ASK MR. ROBOTO

by
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Tap into the sum of *all human knowledge* and get your questions answered here! From software algorithms to material selection, Mr. Roboto strives to meet you where you are — and what more would you expect from a complex service droid?

Q. I have some of those Sharp GP2Y0D340K object sensors and I can't figure out how to adjust the sensing range. The data sheet says it is adjustable from 10 to 60 cm, but the trip point always occurs around 15 inches. Can these sensors be adjusted? If so, how do you do it?

— Jason Reed

A. I have been wondering about this myself. I bought a set of them a couple years ago and never got around to actually using them. So, I decided to dive into this question and see if they can actually be adjusted.

I'll start with a little background information. These sensors are made by Sharp Electronics (**http://sharp-world.com**) and their datasheets can be downloaded from their website or where they were purchased. The housing for this sensor measures 0.59 inches wide by 0.38 inches high and 0.34 inches deep (15 mm x 9.6 mm x 8.7 mm). They require a five-volt power source and two additional components, a resistor and a capacitor. The output is zero volts when it detects an object, and is 4.7 volts when there is no object in its detection range. The normal detection range is 15.75 inches (40 cm). The data sheet does indicate that the range is adjustable from 3.9 inches to 23.6 inches (10 cm to 60 cm). But, it does not provide any information on how this is accomplished. One of the attractive points about this sensor is that it has an extremely fast response time — 6.4 ms — when compared to the other Sharp GP2xxxx class sensors which are at 38 ms. This faster response time allows for a more reliable detection of faster moving objects. Or it will enable your robot to move faster while having a higher confidence in detecting obstacles.

Figure 1. Photo of the Sharp GP2Y0D340K sensor with an inch scale for size comparison.

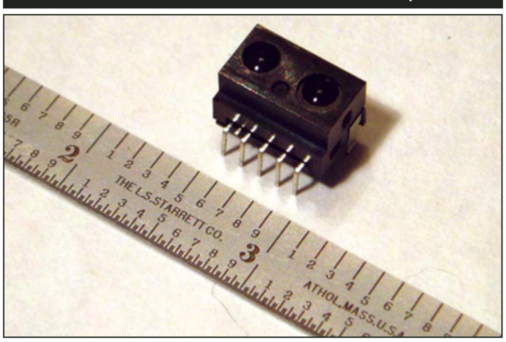


Figure 1 shows a photo of this sensor with a scale to show its relative small size. Figure 2 shows a simple schematic for testing this sensor. R1 and C1 are the only two components required to be used with the sensor. The transistor is only acting as an inverter so that when the sensor detects an object, the LED will turn on. When no object is detected, the LED would be off.

A point to note here is that the current draw from the sensor is not clearly defined in the data sheets. The data sheets talks about the average current draw with a 1 ohm resistor for R1. This can be misleading because it is the time average, not a peak current draw. The IR LED sends out a burst of 16 pulses at a 6.67 kHz frequency. For 18 µs during each time the IR LED is on, the current draw is approximately 300 mA when R1 is a 1 ohm resistor. When R1 is 2.2 ohms, the peak current draw drops to approximately 145 mA. This is important to know so that you can make sure that you use a power supply that is capable of supplying short pulses of current based on the sum of all of the sensors worst-case current draw. Otherwise, voltage drops due to high current draw from the sensors could have adverse effects on the rest of your electronics.

Modifying the sensor so that its detection range can be adjusted turns out to be a relatively simple process. Figure 3 shows a photo of the top of the sensor. You should notice that there is a small plastic tab inside a narrow slot. This tab is what needs to be moved (to the left or to the right) to change the sensor's detection range. But the immediate problem that you will run into is that this tab does not move. This is because the lens mount has been glued in place. Figure 4 shows a photo of the right side of the sensor. There is a small oval shaped hole in the side of the housing. When looking with a microscope, you will notice that a small drop of clear acrylic-like glue was placed in this hole. This glue is used to lock the lens in position. In order to change the detection range of this sensor, the glue spot needs to be removed.

