

Arduino based Student Attendance Monitoring System using GSM

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Abstract: - Due to challenges of the manual method of taking attendance at schools or colleges, an automated attendance system needs to be adopted. The challenges include difficulty in keeping the attendance list over a period of time, unnecessary time wastage in getting the accurate number of attendees, coupled with improper documentation as students insincerely writing for an absentee among others. This paper implements Radio Frequency Identification (RFID) student attendance monitoring system which provides the functionalities of registering students and recording attendance. On the point of passing into the lecture room, the students have to register their attendance using own personal RFID tag. The RFID reader then reads and transfers the code of the respective tags to the controller. It compares the tags code with database stored in the microcontroller and access command is displayed on the LCD. A GSM module is incorporated in the system which provides a messaging platform for informing parents/guardian of students of their ward attendance in schools or colleges.

Keyword: Radio Frequency Identification (RFID), Global System for Mobile Communication (GSM), RFID Tag/Card, RFID Reader, Arduino controller

1.0 INTRODUCTION

Radio Frequency Identification (RFID) refers to the use of radio wave to identify and track the tag implanted into an object or a living being. It is wireless identification techniques used for smart system that can be used to identify, secure, monitor and do object inventory. Today in most institution Lecturers take attendance by calling out names or passing a sheet of paper. Both way have respective drawbacks. For this reason, college needs to create a system to monitor student's attendance and report it to their parents automatically. This project is to simplify attendance record system by using Radio Frequency Identification (RFID) technology which can be transferred to the parents via GSM network systems. Radio frequency identification (RFID) interface with Global System for Mobile communication (GSM) module is an automatic identification module in which data are retrieved from or store onto RFID tags through a non-physical contact process and messages are been sent to the phone numbers that have been saved in the database. The basic component of the RFID system is RFID tags, RFID reader, middleware, a backend database and a GSM module. A tag can either actively transmit signals to the reader or be passively activated by an RFID reader. Through its antenna, the RFID reader reads the information stored on those tags when in its vicinity. The middleware comprises of the components that transmit information from the reader to the backend management system. It consists

of hardware components such as cable and connectivity ports and software components such as filters that monitor network performance of the system. Individual tag identifies are stored in the database so as to distinctively identify the roles of each tag. The GSM Module provides a Short Text Message (SMS) platform in which parents/guardian of students can be notified of their wards attendance in school. The various fields of application of Radio Frequency Identification technology is increasing on a daily basis, such as inventory control, product tracking through manufacturing and assembly, parking lot access and control, Bank Locker Security System, Automatic Toll Collection System (ATCS), Library Management system (LMS), Attendance Management System etc. The focus of this paper work is on the development of an attendance management system using Radio Frequency which will monitor attendance for a group of students. This paper help to avoid human involvement in keeping the attendance record aims at removing problems and drawbacks associated with conventional method. Therefore, the system functionality is not limited to student attendance record only, it also sends SMS message to their parents.

MATERIAL AND METHOD

The application of Radio Frequency Identification (RFID) technology in the automated electronic environment for various functions including academics has widely been implemented by researchers.

Automatic Access Control System using Student's Identification Card based on RFID Technology

This is an automatic access control system which was developed to curb unauthorized entry of people into a building and prevent uninvited people from gaining access to certain organization resources. The door locking system functions in real time, the door open as soon as the user scans the tag or card. The system has the ability to store the login and logout information of the user, so it can tell when a user is entering in or exiting the building. Each user possesses a unique tag or card and only that user is allowed to use the card. The main setback of this system is that once anyone has access to a card, then that person has access to the secured area.

Radio frequency identification security access control system

This RFID system is used to authorize a tag holder enter a secure area. It reads the data present on the RFID tag

and compares it with data present in the database. If the data tallies, it displays the status of authorizing the entry which is indicated with a lamp coupled with an LCD display. It utilizes the RFID card which is inductively coupled to the reader. The card used is the identity card for the particular person and carries his/her details. When this data matches with the data stored in the database of the microcontroller, the person is given the authority to enter the secured area.

