GNG2101 Deliverable F

Prototype II

Submitted by

Team C32

Abdullah Abdulmajeed	300136948
Bowen Zeng	300115382
Christopher Zhang	300135377
Colin Jiang	300140783
Jerry Wang	300146127
Lucas Pitre	8263817

Date: March 7th, 2021

University of Ottawa

To: Mana Azarm, Mr.Jack Walsh, Mr. Sidiki Habib Talib Cisse

Contents

1.0 Introduction

In the previous work, a problem statement was created, stating that a one-handed stent is needed to enable the patient to complete the blood glucose test with one hand. The equipment must be cheap, light, compact and can easily perform blood glucose testing with one hand. After that, each member used the priority design criteria list and benchmarks to create three conceptual designs. From different designs, we have combined three fully functional subsystems. The three designs include watch-style helper, clamshell helper and fixed helper. After careful consideration of the pros and cons, it is determined that a fixed helper is the most feasible.

The previous deliverables included analysis, task lists and material lists. The analysis includes a brief summary of the client meeting, from which we collect feedback and apply it to our existing concepts. We decided to add a rotatable instrument, through which the user can use the lancet in any comfortable direction and adjust the overall size of the helper. The material list includes all items that must be purchased for this equipment. These projects include: 3D printing three-part helper.

For this deliverable, the team first filled in the parts that needed to be improved after the client meeting, and ensured the stability of the entire helper, carried out the friction calculation of the base for stability, and finally completed the entire prototype test. We mainly focus on whether the whole helper can easily complete blood collection and testing with just one hand.

2.0 Summary of Client Feedback：

Clients agreed with our plan and design overall, and since we our prototype 2 is still in virtual , there are few points that we still need to focus on and test:

1. The lancing device holder. Our original design for the lancing device holder was a non rotatable fixed holder, many steps that may be too complicated for a stroke to take off and install

in a different location. Therefore we will change it into a rotatable gear wheel, and make it as simple as possible for disabled patients to use.

2. Weight and size of the box. The current size for the device is 31.5*16.5*23, and will definitely have a large weight. It's definitely not portable for patients to carry around. The clients would've preferred it to be more portable, but have agreed stability is far more important, and have approved using weight & friction to stabilize the box going forward. As the clients agreed with the lots design in the box, we also need to think of how big each lot should be, because the glucometer may require more space to put in compared to other components.

3. Glucometer holder. Our glucometer holder should have a fair height above the level, since it might be hard for patients to insert test strips if it is laying on the table. We are also considering making a handle on the top of the box so patients can carry it easily.

4. Testing phase. When the prototype 2 is done, we can go to clients' hospitals to get patients with limited mobility to test it .

3.0 Second Prototype

- **3.1 Use stability:**

We aim to make sure that the device should have sufficient grip on whatever surface it's on, such that users can apply pulling and pushing forces on it while operating and setting up their glucometers without having to worry about it slipping or fidgeting around. We have explored several means of reaching that goal. We have considered clamps but then concluded that setting up and removing clamps would introduce too many extra steps and unnecessary hassle for users. Consequently, a magnetic solution was discussed where the box would be equipped with some magnetic materials that are attracted to a bigger and heavier base which would be placed on a tabletop. However, we finally decided that the force of friction alone should suffice to prevent movement or fidgeting if the device was used on any of the most common tabletop materials like wood or plastic. We will install rubber feet on the bottom of the glucometer helper in order to increase the friction. Additionally, we will weigh down the device by adding some metal pieces inside the storage compartments. Calculations pertaining as to how the weight figure was computed is attached below. We considered the friction factor produced by our rubber feet and dry wood since that is the most common tabletop surface. Online research suggests that friction factor ranges from 0.7 to 0.95 on these surfaces. For the device to be able to withstand a perpendicularly applied force of 3 pounds (3 pounds force is equivalent to the force gravity applies on a 1.36kg body). It would need to have a mass of at least 1.65kg. Small steel metal weights will be equally distributed on the four corners of the device. These weights along with the rubber pads should maximize device stability for everyday use.

