Work Completed:

On Friday March 23rd, Danielle and I traveled to Walmart to purchase spray paint to cover our assistive robotic arm. Our plan was to try out the paint on an extra piece of PVC that we have kept in lab. We bought one can of navy blue spray paint. This was the Krylon Fusion brand that was recommended on a PVC information site found online. It was recommended to clean the pipe with acetone and then use our brand of paint since it is formulated for both plastic and PVC piping. Danielle tested the paint on the pipe. The finish was exactly what we were looking for.

On Monday March 26th I called up small parts inc to get some help with the pulley system. Our group is happy with the pulleys we bought, but we are unsure of the belts that will fit. I called and left a message and still have not received a reply back.

The largest goal this week was to attach the grippers to the lower arm at the wrist segment. This segment will be stationary. The problem with the original gripper plate was that it was completely covered with the gears and the gripper segments. My first idea to solve this problem was to make an attachment piece. This piece would connect to the bottom of the motor and attach the motor plate to the wrist segment. This figure can be seen below in Fig. 1.

Figure 1: Original plan for motor plate attachment

1 http://www.pvcworkshop.com/pvctips.htm
Once I measured out each of the segment on the existing motor plate, I took my drawing over to the machine shop to discuss my plan with Rich and Serge. After explaining my idea to them, they told me that my attaching an extra piece it would make the arm and gripper movement weaker. After brainstorming a bit I decided that the best way to fix the stability issues would be to make a new motor plate. First I searched the extra material bin in the shop until I found a piece that was large enough. Next using a scale I measured out shape that was desired for the motor plate. Using the band saw I cut out the shape which was a bit tricky because it contained a corner cut. After cutting the shape out I used the electric belt sander to debur the edges. Finally after a little work I got the motor plate to fit inside the inner diameter of the lower arm. In Fig. 2 and 3 is the new motor plate that was machined.

![Figure 2: The new motor plate](image1)

![Figure 3: The new motor plate inserted into the wrist joint](image2)

On Tuesday March 27th I spent most of the day in the machine shop. I wanted to attach the gripper plate by the end of the day. First I took the motor plate and drew with a pencil where I wanted to put the two gears and the two gripper segments. After drawing these out I used a center punch to make a dent where I wanted each hole. Next I cut out the gear holes using the drill press. For the drill press I first used a center bit to make starter holes. Next I did not need to use the drill chuck because it was such a large drill bit. To take it out I inserted it into the hole and hit it with a lead hammer. The drill
chuck popped out and I was able to put in the drill bit. The drill bit was secure after I pushed it up and into the spindle. The drill bit I used was 5/8”. It was important to take my time and go slowly with the holes since so much material was taken off. This can be seen in Fig. 4. After the holes were drilled I put the gears in place to make sure that the fit correctly which they did. The holes in the motor plate can be seen in Fig. 5.

The next part of the process was to drill the holes in the thickness of the material where it will be attached to the side of the pipe. First I put the material into the vice on the milling machine. Using the indicator I found the center of the piece of material. Next using the 8x32 drilling block, I took out the smallest diameter drill bit. I put it into the spindle and tightened it. Next using the computer I moved .25” off of the edge of the piece. I set the x-axis to zero. I drilled a hole here then moved over 1”. I drilled these holes on one side and then flipped over the piece to do the same on the other. I actually ended up drilling all the way through the piece. Next I put the material into a vice and using the tapping tool I created threads inside the hole and can be seen in Fig. 6. It was important to go around three turns and then back a half of turn. This was completed for
each of the four holes. Finally using the larger of the drill bits I made the holes in the lower arm pipe at the wrist joint. I made the top of the holes bigger so the screws will sit flush with the pipe. When this was completed and the machine was cleaned up I returned to the senior design lab.

![Figure 6](image6.png)

Figure 6” Tapping tool used for threading the four holes

In the senior design lab I attached the motor plate to the lower arm as seen in Fig.7. Since the screws were flat heads I used a flat head screw driver. Next using the drill press in the senior design lab I made the holes for the attachment of the gripper segments. When these were completed I attached the gripper segments with nuts and bolts. This can be seen in Fig 8. Finally I made a .25” hole straight through the pipe at the wrist to place the screw which would hold the pulley and seen in Fig.9. When doing this I realized that I would need spacers to hold the pulley in space. I went to the machine shop and Surge helped me quickly cut two spacers out of a plastic pipe that had a quarter inch hole in it that would be perfect for the quarter inch screw and can be seen in Fig. 10. Once the spacers were completed I returned back to the senior design lab where I put the entire arm back together. The device so far can be seen in Fig. 11.

![Figure 7](image7.png)

Figure 7: Attachment of motor plate to lower arm at the wrist joint
Figure 8: Attachment of grippers to the wrist joint

Figure 9: Hole for pulley segment at wrist joint

Figure 10: Machined spacers for wrist pulley
Also today Asma got news that our purchased motor could not be run by batteries. Also she talked to a technician at the Dayton Motor company who told her that this motor was incorrect for what we want to do with the robotic arm. We are staring to search to find a motor that is affordable and can handle the amount of torque involved in this device.

**Future Work:**

Next week the main concern is to find an affordable motor that will be able to hold the torque associated with our assistive robotic arm. Also we need to send back the old motor back to the electric motor wear house. Also next week I will continue work on the pulley system so hopefully that will be functioning very soon. Also to decrease the torque we might cut down the size of the lower arm. Hopefully we can plan a trip down to Hampton Elementary to judge how far away the arm will be places and where we can mount the device.

**Project Review:**

This week the design of the motor plate was changed to provide a strong connection between the grippers and the wrist in the lower arm. Also this week it was concluded that the motor that we have purchased was not going to work for the project. This was the original motor that we had planned on from the start.

**Hours Worked:**

15 Hours