GNG 1103

Design Project User Manual

Lookout

Submitted by:

Group 8

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Abstract

This document is a guide to enable people to use, maintain or reproduce our product. It illustrates our group's approach to solving the increasingly large problem of unintentional deaths resulting from the use of opioids. This is a problem that affects not only the users but their loved ones. Our goal was to create a non-intrusive, accurate and reliable device that detects an overdose and sends an alert to a third party so help can be received in under three minutes. Our team hopes that others may be able to learn from this manual and make effective improvements to our existing product so that more lives can be saved. This document explains the importance of our product. It guides readers through the development of the oximeter sensor, app and earpiece casing. An outline of the cost of materials and equipment used is provided. A step-by-step process of how the prototype is used and an explanation on how to maintain the prototype is given. Lastly we have included our conclusions and recommendations for future work along with the files for our design process.

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List of Acronyms

Acronym	Definition
TPU	Thermoplastic Polyurethane
PLA	Polylactic Acid
GPS	Global Positioning System
BLE	Bluetooth low energy

1 Introduction

The purpose of this project was not only to provide future engineers with experience in working in a team and learning the design process but also to save lives with our product. The opioid monitoring device that we have designed can greatly benefit society by saving thousands of people from overdosing on opioids. Since 2016, over 10, 000 Canadians have overdosed on opioids and an alarmingly 94% of those deaths were accidental [1]. We hope our product greatly reduces the amount of deaths from consuming opioids. To reduce the overall cost of our device we have made the assumption that most users have a cell phone so we have made our device reliant on an app on the user's phone. This document explains the process of making our final prototype with enough detail so that it can be easily replicated. It then outlines how to use the device and the guidelines users should follow to maintain the device. Our document then provides the conclusions our group has made and our recommendations for future work. The appendix contains all our design files that follow the design process: empathize, define, ideate, prototype and test. Below is a block diagram to help readers visualize the structure of our document.



Figure 1.1 Document Structure

1.1 Product Development

Throughout this document we will demonstrate the skills and knowledge we acquired to be able to develop an opioid overdose monitoring detector. A few of the techniques we used were soldering, coding and 3D drawing. We had to overcome many obstacles throughout this process. Time management and the importance of diversity within a group are two of the most important lessons we learned through the development of our device. Our team learned that when breaking down tasks and following the design process, no problem is unsolvable.

1.1.1 Lookout

Our product, which we have named Lookout due to its ability to look out for the user and save their life, detects an overdose and sends for help. We decided to create a product that takes the form of an earpiece (similar to bluetooth headphones) to make it discreet and convenient for users. When a user is overdosing their oxygen saturation is under 90% and their respiratory rate is under 10 breaths per minute [2]. Our team decided to use an oximeter sensor and respiratory rate sensor to increase the accuracy of determining when the user is overdosing. Unfortunately due to time and money constraints we had to drop the respiratory sensors from our design. However, we hope that anyone who wishes to develop our product further considers pursuing this idea. From using the oximeter sensor we were able to determine the user's oxygen saturation and communicate this via Bluetooth to an app we created. If the oxygen saturation went below 90% the app on the user's phone would immediately send a text message alert to a loved one telling them that the user was overdosing and naloxone needed to be administered in under 3 minutes. Naloxone can completely reverse the effects of opioids on the respiratory system if administered quickly enough [2]. To reach this solution our team followed a design process.

1.1.1.1 Design Process

Empathize

The purpose of this stage of the design process is to assume a beginner's mindset so that you can understand the customer. The person that would be using our products are the users of opioids. The customer that pays for the product could either be the user or they could be purchased and provided by the healthcare system. In this stage we gathered raw data from the customer through interviews. From their statements we identified the needs and established their relative importance. Below is a chart we created to organize the client needs.

