Project Deliverable E: **Project Schedule and Cost**

GNG 1103 – Engineering Design

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GNG1103, Section # ____C01___ Team # ___4___

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Introduction

The aim of this deliverable is to create a project schedule in order for our team to stay on task and complete all three prototypes by the end of the semester. This deliverable also provides the estimated cost of the components that we will require for our prototypes as well as final product.

There are three prototypes that are due by the end of the course term. The first prototype is a simple one that will be used for us to better understand how our concept will work in reality. It will use materials that can be found in Makerspace or at home. The second prototype will be medium fidelity and low cost. It will mainly test the capabilities of the sensor that is used to detect the oxygen saturation in the user's blood, it will also integrate the alert function into the system.The aim of the second prototype is to analyse the functionality and practicality of our design as a whole, this should give us a good sensing on whether our product will work. Finally, our third prototype will be tested for consistency and reliability. The third prototype will be our final product.

In order to keep our schedule plan in place, we will use a Gantt chart to monitor our progress from now until the final product. The Gantt chart will consist of a list of all the tasks that needs to be completed for each prototype. The tasks will contain information such as the expected duration of the task and the person in charge, we will also highlight our critical path of tasks that need to be completed in order to stay on track.

As issues and adversaries may arise during the prototyping phase, we will need to create contingencies to ensure that we are still able to run our project as smoothly as possible. It is important for us to have a back up plan to fall back on so no time is wasted on trying to find a new angle to deal with whatever issues that we may face along the course of our prototyping.

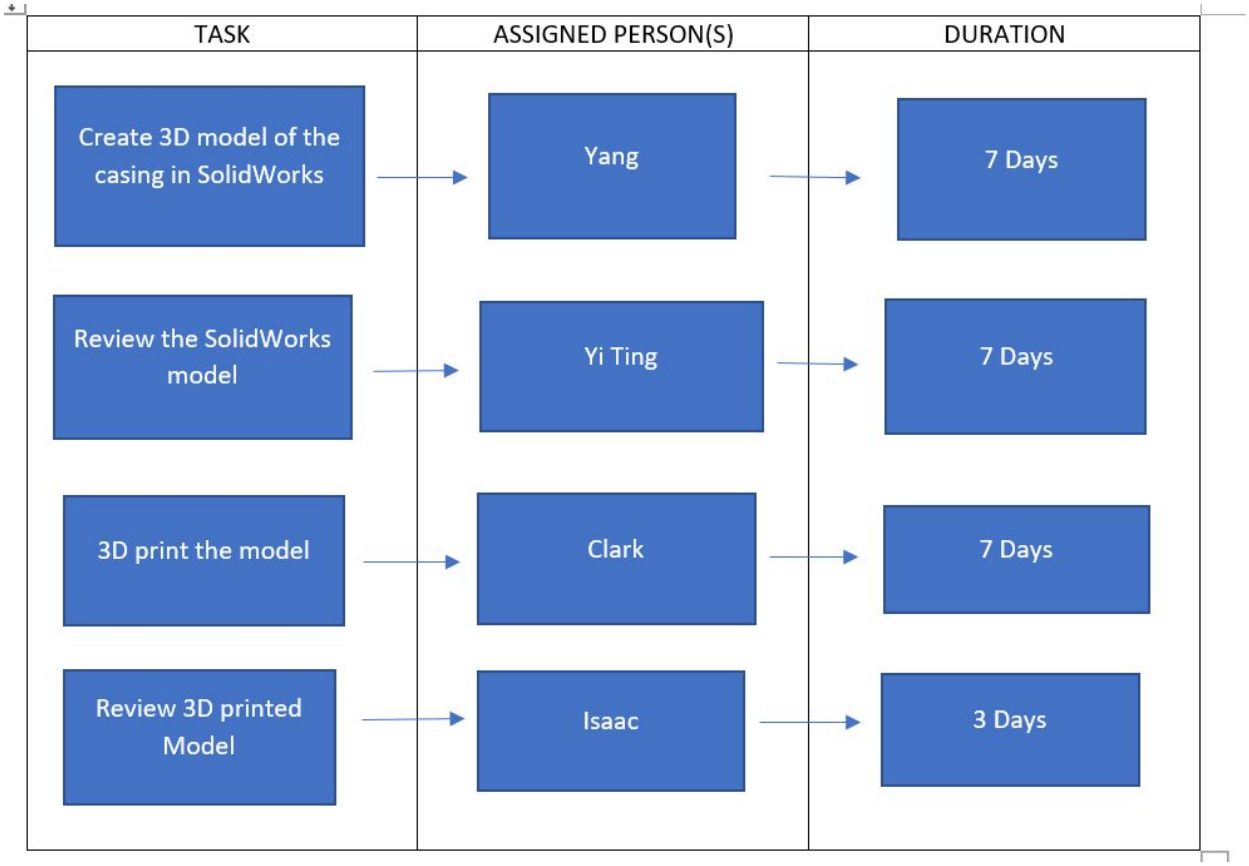
Finally, we will break down the required parts and components for our device as well as the estimated total cost. We have ensured that we stay under the 100 CAD budget for this project.

