

DEPARTMENT OF APPLIED PHYSICS

RFID AND ARDUINO BASED **ATTENDANCE SYSTEM**



ELECTROMAGNETIC THEORY

(EP-303)

PROJECT REPORT

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Thank you

ABSTRACT

Most educational institutions' administrators are concerned about student irregular attendance. Truancies can affect student overall academic performance.

The conventional method of taking attendance by calling names or signing on paper is very time consuming and insecure, hence inefficient. Radio Frequency Identification (RFID) based attendance system is one of the solutions to address this problem. This system can be used to take attendance for student in school, college, and university. It also can be used to take attendance for workers in working places. Its ability to uniquely identify each person based on their RFID tag type of 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 reader and their attendance will be taken immediately.

With real time clock capability of the system, attendance taken will be more accurate since the time for the attendance taken will be recorded.

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INTRODUCTION

An RFID based Attendance System is a very interesting project which can be used in different places say in universities to register the attendance of students and teachers, Private organizations to tabulate monthly working hours of employees and automatically calculate salary based on the number of hours registered in the office and other similar kinds of applications. So this project uses RFID technology to make a note of every student entering into the classroom and also to calculate the time resides in the class. In this proposed system, every student is allotted with an RFID tag. The process of attendance can be done by placing the card near the RFID reader.

Components Required

Lists of the components :

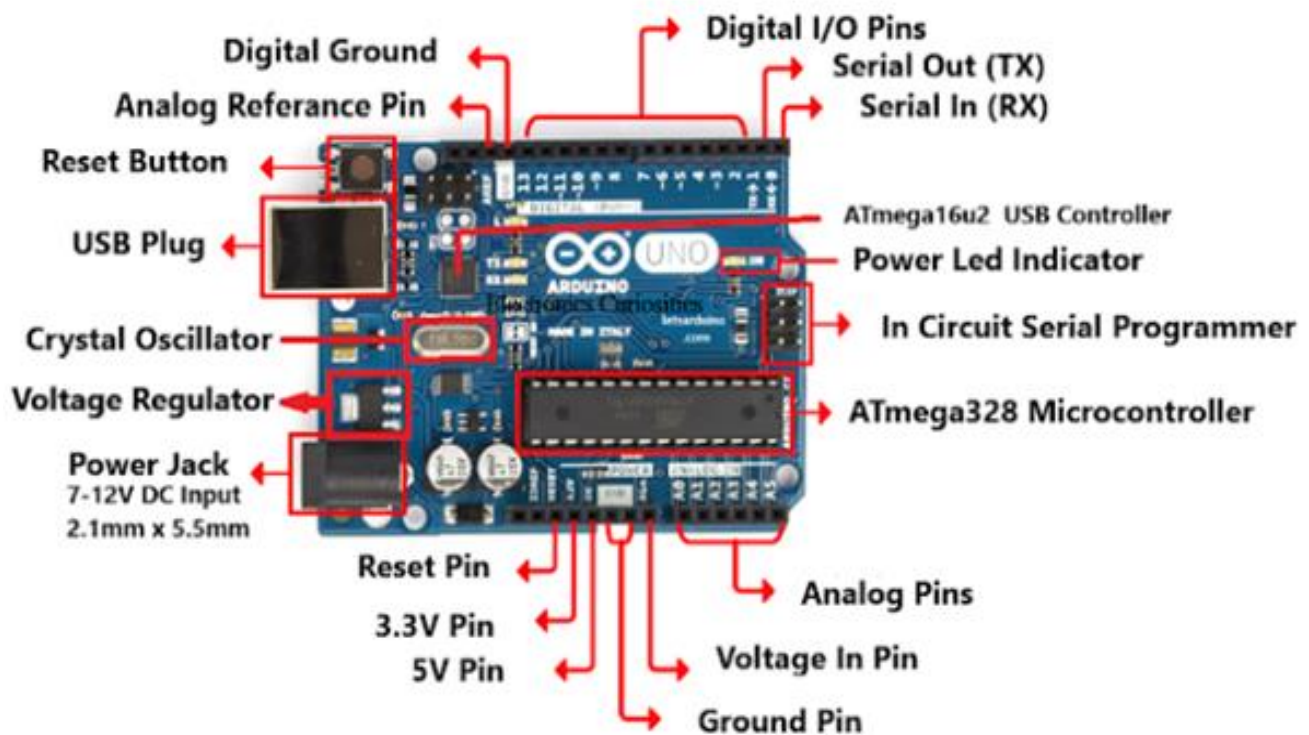
- Arduino Uno
- Breadboard
- Jumper Wires & Cables
- Rfid MFRC522 Module
- SD Card Module
- Arduino Ide
- RTC Module
- LCD Display

1.) ARDUINO UNO

Arduino is an open-source physical computing platform based on a simple micro-controller board, and a development environment for writing software for the board.

