Monitor lift for Adjustment of Computer Display & Oil Paint Cap Removal Aid

Weekly Report 1: 8/31 – 9/14
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Work completed

Over the summer, our team comes up with a new design for the monitor lift. The problem of the previous design is the unstableness of the dashpot. The dashpot originally was used as a main lifting mechanism for the monitor lift project. The four dashpots located at each corner would lift up the U shape frame that is supposed to withhold the 80lb monitor. Prior to ordering the dashpot, the engineer at Airpot, the dashpot company, suggested we should not order them unless we know the exact parameters or the characteristics of the dashpots. Because we wanted a 12” stroke dashpot, there are many complications due to the length of the stroke. The 12” stroke is unusual longer than a normal dashpot. The additional mechanism is needed to stabilize the dashpot, preventing it from damping once it lifts an object to a height. Therefore, we come up with a new design, the linear actuator. The linear actuator is a simple mechanic that is suitable for any pushing or lifting application. The simple design and structure of the device is suitable for our design’s goal, simple and not bulky. The image 1 below shows the image of the actuator.

![Image 1 – 18” stroke 400lb force linear actuator](image)

This linear actuator has a smooth linear operation. We have found one linear in the back of the storage room. The actuator was tested by connecting it to the power supply. The stroke went up and down smooth in a steady slow speed. Seeing the process was working well on the small load actuator, the more load actuator will also work well for the monitor lift project. Because the design is to use only one linear actuator, it has to be a heavy duty actuator, which can lift more than 100 pounds. The catalog on the website [http://www.firgelliauto.com](http://www.firgelliauto.com) provides a full list of available products to be purchased. In the catalog, the item with 18” stroke and 400lb force linear actuator fits our application. The product’s cost is reasonable for our budget also ($129.99). Below is the specification provided by the website. Patrick already ordered the linear actuator from the company.
Specs for the linear actuator:

<table>
<thead>
<tr>
<th>Stroke Length</th>
<th>Closed Length</th>
<th>Extended Length</th>
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<tr>
<td>18”</td>
<td>24.88”</td>
<td>42.88”</td>
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- **Input**: 12VDC
- **Load Capacity**: 400 lbs (Push and pull) 400lbs static
- **Speed**: Approx 1/2” per sec (no load) 2/5” per sec loaded
- **Stroke Length**: Standard stroke sizes 3” 6” 9” 12” 18” 24” 30”
- **Mounting**: Clevis on fixed end, uses MB3 brackets on both ends
- **Limit Switch**: Build-in not movable
- **Duty Cycle**: 20%
- **Current Draw**: Approx 5 amps at full load
- **Inner Tube**: Aluminium Alloy
- **IP Grade**: IP43
- **Operation Temperature**: -26degs C ~ 65degs C
- **Safety Certificate**: CE Certificate

The overall design of the monitor lift is still the same, except without the dashpot and the spring.

Image 2 – Front view and Back view of the monitor lift design.
The guide rails also are needed for the purpose of stabilization. The rails will extend to its maximum height when the stroke of the linear actual reaches to its highest height. The rails can be on each side of the frame, left and right, to help to stabilize the U shape frame, preventing it from shaking while projecting upward. The rails can be purchased from the same company of the linear actuator.

For the paint cap remover design, the motor that we have ordered does not have enough torque to twist open the paint cap. The torque is too low, 0.0317 lbin. It was tested by hooking up the motor to the power supply and used the fingers to hold the shaft. The shaft did not spin with a light grip of the finger. This shows that a new motor is needed.

Most motors listed on the website do not provide the torque parameter. Therefore, I have to find out a way to find the torque for motors.

1 horsepower = 745.7 W

The relationship of horsepower and torque is following:

\[ \text{Power (horsepower)} = \frac{\text{Torque [lb.ft]} \times \text{rotational speed [RPM]}}{5252} \]

The relationship of horsepower and power in electrical parameters:

\[ \text{Power} = I \times E \] where I is the current and E is the voltage

The unit of power is W, and 1 horsepower = 745.7W

For example, the motor with 12V, 3.5A, 102RPM:

\[ P = IE = 3.5 \times 12 = 42 \text{ W} \]
\[ 42/745.7 = 0.0161 \text{ HP} \]
\[ \text{Torque} = \frac{(0.0161 \times 5252)}{102\text{RPM}} = 0.829 \text{ lb.ft} \approx 10 \text{ lb.in} \]

This is the technique I am using to find the torque of all the motors on the website.

I have spent a lot of time searching for the high torque DC motor, which is rare for a low price. The current motor that I am looking at is at

http://www.anaheimautomation.com/brush_dc_spur_gearmotors.htm

Motor Specs:
Rated Voltage (VDC): 12V
No load speed before gearbox (RPM): 5000
No load speed after gearbox (RPM): 25
Rated Speed after gearbox (RPM): 21
Rated Torque (kg.cm) 59 \approx 4 \text{ lbin}
Peak Torque (kg.cm) 18 \approx 15 \text{ lbin}
Rotation Direction: CW
Rated current (A): 0.33
Stall current (A): 1.5
This motor is suitable for our design because of the high torque, which is 500x higher torque than the motor that we have right now. The size of the motor is small enough for the portable design purpose. I will put on the order for this motor this week and hopefully it will arrive within a week. Once we receive this motor, we will proceed on testing the torque.

Project Overview
It was disappointed that the old design for the monitor did not work very well and the motor for the paint cap remover did not have enough torque. However, the team has come up with another good design for the monitor lift, the linear actuator. One problem is the stability of the system. Only one actuator will be used to lift up the 100lb+ of weight, it is now our job to investigate and find out a way to distribute the weight evenly so that the weight will not full concentrate at one point on the U shape frame. The linear actuator will be located on the back of the device, it is important to balance the weight or transfer more weight toward the back of the device. If more weight is distributed toward the front, the device might tilt and the monitor will fall off the table.

The paint cap remover’s new motor is small and compact. This is a good sign for a very portable design. The speed of the motor is not too fast, therefore we do not have to worry about speed control of the motor. The only part that concerns us the most is the torque. The approximate suitable torque is in the range of 1 to 3 lb.in. It is necessary to obtain a motor with a higher torque then expected because torque can always be reduced.

Future Work
The two new orders of the actual linear and the motor are processing. Once we receive the items, we will start testing the strength of lifting and twisting. Nothing can be done until we receive the motor for the paint cap remover.

For the monitor lift, we will stop by at the machine shop and build the U shape frame. The material of the frame is aluminum. Therefore, welding will be involved in our next step.

**Total work hours: 12 hours**