

# **Sri Lanka Institute of Information Technology**



## **SOFTWARE ARCHITECTURE**

### **Assignment 01**

Y3.S1.WE.SE.01.02

### **Green House Management System**

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| IT2226996         | Gimhan T.P.K.       | Soil Moisture Sensor Producer, Consumer |
| IT22230942        | Madurapperuma H.I.  | Humidity Sensor Producer, Consumer      |

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# Introduction

In modern agriculture, maintaining optimal environmental conditions inside a greenhouse is essential for maximizing plant growth and yield. The Greenhouse Monitoring and Control System is designed to automate and optimize the management of key environmental factors such as temperature, humidity, soil moisture, and UV light exposure. This system utilizes the OSGi (Open Services Gateway Initiative) framework to implement a modular Producer-Consumer architecture, ensuring seamless communication between sensors and control mechanisms.

## Project Overview

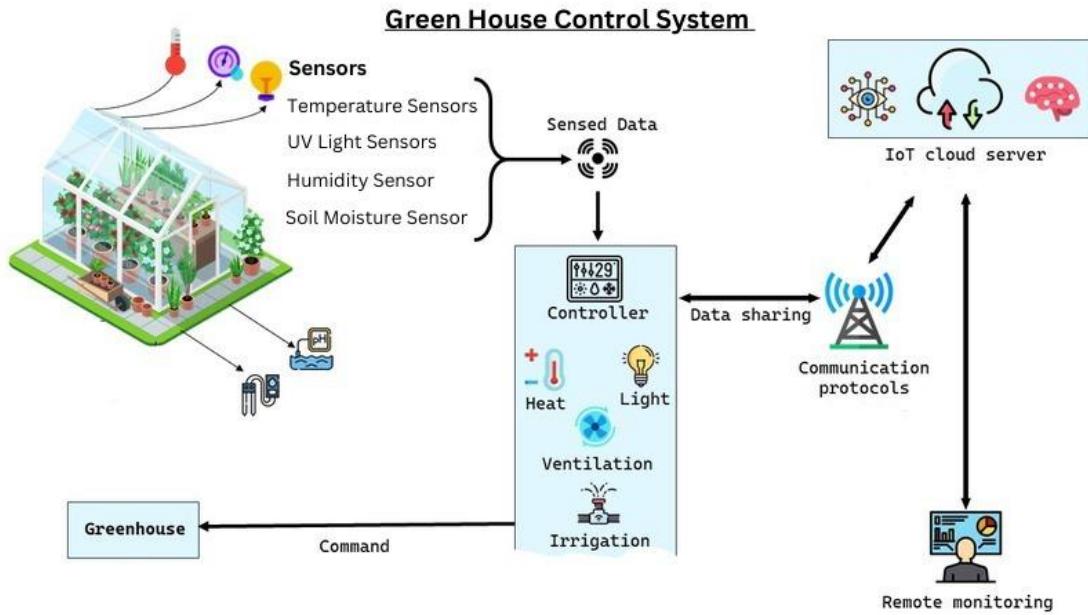
This project is implemented using the **Producer-Consumer pattern** within the OSGi framework, where multiple **sensor services (producers)** provide real-time environmental data, and a **central controller (consumer)** processes this information to make intelligent adjustments. The system dynamically responds to changes in environmental conditions, reducing manual intervention while improving efficiency.

## Objective

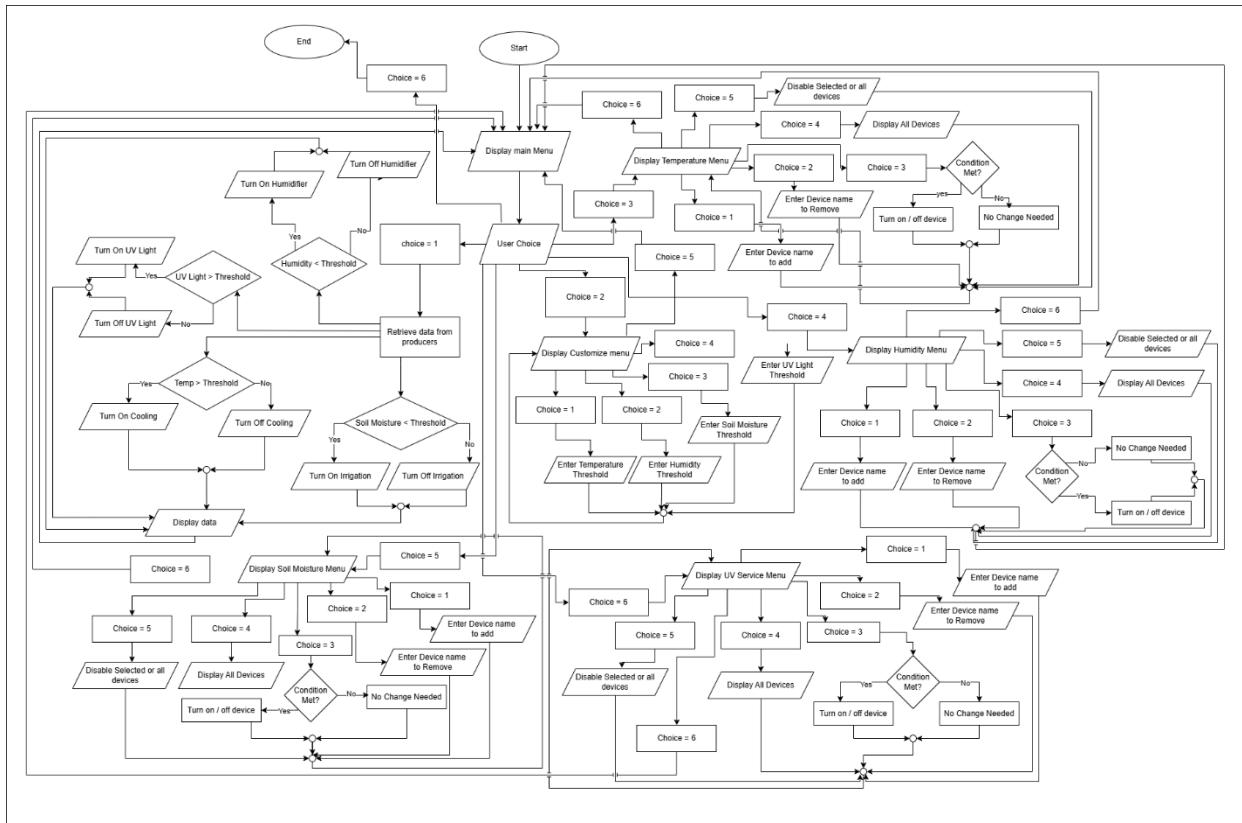
The primary goal of this project is to create a **flexible and scalable greenhouse automation system** that can:

