RFID LOCK USING ARDUINO

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ABSTRACT

The Near Field Communication Radio Frequency Identification Lock using Arduino is an IoT-based system designed to provide secure access control to a specific area using Near Field Communication (NFC) and Radio Frequency Identification (RFID) technologies. The system consists of an Arduino board, an NFC reader module, an RFID reader module, and a servo motor. The NFC reader is used to communicate with smartphones that have NFC capabilities, while the RFID reader is used to identify authorized RFID tags or cards. Once an authorized device or tag is detected, the servo motor unlocks the door, allowing access to the designated area. The system is also connected to the internet through Wi-Fi, enabling remote monitoring and control of the lock. The project showcases the potential of the Arduino platform in developing innovative IoT applications and highlights the importance of secure access control in modern-day security systems.

INTRODUCTION

Radio Frequency Identification (RFID) technology is gaining popularity for its versatility in a wide range of applications. RFID door lock systems are one of the most common applications of this technology, providing reliable, contactless access control with trackable data. In this paper, we explore the benefits of RFID door lock systems for commercial security deployments, highlighting how they offer more security, convenience, and cost-effectiveness compared to traditional locks and keys.

Overview

RFID Technology and Access Control

An RFID door lock system consists of RFID tags, antennas, an RFID reader, and a transceiver, all of which work together to create a complete system. The user's credential (usually a keycard or fob with an RFID chip) contains unique identifying information called a tag. When the user comes within proximity of an RFID reader, the reader's signal locates the information stored on the user's RFID tag and sends it through antennas and transceivers to authorize the tag in the access control system. Once read, the system will either accept or deny the request to unlock the door. Data from an RFID-enabled system is automatically stored, making it possible to track entry activity in an access control system.

Objectives of RFID Door Lock Systems

Contactless Entry Experience

One of the most notable advantages of RFID door lock systems is the frictionless entering experience. RFID technology, unlike traditional locks and keys, employs radio frequency to send and receive data, eliminating the need to swipe a card or enter a key. This touchless entering experience is growing more popular as it eliminates a common touch point and provides greater convenience for consumers. Using an RFID door lock for company can actually improve the employee experience while also making the building safer and more efficient.

Easy to Configure

Compared to generating new keys and retooling locks, configuring an RFID entry system is essentially a digital process, making changes and adjustments considerably simpler. On a cloud-based system, you can remotely configure settings like unlock time, proximity, and permissions, and they'll take immediate effect in your system. Further streamlining the maintenance procedure, cloud systems can support quick software updates that launch instantly as soon as they are ready.

More Secure

Modern key cards and fob credentials use RFID tags that are heavily encrypted, enhancing system security. DESFire EV2 128-bit AES cryptographic cards are fitted with digitally signed identifiers that make

it incredibly difficult to copy cards and help prevent criminals from intercepting signals and skimming data. This makes them much more secure than swipe cards and older types of RFID cards, which are simple to copy and clone. RFID door lock systems are a great option for organizations wishing to safeguard their assets and equipment because of the increased protection they provide.

Increased Awareness

Data is automatically read and stored on RFID devices, making RFID door entry systems a powerful analytics tool for any business. The technology is an important asset when it comes to logging activity, as the system can record every time the RFID reader communicates with a tag. For example, an RFID access control system will track each user's authorized entry as well as failed unlock attempts, giving admins a clear picture of who entered the facility, which door they used, and when the entry event occurred. This data can be used to audit security issues and streamline operations across any size organization.

Low-Maintenance Cost

RFID door entry systems are an extremely effective analytics tool for any business because data is automatically read and stored on RFID chips. As the system can record each time the RFID reader contacts with a tag, the technology is a valuable asset for activity logging. A clear image of who entered the facility, which door they used, and when the entrance event occurred is provided to admins by an RFID access control system, for instance, which tracks each user's allowed admission as well as unsuccessful unlock attempts. Any size firm can use this data to audit security concerns and streamline processes.

LITERATURE SURVEY :

The use of Arduino to construct RFID lock systems is explored in these 4 papers. It gives a summary of the current applications, approaches, and research in this area. RFID locks with Arduino are well-liked because they are inexpensive, flexible, and simple to integrate. In order to understand the present state of RFID lock systems using Arduino, including hardware, software, security, and potential future research, this survey studies pertinent literature. For researchers and programmers interested in RFID lock systems integrated with Arduino, it is a useful resource.

