

VIRTUAL INTERNSHIP 6.0



SMART HOME ENERGY MANAGEMENT SYSTEM

Module 2 –
Smart Device Management

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OVERALL SYSTEM FLOW

The Smart Home Energy Management System is divided into four modules that work sequentially:

Module 1: Authentication & Access Control

- Verifies the identity of the user and prevents unauthorized access.

Module 2: Smart Device Management

- Allows authenticated users to register and control smart devices.

Module 3: Real-Time Energy Tracking

- Records energy consumption of devices.

Module 4: Analytics & Reports

- Analyzes energy data and provides insights for optimization.

Dependency Between Module 1 and Module 2:

Module 2 becomes active only after Module 1 successfully authenticates the user.

This design ensures:

- Only valid users can control devices
- Device operations are secure
- Misuse and safety risks are avoided

Why Module 2 Cannot Exist Independently?

Smart devices control real electrical appliances.

Allowing device control without authentication can lead to:

- Unauthorized access
- Energy wastage
- Safety hazards

Therefore, Module 1 acts as a security gate, and Module 2 works strictly after it.

WHY AUTHENTICATION IS MANDATORY BEFORE SMART DEVICE CONTROL

Logical Requirement

- Smart devices control real electrical appliances such as lights, ACs, and heaters.
- Allowing direct access to these devices without verifying the user can lead to serious problems.

Problems Without Authentication

If authentication is skipped:

- Any person can turn devices ON or OFF
- Devices may be misused intentionally or accidentally
- Energy wastage increases
- Safety risks may occur
- No accountability of actions

Role of Module 1 in Enabling Module 2:

Module 1 performs the following before Module 2 starts:

- Verifies user credentials (username & password)
- Confirms user identity
- Grants access only to valid users

Only after this verification:

- The system allows access to device management features
- Module 2 becomes active

System Rule

No Authentication → No Device Control

PROCESS FLOW FROM AUTHENTICATION TO DEVICE MANAGEMENT

Step-by-Step System Flow

The interaction between Module 1 and Module 2 follows a clear and secure sequence:

1. The user enters login credentials (username and password).
2. Module 1 (Authentication Module) validates the credentials.
3. If credentials are valid, the system creates a session or token.
4. The authenticated user is redirected to the device dashboard.
5. Module 2 (Smart Device Management) becomes accessible.
6. The user can now register and control smart devices.

Failure Handling

- If authentication fails:
 - Access to Module 2 is denied.
 - Device control options remain locked.
 - User is asked to re-authenticate.

Key Dependency Rule

Successful authentication is a mandatory condition to access device management features.

PURPOSE OF MODULE 2: SMART DEVICE MANAGEMENT

What Is Module 2?

Module 2 is responsible for managing smart devices connected to the home.

It allows authenticated users to register, monitor, and control electrical appliances through the system.

Key Objectives of Module 2

The main objectives of Module 2 are:

- To register smart devices in the system
- To store device details securely in the database
- To allow users to turn devices ON and OFF
- To maintain the current status of each device
- To provide a centralized control mechanism for all devices

Types of Devices Managed

Module 2 manages common household devices such as:

- Lights
- Fans
- Air Conditioners
- Washing Machines
- Refrigerators
- Electric Vehicle (EV) Chargers

Why Module 2 Is Important

Without proper device management:

- Devices may be left ON unnecessarily
- Energy consumption cannot be controlled
- Energy tracking and analytics cannot function

Module 2 acts as the foundation for energy monitoring and optimization in later modules.

