Project Deliverable D: **Conceptual Design**

GNG 1103 – Engineering Design

Date: 09 Feb 2020

GNG1103, Section # ____C01___ Team # ___4___

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Introduction

This deliverable is for us to produce a developed and refined design concept. Using the problem statement as a base, each member will use the already identified needs to construct a minimum of three ideas. The team will evaluate the consolidated ideas through the design criteria that we have developed previously. In order to set clear and uniform standards, we weigh our criteria using a numerical scale that ranks from 1 to 5, with 1 being the least and 5 being the most. Finally, each member will rank their ideas and the team will evaluate each member's top idea and collectively produce one concept.

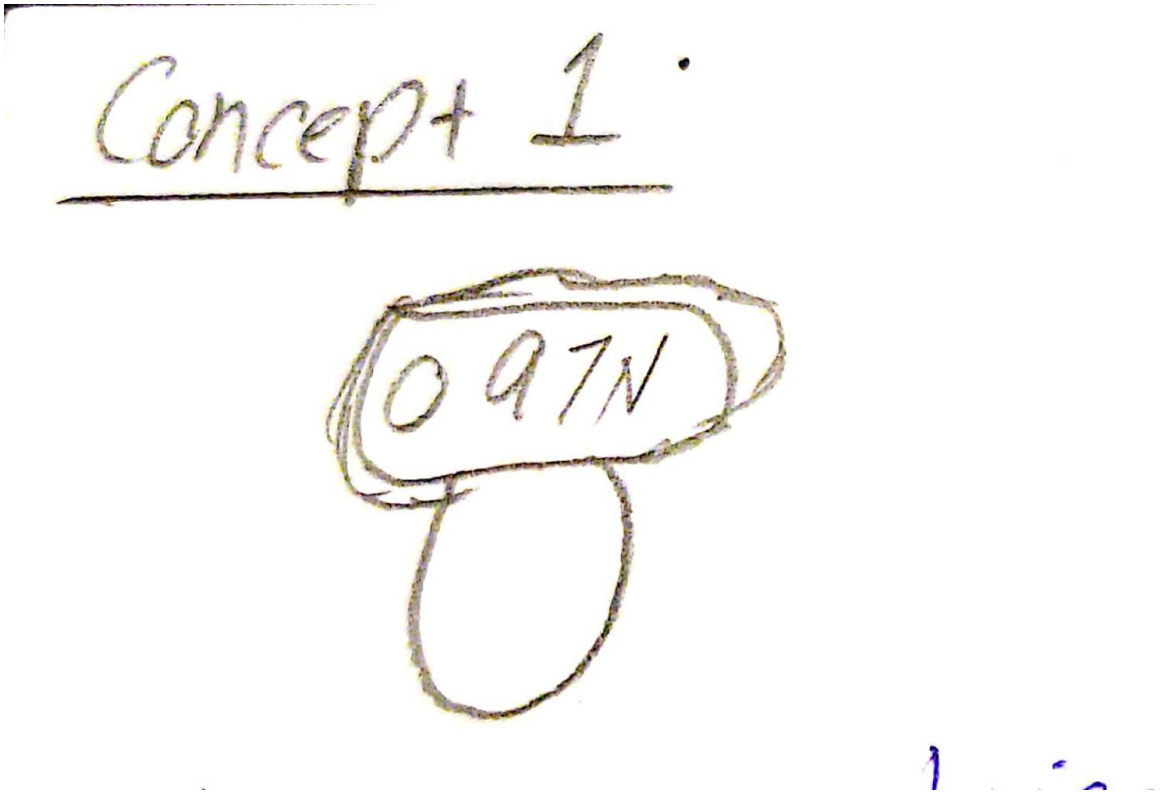
Previously, our team produced a list of functional and non-functional requirements that our device had to adhere to. The more important functional requirements included accurately tracking the vitals of the user as well as being able to signale medical personnel when the device detects an overdose. The non-functional requirements included aesthetics and a low overall cost for the device.

By strictly adhering to the problem statement ‘‘Our clients require a device that accurately tracks the vitals of an opioid user and alert medical personnel to victims of opioid overdose’’, identified needs of the client and the listed requirements, we are able to produce a design that we can begin prototyping on.

