Electronic Design and Workshop (EAEPC10)

ECAM-1

PROJECT REPORT

RFID BASED MONITORING SYSTEM USING ARDUINO

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Netaji Subhas University of Technology

Geeta Colony, New Delhi -110031

Submitted by:

Shubham Goswami (2022UEA6504)

Anirudh Prajapati (2022UEA6512)

Harshit Mishra (2022UEA6513)

Deep Khanna (2022UEA6515)

Ojas Sharma (2022UEA6517)

Parth Sahu (2022UEA6524)

Submitted to:

Mr. Rahul Modanwal

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AIM:

To develop an RFID tracker system capable of retrieving user data upon RFID card interaction with the scanner, and subsequently storing this data securely in the cloud.

DESCRIPTION:

Through this project, we aim to demonstrate a seamless integration of RFID technology, data retrieval, and cloud storage, ensuring efficient tracking and management of user information in various applications, such as access control, inventory management, or personalized services. By leveraging Arduino programming, we seek to not only showcase the technical prowess required for such integration but also emphasize its practical implications in real-world scenarios. Our endeavor extends beyond mere technical implementation; it strives to illustrate the transformative potential of Arduino-based solutions in enhancing data accessibility, security, and usability across diverse domains. Through meticulous design, rigorous testing, and comprehensive documentation, we aim to provide a blueprint for future projects seeking to harness the power of RFID, cloud computing, and Arduino technology in tandem, thereby fostering innovation and advancement in the field of electronic design.

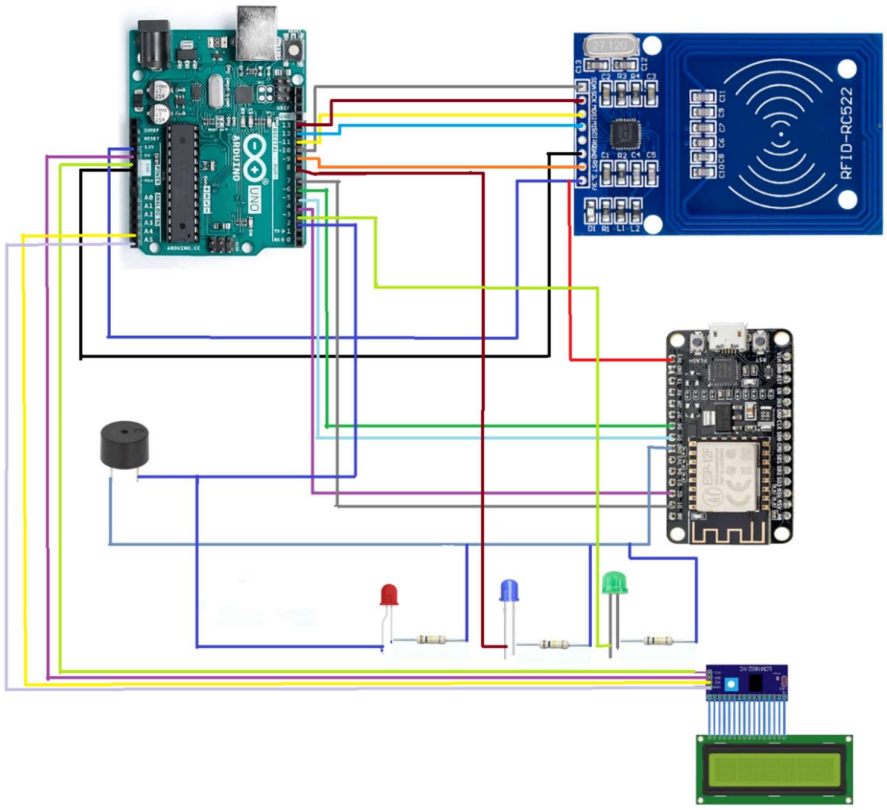

Fig. 1 (CIRCUIT DIAGRAM)

COMPONENTS:

- ARDUINO UNO BOARD:

  Arduino UNO Microcontroller stores the data of the user in the microcontroller memory. Main goal of RFID based data system is to record the data of the user. In this project, Arduino UNO microcontroller is used which is based on 8-bit ATmega328P Microcontroller. It is the main component of project.

