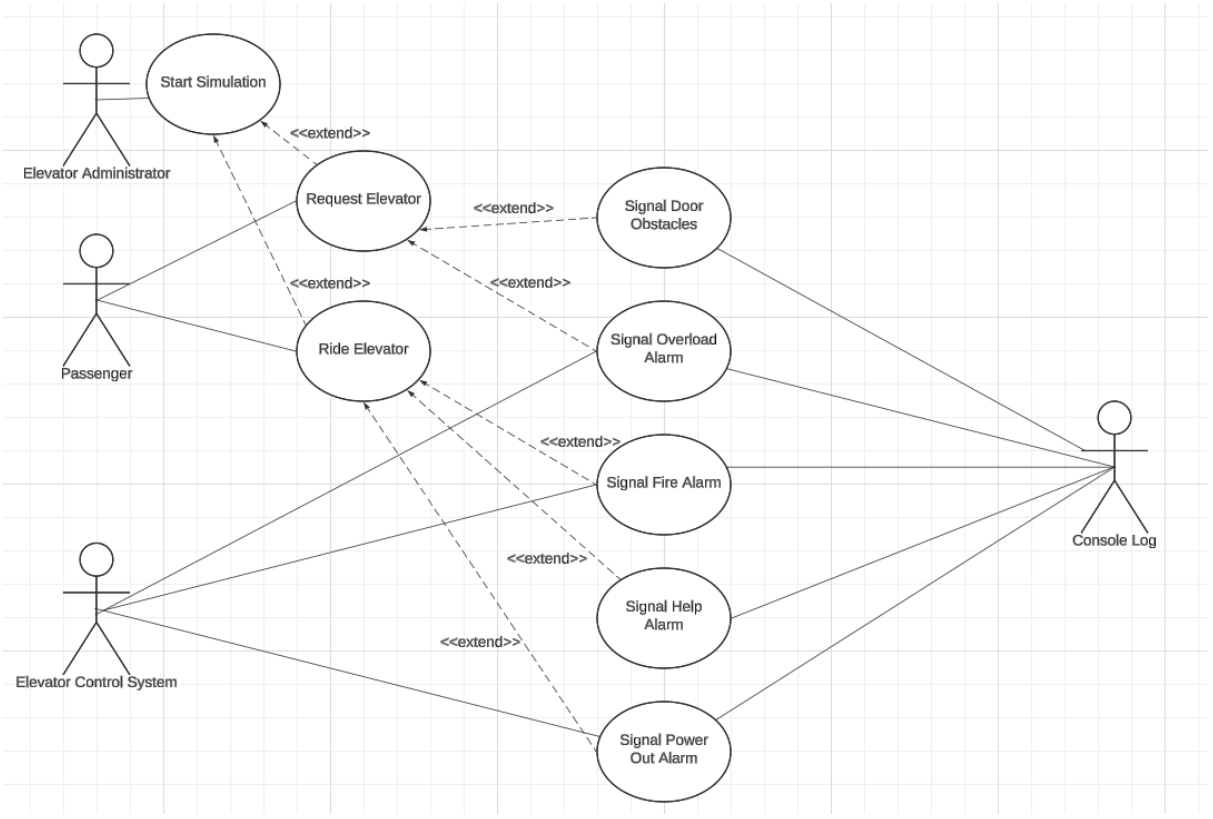

Use Case 1: Start Simulation

Primary Actor(s): Elevator Administrator

Stakeholders:

Elevator Administrator - Initiates the simulation, ensures that the simulation is correctly set up and monitored.

Passenger - Act as the test subjects for the simulations.

Pre-conditions(s):

The elevator system is fully functional and accessible to the administrator.

The configuration options for the elevator car (i.e., floors, buttons, passengers) are operational.

Success guarantees (Post-conditions):

The simulation runs according to the defined specifications.

The log console accurately displays actions and responses.

The administrator can completely control the simulation.

Main success scenario:

1. Administrator begins simulation.
2. Administrator selects the number of floors and elevators in the building.
3. Administrator specifies the number of passengers and their behaviours.
4. Administrator specifies safety events and corresponding simulation time steps.
5. Initial setup is complete, administrator begins simulations.
6. The log console tracks and displays passenger actions and system responses.
7. The administrator monitors the simulation, and can pause, continue or stop the simulation.
8. The simulation displays the current time step, location of each elevator, and each elevator's state.
9. The simulation continues until all events are handled and elevators are idle.

