

COMP3004 W24 - Assignment 3

Name: Jiayu Hu
Student #: 101253627
Date: Mar 9, 2024

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Part 1: Use Cases

USE CASE 1: USER USES ELEVATOR SYSTEM IN A BUILDING

Primary Actor(s): Passengers

Stakeholders and Interests:

- Property owner – wants to provide the elevator service to the passengers in the building
- Safety inspector – wants to inspect the safety of the elevators and issue safety certification
- Safety agency – wants to formulate the regulations for elevators
- Elevator installer – wants to install the elevator based on the requirements and regulations
- Building safety service – wants to provide service to the passengers through a voice connection when passengers press “help”

Precondition(s): The user has access to the elevator in the building

Success guarantee(s) (equivalently Post-conditions): The user arrives at the floors they requested safely

Main success scenario:

1. The user selects to go up or down using the buttons.
2. The elevator moves and arrives at the floor where up or down buttons are pressed.
3. The elevator rings a bell, opens its doors (the elevator and floor doors) for a fixed time (10 seconds) allowing the user to board, and then closes the doors.
4. The user enters the elevator and selects one or more destination floors using a panel of buttons.
5. The elevator proceeds to another door and shows the current floor on the display.
6. The elevator gets notified by the sensor when it arrives at the floors the user requests.
7. The elevator rings a bell, opens its doors (the elevator and floor doors) for a fixed time (10 seconds) allowing the user to exit, and then close the doors.

Extensions:

2-7a. The elevator receives a “Fire” alarm signal:

2a1 and 5a1. Use case 2.

2-7b. The elevator receives a “Power Out” alarm signal:

2b1 and 5b1. Use case 3.

3a and 7a. The user presses “open door” or “close door”:

3a1 and 7a1. Use case 4.

3b and 7b. The elevator’s light sensor is interrupted when the door is closing:

3b1 and 7b1. Use case 5.

3c. The elevator receives an “Overload” alarm signal:

3c1. Use case 6.

4a. The elevator receives a “Help” alarm signal:

4a1. Use case 7.

USE CASE 2: THE ELEVATOR RECEIVES A “FIRE” ALARM SIGNAL

Primary Actor(s): Elevator

Stakeholders and Interests:

- Passengers – want to move to a safe floor.

Precondition(s): The building or the elevator sends a “Fire” alarm signal.

Success guarantee(s) (equivalently Post-conditions): The elevator sends passengers to a safe floor.

Main success scenario:

1. The elevator moves to a safe floor.
2. The elevator presents an audio and text message to passengers informing them of an emergency.
3. The elevator presents an audio and text message asking passengers to disembark once the safe floor is reached.

USE CASE 3: THE ELEVATOR RECEIVES A “POWER OUT” ALARM SIGNAL

Primary Actor(s): Elevator

Stakeholders and Interests:

- Passengers – want to move to a safe floor.

Precondition(s): The building or the elevator sends a “Power Out” alarm signal.

Success guarantee(s) (equivalently Post-conditions): The elevator sends passengers to a safe floor.

Main success scenario:

1. The elevator moves to a safe floor.
2. The elevator presents an audio and text message to passengers informing them of a power outage.
3. The elevator presents an audio and text message asking passengers to disembark once the safe floor is reached.

USE CASE 4: THE ELEVATOR RECEIVES “OPEN DOOR” OR “CLOSE DOOR” SIGNAL

Primary Actor(s): Elevator

Stakeholders and Interests:

- Passengers – want to close or open the door.

Precondition(s): A passenger presses “open door” or “close door” when the elevator stops.

Success guarantee(s) (equivalently Post-conditions): The elevator opens or closes the door as the passenger requests.

Main success scenario:

1. The elevator system overrides the default timing of the doors (10 seconds).
2. The door remains open beyond its default period if the “open door” button is held depressed; the doors can be closed prematurely by pressing the “door close” button.

USE CASE 5: THE ELEVATOR’S LIGHT SENSOR IS INTERRUPTED WHEN THE DOOR IS CLOSING

Primary Actor(s): Elevator

Stakeholders and Interests:

- Passengers – want to enter or exit the elevator safely.

Precondition(s): An object between the door interrupts the light sensor when the door is closing.

Success guarantee(s) (equivalently Post-conditions): The elevator opens the door safely without causing damage.

Main success scenario:

1. The elevator system stops the door from closing and opens it.
2. If this occurs repeatedly over a short period of time, a warning is sounded over the audio system and a text message is displayed.

USE CASE 6: THE ELEVATOR RECEIVES AN “OVERLOAD” ALARM SIGNAL

Primary Actor(s): Elevator

Stakeholders and Interests:

- Passengers – want to ride the elevator safely.

Precondition(s): The passenger or cargo load exceeds the carrying capacity.

Success guarantee(s) (equivalently Post-conditions): The elevator carries the passengers with acceptable carrying weight.

Main success scenario:

1. The elevator does not move.
2. The elevator presents audio and text messages to passengers asking for the load to be reduced before attempting to move again.

USE CASE 7: THE USER PRESSES THE “HELP” BUTTON

Primary Actor(s): Elevator

Stakeholders and Interests:

- Passengers – want to receive help from the building safety service or 911.

