ALTERNATIVE DESIGN I

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

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1. ALTERNATIVE DESIGN PROJECT 1

1.1 Introduction

Monitor Lift

The production of a monitor lift has been requested by Dr. Hallowell at the University of Ohio. It will be used to support a large monitor, which weighs about 80 pounds. The monitor is used in a neurolinguistics laboratory to deliver auditory and visual stimuli to patients. The lift will allow the stimuli to be delivered at a plane of sight that is comfortable for the patient and for an eye tracking device to record their responses. It will not be distracting. The lift will be capable of lifting the monitor from the level of the desk to 12 inches above it and allowing the eye tracking device to be stored underneath it. The first alternative design for the monitor lift is a manual lift with the following major components: a base, two arm bars connected by a circular pivot joint, a spring mechanism and a safety clamp (see Figure 1 below). Safety measures incorporated into the new design are counterweights, hinges, safety straps to secure the monitor and raised edges on the monitor platform.

The original design used a hydraulic lift. The hydraulic lift system has many components (motors, switches, pumps, valves, etc.), and therefore many possible places for defect. Hydraulic systems are notorious for being messy and there is a possibility that it would be too loud for a clinical/laboratory setting. The new design does not involve any hydraulics or electronics. There are far fewer ways for it to fail. It will not make any noise, and it will be easy for the user to lift the monitor to the height they desire manually. Additional safety components have been included.

Oil Paint Cap Remover

The paint cap remover has been requested by Dr. Hallowell. It will be used by a painter to remove the caps from tubes of paint. The client needs a device to remove the caps from the paint tubes because multiple sclerosis has diminished his strength and dexterity. The first alternative design has the following major components: a descending platform, clamp, springs, motor and electrical components.
One of the major differences between the new design and the original one is that the box that contains the motor and cap head will not be hinged. Instead, it will be supported by springs and the box will be lowered onto the paint tube manually. The springs selected for this design will not need much force to stretch, and will lessen the strength needed to operate the device if it was hinged. The cap head has a major change from the original design; it will house the switch to the motor. The switch to the motor will be a button in the center of the cap head. When the platform is depressed and the cap head is on top of the paint cap, the button will get pressed and the motor will turn on. The motor will turn off when the handle is raised and the button inside the cap head is no longer being pressed.

1.2 Subunits

Monitor Lift

1.2 Monitor Lift Subunits

1.21 An Overview

The alternate design for the monitor lift varies greatly from the original first design. The changes come as a result of insight into the workings of the lift as well as suggestions from teachers and other outside sources. The whole nature of the lift was remodeled in order to remove the main component in question, the hydraulic lift. It was brought to our attention that hydraulics and pneumatic lifts have great disadvantages. The hydraulic lift was described as being messy and hard to work with, also at times hard to maintain.
correct working order. Pneumatics were also brought up but with concern with regards to the noise pollution they emit. People with neurological orders could have adverse reactions to loud noises leading to indeterminate data from laboratory studies, or even worse, physical discomfort. The best interest of the patient must be taken into consideration when designing such a device. The new alternative design is a little more technologically basic and relies on simple moving parts. The main component and variable in the machine will be the spring which must provide a balancing point for the lift allowing for smooth raising and lifting of the monitor, as well as maintaining a desired position once in place. The new design consists of a base platform two arm bars attached to a middle circular joint. Atop the higher arm bar is the monitor platform. The spring is located at the pivot joint and is the sole purpose for static equilibrium in the system. The device in its entirety can be seen in figure 2.1:

![Monitor Lift Diagram]

Figure 2.1- Monitor lift in an active upright position and in stationary storage and zeroed position.