Extensions:

2a. Invalid number of floors or elevators selected for simulation:

2a1. The system displays an error message and prompts the administrator to re-enter valid values.

3a. Invalid input for passengers and behaviours:

3a1. The system displays an error message and prompts the administrator to re-enter valid values.

4a. Invalid safety event and time step configurations:

4a1.The system alerts the administrator about inconsistencies.

4a2. The administrator reviews, corrects, and re-submits event configurations and time steps.

7a. Administrator pauses the simulation:

7a1. The system freezes time steps and maintains current states.

7a2. Administrator either continues or stops the simulation.

7b. Administrator stops the simulation:

7b1. The system logs final states and exits the simulation mode.

9a. System failure:

9a1. The system crashes, causing the simulation to crash.

9a2. The system logs the failure details for debugging.

9a3. Administrator restarts the simulation from the last saved state, or from the beginning.

Use Case 2: Request Elevator

Primary Actor(s): Passenger

Stakeholders:

Elevator Administrator - Administers the simulation.

Passenger - Wants to successfully request and enter an elevator.

Log Console - Logs passenger actions and system responses.

Pre-conditions(s):

Elevators are fully operational.

Buttons are fully operational.

Passenger is on a floor that can be serviced by a functional elevator.

Success guarantees (Post-conditions):

The system processes and logs the request correctly.

The elevator car responds to the floor button pressed, and allows passengers to enter.

Main success scenario:

1. The passengers press the up or down button.
2. The button light illuminates, and remains illuminated until the elevator arrives at the passenger's floor.
3. The button light turns off, the elevator bell rings, and the doors open for a fixed 10-second window.
4. Passengers exit/enter the car.
5. The elevator bell rings, and the doors close.
6. The log console records the entire interaction.

Extensions:

3a. Elevator arrives but is at full capacity:

3a1. The system keeps the elevator car request active, until another elevator is dispatched and ready to service the request.

4a. Passenger does not enter the elevator:

4a1. After the 10-second window, the doors close, the log console logs the passenger's actions and the system's response.

5a. Elevator malfunctions:

5a1. The system logs the issue, notifies the administrator, and notifies passengers to disembark from the car.

6a. Log console fails to record the interaction:

6a1. The system alerts the administrator to investigate logging errors.

Use Case 3: Ride Elevator

Primary Actor(s): Passenger

Stakeholders:

Elevator Administrator - Administers the simulation.

Passenger - Wants to successfully travel to the desired floor.

Log Console - Logs passenger actions and system responses.

Elevator Control System - Manages the operation of the elevator, is notified and responds to the sensors in each elevator.

Pre-conditions(s):

The elevator system is operational.

The passengers have entered the elevator.

The destination floor buttons inside the elevator are functional.

The log console properly logs the passengers' actions and the system's responses.

Success guarantees (Post-conditions):

The system processes and logs the request properly.

The passengers reach their selected floors successfully.

Main success scenario:

1. The elevator arrives at a requested floor, the elevator's sensor notifies the elevator control system.
2. The passengers have entered the elevator.
3. The passengers select one or more destination floors using the elevator's button control panel.
4. The elevators close after the 10-second window, or if the close button is pressed.
5. The elevator moves to the selected floors and displays the current floors to the passengers.
6. Once the elevator arrives at the requested floor, the bell rings, and the elevator door opens for 10 seconds.
7. The passengers exit the elevator.
8. The elevator's sensor notifies the elevator control system that it has arrived at a floor.
9. The log console logs the entire interaction.

Extensions:

1a. The elevator's sensor malfunctions:

1a1. The error is logged, and the elevator control system notifies the administrator.

3a. Passenger does not select a floor with the elevator's button control panel:

3a1. The system reminds the passenger with an alert.

3a2. If no selection is made within a certain time, the doors reopen, and the trip is cancelled.

4a. Passenger presses the close door button:

4a1. The doors close immediately if there is no obstruction and the weight capacity of the elevator has not been reached.

