Easel 5000

Week 6 Report

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Work Completed

Research

Research on printed circuit boards was done. This was done to give myself knowledge of what I would be working with when it came time to put together my own. I went through express SCH and express PCB to start figuring out how these programs work. The Digi Key website was searched for potentiometers and knobs for the now completed dimming system.

Contacts

Professor Enderle suggested a few ideas during the team meeting that needed to be taken into account. End caps were suggested as a finishing touch on the easel. Also Professor Enderle suggested using a printed circuit board for the LED circuit.

LED System

A final round of testing was done on the LED circuit to ensure that the dimming option worked and so did the 9.6 V battery. The potentiometers being used to test the circuit were no creating any noticeable difference. This was probably due to the fact that they were 15 turn potentiometers and were very difficult to adjust in the circuit. Instead four 2.2 Kohm resistors were put in series in the circuit as a sort of in prompt to potentiometer. These were then tested with successful results. Different levels of resistance produced a dimming affect. Chris Liebler the provided a one turn potentiometer that solved the potentiometer issue and now the circuit is working in entirety. Also the ball was set rolling on the PCB. The circuit was drawn up in express SCH and will be transferred over to express PCB. This took longer than expected due to the learning curve of new soft wear.
Assembly

This week, the major portion of the work done with the project was easel assembly. The easel base was reconstructed, replacing the square extrusions with rounded extrusions for safety purposes. Attached to the base was the central track made with rectangular extrusion. To this extrusion, a linear unibearing was placed as a track system so the extension arms would be able to slide from side to side parallel to the table. Since the dynamic pivot joints were received from 80/20, the already-machined parts were put together with the joints to assemble the easel extension arms. Finally, the canvas holder was assembled with the remaining two linear unibearings acting as a track system so that the top lip would be able to lock a canvas or painting medium in place. Overall, the initial prototype design before testing used a total of three adjustable pivot joints, allowing three different points of adjustment.

Testing

After the easel was assembled, problem testing was looked at. The initial design definitely had flaws. With assertion of a minimal amount of force, the canvas holder subunit experienced a great amount of torsion. The torsion experienced would then cause the canvas holder to wobble about and oscillate for a long time. This instability would have to be looked into and would be unacceptable. It was observed that since the canvas holder was so much longer than the extrusion arms, the torque exerted all the way down to the pivot closest to the easel base. Since there was only one arm supporting the canvas holder and the fact that this arm was a square extrusion, the moment of inertia for the arm was a defining characteristic for the torsion failure experienced.
Trial and Error

After seeing the problems with the initial prototype, other ideas that came up were attempted to see if it would fix any of the problems mentioned. The first attempt was to replace the second extension arm with a much shorter extension arm. In doing this, the 1.5 foot extension arm was replaced with a four inch arm. With hopes of reducing the distance from the canvas holder to the pivot at the base, doing this replacement would also somewhat limit the adjustability of the easel. Taking consideration of adjustability, the shortening of the arm was preferred for stability reasons over adjustability. With the shortened arm, the easel did seem more stable, but this wasn't enough.

The next idea was to take out one of the pivot joints, setting the second extension arm at 90 degrees with the first arm to see if the design and adjustability would still be stable. Reducing the design by one pivot point meant the possibility of using the now-free pivot elsewhere. Eventually, this idea turned into taking off the second extension arm altogether since it only extended the canvas holder out an additional five to six inches maximum. With the free pivot part now available, another pivot was ordered in attempts to convert the design to a set of two arms instead of just one. Doing this would heavily reduce the torsion experienced since the canvas holder would then have two points bracing it. A force on one side of the canvas holder would make a torque at one arm while the other arm would provide a counterforce to keep the system statically stable.

Solution options explored and Procedures for testing

1. The first idea used was to reduce the length of the second arm. This was done using a spare, 2” piece of 80/20 2525 extrusion.

2. Second, the entire 3rd joint was eliminated from the design.

3. For both options 1 and 2, aluminum braces were borrowed from another team and used to brace the joints.

All 3 solutions were subjected to a trial force applied at the end of the bottom support beam of the canvas holder perpendicular to the beam.

Results
○ Solution 1 Trial Results – Reduced the length of movement to some extent. There was still significant movement 10 seconds after the trial force was applied to the canvas holder.

○ Solution 2 Trial Results – significantly reduced the movement caused by the application of the trial force. However, there was still movement in the canvas holder after 10 seconds.

○ Solution 3 Trial Results – same results as the solution 3 trial results. The movement was significantly dampened but not eliminated entirely.

**Future Work**

Work with the LED system needs to be continued. The PCB for the LED system has to be taken care of. Aside from the LED system, mechanical analysis of the easel itself will be looked into further. Further testing of the easel is required in order to perfect the prototype. After more parts arrive, different aspects of stability can be problem solved and retested. With arrival of the additional pivot joint as well as end-caps for the extrusions, the easel prototype should be completed fairly soon and heavy product testing will take place.

**Project Review**

The project is on a good track. All of the parts of the easel have been at least started, and many of them are extremely close to completion if not already completed. At this point, the arrival of additional parts are necessary in order to make any further progress. A good portion of the construction and machining has been done. The final stages of the project still allow for ample time to complete construction and then do extensive product testing.

**Hours**

Seth- 11 Hours
Justin- 11 Hours
Ali- 11 Hours
Pictures

Figure 6.1 – Testing the Easel with an applied load.

Figure 6.2 – Threading the end of a piece of aluminum extrusion with an M6 tap.