- **3.2 Friction calculations:**

Coefficient of friction – rubber on wood (0.7-0.95)

$\mu=0.825$

Assume maximum force applied perpendicular to the side of the device is 3 pounds (equivalent to the force gravity applies on a 1.36kg body)

$F_N= (9.8*1.36)/0.825$

$m= (9.8*1.36)/0.825$

$m=1.648\ldots kg$

Device must be weighed down by more than 1.648kg

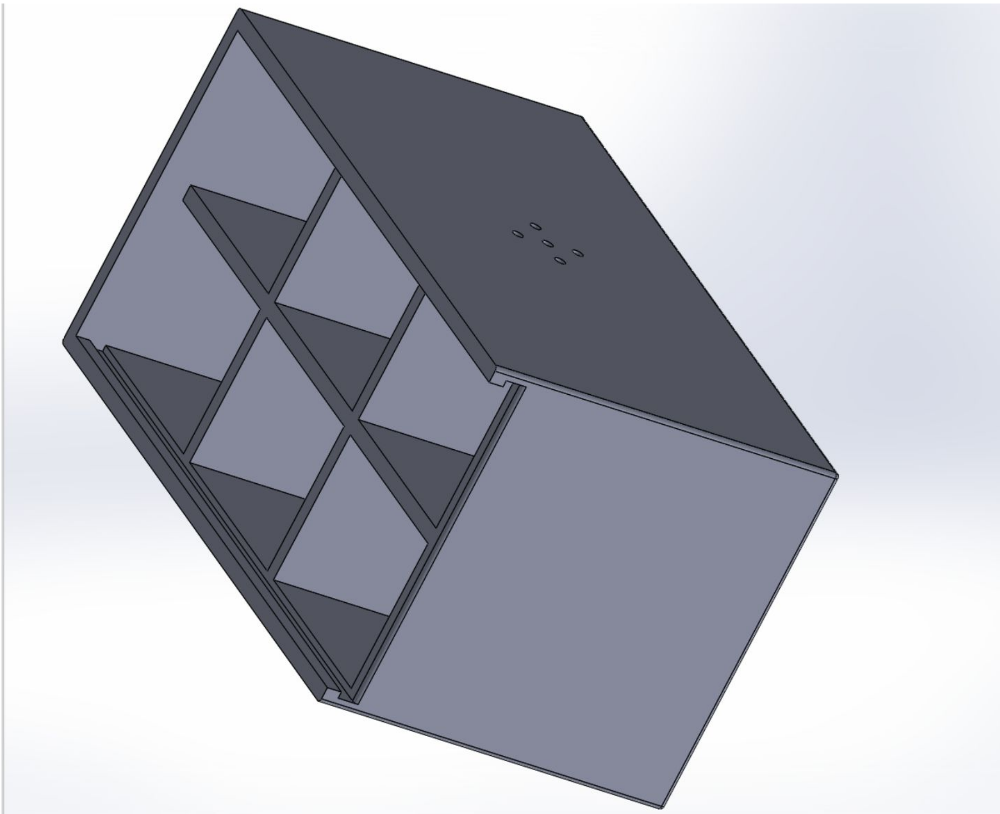
- **3.3 Prototype 2 pictures:**

Prototype 2 can be divided into three main parts: the chassis. The lancing device holder and the glucometer holder.

3.3-1 Main chassis

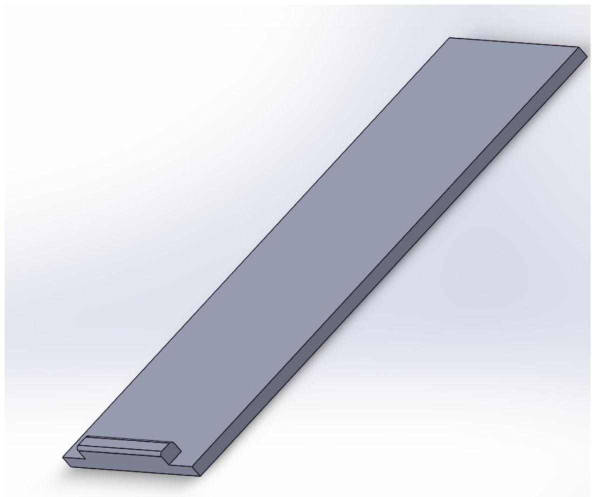
The main chassis of the device functions as the base as well as the storage solution for the client's patients.

