Sensors

Sensors allow our robots to interact with the world by measuring physical events and translating them into digital quantities. We've already used the touch sensor, which measures the presence or absence of physical contact. Today we'll use the Ultrasonic and Light sensors to measure distance and brightness.

Setup Color Sensor

Connect the Light Sensor to one of the numbered ports on your LEGO Brick. The light sensor looks like this:

Before we use the color sensor, we must set the color mode. We can do this with the following command:

```
brick.SetColorMode(SensorPort, mode);
```

Where SensorPort is the sensor port number, 1 through 4, that the color sensor is connected. Mode is also a value between 1 and 4:

Mode	Description
0	*Light Reflect*. Turns on Red LED and gives a single number representing the amount of reflected light.
1	*Light Ambient.* Turns off all LEDs and gives a single number representing the amount of light present in front of the sensor.
2	*Color Code*. Turns on all LEDs and gives a single number representing a color as a coded number. See table below in ColorCode function.
3	Invalid mode. Do not use.
4	*Color RGB*. Turns on all LEDs and gives 3 numbers, each representing the brightness of Red, Green, and Blue reflected light.

We must always set the mode before retrieving the sensor value. The mode only needs to be set once, so it's a good idea to put it at the beginning of the program. For example, to retrieve the reflected brightness value of the sensor on port 2, we use the following commands:

```
brick.SetColorMode(2, 0);
brightness = brick.LightReflect(2);
```

This command returns a number that is related to the brightness of light that the sensor receives.

Light Sensor Characteristics

In this section, we'll explore the characteristics of the light sensor. In the Sumo competition, your robot must stay within the ring in order to avoid losing. The center of the ring is painted white and bordered in black, so it may be useful to be able to detect these differences with a sensor.

Record the average measurements of the light sensor under the following conditions:

- Try the light sensor on light and dark surfaces using the **ColorReflect** command. Record the values you receive for light and dark surfaces. **Observe how shadows effect the sensor value.**
- **Use the ColorAmbient command instead**, Record the values you receive for light and dark surfaces. Observe how shadows effect the sensor value.
- How does distance from an object effect the sensor value? Try with the sensor contacting the object, ½" away, and then 2" away. Record the values you receive for light and dark surfaces.

Detecting Color

Go to the EV3 Documentation (https://sites.google.com/a/asu.edu/fse100-cse-wiki/ev3-matlab-library-documentation#TOC-Color) and read about the **ColorRGB** function.

Setup Ultrasonic Sensor

Connect the ultrasonic sensor to one of the numbered sensor ports.

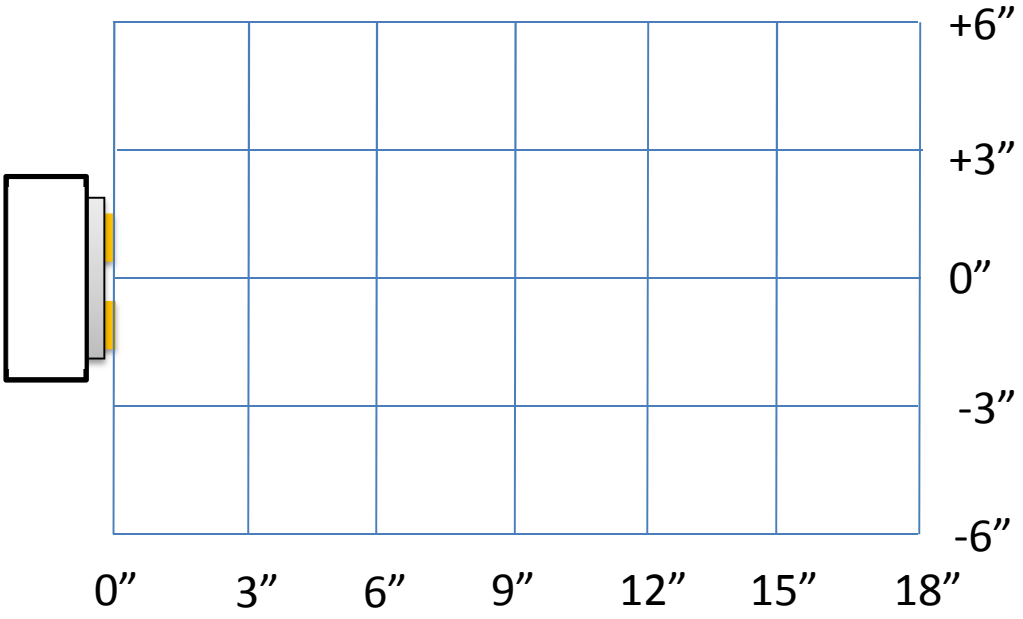
Go to:

https://sites.google.com/a/asu.edu/fse100-cse-wiki/ev3-matlab-library-documentation

Look up the **UltrasonicDist** functions. What does this function do? What unit of measurement does the sensor report?

Ultrasonic Sensor Characteristics

Using LEGO pieces, setup the Ultrasonic sensor on a stand, 4-5” off of the table surface.



Take a series of measurements in 3” grid, 1 foot wide, 1.5’ long. Target a bottle or cup.

Where can the sensor detect objects, and where does it loose them? What can you conclude about the angular range of the sensor?