COMP2121 Project: A Monorail Emulator

In this project, you will be writing a monorail emulator in AVR assembly programming language running on the AVR board.

You are required to work in a group of **two students**. If you cannot find a project mate, contact the course admin Hasindu Gamaarachchi hasindu@unsw.edu.au.

On X Island, there is a monorail. The monorail route is a circle with n stations as shown in Figure 1. Each station has a different name. The monorail starts at Station 1, circling around Station 2, …, Station n, and Station 1. The monorail stops at a station only if a tourist on the monorail wants to get off or a tourist at the station wants to get on the monorail. The monorail travels at a constant speed. Therefore, it takes a fixed amount of time from one station to the next station if it does not stop between the two stations. Nevertheless, sometimes, it may stop half way between two adjacent stations for some reasons. When the monorail stops at any station, it will stop m second, where m is a parameter.

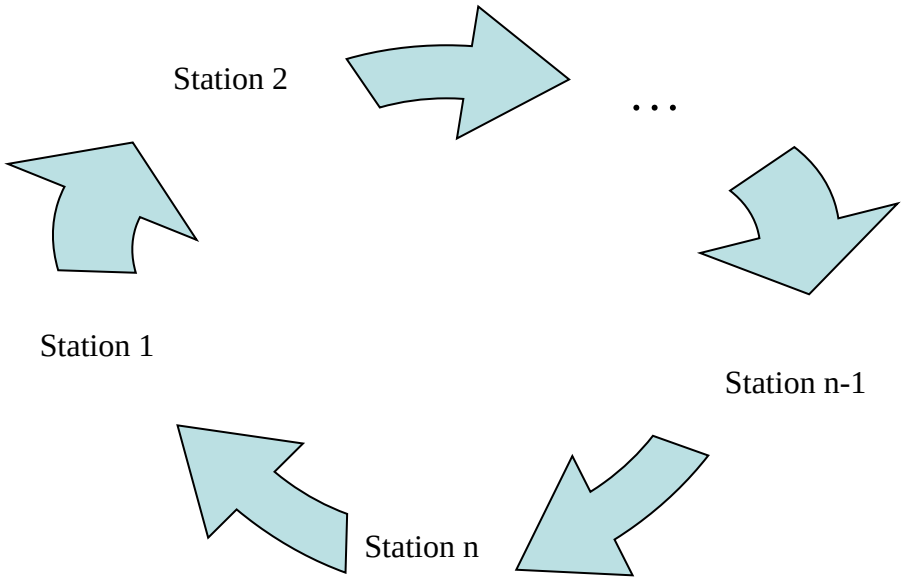

Figure 1: The monorail route.

Your monorail emulator is required to have two components: system configuration and monorail emulation. The system configuration component is used to configure a target monorail system. The target monorail system has the following parameters:

1. The number of stations. The maximum number of stations is 10.
2. The names of all stations. A station name is a string of capital letters and white space, starting with a capital letter. The maximum number of characters of any name is 10.

3. The time for the monorail to travel from one station to the next station without stopping. The longest time is 10 seconds.
4. The stop time of the monorail at any station. The minimum stop time is 2 seconds and the maximum stop time is 5 second.

The system configuration component should provide an interface for the user to input the above parameters in order to configure the target monorail system.

A sample interface by means of the LCD and keypad is shown as follows.

Please type the maximum number of stations: 5

Please type the name of Station 1: ALB PARK

Please type the name of Station 2: BAROKEE

Please type the name of Station 3: CLYDE

Please type the name of Station 4: DILKOON

Please type the name of Station 5: ESKBANK

The time from Station 1 to Station 2 is: 5

The time from Station 2 to Station 3 is: 20

Incorrect! The time from Station 2 to Station 3 is: 10

The time from Station 3 to Station 4 is: 8

The time from Station 4 to Station 5 is: 10

The time from Station 5 to Station 1 is: 6

The stop time of the monorail at any station is: 3

Now the configuration is complete. Please wait 5 seconds.

