# Mechatronics Laboratory Exercise 6
# 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 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 consisdered 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 this 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 senor 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.

# Pre-Lab Report

1. For the voltage divider circuit shown in Figure 2, determine the output voltage at point A in terms of resitance 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 from the photosensor is analog which can be read by a micocontroller. 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 photosenors). Write a C program for the Handy Board to rotate the motor towards the direction of the light source.

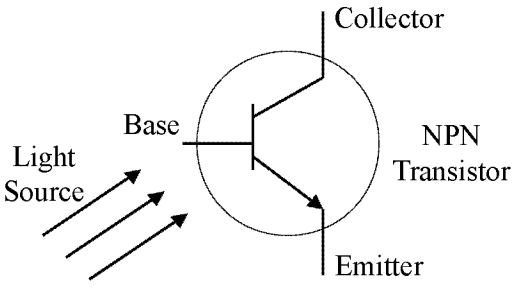


Figure 1. Phototransistor Light Sensor.

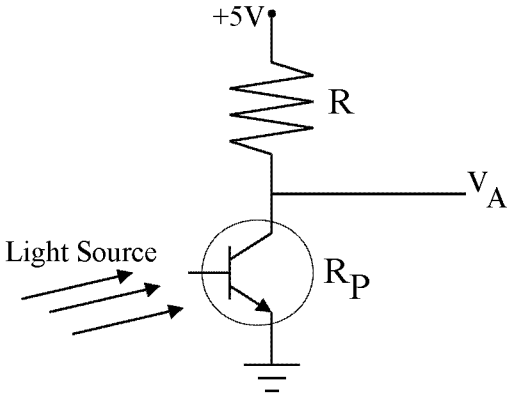


Figure 2. Voltage Divider Using Phototransistor.

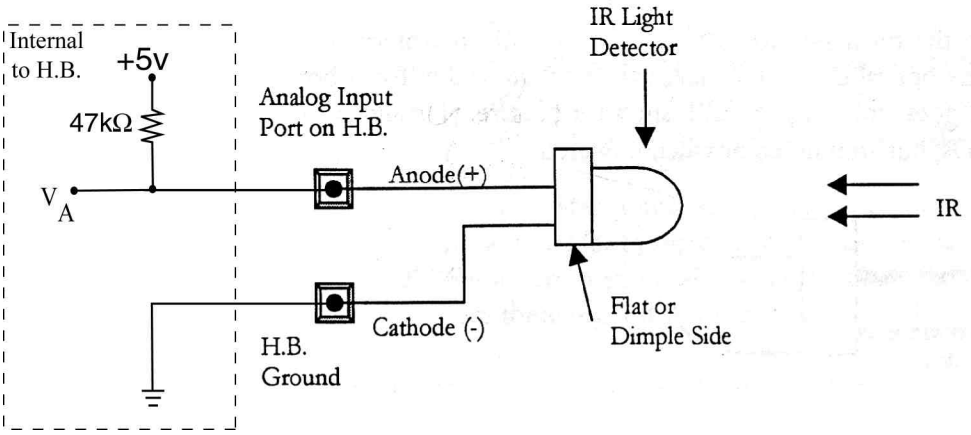


Figure 3. Connection of IR detector to Handyboard.