1.22 Monitor Platform

The subunit monitor platform resembles the one of the previous design. The steel frame and the elevated borders allow for snug placement of the monitor with limited chance of movement inside the custom tailored dimensions of the platform. The safety concern of the monitor falling on the patient was taken into consideration with the elevated edges and the strap attachment accessory. Other safety concerns regarding the falling of the monitor are taken into consideration throughout the entirety of the lift within all the
subunits discussed later. One of the main faults with previous designs concerning the monitor lift was the distracting nature of the machines unkempt wires. The circular cut out at the base and back of the platform allows for bundling of the wires in a clean and neat fashion allowing for the wires to be “behind the scenes” and not be distracting while taking an active role in the operation of the operation of the machine. The drop down steel frame box which will contain the housing for the eye tracking device will be welded to the bottom of the platform ensuring that it travels in sync with the monitor itself. The safety straps will be able to accommodate a variety of straps and attachment clamps. A circular hole will be drilled in the accessory so as to accommodate hooks/ tie downs. The hinge will maintain the level nature of the monitor as the entire unit moves up and down. The hinge will mimic a simple door frame hinge and can be modified to fit the platform. Figure 2.2 shows an aerial and side view of the platform described above.

Monitor Lift Platform

![Monitor Lift Platform Diagram]

Figure 2.2- Monitor platform (side view/ top view) with attachment mechanism and safety constraints taken into consideration.

1.23 Arm Bar/ Working Interior

The focal point of our design in the previous initial schematic was the hydraulic lift. After realizing the difficult nature of the hydraulic lift it was important to devise a method of simple mechanical operation of raising and lowering a computer monitor. The simple yet effective design of a spring in equilibrium attached to a joint and two arm bars came to mind and is our alternative method to the monitor lift system. The main component of
this new system is the middle section of the lift stand that attaches to the monitor platform and the base platform at opposite ends. The simple mechanical nature of the new design relies more heavily on the physical mechanical operation by the person administering the test, but as a result simplifies and alleviates the problem of the hydraulic more automated lift. The spring joint couple will be calibrated to a desired equilibrium resulting in an easier operation and less physically demanding operation. The two arm bars will be attached to a circular pivot joint in a V like fashion. Attachment blocks will be welded to the bars as a point of attachment for the springs. Figure 2.3 shows the middle working components of the lift.

Working Components

Figure 2.3- Middle workings of lift consisting of two steel bars circular pivot joint, spring, and block attachments.
1.24 Circular Pivot Joint/ Arm Bar Connection

The alternative design at hand requires great attention to the circular joint at the middle of the machine. This joint connects the working movable parts to the base and the top shelf which houses the monitor and the eye tracking device. The motion of the two arms, and ultimately the whole monitor, relies on the smooth nature and secure attachment of the arm bars. The circular joint will mimic the nature of wheels on a sliding chair. The middle component will be the moving part sliding in between the two outside stationary parts. An inner bearing will allow for this movement. Within this joint will be stop mechanisms to only allow the arm bars to extend to a maximum of 45 degrees (12 in high) and a minimum of 0 degrees. The top bar will attach to the inner sliding piece while the bottom bar is permanently affixed to the outside parts that are stationary. This allows for the movement of the top arm bar. The simple inner workings of the joint will allow for easy maintenance and will replace the complicated hydraulic lift in the previous design. A metal bearing interior will be housed in a high density polymer casing. The inside of the pivot joint will be able to accommodate the wirings from the monitor which will run down through the hollow arms. The hidden wires will leave a clean look to the machine without sacrificing functionality. The backing of the joint will accommodate the friction from the spring throughout various cycling in the laboratory. Figure 2.4 below shows the circular joint schematic.

**Circular Pivot Joint**

![Circular Pivot Joint Diagram](image)

Figure 2.4- Side and front view of the pivot joint negating the points of attachment of the arm bars in order to gain a better view of the joint itself. Stationary joints are labeled and a mat black finish will be applied to the final product.
1.24 Integration of Arm Bar and Pivot Joint

The mechanical nature of the arm bar requires a solid attachment to the point of motion, the circular pivot joint. The means of attachment will be a machined triangular piece of steel that will be welded and secured to the arm bar. The triangular piece will then be inserted and attached to the inner bearing. The triangular tip will allow for precise integrating of the arm into the circular joint. The triangular nature will also allow for a wider range of movement when approaching the lower limits of the monitor lifts height. The triangle shape will allow for the close proximity of the upper arm bar with the lower arm bar as the angle shown approaches 0 degrees. The tip of the piece will be inserted through the movable piece within the joint and will not be attached to the stationary outside pieces which will be welded to the bottom arm bar. Figure 2.5 shows the basic schematic diagram of the point of attachment.

