COMP9032 Project

Oct. 2022

Description

This project is to be completed in groups formed in Week 1.

The goal of the project is to use the AVR lab board to simulate traffic control of a single-lane road that is short but curvy, as shown in Figure 1. The road only allows traffic pass in one direction at a time.

On each end of the road, there are a traffic light and a sensor. The sensor detects incoming vehicles. The traffic entering the road is controlled by the traffic light.

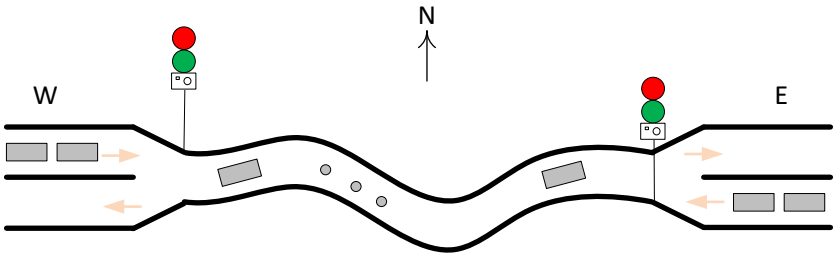


Figure 1

Assumptions and Rules

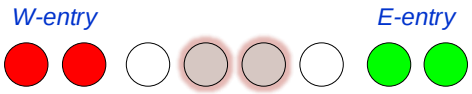
For simulation, the traffic control has the following assumptions/rules:

- When the system starts, no vehicles are on the road and the traffic lights on both ends are set for eastbound traffic, namely, the traffic light on the east end is set to red and that on the west end is set to green.
- If there are vehicles on only one end of the road, the traffic lights should be set to allow that direction traffic through.
- The road is 50 meters long. The speed limit on the road is 15km/hr. A vehicle moving on the road is at a fixed speed that can be in a range from 10km/hr to 15km/hr (six different speeds).
- There are at least 3 second interval between two adjacent vehicles to enter the road. But since they can run at different speeds, collision may incur. Collision should be detected (on a second basis) during simulation. On a collision, the road traffic should be set to an emergency state.
- To alleviate congestion, each direction of traffic is given 3 mins if there are queues on both ends of the road. For control of changing traffic direction, when the traffic light

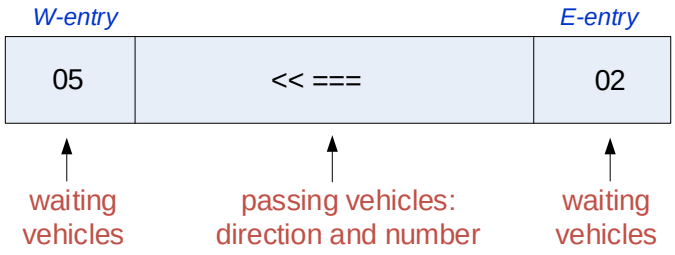
on one end changes from green to red, the traffic light on the other end should wait till the road is empty before it changes from red to green.

- When there are no vehicles, the traffic light stays unchanged.

For other information not specified above, you are allowed to make extra assumptions.



(a) LEDs Display for Traffic & Emergency Lights



(b) LCD Display for Traffic Condition

Figure 2

Simulation

For the simulation implemented on the AVR lab board, a duration can be scaled down to speed up the demonstration. For example, a one-minute duration can be scaled down to 30 seconds. And the following inputs and outputs for the traffic control are used.

Inputs

Inputs to the simulation system are as follows:

- Pushing buttons, PB0 and PB1, are used to simulate the sensor function on both ends of the road. If PB0 is pressed, a new coming vehicle is detected on the west end of the road; Similarly, if PB1 is pressed, a new coming vehicle is detected on the east end of the road. Each vehicle is also assigned a speed, which can be set by a number key on the keypad. For example, assume keys '1' to '6' are used for six different speeds; pressing PB0 and key '1' indicates that a vehicle is coming to the east end and will drive through the single-lane road at the speed of 10km/hr.
- The '*' key on the keypad is for external emergency control. If the key is pressed, the traffic is under emergency state. In this case, both directions of traffic to enter the road are stopped and only vehicles already on this road are allowed to exit. The emergency is in place until the '*' key is pressed again. When exit emergency, the simulation will restart. The emergency can also be triggered internally on a car collision and in this case, press the '*' key to exit the emergency. (Note, a car

collision can be assumed to be detected by some cameras installed on the road and for simulation, the detection is carried out by tracking cars on the road. If two cars are in the same position or one car has been overtaken by the following car on the road, a collision is deemed to have happened.)

Outputs

The following information needs to be displayed on the LED bar and LCD:

- The LED bar acts as the traffic lights for both ends of the traffic. Each traffic light is represented by a pair of LEDs. When they are on (representing green light), vehicles on that end can enter the road; otherwise (red light) vehicles are blocked. During an emergency, both LED pairs are off and the middle 2 LEDS will flash. An example is given in Figure 2(a), where the traffic light on the east end entry is on and on the west end is off, and the middle two LEDs for emergency should be off.

- The LCD display is divided into three sections:
    - the left section: to display the number of waiting vehicles at the west end entry
    - the right section: to display the number of waiting vehicles at the east end entry
    - the middle section: to display the following information of the passing traffic:
        - the direction
            - "<<" for westbound traffic
            - ">>" for eastbound traffic
        - the number of vehicles on the road unless the display space on LCD is used up
            - One '=' symbol represents one vehicle

  An example is given in Figure 2(b), where two vehicles are queuing at the east end and five vehicles at the west end, and three westbound vehicles are moving on the road. Here we assume two decimal digits are sufficient for the queue size.

Submission and Assessment

The project submission is divided into two parts: 1) lab demonstration and 2) written report, which are elaborated below.

1. Group lab demonstration (65 marks), due **your lab session in Week 10**

   The demonstration is run in the following way:
    - One member demonstrates the overall design with the lab board.
    - Other members each explain part of the code development.

   Your marks from the **demonstration** consist of two components:
    - 70% from the group work

        - Based on whether your design implements all functions set in the project specification.
    - 30% from the individual presentation
        - Based on your understanding about the project and the design produced by your group.

2. Group project report *give* submission (35 marks), due **Fri., Nov. 18, 6pm**

   The submission consists of two files:
    - Source code (5 marks)
      The code should be
        - well commented
        - easy to read
    - Project report (30 marks).

      The report is about six pages long in font size 11. It should provide
        - the general description about the project development, management, and the contribution of each group member,
        - the overview of the project design, which includes:
            - hardware components used and related interfacing design
            - software code structure and execution flow, and
            - how software and hardware interact with each other.
        - concluding remarks about the project.

      For a good report, you need to consider appropriate structure, language and supporting graphical illustrations and tables.

      The *give* command for the submission will be available in Week 10, one report per group.

Each member needs to submit a form about the overall contribution of all members (including themselves) in the group. On the submission form, make sure the total contribution of all members adds up to 100%.

Your individual mark of the assignment is based on two components: the whole group's mark (G, that comes from the project demonstration and report) and your relative contribution (C). It is calculated as G*C but capped by 100, as demonstrated in the following two examples:

1. For a group of five members, if everyone contributes equally and the group mark is 90, each member's mark is min{90*(100%/5)/(100%/5), 100}=90.
2. For a group of five members with the group mark of 70, if individual contributions are 10%, 10%, 20%, 20%, and 40%, respectively, the one with the highest contribution will receive a mark of min{70*40%/(100%/5), 100}=100.

The *give* submission and the contribution form will be available in Week 10.