Sensors and Motors Lab

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Team B / Auto Pirates

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ILR #1

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1. Individual Progress

In the sensors and motors lab, I was responsible for implementing stepper motor and potentiometer. The stepper motor that I integrated was MERCURY SM-42BYG011-25 and stepper motor driver was A4988 Stepper motor driver carrier in Pololu.

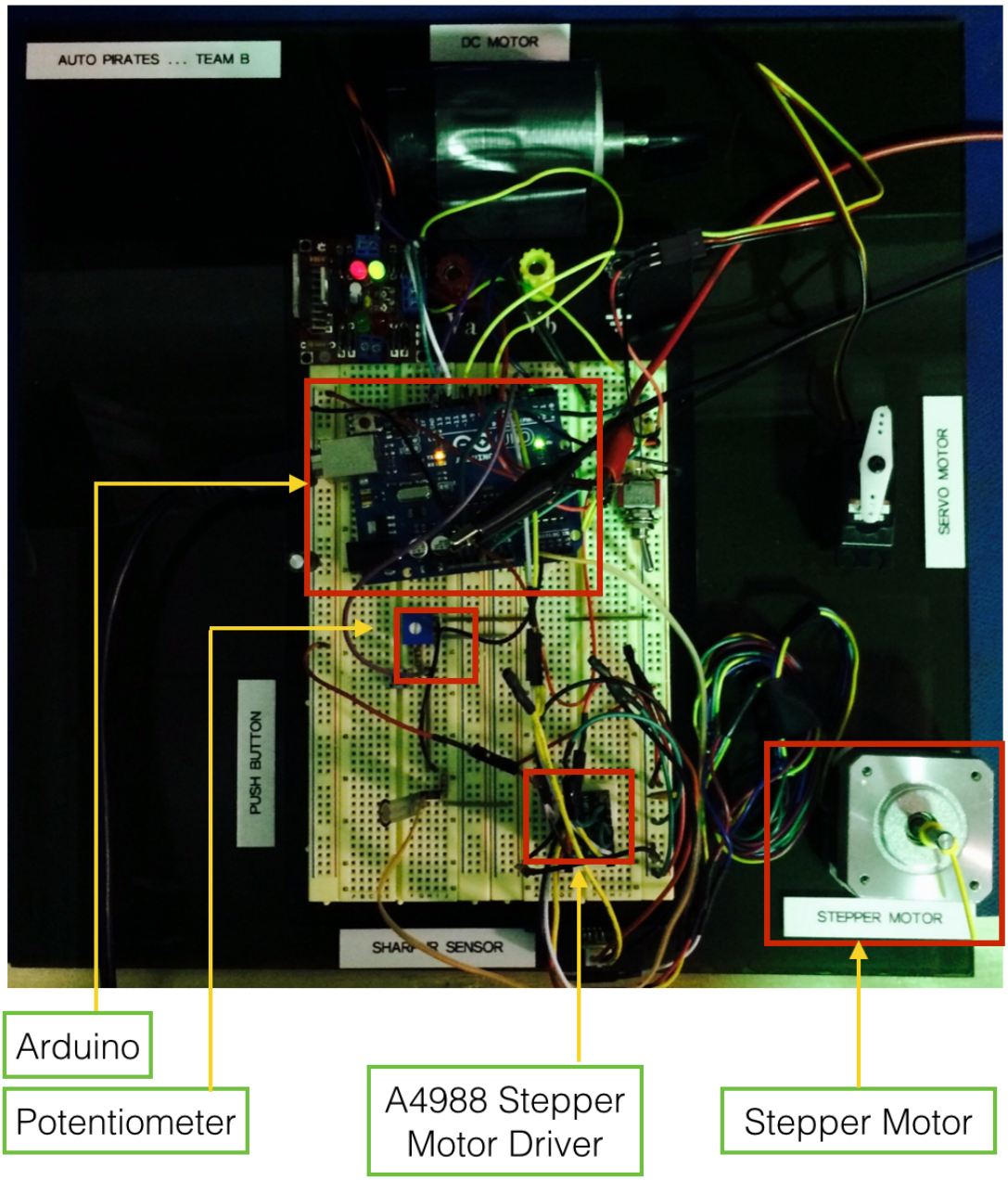

Figure 1. Stepper motor and Potentiometer Circuit

The first job that I worked was soldering pin header into a motor driver board. After that, most of my work was connecting the wire with power and our Arduino micro controller. The stepper motor has wires unable to plug into stepper motor driver, bread board, and micro controller. I did soldering motor's wires and connecting with pin header wires.

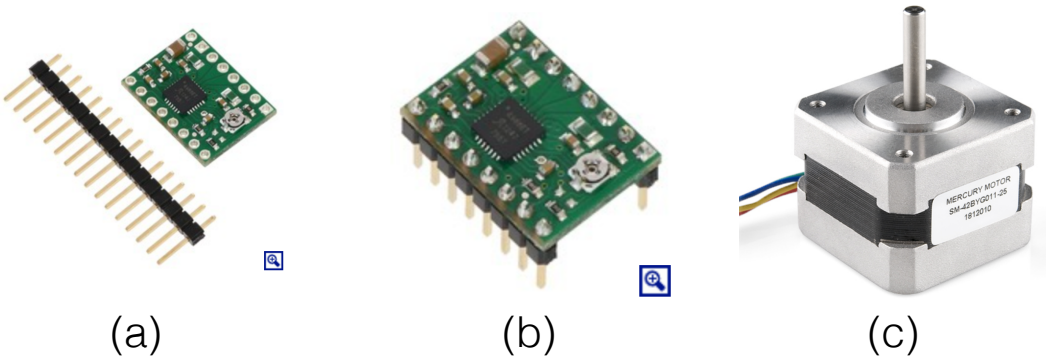

Figure 2. (a) A4988 motor driver pin header (b) A4988 assembled with pin header (c) MERCURY SM-42BYG011-25 Stepper Motor https://www.pololu.com/product/2128, https://www.sparkfun.com/products/9238

The connection of wire is like the following. I connected VMOT with +24V power and GND with 24V GND from power supply. I plugged the aluminum capacitor in a parallel way to prevent impulse power from power supply. Because aluminum capacitor had polarity, I was cautious with it. The logic power of motor driver was one from Arduino. I made pin 4, 5 of Arduino connected with DIR, STEP pin of motor driver. Finally, 4 wires of 2 phase stepper motor was attached to 1A, 1B, 2A, 2B pins of motor driver.

After completing hardware job, I started programming firmware. I found Stepper Library in Arduino community and applied it to our firmware. (https://www.arduino.cc/en/Reference/Stepper) On the test course, I found that the stepper motor was operating only in forward way. After studying library example code, I succeeded to implement reverse revolution.

Potentiometer is a voltage divider. I connected supply voltage with +5V in Arduino and analog input pin to analog pin 3 in Arduino. Its wire connection was simple. I made potentiometer interface software by calling analogRead() function.