Yi Ting's Concepts

Concept 1:
A wearable ring device that uses a sensor for red and infrared light. The sensors detect how much oxygen is in your blood by comparing how much red light and infrared light is absorbed by the blood. Depending on the amounts of oxygenated Hb and deoxygenated Hb present, the ratio of the amount of red light absorbed compared to the amount of infrared light absorbed changes. The reading will then be displayed on the display of the ring. There would also be a vibration alarm in the ring that alerts the medical personnel immediately when low oxygen or low respiratory rate.

Pros: Convenient device to wear
Cons: Display might be insufficient to provide other function

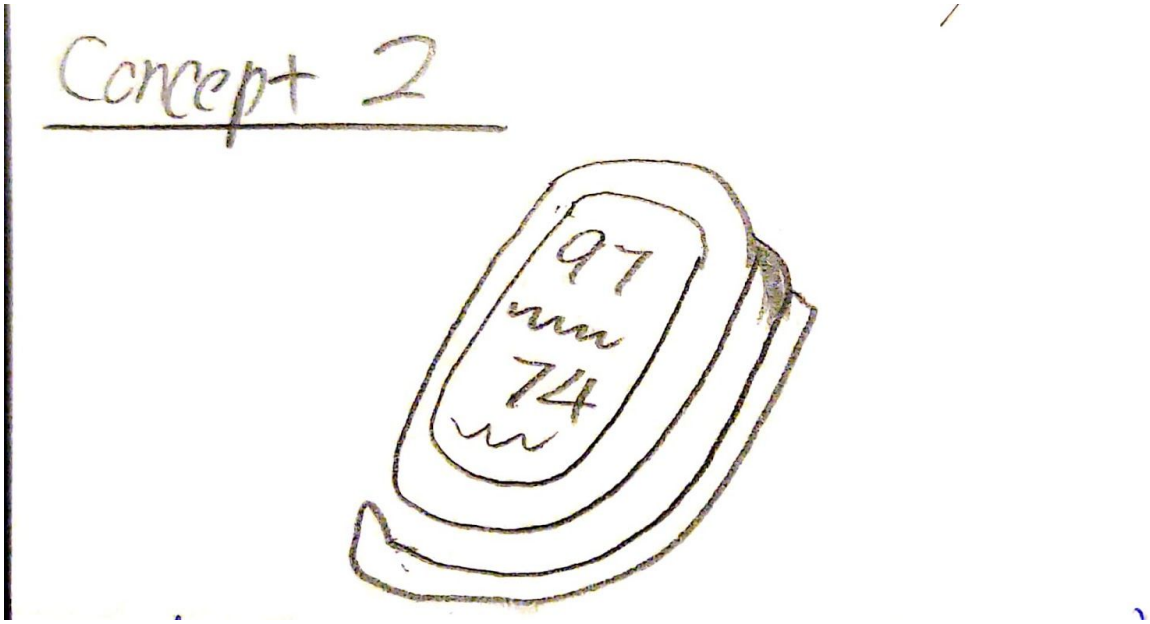


Sketch for Yi Ting's concept 1

Concept 2:

A finger clamp like device with 4 parameters: SPO2, PR, Perfusion Index (PI), and Respiratory Rate (RR). A sensor will be used for these measurements and a LED display with different display modes will display the values of the measurements. The device will also send a distress signal to medical personnel when a situation of low respiratory rate occurs.

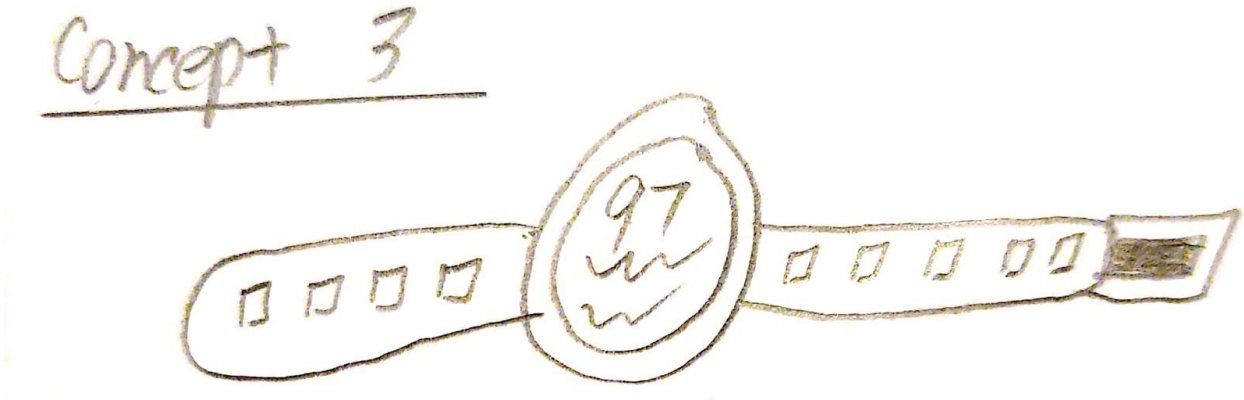
Pros: Various type of measurements
Cons: The finger clamp design might be uncomfortable to some users.



