

3004 A2 - Analysis and Design of an Elevator Controller Simulator

Elevator Control System Use Cases

Name: Elevator Buttons & Display Use-Case

Primary Actor(s): Elevator passenger(s), safety service agent

Stakeholders and Interests:

Elevator passenger/user – they use the buttons to use the elevator

Safety service agent – is alerted if a certain button is pressed

Building owner – needs the elevator system to work properly for users to access all the building's levels

Pre-condition(s): The elevator must be installed correctly.

Success guarantee(s) (equivalently Post-conditions): Any button will be pressed for the elevator, and the intended action will be played out safely. The display will accurately indicate the floor levels and any emergency instruction.

Main success scenario:

- should be complete end to end behavior (not fragments)
- 1. The user stands outside the elevator and presses a button to go either up or down.
- 2. The selected buttons illuminate.
- 3. The elevator arrives, the doors open, and the user can enter.
- 4. The user then presses a button for the floor level they'd like to go to.
- 5. The selected buttons illuminate.
- 6. The elevator goes in the direction it was selected for.
- 7. The display shows the current floor levels as the elevator moves.
- 8. The elevator will come to a stop at the selected level and the selected buttons lights will turn off.
- 9. The doors will open for the user to exit then shut.
- 10. The elevator will repeat this process with the buttons and display.

Extensions:

- 1a. The user selects both up and down outside the elevator.
 - 1a1. The system will prioritize the first one selected and complete the first ride before completing the 2nd button's ride.
- 3a. The elevator's capacity is too high, and the Overload signal goes off alarmed by the sensors.
 - 3a1. A text message will be displayed indicating the problem.
 - 3a2. The elevator does not move floor until the weight in the elevator is within range.
 - 3a3. Once within range, the elevator will move to the selected button's floors.
- 4a. The user selects many levels inside the elevator
 - 4a1. The elevator goes in the direction it was selected for and stops at the closest level selected.
 - 4a2. The elevator proceeds to all the other levels selected in the same way.
- 4b. The passenger wants to accelerate the shutting/opening of the elevator doors.
 - 4b1. They can select the open button or close button instead of waiting for the automatic time.
- 4c. The help button is pushed.
 - 4c1. The help button initiates a call with a safety service agent that can aid in emergencies
- 4d. The safety service agent doesn't answer after the user pressed the help button.
 - 4d1. 911 will be called and connected to the elevator
- 6a. The building's fire alarm goes off.
 - 6a1. The elevators move to a safe floor which is not always the selected buttons and stops motion.
 - 6a2. A text message is displayed indicating the emergency.
- 6b. The power goes out.

- 6b1. The elevator is moved to a safe floor generated by the backup power.
- 6b2. A text message is displayed indicating the emergency.

Name: Elevator Audio System & Sensor System Use-Case

Primary Actor(s): Elevator passenger(s)

Stakeholders and Interests:

Elevator passenger/user – they use the buttons to use the elevator

Safety service agent – is alerted if a certain button is pressed

Building owner – needs the elevator system to work properly for users to access all the building's levels

Pre-condition(s): The elevator must be installed correctly.

Success guarantee(s) (equivalently Post-conditions): The audio and sensor system will work as intended when prompted.

Main success scenario:

- should be complete end to end behavior (not fragments)
- 1. The elevator doors open.
- 2. The audio is played in the elevator indicating the floor level.
- 3. The user enters the elevator.
- 4. The elevator doors close automatically after some time.
- 5. The elevators move to the user selected levels.
- 6. The sensor detects the correct floor.
- 7. The elevator stops and the doors open.
- 8. The elevator audio system plays indicating the floor level
- 9. The doors shut and the cycle repeats

Extensions:

3a. Too much capacity for the elevator aka. 'Overload signal' goes off alarmed by the sensors.

3a1. The elevator does not move, and audio is played indicating the issue

3a2. Once within range, the elevator will move

4a. The door is halfway closed and the user or someone else places something between the shutting doors.

4a1. The light sensor detects the interruption and stops the door from closing.

4b. The light sensor stops the elevator door from closing many times.

4b1. A warning sound over audio system indicates the issue.

5a. The building's fire alarm goes off, someone is inside

5a1. The elevators move to a safe floor.

5a2. The warning & instructions are played in the audio system indicating the emergency.

5b. The building has a power outage

5b1. The elevator's audio will indicate the problem

5b2. The elevator is moved to a safe floor generated by the backup power

Structural UMLs

- Centralized Diagram

The centralized UML diagram's main attribute is the elevator control system that controls everything that is involved in making the elevator function within a building.