This survey focuses on RFID lock systems, which have gained significant attention due to their convenience and security features. RFID locks utilize Radio Frequency Identification technology to enable access control through the use of RFID tags or cards. The survey aims to provide a comprehensive overview of existing research and developments in RFID lock systems, covering topics such as system architecture, authentication mechanisms, integration with other technologies, and security considerations. By analyzing the literature, this survey offers valuable insights into the advancements, challenges, and potential future directions in the field of RFID lock systems, catering to researchers, practitioners, and individuals interested in implementing or enhancing such systems.

MOTIVATION:

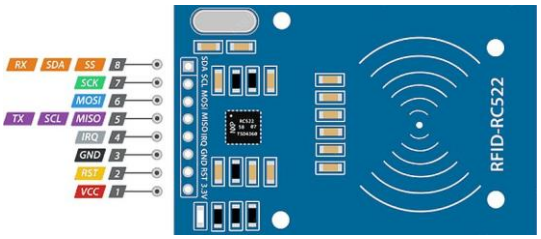
RFID (Radio Frequency Identification) technology has become increasingly popular in recent years due to its ability to provide secure and convenient access control solutions.

By undertaking a project to develop an RFID lock, to get the opportunity to learn about the technology behind RFID, including the communication protocols, circuit design, and software development. This project can also help to develop valuable skills in project management, problem-solving, and teamwork.

Furthermore, an RFID lock project has practical applications and can be useful for future projects or career opportunities. It can also demonstrate student's abilities to potential employers or graduate schools.

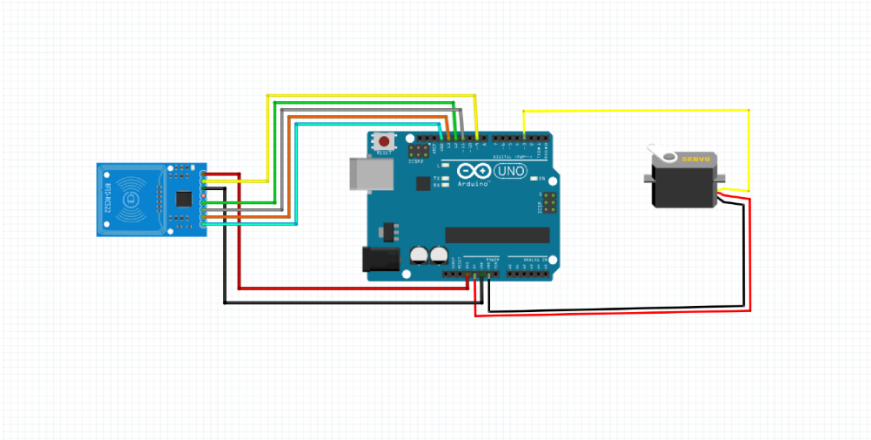
Overall, developing an RFID lock for a college project can be a challenging and rewarding experience that can help to gain knowledge and skills that can be applied in various fields and settings.

PIN DIAGRAM :

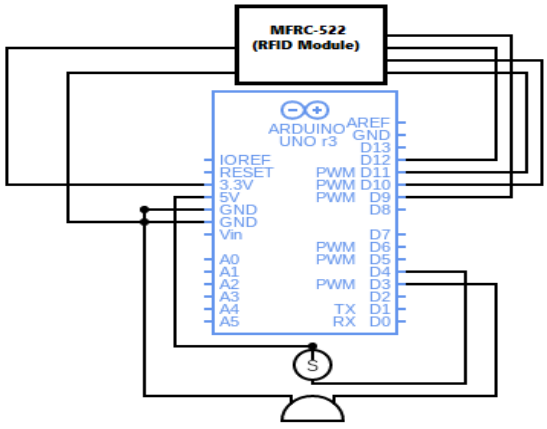


Pin Diagram of Module : RFID-RC522

BLOCK DIAGRAM :



CIRCUIT DIAGRAM:



SOFTWARE USED : Arduino IDE

HARDWARE SPECIFICATIONS:

