MINI PROJECT REPORT 2020

ON **RFID DOOR LOCK SYSTEM**

DECCAN COLLEGE OF ENGINEERING AND TECHNOLOGY

(AFFILIATED TO OSMANIA UNIVERSITY)

DAR-US-SALAM, HYDERABAD.

SUBMITTED BY:

MOHAMMED IMAD UDDIN (1603-18-735-087)

And

MOHAMMED HUSSAIN (1603-18-735-066)

Acknowledgment

I am thankful to Mr. Mohd. Abdul Nayeem, Head of Department of ECE, Deccan College of Engineering and Technology, Hyderabad for providing me permission and facilities to work in, without which this project would not have been possible.

I am also thankful to Mrs. Asma Iqbal, Professor of ECE Department, Deccan College of Engineering and Technology, Hyderabad for providing me the permission, facilities, and help to make this Mini Project successful.

I would also like to thank all the staff of Deccan College of Engineering and Technology, for being so helpful during this Project.

PREFACE

Every Student of Bachelor of Engineering in Electronics and Communication Engineering had to do a Mini Project. The purpose of this project is to let the students explore new opportunities and perform experiments with electronic components, apart from their regular classes to help them understand the concepts well.

This report may depict deficiencies on my part but still, it is an output of my sincere efforts.

The Output of my analysis is summarized in the shape of a project Report arranged sequentially in detail as per the contents.

Table of Content

Abstract

Wireless security-based applications have rapidly increased due to the dramatic improvement of modern technologies. Many access control systems were designed and/or implemented based on different types of wireless communication technologies by different people. Radio Frequency Identification (RFID) is a contactless technology that is widely used in several industries for tasks like access control system, book tracking in libraries, tollgate system, supply chain management, and so on. In this project, an automatic RFID-based access control system using Arduino was designed. The system combines RFID technology and Arduino to accomplish the required task. When the RFID reader installed at the entrance detects an RFID tag, the system captures the user unique identifier (UID) and compares it with the stored UID for a match. If the user UID captured matches with any of the stored UID, access is granted; otherwise, access is denied. The results clearly show that the system is cheap, effective, and a reliable means of granting or denying access in a secured environment.

Keywords

Arduino, RFID, Access Control, Arduino IDE, UID, Sensors

Introduction

Security systems play an important role to prevent unauthorized personnel entry into a secured environment, which may include physical and intellectual property. Various door locks such as mechanical locks or electrical locks were designed to attain basic security requirements. These locks can be easily hacked by unwanted people thereby allowing unauthorized personnel into secured premises.

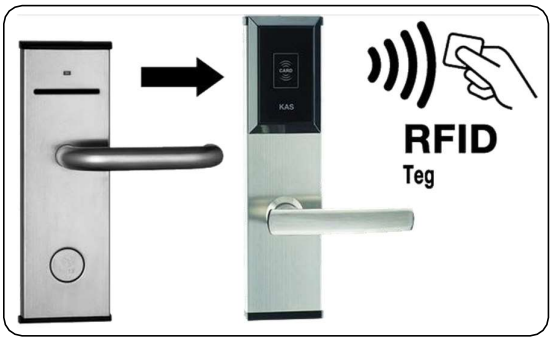

Figure 1: RFID Based Door Lock System

The automatic access control system has become necessary to overcome the security threats faced by many organizations in Nigeria. By installing the system at the entrance will only allow the authorized personnel to enter the organization. The system is not restricted to the main entrance installation but can be installed at various entrances within the organization to track personnel movement thereby restricting their access to areas where they are not authorized.

There are several automatic access control technologies including barcode, magnetic stripe, and Radio Frequency Identification (RFID) applied in the security system. Radio-Frequency Identification (RFID) is an emerging technology and one of the most rapidly growing segments of today's access control. RFID technology offers superior performance over other automatic identification systems and is used in many areas such as public transport, ticketing, animal identification, electronic immobilization, industrial automation, access control, asset tracking, people tracking, inventory detection, and many more.

