

RFID SMART DOOR LOCK

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INTRODUCTION

The project that we will be working on is an RFID door lock that will be available to the general public at an affordable price. The goal of this project is to create a more convenient way to unlock your door than the traditional key. In the key's place is an RFID tag that will unlock the door by proximity. However, the improvements of this RFID door lock must outweigh the complications of implementation. The list of customer needs (in the Requirements and Specifications section) was constructed with that fundamental goal in mind. The design consists of two components. The first component is the actual door lock that must be installed in the doorframe. This will be controlled by a magnetic lock and will need to be powered. The second component is a relatively small module that you can install anywhere near the door. This module is responsible for the RFID sensing.

Next we go over the requirements and specifications determined for the RFID door lock. The requirements are inspired by surveys of various groups as well as personal interest. The specifications are designed in order to meet these requirements. These are created before the actual design of the RFID door lock had been created so the requirements and specifications may not exactly meet the final product. However, the final product is still designed with these ideas in mind. At last the design of the final product is shown and explained. This also documents the tests and complications confronted throughout the design. The design is split into several modules which were tackled individually until finally bringing the whole product together. The necessity of each module is included.

PROBLEM STATEMENT

Inefficient Access Control: Traditional door lock systems, reliant on keys or codes, pose security risks and inconvenience due to lost or stolen keys, and the need for frequent code changes. Additionally, manual tracking of access activity lacks accuracy and real-time monitoring capabilities, leading to potential security breaches and unauthorized access. There is a pressing need for a modern access control solution that enhances security, streamlines access management, and provides real-time monitoring and auditing capabilities, thereby mitigating security risks and improving operational efficiency. Instances of lost keys, forgotten access codes, or employee turnover can disrupt daily operations and compromise security protocols. Time-consuming processes for rekeying locks, reprogramming access codes, or issuing new credentials contribute to productivity losses and operational disruptions.



ABSTRACT

The RFID Door Lock is a lock that is simple to install and allows the user to easily lock and unlock doors. It will contain a RFID reader/writer and a magnetic door lock for simple use. All the user will need an RFID tag to be able to unlock and lock the door. The components included in the module are small and compact. Additionally, the door lock is simple and easy to install. It does not require the consumer to disassemble the door or doorframe as the door lock is merely attachment. This also leaves the consumer with the option of using their original lock and key if they so choose. All in all, this RFID door lock should be a simple and cost-effective upgrade to the average consumer's security and convenience.



