CMPE 8 Lab 7: The Light and Line Sensors

Lab Objectives

By the end of this lab you should be able to:

1. Identify how the robot’s light and line sensors work.
2. Create a program that uses a subroutine and the robot’s LEDs to display the light sensor levels.
3. Create a program that uses a subroutine and the robot’s LEDs to display whether or not the line sensors detect a dark line.

The Light Sensors

The Scribbler 2 is equipped with three light sensors that can be used to detect bright light in front of the robot. The center sensor looks straight ahead and the other two sensors look 30° to the right and left. The location and sensing areas of the light sensors are shown below.

The Scribbler 2 uses phototransistors for light sensing. The phototransistors convert light energy into an electrical current that is proportional to the brightness of the light. The square root of the value of the electrical current is used to represent the brightness of the light “seen” by the sensor. Using the square-root-scaled value provides a larger dynamic range than the raw values do.

We can get information from the three light sensors by using the command:

```python
s2.light_sensor(side)
```

where the variable side is either s2#LEFT, s2#CENTER or s2#RIGHT depending on which sensor we wish to get information from. Unlike the robot’s other sensors, the light sensors can return a range of values between 0 to 255 depending on the brightness of the light that they “see.”

For this lab we will be using the robot’s LEDs to indicate the brightness of light detected by each light sensor. In order to do this, we first need to get an initial value for how much light the robot “sees,” then we can compare the light sensor readings to the initial value and turn on the LEDs accordingly. To get an initial light value, we will take the average of the values of the three light sensors at the start of the program.
The Line Sensors

The Scribbler 2 is also equipped with two line sensors that can be used to detect light or dark lines beneath the robot. The line sensors (shown below) are located on the underside of the robot and consist of a pair of infrared emitters and detectors.

The Scribbler 2 performs line detection by shining infrared light at an angle from the two emitters onto the surface below the robot. The surface reflects the infrared light back up into the two detectors, which measure the amount of light reflected by the surface. Since light colored surfaces reflect more infrared light than dark surfaces, the robot is able to detect whether its sensors are over a dark or light colored line.

We can get information from the line sensors by using the command:

```
s2.line_sensor(side,threshold)
```

where the variable side is either `s2#LEFT` or `s2#RIGHT` and the variable threshold is the value that is compared to the line sensor measurement. The command returns a value of 0 if the sensor detects a dark surface and a value of 255 if the sensor detects a light surface. Changing the value of threshold changes the sensitivity of the sensor.

Exercises

1. Using a subroutine called `LightSense(side)`, create a program that turns the robot's LEDs on or off and changes their color based on the brightness of the light detected by the light sensors. Each LED should correspond to one light sensor, i.e., the right LED should change based the brightness of the right sensor, the left LED should change based on the brightness of the left sensor and so on. If the light detected by the light sensor is greater than or equal to 90% of the initial light value, then the corresponding LED should turn green. If the light detected is greater than or equal to 75% of the initial value, then the corresponding LED should turn red. If the light detected is less than 75% of the initial value, then the corresponding LED should turn off. The subroutine `LightSense(side)` should perform the job of comparing the light values and changing the LEDs. The variable side should be set according to which sensor you are getting information from.
2. Using a subroutine called LineSense(left,right), create a program that turns the robot's LEDs on or off based on information from the line sensors. If the robot "sees" a dark line with its left sensor, then the left LED should turn on. If the robot "sees" a dark line with its right sensor, then the right LED should turn on. If the robot "sees" a dark line with both sensors, then the center LED should turn on. The subroutine LineSense(left,right) should perform the job of turning the LEDs on and off based on information from the line sensors. The variables left and right should be set to reflect the information from the left and right line sensors respectively. Use the provided sheet to test your program.

**Note:** For this lab you don't need to comment every line of your code. Only include enough comments to sufficiently explain your programs.