GNG 1103

Deliverable F: Prototype I

OPIOID OVERDOSE DETECTOR

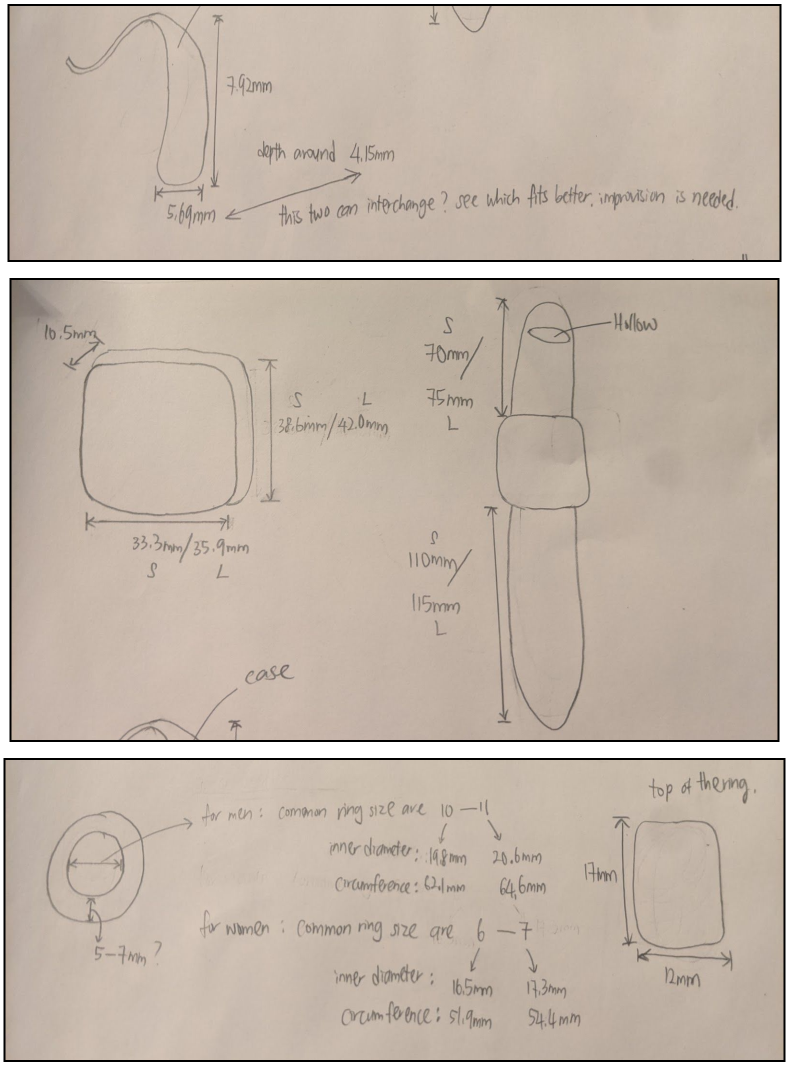
By

GNG1103, SECTION C00, GROUP 5

Yi Ru Loh, 300134586
Mohamad Ahmad, 300108630
Dhvani Patel, 300121365
Sheetal Harakh, 300123274

Introduction

The goal of this deliverable is to develop the three prototypes that were suggested in the previous deliverable, Deliverable D: Conceptual Design. These prototypes are created to prove the feasibility and functionality of the design concept and will be modified and refined for the next phases of prototypes. The prototypes that will be created are a watch model, a ring and also an ear piece. Each prototype is created using SolidWorks and or 3D printed to be analysed. Through analysing, it allows the team to make essential observations and feedback with the practicality as well as identifying the flaws of each design.


7.92mm
depth around 4.15mm
5.69mm
this two can interchange ? see which fits better, improvision is needed.
10.5mm
S L
38.6mm/42.0mm
33.3mm/35.9mm
S L
S
70mm/
75mm
L
Hollow
S
110mm/
115mm
L
case
for men : common ring size are 10 — 11
inner diameter : 19.8mm 20.6mm
circumference : 62.1mm 64.6mm
for women : common ring size are 6 — 7
inner diameter : 16.5mm 17.3mm
circumference : 51.9mm 54.4mm
5–7mm ?
top of the ring.
17mm
12mm

Figures 1-3: Initial Sketches and Dimensions of the Devices.

