GNG2101

Design Project User and Product Manual

Reach - Microwave Transfer Device

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List of Acronyms and Glossary

Table 1. *Acronyms*

Acronym	Definition
MTD	Microwave Transfer Device

Table 2. *Glossary*

Term	Acronym	Definition

1 Introduction

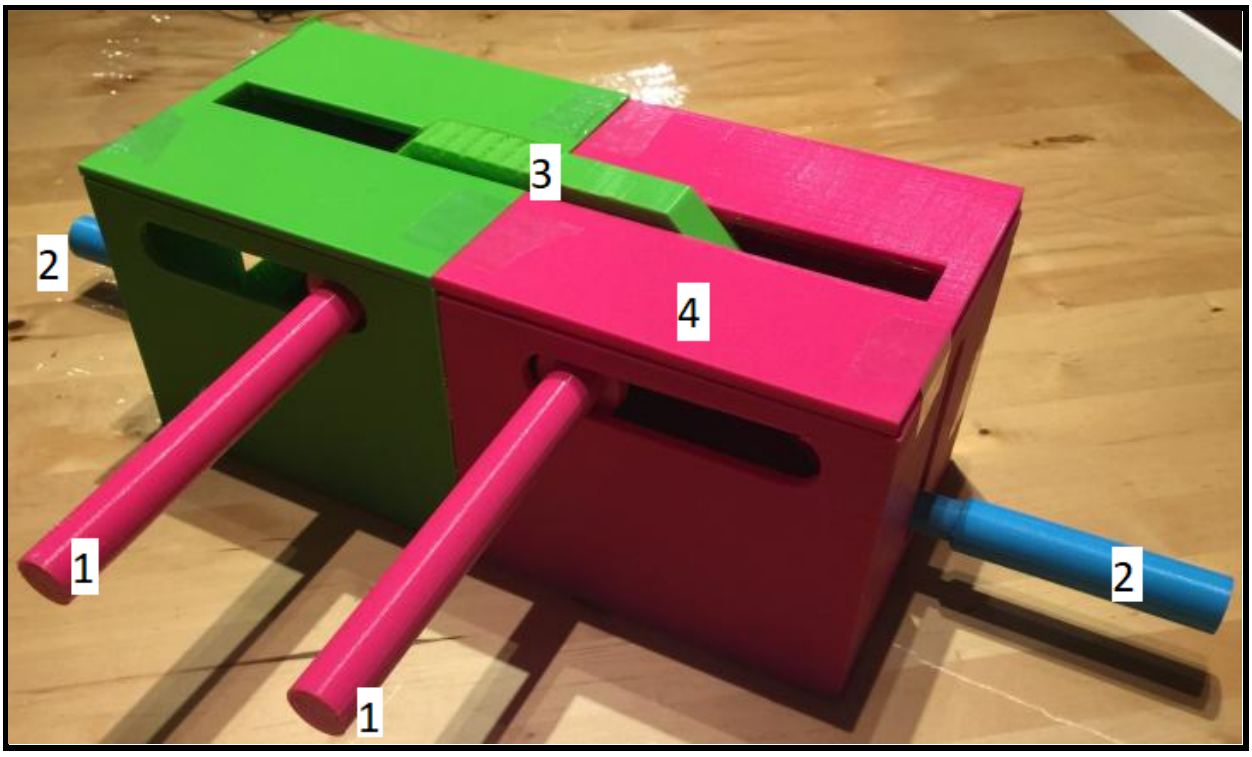
People with mobility issues struggle with everyday tasks that others may find simple. Our client expressed a difficulty with using their microwave oven as their recent stroke had caused them to have involuntary hand tremors. In addition to our client, this is an issue that many others struggle with. The MTD (Microwave Transfer Device) allows for users with certain hand-mobility impairment to take food items or other microwavable items in and out of a microwave oven by oneself.

The following User and Product Manual (UPM) provides the information necessary for hand-mobility impaired users to effectively use our MTD and for prototype documentation. This manual should be read prior to use of the MTD. This document will outline the set-up and use of the MTD, how to navigate issues that may arise with the device and lastly, details of the production process of the device. This user manual was created by students at The University of Ottawa and is mainly intended for use as a reference for future students.

2 Overview

The problem, as gathered from our client interview, was to " Design a compact, easily usable, and remotely-operated device that can carefully and efficiently transport hot food items into and out from a microwave." The user suffers from hand stutters after suffering from a stroke and has trouble picking up items and keeping them balanced; he would like a device that can consistently take food in and out of the microwave so he can regain self-sufficiency. As far as we know we are the first team to make such a product and hope that its ease of use will help our client.

