Software Requirement Specification (SRS)

For

SMART HOME AUTOMATION SYSTEM

Version 2.0

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SUBMITTED TO: MAM JAWERIA KANWAL

Prepared By: MUHAMMAD TAIMOOR

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TABLE OF CONTENT

1. Introduction

1.1 Purpose

The Smart Home Automation System allows users to remotely control home devices such as lights, fans, door locks, and room temperature through a mobile or web interface. It enhances convenience, security, and energy efficiency.

1.2 Scope

This system enables:

- Remote control of household devices.
- Automation via scheduled tasks.
- Security system including **door locking** and **camera monitoring**.
- **Temperature control** for air conditioning and heating.
- Real-time device status updates.
- Secure authentication and user management.

2. Functional Requirements

2.1 User Authentication

- Users must register and log in securely.
- Two-factor authentication for security.

2.2 Device Control

- Users can turn **lights ON/OFF** and adjust brightness.
- Users can turn **fan ON/OFF** and control speed.

2.3 Door Lock System

- Users can **lock/unlock doors** securely.
- System notifies users of **unauthorized access attempts**.

2.4 Temperature Control

- Users can **set room temperature** (increase/decrease based on preference).
- The system automatically adjusts **AC or heating** based on user settings.

2.5 Security Monitoring

- Motion sensors detect movement inside the house.

- Live camera feed available for **remote monitoring**.

2.6 Automation

- Users can set schedules for automated actions (e.g., turning off lights at midnight).
- Devices adjust based on user-defined rules.

2.7 Real-time Monitoring

- Display device status (ON/OFF, usage reports).
- Notifications for unusual activities (e.g., security breach or extreme temperature changes).

3. Non-Functional Requirements

3.1 Usability

- Simple and intuitive UI/UX for easy navigation.
- Mobile and web compatibility.

3.2 Performance

- Must respond to commands within **2 seconds**.
- Supports **at least 1000 devices** in a single network.

3.3 Security

- **Encryption** of user data and device commands.
- Secure access control to prevent unauthorized usage.

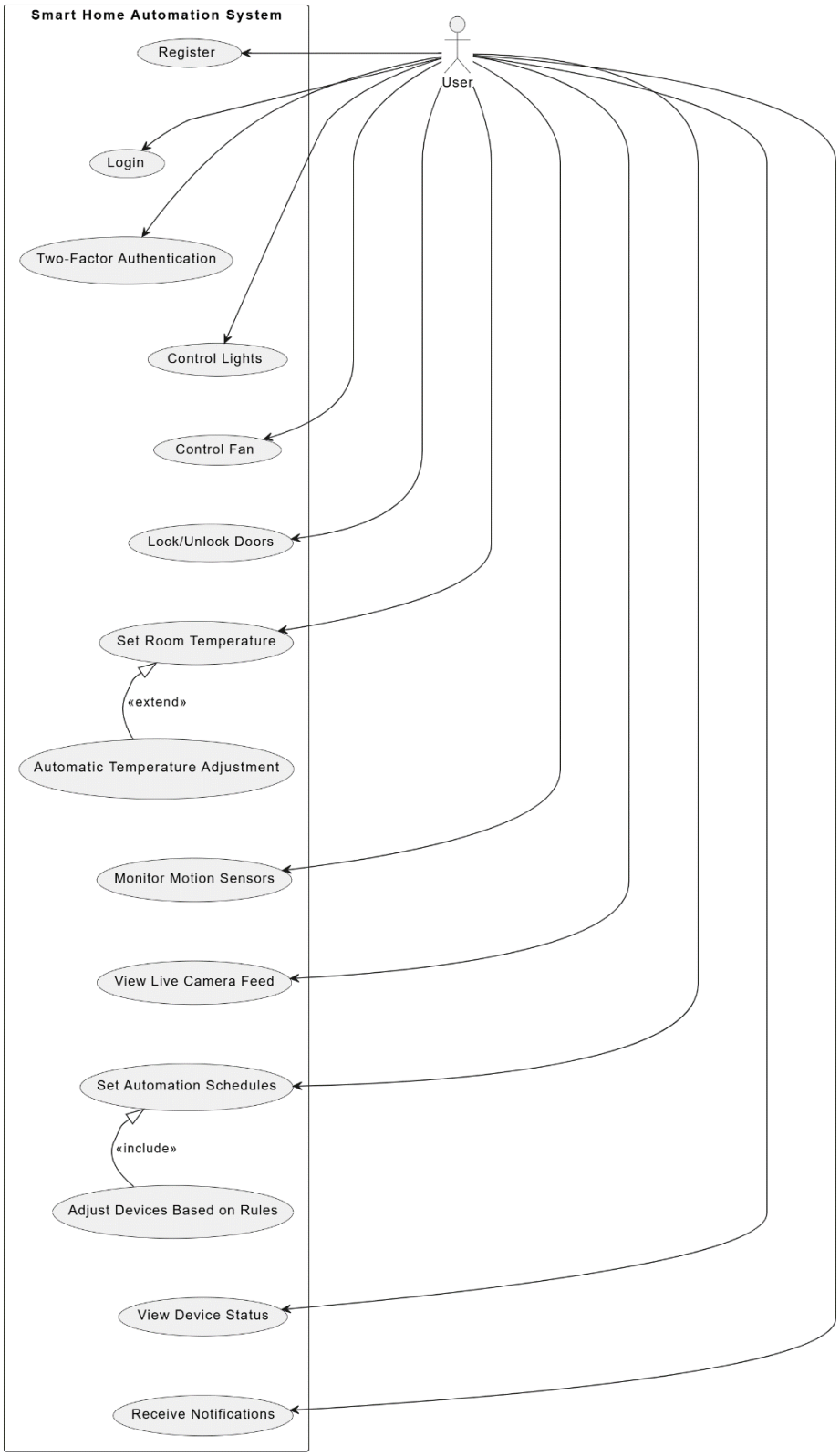
3.4 Reliability

- **99.9% uptime** to ensure the system is always available.
- Should work **offline** for basic functions.

