SPRING24 IOT102 Smart Home

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Abstract

Regular locks are not a safe solution when it comes to protecting a house or room from thieves. Thieves only need a saw or other tools to break the lock in just a few minutes. It poses risks to human and family safety. Smart lock doors based on the Internet of Things (IoT) were created to solve this problem. By using ESP8266 Module, keypad, buzzer, LM35, ultrasonic sensor, photoresistor and LCD1602. Instead of using a regular key, it can accept telegram bots. The door will be opened by telegram bot. In case the homeowner forgets his phone, he can open the door with the keypad. However, if the password is entered incorrectly three times, the bell will ring and the owner's phone will receive a notification via telegram bot. Thanks to that, the house and room will be smart and safe thanks to this technology. [**?**]

1 Introduction

In an era marked by a burgeoning reliance on the Internet of Things (IoT) and a growing need for enhanced security, this project represents a significant contribution to the field of smart home and property protection. [**?**]
The necessity for the design and development of an innovative Integrated Anti-Theft IoT Door Lock model, featuring sound sensors and a temperature sensor arises from the escalating concerns related to security breaches, unauthorized access, and property safety. Traditional door locks, while time-tested, often fall short of providing comprehensive and proactive security measures. In response to these limitations, this project introduces a cutting-edge solution that leverages IoT technology to deliver real-time monitoring, alerting, and advanced security features.
The incorporation of sound sensors empowers the system to detect suspicious entry attempts, break-ins, or tampering with the door, ensuring a rapid

response to potential threats. Simultaneously, the temperature sensor offers an additional layer of security by identifying hazardous conditions, such as someone attempting to tamper with the door or the presence of a potential intruder. [**?**]

With home and property security being a top priority, this project is a valuable initiative, addressing the demand for intelligent, interconnected, and adaptive security systems. This report will delve into the device's functionality, and its potential applications, and underline its significance in the modern security landscape, ultimately contributing to safer and smarter living spaces.

2 Methods and Materials

2.1 Components and peripheral devices

The high-security door lock system is developed to combine key components to maximize security and modernity. The Servo motor acts as a door lock to prevent unauthorized entry. The system is designed with a Button inside the house so you can open the door from inside at any time, which is both convenient and highly safe. The HY-SRF05 ultrasonic sensor plays an important role in detecting someone nearby to activate the system, along with the Photoresistor to turn on and off the keypad illumination. ESP8266 Module NodeMCU makes entering your password more private and secure when you feel someone is trying to see the password on your keypad. The Arduino Uno R3 ATMEGA16U2 facilitates data collection from sensors and modules to process and control signals to output devices such as LCD screens, which display when you operate the system, as well as a Buzzer that emits warning sounds against threats of illegal intrusion. I2C to help save connection ports on the circuit.The total list of required components and tools is provided in table.

Components/Devices	**ID/Remarks**	**Amount**
Arduino Arduino Uno	R3 ATMEGA16U2	1
Arduino Ultrasonic RangeFinger	HY-SRF05	1
Arduino Button		1
Arduino Keypad 4x4		1
Arduino ESP8266 module	NodeMCU	1
Arduino Photoresistor		1
Arduino LCD Display 16x2		1
Arduino Motor Servo		1
Arduino LED		1
Arduino Buzzer		1
Arduino Module I2C WaveShare	PCF8574T	1
Arduino Module I2C LCD 16x2	8574T231501	1
Arduino Module LM35		1

Table 1: SYSTEM'S COMPONENTS AND PERIPHERAL DEVICES

Figure 1: Mobile app to controll module wifi

2.2 System Model and Block Diagram

The developed system consists of hardware and software combined together. Regarding hardware, 2 sensors are used to know distance and brightness. Accessories used to open the door include Keypad, RFID Module, Bluetooth Module, button. To put it all together, we use an Arduino Uno. Also to alarm, we need to use a Buzzer. And use I2C to save connection ports on Arduino Uno. A collection of computer codes is written on the software side of things to accomplish the system's intended functions. The Block Diagram shown below depicts a visual view of how incorporated modules are and how they interact and combine with each other. Keypad, RFID Module, Bluetooth Module, button, Ultrasonic sensor, photoresistor sensor and 5V Power as inputs. And LCD, Buzzer, LED and Motor Servo as outputs. [**?**]