Customer Statement	Interpreted Need	Importance (5-1)	Design Criteria	Functional or Non-functional	Target range
Can't be intrusive	No arterial blood gas test (use of needle)	5	Not intrusive	Functional	n/a
Stigma and discrimination increase risk of isolation and misuse	Aesthetic and doesn't scream "I take drugs", discrete. Doesn't necessarily require assistance to function for people who are isolated (automatic detection)	4	Discrete Size (in)	Non-functional	
Less expensive and affordable to even those in trade	Cost-effective (\$100)	3	Cost (\$)	Non-functional	\$100
Accurate measurement of respiratory rate and pulse to detect an overdose	Accurate and reliable detection of an overdose. An ambulance must only be called when there is an overdose.	5	% error Time - Monitors situation when oxygen concentration goes below 90%	Functional	% 10 seconds

Table 1: Product Needs and Design Criteria

Device can't inhibit people from using drugs or they will not wear it	Device uses other parts of the body instead of fingers to determine oxygen concentration /breathing rate (i.e. earlobe, toe)	5	Does not inhibit drug use (Location of application)	Non-functional	n/a
Some users have disorders that affect their respiratory rate	Customizable to account for any abnormal respiratory rates among users	3	Customizable	Functional	n/a
Is able to notify responders of an overdose and give them an accurate location. Only 3 min until death.	Signals for help within 3 minutes. Ensures help is sent to the right place.	5	Accurately locates user and sends help fast Distance to send help signal (km) [GPS tracking accuracy]	Functional	3 min
Durable and easy for day-to-day use	Strong, light-weight and compact enough to be carried during the entire day. Doesn't interfere with clothing	4	Weight (lbs) Materials Size (in^3)	Non-functional	Less than lb
Can be worn long-term: Clients may not set up the device prior to drug use	At least one-day battery life	4	Long battery life Chargeable	Functional	1 day

Find ways to give people extra time to get to the user	Measure respiratory rate and oxygen concentration so that it can indicate if there is an overdose earlier	4	Detects overdose	Functional	90% 10 breath/min
People won't want to wear the device if it alerts help when they are not overdosing	Create a way to override alert for help if they are not overdosing	2	Override system	Functional	

Define

After determining our needs we were able to define our problem statement which was:

To reduce harm from an opioid overdose, there is a need for a portable, discreet, non-intrusive and cost effective device that efficiently detects an overdose and sends a call for assistance so help can be sent within three minutes.

Then through benchmarking we were able to determine design criteria/constraints which can be seen above in *Table 1*.

<u>Ideate</u>

After forming a problem statement we were able to generate many ideas through sketching and brainstorming. We narrowed down our ideas to three conceptual designs which can be seen below.



Figure 1.2 Conceptual Designs

From our three designs which were a toe sock, watch and sensor focused device we chose to pursue the sensor focused device. We later modified that design by excluding the respiratory sensors. This design was ideal because it was convenient, did not interfere with drug use and was discreet which were some of our most important requirements.



Figure 1.3 Chosen Design

Prototype

After determining our design we moved onto prototyping so that we could learn more about our design and reduce risk. We made physical, focused and analytical prototypes. We had almost completed a fully functioning comprehensive prototype but unfortunately we could not complete it due to COVID-19. Below are images of the final stage of our prototypes.



Figure 1.4 Working Oximeter

•					
		: 🛚 الرچ	9:48		
Anti Opioid	Overdose		э		
Bluetooth Devices					
Turn On					
Tum Off					
Connection Status	s: Connected				
Address					
45 Louis-Pasteur, K1N 9B2, Ontario, Canada					
Oxygen Saturation	n 92%				
Change Emergency	Contacts				
\bigtriangledown	0				

Figure 1.5 App



Figure 1.6 Casing for earpiece with adjustable earbud



Figure 1.7 3D drawing of earpiece casing (still needs to be 3D printed)

Test

We tested different aspects of our device to make sure it was functioning and accurate. We received feedback on our prototypes and modified them based on that feedback. For example, the client said they were concerned that the earpiece would fall off, so we made the piece that goes around the ear thicker and more supportive and we also added adjustable earbuds so that it would fit securely in all users' ear. In future we would continue to rigorously test the comprehensive prototype that we were unable to complete to ensure it is reliable and accurate.