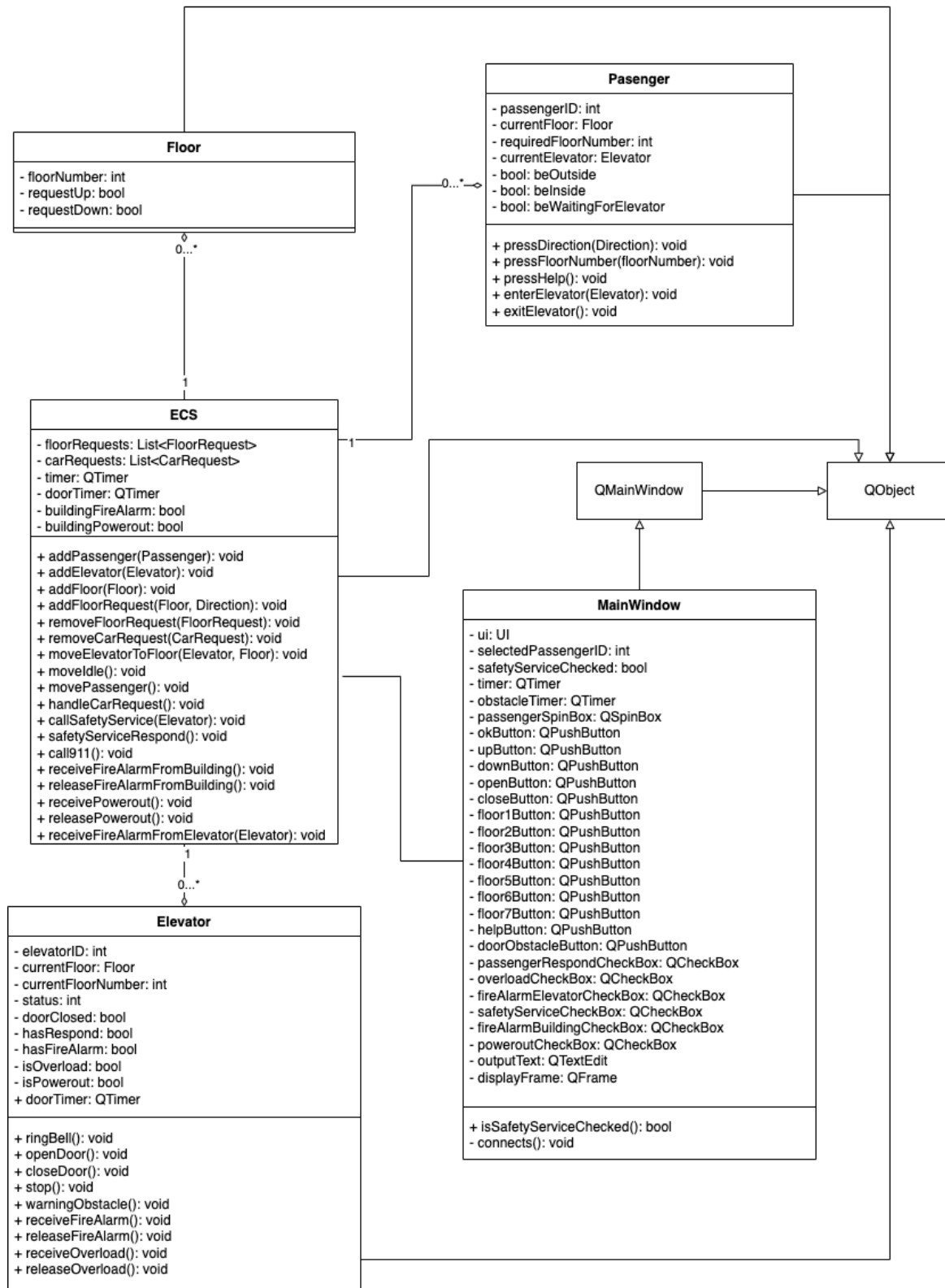
Precondition(s): The passenger presses the “help” button.

Success guarantee(s) (equivalently Post-conditions): The ECS connects the passenger to the building safety service or 911.

Main success scenario:

1. The elevator connects the user to the building safety service through a voice connection.
2. If there is no response from building safety within 5 seconds or if there is no response from the user, a 911 emergency call is placed.

