GNG1103

Technical Report

Prototype III customer feedback

Submitted by

TEAM 01

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Date: March 29th 2020

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Table of contents

Introduction

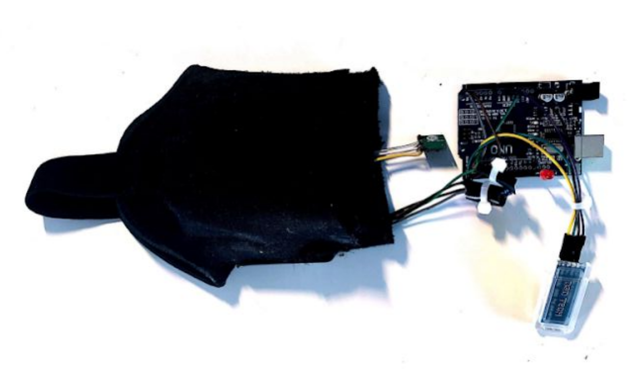
During development of our two prototypes of the project, our group had experienced a couple of specialized troubles which had driven us to structure a third, increasingly proficient, model. In this report we examine our third prototype in detail breaking down the different aspects that make up our finalized model. These aspects are the hardware/software of the model as well as an overall description of the model, a bill of materials and work remaining.

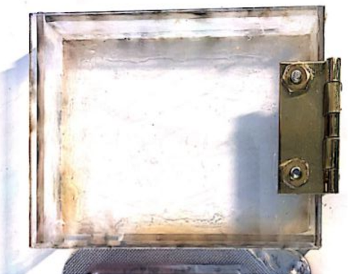
Prototype 3:

Description:

Our third and final prototype finalized our project and met almost all expectations. The third prototype includes physical parts such as an adjustable compression sock with a naloxone compartment as well as a laser cut acrylic casing for all electrical components. The electrical components included in this model are the arduino nano, the bluetooth hc-06 module, the max30100 oximetry sensor as well as Jumper wires and 4 AA rechargeable batteries. All these parts come together to make up a working blood oxidation sensory device that is comfortable, easily adjustable and accurately reads the user information at all times. The one lacking element of this prototype is the functionality of the bluetooth module in regards to the arduino sketch. This defect affected the way the sensor would send values to the mobile application making the prototype not fully functional. Overall we are very happy with the final product and wish we could have finalized all required aspects.

Hardware:

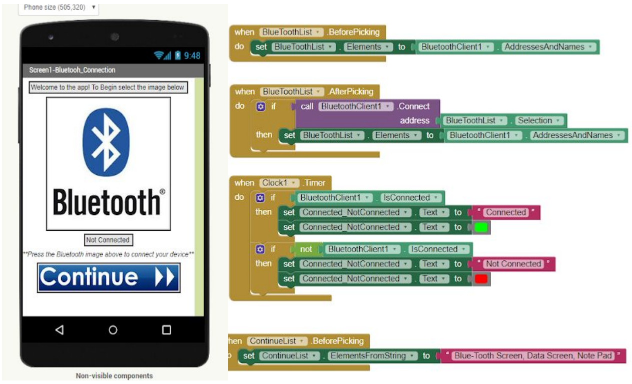




The hardware aspect of prototype 3 is the most refined aspect of all prototypes through customer feedback and testing. The original casing for all electrical components was made up of a mdf laser cut sheet as well as velcro strips and small hinges. The problems that arose from this type of casing was the fact that the mdf was not very thought and lacked the characteristic of being water resistant as mentioned by Talia in the second client meeting. After discussing the problem further our team opted for an acrylic sheet to be laser cut into our second casing for the electrical components. After testing this casing further we decided that it worked perfectly as a protective casing and met all of our required criteria. We then implemented the second casing and decided to also include a narcan storage compartment. This would ensure our clients would always have this life saving drug on them. Since it would be located on their ankle, this feature made the compartment non-intrusive and vital for our final prototype. The final hardware aspect of our final prototype was the adjustable compression sock. This material met all of our criteria from the start of the project and held up against every kind of test we could think of. Overall the hardware aspects of prototype 3 succeeded in all areas of testing and met all product requirements.