Figure 1 shows two different ways the access control system can be accomplished. Use of keys which is an old method and by use of RFID technology. This paper discusses the design of an automatic access control system using the Arduino microcontroller and RFID system. The aim is granting access to authorized personnel and denying access to unauthorized personnel by using RFID technology instead of keys as shown in figure 1. Each person is issued an authorized tag, which can be used for swiping in front of the RFID reader to have access to a secured environment.

Methodology

In this proposed work, the RFID reader reads the data from the tag and sends the card UID number to the Arduino microcontroller for comparison, if the card is valid then the Arduino microcontroller display access granted else, access denied on the screen.

Hardware Overview

1. **RFID Technology -** 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, book tracking in libraries, tollgate systems, and so on.

   An RFID system consists of two main components, a tag that is located on the RFID card one wants to be identified, and a transceiver or a reader that is installed at the secured entrance.

Our system RFID reader consists of a radio frequency module, a control unit, and an antenna coil which generates a high-frequency electromagnetic field as shown in figure 2. On the other hand, the tag used in this work is a passive component, which consists of just an antenna and an electronic microchip, so when it gets near the electromagnetic field of the transceiver installed at the secured entrance (2 to 5 inches), due to induction, a voltage is generated in the tags' antenna coil and this voltage serves as power for the microchip of our system tag.

Now as the tag is powered, it can extract the transmitted message from the reader, and for sending a message (UID) back to the reader, it uses a technique called load manipulation. Switching on and off a load at the antenna of our tag will affect the power consumption of the reader's antenna which can be measured as voltage drop. These changes in the voltage will be captured as ones and zeros and that's the way the data is transferred from the tag to the reader.

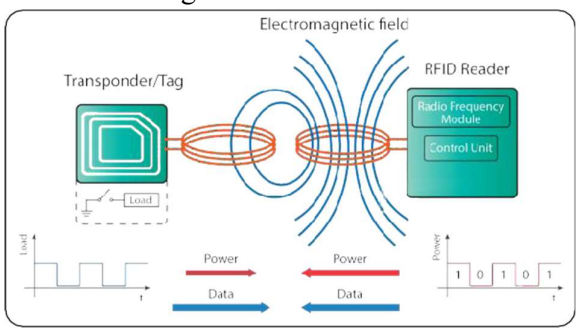

Figure 2: RFID Working Principles

How the reader reads the tag

We have one RFID tag with UID (69 90 E2 B9) and for the RFID reader to get such information from the tag it needs to be converted from hexadecimal value to binary as shown in the table below.

Table 1: UID - 69 90 E2 B9 Conversion

Hexadecimal value	Binary value
6	0110
9	1001
9	1001
0	0000
E	1110
2	0010
B	1011
9	1001

32 bits worth of data is transferred from the tag to the reader in binary form (0110 1001 1001 0000 1110 0010 1011 1001). This data is transferred using high frequency (HF) 13.56MHz, which is the frequency that our RFID system operates on.

2. **Arduino Uno Board -** The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM (pulse width modulation) outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB (universal serial box) connection, a power jack, an ICSP (in-circuit serial programming) header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

Figure 3: Arduino Uno Board

The Arduino UNO board in figure 3 can be toyed with without been concerned about doing something wrong with the board, in the worst-case scenario the chip can be replaced with a new and cheap one and start over again.

Software Overview

1. **Arduino IDE –** The IDE (Integrated Development Environment) is a special program running on a computer that allows one to write sketches for the Arduino board in a simple language modeled after the Processing language.