3.3-1-A Main box



The box has a floor space of 31.5 x 16.5 cm and is 23 cm tall each cell has the dimensions of 9 x 6.375 x 15cm. The box has 5 specially machined holes which are meant to function as the securing point for the chassis to the lancing device holder. It also has rails meat to accept a sliding lid. All edges have fillets as well. Rubber domes were to be secured to the bottom so as to increase friction.

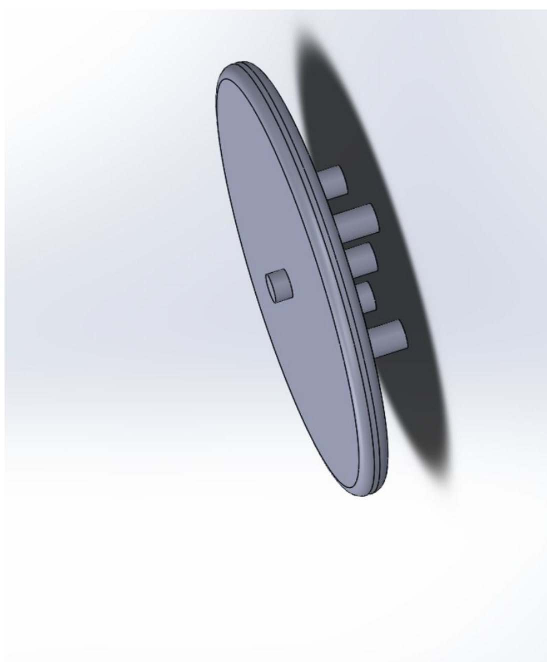
3.3-1-B Main box lid



The main box lid slides into the rails on the main chassis.

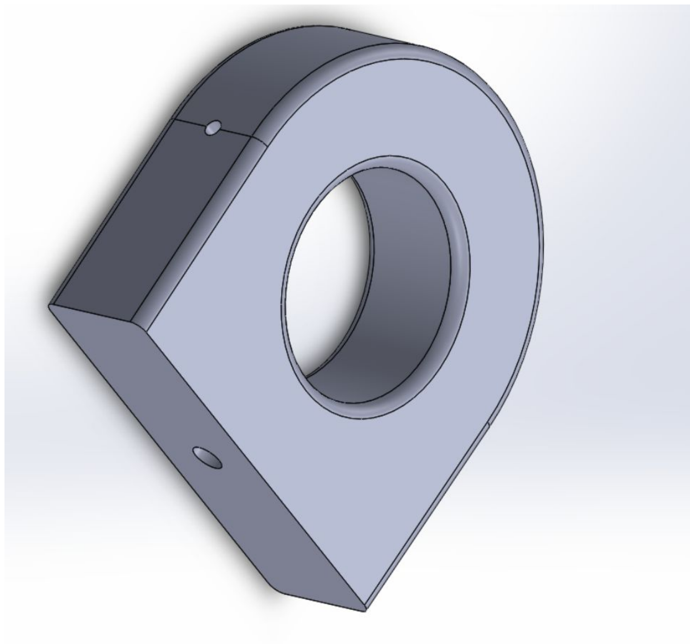
3.3-2 Lancing device holder

3.3-2-A Part A



Part A of the lancing device hodler is the base, the 5 long bottom pegs insert and freely can be removed and put back into the 5 hotels on the side of the chassis so as to allow for easy reorientation. The smaller peg is meant to be a guide for part B's placement which will be for the manufacturer so they know where to glue part B on to A.

