

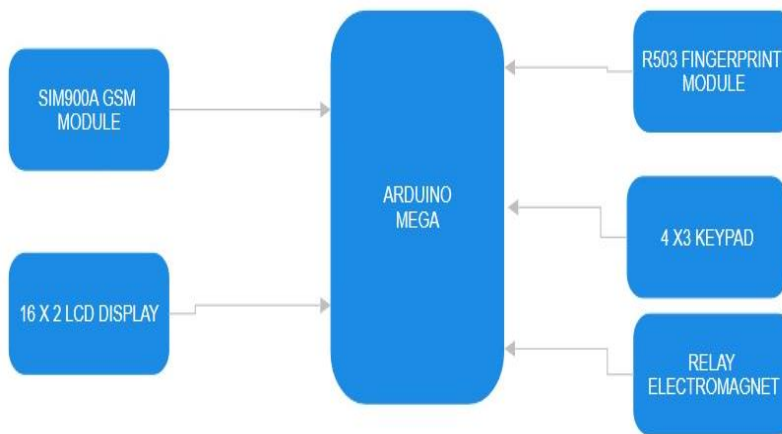
**VIT[®]****Vellore Institute of Technology**
(Deemed to be University under section 3 of UGC Act, 1956)**School of Electronics Engineering (SENSE)****J COMPONENT – REPORT**

COURSE CODE / TITLE	BECE204L – MICROPROCESSORS & MICROCONTROLLERS		
PROGRAM / YEAR/ SEM	B.Tech II Year/ FALL 2023-2024		
LAST DATE FOR REPORT SUBMISSION	23.11.2023, 11:30PM		
DATE OF SUBMISSION	23.11.2023, 9PM		
TEAM MEMBERS DETAILS	REGISTER NO.	NAME	
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PROJECT TITLE	HOME SECURITY SYSTEM		
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COURSE HANDLER'S SIGN			

OBJECTIVE:

The Home Security System project aims to design a robust and user-friendly security solution for residential premises, utilizing the Arduino Mega platform. Our objective is to integrate cutting-edge technology, including fingerprint biometric authentication and OTP verification, to establish a multi-layered security protocol. The system ensures secure entry through accurate fingerprint recognition, displaying a clear "Access Granted" message upon success. In cases of errors, a responsive OTP entry process is initiated via a keypad. With dynamic OTP generation through the GSM module and a lockout mechanism for repeated errors, the system prioritizes homeowner awareness through instant notifications, providing comprehensive protection and peace of mind.

BLOCK DIAGRAM:



COMPONENTS/ SOFTWARE REQUIRED:

- Arduino Mega
- LCD Display(16x2)
- Keypad(4x3)
- Electromagnetic Lock - Relay
- Fingerprint Sensor
- GSM Module (SIM900A)
- 9V Battery
- Connecting Wires

SOFTWARE REQUIRED:

- Arduino IDE

PROJECT DESCRIPTION:

The home security system, built around Arduino Mega, combines state-of-the-art features to ensure robust protection. Utilizing a fingerprint sensor for biometric verification, the system seamlessly displays "Access Granted" on the connected LCD upon detecting a correct fingerprint, subsequently unlocking the relay-operated lock for secure entry.

In cases of an incorrect fingerprint detection, the system dynamically responds by displaying "Wrong Fingerprint" and prompts the user to enter a one-time password (OTP) through a keypad connected to the system. The OTP, generated via the GSM module, adds an extra layer of security. If an incorrect OTP is entered four times consecutively, the system activates a lockout mechanism, enhancing security by preventing further attempts.

To keep the owner informed, the system sends a notification via the GSM module if an incorrect OTP is entered four times, delivering a message like "Wrong OTP entered four times - System Locked." This proactive alert ensures swift owner awareness of potential unauthorized access attempts.

Enhancing the security protocol, the system generates a random OTP, which users manually input through the connected keypad. This multi-layered approach, combining biometric authentication, OTP verification, lockout mechanisms, and owner notifications, establishes a sophisticated and resilient home security system, providing comprehensive protection for the premises.