RFID Based Automatic Attendance System

This RFID automatic attendance system was designed to curb the manual method of taking attendance. Each student is assigned with a particular RFID tag. The RFID tag when swiped over a RFID reader, it reads the data on the tag and save it in the memory unit of the system for record purpose. The main drawback of this system is that, it does not compare the tag data with the already existing database and also does not provide platform for informing parents of their wards attendance in school. Thus,

the objective of this paper is to provide an effective and more convenient method of taking attendance in contrast with conventional method. The system was programmed for twenty lecture days and can be easily be reprogrammed for more lecture days by altering a single line code. More students can be registered to the system by reprogramming the system to do so. Though the paper fails to establish how cost effective it will be to send the attendant information through the GSM network because the cost of sending and receiving was not captured in the paper.

RFID Based Attendance System

The RFID based automatic attendance system incorporates the use of a microcontroller (Arduino Mega 2560); RFID devices (RC522 13.56MHz RFID reader), RFID tags; a 16x2 LCD, a buzzer, a GSM module and a 9v DC supply. The fig1 shows block diagram and how the various components are interfaced with the Arduino microcontroller.

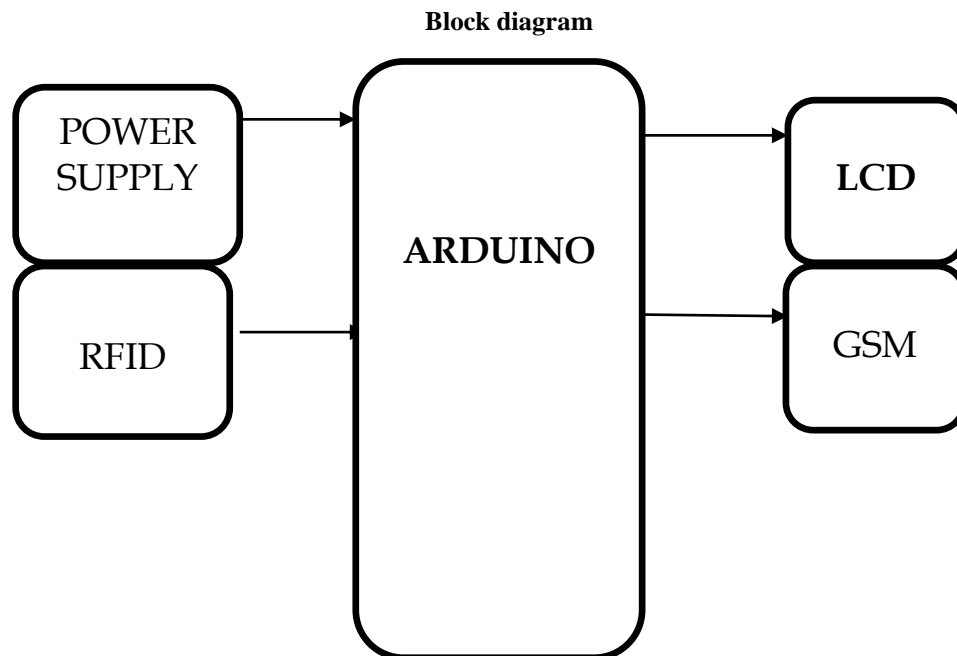


Fig 1: Block diagram description for RFID based attendance system interfaced with GSM Module

The expected result of the RFID technology system is to register student's attendance by means of a mobile device called a tag using wireless technique, the tag is then read by an RFID reader. Tags and cards of 13.56 MHz frequency were used. Arduino reader of the same frequency was also used.