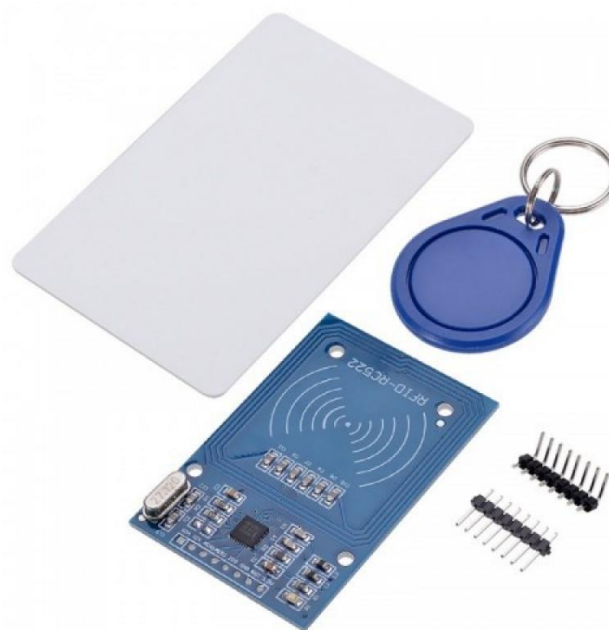
Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs.

The open-source IDE can be downloaded for free. The Arduino programming language is an implementation of Wiring, a similar physical computing platform, which is based on the Processing multimedia programming environment. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button.



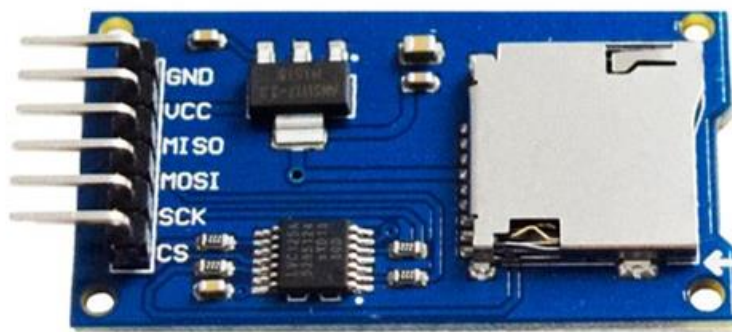
2.)RFID MFRC522 Module

The RC522 is a RF Module that consists of a RFID reader, RFID card and a key chain. The module operates 13.56MHz which is industrial (ISM) band and hence can be used without any license problem. The module operates at 3.3V typically and hence commonly used in 3.3V designs. It is normally used in application where certain person/object has to be identified with a unique ID



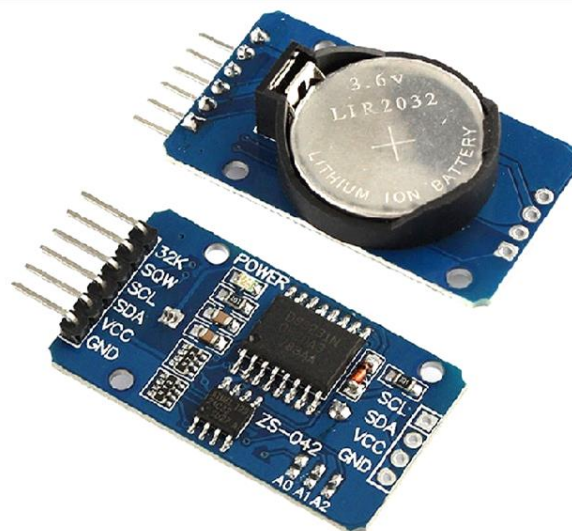
3.)SD Card Module

The SD Card Module is a simple solution for transferring data to and from a standard SD card. The pinout is directly compatible with Arduino, but can also be used with other microcontrollers. This module has SPI interface which is compatible with any sd card and it use 5V or 3.3V power supply which is compatible with Arduino UNO/Mega.SD module has various applications such as data logger, audio, video, graphics.



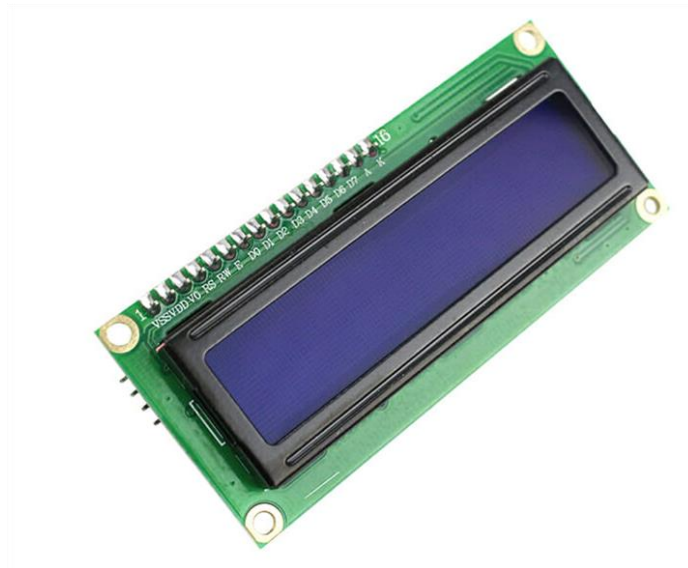
4.)RTC Module

RTC means Real Time Clock. RTC modules are simply TIME and DATE remembering systems which have battery setup which in the absence of external power keeps the module running. This keeps the TIME and DATE up to date. So we can have accurate TIME and DATE from RTC module whenever we want.



