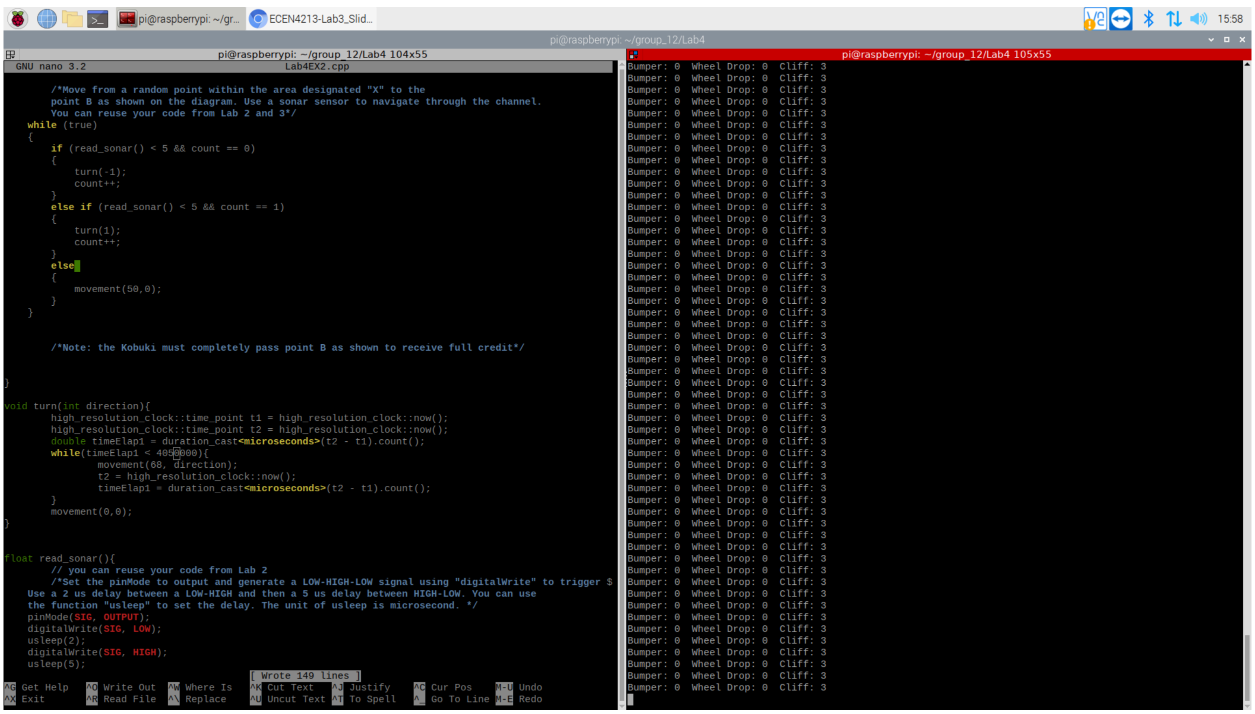
Lab #4 – Autonomous Robot Motion Control with Sensors

Nathan Fant and Brandon Collings, Group #12, Friday 3:30 PM

Exercise 1

1.1 Screenshots



Output of the sensors' serial data translated to the terminal.

1.2 Summary

For Exercise 1, we were tasked with testing and confirming the operation of all the different sensors on the Kobuki robot. We took the serial output from the Kobuki, parsed it, interpreted the sensors being activated, and printed the output to the screen. There are different sums for each of the different sensors that indicate which region is being activated. For the bumper, 0x01 indicates the right side, 0x02 the center, and 0x04 the left, with any combination of the three summing up to indicate the final value and the regions being activated. The cliff sensor follows an identical schema with 0x01 indicating the right sensor, 0x02 the center, and 0x04 the left. The wheel drop sensor is similar with 0x01 indicating the right sensor, 0x02 the left, and 0x03 representing both being dropped.

Exercise 2

2.1 Setup

Sonar Attached to Kobuki

2.2 Summary

For Exercise 2, we were tasked with implementing a wall proximity sensor using a sonar sensor so that the robot would navigate a small maze. We reused code from Lab 2 for this exercise. We would move the robot at a set speed with an interrupt set on the sonar so that when the value in centimeters fell below a certain distance, the robot would turn. The turn direction was controlled by a counter variable as we knew the set path the robot had to take.

Exercise 3

3.1 Setup

Kobuki Cliff Sensor Detecting Dropoff

3.2 Summary

Exercise 3 had us create a repeating behavior within the Kobuki where it turned a random degree, moved forward until it hit a cliff or wall, back up, and turn once more. This behavior continued indefinitely. The primary purpose of this exercise was to ensure that the Kobuki never fell off the table, or got stuck, and responded promptly to sensor inputs. It was supposed to be able to continue to navigate its space without human input.

Supplemental Questions

1. Briefly summarize what you learned from this lab.

   In this lab, we learned how to read and utilize the Kobuki robot's sensors for navigation. Initially, we learned how to read the serial data of the robot's sensors to understand what warnings were being sent and what hazards they corresponded to. In exercise 2, we implemented a bumper system using the sonar sensor where the robot would turn if it was in proximity to a wall. In exercise 3, we learned how much more powerful the sensors on the Kobuki were for navigation, so we developed a cliff avoidance program using the sensor data.

2. If you received out-of-range or missing values from the sonar sensor, what may be the reason for this?

   When we received an out-of-range value it was typically when the object in the sonar's field-of-view was too far. Additionally, we had issues in Lab 2 with the sonar sensor giving an out-of-range value when the object in view was pressed against the sensor, but these issues did not arise in this lab.

3. Summarize the capabilities of sonar, bumper, wheel drop, and cliff sensor in robot navigation.

   The sonar is capable of detecting the proximity of objects to itself using wave reflection timing. The bumper is capable of detecting physical collisions with objects using a momentary switch attached to a physical bumper. The wheel drop is capable of detecting if the robot is being picked up or some change in elevation that is not caught by the cliff sensors. The cliff sensors, mounted on the bottom of the robot, detect the proximity of the ground surface to the robot and if it is approaching a cliff or ledge.

Acknowledgements

We certify that this report is our own work, based on our own personal study and research and that we have acknowledged all material sources used in its preparation, whether it be books,

articles, reports, lecture notes, and any other kind of document, electronic or personal communication, We also certify that this report has not previously been submitted for assessment anywhere, except where specific permission has been granted from the coordinators involved.

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References

1. Provided Lab Manual
2. Provided Supplemental Documentation