![Arm Bar Connection to Pivot](image)

Figure 2.5- upper arm bar attachment to circular pivot joint.

1.25 Arm Bar Integration of Spring Mechanism

The bars on the system will be hollow in nature and will either be preformed during manufacturing or will be constructed from four individual length steel bars welded together. The small attachment welded to the end of the bar will incorporate a stainless steel loop which will be screwed into the bar with a washer and nut and possibly a backing plate for support. This loop will allow for the quick release of springs and provide a means for continually changing and replacing springs as they wear over time. The springs themselves will be chosen with Hooke’s law taken into consideration. The analysis of this equation proves that a variety of springs will do since we have two variables to play with in regards to the type of spring. Hooke’s law is \( F = -kx \) in which \( K \) is the spring constant, \( F \) is the restoring force of the spring, and \( x \) is the distance the
spring will travel. Knowing that the monitor is 80lbs (36.29kg) exerting a force of 355.642N. With the angle of the applied force ranging from 0-45 degrees it is evident that the spring must have a restoring force of between 0 and cos(45)*355.642 or 251.48 N. It was also figured through Pythagorean Theorem that the length of the bars must be 8.5 inches minimum in order to have a hypotenuse distance of 12 inches vertically. All of these measurements must be taken into consideration when building the bars and the final mechanism. The weight of the components must be taken into account as well when considering the restoring force of the spring. Figure 2.6 shows the arm component with the spring attachment and spring.

**Arm Bar and Spring Attachment**

![Diagram of arm bar and spring attachment](image)

Figure 2.6- Top arm bar with spring attachment. Lower arm bar will mirror this image. Circular pivot joint was left out to highlight the identified subunits.

### 1.26 Base Subunit

The base subunit was an area of concern with regards to the safety of the machine. Since the platform is extended upward with arms that are not at the center of gravity there is the potential for catastrophe if safety is not taken into consideration with the design. The moment becomes greater around the circular pivot joint as the arms are lowered. This constant changing of moments requires a steady anchored base. The problem arises in regards to having a heavy base to support the weight shifts, while still maintaining a light frame that could occasionally be transported. The monitor lift should not be too bulky that it becomes a permanent fixture wherever it is placed initially in the lab. The solution to this problem comes in the form of removable weights being placed in designated and designed weight boxes that are attached to the base. These boxes
are positioned so as to counterbalance the outward hanging monitor. Placing the weight boxes towards the back of the base will provide the most stable means of securing the monitors placement on the table. The ability to remove and add weights adapts the monitor lift to future monitor designs be they heavier or lighter. A safety clamp was also installed on the front and back of the base so as to anchor the device to the table it is on. This clamp will be made out of high strength steel and rely on a locking hinge. The anchoring safety mechanism will be described in a later section. The base sub unit will consist of the same material used for the top monitor shelf. The high strength steel will be welded into a square frame. The base will most likely be 1.5-2.0 times larger in area than the upper shelf so as to provide a more stable platform to work with. The clamps will be welded on as well as the weight boxes which will accommodate a variety of weight devices (sand bags, heavy metal, fluid bags, etc.) The base will most likely be just a framework and not have material in its center. If stability is a factor that is not controlled by the weight boxes and geometry then a solid flat bottom steel plate could be instituted to add weight to the base and ultimately increase the stability of the device. An adverse effect would be the transportability of the monitor lift. Figure 2.7 shows the aerial view and a side view of the base.