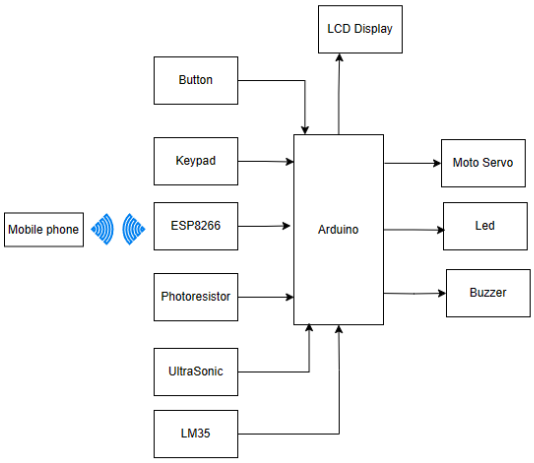

Figure 2: Block diagram of the developed system.

2.3 Electronic Circuit/Hardware Interfacing

Arduino Uno R3 is used to make decisions such as opening doors, changing passwords, changing cards and sending results based on data from sensors. **Figure. 3** shows the circuit communication diagram of the developed device, where the sound sensor and light sensor are communicated with Arduino via D7, D8 and A0, respectively, the Keypad and LCD display are Controlled by SDA and SCL, these two devices are connected to each other and connected to Arduino using I2C. The Bluetooth module is connected to D2 and D3. The RFID module is connected to the Arduino through ports D9 to D13. The complete interface is are further described in **Figure. 4 and 5**

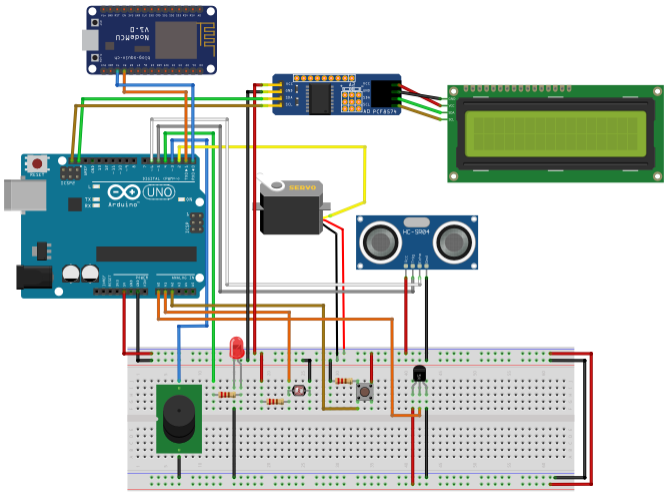

Figure 3: Circuit schematic/hardware interfacing

Arduino Arduino Uno	ESP8266	PCF8574 (I2C)	Keypad 4x4	Module I2C LCD 16x2	UltraSonic HY-SRF05	Servo Motor	Photoresistor	LM35	Button	Buzzer	LED
GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND
5V		VCC(5V)	VCC(5V)	VCC(5V)	VCC(5V)	VCC(5V)	VCC(5V)	VCC(5V)	VCC(5V)		
A0								A0			
A1							A1				
A2									A2		
A3											
A4											
A5											
D0											
D1(TX)	RX										
D2						D2					
D3										D3	
D4											D4
D5						Echo					
D6						Trig					
D7											
D8											
D9											
D10											
D11											
D12											
D13											
SDA				SDA							
SCL				SCL							

Figure 4: Interfacing between Arduino Uno and its components (pin-to-pin)

LCD 16x2	Module I2C LCD 16x2	PCF8574 (I2C)	Keypad 4x4
VSS	1	P0	1
VDD	2	P1	2
V0	3	P2	3
RS	4	P3	4
RW	5	P4	5
E	6	P5	6
D4	11	P6	7
D5	12	P7	8
D6	13		
D7	14		
A	15		
K	16		
	SDA	SDA	
	SCL	SCL	

Figure 5: Interfacing between Arduino Uno and its components (pin-to-pin)

3 Software Programming

3.1 Programming Flowchart

Our device has an Arduino UNO R3 ATMEGA16U2 as the controller and a Bluetooth HC-05 is used to establish a transparent wireless serial connection.Consequently, with the help of the Arduino IDE software, the functionality of the device will therefore depend on programming, represented by the following diagram:

On the one hand, suppose we are inside the house and need to open the door, the button will play its role when user presses it. Then, digital pin of Arduino will send signal "HIGH"; controller will receive signal and send command to Servo to open the door lock. After 5 seconds, Servo will automically close the door thanks to signal of controller for security. Otherwises, digital pin of Arduino will send signal "LOW" all the time.

