# Conceptual Design - Deliverable D

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# Prioritized Design Criteria

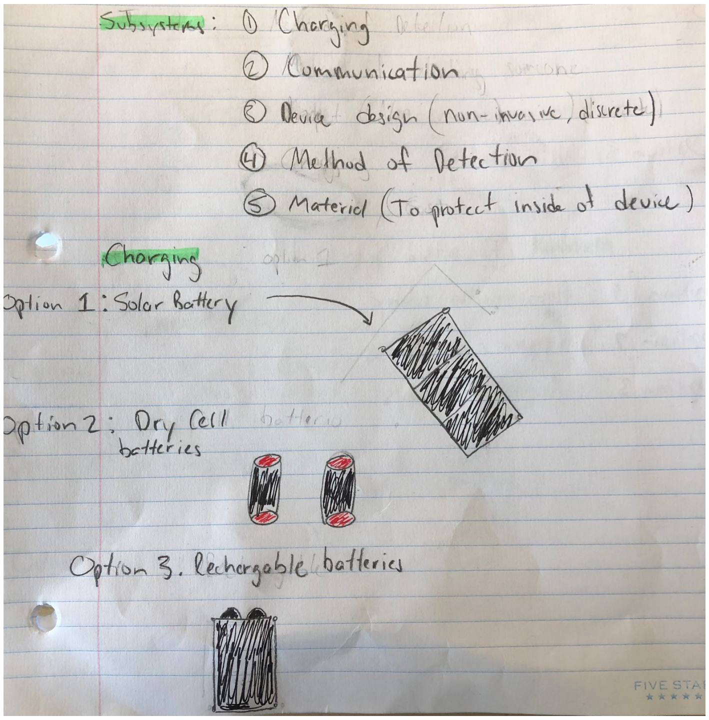
- The device is discrete
- The device is cost-efficient (below $100)
- The device is able to detect if a person's blood oxygen level is below 90%
- The device is able to detect if a person is taking less than 10 breaths per minute
- The device is accurate
- The device can be operated hands-free

# Concepts

Concept #1 (Brandon Joseph Broderick)

1. Charging
    a. Solar battery
    b. Dry cell batteries
    c. Rechargeable batteries
2. Communication
    a. Signal Notification
    b. Arduino Bluetooth
    c. Sound alert
3. Device design
    a. Finger clip-on
    b. Watch
    c. Ankle band
4. Method of Detection
    a. Pulse oximetry
    b. Breaths per minute
    c. Pulse oximetry and breaths per minute
5. Material used
    a. Plastic and Rubber
    b. Aluminum Alloys

## c. Copper and Brass



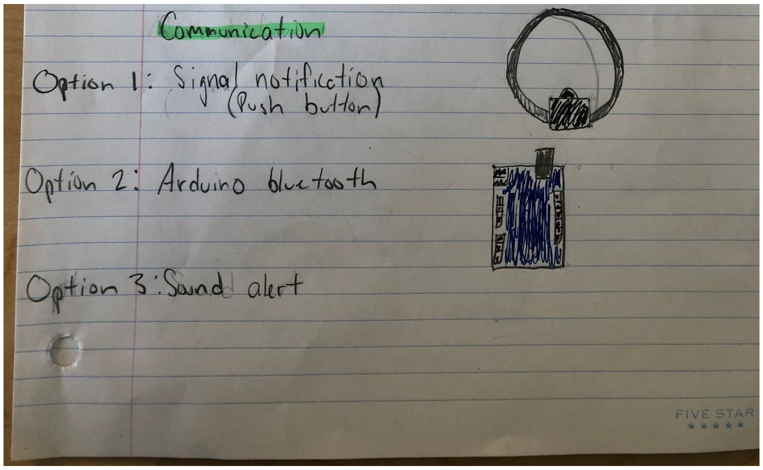
**Subsystems:**
① Charging
② Communication
③ Device design (non-invasive, discrete)
④ Method of Detection
⑤ Material (To protect inside of device)

