GNG 2101 - Introduction to Product Development and Management

Deliverable J:
User Manual

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ABSTRACT

For people with disabilities, independence can be hard to come by. Many people with disabilities have to rely on caretakers or family members to assist them with their needs. Assistive devices can allow people with disabilities to regain a bit of independence and freedom by restoring bodily autonomy. With assistive devices, people with disabilities take back control of their lives and bodies.

Our client, Dr. Finestone, is the Director of Stroke Rehabilitation Research at Elisabeth Bruyere Hospital. He works primarily with recovering stroke victims, who often have mobility issues. Our client said his patients often have trouble with one small thing: cutting their toenails. Although this may seem like a trivial issue, there is a lot of dignity and independence tied to taking care of one's own hygiene. Our goal was to allow people with limited range of motion to regain that independence and dignity, by providing a tool that could help them trim their own toenails.

We took client feedback throughout the project, as well as input from people with disabilities in our own lives, to reiterate through the design process and finally land on our solution. This product is not only more cost-efficient than hiring professionals to complete that task but can be operated alone, as it is a hands-free device, and it is easy to maintain. We hope that EZTrim will help people regain their independence and bodily autonomy.

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Introduction

Three months ago, a very important issue was brought to our attention; people with movement limitations, such as stroke patients, the disabled and the elderly, have great trouble trimming their toenails. This almost trivial task, which is taken for granted by able people is almost impossible for someone who is unable to look down without becoming dizzy and is unable to reach their feet. Our client, Dr. Hillel Finestone, who works with recovering stroke patients at the Bruyere Institute of Medicine & Rehabilitation gave us a clear goal: to provide a practical solution to trim the nails of people who are unable to do sp on their own.

In 2019, According to the Ontario Stroke Network[1], 300 000 Canadians lived with the consequences of strokes. 40% of them were left with moderate to severe impairment, and 25% faced only minor impairment. However, 10% of stroke victims were left with dire consequences requiring long term care assistance.

After consulting with our client and also having taken a look at the current state of our province's long term care conditions — most notably the shortage of staff, it became apparent that an autonomous solution had to be developed to aid long term care workers with the care of their patients.

Our team designed a simple, easy to use machine which could revolutionize toe cutting for future generations to come. The platform is meant to be universally accessible, intuitive to use, and easily expandable. Manufactured using the latest manufacturing techniques, this product is also built to last, bringing the first ever fully autonomous nail trimmer to the market from our desks to your hands.

Sincerely,
The EZTrim Team

[1] http://www.ontariostrokenetwork.ca/pdf/Final_Fact_Sheet_Stroke_Stats_3.pdf

Features and Usage

The features of this accessible trimmer include motion on 3 axes, controlled via servos. The device receives user input via a smartphone application. The physical trimming component is similar to that of an electric nail file. However, the grinding wheel is coarser and the voltage to the device has been increased for more torque to grind toenails. The trim wheel is recessed in the plastic to ensure safe usage and no nicks.

In the box:

- EZTRIM 1.0
- User manual
- EZTrim Sticker x2
- Warranty Documentation

Technical Specifications

Component	**Rating**
Power Supply	5V - 16V DC with transient protection. Internally fused at 8A.
Power supply (average current draw)	Approximately 45mA acquiring, 35-40mA tracking
Plastic	PLA Plastic
Operating temperature	0℃ to 40℃ with 0.5A load
Internal Computer	Maestro servo Driver
Servos	.9-20kg
LED	Tri-Colour
Max Load on Mechanism	.9-20kg/cm
Lubricants	Silicone Lubricant
Minimum Foot Size	Men’s 4.5 US / Women’s 6 US
Maximum Foot Size	Men’s 18 US
Dimensions	25x60x12

Table 1. Technical Specifications

Requirements

- 120V power outlet
- Stable Bluetooth smartphone connection

Using The Device

LED Information

LED Colour	**Significance**
Red	Device has power and is searching for Bluetooth
Four short red flashes	Device has paired with smartphone
Green	Device is ready to trim
Flashing green	Trimming in Progress

Table 2. LED Guide

1. **First Setup**
    a. **Plugging in the device**
    b. **Downloading the app**
    c. **Pairing device to app**

