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User Manual: The Logic Lift

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Abstract

The Logic Lift is a motorized laptop stand designed for individuals with limited mobility. The design features two buttons on the front of the product that increases or decreases the angle of the stand (0° - 35°) through the use of a linear actuator. This product was created using many processes including 3D printing, laser cutting, circuit creation, and milling. This user manual describes how these processes were used in relation to this project and gives the reader an understanding of how the product was created and how to create or improve the product if need be.

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Introduction

A patient at St. Vincent Hospital is in need of an accessible laptop stand that reduces neck strain by raising or lowering a laptop to their desired angle at the push of a button. This problem is in need of a solution because currently, no laptop stands are capable of adjusting their angle without some manual adjustment. This leaves no viable options for those with limited mobility in their hands who are in need of a laptop stand. Our design is motorized, allowing for easy adjustments without the need for any manual adjustments. All the user has to do is ensure that the Logic Lift is connected to power and then push a button. As stated, current laptop stands require the user to manually change the angle their laptop rests at, so the Logic Lift is the first of its kind to be able to adjust the angle electrically with very little effort on the part of the user.
This user manual will describe to readers how the Logic Lift works as well as listing safety precautions, explaining the maintenance procedure, and noting recommendations for future work on the product.

Important Features

Linear Actuator:

The motor used to control the angle of the stand is a linear actuator. This device moves linearly in two directions depending on the path of current flow through the motor. The linear motion that is output, is then converted to angular motion with the use of brackets and rods connecting to the top of the stand, resulting in the raising and lowering of the stand.

Warning: the continuous motion of the actuator for extended periods of time may result in overheating, which can reduce the product's working lifespan. Please allow time for the motor to rest if the stand is being raised and lowered continuously over an extended period of time.

How it's Made/How it Works

The designing of the Logic Lift required the use of laser cutting, 3D printing, circuit configuration, and milling operations. Laser cutting and 3D printing files can be found on MakerRepo. https://makerepo.com/lwhit108/gng2101-accessible-laptop-stand-b01c

Stand Body:

The main body of the stand is where all of the components fit in and where the laptop being raised rests. The body is made out of laser-cut acrylic which is glued together to form a box. The stand is mainly made out of acrylic because the material is very strong while also being very light, which is perfect for our task of making a lightweight motorized laptop stand.

Warning: Refrain from impacts on the stand as is it not drop or impact resistant.