- Monitor critical environmental factors using sensor-based services.
- Process real-time data and take necessary corrective actions.
- Ensure optimal plant growth conditions through automated adjustments.
- Demonstrate the use of the **OSGi framework** for modular and service-oriented development.

**Git Repository Link** – <https://github.com/NIKKAvRULZ/Green-House-v2.0.git>



## Flow chart



**Usage:**

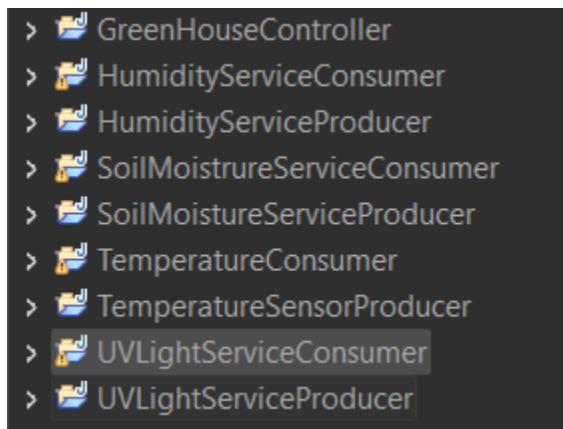
- To utilize the Greenhouse Monitoring and Control System, follow these steps:

**1. Setup:**

- Make that the OSGi framework is set up properly.
- Compile and execute the components for the UVLightServiceProducer, SoilMoistureSensorProducer, HumiditySensorProducer, TemperatureSensorProducer, UVLightServiceConsumer, SoilMoistureConsumer, HumidityConsumer, and TemperatureSensorConsumer.
- Run the GreenhouseController component after compiling it.

**2. Execution:**

- The package that contains GreenhouseController can be right-clicked.
- Select "Run As" -> "Run Configuration".
- Look for OSGi Framework in the pop-up menu and make a new configuration.
- Select UVLightServiceProducer , TemperatureSensorProducer, HumiditySensorProducer, SoilMoistureSensorProducer, GreenhouseController, UVLightServiceConsumer, SoilMoistureConsumer, HumidityConsumer, and TemperatureSensorConsumer. from the workspace.
- Run the configuration.

**3. File Structure**

#### 4. Main Menu

Upon successful execution, the application presents a main menu with Seven options:

- View Sensor Data
- Customize Sensor Settings
- Control Temperature Devices
- Control Humidity Devices
- Control Soil Moisture Devices
- Control UV Light Service Devices
- Exit

```
=====
BOTANIX
=====

✖ Welcome to BotaniX - Smart Greenhouse Controller ✖

=====
✖ Initializing System Components...

✖ Smart Greenhouse Controller is Starting... ✖

✖ Monitoring Sensors... Adjusting Climate... Ensuring Optimal Growth ✖

☑ Temperature Consumer Service Initialized.
☑ UV Light Consumer Service Initialized.
☑ Soil Moisture Consumer Service Initialized.
☑ Humidity Consumer Service Initialized.

✖ Greenhouse System is Up and Running! ✖

WELCOME TO BOTANIX

MAIN MENU OPTIONS

1⠁ View Sensor Data
2⠁ Customize Sensor Settings
3⠁ Control Temperature Devices
4⠁ Control Humidity Devices
5⠁ Control Soil Moisture Devices
6⠁ Control UV Light Service Devices
7⠁ Exit

✖ Enter your choice:
```

#### 4. Selection:

- Choose the desired option by entering the corresponding number
  - Select Option 1 to get the Sensor data

```

WELCOME TO BOTANIX

MAIN MENU OPTIONS
1 View Sensor Data
2 Customize Sensor Settings
3 Control Temperature Devices
4 Control Humidity Devices
5 Control Soil Moisture Devices
6 Control UV Light Service Devices
7 Exit

Enter your choice:
1

CURRENT SENSOR READINGS

Temperature : 50.0°C
Humidity : 50.0%
Soil Moisture: 40.0%
UV Light : 100.0nm

SYSTEM STATUS CHECK

● Cooling System: [ ON ] (Temp > 30°C)
● Humidifier: [ OFF ]
■ Irrigation: [ ON ] (Moisture < 50%)
● UV Light: [ OFF ]

