Lab 1 report

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Topology of the wiring:

Graphical user interface, application

Description automatically generated

The video can be viewed from here:

<https://mediaspace.illinois.edu/media/t/1_od8u884a>

Part 1: Assembling of the car:

There are not much difficulties in the process of assembling and wiring the car and the raspberry pi. Simply following the instruction is good enough. This part of the lab gave me a good understanding of the hardware parts, and what each part is doing. The only thing I will remember is purchasing parts on the internet is tricky, it is better to purchase from the known website and brands. It wasted me couple days since my first purchase of batteries was defects. Additionally, the camera in the car kit was also broken for some reason, I had to buy an additional one.

Part 2: Installing Raspberry Pi OS and making the car functioning

At first I installed 64-bit version, and somehow it gave me lots of error. One example was “ws2811\_init failed with code -3 (Hardware revision is not supported) ”. I had to use some hack from the internet to fix this problem. Then I switched to 32bit version, it gave me no problem at all, so I sticked with it. All functions of the car kit are working, which include the motor (moving forward and backward, turning right and left), led lights, ultrasonic distance measure, infrared line tracking, servo turning, ADC measuring, buzzing, etc.

Part 3: Can the car sense via ultrasonic sensor

The car can sense the obstacle via ultrasonic, and react after sensing an obstacle or wall. Please see the video in “Roomba obstacle avoiding”. This part of code in in lab1\_roomba.py

Part 4: Can the car navigate around the obstacles and get to the other side of the room?

The car can do this kind of navigations. Please see video.

Part 5: Are you able to generate 2D array for mapping?

Yes, I generated a 2D array from rotating the servo, and collecting an array of (angle, distance) metrices, and then I converted that into a 2D array of 1s and 0s that represents where the obstacles exist in the near distance when the car is moving forward. Then I feed this 2D array into A-star algorithm. An example input of the A-star algorithm looks like following:

[[0, 1, 0, 0, 0, 0],

[0, 0, 0, 0, 0, 0],

[0, 1, 0, 1, 0, 0],

[0, 1, 0, 0, 1, 0],

[0, 0, 0, 0, 1, 0]]

And the output of the A-star algorithm is a list of actions to take, that is something like, ['F', 'F', 'F', 'L', 'F', 'L', 'F', 'L']. Here, F is forward, L is left, and R is right. The car is then taking actions according to this array. In the video, as you can see, the car is jittering since it is taking these small steps of actions. Unfortunately, this jittering is causing the car very easy to fall apart (the wheels or the head are flimsy).

Part 6: Image recognition

I used the pretrained model, and I used Tensorflow to detect the stop sign image. Since I don’t have a color printer, I drew a stop sign myself. Unfortunately Tensorflow recognized my sign as a toilet.. Due to the limit of time, I don’t have more time to tune the model or create a more realistic stop sign. Raspberry Pi is also complaining about running out of memory when running the model. On the other hand, it works when I use the real things. I tried several other objects which include cups, and remote control, Tensorflow was able to recognize them.

Part 7: self-driving navigation. Is the car able to route correctly?

Yes, as what is shown in the video, the car is able to route through an area with 3 obstacles (a simple one). It was using 2D array and A-star algorithm. The actions is jittering since the car is taking actions according to the array of actions that is the output from A-Sar algorithm.

Part 8: Is the car able to navigate the complete route along with recognizing a sign using the camera?

My image recognition part was hindered by some complain from Tensorflow and Raspberry Pi, which include lack of memory and GStream pipeline problems, which causes the car to stop responding. Due to the lack of time, I did not resolve these issues (my last few days was spent on putting together the video and report.). On the other hand, the car is able to route through an area with several obstacles using mapping and A-star.