RFID DOOR LOCK SYSTEM USING ARDUINO

A PROJECT REPORT

Submitted by

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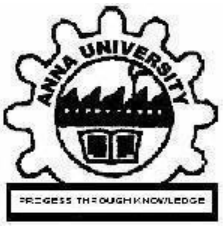

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BONAFIDE CERTIFICATE

Certified that this project report titled **"RFID DOOR LOCK SYSTEM USING ARDUINO"** is the bonafide work of **"SUBHIKSHAA (210701264), TAMIL PRIYA V (210701282)"** who carried out the work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

This project focuses on developing an RFID (Radio-Frequency Identification) door lock system using Arduino Uno, aimed at enhancing security and access control in various environments. The system leverages RFID technology, allowing users to unlock doors with authorized RFID tags or cards. It incorporates a dual-step authorization process where users must first present a valid RFID tag, then enter a correct code on a keypad for additional security. The Arduino Uno controls the locking mechanism, for both servo or electromagnetic lock, based on authentication results. Visual and auditory indicators, like LEDs and buzzers, provide feedback on access status. The system offers real-time monitoring and control on access attempts, enabling administrators to maintain accountability and track activity. Its design is flexible and easily integrates into existing infrastructure, providing a robust solution for security and access control in homes, offices and other restricted areas. Overall, this RFID door lock system represents a robust and adaptable solution for secure access control.

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CHAPTER 1

INTRODUCTION

The RFID door lock system using Arduino Uno is designed to provide a modern solution to access control and security challenges. By utilizing RFID (Radio-Frequency Identification) technology, this system allows users to unlock doors with a simple scan of an authorized RFID tag or card. The addition of a dual-step authorization process, where users must also enter a unique code on a keypad, enhances security by adding an extra layer of authentication. The Arduino Uno microcontroller plays a central role, coordinating the RFID scanning, keypad input and operation of the locking mechanism—typically a servo or electromagnetic lock.

The system's versatility lies in its adaptability to various environments, from residential homes to offices and other restricted areas. With features like real-time monitoring and logging, it offers not just secure access control but also a way to track access attempts for greater accountability. Visual and audio indicators ensure users receive instant feedback on their access status, making this system both secure and user-friendly.

1.1 MOTIVATION

- Traditional locks can be compromised and keys can be lost or duplicated.
- The RFID door lock system offers a more secure method of access control, reducing the risk of unauthorized entry by requiring a unique RFID tag and an additional keypad code.
- Users can gain entry with a simple scan of their RFID tag, making access quicker and more convenient compared to traditional key-based systems. This offers convenient way of unlocking.
- Security these days may be a challenging task and for offering a easy and convenient way for resolving this problem, choosing an RFID sensor would be a better solution.

1.2 OBJECTIVES

- To design a quick sensing and response technique while scanning the tags to unlock.
- To provide a flawless and authorized flow of lock system by ensuring the trueness of the user’s identity.
- To provide scalable solution for access management in various environments.
- To create a robust and user-friendly access control solution.

CHAPTER 2

LITERATURE REVIEW

[1] RFID Security and Privacy (Li et al., 2022)[5] provides an in-depth analysis of security and privacy issues in RFID systems, addressing potential threats and countermeasures.

[2] RFID and Alert System Using Arduino (Avcu, 2021)[2] details the design and implementation of an RFID-based door lock system offering practical insights into Arduino-based access control systems and discusses alert mechanisms to enhance system responsiveness.

[3] RFID and the Internet of Things (Chabanne et al., 2013)[4] explains the role of RFID in the context of the Internet of Things (IoT), highlighting its potential to connect physical objects.

[4] RFID-Enabled Sensor Design and Applications (Rida et al., 2010)[6] describes the use of RFID technology in sensor design and its applications across different industries. It provides insights into integrating RFID with other sensing technologies to create innovative applications.

[5] Arduino Keyless Door Lock System With Keypad and LCD (Avcu, 2021)[3] illustrates the construction of a keyless door lock system using Arduino, integrating a keypad and LCD display. It offers a step-by-step guide, focusing on both the hardware and software aspects of the project.

2.1 EXISTING SYSTEM

The existing system uses provides secure access control by utilizing radio-frequency identification (RFID) scanner to scan the tags and authorize the users with the correct UID. This allows access to unlock further and proceed. It has a single level security implementing the one-way scanning of tags. If the tag's credentials match those in the system's database, the door lock is triggered to open, allowing access. If the tag is unauthorized, the door remains locked, ensuring security.