1. RFID Senosr RC 522
2. Servo motor SG-90
3. Arduino UNO
4. I2C Module
5. LCD Display(16x2)

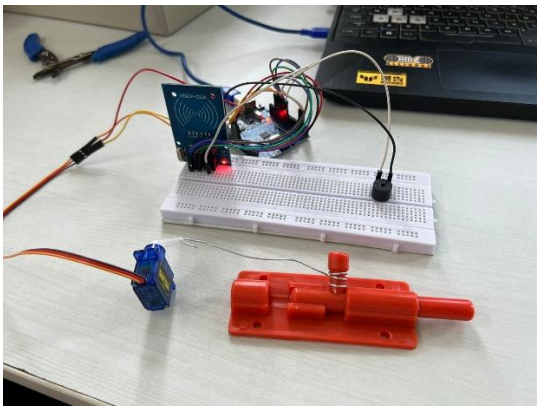
Code

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

#define SS_PIN 10
#define RST_PIN 9
#define LED_G 5                   //define green LED pin
#define LED_R 4                   //define red LED
#define BUZZER 2                  //buzzer pin
MFRC522 mfrc522(SS_PIN, RST_PIN);  // Create MFRC522 instance.
Servo myServo;                    //define servo name

void setup() {
  Serial.begin(9600);  // Initiate a serial communication
  SPI.begin();         // Initiate  SPI bus
  mfrc522.PCD_Init();  // Initiate MFRC522
  myServo.attach(3);   //servo pin
  myServo.write(0);    //servo start position
  pinMode(LED_G, OUTPUT);
  pinMode(LED_R, OUTPUT);
  pinMode(BUZZER, OUTPUT);
  noTone(BUZZER);
  Serial.println("Put your card to the reader...");
  Serial.println();
}
void loop() {
  // Look for new cards
  if (!mfrc522.PICC_IsNewCardPresent()) {
    return;
  }
  // Select one of the cards
  if (!mfrc522.PICC_ReadCardSerial()) {
    return;
  }
  //Show UID on serial monitor
  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) == "4A 50 20 B0")  //change here the UID of the card/cards that you want to give access
  {
    Serial.println("Authorized access");
    Serial.println();
    delay(500);
    digitalWrite(LED_G, HIGH);
    tone(BUZZER, 500);
    delay(300);
    noTone(BUZZER);
    myServo.write(180);
    delay(5000);
    myServo.write(0);
    digitalWrite(LED_G, LOW);
  }

  else {
    Serial.println(" Access denied");
    digitalWrite(LED_R, HIGH);
    tone(BUZZER, 300);
    delay(1000);
    digitalWrite(LED_R, LOW);
    noTone(BUZZER);
  }
}
```

OUTPUT:

Initial Setup :

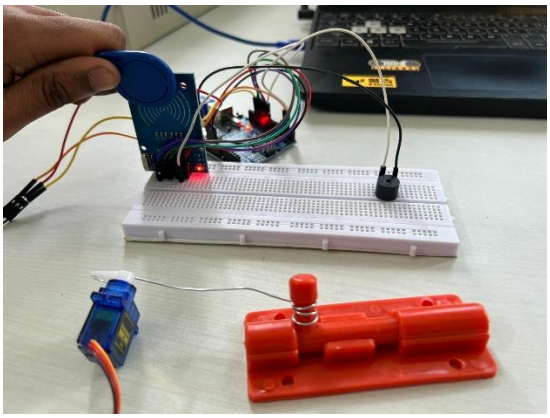
The RFID Lock system is connected to the Laptop(as a power source) in the initial.



Access Authorized :

When the RFID Module is tapped with a NFC tag it opens the Lock as the UID(Unique Identification) Value is registered in the Arduino Uno.

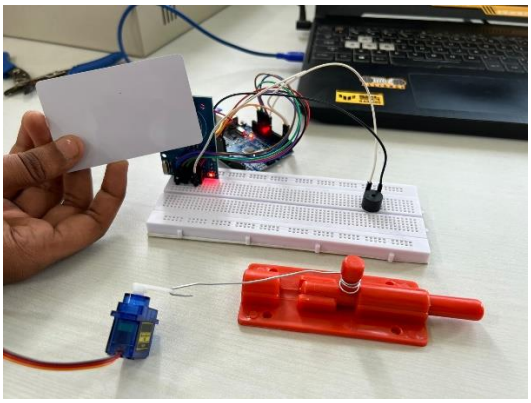
And prints " Authorized Access" as given below.



```
UID tag : 4A 50 20 B0
Message : Authorized access
```

Access Denied :

When the RFID Module is tapped with a NFC card it does not open the Lock as the UID(Unique Identification) Value is not registered in the Arduino Uno code.
And prints “Access Denied”.



