COMP9032 Project

Oct. 2020

Description

This project is to be completed in groups, similar to the group lab exercises.

The goal of the project is to use the AVR board to simulate traffic control of a short single-lane road. The road only allows traffic pass in one direction at a time.

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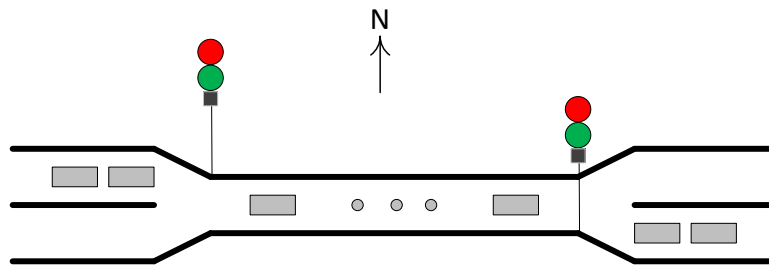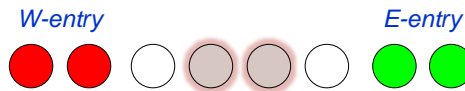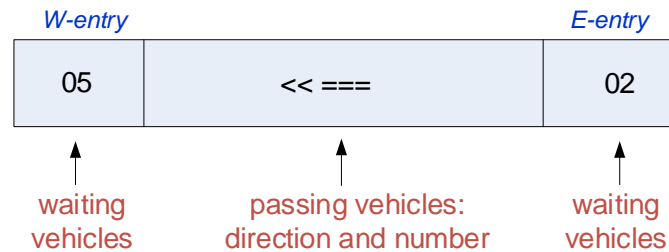

Figure 1

Assumptions and Rules

The traffic control has the following assumptions and rules:

- When the system starts, no vehicles are on the road and the traffic lights on both sides are set for westbound traffic, namely, the traffic light on the east side is set to green and that on the west side is set to red.
- If there are vehicles on only one side of the road, the traffic lights should set to allow that direction of traffic through.
- A vehicle takes 2 mins to pass the road and up to 5 vehicles can travel on the road at the same time.
- There is at least 0.5 min interval between two adjacent vehicles to enter the road.
- To alleviate congestion, each direction of traffic is given 5 mins if there are queues on both sides of the road. For the traffic direction change, when the traffic light on one side changes from green to red, the traffic light on the other side 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 have freedom to make extra assumptions.

W-entry   *E-entry*

(a) LEDs Display for Traffic & Emergency Lights

W-entry		*E-entry*
05	<< ===	02

↑ waiting vehicles   ↑ passing vehicles: direction and number   ↑ waiting vehicles

(b) LCD Display for Traffic Condition

Figure 2

Simulation

For simulation implemented on the AVR lab board, a one-minute duration can be scaled down to 1 second delay, and the following inputs and outputs for the traffic control are used.

<u>Inputs</u>

Inputs to the simulation system are as follows:

- Pushing buttons, PB0 and PB1, are used to simulate the sensor function on both sides of the road. If PB0 is pressed, a new coming vehicle is detected on the west side of the road; Similarly, if PB1 is pressed, a new coming vehicle is detected on the east side of the road.
- The '*' key on the keypad is for emergency. If the key is pressed, both directions of traffic to enter the road are stopped and only vehicles already on this road are allowed to exit. The emergency stop is in place until the '*' key is pressed again.

<u>Outputs</u>

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

- The LED bar acts as the traffic lights for both sides of the traffic. Each traffic light is represented by a pair of LEDs. When they are on (representing the green light), vehicles on that side can enter the road; otherwise (off, the 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 side entry is on and on the west side entry 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 side entry,
  - the right section: to display the number of waiting vehicles at the east side entry,
  - the middle section: to display the following information of the through traffic:
    - the direction
      - "<<" for westbound traffic
      - ">>" for eastbound traffic
    - the number of vehicles on the road
      - One '=' represents one vehicle

An example is given in Figure 2 (b), where two vehicles are queuing at the east side entry and five vehicles at the west side entry, 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) group lab demonstration and 2) individual report submission:

- 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 given in the project specification.
  - 30% from individual presentation
    - Based on your understanding about the project and the design produced by your group.

- Individual _give_ submission (35 marks), due **Monday 12noon, Nov. 23**

  The submission consists of two files:
  - Source code (10 marks)
    The code should be
    - well commented by you
    - easy to read
    Note: Your submission may not necessarily be the same as those submitted by other group members.

- o Project report (25 marks).

The report is about four pages long in font size 11. It should provide

- the general description about the project development, management, and the contributions 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.
- conclusive remarks about the project.

The *give* command for the submission will be available in Week 10.