RFID Based Attendance System

Aman Jha, Garv Jain, Kanishk Giri, KBPD Srinivas and Sharvirala Nithish

***Abstract*—Administrators at the majority of educational institutions are concerned about student's erratic attendance. Absences might impact student performance in school. The traditional way of collecting attendance involves calling names or signing on paper, takes a lot of time and needs to be more secure, making it ineffective. Identification through Radio Frequency (RFID) based attendance system is one way to deal with this difficulty. This technique can record attendance in high school, college, or university. Compared to the traditional way, it makes taking attendance simpler, faster, and more secure due to its ability to uniquely identify each person based on their RFID tag, a kind of ID card. Students or employees need to place their ID cards on the reader to take their attendance. The system's real-time clock feature will allow attendance to be collected more precisely as the time will be recorded.**

***Index Terms*—RFID, Real time clock.**

Components used : Arduino board, RFID module, LCD, potentiometer, RFID cards, SD card, Card reader, RTC module, Buzzer, LED, Connecting wires, Breadboard.

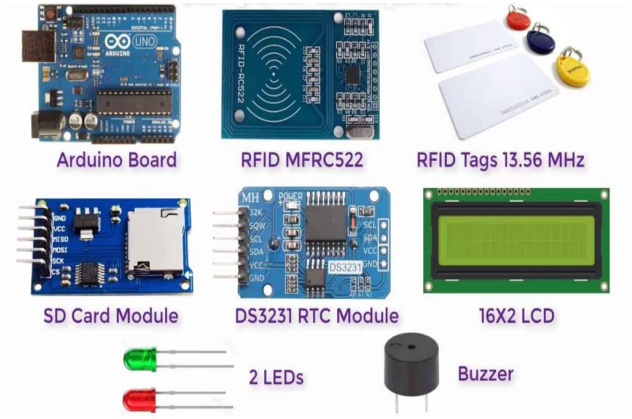

Fig. 1. Components used.

I. Introduction

RFID is an automated tool for locating and identifying objects. It is a wireless communication method that uses electromagnetic and electrostatic coupling in the radio frequency region of the spectrum to communicate between reader and tag through various modulation and encoding schemes. Modulation refers to the variation in the amplitude, frequency or phase of a high-frequency carrier signal to convey information. Encoding is a process of converting data from one format to another. An RFID system consists of two main components, a tag attached to the object to be identified and a reader that reads the tag. A reader consists of a radio frequency module and an antenna that generates a high-frequency electromagnetic field. In comparison, the tag is usually a passive device (it does not have a battery). It consists of a microchip that stores and processes information and an antenna for receiving and transmitting a signal. When the tag is brought close to the reader, the reader generates an electromagnetic field. This causes electrons to move through the tag's antenna and subsequently powers the chip. The chip then responds by sending its stored information back to the reader as another radio signal. This is called backscatter. The reader detects and interprets this backscatter and sends the data to a computer or microcontroller.

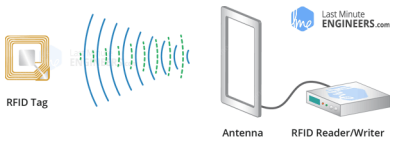

Fig. 2. Basic operation of RFID system.

RFID technology is used in various applications to position and manage people, assets, and goods, including those in the healthcare sector, financial institutions, automobiles, books, mobile phones, and computer hardware. The potential of RFID systems to offer precise and accurate data on tagged objects will enhance efficiency and provide other advantages to the business community and customers in the future. This paper presents an intelligent RFID-based access control and management system for managing lecture attendance. The implemented system can uniquely identify and take attendance for persons. The users only need to place their RFID tag on the reader to take attendance. They can skip the long list to look for their name. Hence, it is very time efficient.

II. Hardware and Design Considerations

The system's hardware consists of an RFID (RC522 SPI) Module reader and tags, DS3231/DS1307 RTC Module, 10K potentiometer, Liquid Crystal Display (LCD) and power supply system. The MFRC522 RFID is a highly integrated reader/writer IC for contactless communication at 13.56 MHz. The MFRC522's internal transmitter can drive a reader/writer antenna designed to communicate with ISO/IEC 14443 A/MIFARE cards and transponders without additional active circuitry. The receiver module provides a robust and efficient implementation for demodulating and decoding signals from ISO/IEC 14443 A/MIFARE compatible cards and

transponders. The digital module manages the functionality of the complete ISO/IEC 14443 A framing and error detection (parity and CRC).

