GNG1103

Final Design Report

uOttawa

Faculté de génie
Faculty of Engineering

Save your Sole

User Manual

Submitted by

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Abstract

Overdosing has become a large issue in Canada recently, with nearly fourteen thousand deaths in the last four years. This report goes into detail on how to create an overdose detection device. The design concept that was chosen to be pursued was a shoe insole that reads blood-oxygen levels and heart rate through contact with the big toe. The prototype production is split into four different components, including the smartphone application, solidworks design, device wiring and code necessary to run the device. Through the use of MIT app inventor (an online app creation software) a smartphone application was able to be designed in order to display the blood-oxygen readings, heart rate, and GPS location of the user in need. These values are taken from the shoe insole that was created using the Solidworks Design Software. The sole was designed by using measurements of a typical shoe insole and modelling it after this. The design includes compartments that were used to store all of the components such as wiring, pulse oximeter, bluetooth module, arduino nano, and a 9 volt battery. It also includes a top that covers all of the components of the sole, that is removable upon the user's liking. For the Arduino, we used the Arduino program to code the device. The main functions of this code were to collect data from the pulse oximeter, analyze the data for signs of an overdose, and transmit the data via bluetooth to the users phone. The device was built by connecting pins on the Arduino, pulse oximeter, and bluetooth module, with wiring held together by soldering. As well, the report goes into how to use the device. This involves turning on the device, setting up the smartphone app. And finally how to maintain the device for everyday use. We have created a product we are proud of and look forward to seeing what it can become.

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List of Acronyms

Acronym	**Definition**
BOM	Bill of Materials
IDE	Integrated Development Environment
GPS	Global Positioning System

1 Introduction

The goal of this deliverable is to give an extensive technical description of our device. In this document, we will outline the making and functionality of our device so that everyone can recreate and operate our overdose detection device. As people affected by overdosing can have a wide variety of background knowledge in this subject, it is important that anyone will be able to follow this manual to create their own device. As many of the skills required to create this device were new to us, we believe that it should be fairly easy to follow along.

This report is separated into three main sections: how the prototype is made, how to use the prototype and how to maintain the prototype. Each of these sections will include the details about the app, the wiring of the device, the 3D computer model and the code from the microcontroller. These were the four main disciplines we learned about throughout this project. Displayed are the early designs all the way up to the final product. As our prototyping moved along we became more skillful in these disciplines, as many of them require practice and research.

We will also include important information such as the BOM as well as an equipment list of the material necessary to reproduce our prototype. All of the parts used can be easily found online. As well, we believe that all users will be able to recreate this device using this manual.

2 How the Prototype is Made

2.1 Smartphone Application

The smartphone app was created using an online program calle MIT App Inventor. You can access this website by using the following link.

https://appinventor.mit.edu/

Once you are on the website, you can start a new app. Using the following code you are able to create the app Second Life. On the layout screen, you are able to rearrange the buttons, as well as change the colours. There are vertical and horizontal arrangements. These allow you to line up buttons and labels perfectly straight. As well you can input the size of each button as well as the spacing in between buttons. Some features that are included are not shown on the display. These are the clocks, database, location tracker, and sound players. You can drag and drop these functions onto the phone and they will be run in the background. We had our location tracker refresh every thirty seconds. If you use a smaller increment, the smartphone will not have time to receive a location before having to refresh, meaning no location will be found.

Once the coding and layout have been completed, download the app inventor companion app on your smartphone. This app allows you to scan a barcode from the website on your computer, which is a download file for the app. Once the download is finished, you will be free to use the app on your phone.

Figure 1 - Code 1

Figure 2 - Code 2

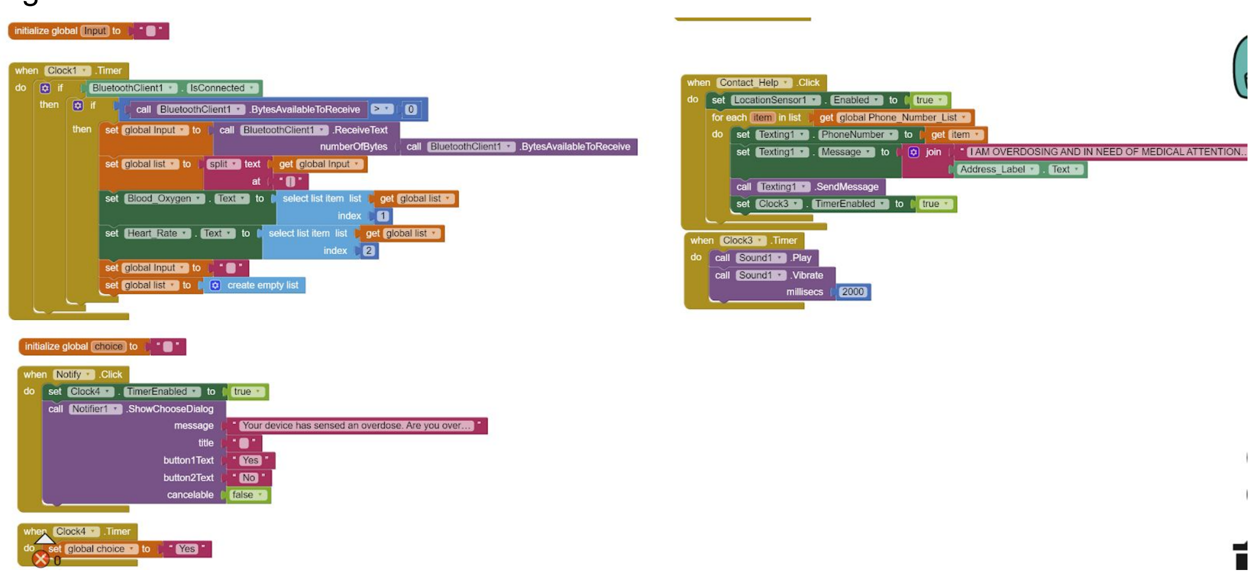
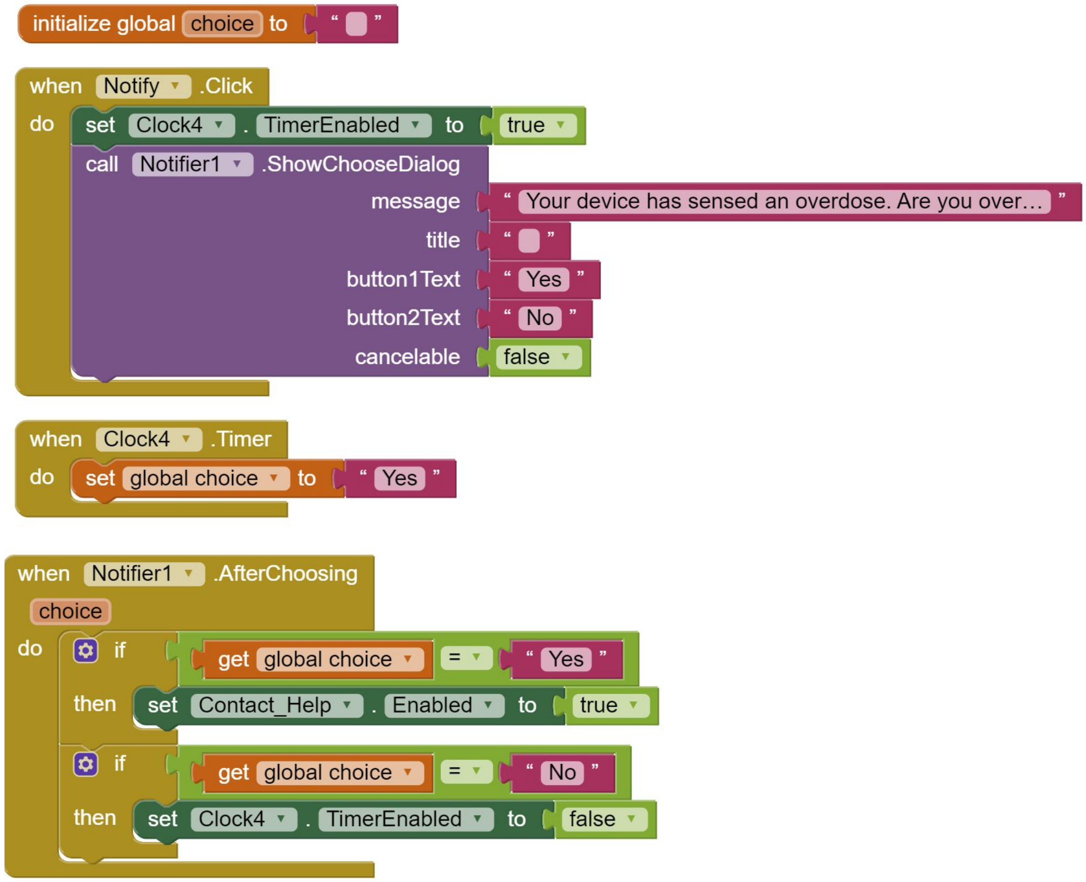


