GNG1103

Deliverable F:Prototype I and Customer Feedback

Opioid overdose prevention device

Submitted by

GNG 1103, Section C00, Group 1

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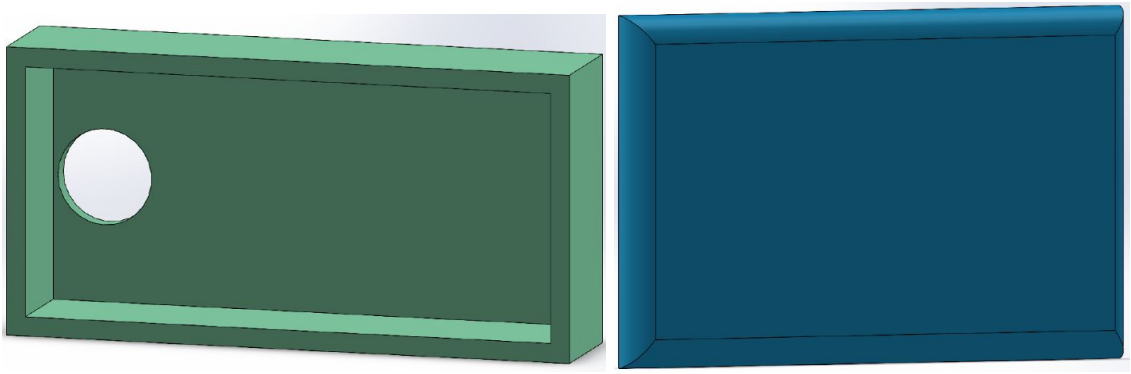
Introduction

The objective of this deliverable is to develop the first of three prototypes involved in this project. This prototype will essentially be used as a base to build off of later on in this project. This prototype will help us visualize what our product will start to look like and will be very helpful and letting us see if we are on the right track to successfully meeting customer needs as well as the design criteria previously set out. This prototype will also help with the proof of concept which will be improved/ refined for further prototypes. Each critical component and system will be created and simple analyses on each of them will be carried out. A non - functional user interface using a compression sock, a preliminary arduino parts holder and velcro strips will all be used to create our first physical model of this product. This prototype allows the team to make essential observations with the functionality of all the components as well as receive feedback one the next client meeting which is aimed towards getting customer feedback on the first prototype.

Hardware Subsystem

Figure 1 - 3D model of the Box to hold electrical components



For prototype one, a basic box was made using SOLIDWORK. This design was made to hold all our arduino related parts and be detachable from the compression sock mount. As a team we decided to take advantage of the laser cutting laboratory by laser cutting out our individual parts instead of 3D printing them.

