**My First Printer**

In the middle of June, I decided to purchase a 3D printer to help support some projects I had in mind, specifically to create pieces to interface with servos or encapsulate hardware I designed. I ended up buying Creality’s Ender 3 Pro, which is a popular choice for beginners. From what I researched, the Ender 3 Pro offered great detail and print quality for entry level printers. It came with all of the tools I needed to set up, and some white PLA filament to get started quickly. After this ran out, I bought a 1 kg spool of black PLA filament to fuel my first large project. I designed a box that was printed first for my sound activated LED strip project. Since 3D printing is so complex, there were many issues that have come up over time for me. The dimensions of the ender 3 pro are about 8x8x9 inches, which allows me to print relatively small to mid-size parts. If I need to create anything larger, it is also possible for me to split up the work between multiple parts and prints.

**Problem Solving**

Leveling the bed is something that is crucial for any 3D printer. The printing bed is where the hot plastic is placed after it is extruded from the small nozzle and hot end of the printer. There are four large gears under the bed that are used to raise or lower that respective corner of the bed. The best way I have found to level the bed is to place a piece of paper between the bed and the extruder nozzle. If the paper cannot go between them, the bed must be lowered so it can. If it is too loose, the bed must be raised enough. After leveling one corner, I go to the opposite back corner and work my way around to the other two corners after that. If the bed is too low, the filament could dry before it reaches the bed, which can lead to your print not sticking and messing up during the middle of the print. If the bed is too close to the nozzle, the extruder will not be able to push out the right amount of plastic and it will become stuck to the printing bed. Luckily, the ender 3 pro uses a magnetic bed, so you can take off the magnetic sheets and replace them easily if it gets damaged. Leveling the bed is generally simple, since you have to lower the z axis of the printer to the bottom and check the corners, but I have learned that it is very important for a successful print.

One of the first problems I faced with my prints was layer shifting. Layer shifting is when after each layer, your print slightly moves off in either the x or y direction to create uneven prints. After narrowing down my problem, I discovered that it had come from two spots. The wheels that mount the x axis and extruder were very loose, which led to them being very wobbly as it moved across the x axis belt. After tightening it with a wrench, half of my problem was solved. The other issue had to do with the loose x axis belt on the printer. When constructing the ender 3, I did not tighten the belt nearly as hard as I should have, since I had to construct the printer out of the box. This is done by using one of the jacks as a lever to push the piece farther over so the belt gets tighter. After this, I retightened the two bolts that hold the piece to the bar. Now that I know how to fix this issue, it shouldn't be a problem in the future if I regularly check the belt.

One other major issue I had over time was my printer not extruding the correct amount of plastic over time. To fix this, I used my calipers to measure out how much distance my printer was pushing through the motors versus how many millimeters I commanded it to push. After finding the difference, I discovered that my extruder was sending less plastic than expected, leading to prints with very thin plastic layers, which would sometimes break my infill layers. To fix this, I commanded my motors to print more e-steps per centimeter of extruded filament, so that my prints would come out fuller.

**Timelapses**

I plan on recording more timelapse videos soon, which will be posted on my YouTube channel. I do this by taking a picture of every layer that my printer extrudes, and then compiling them all into a short video. These take some time to set up and do right, so the videos may take a while to come out, but I'm working on improving the quality of them because I think they are very fun to watch. Hopefully I can get more out soon!