GNG 2101

Design Project User and Product Manual

Power Grabber User Manual

Submitted by:

Power Grabber 2 C2.2

German Soublette, 300265195

Palmer Insull, 300069587

Calum Avon, 3002655709

Ethan Loiselle, 300197590

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University of Ottawa

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List of Acronyms and Glossary

Table 1. Acronyms

Acronym	Definition
BOM	Bill Of Materials
PG2	Power Grabber
UPM	User and Product Manual

Table 2. Glossary

Term	Acronym	Definition
Grabber		Short for Powered Grabber

1 Introduction

The Power Grabber is intended for anyone who struggles with difficulty of movement of their arms, as well as for those with medical conditions that limit grip strength and overall arm strength. This manual is intended to be read along with using the device to know specific modes or options available within the interface, and any safety hazards or precautions that might be important to note. This product manual should only be read by educators, students, and those who intend to use the device.

This User and Product Manual (UPM) provides the information necessary for people to effectively use the Power Grabber (PG2) and for prototype documentation.

2 Overview

Many people with different limb medical conditions, or disabilities, often struggle to pick up and move objects due to a lack of hand and grip strength. Options in the current market are not equipped for users that are below 12 years old, and are often found by the user to be either too heavy, or not short/long enough. Therefore we took up the challenge to produce an alternative for those younger in age to be able to pick things up in an easier and more convenient way.

Power Grabber is the alternative that provides users with a light, sensor powered, adjustable solution that children between 4-8 years old can count on. Our device features two touch-sensors with incredible haptics that allow for ease of operation, fully equipped with a strap based ergonomic arm rest that allows for children for more than 2 years. The power mechanism operates a magnetic jaw which allows for metallic objects to be attached with extra effort from the user. Its weight comes at just over one pound of weight, which allows for ease of use due to its portability, while still allowing to carry objects of up to 4 kg.

2.1 Cautions & Warnings

- Users must be cautious while operating the device and using the touch sensors, the cable used for the touch sensor provides a choking hazard if bundled on the neck of the user.
- The jaws must be operated with caution when opening and must be kept away from people's faces.
- When closing the jaws, make sure peoples hands are kept away from it, it could pose a risk and severe damage to hand and fingers.

3 Getting started

3.1 Configuration Considerations

Setting up the powered grabber is as simple as determining the most comfortable location for the handle, strap, control board and battery. These components are designed to be movable, and configurable to suit the specific user needs as best as possible. For example some users might find it preferable to operate the claw with the control board in their other hand whilst others might prefer to have it in the same hand and attached with magnets. The setup of the grabber is tool-less, and operation of the grabber requires a single usb cable to connect the battery to the grabber itself. longer cables will be required depending on the placement of the battery in comparison to the grabber.

3.2 User Access Considerations

The system is designed to be used by anyone who requires or would like to use it. for this reason it is designed to be compatible for all users. It is however possible to limit the grip strength through the microv controller for users such as small children.

3.3 Accessing/setting-up the System

The system set up is dependent on the previous state of the system. In the event that the grabber was both folded and the battery was disconnected and removed, the setup consists of unfolding the arm and securing it using the built in clasp. In addition the grabber must be powered using the battery. The battery is connected using a USB cable. Once both of these steps are carried out, the grabber arm is operational and ready to pick up objects.

3.4 System Organization & Navigation

The system has no navigable menu.

3.5 Exiting the System

When the system is no longer in use, it is recommended that the claw be left in the open position to avoid stretching the winch wire over time. Additionally the battery can be removed and charged for future use. The battery is charged through a USB cable and a USB socket If desired the claw can also be folded by releasing the clasp half way down the arm and simply folding the grabber in half.

4 Using the System

The grabber was designed to be as simple as possible, as it was to be used by young children. For this reason the controls were made as simple as possible. The main function of the claw can be separated into two categories, Opening and Closing the claw.

4.1 Operating The Claw

The Claw is the main, and only actively user controlled system of the claw. It functions by opening and closing upon user input through the capacitive touch sensors located on the control panel. The claw is designed to remain in position after the user has stopped touching the sensor. This means that the claw will keep objects gripped without user input until the user opens the claw again. The claw can be opened and closed as necessary to pick up and release objects that the user desires to manipulate.

4.1.1 Closing The Claw

The claw can be closed once the battery has been connected and the arm is unfolded and clasped together. to close the claw simply place a finger on the screen that is marked with a close label. This will run the servo motor until the finger is released or until the claw has fully closed. The claw will remain closed and exert a gripping force on the object until it is opened again.

4.1.2 Opening The Claw

The claw can be opened again by pushing the button labeled “open”. It is the sensor that was not used to close the claw. Once the claw is set up as stated previously, simply touch the sensor until the claw is in the desired position or fully open. the claw will remain in this position until closed again by the user.

5 Troubleshooting & Support

In the event of system failure, it is likely that 1 subsystem has failed and not the entire powered grabber. This section is designed to help diagnose and repair the failed system.

5.1 Error Messages or Behaviors

It is possible that the wire connecting the servo motor to the claw mechanism will stretch or break over time. This can be diagnosed from the motor spinning but the claw not moving, the sound of a wire snapping or possibly insufficient grab force and play in the claw. replacing the wire is simple, and is covered in section 5.3

In the event that the system does not power up, it is possible that the battery has not been charged or is not connected to the grabber properly. in the event that this happens check the connection to the battery, and recharge the battery if necessary.