ARCHITECTURE & PROBLEMS SOLVED BY MODULE 2

Architecture Used

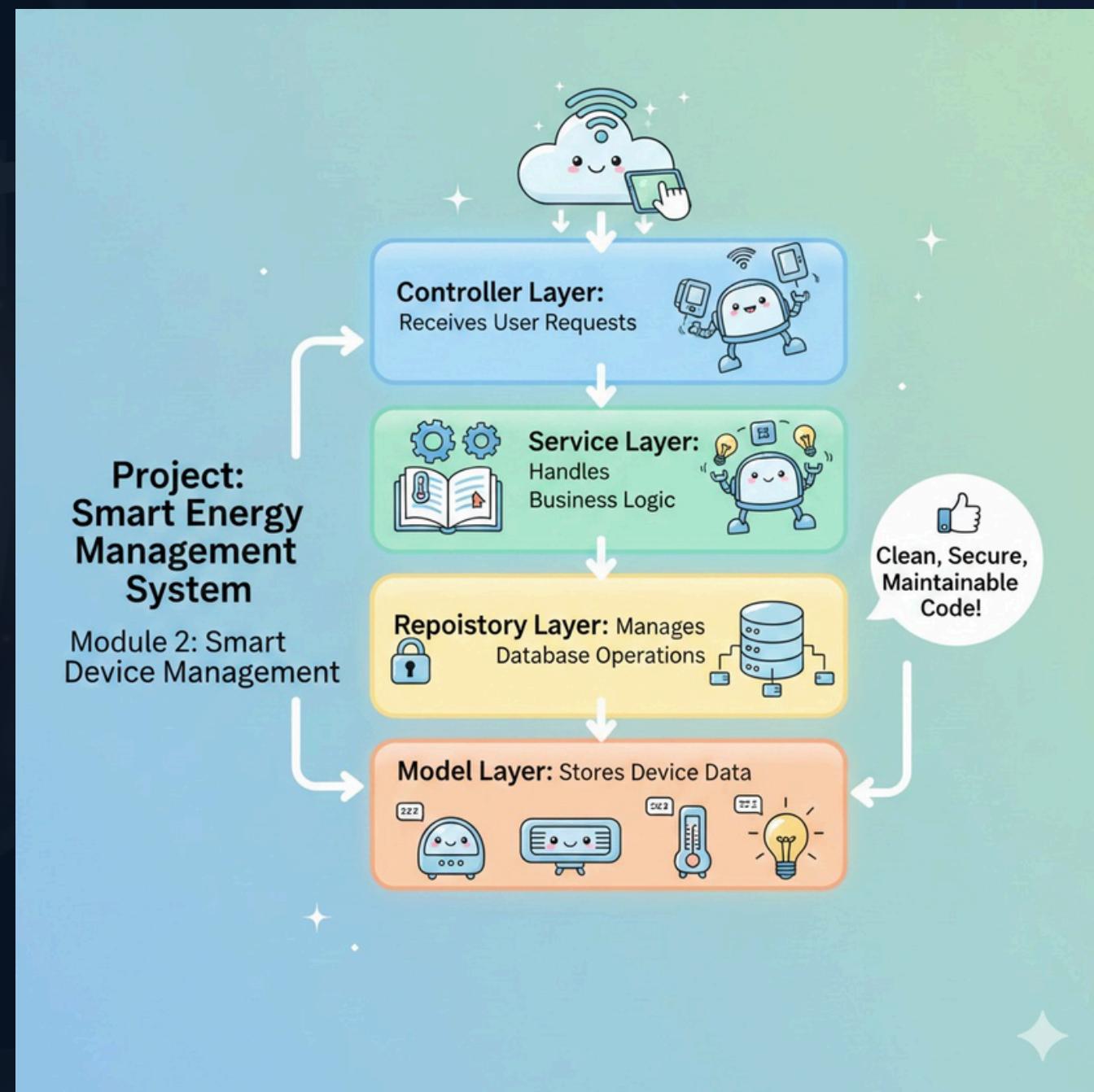
Module 2 follows a layered architecture, which separates responsibilities clearly:

- Controller Layer – Receives user requests
- Service Layer – Handles business logic
- Repository Layer – Manages database operations
- Model Layer – Stores device data

This structure ensures clean, secure, and maintainable code.

Problems Solved by Module 2

- Eliminates uncontrolled device usage
- Prevents unauthorized access (via Module 1)
- Maintains consistent device status
- Enables future energy tracking and analytics



ACTIVITIES AND CLASS STRUCTURE

Activities of Module 2

Module 2 performs the following core activities after successful authentication:

1. Register Smart Devices

- User adds new devices such as Light, Fan, AC, etc.
- Device details are captured and stored.

2. Store Device Information

- Device data like name, type, power usage, and status is saved in the database.