Figure 3 - Code 3



2.2 SolidWorks Design

To create the physical model of the device, the SolidWorks application was used to 3D model the sole. Through the use of SolidWorks the sole was designed to optimally fit all components of the device within the sole. Measurements for all components of the device were taken and implemented into the design of the sole. The size of each component is outlined in the following table.

Table 1: Measurements of Components

Component	Length (mm)	Width (mm)	Height (mm)
Battery	17	48	27
Arduino	19	45	9.5
Bluetooth Module	17	44	8
MAX 30100 Pulse Oximeter	18	19	1.5

Once 3D modelling was complete, the design was printed out in the University of Ottawa MakerSpace. The sole was printed using a 0.7mm thickness nozzle to ensure that all components were accurately printed, preventing the obstruction or discomfort for the user during use.

Taking into account the comfort of the shoe the sole was designed with 3 components. They are the sole itself, a cover of the sole components, and a foam top layer. This is shown in the figures below.

Figure 4 - Cover for Sole Components

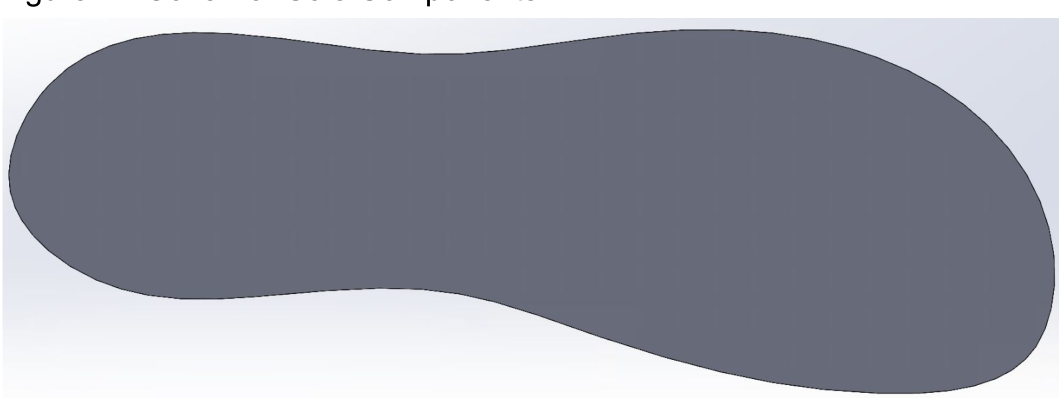
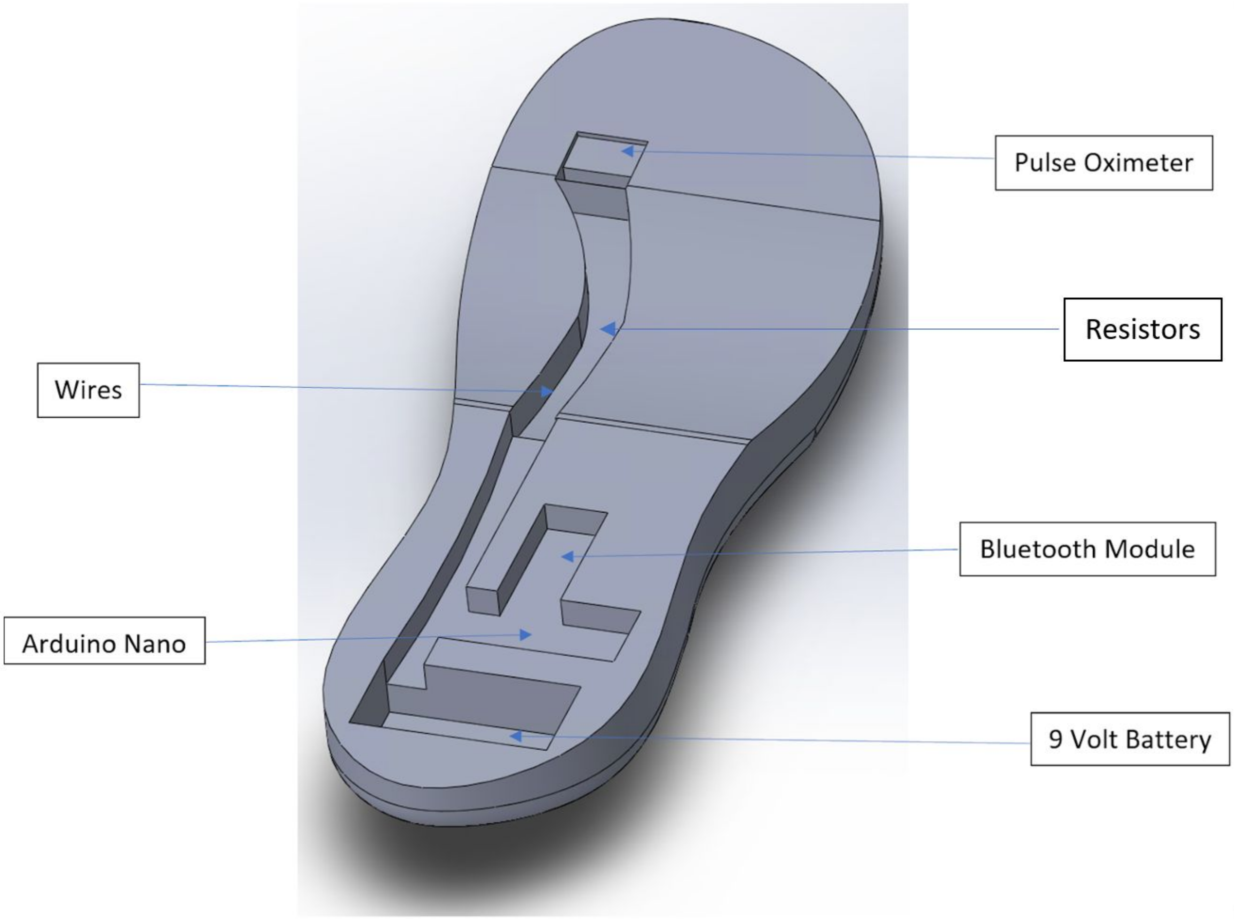


