02/22/24 Midterm Report: Senior Project 2024
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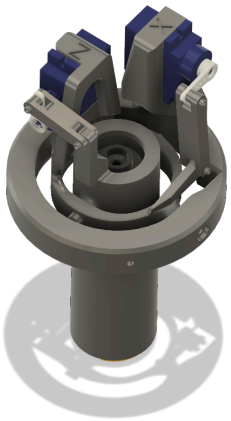
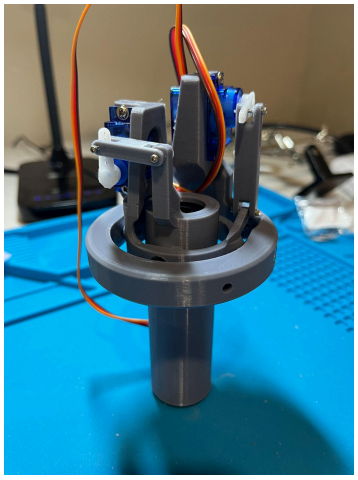



In my proposal I broke down my goals and timeline into separate sections to make tackling them easier. I'm going to use that same format here to show the progress I've made in the last 2 months. The "Mini-Projects" architecture has been a great strategy in acquiring the skills. I've made significant progress in many of the ones mentioned previously. I've been working on these mini-projects in parallel, because many of the skills from a specific project transfer to the others. I've tried to estimate how close I am to completing each skill with a percentage.

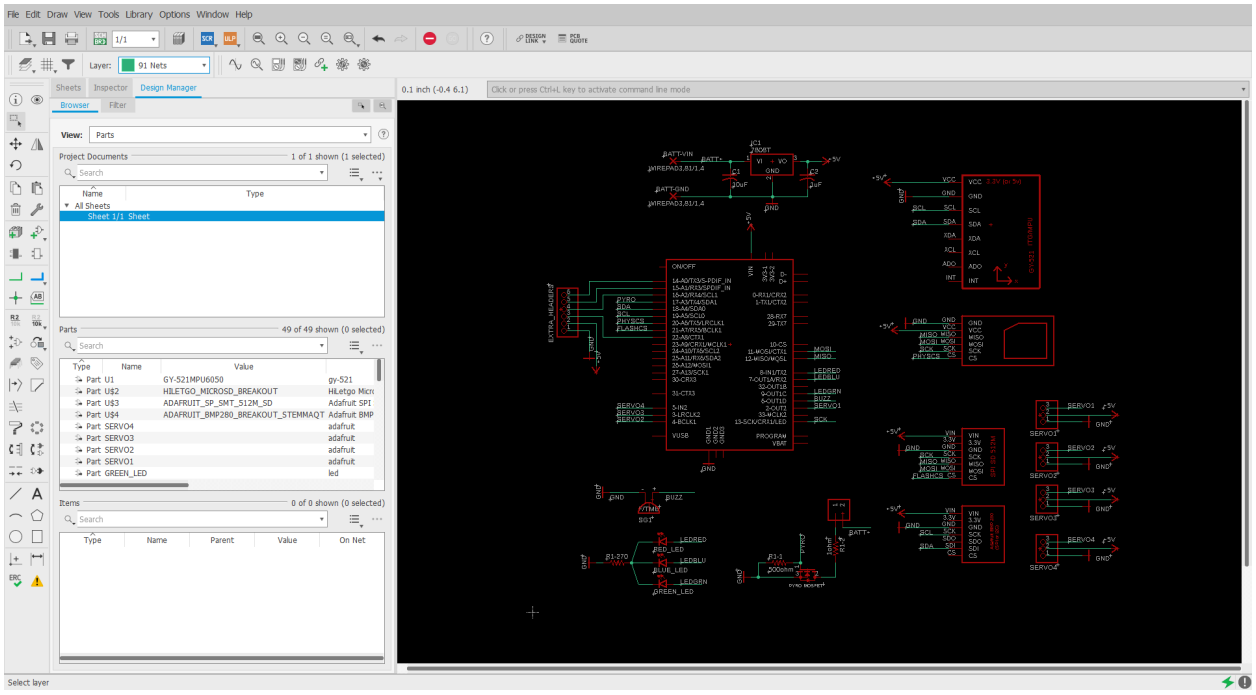
Skill 1: Sensors and Coding (%100)

