

Evan Johnson and Victor Ibe
ECE110 Honors
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Final Project Lab Report

Introduction

Problem Description

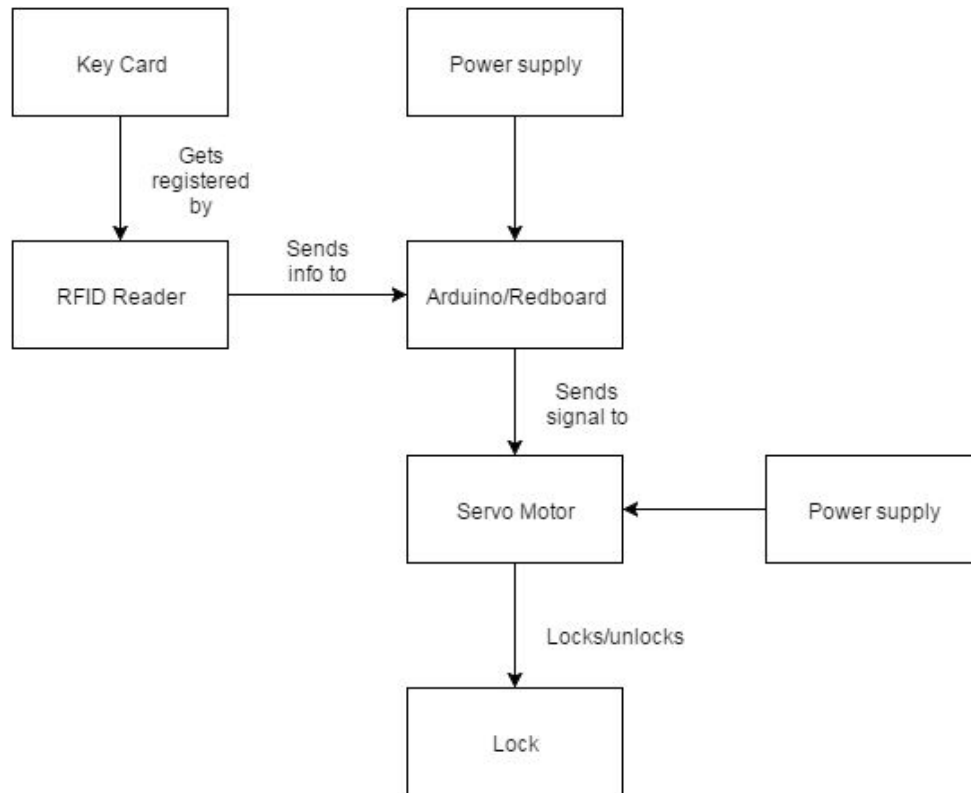
Dorms are one of the areas with highest theft rates on campus, so a more sophisticated way to restrict access to your belongings would be an advantage. Mechanical locks are common and mostly effective, however RFID based locks have the benefit of being able to be improved upon, allowing features like sending messages to your phone when your room is accessed and locking after a timeout phase.

Proposed Solution:

Our proposed solution was to create a lock that was controlled by an RFID Reader and tag. Essentially, anyone who would normally have a key to your room now would have a key card; when they swipe the RFID card past the RFID reader, which would be mounted on the outside of the door, the door would unlock for five to ten seconds and then lock behind you. A feature we added later in the process was for the lock to make a sound whenever it read a card and flashed a green light when a card was accepted and a green light when a card was denied.

Design:

Block Diagram:



Description of Blocks:

Key card: contains the RFID tag which receives a wave from the RFID reader, modifies it and sends it back to RFID reader which then processes it.

RFID Reader: The reader powers the passive RFID tag with its electric field and processes the wave that it receives from the tag into digital data that it then sends to the Arduino.