Sketch for Yi Ting's concept 2

Concept 3:
A watch type device that detects oxygen level and respiratory rate using sensor at the back of the display. The device will also alert medical personnel immediately in cases of low oxygen and respiratory rate.

Pros: Convenient daily wearable design
Cons: Lacking in certain functions



Sketch for Yi Ting's concept 3

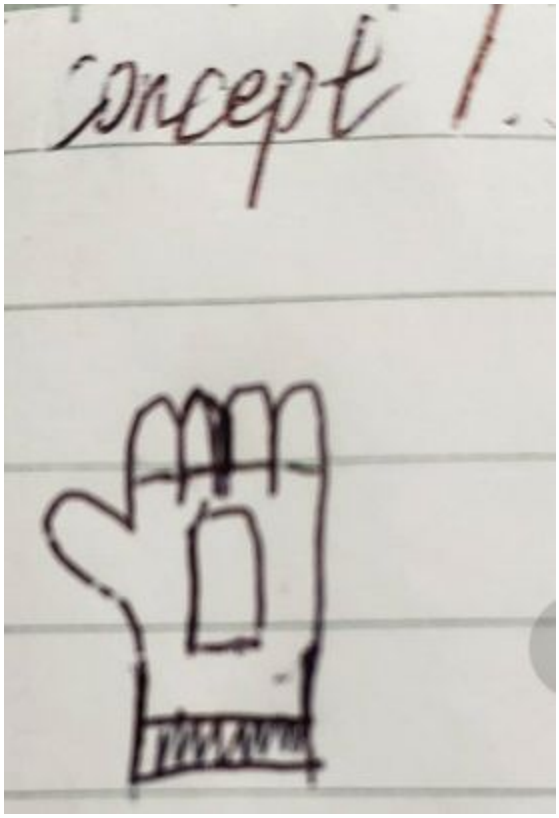
Evaluation of Yi Ting's Concept

Criteria	Concept 1	Concept 2	Concept 3
Ease of Use	4	4	4
Product Life	3	2	3
Cost	2	1	2
Is it Realistic	2	3	2
Automation	4	2	3
Total	**15**	**12**	**14**

Clark's Concept

Concept 1 :

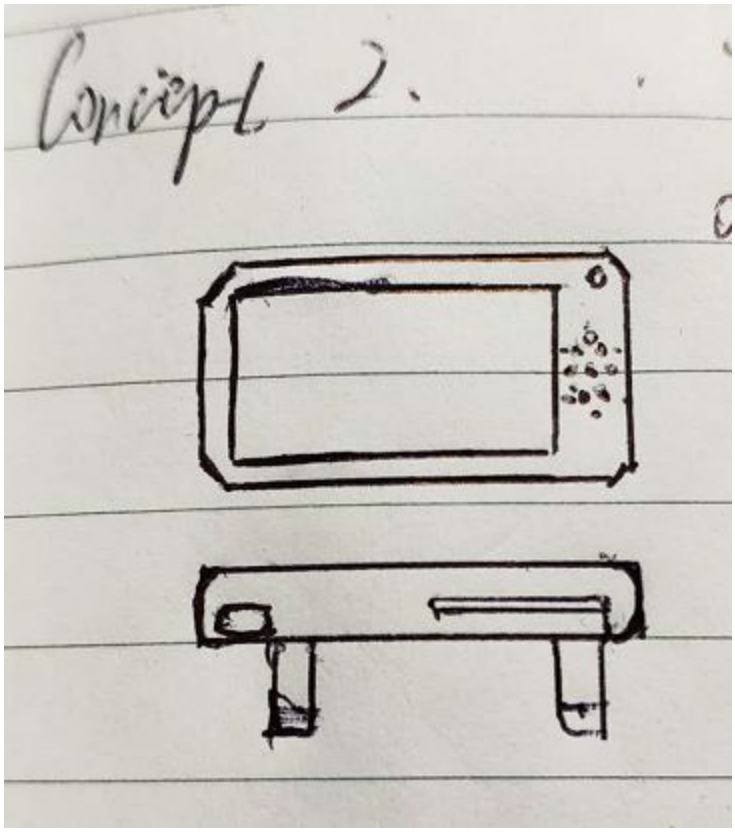
This design is based on a glove. Five sensors are set on each finger tip, and a small screen in the middle of the back of hand. By several sensors detection, the reading of the SeO2 will be much equate. Because the device is based on the glove, it will be good for workers to use. There will be a shake as its alert.