5a. The elevator stops due to a malfunction:

5a1. The system alerts the passengers and notifies the administrator.

5a2. The elevator moves to the nearest safe floor for exit.

9a. Log console fails to record the interaction:

9a1. The system alerts the administrator to investigate logging errors.

Use Case 4: Signal Help Alarm

Primary Actor(s): Passenger

Stakeholders:

Passenger - The person inside the elevator who pressed the help button and seeks assistance.

Elevator Administrator - Administers the simulation.

Log Console - Logs passenger actions and system responses.

Building Safety Service - Responds to passengers requests through voice connection.

Elevator Control System - Detects the help alarm and commences appropriate actions.

911 (Emergency Services) - Responds if there is no response from building safety within 5 seconds, or no response from the passenger.

Pre-condition(s):

Passenger is inside the elevator.

Elevator is fully functional and the help button is operational.

The log console accurately displays actions and responses.

Success guarantees (Post-conditions):

The system processes and logs the request correctly.

The passenger is connected with building safety services or 911 is contacted if no response is made by building safety services or the passenger.

Main success scenario:

1. The passenger presses the help button inside of the elevator.
2. The elevator's control system reacts to the Help button and signals it to the building safety services.
3. The elevator's display and audio system output a warning message.
4. Passenger is connected with the building safety service through a voice connection.
5. The passenger receives assistance from building safety services.
6. Issue is resolved and the log console records the entire interaction.

Extensions:

3a. Unable to establish connection with building safety services.

3a1. The control system places a 911 emergency call.

3a2. The control system outputs a message to the passenger, informing them that 911 has been contacted.

3a3. The elevator control system logs the error.

4a. No response from the passenger after pressing the Help button and connecting with the building safety services.

4a1. The control system places a 911 emergency call after detecting no response from the passenger.

4a2. The control system outputs an alert to the building safety services and logs the incident for further investigation.

6a. Log console fails to record the interaction:
    6a1. The system alerts the administrator to investigate logging errors.

Use Case 5: Signal Door Obstacles
Primary Actor(s): Passenger
Stakeholders:
Passenger - Want to safely enter/exit the elevator without harm or delay.
Elevator Administrator - Administers the simulation.
Log Console - Logs passenger actions and system responses.
Building Owner - Minimize liability and ensure safe and functional elevators.
Elevator Control System - Responsible for detecting obstacles and ensuring doors reopen when necessary.
Building Safety Services - Responsible for ensuring passenger safety and potentially resolving the obstacle issue.
Pre-condition(s):
Elevator and elevator doors are fully operational.
Elevator is equipped with functional light sensors to detect obstacles during door closure.
Success guarantees (Post-conditions):
The system processes and logs the request correctly.
The control system stops the door from closing and opens it when the sensor detects an obstacle.
The elevator doors open again to allow the obstacle to be cleared before closing.
Main success scenario:
1. Passenger attempts to enter/exit the elevator, 1 second before the door closes.
2. The light sensor detects an obstacle.
3. The elevator control system immediately stops the elevator doors from closing.
4. The elevator's display and audio system output a warning message.
5. The object is given some time to be removed from blocking the elevator doors.
6. The object is moved, the sensors detect no obstruction.
7. The elevator control system closes the doors, and the passengers proceed to their selected floors.
8. The log console records the entire interaction.
Extensions:
2a. Light sensor malfunctions and fails to detect the obstacle:
    2a1. The elevator doors attempt to close and encounter physical resistance.
    2a2. A fail-safe mechanism halts the door closure process, and an error is logged in the control system.
    2a3. The elevator remains stationary, with open doors, and building safety services are contacted.
4a. The elevator's display and audio system does not output a warning message:
    4a1. Text messages are sent to passengers, informing them to remove the obstacle.
5a. The object is not removed in time:
    5a1. The control system continuously prompts the passengers to remove the obstacle with warning messages.
    5a2. If the object is not removed after multiple warnings, the system will alert building safety services.
6a. The obstacle is moved, but the sensor malfunctions:
    6a1. The issue is logged, and the system will attempt to close the elevator doors.

