	Intro To Robotics LAB 03 Report	02/15/2024
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Lab Objective:
The purpose of this lab is to analyze the effectiveness of using timers to affect a motor's performance. In order to reduce error we explore the option to ramp up the motors slowly up to their max speed and then ramp down to a stop.

Lab Figures/Tables (Testing Data):

Part A | Drive Straight 1.5 Meters

For ***Part A*** the robot was given instructions to drive straight for 1.5 meters. The code was left unchanged for this part to get an initial reference point of the robot's speed. From that speed we were able to fine tune the robot to travel 1.5 meters.

Table 1: Driving 1.5 Meters (No Ramp Up)

Test	Direction	Left Percentage	Right Percentage	Motor Delay (ms)	Distance (cm)
1	Straight	15	15	4000	60
2	Straight	15	15	8000	120
3	Straight	15	15	10000	150

At 15% power on both motors the robot drove perfectly straight when testing on a lab table. Calculating the speed from the first test the robot drove 0.15 m/s as seen in ***Equation 1.***

$$\frac{60\ cm}{4000\ ms} * \frac{1\ m}{100\ cm} * \frac{1\ s}{1000\ ms} = 0.15\ m/s \quad (1)$$

To make it travel the full 1.5 meters for ***Part A*** of the lab the MOTOR_DELAY must be set to be 10000 ms to travel the required 1.5 meters. The power percentage of the motors was not changed as the speed of the robot fits within the demo time constraint of 15 seconds. The final variable values used can be referenced in ***Table 2.***

Table 2: Final Variable Values (Part A)

Variable Name	Value
MOTOR_DELAY	10000
LEFT_MOTOR_SPEED	15
RIGHT_MOTOR_SPEED	15

Part B | Ramp Up and Drive Straight

First the ramp up of the robot was tested. The requirements of the lab says to have the robot ramp up for the first 30% of the 3-meter line. So the ramp up distance is 0.899 meters.

Table 3: Ramp Up Speed Tests

Test	Direction	Initial Right Speed	Initial Left Speed	Motor Delay 1 (ms)	Motor Delay 2 (ms)	Distance (cm)
1	Right	1	1	2000	100	11
2	Straight	2	1	2000	100	12.5
3	Left	2	1	2000	200	23
4	Slightly Right	1	1	2000	200	22
5	Right	1	1	2000	850	NA
6	Right	2	2	2000	800	95
7	Slightly Right	2	2	2000	750	90

Next the robot must travel straight for 1.2 meters. The move forward test is done at the final max speed of the motor after the ramp up. The power of both motors after the ramp up is 22.

Table 4: Max Motor Speed Tests

Test	Direction	Motor Delay 1 (ms)	Distance (cm)
1	Slight Right	2000	41
2	Straight	5700	120

From the first test the speed of the robot was calculated when the motors were at full power. The speed was used to find the time needed to travel 1.2 meters (40% of 3 meters). The MOTOR_DELAY1 variable was set to the calculated time of 5700 ms. The calculations are provided in equations 2 and 3.

$$\frac{41cm}{2000\ ms} * \frac{1\ meter}{100\ cm} * \frac{1000\ ms}{1s} = 0.205\ m/s \qquad (2)$$

$$\frac{1.2\ m}{0.205\ m/s} = 5.71\ s \approx 5700\ ms \qquad (3)$$

The last bit of time was given for the robot to ramp down to a stop. The final variables can be referenced in ***Table 5.***

Table 5: Final Variable Values (Part B)

Variable Name	Value Set
MOTOR_DELAY1	11100
MOTOR_DELAY2	150
DEFAULT_LEFT_SPEED	2
DEFAULT_RIGHT_SPEED	3

Part C | Combined Code

The code variables were then combined into one code that loops through ***Part A*** on the press of the left button on the MSP432 board. Then on the second button press ***Part B*** was demonstrated.

Commentary and Conclusion:

When demonstrating ***Part A*** of the lab the robot ended up driving further than 1.5 meters. This could be caused by user measurement error or possibly testing on a floor that had more friction force. For the ***Part B*** portion of the experiment when the robot was ramping up the left motor tended to not turn at the initial power setting. This caused the robot to bear to the left at the start of the test. When the robot reached its maximum speed this tilt got corrected and eventually evened out until the ramping down function. This caused the robot to not drive straight which meant it stopped too short.