DESIGN WORKSHOP FINAL PROJECT:

RFID DOOR LOCK SYSTEM

BY AASTHA AND AISHWARYA

Undertaking

We, Aastha Basu & Aishwarya Mohan Iyengar, hereby declare that we have done this project with utmost sincerity under the guidance of Professor N. Mehala.

We hereby affirm that the originality and authenticity of this work is to be undertaken and will be upheld. This work is the result of our own investigation and effort and all sources and references have been cited.

List of Symbols & Abbreviations used

1. RFID: Radio-frequency identification
2. SPI: Serial and Peripheral Interface
3. MOSI: Master Out Slave In
4. MISO: Main out, subnode in
5. CS: Chip Select
6. VCC: Voltage Common Collector (higher voltage with respect to GND; power input of a device.)
7. GND/GRD: Ground
8. RST: Reset
9. IRQ: Interrupt pin
10. Tx: Transmitter
11. SCK: Serial Lock (used for SPI)
12. SS: Slave Select
13. SDA: Serial Data
14. Rx: Receiver
15. MHz: Mega hertz

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1. INTRODUCTION

Sometimes labs, offices, factories or any other workplace require a convenient way of securing important resources. For our project, we have designed a Radio Frequency Identification (RFID) door lock system which is an advanced way of keeping those important resources secure. A Passive RFID system has a reader that reads the tag attached to another object. It works with a radio frequency module with an antenna that generates electromagnetic fields.

The RFID door lock system makes the door lock more secure and convenient to use. It can track the information of who and when they tried to use the system. Usually the system is used in closed network workplaces. It helps keep the security within the network of people who have the key to the RFID.

2. Discussion on the designed 3D Models

We chose to make a door lock and a safe box. The lock has a simple latch that has a gap for the servo motor to rotate so that the latch moves sideways to lock and unlock.

The servo motor will be attached to the back of the lock such that there is a small slot made by two little rods. Between them, the servo blade will move to cause the latch to lock and unlock. The safe box has a door made on the right side. The lock gets attached to the door of the safe box