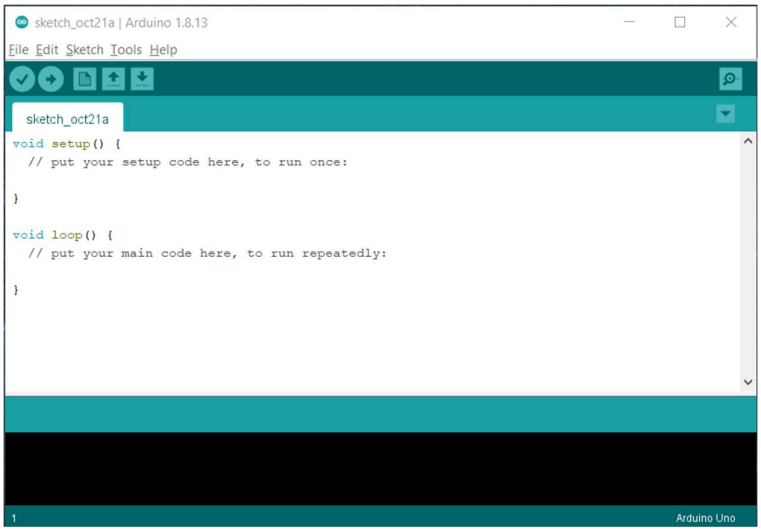

Figure 4: Arduino IDE

To program the Arduino microcontroller Arduino coding language was used. The Arduino language is based on C/C++ and the most basic executable program only needs two functions as shown in figure 4, a setup(), and a loop(), to run. In the setup() function variables, pin modes, serial communication, etc. are initialized. This function only runs once. The loop() function is where one writes the actual code. As the name implies, the loop() function loops continuously until the device is powered off. Simple as it may sound; it is possible to write complex programs using the above-described structure

Working of the System

Before we start our automatic access control system using Arduino and RFID project, let's take a look at the system block diagram and the flow chart of the project.

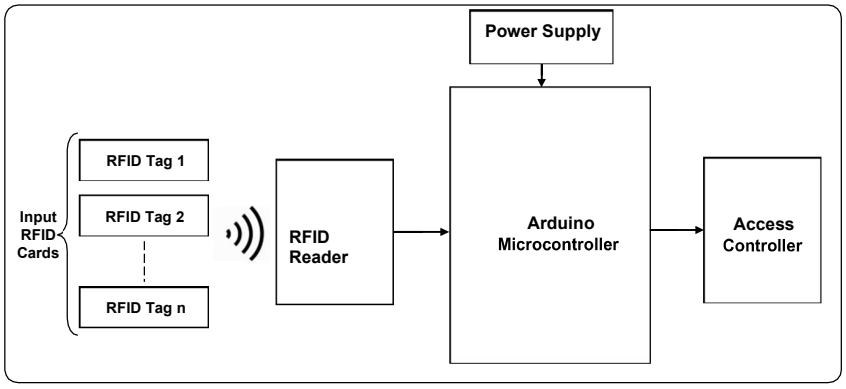

Figure 5: System Block Diagram

Figure 5 shows the access control system block diagram using Arduino and RFID. The system has three separate parts, an RFID reader, a microcontroller, and an access controller. The RFID reader reads the RFID tags and the microcontroller accepts the data from the reader process and uses the result to either grant or deny access to the user using the access controller. The project can be enhanced by connecting an LCD to display if access is granted or denied instead of a serial monitor.

Control Flow

All necessary information about all users is stored in the system. In other to add a new user, we must first register the user with the system then, corresponding user information is burned in an RFID tag. The new tag will now be accessible through the system