Elevator is the Elevator_Centr.h from this diagram with the Building Level as

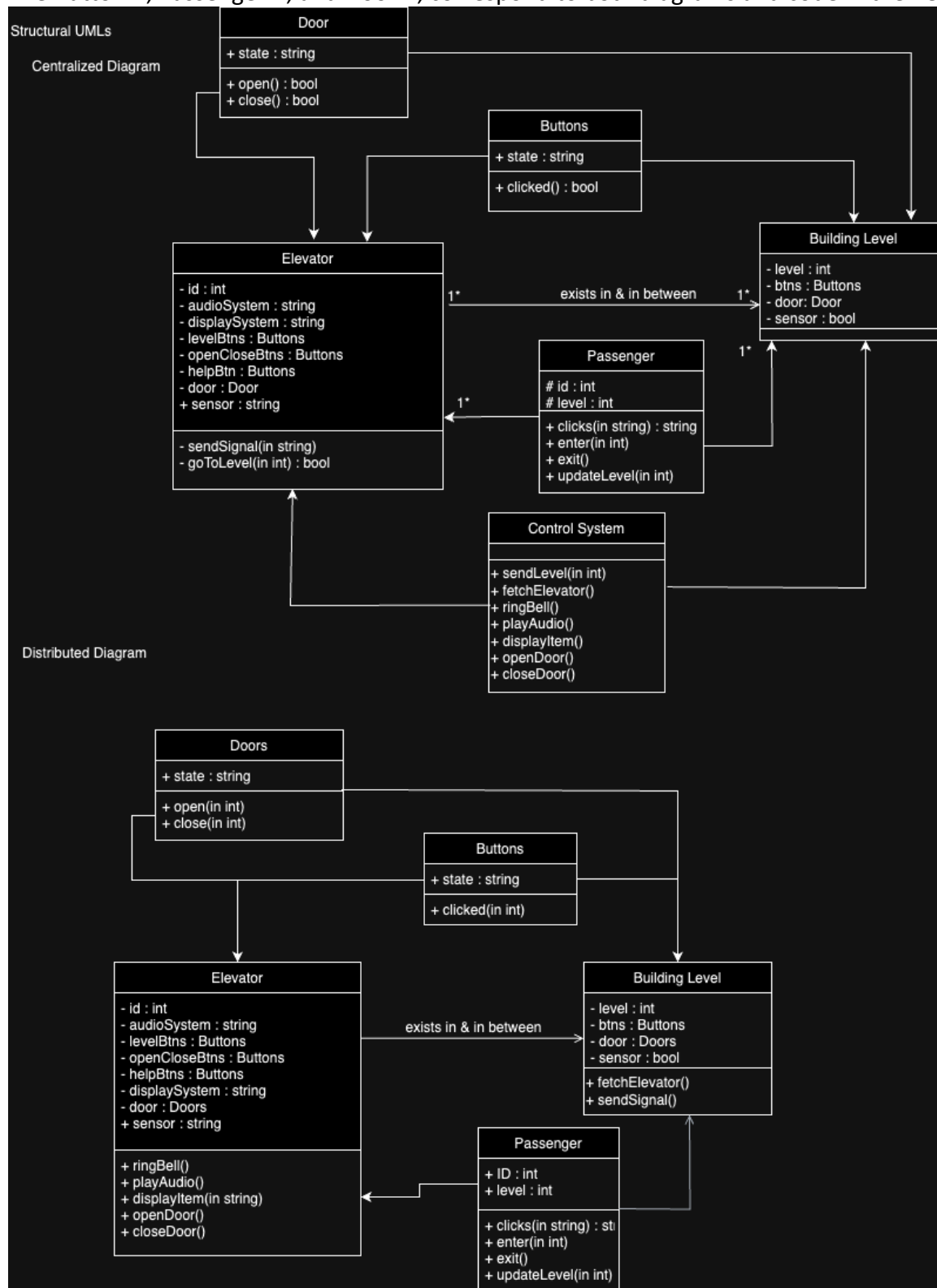
BuildingLevel_Centr.h and finally the Control System as the ControlSystem_Centr.h in the header file.

- Distributed Diagram

The distributed UML diagram's main attribute is the elevator that controls itself and engages directly with the passenger, door, buttons, and building level .

For this diagram, the Elevator is the Elevator_Decentr.h and the Building Level is the BuildingLevel_Decentr.h in the header file.

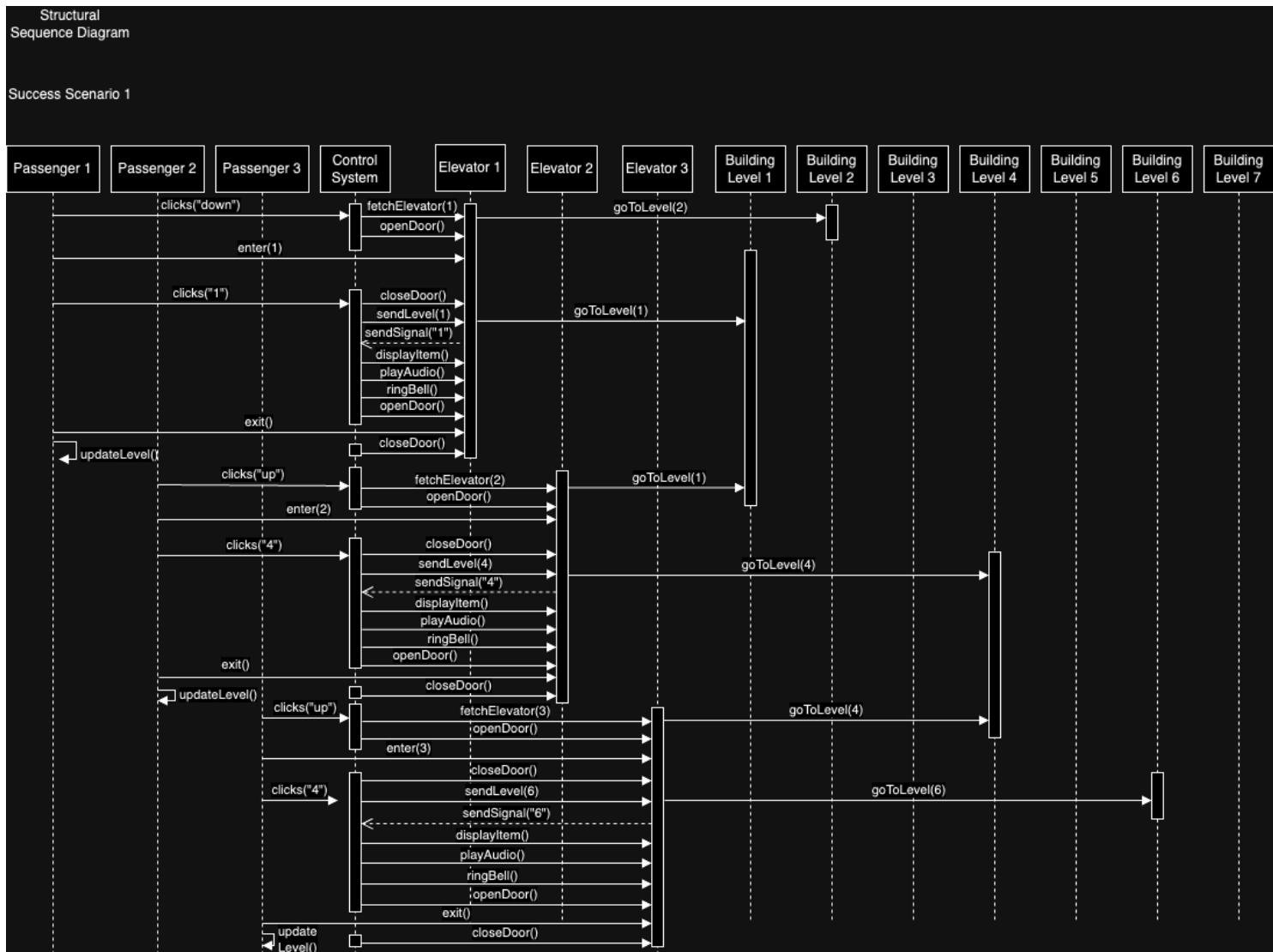
The Button.h, Passenger.h, and Door.h, correspond to both diagrams and code in the header file.



