Assignment 3

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Use Cases

Use Case 1: Ride an Elevator

Actor(s):

- Passenger(primary actor)
- Elevator control System

Precondition(s):

- passenger is in an elevator control system
- elevator control system has been properly tested and installed
- elevator control system is in good working condition and is available for use

Main Success Scenario:

1. The passenger approaches an elevator and looks for the “up” or “down” button
2. The passenger press either the “up” or “down” button, depending on which way the passenger wants to go
3. the button that is pressed illuminates and will remain illuminated
4. the pressed button sends a signal to the elevator control system to bring the elevator to the current floor the passenger is on
5. the sensor detects that the elevator control system arrived at the floor the passenger is on
6. the press button will stop illuminating and elevator control systems rings a bell and opens its doors for 10 seconds
7. passenger boards elevator system and other passengers may enter/exit
8. the elevator control system rings a bell and closes its doors

9. the passenger enters the elevator and looks for the button panel, which includes one button for every floor
10. the passenger presses the button that corresponds to the floor they want to travel to
11. the pressed button sends a signal to the elevator control system to bring the elevator to that floor
12. the elevator control system proceeds to the passenger's requested floor, stopping at intermediate floors if necessary to pick up or drop off other passengers.
13. The elevator control system has a display which shows passengers the current floor of the elevator as it moves.
14. The elevator stops at passenger's requested floor
15. The elevator doors open at the requested floor, and the passenger exits the elevator
16. Passenger has arrived and reached their requested floor

Extensions:

7a. passenger is still waiting for other passengers to exit and needs to hold the door open longer than 10 seconds

7a1. Passenger holds the "up" or "down" button depending on which button they clicked in the first place

7b. passenger wants to hold the door open longer than 10 seconds to let other passengers in the elevator

7b1. Passenger holds the "open" button until not needed to stay open

7c. passenger wants to quickly close the doors and not wait 10 seconds

7c1. passenger can press the "close" button

8a. light sensor is interrupted when the door is closing

8a1. the control system stops the door from closing and opens it

8a2. a warning is sounded over the audio system and a text message is displayed when occurs repeatedly over a short period of time

13a. Sensors indicating that the passenger or cargo load exceeds the carrying capacity

13a1. The control system receives an "Overload" alarm signal from an elevator

13a2. the elevator does not move

13a3. an audio and a text messages are presented to passengers asking for the load to be reduced

13b. a fire occurs in the building

13b1. The control system receives a “Fire” alarm signal from the building

13b2. control system commands all elevators to move to a safe floor

13b3. an audio and text message are presented to passengers informing them of an emergency

13b4. control system asks passengers to disembark once the safe floor is reached

13c. a fire occurs in the elevator

13c1. The control system receives a “Fire” alarm signal from the elevator

13c2. control system commands all elevators to move to a safe floor

13c3. an audio and text message are presented to passengers informing them of an emergency

13c4. control system asks passengers to disembark once the safe floor is reached

13d. a power outage occurs in the elevator

13d1. The control system receives a “Power Out” alarm signal

13d2. an audio and a text messages are presented to passengers informing them of the power outage

13d3. the elevator control system is then moved to a safe floor

13d4. an audio and text message asks passengers to disembark once the safe floor is reached

13e. a passenger presses “Help” button

13e1. The control system receives a “Help” alarm signal from an elevator indicating that the “Help” button has been pressed

13e2. the passenger is connected to building safety service through a voice connection