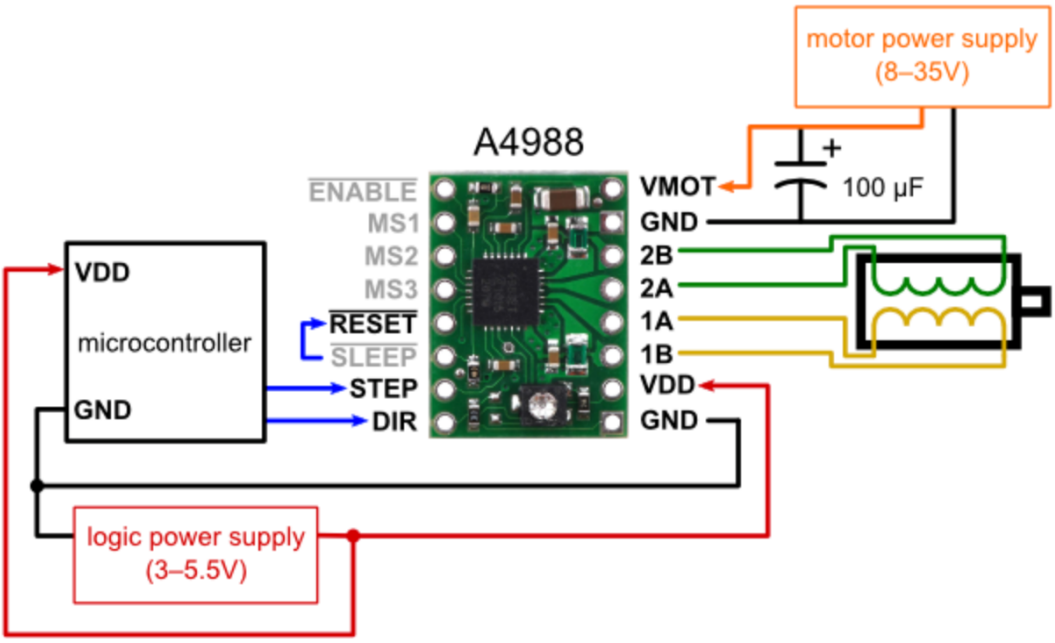

Figure 3.A4988 connection diagram, https://www.pololu.com/product/2128

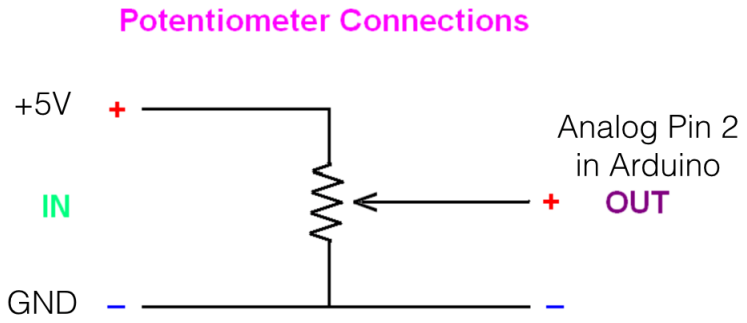

Figure 4. Potentiometer Connections ,
http://www.hometheaterhifi.com/qa/images/volume-control-potentiometer-connections-

2. Challenges

It took a lot of time to debug stepping motor in hardware way. I guessed that hardware connection and software has no problem. So I started debugging using oscilloscope. After measuring some signals by oscilloscope, most of signals and powers are normal status. I doubted that soldering status was poor. After soldering pin header of A4988 motor driver, I could check the stepper motor working properly.

3. Teamwork

Stepper motor and potentiometer were simple tasks compared with DC motor PID control. Shiyu and William took DC motor PID control and spent a lot time to do that. I helped them to implement PID control through encoder debugging and testing timer interrupt program.

When Shiyu and William faced encoder error which was getting error encoder value when DC motor operated in a reverse way, I found some encoder example code in Arduino community site. I guided them to apply that code. They succeeded to resolve encoder problem.

As well, when they experimented DC motor PID speed control, I thought that timer interrupt would be effective for implementing DC motor speed control. I applied timer interrupt and checked signal pulse high every 1ms. My unit test would be helpful for them to test DC motor PID control.

Additionally, Tushar developed GUI used by C# language. He was talented with plotting some sensor values and implemented some working procedures targeting demonstration. Lastly, Bikram developed code of RC servo motor and toggle switch.

4. Future Plans

Future plans are preparing for PR#1. We have some goals of each tasks. Perceptive team 's goals are to visualize the radar data and publish parsed sensor data to ROS topic. Also, path planning team's goal is finding path planning algorithms to be able to apply to autonomous boat. Overall, team members should revise and add additional components of CoDR.