For further understanding of our design process please refer to Appendix I: Design Files.

2 How the Prototype is Made

Our project, as previously mentioned, was created to primarily monitor the oxygen level of the user and send an alert when the levels are too low. As a solution we decided to go with an earpiece paired with an app which would be available for the user to use. As a result we seperated ou project into 2 major sections: hardware (oximeter and and the code associated with it) and the App. In the following section we will go more in depth on how they were built, design consideration, calculation, material and their importance.

2.1 Hardware: Oximeter

2.1.1 BOM (Bill of Materials)

MATERIALS	COST(Taxes not included)
ESP Chip Board	\$3
Oximeter (MAX 30100)	\$24
1KΩ Resistor	\$0.15
Push Button	\$0.60
Battery (5V):	\$23
Solidworks earpiece case	\$0, To be built on Solidworks and 3D printed at the University.

Table 2: Bills of Materials

2.1.2 Equipment list

This subsection of our project contains a major component of our project which is the oximeter. The oximeter is one of the major components of our project, it measures the user oxygen saturation to ensure that the leve are not too low. For the hardware components, we decided to go with the esp32s since it was small, efficient and inexpensive in terms of our budget. We also worked with the Max30100 which is *"an integrated pulse oximetry and heart rate monitor sensor solution"*. However, we recommend using the max30100-GY which would avoid a lot of the error and design issues that will be later encountered. In terms of design consideration, we knew our prototype would be going on the user ear thus it had to be safe and light-weight so that the users would be able to wear it for an entire day without letting the design be too heavy for their ear. Before settling with the esp-32s, we considered using the arduino Nano with the addition of a bluetooth module. However, considering the criteria previously mentioned we settled with the esp32s which included a wifi-module, BLE, bluetooth module which later be needed. We would recommend looking into other models of this nodeMCU to avoid design issues and prevent failure when in the user's hand.

characteristics	Esp 32s	Bluetooth module	Arduino Nano
special feature	wifi module , BLE(bluetooth low energy),bluetooth	bluetooth	none
size(mm)	48.26*25.4*3mm(±0.2mm)	27*12.7mm	45*18 mm

Table 3: Hardware Comparison

For the wiring, we decided to replace our female-male wires with single strand copper wires to reduce its susceptibility to errors and to create good connection throughout the system. A breadboard was used to test the wiring and make sure the components were correctly placed, but when the right connection is determined, the wires should be soldered to the hardware component to create a slicker and aesthetically pleasing design.

The Max30100 is controlled by a list of headers and functions written in C/C++. These headers, which are used to calculate the oxygen saturation and the respiration rate were not written by our team but are referenced later on in this document. In the arduino application we did modify the code for the oximeter reading and frequency to save battery and prevent overheating.

2.1.3 Instructions

Here are the instructions for the "hardware" component of our project. These instructions explain how the hardware used in this project was built and include steps for potential errors and how to fix them as well as diagrams and pictures for a better understanding of the process.

Oximeter: Hardware

This is the datasheet for the esp-32s. Please note that this is a specific type of the esp32s. <u>http://wiki.ai-thinker.com/ media/esp32/docs/nodemcu-32s product specification.pdf</u>

1. On the Max30100 remove the resistor using a soldering iron. Apply the tip of the iron on the resistor to melt the solder which connects the resistor to the board, and using a tweezer, carefully remove the resistor (circled below). These later will be replaced by two 47k resistors (band colors : yellow, purple, red gold)



Figure 2.1 MAX30100 Resistor

- With the wires, connect the following pins together from the Esp32 to the Max30100. Note: the ESP32s will power the sensor (Max30100) so make sure the connections are stable and the wires are well connected.
 - a. Connect the GND (max30100) to the GND pin(esp32s)
 - b. Connect the SCL (max30100) to the P22(GPI022)(esp32s)
 - c. Connect the SDA(max30100) to the P21(GPI021)(esp32s)
 - d. connect the 47k ohm resistors to the SDA and SCL pin (make sure the resistor are not touching
 - e. connect the VIN(max30100) to the VIN(esp-32s) make sure the esp32s is powered by the SDA,SCL,and resistors. you can use the power line and connect VIN(esp32) to the power line to connect both resistors at the same time.