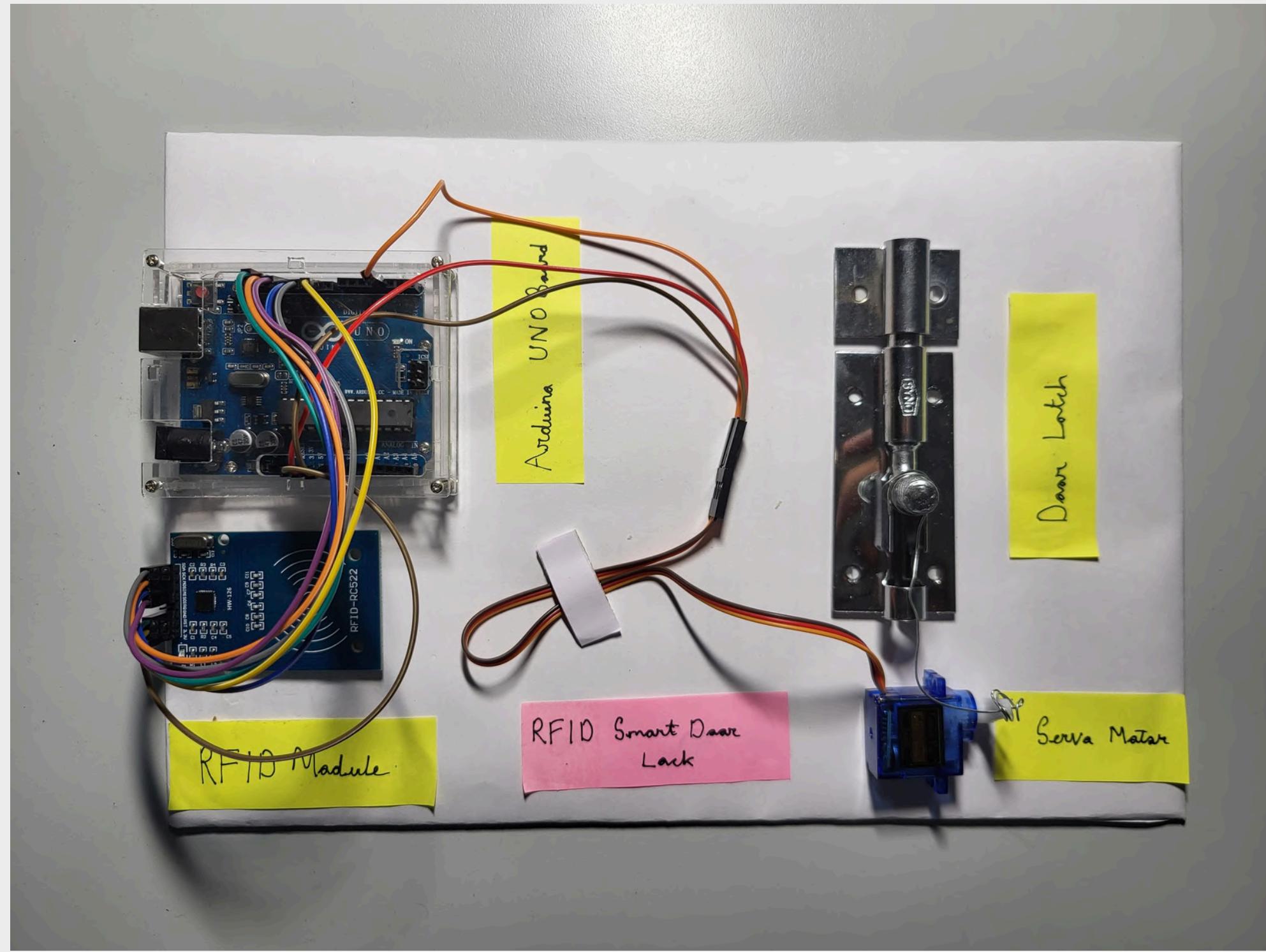
REAL TIME APPLICATIONS

RFID door lock systems find real-time applications across various industries and settings, offering enhanced security, convenience, and efficiency. Here are some real-time applications:

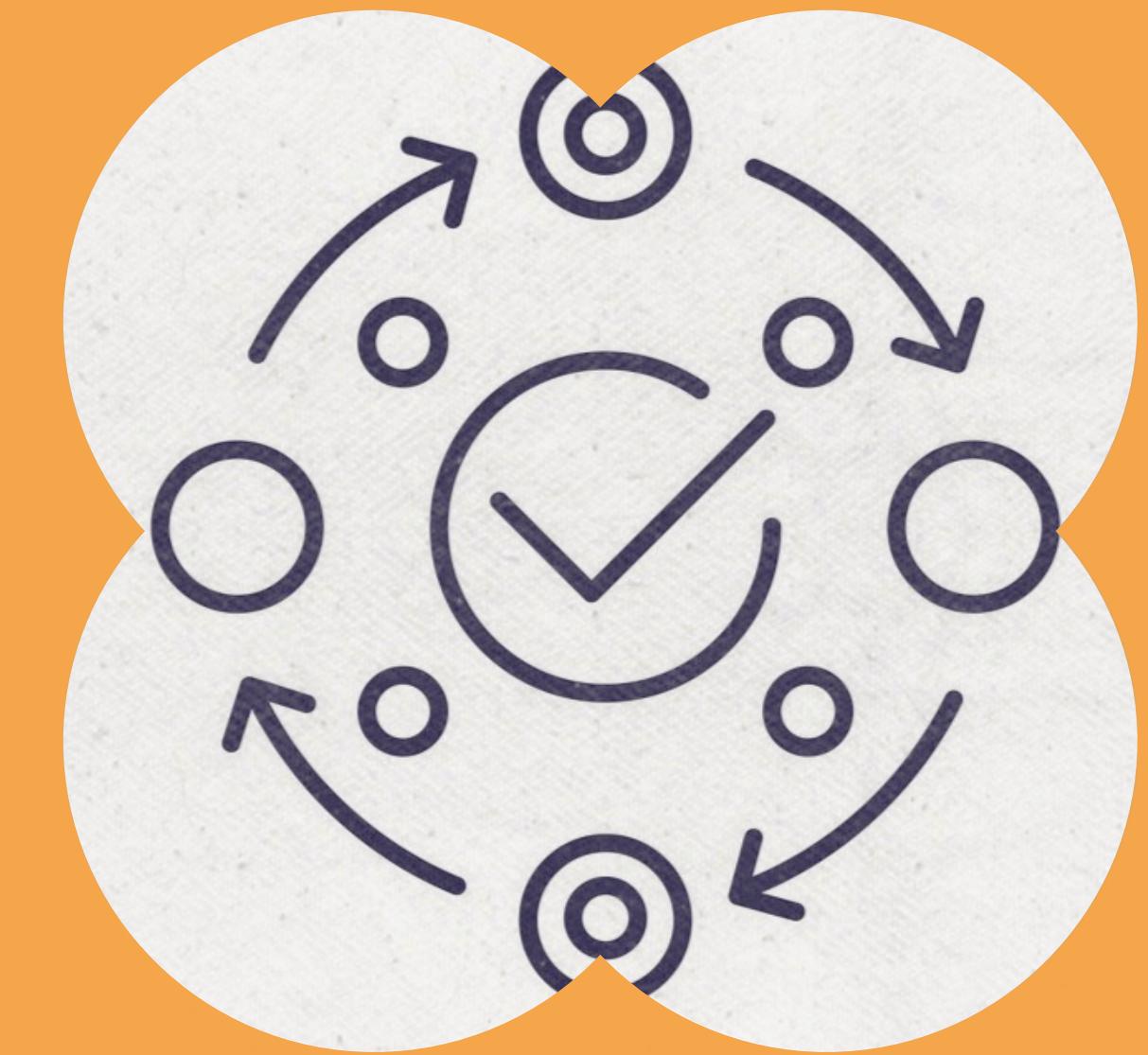
- Commercial Buildings and Offices: RFID door lock systems are extensively used in commercial buildings and offices for secure access control. Employees can use RFID cards or key fobs to gain entry, ensuring only authorized personnel can access restricted areas. Real-time monitoring allows administrators to track employee movement and manage access permissions effectively.