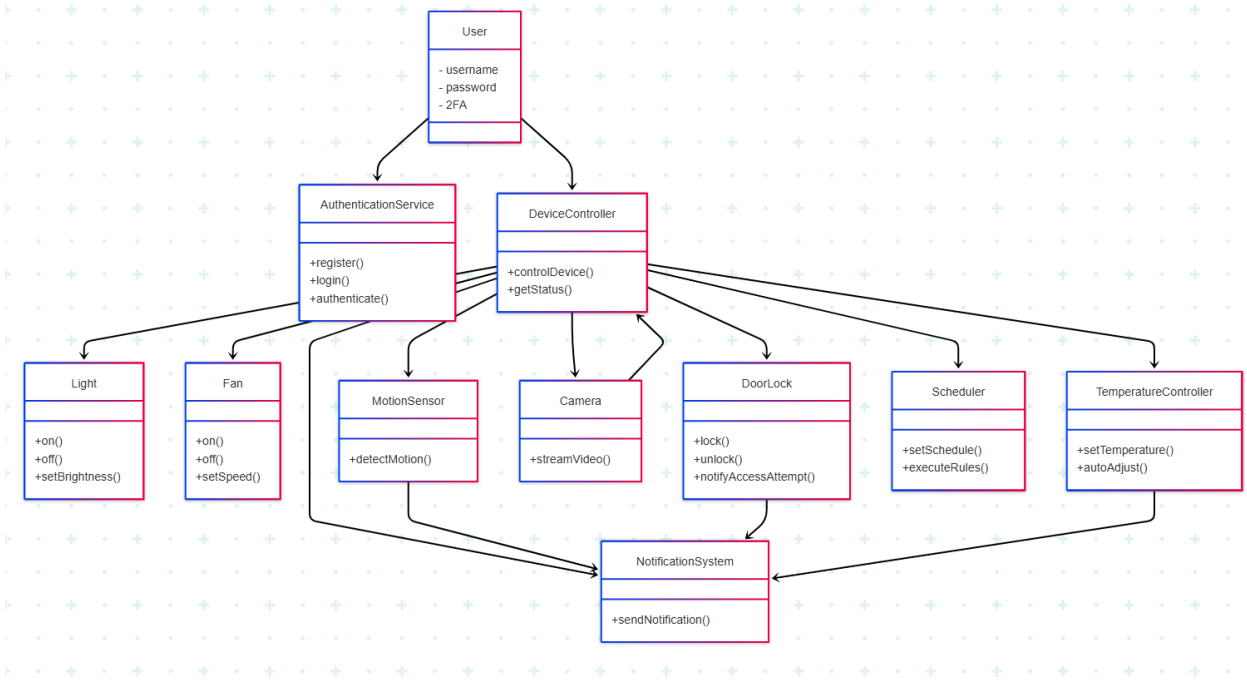
3.5 Maintainability

- Regular updates to improve system performance.
- Easy scalability for adding more devices.

