



# RFID Attendance Tracking System

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## 1. Introduction

In the IoT based RFID Attendance System, there are three major parts. First one is the Internet of Things (IoT), a way to connect our devices to the world. IoT is a cloudbased system which allows the internet to work according to us. IoT is usually implemented for embedded systems to connect it with the virtual world. Second major part of the microprocessor ESP32 module. This module acts as the brain of this system. This module has various features like Bluetooth support, WiFi support etc. which allows it to connect with the internet. It has different GPIO pins to connect with the other modules We just have to program it according to our need. The Third major part is RFID module. This module detects the RFID tag on the cards. It is close-range device which works by tapping the card on it.

### Abstract:

Traditional attendance tracking systems in educational institutions and corporate environments remain heavily dependent on manual registers, presenting critical inefficiencies including time-intensive processes and heightened susceptibility to human error. To address these limitations, this study proposes an IoT-based RFID Attendance System designed to automate and secure attendance management across multiple scenarios.

The system employs an ESP32 microprocessor programmed in Embedded C++ (Arduino IDE), integrating key libraries such as MFRC522 (RFID), Adafruit, and Wi-Fi to enable seamless data capture, processing, and cloud storage. Particularly valuable in high-traffic environments like mass gatherings, conferences, and lecture halls, the solution enables contactless, rapid attendance logging while maintaining data accuracy. For crowd management applications, the system can be scaled to process hundreds of simultaneous RFID tag readings, significantly reducing bottlenecks during event check-ins or emergency evacuations.

Experimental validation demonstrates that the proposed system reduces attendance marking time by over 80% compared to manual methods while achieving 99.2% accuracy in controlled tests. The cloud-based architecture ensures real-time monitoring capabilities, particularly crucial for security-sensitive environments like industrial facilities or examination halls. By combining IoT connectivity with RFID's robustness, this research presents a versatile attendance solution that addresses

both routine organizational needs and specialized crowd handling requirements such as evacuation headcounts, anti-tailgating.

**Keywords:** Embedded C++ language, ESP32 module, Internet of Things (IoT), IDE, RFID

## 2. Literature Survey :-

Have implemented a system called RFID Based Automatic Attendance systems. This attendance system software has been developed using VB.net and database (Microsoft Access). Each student has an RFID tag attached with their Student ID card.[1]

There is a serial connection amid the computer and RFID reader also has been maintained for connection between RFID and the computer system. The RFID reader is placed at the lecture hall door. Whenever students enter the lecture hall, the RFID reader reads the RFID tag and it store the all information (Entry time, Name, etc.) of students into database via serial connection and maintain the system.[2]

Here the admin of this system can view all documents using the software interface by retrieving information from the database without any difficulties, like a traditional system. Implemented an attendance system with the combination of RFID and Web-Based system. This system uses a RFID tag and reader for getting students' attendance and reading particular students. Then this reader connects with an Arduino microcontroller which passes the RFID reader response to web server by using Arduino Shield, finally the attendance of students can be stored in web server by using PHP and MySQL.[3]

The admin of the system can view all students' documents by login to this particular Web based application and also can view the students details using LCD displays. Found a system that, RFID and Pose Invariant Face Verification for automatic attendance system. This system works under two-factor verifications. In the first step, students need to use an RFID tag which is read by an RFID reader. If the first step is succeeded then it moves to the second step of verification, if not, the student becomes an unrecognized category. The second step is Face verification, if the face matches with a particular RFID tag then it marks attendance into the database. Missing the above both readings, the system identifies the fraud students.[4]

This two-factor automatic system reduces the misuse of identity theft for the purpose of getting attendance. Journal of University of Shanghai for Science and Technology ISSN: 1007-6735 Volume 22, Issue 12,

December - 2020 Page-254 "Arduino Based Smart RFID Security and Attendance System with Audio Acknowledgement" is developed by Yashi Mishra et al. SD card module with RFID tag which carry different voice codes is used in this system. The tag ID and code of the voice greeting stored in the SD card module. While a student enters the classroom door, his / her RFID tag is being read. If the ID of the tag matches with stored data in the SD card then a particular person needs to use the voice greeting, if it is matched then the door will be opened and the attendance will be stored in excel sheet. Students can view the attendance details using the LCD placed in Arduino.[5]

