GNG2101

[Microwave Transfer Deliverable B]

Submitted by

[Lab A4 – Group 20]

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1 Introduction

1.1 The Problem

People with limited mobility may experience problems when moving or lifting items from the counter in and out of the microwave. This issue can make their typical life more difficult and leads to loss of independency. Our goal is to develop a device that can safely transport various objects without causing any damage. The device is designed to be used by everyone and can be easily assembled by individuals so that it securely can be moved from one place to another.

1.2 Deliverable B

The goal of this deliverable is to empathize with the client to obtain as much information as possible about their problem. Client statements during the interview are refined into needs and quantified using metrics. Preliminary research into other products is also done to obtain an idea of what currently exist on the market. The result of this deliverable is an understanding of the necessary functionality of the product as well as target specifications to help assess performance and feasibility.

2 Problem Definition

2.1 Client Interview 1 Statements and Observations

On September 21st, 2021, we met with our client Wayne to discuss about the microwave transfer device. We asked him specific questions. He described some of the significant points about the device, which supports us in acknowledging his needs to implement it and effectively generate an appropriate solution. Our stated goal is to recognize his specific needs, which will help us derive the statement problem.

Table 1 - Client Statements from Interview

#	Client Statements
1	Ideally, this product will be usable by everyone struggling with mobility.
2	I don't want to be afraid I'll mess up while using the product.
3	My microwave is 6 feet 8 inches off the group and my counter is 78 inches high. My muscular function is weak, I struggle to lift objects up high into the microwave.
4	The heaviest object I think I would put in the microwave would be 2.5 pounds.
5	I can open the door and input the time myself.
6	My doctor says I should not carry more than 20 pounds.
7	I have a weak short-term memory; I often forget things within 3 minutes.
8	I can carry objects, but my gait is wobbly due to my stroke.
9	I use the microwave to heat up a wide variety of things. Alcoholic beverages are a common use for me.
10	I value my independence; I want to be able to use the device easily and without assistance.

2.2 Prioritized Client Needs

The following table transforms client statement into more focused needs. The needs are rated based on their importance with 5 being the most essential and 1 being not very important.

Table 2 - Interpreted Client Needs and Their Importance

#	Client Statements	Interpreted Need	Imp (1-5)
1	Ideally, this product will be usable by everyone struggling with mobility.	The product is compatible with multiple microwaves.	2
2	My microwave is 6 feet 8 inches off the group and my counter is 78 inches high. My muscular function is weak, I	The product uses a mechanical system that requires a small force input to lift a heavy object	5

	struggle to lift objects up high into the microwave.		
3	I don't want to be afraid I'll mess up while using the product.	The product is easy to use and has safety mechanisms that will prevent the client from dropping dishes. The product has a simple and non-complex design (few buttons and options).	4
4	I use the microwave to heat up a wide variety of things. Alcoholic beverages are a common use for me.	The device can transport objects with a wide variety of shapes to and from the microwave. The objects need to be stabilized to prevent liquid from spilling.	5
5	I value my independence; I want to be able to use the device easily and without assistance.	The product only requires a single user to function properly	5
6	I have a weak short-term memory; I often forget things within 3 minutes.	The device should alert the client when the object is lowered to the counter.	3
7	I can open the door and input the time myself.	The device opens the microwave door and inputs a heating time remotely.	1
8	I can carry objects, but my gait is wobbly due to my stroke.	The device has a good and secure grappling hold that won't allow the transferred object to fall, shake, or spill on the user.	4
9	My doctor says I should not carry more than 20 pounds.	The device is portable and can be transported by the client safely.	3
10	The heaviest object I think I would put in the microwave would be 2.5 pounds.	The device can lift the weight of anything the user wishes to put in the microwave.	5

2.3 Problem Statement

Our client requires a device that can lift dishes from his counter into a microwave safely and securely. The device can lift a wide variety of objects without any inconvenience to the user and has built in safety mechanisms to prevent the dropping of an object.

2.4 Design Metrics

Design needs with quantifiable measurements were selected to be used as design metrics.

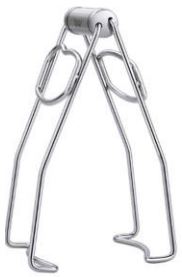
Table 3 - Design Metrics

#	Metric	Associated Needs	Units	F/NF/C
1	Vertical Lift Distance	2	m/in	F
2	Weight of Device	9	Kg/lbs	F
3	Load Bearing Capacity	10	Kg/lbs	F
4	Cost of Product	2	$	C
5	Maximum Area + Height of Microwavable Object	4	m^2/in^2	F

2.5 Benchmarking

Due to a small target demographic, it is difficult to find existing products that are designed specifically for microwave transferring. Products that fulfilled our primary needs —vertically transport and/or pick up a <10lbs object —were what was focused on while benchmarking.