Sequence Diagrams - Centralized

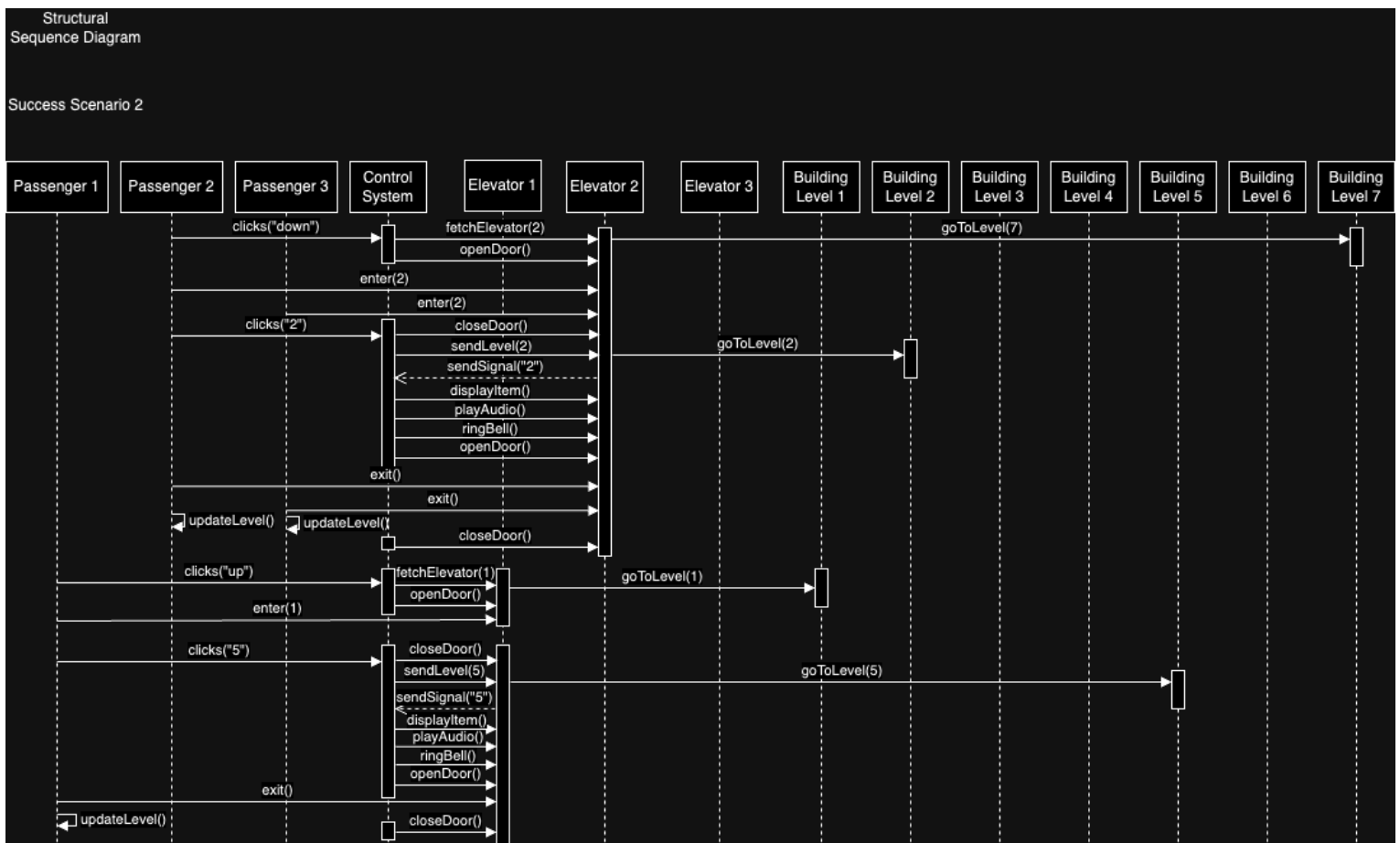
- Success Scenario 1:

- 1st Passenger is at Level 2 and clicks down
- 2nd Passenger is at Level 1 and clicks up
- 3rd Passenger is at Level 4 and clicks up
- The buttons illuminate
- The closest elevators arrives, and the doors open and the bells ring
- 3/3 passengers enter
- The elevators doors close
- 1st passenger clicks level 1, the 2nd clicks level 4, and the 3rd clicks level 6
- The level buttons illuminate in the designated elevator
- The elevators move in their designated directions and the levels are shown on their displays
- The 1st elevator stops at Level 1 and the bell rings, and the doors open
- 1st passenger exits the elevator
- The 2nd elevator stops at Level 4 and the bell rings, and the doors open
- 2nd passenger exits the elevator
- The 3rd elevator stops at Level 6 and the bell rings, and the doors open
- 3rd passenger exits the elevator
- The elevators doors close



- Success Scenario 2:

- 1 passenger is at Level 1 clicks the up button and one of the 2/3 passengers at level 7 clicks the down button (2 elevators are in use)
- The buttons illuminate
- The closest elevators to each of them arrive to their levels and the doors opens and the bells rings
- The passengers enter their elevators
- The ascending passenger clicks level 5 and one of the descending passengers clicks level 4 and the other, level 2.
- The buttons illuminate
- The 1st elevator moves up, the other down, and the levels are shown on the display
- The ascending elevator stops at Level 5 and the bell rings, and the doors open
- The descending elevator stops at Level 4 and the bell rings, and the doors open
- then the elevator doors close and descend to level 2, the bell rings and the doors open.
- The passengers had exited at their selected floors
- The elevators door closes after dropping off the passengers
- The elevator doors shut



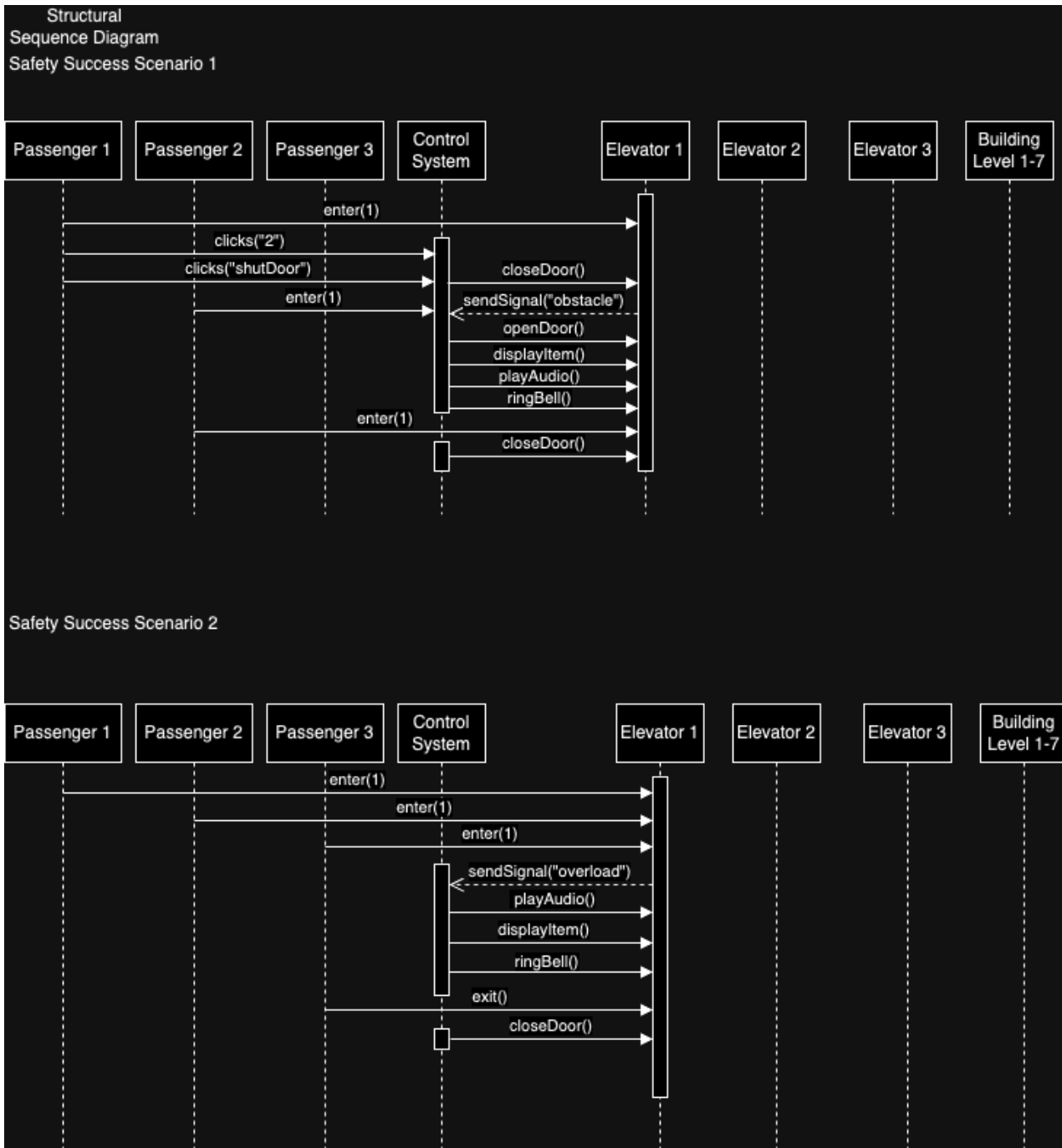
- Safety Success Scenario 1:

- 1 passenger is inside the elevator as the door is still open
- That passenger selects level 2 button and presses the door shutting button
- Another passenger rushes to catch the elevator and interrupts the light sensor for the shutting door
- The elevator rings and the doors open
- The passenger enters and the doors shut

- The elevator doors close

- Safety Success Scenario 2:

- 3 passengers enter one of the elevators when moving into the building with a ton of luggage
- The system receives the overload signal
- The elevator does not move
- Audio is played and text is displayed explaining the error and requesting less load in the elevator
- 1 passenger leaves with their luggage and the elevator is able to move again

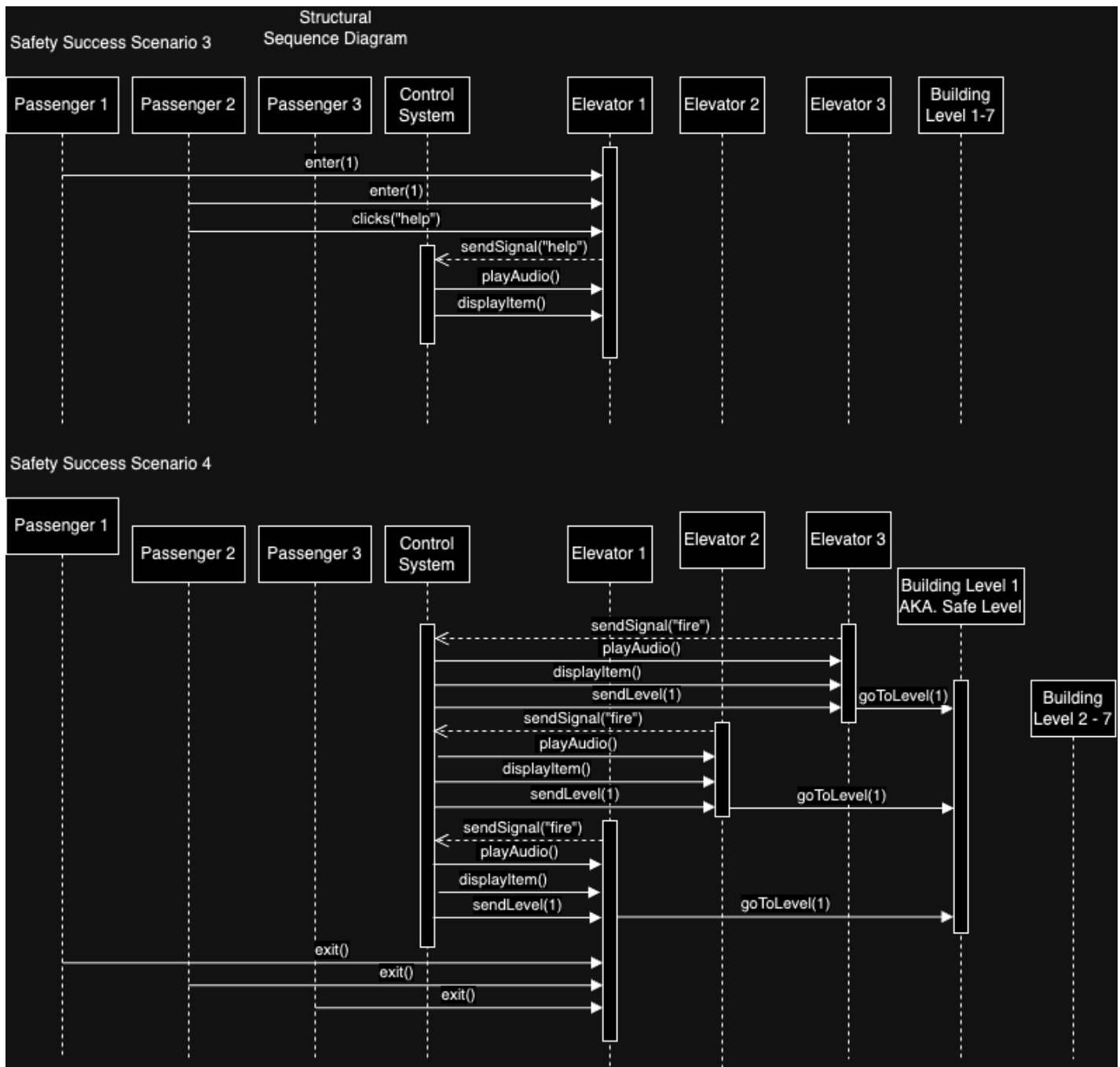


- Safety Success Scenario 3:

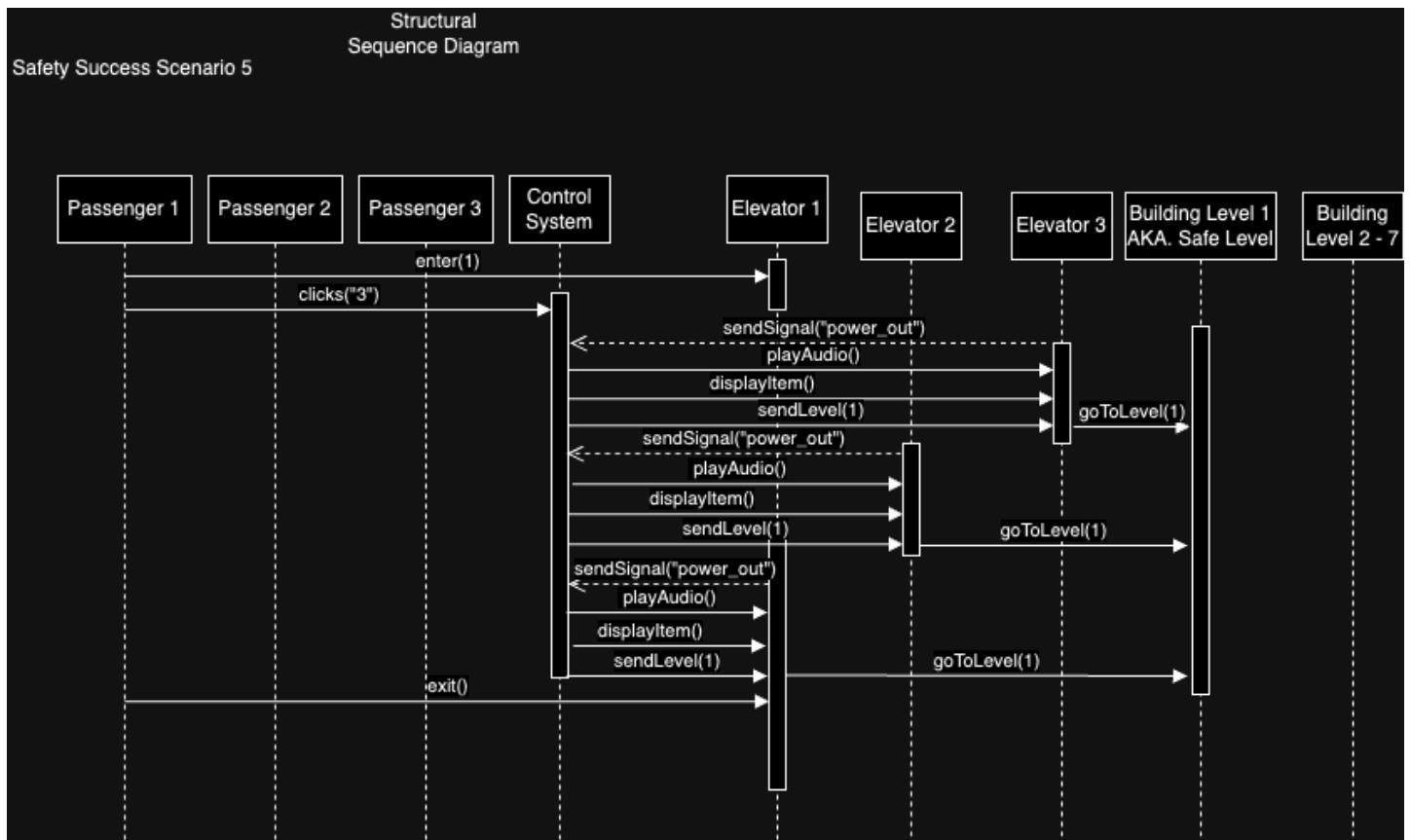
- There are 2 passengers in the moving elevator
- During the ride 1 passenger faints
- The other passenger presses the “help” button
- The system connects them to building safety
- the conscious passenger is told what to do

- Safety Success Scenario 4:

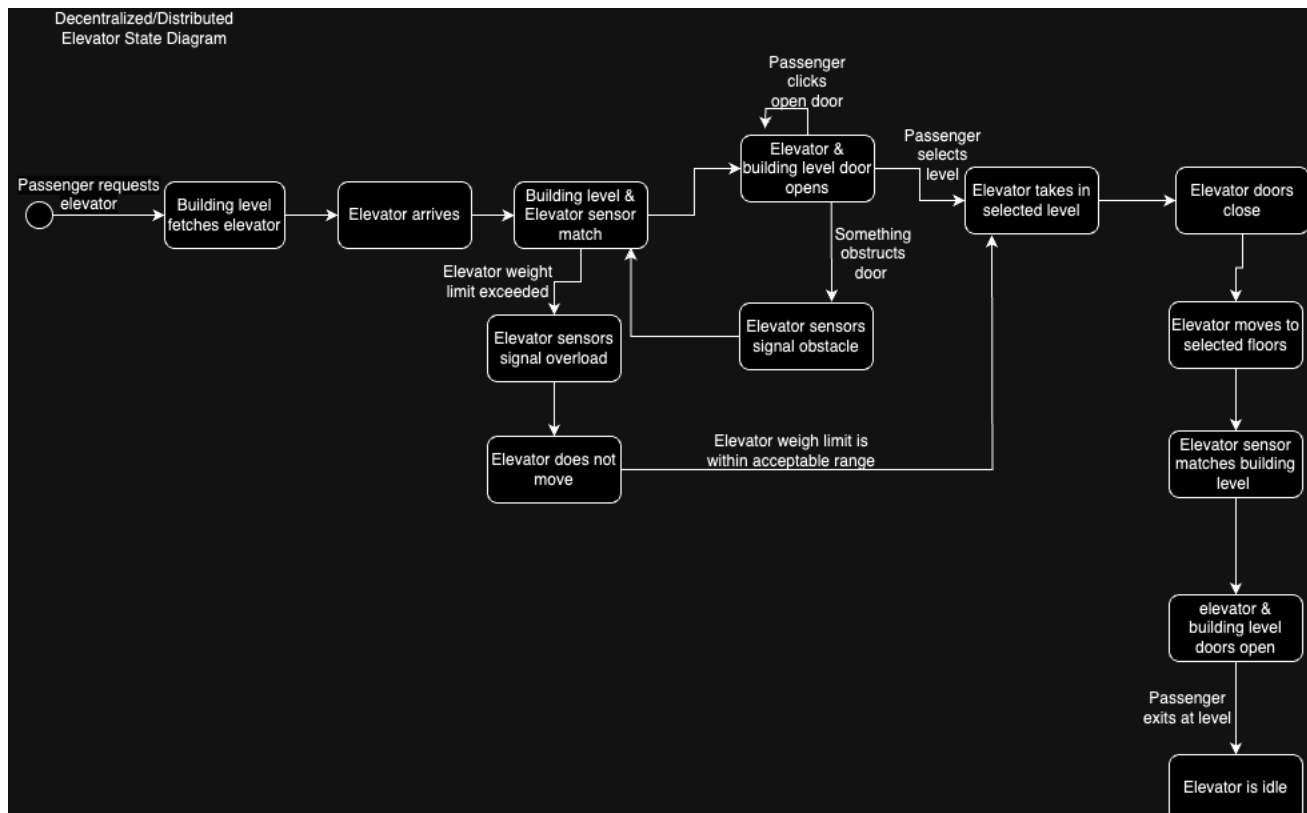
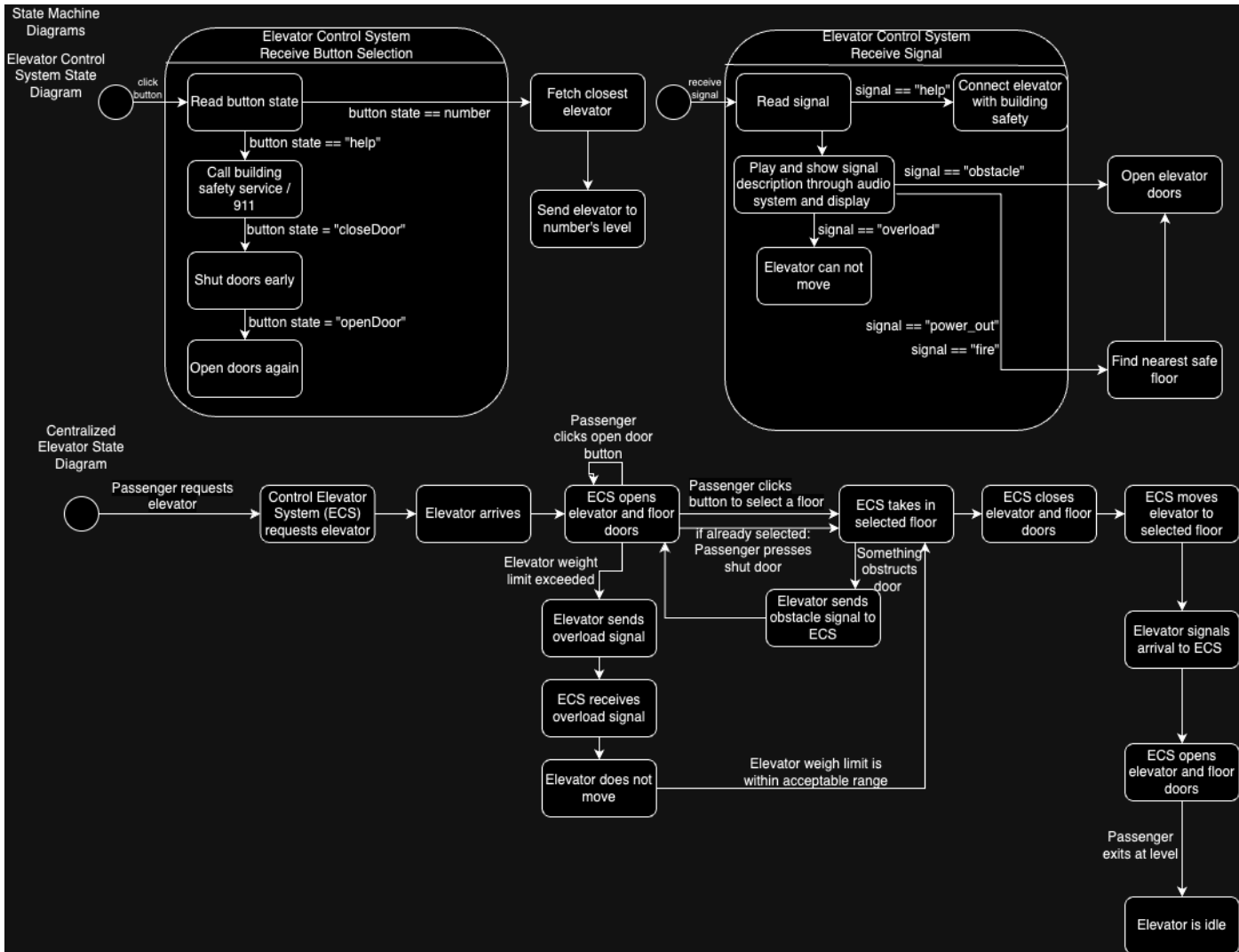
- 3 passengers are in a descending elevator
- The control system receives a fire signal from the building
- The elevator finds the closest safe floor
- Audio and text messages play and explain the situation
- The passengers exit



- Safety Success Scenario 5:
 - o The elevator door opens
 - o 1 passenger enters at level 2 to go to level 3
 - o The control system receives a power out signal
 - o Audio and text plays in the elevator
 - o That elevator stays at the safe floor and does not move