Project Plan

Prototype 1

The initial prototype focuses on a low fidelity/low-cost model to show to the clients and to observe as a team to check general functionality. This is done to help validate the initial concept and reduce the uncertainty of future models. Essentially, this prototype will provide the basic information to see if the current solution holds value as a product and avoid any critical flaws in the future. The first prototype would be a 3D printed casing of our concept that will hold the sensors and display within it. The function of our first prototype is to test whether the sensors and the display would fit into the casing as predicted. Besides, we would like to determine the comfort of our device as a wearable.

TASK LIST FOR PROTOTYPE 1

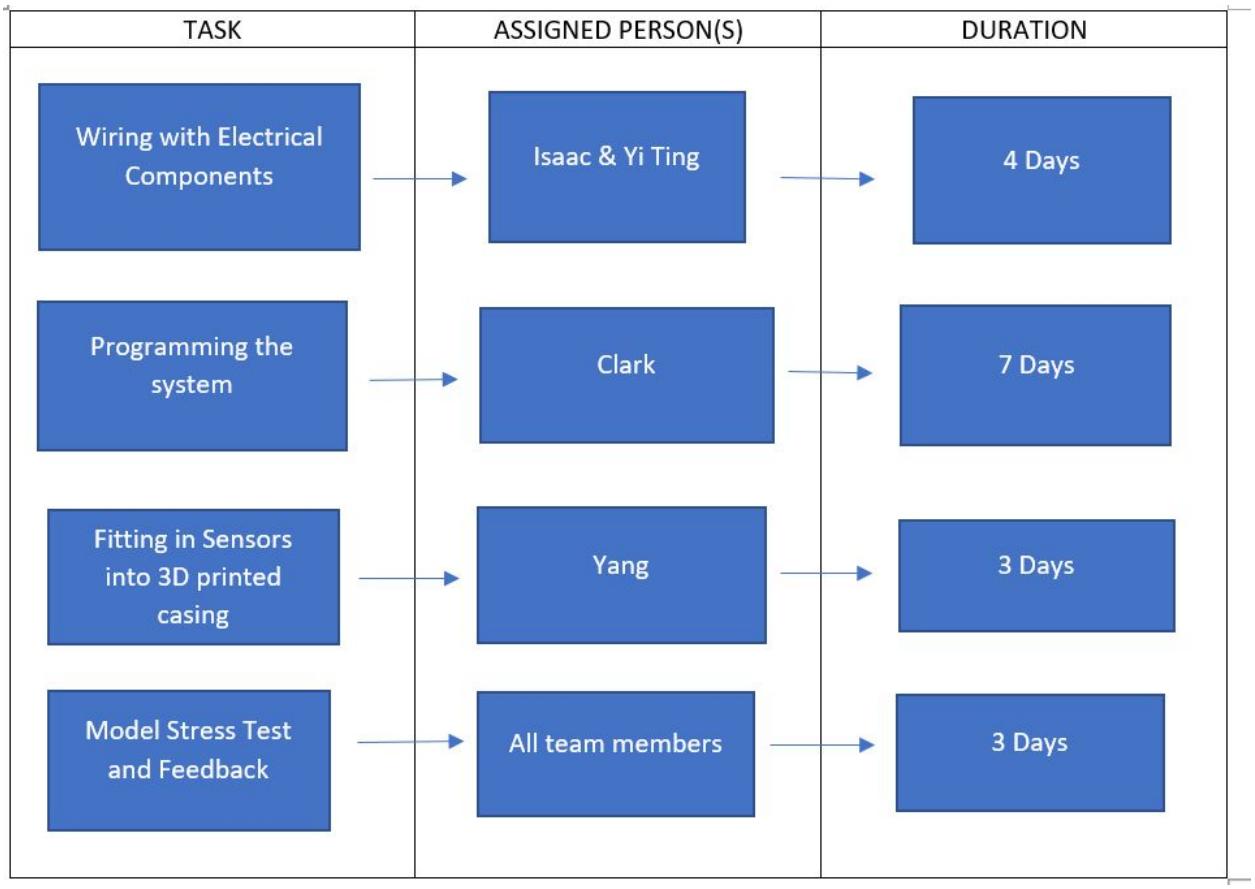


Prototype 2

The second prototype is a medium cost and medium fidelity model that the team will use to test and analyse the functionality and precision of the system. The primary focus is for the team to experiment with the blood-oxygen saturation sensor and the display, thereafter integrating the alert feature into the system.The second prototype aims to determine the accuracy and consistency of the device by testing the responsiveness of both the sensor and the display. As the device is meant to provide aid in life threatening emergencies, our device needs to respond

