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|  | Rose-Hulman  Institute of Technology |

Memo

To: Dr. Carlotta Berry

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Class: ECE425 – Mobile Robotics

Date: 1/7/2013

Title: Lab04 – Reactive Control: Light Sensing

**PURPOSE**

The purpose of this lab is to use the CEENBoT’s two photoresistors to implement some reactive light sensing behaviors. We want to demonstrate some fear behaviors or *photophobic* and some like behaviors or *photophilic.* Using these types of behaviors, we will demonstrate light sensing behaviors similar to Braitenberg’s vehicles 2 and 3. Aside from its light sensing behavior, the robot should also avoid obstacles if it encounters any and then resume its current light sensing behavior.

**PROCEDURES AND STRATEGY**

Before we began implementing a light avoidance and light tracking behavior, we took some measurements for the photoresistor. Table 1 shows the voltage values for each of the photoresistors under the light conditions of the testing lab.

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| |  |  |  | | --- | --- | --- | | CONDITIONS | Left Photresistor (V) | Right Photoresistor (V) | | Ambient light on table | 4.37 | 4.32 | | Ambient light under table | 3.57 | 3.25 | | Sensor covered | 2.75 | 2.10 | | In front of a flashlight | 4.87 | 4.71 | |
| Table 1: Voltage values for photoresistors under the light conditions for the testing lab. These values vary according to the location of the testing area and the light source that is used. |

Once the photoresistors were calibrated for the right testing conditions, we the proceeded to create the photophobic and photophilic behaviors. The four light behaviors we created consist of *fear, love, wander, aggressive.* Refer to Figure 1 for the four types of Valentino Braitenverg’s light reactive robots.

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| Figure 1: These are the four types of light reactive robots developed by Valentino Braitenberg. The connection for the *fear* behavior is shown in the top left corner (Figure1a). The connection for the *love* behavior is shown in the top right coner (Figure 1b). The connection for the *wander* behavior is shown on the bottom left (Figure 1c). Finally the *aggressive* behavior connection is shown on the bottom right (Figure 1d). |

Once we created each of the four different light behaviors, we created another subfunction called *moveBehavior()* That checked what behavior was currently being run. Think of this subfunction as a state status update program. Using basic subsumption architecture and the new *moveBehavior()* function, we were able to suppress our photophobic and photophilic behaviors if an obstacle was detected.

Questions

1. How does the robot behave when the light source is directly in front of the robot and in one side of the robot for the setup of Figure 1a? Is there anything about the robot’s behavior that surprises you?

The robot moved away from the light by turning to a side (sometimes inconsistent) when the light was **directly** in front. Inconsistencies are due to systematic errors coming from the photoresistor calibration values and readings. When the light was in one side of the robot, the robot would turn away from the light by running away from it.

1. How does the robot behave when the light sensors are connected in an inhibitory manner (i.e. Figure 1b)?

The robot would sit and bake in the light if the light was directly in front of the light for the setup shown in Figure 1b. If the light was in one of the sides of the photoresitors, the robot would then proceed to track the light until it was directly in front.

1. How does the robot behave when the connections are crossed for both excitatory and inhibitory?

When the connections were crossed and in an excitatory setup (Figure 1c) the robot would behave more like a cockroach. It would wander in the dark and if it saw light, it would run away from the light. Think of this like a dark finder robot.

When the connections were crossed and in an inhibitory setup (Figure 1d) the robot would track the light and ram the light. It would not stop or slow down if it saw the light directly in front of it.

1. Identify the 4 types of behavior (*fear, love, wander, aggressive*) for each of the sensor connections.

*Refer to Figure1 caption for the identification of all behaviors and connections.*

1. How did you decide on the position of the photoreisors? Were there a certain lightning condition that were most difficult or easier for the robot to sense?

We decided to flip the entire orientation of the photoresistors to match our new front of the robot (caster wheel is now the new front of the robot). We unscrewed the mount containing the photoresistors and temperature sensors and flipped it to the new front. This was better than having the robot back up towards the light.

Sometimes the lightning conditions did severely change the performance of the robot. For best results, a dark room with a single bright light as the source proved to be consistent. The most difficult condition for test consists of a room with plenty of bright ambient light and a poor light source as the beacon. For this lighting condition, the photoresistors changed from around 4.4 volts to 4.7 volts instead of 2.3 volts to 4.7 volts.

CONCLUSION

The purpose of this lab is to use the CEENBoT’s two photoresistors to implement some reactive light sensing behaviors based on the Braitenberg vehicles. We discovered that lighting condition and sensor location on the robot were extremely crucial factors that affected the performance of the robot. We managed to learn about the 4 types of different reactive behaviors as depicted by Braitenberg.