**Charging**

Option 1: Solar Battery

Option 2: Dry Cell batteries

Option 3. Rechargable batteries

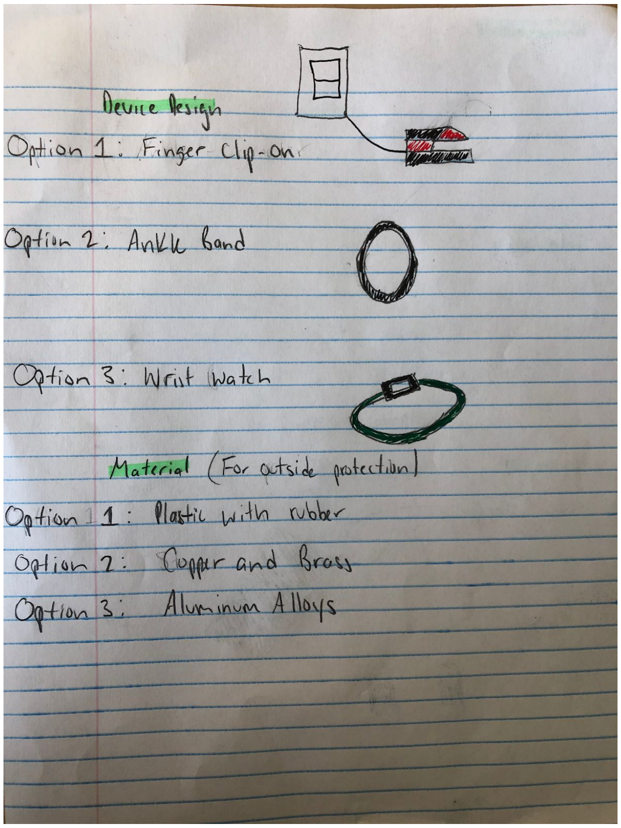


**Communication**

Option 1: Signal notification (Push button)

Option 2: Arduino bluetooth

Option 3: Sound alert



Device Design

Option 1: Finger Clip-on

Option 2: Ankle Band

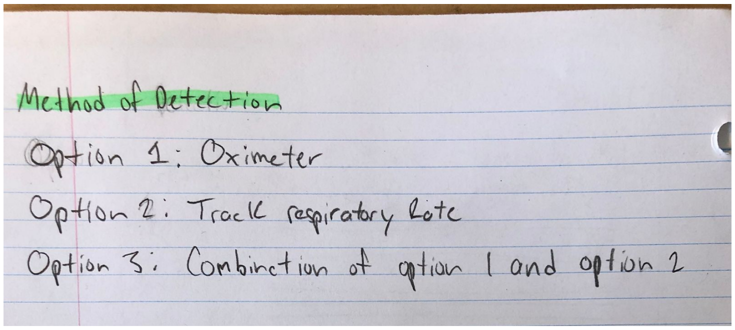
Option 3: Wrist Watch

Material (For outside protection)

Option 1: Plastic with rubber

Option 2: Copper and Brass

Option 3: Aluminum Alloys



Method of Detection

Option 1: Oximeter

Option 2: Track respiratory Rate

Option 3: Combination of option 1 and option 2

Concept #2 (Michel Pellerin)

