PREFACE

PROJECT TITLE : RFID BASED SCAN SYSTEM

Chapter 1

INTRODUCTION

RFID (Radio Frequency Identification) technology is widely used for automatic identification and access control systems. It helps in identifying objects or people using radio waves without physical contact. Traditional security and attendance systems such as manual registers, keys, or ID cards are time-consuming and less secure.

The objective of this project is to design and develop a simple, fast, and reliable RFID Scan System using Arduino, RFID reader, relay module, and display unit. This system can be used for access control, door locking systems, and attendance monitoring.

1.1 Brief History of RFID Systems

RFID technology was first used during World War II for aircraft identification. Later, it was adopted in industries for inventory tracking, toll collection, and security systems. With advancements in microcontrollers, RFID is now commonly used in educational institutions and offices.

In recent years, RFID has been adopted in educational institutions for attendance systems, libraries, and access control. The integration of RFID with microcontrollers like Arduino has made it easier to design low-cost and efficient systems.

1.2 Modern RFID Based Systems

Modern RFID systems are integrated with microcontrollers, IoT platforms, and cloud databases. These systems provide faster authentication, higher accuracy, and improved security.

Modern RFID systems are integrated with microcontrollers, databases, IoT platforms, and cloud services. These systems offer features such as:

Contactless operation

- High accuracy
- Fast response time
- Secure authentication
- Real-time data processing

RFID technology is now a key component in smart systems and automation.

Chapter 2

PROBLEM STATEMENT

2.1 Description

Traditional access control and attendance systems suffer from problems such as:

- Manual errors
- Time consumption
- Unauthorized access
- Lack of automation

2.2 Challenge Statement

The challenge is to design a low-cost, reliable, and efficient RFID Scan System that can:

- Identify authorized users accurately
- Reduce time required for authentication
- Improve security
- Minimize human intervention

Chapter 3

DESIGN AND METHODOLOGY

3.1 Design Thinking Process

a) Empathize

Users such as students, faculty, and staff require a fast and secure system for access and identification.

b) Define

The system should be contactless, easy to use, and affordable.

c) Ideate

Different ideas such as biometric systems, RFID systems, and keypad systems were analyzed. RFID was chosen due to its simplicity and reliability.

d) Prototype

A hardware prototype was developed using Arduino, RFID reader, relay module, and LCD display.

e) Test

The system was tested with multiple RFID cards and showed accurate and consistent performance.

3.2 Methodology

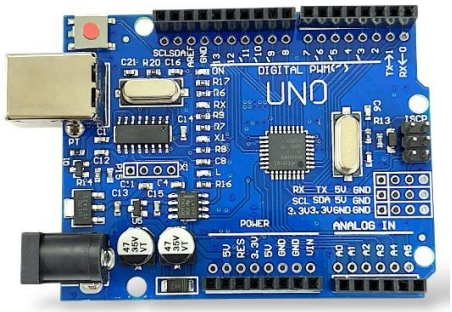
The working of the RFID Scan System is explained below:

1. Power is supplied to the Arduino and peripherals
2. RFID reader waits for a tag to be scanned
3. When a tag is scanned, the UID is read
4. Arduino compares the UID with stored authorized IDs
5. If UID matches:
   - Access is granted
   - Relay is activated
6. If UID does not match:
   - Access is denied
   - Relay remains OFF
7. LCD displays appropriate message

3.3 Prototype Description

3.3.1 Materials Used

a) Arduino UNO



Arduino UNO is a microcontroller-based development board that acts as the central control unit of the RFID scan system. It is based on the ATmega328P microcontroller and is responsible for receiving data from the RFID reader, processing the unique identification number (UID), and controlling the output devices such as the LCD display and relay module. Arduino UNO is preferred due to its ease of programming, sufficient input/output pins, and compatibility with various sensors and modules.

b) RFID Reader (RC522)

The RFID reader is used to read the unique identification number (UID) stored in the RFID tag. It works on radio frequency communication and transmits the tag data to the Arduino when a tag is brought near it. In this system, the RFID reader enables contactless identification, improving speed and security. The reader communicates with the Arduino using SPI communication.

c) RFID Tags/Cards

RFID tags are small passive cards or key fobs that contain a unique identification code. These tags do not require an internal power source and are activated by the electromagnetic field generated by the RFID reader. When a registered RFID tag is scanned, its UID is matched with the stored UID in the Arduino program to grant access.