  Microcontroller does the following functions:

  - Displaying on LCD.
  - Input is read from RFID reader.
  - Transmit card data to ESP8266 WiFi module which then publishes it to google sheets.
  - Making the respective buzzer and LEDs to function when a card is scanned.

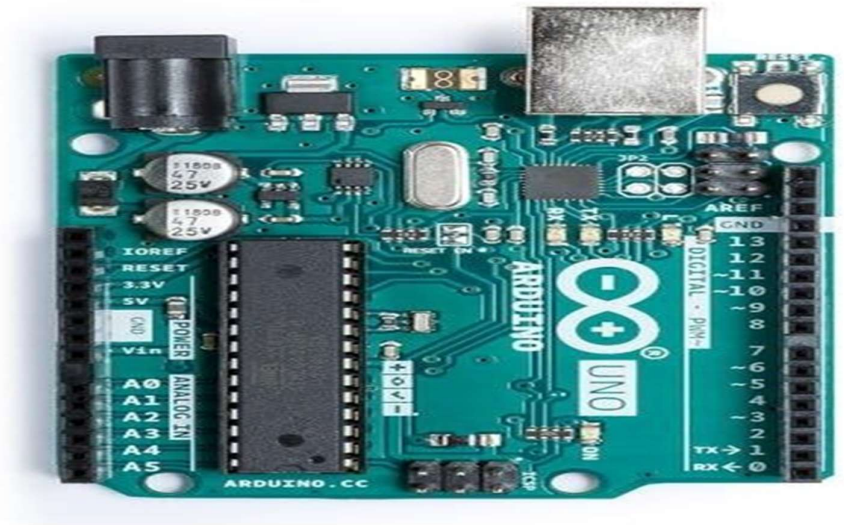

Fig. 2(Arduino Uno Board)

- NODEMCU ESP8266(WI-FI MODULE):

  The NodeMCU ESP8266, a powerful WiFi module, stands as a cornerstone component in modern electronics. Renowned for its versatility and ease of integration, the NodeMCU ESP8266 offers seamless connectivity to wireless networks, making it a quintessential tool for transmitting and receiving data over the internet. Its compact form factor, coupled with an array of GPIO pins, enables developers to effortlessly interface with various sensors, actuators, and peripherals, thereby expanding its functionality to suit a wide range of applications. Whether deployed in smart home systems, environmental monitoring devices, or industrial automation solutions, the NodeMCU ESP8266 empowers developers with the ability to create scalable and interconnected systems that leverage the power of the internet for real-time data exchange and remote control. With its robust capabilities and widespread community support, the NodeMCU ESP8266 continues to serve as a cornerstone in driving innovation and connectivity in the realm of electronics.

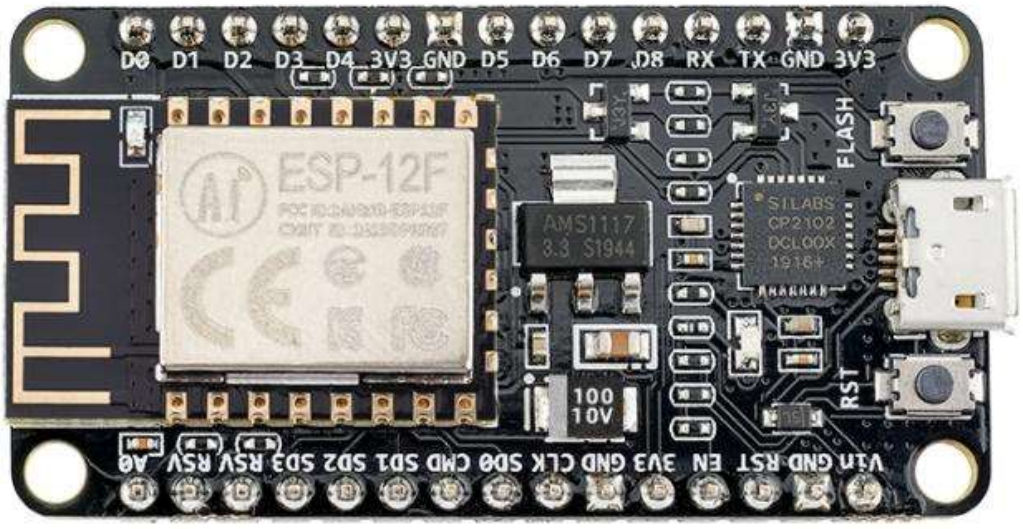

Fig. 3 (NODEMCU ESP8266 : wi-fi module)