quickly without a hitch. Therefore, the prototype will test how quickly the sensor responds to changes in the blood oxygen level. The team will also have to determine the sensitivity of the sensor (i.e.whether the sensor can pick up minute changes are).

The team will also work to integrate the alert system into the prototype. The alert system will be tested for quick response and consistency. We have to ensure that the alert system does not send alert messages when not required and ensure that it sends out alert messages during emergencies. We will test the alert systems by setting the bar for the trigger at a higher oxygen level so as not to endanger the ones testing it. We want to make sure that our prototype sends out the alert at when the blood oxygen saturation reaches the predetermined cut off point. The second prototype will also be shown to the clients to receive feedback for the third prototype.



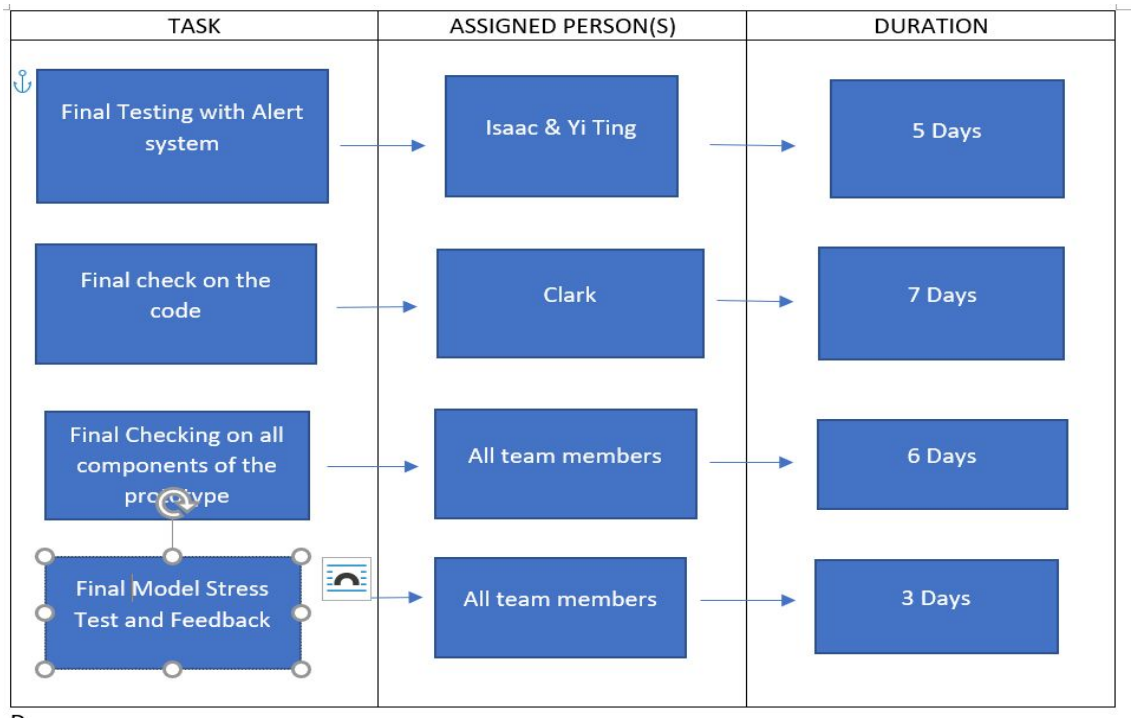
Buying List (Deadline: 1st of March)- Clark
1.Arduino Nano 3
2.Arduino UNO & Genuino UNO
3.Microchip ATtiny85
4.OLED SSD1306 128x32 display
5.Maxim Integrated MAX30102 High-Sensitivity Pulse Oximeter and Heart-Rate Sensor for Wearable Health
6.3mm LED: Red
7.Resistor 1k Ohm
8.Push button