2.1.1 Advantages of the existing system

- Easy to implement and use
- Suitable for small area

2.1.2 Drawbacks of the existing system

- Lack of dual step security
- Vulnerability to tag’s ID cloning

2.2 PROPOSED SYSTEM

In the proposed system, an additional feature is introduced where an LED light is triggered to turn on immediately after the RFID door lock system grants access. Once a valid RFID tag is scanned, the next step it asks to enter valid pass key and only after that the door unlocks. Also a signal is sent to the LED, causing it to light up. This serves a dual purpose: Indicating to the user that the door is unlocked and providing illumination to enhance safety and visibility as they enter. This feature is especially useful in dark or low-light environments, like evening hours or underground parking areas, offering an extra layer of convenience and security.

2.2.1 Advantages of the proposed system

- Enhanced Security
- Dual-Step Authentication
- Increased Visibility Low-Light Conditions
- Reliable Cost
- Efficient Scalability
- Flexible to adopt

CHAPTER 3

SYSTEM DESIGN

3.1 DEVELOPMENT ENVIRONMENT

3.1.1 Hardware Requirements

- Arduino UNO
- RFID module
- RFID tags
- LCD screen and I2C module
- LED light
- Servo Motor
- Door lock
- Steel wire
- Keypad
- Jumper wires

Arduino UNO

The Arduino UNO is a versatile microcontroller board offering digital and analog input/output pins, USB connectivity and programmable with the Arduino IDE.

RFID Module

The RFID module consists of an RFID reader and antenna, designed to read RFID tags' unique identifiers within a certain range. It connects to the Arduino to facilitate scanning and verification of RFID tags.

RFID Tags

RFID tags contain a unique identifier that is read by the RFID module. They come in various forms, such as key fobs or cards and are used to authenticate and grant access in RFID-based systems.

LCD Screen and I2C Module

An LCD screen (commonly 16x2 or 20x4) displays text-based information to the user, such as access status or instructions. The I2C module allows for simpler connectivity with the Arduino, reducing the number of required connections.

LED

An LED (Light Emitting Diode) is a semiconductor device that emits light when an electric current passes through it. Known for their efficiency and versatility, LEDs are widely used in electronics for indicators, displays and illumination.

Servo Motor

A servo motor is a rotary actuator that allows precise control of angular position. It consists of a motor coupled with a sensor for feedback, ensuring accurate positioning. Servo motors are commonly used in robotics, automation and remote-control systems for their reliability and precise motion control.

Door Lock

The door lock is a mechanical device used to secure doors. It operates by

moving a metal bolt when activated, locking or unlocking the door based on the control signal from the Arduino through the servo motor.

Steel wire

Steel wire is a physical wire component that can be used to connect the servo motor with the door lock for facilitating the movement.

Keypad

A keypad is a set of buttons arranged in a matrix, typically used to enter numerical codes for authentication. In this system, it provides an additional security layer by allowing users to input a passkey for dual-step verification before unlocking the door.

Jumper Wires

Jumper wires are used to connect various electronic components to the Arduino, facilitating the creation of the circuit. They come in different lengths and genders (male-to-male, female-to-female and male-to-female) to ensure flexible and reliable connections.

3.1.2 SOFTWARE REQUIREMENTS

Arduino IDE

The Arduino Integrated Development Environment (IDE) is a software platform for programming Arduino microcontroller boards, offering a user-friendly interface to write, compile and upload code. With built-in examples and a vast library of community-contributed code, the IDE simplifies prototyping and development for projects.