```
UID tag : 03 62 CB A9
Message :  Access denied
```

APPLICATIONS

1. **Access Control:** RFID locks are commonly used for access control in buildings, offices, hotels, and residential complexes. Instead of traditional key-based locks, RFID locks use RFID cards or key fobs to grant access to authorized individuals. This offers convenience, enhanced security, and the ability to track access activities.

2. **Automotive Industry:** RFID locks can be utilized in vehicles for keyless entry and ignition systems. With an RFID-enabled key fob, the vehicle can be unlocked and started without physically inserting a key. This technology offers convenience and enhances the security of the vehicle.

3. **Asset Tracking:** RFID locks can be used for tracking and securing valuable assets in industries such as logistics, warehousing, and healthcare. Assets, such as containers, pallets, or medical equipment, can be fitted with RFID tags. These tags are read by RFID locks placed at entry or exit points, allowing real-time tracking and monitoring of the assets.

4. **Cabinets and Lockers:** RFID locks can be installed in cabinets, lockers, or storage units to provide secure access control. This is commonly seen in gyms, workplaces, educational institutions, and libraries, where individuals can use their RFID cards or key fobs to unlock and access their assigned lockers or storage spaces.

5. **Supply Chain and Inventory Management:** RFID locks can be used in warehouses and distribution centers to track inventory movement. By placing RFID locks at various checkpoints, it becomes possible to monitor the movement of goods, improve inventory accuracy, and enhance supply chain efficiency.

6. **Data Center Security:** RFID locks are employed to secure access to data centers, server rooms, or IT equipment. Authorized personnel can use RFID cards or badges to gain entry into restricted areas, ensuring only authorized individuals have physical access to critical infrastructure.

INFERENCE

It can be inferred that RFID lock systems using Arduino are becoming increasingly popular for secure access control applications. These systems typically use an RFID reader to identify authorized users and a servo motor to lock or unlock the door. The Arduino board is used to control the operation of the system, and Wi-Fi connectivity is often included for remote monitoring and control.

The implementation of RFID lock systems using Arduino is relatively simple and cost-effective, making it an attractive option for a variety of applications. These systems can be customized to meet specific requirements, and the modular nature of the Arduino platform makes it easy to add additional features or functionality as needed.

Overall, the literature suggests that RFID lock systems using Arduino are a promising solution for secure access control in various settings, including homes, offices, and industrial facilities. With further research and development, these systems are likely to become even more sophisticated and versatile in the future.

CONCLUSION

In this study, a passive RFID-enabled door lock system is used as part of a digital security system. For controlling and transactional processes, a centralized system is being used. The door locking system works in real time because the door opens as soon as the tag comes into contact with the reader, and the check-in information is recorded in the central server together with the user's basic information. RFID technology is employed to offer a solution for user tracking and secure entry to an area.

FUTURE STEPS

Integration with cloud-based services: Adding cloud connectivity to the RFID lock system using Arduino can enable users to remotely monitor and control the lock system from anywhere in the world. This can be accomplished by integrating the system with cloud-based services such as AWS IoT, Google Cloud IoT, or Microsoft Azure IoT.

Biometric authentication: Incorporating biometric authentication technologies, such as fingerprint or facial recognition, into the RFID lock system can enhance security and reduce the risk of unauthorized access.

Battery backup: Providing a battery backup to the RFID lock system can ensure that the system remains functional during power outages or other disruptions.

Real-time alerts: Adding real-time alert functionality to the RFID lock system can enable users to receive notifications when the door is locked or unlocked, or when an unauthorized access attempt is detected.

Multi-factor authentication: Incorporating multiple layers of authentication, such as RFID and password or PIN, can increase the security of the RFID lock system and reduce the risk of unauthorized access.

Integration with other IoT devices: Integrating the RFID lock system with other IoT devices, such as cameras, sensors, or alarms, can provide a more comprehensive security solution for homes, offices, or industrial facilities.

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[4] X. Zhang, V. Lakafosis, A. Traille and M. M. Tentzeris, "Performance analysis of "fast-moving" RFID tags in state-of-the-art high-speed railway systems," 2010 IEEE International Conference on RFID-Technology and Applications, Guangzhou, China, 2010, pp. 281-285, doi: 10.1109/RFID-TA.2010.5529918.

Websites:

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2. IEEE website: https://ieeexplore.ieee.org/Xplore/home.jsp