# Homework # 4

## Understanding the Sharp GP2D02 IR Range Sensor

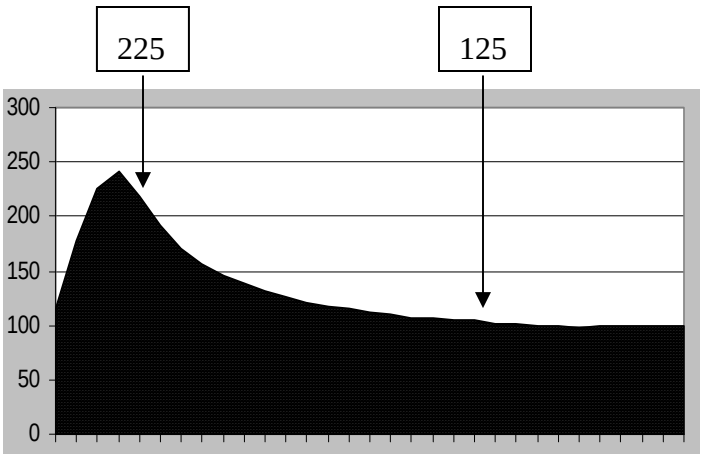
1. Connect the Sharp IR Range Sensor to the HandyBoard using the diagram on the following page.

2. Find a wall that has a smooth surface and is light in color. Tabulate the readout from the IR Sensor vice its distance from the wall (see sample table below). Make the measurements beginning about 1 inch from the wall and moving out until the readings remain constant.

| Distance | Light & Smooth | Dark & Smooth | Light & Rough |
|---|---|---|---|
| 1” | 116 | | |
| 2” | 177 | | |
| 3” | 242 | | |
| 4” | 191 | | |
| … | … | | |

3. Repeat step 2 two more times, once for a dark, smooth surface and again with a light, rough surface. This should provide you with three separate tables.

4. Find the two drop-out points for each of your tables (the closest point to the wall and the farthest point that provides an unambiguous reading) identifying both the distance from the wall and the sensor reading. If there is a difference among the three tables, discuss why the tables may be different and how you can program your robot to overcome these differences.

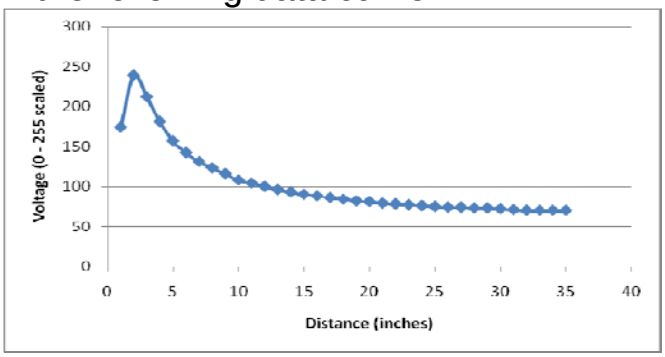


5. To use a PID controller, the data must be linear. According to the datasheet on the Sharp IR sensor, the data should fit the following curve:

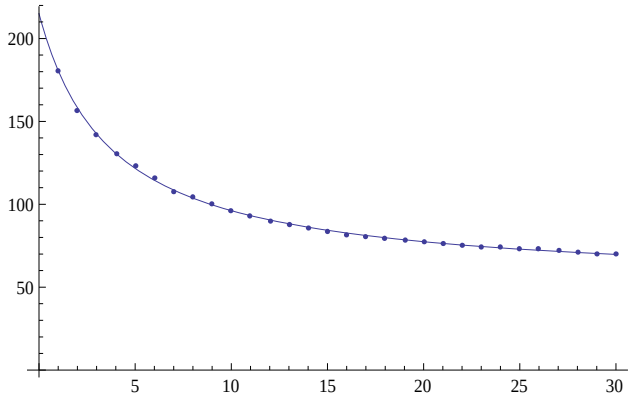
$$V = \frac{b}{R + a} + c$$

**Use any tool you have to fit the data between the two limits you set to determine a, b and c.** Once you have a curve that approximates the Voltage, solve for R (the range) so that, given V, you can find R.