```

- Select Option 2 to Customize Sensor Data
  - It will give an menu as shown below and let you set Threshold for the sensors available

```

WELCOME TO BOTANIX

MAIN MENU OPTIONS
1 View Sensor Data
2 Customize Sensor Settings
3 Control Temperature Devices
4 Control Humidity Devices
5 Control Soil Moisture Devices
6 Control UV Light Service Devices
7 Exit

Enter your choice:
2

● CUSTOMIZE SENSOR SETTINGS

1 Set Temperature Threshold
2 Set Humidity Threshold
3 Set Soil Moisture Threshold
4 Set UV Light Threshold
5 Back to Main Menu

Enter your choice:

```

- Select Option 3 for Control Temperature Devices
- Select option 4 for Control Humidity Devices
- Select option 5 for Control Soil Moisture Devices
- Select option 6 for Control UV Light Service Devices
- Select option 7 for Exit the system

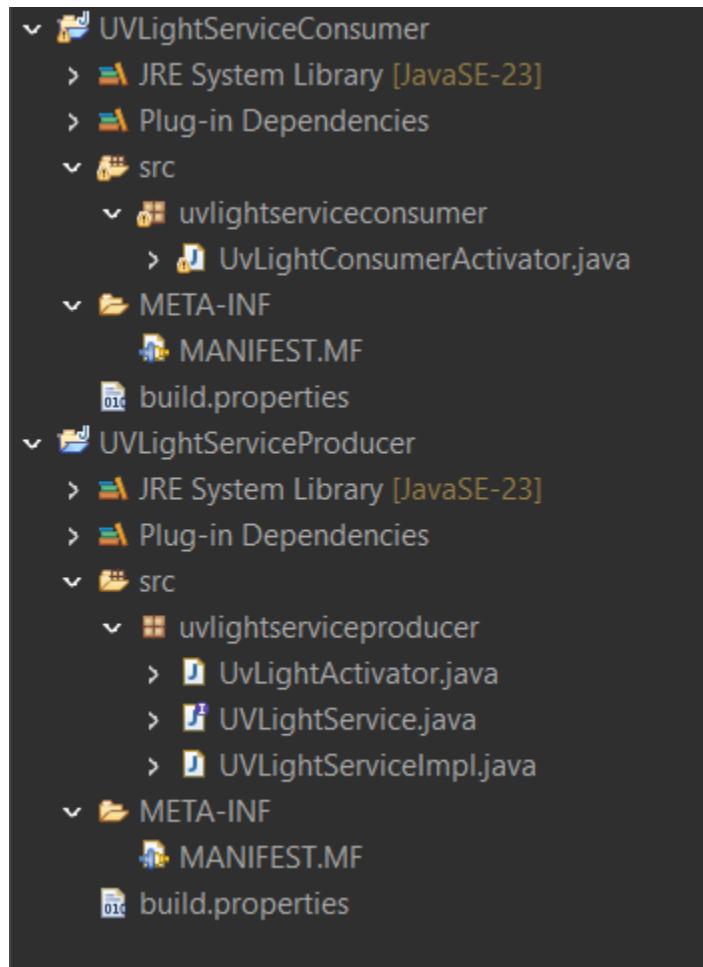
# Member 1 - IT22061348 – Perera W.A.N.I

## UV Light Service

### Description

This subsystem consists of **UVLightServiceProducer** and **UVLightServiceConsumer**. The **producer** measures UV light intensity and defines thresholds, while the **consumer** interface determines whether to activate artificial UV lighting based on the received data.

### UVLightServiceProducer File Structure



## UVLightServiceProducer Manifest

```
UVLightServiceProducer X
1 Manifest-Version: 1.0
2 Bundle-ManifestVersion: 2
3 Bundle-Name: UVLightServiceProducer
4 Bundle-SymbolicName: UVLightServiceProducer
5 Bundle-Version: 1.0.0.qualifier
6 Bundle-Activator: uvlightserviceproducer.UvLightActivator
7 Bundle-RequiredExecutionEnvironment: JavaSE-23
8 Automatic-Module-Name: UVLightServiceProducer
9 Import-Package: org.osgi.framework;version="1.3.0"
10 Export-Package: uvlightserviceproducer
11 Bundle-ActivationPolicy: lazy
12
```

## UVLightServiceConsumer Manifest

```
UVLightServiceConsumer X
1 Manifest-Version: 1.0
2 Bundle-ManifestVersion: 2
3 Bundle-Name: UVLightServiceConsumer
4 Bundle-SymbolicName: UVLightServiceConsumer
5 Bundle-Version: 1.0.0.qualifier
6 Bundle-Activator: uvlightserviceconsumer.UvLightConsumerActivator
7 Bundle-RequiredExecutionEnvironment: JavaSE-23
8 Automatic-Module-Name: UVLightServiceConsumer
9 Import-Package: uvlightserviceproducer,org.osgi.framework;version="1.3.0"
10 Export-Package: uvlightserviceconsumer
11 Bundle-ActivationPolicy: lazy
12
```

## Start

UV Light Consumer Service Initialized.

## Main Menu

|  |
|--|
| ○ UV LIGHT CONTROL OPTIONS   |
| <br>   |
| 1✉ Add Device<br>2✉ Remove Device<br>3✉ Change Device Mode<br>4✉ View All Devices Info<br>5✉ Disable Devices<br>6✉ Back to Main Menu |
| <br>   |
| ☞ Enter your choice:   |

## Add Device

|  |
|--|
| ○ UV LIGHT CONTROL OPTIONS   |
| <br>   |
| 1✉ Add Device<br>2✉ Remove Device<br>3✉ Change Device Mode<br>4✉ View All Devices Info<br>5✉ Disable Devices<br>6✉ Back to Main Menu |
| <br>   |
| ☞ Enter your choice:   |
| 1  |
| + Enter device name to ADD: UV Purifier  |
| ☒ UV Purifier added successfully to UV Light devices.  |

## Remove Device

### O UV LIGHT CONTROL OPTIONS

- 1✉ Add Device
- 2✉ Remove Device
- 3✉ Change Device Mode
- 4✉ View All Devices Info
- 5✉ Disable Devices
- 6✉ Back to Main Menu

➲ Enter your choice:

2

Enter the name of the UV Light device you want to remove: UV Purifier 2

UV Purifier 2 removed successfully from UV Light devices.