RFID Tag

A radio frequency identification tag (RFID tag) is an electronic tag that exchanges data with RFID reader. RFID tag consists of a microchip that stores a unique sequence identifier that is useful in identifying objects individually. The sequence is a numeric serial, which is stored in the RFID memory. The microchip includes minute circuitry and

an embedded silicon chip. The tag memory can be permanent or re-writable, which can be re-programmed electronically by the reader multiple times. RFID Tags are designed specific to its applications and environment. RFID Tags are available in various shapes and sizes. RFID Tags that are initiated by the reader are known as Passive tags, whilst those that do not require external initiation are called Active tags.



Fig 2: RFID cards and tags of different sizes and shapes

RFID Reader Unit

This unit consists of the MIFARE RC522 Arduino RFID reader/writer which is as shown in fig 3. The unit can read and write to RFID tags and cards. The reader employs Serial Peripheral Interface (SPI) for communicating with the microcontroller. The SPI serves as an interface bus that normally sends data between small peripherals (e.g. registers, sensors and SD cards) and microcontrollers. The

chip of the reader supports Inter-Integrated Circuit (I²C) which is a multi-master, multi-slave, packet-switched serial bus developed by Philips typically used for attaching lower-speed peripheral ICs (the RC522 IC in this case) to processors and microcontrollers in a short-distance communication.



Fig 3: MIFARE RC522 RFID reader/writer

LCD Unit

The Liquid-Crystal Display is a flat-panel display that uses light modulating properties of crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector. This unit is the display unit of the device, it is named 16x2 LCD because it consists of 16 Columns and 2

Rows. There are various types of LCD available in the market, however this size was selected because it is the most suitable and could accommodate the number of characters intended to be displayed. Fig 5a and b shows the features of the 16x2 LCD unit.

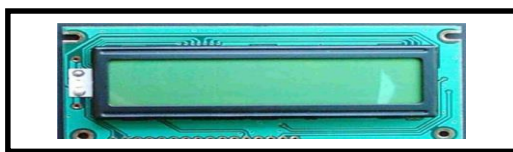


Fig 5: (a) Liquid Crystal Display Unit (16x2)



(b) LCD Pinouts

The LCD consists of: two source pins, that is, supply and ground; 8 data pins used to send data to the LCD although not all were used in this attendance system; three control pins for reading/writing, controlling contrast, and enabling reading/writing; and two LED pins for illuminating the LCD (supply and ground pins).

GSM Module

A GSM module is basically a GSM modem connected to a printed circuit board. A global system for mobile communications (GSM) will be interfaced to the RFID system for the purpose of sending text messages (short message service) to parents which will aid them monitor the presence of their children at school in a specific time.



Fig 7: Pic of the GSM Module

Arduino Mega (Microcontroller)

The most important unit of this project is the Arduino mega microcontroller. The controller is responsible for detection and polling of the peripherals status. It is responsible for making decisions for the connected devices. It is the major part of the system which controls all the operation of the

circuit such as LCD interfacing, square wave generation. It also decides the messages to be displayed on the LCD along with the time duration for which they should be displayed on the LCD. It also sends signal to the buzzer when sound is required, and writes to the micro-SD card. Figure 8 shows the Arduino ATmega2560 microcontroller.