- RFID READER MFRC522 MODULE:

  Full form of RFID is Radio Frequency Identification. RFID tags and RFID reader use wireless communication between them. In this kind of communication RFID Reader does not need any line of sight with the tags. A reader consists of a radio frequency module and an antenna that generates a high frequency electromagnetic field. Whereas 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 in the form of another radio signal. This is called a backscatter. The reader detects and interprets this backscatter and sends the data to a computer or microcontroller. The reader can find the RFID tag even if there is an obstacle between them. RFID tag even if there is an obstacle between them. RFID reader is shown:

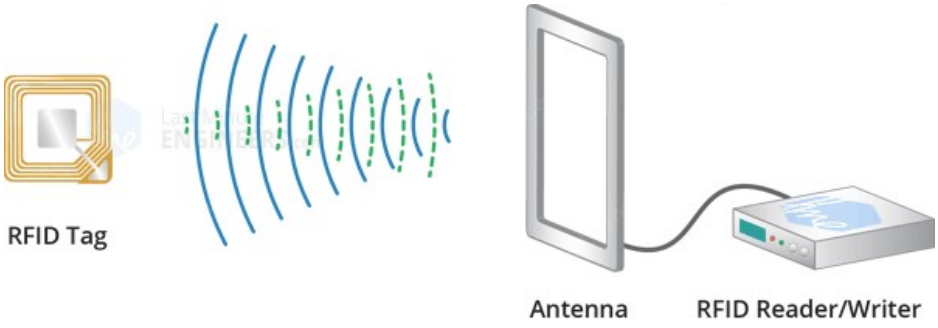

Fig. 4

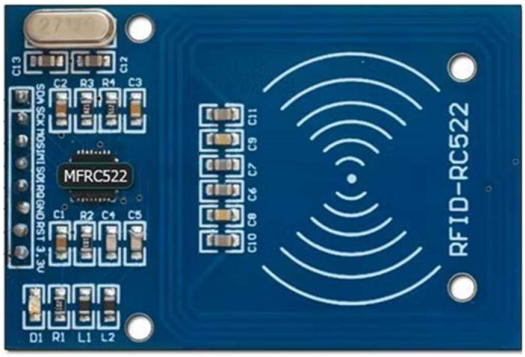

Fig. 5 (MFRC522 Module)

- LCD DISPLAY WITH I2C MODULE:

The LCD display with an I2C module is a convenient tool commonly used in electronics projects. It allows for easy integration of text or graphics output into various applications. The I2C module simplifies the connection process by reducing the number of wires needed to communicate with the display, making it ideal for projects with limited space or where neat wiring is desired. With its straightforward setup and compatibility with microcontrollers like Arduino, the LCD display with an I2C module is a popular choice for displaying information in projects ranging from simple temperature monitors to more complex data logging systems.

Fig. 6
(LCD Display with I2C Module)

- FEMALE TO FEMALE JUMPER:

  Female to Female jumper wires are electrical wires with female pins on both ends. They are commonly used for connecting components on a breadboard or between different modules and devices in electronics projects.

Fig. 7
(Female to Female Jumper Wire)

- MALE TO FEMALE JUMPER:

  Male to female jumper wires are electrical wires with a male pin on one end and a female socket on the other end. They are commonly used for connecting components between a microcontroller or breadboard and modules or sensors in electronics projects.

Fig. 8
(Male to Female Jumper Wire)

- LED:

  LEDs, or Light Emitting Diodes, are fundamental components in electronics, widely appreciated for their simplicity and versatility. They serve as visual indicators, illuminating to convey information or add ambiance in various applications. With their low power consumption and long lifespan, LEDs are ideal for projects where energy efficiency and durability are important considerations. From indicating device status in electronic gadgets to creating eye-catching displays in art installations, LEDs find their way into countless projects due to their ease of use and ability to produce bright, colorful light. Whether used individually or in arrays, LEDs continue to shine as one of the most accessible and impactful components in the world of electronics.