3. Control Devices (ON / OFF)

- User can turn devices ON or OFF through the system.
- Device status is updated centrally.

4. Maintain Device Status

- The system keeps track of current device state.
- Prevents inconsistent or duplicate operations.

5. Provide Centralized Device Control

- All devices are managed from a single dashboard.
- Enables smooth integration with energy tracking.

Classes Involved in Module 2

To perform the above activities, Module 2 uses the following classes:

1. SmartDevice

- Represents a real-world electrical appliance such as a light, fan, or AC. It stores basic device information like name, type, power usage, and status, and acts only as a data holder.

2. DeviceController

- Acts as the entry point for all device-related user actions. It receives requests from the user interface and forwards them to the service layer without performing any business logic.

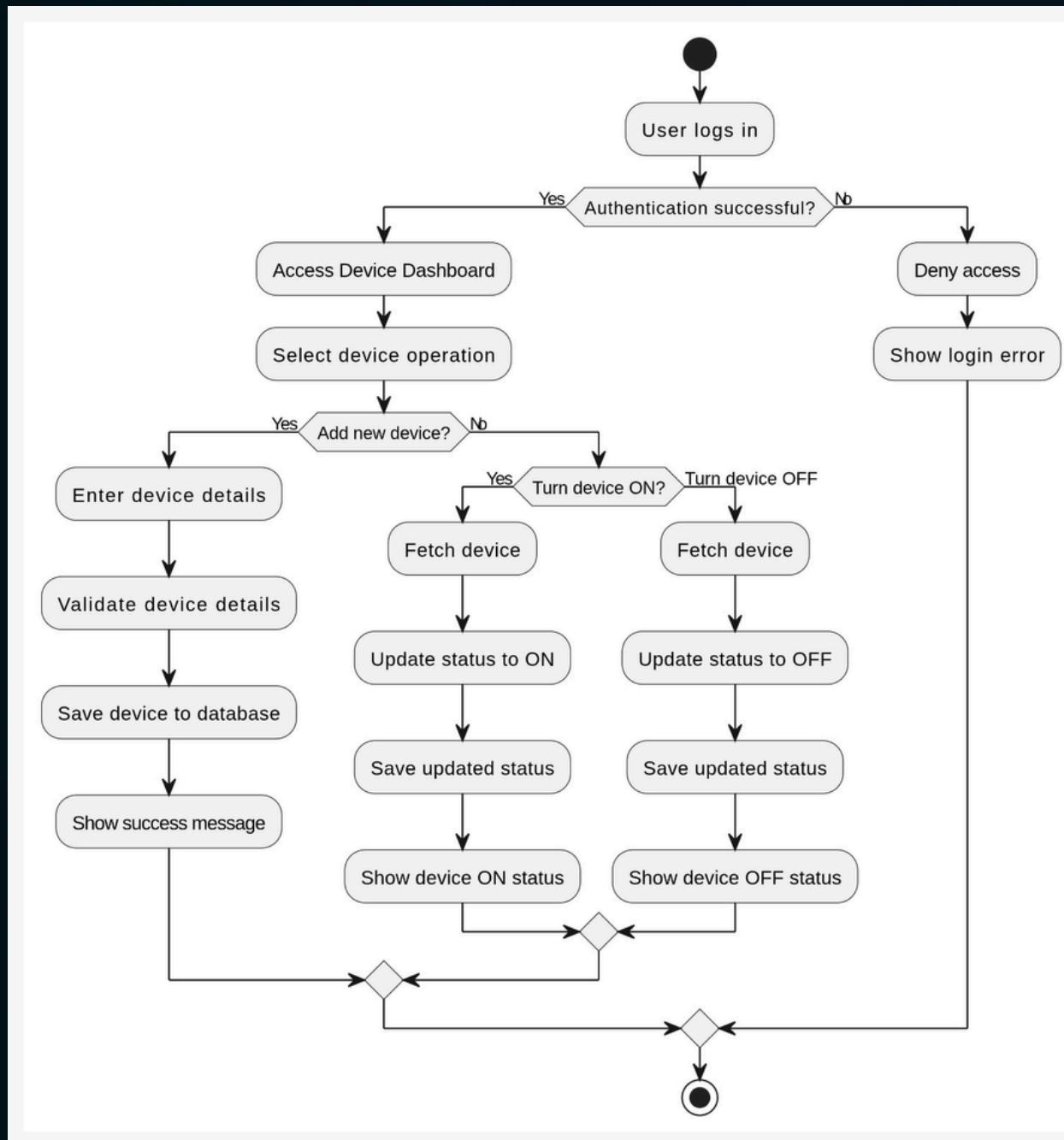
3. DeviceService

- Contains the core logic for device operations. It decides how devices should be registered and how their status should be updated, ensuring that device states remain consistent.

