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Implementation of a Monitoring System using RF Technology

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Abstract- Most educational institutions administrators are concerned about irregular attendance of students. Nonattendance can affect student overall academic performance. The conventional method to take attendance by calling names or signing on paper is very time consuming and insecure, hence this method is inefficient. Radio Frequency Identification (RFID) based attendance system is one of the solutions for this problem. This system can be used to take attendance for student in school, college, university and also for workers in working places. Its ability to uniquely identify each person based on their RFID ID card make the process of taking the attendance easier, faster and secure as compared to conventional method. Students or workers only need to place their ID card on the RFID reader and their attendance will be taken immediately. By real time clock capability of the system, attendance taken be more accurate since the time for the attendance taken is recorded. The system can be connected to the pc through RS232 or Universal Serial Bus (USB) port and store the attendance taken in SD card. Another way of viewing the recorded attendance is by using HyperTerminal software. A prototype of the system has been successfully fabricated.

Keywords- RFID (Radio Frequency Identification), MFRC522 RFID module, arduino uno, RTC module, SD card module, design of RFID based attendance system, analysis of experiment, discussion.

I. INTRODUCTION

Radio frequency identification (RFID) is a technology where radio frequency wave is used to identify and track the tag implanted into an object or a living thing. It is a wireless communication that use electromagnetic and electrostatic coupling in radio frequency portion of the spectrum for communicating between reader and tag through a variety of encoding and modulation scheme. Radio Frequency Identification (RFID) is the combination of radio frequency and microchip technologies that create a smart system to identify, monitor, secure and also do object inventory. At their simplest, RFID systems use tiny chips which are called tags which contain some piece of identifying information and transmit to an RFID reader, a device that in turn can interface with computers.

In the system of RFID Based Student Attendance System, the passive type RFID reader is used, whose maximum range of detection is around 10cm. Its operating frequency is 13.56MHz and operates at 3.3 v power supply. This system has the ability of uniquely identifying and takes attendance of the students. Users need only to place their RFID tag on the RFID reader to take attendance. Users do not need to go through the long list to look for their name. Hence, this system is a very time efficient system. Attendance will be taken if the encoded tagged ID scanned and matches the tagged ID stored in the memory of the microcontroller.

Recently, RFID is one of the automatic identification technologies. There is a broad research and development in this area to take maximum advantage of this technology, and in coming years many new applications and research areas will extend to appear. RFID system has been successfully applied to different areas as transportation, agriculture, healthcare, and hospitality industry to name a few. RFID also brings about some concerns, such as mainly the security and privacy of those who work with or use tags in everyday life which is proposed in [1].RFID is used for identifying tagged objects or people uniquely. RFID is widely used in many application areas such as inventory control, parking lot access and control, product tracking through manufacturing and assembly, Automatic Toll Collection System (ATCS), Bank, Locker Security System, Attendance Management System, Library Management system (LMS) etc. as discussed in [2].

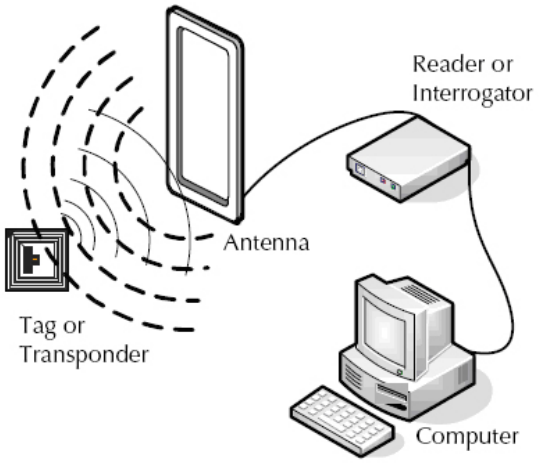

Figure 1: RFID system

II. LITERATURE SURVEY

The first RFID application was the "Identification Friend or Foe" system (IFF) and it was used by the British in the Second World War. In this system, Transponders were placed into fighter planes and tanks, and reading units could query them to decide whether to attack. This technology is still used in armies over the world.