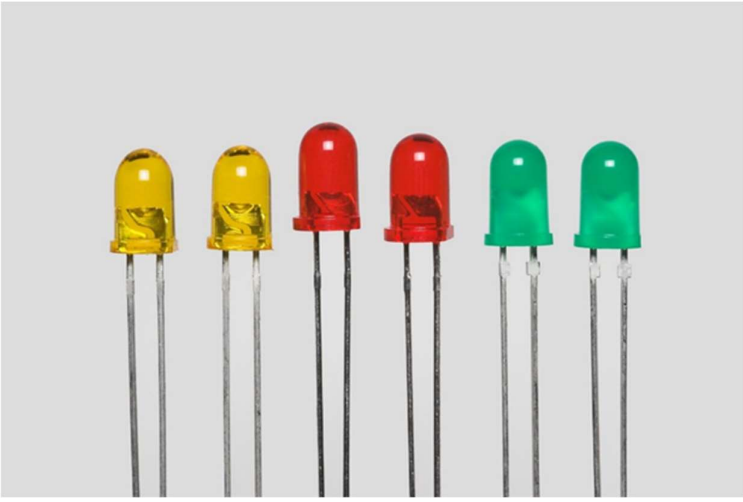

Fig. 9 (LED)

- BUZZER:

  Buzzer, a simple yet effective component in electronics, produces audible alerts or tones in various applications. Commonly used for indicating events, signaling alarms, or providing feedback, buzzers offer straightforward integration into circuits due to their minimal requirements and ease of control. Typically driven by an oscillating electrical signal, buzzers emit distinctive sound patterns, ranging from steady tones to pulsating alerts, depending on the application requirements. Whether employed in security systems, timers, or interactive games, buzzers play a crucial role in enhancing user awareness and engagement through audible cues. With their compact size, low cost, and reliability, buzzers remain indispensable components in electronics projects requiring audible feedback or alerting mechanisms.

Fig. 10 (Buzzer)