CONCEPT LEARNED:

- **Arduino Programming:**

The project utilizes an Arduino Mega 2560 as the central control unit, requiring understanding the Arduino IDE, programming code, and interfacing with sensors and modules.

- **Fingerprint Sensor Integration:**

The integration of a fingerprint sensor with an Arduino involves reading, processing, and making decisions based on the comparison of captured fingerprints with authorized references.

- **Security Concepts:**

The project emphasizes the security features of biometric technology, including the uniqueness of fingerprints, the challenge of replicating biometric data (Fingerprint), and the high level of security provided by OTP verification.

- **Wireless Communication/GSM Module Integration:** Understanding wireless communication protocols and concepts like SIM card integration, AT commands, and handling communication errors is crucial for remote GSM module use.

- **User interface:**

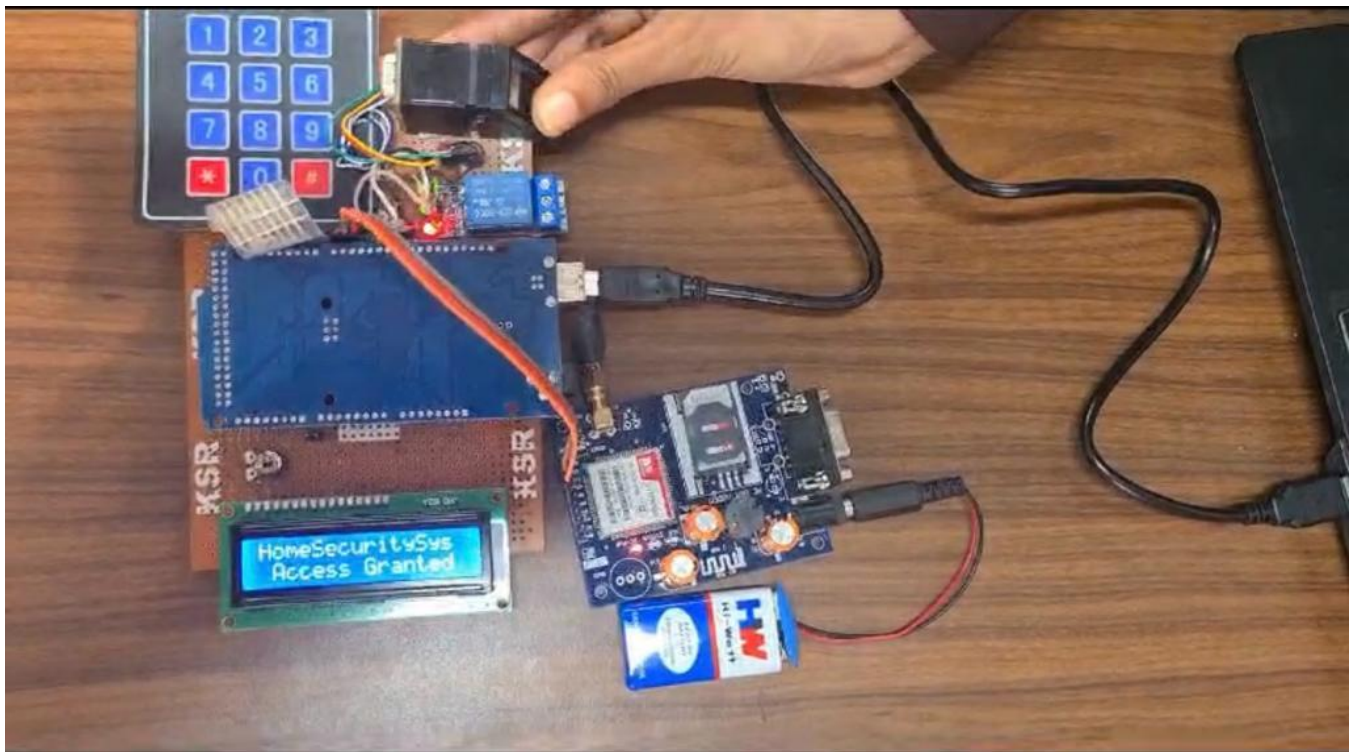
This project utilizes an LCD and push button as the user interface, emphasizing the importance of designing a user-friendly interface, displaying relevant information, and handling user input.

