Elevator Control System Use Case

Primary Actor: Elevator User
Scope: Elevator Usage Process
Level: User goal
Stakeholders and Interests:
- Elevator User: wants safe and reliable use of the elevator
- Building Staff: wants to assist the elevator user to have an overall good experience with building facilities

Precondition:
- The elevator is installed correctly and operational
- Power to the building is supplied
- The elevator is not currently under maintenance

Minimal guarantee:
- The elevator responds to user commands such as selecting floors and opening/closing doors when powered and not under maintenance

Success guarantee:
- Users can enter the elevator, select desired floors, and exit the elevator safely and efficiently
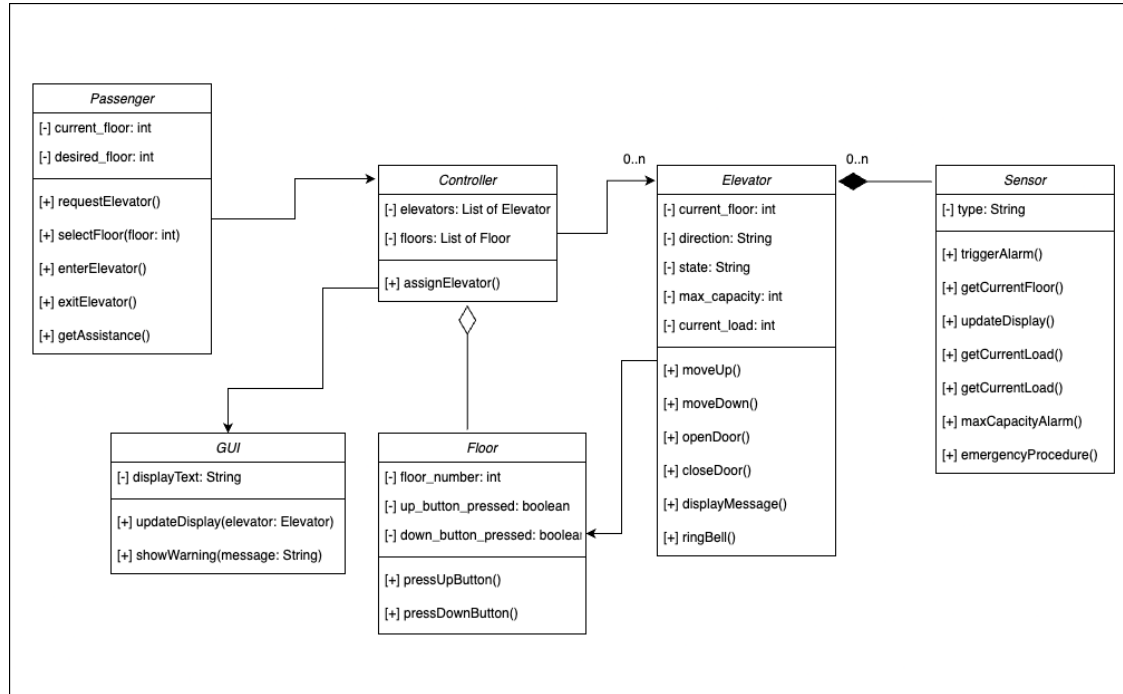
Main Success Scenario:
1. User enters the elevator lobby and waits for the elevator
2. User enters the selected elevator and selects the desired floor using the control panel
3. Elevator doors close, and the elevator moves to the selected floor
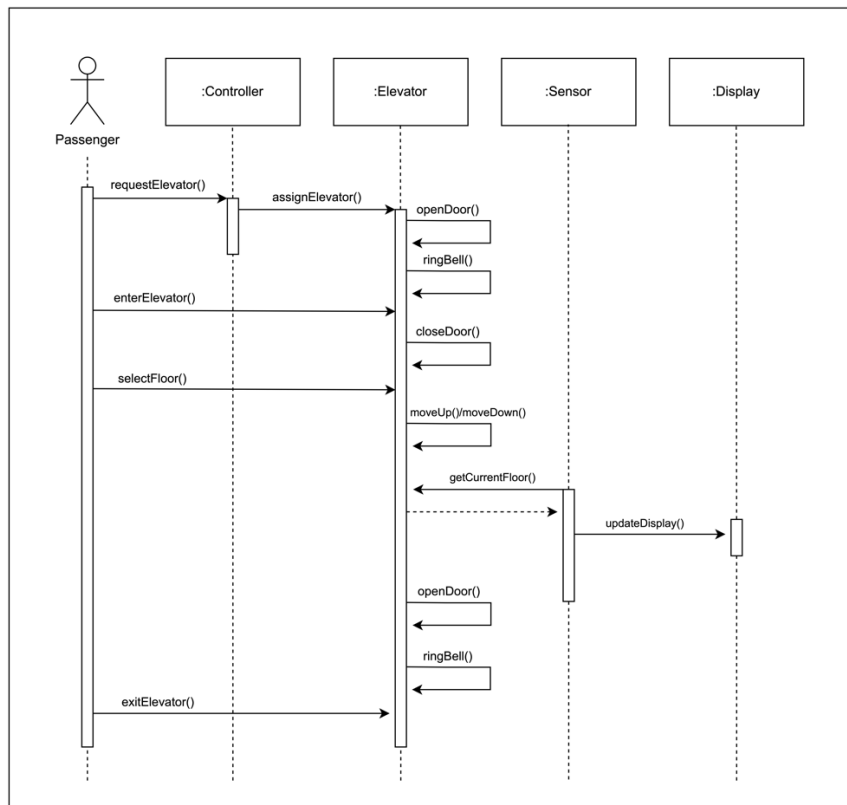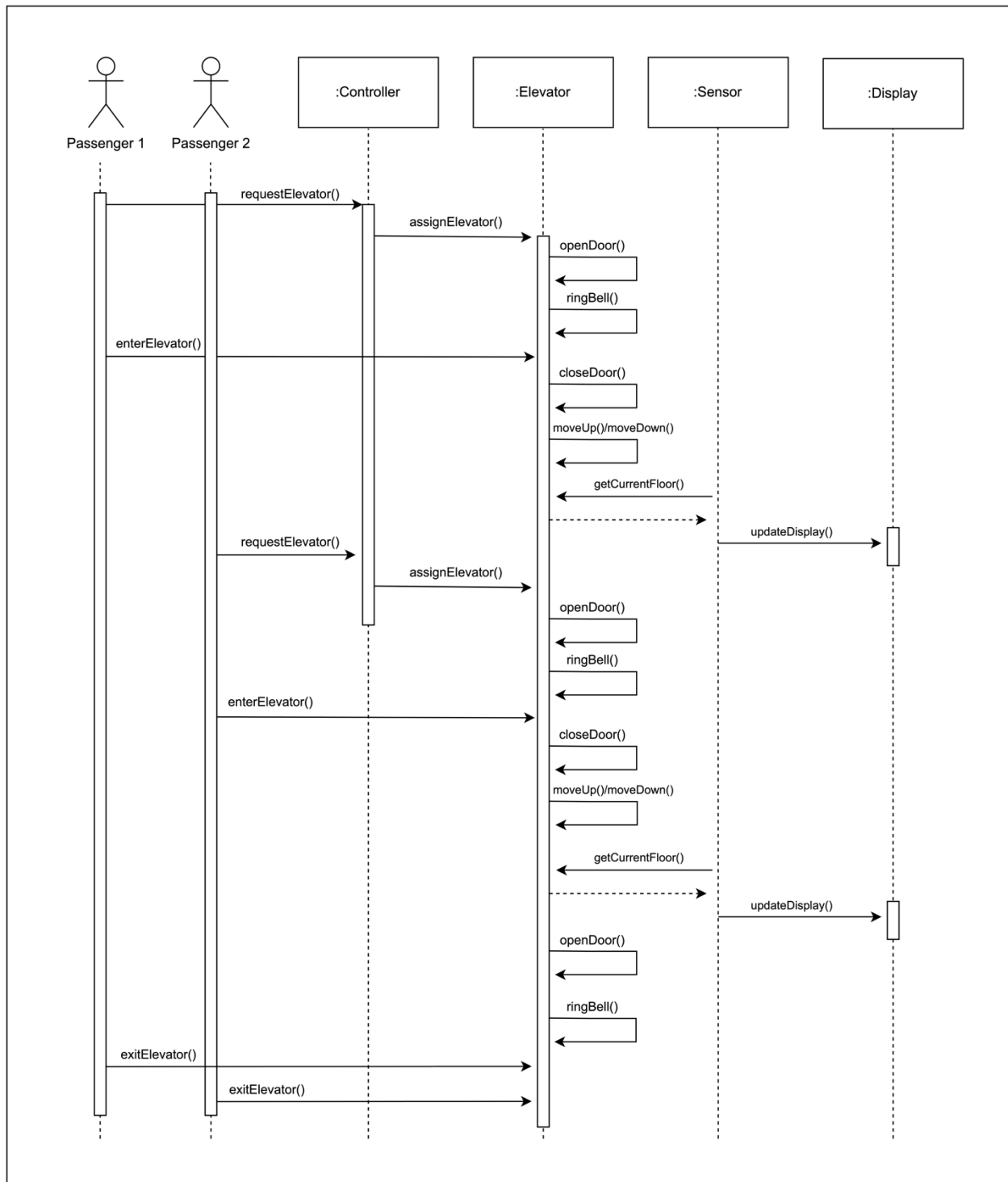4. Elevator doors open at the selected floor, and the user exits