Figure 5 - Sole Design with Components



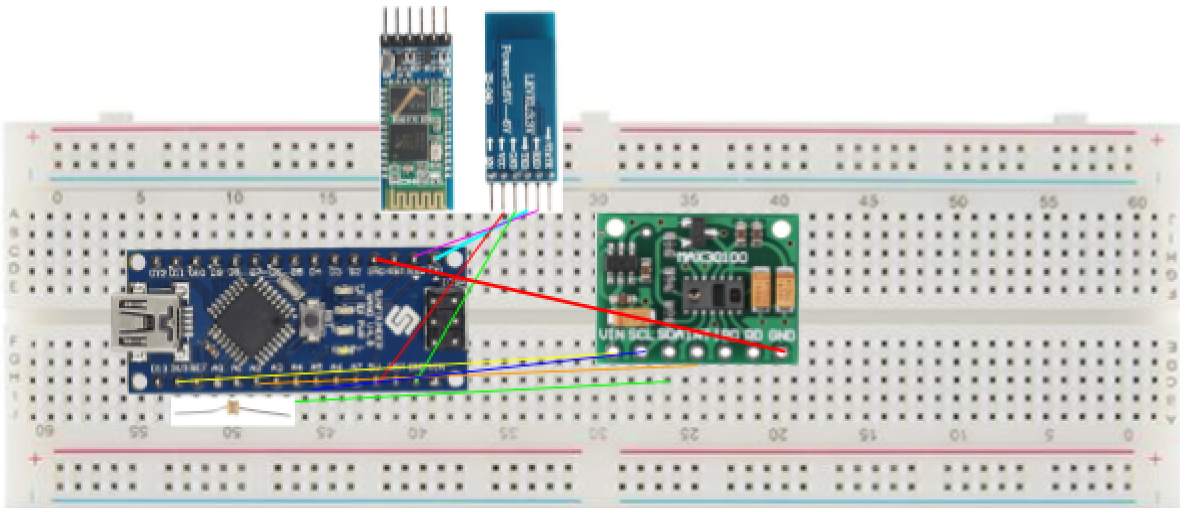
The material used for the top layer of the sole was Plastazote due to its wide range of benefits, including moldable, buoyant, and non-toxic. The reason being is they are widely used in orthopaedics for protection against pressure points, and it's able to be laminated to other components.

This choice was backed using benchmarking done in the design process of the sole. A test was conducted by Prosthetics and Orthotics International measuring the pressure of pressure at the planter of the foot. By using well known footprinting technique, it was determined that “average pressure of a clinically painful plantar area was 398.15 kN/m²”. By testing plastazote as well as other insole materials, the pressure in this area was decreased to an average ranging of 186.33 kN/m² to 286.35 kN/m². Plastazote was one of the most effective materials used in the test, backing the reason we chose to use it in the creation of the sole.

2.3 Device Wiring

The device needs to be wired according to the following figure:

Figure 6 - Wiring of Device



Once the wiring is done, the project will be powered by a 9V battery. The battery negative will be connected to the Arduino GND pin and the battery positive will be connected to the VIN Arduino pin.

2.4 Arduino Code

To accompany the physical Arduino circuit this product requires two Arduino codes. The first is responsible for the pulse oximeter and the second for the Bluetooth module. Both codes were taken from online resources, the links for these websites are provided below.

Pulse Oximeter:
https://how2electronics.com/interfacing-max30100-pulse-oximeter-sensor-arduino/
Bluetooth Module:
https://exploreembedded.com/wiki/Setting_up_Bluetooth_HC-05_with_Arduino

2.1.1.1 BOM (Bill of Materials)

Table 2: Bill of Materials

ID	Description	Vendor	Part Number	Qty	Cost
1	1.75mm MATERIAL 3D PLA FILAMENT	MakerStore uOttawa	--	1	FREE
2	Jumper Cables	Amazon	--	120	$9.99
3	Arduino Nano	MakerStore	ATmega328	1	$22.00
4	9V Batteries	Amazon	-	3-Pack	$18.99
5	Pulse Oximeter Sensor	Amazon	700-MAX30100EWG+T	1	$11.50
6	Bluetooth Module	roboJax	HC-05	1	$18.30
7	Breadboard	MakerLab	424-240-131	1	FREE
8	USB Cable	MakerSpace	-	1	FREE
9	Clip Battery Connectors	Amazon	a13110100ux0258	10-Pack	$9.37
10	4.7k resistor	MakerSpace		1	FREE
	Total				$90.50

