GNG2101 Deliverable D

Detailed Design, Prototype 1, BOM, Peer Feedback and Team Dynamics

Submitted by

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This report will showcase possible construction components of our product and provide a prototype testing outline.

0.Introduction

The purpose of this document is to Provide design details for our concepts and build a prototype to test the product's most critical functionality and target specifications. We are looking forward to getting valuable feedback from our clients by this prototype. Furthermore, we will outline the product assumptions and plan our prototyping phase to test these assumptions. accordingly , we will make a bill of materials that accounts for the budget spent per each component of the prototypes and create a clear path towards having a complete functional product.

1.Summary of client feedback

According to the client meeting last week, our prototype is overall satisfied with clients' needs and meanwhile still has deficits. So we received some feedback on the current design from our clients, and based on the feedback, we will make improvements for the design in future as well.

1.1 Feedback

1. **The device didn't show its ease of use with one hand.** Because the design of the device is simple, therefore it cannot perform any automatic tasks which can free the user's hands. The device only reduces the inconvenience of using the glucometer, which make few patients still unable to use it with one hand
2. **The device could not fit in different types of glucometers.** As we only considered the glucometers that have a long width, we didn't consider the ones with a short width. Therefore the holder on the box may not fit in certain types of glucometer
3. **Test strips may get dirty when inserted into the glucometer.** According to the picture of the design, the holder for the device is placed on the bottom of the box, which means

that the mouth of the glucometer will touch the table when inserting a strip into it. It may cause bacteria to stick on to the strip.

4. **The device is not fully portable and does not have a clear method of stick on platforms.** We thought of using a clamp to hold the edge of the table in order to make the device fixed, but it only fits the situations that the patients use it on a table. generally , the device cannot be fixed in other situations, such as beds, chairs, cars. Meanwhile, the clamp method isn't feasible when the table doesn't have an edge to grab.
5. **The box has no other specific functions if the user already has a place to keep the stips and needles**. Some patients will prefer to use their own strip containers, which makes the box have no specific use other than glucometer and lancing holders. More functions should be added to the box.

1.2 improvements

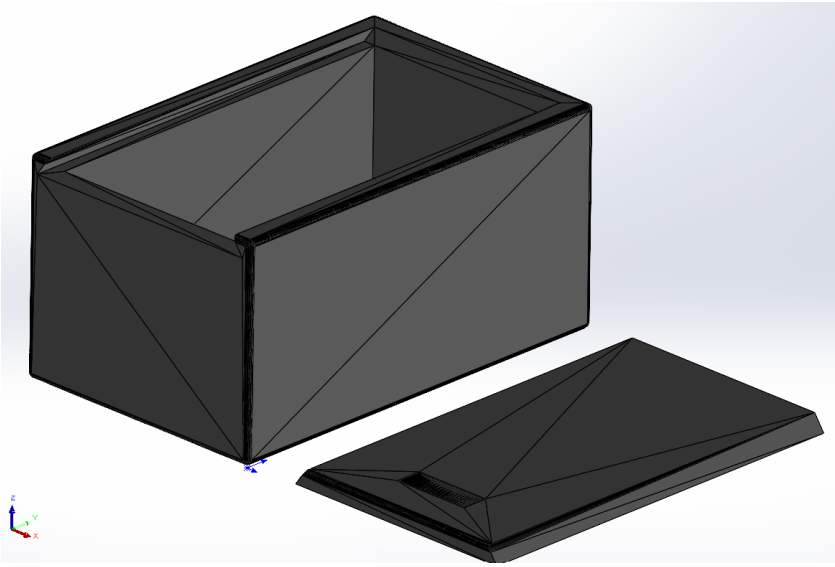
1. Make a detailed and clearer design for the product
2. Change the design of the glucometer holder, so that it's more flexible to use and can fit different types of glucometer.
3. Add more functions to the box. For example, store some components of the device, such as glucometer holders for different types of glucometer
4. Give a detailed description of the lancing device holder
5. Show the ease of using the device with one hand. For example, make the lancing device and glucometer holder more flexible
6. The clamps that connect the table to the equipment are very small in order to generate a lot of torque to help stabilize the equipment
7. The bottom of the equipment should be affixed with some material to prevent the equipment from sliding

2.Updated design

2.1 Subsystem Test Papers Helper Modelling

The purpose of this subsystem is to allow users to take out the test paper and needle with one hand, the bottom of this model will be fixed to the inside of the suitcase.