Part 2: Class Diagram

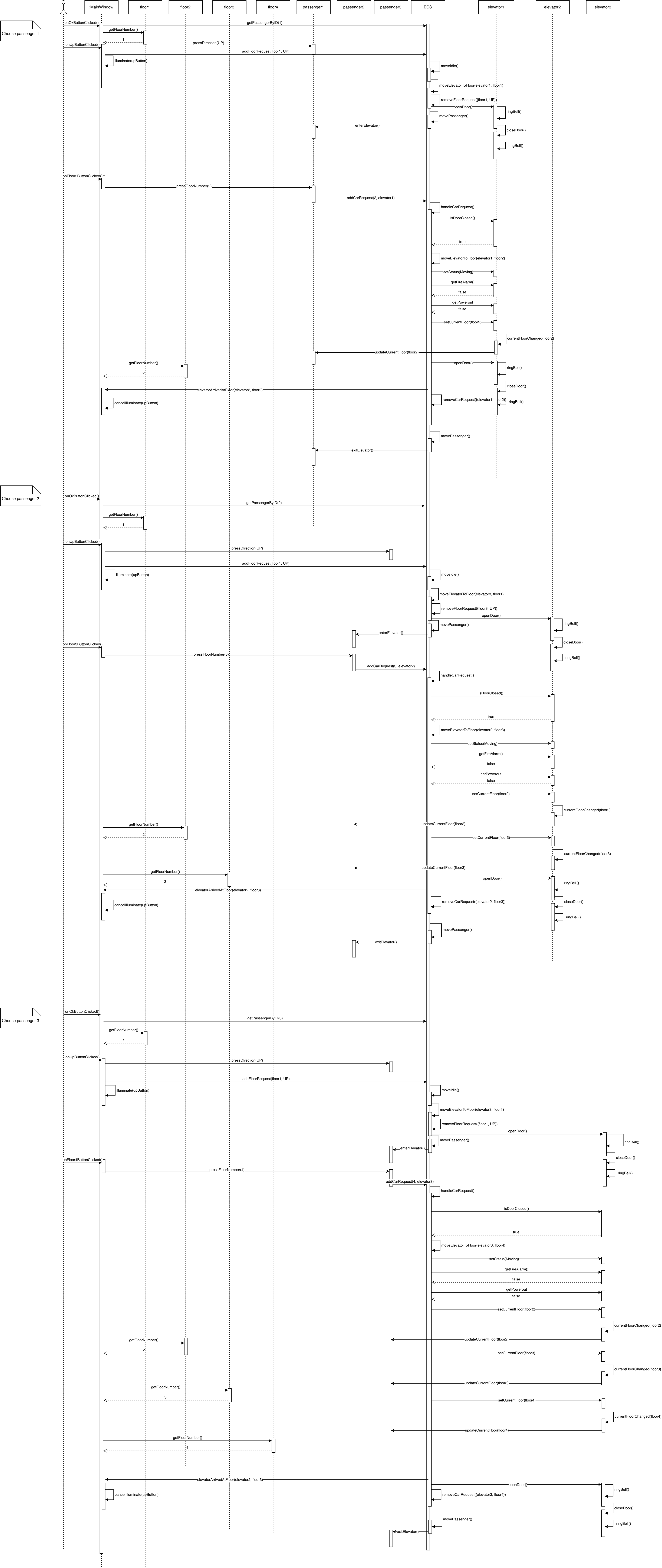


Part 3: Sequence Diagram

Scenario 1

All 3 Elevators are on the first floor initially. All 3 passengers are on Floor 1. Passenger 1 wants to go to Floor 2, Passenger 2 wants to go to Floor 3, and Passenger 3 wants to go to Floor 4.

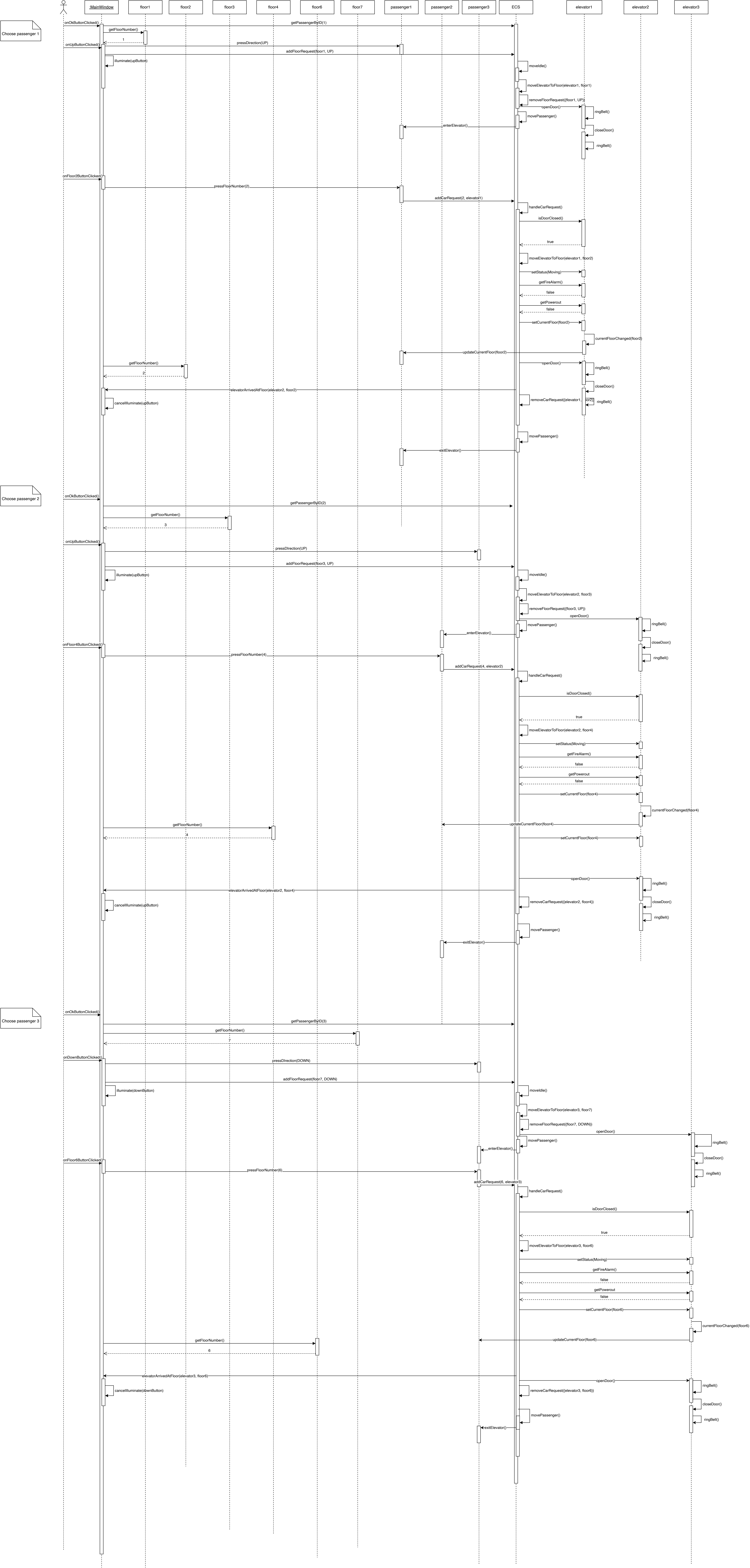
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Scenario 2