2.1.1.2 Equipment List

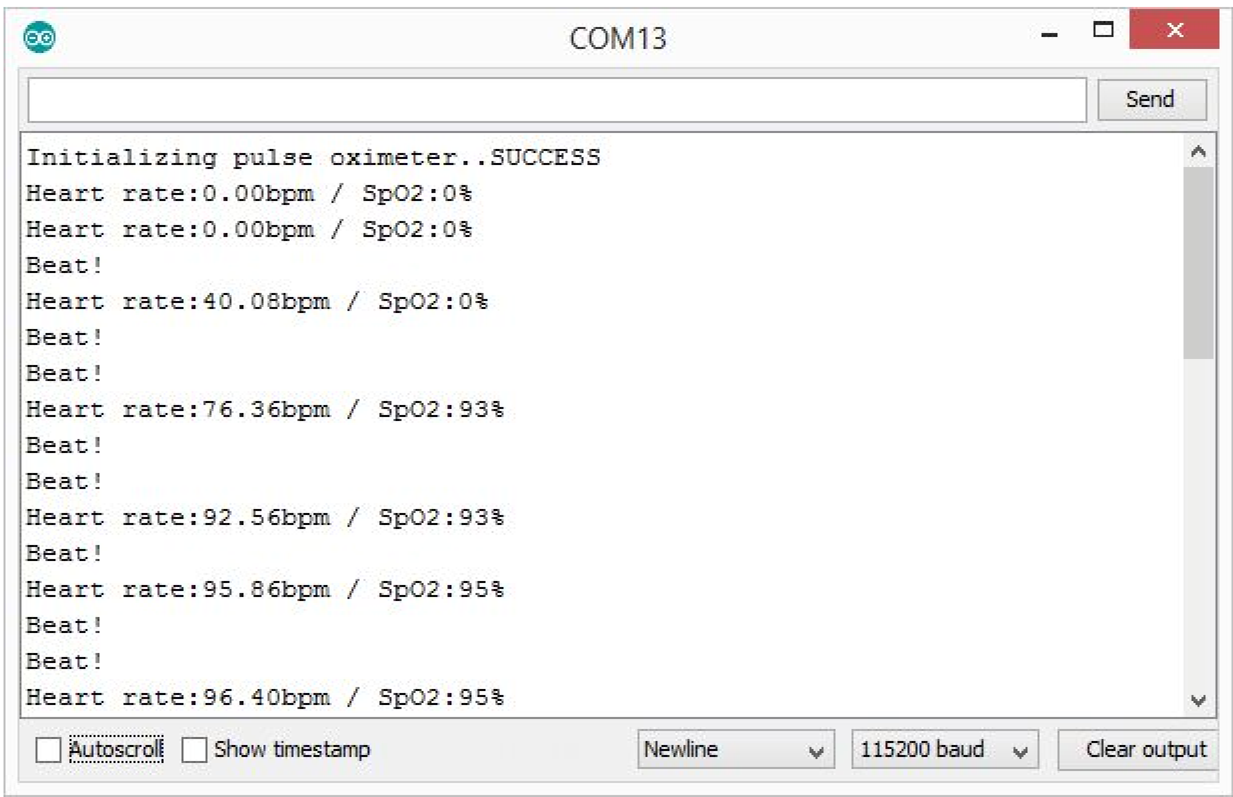
Apart from the aforementioned components and material listed in the BOM, the following is a list of equipment needed to reproduce our prototype:

- Soldering iron
- Solder
- Computer (and Solidworks and Arduino IDE softwares)
- 3D printer

2.1.1.3 Instructions

1. Follow the previously mentioned instructions to recreate the sole model in SolidWorks
2. Follow the previous instructions to recreate the app
3. Recreate the diagram displaying the wiring of the device on a temporary breadboard to test out the device.
4. Download the arduino libraries corresponding to the bluetooth module and oxygen sensor.
   Oxygen Sensor Library Download Link
   HC-05 Library Download Link
5. Upload the codes onto the Arduino and test out the parts by putting a finger on the oxygen sensor and displaying the results in the Arduino IDE serial monitor. Test the bluetooth module by trying to connect it to an Android phone.

Figure 7 - Serial monitor displaying results



6. Once the testing is over and successful, solder the parts together and 3D print the sole model.
7. Combine all parts together and insert the electronic parts in the corresponding compartments in the sole.

The following is the test plan we followed:

First round of testing:

Our first round of testing would've concerned the functional aspects of our device, ie. our oximeter and our bluetooth module.

For our oximeter, testing would have been simple: we would've tested it with our fingers and seen if the readings that appeared on the serial monitor are realistic (ie. around 90-100%). If it is the case and that the readings are consistent and correct (stops when the finger is taken off), then the testing for the oximeter would be complete and successful.

As for the bluetooth module, testing is very simple: if we are able to connect our bluetooth module to the app we created and have it display the blood oxygen level on the app (the data transfer is done through the code), and the app functions correctly and sends a text to the emergency contact list quickly when blood oxygen gets below 85% then testing is complete and successful.

Target Specifications accomplished with this round:

Table 3: Target Specifications

13	Blood-Oxygen Level	5	Constantly measures blood oxygen levels	-Must measure blood-oxygen-level to ensure the functionality of the device -Spo2%
6	Response Time	5	Reacts to overdose within 1 minutes	-Must respond quickly -seconds
15	GPS	4	Sends GPS location of the user to authorities upon activation	-Must send location for medical attention to reach them -Yes/No

Second round of testing

The second round of testing concerns the physical non-functional aspect of our device a.k.a the insole. Testing for the insole would be applying increasing forces on it to see if the material is resistant enough before already putting it in a shoe and walking around with it. If the insole resists the increasing forces, then we can test it in the shoe and try and walk around with it. If the sole resists the impact force of a body, then testing is completed and successful.

Target Specifications accomplished with this round:

Table 4: Target Specifications 2

1	Durable	3	Waterproof and not easily broken	-Has to hold up through everyday activities -Yes/No

4	Discreet	4	Not noticeable and does not interfere with everyday tasks	-Must not be bulky, or very noticeable -Device cannot get in the way during common tasks -Yes/No

Third round of testing

Third round of testing is about putting the non-functional aspects and functional aspects together. Testing will be walking around with the sole (electrical components included) and seeing if it still accurately reads blood oxygen through the toes. It's also about testing different socks to see how strong the infralight that reads blood oxygen levels is and determine if wearing socks with the device is still feasible. If all of the aforementioned features are working then we can say our prototype is complete and functioning.

Table 5: Functional Aspects

5	Accurate	5	Detects overdose and does not go off when there is no overdose	-Must function when a person is having an overdose -Must not call for help when a person isn't having an overdose -Yes/No

7	Automated	3	Updates information without prompt	-Must update information to the app -Yes/No

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3 How to Use the Prototype

On the sole insert, there is a removable lid to allow access to the device itself. To turn on the device you simply have to insert a nine volt battery and put the lid back on. Now the device can be placed in the user's shoe.

Once the device is turned on, the user can open the Second Life app on their phone. Once in the app, the bluetooth button must be pressed. This brings the user to a list of nearby bluetooth devices, simply select the overdose detection device. Once the device is paired, the data collected will be displayed on the phone showing the heart rate and the blood oxygen levels. As well your location will be displayed on the home screen, and is updated every thirty seconds. While in the app, if you press the "Add Contact" button, you can search through your phone's contact list and select people to add to your emergency contact list. If you no longer want someone on your emergency contact list, simply push the "Remove Contact" button, and you can select whichever person you wish to remove. And Finally you can push the "CONTACT HELP" button, which sends a text message to all of the emergency contacts stating that the user is overdosing and needs medical attention. The text also gives the user's current location.

If the device detects an overdose, it will send a notification to the user's phone alerting them that an overdose has been detected. The user can verify if this is true or not. If the user is unable to respond after thirty seconds, it will treat it as an overdose and automatically push the "CONTACT HELP" button.

Below is a link to a video demonstrating how the app is used.
https://www.youtube.com/watch?v=IJ01NaP6Bpo

4 How to Maintain the Prototype

In order to preserve the quality of the product and ensure a long product lifetime, users must make sure to properly maintain the prototype. This involves replacing necessary components as well as taking precautions to avoid product damage.