On the other hands, we are staying outside and need to get in, the UltraSonic HY-SRF05 will detect the distance from user to door. Only when standing 10 centimeters from the door, LCD will light it up and other solutions will include using RFID with card or entering password through bluetooth or keypad. Firstly, RFID detects the card UID and send it to controller. The Arduino will compare with ones saved in EEPROM before. If they are the same, controller will send signal to Servo to open the door lock and close the door lock after 5 seconds. Otherwises, buzzer will sound. Secondly, user can enter password through Keypad to get in. By entering the string and ending with "#", it will be sent to controller, then Arduino will do the functions like the situation when you using RFID. Moreovers, there are 3 times for users when he/she enters password incorrectly. With each time like that, LCD will print the message "Incorrect password", then "Please enter again" for user to enter again. Until the 3rd time with incorrect password, LCD will print "Lock", buzzer will sound in 10 seconds and user must wait for 10 seconds to re-enter. Once you enter correctly, the Servo will open the door lock and buzzer will sound for 1 seconds with the message "Welcome home" is displayed by LCD. There is one function that only when you enter through Keydad, that is changing password. By entering the string and ending with "*", the system will recieve command, delete old password existing in EEPROM, put and save new password in after that. Thirdly, like entering password through Keypad, we can use phone to enter password without ending with "#". The system will work like the above operations. Besides, our team provide additional function using photoresistor, LED will light it up for user to enter password easily when it is dark. When user leaves, the system will initialize from start.

All settings are described in more detail below. [**?**]

3.2 Sensors and Parameter Setup

- Light Sensor: the level of light sensor change based on photoresistor with a 5 V voltage level. [**?**] The sensor values range from 0 to 1023; 0 being the brightest status when it is daylight. Based on the light attribute, the calibration of the light sensor can be changed in programming by the following way:

```
sensorValue = analogRead(sensorPin);
int sensorValueMap = map(sensorValue, sensorMin, sensorMax, 0, 255);
int sensorValueMapConstrain = constrain(sensorValue, 0, 255);
if (sensorValue ≤ 100)
analogWrite(ledPin, 0);
else
analogWrite(ledPin, 255);
```

- Range finder sensor: the distance which is measured, change based on Ultrasonic Range Finder SRF05 with a 5V voltage level. Based on the distance from user to door, the calibration of Ultrasonic Range Finder SRF05 can be changed in programming by the following way:

```
long duration = pulseIn(ECHO_PIN, HIGH);

Distance = duration / 29 / 2;
```

