THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY
Department of Electronic and Computer Engineering
ELEC 1100

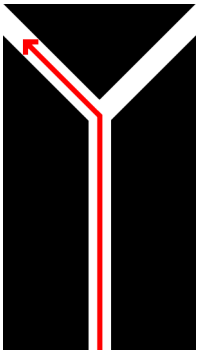
Laboratory 6: Robot Car & Logic (5%)

A) Objectives:

By applying all techniques learned in the previous labs, design and complete the control circuit of the robot vehicle so that it can track a straight line and a split.

B) Experimental Procedures:

Experiment: Tracking a Straight Line and a Split [Lab#06]



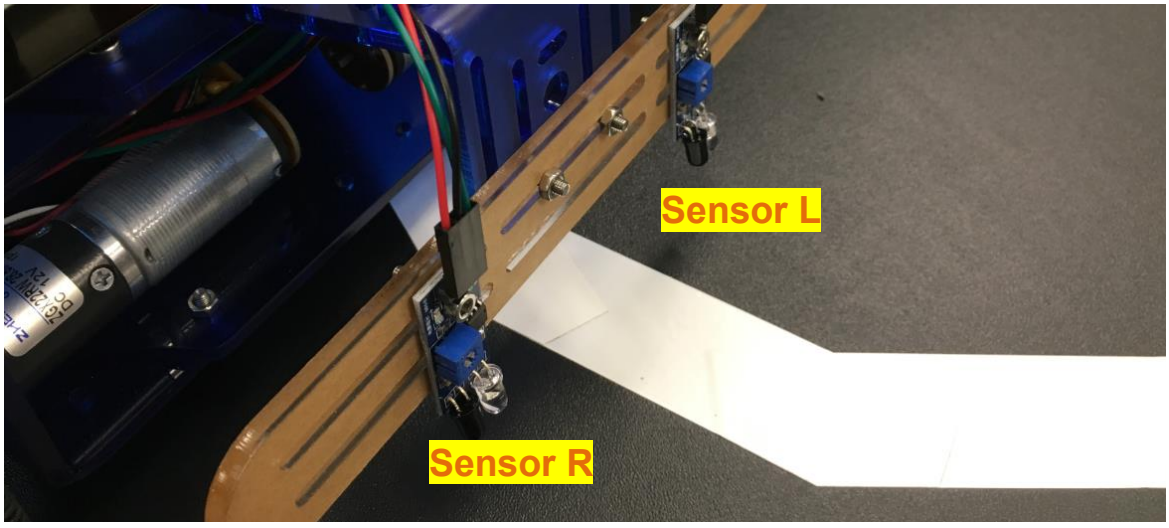
In this experiment, you are going to program the Uno-board to control a robot car to move along a racing track. Your task is to let the robot car to track a straight line and then turn left at the split.

Before the experiment, you are required to understand how the combinations of motor rotating directions are affecting car moving direction, together with control signal status.

The following table summarizes all these relations. These are related to the project coding so please follow this standard.

Case	Car Action	L_DIR	R_DIR	Left Motor	Right Motor
(a)	Backward	0	0	-ve rpm	-ve rpm
(b)	Turn Left	0	1	-ve rpm	+ve rpm
(c)	Turn Right	1	0	+ve rpm	-ve rpm
(d)	Forward	1	1	+ve rpm	+ve rpm

Sensors L & R measuring a surface



Step 1: "Duplicate" your "Lab#05_S4" circuit and change the circuit name to "Lab#06".

Notice that your Uno-board is now with Lab#05 Arduino sketch program, in which the sensor voltages **L** & **R** are set directly by switches to change the motor rotation signals **L_DIR** & **R_DIR**. Here you need to verify your previous work (You may refer to Lab#05 manual).

Step 2: Refer to the photo in **Page 1**, the robot car used in project equipped with two sensors facing downward. When sensing white surface, it gives 0V output. When sensing dark surface, it gives 5V output. However, in Tinkercad, there is no such device. We use **Slideswitch** to simulate these sensor output voltages for coding.

Now, in Tinkercad, for each of the cases in the table below, set the Sensors L & R voltages using slideswitch and check if the DIR signals and the motor rotating directions are matched. If not, try reversely connecting the motor terminals to H-bridge (L293).

Case	Sensor L	Sensor R	L_DIR	R_DIR	Left Motor	Right Motor
(a)	0V | white	0V | white	0	0	-ve rpm	-ve rpm
(b)	0V | white	5V | dark	0	1	-ve rpm	+ve rpm
(c)	5V | dark	0V | white	1	0	+ve rpm	-ve rpm
(d)	5V | dark	5V | dark	1	1	+ve rpm	+ve rpm

After verification, let's go into logic control.

The truth table given below is an example for the logic control of letting your robot car go through the track and turn left at the split. Deriving the required control signals of **L_DIR** and **R_DIR** according to the sensor outputs **L** and **R**.

Sensors		Car Action	Rotation		Left Motor		Right Motor	
L	R		Left	Right	L_DIR	PWM_L	R_DIR	PWM_R
0	0	Turn Left	-ve	+ve	0	Constant (from your Uno-board)	1	Constant (from your Uno-board)
0	1	Turn Left	-ve	+ve	0		1	
1	0	Turn Right	+ve	-ve	1		0	
1	1	Forward	+ve	+ve	1		1	

With two sensors (**L & R**) detecting the track, totally there are four possible combinations of the sensor output voltages as shown in the table (0 - Low Voltage, 1- High Voltage). For each case, think through why the "Car Action" and "Rotation of Left & Right Motors" go this way, and how comes the corresponding values (0 or 1) of **L_DIR** and **R_DIR**.

Also think about if any alternative strategies to achieve "go forward" and "turn left" at split. You may, for example, increase motor's speed, reverse its rotation (going backward) or even stop a motor. This could help you to optimize your design at project period.

Step 3: Download the “lab_06_logic” Arduino sketch program from your Canvas lab page. Copy & paste into your Uno-board coding “text” section in Tinkercad.

Step 4: Based on the truth table given above, fill in the question mark “???” areas with either a “HIGH” or a “LOW” code (You may refer to Tutorial slides).

Step 5: Start Simulation and show demo to your TA.

****** TA Check: Demo that when changing the values of sensor voltages L and R, your motor rotation obeys the table below******

Case	Sensor L	Sensor R	Left Motor	Right Motor
(a)	0V | white	0V | white	**-ve rpm**	**+ve rpm**
(b)	0V | white	5V | dark	**-ve rpm**	**+ve rpm**
(c)	5V | dark	0V | white	**+ve rpm**	**-ve rpm**
(d)	5V | dark	5V | dark	**+ve rpm**	**+ve rpm**

You have learned all the basics, and you are now ready for your project!