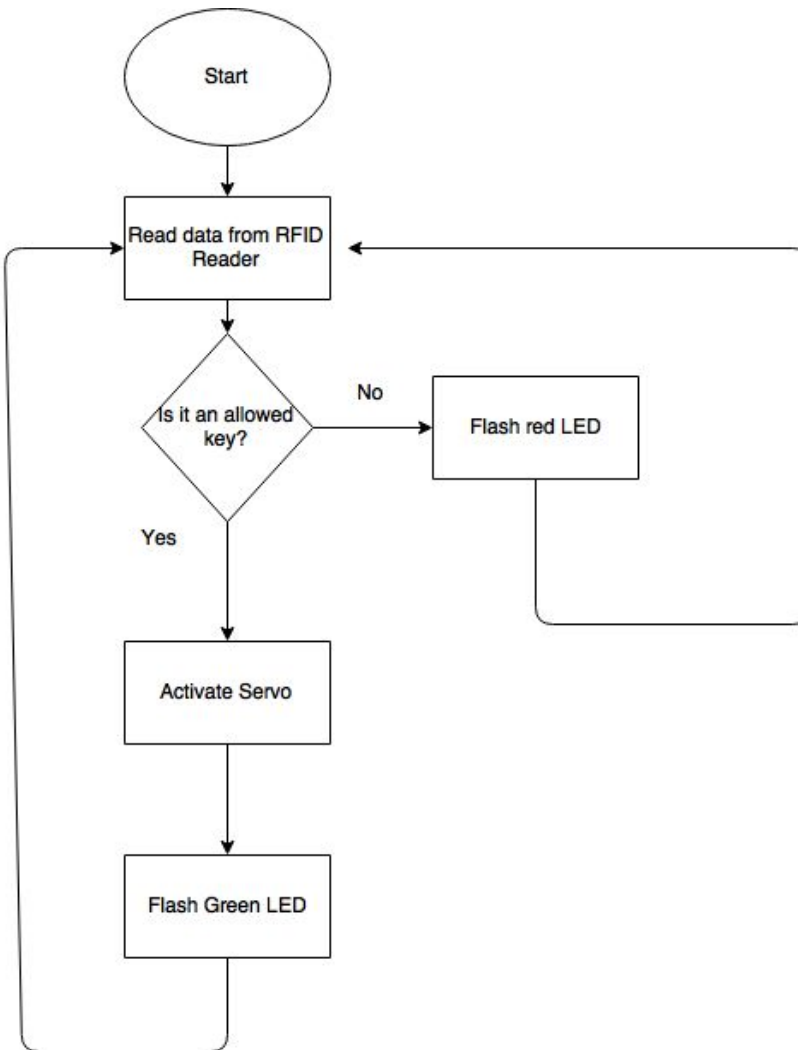
Arduino/Redboard: The Redboard handles all the logic of the device. It receives the digital input from the RFID reader and compares it against the known allowed keys. If the data sent from the RFID reader matches the allowed key then it sends a signal to the servo motor to open the lock.

Servo Motor: This is the mechanism for opening and locking the door. It turns the arm 90 degrees when it receives the proper signal from the arduino.

Lock: is operated upon by the servo.

Power supply: provides a dc voltage to the system.

Flow Chart of code:



Code Used:

Arduino Code

```
int incomingByte = 0; // for incoming serial data
#include <SoftwareSerial.h>
#include <Servo.h>
#define openLED 5
#define closeLED 6
Servo lockServo;
const int servoPin = 9;
```

```
SoftwareSerial rSerial(0, 1); // RX, TX
```

```

String foundKey = "";
String acceptKey = "255694848504852695148504813103";
String denyKey = "255694848497069575250676513103";

void setup() {
  Serial.begin(9600); // opens serial port, sets data rate to 9600 bps
  lockServo.attach(servoPin); //attaches servo to pin
  lockServo.write(1); // sets servo to start position
  //long knownTags[1][30] = {255694848504852695148504813103};
  pinMode(openLED, OUTPUT);
  pinMode(closeLED, OUTPUT);
}

void loop() {

  // send data only when you receive data:
  if (Serial.available() > 0) { // read the incoming byte:
    incomingByte = Serial.read();

    foundKey += incomingByte;

    { if (foundKey.equals(acceptKey))

      {
        Serial.println("accepted");
        lockServo.write(90);
        digitalWrite(openLED,HIGH);
        delay(4000);
        digitalWrite(openLED, LOW);
        lockServo.write(1);
        foundKey = "";

      }

    }

    if(foundKey.equals(denyKey))
    {
      Serial.println("try again");
      foundKey = "";
    }
  }
}

```

```
        digitalWrite(closeLED, HIGH);  
        delay(1000);  
        digitalWrite(closeLED, LOW);  
    }  
}  
}
```

Results

Present results:

As of now, the RFID dorm lock is working as expected. The RFID can successfully convert the wave from the tag into data usable by the Arduino. The device can differentiate between two identical tags by reading the unique ID each card holds, and using that information, determines whether or not access should be granted.

Analysis:

Our initial goal was to incorporate the RFID sensor into a locking mechanism that only recognized certain allowed tags and overall, we did accomplish this goal, However there were some aspects of the project were revised from the original plan and some things that didn't make it to the end because there wasn't enough time. We implemented the 2 colored LED's using 220Ω resistors and the digital output signals from the arduino which only have two settings- digitalWrite(X,HIGH) and digitalWrite(X,LOW) - which are equivalent to analogWrite(X,0) and analogWrite(X,255).

Future plans for improvement:

One option for improvement is to make the system wireless; if the goal were to make the system practical, this would be a necessity. From there the next step would be to get either phone or computer integration with the system in order to be able to implement features such as entry logging.

Conclusion

What worked?

We successfully implemented the code to allow or deny access to any specific card and also got the LED's to respond properly to each scanned card. The red LED flashes when the scanned card is denied while the green LED flashes when it's accepted.

What didn't work?

Our biggest and most time consuming issue was getting the program to work using the arduino library for RFID signal processing. The library just didn't produce any desirable results so that's one thing that just didn't work despite our best efforts; we decided not to use the arduino library and wrote the program without it. We didn't exactly implement a full lock mechanism, but the servo motor and arm moved the full 90 degrees so this is just a matter of implementing a more complex mechanical design.

Lessons Learned:

In terms of circuit components, we learned about how the RFID reader works using radio waves and how the tag can be powered by the electric field of the reader. Also I'd say the most important thing we learned while working on this project was to not be afraid to experiment/ work outside of what you're given. If we kept using the arduino library, we might not have finished the project because we'd probably keep running into more problems.