In order to make the product as thin and compact as possible, it was designed to hold a 9-volt battery in the sole heel. 9-volt batteries have a capacity of around 450 mAh meaning they last around 30 hours. It is suggested that the user should change the battery before it reaches the 30-hour mark to avoid it dying in the middle of an emergency. To change the battery the top of the shoe sole can be removed to reveal the electric components. The battery is located in the sole heel (refer to Figure 2 found in 2.2 Solidworks design) and can be easily removed and replaced. To replace the battery attach a new 9-volt battery to the clip connector.

It is also important to take proper care of the prototype to get a long product life and avoid unnecessary damage. Although the product is water-resistant it is not waterproof and therefore users should avoid contact with water if possible. Try to avoid stepping in bodies of water and emerging the sole in liquids. Users should also wear proper footwear if possible to avoid damage due to weather. Avoid jamming or forcing the product into the shoe if it does not fit as it is designed for size 10 men shoes only. Also, avoid putting too much pressure on the sole as the shell is prone to cracking which may lead to damaging the delicate inside components.

After testing the product by having two members wear the product for a day the sole was found to be somewhat flexible however it would snap if too much pressure was exerted. It was also found to crack and flake under pressure. If a final product was made the flaking issue would be resolved however users should avoid overly bending the product or placing heavy objects on it.

5 Conclusions and Recommendations for Future Work

Our final product *Save your Sole* is an invention we are very proud of. Despite not being able to finish the final product, we are very happy with our design and the functionality of finished components. Our shoe sole design is both discrete and effective in detecting an overdose making it a great option for an opioid overdose detection device. Additionally our app is easy to use and provides high-speed blood oxygen saturation readings. The ability to add multiple contacts to send the automated texts to means the product can catch the attention of multiple loved ones which increases the chance of saving a life. For these reasons we believe we have created a great product which we are very proud of.

Designing and creating our product has been a great learning experience for the whole group. The project has taught us how to work with others and given us a chance to experience a professional project with a real client. Throughout the process of designing and making our product we encountered many unforeseen problems which challenged our conflict resolution abilities. One of the biggest issues we faced was the closing of maker space and distance between members caused by the corona pandemic. Our team was able to pull through because of the strong communication skills and the trust we had grown throughout the year. Despite having a smaller group than anticipated (due to the disappearance of a member) we were able to create an incredible product which we are very happy with. We were only able to do this because members stood up and took on extra responsibilities for work. We are very grateful for the hardworking team we had and that we were given this incredible opportunity.

Given the problem solving, teamwork, and design skills we have developed throughout this project we will be better prepared for future projects in the engineering design field. If we were given more time and resources to continue this project there are a few adjustments we would make. First of all we could create our product in more sizes. Our current design is made for size 10 men shoes only, however this does not work for the majority of the population. Ideally we would make our product in a great range of sizes for both men and women. We would also get a higher quality 3D printer which would create soles which are more durable and less flaky. Finally we would thin down the product as much as possible so that it can fit in smaller shoes as the current sole is quite thick. Overall, although our current product is great there are still many places which we could improve upon in future work.

6 Bibliography

http://www.oandplibrary.org/poi/1986_03_135.asp

https://www.ncbi.nlm.nih.gov/pubmed/3808918

https://exploreembedded.com/wiki/Setting_up_Bluetooth_HC-05_with_Arduino

https://how2electronics.com/interfacing-max30100-pulse-oximeter-sensor-arduino/

https://hwstartup.wordpress.com/2013/03/11/how-to-run-an-arduino-on-a-9v-battery-for-weeks-or-months/

APPENDICES

APPENDIX A: Design Files

A.1 Deliverable B: Needs Identification

Collected customer statements from the client during a meeting on January 21st 2020. Exact words were translated into interpreted needs which directly reflect what was said. Importance of needs were ranked to determine the most significant client needs.

Table A.1.1

Interpreted Needs

Customer Statement (exact words)	**Interpreted Need** (express specifically what the raw data implies)	**Importance** (1-5)
“You need both your hands to take drugs… No one wants to keep something on their finger”	The device cannot get in the way during common tasks	4
“Biggest use is in people who are using alone”	The device doesn’t depend on another person being there	5
“For people working in the trades, It can’t be too expensive”	Relatively cheap cost	4
“Has to do something where it saves them or calls someone in 3 minutes”	The device should react quick enough to get medical attention in time	5
“Should be fairly resistant to water and day to day wear”	Durable enough to wear in everyday activities	4
“Should be discrete... Not totally easily identifiable to other people”	Appears like daily wear	3
“I would love it to measure respiratory rate”	Measures respiratory rate	2
“There should be a way to say ‘this is a false alarm’ and if they were really	The user should be able to overwrite a false alarm if it occurs	4

overdosing they wouldn't be able to override it"		
"Something people can customize"	Different designs and settings depending on certain lung diseases, etc.	2
"Naloxone gives them an immediate overdose (like a flu x100)... No one wants to have a naloxone"	Should administer naloxone if the person is overdosing	2
"More than a days battery life"	The device should be able to last throughout the day	5
"The easiest way is through pulse oximetry"	Use a pulse oximeter to measure blood-oxygen-level	5
"GPS may be a barrier"	Users may not want authorities to know their location	1

From the information collected as well as the determined needs a concise yet descriptive problem statement was made.

The Sandy Hill Community Center wants a discreet and durable device for opioid users, that can detect an overdose and quickly alert medical professionals.

Full deliverable can be found at https://docs.google.com/document/d/17eN75EdSJPIHqA84RVgOMGbik_Xr1zlhFt8OTTuOF0M/edit?usp=sharing

A.2 Deliverable C: Design Criteria and Target Specifications

To aid in the design of the product criteria was established including initial constraints: *Weight (lbs), Cost (💲) , Long battery life (lasts at least a day), Size (cm・cm・cm), Operating Conditions (°C and weather), Prototyping time*, functional requirements: *Efficiency (has to react in less than 1 minutes), Doesn't depend on someone other than the user, Transportable, Contacts help, Accurately detects an overdose, Can effectively read blood oxygen*, and non-functional requirements.

Adding on form the identified needs a list of design criteria was formed.

Table A.2.1

Design Criteria

	Identified Need	Rank	Design Criteria	Criteria
1	Durable	3	Waterproof and not easily broken	-Has to hold up through everyday activities
2	User-Friendly	3	Can connect to apple and android phones	-The device should be compatible with other devices
3	Affordable	4	Costs less than $100	-Relatively cheap cost -Not too expensive for the average person
4	Discreet	4	Not noticeable and does not interfere with everyday tasks	-Must not be bulky, or very noticeable -Device cannot get in the way during common tasks
5	Accurate	5	Detects overdose and does not go off when there is no overdose	-Must function when a person is having an overdose -Must not call for help when a person isn't having an overdose
6	Response Time	5	Reacts to overdose within 1 minutes	-Must respond quickly
7	Automated	3	Updates information without prompt	-Must update information to the app
8	Failsafe	5	Has cancelling option	-Must be able to be cancelled if an overdose is not happening
9	Aesthetically Pleasing	4	Pleasing to the eye	-Must be able to wear everyday -Won't be bulky
10	Measures Respiratory Rate	2	Measures users respiratory rate	-Must measure respiratory rate to ensure proper breathing
11	Customizable	2	User can enter personal stats	-Must be able to be customized to the users specific needs
12	Battery Life	5	Can last at least 24 hours	-Must be able to last multiple days without having to be charged

13	Blood-Oxygen Level	5	Constantly measures blood oxygen levels	-Must measure blood-oxygen-level to ensure the functionality of the device
14	Administer Naloxone	2	Administers Naloxone	-Must provide the user with extra time for medical attention to reach them
15	GPS	4	Sends GPS location of the user to authorities upon activation	-Must send location for medical attention to reach them

Three existing products were benchmarked to determine the best product as well as how they compare to our criteria.