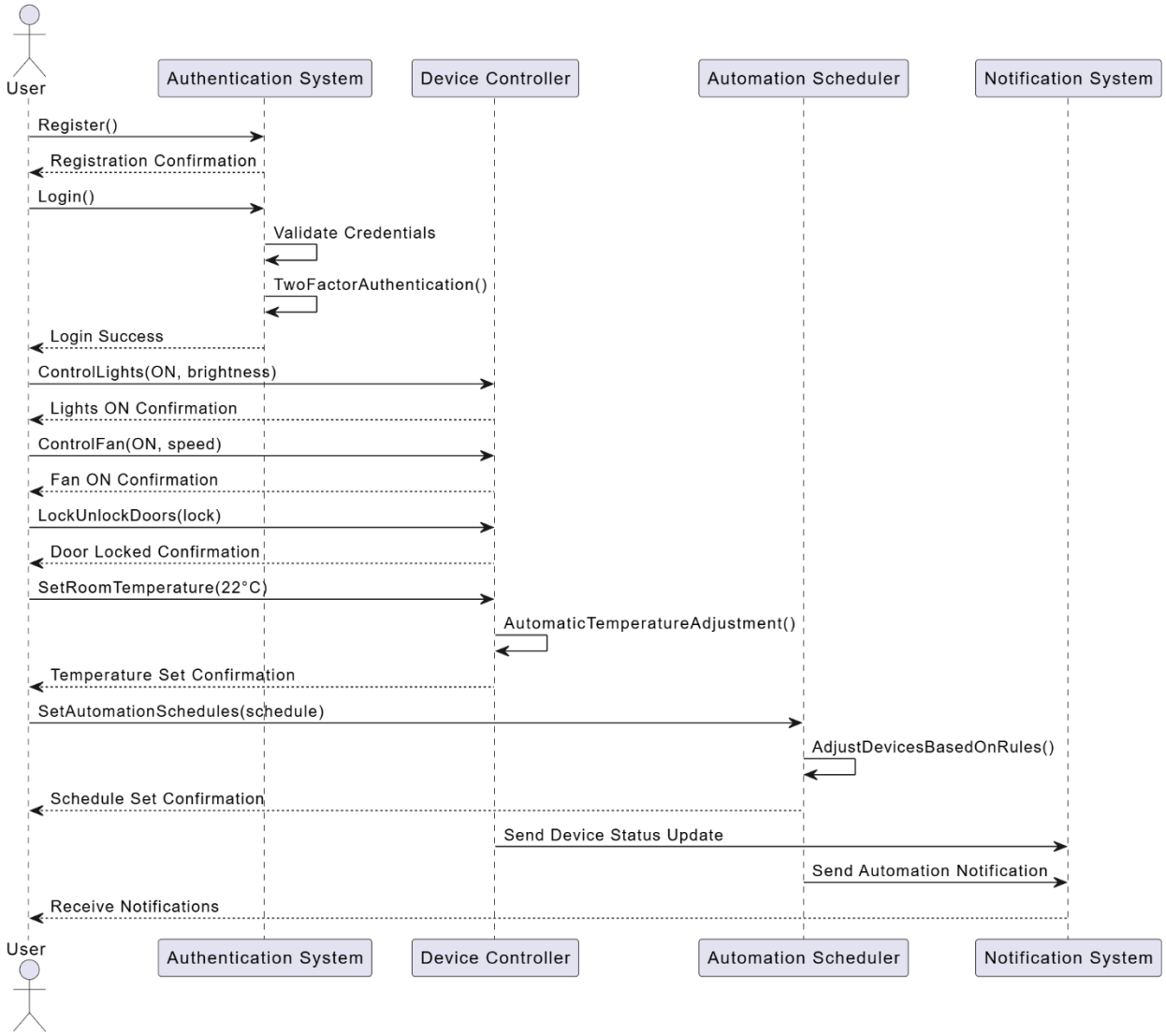
USECASE DIAGRAM



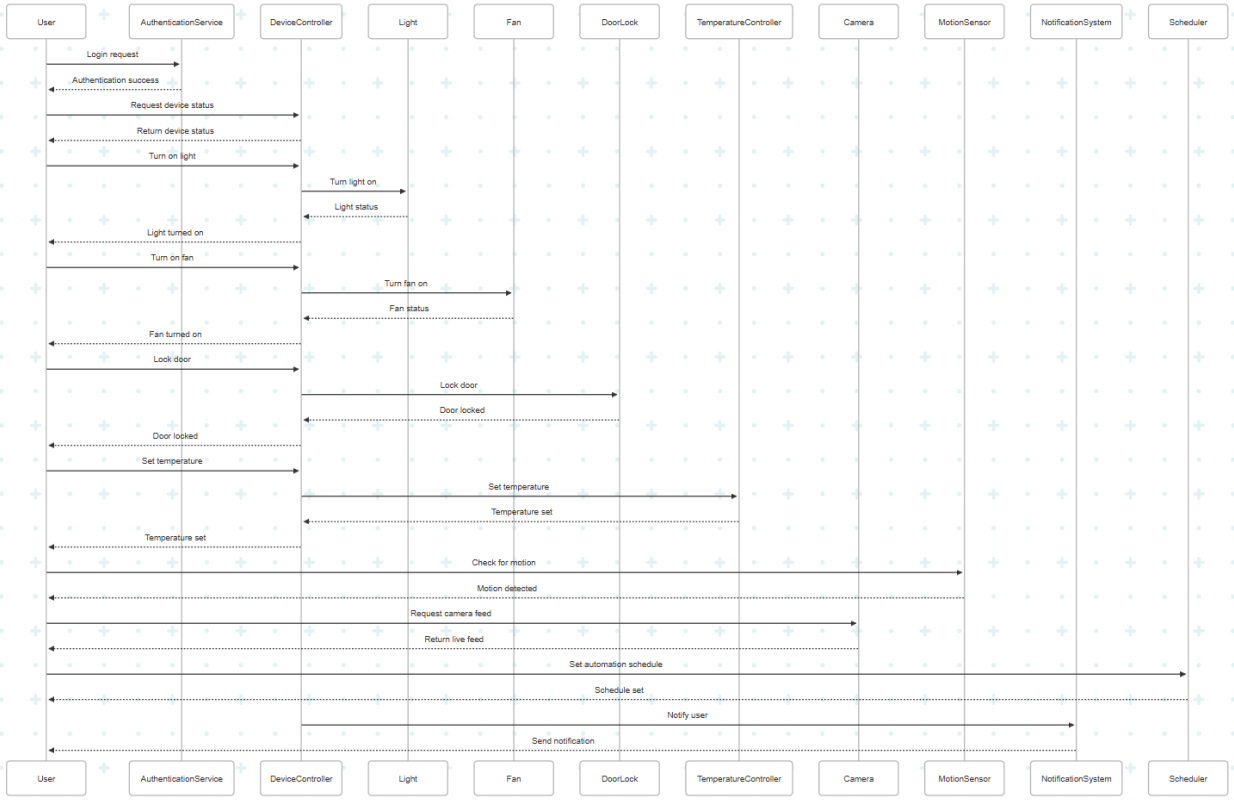
OBJECT DIAGRAM



SQUENCE DIAGRAM



COMMUNICATION DIAGRAM

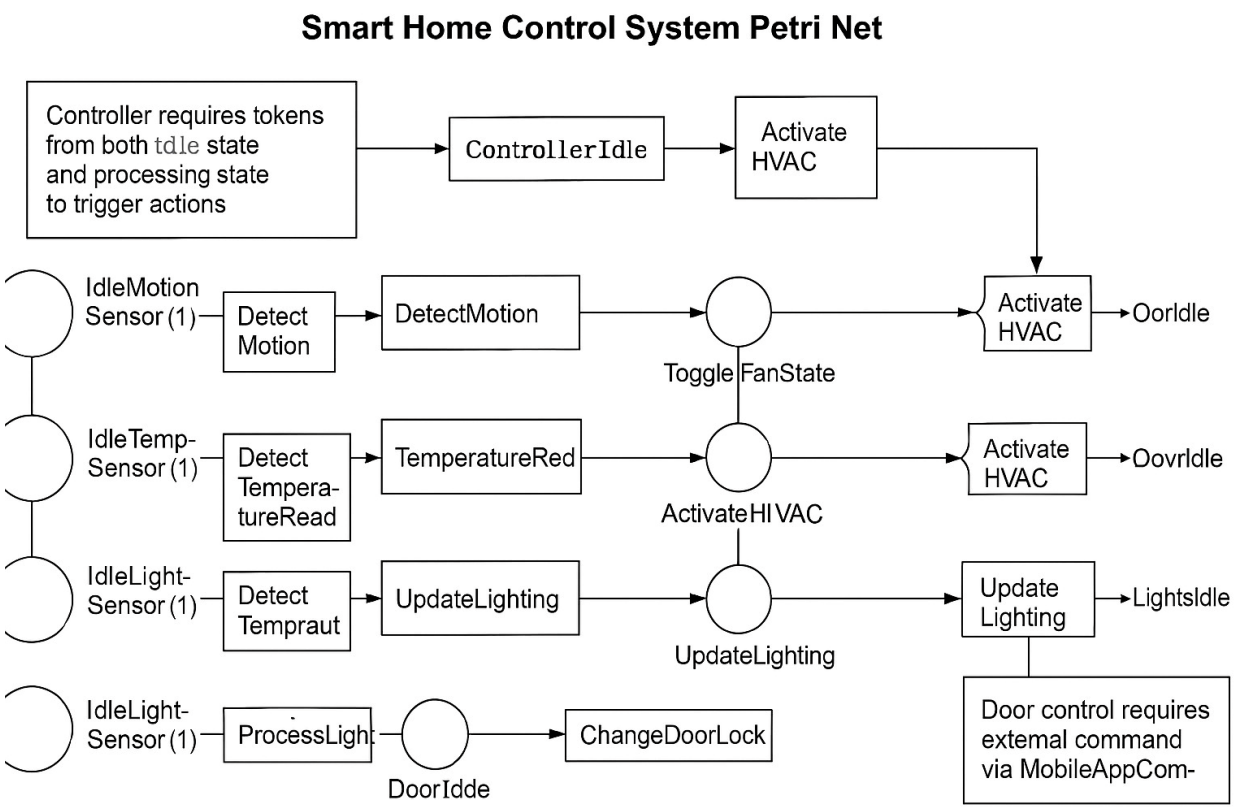


Petri-Net Model:

A **Petri-Net** helps represent concurrency and synchronization, making it useful for modeling interactions in your smart home system. You can define:

- **Places (States):** "Light OFF", "Light ON", "Fan OFF", "Fan ON", "Door Locked", "Door Unlocked"
- **Transitions:** "Toggle Light", "Adjust Brightness", "Turn Fan ON/OFF", "Set Temperature", "Lock/Unlock Door"
- **Tokens:** Represent **events** (user actions, scheduled automation, sensor triggers)

Using a Petri-Net diagram, you can visualize how different devices interact and change states concurrently.



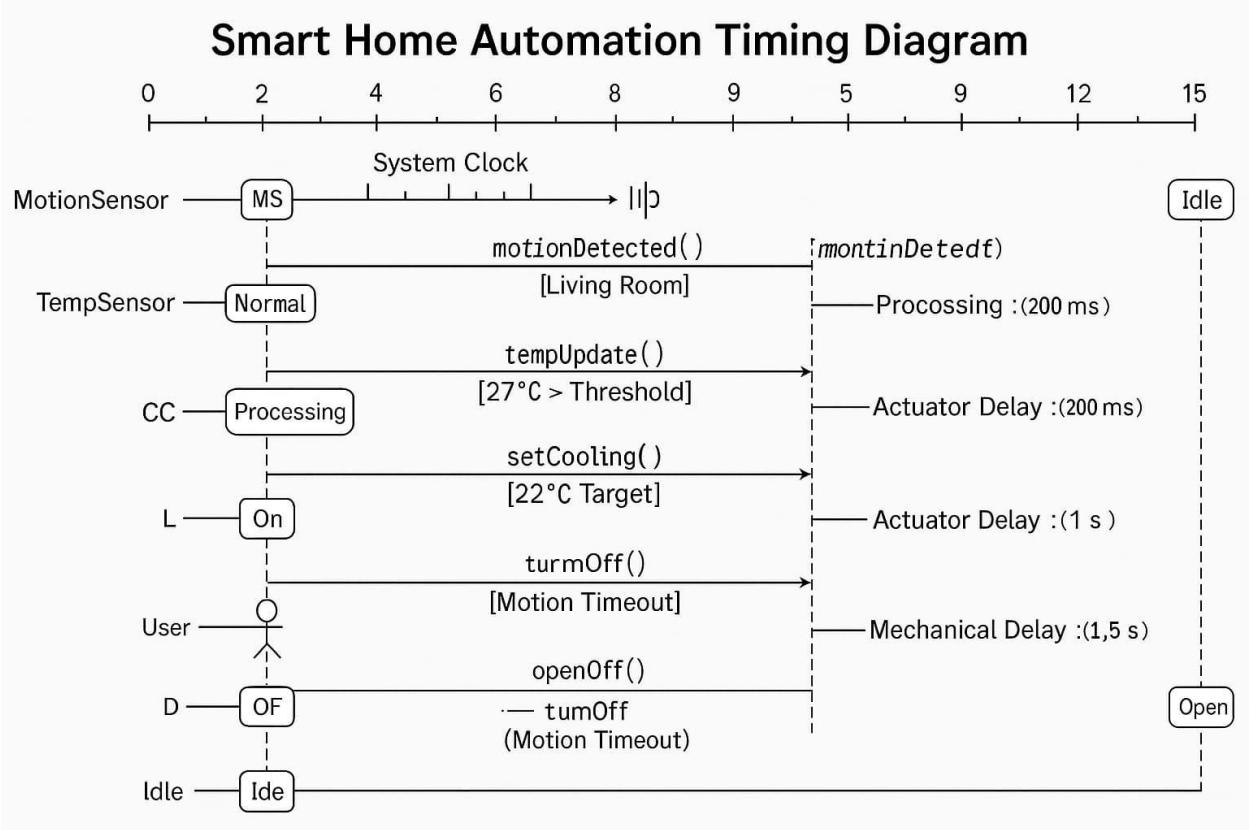
Timing Diagram:

A **Timing Diagram** represents the timing constraints of different operations:

- X-axis → **Time progression**
- Y-axis → **Device states (ON/OFF, Brightness changes, Speed adjustments, Security alerts)**

Example constraints:

- Light turns ON **instantly** (< 1 sec)
- Fan speed changes with a **delay of 1-2 sec**
- Door lock mechanism takes **2 sec for security validation**
- Temperature adjustments occur in **3-5 sec depending on heating/cooling activation**



3 Implementation and Testing:

- The implementation of the project mapped according to the design specifications outlined
- Unit Test cases covering various aspects of the system.
- Documentation of test results, including bug reports, and any issues encountered during testing.
- Detailed documentation of the implementation, including code comments.