5.)LCD Display

If you want to add some visual output to your Arduino projects, you'll need a display. This is LCD1602 Parallel LCD Display that provides a simple and cost-effective solution for adding a 16×2 White on RGB Liquid Crystal Display into your project. The display is 16 character by 2 line display has a very clear and high contrast white text upon a blue background/backlight.

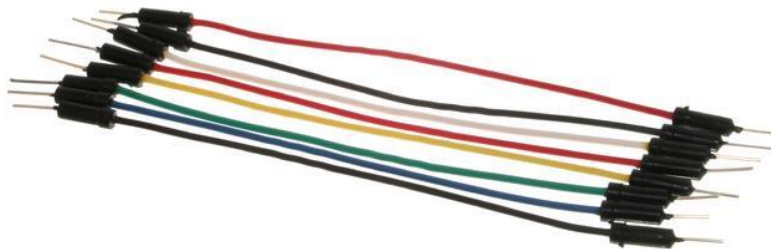


6.)Breadboard



A breadboard is used to make up temporary circuits for testing or to try out an idea. No soldering is required so it is easy to change connections and replace components. Parts are not damaged and can be re-used afterwards.

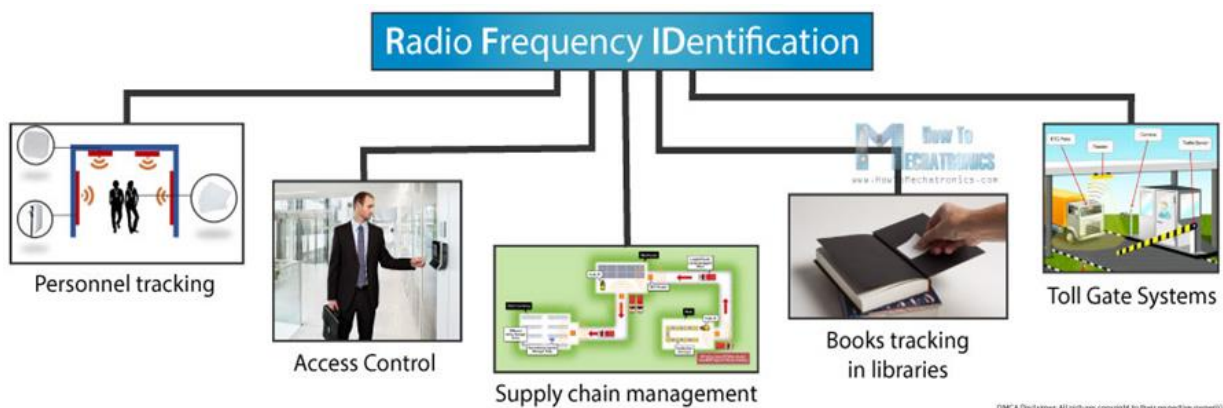
7.) Jumper Wires



Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed.

What is RFID ?

RFID stands for Radio Frequency Identification and it's a non-contact technology that's broadly used in many industries for tasks such as personnel tracking, access control, supply chain management, books tracking in libraries, tollgate systems and so on .The DC voltage on the load is the average over the period T of the output voltage of the rectifier :

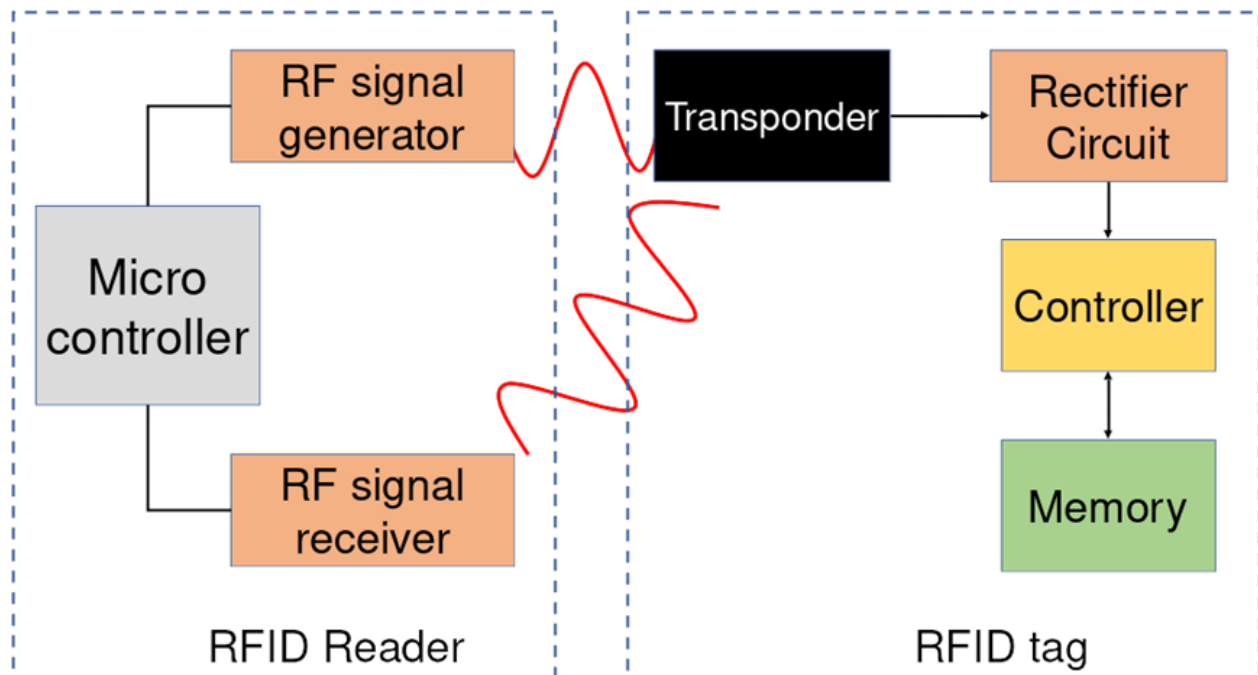


How RFID Works ?