Software:

The images above describe the software implemented in the project. Firstly the app was created with MIT app inventor that has 2 main components, the Designer component which describes the image on the right and the blocks component which is described by the image on the left. The main interface that the user will interact and view is made in the designer component, what happens when the user interacts with said interface is made in the blocks component that allows the creator to sudo code an app. The main function of this prototype was for the user to select the main bluetooth image which would bring up nearby bluetooth devices which would then connect to the hardware component of the project



Welcome to the app! To Begin select the image below

Not Connected

Press the Bluetooth image above to connect your device

```
when BlueToothList .BeforePicking
do  set BlueToothList . Elements to BluetoothClient1 . AddressesAndNames

when BlueToothList .AfterPicking
do  if   call BluetoothClient1 .Connect
                        address BlueToothList . Selection
    then set BlueToothList . Elements to BluetoothClient1 . AddressesAndNames

when Clock1 .Timer
do  if   BluetoothClient1 . IsConnected
    then set Connected_NotConnected . Text to " Connected "
         set Connected_NotConnected . Text to 🟩
    if   not BluetoothClient1 . IsConnected
    then set Connected_NotConnected . Text to " Not Connected "
         set Connected_NotConnected . Text to 🟥

hen ContinueList .BeforePicking
o   set ContinueList . ElementsFromString to " Blue-Tooth Screen, Data Screen, Note Pad "
```

Remaining work:

The remaining work to be done is to fix the bluetooth functionality with the arduino sketch to ensure connection from the device to a mobile phone. In terms of the app itself, adding an additional screen interface within the app to display the users blood oxygen percentage, their breaths per minute as well as graphs to depict their levels over time. Another feature to be added would be a contact screen to select friends and family to whom the user trusts in case of emergency. In addition to this a call functionality to send a distress message must be added via linking blood oxygen levels below 80% to create a warning message for 15 seconds telling the user if they are not having an overdose to hit the stop button. In the case they do not and the 15 seconds passed then a message would be sent to the pre selected contacts.

Test Objectives Descriptions

Tests:

The testing involves the following components: Batteries, Blood oximetry sensor, the mobile application, the electrical casing, and the bluetooth module. The importance for testing these components is based on the functionality of the project. The device needs batteries to function thus we need to test how long the batteries will last while the device operates. The blood oximetry sensor is the focal point of the project, therefore the need to test this is to ensure correct and accurate readings are being measured from the sensor. The mobile application that displays the data sent from the device needed to fulfill the functionality criteria in connecting to the device, while allowing data to be displayed on screen and simultaneously being able to call for help if necessary. The electrical casing which houses the electrical components needed to be tested to ensure none of the hardware could be damaged in case of trauma to the device. The bluetooth module needed to be tested because we needed to ensure the device could send the blood oximetry data to a mobile phone.

Test steps:

Batteries: A endurance test will be performed in which we will measure the length of time it takes for the device to go from 100% charge to 0% charge

Blood oximetry sensor: A test measuring each of our blood oxidation levels to see if it registers different results

Mobile application: Testing the bluetooth features of the application to see if connections can be made and data received.

Electrical casing: Dropping it from different heights to measure its durability, splashing water over it to test its waterproof capabilities

Bluetooth module: Testing the module to see if data can be sent from the device to a mobile phone

TESTING SUCCESS AND FAILURE

Success	Failure
Batteries: The 4 AA rechargeable batteries stood up to our endurance test to see whether or not they could power our prototype for a full day. These batteries had enough (3000 mAh each) to stand up to the test and had extra features that advantaged the user, like the fact that they were rechargeable.	**Bluetooth HC-06:** The bluetooth module failed the testing because even though it could easily connect to any mobile application, it could **not** relay information sent from the blood oxidation sensor because of the arduino code.
Max30100: The max30100 blood oxidation level sensor passed all tests because when connected to the arduino sketch it properly read the users blood oxidation level as well as his/hers BPM. The read values were also very stable and did not fluctuate but a lot which allowed for a steady reading.	**Mobile application:** The mobile application passed some of the testing but failed in other areas. It unfortunately could not contact any pre existing emergency contacts the user could select.
Electrical casing: The electrical casing for the third prototype passed all performed tests on it. It was water resistant and met the dimension testing we performed on it as it fit all electrical components and was small enough not to be intrusive to the user while wearing it on a day to day basis.	
Mobile application: The mobile application passed some important tests but failed others. It successfully could display user information through a home screen as well as had a note section where the user could include the consumed amount of opioids for EMS to read and evaluate in the case of an overdose.	

Table 1: Table outlining which criteria of our product's prototype is considered as successful or a failure depending on the goals set for the design.

Project Plan and Execution

The final prototype of our design is a more comprehensive model. This prototype consists of our smaller parts all coming together to form a fully functioning device, that can be improved and altered. These smaller parts include the arduino uno, bluetooth module, batteries and BOL sensor. These major components have been tested together to confirm there is power access to every component, the signals travel well through the device and it reaches a smart phone application.