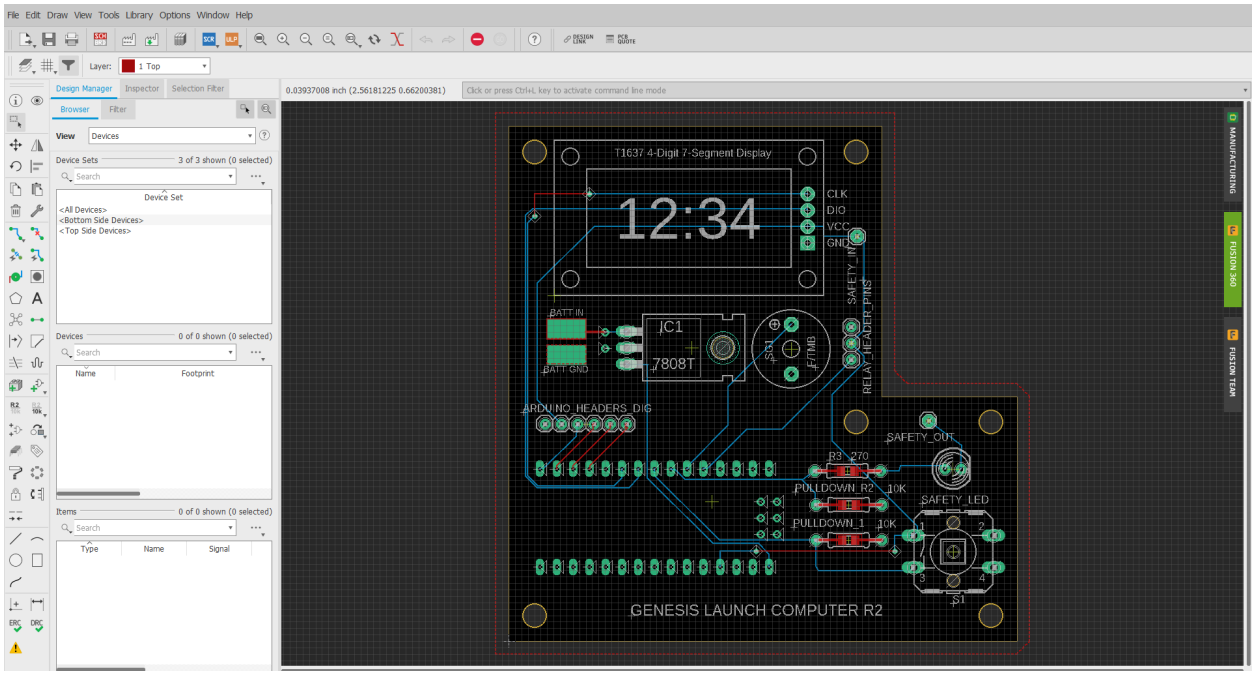
I now have hours of coding under my belt, many of those hours are specific to sensors, filtering, and control theory application. While I still need to work on my control theory to fine tune some things, I think the goal of learning to effectively code is complete. (At least for the scope of this project)

```
void loop()
{
  loop_timer = millis();

  //calculate the current angle of the sensor
  gx = imu1.getRotationX();
  angularVelX = (gx - gxOffset)/gyroScaleFactor;
  xAngleMeasured = angularVelX*deltaT + xAngleMeasured; //Serial.println(xAngleMeasured);

  //determine the error between where we are, and where we want to be
  currentXError = xAngleDesired - xAngleMeasured;

  //apply this error into the PID components
  proportionalError = currentXError;
  integralError = integralError + currentXError*deltaT;
  derivativeError = (currentXError - previousXError)/deltaT;

  Serial.print(proportionalError); Serial.print(" | "); Serial.print(integralError); Serial.print(" | "); Serial.print(derivativeError); Serial.println(" | ");

  //multiply these errors by their repsective gains, add them togehter and write the new angle to the servo it to the servo
  xAngleSet = xAngleSet + proportionalError*pGain + integralError*iGain + derivativeError*dGain;
  servoX.write(xAngleSet);

  //update the errors in preparation for the next loop
  previousXError = currentXError;

  while(millis() < loop_timer + 1000/refresh); {}
}
```

Skill 2: Circuit Design (%100)

I first made a launch computer in Eagle CAD in order to learn the program in depth, and to experiment with a low risk system that can easily be replaced if my design doesn't work. This was a success, as I know I have a working launch computer that is custom designed and assembled. This has led to me designing a custom flight computer based off of Joe Barnards Blip/Blop computer from his "building model rockets" series. This design needs a few finishing touches before boards can be ordered and assembled.