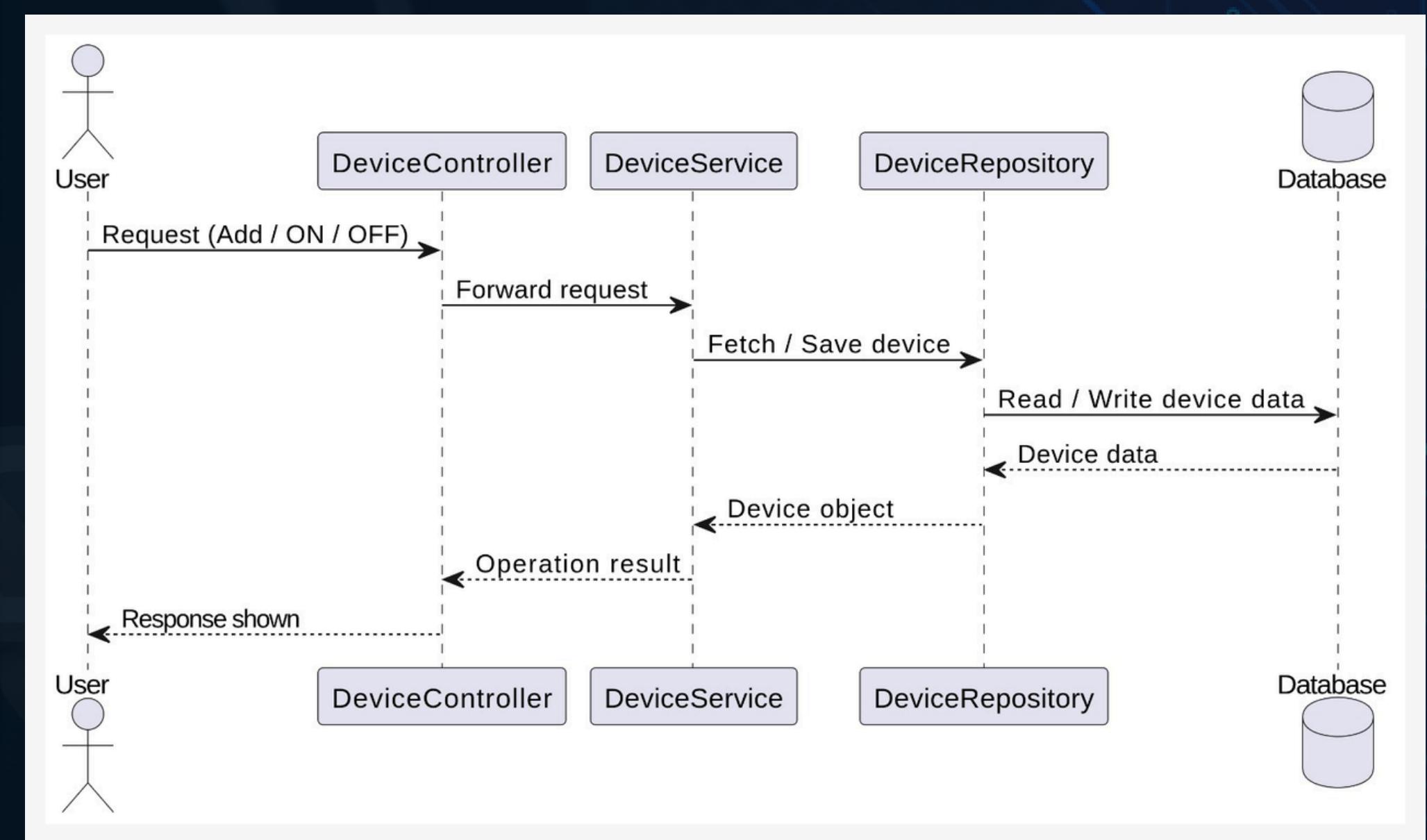
4. DeviceRepository

- Responsible for interacting with the database. It stores and retrieves device information and keeps database operations separate from business logic.