- **Residential Properties:** In residential settings, RFID door lock systems provide homeowners with convenient and secure access control. Residents can use RFID cards or key fobs to unlock doors, eliminating the need for traditional keys. Real-time monitoring capabilities enable homeowners to track entry and exit activity, enhancing security and peace of mind.
- **Hotels and Hospitality:** RFID door lock systems are widely used in hotels and hospitality establishments to provide guests with secure and convenient access to their rooms. Guests can use RFID key cards to unlock doors during their stay, while hotel staff can remotely monitor access activity and manage room assignments in real-time.
- **Healthcare Facilities:** In healthcare settings, RFID door lock systems help ensure secure access to sensitive areas such as patient rooms, supply rooms, and medication storage areas. Healthcare professionals can use RFID badges or key fobs to access authorized areas, while administrators can monitor access activity to ensure compliance with security protocols.

WORKING MODEL



METHODOLOGY



PRINCIPLE

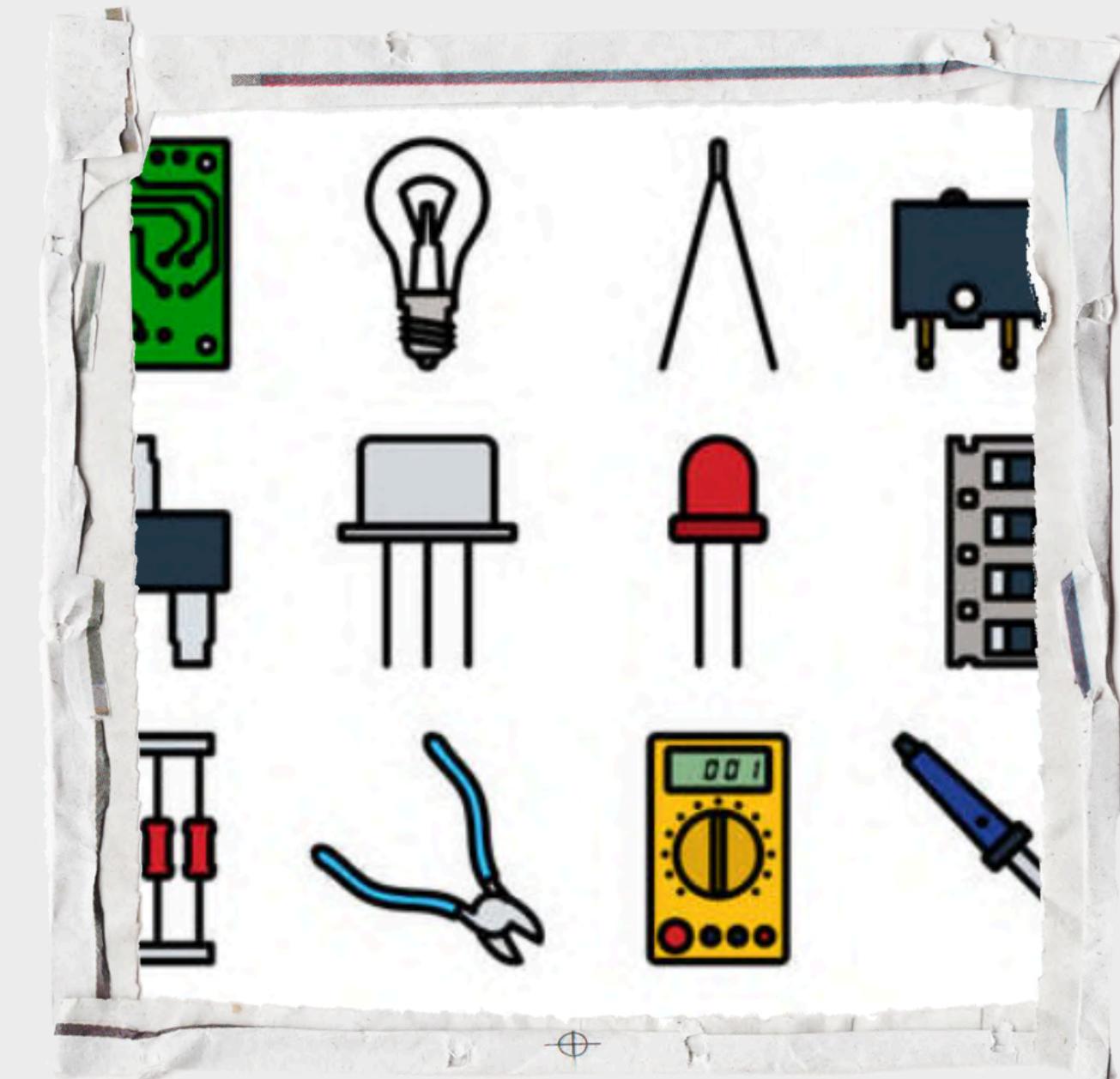
The principle of an RFID door lock system revolves around leveraging radio frequency identification (RFID) technology to control access to a secured area. Each authorized user is issued an RFID tag or card, typically in the form of a key fob, badge, or sticker, embedded with a unique identification number or code. Positioned near the entry point, an RFID reader emits radio waves within a short range. When an RFID tag/card is brought into close proximity to the reader, the reader's electromagnetic field energizes the tag/card. Subsequently, the energized tag/card transmits its unique identification data back to the reader using radio frequency signals, typically comprising the tag/card's unique serial number or code.



The reader then verifies this transmitted data against a database of authorized users stored within the system. If a match is found, indicating that the user is authorized, the reader activates the door lock mechanism, granting access. Depending on the system configuration, additional security measures such as PIN codes, biometric authentication, or time-based access restrictions may be integrated to further validate the user's identity before access is granted. Additionally, the system may include logging and monitoring capabilities to record access events in real-time, facilitating audit trails and security analysis. Some RFID door lock systems also offer remote management functionalities, enabling administrators to remotely manage access privileges, update user credentials, and monitor access activity from a centralized control interface. Overall, the RFID door lock system provides a secure, convenient, and efficient means of controlling access to secure areas while ensuring only authorized individuals are granted entry.

COMPONENTS

1. Arduino UNO
Board
2. RFID Reader
3. RFID Card
4. Servo Motor
5. Jumper Wires
6. Door latch



COMPONENTS DESCRIPTION

Arduino Uno Board

Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button.

RFID Reader

- Operating voltage: 2.5–3.3 V
- Operating current: 13–26 mA
- Idle current: 10–13 mA
- Sleep current: <80 µA
- Peak current: <30 mA
- Operating frequency: 13.56 MHz
- Card reading distance: 0–60 mm

RFID Card

- Physical properties: Size is 85.60 by 53.98 millimeters and made from plastic polymers like PVC (Polyvinyl Chloride) and PET (Polyethylene Terephthalate).
- Technical properties: RFID cards have an antenna that's connected to an RFID IC.
- Operating distance: The operating distance ranges from 1 to 5 centimeters.
- Operating frequency: The operating frequency can be 125 kHz or 13.56 MHz.
- Storage capacity: The storage capacity can be 330 bits or 1K Byte EEPROM.