Figure 1.
Image of final prototype with numeric labeling



Captioned Parts of Interest:

1. Prongs to hold food and containers to be placed in a microwave.
2. Handles to be manually pushed up and down, moving the prongs away and towards each other respectively.
3. The sliding mechanism (slider) in charge of clamping and unclamping the prongs. Is controlled by the handles.

4. The body. Contains the slider and weights to counter the food on the prongs.

Our product can be used by just the user with the need for any motors or separate controllers. Our client will use the two side handles to smoothly pick up the food and move the wheeled tray forwards and backwards to ensure no spillage to deposit the food into the microwave. This product is best used on a flat countertop in front of the microwave.

2.1 Conventions

Parts of the MTD may be addressed according to their enumerative labels in **Fig 2.1** as P1, P2, P3, and P4.

2.2 Cautions & Warnings

- Do not attempt to use the MTD with containers less than 3 inches in length/diameter.
- Do not place anything on top of P3.
- Lift and lower both P2 together with each other.

3 Getting started

3.1 Set-up Considerations

When preparing to use the MTD, ensure that the microwave has counter space in front of it for placement of the device. Additionally, the microwave oven door should be opened manually before using the device as the device simply assists in placing items into the microwave oven. Only operate devices on flat surfaces. Devices should not be used with containers where the food that is resting within is not stable.

3.2 User Access Considerations

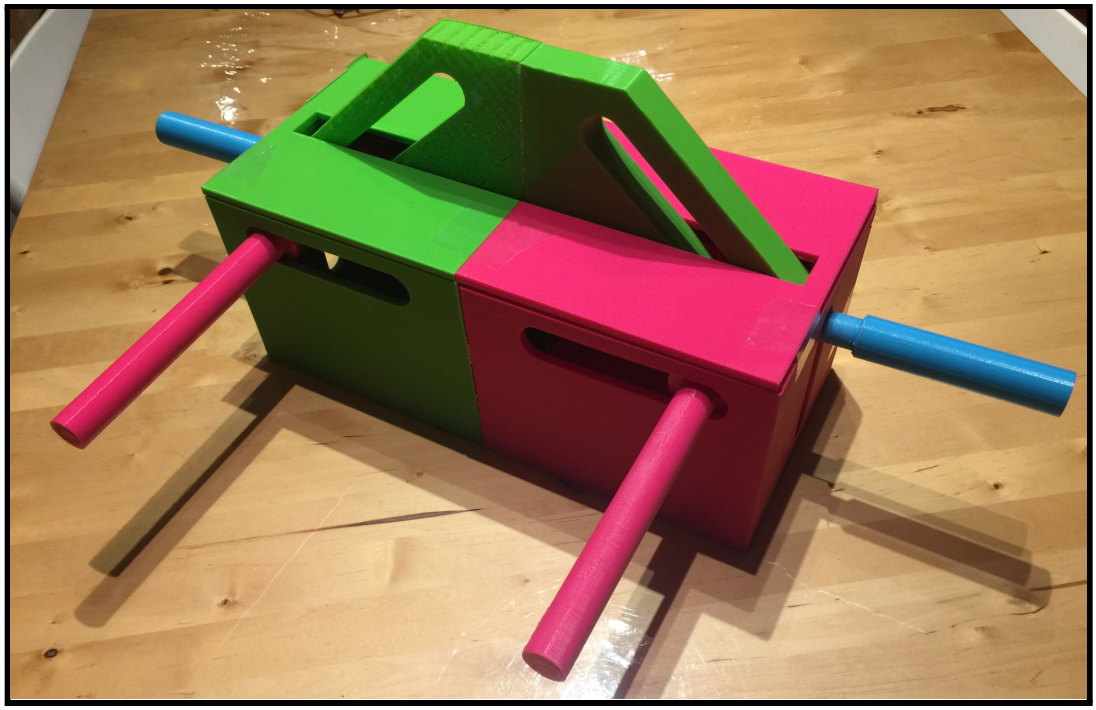
The primary user would be the user with hand-mobility issues, although any person could use the MTD. The biggest restriction is that the device must be in front of the microwave and have enough clearance in front of the microwave to move the MTD, approximately 40cm.

4 Using the System

4.1 Operation of MTD

The device should be placed in the up position by lifting P2 as shown below.