- **Power Supply:**

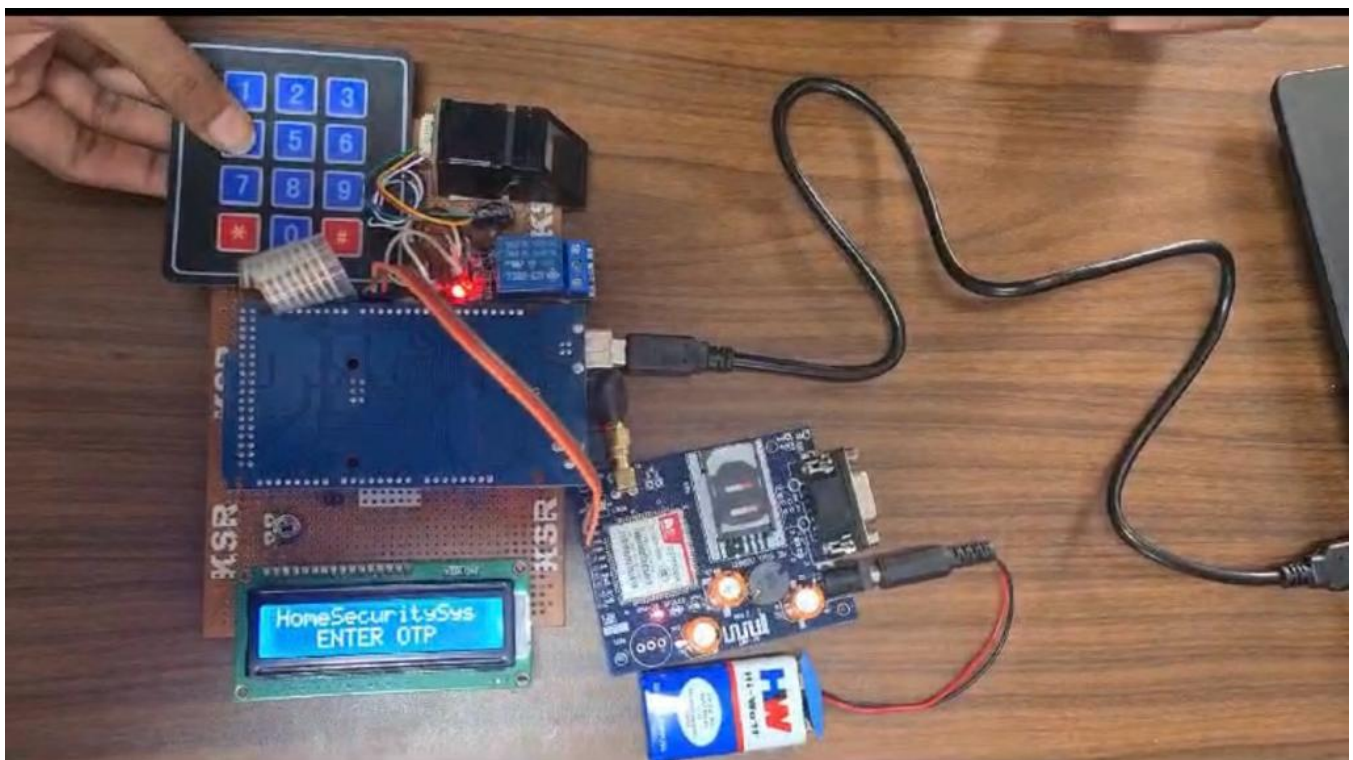
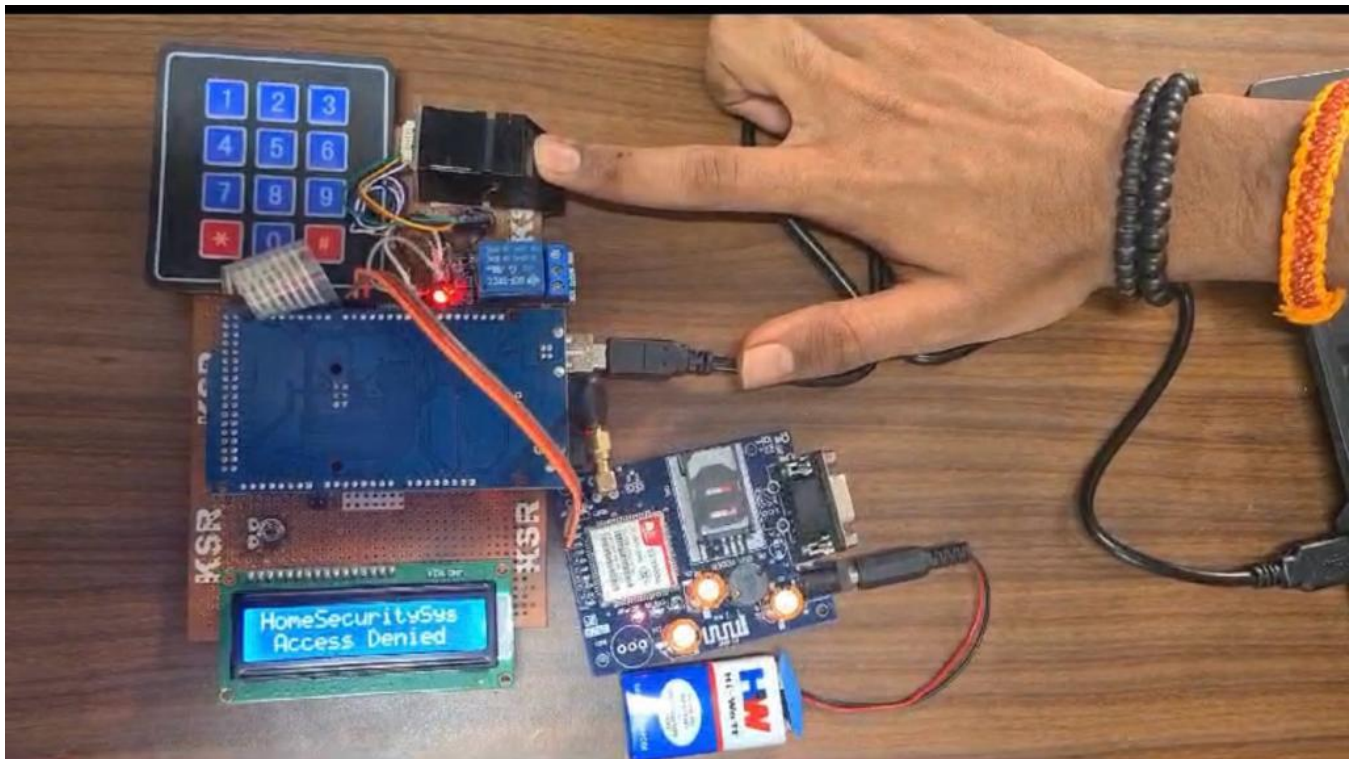
Understanding the power requirements of each component (Arduino, fingerprint sensor, LCD, GSM module) and ensuring a stable power supply is crucial for the reliable operation of the system.

