Work Completed

In the last week our team spent a significant amount of time trying to develop a method of moving the easel in a horizontal direction with a travel distance greater than 6 inches (three inches left and right of center). One idea thought of was to utilize a hydraulic piston which could be moved by the actuator. However, this would significantly increase the speed of the easel. This same problem was found apparent in any lever system we attempted to design.

In response to this problem I called a company located in Waterbury, CT called Haydon Switch & Instrument, Inc. Since they specialize in linear actuators, stepper motors, and sealed switches, I asked to speak to an engineer to discuss the cost and details of a non-captive linear actuator. This type of actuator drives itself along a threaded rod of any length, and does not require the rod to turn. With this method we could design the system with a rod length appropriate for the easel, and the actuator would carry the easel horizontally along the rod. The problems with the actuator are that it is fairly costly, and also utilizes a stepper motor as its drive. This would then require either a stepper motor control, or 120VAC input, therefore changing the design of the circuit. If the 120V is used, the speed then becomes dependent on the line frequency, as
well as the thread pitch on the rod. The Haydon representative mentioned the possibility of a discount, but the overall cost still exceeds what our budget allows.

Finally, just before leaving the lab, I came across a linear screw drive from a previous design project. The setup consists of a bearing plate which rides along a linear rail system and is controlled by a threaded rod turned by a motor. This happens to be perfectly suited to work with our easel, and we also have a gear motor which turns at a speed slow enough to make the horizontal motion nearly identical to the speed of the actuators. A picture of the rail system can be seen below.

![Figure 1: Linear Motion Rail System](image)

**Future Work**

Over the next week, we plan to being assembling the rest of the easel and actually welding the rest of the frame. The new rail system will have to be fit to the easel and the
design modified slightly from the original actuator method. However, this should not
cause much change to the overall design of the easel. Because the new rail system does
not have any limiting abilities, I will need to design a system to limit the range of motion
of the easel in the horizontal directions in order to keep the motor from attempting to
move the easel beyond its maximum range of motion. Because the motor uses reverse
polarity to reverse its direction, the limit switches will need to be equipped with a diode
to allow the motor to turn in the opposite direction one the limit switch has been tripped.

**Project Review**

The project is coming along well and for the most part is fairly on schedule. We
had a small problem again with a purchase order for some aluminum tracking, however I
was recently informed that the order was eventually placed. This will pose a slight
problem as we continue to wait on the part, however, to utilize the time we will continue
to design and fabricate the additional aspects of the easel that do not require the
aluminum tracking.

**Hours Worked**

Design of a system to gain a larger range of motion for the horizontal part of the
easel took upwards of 3-4 hours. Searching the web for a non-captive actuator and the
phone call to Haydon Controls took at least 2 hours. A large problem was solved when
we were given the rail system. We then spent around 2 hours designing a way to
incorporate it into the easel and test it. Finally, roughly 2 hours were spent hooking up an
actuator and relays to a test joystick. With this we were able to test the electrical design
and also take current measurements of the actuators while under significant strain. Total
time for the week is around 10 hours.