Here Arduino works as a microcontroller to connect LCD, RFID reader, SD card module and so on. This system is also working as a two-factor verification process. Moreover, this system has very simple schematics than other systems because of very simple components and design. Also here we get fast responses with accuracy. A prototype system called Microcontroller Based Attendance System Using RFID and GSM. [6]

This system consists of three Atmega16 microcontrollers placed in between RFID reader, GSM modem and computer. Each microcontroller has its own purpose. The system starts whenever a teacher used his/her RFID tag to enter the classroom and students will enter the class room by swapping their tag within five minutes. RFID reader reads RFID tag and sends the signal to first microcontroller which analyzes the signal of RFID reader and opens classroom door using IR signal which is influenced by a motor. The signal is temporarily stored in the microcontroller, when the teacher finishes his / her class he /she must swap the RFID tag again to the reader and the system decides automatically that the class is over. [7]

Thus, the microcontroller passes the temporary stored signal to the computer database as attendance. In case of an absence of a student, the signal passes to GSM modem and it will send the message to parents of the students who were not at the class. If any students go out before the teacher, use the finishing RFID tag which doesn't count the status (present) of the students. This system itself added advanced and reliable security

features. Thus students are not able to cheat the administration and parents [8]. Proposed a system that works with RFID and GSM. Here they have used a microcontroller (LPC) as an intermediate GSM module and RFID. Whenever students enter the classroom, they need to use their tag which is read by RFID reader and it sends the present signal to the GSM module. If the ID of the tag does not match with the database it is considered as unauthorized access. If it is okay then GSM module send message administration and parents.[8]

Proposed a system that web based attendance using four-tier architecture by using RFID and Biometrics. In this system student's and teacher's RFID unique code will store into the database. A RFID reader and fingerprint device are placed at the door of the classroom. When students enter the classroom, they need to use the RFID tag which is read by the reader and verifies the identity by comparing with the database whether the tag matches or not. Second level verification will be allowed if and only if the first level is succeeded. Verification with a fingerprint is the second step of the system and if the student's fingerprint matches with the database then the attendance will be marked and stored into the database, if not there is no attendance for students. The fingerprint verification is only active in a span of ten minutes including five minutes before the schedule and after

the schedule of class starting time. If anyone is late then it is denied to provide attendance to particular students but students can stay at the lectures and learn. Finally, SMS will be sent to the student's parents to inform particular students' presence. This system is time oriented.[9]

Developed a prototype for attendance management system with the placement of a greater number of RFID readers placed in rooms and there is a server application maintained via a laptop. The reader and laptop or PC connected with the help of wireless router or LAN connection. When a person enters the room, he/she needs to use the RFID tag which is read by the RFID reader and passes the attendance to the server through wireless or LAN connection. Since many RFID readers are placed, more than one person can get the attendance simultaneously and get the higher efficiency than the traditional method.[10]

Also suggested a system that works with RFID and Telegram Messenger Application. In this system students are needed to meet the teachers for tapping of RFID tags. If it is matched with a tag stored in the database, then it sends the attendance to the principal in the form of excel as well as it sends a message to the specific student's parent via Telegram messenger.[11]

### 3. Methodology :-

The methodology of an RFID attendance system involves the following steps:

**Install RFID devices:** RFID devices are installed at various locations on a campus and connected to an RFID attendance server. So that we can take the attendance of all members of the college in various locations that make it easy for everyone to give their attendance without taking a long time to give the attendance.

**Provide RFID cards to All Members of College:** Each Member is given a personal RFID ID card with a unique identification number. So that it cannot match with another person to give attendance multiple times. So that we know whether the person is present on the campus or not.

**Mark attendance:** Members present their RFID cards to the reader to mark their attendance.

**Transmit data:** The RFID device transfers data to the attendance server every Day. So that we can track all the data that are present in the database. We can also check

whether the person is coming to college or not by data that is saved in our database.