Test Objectives Description

For the first prototype, the specific test objective was to get a general idea of what combination of devices would work the best with each other. We decided upon the watch and ring because of the simplicity and minimal distance that would be between the two, giving it a higher range for connection when working with the connection of the two devices with each other and transferring information.

The main objective of this prototype is to give an idea of the size, shape, wire connections, and layout of the devices that will be used for the product. The product consists of a watch and a ring, where the watch will display the necessary information obtained from the ring like device that has a built-in oxidation sensor and sends the information to the watch for the user to view.

One of the results obtained from the building of this prototype was that the anticipated dimensions for both the watch and the ring were much smaller than needed to be. Another result that was obtained was, the idea of transferring information via bluetooth from the ring to the watch would not work because of there being no power source for the bluetooth device to work. However, even after facing these problems and the results obtained, we decided to come up with solutions to them rather than completely scraping the idea.

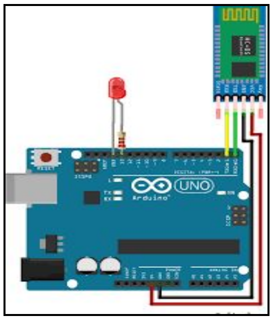


Figure 4: Arduino Schematic of Standard Bluetooth Connection. Image from https://create.arduino.cc/projecthub/mayooghgirish/arduino-bluetooth-basic-tutorial-d8b737

The size/dimensioning problem was easily solved by determining new dimensions for the watch and ring, in order to fit all the necessary components to make the product work. As discussed above, the easy solution of not being able to incorporate bluetooth left us with having to adapt to the idea of transferring information through a wire connection. We still decided to stick with the concept that was determined before because we believe that it is the most efficient and user friendly way to go about the device that will help prevent opioid overdose.

The criteria for test success would be that the device is visually appealing, a reasonable size, noninvasive, accurate, and easy to use. However, only a few of these can be checked off the criteria list for this prototype because of the limitations that we have for all the things that need to be incorporated into the device. The visually appealing, reasonable size, and noninvasiveness of the device have been tested and meet the expectation. The criteria for test failure would be something like the coding of the arduino that is going to be used inside the watch and essentially be the backbone of the device, if this were to not work or we could not figure out the code in the time given before the final due date. Although, this cannot be tested for as of right now because the arduino was recently ordered.

What is Going on and How is it Being Done?

The type of prototyping we had chosen for our first prototype had been focused. This prototype involves implementing one or a few attributes of the product in order to answer specific questions about the product design. With our focused prototype, we were able to recreate our base for the sensor as well as display. Although the prototype did not implement all of the products attributes, it helped us recreate our ideas and have a physical model, this allowed for us to see the dimensions properly and make changes accordingly.

To begin with our testing product, dimensions were determined for the display size, ring size, and earpiece (Table 1.0). With these dimensions, a simple model was created in SolidWorks for each piece of the device. The models were not hollowed or created with the ability to transform like the final product would, in order to avoid wasting materials or using additional time. Moreover, using a more flexible material when 3D printing the Solidworks models would result in an extra fee, causing changes in our cost and budgeting.

Prototype	**Measurements**
Wrist watch	Display Width: 10.5mm Height: 42.0mm Length: 35.9mm Band strap length - (short side) 75mm - (long side) 115mm
Earpiece case	Height: 7.92mm

	Width: 5.69mm Depth of the case: 4.15mm
Ring	Ring size 10 - Inner diameter: 19.8mm - Circumference: 62.1mm - Thickness of the ring: 5-7mm Top of the ring - Width: 12mm - Length: 17mm

Table 1.0: Dimensions of the prototypes

The information that is being measured are the dimensions of the prototype to be able to fit all the required parts and components. The dimensions of the design were determined by research on other products that are existing in the market and are similar to the design of the prototype. Firstly, the dimensions of the watch was based on the dimensions of a traditional everyday watch and adjusted to obtain an ideal dimension that would fit all the parts that will be installed in the watch section. The ring prototype was dimensioned by averaging the common ring size between men and women which is around size 10.5. Whereas the dimension of the earpiece was determined by referring to the Behind-The-Ear(BTE) hearing aid which is popular among hearing aid users as our team finds it suitable in our design. Modifications were made to each prototype to ensure that the prototype is able to fit all the components that are needed for our design to work such as battery, arduino board, sensors, etc.