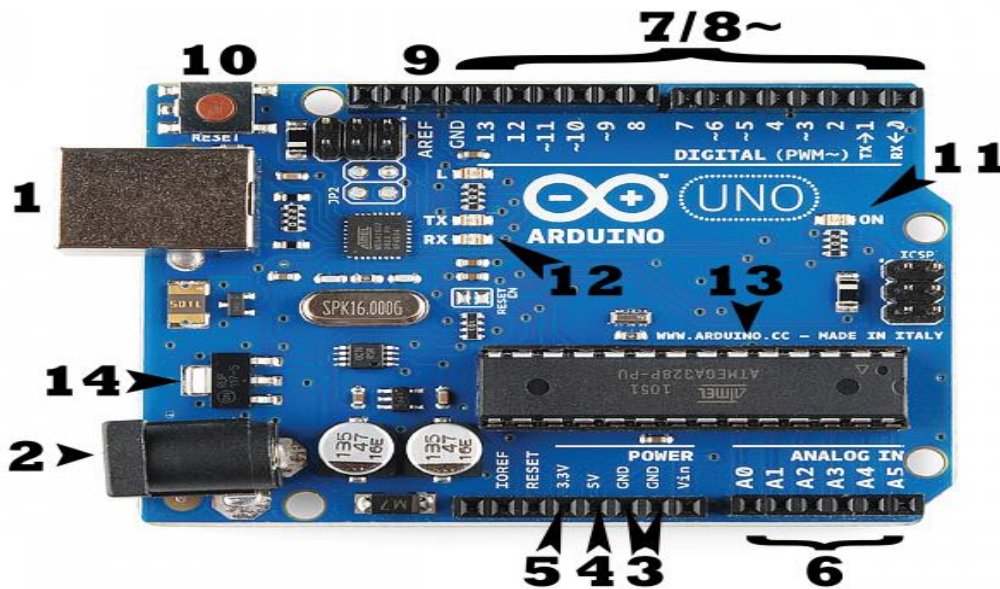


Fig 8: Arduino ATmega2560 Microcontroller,

Arduino is an open source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software or IDE (integrated development environment) that runs on your computer used to write and upload computer code to the physical board.

