Lab #3 – Robot Motion Control

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

Exercise 1

1.1 Setup & Screenshots

Raspberry Pi Attached to Kobuki

Motion	Speed(mm/s)	Radius(mm)
Pure Translation	Speed	0
Pure Rotation	$w^{i)} * b^{ii)} / 2$	1

ttp://yujinrobot.github.io/kobuki/enAppendixProtocolSpecification.html

Translation + Rotation	Speed * (Radius + $b^{ii)} / 2$) / Radius, if Radius > 1 Speed * (Radius - $b^{ii)} / 2$) / Radius, if Radius < -1	Radius

i) w is rotation speed of the robot, in [rad/s].

ii) b is *bias* or *wheelbase*, that indicates the length between the center of the wheels. Fixed at 230 mm.

Table of Kobuki Speed Conversions

1.2 Summary

For exercise one, we programmed the Kobuki to follow a predetermined path. It was programmed to turn ninety degrees to the right, go forward 50 cm, and then follow a quarter circle with a radius of 50 cm. We had to program the speed and rotation to match the types of movement desired. First, purely rotational, then purely translation, then a combination of the two. We determined the correct speed conversion values based off the table in the Kobuki Protocol Specification file.

Exercise 2

2.1 Summary

For exercise two, we used a Logitech controller to control the movement of the Kobuki robot. We used the D-Pad up and down functions to control the forward and back movement of the robot indefinitely. The D-Pad left and right functions have the robot turn ninety degrees left and right respectively. The back button terminates the control.

Exercise 3

3.1 Summary

For the last exercise, we implemented a client/server system where the client Pi was connected to the controller, and the server Pi was connected to the Kobuki. The client pi receives inputs from the controller and sends them to the server Pi, which then sends a command to the Kobuki to move. We implemented both the client and server

sides on our one Pi to send and receive commands, meeting the requirements for Bonus A.

Supplemental Questions

1. Briefly summarize what you learned from this lab.

   This lab introduced us to a couple of new concepts. First, the control of a Kobuki style robot. It has a unique control schema we haven't yet seen. Second, control of a robot of this style via a D-Pad controller layout. Lastly, and most importantly, the control of a robot utilizing a server/client relationship. These will all prove to be important concepts going forward in this class. It was an enjoyable experience to work with the Kobuki

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

   The Kobuki's motion is controlled via 2 parameters: its speed and radius. If the movement is purely translational, there is no radius and the speed is a 1:1 conversion between what you intend the speed to be and what you program it to be. If the movement is purely rotational, the radius is 1 and the speed is the desired rotational speed plus the wheelbase of the Kobuki divided by 2. If the movement is a mix between translation and rotation, then the speed is the desired radius of the arc plus the wheelbase divided by two then divided by the radius and multiplied by the desired speed. The radius for this mix is just the desired radius of the arc to be travelled. These values are all derived from the table listed in section 1.1, as mentioned previously.

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

   The first step in sending a control request is establishing a connection between the client and the server. The connection is done via IP addresses and sockets. The server waits for connections and once a client sends a request for connection, the server gets interrupted to make a new socket for the client. Once they are connected the process of sending commands can begin. First, the client pi receives an input from the controller issuing a direction and speed to begin travel at. The client pi then sends this command to the server pi. The server pi receives this command and forwards it to the Kobuki, which performs the intended action.

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