2. **Getting Ready to Trim**
    a. **Connect device to power and turn on**
    b. **Start the app**
    c. **Place foot in device with foot at heel rest, as seen in Figure 1**

Figure 1. Placement of foot in device

    d. **Click ‘Locate foot’**
    e. **Once located, click ‘Start’**
    f. **Using buttons seen in app, maneuver device to trim nails**

g. **When finished, click ‘Done’**
h. **Remove foot from device**
i. **Disconnect device from power**

3. **Maintenance**
    a. **Maintain silicone lubrication**
    b. **Occasionally brush the trimmer grind wheel to remove nail debris**

4. **Safety**
    a. **Precautions**
    b. **Risks: not recommended for hemophiliacs**
    c. **Warnings**
        i. **Do not operate under the influence**
        ii. **Do not operate near bodies of water or in potentially harmful environments**

Best Practices

In order to trim safely, you should first understand the use of the app and the movement options available. Once you are comfortable with the usage of the device, you are safe to use the device on your nails. Always remember, due to the recessed nature of the trimmer, it cannot cut you. In order to maintain the device, the current model requires an input of silicone grease to keep the PLA from sticking while moving the arm. In the future, we intend to find plastics that require less maintenance. If you ever feel your device isn't responding correctly, you can recalibrate the device by moving it to its primary position and pressing the reset button on the servo driver.

Terms of Use

We are currently running open source software and have found no infringement of patent. Therefore, we intend to sell our product and patent it. As far as legal liability, we would have to take with the Department of Health Canada in order to get a product like this in the market. More testing and better automation of movement would be required to make the product meet specifications as a healthcare product.

Frequently Asked Questions

Q: Why is this product necessary?

A: This product gives freedom to those who would otherwise need help trimming their toenails, restoring independence, dignity, and bodily autonomy.

Q: Is it safe?

A: Yes! EZTrim is the world's safest automatic nail trimmer that offers users the care they need at a reasonable price.

Q: Will it cut my skin?

A: There is no risk of cutting the skin. The trimmer uses a grinding wheel instead of a blade, and the wheel is recessed in order to avoid contact with the skin.

Future Works

The device in its current state will still need a lot of work for it to function properly and reliably. The most important points to be addressed for this project are: to wire a controller up to the positioning system and control the trimmer remotely, to integrate a 3D mapping system and positioning system to detect the nails in 3D space, and to position the trimmer to properly trim the nails. We believe it might also be useful to experiment with different materials, such as carbon fiber, composites, metals and other plastics, as well as a variety of manufacturing techniques to not only improve the quality and durability of our design, but also the aesthetic.

Development

The prototyping process for this project was a long journey that started with many ideas and very little direction. By the end of concept generation, we knew we were going to be able to adapt an automatic nail file to a device that could move in 3D space. As we entered the prototyping phase, we had our first vision of the solution built in macro parts as seen below. This

prototype was never made to function, only to represent what the idea might look like.

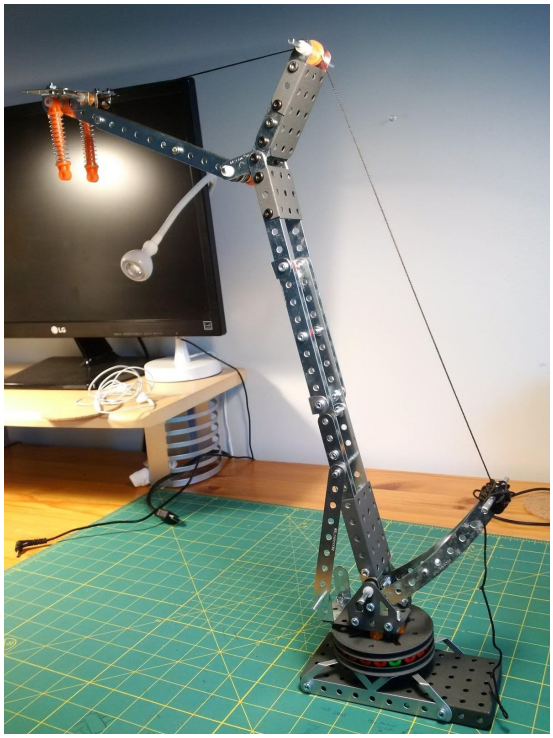


Figure 2.1. First prototype

Our next prototype is similar in that it was not made to function. However, we needed to change the design. We learned from prototype one that we wanted a smaller solution that would be less cumbersome to store and use. Seen below is prototype 2, the more condensed version of the previous prototype.