7a. The elevator control system doors remain open:
    7a1. The elevator control system will output an error message indicating the issue.
    7a2. Building safety services will be contacted to fix the doors.
    7a3. Passengers will be escorted out of the elevator, at the current floor they are on.
8a. Log console fails to record the interaction:
    8a1. The system alerts the administrator to investigate logging errors.

Use Case 6: Signal Fire Alarm
Primary Actor(s): Elevator Control System
Stakeholders:
Passengers - Need to be guided to safety.
Log Console - Logs passenger actions and system responses.
Elevator Administrator - Administers the simulation.
Building Safety Service - Responsible for responding to the emergency and ensuring the building is evacuated.
Elevator Control System - Ensures the elevator follows emergency protocols to priotize safety.
Building Owner - Minimize liability and ensure a safe, operational, and efficient elevator system.
Pre-condition(s):
The elevator control system is fully operational.
The elevator is fully operational.
The elevator control system receives a fire alarm signal from the building.
Success guarantees (Post-conditions):
The system processes and logs the request correctly.
The elevator moves to a safe floor.
Passengers exit the elevator safely on this floor.
Main success scenario:
1. The elevator control system receives a fire alarm signal from the building.
2. The elevator control system commands all elevators to move to a safe floor.
3. The elevator's audio and display system outputs a warning message.
4. The elevator moves to a safe floor.
5. The elevator reaches a safe floor, and the doors open.
6. The passengers safely exit the elevator and proceed to safety.
7. The log console records the entire interaction.
Extensions:
1a. The elevator control system does not receive a fire alarm signal despite a fire in the building:
    1a1. Emergency services are alerted manually by building safety services.
2a. The elevator control system malfunctions, and cannot process the fire alarm signal:
    2a1. Emergency backup systems attempt to take over.
    2a2. Manual override allows building safety services to operate the elevators.
3a. The elevator's audio and display system malfunctions:
    3a1. The control system reinitializes the audio and display systems.
    3a2. Passengers receive their instructions, solely through text messages.
4a. The elevator can not move:
    4a1. The elevator control system alerts building safety services and the fire department.

4a2. Passengers are instructed to remain calm via the elevator's systems.
4a3. Rescue efforts are dispatched to assist the passengers.

5a. The elevator reaches a safe floor, but the doors do not open:
5a1. The control system attempts to reinitialize the doors.
5a2. If unsuccessful, passengers are instructed to remain calm while emergency services are contacted.

6a. Passengers are unwilling/unable to exit the elevator, once the doors have open:
6a1. The elevator's audio and display system provides continuous prompts directing passengers to exit the elevator.
6a2. Building safety services are contacted to assist passengers in leaving the elevator.

7a. Log console fails to record the interaction:
7a1. The system alerts the administrator to investigate logging errors.

Use Case 7: Signal Overload Alarm

Primary Actor(s): Elevator Control System

Stakeholders:

Passenger: Wants the elevator to function safely and efficiently.
Elevator Administrator - Administers the simulation.
Log Console - Logs passenger actions and system responses.
Building Safety Services - Responsible for ensuring passenger safety and resolving the overload issue.
Business Owner - Minimize liability and ensure a safe, operational, and efficient elevator system.
Elevator Control System - Responsible for detecting and handling overload scenarios.

Pre-condition(s):

The elevator control system is fully operational.
The elevator is fully operational.
Overload detection sensors are fully operational.
The elevator is carrying a passenger or cargo load which exceeds carrying capacity.
The elevator control system receives an overload alarm signal from an elevator's sensor.

Success guarantees (Post-conditions):

The system processes and logs the request correctly.
The elevator stops moving.
The elevator control system outputs an audio and display warning message, requesting passengers to reduce the load before allowing the elevator to function.
The system waits until the load is removed, and the elevator proceeds with normal operations.

Main success scenario:

1. The elevator stops at a floor and opens its doors.
2. An object, which exceeds the elevator's carrying capacity, enters through the elevator's doors.
3. The sensor detects the overweight object.
4. The elevator control system prevents the elevator from moving, while the elevator doors remain open.
5. The elevator's audio and display system outputs a message requesting passengers to remove the overweight objects.