Sketch for Clark's concept 1.

Concept 2 'Super Nova':

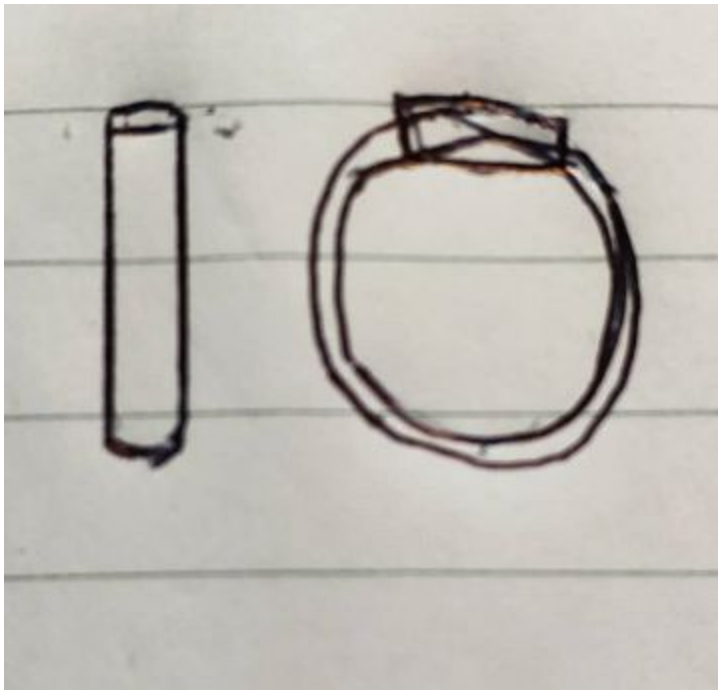
For easy construction and upgrade, a middle size detector will come out. This device is larger than a watch but smaller than a smartphone. In this size, most of opting can be used in it. For example, Bluetooth, touch screen, SD card storage, warning sound and so on. In this design, size is not the key, the powerful function is its shining point. By using a Type-C or USB charging port, it will be much easy for long hours of usage.



Sketch for Clark's concept 2.

Concept 3:

A bracelet with an electrical detector and a Bluetooth chip in it. All the data collected will be automatically send to the owner's smart phone. Because most of things was based on the smart phone, an strong Application may be programed.



Sketch for Clark's concept 3

Evaluation of Clark's concept

Criteria	Concept 1	Concept 2	Concept 3
Ease of Use	3	5	2
Product Life	4	3	2
Cost	1	5	2
Is it realistic?	1	5	1
Size	4	1	5
Total:	13	19	12

Yang's Concept

Yang's design concept involves the incorporation of water-resistance to the device.

Concept 1:

A casing for the device that utilises epoxy resin material to keep the device waterproof. Epoxy resin material is damp proof, anti-corrosive,shockproof. This is a structural waterproof method by using rubber to separate water from devices.

Pros: Good waterproof effect: Easy to install

Cons: Bad looking; Rubber is easy damaged; Difficult to use

Concept 2:

Installing a waterproof shell on key parts, including batteries, chips, and screens. This is an inner water-resistant. We can add some pipes to drain away water. As the figure shows, we just need to install small waterproof shells inside.

Pros: Long time usage.

Cons: May mold if the structure is not well designed.