3.3-2-B Part B

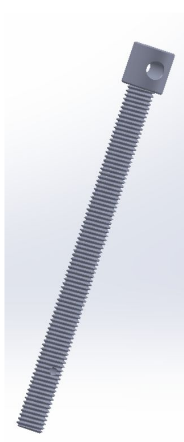


Part B is the bracket that holds the lancing device in place; it has a hole to accept the guide peg from PArt A on the bottom. The hole where the lancing device has a diameter of 5 cm. And next to it there is a threaded hole (threaded for standard 6 screw) where a thumb screw would secure the device in place.

3.3-3 Glucometer holder

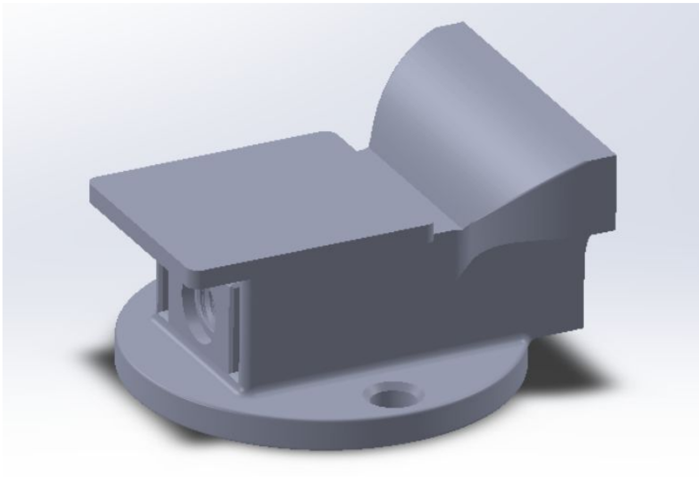
The glucometer holder is a miniature vise that was intended to be adhered to the side of the main chassis so as to hold the glucometer horizontally making the insertion much more simpler.

3.3-3-A Axis



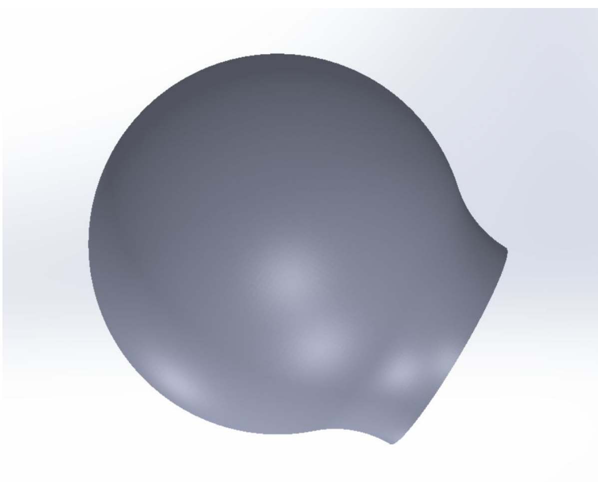
The axis of the vise functioned like any other axis it would be threaded into the base and allow for the jaw to close in on the object being held.

3.3-3-B Base



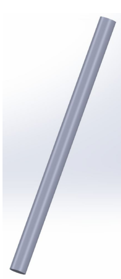
This is the base of the vise and functions as the stationary jaw of the vise as well as the name states the base. The flat side is where it is adhered vertically to the main chassis' side.