TESTING PROCESS

1. User Interface

1.1. Mobile Application

The app testing implicated getting feedback from peers and others on our functioning app design and interface. The feedback indicated our main screen could be more aesthetically pleasing, which is one of the points we improved on. Easier readings from the BOL could have also improved our interface.

1.2. Arduino BOL & Bluetooth Code

We initially ran into some trouble with the ability to solder all the wires onto our devices. We managed to find one and get the parts secured. The main difficulty was trying to get the - fully functioning and operational - BOL sensor's bluetooth module to work with the code we were using. The code works perfectly without the bluetooth module (successfully monitored BOL), but as soon as we incorporate it in the circuit, the readings fail. To say, although we got all our vital components to work together, we lacked the code to get the bluetooth module fully operational.

2. Circuit

Our circuit was a fully soldered blood oxygen monitoring device. It successfully provided accurate BOL readings, the only flaw was the bluetooth module. This prototype was using the arduino Nano compared to the larger Uno, with all wires and connections being soldered. We decided to use a 9 volt battery since it is the most sizable option and will help with storage in our case.

3. Casing

We used the same acrylic casing we used in the last prototype to house our device. We added a hole cut on the side to allow some stiff cables to fit. Although this went against the waterproofness of our device, it was a needed adjustment and since the box is in a sock, it will still remain water resistant. We also sewed part of the sock to make sure the box would not shift or cause any discomfort while moving. The next step for perfecting the casing would have been to round out the corners and edges to preserve the socks fragile cotton composition. We were also able to secure the BOL sensor on the achilles heel and have a steady hold. The casing and physical aspects of our device are fundamentally completed and do in fact function.

REQUIRED MATERIALS/ COST APPROXIMATION

Item number	Part name	Vendor	Quantity	Unit cost	Total cost
1.	PLa filament	uOttawa Maker Store	3	Free	Free
2.	Jumper Wires	uOttawa Maker Store	30	$0.10	$3.00
3.	MAX30100 Heart Rate & Oximetry sensor	Banggod.com	1	$14.02	$14.02
4.	Arduino Nano	uOttawa Maker Store	1	$22.99	$22.99
5.	Compression socks	Amazon.ca	12	$1.92	$22.99
6	USB Cable	uOttawa Maker Store	1	$2.77	$2.77

7	Velcro tape	Amazon.ca	16 feet	&10.99	$10.99
8	9V battery Clip Connector Cable	Amazon.ca	2	$4.50	$8.99
9	Bluetooth HC-06	Banggod.ca	1	$4.41	$4.41
total cost					$90.16

Table 2: Cost Approximation of our product’s production.

DEPENDENCIES

1. Pulse oximeter

The pulse oximeter is arguably the most important aspect of the device, due to the fact that the pulse oximeter will read the users blood oxygen saturation level. The rest of the device is dependent on the pulse oximeter because the user's BOL (blood oxygen level) is continuously read and sent to the phone applications. If the pulse oximeter is not working then our device is not functional. Therefore, the pulse oximeter had major priority for the completion of the device.

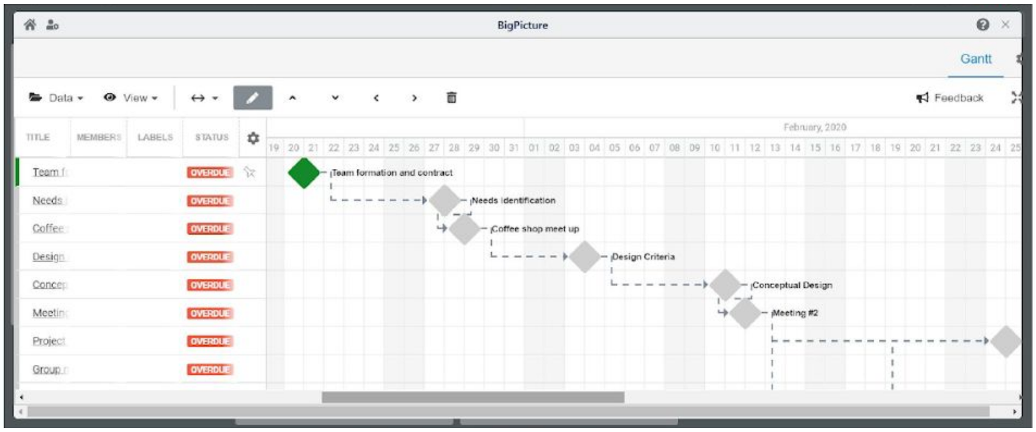
2. Arduino coding

The arduino coding and programming aspect had a great importance to our device, mainly because its role being the “middle man” between the pulse oximeter and the phone application. Due to complications, this aspect took a large portion of our time, mainly due to difficulties with the bluetooth module and connection. We are still in the process of completing the bluetooth coding, however it remains at a high priority.