Table A.2.2

Benchmarking

Criteria Category	Oxalert Epo	Carnegie Mellon University	Vancouver
Image		 (in prototype but resembles smartwatch)	
Everyday wear	No	Yes	No
Durability	Not stated	Same as smartwatch	Fragile
Reaction	Arouses them to breath	Triggers alarm, administers naloxone and contacts authorities	Alerts authorities
Response time	Immediate	30 seconds	Not stated
Administers Naloxone	No	Yes	No

Price	$1,000	Not stated	Less than Naloxone

Full deliverable can be found at https://docs.google.com/document/d/1AjYHzucB1mNoenL9pFYsNQi02ChTtYWiYpcnBNetEnM/edit?usp=sharing

A.3 Deliverable D: Conceptual Design

Each member came up with three product designs the best of which were benchmarked to obtain the best product designs. Designs were presented during a client meeting.

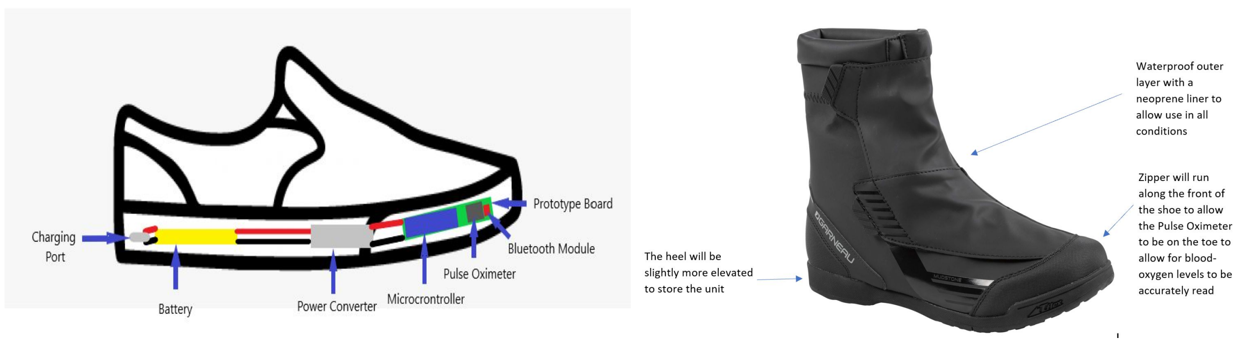


Figure 1: Shoe/boot design

Figure 2: Watch design

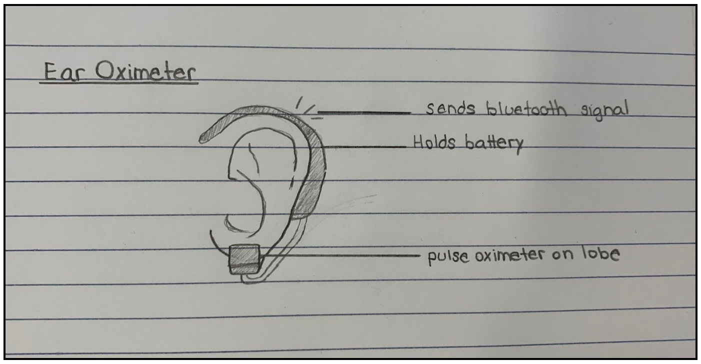


Figure 3: Ear Oximeter design

Full deliverable can be found at https://docs.google.com/document/d/1hnXPTQM4SW2pzJ5rNRiufy6tNwy1-RcibhBGfKCUn88/edit?usp=sharing

A.4 Deliverable E: Product Schedule and Cost

A plan for a prototype schedule was created. These involved required tasks, who would be held responsible, required materials, task duration and corresponding dependencies.

The first prototype is a simple shoe sole model.

Table A.4.1

Prototype 1

Tasks	Assigned Person(s)	Duration
1. Purchase Sole Material	Heidi	2 days
2. Cut scrap metal into component dimensions	Brendan and Tony	3 days
3. Assemble parts and sole	Tara	1 day
4. Evaluate final prototype 1/come up with alternative solutions if necessary	Joe, Brendan, Tony, Tara, Heidi	1 meeting

Dependencies:

Here, task #3 depends on task #1-2 and task #4 depends on task #3.

Buying List:

- 2 square feet of leather

Other materials needed:

- Scrap metal material
- Tape
- Shoe (for fitting purposes)

The second prototype is a functional electrical oximeter and app.

Table A.4.2

Prototype 2

Tasks	Assigned Person(s)	Duration
1. Purchase Arduino nano and needed components	Tara	2 day
2. Research app development on android and apple devices	Brendan and Joe	2 days
3. Assemble Arduino nano pulse oximeter	Tony, Tara, Heidi	4 days
4. Program app for android	Brendan	4 days
5. Program app for apple	Joe	4 days
6. Evaluate final prototype 2/come up with alternative solutions if necessary	Joe, Brendan, Tony, Tara, Heidi	1 meeting

Dependencies

Task #3 depends on task #1, task #4 and #5 depend on task #2 and task #6 depends on tasks #4 #5 and #3.

Buying list (deadline March 3rd)

- Arduino Nano
- Tape to flatten wires
- Battery pack
- GPS

The third prototype is a fully functional product.

Table A.4.3

Prototype 3

Task	Assigned Person(s)	Duration

1. Finish Android app	Brendan	5 days
2. Finish Apple app	Joe	5 days
3. Connect all hardware	Tara, Tony, Heidi	2 days
4. Model and print the container for all of the hardware	Tony, Brendan	3 days
5. Insert the hardware into the container	Heidi, Tara	1 day

Dependencies
Step 3 must be completed before the beginning of step 5. Step 4 must also be completed before the beginning of step 5.

Project risks were determined so that preparation could be made and issues could be predicted. Risks included busy school schedules/midterms, technical problems and delays in receiving products.

A BOM/cost estimate was made with an attempt to reduce fees as much as possible.

