EE1002 – Lab. 6: Logic Circuit and Comparator Circuit

Name:_____

Matric. No._____

Group:_____

Activities Completed	Verified By	Marks From 5
a		
b		
c		

1. Objectives of the Experiment

a) To design, build and test the interfacing circuits between the sensors and the actuator for the project on breadboard :-
   1) LED and LDR Circuit Block
   2) Comparator Circuit Block
   3) Logic Circuit Block
b) To learn how to use soldering iron
c) To solder the LEDs & LDRs on to the Printed Circuit Board (PCB) for line sensor

2. Equipment involved

- Lab DC power supply
- Signal Generator
- Oscilloscope
- Digital multi-meter
- Breadboard
- Soldering Iron & Soldering Lead

3. Components

- White Light Emitting Diodes (LED)
- Colored LEDs
- Light Dependent Resistors (LDR)
- Resistors
- Variable Resistors
- Integrated Circuit (IC) Chips as listed below :

Part Number	Description
LM324	Quad Operational Amplifier
74xx**00**	Quad 2-input NAND gate
74xx**04**	Hex Inverter
74xx**08**	Quad 2-input AND gate
74xx**32**	Quad 2-input OR gate

In-lab Activities

a) LED & LDR Circuit

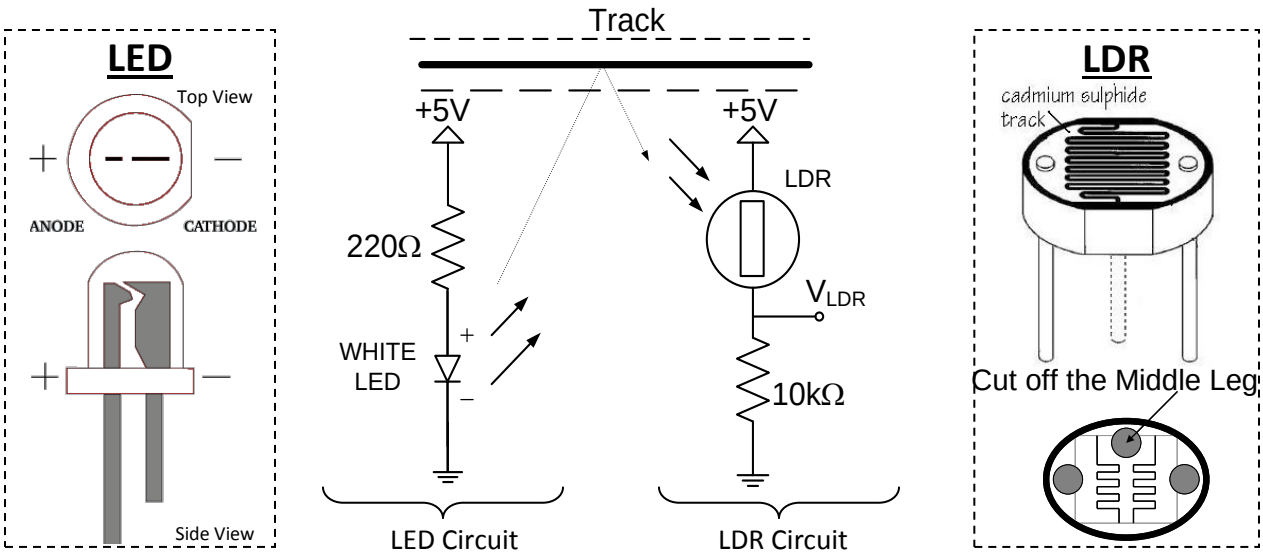

Fig. 1: Schematics of (a) LED and (b) LDR Circuits.

1) Construct the LED Circuit as shown in Fig. 1 (a) on your breadboard using the WHITE LEDs provided.

   Ensure that the LED lights up when the power supply is switched on.

   Observe what happens when the value of the power supply voltage is increased from 5V to 7V.

2) Construct the LDR Circuit as shown in Fig. 1(b).