Prototype 3

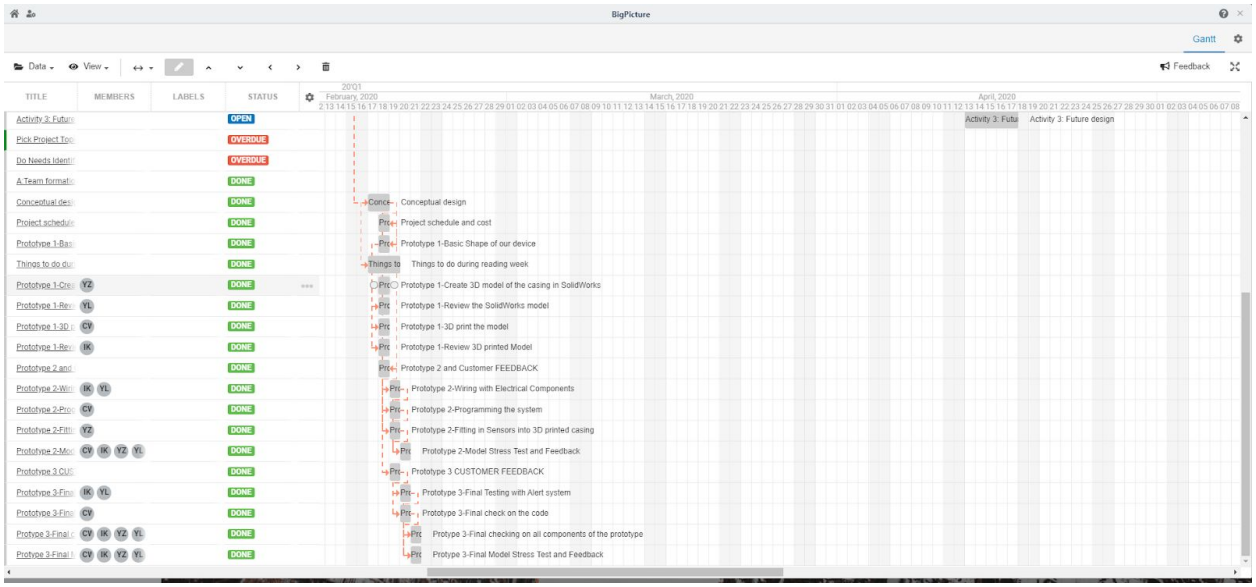
Prototype three is a high fidelity and high cost prototype, it will be the final prototype of the project and it will be our final product. Prototype three is a continuation of prototype two that will focus mainly on debugging and ensuring consistent and smooth operation of the device. The team will run tests to ensure that the device is running well and that there are no bugs in the device and that will cause malfunctions. Using the data collected from the test runs conducted in prototype one and two, the team will refine the device's functionality and improve the program of the device if necessary. Prototype three will be tested for how quickly it will respond to any changes in the blood-oxygen saturation level and how quickly it sends the alert to the target recipient(i.e. Medical staff, next of kin etc). The third prototype will utilize the same components as the first 2 prototypes.

The team will work to ensure the third prototype will operate without technical issues, we will also work on prototype three based on the feedback given by the customer for prototype one and two so that our final product will satisfy the

client's needs. Prototype three will also feature a model to show how the initial stages of our prototyping phase differs with the final product. Prototype three will be presented to our clients for their final feedback before we make any final changes to the product for Design Day.



Gantt Diagram



Project Risk and Contingency Plans

When completing a project that has many different sections and weekly deadlines like this one, we have to take into account the risks associated with the project and create a contingency plan to deal with them if they arise.

Being full time students, we all have busy schedules with classes and work. Midterms and due dates for other courses could prevent us from completing our tasks for this course on time. One solution to that problem would be to keep things simple by abandoning unnecessary features (ex: GPS, cellular connectivity). This would be the same for coding, our coding would mainly consist of essentials features of our product. By doing so, we would be able to achieve our ultimate goal which is to complete the prototype and ensure that it is working and ready for presentation for Design Day.

Our project could also be delayed by various technical problems such as the Arduino not being able to handle our code, the pulse oximeter and heart rate sensor is not working, our LED display is not functioning as expected. If those problems arise, we will come up with alternative plans to make our project work. For example, we could replace our Arduino with a Raspberry Pi to handle our code. For oximeter and sensor issues, we could replace them with our back up sensors. Finally, if our LED display does not work as well as we expect, we will switch to a different OLED display. If all goes well, we will have a final working prototype by Design Day.