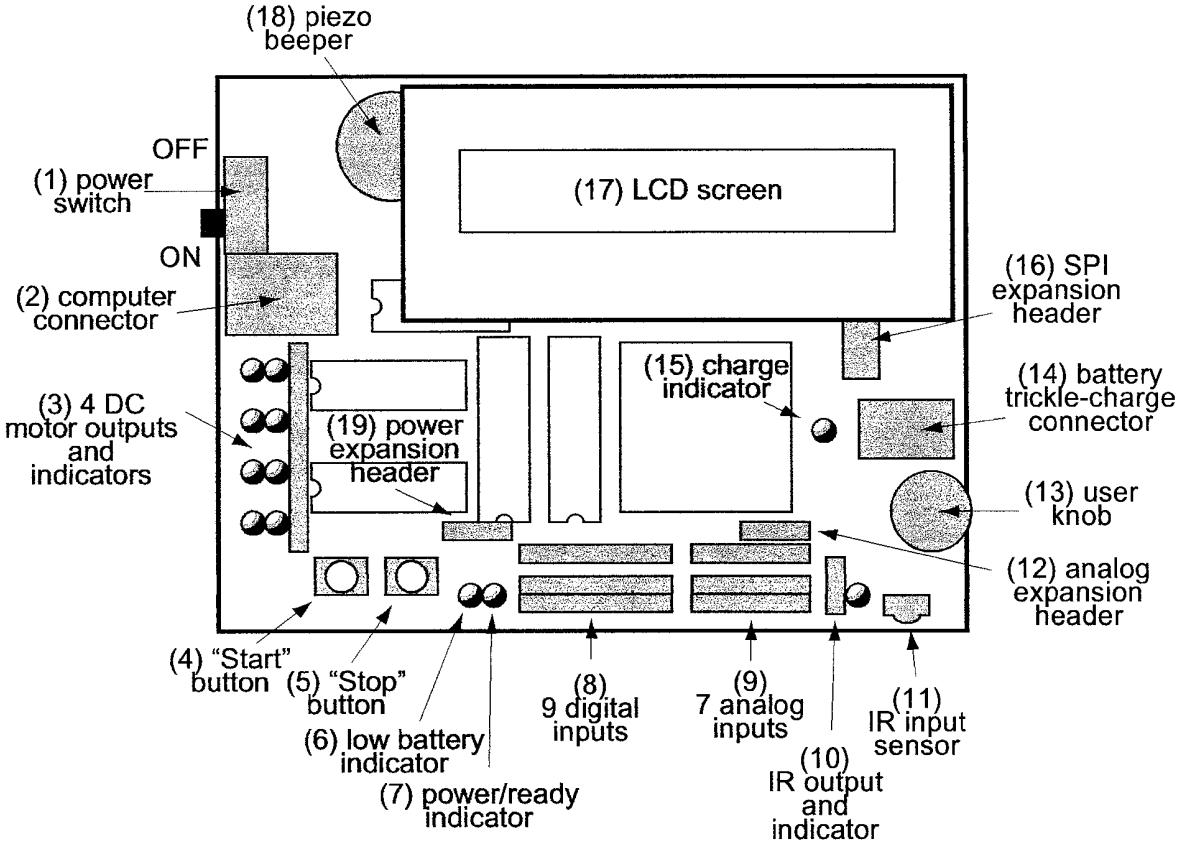


Figure 4 Handyboard Diagram

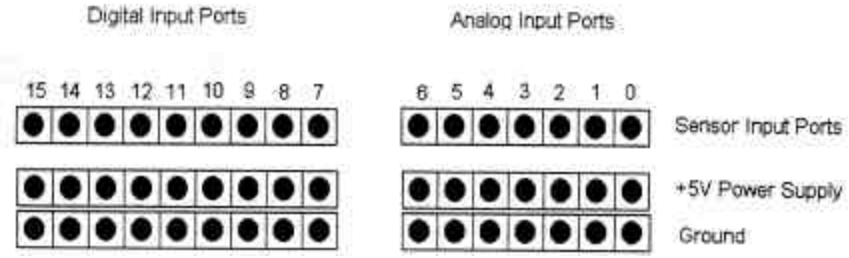


Figure 5. Handyboard input ports.

## Laboratory Excerise

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

1. Connect a photosensor to the Handy Board. Figure 3 illustrates the connection of the photosensor to the Handyboard. Note that the Handyboard has an internal 47kΩ resistor connected to a 5V source, as shown in Figure 3. This assures a voltage divider similar to that shown in Figure 2. A diagram of the Handyboard is shown in Figure 4 and a detailed view of the input ports is shown in Figure 5
2. Place the Handy Board in Interactive Mode and use the **analog(*int p)*** command. Expose the sensor to light and discuss your results. Is the sensor affected by the distance or angle from the light source? What value does the sensor read when there is no light? What value does the sensor read during saturation? Explain.
3. Take two photosensors and route the information to a motor port using your C program. 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 all questions in the lab handout.