3.3-3-C Cap



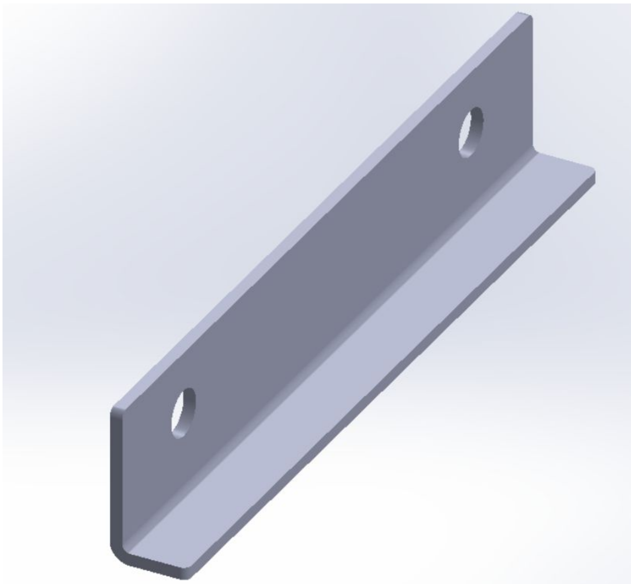
Simple rounded caps for the handle, two are needed and they serve the double purpose of preventing the handle from falling out of the axis.

3.3-3-D Handle



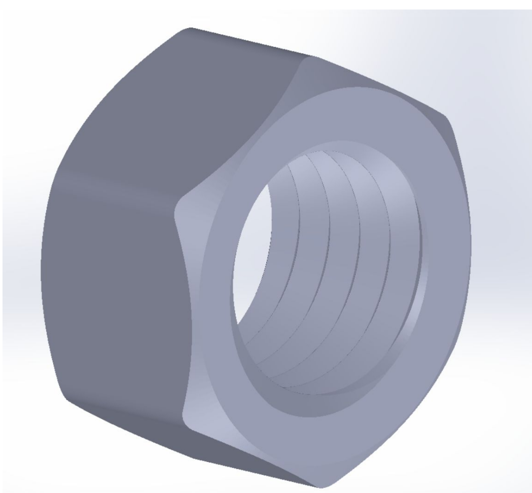
The handle which is effectively a simple rod.

3.3-3-E L bracket



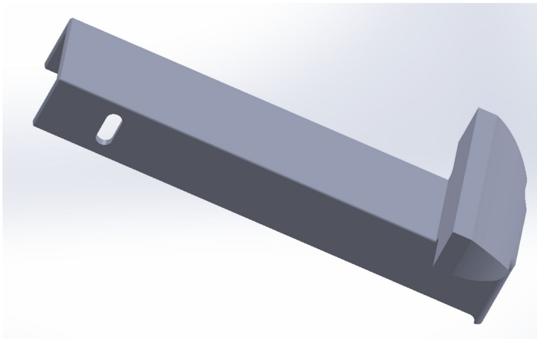
Simple L bracket two are needed to cover the vise jaws (the stationary and the non stationary). Rubber pads are also adhered onto them so as to prevent any damage to the glucometer.

3.3-3-F Standard M10 nut



Simple M10 nut two are needed for the construction of the vice.