**Base Subunit (Top/Side View)**

![Base Subunit Top View](image)

![Base Subunit Side View](image)

Figure 2.7 - Top and side view of the base subunit, detached from other subunits for clarity.
1.27 Safety Clamp Mechanism

The final subunit of the device is solely for safety. Safety was a big issue with regards to the previous design, in particular the stability of the monitor off of the table. The catastrophic event of the monitor falling on the patient has been taken into great consideration and certain safety measures have been taken with regards to counterweight balancing as well as safety harnesses. These measures taken to secure the monitor to the lift itself are useless if the whole monitor lift and monitor fall over. This final means of protection against such an event anchors the whole mechanism, which up to this point is all securely anchored within its subunits, to the table or fixture it is being placed on. The idea is simple in that it relies on the use of a hinge as used before on the arms. This hinge will be welded to the end of the steel base unit. An L shaped steel piece will be machined and welded to the other end of the hinge (as seen below). This hinge will have a through bolt with a safety cable that when in the locked position will not be able to unhinge. The L shaped steel fabricated piece will butterfly out as its placed on the table and then secured under the table as shown in the locked position, with the through bolt through the hinge. At this point, once both L bars are secured under the table, the monitor lift/monitor are secured to the table which remains a relatively permanent fixture within the laboratory. The nature of this design relies on the use of a durable and relatively permanent/heavy table to be present within the laboratory. Figure 2.8 shows the device in the unlocked and locked position.
Safety Hinge Anchoring Mechanism

Close-up of Safety Clamp

Safety Clamp Attached to Lift Base

Locked Position (locked)

Open Position (unlocked)

Figure 2.7- Here the device fabricated from scratch is seen on the left. The mounted assembly of the safety hinge is seen on the right in both the locked (safe mode) and unlocked (unsafe mode) position.

Oil Paint Cap Remover

1.21 An Overview

As an alternate design for the paint cap remover, we have made several modifications which will affect the way the cap is removed. Our changes were based on suggestions from teachers and classmates to try to improve the effectiveness of the removal system as well as fix problems with the original design. Our new design is shown in its entirety in Figure 3, below. Alterations were made to how the cap-remover head is brought down onto the cap. The hinged arm was in this case replaced with a spring guided platform. This helps to significantly reduce the amount of strength needed to lower the cap remover and will make it easier for someone with minimal grip to operate the device. The clamp design was also taken into consideration. It was noted that a tight clamp squeezing the paint tube might compress the paint and force it out of the bottle unnecessarily. To prevent this from happening we’ve designed a non-compressive clamp which will not expel any paint from the tube. I will now go into detail about the
specific subsections of the design. All components will be described to explain their form and function as well as to give a visual diagram of how it will be incorporated into the final project.

Figure 3: Front View of Entire Paint Cap Removal Device
1.22 The Descending Platform

To reduce the amount of force needed to operate the device, we have removed the hinged arm of the previous design. The hinged arm would have to support the whole weight of the components used to remove the cap, including the motor and head. Although the hinged arm would be easy to lower onto the paint tube, the sheer weight of the unit would make it difficult for someone with limited strength to lift it up again. Our new design capitalizes on this disadvantage by replacing the hinged arm with a descending platform. The beauty of the platform is that it uses the weight of the motor and electrical components to its advantage. Four springs are attached to the corners of the platform and are tethered from above to overhang support bars. A total of 8 support bars (4 horizontal support bars and 4 vertical support bars) make a box-like cage around the entire device and provide a structural scaffold for the descending platform. The platform itself, which can be made out of aluminum, is 10” by 10” can be either ¼ or ½ an inch thick.

Figure 4: Descending Platform
It houses everything essential to the actual removal of the paint cap, including: the DC motor, the motor circuit with batteries and switch, the motor gear, the cap-head gear, and the cap-remover head. The basic idea of the descending platform is as follows. The motor is in a very simple circuit with a battery, a switch and the motor itself. The user presses a switch in the motor circuit which begins operating the motor. This happens because the switch closes the circuit, allowing for the flow of current from the battery into the motor, driving the rotation of the motor head. The head of the motor is attached to a “motor gear”. When spinning, this vertical gear rotates a horizontal “cap-head gear”. The cap-head gear drives a rod which goes through a drilled hole in the platform. The rod ends at the cap-head itself, so therefore whenever the switch is depressed, the cap-head will continuously turn.