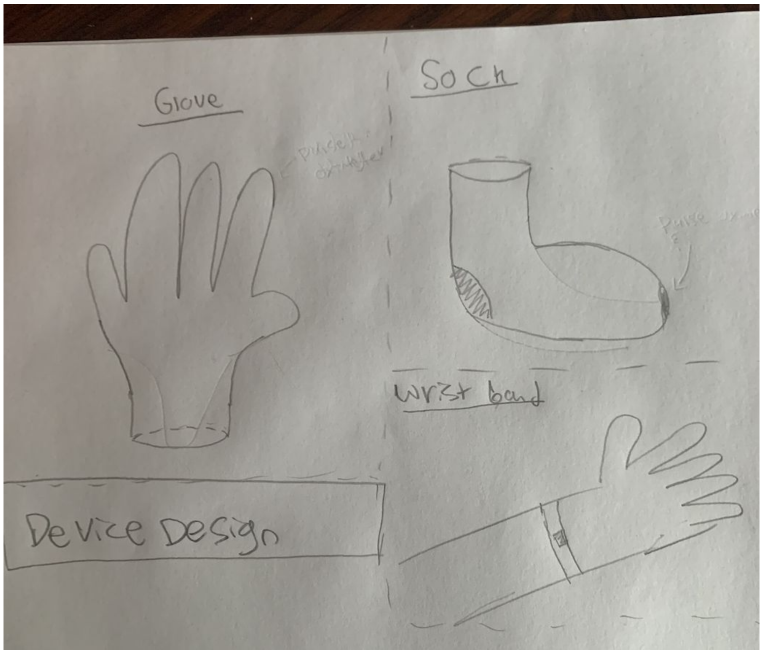
1. Charging
    1. Rechargeable battery (plugs into the wall)
    2. Wireless charging
    3. Lithium coin batteries (replace when dead)
2. Communication
    1. App
    2. Text message
    3. Separate device (comes with a device that receives alerts)

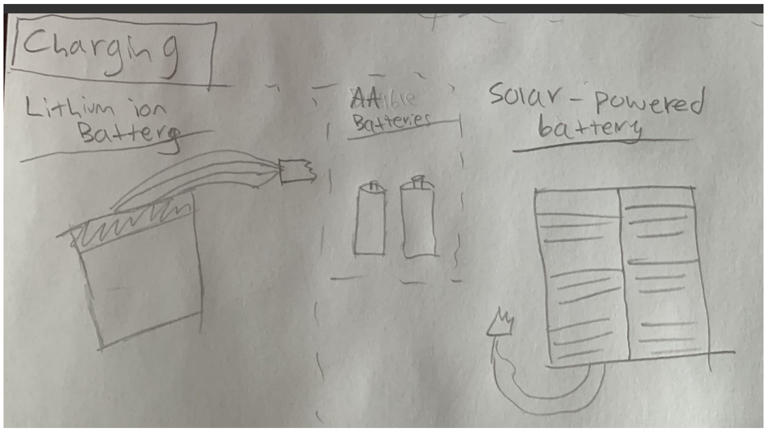
3. Device design
    a. Wristband
    b. Ring
    c. Armband (around bicep)
4. Method of Detection
    a. Pulse oximeter
    b. Breaths per minute
    c. Pulse oximetry and breaths per minute
5. Material used
    a. Rubber
    b. Metal
    c. Plastic

Concept #3 (Nathan Gaudaur)

1. Charging
    a. Rechargeable lithium-ion battery
    b. AA batteries
    c. Solar-powered battery
2. Communication
    a. Sends a text message to all emergency contacts on the user's phone
    b. Sends a signal to emergency services with the user's location
    c. Loud noise plays when the device detects an overdose to alert nearby people
3. Device design
    a. Glove
    b. Sock
    c. Wristband
4. Method of Detection
    a. Skin colour (turns blue when an overdose is taking place)
    b. Oximetry
    c. Breathing rate
5. Material used

    a. Stainless steel
    b. Cloth
    c. Plastic





Concept #4 (Andrew Bui)