Your interface needs to provide the following:

a. A way of generating all the capital letters from A to Z, and the white space character.
b. A special key to indicate the end of each input.
c. Proper handling of wrong inputs.

After the system configuration is complete, the emulation component starts emulating the monorail. The emulation component needs to meet the following requirements.

- Use the DC motor on the board to emulate the behaviour of the monorail. If the monorail is travelling, the motor spins at a speed of 60 rps. If the monorail stops, the motor stops.

- Use PB0 and PB1 to simulate if a tourist wants to get off and a tourist wants to get on, respectively, at the next station. If PB0 is pressed, it indicates that a tourist wants to get off at the next station. If PB1 is pressed, it indicates that a tourist wants to get on at the next station.

- Use the key # to simulate if the monorail stops half way between two stations. If the key # is pressed, the moving monorail will stop immediately. If the key # is pressed again, the monorail will continue to travel.

- The LCD will always display the name of the next station. Whenever the monorail stops, 2 LEDs blink at a frequency of 3 Hz (3 blinks per second). When the monorail is travelling, the 2 LEDs switch off.

Submission information

The following items should be submitted:

1. Source code. Your program should be well commented.
2. User manual. The user manual describes how a user uses your emulator, including how to wire up the AVR board.
3. Design manual. The design manual describes how you design the monorail emulator. It must contain the following components.
    a. System control flow, describing the control flow of the emulator at the module level using a diagram. This also shows how and when you service the inputs.
    b. Data Structures, describing the main data structures used in the system.
    c. Algorithms, describing how your emulator emulates the behaviour of the monorail.
    d. Module specification, describing the functions, the input and the output of each module.

    Overall, anyone with knowledge about this subject and the AVR board should understand how your emulator is designed after reading this design manual.

Put all your files in a zip file or a tar file, or a rar file and do the following:

a. Go to the course home page.
b. Click on "Project" in the left pane.
c. Click on "Make Submission".
d. Upload your file.
e. Click on "Submit".

Submission Deadline

The deadline of submitting your documents is 23:59:59, 28 Oct. (Sunday, Week 13).

Marking

This assignment is worth 15% of your course marks and will be marked under the following criteria:

- Implementation (80%):
    - ❖ Adherence to the specification.
    - ❖ Correct implementation of all the functionality.
- Code Style (5%):
    - ❖ Easy to read.
    - ❖ Well documented.
- User Manual (5%)
    - ❖ Accurately describes the board set-up.
    - ❖ Correctly describes how each character used in the emulator is generated.
- Design Manual (10%)
    - ❖ Adherence to the specification.
    - ❖ Readability and Completeness.

Demonstration of Your Emulator

You are required to demonstrate your emulator on Friday, Week 13, 26 Oct. We will inform you of the venue and how to book your demo time slot in early Week 12.

Marking scheme:

Demo: Full raw marks: 100

Test suite:
Five stations: ABC PARK, ELF BEACH, ROVER, LEEDS, NEW ARK
Travel time:
- ABC PARK to ELF BEACH: 5 seconds
- ELF BEACH to ROVER: 8 seconds
- ROVER to LEEDS: 6 seconds
- LEEDS to NEW ARK: 5 seconds
- NEW ARK to ABC PARK: 10 seconds

Stop time: 4 seconds

The breakdown of the full raw marks:

1. System Configuration: 45 marks
    a. Correctly generating all the station names: 40 marks and 8 marks for each name.
    b. Properly handling wrong input of names: 5 mark.
2. Monorail emulation: 55 marks
    a. Correct monorail travel time: 15 marks.
    b. Correct monorail stop time: 5 marks.
    c. Correct response to PB1: 5 marks.
    d. Correct response to PB0: 5 marks.
    e. Correct response to # key: 10 marks
    f. Correct display of station names: 10 marks.
    g. Correct LED blinking: 5 marks