The user then applies a very small amount of force on the depression handle that is attached to the platform. The 4 corner-springs which rest at equilibrium are easily stretched when the handle is pulled downward. This allows the platform to be lowered toward the tube of paint which has been placed into the clamp. The spinning cap head approaches the cap of the paint tube. Our cap-head design is shown below in Figure 5. There are small teeth in the head which will fit around the cap snugly. Since the type of paint is specific, we can design this cap head to fit our cap precisely. Upon request, we could also design multiple sized cap heads for different types of paint. The cap-head remover is a cross section of a small cylinder that can be made from plastic. We can make these easily by drilling a hole through the circle of plastic and then using a utility knife and a file to make the teeth. The final product is a specialized cap head with small grip-teeth that perfectly matches the cap of the paint tube. When the rotating, the cap-remover head is finally lowered onto the cap, and the grooves of the cap-head will lock into the cap, spinning both the cap and tube counter-clockwise.

1.23 The Clamp

If the tube were uninhibited, our device would not accomplish the goal of opening the paint tube, since the tube could simply rotate endlessly. Think about trying to unscrew a nut from a bolt. If the bolt is free to rotate, the nut will be nearly impossible to twist off since the bolt would spin too. The same is true for our paint cap and tube.
To prevent the tube from spinning along with the head, the tube must be restricted from spinning. Our original design used a tight clamp to secure the paint tube from spinning. One major drawback that we were asked to consider was that a tight clamp might put too much pressure on the paint tube. This could result in the tube expelling paint superfluously. Not only would this be a waste of paint but it would be very messy and would require unnecessary cleaning of all parts involved in the device. Our design is unique because it will secure the paint tube without expelling the paint. The key to our design is that it takes advantage of the ovular shape of the paint tube. If you look at the tube from a birds-eye angle you can see that its width is larger than its depth, resulting in an oval shaped tube. This can be seen in the figures below. Figure A shows a top view of a full paint tube after it has been placed into the box-shaped clamp. The clamp fits around the outside of tube without applying any pressure to the tube. These simple metal clamps are cheap and come in many sizes at local hardware stores or online stores.

The left figure shows the front view of the paint tube inside of the clamp. The figure above shows different stages of the paint tube in the process of cap removal.

Figure 5: Paint Cap Remover Head

Figure 6. Front view of the clamp
Figure B shows what happens once the cap head remover comes into direct contact with the cap of the paint tube. When the cap head locks into place over the cap of the tube, both the tube and the cap begin to rotate counterclockwise. However, since the tube is wider than it is deep, it is prevented by the clamp from rotating fully. The clamp stands firm and holds the tube with minimal pressure, and this allows for the cap to be twisted counterclockwise. After several rotations the cap will be removed. At this point there is no pressure at all on the tube because nothing is twisting it. The user can now let go of the depression handle. This will allow the 4 corner-springs to retract the descending platform. The descending platform returns to its steady-state resting height, and the motor can be turned off. The final result leaves the paint tube sitting loosely in the square clamp with its cap removed. The tube can be easily picked up out of the device and the user is ready to use the paint.

Figure C shows a paint tube with less paint inside of it. One important concept to take into consideration is that the paint tubes change size as they expel more and more paint. The specific type of paint, Grumbacher Oil Based Paint, comes in small 1.25 OZ containers. These containers are shaped like a toothpaste tube, except the paint tube is made out of a thin metal. What is unique to the shape of the tube is that it is sealed at a flat line at the very bottom of the bottle. This means that no matter how much paint is already used, the width of the tube will never be less than its original width. Figure C shows this concept: that although the depth of the tube will decrease as the paint gets used up, the width will remain nearly the same.

Figure D shows the tube with less paint in it once the cap head remover comes into direct contact with the cap. Even though the tube has less paint in it and the depth has decreased, the width of the tube cannot change because it is sealed in a flat line at the bottom. The metal tube retains its rigidity and when the tube begins to rotate it comes into contact with the clamp. The clamp prevents the tube from rotating in a complete circle and therefore the cap is allowed to be unscrewed counterclockwise. After several rotations the cap will be removed. Just like with the full tube, at this point there is no pressure at all on the tube because nothing is twisting it. The user will once more let go
of the depression handle enabling the springs to retract the descending platform. The descending platform returns to its steady-state resting height, and the motor can be turned off. The final result again leaves the paint tube sitting loosely in the square clamp with its cap removed. The tube can be picked up out of the device and the user is ready to use the paint.