Skill 3: Control Theory and Algorithms (%70)

As I mentioned before, this is the most technically complicated part, and it is still challenging to master. I have a grasp on basic PID loops and I've built a few simple examples to prove it out. However, implementing it into code, and then tuning it to my specific system is something that is

going to require more study and more work. Much of this work left to do requires a physical system to test and gather data, so I am working on building the first prototype to test with. This prototype will require a functioning flight computer so that is why it is stuck at %70.

Skill 4: Building a Testing Program (%0)

Because a prototype is still being built, no testing has been done.

Timeline and Hours

As of 02/22/24 I have accumulated 55 hours. The majority of this time has been spent researching, studying, designing, and coding. I suspect reaching 75 hours will not be a problem, as there is still plenty of work and testing to do before a final launch.

The timeline of the project is going well too. I was hoping to be testing in March, and I think that will still be the case. I would like to think the preparation I've done in design and code will make my testing phase very efficient and fast, but we will only know for sure once it's started!

	Date	Hours	Activity	Activity Category	Total Hours:	55
3	01/09/24	1	UROC and NAR Coordination	Planning		
4	01/11/24	2	Schedule, Monday Board, Project Outline	Planning		
5	01/17/24	3	"Calibration" Mini Project Coding	Coding		
6	01/17/24	1	Signal Filtering Research	Research		
7	01/18/24	1	Recursive Averaging Filter Coding	Coding		
8	01/19/24	0.5	Low Pass and Kalman Filter Research	Research		
9	01/19/24	1	Integrating GitHub into Workflow	Documentation		
10	01/20/24	1.5	TVC Mount CAD Design	Design		
11	01/22/24	2.5	Coding IMU Noise Filters	Coding		
12	01/22/24	2	DSP Textbook Reading	Research		
13	01/23/24	2	"Display Angluar Velocity" Mini Project Coding	Coding		
14	01/24/24	1.5	TVC Mount CAD Design	Design		
15	01/25/24	4	TVC Mount CAD Design	Design		
16	01/25/24	0.5	STL Slicing and File Preparation for 3D Printing	Building		
17	01/26/24	1	TVC Mount Cad Design (Adjustments)	Design		
18	01/26/24	2	Launch Computer Design	Design		
19	01/27/24	1.5	Launch Computer Schematic Design	Design		
20	01/29/24	1	TVC Mount Cad Design (Adjustments)	Design		
21	01/29/24	3	Launch Computer PCB Design	Design		
22	01/31/24	1	Launch Mount CAD Design	Design		
23	02/05/24	2	Kalman Filter Research	Research		
24	02/05/24	2	Launch Computer PCB Assembly	Building		
25	02/09/24	1	"Display Orientation" Mini Project Cad Design	Design		
26	02/12/24	1	"Display Orientation" Mini Project Coding	Coding		
27	02/12/24	0.5	Test Stand CAD	Design		
28	02/12/24	4	"Display Orientation" Mini Project Coding and Del	Coding		
29	02/14/24	2	"Single Axis PID" Mini Project Coding	Coding		
30	02/14/24	1.5	Launch Computer PCB Re-assembly	Building		
31	02/16/24	0.5	PID Loop Research	Research		
32	02/16/24	0.5	"Single Axis PID" Mini Project Coding	Coding		
33	02/21/24	2	Flight Computer Design	Design		
34	02/21/24	3	Flight Computer Design	Design		
35	02/22/24	2	Flight Computer Design	Design		

Documentation

My documentation has also gone very well. Throughout the design phase, I've uploaded all of my code, designs, and references to the open source platform "Github" which allows for anyone to inspect and download my work. (https://github.com/AlpineAce27/Senior-Project-TVC-Guidance)

It also shows a revision history behind each file. Most of the current documentation has been digital. Composed of file histories, screenshots, and timelapses. But once testing begins I

would like to create more video and physical documentation to compliment the current digital history.

Conclusion

While I would love to be a little further along the schedule, I still think I'm on good track to reach my hours, AND launch in April. This has already been an incredible learning experience, and it has been very rewarding to work on.

I have to say, seeing all the inert parts like code, plastic, wires, and motors come together to make something that reacts to its environment is an incredible feeling.