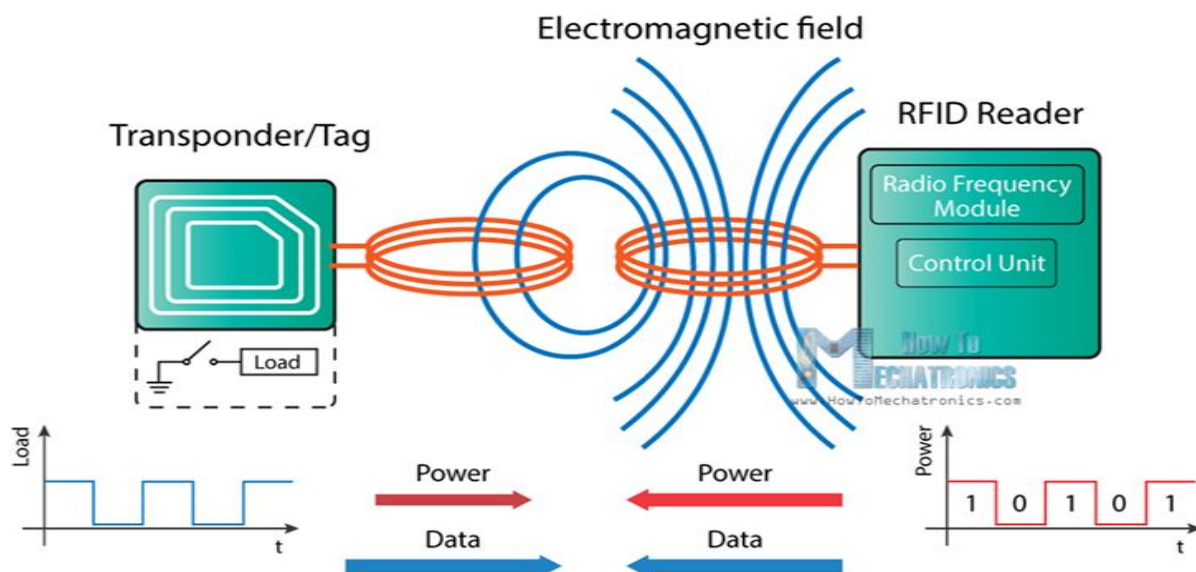
An RFID system consists of two main components, a transponder or a tag which is located on the object that we want to be identified, and a transceiver or a reader