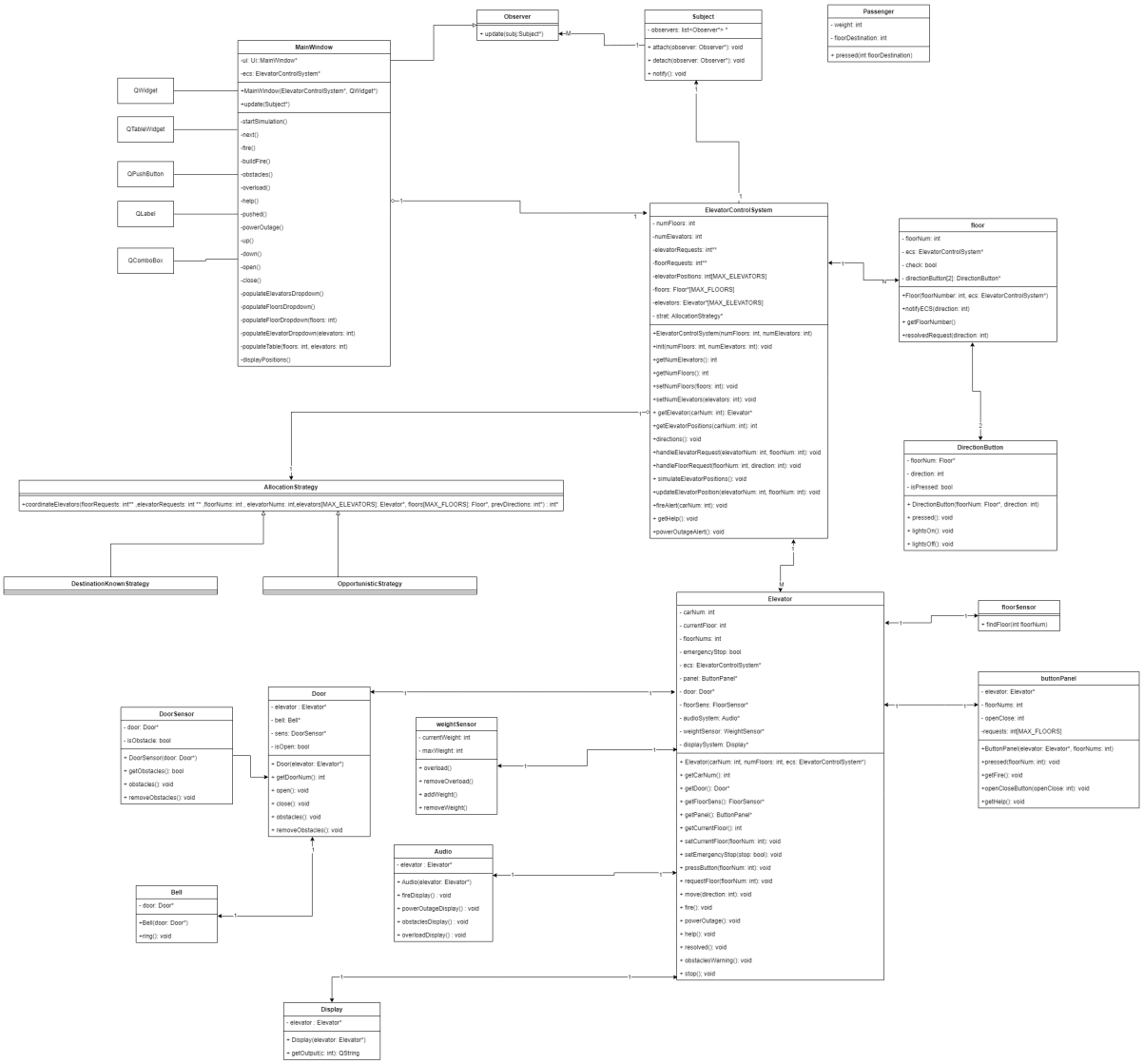
13e3. If there is no response from building safety within 5 seconds or if there is no response from a passenger a 911 emergency call is placed

Goal: the passenger can successfully and safely move from their current floor to their desired floor using the elevator

Post Condition(s):

- the elevator is functioning properly and that the user's experience is as smooth and seamless as possible

UML Class Diagram



The use case of riding an elevator requires an allocation strategy to ensure that passengers are efficiently and safely transported to their desired floors. Without an allocation strategy, there could be potential delays and confusion as passengers may not be able to quickly access the elevator, or the elevator may not be able to efficiently transport passengers to their desired floors due to poor allocation decisions. An allocation strategy can help to ensure that passengers are transported to their desired floors as quickly and safely as possible, by optimizing the use of available elevators and minimizing wait times for passengers.

Opportunistic strategy is needed when the elevator control system is determining which elevator to send to a specific floor. For example, if there are several elevators in a building and one is closer to the floor where the passenger is located, the elevator control system can choose that elevator as the best option. This would optimize the travel time and waiting time for the passenger and other passengers who may be waiting for the elevator.

