ENPM809T Assignment #6

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Course code: ENPM809T Autonomous Robotics

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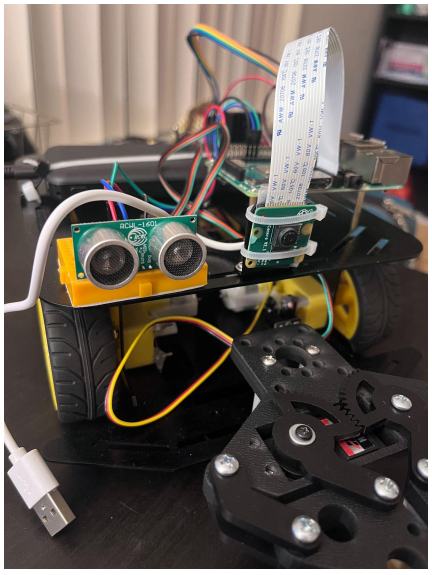
HW#6 Goals

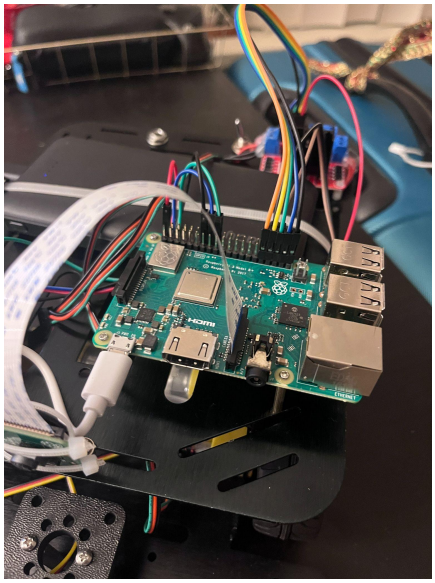
HW#5 involves the electrical and mechanical assembly of the ground vehicle, servo control, adding distance measuring capability to teleoperation code and tele-operating and recording the robot from Pi camera in forward, reverse ,pivot right and pivot left movements along with Servo gripper control.

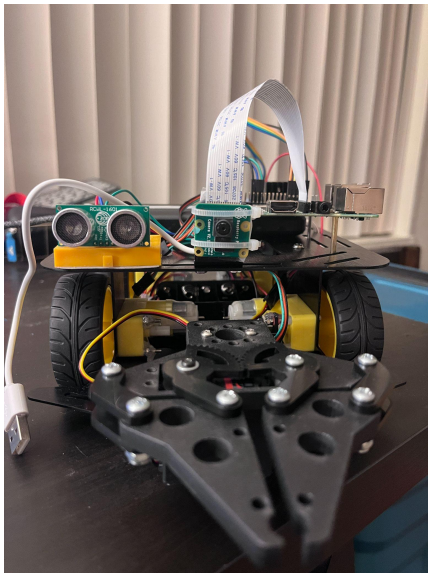
Question 0.1: (No submission)

Question 1:

1: Mechanical and Electrical Assembly







2: Servo Control

Link to Youtube Video: https://youtu.be/3F9HEMRrsuk

3: Ultrasonic with teleoperation, terminal output:

```
pi@raspberrypi:~ $
Program Start
Forward || Distance: 36.97
Forward || Distance: 61.1
Right || Distance: 60.66
Left || Distance: 57.26
Reverse || Distance: 45.09
Program End
```

4: Teleoperation with servo functionality

Link to youtube video: https://youtu.be/oy4jjJJAPFI

Question 2:

Given:

Gear ratio = 1:120

Wheel diameter = 65mm = 0.065m

Wheel radius = r = 32.5mm = 0.0325m

Encoder ticks per motor revolution = 8

a) Revolutions of each motor required for vehicle to move 1m

$$= \frac{120\ motor\ rev}{1\ wheel\ rev} * \frac{1\ wheel\ rev}{2\pi r}$$

$$= \frac{120\ motor\ rev}{2\pi(0.0325)}$$

=587.65 motor revolutions

b) Encoder ticks registered when vehicle moves 2m

Encoder ticks registered when vehicle moves 1m

$$= \frac{120\ motor\ rev}{1\ wheel\ rev} * \frac{8\ encoder\ ticks}{1\ motor\ rev}$$

$$= \frac{960\ encoder\ ticks}{1\ wheel\ rev}$$

$$= \frac{960\ encoder\ ticks}{1\ wheel\ rev} * \frac{1\ wheel\ rev}{2\pi\ (0.0325)}$$

= 4701.2 ticks per meter

Encoder ticks registered when vehicle moves 2m = 9402.4 ticks

Question 3:

Given:

Gear ratio = 1:53

Wheel diameter = 14cm = 0.14m

Wheel radius = r = 7cm = 0.07m

Robot width = 30am = 0.3cm

Revolutions of each motor required for each wheel to move 1m

$$= \frac{53\ motor\ rev}{1\ wheel\ rev} * \frac{1\ wheel\ rev}{2\pi(0.07)}$$

$$= \frac{53\ motor\ rev}{\pi(0.14)}$$

Distance travelled by each wheel for vehicle to turn 180 degrees in place is πr where r is approximately half of the robot's width, since the robot turns 180 degrees, its trajector is semicircular, so the distance needed to be covered by each wheel in opposite direction is:

$\pi\ (0.15)$

Revolutions of each motor required for vehicle to turn 180 degrees in place:

$$= \frac{53\ motor\ rev}{\pi(0.14)} * \pi\ (0.15)$$

= 56.8 motor revolutions

If the robot is facing North, then the right motor must turn clockwise for 56.8 revolutions and the left motor must also turn clockwise for roughly 56.8 revolutions for the robot to turn 180 degrees in place assuming no wheel slip.