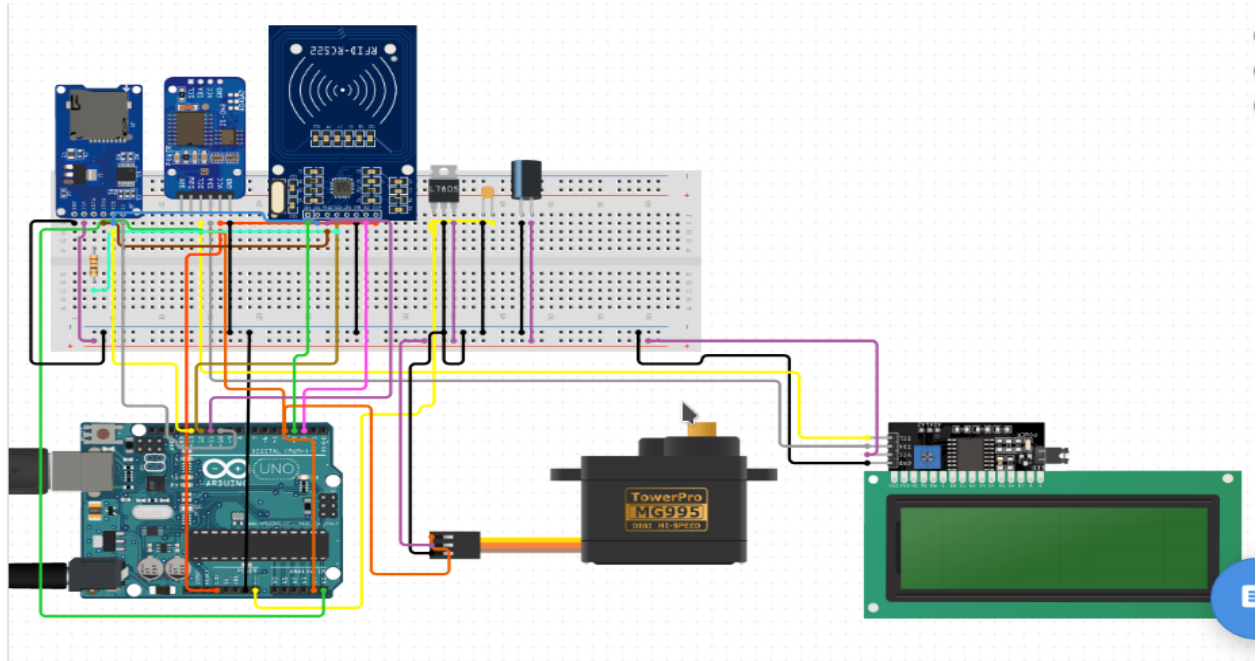
Working Principles of RFID



The RFID reader consists of a radio frequency module, a control unit and an antenna coil which generates high frequency electromagnetic field. On the other hand, the tag is usually a passive component, which consists of just an antenna and an electronic microchip, so when it gets near the electromagnetic field of the transceiver, due to induction, a voltage is generated in its antenna coil and this voltage serves as power for the microchip.



Schematic Diagram



CODING ARDUINO WITH IDE



CODE :

```
#include <SPI.h>

#include <MFRC522.h> //library for rfid sensor
#include <RTClib.h> //library for rtc module
#include <SD.h> //library for sd card module
#include <Wire.h>

#include <LiquidCrystal_I2C.h> //library for i2c module
#include <Servo.h> //library for servo moter

//define pins for rfid sensor
#define SS_PIN 10
#define RST_PIN 9
//define select pin for SD card module
#define CS_SD 4

Servo myservo; // create servo object to control a servo.
MFRC522 mfrc522(SS_PIN, RST_PIN); // Create MFRC522 instance.
```

```
RTC_DS3231 rtc;// Instance of the class for RTC
```

```
LiquidCrystal_I2C lcd(0x27,2,1,0,4,5,6,7,3,POSITIVE);//instance for lcd display
```

```
const int numOfCards = 5;//the nubur of cards used. this can change as you want
```

```
byte cards[numOfCards][4] = {{0x69, 0x38, 0xFD, 0x6E},{0x29, 0xCE, 0xE2, 0x6E},{0xD9, 0x45, 0xE5, 0x6E},{0xA9, 0x76, 0x47, 0xB8},{0x59, 0x3F, 0x16, 0x98}}; // array of UUIDs of rfid cards
```

```
int n = 0;//n is for the total number of students//j is for to detect the card is valid or not
```

```
int numCard[numOfCards]; //this array content the details of cards that already detect or not .
```

```
String names[numOfCards] = {"Janith Hasitha","Nirosh Bandara","Manoj Akalanka","Milan Sankalpa","Chamila Bandara"};//student names
```

```
long sNumbers[numOfCards] = {16242,16273,16389,16322,16323};//student sNumbers
```

```
void setup() {
```

```
  Serial.begin(9600); // Initialize serial communications with the PC
```

```
  SPI.begin(); // Init SPI bus
```

```
  mfrc522.PCD_Init(); // Init MFRC522 card
```

```
  //setup for lcd screen
```

```
  lcd.begin(20,4);// initialize the lcd
```

```
  myservo.attach(6); // attaches the servo on pin 9 to the servo object
```

```
  //setup for RTC module
```

```
  #ifndef ESP8266
```

```
  while (!Serial); // for Leonardo/Micro/Zero
```

```
  #endif
```

```
  if (!rtc.begin()) {
```

```
    Serial.println(F("Couldn't find RTC"));
```

```
    while (1);
```

```
  }
```

```
  else{
```

```
    rtc.adjust(DateTime(F(__DATE__), F(__TIME__))); //time will set auto when it compiles
```

```

    //rtc.adjust(DateTime(2020, 1, 9, 16, 59, 45)); // manually set time
}
if (rtc.lostPower()) {
    Serial.println(F("RTC lost power, lets set the time!"));
}

//setup for display option (serial monitor)
Serial.println(F("\t\t\t<<<< Library Attendance >>>>\n")); // introduction
Serial.println(F("COUNT\tRegNO\tNAME\t\tDATE\t\tARRIVAL\t\tDEPARTURE")); // make
four columns

//setup sd card
// Serial.print(F("Initializing SD card..."));
digitalWrite(CS_SD, LOW);

// if (!SD.begin(4)) { //checks the sd card inserted and if it not the program will not working.
// Serial.println(F("initialization failed!"));
// while (1);
// }
// Serial.println(F("initialization done.));

File myFile = SD.open("test.txt", FILE_WRITE);
if (myFile) {
    myFile.print(F(" \t**** Library Attendance ****\n"));
    myFile.println(F("COUNT\tRegNO\tNAME\t\tDATE\t\tARRIVAL\t\tDEPARTURE"));
    // close the file:
    myFile.close();
    Serial.println(F("done.));
} else {
    // Serial.println(F("error opening test.txt"));
}