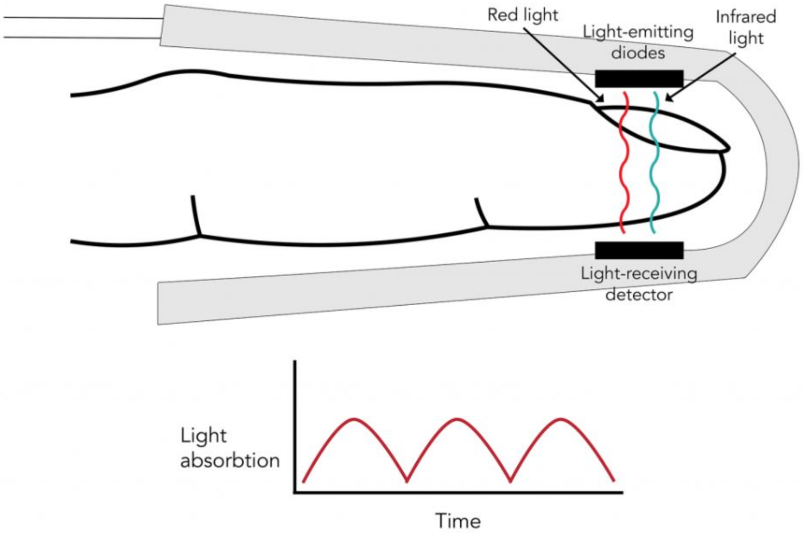


Figure 5: Diagram of Pulse Oxygen Saturation Device. Image from http://blog.tunstallhealthcare.com.au/connected-health/what-is-a-pulse-oximeter/

In this prototype we are observing the dimensions of the device, how intrusive it is, and if the design is feasible. This had been recorded by looking at the physical models that were printed and discussing whether changes needed to be made and why. When we had the model in person to look at, it was easier to determine if components could fit in the device or if it would become too bulky and intrusive. Each criticism was then recorded and discussed in order to determine our next steps.

The material required for our first prototype is the common 3D printer plastic PLA (polylactic acid). The plastic is cheap, degradable and is capable of creating a model that fits our needs. For this prototype there is no approximate estimated cost due to the MakersSpace providing free 3D printing with the PLA material.

The work needed to be done for this prototype is researching the dimensions of the hardware required to fit inside of our devices and comparing it to the printed examples. In addition, getting opinions and feedback on the design and wearability will be required in order to let us know what should be changed or continued. Moreover, benchmarking previously created devices and creating a design of our own needs to be done as well. Finally, modelling needs to be done before creating the prototype in order to prevent wasted time and materials.

When is it happening?

The preliminary work required before prototype tests begin are a lot of benchmarking, research, and modelling.

Benchmarking:
Before we pursue a prototype, we must first see if similar devices are already out on the market. This gives us a great reference for modelling (dimensions, geometry, materials, mechanisms, etc.). In addition, we can get an informative glimpse into what aspects customers love/hate about this product - ultimately trying to avoid some mistakes that the previous developers made.

Research:
A very time demanding task was research. For instance - we may have caught ourselves wanting to pursue an earlobe attached oximeter which would wirelessly transmit data to a wrist watch. However, before we jumped right into the modelling, 3D printing, and circuitry, we needed to perform a sanity check. The following are some of the questions that may come up:

- Is it possible to fit an oximeter, battery, circuit board, and bluetooth module onto an ear while keeping reasonably small dimensions?
- How much space do we have available for this prototype? Exactly how large is “too large”?

- What are the existing dimensions of some of these components?
- Can we even wire these? Do some tutorials or code libraries exist which could help us out with this in the future?

Modelling:

For us, modelling consists of using Solidworks to get our ideas from paper to computer (and eventually to a physical model via 3D printing). Although it may be a bit more complex than just using pen and paper, Solidworks modelling has very quickly displayed its utility to us. Upon modelling a prototype we can accurately view the geometry and metrics of an idea (length, width, height, volume, weight with different materials, etc.). *Figure 6* displays the Solidworks models crafted thus far for a wrist watch, ear frames, and rings.