6. The passengers remove the overweight objects until the carrying capacity is no longer exceeded.
7. The elevator continues normal operations, and proceeds to the requested floors.
8. The log console records the entire interaction.

Extensions:

3a. The sensor malfunctions and does not detect the overweight object:
- 3a1. The elevator control system fails to receive the overload alarm signal.
- 3a2. The elevator operates as usual, but may experience some operational/safety issues due to overload.
- 3a3. Building safety services are alerted of the unusual operation of the elevator and inspect the overload sensors.

4a. The elevator control system continues, despite the overload alarm signal:
- 4a1. The elevator begins moving with the overweight load.
- 4a2. The elevator control system detects the heavy strain, and initiates an emergency stop at the nearest floor.
- 4a3. Audio and display messages instruct the passengers to remove excess weight, while the elevator doors remain open.

5a. The elevator does not output audio and display messages, to request passengers to remove the overweight objects:
- 5a1. The control system attempts to reinitialize the audio and display streams.
- 5a2. If unsuccessful, the control system sends the message to building safety services, who manually intervene.

6a. The passengers do not remove the overweight objects:
- 6a1. The elevator remains stationary, with open doors, until the load is reduced.
- 6a2. Audio, display, and text messages are looped with warnings of the overload.
- 6a3. If the issue persists, building safety services are contacted to resolve the issue.

8a. Log console fails to record the interaction:
- 8a1. The system alerts the administrator to investigate logging errors.

Use Case 8: Signal Power Out Alarm

Primary Actor(s): Elevator Control System

Stakeholders:

Passengers - Ensure their safety and facilitate evacuation during the power outage.
Elevator Administrator - Administers the simulation.
Log Console - Logs passenger actions and system responses.
Building Owner - Minimize liability by following safety protocols during power outage.
Elevator Control System - Maintain functionality, with backup power source, during power outage and ensure passengers reach safe floor.
Building Safety Services - Responsible for ensuring passenger safety.

Pre-condition(s):

The elevator control system is fully operational.
The elevator is fully operational.
Both the elevator and elevator control system have backup power sources and can account for power outages.
A power outage has been detected within the building.

Success guarantees (Post-conditions):

The system processes and logs the request properly.
The elevator reaches a safe floor.

The elevator doors open, and passengers are able to safely disembark.

Main success scenario:

1. A power outage is detected by the elevator control system through the power out alarm signal.
2. The elevator control system switches to backup power.
3. The elevator switches to backup power.
4. The eleavor's audio and display system outputs a message, informing the passengers of the power outage.
5. The elevator moves to a safe floor.
6. The elevator doors open.
7. Passengers disembark, guided by the elevator's audio and text system.
8. The log console records the entire interaction.

Extensions:

1a. Power outage occurs but is not detected by elevator control system:
    1a1. The elevator stops functioning mid-operation due to lack of power.
    1a2. The system performs diagnostics to detect the power outage.
    1a3. Once detected, the system resumes normal power outage handling.
    1a4. The elevator and elevator control system default to their backup power sources.
    1a5. A message is sent to passengers informing them of the outage.

2a. Backup power source fails:
    2a1. The elevator control system alerts the building safety services and emergency services.
    2a2. The elevator remains stationary.
    2a3. Passengers are informed to remain calm via the elevator's display and audio system until assistance is dispatched to rescue them.

4a. Audio and display system malfunctions:
    4a1. The passengers only receive a text message from the system, informing them of the situation.

5a. Elevator gets stuck while moving to safer floor:
    5a1. The control system determines the nearest safest floor and slowly descends towards it.
    5a2. The control system notifies passengers of delays and further instructions.

6a. The elevator doors do not open, once the elevator has arrived at a safe floor:
    6a1. The control system attempts to troubleshoot and override the door mechanism to open the doors.
    6a2. If unsuccessful, the elevator's audio and display system will inform passengers to remain calm, building safety services and emergency services will be notified to assist.

7a. Passengers do not disembark:
    7a1. The control system will continuously output audio and text prompts reminding passengers to exit the elevator.
    7a2. Build safety services will be notified to assist any passengers who may be unwilling or unable to leave the elevator

8a. Log console fails to record the interaction:
    8a1. The system alerts the administrator to investigate logging errors.