Figure 2.
Image showing initial position when using the device



Thereafter the object that is to be picked up should be in front and centre of the prongs. The two handles on the side should then be lowered until the prongs have a tight grip with the item in question. The closest they will get is as shown below.

Figure 3.
Image showing the device with the prongs in the closest position

Once the item is secured, move the device towards the open microwave until the item is over the rotating table. Thereafter carefully raise the handles to move the prongs sideways to drop the item, move the device out of the microwave and then close the microwave door and heat up the fitem. These steps should be repeated in reverse to take the item out of the microwave.

5 Troubleshooting & Support

5.1 Error Messages or Behaviors

Possible errors would include slow and uneven movement in the prongs, it is recommended that operation of the device is stopped and slots be cleaned with damp cloth, dried and then lubricated to remedy the issue.

5.2 Maintenance

The user should brush lubricant onto the slots as necessary, i.e. when excessive friction is felt in the device slots. The same maintenance is required for any excessive friction detected in the

wheels of the device. To clean the device, wipe with a damp cloth and air dry. If any lubricant is wiped off, it is recommended to reapply lubricant before use.

6 Product Documentation

6.1 Production Details

6.1.1 BOM (Bill of Materials)

Table 3.
Bill of Materials

Name and Link	Quantity	Price ($ CAD)
Caster Wheels	1	14.66
Lubricant	1	5.49
Electrical Tape	1	6.49

6.1.2 Equipment list

- Sandpaper
- Ultimaker 2+ 3D Printer
- Cura software
- PLA 3D printing filament
- Glue gun
- Caster wheels

6.1.3 Instructions

1. Using Cura and the Ultimaker 2+ 3D printer, print two of every STL file provided in the makerepo's project files.
2. Make the slider by gluing the two printed Clamp_Mech_Half together so that the slanted faces are away from each other.
3. Stick a printed Prong_Nut through a slot of the slider. Centerly glue the thin end of the Prong_Nut to the wide end of a New_Prong.
4. Repeat step 3 in the other slot of the slider with the other Prong_Nut and New_Prong.
5. Make the body by gluing the two printed Base_Half together with the fat slots horizontal and adjacent to each other, and the thin slots vertical and opposite each other.
6. Place the slider inside the body so that the prongs are going through the fat slots, and the slider is linearly connecting the thin slots.
7. Glue a printed Clamp_Handle to the base of the slider through a thin slot of the body.
8. Repeat step 7 with the other Clamp_Handle through the other thin slot of the body.

9. Make the back by gluing the two printed Base_Back_Half together so that their rectangular slots create a single continuous slot.
10. Glue the back to the body so that a small part of the slider protrudes through the slot of the back.
11. Attach caster wheels as needed to the bottom of the body.