ACTIVITY AND SEQUENCE DIAGRAMS OF MODULE 2

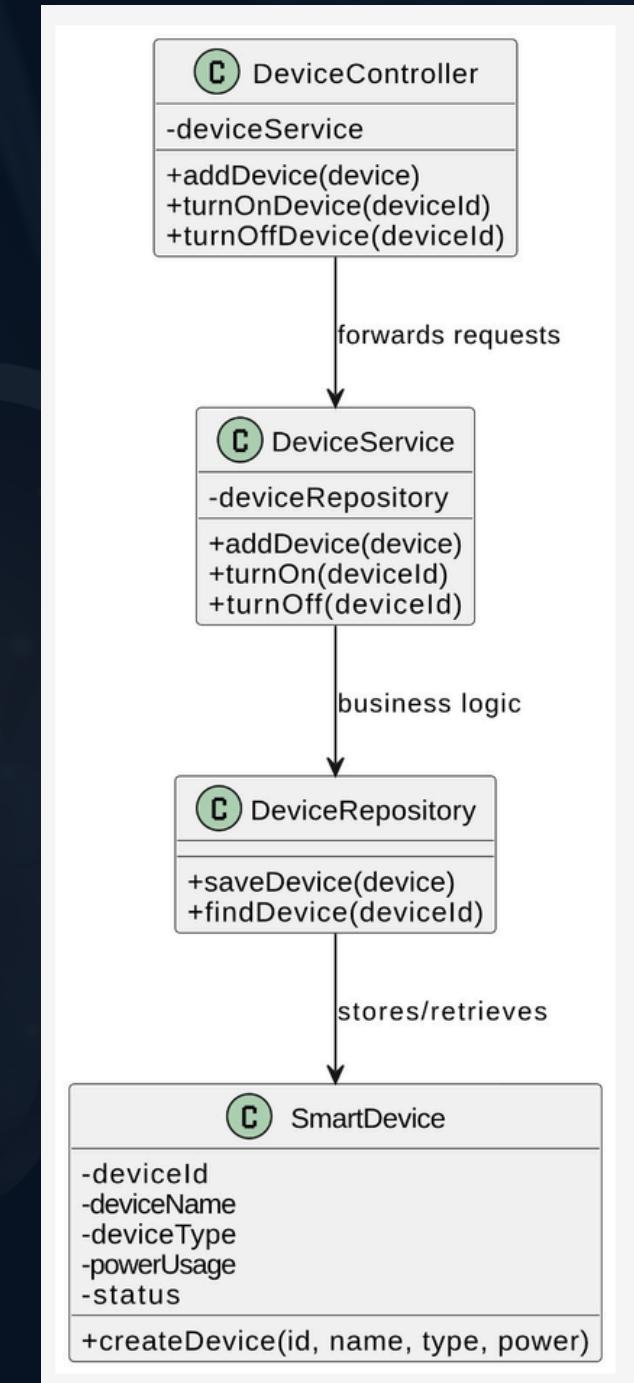