3. Phone applications

The phone application is a crucial part of our device, as it incorporates the user interface, it alerts the user's emergency contact once the user's BOL reaches the critical point. At this point in time, the app is complete, however we've been unable to test its functionality because of difficulties mentioned earlier about the bluetooth module and connection.

Gantt chart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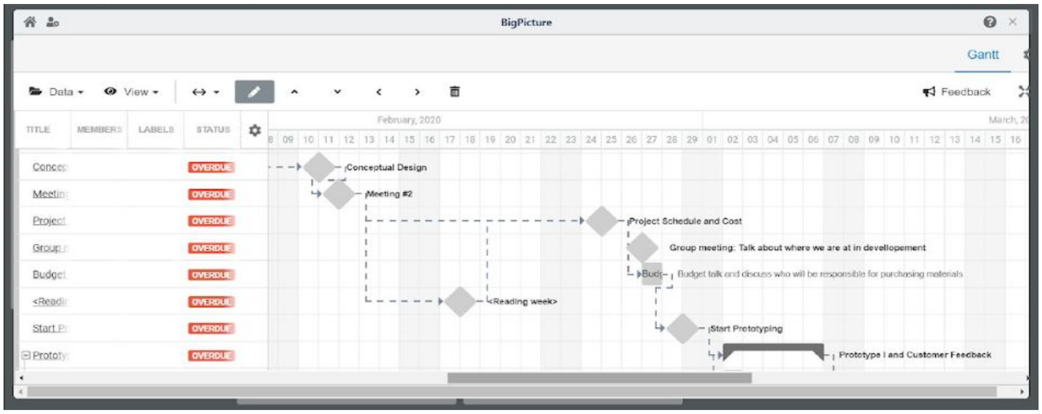
OVERDUE
Team formation and contract
Needs identification
Coffee shop meet up
Design Criteria
Conceptual Design
Meeting #2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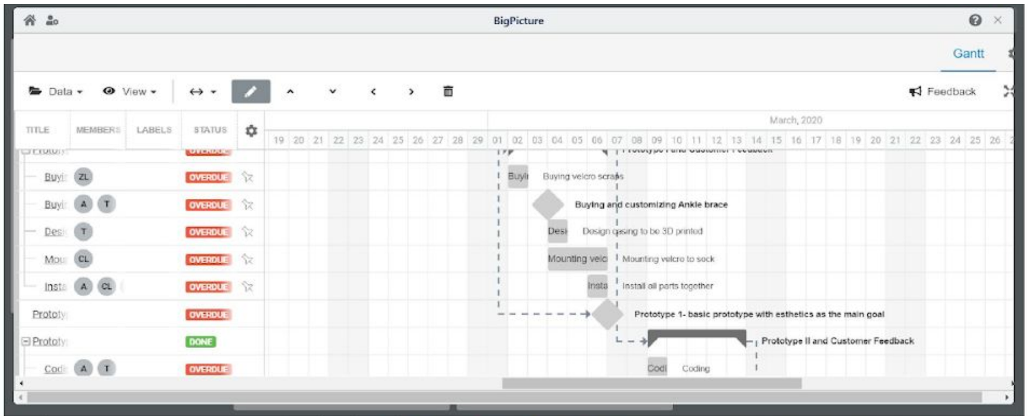
Conceptual Design
Meeting #2
Project Schedule and Cost
Group meeting: Talk about where we are at in devellopement
Budg
Budget talk and discuss who will be responsible for purchasing materials
<Reading week>
Start Prototyping
Prototype I and Customer Feedback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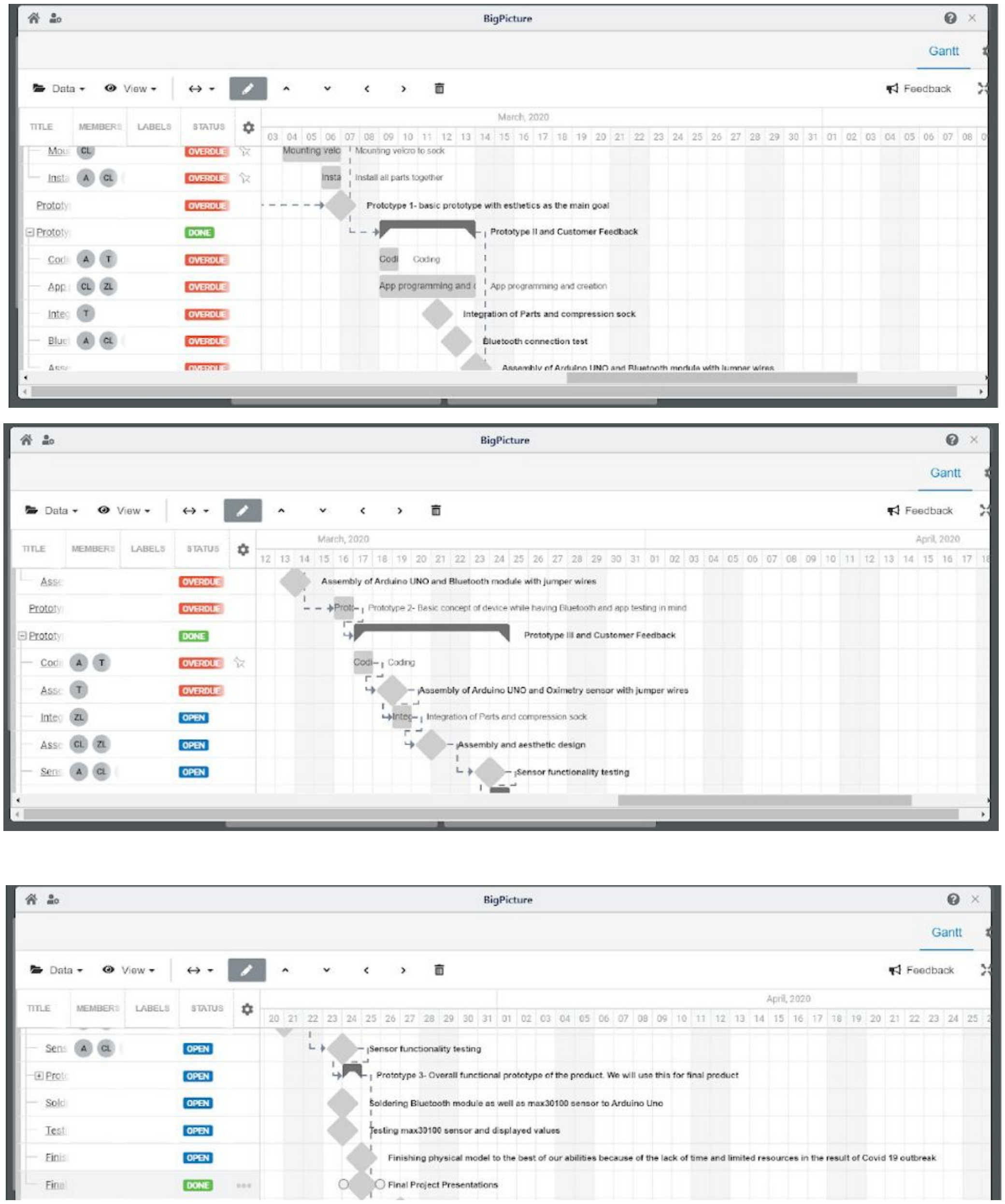
Buyi
Buying velcro scraps
Buying and customizing Ankle brace
Desi
Design casing to be 3D printed
Mounting velc
Mounting velcro to sock
Insta
Install all parts together
Prototype 1- basic prototype with esthetics as the main goal
Prototype II and Customer Feedback
Codi
Coding