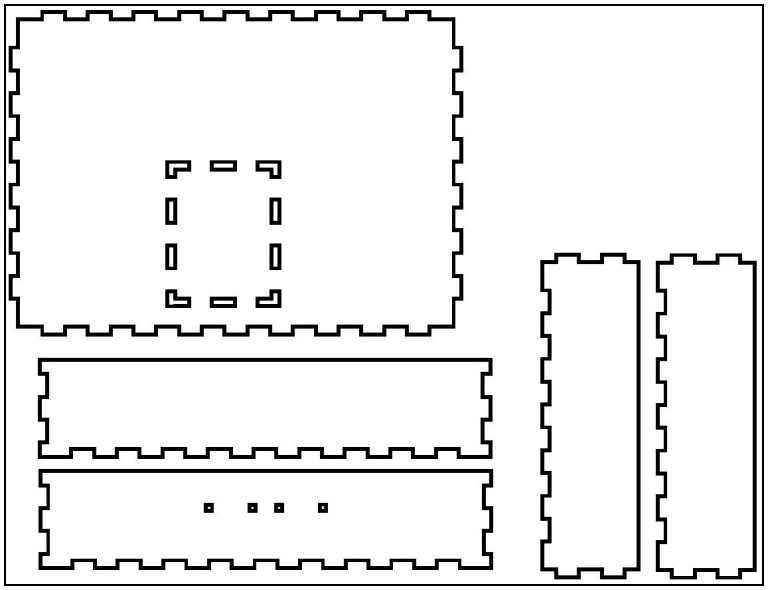

Figure 1: Laser cutting design for main box

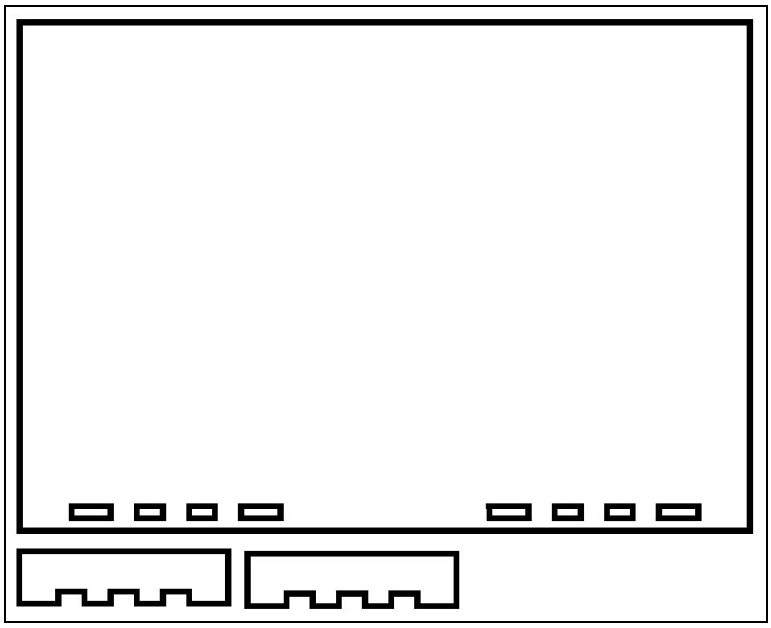

Figure 2: Laser cutting design for top of box

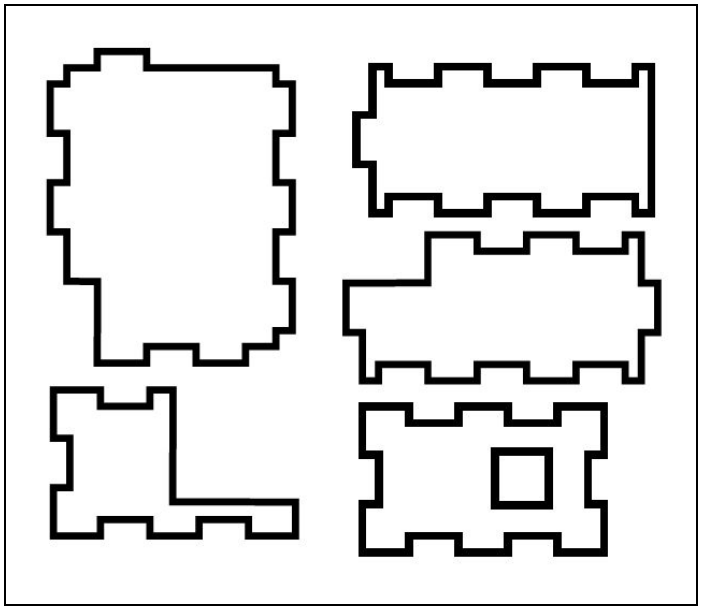

Figure 3: Laser cutting design for inner actuator box

To strongly hold the stand together, "finger" cut designs (figure 1) were added to increase the surface area being glued together and increase the accuracy of pieces being attached together. The top of the stand (figure 2) was not attached this way because it is hinged on the front of the stand, allowing its angle to be changed by the linear actuator. The linear actuator is secured in the stand in a miniature box (figure 3) which prevents it from moving while still allowing it to control the lifting required of the stand.

Buttons/Wiring:

The wiring for the buttons is demonstrated in the circuit diagram below. A 12V power source is connected to the circuit on both sides, where the electricity is allowed to flow through the motor when the buttons are pressed. Two buttons are used to control the positive and negative directions respectively on a given side of the actuator. This allows for current to flow through the actuator in the desired direction, resulting in the motion of the stand.

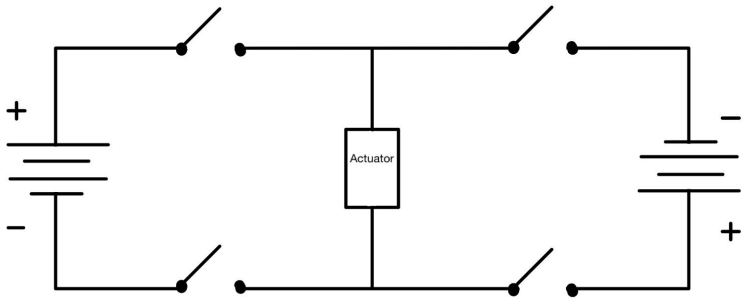

Figure 4: Circuit Diagram

The wires are glued to the inside of the stand to prevent loose wiring from getting stuck in the actuator and breaking the circuit.

Button Casing:

The buttons are housed in a 3D printed plastic case on the front of the product.