Servo Motor

- Weight: 9 g
- Dimension: 22.2 x 11.8 x 31 mm approx.
- Stall torque: 1.8 kgf·cm
- Operating speed: 0.1 s/60 degree
- Operating voltage: 4.8 V (~5V)
- Dead band width: 10 µs
- Temperature range: 0 °C – 55 °C

Jumper Wires

The tensile strength of the material shall at least be 120 Kg/cm² and its elongation, minimum 100%. The nominal thickness of the PVC insulation shall be 0.25mm. Over all Insulated Conductor Diameter = 1.10 mm with a tolerance of +0.01mm. The insulation shall neither be loose around the wire nor adhere to it.

Door Latch

A door latch is a mechanical fastener that connects two surfaces or objects and provides a secure, safe, and strong connection. The latch portion of the mechanism is mounted on a flat surface such that when it meets a second surface it latches to a piece of hardware located on the second surface.

ARDUINO CODE

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

#define RST_PIN 9
#define SS_PIN 10
byte readCard[4];
byte a = 0;

MFRC522 mfrc522(SS_PIN, RST_PIN);

void setup() {
    Serial.begin(9600);
    while (!Serial);
    SPI.begin();
    mfrc522.PCD_Init();
    delay(4);
    mfrc522.PCD_DumpVersionToSerial();
}

void loop() {
    if ( ! mfrc522.PICC_IsNewCardPresent() ) {
        return 0;
    }
    if ( ! mfrc522.PICC_ReadCardSerial() ) {
        return 0;
    }

    a = 0;
    Serial.println(F("Scanned PICC's UID:"));
    for ( uint8_t i = 0; i < 4; i++) { //
        readCard[i] = mfrc522.uid.uidByte[i];
        Serial.print(readCard[i], HEX);
        Serial.print(" ");
        a += 3;
    }
    Serial.println("");
    mfrc522.PICC_HaltA();
    return 1;
}
```

FOR SCANNING RFID TAG

```
MFRC522 mfrc522(SS_PIN, RST_PIN);

void setup() {
    Serial.begin(9600);
    while (!Serial);
    SPI.begin();
    mfrc522.PCD_Init();
    delay(4);
    mfrc522.PCD_DumpVersionToSerial();
}

void loop() {
    if ( ! mfrc522.PICC_IsNewCardPresent() ) {
        return 0;
    }
    if ( ! mfrc522.PICC_ReadCardSerial() ) {
        return 0;
    }

