CS223 Laboratory Project

Smart Evacuation Elevator

Groups: Each student will do the project individually. Group size = 1

Important dates:
Demo presentation day and final report: 24/12/2018 during lab times of each section

Description:

Nowadays, in parallel with the increasing workload of modern life and increasing pace of daily life, more efficient functionality is expected from elevator systems. In the evaluation of the efficiency of an elevator control system, the elevator distribution method, which determines which elevators to be assigned to the incoming calls, plays a critical role. The elevator distribution method used must provide solutions to some exceptional cases like evacuation scenarios (this is a special elevator which can be used for evacuation). Expectations of passengers are waiting time, movement time and travel time as short as possible. Therefore, in terms of targeted requirement, an elevator distribution method deals with the minimization of these parameters. On the system side, it is desirable to optimize the number of passengers that can be serviced **at the same time**, **the movement time** of the elevators and the number of stops.

Reset State: Regardless of the state of the elevator, elevator will be located at Floor 0 and it will be empty.

Each **stop of elevator** at a floor will take **2 seconds**.

Travel time of elevator between adjacent floors will take **3 seconds.**

Maximum number of passengers waiting for an elevator at a floor is limited by **12**.

On each press of **(Passenger+) button** the number of passengers waiting at that floor will **increase** by one and each elevator waiting passengers will be shown by a single **red LED** of the same floor. Examples of passengers waiting for an elevator are shown in figures below.

Figure 1: No passengers waiting on a floor

Figure 2: 1 passenger waiting on a floor

Figure 3: 3 passengers waiting on a floor

On each press of **(Passenger-) button** the number of passengers waiting on that floor will **decrease by one** and the **red LED** that indicates the passengers waiting for an elevator will be switched off.

The maximum number of passengers which the elevator can take is **4**. All alternative passenger distributions that the elevator can carry are shown below.

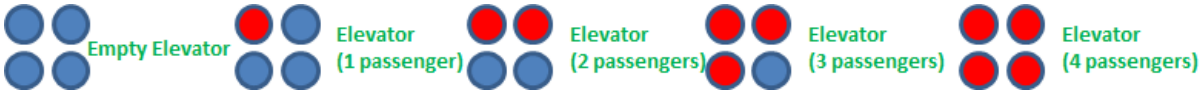

Figure 4: Elevator Alternative Passenger Distribution

The least significant 3 seven segments on the BASYS3 board will be used to display the total elapsed time of (**time table**) scenario. If the elevator stops at a floor, the timer will be **increased one by one and the total amount of time which will spend at a floor will be 2 seconds regardless of the number of passengers**. For travel time in between two adjacent floors this timer value will be **increased one by one and the total amount of time which will be spent in between two floors is 3 seconds**. After reset the initial state of the seven segment display will show 0 as given in Figure 5.

Figure 5: Initial value of time table

The most significant seven segment on the BASYS3 board will be used to display the direction of the elevator during travel. Only one segment will rotate clock wise while the elevator is going up and this segment will rotate counter clock-wise when elevator is going down. The segment will be ON for duration of 250 msec and then continue with the next step depending on the direction of the elevator.

Figure 6: Elevator Direction Display (upward)

Figure 7: Elevator Direction Display (downward)

4x4 key matrix on the beti board will be used for increasing and decreasing the number of passengers waiting on the floors and also these buttons will be used for elevator calls. The assignments of buttons are given in Figure 8.

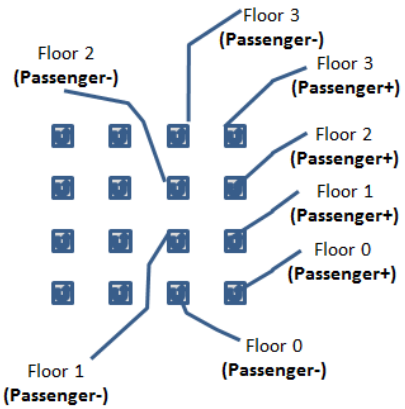

Figure 8: Function Assignments of elevator Passenger Keys

Floor X Passenger+: On each press, increment the number of passengers on the corresponding floor, maximum number of passengers waiting on a floor is limited to 12.