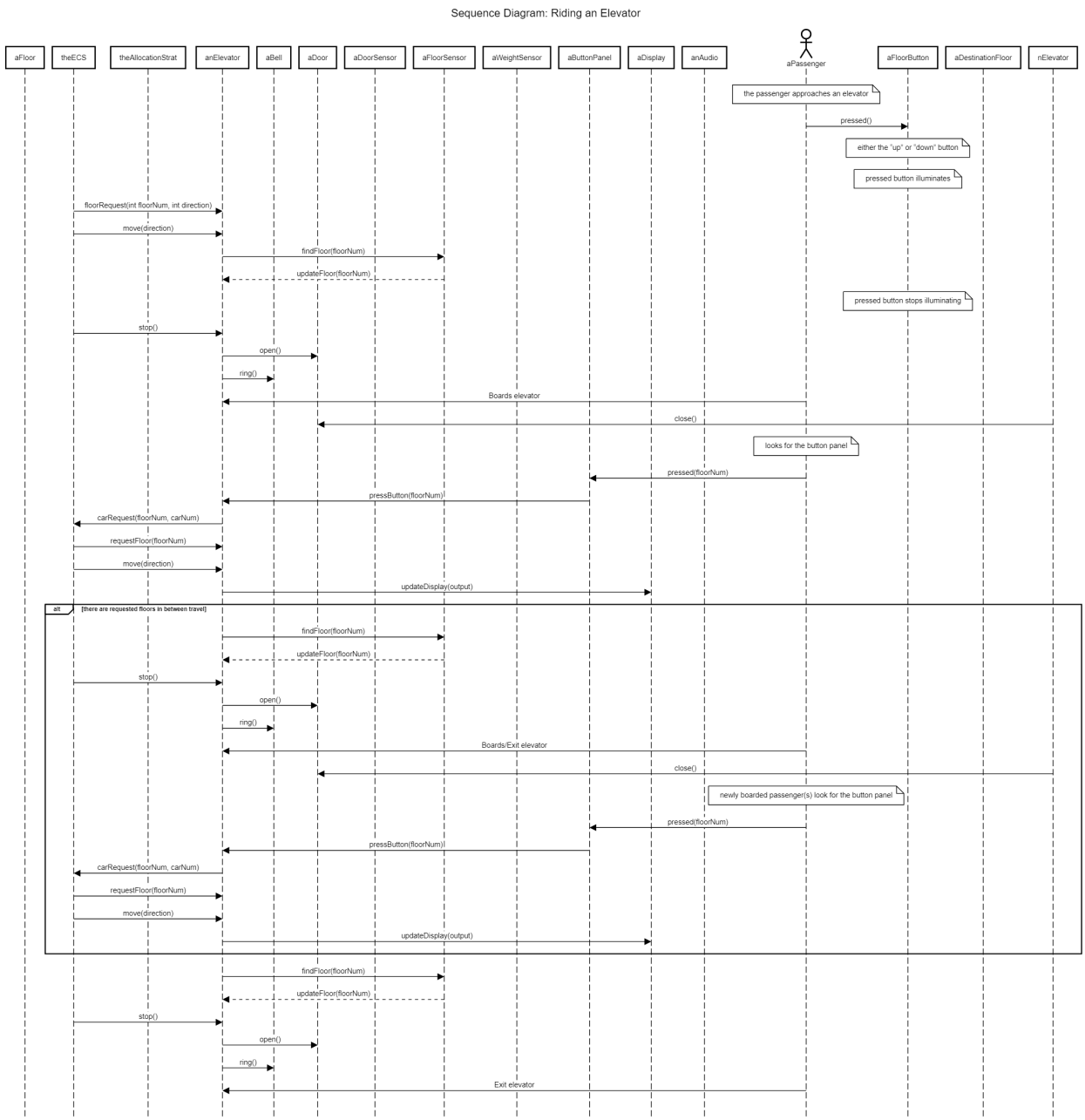
Sequence Diagrams

Participants:

- aFloor: the floor that the elevator is on
- theECS: the elevator control system
- theAllocationStrat: the allocation strategy used to assign the elevator to a passenger
- anElevator: the elevator car that the passenger is riding
- aBell: the bell that rings when the elevator arrives or the doors open/close
- aDoor: the door of the elevator
- aDoorSensor: the sensor that detects whether the door is open or closed
- aFloorSensor: the sensor that detects the floor that the elevator is on

- aWeightSensor: the sensor that detects the weight of the elevator
- aButtonPanel: the panel inside the elevator that has buttons for each floor
- aDisplay: the display inside the elevator that shows the current floor and other information
- anAudio: the speaker that provides audio messages to passengers
- aPassenger: the person who is riding the elevator
- aFloorButton: the button on the floor that the passenger presses to call the elevator
- aDestinationFloor: the floor that the passenger wants to go to