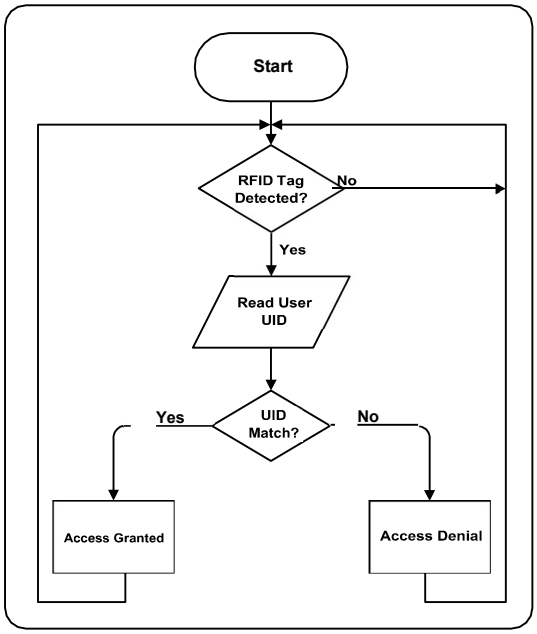

Figure 6: Control Flow Diagram

When a user comes to the entry point where the RFID reader is installed and places the RFID tag close (contactless) to the reader, the system checks whether it is a registered user or not. If the user is registered, the tag information is matched with the user information stored in the system as shown in figure 6. Access is granted to such users while access is denied to unauthorized users see figure 6.

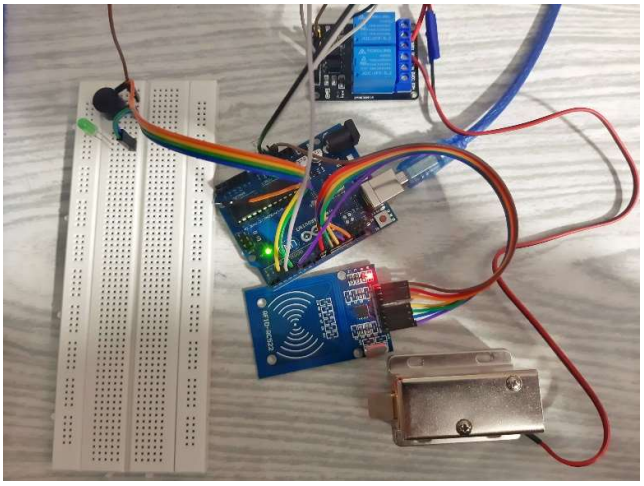

Figure 7: Automatic Access Control prototype using Arduino and RFID

In figure 7, when the RFID tag is placed close to the RFID reader, access is granted or denied. The right tag stored on the microcontroller grants accesses to the secure environment while the wrong tag not stored on the microcontroller will deny access to the cardholder. Access granted or denied is displayed on the serial monitor as shown in figure 9.

Table 2: Connection of the RFID Reader with Arduino Microcontroller

RFID Module	Arduino
SDA	Digital Pin 5
SCK	Digital Pin 13
MOSI	Digital Pin 11
MISO	Digital Pin 12
IRQ	No Connection
GND	GND
RST	Digital Pin 9
3.3V	3.3v

Table 2 shows how the Arduino is interfaced with the RFID reader. Also, note that 3.3v of the RFID module must be connected to 3.3v on the Arduino board, not 5v. With the above connections, the Arduino is ready to take commands and execute accordingly.

