ECEN 3033 - Lab #4 Report

Miles Sanders, Alberto Espinosa, Mark Abbott

1. Roughly how much time did your group spend programming this lab?

The lab was done over the course of two days.

2. The display is setup with 300 rows and 300 columns to cover a 1m x 1m area. What is the spatial resolution of each pixel in the map? Show how you arrived at your answer to get credit.

Since we must represent 1 meter in 300 pixels for both the x and y directions, we simply scale our odometry calculations for the robots pose (pose_x and pose_y) by 300, and then rounded this number to the nearest integer, therefore achieving a spatial resolution of ⅓ centimeters per pixel or 0.003 meters per pixel in both the x and y direction of the map.

3. How would mapping be affected if the odometry is not perfect and has errors?

If the odometry is imperfect, we would not be able to get an accurate representation of the robots pose. This would present many different problems seeing as how we use the pose of the robot at all times to determine the placement of every obstacle on the map.

4. How could you choose a good resolution for your map? Elaborate on what happens if your resolution is too low or too high.

If our resolution is too low, the map will be less detailed and will therefore fail to record the smaller objects of the world. This leads to a couple of problems, first the robot may fail to see and avoid these smaller obstacles, and second since the map is not accurate enough, it will be hard to apply any sort of path planning successfully. On the other hand, if our resolution is too high, this will lead to more overhead calculations to record all of the e-puck's readings. More computations will lead to a slower program and a harder time for the e-puck to navigate in real-time. Moreover, since we know LiDAR sensors are limited, a higher resolution may lead to more errors due to these limitations. Therefore, in order to choose a good resolution, we must find the balance between achieving accurate enough computations that allows the e-puck to capture enough detail of its environment in order to avoid obstacles successfully, while minimizing the program's computations to keep it somewhat efficient and able to run independent of the computing power of the computer that is running the simulation.

5. You have been using the starting line to perform "loop closure", recognizing where the robot is to reset its odometry and prevent localization drift. How can you use the LIDAR sensor to accomplish a similar goal?

We can use LIDAR to perform loop closure by first setting the robots state to "stationary". We would then identify the values measured by the robots LIDAR sensors when it is stationary at the starting position. Using this vector of values, set a conditional that resets the robot's odometry when the sensors measure this exact combination of values again. The sensors are a bit finicky and can fluctuate, so it would be prudent to make the condition a small range instead of a single value.