Mounting velcro to sock
Install all parts together
Prototype 1- basic prototype with esthetics as the main goal
Prototype II and Customer Feedback
Coding
App programming and creation
Integration of Parts and compression sock
Bluetooth connection test
Assembly of Arduino UNO and Bluetooth module with jumper wires

Assembly of Arduino UNO and Bluetooth module with jumper wires
Prototype 2- Basic concept of device while having Bluetooth and app testing in mind
Prototype III and Customer Feedback
Coding
Assembly of Arduino UNO and Oximetry sensor with jumper wires
Integration of Parts and compression sock
Assembly and aesthetic design
Sensor functionality testing

Sensor functionality testing
Prototype 3- Overall functional prototype of the product. We will use this for final product
Soldering Bluetooth module as well as max30100 sensor to Arduino Uno
Testing max30100 sensor and displayed values
Finishing physical model to the best of our abilities because of the lack of time and limited resources in the result of Covid 19 outbreak
Final Project Presentations

Table 3 : Gantt Chart of the process of development that led to the completion of the third prototype.

Conclusions and Recommendation for Future Work

The goal of our final device is to create a fully functional opioid overdose detection device. This deliverable provides a status update on the third and final prototype, which includes our planned execution under normal conditions. As well as, the test plan for this prototype, a list of material and cost of our device and our dependencies.