With the help of the fixed bottom, the user only needs to open the sliding cover with one hand to open the box.



2.2 Subsystem Lancing Device Helper Modelling

This model is based on the requirements described by the customer and our design principles. Since the user needs to complete all the procedures with one hand as much as possible, a shelf which is fixed on the main box and can store the blood collection pen is designed for the convenience of the customer.

The whole thing is divided into two parts. The first one is the base and body. This one is used to attach the whole stand and blood collection pen to the Test Papers Helper. The base is designed with two holes for the convenience of fixing the bracket with screws. The second part is to fix the frame of the blood collection pen. Two holes for inserting screws are designed on both sides of this part, which is convenient for the blood collection pen to be firmly fixed on the bracket and convenient for the customer to use one hand and finally complete the blood collection.

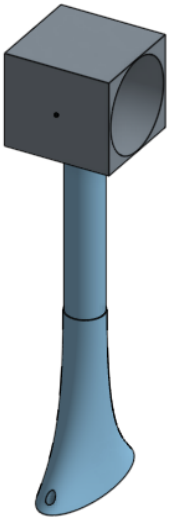


Figure 2.2.1 Lancing Device Helper Trimetric Diagram

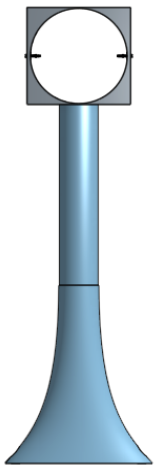


Figure 2.2.2 Lancing Device Helper Left Side Diagram

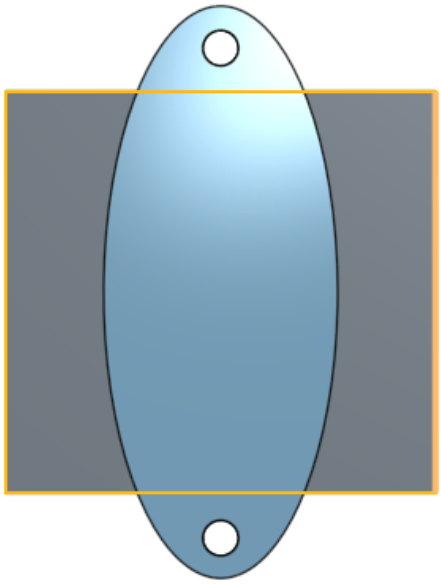


Figure 2.2.3 Lancing Device Helper Left Bottom Diagram

3. Product assumptions

3.1 Assumption 1

The first assumption about our design is that our design will be compatible with the clients glucometer. Our design has a lot of reliance on being able to physically slot the glucometer, lacing devices into the designated tools so as to help the client manipulate them. As this design hinges almost entirely on this assumption holding true. Thus it is a critical point to focus on. It will be addressed in later iterations when the design is more finalized. The current idea is that it will be solved via a bracket that uses a clamp and rubber pads to secure the glucometer and up to two extensions of the main body which will have thumb tightened screws so as to secure the lancing device that will freely rotate.

3.2 Assumption 2

Assumption two of this product is the physical capabilities of the client. Our group currently understands that our client in question will most likely only have control over one of their hands and may be blind or visually impaired to an extent. As such we have made our design based upon such criteria. However, our client's may have varying aliments and therefore

our products design may not entirely be able to cater towards a client in a more specific situation. For example some parts of our product require slightly higher levels of dexterity such as thumbscrews which to an extent requires that the clients active hand be able to properly manipulate the thumbscrew which they may not be able to. Because of this if early designs prove to be very difficult to properly operate with one hand alternatives will be looked into such as using friction fit or more mechanical solutions such as using a hyperboloid rotary clamp.