CODE:

```
#include <SPI.h>
#include <MFRC522.h>
#define RST_PIN         9          // Configurable, see typical pin layout above
#define SS_PIN          10         // Configurable, see typical pin layout above
#include<LiquidCrystal_I2C.h>
#include<ArduinoJson.h>
#include<SoftwareSerial.h>
SoftwareSerial nodemcu(5, 6);
LiquidCrystal_I2C lcd(0x27, 16, 2);
MFRC522 mfrc522(SS_PIN, RST_PIN);  // Create MFRC522 instance
MFRC522::MIFARE_Key key;
const int Buzzer = 2;
int temp[4] = {0};
int data_card[4] = {60, 55, 163, 224};

int check_card(int arr[]){
  bool f=false;
  for (int i=0 ; i<4 ; i++){
    if (data_card[i] != arr[i]) {
      f = true; break;
    }
  }
  if (!f) return -1;
  return 0;
}

void setup() {
  Serial.begin(9600); nodemcu.begin(9600);
  pinMode(4, INPUT);  pinMode(7, INPUT);  pinMode(2, OUTPUT);  pinMode(3,
OUTPUT);  pinMode(8, OUTPUT);
  digitalWrite(3, HIGH);
  while (!Serial);
  SPI.begin(); mfrc522.PCD_Init();
  delay(4);
  mfrc522.PCD_DumpVersionToSerial();
  Serial.println(F("Scan PICC to see UID, SAK, type, and data blocks..."));
  lcd.init();   lcd.backlight();    lcd.clear();    lcd.setCursor(0,0);
  lcd.print("Connecting to");   lcd.setCursor(0, 1);   lcd.print("Wifi");
  while (!digitalRead(4)) {
    continue;
    }
  if (digitalRead(7)) {
  lcd.setCursor(0,0);  lcd.clear();
  lcd.print("Connected to "); lcd.setCursor(0, 1);
  lcd.print("Wifi");
  digitalWrite(8, HIGH);
```

```
  }
  for (byte i = 0; i < 6; i++) {
        key.keyByte[i] = 0xFF;
    }
    dump_byte_array(key.keyByte, MFRC522::MF_KEY_SIZE);
}
bool ff = false;
String prev = "";
int x;
void loop() {
  DynamicJsonBuffer jsonBuffer;
  JsonObject& data = jsonBuffer.createObject();
  // Reset the loop if no new card present on the sensor/reader. This saves the
entire process when idle.
  if ( ! mfrc522.PICC_IsNewCardPresent()) {
    return;
  }
  // Select one of the cards
  if ( ! mfrc522.PICC_ReadCardSerial()) {
    Serial.println("fdf");
    return;
  }
  dump_byte_array(mfrc522.uid.uidByte, mfrc522.uid.size);
  prev = "";  prev += read(0, 1, 3) + "," + read(0, 2, 3) + "," + read(1, 4, 7) +
"," + read(1, 5, 7) + "," + read(1, 6, 7) + "," + read(2, 8, 11);
  Serial.println(prev);
  mfrc522.PICC_HaltA();
  mfrc522.PCD_StopCrypto1();

  digitalWrite(Buzzer, HIGH); delay(200);
  digitalWrite(Buzzer, LOW); delay(100);
  digitalWrite(Buzzer, HIGH); delay(200);
  digitalWrite(Buzzer, LOW);
  temp[0] = mfrc522.uid.uidByte[0];  temp[1] = mfrc522.uid.uidByte[1];  temp[2] =
mfrc522.uid.uidByte[2];  temp[3] = mfrc522.uid.uidByte[3];
  x = check_card(temp);
  if (x == -1) return;
  data["hum"] = prev;   Serial.println(x);
  data.printTo(nodemcu);   jsonBuffer.clear();
  lcd.clear();   lcd.print("Registering ...");
  while (!digitalRead(4)) continue;
  if (digitalRead(7)){
    lcd.clear(); lcd.print("Success");
  }
  else {
    lcd.clear(); lcd.print("Unsuccessfull");
  }
  delay(2000);
```

```
  standby();
}


void standby(){
  Serial.println("5"); lcd.clear(); lcd.print("Wait for 5 ..."); delay(1000);
  Serial.println("4"); lcd.clear(); lcd.print("Wait for 4 ..."); delay(1000);
  Serial.println("3"); lcd.clear(); lcd.print("Wait for 3 ..."); delay(1000);
  Serial.println("2"); lcd.clear(); lcd.print("Wait for 2 ..."); delay(1000);
  Serial.println("1"); lcd.clear(); lcd.print("Wait for 1 ..."); delay(1000);
  lcd.clear();
  lcd.print("ready");
}


void dump_byte_array(byte *buffer, byte bufferSize) {
    for (byte i = 0; i < bufferSize; i++) {
        Serial.print(buffer[i] < 0x10 ? " 0" : " ");
        Serial.print(buffer[i], HEX);
    }
}

String read(int x, int y, int z){
    byte sector = x;   byte blockAddr = y;   byte dataBlock[] = {"08Gate
3"};  byte trailerBlock = z;
    byte status;  byte buffer[18];  byte size = sizeof(buffer);

    status = mfrc522.PCD_Authenticate(MFRC522::PICC_CMD_MF_AUTH_KEY_B,
trailerBlock, &key, &(mfrc522.uid));
    if (status != MFRC522::STATUS_OK) {
        Serial.print(F("PCD_Authenticate() failed: "));
Serial.println(mfrc522.GetStatusCodeName(status)); return;
    }
    status = mfrc522.MIFARE_Read(blockAddr, buffer, &size);
    if (status != MFRC522::STATUS_OK) {
        Serial.print(F("MIFARE_Read() failed: "));
Serial.println(mfrc522.GetStatusCodeName(status));
    }
    String temp = "";
    temp += (char) buffer[0]; temp += (char) buffer[1]; int cap = temp.toInt();
    String str = "";
    for (uint8_t i = 2; i < cap; i++) str += (char)buffer[i];
    // dump_byte_array(buffer, 16);
    Serial.println(str);
    return str;
}
```

WORKING:

The working of the project can be outlined as follows:

1) Initialization: The system initializes with the LCD displaying the message "Connecting to WiFi," indicating the commencement of the connection process with the WiFi.

2) Network Connection: Upon successful connection to the WiFi network, the LCD updates to display "Connected to WiFi," confirming the establishment of the network connectivity.

3) RFID Card Interaction: When a user approaches the RFID reader with their RFID card, the system initiates the process of reading the card data, mirroring the action of a user showing their RFID card to the reader for data marking.

4) Data Processing: The LCD screen responds by displaying "Registering..." as the system processes and registers the card data, akin to how the data system records the in-time of users upon swiping their RFID cards.

5) Data Upload: Once the card data is successfully processed, the system uploads the data information to the google sheets API, reflecting the recording of data in the User Data system.