Concept 3:

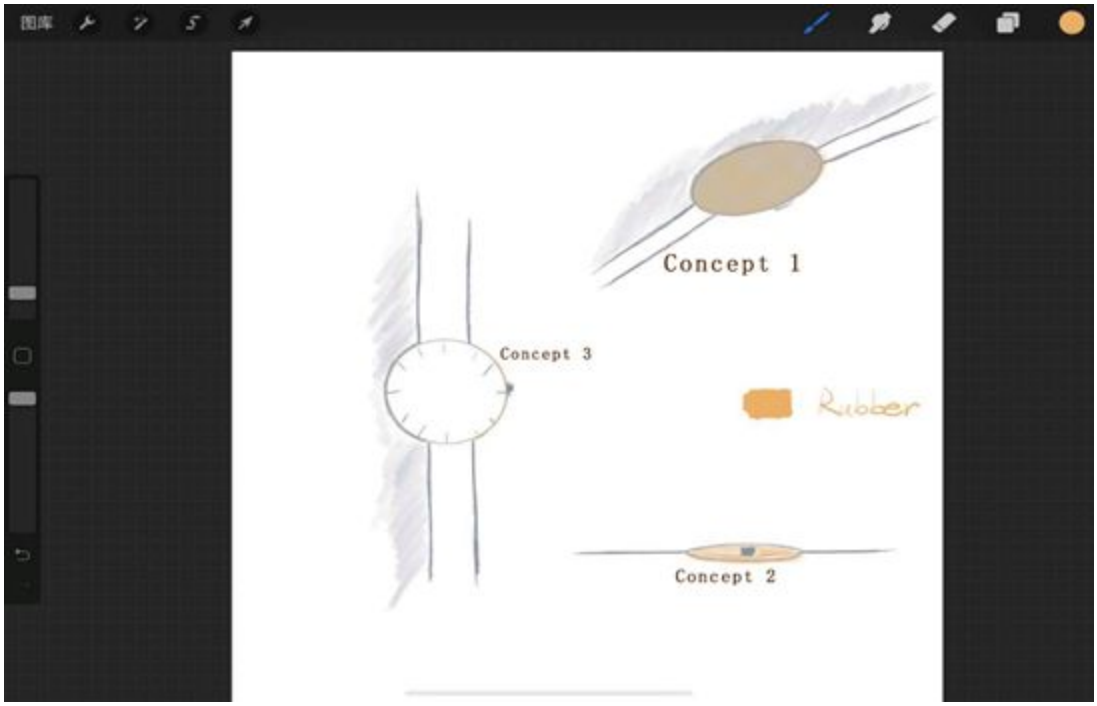
We can use nano waterproof coating—smear nano materials on the electrical device surface. These coats can fill in surface gaps. They are transparent, so that we can clear see the screen and press the buttons.

Pros: Best water-resistant effect; Don't need to redesign; Convenient

Cons: Increase costs; Easy to wear and tear

Evaluation for Yang's Concepts

Criteria	Concept 1	Concept 2	Concept 3k
Ease of Use	2	3	3
Product Life	2	3	2
Cost	3	2	1
Is it realistic?	3	1	3
Automation	3	1	1
Total	13	10	10



Sketch for Yang’s concepts.

Dylan’s Concept

Concept 1:
Adopts the design of a watch. Placing a pulse detector on the wrist allows a more accurate measurement of the user's heart rate.Small LED screen will serve as a display function for the device.

Pros: Easy to wear, no sense of discomfort, accurate detection of heart rate, can be used as a watch
Cons: Because of the small volume of the product, the production process requirements are higher

Sketch for Dylan's concept

Concept 2:

Add vibrating motors to the product to sound the alarm so that it can be used by people with hearing difficulties. Can use the small vibrating motor in the cellphone.

Pros: Provide convenience for special groups

Concept 3:

Add Bluetooth and connect to the phones number of special contacts. And alert can be sent to contact' phone when an alert occurs.

Pros: Notify the contact person if the patients are in danger and unable to save themselves.