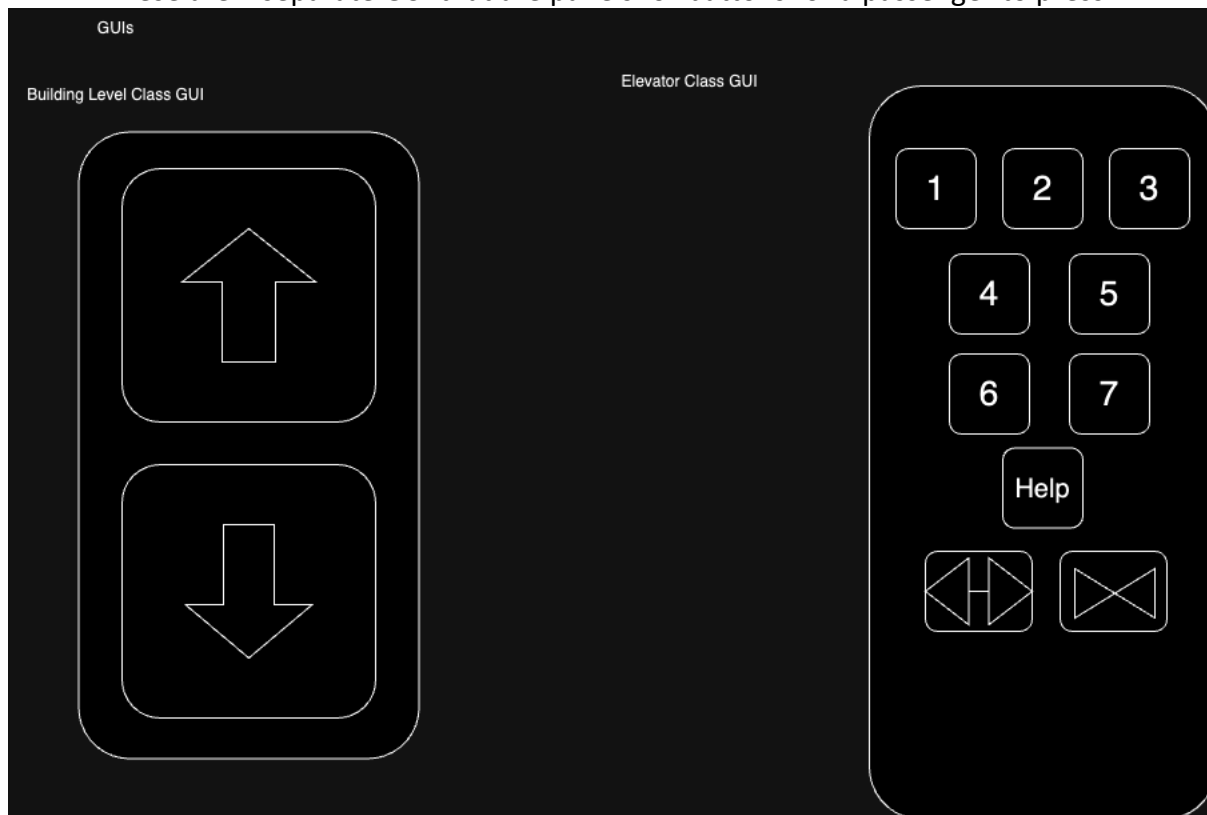


State diagram for elevators & State diagram for controller



Sketch of a GUI. You may assume there are 3 passengers, 7 floors, and 3 elevators.

- There's 7 instances of the Building Level Class GUI and the 3 instances of the Elevator Class GUI
- These are 2 separate GUI that are panels for buttons for a passenger to press



C++ **header files** (for each class provide the interface and significant variables)

- In the zip file

Requirements **Traceability matrix** that includes columns for both designs

ID	Requirement	Related Use Case	Fulfilled by Centralized	Fulfilled by Decentralized	Description
1.	The buttons on the building level floors.	Elevator Buttons & Display Use-Case - 1	Building Level GUI, Elevator Control System	Building Level GUI	This allows a passenger to select what direction they would like to go with the elevator.
2.	Buttons should illuminate when selected.	Elevator Buttons & Display Use-Case – 2 & 5	Building Level GUI, Elevator Control System, Elevator GUI	Building Level GUI, Elevator GUI	The button being illuminated when selected allows the user to know when it has been selected.
3.	Current level and text should show on the elevator display.	Elevator Buttons & Display Use-Case – 7 & 10	Elevator Control System, Elevator (displaySystem object)	Elevator (displaySystem object)	The display should indicate the current level for passengers along with text during emergency instances explaining situation. For example, if

					there's a fire the display should indicate so and the procedure.
4.	Current level and audio should play in the elevator sound system.	Elevator Audio System & Sensor System Use-Case – 2 & 8	Elevator Control System, Elevator (audioSystem object)	Elevator (audioSystem object)	The audio should indicate the current level for passengers along with other informative audios during emergency instances explaining the situation. For example, if there's a power outage the audio should indicate so and the procedure.
5.	The sensors should detect the moving elevator.	Elevator Audio System & Sensor System Use-Case – 6	Building Level, Elevator, Elevator Control System	Building Level, Elevator	The sensors should detect the moving elevator to indicate where the elevator is. In the instance of the decentralized system, it will also indicate when there's an emergency to the elevator.
6.	The elevators weight limit should be accounted for.	Elevator Audio System & Sensor System Use-Case – 3a	Elevator, Elevator Control System	Elevator	The weight limit for an elevator ensures the security and safety of passengers by when not exceeding it.
7.	The passenger should update their current level after exiting the elevator.	N/A	Passenger	Passenger	To keep track of the passenger's current floor so they cannot try to access their same floor with the elevator.