Finally, our project could also be facing programming issues as we have going to programming a system that sends an alert message through cellular network, and we are inexperience in a programming system that deals with cellular connectivity. If we are incapable of programming such a system, our contingency plan would be to switch our alert system from cellular to Bluetooth. Besides, due to the fact that most of our parts that are needed for project are ordered online. There

might be issues such as late delivery and so on. In the event of that happening, we would be purchasing our part in a physical store.

Estimated cost

Our product uses less than ten components. As our prototyping plan revolves around testing the functionality and accuracy of the device, we are able to reuse major components of the the prototypes in order to be more cost effective. For example, we can reuse components like the Arduino Nano 3, Arduino UNO & Genuino UNO ,the Pulse Oximeter and so on. The electrical components of our product can be tested using a breadboard and will be recycled for the final product.

Bill of Materials

ID	Description	Qty	Cost
1	Arduino Nano 3	1	27.37
2	Arduino UNO & Genuino UNO	1	29.09
3	Microchip ATtiny85	1	1.59
4	OLED SSD1306 128x32 display	1	2.34
5	Maxim Integrated MAX30102 High-Sensitivity Pulse Oximeter and Heart-Rate Sensor for Wearable Health	1	23.97
6	3mm LED: Red	1	0.57
7	Resistor 1k Ohm	1	0.089
8	Push button	1	1
9	Jumper Wires	10	1

Note 1: These prices are all in CAD on their respective websites and are calculated before Ontario HST rates of 13%.

Total Sum of Material Cost: CAD87.018

Discussion

The first criteria for our prototype would be high accuracy and precision of our sensors and display. To achieve this criterion, we would be using high precision pulse oximeter and heart rate sensor. We will run a couple of tests in conditions of extreme difference to ensure the accuracy and precision of our sensor. If the sensors do not perform as expected, we would need to rerun all the tests with similar models of the sensor but of a different maker.

The second criteria for our prototype would be the comfort of our device as a wearable. We have to ensure that the user feels at ease while using our device. As mentioned in a previous meeting with our client, many opioid uses face social stigmas as they are afraid of being classified as “druggies” by the general public, hence our design has to be inconspicuous and less likely to draw attention. The device should not hinder the user’s movements as well, as it will make it less appealing for the user to utilise our device if it gets in their way often.

By taking these two criteria into consideration, our final product must be able to do its job whilst staying as hidden as possible. However, as our product uses an oximeter, it will be challenging for us to incorporate these criteria into our product as there are only certain areas where an oximeter is the most effective. Moreover, as the underlying issue is to save opioid overdose victims, the device has to work during emergencies as it will be a life or death matter. As such, our prototypes will focus greatly on the accuracy of the sensor and the responsiveness of our device. We also have to ensure that the prototypes are able to send an alert when triggered, and that they do so as fast as possible.

Conclusion and Next Steps

In conclusion, the report consists of a project plan that the team will adhere to. By following the project plan closely we can ensure that our progress is smooth and that we are able to meet the deadlines for each prototype.

Our first prototype will be a simple model of the final product that we will show to the client and garner some feedback from them. The second prototype features the blood oximeter sensor, the display sensor and the alert system. It will be used to test the general functions of the concept. The final prototype will refined version of the second prototype, the final prototype will focus on smooth operation and ensure that the final product functions well. Also, the third prototype will incorporate feedback given by the clients in order to fully satisfy their needs.

We have also included the cost estimate in this report in order to gauge the cost we have used against the budget that was allocated to us. During our prototyping phase, it is important that we keep our contingency plan prepared in the event that we hit a dead end during this phase. Having a contingency plan will ensure that any issues that we face while prototyping will not slow us down and allow us to still meet the given deadlines.

Moving forward, we have to ensure that the team strictly follows this project plan during the prototyping phase so that we are able to complete the prototypes in a swift and timely fashion. It is also important that we take our clients' feedback into deep consideration for each prototype as ultimately the final product is for our clients.

References for materials

[1] - https://www.mouser.ca/Search/Refine?Keyword=Pulse+Oximeter

[2] - https://store.arduino.cc/usa/arduino-uno-rev3

[3] -

https://www.protocentral.com/sensors/1030-protocentral-pulse-oximeter-heart-rate-sensor-based-on-max30100.html