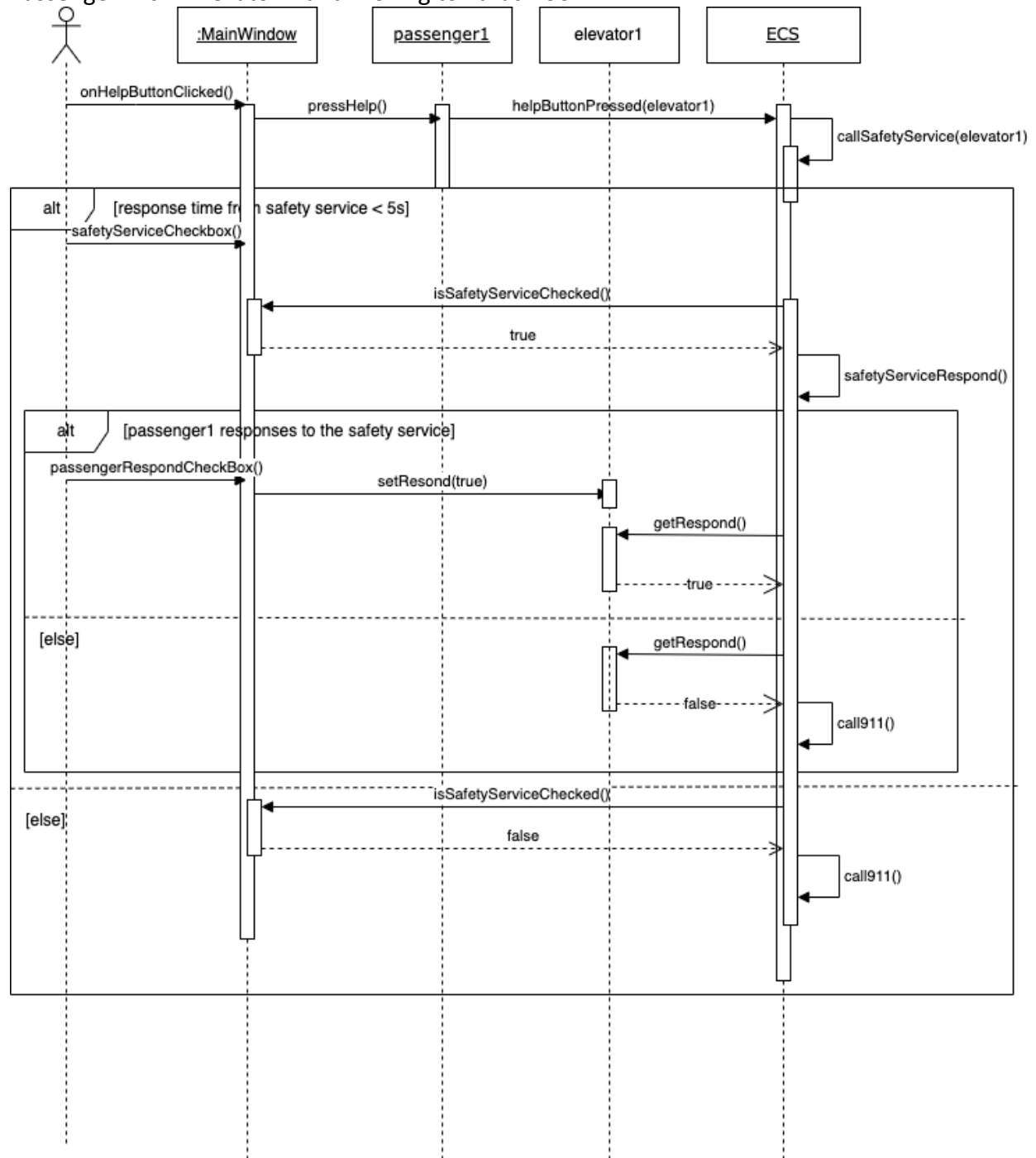
Elevator 1 is on Floor 1, Elevator 2 is on Floor 3, and Elevator 3 is on Floor 6. Passenger 1 is on Floor 1, Passenger 2 is on Floor 3, and Passenger 3 is on Floor 7. Passenger 1 wants to go to Floor 2, Passenger 2 wants to go to Floor 4, and Passenger 3 wants to go to Floor 6.