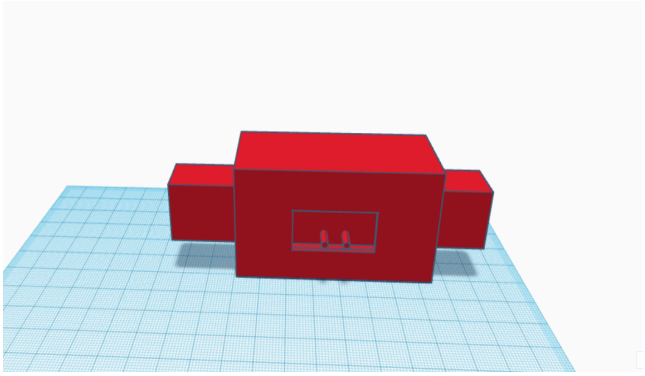


Fig. 1 Front view of the latch

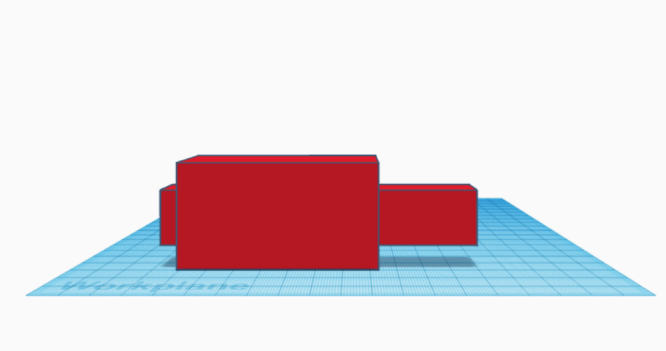


Fig. 2 Side (right) view of the latch

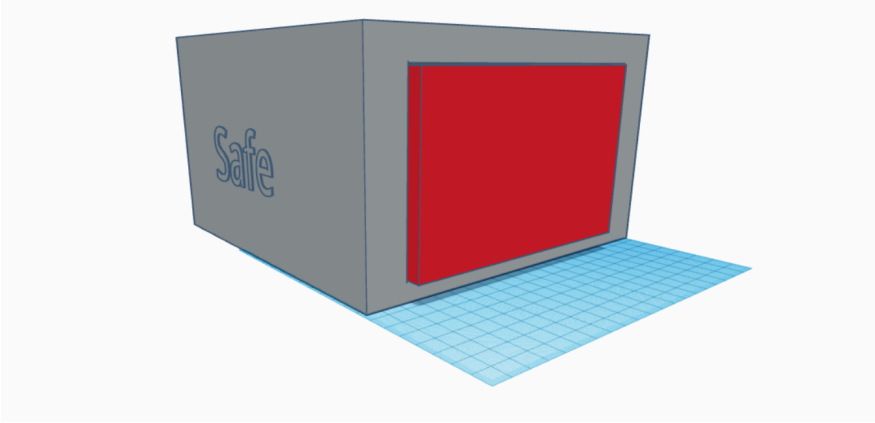


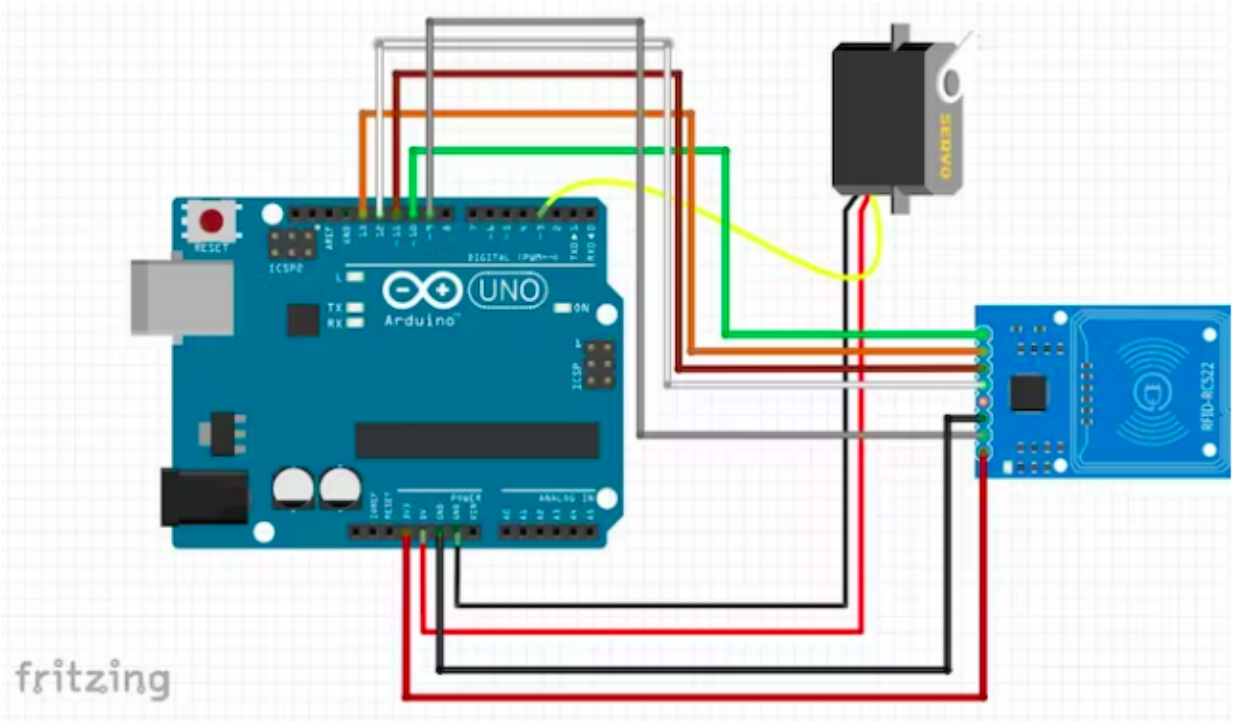
Fig.3 Front- right side view of safe

The print of the word “safe” will later be engraved using Cnc/Laser.

