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Password-OTP, RFID and Android Biometric based Door Lock System Using Arduino Mega 2560 Microcontroller

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Abstract - *Nowadays, there is a growing interest in smart and secured homes using the Internet of Things. One of the important aspects of the smart home system is the security capability which can simply lock and unlock the door or the gate. Since most of us are still using traditional keyed locks, we must always worry about losing the key or breaking into our house. With traditional locks, there is a higher risk of keys being misplaced or getting into the wrong hands. So, this project proposes a new security system using a password, OTP, Biometric, etc. In this system, one can gain authorized access by correctly entering the password and OTP or by using the authorized RFID card/tag or if it is an emergency then by using Biometric access via a mobile phone. It is also very cost-effective for daily use.*

***Key Words*: Password Based OTP, RFID, Biometric, GSM, LCD, Arduino Mega 2560.**

1. INTRODUCTION

The main idea behind this project is to make your home and office where this project would be implemented to be more secured. But along with that, the system should be easy to access and also execute as fast as possible. All the existing door lock systems mainly use key-based locks or outdated RFID chips. So there is a higher risk of keys being misplaced or getting into the wrong hands. This where this project comes into the scene.

1.1 PROBLEM STATEMENT

Traditionally key-based locks are used since time immemorial. But in the case of traditional locks, there is a higher risk of keys being misplaced or getting into the wrong hands.

1.2 SOLUTION TO PROBLEM

To overcome the security problem this project is introducing a new security system using a password, OTP, RFID, and Biometric access using an Android device.

1.3 SURVEY

1.3.1 GSM MODULE

GSM module is a communication module that is used to make calls and SMS text messages.

In GSM Module there is a sim slot for sim insertion.
It also has an antenna, VCC, RST, RXD, TXD, GND pins. These pins are used for sending and receiving messages. Other pins are used to make or answer voice calls.
We need to solder the helical antenna which is used for the connection. Tx pin for sending out the data. Rx pin for receiving commands from the microcontroller. Tx and Rx pins communicate with the microcontroller.
It is used for serial communication. GSM Module blinks every one second which means it is looking for a signal.
When GSM Module blinks every three seconds, it means it is connected to the network.

1.3.2 RFID MODULE:

RFID is an acronym for Radio Frequency Identification, as the name defines the operation of the device as based on the Radiofrequency signals.
The RFID systems consist of an RFID Reader and a tag which is normally used in the identification and tracking of objects. RFID door locks and RFID attendance systems are very popular nowadays and many organizations have provided RFID tags to their employees to lock and unlock the door. This system can also be used in many places.
Three popular RFID Readers – EM18 RFID Reader Module, RC522 RFID Module, and PN532 NFC RFID Module.

1.3.3 BLUETOOTH MODULE:

Bluetooth module is generally used for wireless communication.
In this project, we have used the Bluetooth HC05 module to communicate with an android device. When connected to an android device, it receives a single bit.
This bit is used to unlock the solenoid lock.

2. PROPOSED SYSTEM

2.1 WORK FLOW OF PROPOSED SYSTEM

Figure 1 shows work flow of proposed system.

