

ILR#1 : Sensor and Motor Lab

Huan-Yang Chang Team G

October 14, 2016

Table of contents

Individual Progress.....	2
Individual Work.....	3
Team Work.....	6
Future Plans.....	6
My project work progress.....	7
Camera calibration knowledge	7
Robot arm control.....	7
Project Management.....	7
Appendix A	8
Code.....	8

Individual Work

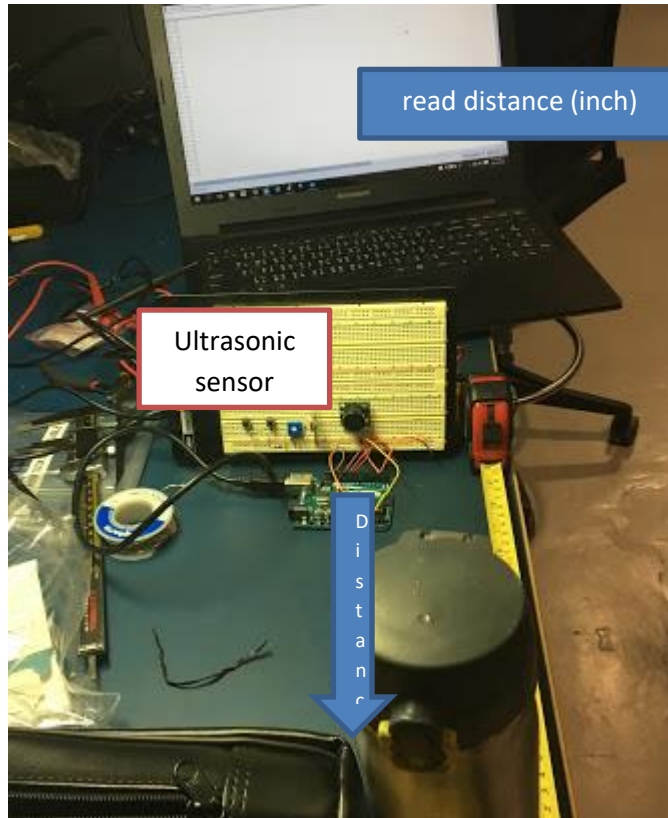
Individual Progress

In Sensor and Motor lab, I was responsible for the ultrasonic range finder and DC motor with PID control on velocity and position. My team work was software integration (assist communication) and circuit integration debug.

Ultrasonic sensor

We select the ultrasonic range finder (LV-MaxSonar MB1010) to detect the target distance sensor. This sensor has three output mode: Analog, PWM, RS232 to transmit the data to the computer or controller. We chose the analog, because we can easily use Arduino analog port to read data. In the analog mode, the sensor's resolution is (5v/512) inch (~9.8mv/inch), however the Arduino analog read resolution is (5v/1024), so we have to divide the analog read by 2 to give the correct read of inch. And also this sensor have some voltage bias, by experiment, I offset the distance by 1 to get more accurate data. And by finding the relationship between the output voltage and distance, I found a minimum voltage offset in the sensor that would make detect the distance less than 7 inch is impossible. By that data, we can set our work rang for after application.

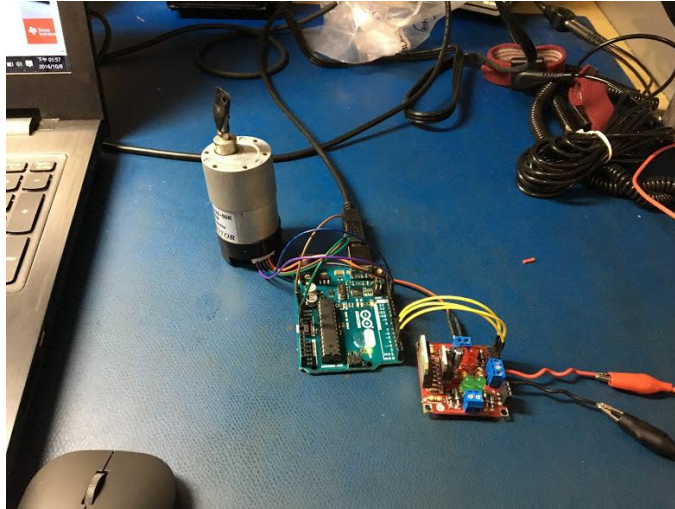
In this subsystem level test, I did a distance detect system with Arduino which can detect the distance in front of the ultrasonic sensor in resolution 1 inch.