Measure and note down the values of V_{LDR} (across the 10KOhm resistor) in each of the following instances.

When LDR is covered, $V_{LDR,dark}$ =

When LDR is uncovered, $V_{LDR,light}$ =

You need these values in section (b) for setting the V_{ref} in the comparator.

3) **Solder the LEDs and LDRs on to the PCB provided (not marked).**

b) Comparator Circuit

To utilize the output voltages from the LDR circuits to control the motors, the voltages need to be converted to logic levels at the output $Sensor_{OUT}$ using the circuit as shown in Fig. 2. $V_{LDR,light}$ is to be converted to logic '1' or 5V, $V_{LDR,dark}$ to '0' or 0V and $V_{LDR,light}$ to '1' or 5V.

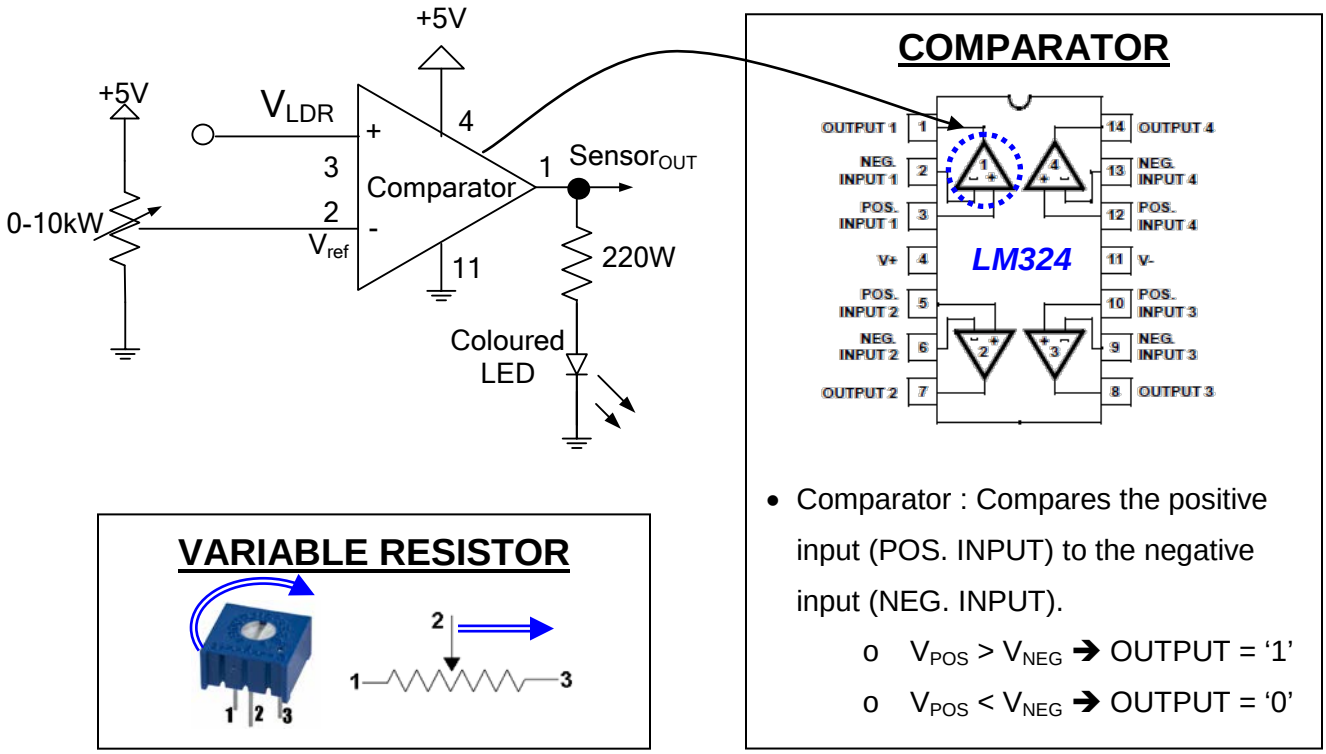

Fig. 2: Schematic of Comparator Circuit.