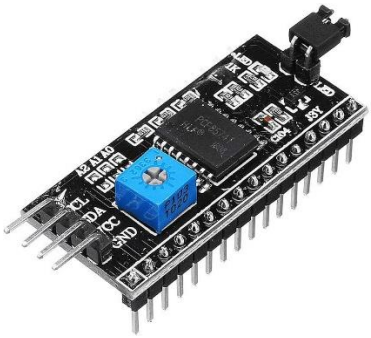
d) Relay Module

The relay module acts as an electrically operated switch that allows the Arduino to control high-voltage or high-current devices using a low-voltage signal. In this project, the relay module is used to simulate or control an access mechanism such as a door lock or alarm system. When access is granted, the Arduino activates the relay, enabling external device control.

e) LCD Display (16×2)

The LCD display is used to visually display system messages such as “Access Granted” or “Access Denied.” A 16×2 LCD is commonly used in this project due to its simplicity and readability. It provides real-time feedback to the user and enhances the usability of the RFID scan system.

f) I2C Module

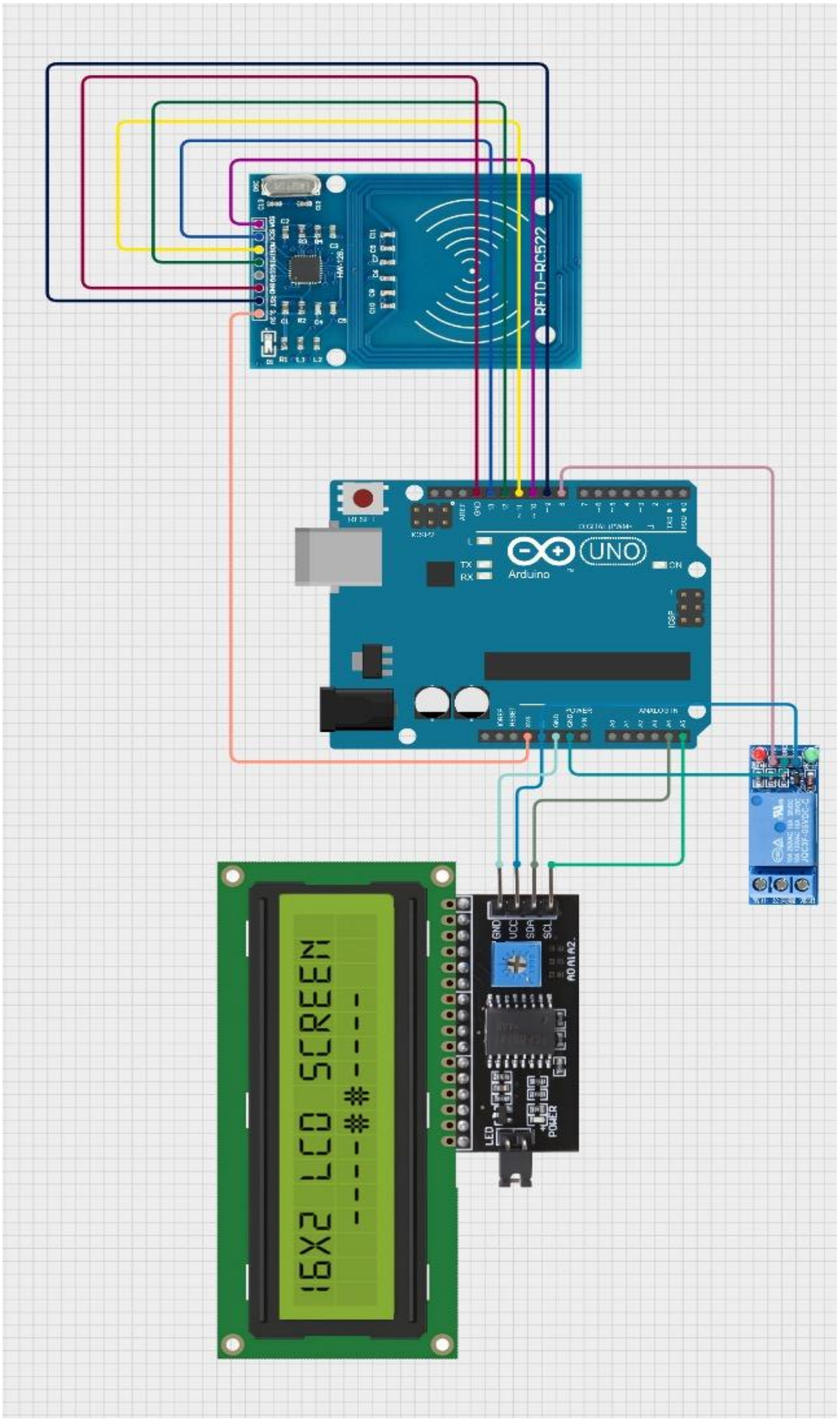


The I2C module is interfaced with the LCD display to reduce the number of connecting wires required between the LCD and Arduino. Instead of using multiple data pins, the I2C module allows communication using only two lines: SDA (data) and SCL (clock). This simplifies circuit design and improves system reliability.

g) Jumper Wires

Jumper wires are used to establish electrical connections between different components in the RFID scan system. They provide a flexible and convenient way to connect the Arduino UNO with modules such as the RFID reader, LCD display, I2C module, and relay module. Jumper wires are commonly used in breadboard-based and prototype circuits, allowing quick modifications without soldering.

3.3.2 System Diagram



Chapter 4

IMPLEMENTATION

The implementation involves both hardware and software. The Arduino program is written in Embedded C using Arduino IDE. The code initializes the RFID reader, LCD display, and relay module.

When an RFID tag is scanned, the Arduino reads the UID and compares it with predefined values. Based on the comparison, the relay is switched ON or OFF.

4.1 Arduino Code

```
#include <SPI.h>
#include <MFRC522.h>
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

#define SS_PIN 10
#define RST_PIN 9
#define RELAY_PIN 8

MFRC522 rfid(SS_PIN, RST_PIN);
LiquidCrystal_I2C lcd(0x27, 16, 2);
byte authorizedUID[4] = {0x96, 0x30, 0x2D, 0x06};
void setup() {
  pinMode(RELAY_PIN, OUTPUT);
  digitalWrite(RELAY_PIN, LOW);

  SPI.begin();
  rfid.PCD_Init();

  lcd.init();
```

```
  lcd.backlight();
  lcd.setCursor(0,0);
  lcd.print("Scan RFID Card");
}
void loop() {