Table A.4.4

BOM

ID	Description	Vendor	Part Number	Qty	Cost
1	1.75mm MATERIO3D PLA FILAMENT	MakerStore uOttawa	--	1	$40.00
2	Jumper Cables	Make Store uOttawa	--	30	$3.00
3	Arduino Nano With Bluetooth	Mouser Electronics	782-ABX00030	2	$60.72
4	Battery Packs	Mouser Electronics	409-EP-UPSHAT B3000M	2	$79.52
5	Pulse Oximeter Sensor	Mouser Electronics	700-MAX30112E WG+T	2	$18.00
6	Bluetooth Modules	Mouser Electronics	377-BMD-360-A-R	2	$23.78

7	Breadboard	Mouser Electronics	424-240-131	2	$14.18
8	USB Cable	Mouser Electronics	562-3023001-01M	1	$8.78

Full deliverable can be found at https://docs.google.com/document/d/1moYkr0dUMJozORv1S3Ha_znwlFokMsBXjWzNxo2daik/edit?usp=sharing

A.5 Deliverable F: Prototype I and customer feedback

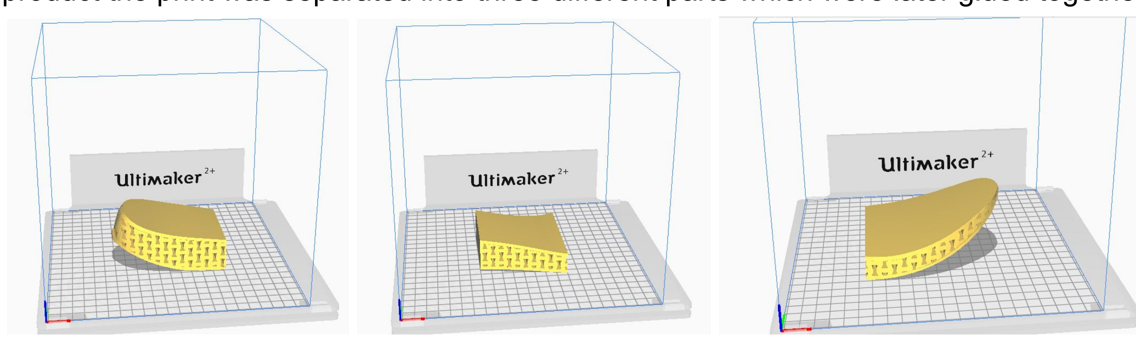
To begin designing the prototype the dimensions of the required components were taken note of to determine the size of the shoe model.

Table A.5.1

Component measurements

Measurement	Length (mm)	Width (mm)	Height (mm)
Arduino nano	45	18	-
Battery	48.5	26.5	17.5
Pulse oximeter device	12.7	12.7	-
HC-05 Bluetooth Module	15.5	39.8	-

The prototype was designed using solidworks to 3D print a shoe sole. Due to the size of the product the print was separated into three different parts which were later glued together.



Figures 1-3: solidworks sole designs

The tasks were split among group members and the final prototype included cardboard cutouts taped to the model. The purpose of these cutouts was to compare the size of the electrical components to the size of the sole.

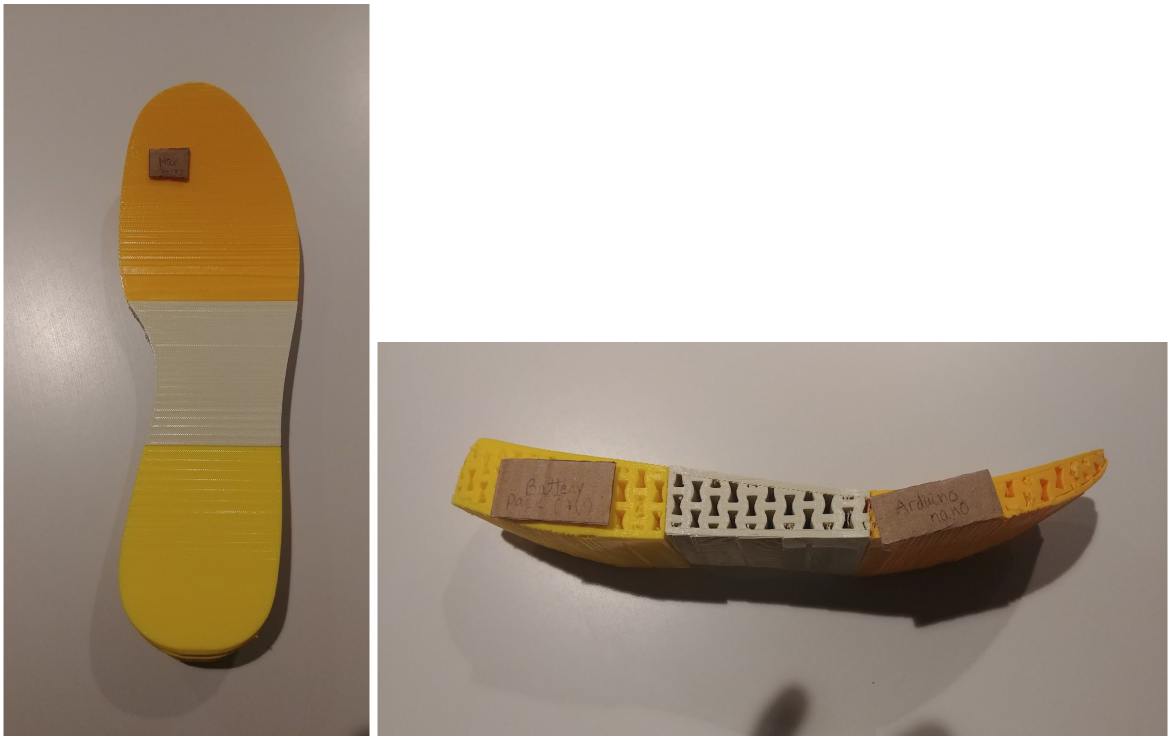


Figure 4-5: Top and size views of final prototype

The group received feedback from classmates during the product pitch

Table A.5.1

Class Feedback

Name and age	Criticism	Grade out of 10	What more could we add
Mark, 19	Could cause problem if person is not wearing shoes (indoors)	7	- Customizable settings - Failsafe
Tom, 18	Could cause problems if user doesn't own phone	9	- Could contact more than one person in case emergency contact is not reachable
George, 21	Could cause the person to be uncomfortable if the shoe does not fit correctly	8	- Ensure that the shoe is comfortable

Kim, 28	May get worn down through constant use, especially in a construction setting	9	- Quality materials to have high durability

Full deliverable can be found at https://docs.google.com/document/d/1gdHmegSxbP8gie0jIoPBRTKCRj-d3W1Imdyuavrw3d0/edit?usp=sharing

A.6 Deliverable G: Prototype II and testing

The goal of the second prototype was to get a functional electrical oximeter and app. The oximeter used Arduino components as was wired as shown.