The unique feature of this simple metal clamp is that it will work properly and efficiently for the paint tube no matter how much paint is remaining in it. Because of the distinctive sealing of the tube at the base of the bottle the width of the tube will not be variable. Therefore since the clamp is rectangular shaped it will prevent the tube from rotating no matter how full it is. Even if the tube is almost completely empty, it will still have relatively the same width as when it is brand new.

Another important fact to note about these simple metal square-shaped clamps is that they are cheap and easily found in a hardware store. If the user decides he wishes to use larger tubes of paint he would only needs buy a larger clamp to fit those requirements. The clamps can be easily exchanged and replaced while leaving the rest of the device the same, accommodating different size tubes.

1.24 The Springs

The final component of this alternative design is the spring. As can be seen from figure 1 and 2, there are 4 springs on each of the corners of the descending platform. The spring system is the biggest change from the original design, and it makes use of the weight of the descending platform to help operate our device. Instead of trying to manipulate a heavy bending arm, the user is able to exert very little effort to move the platform.

The key to the whole design is based on the intrinsic nature of how springs perform. Generally, basic springs obey Hooke’s Law. See Equation 1 below:

\[
F = -kx \tag{1}
\]

F is the force applied to the spring  
k is a predetermined spring constant  
x is the distance the spring travels

Using Hooke’s Law for the springs involved in our design, it is possible to mathematically determine the type of spring needed for our system. Below, Figure 4 shows springs at different lengths during tensile stretching.
Obeying Hooke’s Law, the springs will deform linearly. Part A shows a spring sustaining 1” deformation. If we assign an arbitrary value of $k = 2.5$ lbs/inch, we could calculate the force on the spring being 2.5 lbs. Next, we examine the spring in part B. The spring has deformed 2”. Using the same value of $k = 2.5$ lbs/inch, we can determine that a force of 5 lbs is being carried. Finally, in part C, the spring has stretched 4 inches. This would require 10 lbs of force.

Determining the amount of weight required to deform a spring a specific distance is useful in instances where the spring has already been purchased or placed into a device. Graph 1 shows the relative weights and distances a spring with a constant of $k = 3$ lbs/inch would deform. The force vs. deformation forms a linear line for a linear spring.

A scenario that is more pertinent to our design rather than determining how much weight deforms a specific spring, would be to determine which type of spring we need to buy. To do this we would need to calculate the specific weight of the descending platform and the distance traveled. Optimally, our design would allow the sheer weight
of the platform to stretch the springs a certain distance. I will refer to this distance as the equilibrium height, since the springs will come to rest at this point and will hang below the overhang support-bars at this level. The equilibrium height would ideally be about 4 inches above the clamp. This provides enough space in between the platform and the clamp and would allow the user to insert the paint tube.

The weight needed to pull the descending platform down to the paint tube would be additional force added to the preexisting force caused by the weight of the components and the platform. Table 1 estimates the weight of these separate elements. All together the components of the descending platform will weigh around 3.5 lbs. If we desire the springs to depress around 4 inches, we can use Hooke’s Law to find a spring with the appropriate spring constant. Solving for k in equation 1, we get

\[ \text{Equation 2: } \text{Solving for } k \quad k = -F/x \]

![Graph 1: Spring Deformation](image.png)
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</table>

Table 1: Calculating Total Weight of Descending Platform

If we plug in the desired length and weight into equation 2 we get \( k = 3.5 \text{ lbs/4 inches} \), or \( k = 0.875 \text{ lbs/inch} \). Since we are using 4 springs, we can divide this \( k \) by 4. So for each spring, \( k = 0.875/4 = 0.219 \). Graph 2 shows the deformation of 4 springs with each \( k = 0.219 \text{ lbs/inch} \). We can see from this graph the equilibrium distance of 4 inches is 3.5 lbs, as calculated. As the user applies more force to the system, the springs can further depress and lower the platform to the paint tube. The user can easily depress the platform several inches with only a couple of lbs of additional force. Most importantly, the system requires very little grip strength and can be operated with one hand.