3.3-3-G Vise Jaw

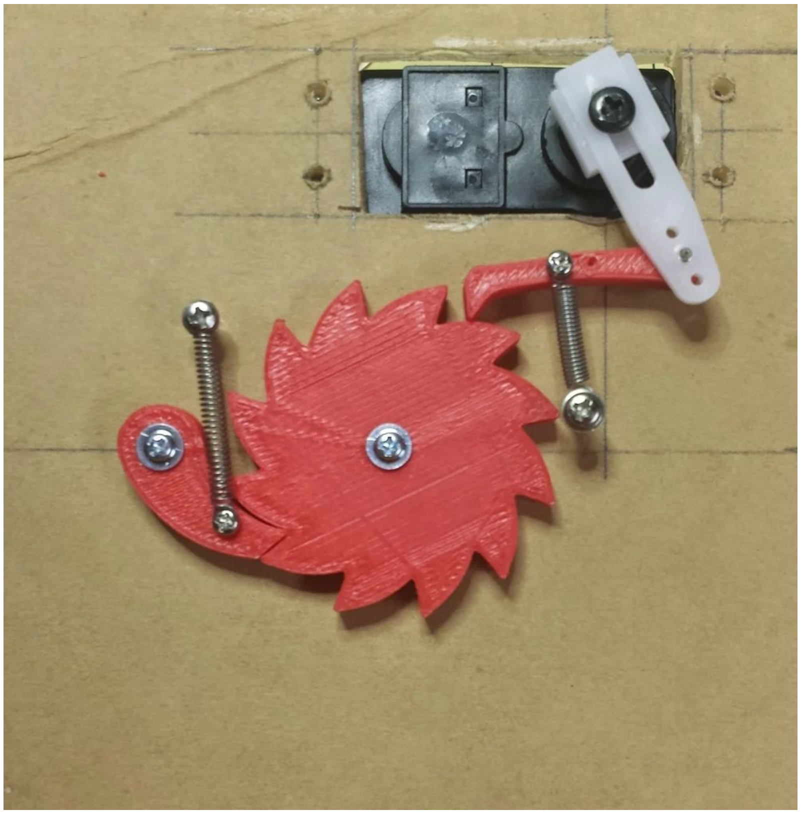


The vise jaw rides along the base and the axis so as to close in on the glucometer and hold it in place.

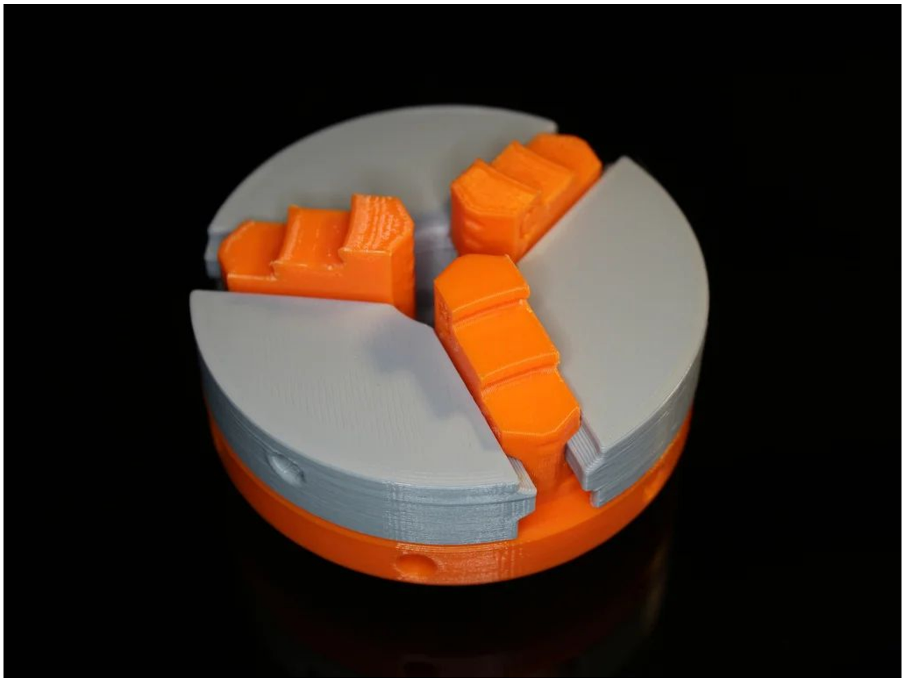
- **3.4 Changes to Prototype 2 based on client feedback**

The main focus of feedback from the clients was that, not only should the device be usable with only one hand, but also there should be as few steps as possible when the patient is doing a task: to accommodate as many people as possible.

The client specifically wanted the lance holder to be rotatable, so we will be changing from the peg design to a ratchet system to allow it to rotate while also having stability in one direction.



We also looked for other places where the usability can be simplified. Two places that stood out were the glucometer holder and the lance holder. While we are still finalizing the design for the glucometer holder, we have decided to secure the lance with essentially a large drill chuck.



4.0 Prototype II Testing:

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

5.0 Sources

Thingiverse.com. "Mini Vise by nba2006428." *Thingiverse*, www.thingiverse.com/thing:4659348.

https://www.amazon.ca/Shepherd-Hardware-3602-Adhesive-16-Count/dp/B00FFY7X3S/ref=sr_1_88?dchild=1&keywords=rubber%2Bfriction&qid=1615064928&sr=8-88&th=1