IMPLEMENTATION:

Correct Fingerprint:



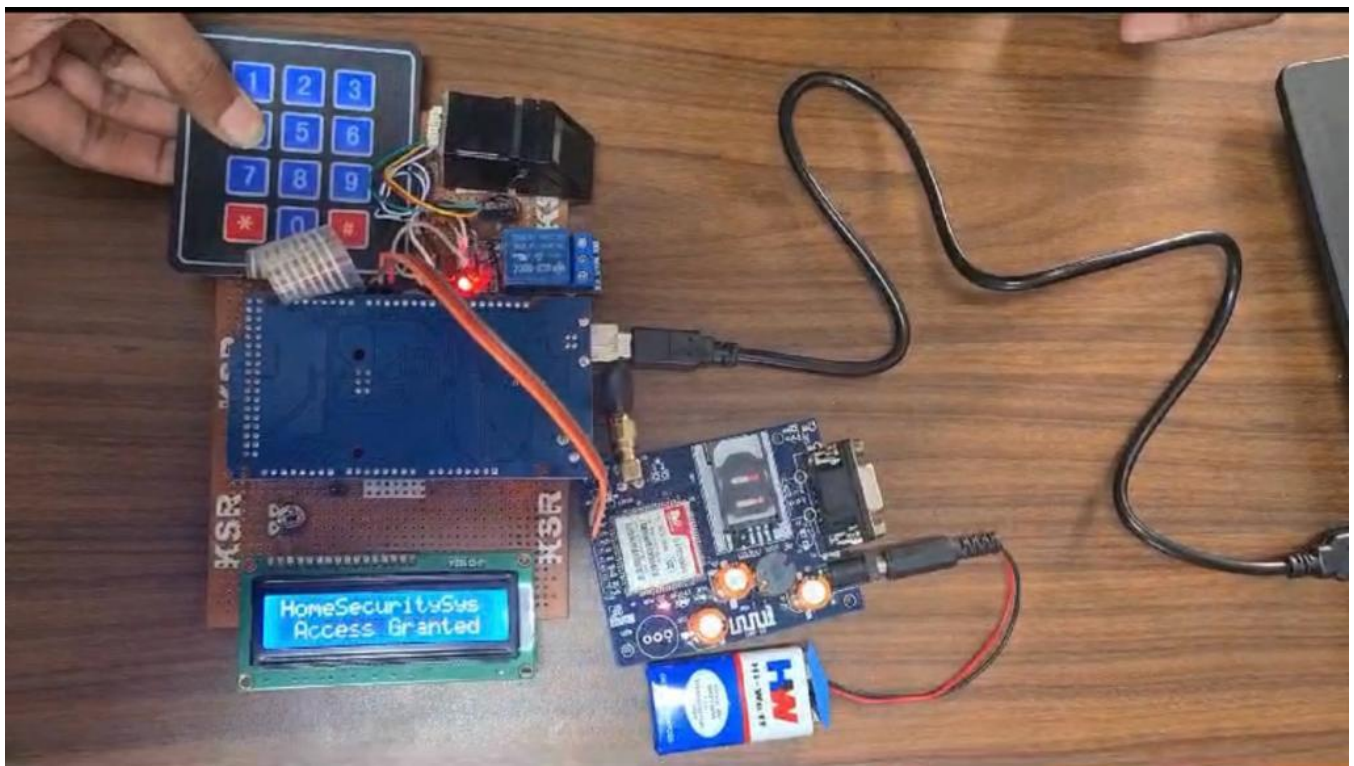
Wrong Fingerprint:



```
sketch_nov23a | Arduino IDE 2.2.1
File Edit Sketch Tools Help

sketch_nov23a.ino
166      delay(1000);
167
168      lcd.setCursor(0, 1);
169      lcd.print(" ");
170      delay(200);
171      break;
172    }
173
174    else //if((customKey == '1') || (customKey == '2') || (customKey == '3') || (customKey == '4') || (customKey == '5') || (customKey == '9') || (customKey == '7') || (customKey == '0'))
175    {
176      delay(200);
177      lcd.setCursor(0, 1);
178      lcd.print("  WRONG OTP  ");
179
180      delay(2000);
181
182      lcd.setCursor(0, 1);
183      lcd.print("  ENTER OTP  ");
184      delay(200);
185    }
186  }
187}

Output Serial Monitor x
Message (Enter to send message to 'Arduino Mega or Mega 2560' on 'COM7') New Line 9600 baud
0
-1
0
-1
1
AT
AT+CMGF=1
AT+CMGS="7200389099"
'Security Alert - Wrong Fingerprint Door Close'; OTP:4
```