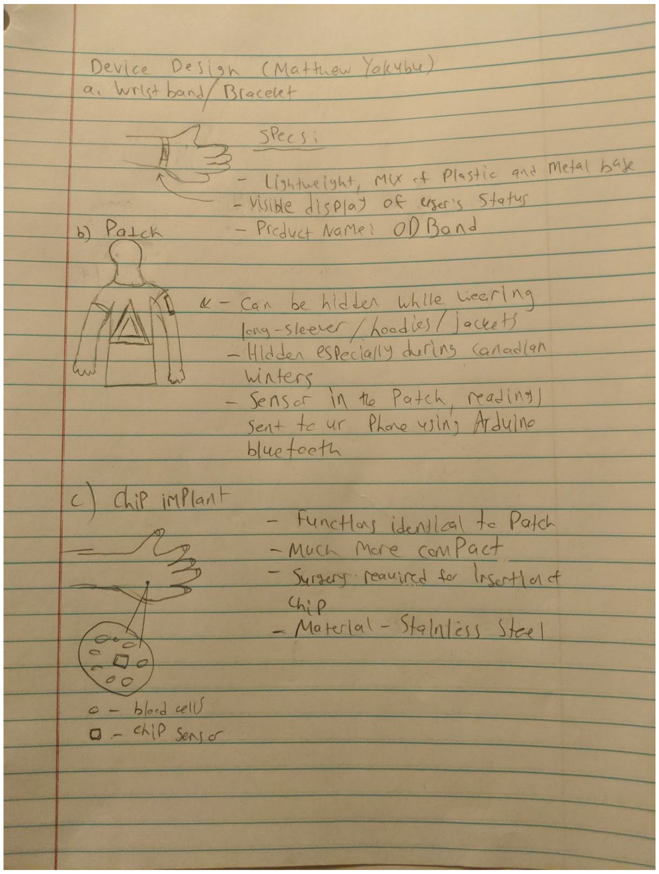
1. Charging
    a. Rechargeable Battery (Plug-in)
    b. Charges through movement (like in auto watches, power is stored in a spring and will last 38 hours when fully charged)
    c. Solar-powered (Should be able to last long after charging)
2. Communication

        a. Bluetooth (Like in lab) will send feedback to an app and will send a notice when there is an abnormality
        b. Device will keep constant measure while in contact, makes a loud enough noise to be noticeable
        c. Same as the last but vibration instead for people doing drugs at loud environments (parties) or are hard of hearing
3. Device design
    a. Watch
    b. Finger band
    c. Pad (cheap and disposable)
4. Method of Detection(Multiple should be used in combination)
    a. Breathing Rate
    b. Oxygen Level
    c. Temperature Spikes (?)
5. Material used
    a. Stainless steel
    b. Aluminum (for cost)
    c. Silver (good conductor for the temperature idea)
    d. Copper (same as silver just cheaper)

Concept #5 (Matthew Yakubu)

1. Charging
    a. Solar Power (not as efficient, less costly,
    b. Plug-in (all-day battery to accommodate for wired charging)
    c. Wireless (Place on a port and immediately start charging, costly)
2. Communication
    a. Arduino Bluetooth (cheap and works, easy to make and maintainable)
    b. Wireless alert - function similar to that of an Amber alert (Bluetooth/airdrop), those in the area with Bluetooth on will receive a notification about overdose

    c. Phone option, **1 contact** - Call function can only call emergency services within the region of the product
3. Device Design
    a. Wristband/Bracelet
    b. Discrete patch
    c. Chip implant (most discrete, most likely around the hand/wrist area)
4. Method of Detection
    a. Oxygen sensors
    b. Oxygen blood sugar rate
    c. BrPM (Breaths per minute)
5. Material Used (Could be a combination of materials listed below)
    a. Plastic (cheap, not well-suited for cold weather)
    b. Aluminum
    c. Gold (just silver coated with gold, appeal to middle-class users)



Device Design (Matthew Yakubu)

a. Wrist band/ Bracelet

Specs:

- Lightweight, mix of Plastic and Metal base
- Visible display of user's Status
- Product Name: OD Band

b) Patch

- Can be hidden while wearing long-sleeves / hoodies / jackets
- Hidden especially during Canadian winters
- Sensor in the Patch, readings sent to ur Phone using Arduino bluetooth

c) Chip implant

- Functions identical to Patch
- Much More compact
- Surgery required for insertion of chip
- Material - Stainless Steel

○ - blood cells
□ - chip sensor

# Abstract

In this report our group has come up with plenty of different ways to approach the problem at hand, that being creating a cheap and discreet wearable device that detects when a user is having an opioid overdose after we had come up with these different concepts we all got together and talked about which concepts we thought were the best overall.