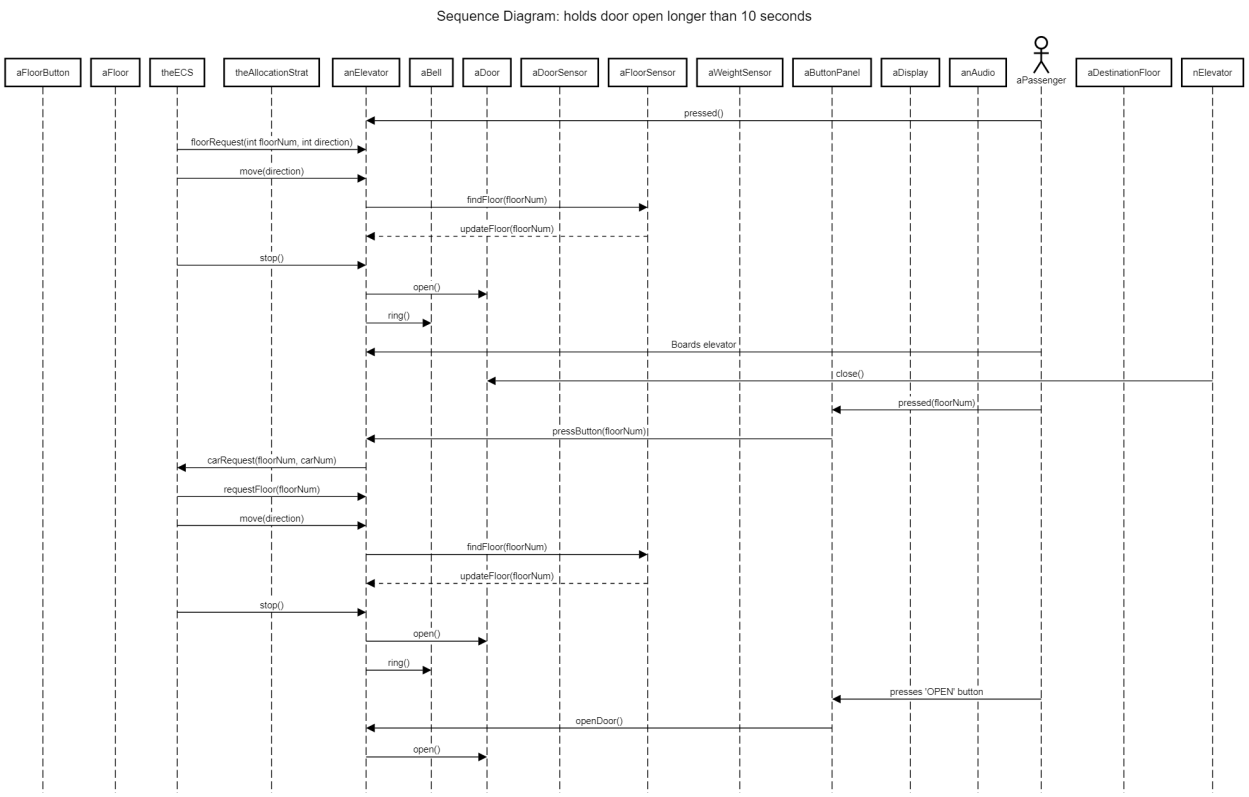
Main Scenario



1. The passenger approaches the elevator and presses the "up" or "down" button on the aFloorButton, depending on which direction they want to go.
2. The aFloorButton that is pressed illuminates, and the pressed button sends a signal to theECS to bring the elevator to the current floor the passenger is on.
3. The ECS then assigns anElevator to the passenger based on the allocation strategy.
4. The elevator moves in the direction of the requested floor.

5. Once the elevator reaches the requested floor, the aFloorSensor detects the floor number, and the elevator stops moving.
6. The elevator doors open for 10 seconds, and the aBell rings to signal that the elevator has arrived at the requested floor.
7. The passenger boards the elevator, and other passengers may enter or exit if applicable.
8. The passenger looks for the button on the aButtonPanel that corresponds to the floor they want to go to.
9. The passenger presses the button, and the pressed button sends a signal to theECS to bring the elevator to the requested floor.
10. The elevator moves in the direction of the requested floor, stopping at intermediate floors if necessary to pick up or drop off other passengers.
11. The aDisplay inside the elevator shows the current floor of the elevator as it moves.
12. Once the elevator reaches the requested floor, the aFloorSensor detects the floor number, and the elevator stops moving.
13. The elevator doors open for 10 seconds, and the aBell rings to signal that the elevator has arrived at the requested floor.
14. The passenger exits the elevator, and the elevator doors close.
15. If there are requested floors in between the travel, the same steps from 9 to 14 are repeated for each requested floor.
16. The passenger has arrived at their destination floor, and the elevator continues to operate until all passengers have reached their destination.

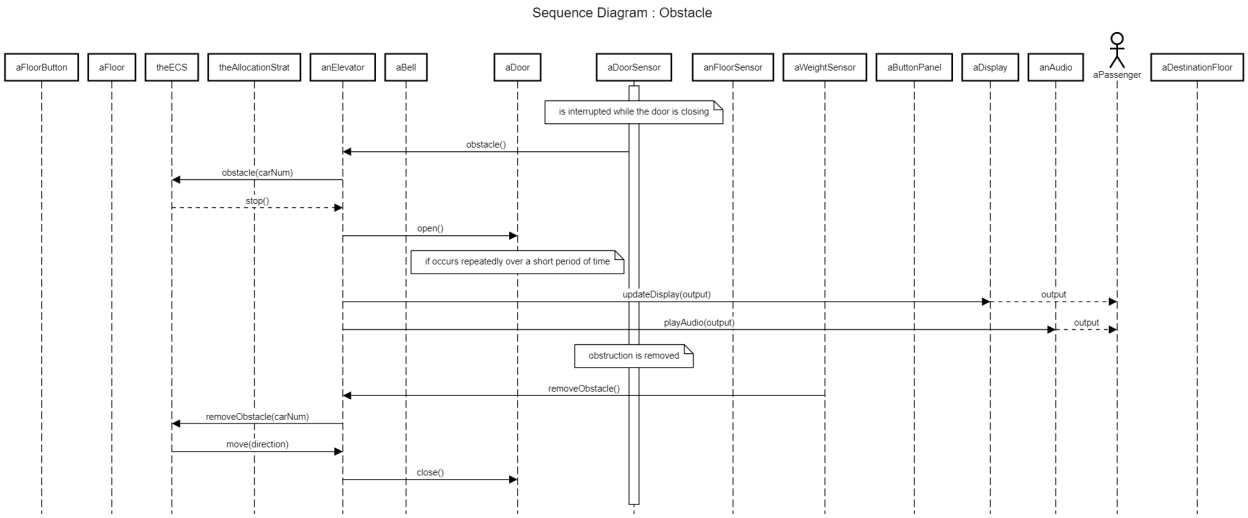
Passenger holds the door open longer than 10 seconds