The first commercial RFID application was the "Electronic Article Surveillance" (EAS) which was developed in the seventies as a theft prevention system. It was based on tags that can store a single bit which was read when the customer left the store and when the bit was not unset the system would sound alarm. In the end-seventies RFID tags developed its way into the agriculture for example for animal tagging. In the eighties when Norway and several US states decided to use RFID for toll collection on roads (EZ-Pass), RFID technology got a boost. In addition to toll collection, the following decade brought a large number of new applications, such as ski passes, gasoline cards (Speed Pass), money cards, etc.

In 1999, the Auto-ID Centre at MIT was founded. That task was to develop a global standard for item-level tagging. After completing the work on the Electronic Product Code (EPC), The Auto-ID was closed in 2003.

At the same time the newly founded EPC global Inc. continued their work. The probably first paper related to RFID technology was the landmark paper that was published by Harry Stockman, "Communication by Means of Reflected Power" in October 1948. In 1973 the first patent on RFID was issued for a passive radio transponder with memory. It refers to [13, chapter 2].

III. RADIO FREQUENCY IDENTIFICATION

RFID stands for Radio Frequency Identification. RFID means that identifying a person or object using Radio Frequency Transmission. RFID is used to collect information automatically by radio frequency data communication between a object and an RFID reader for identifying and tracking them. They are most commonly referred to as reader and tag respectively in ref..The RFID system is shown in figure 1. There are Tags and Reader in the system. A reader is a device that has one or more antennas that emits radio waves and receives signals back from the tag. To read or collect the data stored on an RFID tag, a reader is needed. RFID is used to read or write information on a tag and passing this information to a system for storage and processing. This section is broadly discussed in reference [17].

Generally, RFID system consists of 2 parts one is the Interrogator and another is the transponders. Interrogator and Transponder are known as RFID Reader and RFID Tag respectively.

IV. RFID TAG

RFID Tag is an IC chip which has unique hexadecimal or electronic product code(EPC) contained in it. Here, unique refers to each and every code word of the tag and it is independent of other code word. The tag acts as a Key which is capable of opening particular locks .The sequence is a numeric serial which is stored in the RFID memory. The microchip contains minute circuitry and an embedded silicon chip. Each tag is capable to store a maximum of 2KB information in the microchips. The tag memory may be permanent or rewritable, which can be re-programmed electronically by the reader multiple times. Tags are designed as specific to an application and the environment it is proposed in.

Three types of RFID tags are existed, which are active, semi passive and passive. It refers to [6].The features of three types tags are shown in table 1.

Table1. Features of different types of RFID tag

Feature	Active	Semi-Passive	Passive
Read Range	long up to 100 m.	Long.	Short upto 10cm.
Battery	yes	yes	no
Storage	128 kilo bytes read/write	128 kilo bytes read/write	128 bytes read/write
Life validity	Between 5 to 10 years	Up to 10 years	Up to 20 years
Cost	Very expensive	expensive	cheap
Application	Monitoring the condition	Measurement of the temperature	Attendance management system

V. RFID READER

RFID Reader is a scanning device that uses the antenna to realise the tags that are in its proximity. It transmits signals at certain frequencies. RFID readers are usually ON; it continuously transmits radio energy and awaiting any tags that enter their field of operation.

Three primary frequency bands have been allocated for RFID

Low Frequency (125/134 KHz) band – Most commonly used for access control and asset tracking is low frequency band.

Mid-Frequency (13.56 MHz) band – This frequency band is used where medium data rate and read ranges are required.

Ultra High-Frequency (850 MHz to 950 MHz and 2.4 GHz to 2.5 GHz) band – It offers the longest read.

VI. PROPOSED SYSTEM

We have built a time attendance system with MFRC522 RFID Reader, Arduino uno, RTC module, SD card module. When I swipe an RFID tag next to the RFID reader, it saves the user UID and time in an SD card. It also shows if anybody are late or in time accordingly to a preset hour and minute. It contains an RFID reader that reads RFID tags; in our setup has a real time clock module to keep track of time; When the RFID reader reads an RFID tag, it saves the current time and the UID of the tag in an SD card; the arduino uno communicates with the SD card using an SD card module. We set a check in time to compare if anybody is in time or late; if he or she is on time, a green LED lights up, if he or she is late, then a red LED lights up. We have also used a buzzer that beeps when a tag is read.