One last important note to consider is the linearity of springs. A spring can only be stretched elastically to a certain length. After a certain length the linearity of springs no longer exists and a significant amount of extra force is required to deform the spring. While purchasing springs we must be careful to consider the manufacture's maximum deformation of the spring. Exceeding this value will not only require an excess amount of force but can also damage the springs.
2. REALISTIC CONSTRAINTS

Monitor Lift

Oil Paint Cap Remover

3. SAFETY ISSUES

It is very important to keep the safety considerations in mind when initially design and build any device. Errors are unavoidable in many designs and it takes many trials of testing in order to successfully removing all the possible hazards from the device. It is essential to pay a very close attention to every small detail as much as possible to limit the severe damage to both designers and users.
Monitor Lift

Our monitor lift is manually operated by a person who monitors and controls the experiment. This is a manual labor device, so there is no electric hazard exists in our application.

The heavy weight of the monitor is a big mechanical issue in our design. Because the monitor will be lowering or raising in the front of the patient who is sitting not too far away from it, it is very important to keep the monitor in place. Straps and attachment clamps will be used to stabilize the monitor all the time. Another safety issue regarding the platform which holds the monitor is that it might be lifted due to the extension upward with loading arms that are not at the center of gravity. To solve this problem, we use the safety clamp with a L shape that attach to both the base frame and the laboratory table. To enhance the safety in our anchoring system, we also add the weight boxes towards the back of the base frame to compensate the downward force applied by the monitor.

Oil Paint Cap Remover

For any device that is connected to a battery or AC power supply, electrical hazard might happen at any time during or after operation. Our device, the oil paint cap remover, is considered a simple electrical application that does not involve complicated electrical component and wire network. Our system encompasses a DC motor that can be operated using 12VDC batteries. Because most motors found for our application are functioning with minimum of 3Amp, which is not very safe. To limit the current carrying by the wire, we add resistors in a simple circuit placed inside the descending platform. In addition, choosing the right size of the electrical wire and cable is crucial in reducing the heating up and causing fire during the performance [2]. Since all the electrical components are hold in the descending platform which is constantly moving up and downward, all the wires should be held in place firmly. Because all the electrical components are kept inside the aluminum descending platform, the user is safe from being in contact with wires and all other electrical components.

For mechanical safety in our application, we implement the switch which can be turn on or off by the user. The switch allows the motor and the head to spin only when it is depressed by the user. The new non-compressive clamp which holds the paint tube will not squeeze out the paint when its cap is being opened by the device.

4. IMPACT OF ENGINEERING SOLUTIONS

Monitor Lift
Our device has shown a great improvement in the dimension of the whole system. We are able to reduce the unnecessary bundle of wires, noises, and bulkiness in the device. This will provide more space in the laboratory, and possibly will create less distraction to the patient being tested.

Beside the neurological laboratories at Ohio University, any other place can use our device due to its portable and simple design. People from different locations in the world can operate the device easily because of its self-explanatory instruction.

In the neurological laboratories, many benefits will be gained through the use of our device. Upon achieving all the requirements, our device will help in bring more accurate and effective discoveries or solutions to the laboratorial experiments. Once the results are obtained from successful experiments, new solutions such as drugs, devices, or methods will be given to patients, helping them to recover their illness and complications. There is a great number of populations who are suffering from neurological disorders, new discoveries and findings will have such a great impact on mankind. It will reduce many burdens for families and friends. Life will be much more easier than it always is.