Programming the Arduino Board

The Arduino board was programmed through Arduino IDE and this paper captured the necessary code. The loop() starts with a few lines of code that are looking for input, if there is no user input the device will do nothing but wait.

```
#include <SPI.h>
#include <MFRC522.h>
 #define SS_PIN 5
#define RST_PIN 9
#define RELAY 3
#define BUZZER 2
#define LED 8
#define ACCESS_DELAY 10000
#define DENIED_DELAY 500
MFRC522 mfrc522(SS_PIN, RST_PIN);
void setup()
{
  Serial.begin(9600);
  SPI.begin();
  mfrc522.PCD_Init();
  pinMode(RELAY, OUTPUT);
  pinMode(LED, OUTPUT);
  pinMode(BUZZER, OUTPUT);
  noTone(BUZZER);
  digitalWrite(RELAY, HIGH);
  Serial.println("Please Scan Your Key");
  Serial.println();

}
```

```
void loop()
{

  if ( ! mfrc522.PICC_IsNewCardPresent())
  {
    return;
  }

  if ( ! mfrc522.PICC_ReadCardSerial())
  {
    return;
  }
Serial.print("UID tag :");
  String content= "";
  byte letter;
  for (byte i = 0; i < mfrc522.uid.size; i++)
  {
     Serial.print(mfrc522.uid.uidByte[i] < 0x10 ? " 0" : " ");
     Serial.print(mfrc522.uid.uidByte[i], HEX);
     content.concat(String(mfrc522.uid.uidByte[i] < 0x10 ? " 0" : " "));
     content.concat(String(mfrc522.uid.uidByte[i], HEX));
  }
  Serial.println();
  Serial.print("Message : ");
  content.toUpperCase();
  if (content.substring(1) == "69 90 E2 B9")
  {
    Serial.println("Access Authorized");
    Serial.println("Welcome");
    Serial.println();
    delay(500);
    digitalWrite(RELAY, LOW);
    digitalWrite(LED, HIGH);
    tone(BUZZER, 3000,200);
    delay(ACCESS_DELAY);
    digitalWrite(RELAY, HIGH);
    digitalWrite(LED, LOW);
    noTone(BUZZER);
    digitalWrite(LED, LOW);
  }

 else   {
    Serial.println(" Access denied");
    tone(BUZZER, 300);
    delay(DENIED_DELAY);
    noTone(BUZZER);
    delay(DENIED_DELAY);
    tone(BUZZER, 300);
    delay(DENIED_DELAY);
```

```
    noTone(BUZZER);
    delay(DENIED_DELAY);
    tone(BUZZER, 300);
    delay(DENIED_DELAY);
    noTone(BUZZER);
    delay(DENIED_DELAY);
    tone(BUZZER, 300);
    delay(DENIED_DELAY);
    noTone(BUZZER);

  }
}
```

Once the program sees the correct combination of tag UID it will grant access to the user. While access will be denied to incorrect tag UID or tags that are not stored in the system. Tag UID can be added or remove by admin through the IDE and re-uploaded back to the Arduino board for effective operation.

Result

The project has the following workflow: on arriving at the door where the access control is installed, one is asked to approximate their RFID tag to the reader as shown on the output window (see figure 9). The reader reads the tag and the microcontroller compares the tag's UID for match and grant access if there is a match and deny access if there is no match.