Flow Chart of the RFID Based Attendance System Program

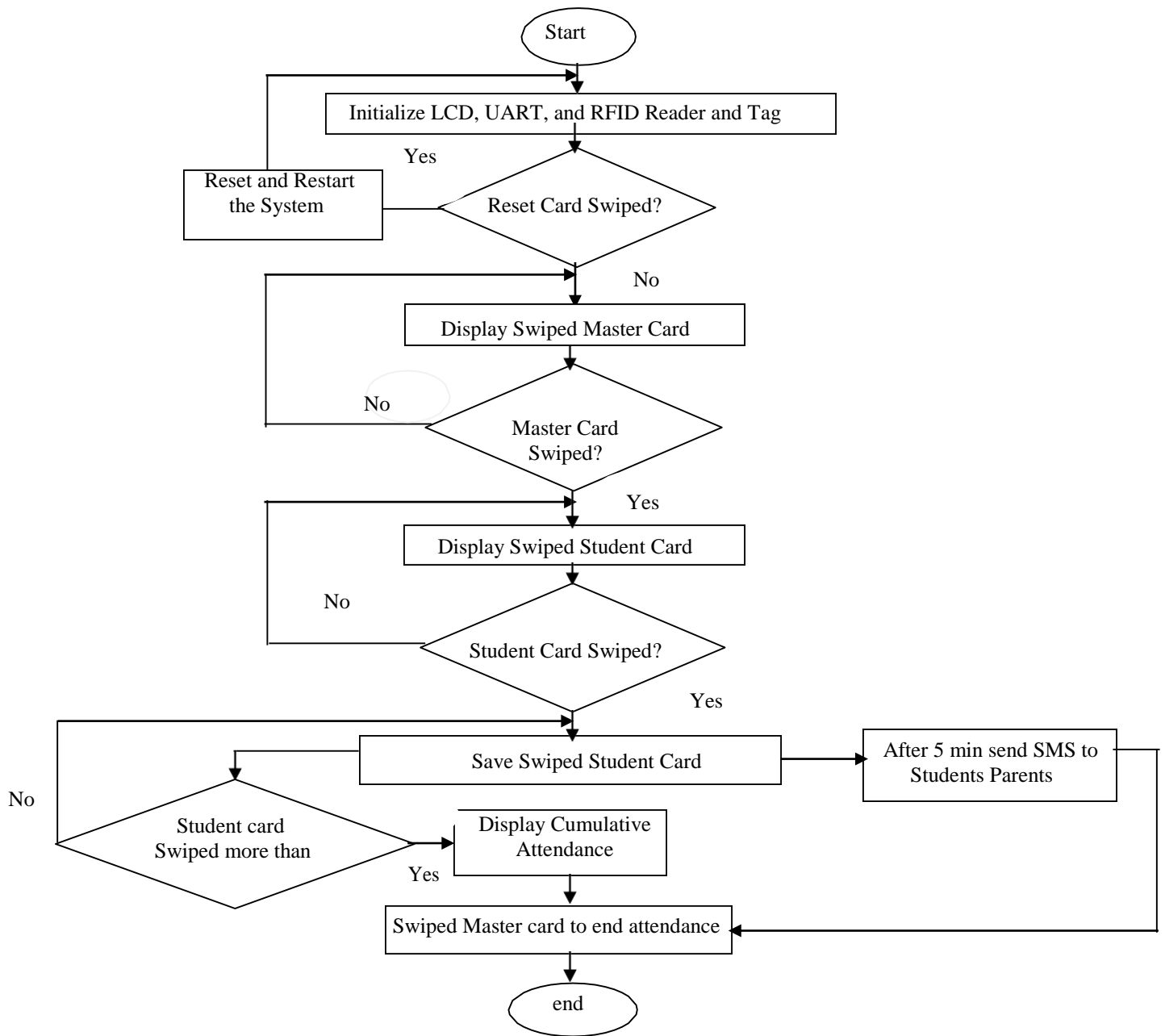


Fig. 11 Flow Chart of the RFID Based Attendance System

3.0 PERFORMANCE EVALUATION AND RESULT

The design of the circuit in Fig 11 was fully drawn inside PROTEUS 8 PROFESSIONAL using 2D graphics feature. Due to lack of some Arduino libraries, the circuit was not fully simulated as in the case of the RC522 RFID Reader unit and the SD card unit.

The main function of the RFID based student attendance monitoring system is designed to scan and authenticate a RFID tag, attendance will be taken based on the card scanned. A radio frequency signal was generated and transmitted to surrounding using antenna by the RFID reader. If a cards is swiped, a small power will be induced from the radio wave to the RFID tag and allow modulated electromagnetic wave to be sent back to the reader. The reader receives the modulated signal from the tag and produces an output in Wieg and 26-bit format. The output is sent to the microcontroller through data line for further processing. The microcontroller receives the data from the reader and reconstructs the signal in wieg and 26 bit format. The result will be used to compare with the ID stored in the microcontroller. If the ID exists, the respective name and ID will be stored in the memory unit. If the ID cannot be found or swiped more than once, then an error will have displayed

and read Cumulative Attendance on the LCD.

The implementation of the system was tested using four different tags which include; the master card, student tag1, student tag2 and the reset tag. When the device is switched on (by connecting it to a power source, although a power bank was used to test the system). It initializes and display the lecture day after which the LCD displays swipe master card (tag). The master card has to be swiped before any other student gains access to swipe their tags as well. When a student swipes his/her tag, it is stored in the SD card to his/her name or I.D number as the case may be. The master card is swiped again at the end of each lecture day marking the end of the attendance exercise. At this point no student can be able to access the attendance system. The system has been programmed for twenty (20) lecture days. The reset card is used to reset the system to commence a fresh attendance thereby erasing any other information that has been stored in the SD card. At any point a student card is swiped, a text message is being forwarded to the guardian of such student by the aid of the GSM module which has been interfaced with the Arduino ATmega2560 Microcontroller to notify his/her presence in class. The circuit diagram of the complete attendance system is shown in fig 11.

