Assignment 2: Analysis and Design of an Elevator Controller Simulator

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Grace period of 3 days at 10% per day penalty for lateness

Raven Elevators Inc. (REI), a manufacturer of elevators, has hired you to build them a simulator for their line of elevator control systems. You happily accept the task, eager to impress your new employer with your development skills. REI asked you to implement it in Qt C++, but before doing the implementation REI requested that you first explore two different design ideas for control: centralized and distributed. The centralized one would have a controller that manages allocation of elevators to floor requests, and the decentralized one would have elevators coordinate servicing of floor requests among themselves.

Learning objectives:

- Designing and expressing your design in UML
- Verifying consistency between use cases and design
- Developing a requirements traceability matrix
- Comparing two different design approaches

Deliverables:

- Use cases (can borrow from A1 & grading feedback)
- Design documentation – structure and behavior:
    - UML Class diagram (both designs)
    - Sequence diagrams for one design. Sequence diagrams for 2 success scenarios from the basic use case and 5 safety scenarios (one for each safety feature). Assume there are 3 passengers, 7 floors, and 3 elevators.
    - State diagram for elevators (both designs)
    - State diagram for controller
    - Discussion of your design decisions including use of design patterns, if any.
    - Sketch of a GUI. You may assume there are 3 passengers, 7 floors, and 3 elevators.
- C++ header files (for each class provide the interface and significant variables)
- Requirements Traceability matrix that includes columns for both designs

Your design should include passenger and sensor actors driving the elevator system responses that are displayed through a simple GUI.

Your design should accommodate for variability in number of floors and elevators.

Elevator system specification (same as Assignment 1)

<Paragraph 1> A building is serviced by M elevators (also called cars). 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 customers who, at this floor, have requested an elevator going in a certain direction. 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. 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. 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.

<Paragraph 2> 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.

<Paragraph 3> 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.

Safety features:

<Paragraph 4> 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 from building safety within 5 seconds or if there is no response from a passenger a 911 emergency call is placed.

<Paragraph 5> 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.

<Paragraph 6> 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.

<Paragraph 7> 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. 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.

<Paragraph 8 > 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. 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.