Extensions:
1a. Elevator cabin exceeds maximum capacity
   1a1. Users exit the elevator and wait for the next available cabin.
1b. Users with mobility challenges experience difficulty
   1b1. Users press the 'assistance' button or use the intercom to request assistance.
   1b2. Building staff provides necessary assistance to the user.
2a. Power outage occurs while in the elevator
   2a1. Emergency lights and communications systems activate.
   2a2. Users are informed of the situation and advised to stay calm and wait for assistance.
2b. Elevator stops moving during transit
   2b1. Users press the emergency button or call for help using the intercom.
   2b2. Users are informed about the situation and advised to wait for assistance.
2c. Control panel/buttons do not respond
   2c1. Users try pressing the button again.
   2c2. If unsuccessful, users use the emergency communications system.
2d. Mechanical failure occurs (e.g. door jam)
   2d1. Users press the emergency button or call for help using the intercom.
   2d2. Users are informed about the situation and advised to wait for assistance
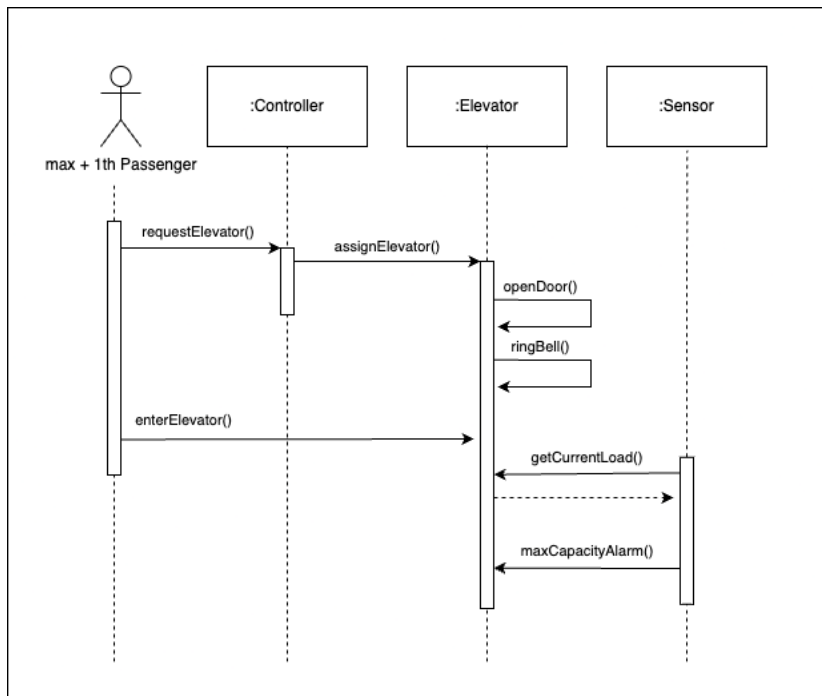
UML Class Diagram

Passenger
[-] current_floor: int
[-] desired_floor: int

[+] requestElevator()
[+] selectFloor(floor: int)
[+] enterElevator()
[+] exitElevator()
[+] getAssistance()

Controller
[-] elevators: List of Elevator
[-] floors: List of Floor

[+] assignElevator()

0..n

Elevator
[-] current_floor: int
[-] direction: String
[-] state: String
[-] max_capacity: int
[-] current_load: int

[+] moveUp()
[+] moveDown()
[+] openDoor()
[+] closeDoor()
[+] displayMessage()
[+] ringBell()

