Project Specifications

Monitor Lift for Adjustment of Computer Display
&
Paint Cap Remover

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Monitor Lift

Introduction and Overview

The monitor lift must be able to lift an 80 lb monitor from approximately desk height, up vertically 12 inches. The lift is being designed so that it can be used in a neurolinguistics laboratory at the University of Ohio. It will be used in conjunction with an eye-tracking device to monitor and record eye movements of patients with neurological disorders in response to stimuli. The device is to be used in a laboratory/clinical setting so it must be safe and must not be distracting to patients. An eye-tracking device is placed underneath the monitor lift when it is raised off of the desk so the lift must accommodate for this by having enough open space underneath it when raised. While there are monitor lifts currently on the market, this lift must be able to accommodate a bulkier, heavier monitor than most are designed to handle. The need for it to have space for storage underneath it when raised is also unique. It must sit upon the desk but not be permanently fixed to it, and the desk cannot be modified in any way.

Realistic Constraints

Realistic constraints exist for the manufacturability of this device. The manufacturability of the parts of the monitor lift faces some constraints. It should be relatively simple. Parts cannot be custom made by an outside company since we are working on a timeline and they would probably take too long to receive. If a custom part is needed, it must be thoroughly planned out, absolutely necessary, and ordered far in advance from when it is needed. Any pieces we order that are not already welded or put together should be materials that are easy enough to assemble that we can do it ourselves. The tools available to us in the machine shops and labs constrain which pieces we will and will not be able to assemble ourselves. Another manufacturability constraint is that the parts ordered must meet specifications calculated (i.e. springs must have proper force constants). Time is a major manufacturability constraint on the project.

An economical constraint for the monitor lift is our budget. The sum of all of the parts needed to build the lift must not exceed the preset budget. Shipping and handling and tax must also be considered in the budget. Our budget for this prototype is $750 and it is required that all other expenses including shipping and handling should not exceed this limit.

An ethical constraint regards the use of budget money. The budget money should not be spent “just because it is there”. Materials should be researched and shopped around for before purchasing to make sure that the money provided by the sponsor is not wasted on overpriced goods. If there is a sale, or a different company can provide the same quality part at a lower
price, the lower priced piece should be purchased. Concern for safety is another ethical constraint. It would be unethical to design a lift that could support only 80 lbs. The monitor lift is going to be used in a clinical setting. An object weighing 80 lbs could seriously harm somebody if it fell on them for instance. If the lift failed while it was raised, it would most likely also crush the eye tracking device (which is most likely very expensive) underneath it. It would be unethical and reckless to not incorporate a variety of safety measures.

The monitor lift has no set constraints when it comes to sustainability. Wear is impossible to avoid forever but, keeping safety in mind, it should not be made of a material or in a fashion that would increase its likelihood of breaking suddenly. It will probably not be used or moved too often, so we hope the device sustains for at least 5-10 years.

Health and safety constraints for the monitor lift include the safety of the patients and users. There are no electrical devices to pose a threat. The balance of the monitor and the risk of it falling or the joint failing are the only real potential problems. Safety measures (clamp, strap, raised edges on the platform) have been taken to meet these. If a spring or dashpot broke, the direction of the fall would be managed by the guide bars and cylinders. It would not fall towards a subject. The other dashpots and other springs would lessen the impact of the failure of a single component.

There are no political constraints for the monitor lift but the social constraints include the status of the patients and the environment. The lift must not disturb the patients while they are being tested. This means that the lift cannot be aesthetically distracting (it will be all black and is designed to house the wires for the computer in a tube) and it cannot be noisy. It needs to make looking at the screen comfortable for the patients. It will also make testing the patients easier for the technicians. The implementation of the monitor lift will help make the patients more comfortable while being tested, and will also make the test results more accurate/easier to obtain. These test results may help uncover solutions to a variety of neurolinguistic problems.

The monitor lift is going to be used in a laboratory or clinical setting. It needs to be quiet so it will not disturb the patients. It cannot emit any kind of pollution or mess that may harm those around it (this is not a problem for this design since it is not powered). It must be able to stand on a desk and be compact. When it is raised, it must leave the smallest possible footprint on the desk so that a tracking device may be stored underneath it. Temperature of the room should not affect this design, though it may have an impact on the functionality if hydraulics were still being used.
Technical Specifications

Mechanical Parameters

Adjustable height
  Max. height at least 12”
  Min height no more than 2-3”
Portability
  no permanent fixation
Stability
  Noise level during operation low
Minimum Load
  100 lb
Footprint
  10”x12” clear area when raised
Execution speed
  min-max height in 1 min or less
Manual Force for Operation
  Maximum force 15 lbs
Low wear
Platform
  minimum 20”x18”
Direction movement
  up, down
  max 5” any direction not vertical
Operating Temp
  -20 to 600 F
Storage Temp
  -20 to 300 F
Storage
  sits on top of a laboratory table
Weight
  light enough to be held by a table

Aesthetic Parameters

Nondistracting
  Keep wires from user’s sight

Paint Cap Remover

Introduction and Overview

The paint cap remover is being designed to remove the caps from paint tubes. There are no products on the market for this specific application at the moment. The need for a paint cap remover has been found by our client: a painter who has multiple sclerosis. This degenerative disease makes it difficult for him to perform this simple task. The paint cap remover must be able to automatically remove the paint cap from the specific type of paint tube that this client prefers...
to use. It must be able to do this without requiring the user to apply any significant amount of strength in any way, and must not require the user to use more than one hand since he only has use left in one of them. It cannot puncture the tube since the client will not use an entire tube of paint the first time he opens it, and the device must have a long operating life under frequent use.