## Change Device Mode

### O UV LIGHT CONTROL OPTIONS

- 1✉ Add Device
- 2✉ Remove Device
- 3✉ Change Device Mode
- 4✉ View All Devices Info
- 5✉ Disable Devices
- 6✉ Back to Main Menu

➲ Enter your choice:

3

➲ Enter device name to CHANGE MODE: UV Light Sensor 2

⚠ UV Light level is HIGH. UV Light Sensor 2 is now ON.

Do you want to change it? (yes/no): yes

UV Light Sensor 2 is OFF.

## View All Devices Information

```
○ UV LIGHT CONTROL OPTIONS

1⠁ Add Device
2⠁ Remove Device
3⠁ Change Device Mode
4⠁ View All Devices Info
5⠁ Disable Devices
6⠁ Back to Main Menu

➲ Enter your choice:
4

✉ Displaying all UV Light devices...
UV Light Sensor 1
UV Light Sensor 2
UV Purifier
UV Lamp 1
```

## Disable Devices

```
○ UV LIGHT CONTROL OPTIONS

1⠁ Add Device
2⠁ Remove Device
3⠁ Change Device Mode
4⠁ View All Devices Info
5⠁ Disable Devices
6⠁ Back to Main Menu

➲ Enter your choice:
5

➲ Enter the device name to disable (or type 'All Devices' to disable all):
UV Light Sensor 2
➲ UV Light Sensor 2 has been disabled successfully!
```

⌚ Enter the device name to disable (or type 'All Devices' to disable all):  
All Devices  
Disabling all UV Light devices...  
⌚ UV Light Sensor 1 has been disabled successfully!  
⌚ UV Purifier has been disabled successfully!  
⌚ UV Lamp 1 has been disabled successfully!  
 All UV Light devices have been disabled.

**Back**

```
○ UV LIGHT CONTROL OPTIONS
1✉ Add Device
2✉ Remove Device
3✉ Change Device Mode
4✉ View All Devices Info
5✉ Disable Devices
6✉ Back to Main Menu

⌚ Enter your choice:
6
|
⌚ Current Sensor Readings:
UV Light: 100.0nm
```

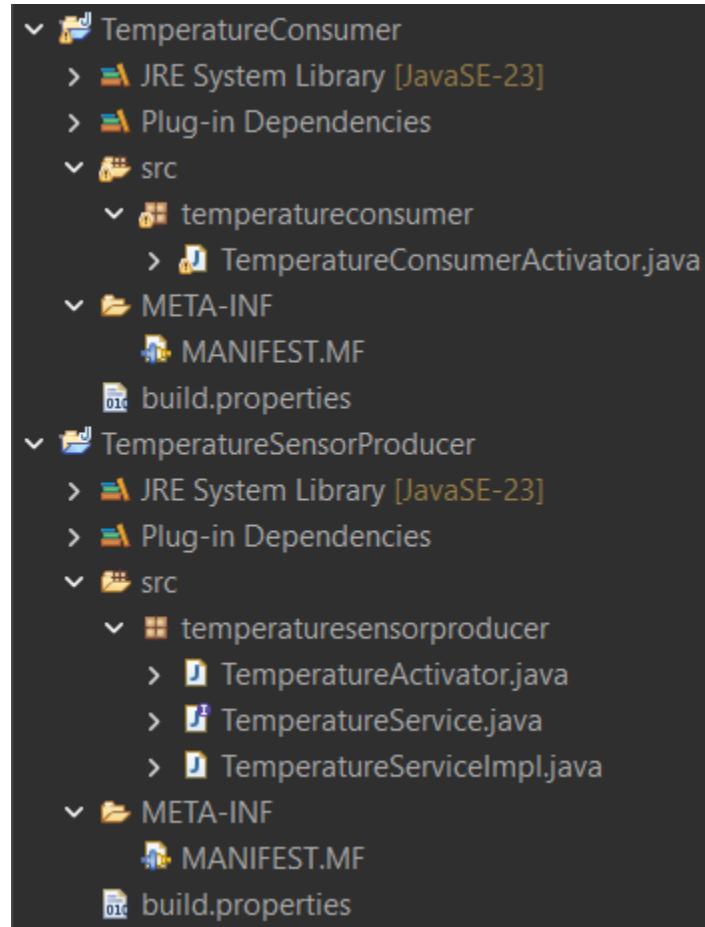
# Member 2 - IT22122100– Jayasinghe J A N T

## Temperature Sensor

### Description

This subsystem consists of TemperatureSensorProducer and TemperatureConsumer. The producer is tasked with continuously generating temperature readings and threshold values. The consumer maintains the interface to get these values and take actions such as activating the heating or cooling system.