3.3 other Assumptions

- When the product is deployed for operations, it will not move or fidget when the user interacts with it.
- The glucometer helper can be moved and stationed elsewhere with ease.
- There is storage space for extra lancets and test strips within the frame of the device.
- Lancets can be easily taken out and changed one handedly.

4.prototype pictures

Figure 1. Overview of the device

Figure 2. Vertical view for the device while working

Figure 3. Lancing device helper overview

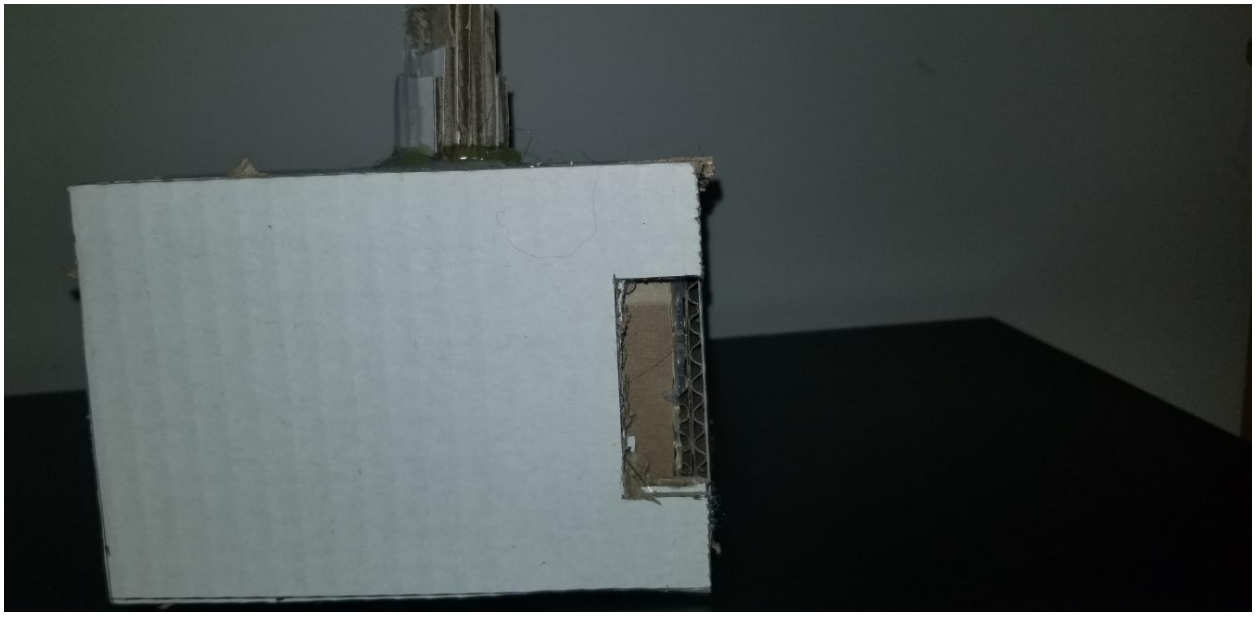


Figure 4. Place for inserting glucometer

Figure 5. Box overview

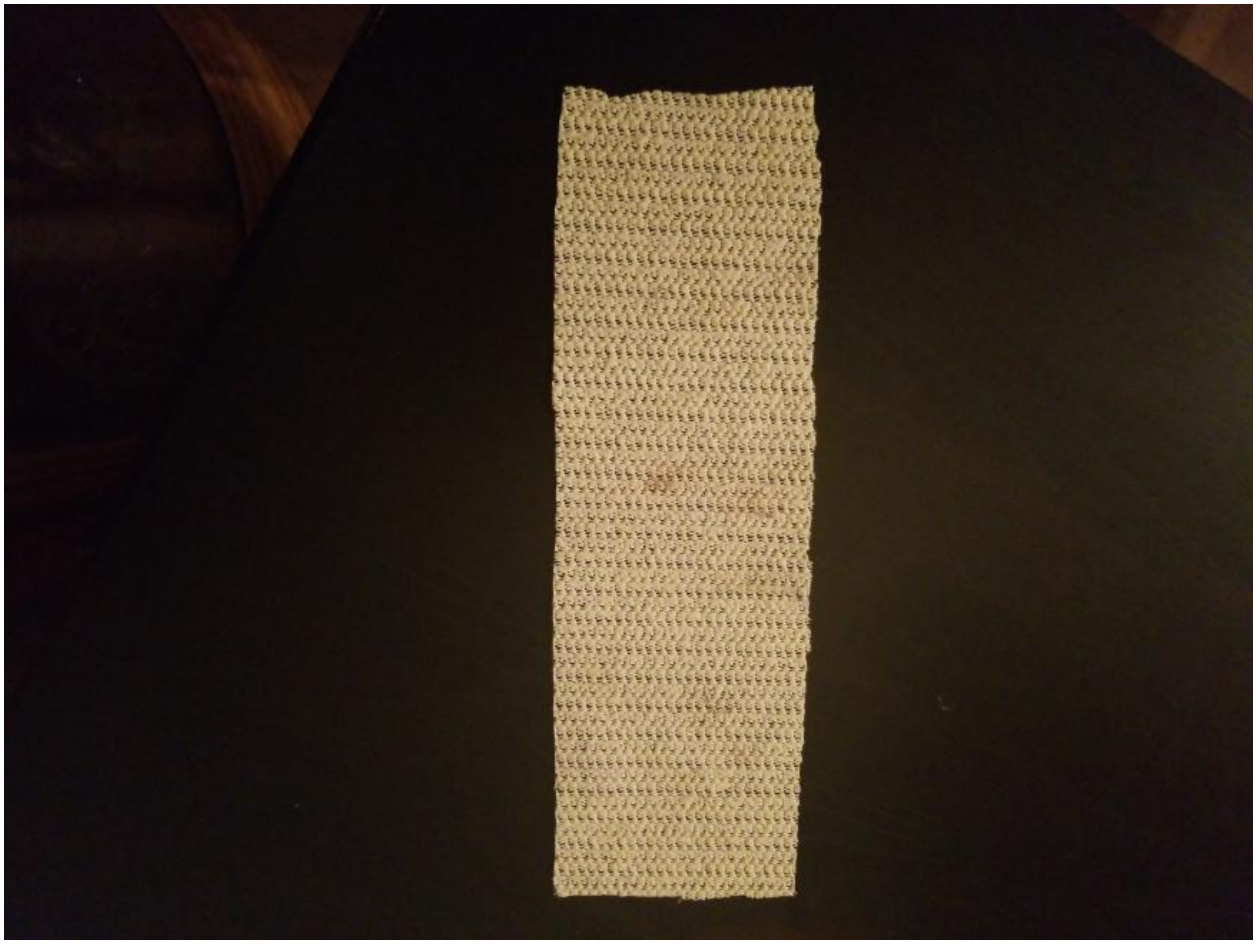


Figure 6. Mat material on the bottom of the box in order to prevent shifting

5.Prototype testing & performance

5.1 Comparison with target specifications:

4. Target Specifications

Our final product will cost less than or equal to 100 CAD in total with all parts. Acceptably have a 95%+ accuracy with a result return rate of within 10 seconds of analysis initiation. It should be able to be easily used while not being able to see and or use only one hand. And store up to at least a 100 past readings. In an ideal situation we will be able to create a design that weighs less than a 100 grams as well as be small enough to fit into a small bag and do at least 500 tests before recharge.