Floor X Passenger-: On each press, decrement the number of passengers on the corresponding floor, minimum number of passengers waiting on a floor is 0.

Within the scope of the project, the scenario explained below will be executed by using the keys on the BASYS3 board. Key functions in order to execute the scenario are shown in Figure 9.

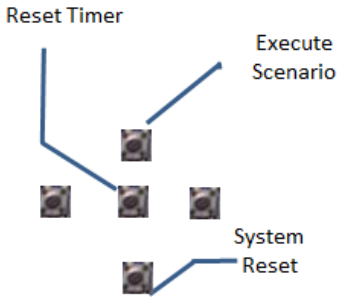

Figure 9: Reset and Scenario Keys

Reset Timer: This button will reset the seven segment display regardless of the state or position of the elevator. If one of the scenarios is being executed when this button is pressed, the execution will continue. This button only resets the timer.

System Reset: This button will reset the whole system and take every component to its initial position. (Timer display, elevator, passenger indications will return to reset state and elevator will return to Floor 0.) The system after reset will look like as given in Figure 10.

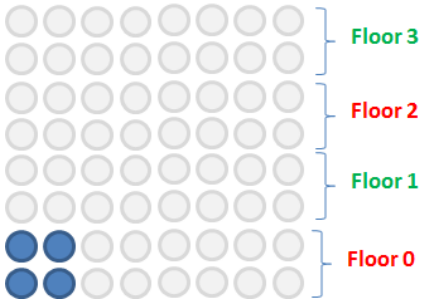

Figure 10: Main Display After Reset

Execute Scenario: This button will be used in order to execute the scenario defined below. During the execution of a scenario the Passenger+ and Passenger- buttons will be functionless (don't care).

- **Scenario: (Smart Evacuation)** Scenario starts by distributing the passengers waiting for an elevator on the floors as given in Figure 11. This distribution will be done by using the **Passenger+** and **Passenger-** keys. Main purpose in this scenario is to take all the passengers to Floor 0. Timer will start counting when scenario start button is pressed and will stop when the elevator takes the last passenger to Floor 0. Elevator will move up and down in order to take all the passengers to Floor 0 in the shortest time. When the passengers waiting arrives at Floor 0, these passengers will not be indicated by LEDs any more. During scenario execution depending on the direction of the elevator corresponding direction seven segment display will show the direction. When the elevator stops at a Floor the direction display segment will also stop at the position it is.

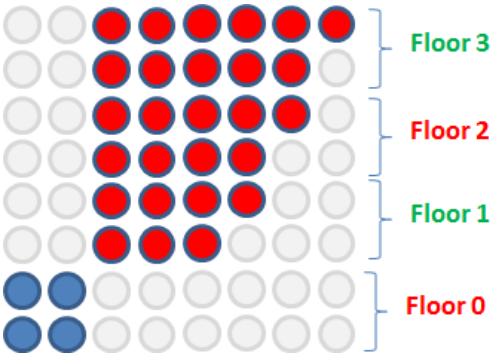

Figure 11: Scenario Passenger Distribution

Notes:

1. You have been given some ready modules. You should use them directly without editing them. It is better to test them first to be sure that your Beti board works properly. (4x4 keypad, 8x8 RGB-display and 7-segment modules. I attached them. From previous semesters, students usually had no problem in using them, as there is a sample project (with a photo of board setup) for each module. You can download these modules from Unilica.
2. Please refer to comments in each module, check also ports and sample projects to see how to use ready modules.
3. Instead of using 4x4 keypad, the switches on the Basys3 board can be used with 10/100 points penalty.
4. 7-segment module has already been used in Lab-3. By using this module hexadecimal numbers can be displayed. As you will use decimal digits in this project, you can simply replace the unused A-F hex digits in this module (by editing the module), with the special representations you need for MSB digit (in order to display elevator direction).
5. Do not use "green color" in 8x8 modules, as green light is very weak on 8x8 display. Use only red and blue color as described in the project.
6. Study Basys3 and Beti board documents carefully to avoid connecting different wires to each other and damaging your Basys3. Specifically, read Basys3_converter_board.pdf file on Unilica. Do not connect two modules at the same time using parallel cables. Use cable for one Module (like 8x8 RGB display) and for others use wires.