0..n

Sensor
[-] type: String

[+] triggerAlarm()
[+] getCurrentFloor()
[+] updateDisplay()
[+] getCurrentLoad()
[+] getCurrentLoad()
[+] maxCapacityAlarm()
[+] emergencyProcedure()

GUI
[-] displayText: String

[+] updateDisplay(elevator: Elevator)
[+] showWarning(message: String)

Floor
[-] floor_number: int
[-] up_button_pressed: boolean
[-] down_button_pressed: boolean

[+] pressUpButton()
[+] pressDownButton()

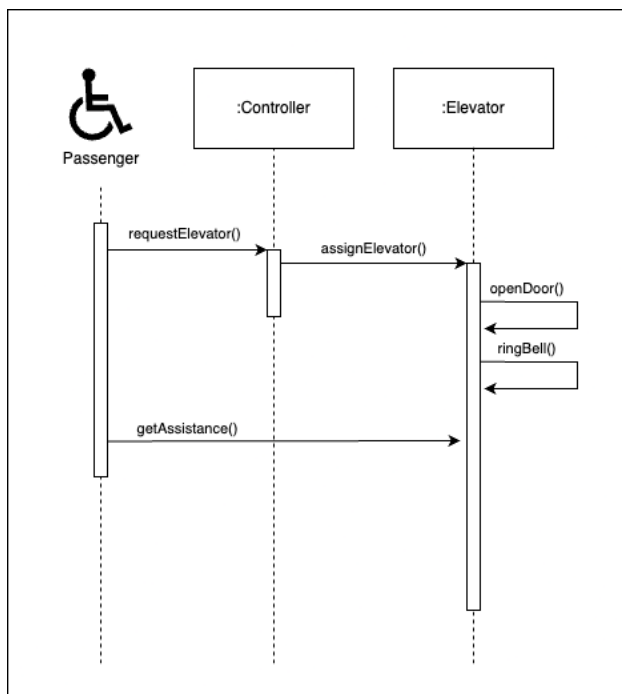## Sequence Diagrams – Success Cases
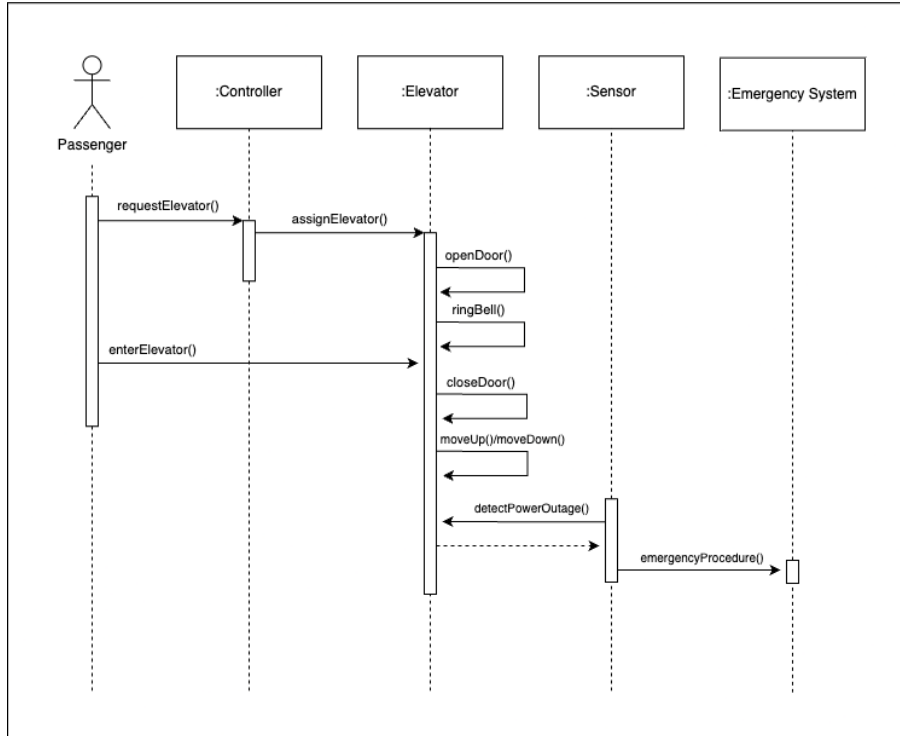
Sequence Diagrams – Safety Cases