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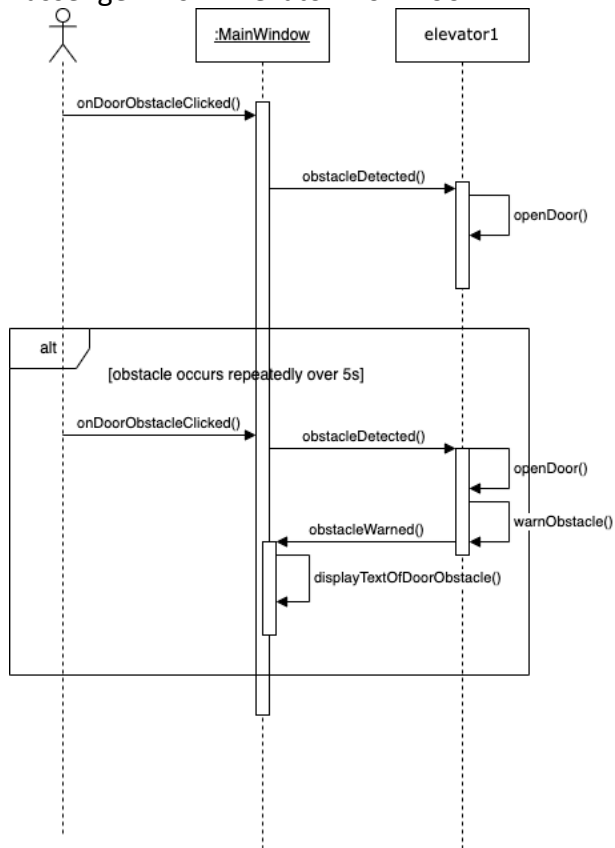
Scenario 3: Help

Passenger 1 is in Elevator 1 and moving towards floor 7.



Scenario 4: Door Obstacles

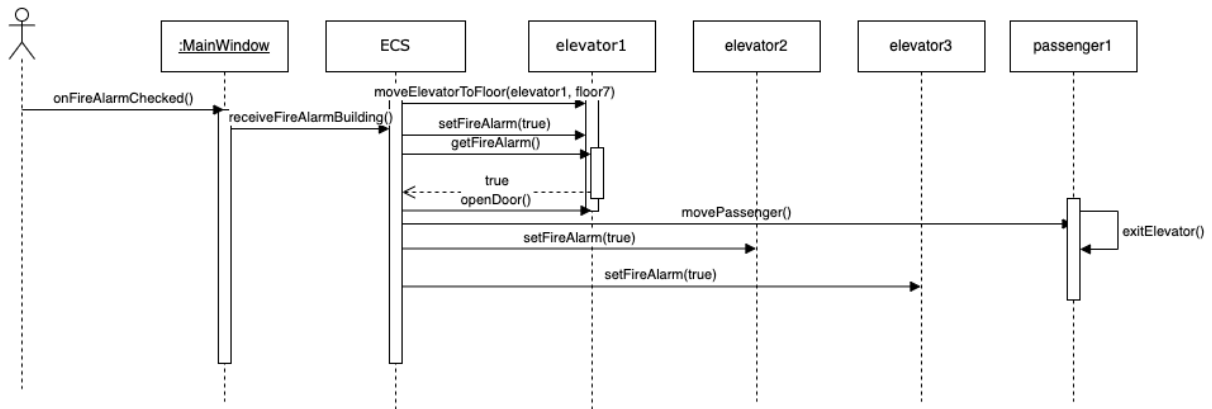
Passenger 1 is in Elevator 1 on Floor 1.



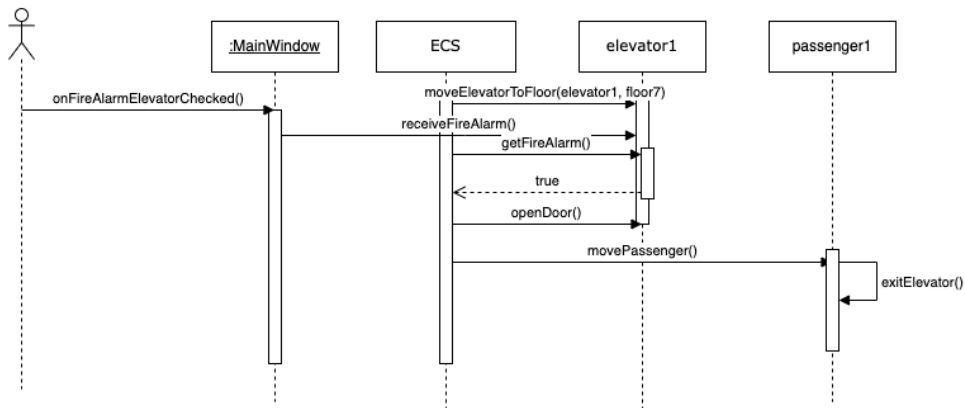
Scenario 5: Fire

Passenger 1 is in Elevator 1 and moving to Floor 7.

[ECS recieves fire alarm from the building]

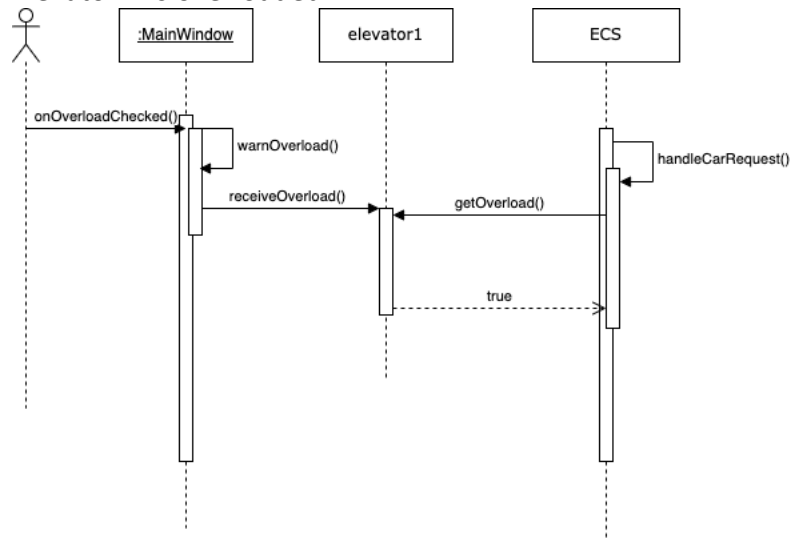


[ECS recieves fire alarm from the elevator]



