GNG1103

Deliverable G: Prototype II

Opioid overdose prevention device

Submitted by

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Introduction

In this deliverable we will be developing the second prototype based on our feedback received during our pitch to the client about prototype one.

After receiving feedback on prototype 1, our second prototype will be a refined version of the first prototype with a couple added features. The dimensions as well as the material of our compartment for the electrical components will be revisited, to fulfill our clients needs. We will also revise the location of the box itself within the device to guarantee user comfort and discreteness. A compartment for a naloxone nasal spray bottle will also be added to the device. Aside from those physical features, the main addition for prototype 2 will be the coding for all the bluetooth related arduino components.

As this is one of the final prototypes for this project, it will be important for our team to receive even more feedback, in order to optimize our design leading into design day.

Client Feedback

We recently had the chance to pitch our ideas to our client in the form of an in class presentation. We got a lot of positive feedback about our pitch and our first prototype, as well as recommendations and ideas to improve our design.

The client thought our problem statement was very clear and well written that express her needs well. The client clearly understood the goal of the first prototype as well as understood what we were going for as our first design. Their main comments about the design were the possibility of the device being a little too bulky as well as making sure the device could accurately read the user's blood oxidation level. A secondary comment we got from the presentation was that the client was worried the external casing for all the electrical components wouldn't be waterproof and therefore would affect the durability of the product. Going forward in the next prototype, one of the main goals will be to make a waterproof casing made out of acrylic sheet instead of mdf, therefore making it more water resistant. As for the device being too bulky the team is undergoing research on optimizing the dimensions of the electrical casing to ensure that all

parts will properly fit while also allowing for extra space to fit the naloxone nasal spray. The dimensions will also keep the device as small as possible. Ideally, the client would like us to reduce dimensions, make the casing waterproof, allow space for naloxone nasal spray as well as display accurate and timely readings of the users BOL on their given smartphone.

Finally, it is important to the client that we complete our project on time for design day. For that reason, they recommended we go for ideas that will maximize client needs and allow for a fully functional product that works and will serve as a life saving device in the case of extreme need. But the main goal is to have a working product by Design Day.

Discussion

Our original plan was that the device will contact emergency services after detecting an overdose. However, it was brought to our attention that it is illegal to remotely call emergency services, this caused us to rethink our plan entirely. Now, we are currently sitting with 2 possible solutions. One, instead of the device calling emergency services, have the device call the users preset emergency contact. Two, have the device or the users phone start playing a pre recorded message with the hopes of someone being in the vicinity.

Now comes the difficulty of having to choose between the two possible solutions. In order to help make this decision, a list of pros and cons for each solution be made. For the first solution possible pros will be that the person contacted will know the users location, as well that the person will be more adapt and understanding of the situation compared to a stranger, however the possible cons are the reliability of the person answering or receiving the message in time. For the second solution, possible pros are that if the user is in public that it is safe to say that it is a guarantee of someone either calling ems or administering naloxone. Meanwhile, possible cons are that if the user is alone the device becomes obsolete. We have a team meeting schedule for the near future where we will be further discussing the pros and cons of each solution and finally choosing one for our final design.

Goal of prototype 2

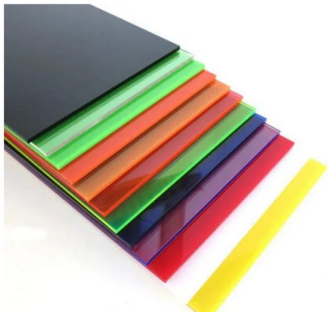
The primary goal for prototype 2 is to refine and add features based on the feedback received from prototype 1. Having a second prototype will allow us to undergo even more testing and receive even more feedback, to further our design leading into design day.
The secondary goal for prototype 2 is to begin the coding process for the arduino pieces. Our current objective for the coding process will be to gain an understanding of the arduino coding language, as well as to create a functioning code which will be able to optimize in the future, as we gain more experience coding.

