SYSTEM INTEGRATION

After the 'eyes', 'brain' and 'limbs' are constructed, it is time to integrate them together and build the complete electrical subsystem of the vehicle. It is always a good practice to test the sub-systems again and ensure proper operation of ***each*** portion before building the complete system.

First, integrate the sensor, comparator and logic circuits on the breadboard, according to Fig. 1. Ensure that each part is functional before connecting to the next part.

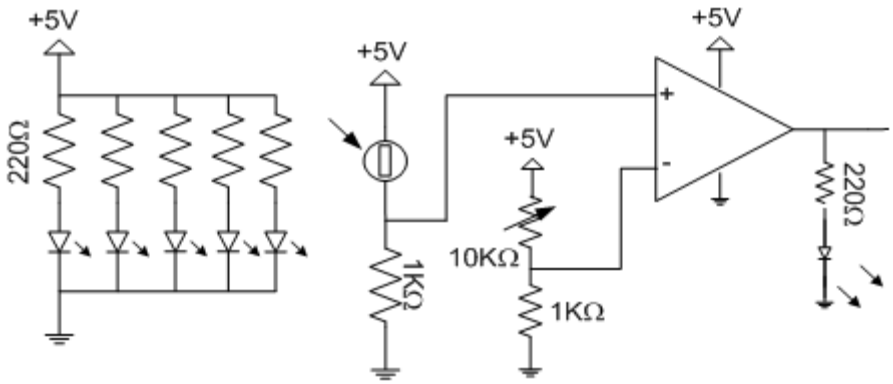

Fig. 1: Sensor and Comparator Circuits

This diagram only shows an example of one LDR in the system, but you need at least 2 LDRs (or even more) to finish the project, thus you should connect all of them.

Measure the voltage output of the comparator using the digital multi-meter. It should change according to the amount of light that LDR receives. Ensure that you understand each portion of the circuit and how it controls the subsequent part.

You can now solder all LED and LDR circuits to PCB, which shall be located at the bottom of your vehicle. You need to decide the LDR positions before soldering. LDR positions will determine your programming logic and hence are very important!

To understand more about the internal connections of the PCB, you may refer to PCBs.pptx in the IVLE workbin.

Next, connect the PWM generator, motor driver circuit with the 'brain' (logic circuits), according to the following block diagram.

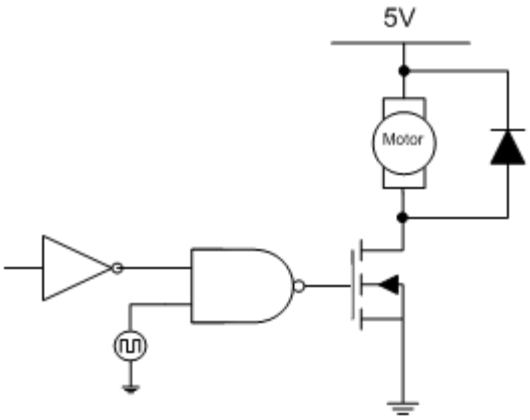

Fig. 16: Use of MOSFET as a switch to operate DC motor

You should observe motor M1 changing speed when the duty cycle is varied. You can build a similar circuit to test the operation for another motor.

Turning the vehicle left and right

The two wheels on the left and right will be driven independently by two different motors. The vehicle can be turned left or right by introducing a speed differential between the left and right wheel. For example, if the left wheel is turning faster than the right wheel, the vehicle will turn right. If the right wheel is turning faster than the left wheel,, the vehicle will turn left. The bigger the speed differential, sharper will be turn.

Finally, you can integrate the sensor, logic circuit and the motor driver circuit together, as shown below. You need to build 2 similar circuits in order to control 2 wheels at the same time. But you need to redesign the logic parts to meet the requirements in your autonomous vehicle project. Develop your own logic and test the working condition of the entire system.

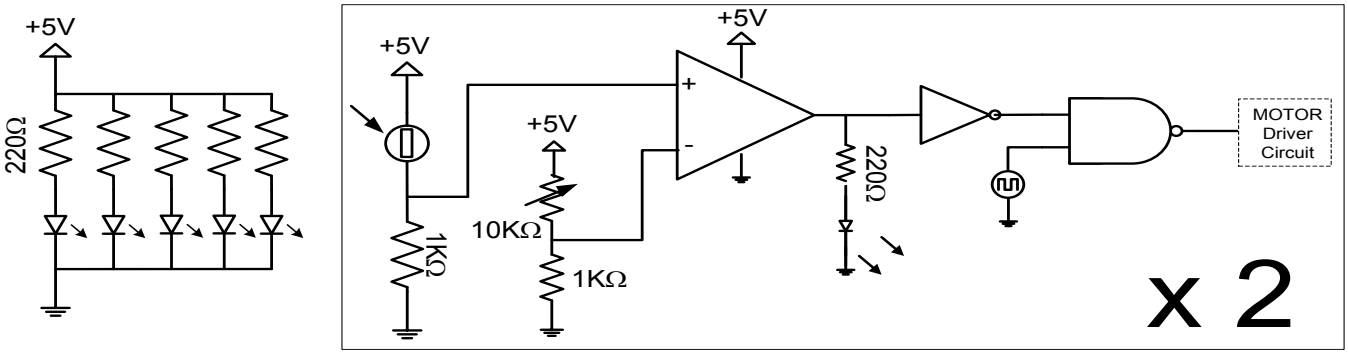

Fig. 17: Skeleton circuit design

System Debugging

In the event that the vehicle does not function as per the specifications, we have to do the trouble shooting or debugging. Though a random testing may yield a quick result at times, it may also lead to frustration and loss of more time. While trying to locate the problem, we must be very systematic.

The various subsystems have to be isolated and tested one by one and confirmed to work independently. As each subsystem needs input from some other subsystems, we need to simulate the required input conditions, while testing a subsystem. A logic signal (HIGH or LOW) can be simulated by connecting the input to 5V or GND. A variable voltage (analog signal) can be obtained from the laboratory DC supply. The PWM signal can be obtained from the Signal generator etc. If this process is followed with patience, success in identifying the problem is guaranteed.

Sometimes, loose connections cause intermittent problems, which cause working-some-time/not-working-some-time type of behavior. This type of problems are best avoided by proper wiring/soldering/connection practice while assembling the system.