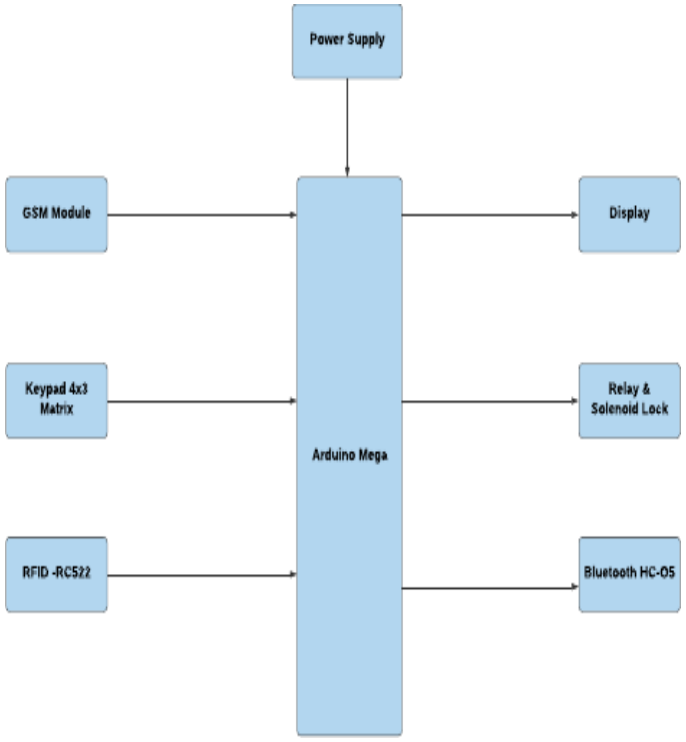


Figure 1: Block Diagram of Door Lock System.

2.2 FUNCTIONS OF EACH BLOCK

2.2.1 PASSWORD AND OTP BASED ACCESS

Step 1: Once the circuit is powered on, the Arduino Mega microcontroller sends commands to LCD to show 'Enter Password'.

Step 2: As the password is entered by the user it will be printed on the display.

Step 3: Arduino microcontroller then compares the entered password with the stored password.

If the entered password matches with the stored one then the LED will emit green light.

Step 4: GSM module sends an OTP message to the owner's registered mobile which contains a four-digit random number.

Step 5: After entering the right OTP the door will open.

If OTP does not match then the LED will emit red light and the buzzer will sound.

Step 6: If the password does not match then the LED will emit red light and the buzzer will sound.

Flow diagram of same is given in Figure 2.

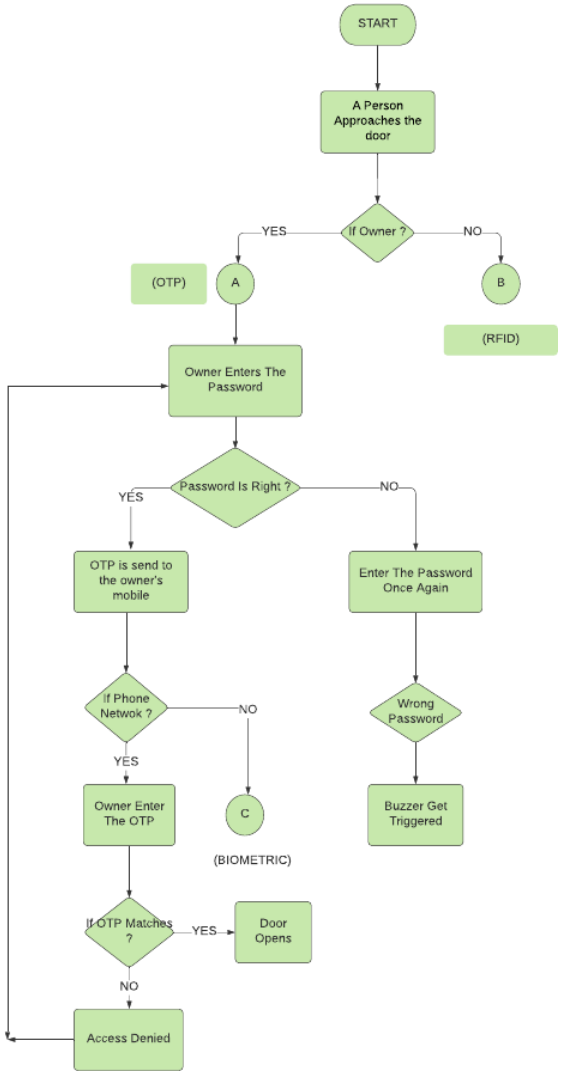


Figure 2. Flow Chart of Password-OTP based access

2.2.2 RFID BASED ACCESS

Step 1: When the owner brings the card/tag to the RFID module it detects the card/tag and reads its value.

