CMPE 443 PRINCIPLES OF EMBEDDED SYSTEMS DESIGN

Final Project

"Autonomous Car"

1) Problem Description

Recall that in the Interim submission, you had already used 1 Motor Controller, Joystick and 4 LEDs. In this last phase of the Final project, you will continue using them. In addition, you will also use ESP8266 WiFi module, 2 LDRs, 1 Trimpot, 1 Push Button and 1 Ultrasonic Sensor to the car.

This phase will differ from the Interim submission as follows:
- Previously you used parameter for changing the speed of the car, but in this phase the speed of the robot will be determined by the Trimpot which is located on the Experiment Base Board:
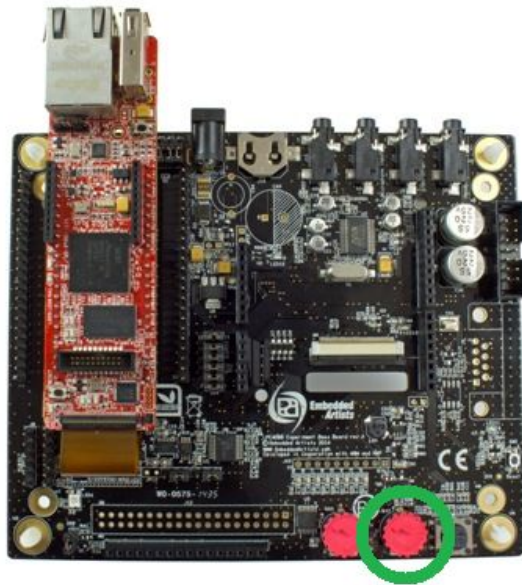
According to Trimpot resistance value, your speed will change in [0 - 100] duty cycle range.

- For the ultrasonic sensor case, the robot should not hit any obstacle while going forwards. Therefore, you should check the distance value and if you detect an obstacle which 15 cm away, the robot should go backwards until it detect obstacle which is more than 30 cm

away. This value should be in your **Parameter.h** file (**OBSTACLE_DISTANCE** and **OBSTACLE_ESCAPE_DISTANCE**).

- The robot will have two modes which are **autonomous** and **manual** mode. The switch between autonomous and manual mode will be done via (**WiFi** or **UART**) and **Push Button**. You can implement either **WiFi** or **UART**. In other words, if you implement WiFi, you do not need to implement UART and if you implement UART, you do not need to implement WiFi).
  The character for the switching to manual mode will be '*' and for autonomous mode '#'. These characters will be send by the user. Whenever the robot changes the mode, the robot should send **'MANUEL'** or **'AUTO'** via **UART** or **WiFi**.
  For Wifi case: WiFi SSID = **HWLAB** and Password = **12345678**
  The data will be available at:
  http://192.168.0.100:8080/HWLAB_IoT/GetInformation?ID= (If your group ID is 1 the url will be http://192.168.0.100:8080/HWLAB_IoT/GetInformation?ID=1)
  The data will be send to:
  http://192.168.0.100:8080/HWLAB_IoT/SendInformation?ID=.&DATA= (If your group ID is 1 and the data **'MANUEL'** the url will be
  http://192.168.0.100:8080/HWLAB_IoT/SendInformation?ID=1&DATA=MANUEL)

  The start mode for the robot can be changable, in **Parameter.h** file you will add a parameter for starting mode (**START_MODE**)

  In the manual mode (40 / 100 points),

  ➢ The robot will be at the stop phase when robot enters manual mode.
  ➢ When Joystick Left button is pressed, your robot should start to rotate counter-clockwise direction (Point Turn is not necessary).
  ➢ When Joystick Up button is pressed, your robot should start to travel in forward direction.
  ➢ When Joystick Down button is pressed, your robot should start to travel in backward direction.
  ➢ When Joystick Center button is pressed, your robot should stop.
  ➢ When Joystick Right button is pressed, your robot should rotate clockwise direction (Point Turn is not necessary).
  ➢ While robot is going in forward direction, if Ultrasonic sensor detects an obstacle which is 15 cm away from the robot, robot should drive in backward direction until ultrasonic sensor reads at least 30 cm. Then, drive in forward direction.
  ➢ The robot speed can be changable via Trimpot.