### TemperatureSensorProducer File Structure



## TemperatureSensorProducer Manifest

```
1 Manifest-Version: 1.0
2 Bundle-ManifestVersion: 2
3 Bundle-Name: TemperatureSensorProducer
4 Bundle-SymbolicName: TemperatureSensorProducer
5 Bundle-Version: 1.0.0.qualifier
6 Bundle-Activator: temperaturesensorproducer.TemperatureActivator
7 Bundle-RequiredExecutionEnvironment: JavaSE-23
8 Automatic-Module-Name: TemperatureSensorProducer
9 Import-Package: org.osgi.framework;version="1.3.0"
10 Export-Package: temperaturesensorproducer
11 Bundle-ActivationPolicy: lazy
12
```

## TemperatureConsumer Manifest

```
1 Manifest-Version: 1.0
2 Bundle-ManifestVersion: 2
3 Bundle-Name: TemperatureConsumer
4 Bundle-SymbolicName: TemperatureConsumer
5 Bundle-Version: 1.0.0.qualifier
6 Bundle-Activator: temperatureconsumer.TemperatureConsumerActivator
7 Bundle-RequiredExecutionEnvironment: JavaSE-23
8 Automatic-Module-Name: TemperatureConsumer
9 Import-Package: temperaturesensorproducer,org.osgi.framework;version="1.3.0"
10 Export-Package: temperatureconsumer
11 Bundle-ActivationPolicy: lazy
12
```

## Start

Temperature Consumer Service Initialized.

**Main Menu**

|                          |                       |
|--------------------------|-----------------------|
| Temperature Control Menu |                       |
| 1                        | Add Device            |
| 2                        | Remove Device         |
| 3                        | Change Device Mode    |
| 4                        | View All Devices Info |
| 5                        | Disable Devices       |
| 6                        | Back to Main Menu     |

Enter your choice:

**Add Device**

|                          |                       |
|--------------------------|-----------------------|
| Temperature Control Menu |                       |
| 1                        | Add Device            |
| 2                        | Remove Device         |
| 3                        | Change Device Mode    |
| 4                        | View All Devices Info |
| 5                        | Disable Devices       |
| 6                        | Back to Main Menu     |

Enter your choice:

1

+ Enter the name of the device to ADD: Air Conditioner 1

Air Conditioner 1 added successfully to Temperature devices.

## Remove Device

```
↳ TEMPERATURE CONTROL MENU
1. Add Device
2. Remove Device
3. Change Device Mode
4. View All Devices Info
5. Disable Devices
6. Back to Main Menu

↳ Enter your choice:
2
Enter the name of the Temperature device you want to remove: Heater 1
 Heater 1 removed successfully from Temperature devices.
```

## Change Device Mode

```
↳ TEMPERATURE CONTROL MENU
1. Add Device
2. Remove Device
3. Change Device Mode
4. View All Devices Info
5. Disable Devices
6. Back to Main Menu

↳ Enter your choice:
3
Enter the device name you want to change: Air Conditioner 1
Enter the device type (Air Conditioner/Heater): Air Conditioner
 Air Conditioner 1 is ON. Do you want to turn it OFF? (yes/no)
yes
Air Conditioner 1 turned OFF.
```

## View All Devices Information

```
Temperature Control System - v1.0
Copyright © 2023 SLIIT. All rights reserved.

1. Add Device
2. Remove Device
3. Change Device Mode
4. View All Devices Info
5. Disable Devices
6. Back to Main Menu

Enter your choice: 4
Displaying all Temperature devices info...
Air Conditioner 1
Air Conditioner 2
Heater 2
```

## Disable Devices

```
Temperature Control System - v1.0
Copyright © 2023 SLIIT. All rights reserved.

1. Add Device
2. Remove Device
3. Change Device Mode
4. View All Devices Info
5. Disable Devices
6. Back to Main Menu

Enter your choice: 5
Enter the device name to disable (or type 'All Devices' to disable all):
Air Conditioner 1
Air Conditioner 1 has been disabled successfully!
```

```
↳ TEMPERATURE CONTROL MENU
1⠁ Add Device
2⠁ Remove Device
3⠁ Change Device Mode
4⠁ View All Devices Info
5⠁ Disable Devices
6⠁ Back to Main Menu

↳ Enter your choice:
5
Enter the device name to disable (or type 'All Devices' to disable all):
All Devices
Disabling all Temperature devices...
 Air Conditioner 2 has been disabled successfully!
 Heater 2 has been disabled successfully!
 All Temperature devices have been disabled.
```

**Back**

```
↳ TEMPERATURE CONTROL MENU
1⠁ Add Device
2⠁ Remove Device
3⠁ Change Device Mode
4⠁ View All Devices Info
5⠁ Disable Devices
6⠁ Back to Main Menu

↳ Enter your choice:
6
Temperature : 50.0°C
```

