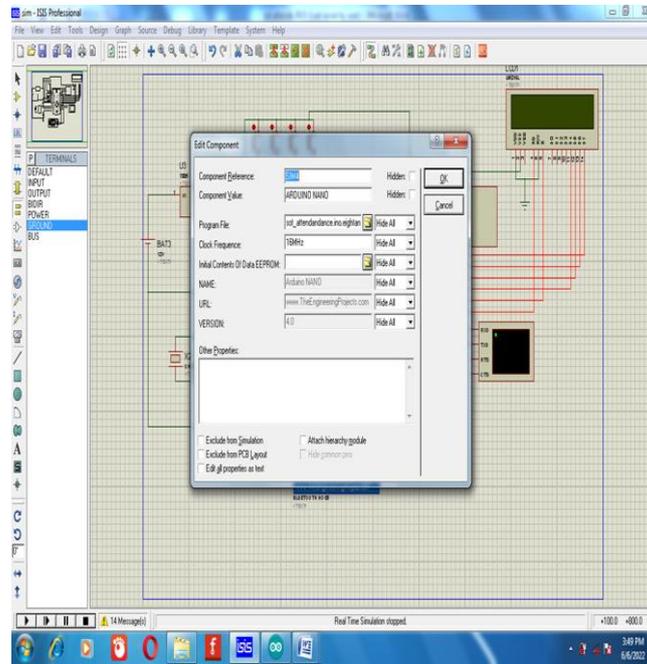

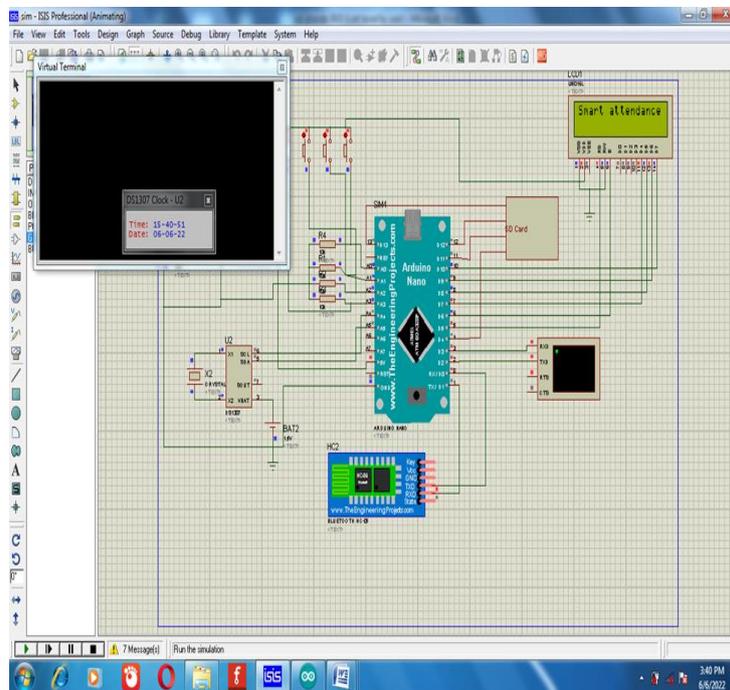Fig. 8: The simulation result demonstrates how the program is loaded.

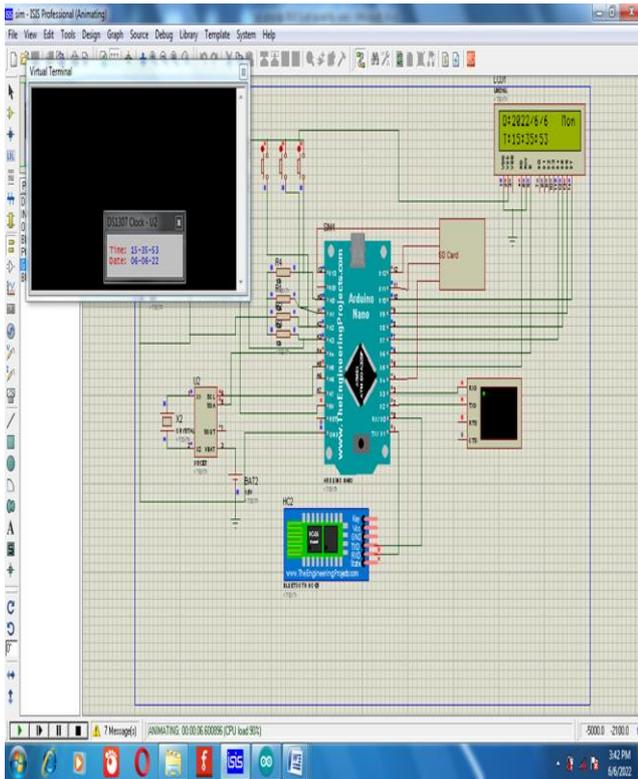Fig. 9: The simulation result shows the tittle of the research.

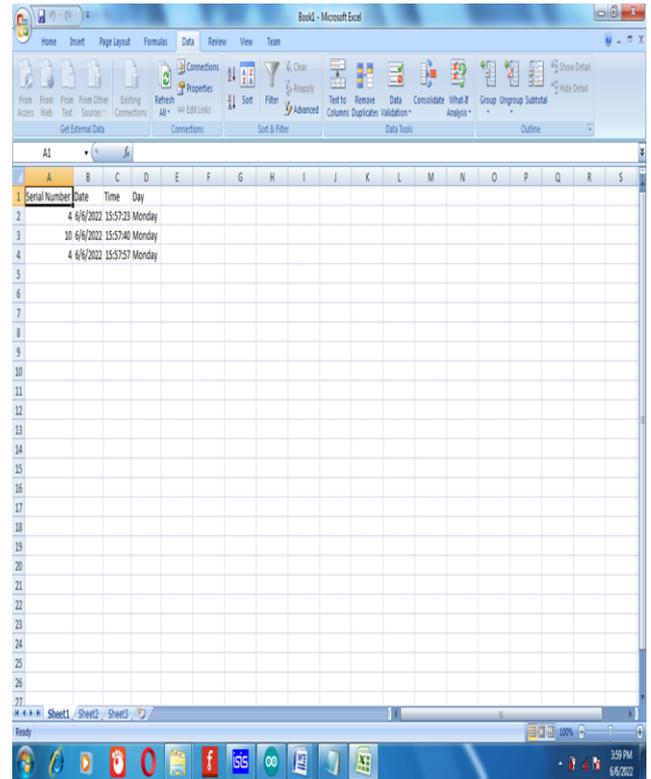Fig. 10: Real-time clock (RTC) simulation result

Fig. 11: The number of students present in the class is extracted from the SD card with the help of an excel sheet.

CONCLUSION

This research makes use of low-cost, off-the-shelf materials. As a result, the net deployment cost is very low and affordable for the average consumer, especially those from Africa. This low-cost scheme is intended to know the number of students present in a particular class and enables their parents or guidance to know if the students are currently in the class attending lectures. The research can be modified by constructing a face recognition module and can also be improved by adding a camera for image capture of the system.

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