Step 2: If the value is the same as defined in the code then the "Door is open" message is shown on LCD, the LED will emit green light and the door opens for the owner.

Step 3: If the value does not match with the defined code then an access denied message is shown on the serial monitor and, the buzzer will sound, the LED will emit red light and the door won't open.

Flow diagram of same is given in Figure 3.

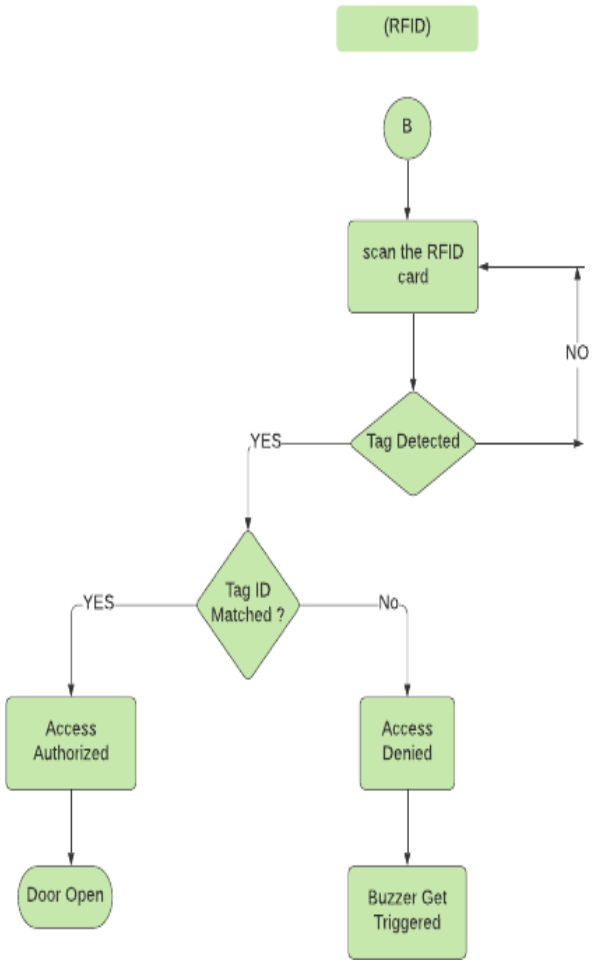


Figure 3. Flow Chart of RFID Based Access

2.2.3 BIOMETRIC ACCESS THROUGH ANDROID DEVICE

Step 1: On Android device, pair with HC-O5 module using Bluetooth.
Step 2: Open the app on the mobile and connect to paired HC-O5 module.
Step 3: Using the fingerprint sensor of the phone, check for an authorized user.
Bluetooth module is used to send a signal bit to the HC-O5 module. The signal bit is used to decide if the door is to be unlocked or not.
Step 4: If fingerprint matches then the LED will emit green light and opens the door for the owner.
Step 5: If it does not match then the LED will emit red light, the buzzer will sound and the door will not open.
Flow diagram of same is given in Figure 4.