Capacity Reached:

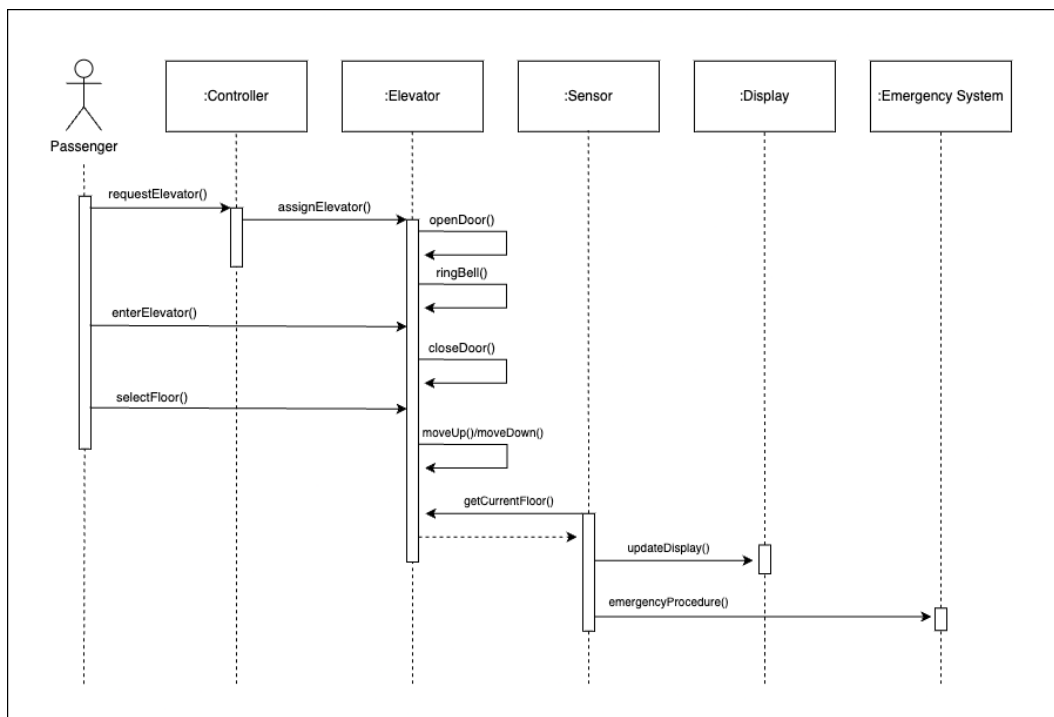