Block diagram of our proposed system is shown in “figure 2”.

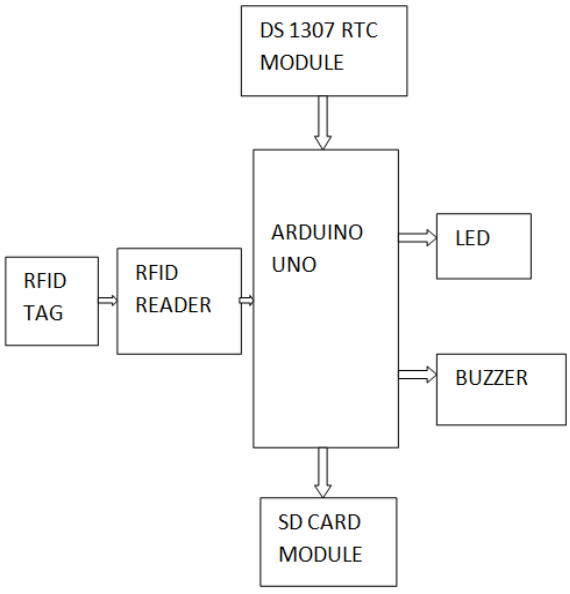

Figure 2: Block diagram of proposed system

VII. COMPONENTS DESCRIPTION

7.1 Arduino uno

Arduino Uno is a microcontroller board which is based on the ATmega328P microcontroller. It has 14 digital input/output pins. In which 6 pin can be used as PWM outputs, 6pins are analog inputs. There are existed a 16 MHz quartz crystal oscillator, USB connection port is existed. It has a power jack, an ICSP header and a reset button. Each of the 14 digital pins and 6 Analog pins on the Uno can be used as an input or output, it uses pin Mode (), digital Write (), and digital Read () functions. It operates at 5 volts. Each pin can provide or receive 20 mA current as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. Here maximum of 40mA is the value that must not be exceeded on any I/O pin for avoiding permanent damage to the microcontroller of this. Serial Pin 0 is used as Rx and pin 1 is used as Tx; the Rx and Tx pins are used to receive and transmit TTL serial data. Those pins are connected with the corresponding ATmega328P USB to TTL serial chip. PWM Pin (3, 5, 6, 9 and 11) pins is used to provide an 8-bit PWM output by using analog Write() function. SPI Pins (10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK)) are used for SPI communication. This refers to [22]. Technical specifications of arduino uno are shown in table 2.Arduino uno is shown in "figure 3".

Table2. Technical specifications of arduino uno

Operating voltage	5v
Microcontroller	ATmega328P (It is 8 bit AVR family microcontroller)
Recommended input voltage	7 to 12 v
Input voltage limits	6 to 20 v
Analog input pins	6(A0 to A5)
Digital I/O pins	14(Out of which 6 provide PWM output)
DC current on I/O pins	40 mA
DC current on 3.3v pin	50 mA
Flash memory	32 KB(Here, 0.5 KB is used for boot loader)
EEPROM	1 KB
Frequency (speed of clock)	16 MHZ
SRAM	2 KB