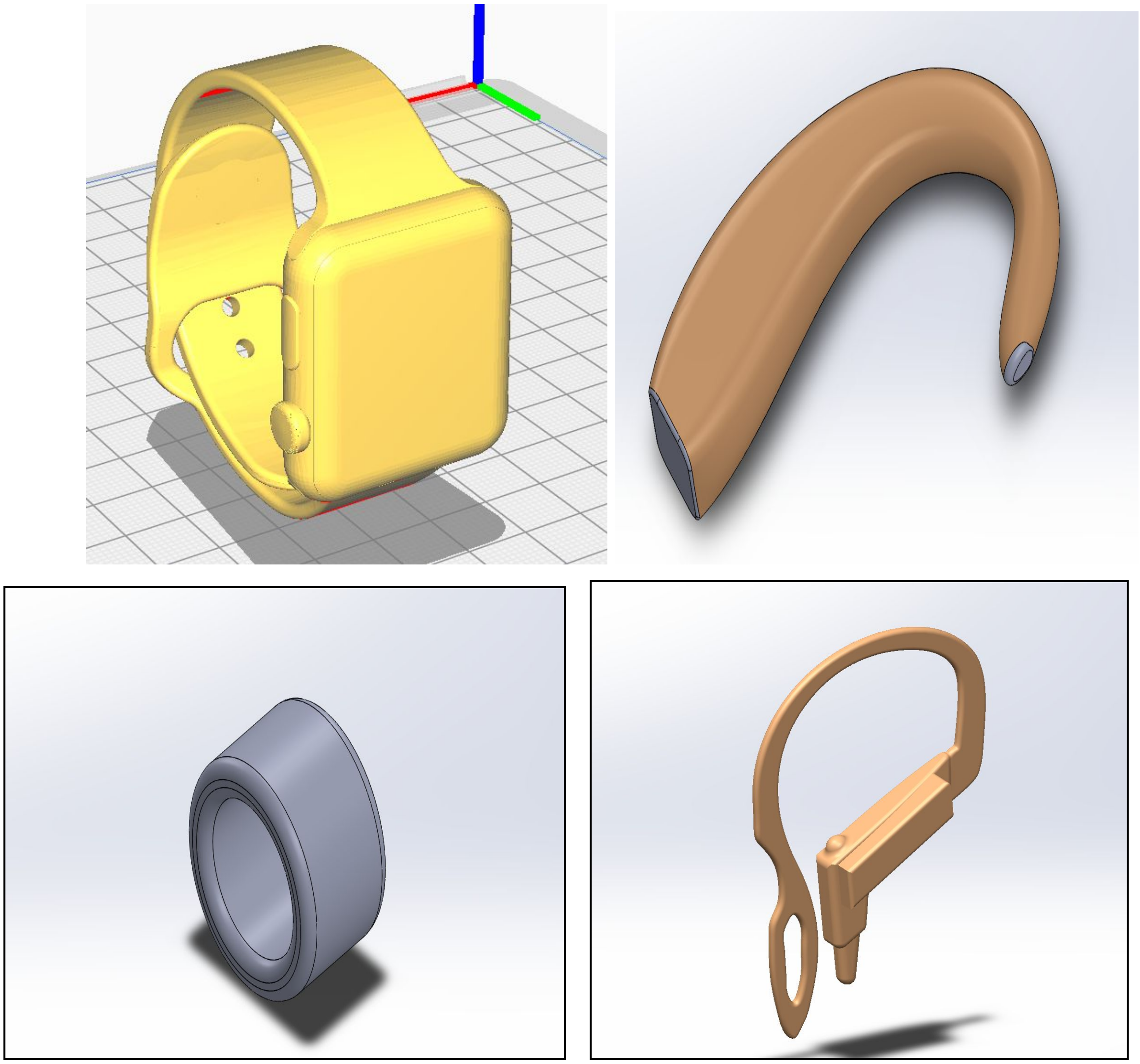


Figure 6: CAD models crafted in Solidworks based on hand-sketched prototypes.

Our Gantt chart states that we should begin our creation of a working oximeter sensor on Monday, March 2nd. This means that by that date, we need to have the following answers:

- Have we opted to put the oximeter on the ear-lobe or finger?
- Is the oximeter we're buying able to capture data at this location?
- How will the oximeter connect to other components? By wire or by bluetooth?
- Is wiring and programming such a system feasible?
- Are there any online resources which can help us program and wire this system?

