Project Summary

The original design problem wanted our team to design a three pylon system for moving a payload in three dimensional space. The customer wanted the payload to be fast, able to draw using a known interface, be accurate and inexpensive and to be able to switch out writing utensils quickly. As a team, we first began with looking at what was necessary for the project and what role everyone played in. Once we decided on who's doing what we began with individual research. Each member of the team researched on what they needed to do and how to implement it. Every week the team would commit an online meeting on Tuesdays and Thursdays.

The PCB providing connections between the arduino, motor driver chips, motors, and encoders was designed in EAGLE, based on the 3D enclosure files created previously in Fusion360. The motor control code to go along with the driver chips and encoders proved to be more challenging than expected. Based on an initial recommendation from our mentor, we decided to use standard DC motors with encoders. In hindsight we should have used stepper motors, but due to our collective lack of experience with motor controls and robotics, this realization did not occur until much too late into the project to change our approach. The main drawback with the use of DC motors with encoders is the lack of precision due to the unpredictable response of the motors to various voltages. To overcome this obstacle, we decided to implement PID controllers for each of the motors on the Arduino to enable more precise control over the motors positioning. While this led to more precise control over the motors' final position after a move, it came with a tradeoff of less precise control over motor speed during the move, leading to imperfect lines.

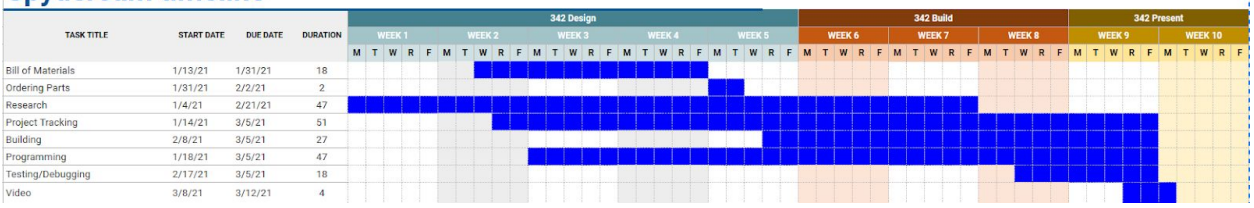
When writing code, both for the image processing, and for the arduino, there were two main phases. The first phase was doing research such as what libraries to use and how to do the math. The second phase was implementing the code.

Designing the computer controller block had two main questions: What language to code in, and what interfaces to use within that language. I decided to try using Python first, as I had heard that it is an easy language to learn, has lots of libraries to import functionality, and I wanted the experience in a language I had never used practically. The interfaces I chose were PySerial, which Mr. Shuman had recommended to us in the requirements collection meeting, and Python already contains an interface to open files with. I studied and learned these two interfaces well to ensure that transmission of Gcode to the Arduino would go smoothly, and the Python script worked well. Measurement tooling had a different set of challenges. The first was physical implementation of the design, and which system to use - visual or physical measuring. The second challenge was a coding implementation. The main influencing factor for the physical decision was the coding implementation. At first glance, using the solution of using a camera sounded like less code, as the camera had software already and our computer vision code was developed and could be used to extrapolate values from an image taken. After designing a holder that could be mounted using our tool mount, the next challenge was finding the correct point to send the camera to to have proper measurements. With that point found, the procedure for measurement of lines drawn could be designed and implemented.

The PCB and Arduino enclosure began with learning the program Fusion360. After that a rough sketch of the enclosure was drawn out on paper with all the needed measurements. The team decided to construct the PCB around the enclosure using its measurements. Using Fusion360, the enclosure and lid for the PCB and Arduino was constructed. Next the system mount had to be constructed. It began with a drawn schematic of the mount with all its measurements. The mount was designed to reduce sway and increase stability while moving and after the 3D model was finished using the Tekbots OSU resource the tool mount was printed. Then began work on the Pulleys. The pulleys began with a prototype drawing with measurements. Then began research on how to construct a pulley shape. After that the pulley was made in Fusion360 and printed using Tekbots OSU. The team met up on week 8 and week 9 of the school term and we found out that the pulleys dont fit on the motors. The pulleys were revised and reprinted again to

fit the requirements.

Spydercam timeline



TASK TITLE	START DATE	DUE DATE	DURATION
Bill of Materials	1/13/21	1/31/21	18
Ordering Parts	1/31/21	2/2/21	2
Research	1/4/21	2/21/21	47
Project Tracking	1/14/21	3/5/21	51
Building	2/8/21	3/5/21	27
Programming	1/18/21	3/5/21	47
Testing/Debugging	2/17/21	3/5/21	18
Video	3/8/21	3/12/21	4

One of the key points that the team learned was time management. The reason that the team struggled with time management was because of the research phase and the fact that the team had to do the project remotely. Also the shipping delays and passing winter storm this term did not help. Due to these problems the team has learned the importance of time management.