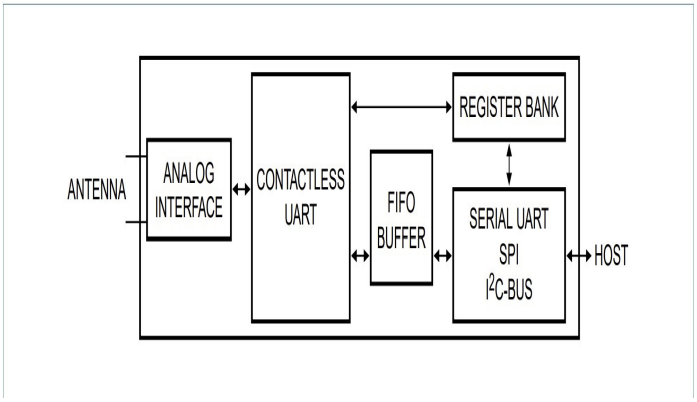

Fig. 3. Simplified block diagram of the MFRC522.

The analogue interface handles the modulation and demodulation of the analogue signals. The contactless UART manages the protocol requirements for the communication protocols in cooperation with the host. The FIFO buffer ensures fast and convenient data transfer to and from the host, contactless UART, and vice versa. The following host interfaces are provided:

- Serial Peripheral Interface (SPI)
- Serial UART (similar to RS232 with voltage levels dependant on pin voltage supply)
- I 2C-bus interface

In this project, Serial Peripheral Interface (SPI) is used to interface MFRC522 RFID with Arduino UNO.

The DS3231 is a extremely accurate I2C real-time clock (RTC) with an integrated temperature compensated crystal oscillator (TCXO) and crystal. The device incorporates a battery input, and maintains accurate time keeping when main power to the device is interrupted. The integration of the crystal resonator enhances the long-term accuracy of the device. The RTC maintains seconds, minutes, hours, day, date, month, and year information. The date at the end of the month is automatically adjusted for months with fewer than 31 days, including corrections for leap year. The clock operates in either the 24-hour or 12-hour format with an AM/PM indicator. Two programmable time-of-day alarms and a programmable square-wave outputs are provided. Address and data are transferred serially through an I2C bidirectional bus.

A precision temperature-compensated voltage reference and comparator circuit monitors the status of VCC to detect power failures, to provide a reset output, and to automatically switch to the backup supply when necessary. Additionally, the RST pin is monitored as a push button input for generating a P reset.

Tapping an RFID tag next to the RFID reader saves the user UID and time in an SD card. It also shows if the person is late or on time accordingly. RC522 – RFID Reader features an outstanding modulation and demodulation algorithm to serve effortless RF communication at 13.56 MHz. The MFRC522 RFID SPI module is interfaced with Arduino and SD Card Module as a Datalogger, where the data is saved in text format. SD Card Module has various applications such as data logger, audio, video, and graphics. This module significantly expands the capability an Arduino can do with their poor limited memory. RTC means Real-Time Clock. RTC Module DS3231 or DS1307 is used to store time information; it is simply a TIME and DATE remembering system with battery setup, which keeps the module running in the absence of external power. This keeps the TIME and DATE up to date.

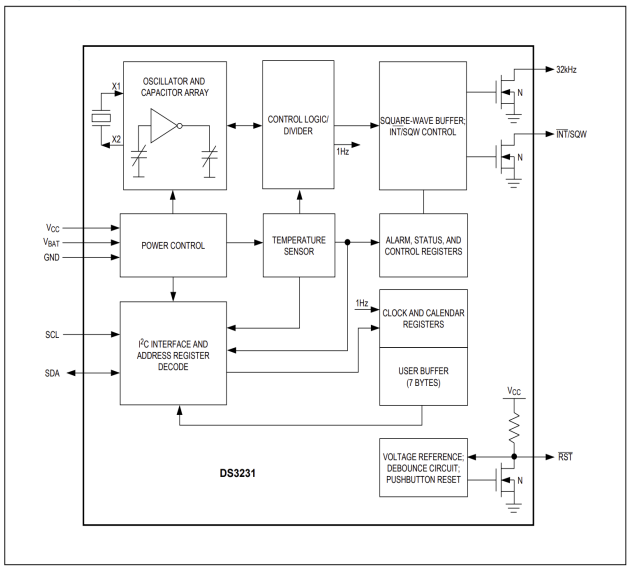

Fig. 4. Block diagram of DS3231 RTC Module.

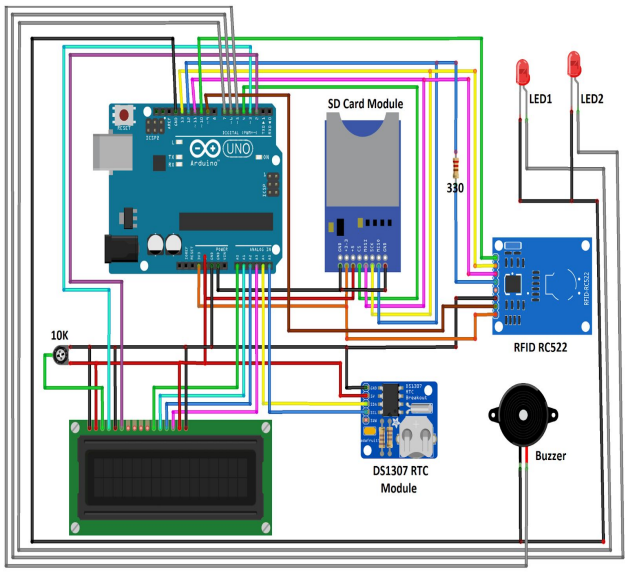

Fig. 5. Complete project setup.