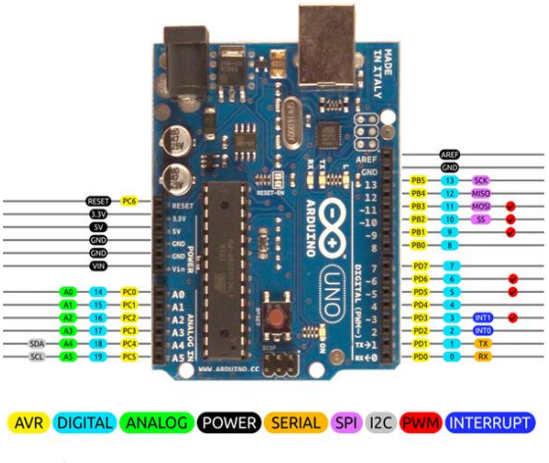

Figure 3: Arduino uno

7.2 RFID tag and reader

We have used MFRC522 RFID unit. The MFRC522 RFID reader works at 3.3V. It can use SPI or I2C communication. The library is used to control the RFID reader only supports SPI. MF RC522 is integrated. It has 13.56MHz contactless communication card chip. It is suitable for Smart meters and portable handheld devices. It has advanced modulation and demodulation concept completely integrated in all types of 13.56MHz passive contactless communication methods and protocols. It has 14443A compatible transponder signals, ISO14443A frames and error detection. It supports rapid CRYPTO1 encryption algorithm, terminology validation MIFARE products. It supports

MIFARE series of high-speed non-contact communication, its two-way data transmission rate up to 424kbit/s. Each tag has its own unique identification (UID).The tag type is passive. It refers to [2].It is Low cost, and also ideal for user equipment development.

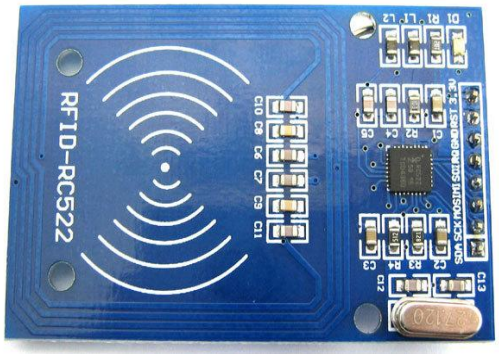

Figure 4: RC522 reader

Figure 5: Passive RFID tag

7.3 RTC module

We have used DS1307 RTC module. Real Time Clock (RTC) is capable to track the current time and date. This is generally used in computers, laptops, mobiles, embedded system applications devices etc. In many embedded system, we need to set timestamp while logging data i.e. sensor values, GPS coordinates etc. To get timestamp, we need to use RTC (Real Time Clock).Some microcontrollers like LPC1768, LPC2148 etc., have on-chip RTC. But in other microcontrollers like ATmega16/32, PIC, they do not have on-chip RTC. This refers to [2]. So, we should use external RTC chip. There are different types of ICs used for RTC like DS1307, DS3231, and DS12C887 etc. This is shown in "figure 5".

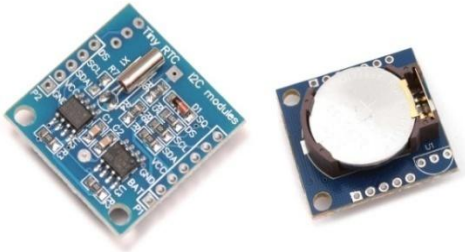

Figure 5: DS1307 RTC module

7.4 SD card module

Micro SD card module is used. This module is a simple solution to transfer data to and from a standard SD card. The pin out is directly suitable with Arduino, but can also be used with other microcontrollers. It allows us to add mass storage and data logging to your project. This module has SPI interface (serial peripheral interfacing) which is compatible with any SD card and it use 5V or 3.3V power supply which is compatible with Arduino UNO/Mega. It refers to [2].SD module has various applications such as audio, video, data logger, graphics. This module will widely develop the capability an Arduino can do with their poor limited memory. This module is shown in "figure 6".