Evaluation of Dylan's Concept

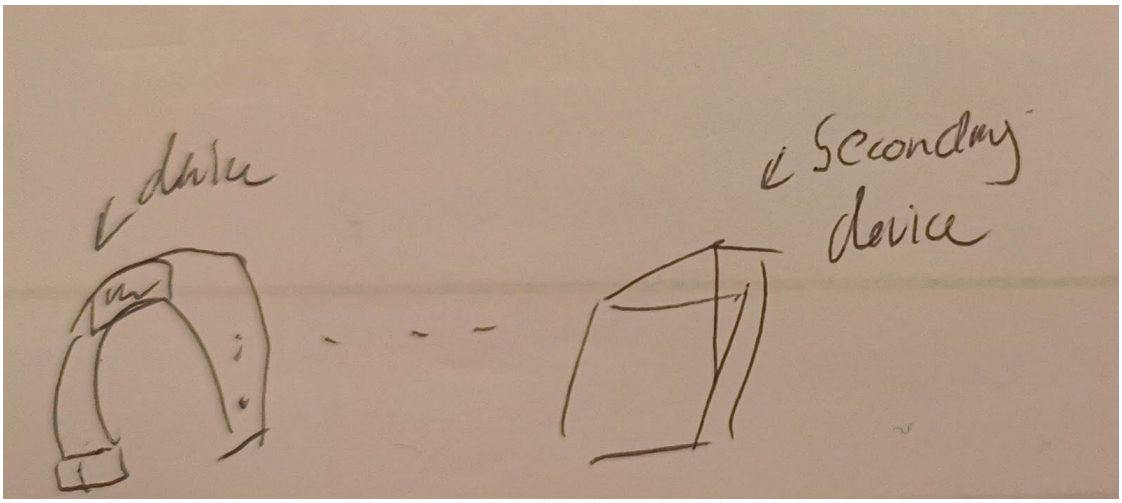
Criteria	Concept 1	Concept 2	Concept 3
Ease of Use	5	3	4
Product Life	3	3	3
Cost	4	4	2
Is it realistic?	3	4	2
Size	4	3	3
Total:	19	17	14

Isaac's Concept

Concept 1:
A wearable, band-like device that tracks the user's oxygen level, respiration rate and heartbeat using EKG(Electrocardiography). This concept utilises two devices, one device will be worn on the user in order to monitor their vitals, while the other device will be placed in the user's home. In the event of an overdose, the device worn by the user will send a signal to the secondary device which will then alert medical personnel using WiFi.

Pros:
The device will be able to reach medical personnel regardless of distance.

Cons:
The concept may not benefit those who do not have WiFi connection at home, it may also be difficult for homeless people to fully utilise.



Sketch for Isaac's concept 1

Concept 2:

An armband-like device that tracks the user's vitals using EKG. The device will be worn on the user's arm. By using a SIM chip, the device will alert medical personnel as soon as the user's vitals drop to dangerous levels.

Pros:

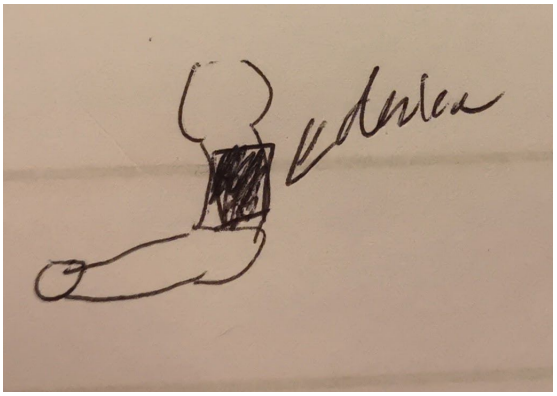
-The device is portable.

-Able to reach medical staff regardless of distance

Cons:

-Device is not as appealing to wear due to its larger size.

- There is no display on the device.



Sketch for Isaac's concept 2

Concept 3:

Similarly to concepts 1 and 2, concept 3 comprises a wearable, watch-like design that utilises EKG to track the user's vitals. The device will emit a beeping sound when the user's vitals drop to dangerous levels, it also concurrently sends an alert to medical personnel using a SIM card function. This concept aims to increase the likelihood of passers by discovering an opioid overdose victim, especially applicable to the homeless.

