GNG2101

Design Project User and Product Manual

DELIVERABLE I

Submitted by:

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Table 1. Acronyms

Acronym	Definition
ABS	Acrylonitrile butadiene styrene
PLA	Polylactic acid
DPDT	Polarity reversing switch
CAD	Computer aided design
3D	Three dimensional
PVC	Polyvinyl chloride

Table 2. Glossary

Term	Acronym	Definition
ABS	ABS	Acrylonitrile butadiene styrene
PLA	PLA	Polylactic acid
PVC	PVC	Polyvinyl chloride

1 Introduction

The purpose of this user manual is to help the reader better understand, maintain, or integrate into future projects. With the task of creating a wheelchair tablet holder, a prototype was created to best fit the desired user. The prototype consisted of various electrical components such a linear actuator, 9volt battery, and many others listed in the document. The overall goal was to give children with disabilities a little autonomy when using their devices. With just the simple push of a button the user can adjust the tablet holder to their preferred position.

2 Overview

The problem we were presented with was the following: to make a innovate and better tablet holder, for wheelchair users, than what is currently offered on the market. The fundamentals needs that are customer presented to us were automated design, had to stay on the tray at all times, must be able to be put away when not in use and small and compact. The automated design was to make to give some of the wheelchair users more autonomy as not all of them would be able to put up and put down a tablet holder by themselves. They wanted a holder that could stay on at all times and one that could be put away for the same reason. Not all wheelchair users are autonomous enough to take off or attach a tablet holder. The small and compact size was a need as we did not want our product to affect the comfort of the user whilst it was in use.

The key difference between our product and the ones available on the market is truly the automated design. Most products available now must be attached and taken off when not in use. Others are small divots in the tray that allow a tablet to be leaned on. our product can be put away when not in use with a push of a button. Also, when our product is put away it allows the whole tray to be used.

Figure 1. Final Prototype

Our final product can be broken down into a few key components. The tray itself is a regular PVC tray that we bought. The cover that comes down over the Ipad is a plastic board. The tablet is pushed up by an actuator and is held up by a plastic printed part. The whole electrical circuit is powered by a 9-volt battery.

2.0 Conventions

- Action press button to the left to make Ipad go up.
- Action press button to the right to make Ipad go down.

These two commands are self-explanatory, when you push the button one way it makes the tablet go up and if you push it the other, it goes down.

2.1 Cautions & Warnings

The only warning needed would be to no use our product outside or anywhere where the tablet could get wet. The cover is not designed to be waterproof; moisture could damage the tablet.

3 Getting started

1. Install tray on wheelchair using the designated velcro straps to go around the arms of the wheelchair and tie them tightly so that the tray is secure.
2. Install Ipad on the velcro attachment of the tablet holder.
3. The user can then press the button to have the ipad lift upwards, to the desired angle.
4. When the button is released, the motion will stop and the Ipad will be held in place at that angle.
5. To bring the ipad down, simply press on the other side of the switch and hold.
6. At the limits of its movement (up or down) the tablet holder will automatically stop its movement.

Figure 2. Activation switch for user

3.1 Configuration Considerations

Our configuration is based on a mechanical arm that moves horizontally enabling the tablet holder to go up and down at an angle due to a pin connection. The mechanical arm's movement is powered by an actuator, which is a motor pushing a rod in or out of a casing.

3.2 User Access Considerations

The main user for the system would typically be a disabled child that is unable to hold or to move an iPad when he wants. The system enables a child to bring an Ipad to a usable position with the simple click of a button. The restriction for the user with this system would be the fact that the tray as a whole would have to be removed by someone else, since it is fairly big and needs to be detached from the wheelchair.

3.3 Exiting the System

The system is automatic. It does not need to be turned off since it will not move if the button is not pressed in the ascending or descending position. To completely close the system, press the button in the descending position until the iPad is parallel to the tray and the tray covers the entirety of the iPad. The system is then flushed with the tray. If the user wishes to take off the system, screws and hinges can be taken off. It is possible to use the entire tray while the system is off.

4 Using the System

4.1 Pressing button to the right

Pressing the switch to the right will make the linear actuator come out, meaning that it will push against the arm to make the tablet holder come upwards at an angle.

4.1.1 Releasing the switch

Releasing the switch will make the linear actuator come to a complete stop and hold the tablet holder in place at that angle.

4.2 Pressing button to the left

Pressing the switch to the left side will make the linear actuator retract, causing the tablet holder to come down and eventually stopping when it is flush with the tray's surface. While coming down, the cover will come down as well by that movement, then completely covering the tablet and the holder.

5 Troubleshooting & Support

If the user is pressing the button and the iPad is not moving, there might be multiple reasons as to why this might be the case. First, the user should check if they are pressing the button all the way down. If the system is clearly not moving, use a screwdriver to take off the screws that hold the system to the tray, and change the battery. The user can then proceed to test the system before screwing it back to the tray. If it works, the system can be screwed back, if it doesn't, then the problem might come from the wires, the polarity invertor or the linear actuator. If the problem comes from any of these parts, please contact support, since it might be dangerous to change these parts without any caution.

5.1 Error Messages or Behaviors

5.1.1 Errors behaviours concerning physical subsystem

- Failure of adhesive: If the adhesive between two components fails and causes the components to separate, the components can be merged again with another application of adhesive. Make sure all the adhesive from before is cleaned before appliance.
- Failure of a physical component: If a specific component fails, it can most likely repair with application of adhesive. If it can't be repaired the part needs to be changed.

5.1.2 Errors behaviours concerning electrical subsystem

- Short-circuiting:

If there is smoke or heat coming out of the bottom compartment of the tray; remove the battery immediately, allow the product to cool and ventilate the room.