The Starfield Group, Inc had come up with a design that is similar to our design [6]. The counter-balanced spring assisted mechanism in this device has brought to its success by allowing user to adjust to any height. It can lift up to 120 lbs monitor and has 11” vertical adjustment. As shown in Figure. The size is very portable and can be movable. Another company, Solutions for Human, as well developed a similar device named Fox Bay Sit [7] which lifts the 60lbs monitor 13” above the desk surface. Their purpose is to provide people easy access to the monitor while standing. Our device, with all the similar advantages, can be successfully deliverable in the near future. With our additional safety straps and clamps, we will add more benefits, also success, to the monitor devices in general. Our device is cost effective in a way that it can be manufacture in bulk with cheap budgets. Many people, not necessary industries, hospitals, or laboratories only can afford one.

**Oil Paint Cap Remover**

The paint cap remover has the great impact in improving life of the MS painter. Ever since opening the paint cap is a big problem for him, he has been very disappointed with his ability and with life in general. However, this device will provide him with more confidence in achieving his goal since he will not worry about such a small task. The
user can be independent whereas he will not need any help from an assistant. He will feel much comfortable in a sense that he can use it any time he wants without asking anyone to help him. According to psychologists, humans tend to feel much confident in their work when they have a full control over it. The painter will gain back his confidence and positive determination in achieving his ultimate life goal.

Economically, the price of our device is reasonable for it can last for a long period of time. Our future implementation of the device might bring down the cost. Nevertheless, the painter is able to save a good amount of money since he does not need human assistant or any other aids.

Our goal is to be able to provide the client the maximal convenience in operating such a task. The lesser the amount work required doing, the better the result is. Globally, there are several devices in the industry that allow users to open bottle, can, or lid [3][4][5] that our client might possibly use. However, those devices do not give him a maximal comfort and minimal use of hand grip. Our device's impact is that we satisfy every request our client asked for and it is specific made to accommodate the needs of our client.

If many positive feedbacks are given by our client, we might be able to expand the use of our device to the greater extend. Since our device is very unique and specific for one application, we might be able to produce in mass amount and deliver to all MS patients all over the nation, possibly the world. This device can be used by any other people who have the same or similar complication. The device is very easy to operate; therefore people with any age will not find any problem to use it.

5. LIFE-LONG LEARNING

Our projects have expanded our knowledge much further in engineering discipline. Every part of our designing process allows us to gain much valuable experience that we will use in our future career. The purposes of the projects are incredibly relevant to our career that is being able to improve health and life of mankind using technological aids.

So far, we have learned different types of mechanical systems that could be used in our monitor lift. The systems included hydraulic, pneumonic, spring, and air. Through some investigation of each system, we are able to discover the advantages and disadvantages of each system regarding our unique application. For our first alternative design, we have decided on using the spring and pivot system for our device for many reasons. The advantages of this system are flexible and adjustable vertical height adjustment, avoidable unnecessary sound, compact, reliable, and simple design and manufacture. The bar integration of spring mechanism and the integration of arm bar and pivot joint allow a very smooth and substantial lowering and raising manipulation. Most devices in the world today use spring in their applications. With this knowledge about spring, we will be able to understand how other devices work and learn from it.
As mentioned, because we have used spring in our monitor life project, we are able to proceed through our second project easily. The cap removal device also uses spring system to descend the cap head to be fitted directly on top of the oil paint cap. The spring and the weight of our motor compartment together create advantages in which reduce the amount of work the user has to apply to push the head downward. This project has developed the basic knowledge of motor among the team members. Acquiring a right motor is not such an easy task as it sounds, thus it requires a good amount of knowledge about gears, rotation speed in relation with voltage supply, current in relation with the torque, size, and many other important factors. Almost all technologies operated by motors, therefore motor comprehension will serve a very important and beneficial foundation in our career lives.

Learning will never end. We acknowledge that we will have to learn more in depth about every part in our designs. Learning is not only through successful trial, also through failures in both hardware and software designs. Our projects might fail, but failure does not mean the termination of our goals. With the goals set in mind, we will accept any failure, learn, implement, and improve from it. In the future, besides our ultimate goals of which producing a working device, we also look forward to acquiring important education and expertise related to engineering.

6. REFERENCES

Subunits:


Impacts:


URL[http://www.sforh.com/accessories/workrite-lift.html]