Pros:

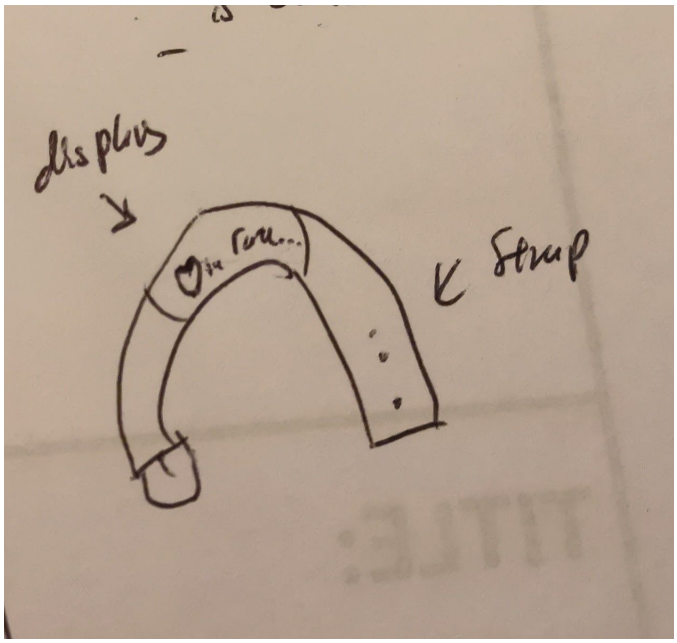
-The device is portable

- The device is able to reach medical staff without connectivity hiccups

-The device can function as a watch, making it more appealing to wear.

Cons:

- The alarm function will only be more useful for homeless people as they are outside and more likely to attract attention.



Sketch for Isaac's concept 3

Evaluation of Isaac's Concept

Criteria	Concept 1	Concept 2	Concept 3
Ease of Use	4	4	4
Product Life	3	2	4
Cost	3	2	2
Is it Realistic	2	3	3
Automation	4	4	4
Total	**16**	**15**	**17**

Synthesis of Ideas

After having a group discussion and going through our ideas, we synthesized our ideas into 3 fully-functional solutions. Despite overlapping ideas among the concepts (e.g. having a few ideas related to a watch-like design), we were able to sieve out concepts which we could use to further proceed with our final design.

Solution 1
“SuperNova”

Clark’s design involves a device that is akin to a phone’s sport band casing. The concept focuses on the device’s ability to accurately detect the victim’s vitals. By making the device larger in size, it will enable a more even and accurate reading of the user’s vitals, this is possible due to a wide distribution of sensors. However, the downsides are its bulky size, as the device is designed to be as big as a phone, it will be an inconvenience to bring the device around. Also, the large size makes it stand out and eye-catching, this could make the user uncomfortable to wear it in public areas.
Things that we need to think about:

- Battery life of the product
- Battery capacity that we should use

Solution 2

Isaac's concept involves a wearable device that tracks the user's vitals through the use of Electrocardiography, a feature that most modern smart watches currently utilise. The device also contains a SIM card, that allows the device to send alerts to medical units using SMS. This would improve the reliability of the device as it would least likely have any connection issues. However, this could be very difficult to execute as the device will use two relatively advanced features.
Things that we need to think about:

- The technology and ecosystem behind a smart device (involves heavy programming and time)

Solution 3

Yi Ting's concept centres on a wearable ring design that has sensors and display for vitals. It includes a vibration alert system. However, the device may not be as accurate as larger devices due to its small size.
Things that we need to think about:

- There might be Nano-technology involved to produce internal components that are small enough to fit into a ring. This may be challenging to introduce to the device.

Final Design

After careful evaluation of all the designs, we have decided to use Clark's concept. Clark's concept is a high precision device that mainly focuses on the accuracy of tracking the users vitals. It is integrated with a vibrating alarm, that will garner attention of nearby passers by.
To further improve on this concept, we have used the pros of the other member's ideas. The device will utilise the SIM card / WIFI connectivity feature from Isaac's concepts to alert medical personnel. Incorporating YiTing's design will allow the device to be more mobile and make it more convenient for the user to bring the around. By integrating Yang's material design, we can ensure that the device is more durable and waterproof.

In order to further proceed with the prototyping, we will need to research the following:

- Methods to sustain the device's battery life.
- The best type of material to ensure optimum durability of the device.
- How to go about with the programming of the device.
- The best ways to keep the device under the budget yet remain as functional as possible.
- Best methods to accurately measure the user's vitals.
- How to ensure that the device's functionality lasts for the longest time possible.