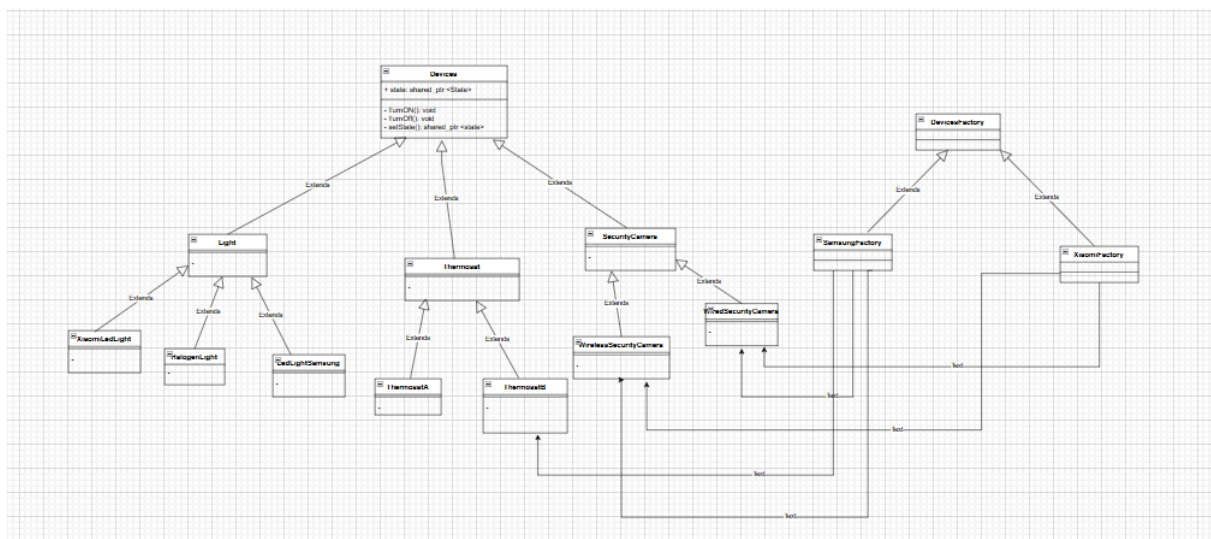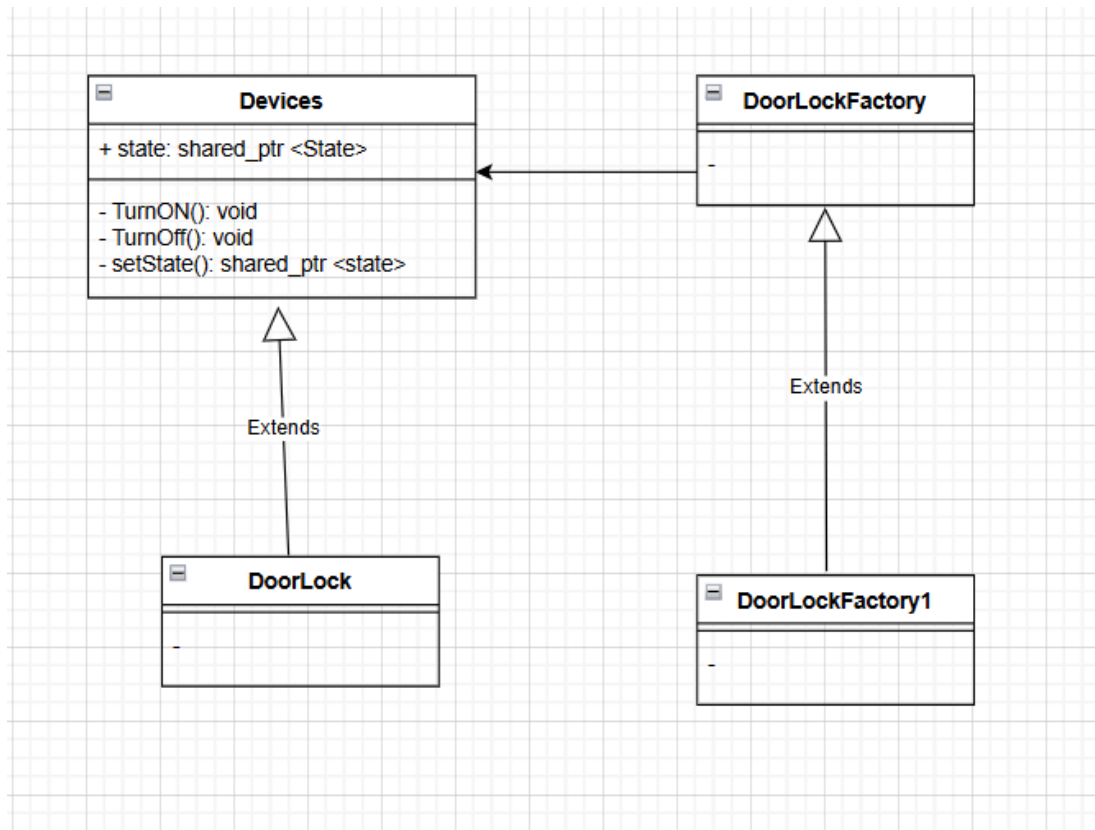# Design Patterns