```



```

myFile = SD.open("test.txt");
if (myFile) {
    Serial.println(F("test.txt:"));

    while (myFile.available()) {
        Serial.write(myFile.read());
    }

    myFile.close();
} else {
    // Serial.println(F("error opening test.txt"));
}
digitalWrite(CS_SD,HIGH);
}

void readRFID(){
    int j = -1;
    byte card_ID[4]; //card UID size 4byte

    if ( ! mfrc522.PICC_IsNewCardPresent()) { //look for new card
        return; //got to start of loop if there is no card present
    }

    if ( ! mfrc522.PICC_ReadCardSerial()) { // Select one of the cards
        return; //if read card serial(0) returns 1, the uid struct contains the ID of the read card.
    }

    for (byte i = 0; i < mfrc522.uid.size; i++) {
        card_ID[i] = mfrc522.uid.uidByte[i];
    }

    for (int i = 0; i < numOfCards; i++) {
        if (card_ID[0] == cards[i][0] && card_ID[1] == cards[i][1] && card_ID[2] == cards[i][2] &&
            card_ID[3] == cards[i][3]) {

```

```
j = i;
}
}

if(j == -1) { //check the card validity
    invalid();
}
else if (numCard[j] == 1) { //to check if the card already detect
    alreadyRead(names[j], sNumbers[j], j);
}
else {
    //send data to display and save
    logCardData(names[j], sNumbers[j], j);
}
delay(1000);
}

void servo() { //method for servo motor
    int pos = 0; // variable to store the servo position
    for (pos = 90; pos >= 0; pos -= 1) { // goes from 0 degrees to 90 degrees
        // in steps of 1 degree
        myservo.write(pos);
        delay(5);
    }
    delay(5000);
    for (pos = 0; pos <= 90; pos += 1) { // goes from 90 degrees to 0 degrees
        myservo.write(pos);
        delay(5);
    }
}

void logCardData(String name, long sNumber, int j){
```

```

displayAllow(name,sNumber);

DateTime now = rtc.now();

numCard[j] = 1;//put 1 in the numCard array : numCard[j]={1,1} to let the arduino know if the card
was detecting

n++;//to get the count


//display details to the console (serial monitor)
Serial.print(n);//print number
Serial.print(F("\t"));
Serial.print(sNumber); //print name of student
Serial.print(F("\t"));
Serial.print(name); //print name of student
Serial.print(F("\t"));
Serial.print(now.year(),DEC); //print year
Serial.print(F("-"));
if(now.month()<10){Serial.print("0");Serial.print(now.month(),DEC);}
else Serial.print(now.month(),DEC); //print month
Serial.print(F("-"));
if(now.day()<10){Serial.print("0");Serial.print(now.day(),DEC);} //if the day is one digit this will
display it with zero in front as two digits.
else Serial.print(now.day(),DEC);
Serial.print(F("\t"));
if(now.hour()<10){Serial.print("0");Serial.print(now.hour(),DEC);}
else Serial.print(now.hour(),DEC);
Serial.print(F(":"));
if(now.minute()<10){Serial.print("0");Serial.print(now.minute(),DEC);}
else Serial.print(now.minute(),DEC);
Serial.print(F(":"));
if(now.second()<10){Serial.print("0");Serial.print(now.second(),DEC);}
else Serial.print(now.second(),DEC);
Serial.print(F("\t"));
Serial.println(F("--:--:-- "));

```

```

digitalWrite(CS_SD,LOW);

File myFile = SD.open("test.txt", FILE_WRITE);//record the data to the sd card
if (myFile) {
    myFile.print(n);//print number
    myFile.print(F("\t"));
    myFile.print(sNumber); //print name of student
    myFile.print(F("\t"));
    myFile.print(name); //print name of student
    myFile.print(F("\t"));
    myFile.print(now.year(),DEC); //print year
    myFile.print(F("-"));
    if(now.month()<10){myFile.print("0");myFile.print(now.month(),DEC);}
    else myFile.print(now.month(),DEC); //print month
    myFile.print(F("-"));
    if(now.day()<10){myFile.print("0");myFile.print(now.day(),DEC);}
    else myFile.print(now.day(),DEC);
    myFile.print(F("\t"));
    if(now.hour()<10){myFile.print("0");myFile.print(now.hour(),DEC);}
    else myFile.print(now.hour(),DEC);
    myFile.print(F(":"));
    if(now.minute()<10){myFile.print("0");myFile.print(now.minute(),DEC);}
    else myFile.print(now.minute(),DEC);
    myFile.print(F(":"));
    if(now.second()<10){myFile.print("0");myFile.print(now.second(),DEC);}
    else myFile.print(now.second(),DEC);
    myFile.print(F("\t"));
    myFile.println(F("--:--:--"));
    myFile.close();
    Serial.println(F("done.));
} else {
    // Serial.println(F("error opening test.txt"));
}