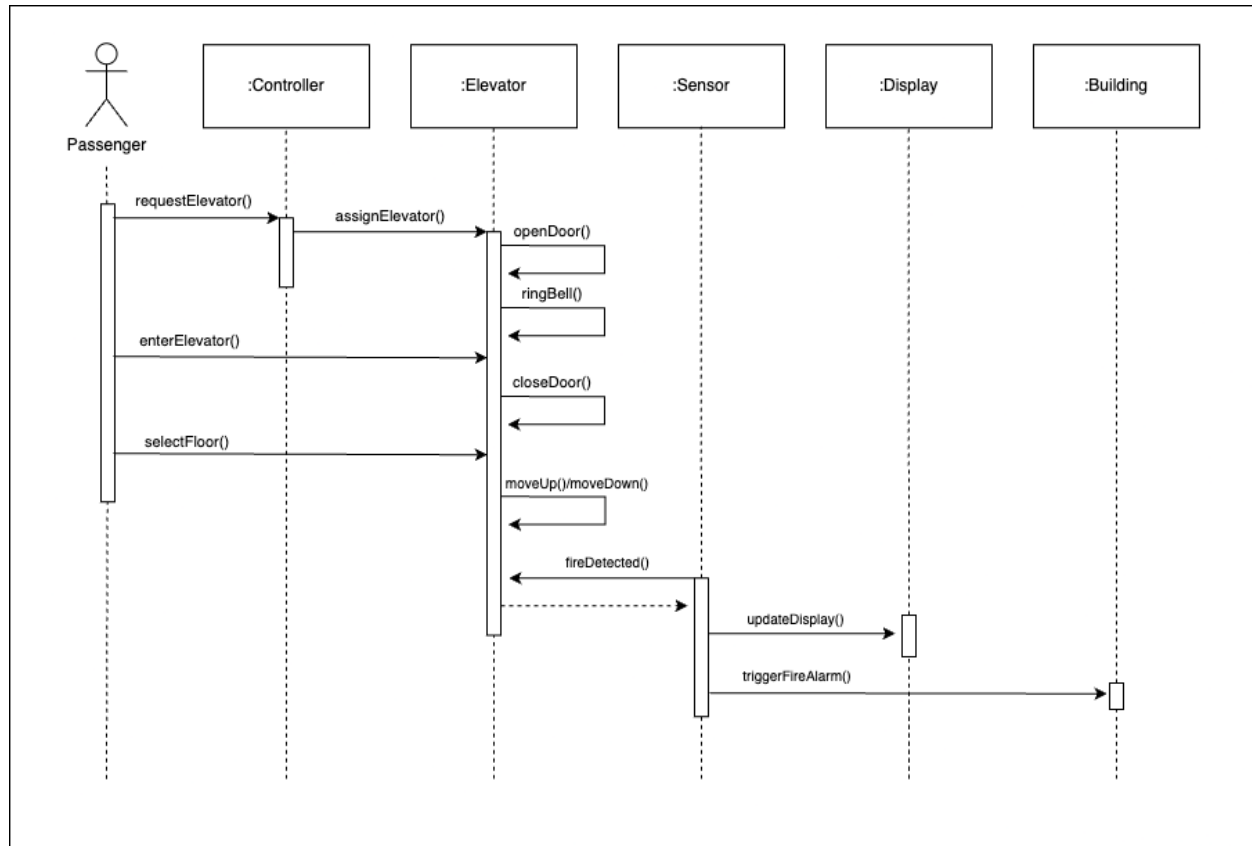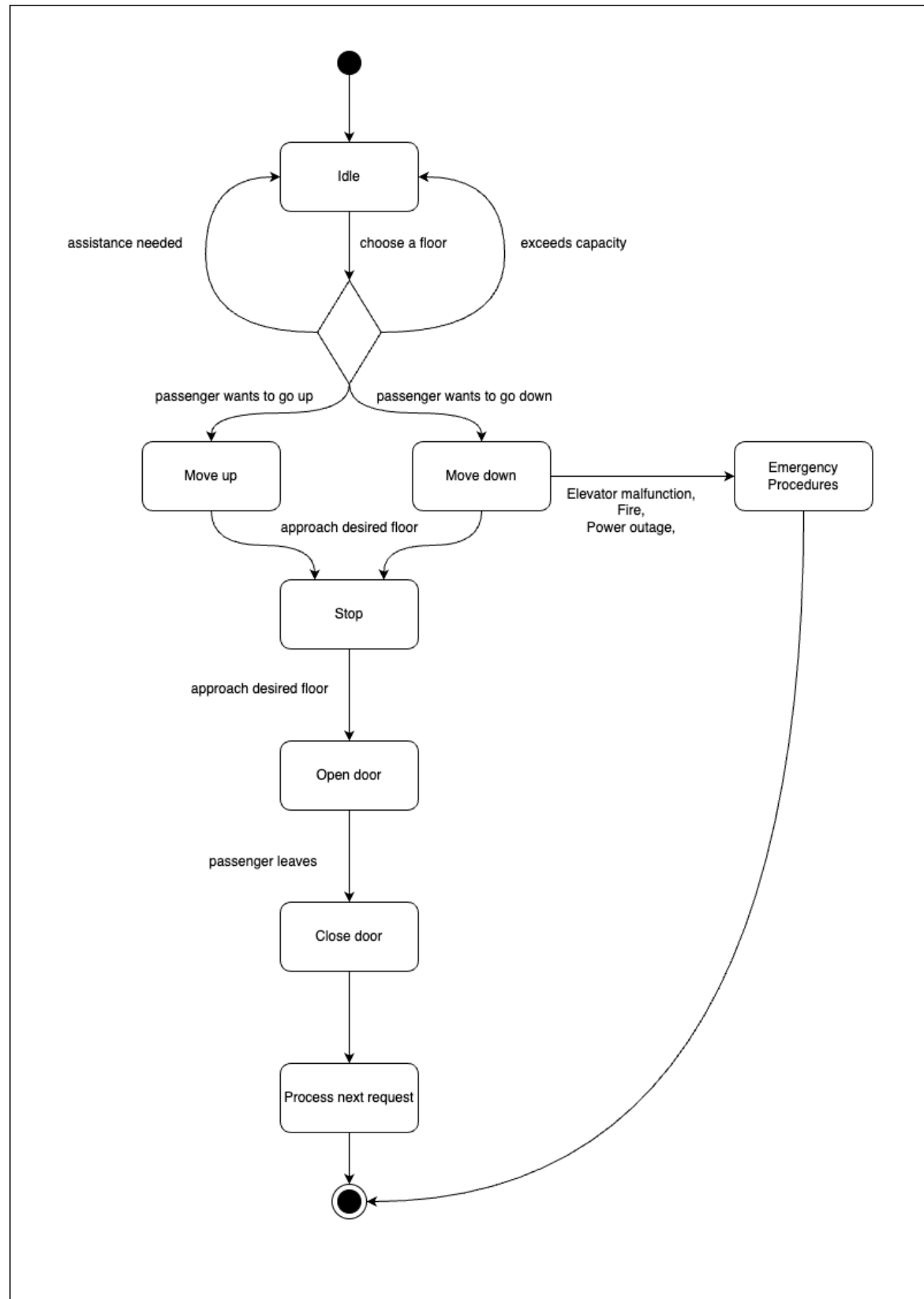

