

Mechatronics I Laboratory Exercise:

Photosensors

In this laboratory exercise, you will use photosensors and the Handy Board to detect the presence of infrared light.

Photosensors come in a variety of types, but in general, they are used to detect the presence of light. Some are designed to detect visible light, while others can detect infrared light. Figure 1 shows a simple schematic of a phototransistor. As the base of the transistor is exposed to light, a bridge is formed between

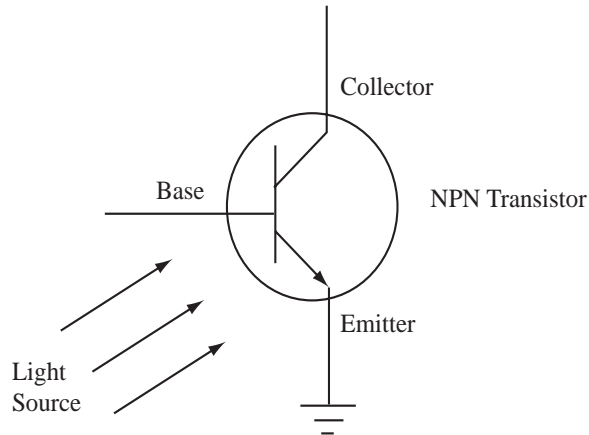


Figure 1: Phototransistor Light Sensor.

the collector and emitter. The strength of the bridge, which in turn determines the current flow, is dependent upon the amount of light that shines on the base of the transistor. Think of the bridge between the collector and emitter as a switch. The switch is light activated.

A phototransistor can also be considered as a variable resistor. In Figure 1, if you were to measure the resistance between the collector and emitter of the photosensor, the resistance, R_p , would change depending upon the amount of light presence. Why is that? When no light is presence, the resistance should be “Over Load” or very high and when the sensor is saturated with light, then its resistance is near zero. Explain why is true in your report.

Since photosensors behave as variable resistors, one way to use them is to wire them in a voltage divider circuit shown in Figure 2. The amount of light seen by the sensor will produce a proportional output voltage between 0 to 5 volts at point A. Do you know why this is true?

Photosensors will be used for your robot project and it is important that you understand how they work and their applications. Refer to “The Mechatronics Robot Handbook”, by Kam Leang for applications involving photosensors.

Pre-Lab Report

1. For the voltage divider circuit shown in Figure 2, determine the output voltage at point A in terms of resistance R , the resistance of the phototransistor, R_p , and the supply voltage (+5V). Hint: This is a simple voltage divider circuit!
2. The output at point A will vary between 0 and 5 volts. This output voltage from the photosensor is analog which can be read by a microcontroller. You can use two photosensors oriented towards the light source to determine the direction of the light (the output from one of the photosensor will be higher than the other one if the light is not exactly centered between the two photosensors). Write a C program for the Handy Board to rotate the motor towards the direction of the light source.

Laboratory Exercise

Equipment Needed: Handy Board, infrared light source, and photosensors.

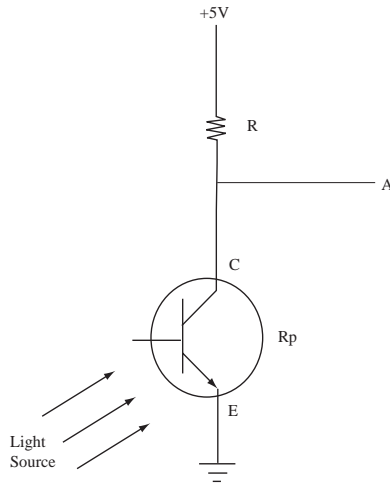


Figure 2: Voltage Divider Using Phototransistor.

1. Interface a photosensor to the Handy Board as explained in “The Mechatronics Robot Handbook”. See the chapter on Sensors. Place the Handy Board in Interactive Mode and use the `analog(int p)` command. Expose the sensor to light and discuss your results. What value does the sensor read when there is no light? What value does the sensor read during saturation? Explain.
2. Take two photosensors and attach them to a DC motor shaft. Refer to instructions presented by your TA. Download the program you wrote for the prelab into the Handy Board. Start the program and expose both sensors to a light source. What happens? Can the two photosensor system attached to the motor track the light source? Explain the behavior of your system. Is it sensitive to light? Why?

Post-Lab Report

Why does the resistance between the collector and emitter of the photosensor change when there is light? Discuss your two-photosensor system and answer questions presented under the Laboratory Exercises.