➢ While robot is going in forward direction, if robot detects an light source from the left or right side, the robot should escape from the light source. If light source is in the left side, robot should go to the right side and if light source is in the right side, robot should go to the left side.

In the autonomous mode (40 / 100 points),

➢ The robot will be at the stop phase when you enter autonomous mode.
➢ The autonomous execution will start with two different way: When you press the **Joystick Up** or when you send **'66'** via UART or WiFi, your robot will execute the order and start moving according to LDR sensor values.
➢ The robot speed can be changable via Trimpot.
➢ While robot is going in forward direction, if Ultrasonic sensor detects an obstacle which is 15 cm away from the robot, robot should drive in backward direction until ultrasonic sensor reads at least 30 cm. Then, drive in forward direction.
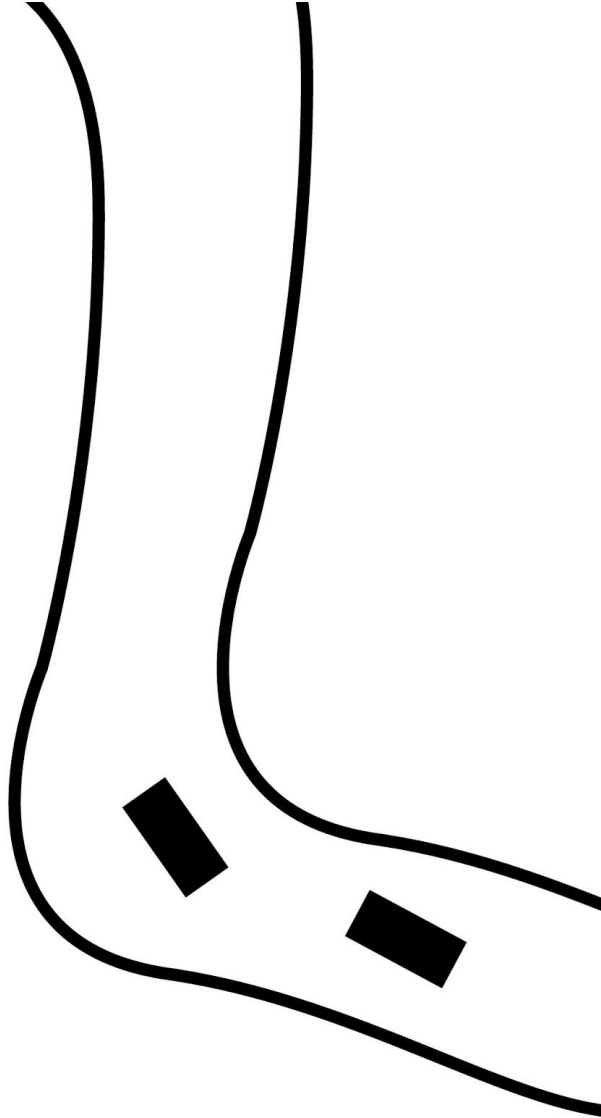➢ The robot should go along the road.

Your robot car has 4 LEDs which are located to the Front-Left, Front-Right, Back-Left and Back-Right The state of the LED is changed according the action which robot performs:

➢ When robot stops, all the LEDs should be turned off.
➢ When robot drives in forward direction, Front-Left and Front-Right LEDs should be turned on and the other LEDs should be turned off.
➢ When robot drives in backward direction, Back-Left and Back-Right LEDs should be turned on and the other LEDs should be turned off.
➢ When robot drives counter-clockwise direction, Front-Left and Back-Left LEDs should blink (2 times in a second) and the other LEDs should be turned off.
➢ When robot drives clockwise direction, Front-Right and Back-Right LEDs should blink (2 times in a second) and the other LEDs should be turned off.