Accessibility Issue:

Power Outage:

Door Doesn't Open:

Fire:

State Diagram

Textual Explanation

In designing the elevator system, the primary objective was to capture core functionalities and user interactions, with a focus on modularity and clarity. The UML sequence diagrams showcase the dynamic behavior of the system through five distinct scenarios: a regular passenger's journey, simultaneous requests by two passengers, overloading, handling of passengers with special needs, and updates on the display system. Notably, certain peripheral classes or entities might appear in more comprehensive diagrams to offer an in-depth view; however, these were omitted here to prioritize central functionalities and maintain brevity. The design decisions were grounded in established software design patterns, ensuring both scalability and ease of understanding.

For the state diagram, initially at an idle state, the system awaits user input. When a passenger chooses a floor, the system determines the direction, either moving up or down based on the user's selection. As the elevator nears the desired floor, it ceases movement, opens the door allowing the passenger to exit, and then promptly shuts the door. Should the elevator exceed its capacity or encounter malfunctions, fire, or a power outage, it defaults to emergency procedures. Once all immediate tasks are managed, the system processes any queued requests, before reverting to its idle state, ready for the next operation.

Traceability Matrix

ID	Requirement	Related Use Case	Fulfilled By	Test	Description
1	Elevator responds to user commands	Main Success Scenario	Elevator Control System	Test elevator response to button presses for floor selection and door operations	Ensures that the elevator behaves as expected under standard operational scenarios.
2	User enters the elevator lobby and waits	Main Success Scenario (1)	User Action	Observe user entering the lobby and waiting	Verification of typical elevator request behavior
3	User selects desired floor using control panel	Main Success Scenario (2)	User Action	Test floor selection on control panel	Ensures that users can make a floor selection
4	Elevator doors close and move	Main Success Scenario (3)	Elevator Control System	Test elevator movement after door closure	Ensures that the elevator moves to the desired floor after door closure
5	Elevator doors open at the selected floor	Main Success Scenario (4)	Elevator Control System	Test elevator door opening at correct floor	Verification that the elevator stops and opens the door at the correct floor
6	Elevator cabin exceeds max capacity	Extension (1a)	Elevator Control System	Test elevator's response to weight exceeding limit	Ensures that the elevator can detect when it is overloaded
7	Assistance for mobility-challenged users	Extension (1b1, 1b2)	Building Staff	Simulate a scenario where assistance is required	Ensures that building staff can assist users in need
8	Response during power outage	Extension (2a1, 2a2)	Elevator Control System	Simulate a power outage while elevator is in operation	Verification of the elevator's emergency response during a power outage
9	Elevator stops moving during transit	Extension (2b1, 2b2)	Elevator Control System	Simulate an elevator halt while in transit	Ensures that the elevator has a proper emergency response mechanism
10	Control panel/buttons non-responsive	Extension (2c1, 2c2)	Elevator Control System	Test malfunction of control panel	Verification of the elevator's response to a non-functional control panel
11	Mechanical failure (e.g. door jam)	Extension (2d1, 2d2)	Elevator Control System	Simulate mechanical failures like door jam	Ensures that the elevator can detect and respond to mechanical issues