Monitor Lift and Paint Cap Remover

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Weekly Progress Report
8/14-9/21

Work Completed
Paint Cap Remover Head

The majority of our time was spent trying to find a good way to make the paint cap fit nicely inside of a paint cap remover-head. We wanted to use the HDPE plastic rod slices that we machined in previous weeks to create a specific shape that would fit over the cap head. Figure 1 below shows the HDPE plastic pieces.

![Figure 1](left) Shows the HDPE pieces cut into 1.5” pieces. On the left we used a drill to bore a hole large enough to fit the paint cap into.

We planned on machining the plastic so it would fit over the paint cap, perhaps with a combination of the drill press and with files. We could trace the exact shape of the paint cap onto the top of the HDPE piece. Then we could use a file to whittle it down to size. This process may work but would be very difficult and require a lot of tries to get it to fit nicely.

Pat came up with a great alternative method to carving the HDPE piece to fit over the paint cap. We had already planned on using epoxy to help adhere the plastic piece to the motor head. Epoxy is made from two chemicals, epichlorohydrin and bisphenol-A. When these two parts are mixed together, an exothermic reaction takes place that cures the chemicals and creates a final product which is extremely hard, and extremely strong. Pat hypothesized that we could use the epoxy to make a sort of mold around the cap head.
We tested Pat’s theory using epoxy inside of a paper barrier and pressing the paint cap into the epoxy to create a mold. Figure 2 shows this process:

![Figure 2](image)

The two-part epoxy is shown on the left. By pressing the applicator we can squeeze the chemicals into the cardboard circle. The second we begin mixing the chemicals you can actually feel a significant amount of heat coming from the epoxy. This heat is due to the catalyst in the epoxy, and the oxygen on the epoxy monomers is "flipped." This results in a matrix with a high stress tolerance and "glues" the materials together. In the right of Figure 2 the paint cap has already been pressed into the epoxy. We tested many different lengths of time to put it in the epoxy, and it’s necessary to wait at least 20 seconds for the bonds in the epoxy to start forming. The cap can be most easily removed when the epoxy is still hot.

Figure 3 shows Pat removing the paint cap from the epoxy. By lifting slowly with an upward motion the paint tube and cap can be removed as one piece, leaving an impression of the cap on the epoxy underneath. Figure 4 shows a close-up of the impression left in the epoxy. This process has become very successful. As you can see from figure 4, the paint cap leaves an impression with highly defined teeth. The paint cap can be inserted into the hardened impression and can easily be removed by spinning the epoxy base. This means that after we incorporate the epoxy with the motor head we’ll have a complete system for removing the paint cap.
Monitor Lift Revisions

This week I took the time to revise the actual design drawings in Microsoft Visio for our monitor lift using the new plan of the linear actuator. The first part of the design is to show how we will actually create the monitor box from the raw metal. See figure 5 below:

Figure 5 shows how we will machine the metal for the monitor lift. The advisors in the machine shop told us not to use aluminum because it will not be strong enough. We will use a very thin steel to provide the strength and flexibility we need. As you can see in Figure 5, we will cut the four corners out of the sheet of metal and then fold the metal to make a box. This box can be used to house the monitor which will move up and down and is controlled by the linear actuator.
Figure 6 below shows how the linear actuator will be attached to the base plate. We will weld it and secure it with brackets. The back plate, shown in light blue is used to secure the monitor box using guide rails. These are on a track that can slide up and down and extend above the back plate. The linear actuator is concealed behind this back support plate and will therefore not be seen by the user or the patient.

This design allows for maximal support with minimal weight. The guide rails will prevent the monitor from moving in any direction but the Z-Plane, and the linear actuator will control the upward and downward motion. The base plate can be placed on a table or desk and will be the foundation for the whole system.
**Project Overview**

The project is going great. We are making significant progress on the paint cap remover and have already designed a working prototype for how to remove the cap. The epoxy mold is working efficiently and is strong enough to continually remove the paint cap.

The new plans for the monitor lift should work properly. The linear actuator has recently arrived and we can begin the process of machining the steel for the monitor box as well as the base and back plates.

**Future Work**

We need to test our linear actuator and see its limitations.

We need to begin constructing the frame for the monitor lift.

We need to begin creating the box for the paint cap remover.

We need to attach the linear actuator to the base.

**Total Work Hours**

12 Hours