Lab 3: Robot Motion Control

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1 Exercise 1

1.1 Autonomous Control

Within this first exercise, serial communication is established between the Pi and the Kobuki in order to direct simple movement commands. The Kobuki is programmed to drive a short distance straight forward and then make a complete 90-degree right turn at a fixed radius autonomously.

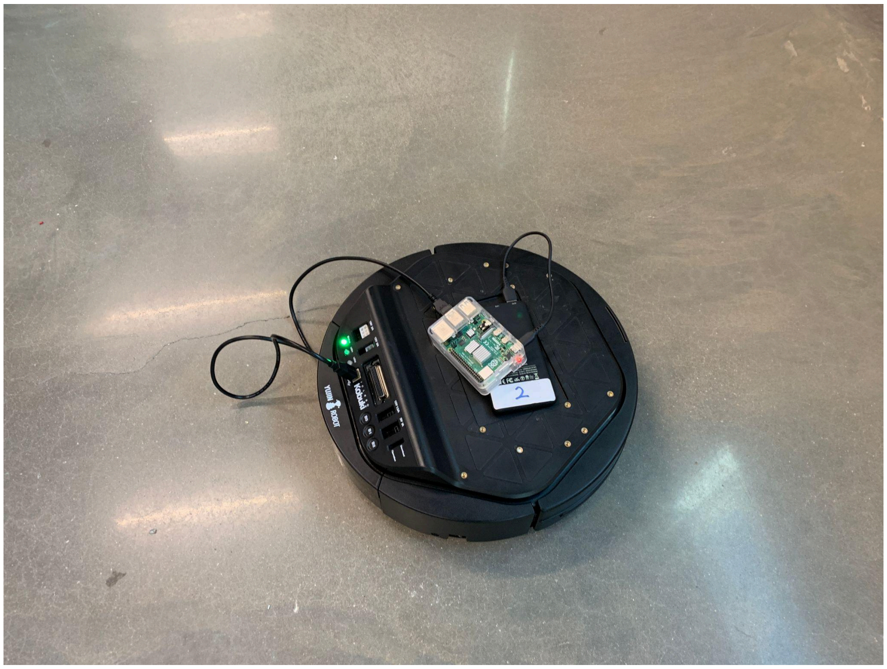

Figure 1: Autonomous Control of Kobuki Robot

2 Exercise 2

2.1 User Input to Robot Control

Within this exercise the Kobuki is connected to a controller that directly impacts its movement. By mapping specific movement functions to buttons on the controller we are able to directly control all movement the Kobuki is capable of. By pressing up or down on the d-pad the Kobuki will move forwards or backwards respectively. By pressing the left or right buttons on the d-pad the Kobuki will make a 90-degree turn either left or right to face another direction. The start button will stop the Kobuki's movements and the select button will close all connections.