DC motor with encoder

By L298N H bridge, I could use Arduino to control the DC motor's speed and direction. I used interrupt to count plus from encoder to calculate the velocity and degree of the motor. I imported Timer library in Arduino which can make Arduino to execute some task in the regular period. And I used both regular time period and number of plus to calculate the rpm. For Degree estimation, in the datasheet of this motor said there was 180 plus in single circle. So I can time the count of plus by 2 to get the degree.

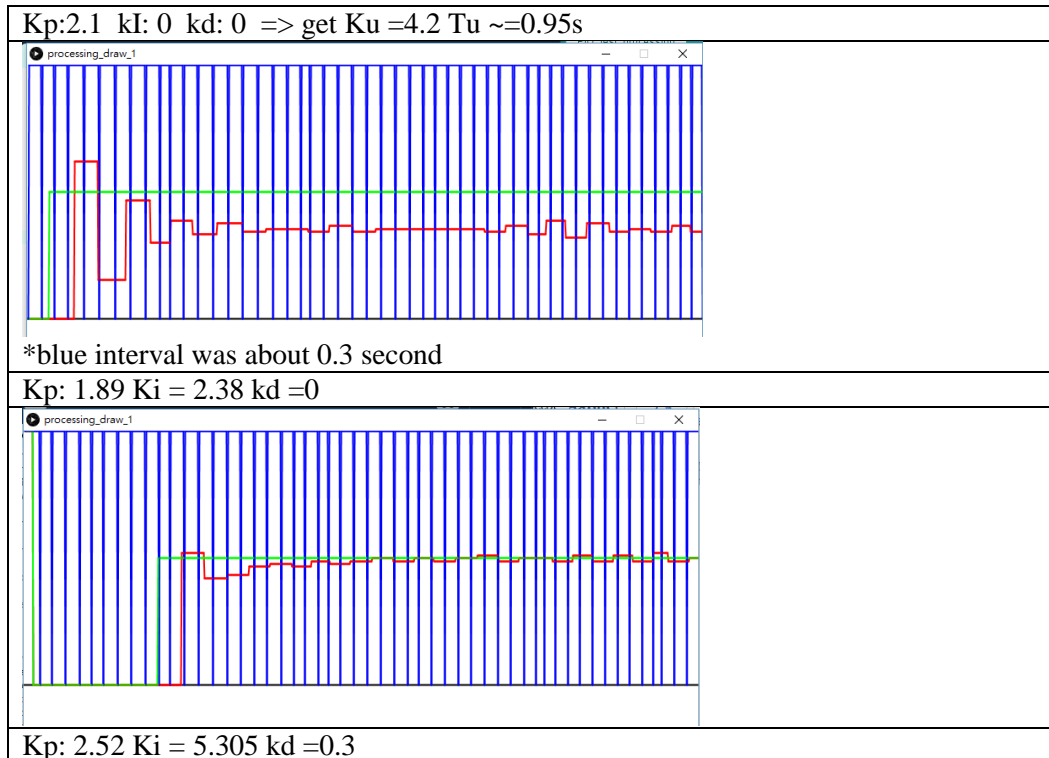
For motor control, I found the motor had a minimum work voltage, around 2.3-2.8v, thence, in my code, I would offset this minimum work voltage in my input voltage.