The first step is to remove the front plastic lens mount from the sensor module. The adjustable lens mount is

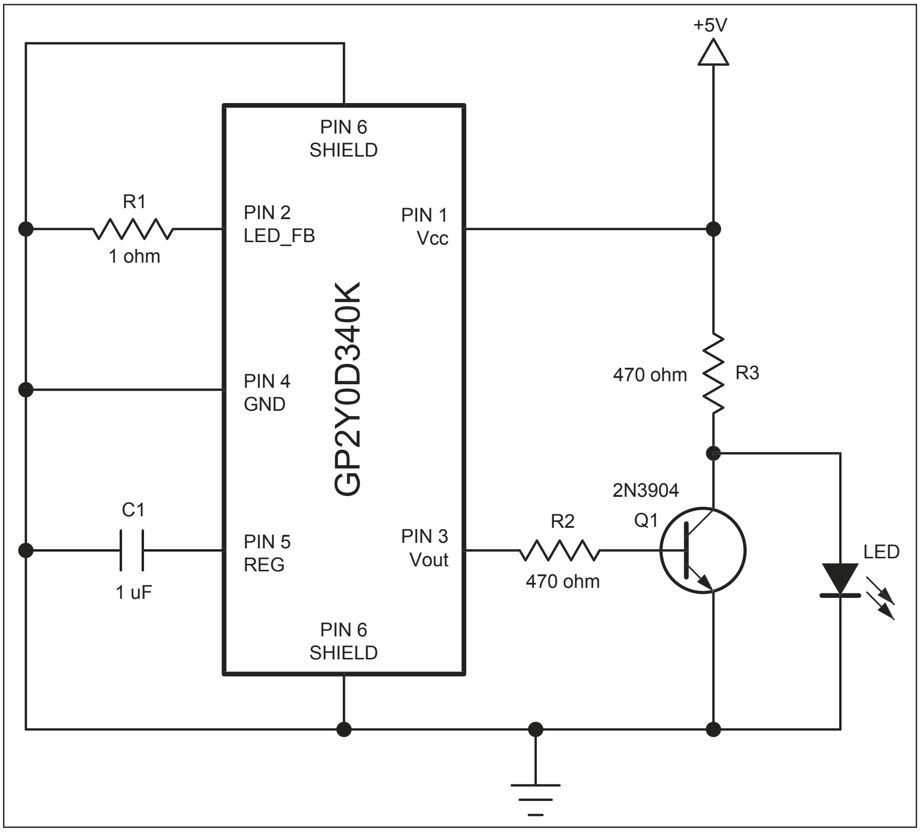


Figure 2. Schematic for testing the Sharp GP2Y0D340K sensor.

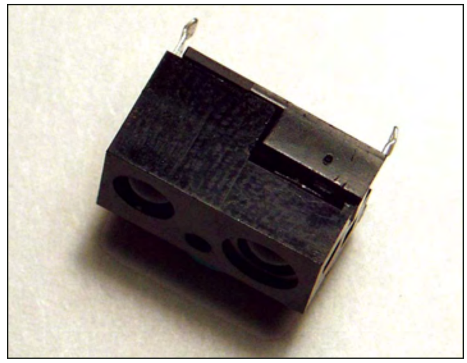


Figure 3. Closeup view of the Sharp Sensor showing the range adjusting sliding tab.

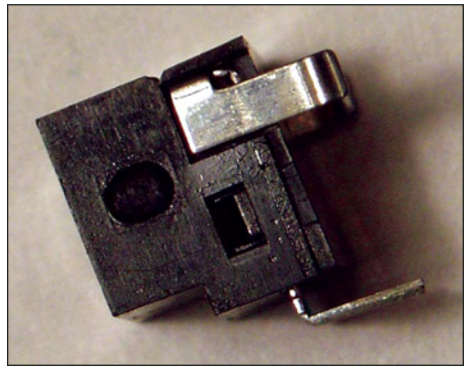


Figure 4. Side view of the GP2Y0D340K showing the hole where the lens mount is glued in position.

used to focus the reflected IR light onto the position detection sensor. The fixed lens covers the IR LED. Use a small jeweler's screwdriver and pry the tabs on the sides of the forward housing away from the hooks on the back side of the housing (see Figure 5). Figure 6 shows the forward lens housing and back housing removed from the sensor module. Figure 7 shows an interesting closeup view of the sensor module.

The next step is to use the jeweler's screwdriver to pry up the adjustable lens mount out of the forward housing. Figure 8 shows a photo of how this is done. You will want to use the screwdriver to work on both sides of the lens mount and slowly work (wiggle) the mount out. This will cause the glue on the side of the housing to break loose. The glue is a hard material and shatters/cracks when it finally breaks loose. When this happens, it will become easier to remove the lens mount. Figure 9 shows the lens mount removed from the forward lens housing.

The next step is to use a blade (such as an Xacto knife) to scrape off all of the glue remnants from the lens mount and housing. If any glue residue is left in place, it will be difficult to adjust the lens position. Then finally, the sensor is reassembled. Place the lens mount back in the housing with the small tab at the base of the mount inside the original slot that is above the lens mount hole (use Figure 8 as a reference). The lens mount should easily rotate left or right and the tab limits the full range of motion. Next, place the rear housing back on the rear of the internal sensor module. Then with the forward lens

Figure 5. Removing the front housing cover from the sensor.