6) Confirmation: The LCD updates to display "Success," indicating the completion of the data transfer process and successful data marking, similar to how the data system confirms the successful registration of user data.

7) Standby Period: Following the successful data upload, the system enters a standby mode for 5 seconds.

8) Ready State: After the standby period, the LCD displays "Ready," signaling that the system is prepared for the next user interaction, just like the readiness of the data system for the next user to swipe their RFID card for data marking.

By aligning the project's operation with the workflow of a User Data system, the aim/objective of demonstrating a seamless integration of RFID technology, data retrieval, and cloud storage for efficient tracking and management of user information is effectively realized.

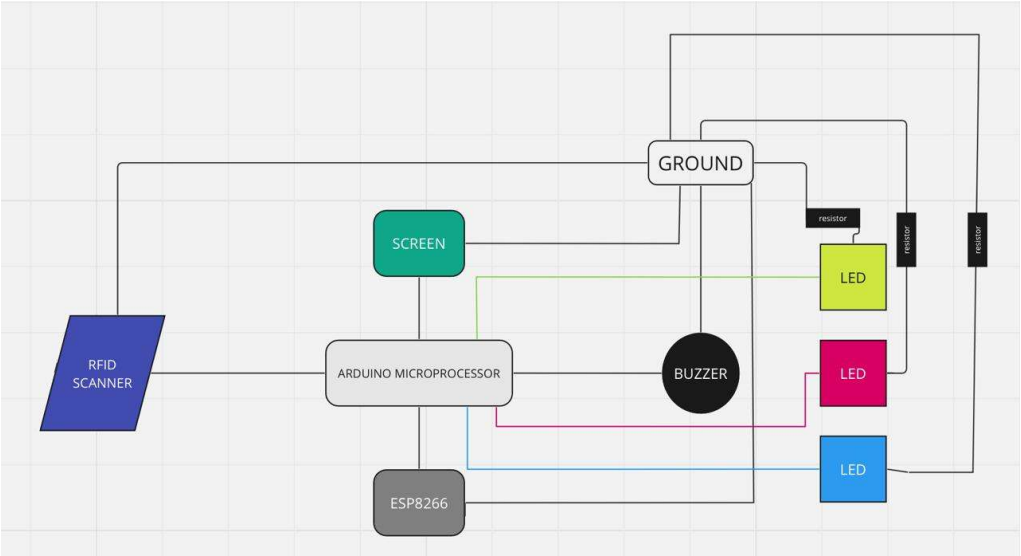

Fig. 11

(This is the block diagram of the project RFID tracker using Arduino. Here Arduino UNO acts as a central processor for controlling all other components as input/output unit.)

OBSERVATIONS:

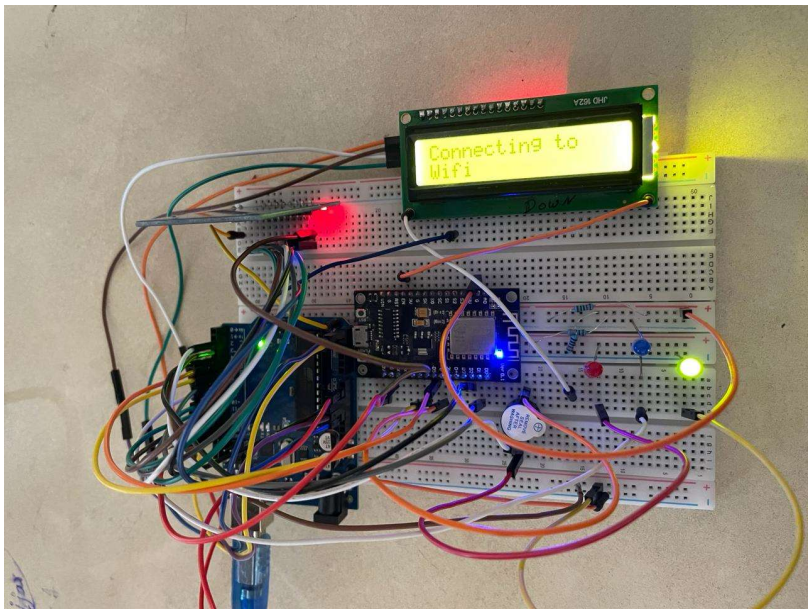

Fig. 12

This is when we power on our project and connect our wifi module to a wifi source. The LCD display shows “connecting to wifi”. The yellow LED glows to show us that it is connecting.