1) Construct the circuit as shown in Fig. 2.
   V_{LDR} is the LDR circuit output V_{LDR} from Section (a) Fig. 1(b).

2) By adjusting the trimmer, set V_{REF} to an appropriate value to achieve the following:
   - When $V_{LDR} = V_{LDR,light}$ ➔ Colored LED lights up
   - When $V_{LDR} = V_{LDR,dark}$ ➔ Colored LED does not light up

3) Ensure that behaviour of the circuit is consistent by testing it several times.

4) You may use more than one LDR circuit in your line sensor. You need a separate comparator for each LDR circuits.

c) Logic Circuit

After converting the output LDR voltages to proper logic voltage levels, we can use logic gates to make decisions based on them. For example, based on the value of the LDR $Sensor_{OUT}$, the circuit below can be used to switch the motor ON and OFF.

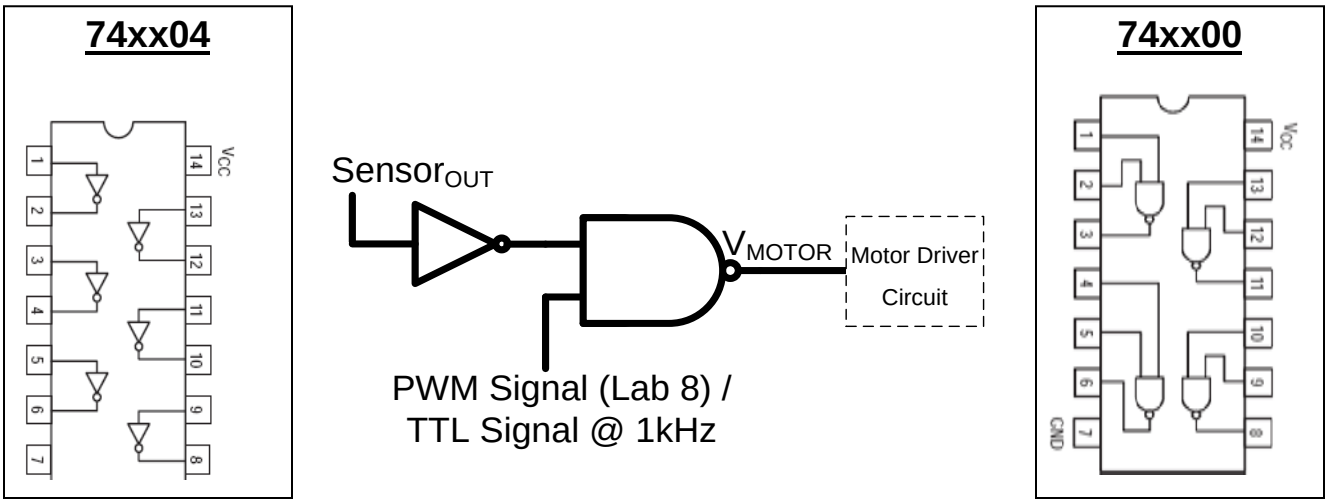

Fig. 3: Schematic of Logic Circuit.

1) Build the circuit as shown in Fig. 3.

   Connect the input of the NOT gate to the Sensor Output ($Sensor_{OUT}$) from Section (b).

   Connect the TTL signal from the signal generator with the frequency set to 1kHz.

2) Observe the waveforms at V_{MOTOR} using the oscilloscope and plot them below. Note down the voltages and period of the waveform.

d) Conclusion

You have now learnt how to build a line sensor using LDR and comparator. You have also learnt how to implement a simple logic circuit using NAND gates and NOT gates. You have to build more complex logic later, depending on the number of LDR sensors you decide to use for our vehicle.

You have to build all your circuits in this vehicle project (more to be done in Lab 8) on a single breadboard. Be careful about the space on breadboard and make your circuit neat.