1. A passenger enters the elevator and selects a floor by pressing the corresponding button on the button panel.
2. The elevator control system (ECS) receives the floor request and sends a request to the elevator to move in the direction of the selected floor.
3. The elevator finds the requested floor using its floor sensor and updates its current floor.
4. The elevator stops at the requested floor and opens its doors. The bell rings to signal that the elevator has arrived at the requested floor.
5. The passenger boards the elevator and the doors close.
6. The passenger selects the floor they want to go to using the button panel.
7. The elevator receives the floor request and the ECS sends a request to the elevator to move to the selected floor.
8. The elevator finds the requested floor using its floor sensor and updates its current floor.

9. The elevator stops at the requested floor and opens its doors. The bell rings to signal that the elevator has arrived at the requested floor.
10. The passenger presses the 'OPEN' button on the button panel to hold the door open longer than 10 seconds.
11. The button press is received by the elevator's button panel, which sends a signal to the elevator to open the doors.
12. The elevator doors open and remain open until the passenger closes them or until 10 seconds have passed.

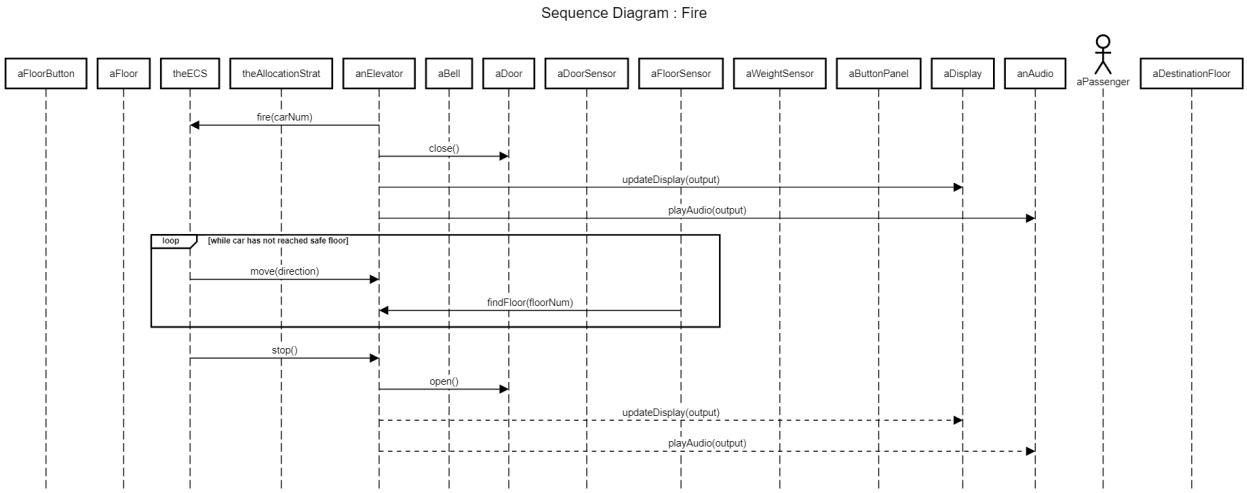
Safety Feature: Obstacles



1. The door sensor is activated and is interrupted when the door is closing.
2. The door sensor sends a message to the elevator to indicate that an obstacle has been detected.
3. The elevator sends a message to the ECS (Elevator Control System) to indicate that there is an obstacle.
4. The ECS sends a message to the elevator to stop the elevator immediately.
5. The elevator sends a message to the door to open.
6. If the obstruction occurs repeatedly over a short period of time, the elevator updates the display with an appropriate output and plays an audio message to notify the passenger of the issue.

7. When the obstruction is removed, the weight sensor sends a message to the elevator to remove the obstacle.
8. The elevator sends a message to the ECS to remove the obstacle associated with the car number.
9. The ECS sends a message to the elevator to move in the current direction.
10. The elevator sends a message to the door to close.