**Realistic Constraints**

The device is less bulky and relies on a smaller frame to operate further reducing the risk of being unstable and falling off the table. The design relies on a simple gear and motor combination that can easily be altered to get a desired speed and a safe operating motion. The nature of the design allows for the client to set the tube in the device and then leave it until complete, resulting in less risk of the client becoming endangered during the operation of the machine. The moving parts of the machine will be contained but further precaution will be able to be observed if the client can remove themselves from the area during the working operation of the device. The paint cap remover design safety has been addressed in the design through the housing of electrical components in a box. All electrical components will be grounded and the user will not come into contact with them during regular use (only when changing batteries, but those will still be separated from the rest of the electrical components. The wires used will meet engineering standards. Since the output current is relatively small, the thickness of all electrical wires that will be used in our application is small within a range of 0.254 – 0.28702 mm of diameter. These wires can also be enclosed in PVC electric conduits that are light-weight and have high impact resistance, safe and low flammability, and long lifespan. The fuse will safeguard against power surges or excessive current, which could be dangerous.

The main manufacturability constraint on the paint cap remover is the timeframe given to build it. The oil paint cap remover has a wide variety of parts; it has electrical components, structural components, and springs. Not all of these parts will be easy to find at one company. This may increase the amount of time spent waiting for parts to arrive since sometimes companies take longer to ship smaller orders.

An economical constraint for the paint cap remover device is the cost to run it. Especially since it is a device for personal use that will be used often, the cost to power the machine should not be excessively high. The budget is the main economical constraint on the paint cap remover device design. Particularly for our first prototype, the budget is $750 and it is required that we will not go over this budget.

The same sorts of ethical constraints apply to the paint cap remover. The budget money cannot be used recklessly or for anything other than the development of the project. The safety of the client is also an ethical constraint since it would be entirely unethical to develop
a product for a client that might harm them in any way. Thorough testing and planning will be done to make sure the device is safe for constant use.

The paint cap remover has no set constraints on sustainability. It is no longer battery operated so maintenance of the power supply is unnecessary. The device should function for as long as the individual components last. We expect the device to be used often so it we hope it sustains for at least 1-3 years.

The paint cap remover has more health and safety constraints because it has more types of parts. The electrical components must be grounded at all times. The client/user should not ever come into direct contact with any live wires or components. They will all be housed in a box. The motor and the cap head are moving parts. They should not be easy to get things such as hair tangled in, or fingers caught in. The device should be sturdy so that it will not fall over or wobble when it is being operated. The client may not have the strength, dexterity, or reflexes left to be able to react accordingly in such a situation. The device should be of a stable nature so that it can withstand a variety of forces without falling to the ground or becoming a projectile. The device should at no time expose the individual’s eyes, or mucous membranes to the paint which is contained in the container. The device must be designed to effectively remove the cap without removal of any of the paint which would cause exposure to the individuals own person and their environment.

The paint cap remover does not have any political constraints but it has more social constraints. The client has multiple sclerosis and as a result can only use one hand, and with little force or grip. The paint cap remover must be simply operable with only one hand. It must be mostly automatic. The objective of the paint cap remover is to give the client back his independence. Since the client is in a wheelchair there is the constraint of accessibility. The device must be readily accessible to the client so as not to promote an unnatural stance or posture during the use of the machine. Any reaching or unnatural posture during the operation of the device could lead to the device malfunctioning or becoming a falling object. The client should not have to leave a comfortable relaxed position in their chair so as to operate this device.

Since the paint cap remover is being designed with the goal to give back a sense of independence to a person, it should not be confined to a certain space. It must be not only easily operable but also easily accessible even in a wheelchair. By having the paint cap remover run on power from an outlet, the painter may be confined to use the device in only certain areas, but he will not have to maintain the device. Changing batteries may be a difficult task for the client as a result of his condition. Since the device will most likely be stored in an art room, the probability that it will get messy is a constraint. The device will either have to function when it is dirty (maybe has paint from the client’s hands built up on
it), or be easy to clean. Rubber sealants may be used to further contain the inner workings of the device so as to protect them from contamination.

**Technical Specifications**

**Electrical Parameters**

**Motor**

- **Torque**: 2-10 lb-in
- **RPM**: 45 – 1000 rpm
- **Voltage**: 1.5 – 12 V
- **Current**: 0.4 - 0.7 A

Power Source: frequent-continuous operation life of 6 months minimum

**Fuse**

**Switch**

- **Size**: 0.5”x0.5” min
- **Force to operate**: minimal~ 0.25 lb max
- **Execution time**: 40 sec max

**Resistors**: vary

**Mechanical Parameters**

**Unit size**: min 2”x2”x1”

**Specificity**: fit Gumbracher brand 1.25oz tubes

**User ability**

- **Strength level**: low
- **Dexterity level**: low

**Clamp Unit**

- **Size**: Rectangular, larger than the paint tube
- **Features**: light and easy to lift up
- **Stability**: Rubber feet for the base stabilization
- **Efficient**: Motor should run effectively once the switch is on