  if (!rfid.PICC_IsNewCardPresent()) return;
  if (!rfid.PICC_ReadCardSerial()) return;
  bool accessGranted = true;

  for (byte i = 0; i < 4; i++) {
    if (rfid.uid.uidByte[i] != authorizedUID[i]) {
      accessGranted = false;
      break;
    }
  }
  lcd.clear();
  if (accessGranted) {
    lcd.print("Access Granted");
    digitalWrite(RELAY_PIN, HIGH);
    delay(2000);
    digitalWrite(RELAY_PIN, LOW);

  } else {
    lcd.print("Access Denied");
    delay(2000);
  }
  lcd.clear();
  lcd.print("Scan RFID Card");
```

Chapter 5

RESULTS AND ANALYSIS

5.1 User Testing

Testing Procedure

- Multiple RFID cards/tags were scanned, including **registered** and **unregistered** tags.
- Users were instructed to scan the card at different angles and distances.
- The response shown on the **LCD display** and the action of the **relay/lock** were observed.
- Repeated scans were performed to check consistency and system stability.

Observations During Testing

- The system correctly **identified registered RFID tags** and displayed **"Access Granted"** on the LCD.
- For **unregistered tags**, the system displayed **"Access Denied"** and no relay action occurred.
- The response time of the system was found to be **quick and satisfactory**.
- The relay operated smoothly when access was granted.
- The system remained stable during continuous scanning without hanging or resetting.

5.2 Feedback

User Feedback Obtained

- Users found the system **easy to use** and **simple to understand**.
- The LCD messages were **clear and readable**.
- The system was appreciated for its **contactless operation**, improving hygiene and convenience.
- Some users suggested adding a **buzzer or LED indicator** for better user interaction.
- A few users recommended extending the system to support **multiple user IDs** and **data logging**.

Chapter 6

CONCLUSION AND FUTURE WORK

The RFID Based Scan System successfully meets the project objectives. It provides a secure, fast, and efficient solution for authentication and access control. The system is easy to implement and suitable for educational institutions and offices.

Future Work

- Integration with IoT and cloud database
- Mobile application support
- Biometric and RFID combined system
- Automatic report generation

REFERENCES

1. K.R. Venugopal, K.G. Srinivas – Microcontroller Systems

2. Arduino Official Documentation

3. RFID Technology – Wikipedia