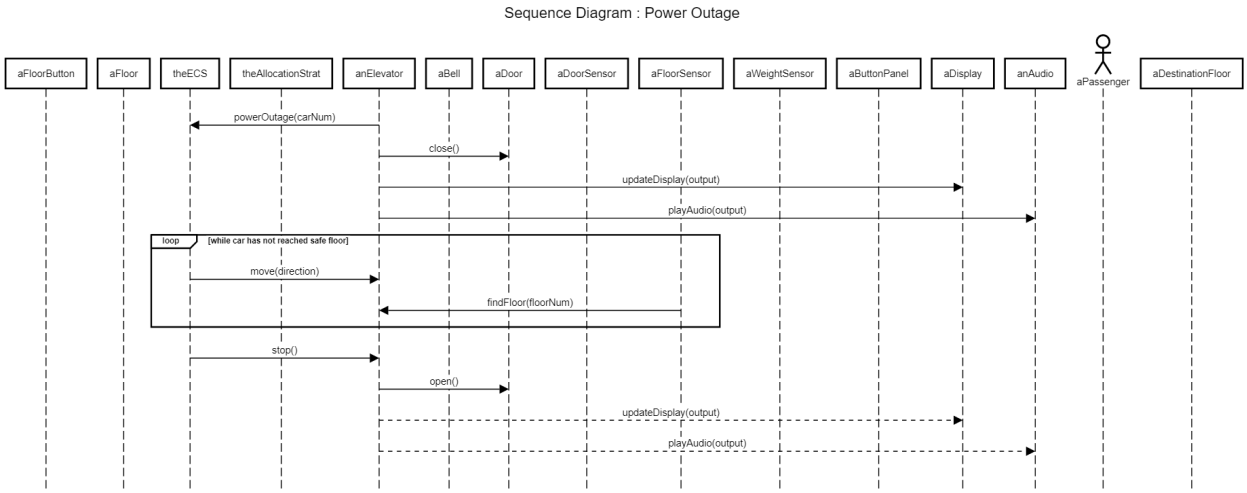
Safety Feature: Fire



1. The elevator system (theECS) receives a message from an elevator (anElevator) that there is a fire in the elevator car (fire(carNum)).
2. The elevator door (aDoor) is closed to prevent smoke from entering the elevator car.
3. The display (aDisplay) is updated to indicate the situation and the audio system (anAudio) plays an alert message to passengers.
4. The elevator moves to a safe floor.
    - The elevator system (theECS) moves the elevator (anElevator) in a certain direction.
    - The elevator's floor sensor (aFloorSensor) finds the floor number of the current floor.
    - This loop continues until the elevator reaches a safe floor.

5. The elevator stops at the safe floor.
    - The elevator system (theECS) stops the elevator (anElevator).
6. The door (aDoor) is opened at the safe floor.
7. The display (aDisplay) is updated to indicate the situation and the audio system (anAudio) plays an alert message to passengers.

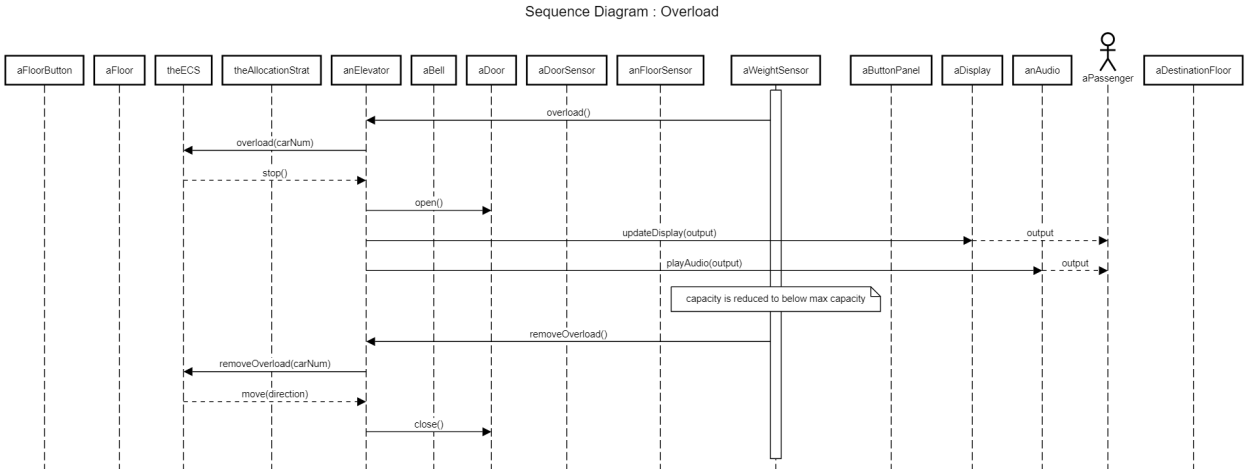
Safety Feature: Power Outage



1. The elevator sends a message to the Emergency Control System (theECS) to report a power outage, along with the car number.
2. The elevator closes its door.
3. The elevator updates its display to show a message indicating a power outage.
4. The elevator plays an audio message to inform the passengers of the power outage.
5. The elevator enters a loop to wait for the car to reach a safe floor. It continues to move in the direction it was previously moving until it reaches a safe floor.
6. At each floor, the elevator's floor sensor finds the floor number and updates the elevator.
7. Once the car has reached a safe floor, the loop ends.
8. The ECS sends a message to the elevator to stop moving.