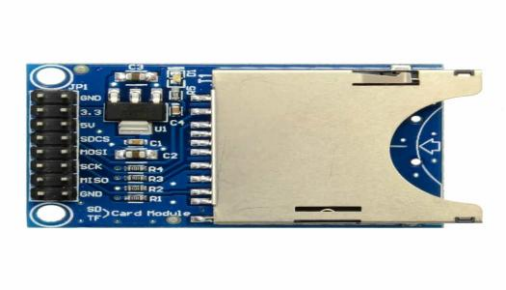

Figure 6: SD card module

VIII. CIRCUIT DIAGRAM OF PROPOSED SYSTEM

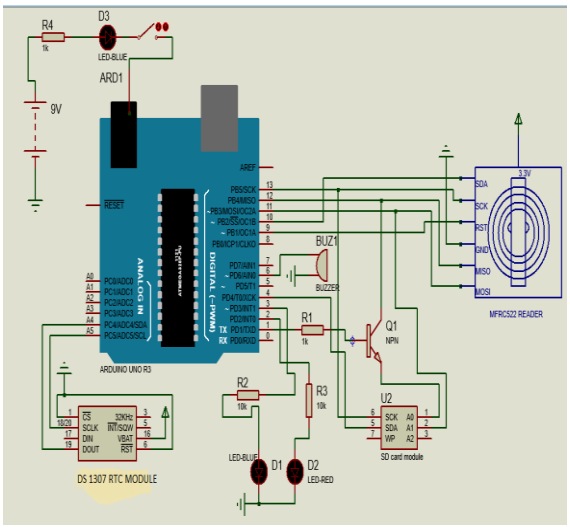

Figure 7: Circuit diagram of proposed system

IX. PRESENT SCENARIO OF PROPOSED SYSTEM

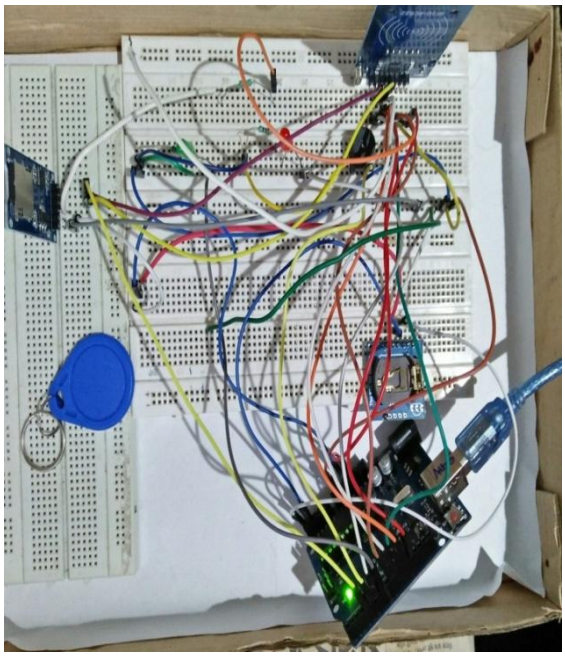

Figure 8: Present scenario of RFID based attendance system

X. SOFTWARE DESIGN OF PROPOSED SYSTEM

Direction flow of the program is shown in "figure 9". We have used Arduino IDE software for programming of RFID based attendance system.

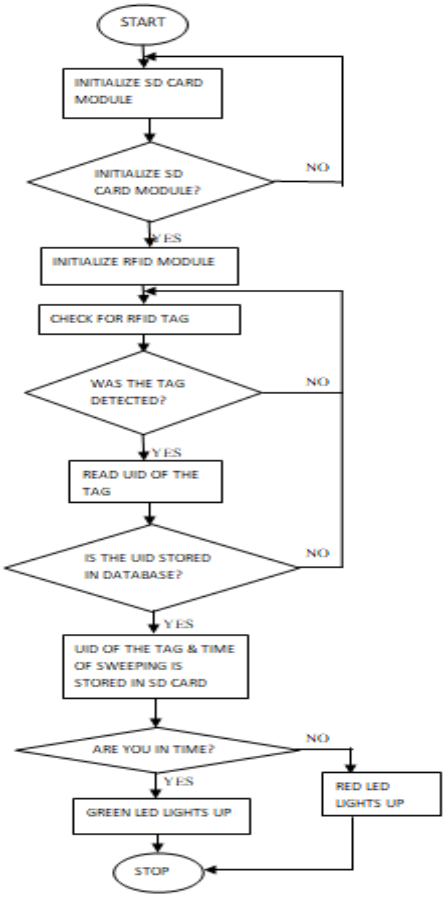

Figure 9:Flow chart of the proposed system

XI. OUTPUT OF THE PROPOSED SYSTEM

The RFID reader reads an RFID tag, then the current time of sweeping of the tag and the UID of the tag is stored in SD card. In SD card, we have created a folder name as myFile, in this folder we have save a notepad file name as DATA. The UID of tag along with its sweeping time is stored in DATA file. Here, also we set a check in time to compare if anybody is in time or late. Output is shown in "figure 10".