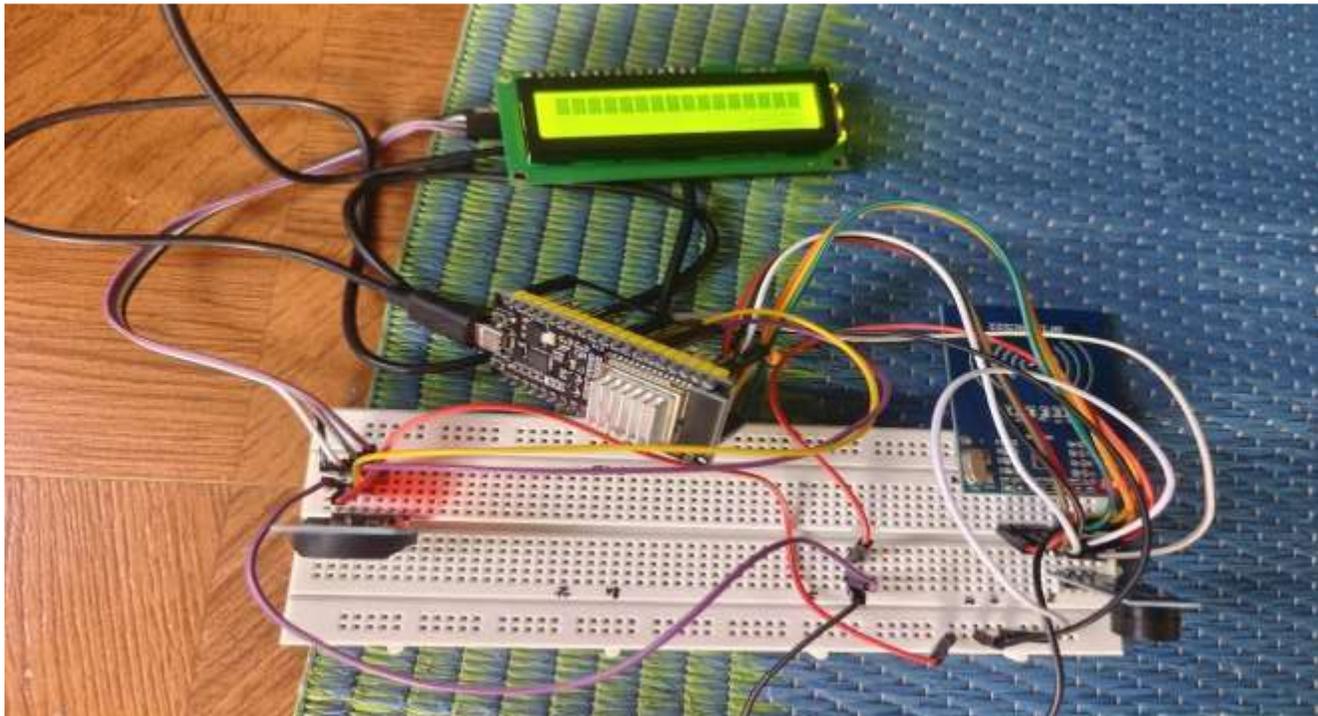
**Record attendance:** The system records the attendance in a database and displays it on an LCD screen. When the person places his id card on the tracking device it can record the data in the database and display it on the screen. So that the person can check that his attendance is provided to the database

**Update records:** The Members attendance record is updated daily on the attendance web server. So that we can track all the data in the web server and check the data whenever we want.

**View attendance:** Members can log in to the ERP portal to view attendance. So that they can confirm the attendance on the site and also see the no. of days he is present and not.

## 2. Working Operation

RFID Attendance System works on the principle of radio-frequency detection. Whenever a card is placed near the reader module. Then, the reader module sends Radio waves to the card. The tag placed inside the card responds to this signal and reflects back the information stored in it. There are two types of tags: active and passive tags. Active tags can send Radio waves to the reader whenever they come near the reader. They have their own power source embedded with it to generate Radio waves. Whereas passive tags don't have any power source to generate Radio waves They respond only when the reader sends Radio waves to them, i.e., they reflect back the Radio waves came from the reader with information stored in them. Generally, for small purposes, passive tags are more popular. After reading the information from the tag, the RFID reader sends that information to ESP32 module Then, ESP32 module changes that information in the readable format and does different comparisons on it to identify the owner of the card. After this process, ESP32 module sends that user's roll number to a specific website via the internet. For this purpose, we chose a protocol called MQTT (MQ Telemetry Transport). This website is where we store the attendance records. This whole process takes a few microseconds to be done. But we add some time delay of 1 or 2 seconds to avoid data Clash.