9. The elevator opens its door.
10. The elevator updates its display with a message indicating that it has reached a safe floor.
11. The elevator plays an audio message to inform the passengers that they have reached a safe floor.

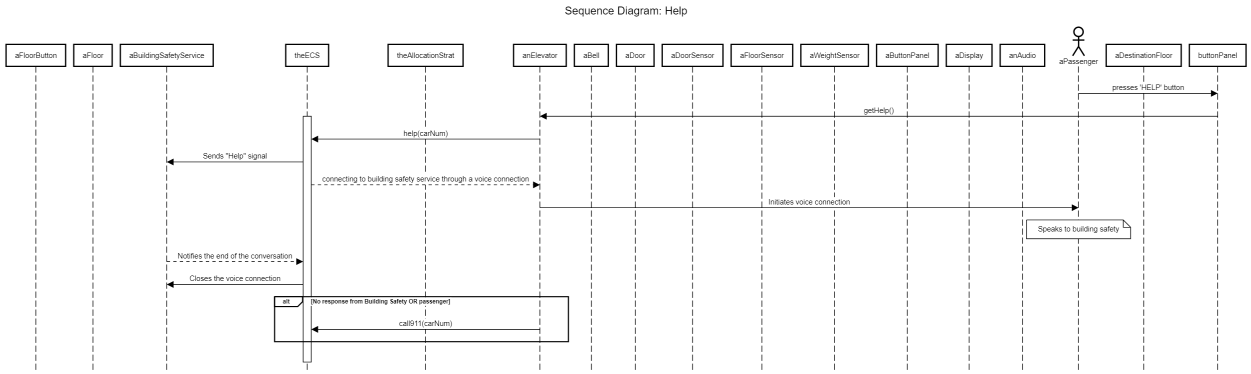
Safety Feature: Overload



1. The WeightSensor detects that the elevator is overloaded and sends an "overload()" message to the Elevator.
2. The Elevator sends an "overload(carNum)" message to the ECS (Elevator Control System) with its car number.
3. The ECS receives the message and sends a "stop()" message to the Elevator to stop its movement.
4. The Elevator receives the "stop()" message and sends an "open()" message to the Door to open it.
5. The Elevator sends two messages in parallel to update the display and play an audio output. Both the display and audio output are intended for passengers to be notified about the overload situation.
6. The WeightSensor detects that the capacity has reduced below the maximum capacity and sends a "removeOverload()" message to the Elevator.

7. The Elevator sends a "removeOverload(carNum)" message to the ECS with its car number.
8. The ECS sends a "move(direction)" message to the Elevator to move in the specified direction.
9. The Elevator sends a "close()" message to the Door to close it.

Safety Feature: Help



1. The passenger presses the "HELP" button on the button panel.
2. The button panel sends a "getHelp()" message to the elevator.
3. The elevator activates the ECS and sends a "help(carNum)" message.
4. The ECS sends a "Sends Help signal" message to the building safety service.
5. The ECS establishes a voice connection with the building safety service and sends a "connecting to building safety service through a voice connection" message to the elevator.
6. The elevator initiates a voice connection with the passenger and sends an "Initiates voice connection" message.
7. The passenger speaks to the building safety service over the voice connection. (Note: This step is represented by a "note over aPassenger" in the diagram.)
8. The building safety service notifies the end of the conversation by sending a message to the ECS.
9. The ECS closes the voice connection with the building safety service and sends a "Closes the voice connection" message.

10. If there is no response from the building safety service or the passenger within 5 seconds, the elevator calls 911 by sending a "call911(carNum)" message to the ECS.

