LAB #3
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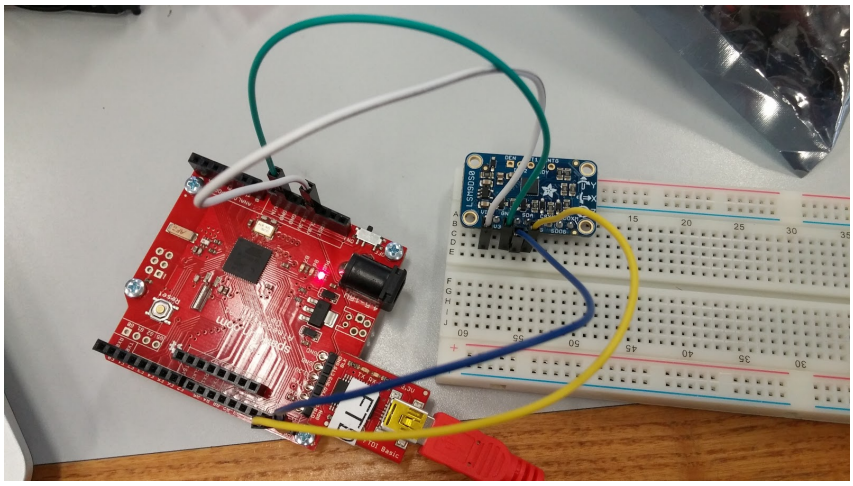
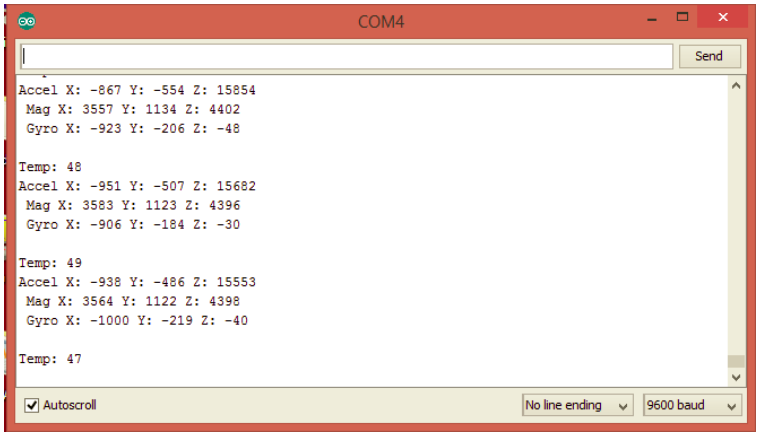
- **IMU circuit and control**

First the following connections were made before controlling the IMU LSM9DSO board

Red Board	LSM9DS0 Breakout Board
3.3V	VIN
GND	GND
SCL (Pin D0)	SCL
SDA (Pin D1)	SDA



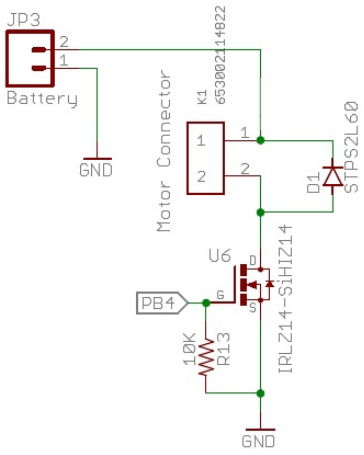
After using the program for reading the results of the Gyroscope, Accelerometer and Magnetometer measurements of spatial positioning we received the following output on the serial monitor of the Arduino software:



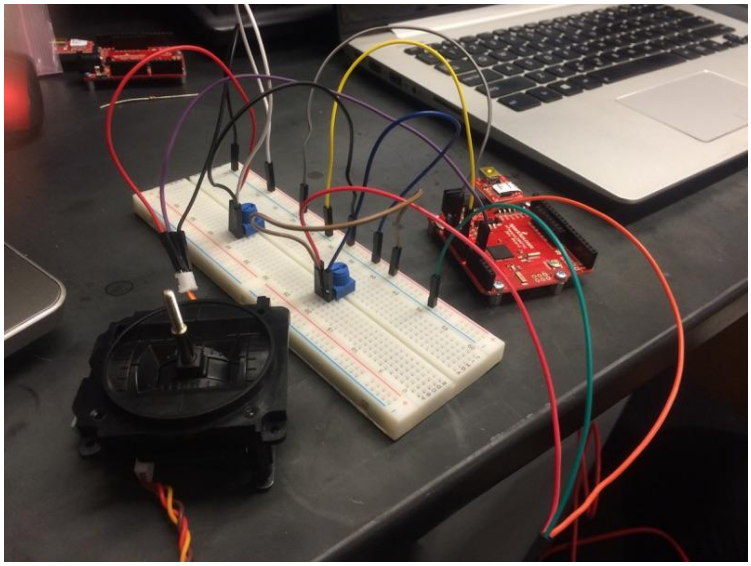
The displayed values of the coordinates are constantly being updated as the chip is being in motion.