Table 4 - Similar Products

Product Name	Specifications	Issues	Comments
Germany Stainless Steel Hot Dish Plate Gripper 	Price: $14.35 CAD Weight: 148g Dimensions: 7.5 x 18cm Load capacity: not stated but likely not much greater than a singular dish. Lift Height: N/A	Only grips the item; vertical and horizontal transport requires a human. Works for plates but not other dishes such as glasses.	This product demonstrates a method of securely gripping dishes without the use of one's hand.

TENAQUIP industrial equipment Forklift Stacker 	Price: $227.00 CAD Weight: 226 lbs. Dimensions: 43-7/8"L x 42-1/2"W x 79-1/8"H Load Capacity: 350lbs Uses Hydraulics Hand winch operated Material: constructed of durable steel and aluminum A hold-down device for securing	Not applicable to be placed in the kitchen Overpriced Excessive weight capacity Hand winch operation is hard to use	This product is not suitable for moving items into and out of the microwave. This mechanism works well for lifting heavy objects
Sumner 2015 15' Lift 800lb. Capacity Material Lift 	Price: $3,845.67 Weight Capacity: 800lbs Weight: 315.00 LBS Lift Height: Extends from 3.5 meters to 7.7 meters with forks flipped Winch operated Forklift can be flipped or changed Pulley system	Material handling product made for warehouses. Not applicable for home use: -Too large -Excessive weight capacity -Winch operation could be too difficult for person with limited mobility	★ The lifting mechanism is to be noted. -This product allows the user to use it as a pulley and a forklift depending on requirement. -winch can be motorized?
OWI Wireless Robotic Arm Edge	Price: $64.04 CAD Dimensions: 9 x 6.3 x 15 inch	Despite the low cost of the device, the reach it provides isn't sufficient for the	This product is clearly one that can be made accessible to consumers especially

	Wrist Range of Motion: 120° Elbow Range of Motion: 300° Base Rotation: 270° Base Motion: 180° Vertical Reach: 15 inch Horizontal Reach: 12.6 inch Lifting Capacity: 100g Max Claw Width: 1.77in	task of transferring something in and out of a microwave. The device also runs on batteries instead of an AC power supply.	with its cheap price of $64. The remote control of the arm has a level of complexity (control wise) that is required for the task of precisely transferring an object in and out of a microwave.
24” Stroke 400lb Force Linear Actuator 	Price: $166.65 CAD Load Capacity: 400lbs Lift Distance: 24in Weight of Device: Not Available	Overbudget Insufficient stroke distance Excessive load capacity No gripping function	A common trend with linear actuators is having too large a load capacity and too small a stroke length for our project purposes. Finding a suitable one if we wish to use one for this project will be challenging.

Table 5 - Benchmarking Metrics

Metric #	Units	24” Stroke 400lb Force Linear Actuator	TENAQUIP Industrial Equipment Fork-Lift Stacker	Sumner 2015 15' Lift 800lb. Capacity Material Lift	OWI Wireless Robotic Arm Edge
1	in	24	-	137 - 303	15
2	lbs	-	226	315	-
3	Kg/lbs	400	350	800	0.22

4	$	166.65	227.00	3845.67	64.04
5	in^2	-	42.5	-	1.77

2.6 Target Specifications

Table 6 - Target Specifications

#	Metric	Units	Ideal Value	Marginal Values
1	Vertical Lift Distance	in	>72	>48
2	Device Weight	lbs	<20	<10
3	Load Bearing Capacity	lbs	>20	>5
4	Cost of Product	$	>80	>100
5	Maximum Dimensions of Transported Object	in/in/in	>20,>20,>10	>12,>12,>10

In the interest of making the product usable for multiple microwave setups, a lift distance of 72 inches would be ideal, but 48 inches should be sufficient for our client's setup.

The client is only able to carry 20lb himself which would make a device of less than 20lb that he can transport himself in one piece necessary if he wishes to use it completely independently.

A load capacity 20lb should include the most majority of items one would put in the microwave. The client however said he would only ever put things of 5 pounds or less in the microwave.

The budget of our project is $100. Ideally, we can create a product for less.