```

```
digitalWrite(CS_SD,HIGH);
}
```

```
void invalid(){
  Serial.println(F("Invalid Card.));
  digitalWrite(CS_SD,LOW);
  File myFile = SD.open("test.txt", FILE_WRITE);
  if (myFile) {
    myFile.println(F("Invalid Card.));
    myFile.close();
    Serial.println(F("done.));
  } else {
    // Serial.println(F("error opening test.txt));
  }
  digitalWrite(CS_SD,LOW);
```

```
lcd.home ();
lcd.clear();
lcd.setCursor (6, 0 );// go home
lcd.print(F("Warning!"));
lcd.setCursor (4, 2 );
lcd.print(F("Invalid Card!"));
lcd.setCursor (3, 3 );
lcd.print(F("Access Denied!"));
delay(3000);
lcd.clear();
}
```

```
void alreadyRead(String name, long sNumber, int j){
  DateTime now = rtc.now();

  numCard[j] = 0;//put 1 in the numCard array : numCard[j]={1,1} to let the arduino know if the card
was detecting

  n--;//to get the count
```

```

//display details to the console (serial monitor)
Serial.print(n); //print number
Serial.print(F("\t"));
Serial.print(sNumber); //print name of student
Serial.print(F("\t"));
Serial.print(name); //print name of student
Serial.print(F("\t"));
Serial.print(now.year(),DEC); //print year
Serial.print(F("-"));
if(now.month()<10){Serial.print("0");Serial.print(now.month(),DEC);}
else Serial.print(now.month(),DEC); //print month
Serial.print(F("-"));
if(now.day()<10){Serial.print("0");Serial.print(now.day(),DEC);}
else Serial.print(now.day(),DEC);
Serial.print(F("\t"));
Serial.print(F("--:--:--"));
Serial.print(F("\t"));
if(now.hour()<10){Serial.print("0");Serial.print(now.hour(),DEC);}
else Serial.print(now.hour(),DEC);
Serial.print(F(":"));
if(now.minute()<10){Serial.print("0");Serial.print(now.minute(),DEC);}
else Serial.print(now.minute(),DEC);
Serial.print(F(":"));
if(now.second()<10){Serial.print("0");Serial.println(now.second(),DEC);}
else Serial.print(now.second(),DEC);
Serial.println(" ");

digitalWrite(CS_SD,LOW);
File myFile = SD.open("test.txt", FILE_WRITE);
if (myFile) {
    myFile.print(n); //print number

```

```

myFile.print(F("\t"));
myFile.print(sNumber); //print name of student
myFile.print(F("\t"));
myFile.print(name); //print name of student
myFile.print(F("\t"));
myFile.print(now.year(),DEC); //print year
myFile.print(F("-"));
if(now.month()<10){myFile.print("0");myFile.print(now.month(),DEC);}
else myFile.print(now.month(),DEC); //print month
myFile.print(F("-"));
if(now.day()<10){myFile.print("0");myFile.print(now.day(),DEC);}
else myFile.print(now.day(),DEC);
myFile.print(F("\t"));
myFile.print(F("--:--:--"));
myFile.print(F("\t"));
if(now.hour()<10){myFile.print("0");myFile.print(now.hour(),DEC);}
else myFile.print(now.hour(),DEC);
myFile.print(F(":"));
if(now.minute()<10){myFile.print("0");myFile.print(now.minute(),DEC);}
else myFile.print(now.minute(),DEC);
myFile.print(F(":"));
if(now.second()<10){myFile.print("0");myFile.print(now.second(),DEC);}
else myFile.println(now.second(),DEC);
myFile.close();
Serial.println(F("done."));
} else {
    // Serial.println(F("error opening test.txt"));
}
digitalWrite(CS_SD,HIGH);

lcd.home ();
lcd.clear();

```

```

lcd.setCursor (5, 1 );// go home
lcd.print(F("Thank You"));
lcd.setCursor (4, 2 );
lcd.print(F("Come Again!"));
delay(3000);
servo();
lcd.clear();
}

```

void printLoopLCD() { //method for display date and time and number of students attendance to the lcd display

```

    DateTime now = rtc.now();

    lcd.home (); // go home
    lcd.setCursor (1, 0);
    lcd.print(F("Welcome to Library"));
    lcd.setCursor (0, 1 );
    lcd.print(now.year(),DEC); //print year+
    lcd.print(F("-"));
    if(now.month()<10){lcd.print("0");lcd.print(now.month(),DEC);}
    else lcd.print(now.month(),DEC); //print month
    lcd.print(F("-"));
    if(now.day()<10){lcd.print("0");lcd.print(now.day(),DEC);}
    else lcd.print(now.day(),DEC);
    //lcd.print(now.day(),DEC); //print date
    lcd.setCursor (12, 1 );
    if(now.hour()<10){lcd.print("0");lcd.print(now.hour(),DEC);}
    else lcd.print(now.hour(),DEC);
    //lcd.print(now.hour(),DEC);
    lcd.print(F(":"));
    if(now.minute()<10){lcd.print("0");lcd.print(now.minute(),DEC);}
    else lcd.print(now.minute(),DEC);
    //lcd.print(now.minute(),DEC);
    lcd.print(F(":"));