Creational Design Patterns

- **Abstract Factory DP:**
    - To create families of related devices (Lights, Thermostats, Cameras) **dynamically**.
    - Also supports different brands and models with no changes to the core system.
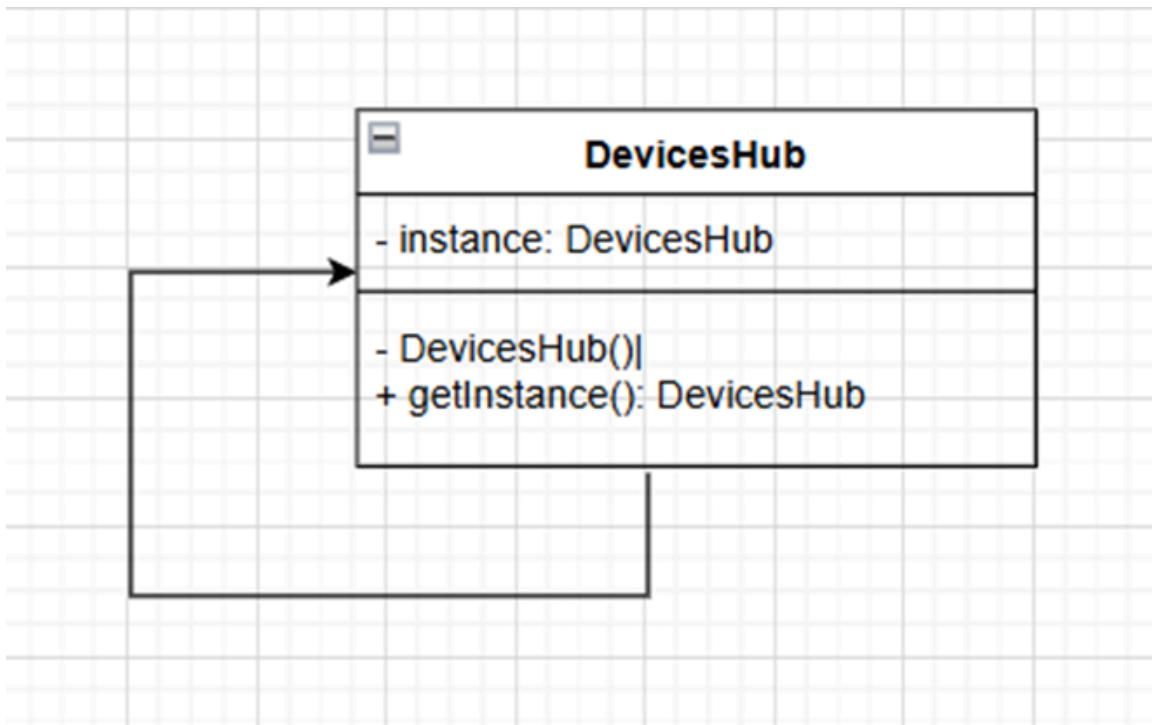