3. Components Used

1. Arduino Uno R3: Mircrocontroller. Contains digital pins(1-12 and ground), analog pins(A0-A5), 3.3V PIN , two 5V pins and two ground pins.
2. Servo: Motor with gears for precise movement. Contains 5V pin, ground pin and control pin.
3. RFID RC522: Radio Frequency Identification, used to identify the tag attached to the object. Contains the VCC pin, RST pin, GRD pin, IRQ pin, MISO / SCL / Tx pin , MOSI pin, SCK pin and SS / SDA / Rx pin.
4. Jumper Wires: to connect the components to each other.
5. USB cable: used to connect the CPU to the Arduino UNO board.

4. Discussion on the Circuit Diagram



The RC522 RFID reader module is designed to create a 13.56 MHz electromagnetic field and communicate with RFID tags (ISO 14443A standard tags).

The RC522 module has a total of 8 pins. The connections are as discussed in detail. The VCC pin supplies power to the module. This can be anywhere from 2.5 to 3.3 volts. You can connect it to the 3.3V output from your Arduino. Connecting it to the 5V pin will probably destroy the module.

RST is an input pin for reset and power-down. When this pin goes to LOW, the module enters power-down mode.The oscillator is turned off and the input pins are disconnected. The module is reset on the rising edge of the signal. Pin RST can be connected to any digital pin on the Arduino.

GND is the ground pin and needs to be connected to the GND pin on the Arduino.

IRQ is an interrupt pin that alerts the microcontroller when an RFID tag is in the vicinity. In our circuit, the IRQ pin is left unconnected because the Arduino library we are going to use does not support it.

The MISO/SCL/Tx pin acts as master-in-slave-out when Serial and peripheral (SPI) interface is enabled, as serial clock when I2C interface is enabled and as serial data output when the UART interface is enabled.

MOSI (Master Out Slave In) is the SPI input to the RC522 module. MOSI transmits data from the main to the subnode and MISO transmits data from the subnode to the main.

SCK (Serial Clock) accepts the clock pulses provided by the SPI bus master i.e. Arduino.

SS/SDA/Rx pin acts as a signal input when the SPI interface is enabled, as serial data when the I2C interface is enabled and as a serial data input when the UART interface is enabled. This pin is usually marked by encasing the pin in a square so that it can be used as a reference to identify other pins.

This leaves the pins that are used for SPI communication. SPI is a library that allows you to communicate with SPI devices, with the Arduino as the controller device. This library is bundled with every Arduino platform (avr, megaavr, mbed, samd, sam, arc32), so you do not need to install the library separately.

In our circuit diagram, we used the Arduino Uno R3 board. Each Arduino board has different SPI pins that must be connected accordingly. The MOSI pin on the RFID module is connected to digital pin 11 on the Uno board. Digital pin 12 is connected to the MISO pin. Pin 13 is connected to the SCK pin and the CS pin is connected to pin number 10 on the Uno board.

5. Arduino Program with Explanation

```
#include <Servo.h>

#include <SPI.h>

#include <RFID.h>


RFID rfid(10, 9); //SDA connected to pin 10, RST to 9

byte password[5] = {
  208,
  74,
  76,
  37,
  243
}; //array with 5 bytes, unique to RFID key

Servo myservo; //represents servo motor

boolean card = false; // initialises card to false, boolean data type

void setup() {

  Serial.begin(9600); //serial port is capable of transferring max 9600
bits/s

  SPI.begin(); // allows you to communicate with SPI devices, with the
Arduino as the controller device, send information one by one

  rfid.init(); // initializing the RFID sensor module

  myservo.attach(3); // servo connected to digital pin 3 on UNO

  myservo.write(100); // changes servo angle to 100 degrees

}
```

```
void loop()

{

  if (rfid.isCard()) //goes to block statements if value is true

  {
    if (rfid.readCardSerial())
    //checking if the RFID matches the Serial Number of the card

    {
      Serial.print("Found ID: ");

      Serial.print(rfid.serNum[0]);

      Serial.print(",");

      Serial.print(rfid.serNum[1]);

      Serial.print(",");

      Serial.print(rfid.serNum[2]);

      Serial.print(",");

      Serial.print(rfid.serNum[3]);

      Serial.print(",");

      Serial.println(rfid.serNum[4]);
    }

    card = true;

    for (int i = 0; i < 5; i++)
    {
      card = card && (rfid.serNum[i] == password[i]);
      // card is false if any digit does not match.
    }
```

```
    if (card)
    {
      Serial.println("Correct Card");
      myservo.write(20);
      delay(15000);
      myservo.write(100);
    }
    else
    {
      Serial.println("Wrong Card");
    }
    rfid.halt(); // prevents the RFID module from reading the same card
  }
}
```