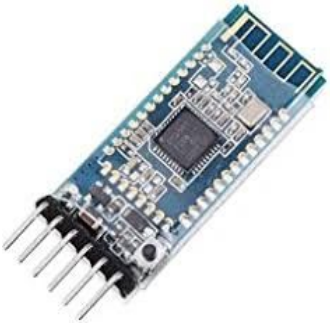
Prototype 2:

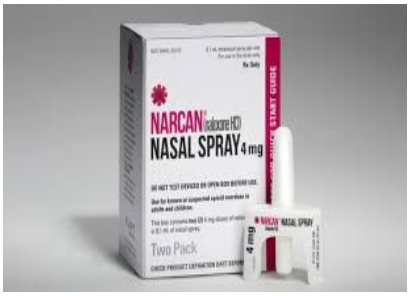
Description: Prototype 2 will greatly be based on our current design for prototype 1 with refinements and added features. The main goal of this prototype will be to implement the bluetooth connection between the arduino nano and the mobile application. The secondary goal of prototype 2 will be to refine all physical design aspects of prototype 1 discussed with the client. The idea of doing this in the second prototype will be that with all physical aspects out of the way, this will allow the team to highly concentrate on the more technical parts of the project like the coding for the arduino parts as well as testing and final refinement towards the end of the design.

Materials: Prototype 2 will capitalize on the clients comments and recommendations and make changes to the materials and build accordingly.

-Acrylic sheet to be laser cut for electrical components casing
-4 rechargeable AA batteries with charger
-Compression sock
-Naloxone nasal spray
-Arduino nano
-Bluetooth module
-Jumper wires







Client feedback solutions:

Reduce dimensions: The goal for prototype 2 is to make the casing much smaller in thickness and in width. After evaluating the leftover space on the prototype 1 with all parts inside the casing, it was decided by the team to reduce the height of the box by at least 6mm or more. As for the width, further analysis will need to be done on space and dimensions but the goal is to minimize the size of the physical box while maximizing space for parts.

Making the casing waterproof: The goal for prototype 2 is make the electrical casing waterproof. The issue was brought up by the client because of the location of the device. Since our target audience are middle aged men in the construction industry who regularly are on the work site the need for a waterproof casing very is important to note. This will be done using Acrylic laser cut sheets obtained from the maker store. The reason for the selection of this material is

because acrylic sheets are much more waterproof than mdf and much more resistant to impacts which makes the switch of materials a no brainer.

Space for naloxone nasal spray: The goal for prototype 2 was to allow for the space of a Nasal nasal spray. This decision was made by evaluating the pros and cons of having a nasal spray instead of the device calling EMS. The space made for the nasal spray will come from the downsizing of the overall dimensions of the electrical housing.

Display BOL on their given smartphone: The main goal for prototype 2 is to successfully complete a working mobile applications with included features such as displaying sensor read values, playing the pre recorded emergency message for anyone standing in the nearby surroundings as well as received timely sensor value updates every minute or so while being very user friendly and easy to use.

Prototype 2 test plan:

The main design characteristics that need to be tested in prototype 2 are the dimensions and the water resistance of the components box. We will also be evaluating how much extra space we have in order to be able to carry a nasal naloxone spray inside the box. Reducing the room that the hardware occupants could provide enough room to meet this improvement idea. Lastly, prototype 2 will test the mobile application that will interact with the user. We will be testing the bare functionality of the app, as well as user interface and practicality in terms of consistency and reliability. We also implement further comfort and aesthetic additions to meet the critical requirements of discreteness and physical comfort.

The procedure:

Step 1: Acrylic box and Application design

This first step will include designing the new components box on solidworks as well as designing the mobile application that will interact with our hardware and the user. The box will be laser-cut in the makerspace with the newly specified dimensions. This part should take a minimal amount of time since we already have a foundation, that being the initial wood box design that we can work off of. The major part of this step will be creating the mobile application. This specific step is crucial in order to test if our device is actually capable of sending an alert in the case of an emergency. We have many different resources and programs to help design our app, as well as fine tune it to be as user-friendly as possible.