After speaking with each other for a while we decided that the best option for the charging of the device would be to use a lithium-ion battery that you could use a power cable to charge up. We decided that the best way for the device to signal someone when a user is having an overdose would be to use Bluetooth to pair the device to your phone and then send an alert using your phone. For the design of the device. Our group believed that out of all the options we had come up with that a wristband was the best choice based on our design criteria. For the method of detection, the group decided using pulse oximetry was the best option as it is one of the only known ways to detect blood-oxygen levels, which is one of the main symptoms of having an opioid overdose, and finally, the materials that our group thought best suited a wristband design was plastic and rubber as they are discrete, inexpensive and stylish materials.

# Introduction

This document will analyze multiple design ideas that we have developed. We will compare them to the design criteria that we have made. Throughout the document, we will state the advantages and disadvantages of our different ideas. We will decide on the best and most practical idea to continue developing throughout our project.

# Description of 3 solutions

We will now begin to analyze and describe our 3 best functional solutions for each subsystem and conclude the one we will continue to use for the semester.

## **Charging:** Rechargeable lithium-ion battery

- We were concerned about the use of solar batteries since in Canada the winters can be long and people are not exposed to much sun.
- The AA batteries were also a close choice for us but we decided it may become too expensive and inconvenient to buy batteries every time the device dies.
- We decided to use the rechargeable battery since it will be the most reliable. Compared to our design criteria we said the device should hold a full day worth of charge. So at the end of each day the user can go home and charge the device every night, without needing to go out and buy new batteries.

## **Communication:** Arduino Bluetooth

- We had some concerns with using a loud noise from the device as the source of communication. If the user was in a very isolated location, which most people using tend to be in, the communication device would fail to notify anyone.
- We decided the Arduino uno Bluetooth device would be the optimal choice for our design. This is because if we design some circuitry connected to the board this will allow us to send messages directly to phones. Based on the design criteria this is the optimal choice for communication.

## **Method of Detection:** Pulse oximeter

- The breaths per minute was an option for the device, but it may be complicated to implement into our design. So, for now, we will consider this a secondary option and if later on, we find a way to include this may consider it.
- A respiratory rate detector was considered but concerns arose when we realized this is not the most accurate way of detecting an overdose.

- We decided the pulse oximeter was the optimal choice for our design. Based on the design criteria this was ranked the most important as it is the most reliable way to detect a user overdosing.

**Material used:** Mix of plastic and rubber

- The group did not want to use metals as they are heavier. We wanted to make sure that the device would be light and comfortable for the user.
- The group also thought that using metal would be more expensive. We want to make sure that we don't go over our budget for the project.
- The group did not use cloth as we decided not to go through with the device that this material associated with.
- We thought that plastic and rubber would be the best because it is light, cheap and easy to form. These materials best matched our design criteria

**Device Design:** Armband

- The group felt as though a ring was not the optimal design for the device, as we felt as though it would be difficult to fit all the appropriate features to detect an overdose within it.
- The group did not want to use an armband as the design for the device as we thought that they are less comfortable than a wristband, which did not fit our design criteria as well, so as a result we decided not to go for this design
- Our group thought that a wristband would be the best as it is quite discrete and stylish while still being relatively inexpensive to create.

# Conclusions and Recommendations

In conclusion, we decided that the wristband would be the best design to continue developing. The wristband was the idea that best matched the design criteria that we developed.

# References

Hope Band Article
Wearable Overdose Detector