CHAPTER 4
PROJECT DESCRIPTION

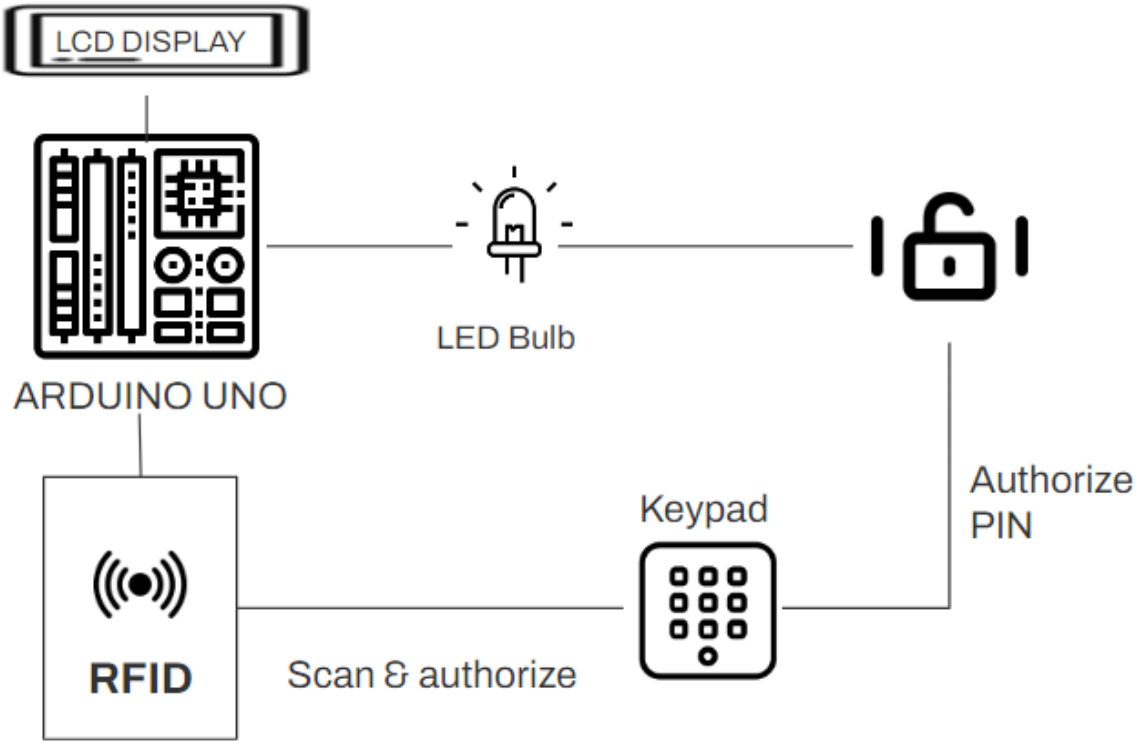
The RFID Door Lock System with Dual-Step Authorization is a security project built with Arduino Uno that integrates multiple components for enhanced access control. The core of the system is the Arduino Uno, a versatile microcontroller that coordinates inputs from various components and controls the door lock mechanism. The system uses an RFID module to scan RFID tags or cards, each containing a unique identifier. When a user presents a tag, the RFID module reads its unique ID and sends this data to the Arduino Uno.

The Arduino Uno checks the received RFID tag ID against a predefined list of authorized IDs stored in its memory. If the tag is authorized, the system moves to the next step, which requires the user to enter a correct passcode on a keypad. This dual-step authorization ensures that even if a tag is compromised, the correct passcode must also be known to unlock the door.

If the RFID tag is valid and the passcode entered on the keypad is correct, the Arduino Uno sends a signal to a LED bulb, which then triggers to light up and also signals the motor to rotate and open the door lock. This action unlocks the door, allowing access. Alongside this, the system activates an LED light to provide visual feedback, indicating that the door has been successfully unlocked.

This illumination is particularly useful in low-light or dark environments, providing safety and guidance to users. To keep users informed, the system employs an LCD screen with an I2C module to display relevant information, such as instructions for entering the passcode or notifications when access is granted or denied.

4.1 SYSTEM ARCHITECTURE



4.2 METHODOLOGY

The methodology for the RFID Door Lock System with Dual-Step Authorization involves several key steps. First, set up the Arduino Uno as the central control unit, connecting it to an RFID module to scan RFID tags, a keypad for passcode input and an LCD screen with an I2C module for displaying messages. When an RFID tag is presented, the system checks if the tag ID matches an authorized list stored in the Arduino. If valid, the system prompts for a passcode via the keypad. If the passcode is correct, the Arduino triggers the motor to unlock the door through the steel wire connection, allowing access. An LED light is also activated for visual feedback. This process ensures secure and controlled access with dual-step authorization.

CHAPTER 5

RESULTS AND DISCUSSION

The RFID Door Lock System with Dual-Step Authorization demonstrated effective security and access control through rigorous testing. The system reliably granted access only to users with both an authorized RFID tag and the correct keypad passcode, reducing the risk of unauthorized entry. The LED indicator provided clear visual feedback, confirming when the door was unlocked, enhancing safety in low-light conditions. The LCD screen with I2C module displayed relevant messages, aiding user interaction and minimizing confusion. While the dual-step process significantly improved security, it may require more time for user access, highlighting a trade-off between security and speed. Overall, the system achieved its goal of providing a secure and user-friendly solution for controlled access.

CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1 CONCLUSION

Using Radio Frequency Identification (RFID) technology to enable keyless entry, it offers significant advantages over traditional lock-and-key mechanisms. By using unique, encrypted RFID tags or cards, this system minimizes the risk of unauthorized access, as these tags are harder to duplicate or lose. The system's flexibility allows for easy scalability and customization. Therefore, this project offers an opportunity to explore advanced concepts in electronics, programming and IoT while delivering a robust and user-friendly security solution.

6.2 FUTURE WORK

A future enhancement could involve real-time notifications to users about lock and unlock events. By integrating the system with a mobile app or a messaging service, you can send instant alerts whenever the door is accessed. This feature adds an extra layer of security, allowing users to monitor their door's activity even when they are not on-site. If unauthorized access occurs, users can quickly take action, such as remotely locking the door or notifying security personnel. This advancement promotes greater awareness and control over the access system, contributing to a more secure environment.

APPENDIX

SOFTWARE INSTALLATION

Arduino IDE

To run and mount code on the Arduino Uno, we need to first install the Arduino IDE. After running the code successfully, mount it.

SAMPLE CODE

//scan.ino

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

#define RST_PIN 9
#define SS_PIN  10

MFRC522 mfrc522(SS_PIN, RST_PIN);

void setup() {
  Serial.begin(9600);
  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..."));
}

void loop() {
  if ( ! mfrc522.PICC_IsNewCardPresent()) {
    return;
  }
  if ( ! mfrc522.PICC_ReadCardSerial()) {
    return;
```

```
  }

  mfrc522.PICC_DumpToSerial(&(mfrc522.uid));
}
```

//doorlock.ino

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

#define SS_PIN 10
#define RST_PIN 9
#define buzzer 2
#define servoPin 3

String UID = "51 23 08 06";//Enter your card ID
byte lock = 0;

Servo servo;
LiquidCrystal_I2C lcd(0x27, 16, 2);
MFRC522 rfid(SS_PIN, RST_PIN);


void setup() {
  Serial.begin(9600);
  servo.write(70);
  lcd.init();
  lcd.backlight();
  servo.attach(servoPin);
  SPI.begin();
  rfid.PCD_Init();
  pinMode(buzzer, OUTPUT);
}

void loop() {
  lcd.setCursor(4, 0);
  lcd.print("Welcome!");
```

```
  lcd.setCursor(1, 1);
  lcd.print("Put your card");

  if ( ! rfid.PICC_IsNewCardPresent())
    return;
  if ( ! rfid.PICC_ReadCardSerial())
    return;

  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Scanning");
  Serial.print("NUID tag is :");
  String ID = "";

  for (byte i = 0; i < rfid.uid.size; i++) {
    lcd.print(".");
    ID.concat(String(rfid.uid.uidByte[i] < 0x10 ? " 0" : " "));
    ID.concat(String(rfid.uid.uidByte[i], HEX));
    delay(300);
  }

  ID.toUpperCase();

  if (ID.substring(1) == UID && lock == 0 ) {
    digitalWrite(buzzer, HIGH);
    delay(300);
    digitalWrite(buzzer, LOW);
    servo.write(50);
    delay(100);
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("Locked");
    delay(1500);
    lcd.clear();
    lock = 1;
  }

else if (ID.substring(1) == UID && lock == 1 ) {
    digitalWrite(buzzer, HIGH);
```

```
    delay(300);
    digitalWrite(buzzer, LOW);
    servo.write(110);
    delay(100);
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("Unlocked");
    delay(1500);
    lcd.clear();
    lock = 0;
  }

else {
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("Wrong card!");
    digitalWrite(buzzer, HIGH);
    delay(200);
    digitalWrite(buzzer, LOW);
    delay(200);
    digitalWrite(buzzer, HIGH);
    delay(200);
    digitalWrite(buzzer, LOW);
    delay(200);
    digitalWrite(buzzer, HIGH);
    delay(200);
    digitalWrite(buzzer, LOW);
    delay(200);
    delay(1500);
    lcd.clear();
  }
}
```

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