- Failure of an electrical component:

If an electrical component fails, it is unlikely that it can be repaired. In this case, the failed component needs to be identified and replaced.

5.2 Special Considerations

- The product runs on a 9V battery. If the assembly is not working at all, first, you would like to check if the battery is dead.
- If the electrical subsystem is not assembled correctly, this may result in permanent damage to some components.
- The limits of the are already determined with extensive testing and analysis. If the limits mentioned in the Testing and Validation (Section 6.3) are exceeded, this may result in permanent damage to some components.

5.3 Maintenance

- Clean every two months.
- Apply lubricant to joints every year. (WD-40 recommended)
- Change the battery at least once a year to avoid battery leakage.

5.4 Support

If you want to make an inquiry about the product you can click this link https://innovativesolutionsltd.com/customersupport/ or you can call +1(123) 456-7890

6 Product Documentation

6.1 Physical Subsystem of Prototype

6.1.1 BOM (Bill of Materials)

TABLET HOLDER FOR WHEELCHAIR TRAY (PHYSICAL SUBSYSTEM)			
ITEM NO	**DESCRIPTION**	**QUANTITY**	**MATERIAL**
1	Tray	1	ABS
3	Hinge	3	Brass
4	3D Printed Holder	1	PLA
5	3D Printed Arm	1	PLA
6	Cover	2	ABS
7	Velcro	1	Velcro?
8	Screws	6	Stainless Steel
9	Box For Electrical Components	1	ABS

Figure 3: Bill of Materials for Physical Subsystem

6.1.2 Equipment list

- Adhesive Tape
- Screwdriver (Slotted)
- Strong glue

6.1.3 Instructions

1. Carefully open the packaging of the contents.
2. Glue the **box for electrical components** under the **tray**. The hole for the polarity reversing switch must be facing the user.
3. **Screw** all of the **hinges** to the pre-drilled holes on the cut side of the tray. Note that there are two pre-drilled holes for every hinge.
4. Glue the socket on the **3D printed holder** to the **hinge** in the middle. Note that thinner side of the part must be facing up when it is lifted.
5. Glue the sockets of the **covers** to the **hinges** on the sides.
6. Once the electrical assembly is done, put the assembly to the wheelchair using **Velcro**.

6.2 Electrical Subsystem of the Prototype

6.2.1 BOM (Bill of Materials)

TABLET HOLDER FOR WHEELCHAIR TRAY (ELECTRICAL SUBSYSTEM)			
ITEM NO	**DESCRIPTION**	**QUANTITY**	**MATERIAL**
1	Actuator	1	Metal?
2	Polarity Reversing Switch	1	ABS and Metal
3	Copper Wire	40cm	Copper (Plastic Coated)
4	9V Battery Connector	1	ABS and Metal

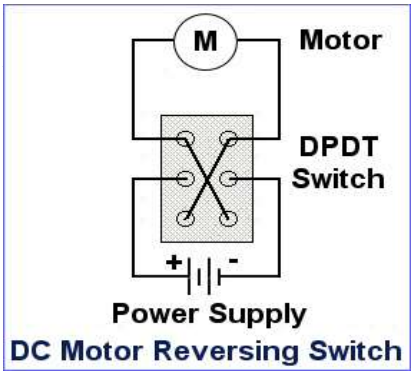
Figure 4: Bill of Materials for Electrical Subsystem

6.2.2 Equipment list

- Soldering Iron
- Solder
- Electrical Tape
- Adhesive

6.2.3 Instructions

1. Assemble the **polarity reversing switch** as shown in the figure below



2. Glue the **polarity reversing switch** to its place on the **box for electrical components.**
3. Solder the 2 wires coming out from the cross cables on the **DPDT** to the two terminals on the **actuator**.
4. Cut two pieces of **copper wire** and peel both ends of them.
5. Solder one side of the **copper wire**s to the remaining two terminals on the **DPDT**.
6. Solder the other side of the **copper wire**s to the **9V battery connector**.
7. Cover the naked wires with electrical tape.
8. Glue the **actuator** to the marked place on the **box for electrical components**.
9. **Go back to step 6 of the instructions on physical subsystem**.

6.3 Testing & Validation

Structural integrity and reliability of the product has been tested in both CAD and real life. The tray can hold up to 11 lbs worth of load and the product is compatible with any tablet in the market which are smaller than 9.74 x 7.02 inches.
The battery life of the product has been confirmed to be >4 hours in continuous usage.

SPECIAL REQUIREMENTS:

- Avoid contact with water.

7 Conclusions and Recommendations for Future Work

During the design process we encountered challenges and faced unforeseen circumstances that hindered the progression of further work, this project was a beneficial learning experience. As a team we were able to utterly understand the implementation of the design process, each team member learned valuable characteristics of themselves and how they interact with other team members, as well as how they can improve to avoid any problems that may have occurred during the semester. The main lessons our group learned were in areas such as organization, time management, and contingency planning. Organization was key to keep the group constantly on task. With members unable to meetup and work together, work had to be divided strategically among members and durations set, keeping in mind dependencies. Furthermore, with changes in circumstances unpredictable, there was a need to be very flexible at times with our plans and consider different scenarios that might unfold. These are lessons which can be applied in the real world of engineering jobs. Our team's solutions is a steppingstone for anyone looking to further the design of this protype.

APPENDICES

8 APPENDIX I: Design Files

Document Name	Document Location and/or URL	Issuance Date
Youtube Video	https://www.youtube.com/watch?v=7VG19yu6obo	April 6th 2022
Solidworks Assembly	Concept2.zip	April 11th 2022