Oximeter: Software

- 1. Download the latest version of arduino
- 2. Download the library from this link https://github.com/oxullo/Arduino-MAX30100
- 3. Add the zip folder you downloaded to your library *Sketch>>Include Libraries>> Add .ZIP libraries*

Installing the Board manager

 Follow these instructions to connect the board <u>https://github.com/espressif/arduino-esp32/blob/master/docs/arduino-ide/boards_m</u> <u>anager.md</u>

If you are on a MAC used these instructions to connect your port:

https://www.instructables.com/id/Getting-Started-With-ESP32-on-a-Mac-B link-and-LED/

- Download the drivers through the SiLabs website: <u>https://www.silabs.com/Support%20Documents/Softwar...</u>
- Install the drivers onto the computer
- Plug-in the ESP32 through the micro-USB cable to the computer, and the port will appear on the Arduino IDE under Tools>>Ports.
- 2. Run the blink example (make sure the pin for the LED is correct)
- 3. Under *Tool>>Upload Speed* and change the speed to *115200*
- 4. Try this code. Run and compile the code. If no error messages are displayed go to *Tool>>Serial Monitor* and at the bottom of the screen change the baud to *115200 baud*.

```
#include <Wire.h>
#include "MAX30100_PulseOximeter.h"
#define REPORTING_PERIOD_MS 1000
// PulseOximeter is the higher level interface to the sensor
// it offers:
// * beat detection reporting
// * heart rate calculation
// * Sp02 (oxidation level) calculation
```

```
PulseOximeter pox;
uint32 t tsLastReport = 0;
// Callback (registered below) fired when a pulse is detected
void onBeatDetected()
{
Serial.println("Beat!");
}
void setup()
{
Serial.begin(115200);
Serial.print("Initializing pulse oximeter..");
// Initialize the PulseOximeter instance
// Failures are generally due to an improper I2C wiring, missing power
supply
// or wrong target chip
if (!pox.begin()) {
Serial.println("FAILED");
for(;;);
} else {
Serial.println("SUCCESS");
}
// The default current for the IR LED is 50mA and it could be changed
// by uncommenting the following line. Check MAX30100 Registers.h for
all the
// available options.
// pox.setIRLedCurrent(MAX30100 LED CURR 7 6MA);
// Register a callback for the beat detection
pox.setOnBeatDetectedCallback(onBeatDetected);
}
void loop()
{
```

```
// Make sure to call update as fast as possible
pox.update();
// Asynchronously dump heart rate and oxidation levels to the serial
// For both, a value of 0 means "invalid"
if (millis() - tsLastReport > REPORTING_PERIOD_MS) {
   Serial.print("Heart rate:");
   Serial.print(pox.getHeartRate());
   Serial.print(pox.getSp02());
   Serial.print(pox.getSp02());
   Serial.println("%");
   tsLastReport = millis();
}
```

Above is the arduino code that interacts with the MAX30100 (oximeter sensor) and ESP32. The oximeter sensor measures the oxygen saturation and heart rate. This information is sent through the ESP32 via Bluetooth to an app on the user's phone.

You should see the red light turn on the sensor or if the code doesn't work out/Shows a fail message:

- 1. Check the SDA and SCL connections
- 2. If you have packet error
- 3. Make sure the right port is connected and selected
- 4. Make sure the wire are well connected

2.2 Software: Android Application

2.2.1 Equipment List

-Cellphone with Android OS.

-Laptop with WIFI connection.