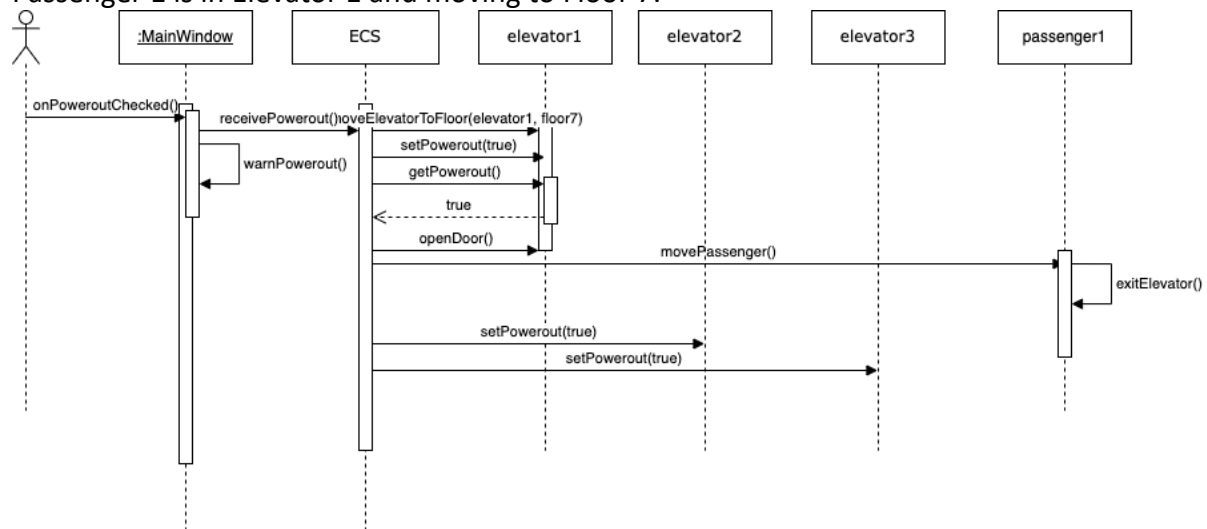
Scenario 6: Overload

Elevator 1 is overloaded.