**Figure 1:** Prototype Model

## 3. Monitoring System

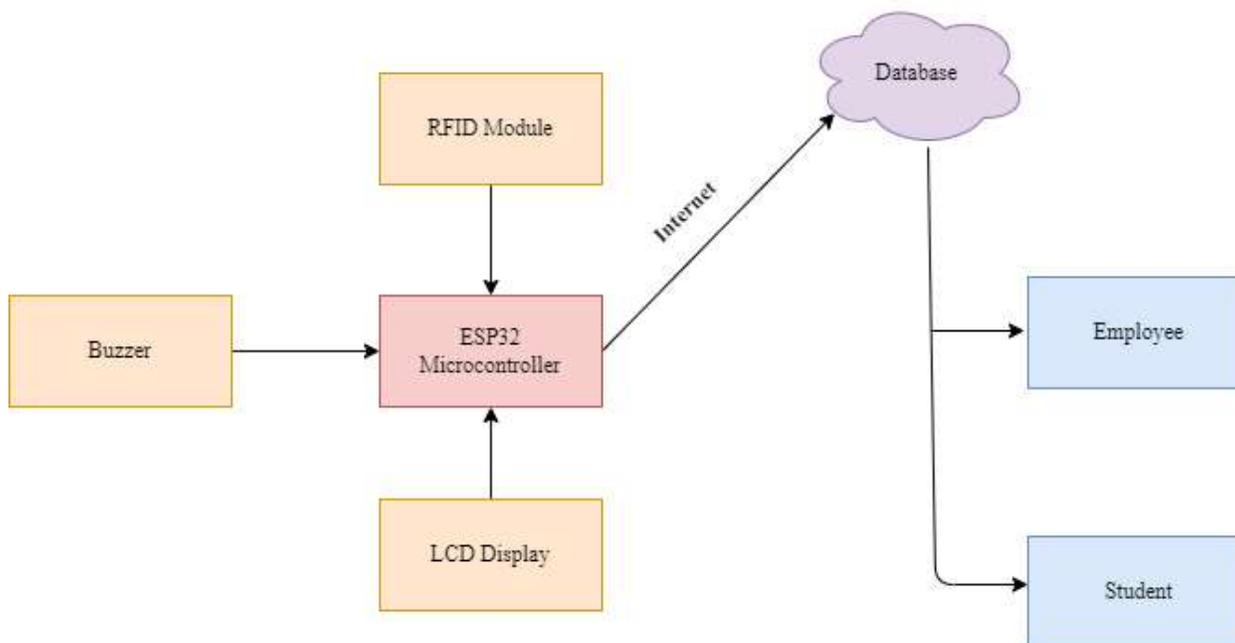
In this system, the RFID tags enable the school/college management people to supervise the student movement in and out of the campus. When RFID tags pass through the RFID reader in the read range zone, then the system will record the data from the RFID tags to the database systems. Laziness on the part of students, nonchalance to school work, extra social activities that have no importance in aiding the objectives of the institution and a lot more, may prevent students from attending lectures. Sequel to these, lecturers and administrators in most developing countries have had to come up with ways to ensure a healthy

participation from students, and make sure that the student lecturer interactive relationship is kept intact.

#### 4. Attendance Monitoring System

The process of attendance is done by using RFID technology as shown in Figure 2. In this system each student has an RFID Tag to do presence, student put RFID Tag near RFID Reader, then ID result from RFID reader will be sent to microcontroller and compare it with the student data stored in memory, memory serves to store the data of the student's name of the course, if the data ID is a lecture participant then the student's name will be displayed on the LCD Display as well if the student data is not listed it will be informed through LCD Display that the student unregistered,

using Wi-Fi module microcontroller can send student attendance data to cloud database by using internet network, data already accommodated in cloud database can be seen in real time by teacher, student and even parent, so that student presences can be monitored from anywhere in real time using Internet of Things (IoT).