Wrong OTP entered 4 times:

```
AT+CMGF=1
AT+CMGS="7200389099"
'Security Alert - Wrong Fingerprint Door Close'; OTP:7
5
5
6
6
3
3
8
8
AT
AT+CMGF=1
AT+CMGS="7200389099"
'Wrong OTP Entered 4 times - System Lock'
```

YOUTUBE LINK:

https://youtu.be/h8rBGLOdKo4?si=_RtUDkXZMG7FINfO

CORRECT FINGERPRINT

1. Fingerprint Detection:

- The system detects a fingerprint using a fingerprint sensor.
- If the fingerprint matches the stored data, it proceeds to the next step.

2. Access Granted:

- The LCD display shows "Access Granted."
- The system allows entry.

WRONG FINGERPRINT

1. Fingerprint Detection:

- The system detects a fingerprint using a fingerprint sensor.
- If the fingerprint does not match the stored data, it proceeds to the next step.

2. Access Denied - OTP Authentication:

- The LCD display shows "Access Denied."
- An OTP (One-Time Password) is generated randomly.

3. OTP Transmission:

- The generated OTP is sent to a predefined mobile phone number via a GSM module.

4. OTP Entry:

- The user is prompted to enter the received OTP through the system interface.

5. Correct OTP Entry:

- If the entered OTP matches the generated one, the LCD displays "Access Granted."
- The system allows entry.

6. Incorrect OTP Entry (Repeated):

- If an incorrect OTP is entered, the system counts the attempts.
- If incorrect OTP is entered four times consecutively, the system locks itself.

7. System Lock Notification:

- A message is sent via SMS to a predefined number, indicating that the wrong OTP has been entered four times.

CHALLENGES FACED:

- **Choice Of Arduino:** The Arduino Nano board was not suitable for a fingerprint recognition system due to its compact size, but a more powerful board like the Arduino Mega 2560 may be necessary due to its increased processing power.
- **Random PINs:** Generating random PINs is a challenging task, but ensuring their quality is crucial for cryptographic applications and security-related systems. We were not able to generate pin due to the Arduino board we used.
- **Detecting fingerprints:** Due to the Arduino nano's storage we were not able to detect all person's fingerprint and only the stored fingerprint was detected to open and lock the system.
- **Debugging:** Debugging complex systems with multiple components can be challenging due to communication issues, incorrect wiring, or software bugs.

APPLICATIONS:

- **Residential Security and Office Access Control:**
 - Provides robust protection for homes and office environment, ensuring that only authorized individuals can access the premises.
- **Data Center Security:**
 - Secures access to server rooms, reducing risks of unauthorized tampering or data breaches.
- **Server Rack Security:**
 - IT environments benefits in securing server racks, preventing unauthorized individuals from tampering with critical network infrastructure.
- **Personal Safe or Vault:**
 - Integrates system into personal safes or vaults for securing valuable items.
- **Medical Records Access:**
 - Secures access to confidential medical records, ensuring patient information is protected and compliance with privacy regulations.
- **Restricted Areas in Airports or Government Buildings:**
 - Control access to restricted areas, enhancing overall security measures.

CONCLUSION:

In conclusion, our Home Security System project wraps up with a solid solution for keeping homes safe and simple to use. By using the Arduino Mega and adding cool features like fingerprint recognition and special passwords, we've built a strong defense system. It makes sure only the right people get in and if something goes wrong, it smartly asks for a different

password. We even added a way for the system to let homeowners know if something fishy is going on. In the end, our project not only makes homes more secure but also keeps it easy and hassle-free for everyone using it. It's a win-win for safety and simplicity.