Finally, the product can ideally transport any size of object. Marginal values try to reflect average sizes of common microwavable dishes such as plates and glasses.

3 Conclusions and Recommendations for Future Work

To conclude, after having the first client meeting, we were able to focus on his needs analysis and transform it into design criteria. Based on the client feedback, A problem statement was made. Metrics helps us prioritize the needs of the design criteria. Through benchmarking that we have done, we can have a similar idea of the product we design.

The next phase of the project will involve generating conceptual designs that fulfill the identified needs and are within at least marginal specifications. This deliverable will serve as a good reference when evaluating how well a concept caters to the client's requirements.

4 Links to Benchmarked Products

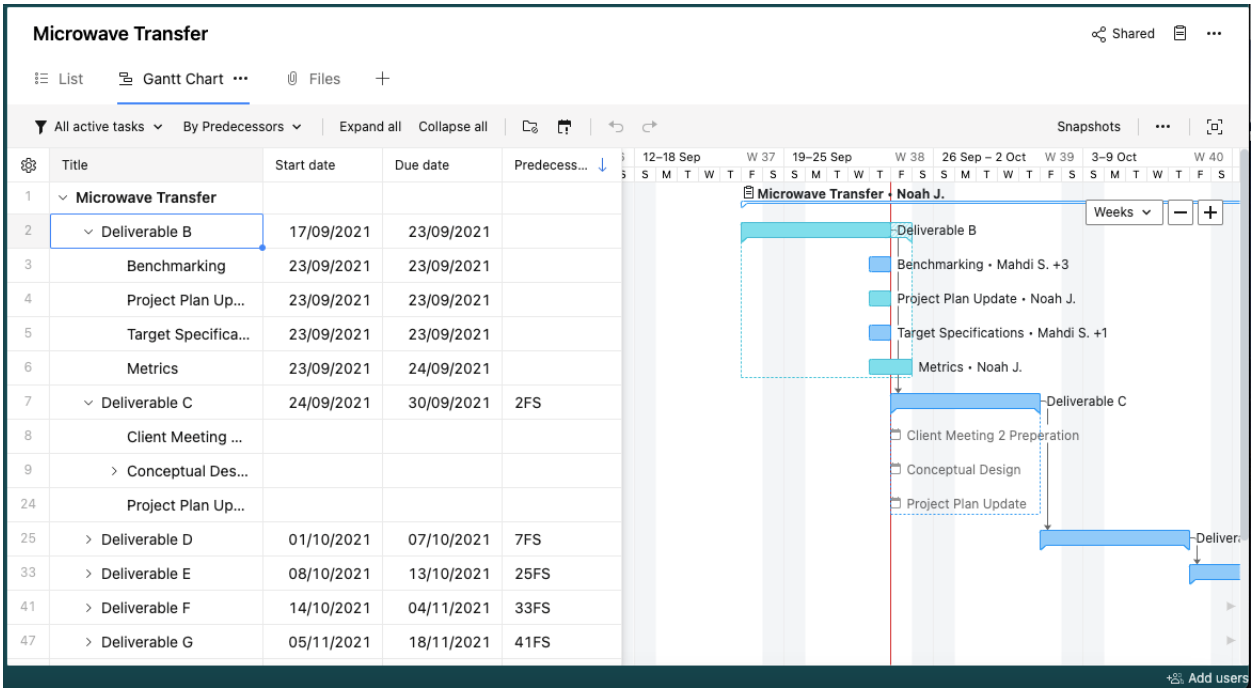
https://www.tenaquip.com/product/vestil-fork-lift-stacker-counterbalance-design-hand-winch-operated-350-lbs-capacity-122-max-lift-a-lift-s-ehp-lu502?gclid=CjwKCAjwy7CKBhBMEiwA0Eb7alGp2d_x2fcgOnk83oad9OP2ZJmwpMFLd9L4kzelNDNNZnKlJiVXihoC11IQAvD_BwE

https://www.aliexpress.com/item/32961307142.html

https://www.robotshop.com/ca/en/firgelli-24-400lb-linear-actuator.html?gclid=CjwKCAjw7rWKBhAtEiwAJ3CWLGPFQajIA1TQBxWsXFXenNLtHax9o0ATzoYMG_Os8WpY0FQ-Shg00RoCoioQAvD_BwE#Dimensions

https://www.robotshop.com/ca/en/owi-wireless-robotic-arm-edge.html

Appendix:



1.1 A screenshot of the plan on the wrike