2) Road Demo

In order to enter the road demo (20 / 100 points), you should complete manual mode and implement autonomous mode. In the race, we will put two LED strips on the left and right of the robot.
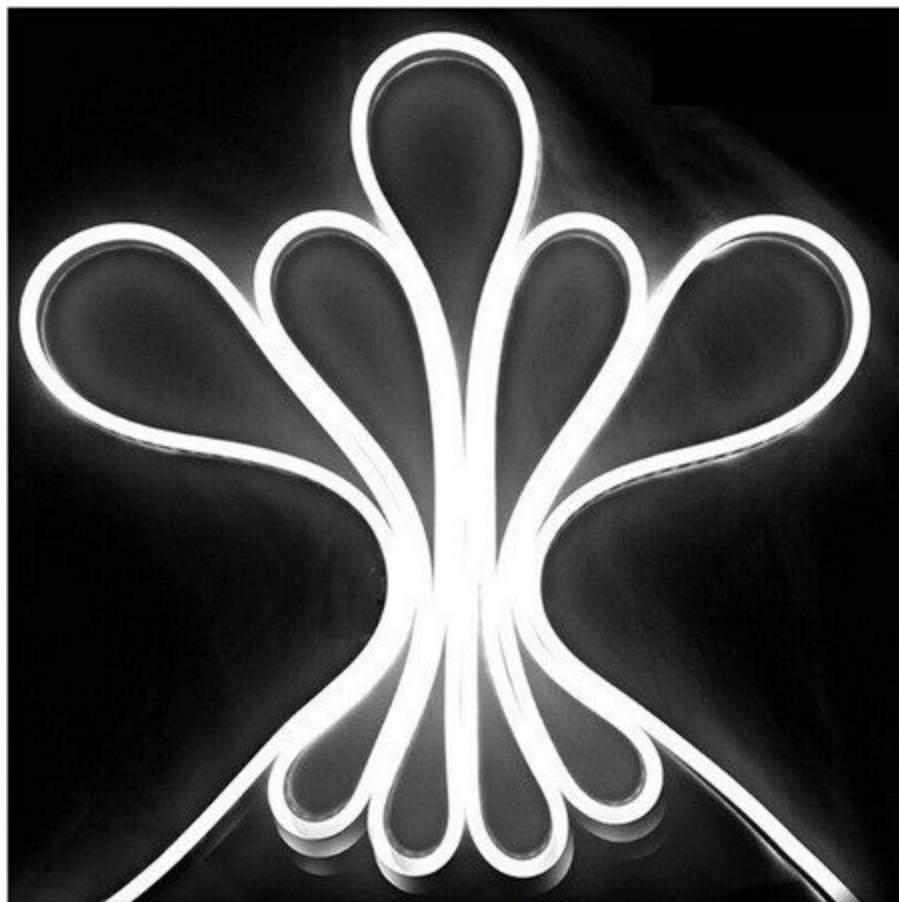
The robot should follow the road and always be at the center of the road. Also, there can be more than one robot on the road. Therefore, the robot should not hit the car which is in front of the car.

3) Race

In order to enter the race, you should complete the road demo.

The bonus points will be given according to code and race performance (these bonuses will be added to total grade of the course):

	1	2	3	4
WiFi	Half Letter Grade	7.5	5	2.5
UART	5	3.5	2.0	
Basic	2	1.5	1	

4) Group Report

Your report has to be genuine. It should include all necessary details such as Block Diagram(s), System-Level Functional Diagram, Sequence Diagram(s), Connection Table(s) and Circuit Schematic(s), Expense List. In addition, you should write the pseudocodes for each function in your code.

Some Important Notes

- The total cost of the components that you buy for this experiment should not exceed the 100 TL. If the total cost exceeds this budget, your group will not be eligible for the bonus scenario. In addition, we will reduce points. The amount of reduction will be proportional to the excess amount.
- For this phase, we allow groups to bring their own batteries. In the lab, we use Samsung ICR18650-26JM. Therefore if you bring your battery for the demo, this battery should be an 18650 type battery and the max allowable capacity for this battery is 2600mAh. (Warning: Some of the Chinese batteries even if they say they have 6800mAh capacity, the actual capacity of these batteries is around 250mAh). The given batteries for the demo section will have at least 3.8V and while the demo section, we will not change your batteries. In other words, your code quality will determine the durability of your car in the race.