CARLETON UNIVERSITY
Department of Systems and Computer Engineering

SYSC 4805 Project Specification

Design, implement and test the UML-RT model of an Elevator Control software system that controls a bank of two or more elevators. The system is required to schedule elevators to respond to requests from users at various floors and to control the motion of the elevators between floors. The control system should be configurable for buildings with different number of floors.

For each elevator there are:

- A set of elevator buttons used by the users to select the destination floor;
- A set of elevator lamps corresponding to each button, indicating the floors that have been selected as destinations in the current trip;
- An elevator position lamp indicating the current floor of the elevator during the trip;
- An elevator motor controlled by commands to move up, move down and stop. A status sensor indicates when asked by the control system whether the elevator is moving or stopped;
- Emergency breaks that are triggered in different unsafe conditions, as described below;
- An elevator door controlled by commands to open and close the door;
- A door sensor indicating whether there is an obstacle impeding the door from closing.

For each floor there are:

- A floor door for each shaft controlled by commands to open and close the door;
- Up and down floor call buttons, used by a user to request an elevator for going in a certain direction (up or down).
- A corresponding pair of floor lamps indicating the direction(s) already requested.

At each floor and for each elevator there is a pair of direction lamps to indicate whether an arriving elevator is heading in the up or down direction. For the top and bottom floors there is only one floor call button and corresponding direction lamp. There is also an arrival sensor at each floor in each elevator shaft to detect the arrival of an elevator at the respective floor.

For system safety certification, the emergency brake will be triggered and the elevator will be forced to stop under any unsafe conditions, such as:

- if an elevator is commanded to stop but will not stop at the desired floor;
- if an elevator is commanded to move but will not move;
- if the doors are commanded to open when the car stops at a floor, but the doors will not open;
- if the elevator keeps going after reaching the highest floor on its way up or the lowest floor on its way down.

Once a floor call button is pressed by a user, one of the elevators will be dispatched by a central coordinator to serve the request. After entering the elevator, the passenger presses a selected elevator button to indicate his destination floor. The elevator then moves up/down to the destination floor. To increase the utilization of the entire system, the elevator may stop at other floors on the way to service other requests for the same movement direction. The elevator stops at the nearest requested floors for all the requests assigned to it by the central coordinator. When all calls are served, the elevator stops and waits for the next call to arrive, and the above cycle repeats again.

The control policy should comply with a common rule that requests are to be served on a first-come-first-serve basis, except for other requests in the same direction that could be served simultaneously. So, when the elevator is heading in a particular direction, the coordinator will assign to it other requests heading in the same direction along the way. After serving all the requests assigned by the coordinator in a direction, the elevator will be assigned requests for the opposite direction. An elevator will move up and down as long as there are outstanding requests to be served.

Hint. Use two levels of control in your system: a local controller for each elevator and a central coordinator that receives all the user requests (when the users presses the floor call buttons) and distributes the requests to different elevators. You may experiment with different scheduling algorithms in order to increase the utilization of the bank of elevators.