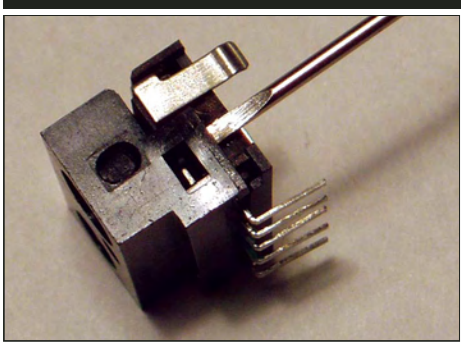


Figure 6. Optical sensor module removed from the forward lens housing and rear plastic housing mounts.

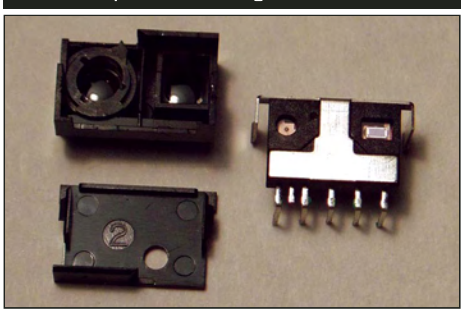
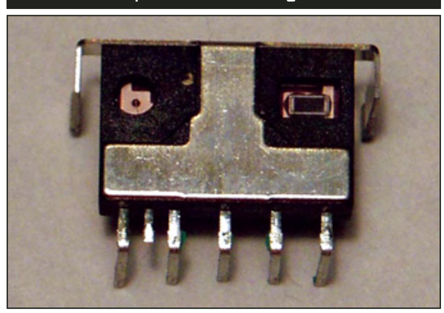


Figure 7. Closeup view of the front of the sensor module showing the IR LED and the position sensing detector.



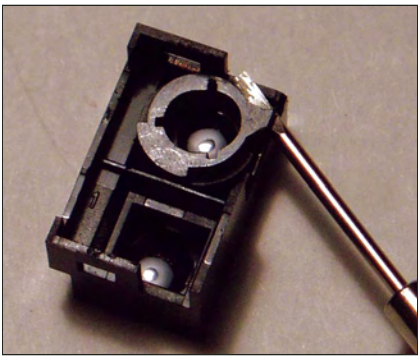


Figure 8. Using a small jeweler's screwdriver to slowly work the lens mount out of the forward lens housing.

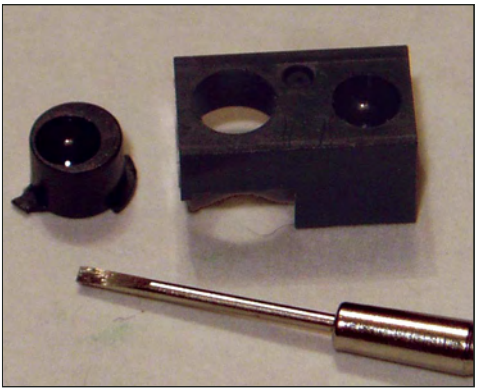


Figure 9. Adjustable lens mount removed from its housing.

housing facing down, snap the sensor module and rear housing back into the forward lens housing. If the forward lens housing is not facing downward, then there is a chance that the lens mount might fall out of position and get jammed up against the sensor module.

At this point, you should be able to freely adjust the sensor's detection range by rotating the lens mount clockwise and counter-clockwise, and have the full detection range of the sensor.

With the sensors that I have, the detection range is not proportional with the rotational position of the lens. Figure 10 shows a plot of the detection range as a function of the sensor's detection lens position. 0% means that the tab position is all the way to the left side of the sensor. 50% means that the tab is centered in the middle of the slide slot. And, 100% means that the tab is pushed all the way to the right (towards the fixed lens). Figure 10 shows that the position of the lens and the detection range is not linear. The greater the detection range, the more sensitive the position of the sensor becomes.

At this point, you should have all the information needed to modify your sensors to detect an object anywhere between the 10 cm to 60 cm range. If you need to lock the sensor in a particular position, all you have to do is add a dab of glue in the oval hole on the side of the sensor. Ideally, you would want to use a semi-permanent glue that can be broken easily if needed. One suggestion would be red finger nail polish. It holds small things together just fine, will break off if pried apart, and the red will be easy to see. **SV**

Figure 10. Sensing distance as a function of rotational position of the detector lens.