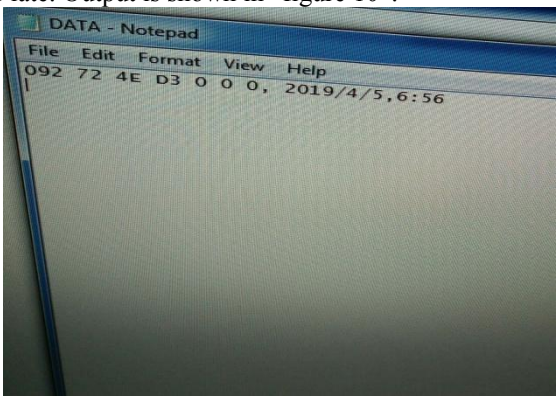

Figure 10: Output of RFID based attendance system

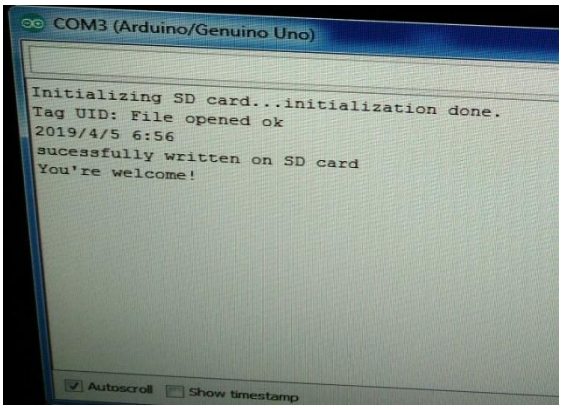

Figure 11: serial monitor output of arduino programming of RFID based attendance system

XII. ANALYSIS OF EXPERIMENT

The performance analysis of an electronic device is very important because this helps the end users of the device to know about its efficiency, life span and its limitations. The performance analysis concerned with this device limitation of components specification/tolerance.

Table 3: Components specifications/tolerance

Module	Current(max)	Voltage	Power(max)
Arduino uno	50mA	5v	0.25
MFRC522 reader	26mA	3.3v	0.0858
DS1307 RTC	0.5mA	5v	0.0025
SD card module	100mA	5v	0.5
Piezo Buzzer	30mA	5v	0.15
LEDs	50mA	5v	0.25
TOTAL		Total Amperage 256.5mA	Total wattage 1.283watts

Since the 9v battery can supply up to 1200mA in every hour, so a single battery would sustain the project for a minimum of 4.6hours which can be greatly increased based on the usage.

XIII. DISCUSSION

More compatible modules can be used for the construction as SD card module and MFRC522 was not really compatible together. But this has worked together through ingenious means. The memory allocation for data collection can be improved on. The timing module (DS1307) despite the high-level of accuracy and temperature compensation can be made more accurate for long term purpose of time keeping. As it has a slack of few minutes yearly.

For high security use, it is recommended to use this system along with other devices to complement it. Another disadvantage is cards can be stolen or misplaced. This device is also limited by the amount of memory allocated to it by the administrator to store data. Batteries can be a limitation for prolonged usage.

XIV. CONCLUSION

The RFID based attendance system is more secure and reliable and fast responded. Tag works in any environmental condition. RFID technology provides diplomatic, better comfort and also promises an increased effectiveness and also improves efficiency. Hence this device can be very much useful and can be implemented in real time application for attendance recording purpose. This system is very important in today's world because of its application in various areas. It makes life easier which is the purpose of engineering, it makes work more efficient. The device is also cheaper and small which is the current trend in today's technology. Anyone can easily own one for personal use. Lecturers can automatically take their attendance and accurately time students, workers attendance can be much more reliable and it adds class in business environment at such little cost. It is a unique design which is very easy to implement by everyone.

XV. ACKNOWLEDGEMENT

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