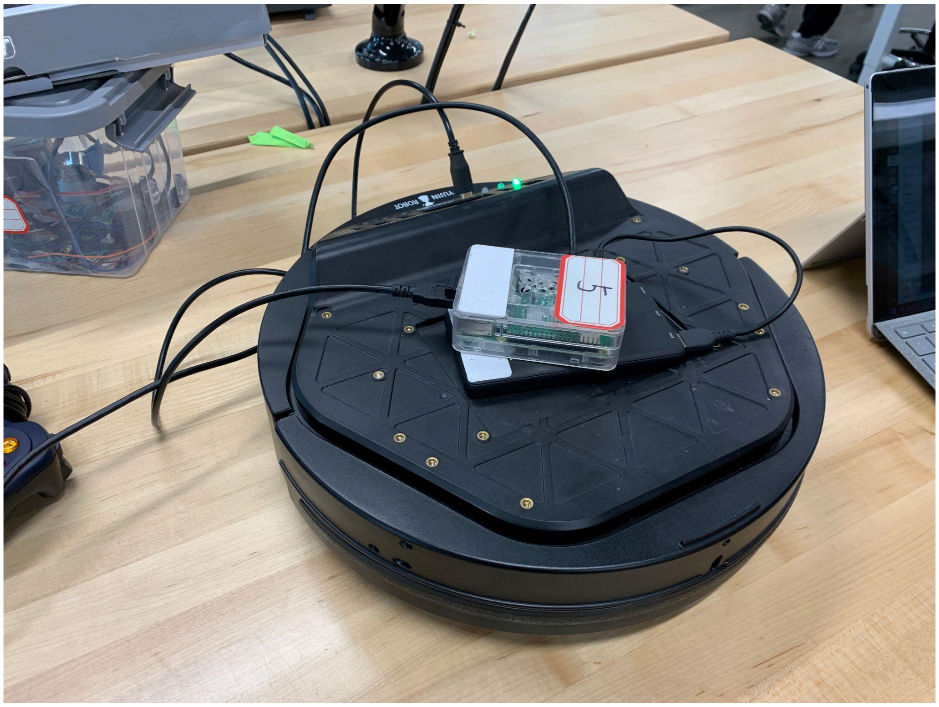

Figure 2: Kobuki Robot with Logitech Controller

3 Exercise 3

3.1 Server and Client Communication

By implementing socket programming across two devices, information can be sent about the controls of a client to a handler server that drives the movement of the Kobuki robot. In our program, the controls of the joystick (eventRaised, isButton, isAxis, number, value) were compiled in an integer array to be transmitted from the client to the server. The handling for these controls was reused from Exercise 2 to define the movement of the Kobuki.

4 Bonus Exercise

4.1 Analog Control over Network

In the bonus exercise, the varying values of the joystick range are programmed to directly correspond to the movement speed and radius of the Kobuki. By slightly moving the speed joystick the Kobuki will move slowly, while moving the joystick as far forward as it can go will cause the Kobuki to move at max speed. The same principle applies for the radius joystick as barely moving it will cause a small turn radius and moving it to its max position will cause a large turn radius.

5 Supplemental Questions

1. Briefly summarize what you learned from this lab.

Through the course of work in this lab, we have implemented controller code for the Kobuki mobile robot using a variety of methods that may find applications in various user scenarios. The first controls implemented require the development of control commands to be transmitted to the device. Using the developed method, we were able to autonomously control the Kobuki with a given speed and radius.

Next, using prebuilt drivers for a Logitech controller could translate user input into movement from the Kobuki unit in real time. Using event handlers from the controller driver library, any change in the controller state could be monitored and directed into motion in the robot.

Since network programming would be necessary for controlling a device over long distances, we have implemented socket networking to send messages over a network of two Raspberry Pi devices. By converting the values of the controller on the client device to an integer array, this message could be sent across the network to be decoded and implemented by the server to control the Kobuki movement.

Utilizing this same method of network transmission, the analog joystick inputs of the Logitech controller could be decoded and translated to control the speed and radius parameters defined in our motion method.

2. Explain the way the Kobuki’s movement is controlled.

The Kobuki defines its input through a series of headers and subheaders to control a variety of parameters available in the system. The movement of the wheels can be selected through its defined header. By determining the desired speed and radius of the Kobuki, these values may be placed in the serial output of the Pi to control the motors on the system. Pure rotation may be defined as a radius of 1, and

pure translation using a radius of 0 where these values are relative to a fixed real-world value of 230mm.

3. Explain the steps of a complete control request from the client to the server.

First, the server must define a socket on which it will be listening for client input. Until the server is in connection with the client, it will seek out a device on the socket until a timeout occurs. Upon the client program's start, it will immediately attempt to find a device on the common socket. Once both the client and server acknowledge one another, a stream of information will be sent between the two as defined by both devices' programming.

ACKNOWLEDGMENTS

I certify that this report is my/our own work, based on my/our personal study and/or research and that I/we have acknowledged all material and sources used in its preparation, whether they be books, articles, reports, lecture notes, and any other kind of document, electronic or personal communication. I/We also certify that this assignment/report has not previously been submitted for assessment anywhere, except where specific permission has been granted from the coordinators involved.

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