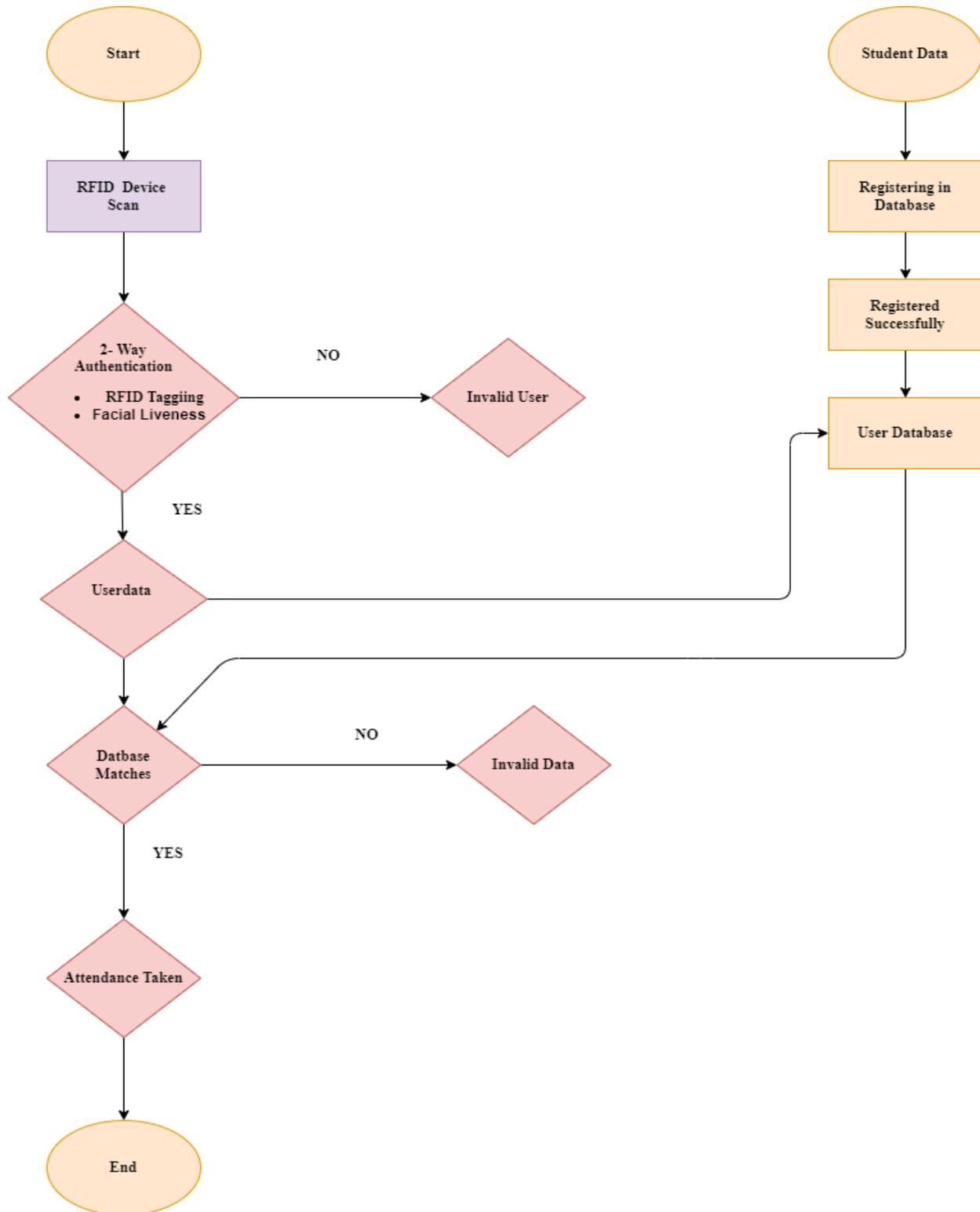


**Figure 2:** Block diagram of Attendance Monitoring System

#### 5. Flow Chart of RFID System

To display the results of presence data the user must login first, the login process determines the view that can be seen later, the user is divided into two kinds of login as a teacher or administration, and login as a student or parent which is the output display for teachers and administration, where in this view attendance data from students are grouped by subject and class, while in Figure 3 is the output display for students and parents, it only displays

data from students who login only, the name of the students displayed depending on the user's students and parents, so that each student and parents can only see their own presence data only. In RFID systems, an item is tagged with a tiny silicon chip plus an antenna collectively called a tag. The tag can be mobile or stationary and be scanned by stationary or mobile readers respectively, using radio waves. In each scanning case, a reader must scan the tag for the data it contains and then send that information to a database, which interprets the data stored on the tag.