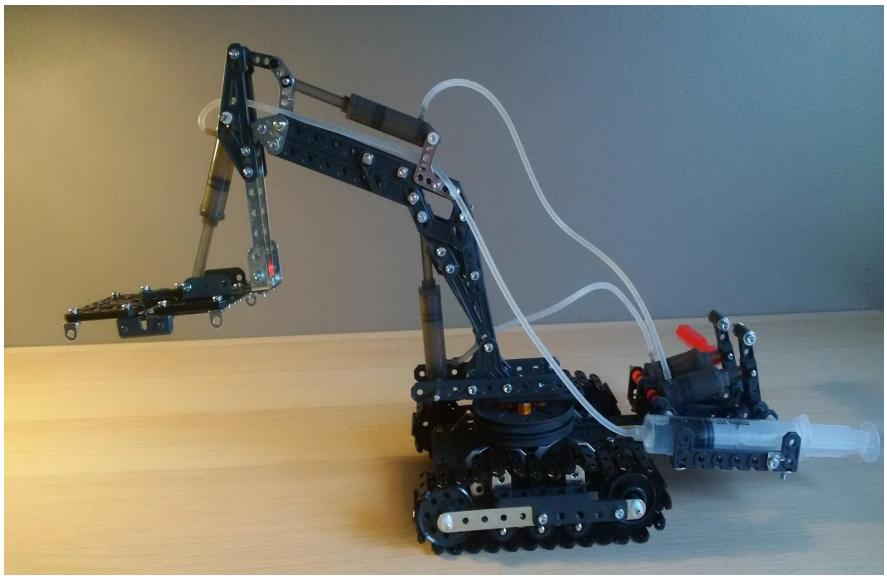


Figure 2.2. Second prototype

In our third prototype, we made a CAD version of our revised design that could be 3D printed and operated with servos. Seen below is the 3rd prototype. We were unable to find a model of the automatic nail trimmer, and used a traditional trimmer as a stand-in.