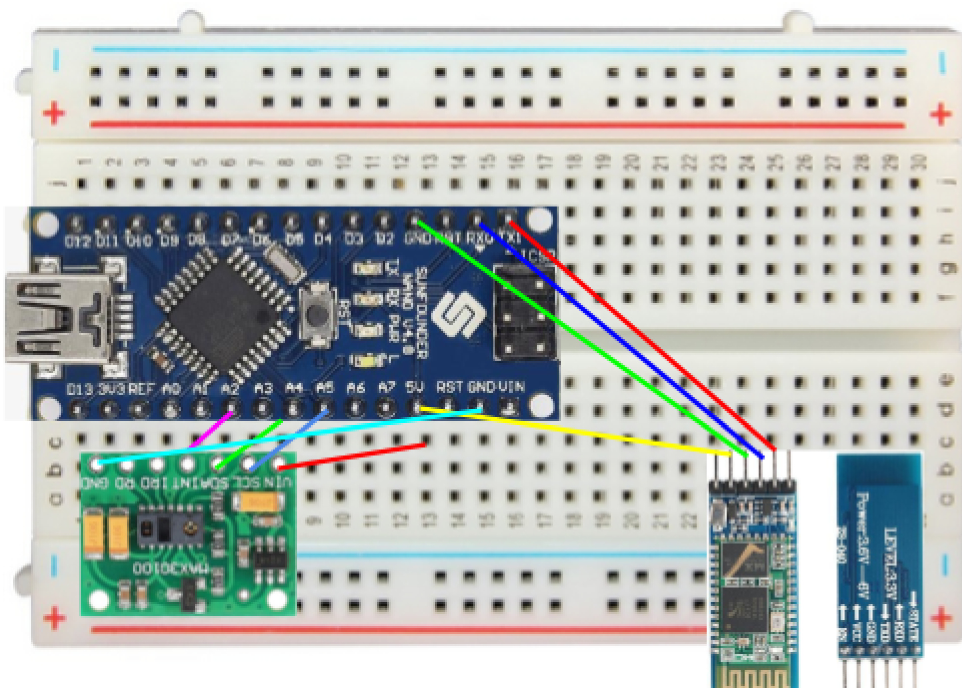
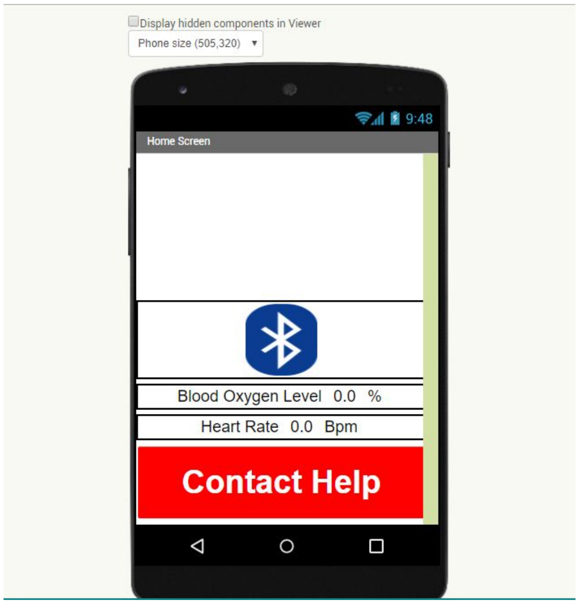
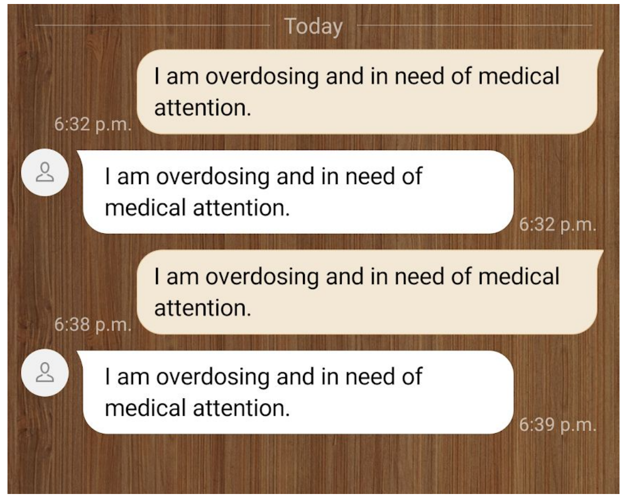


Figure 1: Oximeter wiring

The code was retrieved from websites sourced in *2.4 Arduino Code*

The app was created using the MIT app inventor for android phones. It was designed to constantly read blood oxygen saturation levels displayed on the main app screen and send an automated text to inputted phone numbers.





Figures 2-3: App design

Full deliverable can be found at https://docs.google.com/document/d/14HPdG_NVtJXzIhnJzCcWz5kLlybQ5zwrZpPfXeJVW3E/edit?usp=sharing

A.7 Deliverable H: Prototype III and customer feedback

Due to the corona pandemic and the closing of maker space the third prototype was not finished. However the group was able to make an updated and thinner solidworks sole model. The group was also able to solder parts of the circuit.

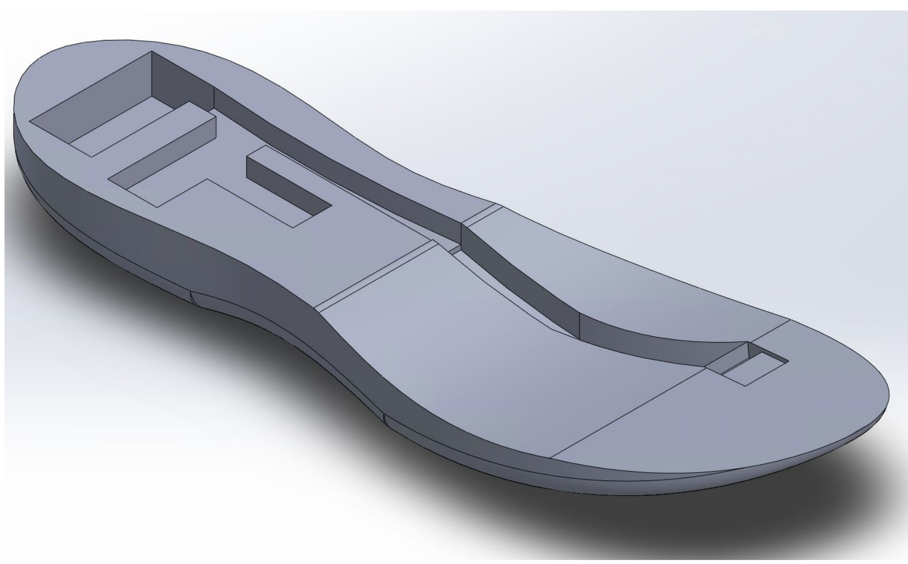


Figure 1: Updated sole

The group was also able to complete some testing as outlined in *2.1.1.3 Instructions.*

Full deliverable can be found at https://docs.google.com/document/d/14GVIRekYFB2UGP_Yvzy71ysgcOgSW-eSOoYrB9i8nFs/edit?usp=sharing

Our Makerrepo page can be found using this link https://makerepo.com/Brendan9Penn/save-your-sole-c01-team-3

APPENDIX B: Other Appendices

B.1 Pulse Oximeter Code

Code retrieved from
https://how2electronics.com/interfacing-max30100-pulse-oximeter-sensor-arduino/

B.2 Bluetooth Module Code

Code retrieved from
https://exploreembedded.com/wiki/Setting_up_Bluetooth_HC-05_with_Arduino