Assignment 3: Elevator System Simulator in Qt C++

Submitted on Brightspace by Sun Mar 19th 11:59pm

Grace period of 2 days at 10 marks per day penalty for lateness

With Assignment 2 you have delivered your first version of design to Raven Elevators Inc. (REI) and the company is confident that you can implement a high quality elevator system simulator in Qt C++. REI asks you to proceed with the implementation and testing. Understanding that design is typically fine-tuned during implementation, REI also asked you to update the documentation. You will be delivering use cases, design documentation, source code, tests and traceability matrix.

Learning objectives:

- Exploring Qt architecture and functionality
- Implementing an elevator system simulator using Qt C++ and updating your design as needed
- Implementing variability in elevator allocation strategy
- Building a requirements traceability matrix that includes implementation and testing

Deliverables (5 parts)

- **Use cases** (can borrow from A1 & grading feedback)
- **Design documentation** – structure and behavior – updated as needed (can borrow from A2 & grading feedback)
    - UML Class diagram
    - Sequence diagrams for these scenarios: 2 scenarios for the basic use cases for 2 of the strategies and 5 safety features scenarios (total of 7 sequence diagrams)
    - Activity or state diagram
    - Textual explanation of your design decisions
- **Implementation**
    - Source code of your Qt C++ project that builds and runs on the course VM (COMP3004-F21.ova found at https://git.scs.carleton.ca/downloads/CourseVirtualMachines/2021F-2022W/COMP3004-F21.ova)
    - Tests based on scenarios specified in design
    - Your implementation should have 1) a GUI that drives the program and 2) console output to display events such as floor button presses, elevator arrives, door opens, etc.
- **Video:** record a video of running your simulation through the 7 scenarios corresponding to the 7 sequence diagrams.
- **Traceability matrix** (can borrow from A2 & grading feedback)
    - Update the traceability matrix from A2 to include "implemented-by" and "tested-by" columns

Testing the simulation

Your implementation should be able to handle a variable number of floors, elevators, and passengers. For purposes of testing, however, you can constrain it to 5 floors, 2 elevators, and 3 passengers and show a simulation run for

- Two normal scenarios, one per allocation strategy: 1 passenger at floor 1 going up to floor 5, 1 passenger at floor 5 going down to floor 1, and 1 passenger at floor 3 going up to floor 5
- 5 safety scenarios as you see fit

Elevator system specification (same as Assignment 1)

<Paragraph 1> A building is serviced by a group of 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.