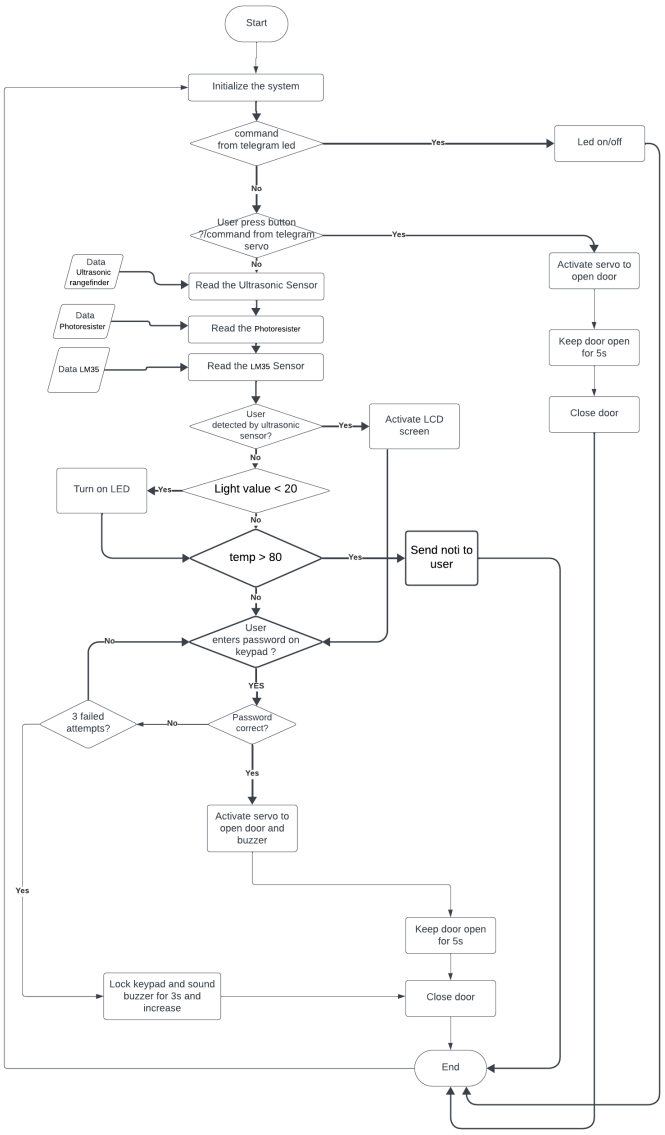

Figure 6: Programming flowchart of the developed system

4 Results and Discussion

4.1 Results from Prototype Testing

To test this system, you need to mount it on a door. After that, the system will running based to the above principles and connections. Open the door with Keypad or Telegram by a phone. The LCD will display the password entered and notifications about success or falied. It also send this notifications to the phone.

4.2 Discussion

When using Telegram by phone, the range for connection is very short, so it will make it difficult for users to connect and make slows the opening of the door.Next, the notifications about open door or fail to open with incorrect password just send to the phone when the phone have connected to the Bluetooth with the system. Next, the keypad is made of plastic and has a lot of contact on the outside, so it breaks quickly after a while. [**?**]

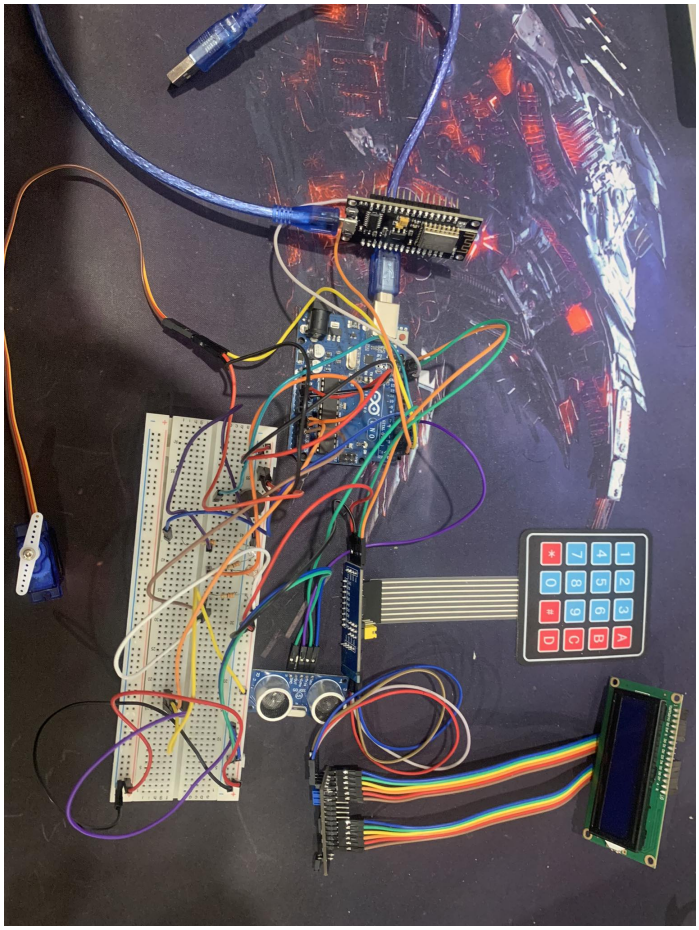

Figure 7: Implemented prototype of the developed system with labeling.

Table 2: Research Plan

No	Task	Result form	Time schedule
1	Writing abstract	Proposal	15 Feb, 2024
2	Writing introduction	Proposal	1 March, 2024
3	Writing proposal	Tinkercad and Flowchart	5 March, 2024
4	Writing proposal	Proposal	6 March, 2024
5	Writing Discussion	Proposal	7 March, 2024
6	Writing Discussion	Proposal	8 March 2024
7	Writing final paper	Paper	10 March, 2024

5 Conclusion

To deal with the thief problems increasing day by day, the Smart Home System is developed. It compeletely remove standard lock with the keys. Instead of this, the Lock ESP8266 Module to open the door, or opening the door with a password by Keypad. It's much more convenient and extremely security. It can open the door when you in home with 1 click the button. Overall, it is almost complety project and a good starting point for implement it in the real life. Keep in mind that the hardware and software being used will determine the precise implementation details, and extra precautions could be needed to guarantee the system's security.

References