6. Discussion on the Other Applications (if any)

This sort of RFID system can be used for any identification systems in other domains as well. The following are some applications:

- Shopping registers
- Check-in system for employees
- Cargo shipping
- Vehicle tracking
- Items in Factories
- Inventory management

7. Application of Laser/CNC engraving

In our project, we have used laser engraving for text on the box. The box says “safe” to indicate that it’s a safe, locked box. We have chosen to make this sign a customised one, to make it look more appealing.

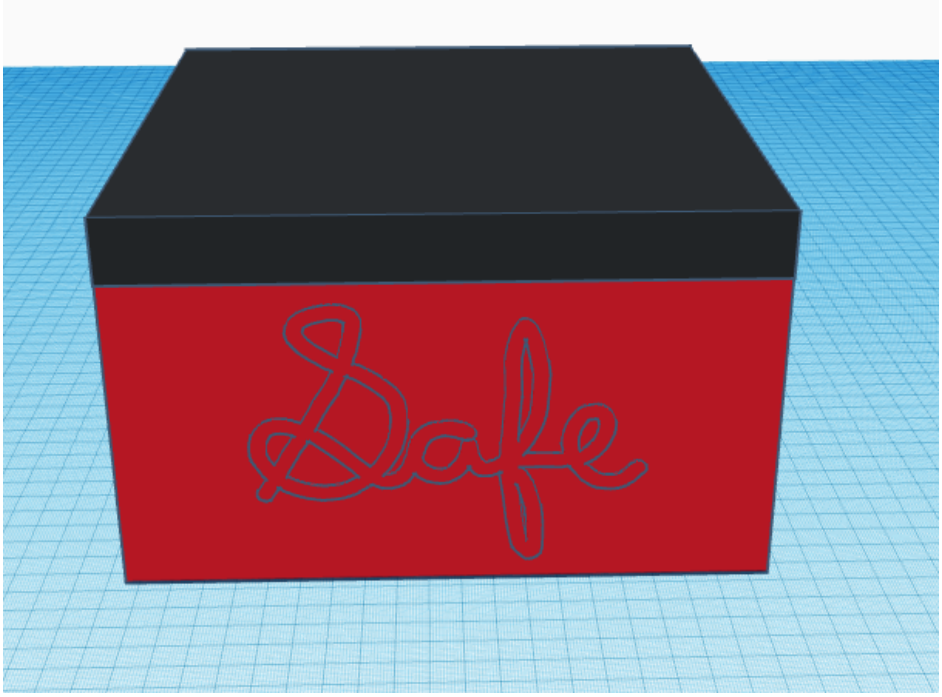


Fig. 3 Laser Engraving in our Model

The applications of laser and CNC engraving on cardboard are many. Labelling is highly used with paper and cardboard to provide important logistics information in a clear and efficient way. Recent innovations make paper and cardboard laser marking a real possibility. Inkless printing represents a great method for marking important information, whilst reducing the impact on the environment.

In particular, etching logos and brand names on different customized products or marketing materials is very popular. Stamping codes, manufacturing data, identifying information quickly and with minimum stand down of the equipment presents laser labelling machines as an irreplaceable part of production.

8. References

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