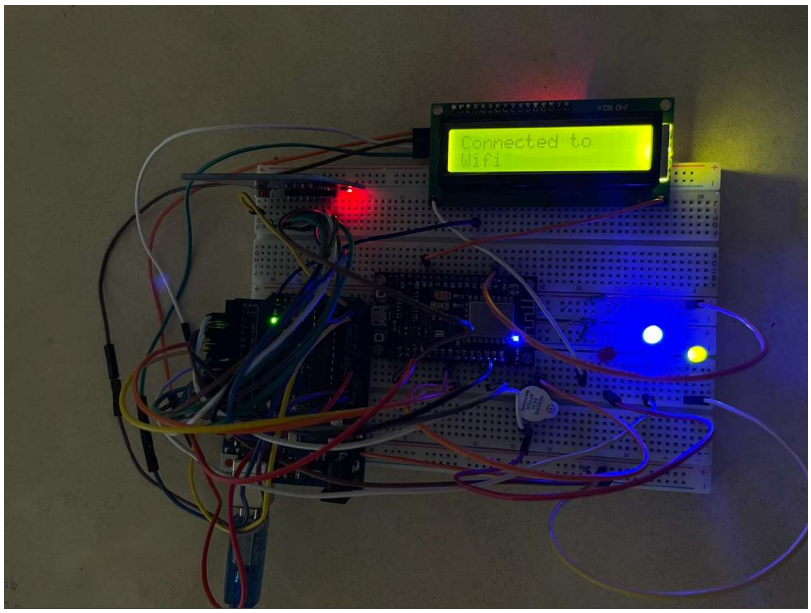

Fig. 13

This is when it is successfully connected to a wifi source. The LCD display screen shows “Connected to Wifi”. The blue LED glows to show us that the RFID CARD READER is now ready to be used.

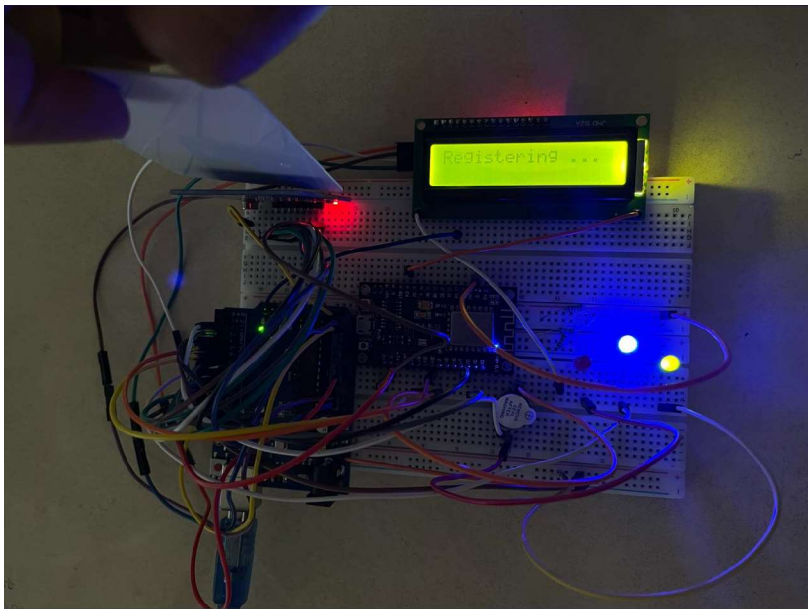

Fig. 14

In this, we have tapped our RFID card to our RFID reader MFRC522 module. The LCD display shows “Registering..” to imply that the data/details of the user are being fetched. The buzzer also beeps.