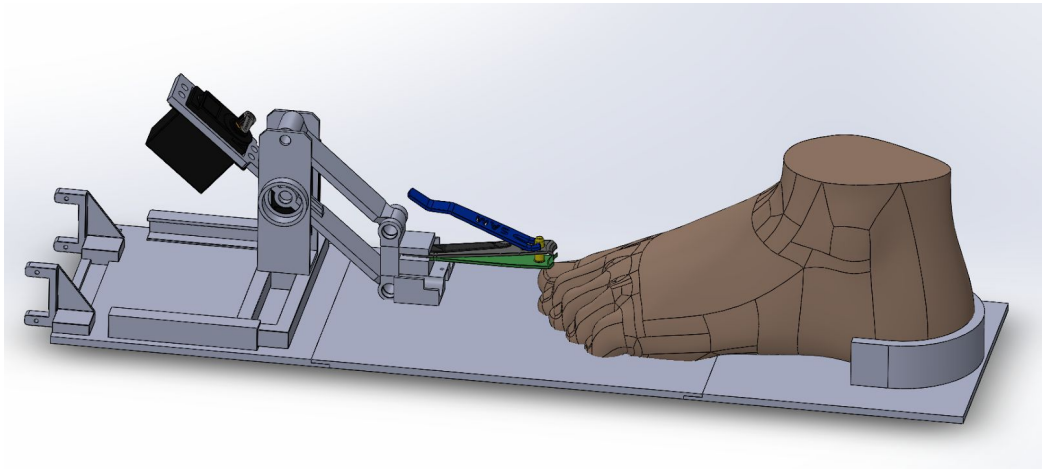
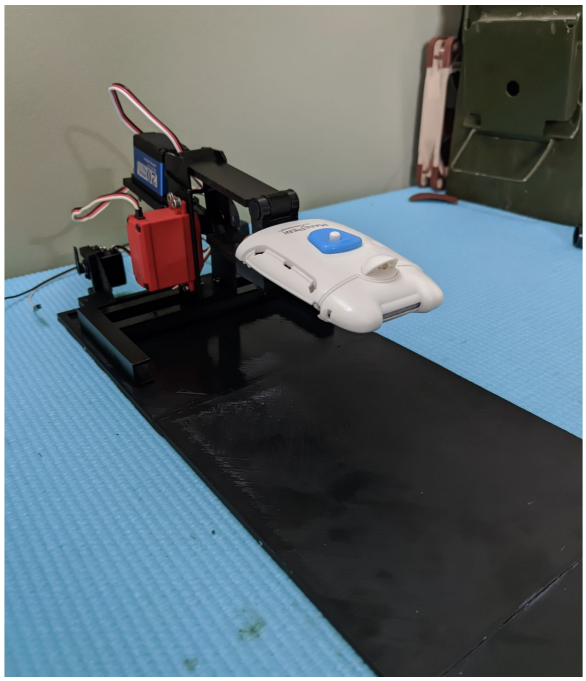
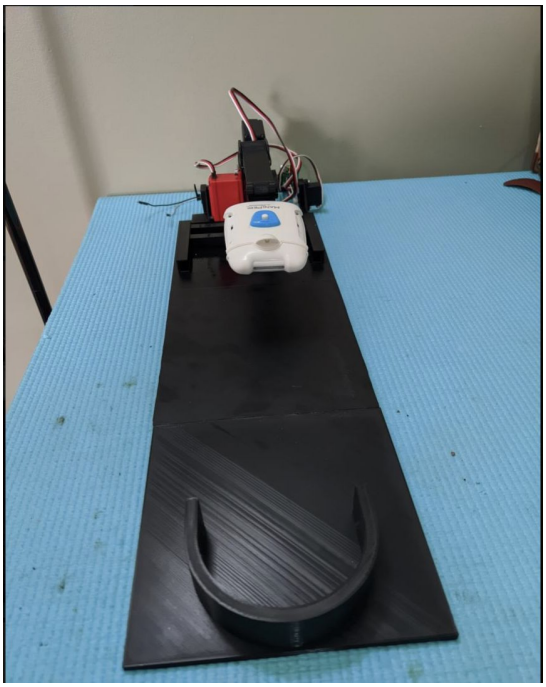


Figure 2.3. CAD Model

We then printed and assembled the design and created our final prototype.





Figures 2.4, 2.5, 2.6. Final product

Troubleshooting

If your device is not operating correctly, first check the lubrication of the arm to ensure it's not dry. If there is insufficient lubrication, apply more. If there is sufficient lubricant, you should rest the arm by moving the arm to its primary position and storage position in the left back corner of the device, then hit the reset button on the Maestro servo controller and the arduino. Disconnect your phone from the device via bluetooth, and reconnect. If problems persist, restart the device and your smartphone. If the device is still malfunctioning, please contact our customer service line at 1-800-xxx-xxxx.

Conclusion

In conclusion, there are many people, even today, suffering in silence, unable to care for themselves. Our team saw an opportunity not only to help people trim nails, but also to help change lives. Taking feedback and working together with our client, a professional in the field, our efforts resulted in a device that has the potential to aid many people in the future.

Appendices

Bill of Materials

Item	Quantity	Price	Link
20 kg Servo	1	23.99	https://www.amazon.ca/gp/product/B0887TFL38/ref=ppx_yo_dt_b_asin_title_o02_s00?ie=UTF8&psc=1
15 kg servo	1	already had	Old servo from rc car
9g servo	2	already had	Old servos from rc plane
Capacitors	1	4.67	https://www.robotshop.com/ca/en/electrolytic-capacitor-1000uf-10pk.html
Servo Driver	1	26.6	https://www.robotshop.com/ca/en/pololu-micro-maestro-6-channel-usb-servo-controller-assembled.html
Nail trimmer	1	30.19	https://www.amazon.ca/Personal-Professional-Automatic-Clipper-Laurant/dp/B014LEUHEE/ref=cm_cr_arp_d_product_top?ie=UTF8
Black PLA filament	1 kg	already had	1.75mm filament. Had this on hand for 3D printer.
total:		85.45	
total after tax and shipping		102.16	