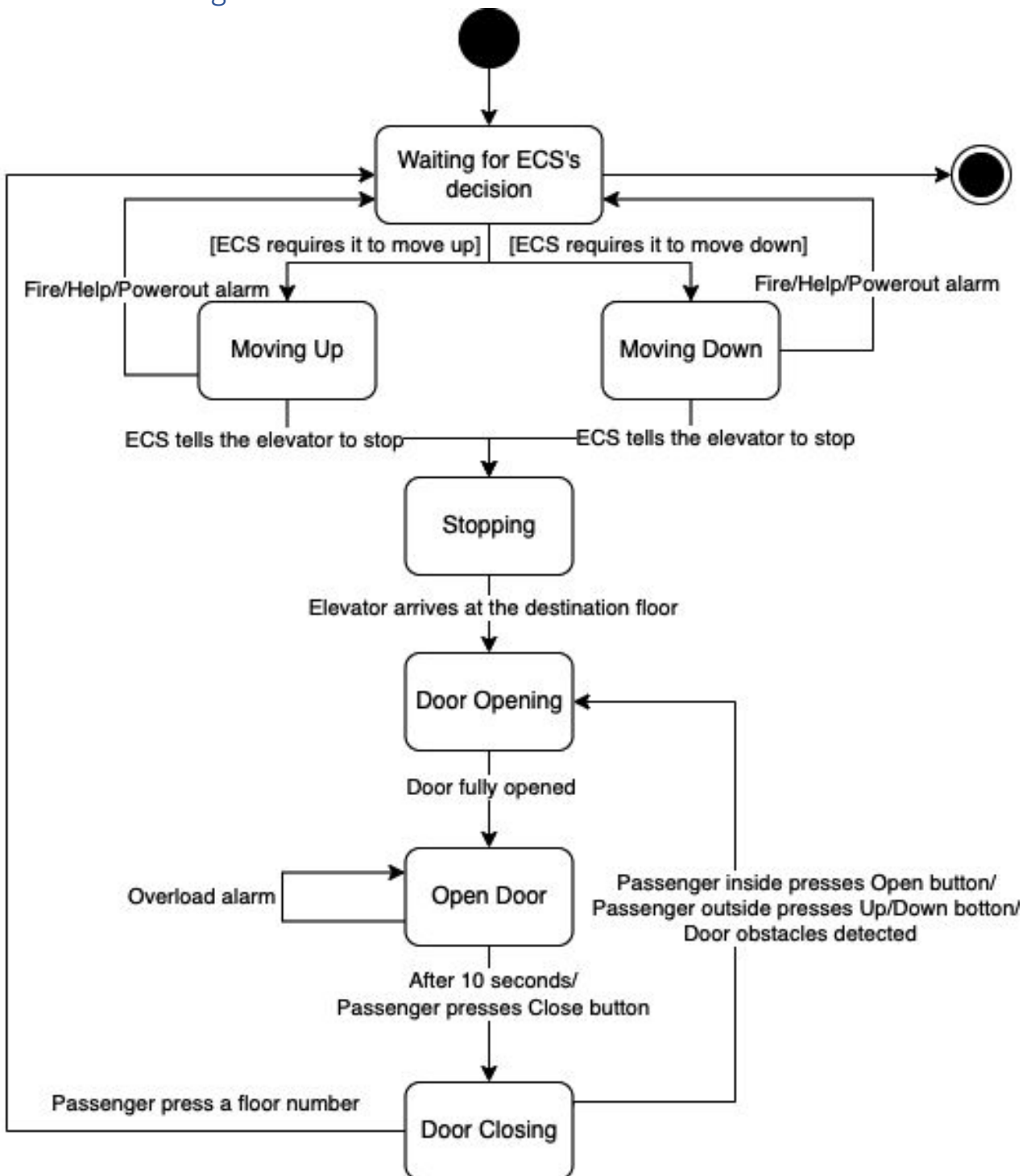


Scenario 7: Power Out

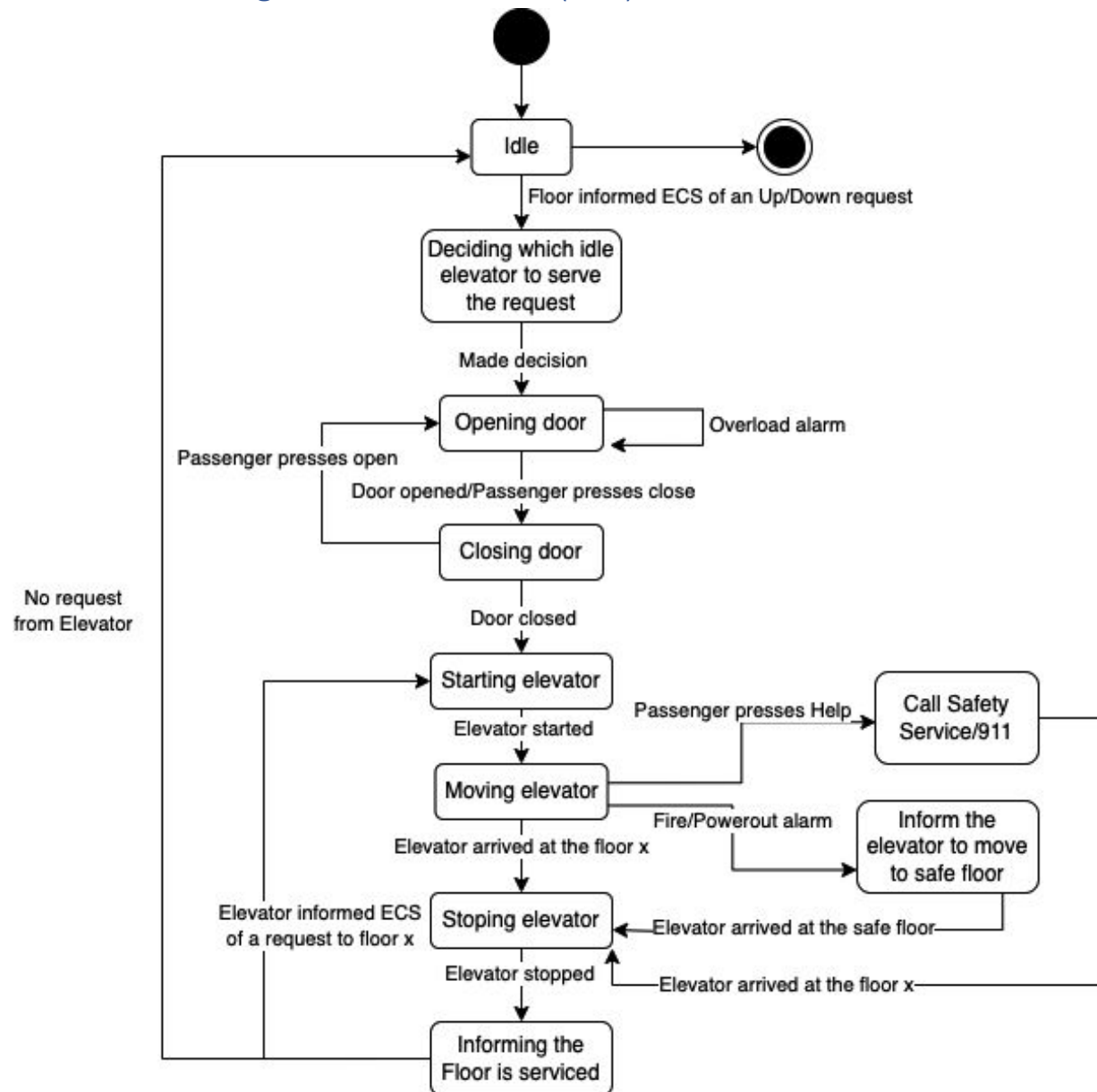
Passenger 1 is in Elevator 1 and moving to Floor 7.



Part 4: State Diagram for Elevators



Part 5: State Diagram for Controller (ECS)



Part 6: Discussion of the Use of Design Patterns

The centralized design uses the **mediator pattern**. Instead of Elevator and Floor objects communicating with each other directly, they now communicate through a **mediator**, ECS. The ECS will decide which elevator serves on which floor, should an elevator start or stop on a floor, should the elevator open the door on the floor, etc.