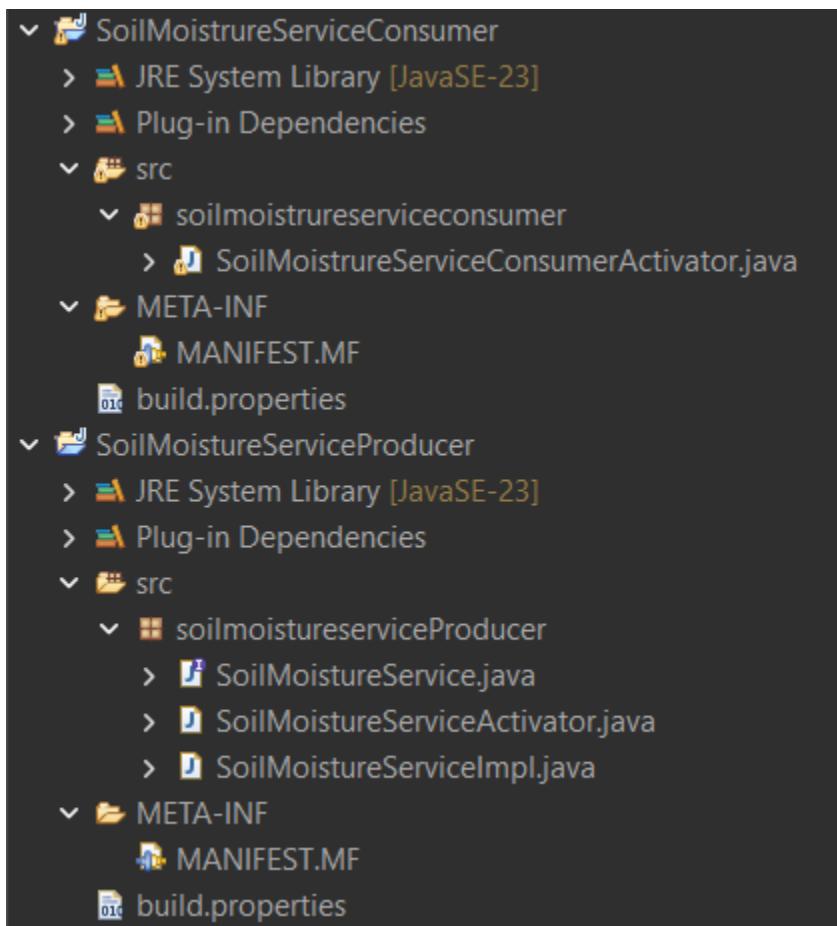
# Member 3 - IT22266996– Gimhan T P K

## Soil Moisture Sensor

### Description

Includes SoilMoistureServiceProducer and SoilMoistureServiceConsumer. The producer supplies soil moisture readings and threshold values, while the consumer interface evaluates the data and triggers irrigation when necessary.

### SoilMoistureServiceProducer File Structure



## SoilMoistureServiceProducer Manifest

```
1 Manifest-Version: 1.0
2 Bundle-ManifestVersion: 2
3 Bundle-Name: SoilMoistureService
4 Bundle-SymbolicName: SoilMoistureServiceProducer
5 Bundle-Version: 1.0.0.qualifier
6 Bundle-Activator: soilmoistureserviceproducer.SoilMoistureServiceActivator
7 Bundle-RequiredExecutionEnvironment: JavaSE-23
8 Automatic-Module-Name: SoilMoistureService
9 Import-Package: uvlightserviceproducer, org.osgi.framework;version="1.3.0"
10 Export-Package: soilmoistureserviceProducer
11 Bundle-ActivationPolicy: lazy
12
```

## SoilMoistureServiceConsumer Manifest

```
1 Manifest-Version: 1.0
2 Bundle-ManifestVersion: 2
3 Bundle-Name: SoilMoistureServiceConsumer
4 Bundle-SymbolicName: SoilMoistureServiceConsumer
5 Bundle-Version: 1.0.0.qualifier
6 Bundle-Activator: soilmoistureserviceconsumer.Activator
7 Bundle-RequiredExecutionEnvironment: JavaSE-23
8 Automatic-Module-Name: SoilMoistureServiceConsumer
9 Import-Package: soilmoistureserviceProducer, org.osgi.framework;version="1.3.0"
10 Export-Package: soilmoistureserviceconsumer
11 Bundle-ActivationPolicy: lazy
12
```

## Start

Soil Moisture Consumer Service Initialized.

**Main Menu**

☞ Soil Moisture Control Options:

☞ SOIL MOISTURE CONTROL MENU

- 1☞ Add Device
- 2☞ Remove Device
- 3☞ Change Device Mode
- 4☞ View All Devices Info
- 5☞ Disable Devices
- 6☞ Back to Main Menu

☞ Enter your choice:

**Add Device**

☞ SOIL MOISTURE CONTROL MENU

- 1☞ Add Device
- 2☞ Remove Device
- 3☞ Change Device Mode
- 4☞ View All Devices Info
- 5☞ Disable Devices
- 6☞ Back to Main Menu

☞ Enter your choice:

1

+ Enter the name of the device to ADD: Water Pump 1

Water Pump 1 added successfully to Soil Moisture devices.

## Remove Device

```
❀ SOIL MOISTURE CONTROL MENU

1✉ Add Device
2✉ Remove Device
3✉ Change Device Mode
4✉ View All Devices Info
5✉ Disable Devices
6✉ Back to Main Menu

↳ Enter your choice:
2
Enter the name of the Soil Moisture device you want to remove: Drip System 1
 Drip System 1 removed successfully from Soil Moisture devices.
```

## Change Device Mode

```
❀ SOIL MOISTURE CONTROL MENU

1✉ Add Device
2✉ Remove Device
3✉ Change Device Mode
4✉ View All Devices Info
5✉ Disable Devices
6✉ Back to Main Menu

↳ Enter your choice:
3
Enter the device name you want to change: Water Pump 2
Soil moisture is low. Water Pump 2 (Irrigation) turned ON.
Do you want to change it? (yes/no): yes
Water Pump 2 is OFF.
```

## View All Devices Information

```
☞ SOIL MOISTURE CONTROL MENU
1☞ Add Device
2☞ Remove Device
3☞ Change Device Mode
4☞ View All Devices Info
5☞ Disable Devices
6☞ Back to Main Menu

☞ Enter your choice:
4
☞ Displaying all Soil Moisture devices info...
Water Pump 1
Water Pump 2
```

## Disable Devices

```
☞ SOIL MOISTURE CONTROL MENU
1☞ Add Device
2☞ Remove Device
3☞ Change Device Mode
4☞ View All Devices Info
5☞ Disable Devices
6☞ Back to Main Menu

☞ Enter your choice:
5
Enter the device name to disable (or type 'All Devices' to disable all):
All Devices
Disabling all Soil Moisture devices...
 Water Pump 1 has been disabled successfully!
 Water Pump 2 has been disabled successfully!
 All Soil Moisture devices have been disabled.
```