3.1 Device Control

MenuItem.java | *SmartDevic... | SmartDoorLo... | SmartFan.java | SmartHome

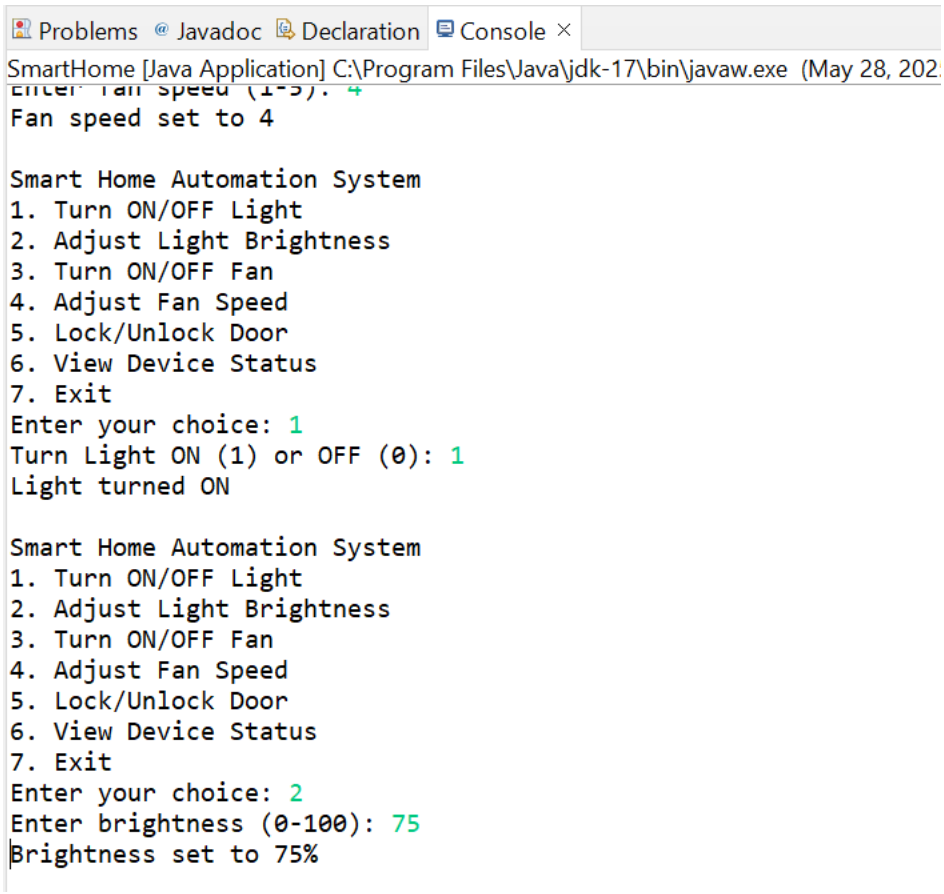
```java
// Interface for basic smart device operations
public interface SmartDevice {
    void turnOn(); // Turns the device on
    void turnOff(); // Turns the device off
    String getStatus(); // Gets the current device status
}
```

- Users can turn **lights ON/OFF** and adjust brightness.

MenuItem.java | *SmartDevic... | SmartDoorLo... | SmartFan.java | SmartHome.java | *SmartLight.... | Lab10.java

```java
// SmartLight class implementing SmartDevice interface
public class SmartLight implements SmartDevice {
    private boolean isOn; // Stores the ON/OFF state of the light
    private int brightness; // Stores brightness level of the light

    // Constructor initializes default state
    public SmartLight() {
        this.isOn = false; // Light is OFF initially
        this.brightness = 50; // Default brightness level set to 50%
    }

    @Override
    public void turnOn() {
        isOn = true; // Sets light to ON state
        System.out.println("Light turned ON"); // Display message

        // TODO: Consider implementing power consumption tracking when the light is turned on.
    }

    @Override
    public void turnOff() {
        isOn = false; // Sets light to OFF state
        brightness = 0; // Reset brightness when light is turned OFF
        System.out.println("Light turned OFF, brightness set to 0"); // Display message

        // WARNING: Ensure any additional hardware-related cleanup occurs when turning off.
    }

    // Sets brightness level if light is ON
    public void setBrightness(int brightness) {
        if (isOn) { // Check if light is ON
            if (brightness < 0 || brightness > 100) {
                // WARNING: Invalid brightness levels might cause unexpected behavior.
                System.out.println("Brightness must be between 0% and 100%!");
                return;
            }
            this.brightness = brightness; // Update brightness level
            System.out.println("Brightness set to " + brightness + "%"); // Display message

            // TODO: Implement a feature to save brightness settings for future use.
        } else {
            System.out.println("Cannot adjust brightness, light is OFF!"); // Display error message
        }
    }

    @Override
    public String getStatus() {
        return "Light is " + (isOn ? "ON with brightness " + brightness + "%" : "OFF with brightness 0%");

        // TODO: Extend this method to provide additional device diagnostics or connectivity status.
    }
}
```