2.2.2 Instructions



Go to MIT app inventor website <u>http://ai2.appinventor.mit.edu/</u>

Elements

- 1. Create a new account and start a new project
- 2. On the palette menu drag a Listpicker (ListPicker1)
- 3. Below the Listpicker drag 2 buttons (Button1 and Button2)
- 4. Below Button2 drag a label (Label1)
- 5. Change the text from the Listpicker 1 to Bluetooth Devices
- 6. Change the text from the Button1 to Turn On and Button2 to Turn Off
- 7. Change the text from Label1 to Connection Status
- 8. Add 3 labels each other (Label2, Label3 Label4)
- 9. Add a Contact Picker (ContactPicker1)
- 10. Add 2 more labels (Label5, Label6)
- 11. Add 3 Clocks (Clock1, Clock2, Clock3)
- 12. Click on the clocks and set the time to 1000 (10 seconds)
- Add LocationSensor (LocationSensor1) and Bluetooth Client (BluetoothClient1)
- 14. Add Texting (Texting1)
- 15. Change the Background colour to Black
- 16. Make all the texts on the app white with font size 17

Blocks

1)Create a connection between the app and the Arduino



2) Give Turn Off and Turn On buttons active



3)Send Location to the Arduino

do	1 😒	C,	BluetoothClient1 * . IsConnecte	ed 💌	
	then	call	BluetoothClient1 . SendText		
			text (LocationSensor1 ·	CurrentAddress
		set	Label3 . Text . to Loca	tionSensor1 Curre	entAddress *

4)Receive oxygen saturation from the user and display it on the app

do	O I I	BluetoothClient1 . IsCo	nnected ···	
	then set	Label7 . Text . to	call BluetoothClient1 . Receive Text	
			numberOfBytes	call BluetoothClient1 . BytesAvailableToReceive

5)Show the current emergency contact in the screen

whe	n ContactPicker1 - AfterPicki	ing
do	set Label8 • . Text • to (ContactPicker1 · ContactName ·

6)Text emergency contact



2.3 Casing

2.3.1 Equipment List

-Solidworks

-3D Printer

-Earbud Rubber Piece

2.3.2 Instructions

Develop design idea for the expected physical outlook and parts of prototype like in the figure below



- Use the dimensions of the components to be embedded in the prototype casing to calculate an estimated minimum for the dimensions of the casing.
- By comparison of size specification of a mono bluetooth earpiece such as the one below and the estimated minimum for the dimensions, calculate an finalized dimensioning (LxWxH) for the prototype casing.



Figure 2.2 Model for Earpiece Casing

Summarize the comparison of dimensions in a table for clarity and for easy modification

Table 4: Earpiece Dimensions

	Overdose Device	Bluetooth headset
Size (LxWxH)	48.5 x 20 x 25 mm (estimate to be modified)	48.4 x 19.6 x 24.8 mm [9]

- Use the solidworks modelling application to sketch the various parts of the casing, including the earhook, lowercase and uppercase, with the calculated dimension. These sketches should be properly dimensioned and prepared for 3D printing.
- Sketches should show that casing would not have any sharp edges to avoid user's discomfort
- Convert the designed model sketches to the STL file format which is the format that is used for 3D printing.
- Following the makerspace instruction for 3D printing and print the prototype casing.
- For the earhook the material to be used would be the flexible TPU filament and for the lower and upper parts of the casing use PLA (for dimensional accuracy). Advisably, use black or dark colours to ensure the prototype remains discreet.
- Once the casing has been printed the other hardware component (ESP32, Max30100) can then be soldered together and fit into the casing.
- The above steps may need to be repeated to finalize a precise and aesthetically pleasing prototype

3 How to Use the Prototype

Functions of the prototype and how it works

Upon completion of the prototype, considering possible improvements from future work, it would include the following aspects and functions. The table below divides the functionalities based on the two aspects of the prototype and contains the functions of each significant part.