Video

https://youtu.be/llYO02AcstE

Traceability Matrix

ID	Requirement	Related Use Case	Fulfilled By	Tested-by
1	A building is serviced by M elevators and N floors	N/A	Elevator, Floor, ECS	TC1
2	On each of the N floors is a pair of buttons marked "up" and "down. When a button is pressed it illuminates, and remains illuminated, until an elevator arrives to transport the passengers who, at this floor, have requested an elevator going in a certain direction.	Riding an Elevator (UC1)	Elevator, FloorButton, ECS	TC1

ID	Requirement	Related Use Case	Fulfilled By	Tested-by
3	When the elevator arrives, it rings a bell, opens its doors for a fixed time allowing passengers to exit or board, closes its doors and proceeds to another floor.	Riding an Elevator (UC1)	Elevator, ECS, Door, Bell	TC1
4	Once on-board passengers select one or more destination floors using a panel of buttons; there is one button for every floor. The elevator has a display which shows passengers the current floor of the elevator.	Riding an Elevator (UC1)	ButtonPanel, Display, Elevator, ECS	TC1

ID	Requirement	Related Use Case	Fulfilled By	Tested-by
5	There is also a pair of buttons on the elevator control panel marked "open door" and "close door". These buttons 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. Inside the elevator there is also a help button linked to building safety service.	Riding an Elevator (UC1)	ButtonPanel, Door, Elevator, ECS	TC1
6	Each elevator has a sensor that notifies it when it arrives at a floor.	Riding an Elevator (UC1)	Floor, FloorSensor, Elevator, ECS	TC1

ID	Requirement	Related Use Case	Fulfilled By	Tested-by
7	The elevator control system should ensure that the group of elevators services all (floor and on-board) requests expeditiously.	Riding an Elevator (UC1)	ECS, AllocationStrategy, Elevator	TC1
8	Each elevator has a display and an audio system. The display shows the current floornumber and warning messages that are synced with audio warnings.	Riding an Elevator (UC1)	Display, Audio, Elevator, ECS	TC1
9	Help: The control system receives a "Help" alarm signal from an elevator indicating that the "Help" button has been pressed.	Help is requested (UC6)	ButtonPanel, Elevator, ECS	TC7

ID	Requirement	Related Use Case	Fulfilled By	Tested-by
10	Help: The passenger is connected to building safety service through a voice connection. If there is no response from building safety within 5 seconds or if there is no response from a passenger a 911 emergency call is placed.	Help is requested (UC6)	ECS, Display, Audio, Elevator	TC7
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.	Door obstacle detected (UC2)	ECS, DoorSensor, Door	TC2
12	Door obstacles: If the sensor is interrupted repeatedly over a short period of time, a warning is sounded over the audio system and a text message is displayed.	Door obstacle detected (UC2)	ECS, DoorSensor, Door, Display, Audio, Elevator	TC2

ID	Requirement	Related Use Case	Fulfilled By	Tested-by
13	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.	Riding an elevator when a fire occurs in the building (UC4)	ECS, Elevator, ButtonPanel	TC3 and TC4
14	Fire: 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.	Riding an elevator when a fire occurs in the building (UC4)	ECS, Elevator, Display, Audio, Door	TC3 and TC4
15	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 capacity.	Capacity is exceeded (UC3)	WeightSensor, Elevator, ECS	TC5

ID	Requirement	Related Use Case	Fulfilled By	Tested-by
16	Overload: 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.	Capacity is exceeded (UC3)	WeightSensor, Elevator, ECS, Display, Audio	TC5
17	Power out: 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.	Riding an elevator when a power outage occurs (UC5)	ECS, Display, Audio, Elevator	TC6
18	Power Out: 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.	Riding an elevator when a power outage occurs (UC5)	ECS, Elevator, Display, Audio, Door	TC6

Testing

Note: The ‘Next’ button should be pressed between each step

Test case 1: Ring an Elevator

1. User selects floor and press either up/down
    - floor creates a floor request
    - pressed button lights up until elevator arrives
2. Elevator reaches a floor with a request
    - doors open
    - bell ring
    - doors close
    - bell ring
3. User inputs a floor using floor # drop and presses push
    - creates an elevator request
4. elevator travels to requested floor
    - displays current floor
5. Elevator arrives requested floor
    - doors open
    - bell ring
    - doors close
    - bell ring
6. User arrives at requested floor

Test case 2: Obstacles

1. Select elevator # dropdown to choose which elevator will have an obstacle
2. press door block button
    - attempt to close doors and remove obstacles 3 times
3. failed to remove obstacles

- display will display a message
- audio will play a message

Test case 3: Fire inside elevator

1. Select elevator # dropdown to choose which elevator will have a fire
2. press fire button
    - selected elevator will go down
    - display fire message in elevator’s display

Test case 4: Fire inside building

1. press build fire button
    - all elevators will go down
    - display fire message in elevators’ display

Test case 5: Overload

1. Select elevator # dropdown to choose which elevator will have an overload
2. press overload button
    - display will display a message
    - audio will play a message

Test case 6: Power Outage

1. press build Power Outage button
    - all elevators will go down
    - display power outage message in elevators’ display

Test case 7: Help

1. Select elevator # dropdown to choose which elevator requested help
2. press help button
    - connects to building services

3. building services connects
    - wait for 5 seconds, if no response call 911