- **Factory DP:**
    - Used with `MotionSensor` and `DoorLock` where the only variant is the type of Factory
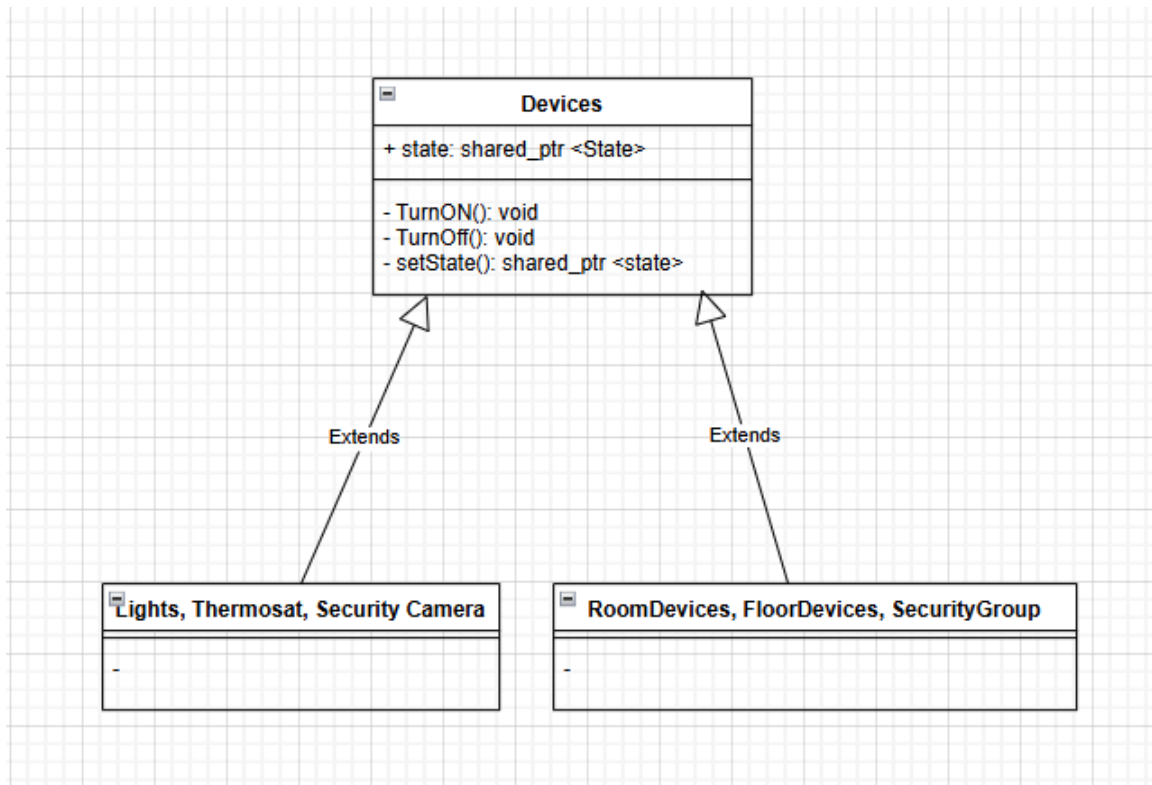
- **Singleton DP:**
  - For the **Central Smart Home Controller / Hub**.
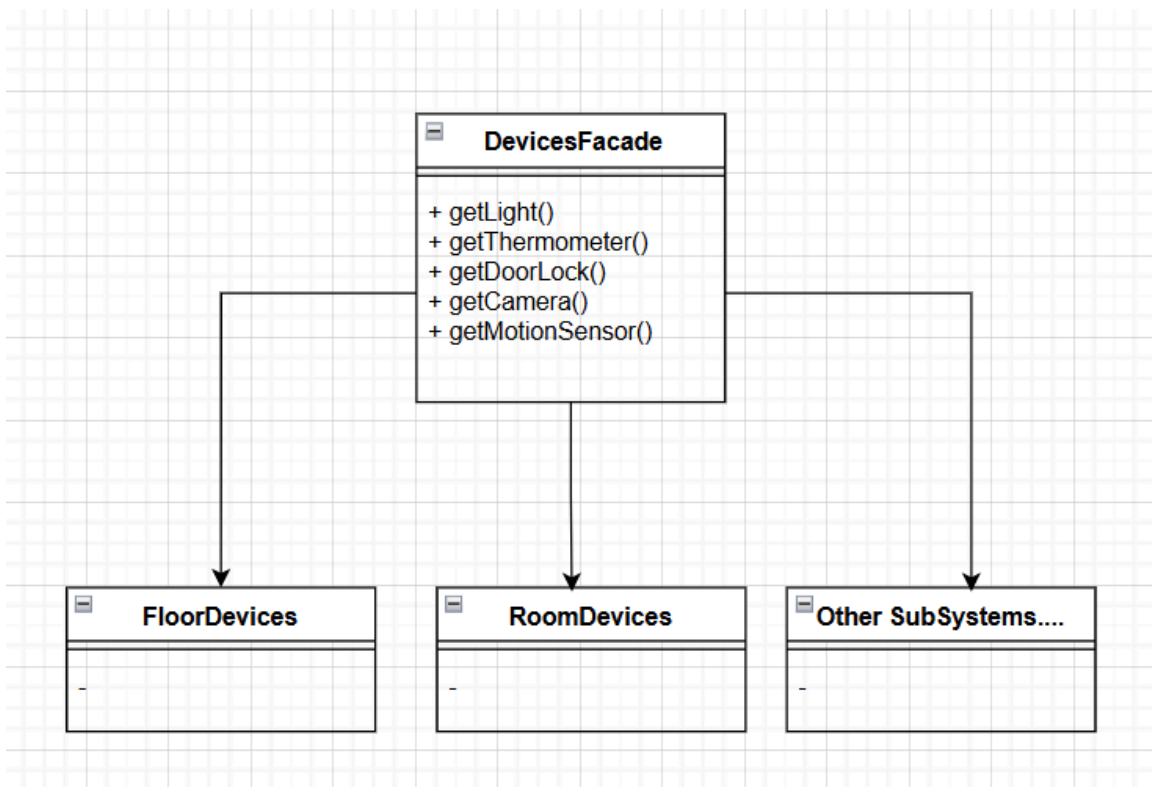 - Ensures only one global controller manages all devices.