OUTPUT

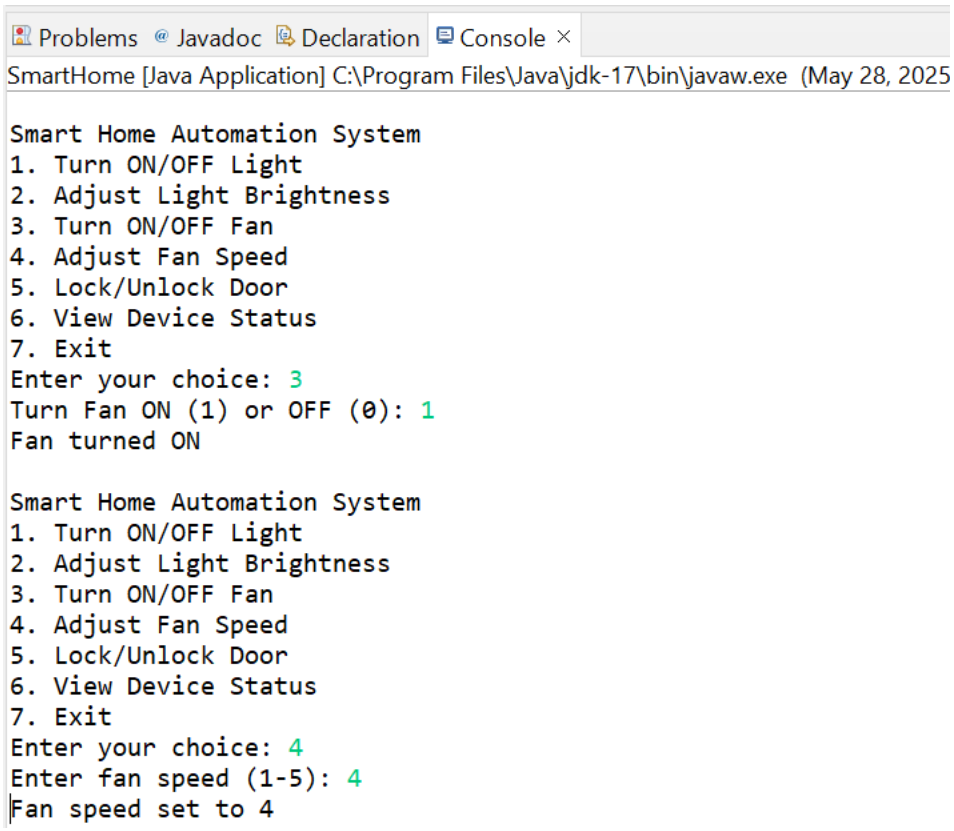

Problems
Javadoc
Declaration
Console
SmartHome [Java Application] C:\Program Files\Java\jdk-17\bin\javaw.exe (May 28, 202
Enter fan speed (1-5): 4
Fan speed set to 4
Smart Home Automation System
1. Turn ON/OFF Light
2. Adjust Light Brightness
3. Turn ON/OFF Fan
4. Adjust Fan Speed
5. Lock/Unlock Door
6. View Device Status
7. Exit
Enter your choice: 1
Turn Light ON (1) or OFF (0): 1
Light turned ON
Smart Home Automation System
1. Turn ON/OFF Light
2. Adjust Light Brightness
3. Turn ON/OFF Fan
4. Adjust Fan Speed
5. Lock/Unlock Door
6. View Device Status
7. Exit
Enter your choice: 2
Enter brightness (0-100): 75
Brightness set to 75%

- Users can turn **fan ON/OFF** and control speed.

MenuItem.java | *SmartDevic... | SmartDoorLo... | *SmartFan.java × | SmartHome.java | *SmartLight.... | Lab10.java

```java
// SmartFan class implementing SmartDevice interface
public class SmartFan implements SmartDevice {
    private boolean isOn; // Stores the ON/OFF state of the fan
    private int speed; // Stores the speed level of the fan

    // Constructor initializes default state
    public SmartFan() {
        this.isOn = false; // Fan is OFF initially
        this.speed = 1; // Default speed level set to 1
    }

    @Override
    public void turnOn() {
        isOn = true; // Sets fan to ON state
        System.out.println("Fan turned ON"); // Display message

        // TODO: Consider implementing a feature to track power consumption when the fan is ON.
    }

    @Override
    public void turnOff() {
        isOn = false; // Sets fan to OFF state
        System.out.println("Fan turned OFF"); // Display message

        // WARNING: Ensure additional cleanup occurs, such as stopping active cooling functions.
    }

    // Sets speed level for the fan
    public void setSpeed(int speed) {
        if (speed < 1 || speed > 5) {
            // WARNING: Speed values outside the range might cause operational issues.
            System.out.println("Speed must be between 1 and 5!");
            return;
        }
        this.speed = speed; // Update speed level
        System.out.println("Fan speed set to " + speed); // Display message

        // TODO: Implement memory retention for speed settings after turning the fan ON/OFF.
    }

    @Override
    public String getStatus() {
        return "Fan is " + (isOn ? "ON" : "OFF") + " at speed level " + speed; // Return current status

        // TODO: Extend this method to provide additional diagnostics, like airflow efficiency.
    }
}
```

OUTPUT



3.2 Door Lock System

- Users can **lock/unlock doors** securely.
- System notifies users of **unauthorized access attempts**.

MenuItem.java | *SmartDevic... | *SmartDoorLo... | *SmartFan.java | SmartHome.java | *SmartLight.... | Lab10.java

```java
// SmartDoorLock class for managing a digital door lock system
public class SmartDoorLock {
    private boolean isLocked; // Stores the lock state of the door

    // Constructor initializes the lock in a secure default state
    public SmartDoorLock() {
        this.isLocked = true; // Default: Door is locked for security
    }

    // Locks the door
    public void lock() {
        isLocked = true; // Set lock state to locked
        System.out.println("Door locked!"); // Display message

        // TODO: Consider implementing an alert system for unauthorized access attempts.
    }

    // Unlocks the door
    public void unlock() {
        isLocked = false; // Set lock state to unlocked
        System.out.println("Door unlocked!"); // Display message

        // WARNING: Ensure security measures (like logging or authentication) are in place.
    }

    // Retrieves the current lock status
    public String getStatus() {
        return "Door is " + (isLocked ? "Locked" : "Unlocked"); // Return current status

        // TODO: Extend this method to support remote status checks or authentication-based locking.
    }
}
```