Design Criteria	Acceptable Specifications	Ideal Specifications
Accuracy	92%-95%	95%+
Result Time	Under a minute	Less than 10 seconds
Accessibility of use (number of steps)	5-10 steps	Under 5 steps
Cost (CAD)	100$ - 140$	Under 100$
Weight	Less than 150 grams	Less than 75 grams
Memory	Stores at least a day worth of data	Stores a week worth of data or more

Prototype testing Criteria	Testing results	Comments
Accuracy	>99%	The accuracy of the blood sugar reading is the same as the glucometer used
Result Time	>5min	The time to perform the whole test was significantly increased, due to the Glucometer Helper sliding around when attempting to change the lance

Accessibility of use (number of steps)	9 steps	1.put in lancing device 2.put in glucometer Plus normal process of testing
Cost (CAD)	8$	4 Glue sticks, costless cardboard
Weight	120 grams	Slight and portable
Memory	Stores a week of data	The box is able to fit in glucometer and lancing device, and still have space for decent amount of strips and Lancets

5.2 Prototype performance self review:

-The arm connecting the clamp needs to be very small, as a fair amount of torque was generated with even that short arm

-The force to remove the cap was too much for friction to resist (tried some rubber material to increase friction and weighed it down with a phone, and it wasn't close to enough to stop it from moving)

6.presentation outline

For the next client meeting, we'll present the following things about our product to the clients:

1. A flexible Lancing device holder, which is fixed when using it and easy to take out by rolling out the screws.
2. The operation of the design
3. Why we think this is an optimal design.
4. The decisions we made in regards to certain aspects of our design and how we believe it will help the client (such as the swiveling bracket)
5. Issues we found with our first prototype, and how we both acknowledge them and how we have or will approach this situation.

Meanwhile, we'd like to know some information from the clients in the next meeting

1. The average strength and dexterity of our clients capabilities in their active hand compared to an average person.
2. How realistic it is for the stroke victims to use their active hand to properly manipulate their off-hand to take samples from.

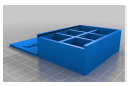
7. Bill of materials(BOM)

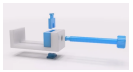
7.1 current iteration

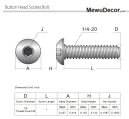
Part #	Part Name	Description	Qty	Units	Picture	Unit Cost	Extended Cost
1	**Cardboard**	**As this is the first iteration we decided to go for a more economical choice that would both allow us to easily change and throw away easily for the sake of testing**	**1**	**Weight of cardboard**		**None**	**The cardboard was from a box from delivery So it doesn't cost anything by recycling a cardboard**

2	**Hot Glue**	**We used hot glue as a means to bind the cardboard as it is cheap, fast acting and for the short term very durable for what we are testing.**	**1**	**sticks**		**0.33 CAD**	**Used around 4 or 5 sticks so: 1.33-1.67CAD**

7.2. Projected final iteration

Part #	Part Name	Description	Qty	Units	Picture	Unit Cost	Extended Cost
/EW1	**Main body frame**	**The main body frame is roughly 30 cm long by 20 cm wide by 10 cm tall. Inside the box are smaller boxes that act as storage. It will be 3D printed the file was obtained from thingiverse and will be modified to fit out intentions**	**1**	**Grams**		**0.05CAD**	**While difficult to calculate right now as the cost is based on the fill structure density it can be assumed that it'd cost roughly 20 to 30 dollars.**

		(credit in bibliography)					
2	**Vice Bracket**	**The bracket that will hold the glucometer in place, utilizing a thumbscrew It will be screwed into the mainframe if not welded. It will be 3D printed the file was obtained from thingiverse and will be modified to fit out intentions (credit in bibliography)**	**1**	**Grams**		**0.05CAD**	**For the same reasons as the mainframe it is hard to calculate exactly but as the device is smaller but also will require a more heavy duty fill structure it can be assumed to cost roughly 8 dollars.**
3	**Curtain Rod mount**	**It is an extension off of the main frame that will have a circular bracket with a thumbscrew that will secure the lancing device. For this the use of a curtain rod mount with maximum capacity of a**	**1**	**Number of brackets**		**8CAD**	**8CAD**