In order to have these questions answered, we will need to do some modeling, 3d printing, dimensioning, and research. *Table 2.0* displays some current leads/info regarding these concerns:

Source	Statements/ Information Gathered	Significance
Ms. Damuluri - Lab TA	Having wireless transmission from an ear oximeter requires transmission to the arduino (which will be located on the wrist in our case). This means that the ear frame will require a bluetooth module.	Considering the dimensions of the bluetooth module we plan on using (HC-05 or HC-06), wireless oximeter data transmission is not very feasible. This means that there must be a wire running from the oximeter to the arduino on the wrist. Running a wire from the ear all the way to the wrist is not very practical. Therefore, we have concluded that the oximeter will be located on the finger and wired up to the wrist module.
1 - shorturl.at/ghmrK 2 - shorturl.at/swVZ6 3-shorturl.at/mFMW1	In the 3 online resources, the oximeter sensor we plan on purchasing (MAX 30100 or MAX 30102) is used at the site of the fingers. Furthermore, all circuitry guides show that the oximeter sensor is connected by a wire to the arduino.	These resources gave us some great information about the oximeter sensor we're most likely going to buy. Some quirks were mentioned, as well as advice for troubleshooting. The site of data collection was always seen to be at the finger which further reinforced our choice for wired transmission between the oximeter (finger) and arduino (wrist). We now have a plethora of guides to follow and issues to expect.

Table 2.0: Current leads/information on our current and next prototypes.

Conclusion

Our first prototype had been greatly successful. After determining which design models we wanted to pursue, we had 3D printed our SolidWorks designs. During the initial prototyping, we had run into implications such as realizing that our earpiece design was not feasible given our project. Each of our concepts had fulfilled our expectations and we are currently on schedule for our next round of deliverables and prototyping. These will be completed with more functional capabilities and require more physical building.

Following this, we will need to attempt to do more collaborating work and communication ideas better. This will involve increasing the amount of time done in the MakersLab and programming. In addition, we will be required to have more meetings in order to ensure we are on time for our future deadlines.

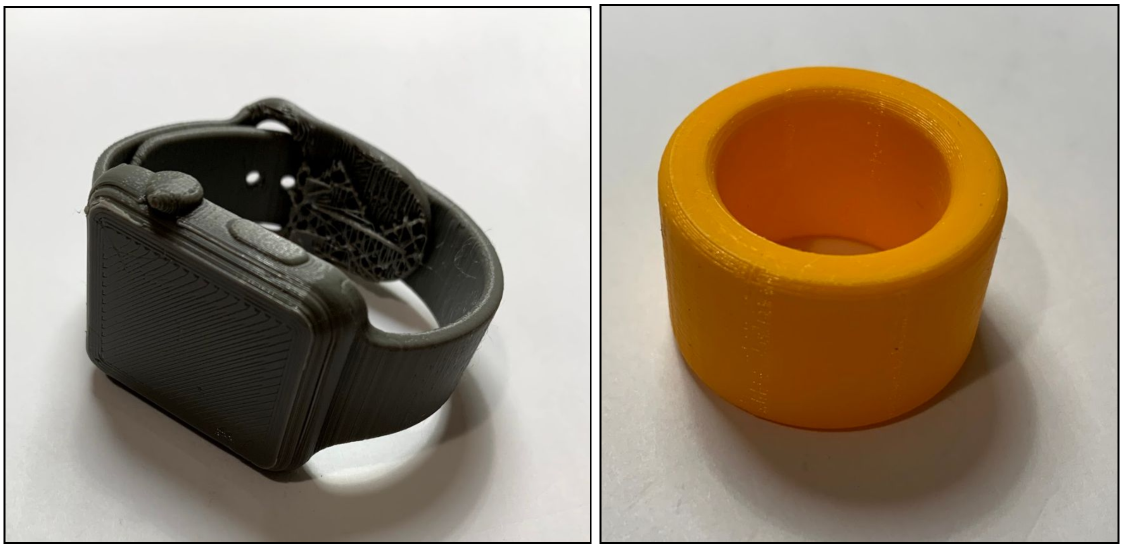


Figure 7: 3D printed product for prototype