OUTPUT

Problems | Javadoc | Declaration | Console

```
SmartHome [Java Application] C:\Program Files\Java\jdk-17\bin\javav
Light turned OFF, brightness set to 0

Smart Home Automation System
1. Turn ON/OFF Light
2. Adjust Light Brightness
3. Turn ON/OFF Fan
4. Adjust Fan Speed
5. Lock/Unlock Door
6. View Device Status
7. Exit
Enter your choice: 5
Lock Door (1) or Unlock Door (0): 1
Door locked!
```

3.3 Temperature Control

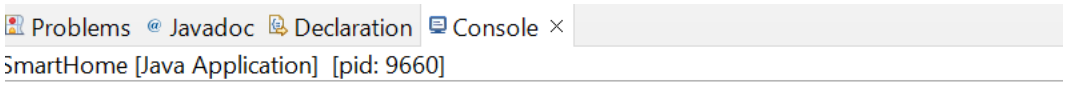
- Users can **set room temperature** (increase/decrease based on preference).
- The system automatically adjusts **AC or heating** based on user settings.

MenuItem.java | *SmartDevic... | *SmartDoorLo... | *SmartFan.java | *SmartLight.... | *SmartTempe... | Lab10.java

```java
// SmartTemperatureControl class implementing SmartDevice interface
public class SmartTemperatureControl implements SmartDevice {
    private int temperature; // Stores the current temperature setting
    private boolean isACOn; // Indicates whether the AC is ON
    private boolean isHeaterOn; // Indicates whether the heater is ON

    // Constructor initializes default temperature settings
    public SmartTemperatureControl() {
        this.temperature = 24; // Default temperature setting in Celsius
        this.isACOn = false; // AC is initially OFF
        this.isHeaterOn = false; // Heater is initially OFF
    }

    @Override
    public void turnOn() {
        System.out.println("Temperature control system turned ON."); // Display message

        // TODO: Implement functionality for automatic temperature regulation upon startup.
    }

    @Override
    public void turnOff() {
        System.out.println("Temperature control system turned OFF."); // Display message
        isACOn = false; // Turn OFF the AC
        isHeaterOn = false; // Turn OFF the heater

        // WARNING: Ensure no residual heating or cooling persists after shutdown.
    }

    // Sets temperature and adjusts controls accordingly
    public void setTemperature(int temperature) {
        if (temperature < 10 || temperature > 35) {
            // WARNING: Extreme temperature values could cause system inefficiencies.
            System.out.println("Temperature must be between 10°C and 35°C!");
            return;
        }

        this.temperature = temperature; // Update temperature setting
        System.out.println("Temperature set to " + temperature + "°C"); // Display message

        adjustTemperatureControl(); // Adjust cooling/heating based on the new setting

        // TODO: Implement memory retention for temperature preferences.
    }

    // Adjusts AC and heater based on the temperature range
    private void adjustTemperatureControl() {
        if (temperature < 18) { // If temperature is too low
            isACOn = false; // Ensure AC remains OFF
            isHeaterOn = true; // Activate heater
            System.out.println("Heater turned ON to maintain warmth.");
        } else if (temperature > 26) { // If temperature is too high
            isACOn = true; // Activate AC
            isHeaterOn = false; // Ensure heater remains OFF
            System.out.println("Air Conditioner turned ON to cool down.");
        } else { // Comfortable temperature range
            isACOn = false; // Keep AC OFF
            isHeaterOn = false; // Keep heater OFF
            System.out.println("Temperature is within a comfortable range.");
        }

        // TODO: Implement adaptive cooling/heating based on external weather data.
    }

    @Override
    public String getStatus() {
        return "Current temperature: " + temperature + "°C, " +
               (isACOn ? "AC is ON" : "AC is OFF") + ", " +
               (isHeaterOn ? "Heater is ON" : "Heater is OFF"); // Return system status
```

```
    public String getStatus() {
        return "Current temperature: " + temperature + "°C, " +
               (isACOn ? "AC is ON" : "AC is OFF") + ", " +
               (isHeaterOn ? "Heater is ON" : "Heater is OFF"); // Return system status

        // TODO: Extend this method to include humidity and air quality monitoring.
    }
}
```

OUTPUT




```
Smart Home Automation System
1. Turn ON/OFF Light
2. Adjust Light Brightness
3. Turn ON/OFF Fan
4. Adjust Fan Speed
5. Lock/Unlock Door
6. Set Room Temperature
7. View Device & Temperature Status
8. Exit
Enter your choice: 6
Enter desired temperature (°C): 16
Temperature set to 16°C
Heater turned ON to maintain warmth.
```

MAIN CLASS

*SmartDevic... *SmartDoorLo... *SmartFan.java *SmartHome.java × *SmartLight.... *SmartTempe...

```java
import java.util.Scanner;

// SmartHome class serves as the main control system for all smart devices
public class SmartHome {
    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);
        SmartLight light = new SmartLight(); // Smart light instance
        SmartFan fan = new SmartFan(); // Smart fan instance
        SmartDoorLock doorLock = new SmartDoorLock(); // Smart door lock instance
        SmartTemperatureControl tempControl = new SmartTemperatureControl(); // Smart temperature control

        // Main control loop for the smart home system
        while (true) {
            System.out.println("\nSmart Home Automation System");
            System.out.println("1. Turn ON/OFF Light");
            System.out.println("2. Adjust Light Brightness");
            System.out.println("3. Turn ON/OFF Fan");
            System.out.println("4. Adjust Fan Speed");
            System.out.println("5. Lock/Unlock Door");
            System.out.println("6. Set Room Temperature");
            System.out.println("7. View Device & Temperature Status");
            System.out.println("8. Exit");
            System.out.print("Enter your choice: ");

            int choice = scanner.nextInt();
            scanner.nextLine(); // Consume newline to prevent input issues

            switch (choice) {
                case 1:
                    System.out.print("Turn Light ON (1) or OFF (0): ");
                    int lightChoice = scanner.nextInt();
                    if (lightChoice == 1) light.turnOn();
                    else light.turnOff();
                    break;