Step 2: Physical improvement Implementation

We will explore different styles and types of hardware that our device operates on, with the goal of finding even more compact components that will provide the same output and reliability as the ones we are currently using. Furthermore, this step will also include improving the straps and reducing the “bulkiness” of our device to make it more comfortable and stable after extended use. This step will also include the change of material for our box in order to make it waterproof. Not only will we be using waterproof acrylic, but we will also line the inside with waterproof plastic to protect the components from moisture build up and gradual water accumulation through the imperfections of our box design.

Step 3: Comfort and functionality testing

This step includes physical testing of the new design, as well as technical evaluation of the application we have designed. For the physical part of the testing phase, we will wear the device with the new straps and material (new weight and bulkiness) for a prolonged amount of time to know how comfortable it is. We will also test the water resistance by removing the hardware and submerging it underwater for a short amount of time. It is our hypothesis that there will be water that enters the box, but our goal is to minimize the amount that does get through. Splashing it with water and other substances will also be a part of our physical testing phase.

The last thing we will test for this prototype is the alert system we have created from the mobile application design. We will connect our device to one of our mobile phones and personally test the alert and sound system to measure time delay and overall function of our software. The goal is to receive the notification, if not, we will have more information to allow us to find the problem and perfect our design.

Step 4: Stopping Criteria

Our prototype 2 is based off of improvements implemented from the feedback received in the client meeting. The objective of this prototype is to test the core functionality of our application and perfect the physical comfort and look of our device. If our established criteria is met, we will know that this prototype has met expectations. If not, we will know that further brainstorming, planning and testing is needed to meet our criteria, being that the device is:

- Waterproof (water resistant)
- Comfortable for constant, extended use

- Successfully sending alerts to a mobile device
- Able to fit under a pant leg (and over a boot)
- Spacious enough for a nasal naloxone spray
- Successfully measuring BOL

Benchmarking

From the prototype 1 presentations that happened on march 6th 2020, we noticed an excess amount of designs that were designed for the arm or for the ear and we are the only group that is taking advantage of the heel location to sample the patient's blood oxygen levels.

not many groups utilized an article of clothing to serve as a mount for their respective devices. We concluded that this is probably done in order to save cost on buying and requiring a separate piece from another source. Since we started off with the idea of mounting the device to the body through the use of a compression sock, we thought about designing something like an ankle watch, and tried to cut out the compression sock from the design. However, after several design attempts, we deemed the idea to be too fragile for daily use and that we would be sticking to our compression sock, Velcro straps idea.

Some of the ideas seen utilized the earlobe as the site for blood oxygen level testing, though their design seemed more unique and ´cool" than our team's design, most of their designs rely on the primary housing for the Arduino and Bluetooth to be separate from the BO sensor. We have thought about this idea before during the earlier phases of designing phase and we ruled it out as it often introduced multiple weaknesses to the overall product because it is difficult to attach anything to a person's head.

The budget of most of the other groups seemed to be in the 40-50$ range while our device is projected to cost around $30. We reasoned that this was the case because of our extremely cost-efficient mounting method with the Velcro and compression sock design.

Regarding the sensors from the other groups, there was a single group that utilized another type of overdose detection method, where it did not require to be on a location of the body where the light could reflect and be detected by the sensor. After debate amongst the group, we collectively decided that this technology was out of our skill level and that the quality of life

change this change would bring to our device would be so minute that it is not worth the time dedication.

Conclusion

We have had a successful second round of prototyping, our general focus for the second prototype was to enhance the previous prototype based on the feedback gathered from the client meeting, we gathered new ideas based on a recurring problems that was brought up from other groups during the client meeting, this prototype also includes a further refined app that the final product will connect to. Moving forward we will need to bring our individual prototyping work together making sure everything fits together and is functional, this means more regular meeting ensuring we're all on the same page as design day comes closer.

We have had a successful second round of prototyping, even though our prototypes are not as far along as we had planned. All of our proof-of-concepts have fit within our expectations and we are on schedule for our third round of prototyping and eventually design day. Moving forward, we will need to do more collaborative work to bring our individual prototyping work together and connect all the subsystems together with Dashboard. This will likely involve increasing the amount of times we meet out of our regular lab sessions and our weekly team meetings as we combine the electrical and software subsystems, the electrical and hardware subsystems, and the two software subsystems.