- **Reading Values from the Controller Gimbals.**

After all of the necessary connections being made the complete circuit for reading the gimbal values looked as follows:



Motor Driver Schematic
Recomended output pins for PWM
(PB4,PE3, PE4, PB5)



The values of the potentiometer recorded for being able to read as wide region of analog values as possible are given below: (The High and Low integer values are the digital readings from the analog input applied to the analog A1 and A2 pins on the Red Board)

Gimbal Horizontal Direction:

High: 1023

Low: 280

Potentiometer DMM reading: 4 kOhms

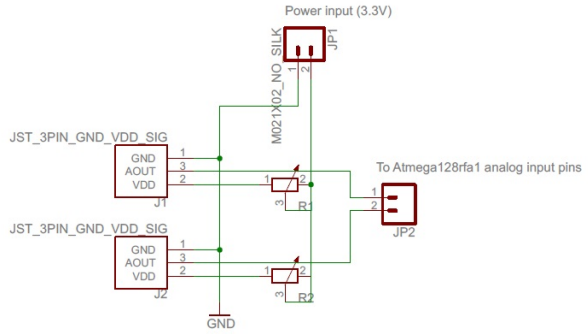
Vertical Direction:

High: 1023
Low: 200

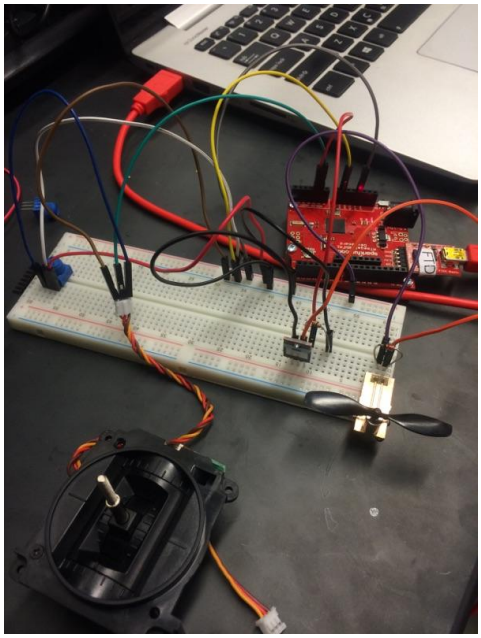
Potentiometer DMM reading: 2 kOhms

- **Driving the DC Motor with the Gimbal**

In this part of the experiment the circuit for reading the gimbal values was kept intact. The extra circuit built for this part was for driving the motor and controlling it's speed depending on the positioning of the gimbal sticks. Complete circuit looks like this:



Schematic for the Gimbal-DC Motor circuit



We used the gimbal's horizontal direction which readings were mapped from 280 -> 1023 to 0->255, which is the range the output PWM signal duty cycle is being controlled in. After the software and circuit were ready to run, the result was as expected. For high end of the gimbal readings the motor spinned the fastest, because the average power supplied to the motor was maximum possible. And on the lower end of the readings from the gimbal the PWM signal supplied was of such low power that it couldn't even run the motor.

Difficulties

Another difficulty was when we initially connected the motor circuit on the breadboard, the gimbal position controls did not seem to be interacting with the motor output. After concluding that the wiring was correct, we analyzed the position of the gimbal on the breadboard with respect to the motor. We essentially had two different circuits on either side of the middle breadboard dividing line, so the power input and output were not even interacting with each other! When we moved both mini-circuits to the same side, the output worked fine.

One minor difficulty we faced was that we were getting output readings from the IMU circuit that were inconsistent with expected values. For example, the readings were from a high of 1023 to a low of about 350, but we since other groups were getting low values of about 280, our measurements could not be entirely accurate. The main issue was that we had the motor circuit also connected at the time we took the original readings. When we removed that circuit, the lowest value decreased to about 280.

Conclusion

Although the range of the system was not perfectly ideal, the motor seemingly had more a lot of power for an input voltage of only 3.3V!