Alex Boyd
Aboyd37@uncc.edu
Edgar Joya
ejoya@uncc.edu

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General Learning Objectives:

The general learninig objective of this experiment is to introduce the concepts of motor control and to demonstrate this by programming DaNI to complete a 2x2 meter square

General Steps Needed to Complete the Lab:

The general steps needed to complete this lab were listed by the following requirements:

- Req. 1 The robot will be tested on a surface decided by the course instructor.
- Req. 2 Only the motors may be used (No sensors).
- Req. 3 A LabVIEW program will be written that will use the motors to travel 2 meters, make a 90° turn, and repeat process until the robot has completed a 2×2 meter square.
- Req. 4 Robot will operate autonomously.
- Req. 5 The demonstration area where the square is marked on the ground will be available to students for testing purposes prior to the final demonstration.
- Req. 6 Robot should run in a continuous loop so that accuracy after many squares have completed may be tested. (Optional-At request of course instructor)
- Req. 7 The velocity of the robot throughout the loop must be consistent. (If the robot moves forward at 5 rad/s, then it must also turn at 5 rads/s)
- Req. 8 Solved equations must be included in the lab report. Also include tweaked values vs. theoretical values.

Procedure / Detailed Steps to Complete the Lab:

Useful Information

- Gear Ratio:
$$83:1$$
- Wheel Diameter:
$$.095\text{m}$$
- Wheel Circumference:
$$C = \pi \cdot \text{d(m)} = .298\text{m}$$

Straight Away

- Revolution Distance:
$$\frac{C}{\text{Total Distance}}(\text{m}) = .298\text{m}$$
- Motor Revolutions:
$$\text{Gear Ratio} \cdot \text{Revolution Distance} = \frac{1\text{WR}}{.298\text{m}} \cdot \frac{83\text{WR}}{1\text{WR}} \cdot 2\text{m} = 557.04\text{MR}$$

For angular velocity we chose 7 seconds for the straight away:

- Angular Velocity:
$$\omega = \frac{\frac{MR}{2\pi}}{t} = \frac{88.66}{7} = 12.66(\frac{\text{rad}}{\text{s}})$$

Turns

- 90° Turn:
$$\frac{\pi \cdot 35}{4}\text{m} = .2905$$
- Turn Revolution Distance:
$$\frac{C}{90^\circ}\text{m} = 1.026$$
- Turn Motor Revolution:
$$83 \cdot 1.026 = 85.271$$
- Turn Time:
$$t = \frac{\frac{\text{Turn Motor Revolution}}{2\pi}}{\omega}\text{s} = 1.072\text{s}$$

After obtaining the values to build the block the diagram, the instructions were followed from the Lab Manual to configure the following.

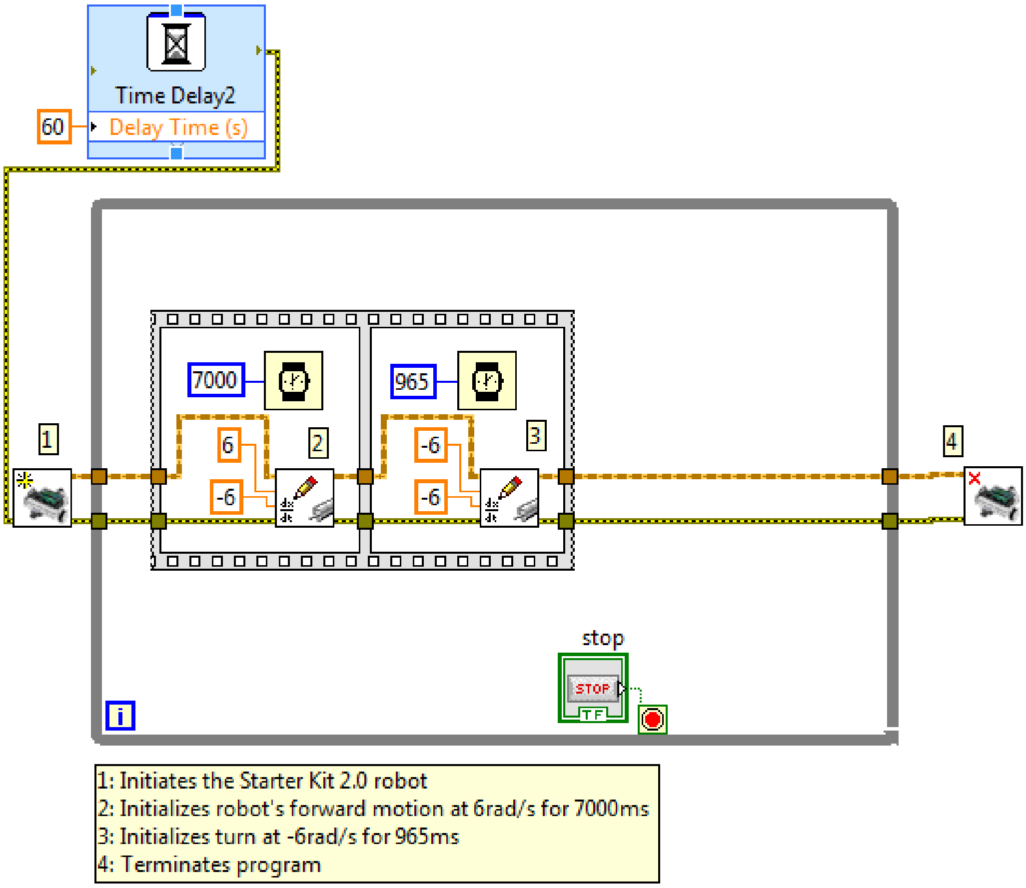

Figure 1: Block Diagram

Observations while completing/testing the Lab:

When testing the lab, there was an issue with traction. As the robot kept going around the laps, the precision was offset on the second and third turn. Also, because of testing all day, the battery was drained to the point were it was affecting the performance of the turn. The calculations were also a little off, so there was some adjustment on code to meet the requirements. These changes were apploed for the turn time to obtain a sharper turn.

Lessons Learned:

Calculations aren't always exact when it comes to eperimentation. The physical variables need to be kept in mind, so testing rigirously before hand is very important.

All files for this lab can be found on github.com . [1]

References

[1] Alex Boyd and Edgar Joya. *Github Repository.* https://github.com/eujc21/ECGR-4161.git, 2014.