6.2 Testing & Validation

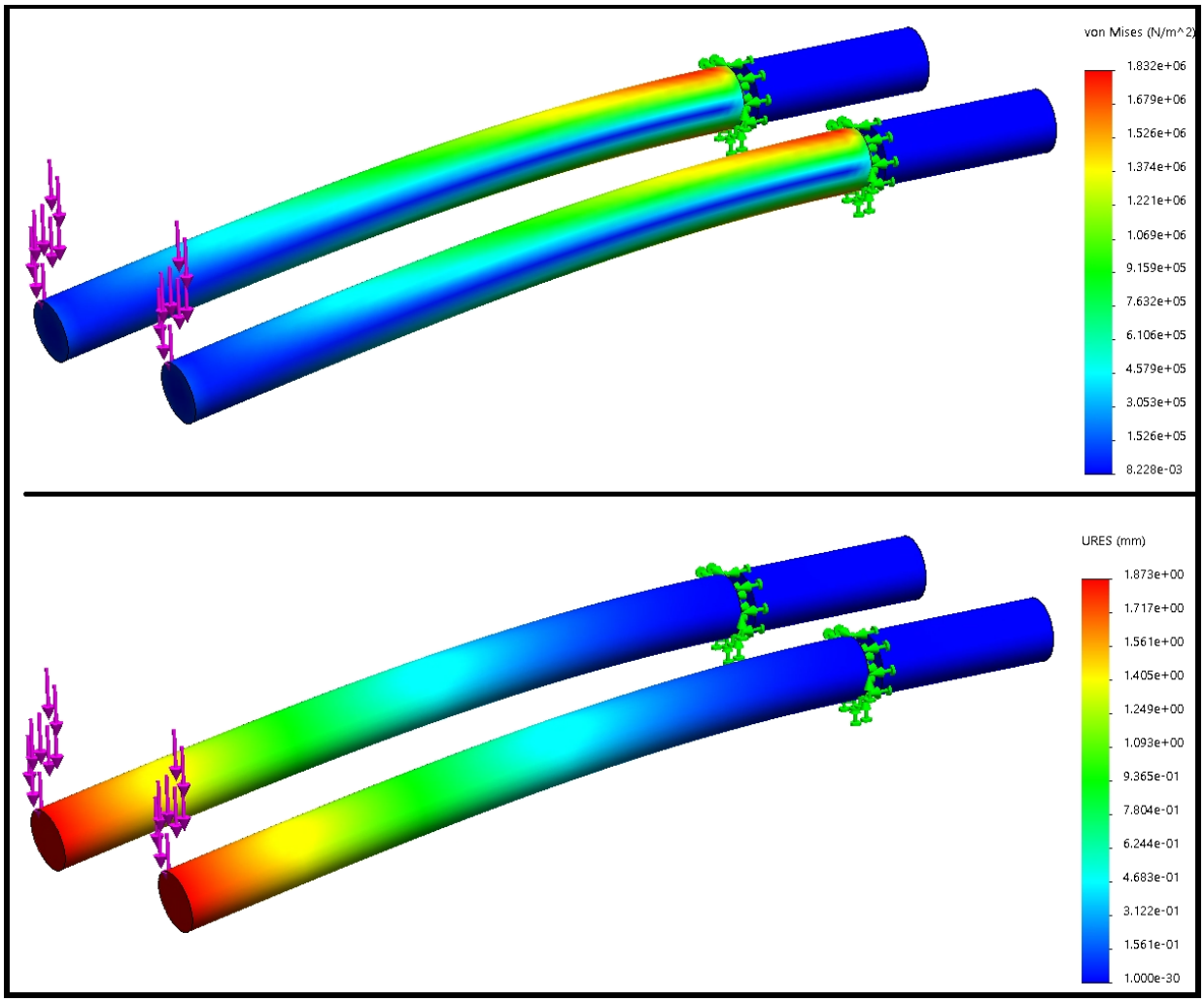
Our initial tests were conducted in solidworks to minimize cost and reduce re-iteration time as any changes would be easy to conduct in solidworks, we tested how much weight it could hold as well as vertical displacement of the prongs.

Table 4.
Tabulated results from the SOLIDWORKS simulations.

Iteration	Added Weight (N)	Highest Von Mises Stress (MPa)	Largest Displacement (mm)	Notes
1	9.81	0.9159	0.9365	This was a simple introductory weight, mostly to test if the simulation functions as expected. 0.9159 << 92.4, so the prongs would not break. The displacement is also negligible, which is a common theme with all 4 testing iterations.
2	19.62	1.8130	1.873	In this iteration, 2 kg were used as the extra mass. This means that the client-specified weight capacity of 4 pounds was surpassed at ~4.41 lb, with still non-breaking prongs and minimal loss in stability.
3	29.43	2.7200	2.810	To test further beyond the client's requested capabilities, the prongs still hold up properly and show almost no signs of failing under the pressure.

4	39.24	3.6260	3.746	Through simulating the addition of a 4 kg load, the maximum capacity target specification of 4 pounds has been far surpassed. Not only would the stress not cause damage, the displacement would barely cause any inconvenience as well.

Figure 4.
SOLIDWORKS simulation results of iteration 2



7 Conclusions and Recommendations for Future Work

The ideas us as a team that we would like to add in the future would be to motorize the system so that it can be controlled via a button interface so that it can be completely hands free, this would mean programming something like an arduino so that it can control actuators and motors to move the clamps up and down as well as move it forwards and backwards. Unfortunately we ran out of time due to having to restart our ideas but we think this would be the best course to improve the device moving forward.

APPENDICES

8 APPENDIX I: Design Files

The following table includes links*MakerRepo* page, as well as the product design files found there.

Table 5. Referenced Documents

Document Name	Document Location and/or URL	Issuance Date
Project MakerRepo	MakerRepo	01/12/2021
Prong Nut .STL File	Prong Nut	05/12/2021
Clamp Mechanism .STL File	Clamp Mechanism	05/12/2021
Clamp Handle .STL File	Clamp Handle	05/12/2021
Base Front Half .STL File	Base Front Half	05/12/2021
Base Back Half .STL File	Base Back Half	05/12/2021