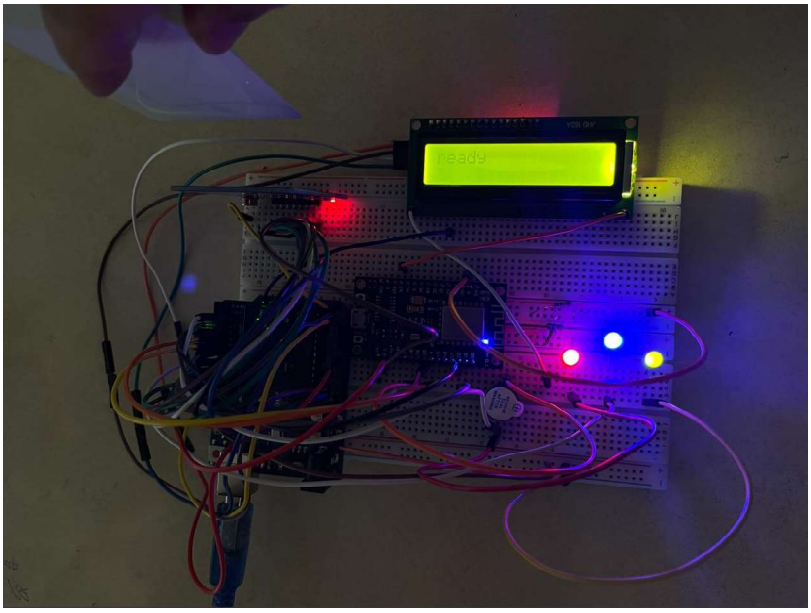

Fig. 15

In this, the details have been fetched and registered. Now the LCD shows “Ready”. The red LED glows to show us that the details have been collected.

RESULTS:

The data of the users is automatically uploaded into google sheet assigned to it. Data is stored in numerical format with different unique ID. Date & Time along with the student ID is stored.

ADVANTAGES:

1. Less Paperwork:

   There is less paperwork because system's attendance management module digitally records attendance instead of requiring attendance registers to be kept up to date. It really is a fully environmentally friendly choice that conserves natural resources.

2. A Lessened Task for Teachers:

   It takes a teacher 10 to 15 minutes a day on average to record pupils' attendance in class. The online attendance management solution can eliminate this time completely. Students' attendance will be punched by the specialized software using biometric or RFID card punching. To have their attendance recorded, students only need to press an RFID tag while standing in front of the machine. In this way, the teachers save a ton of time by being freed from this tedious duty.

3. Enhanced Precision:

   The manual attendance management system's drawbacks are eliminated by our online attendance system, which also yields superior outcomes. The attendance system guarantees accuracy in maintaining correct attendance because biometric measurements cannot be changed or replicated. This can yield precise data for additional computations. Since it doesn't require human intervention and produces more accurate data, proxy attendance may be avoided and errors can't occur.

4. Enhanced Safety for Students and the School :

   Students are protected when there is an automatic attendance management system on school property since it can track their constant movements around the building. It will verify that all of the students are present in each class, and if any are absent during the academic session, it will promptly notify the relevant parties. Additionally, biometric integration ensures that only personnel and kids with legitimate credentials are entering the building, which enhances school security. Furthermore, since the attendance is digitally stored on a cloud server, there is very little possibility of data loss or manipulation. This data is only accessible to authorized persons, guaranteeing the highest level of record security.

APPLICATIONS:

- 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.

- In real time, one can issue active tags to the students, with their roll numbers as their tags. RFID reader contains a copper winding in it. This winding acts as an antenna.

- Advanced Product Tracking
    - Real-time data management
    - Dramatic benefits to manufacturing process

- Quick Convenience
    - Offices, Library, Hospital
    - Instant identification
    - Time saver

- Safety and Security
    - Locate/identify missing persons
    - Monitor prisoners

- Easy Access
    - Access by authorized personnel only
    - Ease security concerns

CONCLUSION:

In this project attempt has been made to mark the data of the users using RFID technology. It has been up to mark, the use of RFID is a success, it is storing up data much faster than traditional method and with much higher accuracy. Just swiping the RFID tags, data is being stored and time saving for the users and the management. It is obvious that the use of biometrics could improve some aspects of using this kind of system. High security level can be increased, much wider range of RFID can be set to capture the data over from distance. This system can be further improved by storing the attendance in a much bigger database, even data can be sent to the parents about the presence and absence of the student, cards can be misused by the student's, proxy attendance can be given, where fingerprint can be a essential as well as implementing NFC Near field communication and improve and be much more secure to use.

BIBLIOGRAPHY:

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- https://www.electronicsforu.com/
- https://github.com/
- PROJECT REPO: https://github.com/ojas-sharma-01/arduino
- https://how2electronics.com/