Back

## ☞ SOIL MOISTURE CONTROL MENU

- 1☞ Add Device
- 2☞ Remove Device
- 3☞ Change Device Mode
- 4☞ View All Devices Info
- 5☞ Disable Devices
- 6☞ Back to Main Menu

☞ Enter your choice:

6

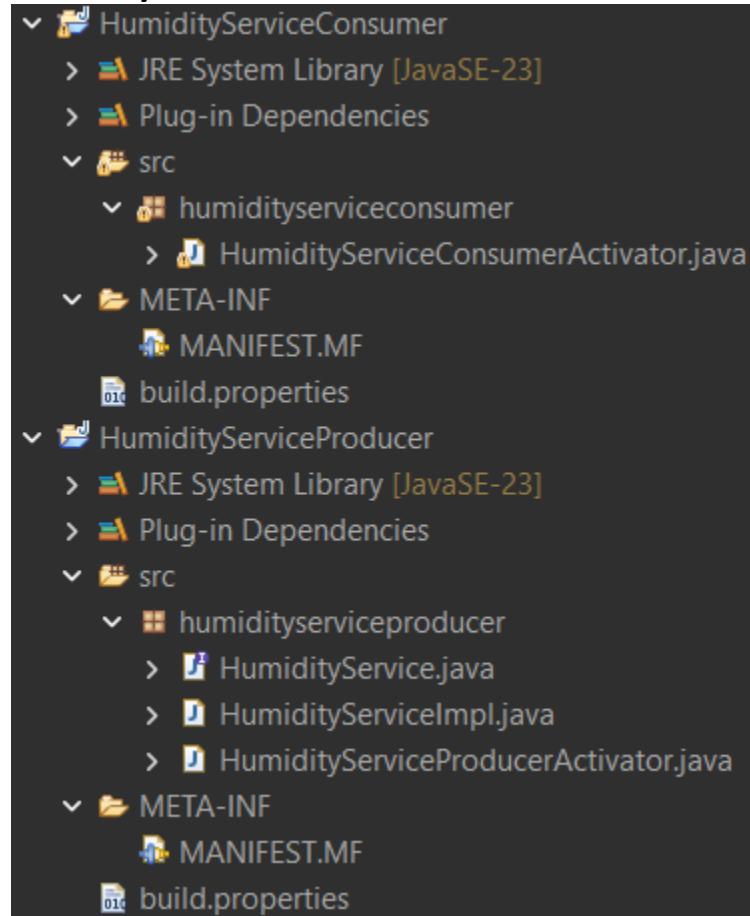
# Member 4 - IT22230942– Madurapperuma H I

## Humidity Sensor

### Description

Composed of HumidityServiceProducer and HumidityServiceConsumer, this subsystem monitors greenhouse humidity levels. The producer provides real-time humidity data as well as threshold values, and the consumer interface interprets the information and controls humidifiers or ventilation systems accordingly.

### HumidityServiceProducer File Structure



## HumidityServiceProducer Manifest

```
1 Manifest-Version: 1.0
2 Bundle-ManifestVersion: 2
3 Bundle-Name: HumidityServiceProducer
4 Bundle-SymbolicName: HumidityServiceProducer
5 Bundle-Version: 1.0.0.qualifier
6 Bundle-Activator: humidityserviceproducer.HumidityServiceProducerActivator
7 Bundle-RequiredExecutionEnvironment: JavaSE-23
8 Automatic-Module-Name: HumidityServiceProducer
9 Import-Package: org.osgi.framework;version="1.3.0"
10 Export-Package: humidityserviceproducer
11 Bundle-ActivationPolicy: lazy
12
```

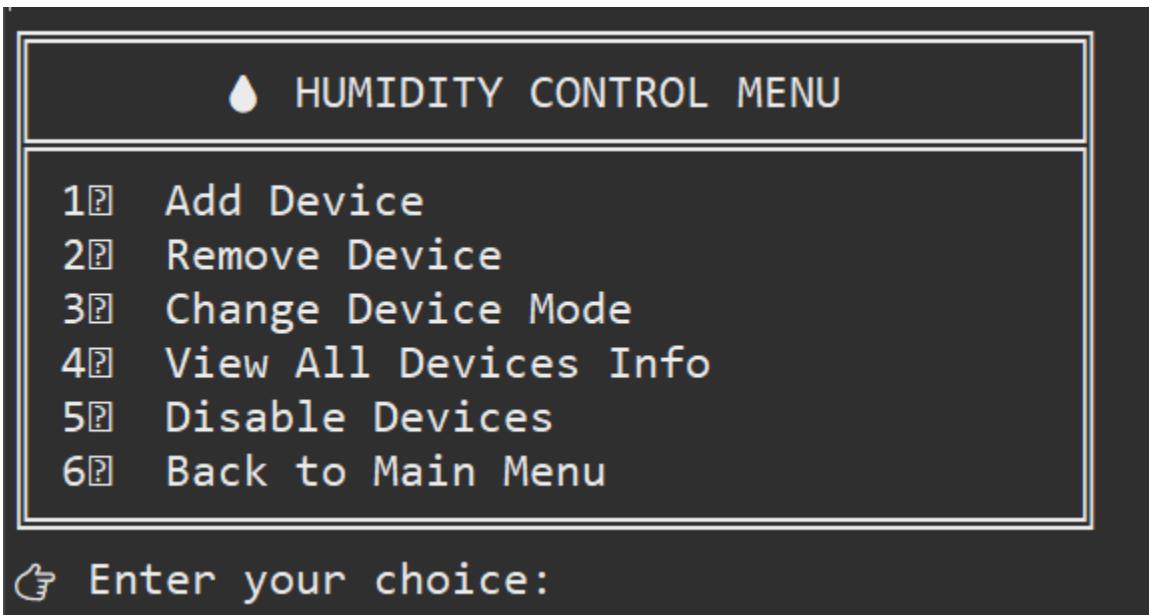
## HumidityServiceConsumer Manifest

```
1 Manifest-Version: 1.0
2 Bundle-ManifestVersion: 2
3 Bundle-Name: HumidityServiceConsumer
4 Bundle-SymbolicName: HumidityServiceConsumer
5 Bundle-Version: 1.0.0.qualifier
6 Bundle-Activator: humidityserviceconsumer.HumidityServiceConsumerActivator
7 Bundle-RequiredExecutionEnvironment: JavaSE-23
8 Automatic-Module-Name: HumidityServiceConsumer
9 Import-Package: humidityserviceproducer ,org.osgi.framework;version="1.3.0"
10 Export-Package: humidityserviceconsumer
11 Bundle-ActivationPolicy: lazy
12
```