III. SOFTWARE DESIGN

The program is written using Arduino Integrated Development Environment (IDE). It is a cross-platform application (for Windows, mac OS, and Linux) written in Java. A program which allows the microcontroller to control the system is prepared and divided into functions or modules. The program is written in a modular fashion where each part is written separately.

```
 47  > void setup() {···
100    }
101
102  > void loop() {···
110    }
111
112  > void readRFID() {···
132    }
133
134  > void logCard() {···
204    }
205
206  > void verifyCheckIn(){···
227    }
```

Then, all the software sub-modules are combined to form the final software system. LiquidCrystal, SPI, SD, RTClib, MFRC522 are some of the libraries used to program the system.

```
#include <LiquidCrystal.h>
#include <MFRC522.h> // for the RFID
#include <SPI.h> // for the RFID and SD card module
#include <SD.h> // for the SD card
#include <RTClib.h> // for the RTC
```

Before starting to write the program for the system, a basic program was written to detect switches, turn on LED , display character on LCD, initializing input and output ports, setting up SPI bus and SD card module in the setup function.

Starting from reading RFID cards to displaying whether the person is late or on time is done by invoking the respective functions inside the loop function. Functioning of each of the functions is as follows:

A. readRFID

• Card serial number is read and stored in UID string, buzzer is turned on conveying that a card is read.

```
void loop() {
  //look for new cards
  if(rfid.PICC_IsNewCardPresent()) {
    readRFID();
    logCard();
    verifyCheckIn();
  }
  delay(10);
}
```

B. logCard

• SD card is enabled with digitalWrite function.

• From the DateTime module, rtc.now() function is used to get the login time.

• A file is opened to write the UID and the login time and the same is displayed on the LCD and serial monitor.

• User check in hour and minute is stored to be used in verifyCheckIn() function.

• SD card is disabled with digitalWrite() function.

C. verifyCheckin

• User check in hour and minute from the previous function are compared with the stored values and corresponding text is displayed on the LCD depending on whether the person is late or on time.

IV. PERFORMANCE EVALUATIONS AND RESULTS

This project's RFID-based attendance system's primary function is to scan an RFID tag. Then, attendance is recorded using the ID that was scanned. The RFID reader creates a radio frequency field and uses an antenna to broadcast it to the surrounding area. A small amount of power will be induced from the radio wave to the tag if a passive RFID reader approaches it, allowing modulated electromagnetic waves to be delivered back to the reader. The output is sent to the microcontroller using the SPI protocol. The real-time clock circuit is part of the system. The real-time clock circuit's backup power source will make sure that the time continues to operate even after the system has been turned off. The time does not need to be set each time the system is turned on. The attendance data together with the time is stored in SD card. The SD card may be utilized to retrieve the stored attendance, which can then be used to update the database. Different tag placements and distances have been used to evaluate the RFID-based attendance system's performance. To determine the most detectable distance from the reader for various tag orientations, a straightforward detection range test has been carried out. The main goal of the test is to assess how well the system performs in terms of detection range. The test resulted in a detection range of approximately 4 cm for the reader while scanning from the top position. Below table displays the system's passive RFID reader's detection range.

Tag orientation	Parallel with reader	Perpendicular with reader	45 degrees with reader
Top	4cm	0cm	4cm
Side	1cm	2cm	2cm
Corner	0cm	0cm	1cm
Bottom	3cm	0cm	2cm

V. DISCUSSION

The edge of the system over other similar products is critical and can usually impact the consumer's decision to choose a product. The RFID Based Attendance System developed in this project also has advantages over similar market products. It is cheaper compared to those systems currently in the market. With physical benefits such as small size, portable, compact design and lightweight, the system is perfectly suitable as a mobile access control or attendance-taking device. The dual power feature of the system allows the system to be powered by a power adapter or batteries. Design can execute several tasks at the same time. The button switch and LCD integrated into the system are user-friendly. LCD show whether the user is on time or not. One possible future extension work for this project is implementing Multimedia Card (MMC) in the system. With MMC included, retrieve attendance directly from files stored inside the MMC card. The system Can update attendance in those files with the time of attendance. Student information can be obtained and displayed based on the RFID tag scanned.

VI. CONCLUSION

RFID technology promises increased effectiveness and improved efficiency for business and administrative processes. The successful design and implementation of an automated attendance system based on RFID technology have been successfully presented and provide several advantages over the conventional method of taking attendance in class and effectively shift the paradigm towards a digital and contactless environment. The system developed provides an accurate, simple and cost-effective. Moreover, the compactness and portability of the design make it more facilitative to being deployed as and when needed. Another advantage of the system is its high identification and verification speed. This system can be applied not just in the classes but also in working places with the feature total working hours can be recorded.