Structural Design Patterns

- **Composite DP:**
  - To group devices by:
    - Room `RoomDevices`
    - Floor `FloorDevices`
    - Function `(LightingGroup, SecurityGroup)`
  - Allows treating **individual devices and whole groups the same way**.
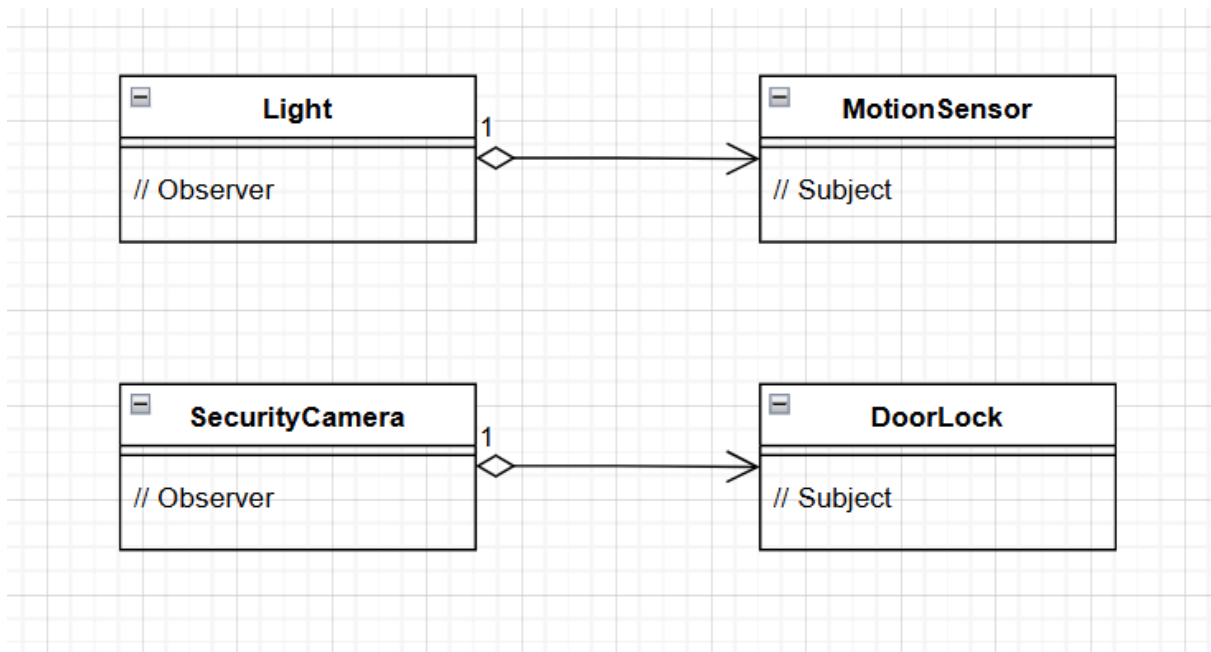
- **Facade DP:**
  - Provide a **simple interface to the entire home system**.
  - Hides complexity from the client (user UI, CLI, automation script...).

Behavioral Design Patterns

- **Observer DP**
    - Devices communicate automatically:
        - Motion sensor notifies light → turn on
        - Thermostat notifies heater
        - Door lock notifies security system
    - Event-driven communication.

- **Strategy Design Pattern**
    - For automation modes:
        - EnergySavingMode
        - ComfortMode
    - Switch automation logic at runtime.
- **State Design Pattern**
    - For representing internal device states:
        - Light: OFF → ON → DIMMED

- Thermostat: HEATING → COOLING → IDLE
  - Clean state transitions.