```



```
if(now.second()<10){lcd.print("0");lcd.print(now.second(),DEC);}
else lcd.print(now.second(),DEC);
//lcd.print(now.second(),DEC);
lcd.setCursor (0, 3 );
lcd.print(F("No of Students:"));
lcd.setCursor (16, 3 );
lcd.print(n);
delay(1000);
}

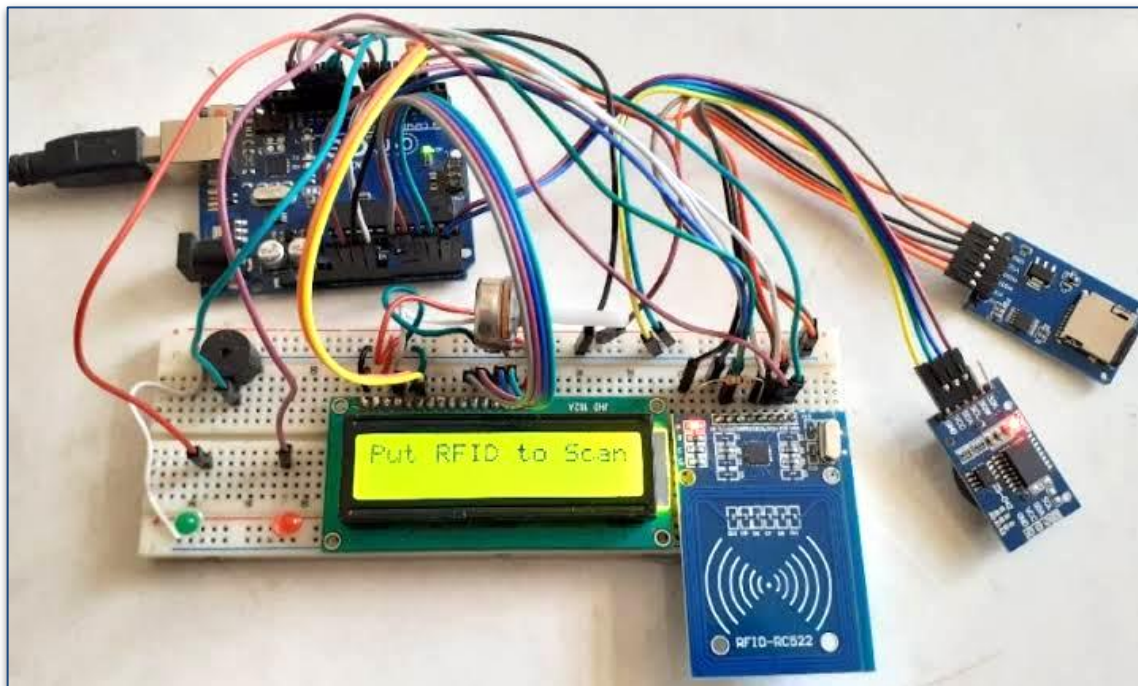
void displayAllow(String name,long sNumber){
  lcd.home ();
  lcd.clear();
  lcd.setCursor (6, 0 );
  lcd.print(F("Welcome!"));
  lcd.setCursor (1, 1 );
  lcd.print(F("Authorized Access!"));
  lcd.setCursor (0, 2 );
  lcd.print(F("Name:"));
  lcd.setCursor (5, 2 );
  lcd.print(name);
  lcd.setCursor (0, 3 );
  lcd.print(F("SNo :S"));
  lcd.setCursor (6, 3 );
  lcd.print(sNumber);
  delay(3000);
  servo();
  lcd.clear();
}

void checkTime(){
  //check the time if the time is 6pm the system will stop working (time out)
```

```
lcd.home ();  
lcd.clear();  
  
if(n != 0){ //check the nuber of student is 0 or not  
    Serial.println(F("Warning!"));  
    Serial.print(F("Count not zero!"));  
    lcd.setCursor (6, 1 );  
    lcd.print(F("Warning!"));  
    lcd.setCursor (3, 2 );  
    lcd.print(F("Count not zero!"));  
    delay(5000);  
}  
//else{  
    Serial.println(F("Session has expired!"));  
    Serial.print(F("No of students :"));  
    Serial.println(n);  
    lcd.home ();  
    lcd.clear();  
    lcd.setCursor (6, 0 );  
    lcd.print(F("Library"));  
    lcd.setCursor (0, 1 );  
    lcd.print(F("Session has expired!"));  
    lcd.setCursor (0, 3 );  
    lcd.print(F("No of students :"));  
    lcd.print(n);  
// }  
  
    delay(46800000); //delay for 12 hours  
    lcd.clear();  
}  
  
void loop() {
```

```
DateTime now = rtc.now();  
if (now.hour() < 7 || now.hour() >= 18) {  
    checkTime();  
}  
printLoopLCD();//print details on lcd screen(loop)  
readRFID();  
}
```

FINAL PROJECT



Some important applications of RFID

- **Product Tracking** – RFID tags are increasingly used as a cost-effective way to track inventory and as a substitute for barcodes. For instance, bookstores such as Barnes & Noble use RFID to identify books to be removed from shelves and returned to publishing houses.
- **Toll Road Payments** – Highway toll payment systems, such as E-Z Pass in the eastern states, uses RFID technology to electronically collect tolls from passing cars. Instead of stopping at the toll booth, cars pass directly through in the E-Z Pass lane and the toll is automatically deducted from a pre-paid card.
- **Passports** – A number of countries, including Japan, the United States, Norway, and Spain incorporate RFID tags into passports to store information (such as a photograph) about the passport holder and to track visitors entering and exiting the country.
- **Identification** – RFID chips can be implanted into animals and people to track their movements, provide access to secure locations, or help find lost pets.
- **Libraries** – Libraries use RFID tags in books and other materials to track circulation and inventory, store product information (such as titles and authors), and to provide security from theft. Because RFID tags can be scanned without physically touching the item, checking books in and out, plus doing laborious tasks such as shelf inventory, can be accomplished quickly and efficiently using RFID technology.
- **Shipping** – Large shipments of materials, such as retail goods, often utilize RFID tags to identify location, contents, and movement of goods.

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