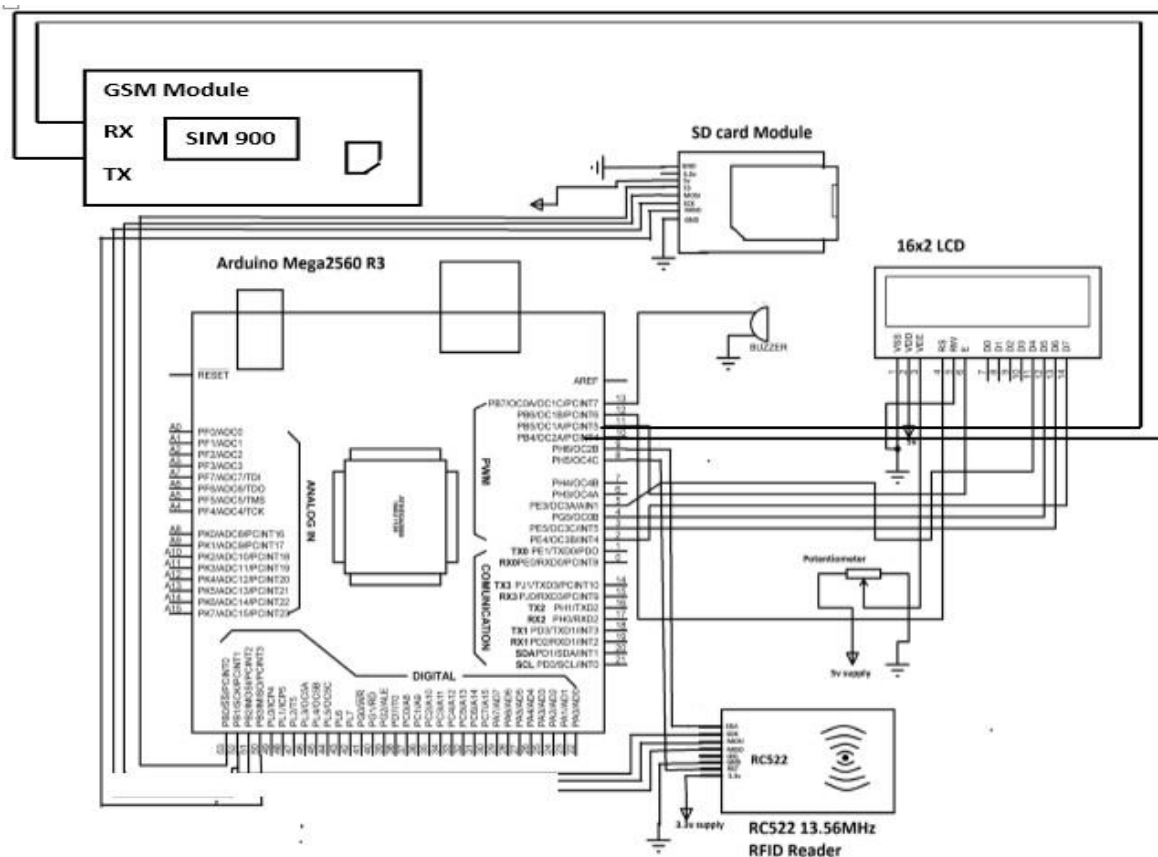


Fig 11 RFID Attendance System (Schematic/Circuit Diagram)

Also the performance of the RFID based student attendance system has again been evaluated on different tag positions and distance. A simple detection range test was conducted to evaluate the maximum detectable distance from the reader for different tag orientation. The main purpose of the

test is to evaluate the performance of the system in terms of the detection range. The test proved that the reader has about 5cm detection range if scan from top position. Table 1 shows the range of detection for passive RFID reader used in this system.

Table 1: Range of detection for passive RFID reader used

Tag orientation Location of reader	Parallel with reader	Perpendicular with reader
Master Card	5cm	0cm
Student tag1	1cm	2cm
Student tag2	1cm	2cm
Reset tag	4cm	0cm

CONCLUSION

The system provides a more efficient and less cumbersome way of taking attendance in school and shifts the paradigm of students' lecture attendance monitoring. The prototype of the system provides several benefits over conventional method of taking attendance. The prototype developed is compact and light weight and can run on power adapter or battery power. Further, it is very portable and can be moved from one point to the other. The system can be applied not just in the colleges but also in the working places. Therefore, applying RFID technology as the attendance process is quite efficient, fast, paperless and minimize the cheating process by the students compare to the attendance process using conventional method.

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