For example, given the following data curve:



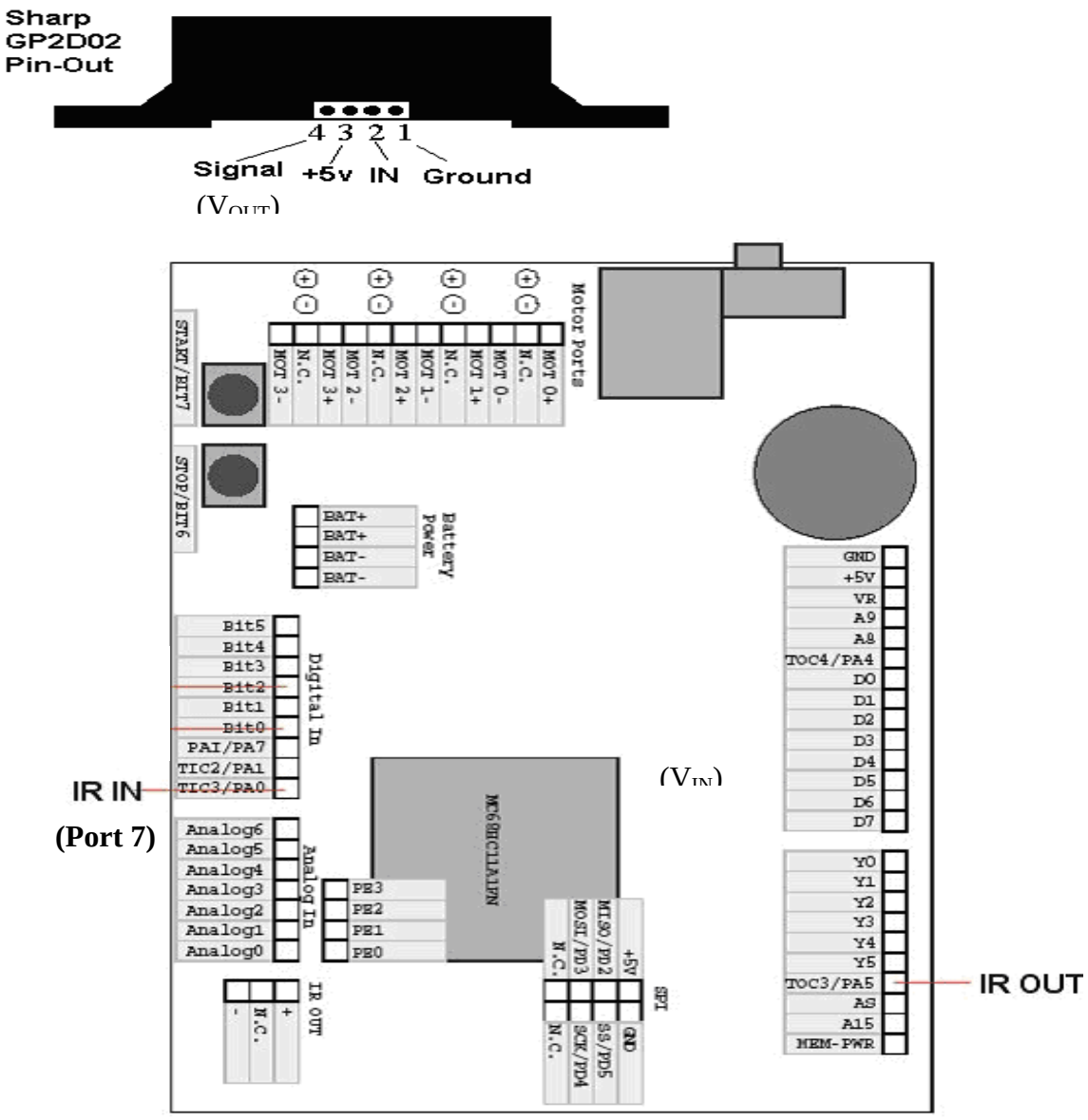

A curve fit would yield where the origin has been shifted to 3 inches:




The equation of this line was determined to be:

$$V = \frac{612}{R + 52} + 0.7$$

Solving for *R* (and adding the 3 inches back to it) will now give you the distance in inches needed to use the PID controller.

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Sensor has four pins for electrical contact.

- Pin 2 (IN - Green Wire) from the sensor connects to IR OUT (marked as TOC3, not in the same position on all HandyBoards).
- Pin 4 (Signal - Yellow) from the sensor connects to (IR IN).
- Pin 1 (Black) is connected to ground (IR IN).
- Pin 3 (Red) is connected to +5V (IR IN).