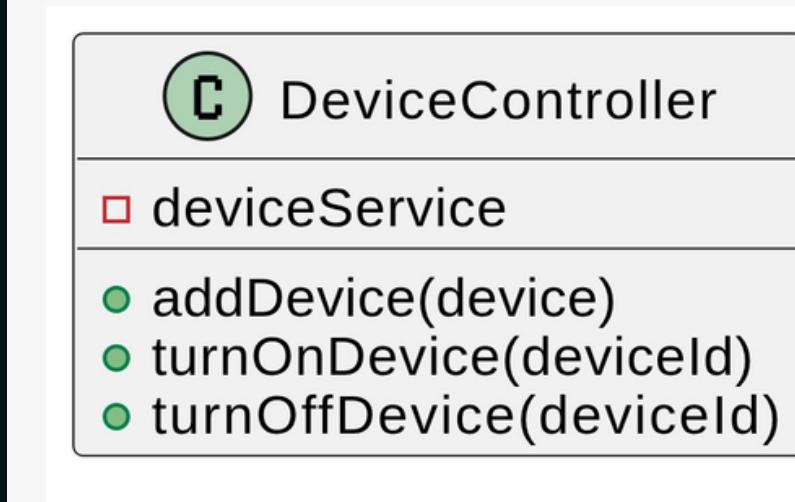
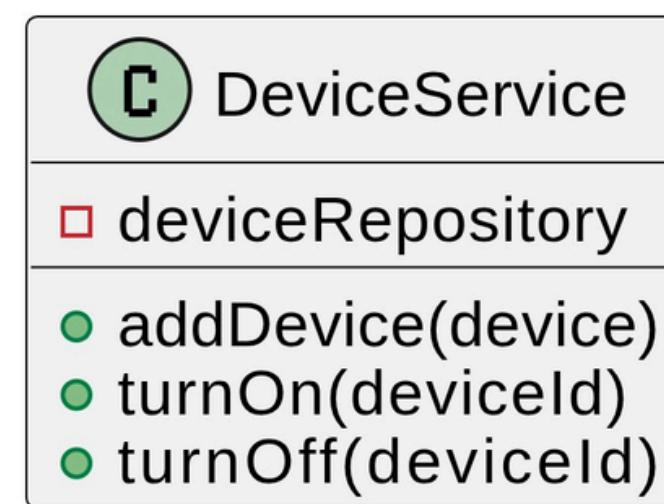
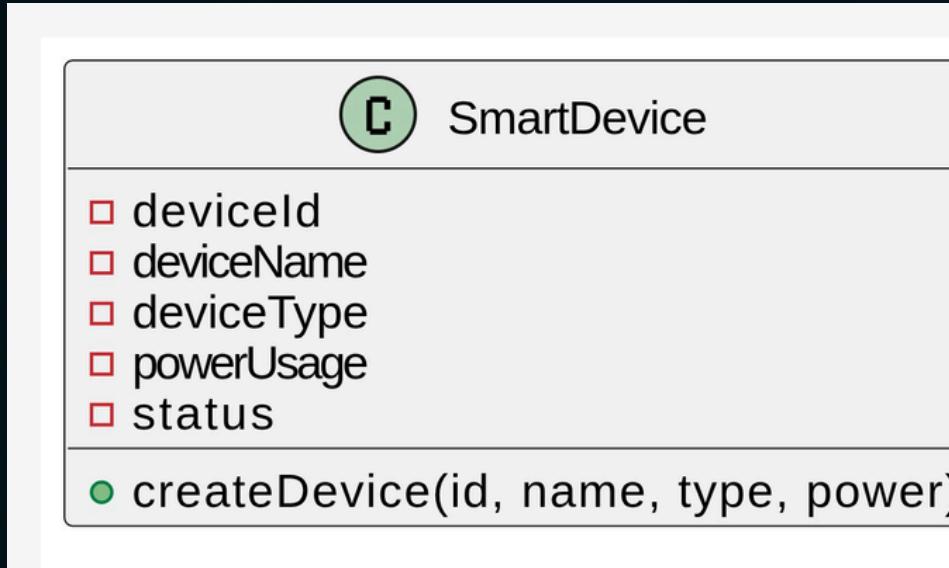