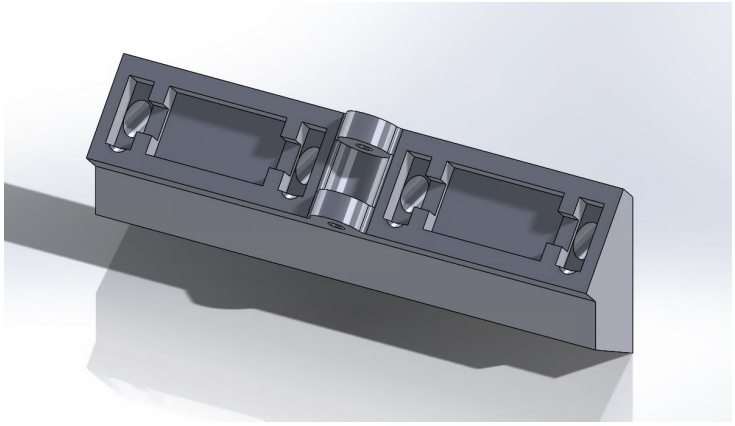

Figure 5: Trimetric view of button base

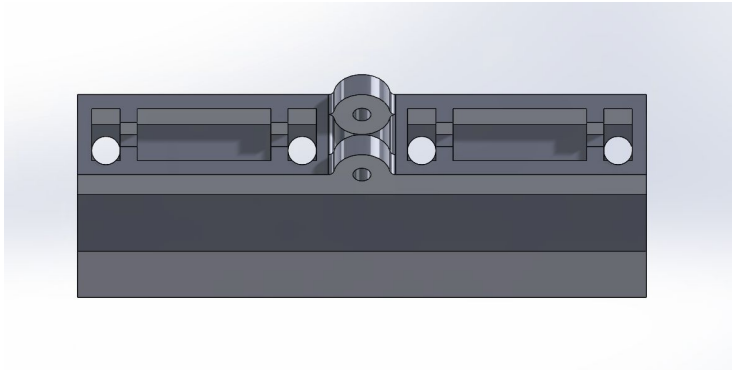

Figure 6: Front view of button base

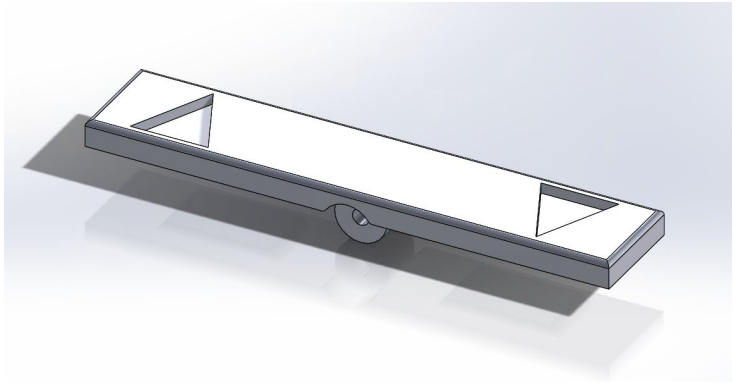

Figure 7: Trimetric view of button top

The button base and top are two separate parts that connect at the hinge in the middle. The buttons discussed in the previous section are glued into the slots on either side of the base (figures 5 and 6) and the wires are fed through the holes in the back (figure 6) and into the actual laptop stand box. The button casing allows for an easy and convenient way to push both buttons required to power the linear actuator at the same time. Because the back of the button case has a relatively large surface area, it is strongly attached to the Logic Lift by super glue.

Rods:

The lift mechanism is made out a number of pieces ranging from steel brackets, steel rods, and custom machined aluminum connecting nuts. One of the steel rods are connected to the linear actuator, which has the connecting rods attached to brackets that are bolted to the top of the stand. The steel bolts and the aluminum connectors are tapped and threaded for a M8 x 1.0 thread. All threaded connections have loctite applied so the connection is solid and won't come loose.

Figure 8: Rods connected from actuator to top of stand

Health and Safety

Always use a grounding outlet when plugging in the stand to avoid any short-circuiting and damage to the motor.

Troubleshooting

1.) Ensure that the plug at the back of the stand is completely connected to the power source
2.) Remove the top of the button casing to check if the 2 up and 2 down buttons are being pressed simultaneously

Conclusions and Recommendations for Future Work

For future development on the Logic Lift, the holes for the hinges and brackets should be added to the laser cutting file to more accurately place the holes. Next-generation lifts may want to use materials other than acrylic as the long term structural resiliency of the lift is unknown. Water jet cut aluminum may be a stronger material and would increase the lifespan of the product.

Appendices

The button case design was adapted from the "Light Touch Switch" design found on Makers Making Change, a website on which makers take on accessibility projects requested by clients with disabilities. The light touch switch is only designed for one button and one wire, so major modifications were made for the purposes of this project. The original design can be found here: https://www.makersmakingchange.com/project/light-touch-switch/