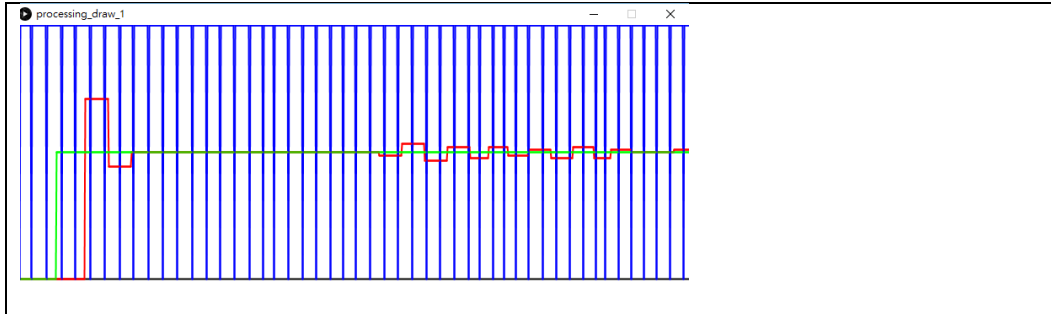


PID control

In PID control, I used Ziegler–Nichols method to find the parameter which will decide K_p first and tried to make a most stable k_p by adjustment, and calculate the oscillation period T_u and K_u . Then, I used this K_u and T_u to make a K_p, K_i and K_d . Also, in order to make a good visual PID control output, I also used Processing to visualize the result of the PID control.

For example : velocity: setpoint: 30 rpm





In the end, I choose the PI control for this project, because it didn't exceed the set point too much and quickly reach to the set point.

Team Work

Software Integration

In the first beginning, Our team choose using Processing directly control Arduino which can give us some advantages like time saving, data correctness, and don't have to worry about the communication interface. However, Processing couldn't support Arduino's interrupt port which I used in the DC motor part, to count the encoder's plus. After finding this problem, we made a quick team meeting to discuss this problem, and then we decide to separate the Arduino and Processing part, and used Serial port to communicate in between. In that while, we have to confirm the format of data in this two systems. For easier testing and debug, I made an Arduino program which only read and print the information through Com port. By that program, we can separately work on Arduino part and Processing part and let the work be more parallel.

Circuit integration debug

Because each team member was responsible for different parts in this assignment, the final integration was hard. For example, the wiring style, Port number used and the Isolation were needed to be check to prevent something invertible. I assisted the final Circuit integration debug. What I used is a checklist to record the relationship of each pin/ sensor and check correctness of power and ground and make no short and inversed connection happen. In this assignment, I found one analog port was connect to digital port and solve the wrong data read problem.

Future Plans

For sensor and control part in our project, we probably would use some ultrasonic range finder in our project to make an alarm for too close distance form robot arm to objects. However, this safe requirement was optional in our requirements.

For the motor control

My project work progress

Camera calibration knowledge

Our team was visiting the Panoptic Lab, PHD student Hanbyul Joo. Mr. Joo showed us the basic calibration knowledge and the resource which might help us to know more about camera calibration and 3D reconstruction.(their calibration work flow and tools)

I started literature reading about the popular camera calibration method (Zhang's method) and started to get familiar with Matlab calibration tool box and Caltech toolbox.

In the Oculus side, we started to calibrate the CMOS's fixed pattern noise before other calibration.

Robot arm control

By the help with Oculus team to setup the robot arm, we started to control the robot arm. We used the controller with plus output(Position Synchronized Output) to trigger the camera. I also make a program to make the movement a module which would be convenient for future usage.

Project Management

After finishing the CodR, we found that the work tasks and schedule was really important for the success of this project. Thence, we summarized our Gantt chart and the work path and made a discussion with our sponsor to make the synchronize between the sponsor and our team in both goal and schedule.

Appendix A

Code

Ultrasonic range finder code

https://docs.google.com/document/d/184QNWjkZ6gH8BRfzB86aGsmTmKsKqCw_uqYJNAMwx0s/edit?usp=sharing

Dc motor with encoder and PID code

<https://docs.google.com/document/d/173M5DzRbMw8lJDYW4A46WAwSsm7k0x2mS-IWmWASM/edit?usp=sharing>

Processing code for draw PID result

https://docs.google.com/document/d/1GYalJWT7ScdX4zpP7epnT06j0cJdXY8I2QYY_EX-nJo/edit?usp=sharing