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Memo

To: Dr. Carlotta Berry

From: Ander A Solorzano \_\_\_\_\_\_\_\_\_\_\_\_\_\_ and Ruffin White \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Class: ECE425 – Mobile Robotics

Date: 12/9/2012

Title: Lab02 – Random Wander, Obstacle Avoidance

**PURPOSE**

The purpose is to develop random wander and obstacle avoidance behaviors for the CEENBoT. We used *submission architecture* for the design of our program to incorporate several basic levels or *layers* of obstacle avoidance. Layer 0 of our control architecture included *collide* and *run away* behaviors to keep the robot from hitting obstacles. Layer 1 of our control architecture incorporates the *random wander* behavior which moves the robot a random distance and/or heading every *n* seconds.

**PROCEDURES AND STRATEGY**

Before we actually started programming the robot, we started testing the range sensors of the robot. Our CEENBoT is equipped with 4 short distance IR sensors that the robot can use to perceive information, in this case distance, from the environment.

We verified that the range of our sensors is valid from at least 5 cm and up to 45 cm away from each of the sensors. Although the robot can sense objects farther than 45 cm away, the feedback signal is too noise to make sound computations. *Refer to Figure 1 for a table displaying the IR analog voltage values for each of the IR sensors.*

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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Distance (cm)** | **Distance (")** | **IR Front** | **IR Left** | **IR Right** | **IR Back** | | 5 | 1.97 | 5.50 | 5.35 | 5.15 | 5.27 | | 10 | 3.94 | 11.09 | 11.19 | 10.04 | 10.29 | | 15 | 5.91 | 15.50 | 15.75 | 14.92 | 14.92 | | 20 | 7.87 | 20.90 | 21.42 | 19.96 | 19.67 | | 25 | 9.84 | 25.50 | 25.98 | 25.25 | 24.79 | | 30 | 11.81 | 30.00 | 30.00 | 29.35 | 28.14 | | 35 | 13.78 | 37.00 | 37.00 | 34.98 | 34.98 | | 40 | 15.75 | 41.00 | 40.63 | 41.85 | 41.23 | | 45 | 17.72 | 53.98 | 50.12 | 47.57 | 44.53 | |
| Figure 1: Range Sensor calibration data for the IR sensors. The minimum range observed was 5 cm away from the sensors while the maximum consistent range was 45 cm away. |

From the data measured above, we were also able to compute some basic error analysis for our sensors and verified that sensors, including sensors with same make and model, are not 100% identical. Thus these minute differences can yield to systematic errors that can yield great errors for robots that operate at large scales (i.e. not dead reckoning).

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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Distance (cm)** | **IR Front** | **IR Left** | **IR Right** | **IR Back** | | 5 | 0.50 | 0.35 | 0.15 | 0.27 | | 10 | 1.09 | 1.19 | 0.04 | 0.29 | | 15 | 0.50 | 0.75 | -0.08 | -0.08 | | 20 | 0.90 | 1.42 | -0.04 | -0.33 | | 25 | 0.50 | 0.98 | 0.25 | -0.21 | | 30 | 0.00 | 0.00 | -0.65 | -1.86 | | 35 | 2.00 | 2.00 | -0.02 | -0.02 | | 40 | 1.00 | 0.63 | 1.85 | 1.23 | | 45 | 8.98 | 5.12 | 2.57 | -0.47 | | **Stand. Deviations** | 2.7793275 | 1.5203738 | 1.043093689 | 0.818191 | |
| Figure 2: Error analysis and standard deviations computed for the IR sensors of our CEENBoT. From this data we can see that the IR sensor with the most error is the front sensor while the most reliable IR sensor is the back sensor. |

Layer 0: Collide and Run Away behaviors

**CONCLUSION**

We were able to observe various types of odometry error involved in the locomotion of mobile robotics. We learn that the offsets can be due to systematic and non-systematic errors. To account for the errors we observed, we use the UMBark method to compute the offsets from the initial starting point and generate a set of tuning parameters for our wheels. The tuning parameters barely affect the locomotion of our robot since they are close to 1 and because the robot is actually traveling a small distance.

In the future, we want to add subroutines that will calculate the number of steps to perform any single point turns or arc lengths to perform any geometric pattern.