Singleton pattern is used on the MainWindow w object, which can only have one instance created in the program. ECS can access the instance by using `MainWindow::getInstance(this)`.

Part 7: Requirements Traceability Matrix

ID	Requirement	Related Use Case	Implemented By	Tested By
1	A building is serviced by 3 elevators (also called cars). On each of the 7 floors is a pair of buttons marked "up" and "down".	N/A	MainWindow, Floor	Run the simulator in Qt to observe the MainWindow, there are UP and DOWN buttons in the floor view.
2	When a button is pressed it illuminates, and remains illuminated, until an elevator arrives to transport the customers who, at this floor, have requested an elevator going in a certain direction.	UC1	MainWindow, Floor, Passenger	Select any passenger on a floor, then click on UP or DOWN button, which will turn green until an elevator has arrived on the floor.
3	When the elevator arrives, it rings a bell, opens its doors (the elevator and floor doors) for a fixed time (10 seconds) allowing people to exit or board, rings the bell again, closes its doors and proceeds to another floor.	UC1	Elevator, Floor, ECS, MainWindow	Wait for the elevator to arrive and observe the behavior in the console output.
4	Once on-board passengers select one or more destination floors using a panel of buttons; there is one button for every floor.	UC1	Passenger, MainWindow	Press a floor button in the elevator view in MainWindow.
5	The elevator has a display which shows passengers the current floor of the elevator.	UC1	MainWindow, Elevator	Observe the current floor in the elevator view in MainWindow.
6	There is a pair of buttons on the elevator control panel marked	UC4	MainWindow, Elevator, Passenger	When an elevator is open, press OPEN button in the MainWindow to restart the timer; press CLOSE

	“open door” and “close door” that can be used by a passenger to override the default timing of the doors. The door will remain open beyond its default period if the “open door” button is held depressed; the doors can be closed prematurely by pressing the “door close” button.			button in the MainWindow to stop the timer. The open and close behaviors will be shown in the console output.
7	Inside the elevator there is a help button linked to building safety service.	N/A	MainWindow	Observe the HELP button in the elevator view in MainWindow.
8	Sensor: Each elevator has a sensor that notifies it when it arrives at a floor. The elevator control system should ensure that the group of elevators services all (floor and on-board) requests expeditiously.	UC1	ECS, MainWindow	When an elevator is moving, observe the current floor text in the elevator view in MainWindow.
9	Audio: Each elevator has a display and an audio system. The display shows the current floor number and warning messages that are synced with audio warnings.	UC1	MainWindow, Elevator	Observe the display text in the elevator view, and the audio message in console output in MainWindow.
10	Help: The control system receives a “Help” alarm signal from an elevator indicating that the “Help” button has been pressed. In that case, the passenger is connected to building safety service through a voice connection. If there is no response	UC7	Elevator, Passenger, ECS, MainWindow	<p>When a passenger is inside an elevator, press HELP button. Then observe the display text in elevator view and the console output.</p> <p>To test the case where there is response from building safety within 5 seconds, check the Safety Service Respond Checkbox within 5 second, or vice versa.</p>

	from building safety within 5 seconds or if there is no response from a passenger a 911 emergency call is placed.			To test the case where there is response from the passenger, check the Respond to SS Checkbox , or vice versa.
11	Door obstacles: If the light sensor is interrupted when the door is closing, the control system stops the door from closing and opens it. If this occurs repeatedly over a short period of time, a warning is sounded over the audio system and a text message is displayed.	UC5	Elevator, ECS, MainWindow	When the door is open, click on the Door Obstacle button, then observe the console output. If click Door Obstacle button within 5 seconds again, observe the display text in elevator view and console output.
12	Fire: The control system receives a “Fire” alarm signal from the building and commands all elevators to move to a safe floor. Similarly, a “Fire” alarm signal from the elevator itself will cause that elevator to go to a safe floor. In both cases an audio and text message are presented to passengers informing them of an emergency and asking them to disembark once the safe floor is reached.	UC2	ECS, Elevator, MainWindow	<p>When an elevator is moving:</p> <p>To test the fire alarm from the building: check the Fire Alarm Checkbox in the admin view, observe the display text in elevator view and console output.</p> <p>To test the fire alarm from the elevator: check the Fire Alarm Checkbox in the elevator view, observe the display text in elevator view and console output.</p> <p>To release the fire alarm, uncheck the fire alarm checkbox.</p>
13	Overload: The control system receives an “Overload” alarm signal from an elevator if the sensors indicate that the passenger or cargo load exceeds the carrying	UC6	ECS, Elevator, MainWindow	When an elevator is open, check the Overload Checkbox in the elevator view, observe the display text in elevator view and console output. To reduce the load, uncheck the Overload Checkbox.

	capacity. In that case, the elevator does not move and an audio and a text messages are presented to passengers asking for the load to be reduced before attempting to move again.			
14	Powerout: The control system receives a "Power Out" alarm signal. In that case, an audio and a text messages are presented to passengers informing them of the power outage. Each elevator is then moved to a safe floor and passengers are asked to disembark via audio and text messages. The battery backup power is sufficient to do all of this.	UC3	ECS, Elevator, MainWindow	<p>When an elevator is moving, check the Powerout Checkbox in the admin view, observe the display text in elevator view and console output.</p> <p>To release the powerout alarm, uncheck the Powerout Checkbox.</p>