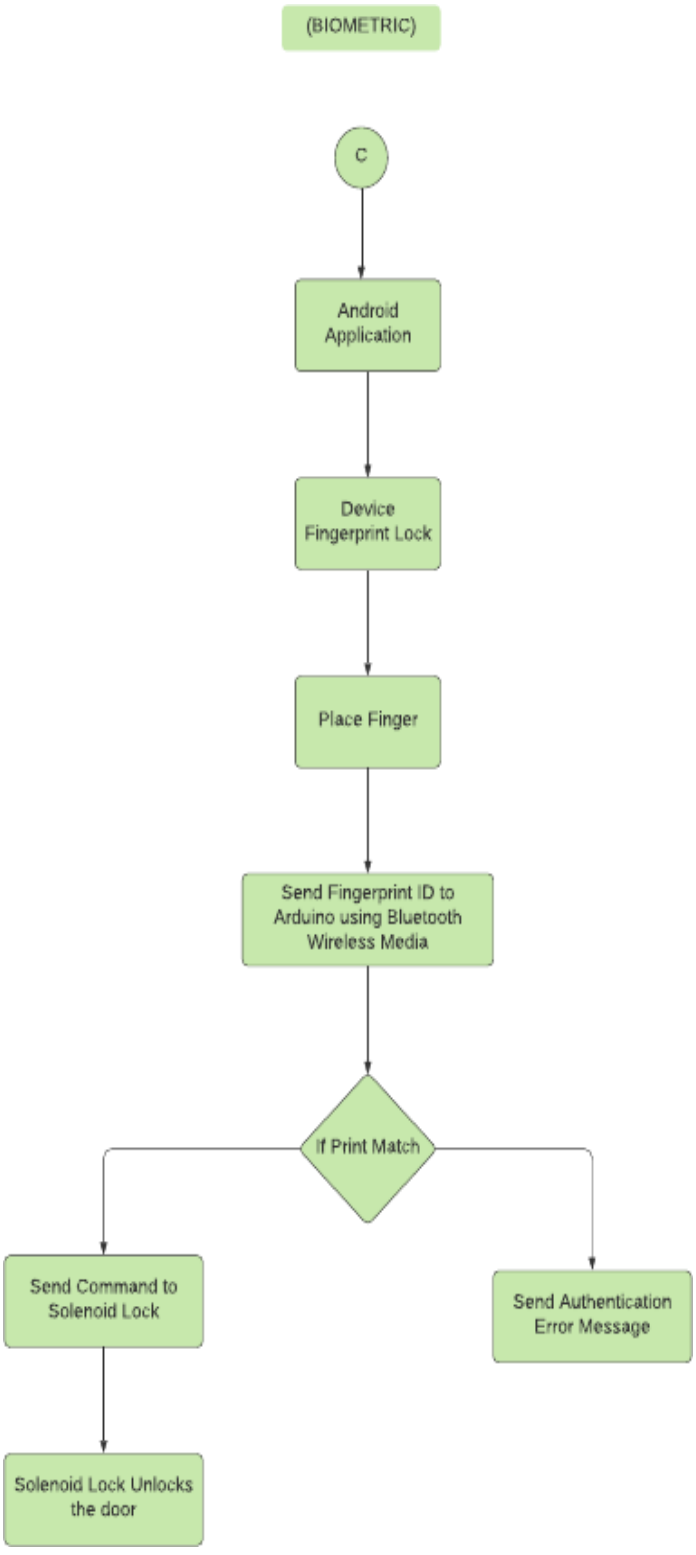


Figure 4: Flow Chart of Biometric based access using Android device.

3. MODEL DEVELOPMENT AND IMPLEMENTATION

3.1 CIRCUIT DIAGRAM

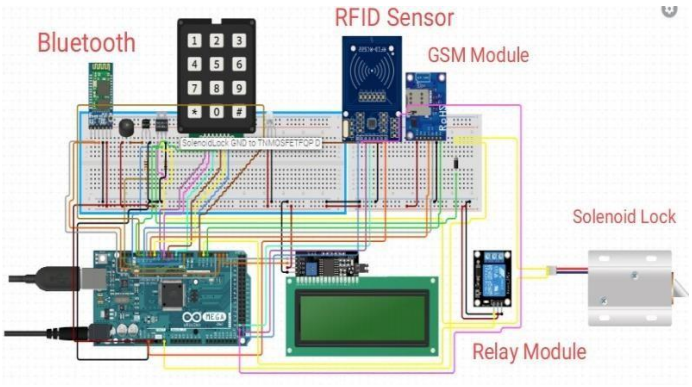


Figure 5 Circuit Diagram of Door Lock System

3.2 PIN CONFIGURATION AND CONNECTIONS

Since this project is implementing various modules, the developed system is using Arduino Mega 2650 as a microcontroller. Pin connections for Arduino Mega are given in Table 1.