Part and components	Outlook	Function
Hardware: - Esp32 board - Max 30100 sensor - Casing with earhook - Battery		 Battery powered to keep the device functional for at least 24hrs per charge. Measures user's blood oxygen levels (SpO2) and heart rate (bpm) using the Max 30100 sensors Sends the measured values to the phone application by communication with the Esp32 board via bluetooth. Uses the measured oxygen levels to detect an overdose Triggers the application to send an emergency alert for assistance in the event of an overdose Upon future the hardware is expected to contain a power button to help save battery life
Software: - Application - Smartphone	Anti Opioid Overdos I Restedit Deves I Tea o Connection Status: Connected Addres Connection Status: Connected Origon Statustion Origon Statustion Origon S	 Communicates via bluetooth on the Esp32 board to the sensors Bluetooth devices button: used to locate and connect with the hardware aspect of the prototype. Displays the current connection status with the device i.e. connected/disconnected Obtains the user's location using the GPS tracking system of the user's phone.

Table 5: Function of Prototype Components

Installation of Prototype.

Before the prototype can be used and made functional, there are certains steps to take and measures to follow. Considering that the overall prototype is made up of two separate components (the hardware and the application), steps have been separated into two categories which include those for the hardware part of the prototype and those for the software parts.

For the hardware follow these steps:

- ➤ Install a working set of batteries
- > Attach ear hook and earbuds to the prototype
- ➤ Check that the sensor is stable and secure

For the software follow these steps:

- Open Google play store on user's smartphone and search for the application Anti Opioid Overdose
- > Install the application and start it up once installation is completed
- > Set up application access to smartphone bluetooth, contacts and GPS tracking system.
- > Ensure that the user's smartphone can find and connect to the prototype
- > Set up and save the contact information of user's chosen emergency contacts

Safely Operating the prototype.

To operate the prototype safely and ensure that the prototype is reliable to save the user's life in the case of an emergency. Listed below are the steps that need to be followed regularly before each use.

- → Turn on the hardware, make sure the sensor is active and there is enough battery power for expected duration of use before next recharge
- → Place prototype on the ear in a secure and comfortable position using the earbuds and earhook

- → Ensure that sensor is also positioned in a way that it is steadily in contact with user's earlobe
- → Open the application, select the right bluetooth device and ensure that the connection status reads connected
- → Confirm that the right emergency contact is saved and that the correct address is obtained from the GPS tracking system
- → Ensure that oxygen levels read and displayed on the application is accurate and not fluctuating
- → Before each use ensure that both the prototype and user's smartphone are fully charged to have enough battery power for the expected duration of use.

4 How to Maintain the Prototype

Although tests were realized, due to the limitations caused by coronavirus the testing process could not be finished. For the software, the successful tests were the time monitoring time that was set at 10 seconds, GPS tracking accuracy at 10 meters and the connection between Arduino and app. For the hardware, the successful tests were size, discreetness, and oxygen saturation sensor functionality. Many tests could not be realized such as percentage error of the sensor, battery life, weight, and emergency text.

Since the project is a monitoring system, there are not many maintenance processes that the user must acquire, other than plug the device to an electrical socket once a day of use is completed and check their oxygen saturation on the app when they turn the device on, if the app displays not reasonable numbers such as 0 or 200 the user must contact our team in order to replace the oxygen saturation sensor. In order to preserve the device, the user must avoid the device to be subject to impacts of big magnitude such as falling. The user is recommended to clean the silicone ear tip by washing them with warm water to maintain good hygiene and to update the ear tip periodically to avoid ear irritations.

5 Conclusions and Recommendations for Future Work

With the increase in opioid users today, there is also an increase in the fatal cases that occur due to overdosing. In order to help control the effects of overdosing, and prevent these negative outcomes, we created an overdose detection device that aims to reduce harm of potential overdoses through its portability, discreetness, being non-intrusive and cost effective to our target consumer. Our goal is that the device must efficiently detect an overdose and send a call for assistance and the location of the user for a third-party response within three minutes. This criteria outlines our problem statement, which helped us to keep focus on our goals throughout the project. Referring back to our problem statement helped us prioritize the important design components, and ensure we were working towards making the whole design as efficient as possible relative to the criteria.