If the light on the control panel confirms the input of the user and power, it is possible that a wire or soldered connection has broken. To fix this open the electronics box and inspect for loose or broken connections. if necessary, resoldering might be required, otherwise reconnect loose wires.

5.2 Special Considerations

In the event that a solder joint has broken, the grabber may be returned for repair if the client is not capable or comfortable resoldering the joints.

5.3 Maintenance

If necessary, to change the wire connecting the motor to the claw, simply fold the claw in half, remove the claw mechanism from the rod, and pull the wire through the whole on the servo motor. to replace the wire, run the wire through the servo motor until reaching the ball on the end. then run the wire through both sections of the arm and connect it to the claw mechanism. The wire can be cut to length once connected if desired. The process is completed by reassembling the grabber arm.

5.4 Support

In the event that support is required, feel free to contact one of the group members. Please include images of the area in question. Group members can be reached at the following emails;

pinsu092@uottawa.ca elois095@uottawa.ca gsoub100@uottawa.ca cavon014@uottawa.ca

5.5 Claw Assembly

5.5.1 BOM (Bill of Materials)

Item / Source	Qty	Unit Price	Total Price	Description
Seeeduino XIAO	(1)	7.80	(0)	Donated USB C Arduino microcontroller.
20KgCm Servo Motor	(1)	26.00	26	Main actuator, 20KgCm servo motor.
DRV8871 Drivers	(1)	12.20	(0)	Motor/Stepper drivers, pre-owned.
Touch Sensor	2	8.60	17.2	Adafruit AIO capacitive touch sensor.
Limit Switch	(1)	NA	(0)	Pre-owned spare limit switch.
Perf Board	(1)	NA	(0)	
Battery Bank	1	22.70	22.70	Battery bank to power the whole system.
LED Light Strip	(1)	NA	(0)	Generic lighting strip.
Donation Grabber	(1)	NA	(0)	Donated from the Tetra Society. Will use parts, or adapt to utilize pre-existing gripper mechanisms.
3D Printed Parts	?	0	0	Free of charge from the UOttawa makerspace. The space 3D printers will be used to make many custom components.
TBD Fasteners	?	?	?	Unfortunately at this stage we do not know which fasteners we will need. We will design our components to use simple, cheap, and available fasteners or glue.
Budget Total	$77.30 ignoring donations, $65.90 including donations			

5.5.2 Equipment list

The following Equipment was used to assemble the prototypes

- 3D Printer/filament
- Soldering Iron/Solder
- pliers/wirestrippers
- screwdriver kit

5.5.3 Instructions

To build the grabber arm, start by removing the handle on the grabber. This is done by removing all necessary screws. Once done, place the control panel on the claw side of the arm followed by the handle. Once done, place the 3D printed loop and strap on the back side of the arm(where the grip was taken off). finally mount the servo mount on the end, just behind the loop

Mount the winch to the servo and glue the servo into the mount. The winch end should be on the far side. Once complete the wire can be run through the hole in the winch, run through the arm and connected to the claw assembly. The wire can then be connected to the grabber assembly and cut to a desired length. After this is done the grabber assembly must be placed on the end of the rod to complete the assembly. .

5.6 Testing & Validation

The Prototype was tested by simulating some basic use cases that the user might experience. Objects ranging in size, weight and material were picked up and released using the grabber. Additionally the grabber was tested in terms of durability.

Unfortunately due to time constraints and our relatively late prototyping, we were not able to get the prototype into the clients hands to be tested. This means that the ergonomics could not be tested as none of us had small enough hands and arms to simulate the client. We would like to in the future have the client test and comment on the ergonomics and make the necessary changes.

6 Conclusions and Recommendations for Future Work

We believe that our idea of moving as much weight to the back of the grabber as possible was ideal for the specific client, as it reduces the amount of torque the user would endure from the end of the grabber. This idea was created through brainstorming and collaboration. This step is vital as the smallest ideas can become game changers later in the process. In the future we believe in time management. It would have been ideal to complete the prototype earlier to allow the client to test the prototype and find places where it could've been improved. We believe that the product could have been made even lighter with the use of a carbon fiber or fiberglass tube, and removing material where it is not necessary in the 3d prints. These would combine to remove additional weight and increase the amount of weight the user can carry.

If more time was allocated for the project, we initially planned on implementing a toggleable LED light strip at the bottom of the grabber, this would make picking up objects in dark areas more feasible. There was room in the budget but we ultimately decided not to incorporate it due to time constraints. We could also include a magnetic claw to help pick up metal objects. Additionally it would have been ideal to get the product into the users hands to be tested. This would allow us to alter the ergodynamics to make them ideal for the user, and make any other changes that would be suggested. we didn't have a chance to give the client the powered grabber due to time alone. We would have also liked to implement a system that would allow the user to adjust the tension of the wire, and the length of the rod eventually.

APPENDICES

7 APPENDIX I: Design Files

Makerepo Link: https://makerepo.com/CalumAvon/1163/edi

Table 3. Referenced Documents

Document Name	Document Location and/or URL	Issuance Date
Solidworks Files + Stl Files	Makerepo Within Zip - Power Grabber Solidworks	2022-04-10
Arduino Sketch	Makerepo - Power Grabber Sketch.ino	2022-04-8
Circuit Diagram	Makerepo - Circuit Diagram	2022-04-8