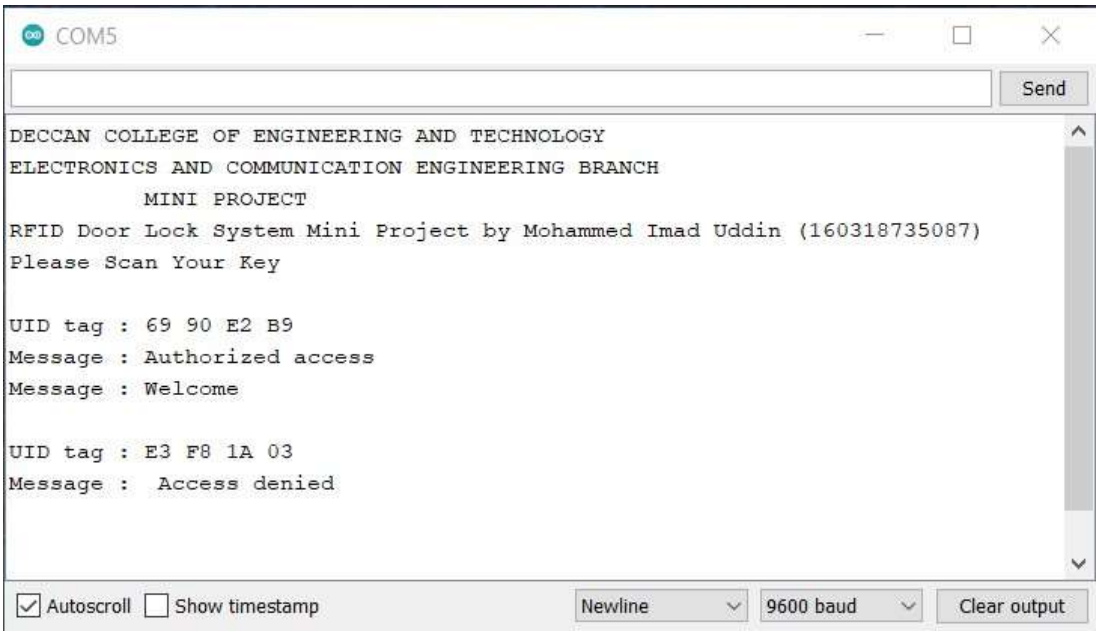

Figure 9: Output through the serial monitor

An RFID tag can be added or removed through the Arduino IDE or any other programming language that Arduino understands. For changes made on the sketch (i.e. adding or removing a tag) to be effective on our system, the sketch must be re-uploaded to the Arduino board to override the previous sketch.

Demo Video link : https://youtu.be/aVERvM1YZ3U

Access Control System Analysis

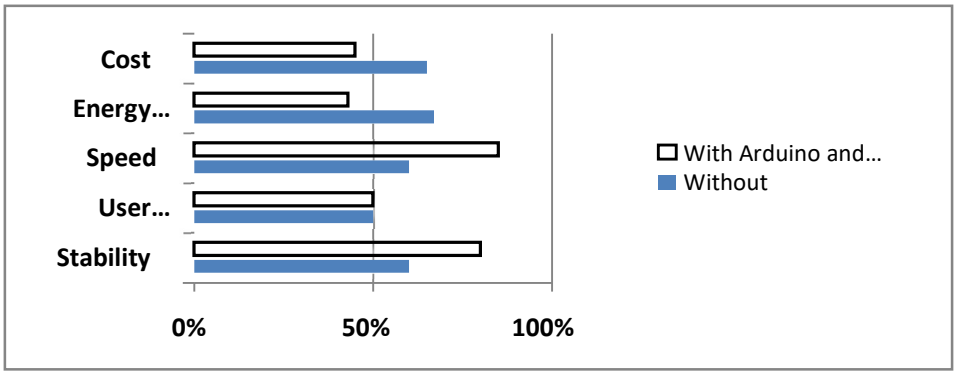

Figure 10: Access Control System with Arduino and RFID and without

An access control system was analyzed using the following criteria: cost, energy consumption, speed, user satisfaction, and stability. The bar chart (figure 10) shows that there are significant enhancements in the access control system using Arduino and RFID technology. The enhancements come in the area of cost, energy consumption, speed, and stability. Other access control systems have a high energy consumption rate which is a great problem in Nigeria where energy is very expensive, while the users of the system have equal satisfaction in both systems.

Conclusion

In this paper, a prototype of an automatic access control system for use in an environment is presented. The system uses radio frequency identification (RFID) with Arduino technology to differentiate between authorized and unauthorized users. The RFID reader reads the RFID tag issued to the user and matches it with the stored UID on the Microcontroller. On a successful match, the microcontroller grants access or deny access if no match was found. An automatic access control system using Arduino and RFID has been prototyped and functioned as desired. The system can be installed at the entrance of a secured environment to prevent unauthorized individual access to the environment.

References

[1]. Tarun Agarwal, (2015), "RFID based Automatic Door Lock System with Arduino", Retrieved 19 October 2017, from https://www.elprocus.com/automatic-door-lock-system-using-rfid-and-arduino/.

[2]. Ramalatha, M., Ramkumar, A. K., Selvaraj, S. and Suriyakanth, S, (2014), "RFID Based Personal Medical Data card for Toll Automation". Elysium Journal of Engineering Research and Management. Volume1, ISSN: 2347-4408, pp 51-52.