		one inch diameter will be used. It can be readily purchased from amazon					
4	**Rubber furniture bumpers**	**This will be used to help with friction both on the bracket for the glucometer and the mainframe.**	**4**	**Number of bumpers**		**0.05CAD/ bumper**	**0.20CAD**
5	**Screws**	**Screws will be our main means of securing the parts together. They will be purchased online.**	**4**	**Number of screws**		**0.6CAD**	**2.40CAD**
6	**Nut**	**A single nut outfitted to thread in a quarter inch screw will be used so that the lancing device will be threaded into the nut and not the box so as to more easily swivel it so as to not cause concerns with damaging the**	**1**	**Number of nuts**		**0.3CAD**	**0.30CAD**

		plastic shell.					
7	**Epoxy**	**This will be used to secure things permanently.**	**1**	**Tubes**		**8.28CAD /tube**	**8.28CAD/tube**
8	**Metal sheet**	**This will be used to add weight to the design by simply attaching it to the bottom of the frame which would also make it more rigid.**	**1**	**Plates**		**12.99CAD/ sheet**	**12.99CAD**
Total costs: 60. 17(estimately)							

7.3 web links

Main body frame:https://www.thingiverse.com/thing:1999256
Vice Bracket :https://www.thingiverse.com/thing:2086443
Curtain Rod
Mount:https://www.amazon.ca/Curtain-Brackets-Supports-Stainless-CFL4025W-2P/dp/B07XWZZ18K/ref=dp_prsubs_2?pd_rd_i=B07XWZZ18K&psc=1
Rubber Bumpers:
Screws:https://www.amazon.ca/dp/B07L2SRBPV/ref=sspa_dk_detail_3?pd_rd_i=B07L2SRBPV&pd_rd_w=lefbW&pf_rd_p=ee2c0276-494d-4674-b83e-819a186d9d36&pd_rd_wg=OBiOK&pf_rd_r=9VS8FDY9C2SA1TEWW4FK&pd_rd_r=2b005e58-9df6-46b7-a345-0063da2ae1c2&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUEyNURQRzU3SDBHN0wwJmVuY3J5cHRlZElkPUEwOTc5NjkyMVdON0FPRFUzRFM0RCZlbmNyeXB0ZWRBZElkPUEwNjMxMDE0M0RQTUNITjE1OTlXOSZ3aWRnZXROYW1lPXNwX2RldGFpbCZhY3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ0NsaWNrPXRydWU&th=1

Nut:https://www.amazon.ca/Pieces-Stainless-Bolt-Dropper-Insert/dp/B06VY6F67P/ref=sr_1_4?dchild=1&gclid=Cj0KCQiAvP6ABhCjARIsAH37rbTKzKnk7mEW8NISOlvxJu_TaulmTukADVY4xR-VQXM0cbO65aDx1GYaAu71EALw_wcB&hvadid=365976058976&hvdev=c&hvlocphy=9000833&hvnetw=g&hvqmt=e&hvrand=16151542636693844990&hvtargid=kwd-315721597334&hydadcr=24907_10283482&keywords=1%2F4+inch+nuts&qid=1612741396&sr=8-4&tag=googcana-20
Epoxy:https://www.amazon.ca/Gorilla-4200602-Epoxy/dp/B07W6C9R4K/ref=asc_df_B07W6C9R4K/?tag=googleshopc0c-20&linkCode=df0&hvadid=335341764197&hvpos=&hvnetw=g&hvrand=11884499377780738159&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9000833&hvtargid=pla-835452876955&psc=1
Steel plate :
https://www.canadiantire.ca/en/pdp/sheet-metal-0475780p.0475783.html?gclid=Cj0KCQiAvP6ABhCjARIsAH37rbRLJEi9Nx458got6PvMnZVzOcIDAXBqtLLMTuYvRDnO0HC7j-smVfgaAozeEALw_wcB&gclsrc=aw.ds#store=429

9. Bibliography

Stackable multi box / slide lid with text and compartments by magonegro. (2016, December 27). Retrieved February 5, 2021, from https://www.thingiverse.com/thing:1999256

Desktop vise by Shoyun. (2017, February 04). Retrieved February 07, 2021, from https://www.thingiverse.com/thing:2086443