    a = 0;
    Serial.println(F("Scanned PICC's UID:"));
    for ( uint8_t i = 0; i < 4; i++) { //
        readCard[i] = mfrc522.uid.uidByte[i];
        Serial.print(readCard[i], HEX);
        Serial.print(" ");
        a += 3;
    }
    Serial.println("");
    mfrc522.PICC_HaltA();
    return 1;
}
```

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

#define SS_PIN 10
#define RST_PIN 9
String UID = "33 73 E4 0F";
byte lock = 0;

Servo servo;
MFRC522 rfid(SS_PIN, RST_PIN);

void setup() {
    Serial.begin(9600);
    servo.write(70);
    servo.attach(3);
    SPI.begin();
    rfid.PCD_Init();
}

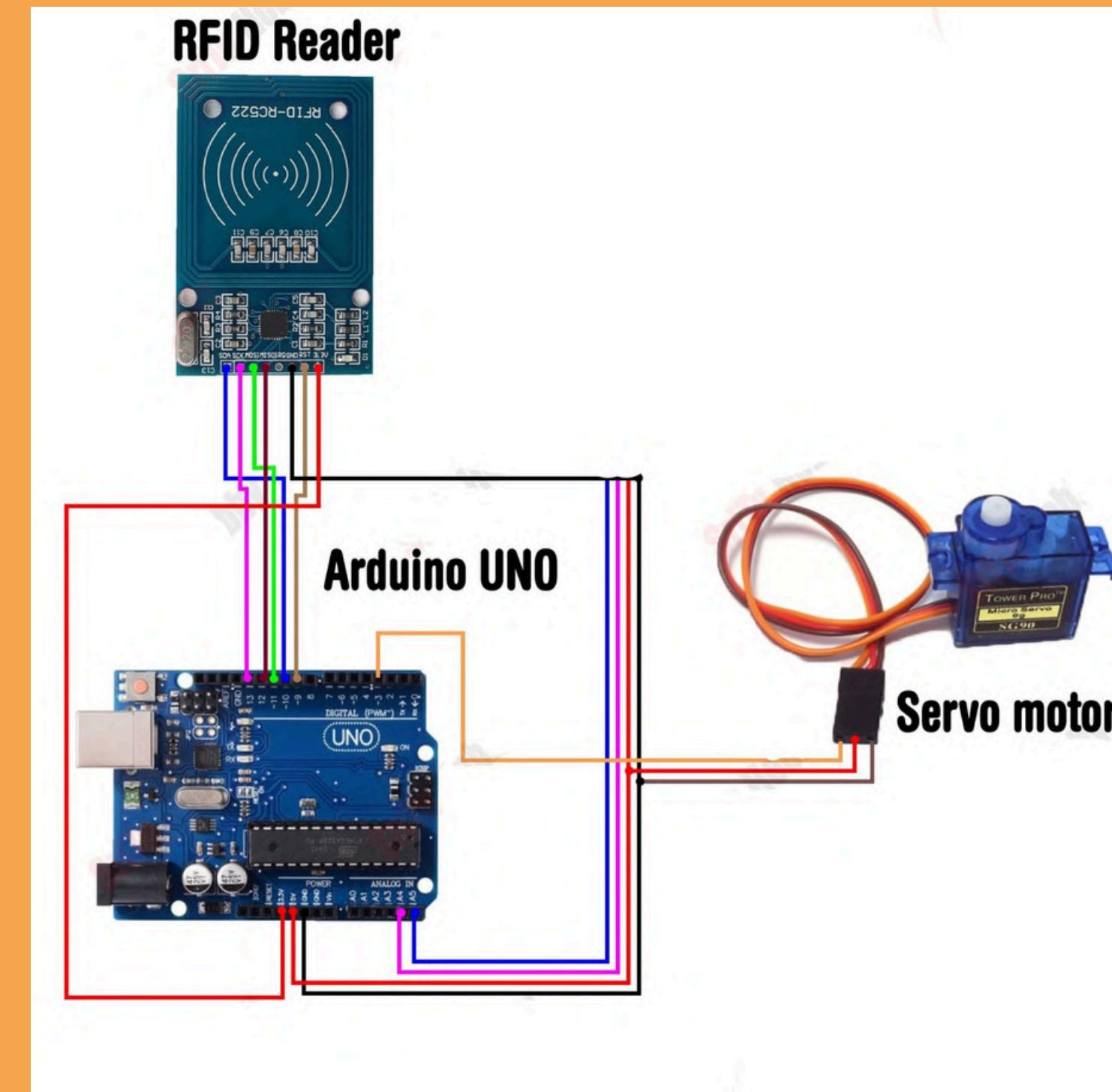
void loop() {
    if ( ! rfid.PICC_IsNewCardPresent() )
        return;
    if ( ! rfid.PICC_ReadCardSerial() )
        return;

    String ID = "";
    for (byte i = 0; i < rfid.uid.size; i++) {
        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 ) {
        serial.println("Door Lock");
        servo.write(70);
        delay(1500);
        lock = 1;
    } else if (ID.substring(1) == UID && lock == 1 ) {
        Serial.println("Door Open");
        servo.write(160);
        delay(1500);
        lock = 0;
    } else {
        serial.println("Wrong Card");
    }
}
```

FOR DOOR LOCK MECHANISM

CIRCUIT DIAGRAM



RESULTS

In this study, we used passive RFID to construct a digital security system that includes a door lock mechanism. When the user places the tag in contact with the scanner, the door locking system activates in real time. One of the most pressing issues of business owners in the modern period is the safety and security of customers, staff, and the overall firm. All business owners deal with lost keys, thievery, and forgotten pins on a daily basis. RFID locker locks are a fantastic answer to these issues.

CONCLUSION

The RFID Door Lock is a very cheap and affordable design that allows convenience and security for users. The design is relatively small and easy enough to install with just a couple of screws. Of course, there are additional features that can be added to improve the system as a whole. However, it is important to note the cost of the improvement should be taken into consideration. The following are a few ideas that can be implemented without adding much cost to the design as a whole. These are just a few of the ideas for the RFID Door Lock in which improvements can be made to further improve both the security and convenience of the product. The first addition is strictly a change in the code. As of now, the RFID reader used is linked to the tag and card reader. However, either by adjusting the code or using a different RFID reader, one should be able to read the RFID code of the individual tags and cards. This will allow for more options in terms of how the user wants the security to be set up. By reading the specific RFID codes, you can change the accepted keys and also deny access for certain keys.

THANK YOU