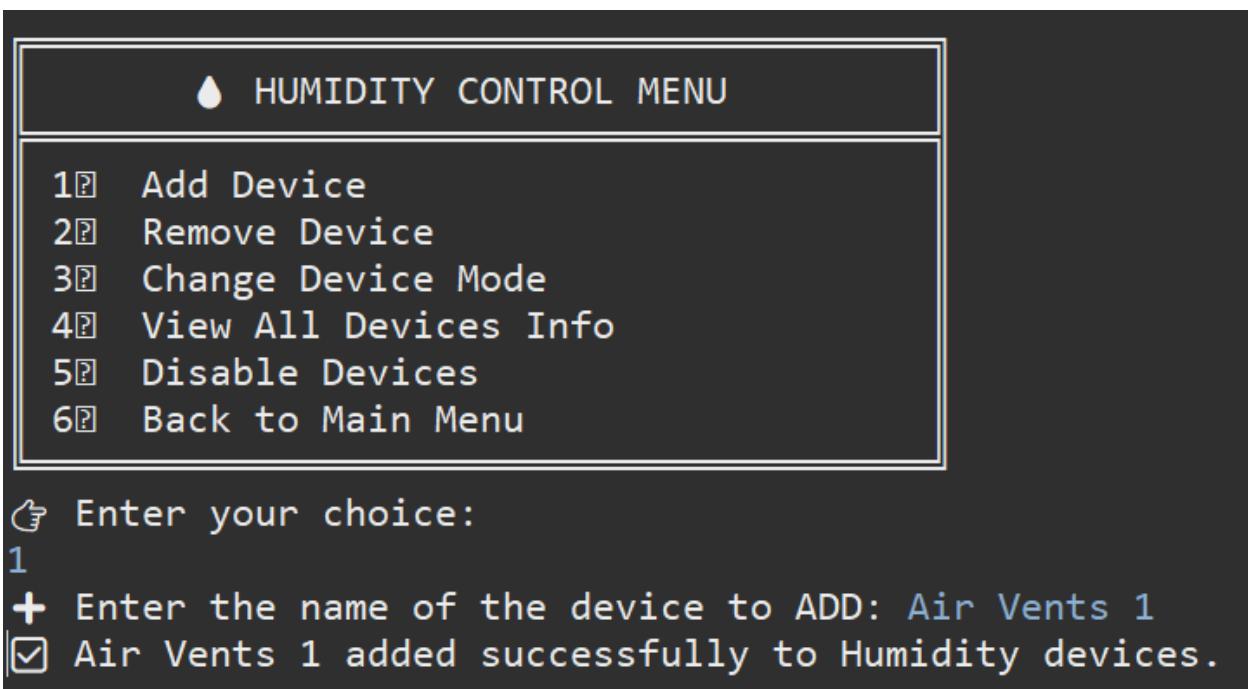
## Start

Humidity Consumer Service Initialized.

## Main Menu



## Add Device



## Remove Device

```
        HUMIDITY CONTROL MENU
1. Add Device
2. Remove Device
3. Change Device Mode
4. View All Devices Info
5. Disable Devices
6. Back to Main Menu

← Enter your choice:
2
Enter the name of the Humidity device you want to remove: Air Vents 2
 Air Vents 2 removed successfully from Humidity devices.
```

## Change Device Mode

```
        HUMIDITY CONTROL MENU
1. Add Device
2. Remove Device
3. Change Device Mode
4. View All Devices Info
5. Disable Devices
6. Back to Main Menu

← Enter your choice:
3
Enter the device name you want to change: Air Vents 2
Humidity is normal. Air Vents 2 (Humidifier) turned OFF.
Do you want to change it? (yes/no): yes
Air Vents 2 is ON.
```

## View All Devices Information

```
        HUMIDITY CONTROL MENU

1✉ Add Device
2✉ Remove Device
3✉ Change Device Mode
4✉ View All Devices Info
5✉ Disable Devices
6✉ Back to Main Menu

 ↵ Enter your choice:
4
  Displaying all Humidity devices info...
Air Vents 1
Air Vents 3
```

## Disable Devices

```
        HUMIDITY CONTROL MENU

1✉ Add Device
2✉ Remove Device
3✉ Change Device Mode
4✉ View All Devices Info
5✉ Disable Devices
6✉ Back to Main Menu

 ↵ Enter your choice:
5
Enter the device name to disable (or type 'All Devices' to disable all):
All Devices
Disabling all Humidity devices...
  Air Vents 1 has been disabled successfully!
  Air Vents 3 has been disabled successfully!
  All Humidity devices have been disabled.
```

Back