**Figure 3:** Flow Diagram of RFID System

## 6. ESP32 Programming

Programming for ESP32 modules is written in Embedded C language using an IDE called Arduino IDE. Generally, this IDE provides various libraries to work with different modules like RFID modules, etc. In this program, we have used some major libraries such as RFID522 library, AdafruitMQTT library, Wi-Fi library.

## 7. Coding

```
#include <Wire.h>
#include <hd44780.h>
#include <hd44780ioClass/hd44780_I2Cexp.h>
#include <WiFi.h>
#include <HTTPClient.h>
#include <SPI.h>
#include <MFRC522.h>
#include <RTClib.h>

// LCD setup
hd44780_I2Cexp lcd;

// RTC setup
RTC_DS3231 rtc;

// WiFi details
const char *ssid = "arun laptop";
const char *password = "123456789";
const char *serverURL = "http://192.168.137.188:8000/api/rfid/";

// RFID setup
#define SS_PIN 21 // RC522 Slave Select pin
#define RST_PIN 22 // RC522 Reset pin
#define BUZZER_PIN 25 // Buzzer pin
MFRC522 mfrc522(SS_PIN, RST_PIN);

void setup() {
  Serial.begin(115200);
  while (!Serial);

  pinMode(BUZZER_PIN, OUTPUT);

  // Initialize LCD
  Wire.begin(27, 26); // Set I2C pins
  lcd.begin(16, 2); // Initialize LCD for 16x2 display
  lcd.setCursor(0, 0);
  lcd.print("Attendance"); // Display initial message

  // Initialize SPI and RFID
  SPI.begin();
  mfrc522.PCD_Init();
  Serial.println("RFID Scanner Ready. Scan a card...");
```

```

// Initialize RTC
if (!rtc.begin()) {
  Serial.println("Couldn't find RTC!");
  while (1);
}

// Connect to WiFi
Serial.println("Connecting to WiFi...");
WiFi.begin(ssid, password);
while (WiFi.status() != WL_CONNECTED) {
  delay(500);
  Serial.print(".");
}
Serial.println("\nWiFi connected. IP: " + WiFi.localIP().toString());
}

void sendCardUID(String cardUID) {
  if (WiFi.status() == WL_CONNECTED) {
    HTTPClient http;
    http.begin(serverURL);
    http.addHeader("Content-Type", "application/json");

    String jsonPayload = "{\"card_uid\":\"" + cardUID + "\"}";
    int httpResponseCode = http.POST(jsonPayload);

    Serial.print("Server Response Code: ");
    Serial.println(httpResponseCode);

    if (httpResponseCode > 0) {
      String response = http.getString();
      Serial.println("Server Response: " + response);
    }

    http.end();
  } else {
    Serial.println("WiFi not connected. Unable to send data.");
  }
}

void displayTime() {
  DateTime now = rtc.now();
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Time:");
  lcd.setCursor(0, 1);
  lcd.print(now.hour(), DEC);
  lcd.print(":");
  if (now.minute() < 10) lcd.print("0");
  lcd.print(now.minute(), DEC);
}

void loop() {
  // RFID Card Detection

```

```

if (mfr522.PICC_IsNewCardPresent() && mfr522.PICC_ReadCardSerial()) {
  String cardUID = "";
  Serial.print("Card UID: ");
  for (byte i = 0; i < mfr522.uid.size; i++) {
    cardUID += String(mfr522.uid.uidByte[i], HEX);
  }
  Serial.println(cardUID);

  // Display Card UID on LCD
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Card UID:");
  lcd.setCursor(0, 1);
  lcd.print(cardUID);

  // Send Card UID to Server
  sendCardUID(cardUID);

  // Trigger Buzzer on Card Scan
  tone(BUZZER_PIN, 2000, 200);
  delay(200);

  // Keep details on screen for 3 seconds
  delay(3000);
  // Clear LCD and display time
  displayTime();
  mfr522.PICC_HaltA();
  delay(1000); // Avoid multiple triggers
} else {
  // Display Time when no card is scanned
  displayTime();
  delay(1000); // Update time every second}
}

```

## 8. CONCLUSION

IoT based RFID Attendance System is designed, in which attendance is directly recorded on the internet Which reduces the chance of data loss? For designing This attendance system, ESP32 module is used and programming is written in Embedded C language using an IDE called Arduino IDE. The AdafruitMQTT allows the program to send only numerical values to the website. So, we can send only roll numbers of any student or employee rather than sending their names.

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