Table 1 Pin Connections of Arduino Mega

Pin No of Arduino Mega	Connected to components
Pin 2 and 3	LED
Pin 7,8,9,12	Keypad(rows)
Pin 10,11,6	Keypad(columns)
Pin 16,17	Bluetooth Module
Pin 18,19	GSM Module
Pin 20,21	LCD
Pin 22	Buzzer
Pin 33	Single Channel Relay/Lock
Pin 49,50,51,52,53	RFID Module
Vcc	+5V
GND	GND.

Apart from this, the developed system has connected, Single Channel relay to a +12V source and solenoid lock. Solenoid lock is also connected to a +12V source.

4. RESULTS

4.1 DOOR UNLOCKED

Once either RFID, Biometric, or Password-OTP module is executed successfully as given in Proposed System, the door will open and the user is allowed to access the area. The implemented result is showed in the Figure 6.

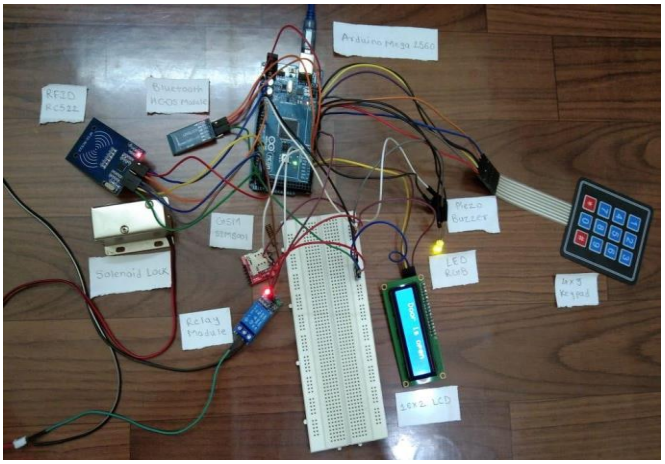
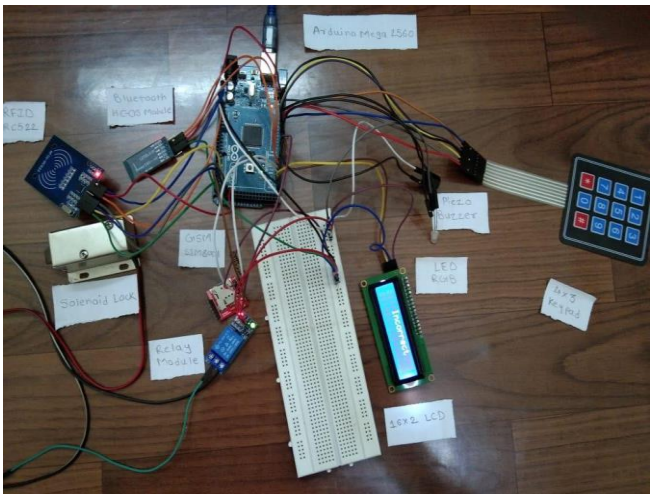


Figure 6 Results for Door Unlock

4.2 DOOR LOCKED

Again, if another user arrives, it will request to verify authentication using either RFID, Biometric, or Password-OTP, if the authentication is wrong, then the door would remain closed, denying access to the user. The implemented result is shown in the Figure 7.

Figure 7 Results for Door Lock



SCOPE

This is a generic system which can be modified as per user's requirement. It can be installed in various places such as:

- school and college labs
- Hotels
- safes in-home or offices
- prison cells, etc.

CONCLUSION

This project can be used at residential places to ensure better safety and also at organizations to ensure authorized access. Power consumption for implementation of this circuit is relatively less and it also uses commonly available components. It is a low-range circuit, so it is possible to only operate the circuit locally. If we forget the password it is still possible to open the door since we have integrated extra measures. This project cannot be used by remote access. Since this project uses Solenoid Lock it requires a constant electric supply, if supply is cut it would not be possible to open the door.

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