Throughout the design process, we were able to explore different options to each of the problems we came across. After the client meeting and continual design analysis, we determined the importance of accuracy. Accuracy could be the difference between life or death if the pulse oximeter does not correctly detect an overdose. Therefore, we aimed for minimal detection error through testing and quality analysis. GPS detection accuracy is also important when discussing accuracy of the overall device, so our goal was for the pinpointed location to be within 10 meters of the user. Analysis of device's accuracy helped us to realize the value of an override option if there is a false overdose detection. In future designs, we would implement this feature. Another feature that could be valuable to life-or-death overdose situations is the option to have an overdose text alert sent to multiple third parties in order to increase the chances that someone will be able to respond with naloxone in under three minutes. Improving probability features such as this one (others include improved pulse oximeter detection or faster text message speed) could improve the quality of the device, increasing the chances of an overdosing user to be saved.

Throughout the design process, we also had to consider and implement some constraints and solutions so that the device would reach the target market. For instance, we had to ensure the device was cost-effective, under \$100, and that the size and weight were practical for the user's day-to-day life. Subtlety was also an important consideration so that the device was attractive to users.

Benchmarking was an important step in the design process as it allowed us to compare our device to others in the market which had both effective and ineffective features. This helped us develop guidelines for current standards in the opioid overdose detection market, so we could find ways to improve our features and extend the usability of our device in the real world. This also helped us to be objective during reflection, in order to understand what we did well and what could be improved.

The design process gave us different perspectives on the ups and downs of developing a product from start to finish. Changes in design plans, problems we encountered, learning to work in a team, and of course the uncontrollable series of pandemic-related events caused delay in our schedule, and affected our progress. Although, learning to overcome adversities also made us a stronger, more versatile, and resilient team and helped us to learn to think on our feet, be creative, and find ways to implement new solutions. Preparation, contingency plans, and scheduling are extremely necessary in order to keep everything on track and for team members to feel useful. Team spirit and trust is important in developing a strong team identity. Our diverse team of different ages, backgrounds, and expertise added a lot of value to our development process. Throughout the project, we not only learned from the course content, but we also experienced the value and difficulties of teamwork, and individually learned from each other. -send alert text to multiple people to increase chances of administering naloxone

6 Bibliography

- 1. Knox, David. "Overdose Detection Module." University of Ottawa, Ottawa
- 2. Cahill, Tali. "Canada's Overdose Crisis." Sandy Hill Community Health Centre, Ottawa
- Espressif, "espressif/arduino-esp32." [Online]. Available: https://github.com/espressif/arduino-esp32/blob/master/docs/arduino-ide/boards manager.
- 4. Instructables, "Getting Started With ESP32 on a Mac: Blink and LED," 02-Aug-2017.[Online]. Available:

https://www.instructables.com/id/Getting-Started-With-ESP32-on-a-Mac-Blink-and-LED/.

- Oxullo, "oxullo/Arduino-MAX30100," 11-Mar-2018. [Online]. Available: https://github.com/oxullo/Arduino-MAX30100.
- shedboy71, "ESP32 and MAX30100 heart-rate monitor sensor," 24-Nov-2017. [Online]. Available:<u>http://www.esp32learning.com/code/esp32-and-max30100-heart-rate-monitor-s</u> ensor.php.
- 7. https://datasheets.maximintegrated.com/en/ds/MAX30100.pdf
- 8. http://wiki.ai-thinker.com/_media/esp32/docs/nodemcu-32s_product_specification.pdf
- 9. "Jabra Talk 35 Mono Bluetooth Headphones." Jabra, www.jabra.ca/bluetooth-headsets/jabra-talk-35#/#100-95500900-02#100-95500900-02

APPENDICES APPENDIX I: Design Files

Below is our project MakerRepo link, it includes all the design process files, youtube links of working components and images of our prototype.

https://makerepo.com/TashaM/lookout

APPENDIX II: Other Appendices

Data sheets ESP32s

http://wiki.ai-thinker.com/_media/esp32/docs/nodemcu-32s_product_specification.pdf