**Pre-Lab 4 Report       Calvin Ton**

ECE 100-02 Teammates:

Prof. Oruklu Lab Date: 09/26/18

TA: Matthew Francis Due Date: 09/26/18

**Problem Statement (Proposal)**

Design and construct an autonomous robot that utilizes two light sensors to navigate through a maze while using Interactive C and a HandyBoard.

**Investigation/Research**

While touch sensors were great to use, light sensors, which are created with cadmium sulfide photocells, are more useful and more efficient. Light sensors are sensors that take in any source of light in order to operate. The strength of the signal the sensor sends to the motor corresponds with the strength of the light source. Therefore, the stronger the light source, the stronger the signal, making the motor execute a faster turn. When constructing the robot, the light sensors must be “cross-wired—each to the motor on the opposite side—with stimulatory effect” (Martin 76). Because the sensors are cross-wired, the light will affect the robot in a different way compared to if they were not cross-wired. If the right sensor is closer than the left sensor to the light source, the left motor will begin to speed up causing the robot to make a right turn. If they were not cross-wired, the light would have caused the robot to execute a left turn instead.

If configured correctly, the robots should turn towards and approach light sources. This is called negative feedback. Negative feedback brings the “system toward a goal state” (Martin 77). Because the system is goal oriented, the robot will be determined to find a light and approach it in order to complete and execute a turn. Positive feedback is the opposite. Instead of being goal oriented, the robot would be pushed away from a stable state. Therefore, the robot would not follow or look for the light source, if the robot were to detect the light source, it would turn away from the light and direct itself into a darker area since it will be drawn to darkness.

Braitenberg was the one to come upon using light-sensors while creating an autonomous vehicle. His first vehicle allowed him to be exposed to the use of the sensor, connecting it to the vehicle’s motor. In his first trial of Vehicle 1, the vehicle detected the light and started moving. As the vehicle approached the light source, it began to speed up and overshot the light due to the vehicle not having the function of steering or slowing down when it reaches the light. Braitenberg then created Vehicle 2 which contained two motors and two sensors that were cross-wired with the motors. The outcome elicited better results because Vehicle 2 is able to slow down and execute turns so that it could follow the light, while Vehicle 1 was only able to go in a straight path towards a light without slowing down.

**Alternate Solutions**

void main(){

while(1){

printf("sensor 0=%d sensor1=%d\n",

analog(2), analog (3) =);

sleep(0.1);

}

}

testLight.ic is a program that allows the sensors of the robot to be test. This is the simplest form of the code that continuously prints the value of analog inputs 2 and 3 to the HandyBoard LCD screen.

/\* normal.ic \*/

/\* converts light sensor reading to 0-to-100 motor power levels \*/

int normalize(int light){

int MAX\_LIGHT = 10;

int MIN\_LIGHT = 200;

int output = 100 - ((light - MAX\_LIGHT) \* 100 / (MIN\_LIGHT - MAX\_LIGHT));

if (output < 0) output = 0;

if (output > 100) output = 100;

return output;

}

In normal.ic, it can be seen that MAX\_LIGHT has a value of 10 and MIN\_LIGHT has a value of 100. The reason for the maximum reading containing the smaller value is because brighter light yields smaller readings. The value 0 is considered very bright while the value 100 is considered very dark. The expression gives smaller numbers with brighter light.

/\* normalImp \*/

void main(){

while(1){

printf("sensor 0=%d sensor1=%d\n",

analog(2), analog (3) =);

sleep(0.1);

}

}

With this program, it uses an infinite loop to continually set left and right motor powers based on the normalized value of the opposing sensor.

**Optimum Solution**

The solution with the best outcome for the robot is to place both light sensors at the front of the robot, one on the left side and one on the right side. While the robot is moving forward, the robot will approach the light that is within’ the maze. Once the robot detects the light in the maze, it will conduct a 90 degree, or a 270 degree turn to avoid the obstacles in its path. Using round sensors with stimulatory effect would be better than using rectangular sensors with inhibitory effect will have a greater effect on the robot because the round sensors would be twice as strong.

**References**

1. Martin, Fred G. 2001. Robotic Explorations: A Hands-On Introduction to Engineering. New Jersey: Prentice Hall.

2. Oruklu, Erdal. 2018. ECE 100 Lecture Notes. Chicago: Illinois Institute of Technology, Electrical and Computer Engineering Department.

**Appendix**