Figure(i)

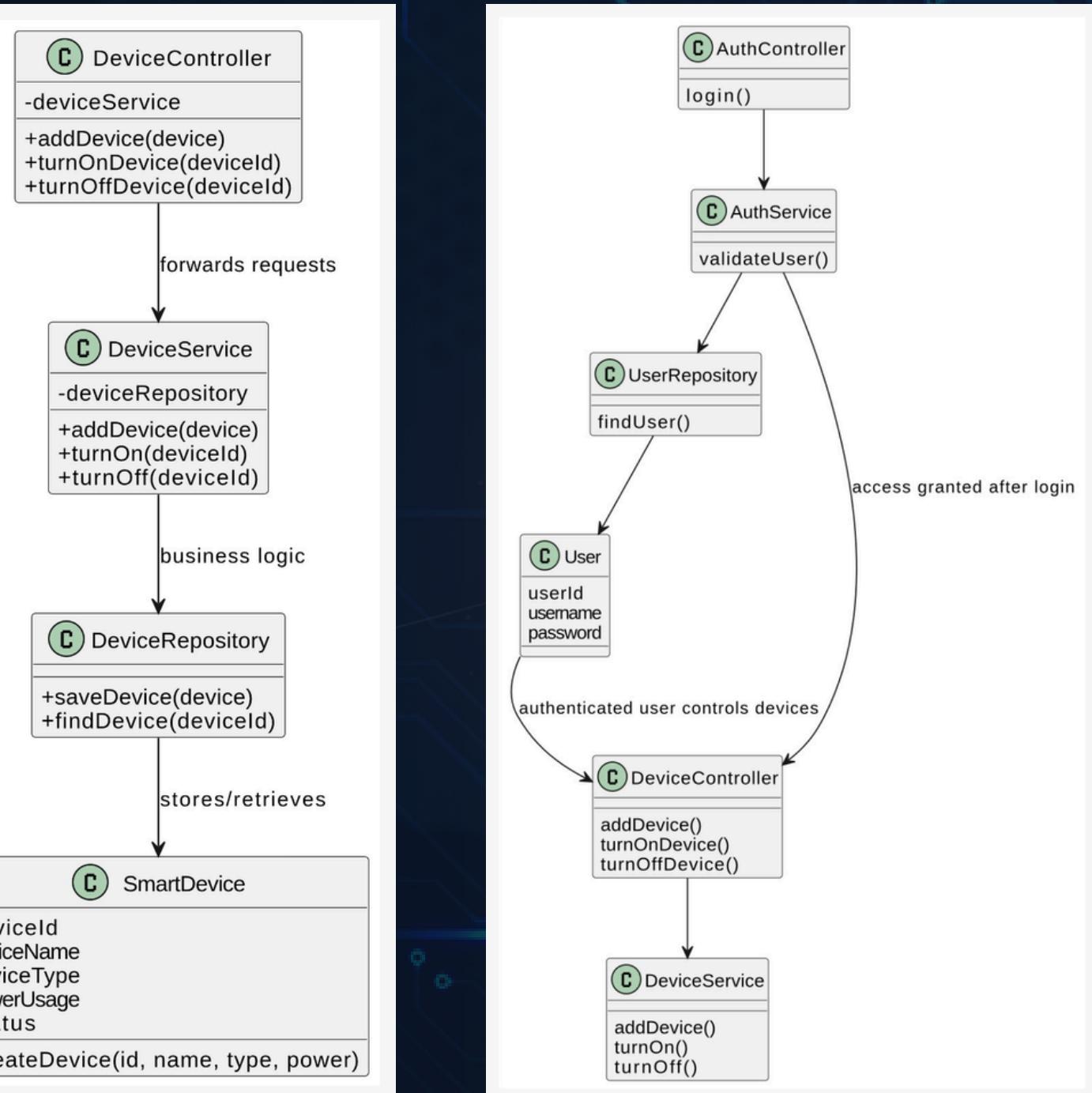


Figure(ii)

CLASS DIAGRAM FOR MODULE 2 AND ITS CONNECTION WITH MODULE 1



Figure(i)



Figure(ii)

Figure(iii)

DB SCHEMA FOR MODULE 2

```
CREATE TABLE devices (
    device_id BIGINT PRIMARY KEY AUTO_INCREMENT,
    device_name VARCHAR(100) NOT NULL,
    device_type VARCHAR(50) NOT NULL,      -- Light / Fan / AC / etc.
    power_usage FLOAT NOT NULL,           -- Power consumption in watts
    status VARCHAR(10) DEFAULT 'OFF',     -- ON / OFF
    user_id BIGINT NOT NULL,
    created_at TIMESTAMP DEFAULT CURRENT_TIMESTAMP,
    CONSTRAINT fk_user_device
        FOREIGN KEY (user_id)
        REFERENCES users(user_id)
        ON DELETE CASCADE
);
```