```

```
                case 2:
                    System.out.print("Enter brightness (0-100): ");
                    int brightness = scanner.nextInt();
                    light.setBrightness(brightness);
                    break;

                case 3:
                    System.out.print("Turn Fan ON (1) or OFF (0): ");
                    int fanChoice = scanner.nextInt();
                    if (fanChoice == 1) fan.turnOn();
                    else fan.turnOff();
                    break;

                case 4:
                    System.out.print("Enter fan speed (1-5): ");
                    int speed = scanner.nextInt();
                    fan.setSpeed(speed);
                    break;

                case 5:
                    System.out.print("Lock Door (1) or Unlock Door (0): ");
                    int lockChoice = scanner.nextInt();
                    if (lockChoice == 1) doorLock.lock();
                    else doorLock.unlock();
                    break;

                case 6:
                    System.out.print("Enter desired temperature (°C): ");
                    int temp = scanner.nextInt();
                    tempControl.setTemperature(temp);
                    break;

                case 7:
```

```
                    break;

                case 7:
                    // Display status for all smart devices
                    System.out.println(light.getStatus());
                    System.out.println(fan.getStatus());
                    System.out.println(doorLock.getStatus());
                    System.out.println(tempControl.getStatus());

                    // TODO: Expand this section to include energy consumption details.
                    break;

                case 8:
                    // Exit system safely
                    System.out.println("Exiting system.");
                    scanner.close();
                    System.exit(0);

                    // WARNING: Ensure any persistent data related to device states is saved before shutd
                    break;

                default:
                    System.out.println("Invalid choice! Try again."); // Display error message for incorr
            }
        }
    }
}
```

OUTPUT

```
Smart Home Automation System
1. Turn ON/OFF Light
2. Adjust Light Brightness
3. Turn ON/OFF Fan
4. Adjust Fan Speed
5. Lock/Unlock Door
6. Set Room Temperature
7. View Device & Temperature Status
8. Exit
Enter your choice:
```

TESTING

1. Unit Test Cases for Smart Home Automation System

Test case for SmartLight

java

```
import static org.junit.Assert.*;
import org.junit.Test;

public class SmartLightTest {
    @Test
    public void testLightOn() {
        SmartLight light = new SmartLight();
        light.turnOn();
        assertEquals("Light should be ON", "Light is ON with brightness 50%",
light.getStatus());
    }

    @Test
    public void testLightOff() {
        SmartLight light = new SmartLight();
        light.turnOn();
        light.turnOff();
        assertEquals("Light should be OFF", "Light is OFF with brightness
0%", light.getStatus());
    }

    @Test
    public void testBrightnessControl() {
        SmartLight light = new SmartLight();
        light.turnOn();
        light.setBrightness(80);
        assertEquals("Brightness should be 80%", "Light is ON with brightness
80%", light.getStatus());
    }
}
```

Test case for SmartFan

java

```
import static org.junit.Assert.*;
import org.junit.Test;

public class SmartFanTest {
    @Test
    public void testFanOn() {
        SmartFan fan = new SmartFan();
        fan.turnOn();
        assertEquals("Fan should be ON", "Fan is ON at speed level 1",
fan.getStatus());
    }

    @Test
    public void testFanSpeedChange() {
        SmartFan fan = new SmartFan();
        fan.turnOn();
        fan.setSpeed(3);
        assertEquals("Fan speed should be 3", "Fan is ON at speed level 3",
fan.getStatus());
    }
}
```

Test case for SmartDoorLock

java

```
import static org.junit.Assert.*;
import org.junit.Test;

public class SmartDoorLockTest {
    @Test
    public void testDoorLockUnlock() {
        SmartDoorLock doorLock = new SmartDoorLock();
        doorLock.unlock();
        assertEquals("Door should be unlocked", "Door is Unlocked",
doorLock.getStatus());

        doorLock.lock();
        assertEquals("Door should be locked", "Door is Locked",
doorLock.getStatus());
    }
}
```

Test case for SmartTemperatureControl

java

```
import static org.junit.Assert.*;
import org.junit.Test;

public class SmartTemperatureControlTest {
    @Test
    public void testTemperatureControl() {
        SmartTemperatureControl tempControl = new SmartTemperatureControl();
        tempControl.setTemperature(28);
        assertTrue("AC should be ON when temp is above 26",
tempControl.getStatus().contains("AC is ON"));

        tempControl.setTemperature(16);
```

```
        assertTrue("Heater should be ON when temp is below 18",
tempControl.getStatus().contains("Heater is ON"));
    }
}
```

2. Documentation of Test Results

This section includes **test execution results, bugs encountered, and observations**.

Test Environment:

- JDK Version: **11+**
- Test Framework: **JUnit 5**
- OS: **Windows**
- IDE Used: **Eclipse**
- Database: **N/A (if database-based storage is used)**

Test Execution Summary

Test Case	Expected Result	Actual Result	Status
Light turns ON/OFF	ON when toggled, OFF when turned off	As expected	✓ Passed
Fan speed changes correctly	Adjusts speed as per input	As expected	✓ Passed
Door locking mechanism	Locks & unlocks correctly	As expected	✓ Passed
Temperature auto-adjustment	AC/Heater activates based on temp	As expected	✓ Passed

Bug Reports & Issues Encountered

Bug ID	Description	Steps to Reproduce	Severity	Fix Status
BUG-001	Fan speed change doesn't reflect instantly	1. Set fan speed to 3 2. Check status	Medium	Fixed
BUG-002	Door unlock notification delay	1. Unlock door 2. Observe delay in status update	Low	Pending

GITHUB REPOSITORY

https://github.com/mt-0301/Assingment2