Figure 2 - Technical drawing of the compression sock mount

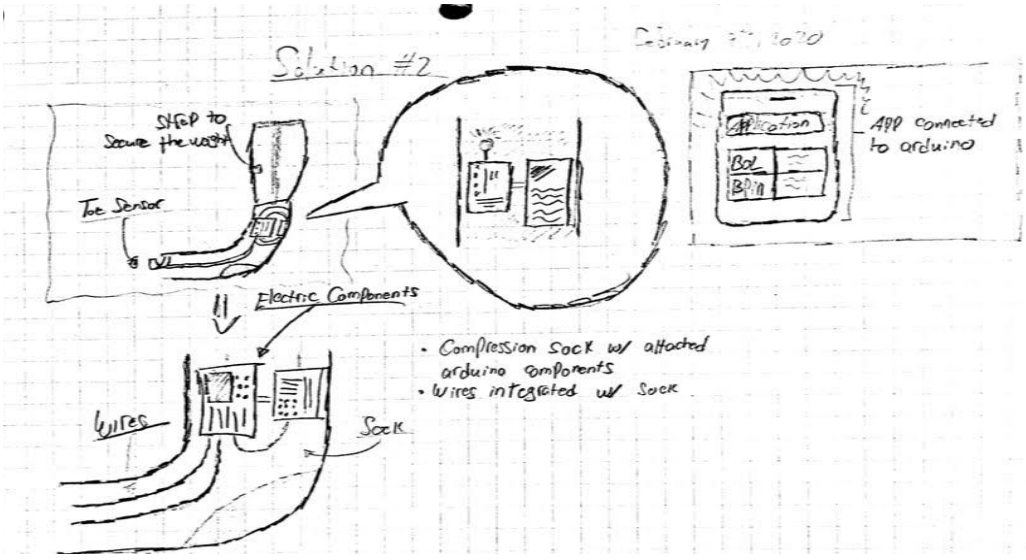


Figure 3 - The first prototype of our model

The test objectives/ goal is to see if the other hardware components such as arduino Nano and the MAX30100 Heart Rate & Oximetry sensor would fit into the Boxinteaded to hold all the electrical components and how much extra room there would be for wiring and for the battery pack. The results obtained will be a simple yes or no answer to whether the components fit. This test allows for refinements to the 3D model in order to develop a better shell for the electrical parts involved in the second prototype. The two main criteria that will be used to test

the model are the following:

1. Do all the electrical components fit?

2. If so, is there enough room to allow for a battery pack as well or does a secondary model have to be made to incorporate it?

In addition to qualitative observations, some quantitative data will be recorded if possible to allow for further improvements to the model. The measurements recorded will be the amount of space left if everything fits inside, or what the required dimensions will be for the future prototypes (in mm). The material being used for this sub component is laser cut sheets of wood like material obtained from the makerspace lab. The only dependency for this will be if the lab will allow for enough time to make our own personal parts. If not, spare time will be allocated to make sure the all the necessary parts are completed before our next client meeting

After making the first 3D designed model and receiving the necessary parts to make it (hinges, screws, velcro …) a test of the first prototype will be conducted. It will be determined if the Box made to hold arduino parts will be adequate for the task. It will have to fill requirements set out by the team ahead of time. Requirements such as, will it fit all of our parts, will it be too big and bulky, will we be able to attach and detach the casing with ease and finally will the sock be comfortable and discreet enough to meet customer needs. All of these requirements are essential to the first prototype and will need to be tested.

In the event of the prototype not being adequate, further refinement work will need to be done to improve on certain parts of the prototype. The group has agreed that the project will not be able to move forward without the first prototype fitting all of the set out requirements. The first prototype is therefore essential for the project deadline and must be completed as quickly and effectively as possible.

TABLE I

Various measurements obtained from testing the prototype.

Measurement of box holding the electrical components	Value (mm)
Height	120
Thickness	30
Width	60

Going forward, many additional adjustments and add-ons will be required for the physical model and will be implemented in the following prototypes. One essential add-on is the extra room of the casing for the battery pack that will need to be made in order to adequately power the arduino parts as well as make it easy for the customer to change and charge the portable power source. A potential idea for this is to either make the casing longer therefore allowing for the battery pack to fit inside. A secondary idea will also be to have the battery pack on the outside of the casing therefore allowing the change of the battery to be much easier while also minimizing the casings overall size. Currently, the most viable option to achieve this is the secondary idea, because it means that no further modifications have to be made to the 3D model and since no testing has been yet to date, making the part as small as possible will always be advantages to our group.

Objective

The objective for prototype 1 was to create a physical model of our design. In which we could all physical aspects of the prototype. The test's will focus on the discreteness, comfort, and size to ensure user satisfaction. The tests will also focus on, determining if the method to attach and detach the electrical component is feasible as well as determining the proper dimensions for the casing of arduino parts.

Parts included: After setting out a set goal for this prototype we made a list of necessary parts the prototype needed to properly function. Part description and use also needed to be included to see how useful the part was going to be as well as tell us if everything would properly come together:

Figure 4-Velcro strips

Intended use: Will be used to mount and unmount the electrical casing to the compression sock. This will allow the user to easily wash the compression sock without having to make the casing waterproof. It will also allow for easy and effective mounting systems while being relatively cheap.

Figure 5-Compression sock

Intended use: Will be used as the overall mount of the project. The reason for picking a compression sock is because it is located in an area that is overall discret and also provides for easy BOL(blood oxidation level) and heart rate reading. It also is a comfortable way of having electrical components and parts for the project.

Figure 6-Rectangular wooden box

Intended use: Will be used as a casing for Arduino related parts and possibly will also store the battery source. Will utilize the parts from makerspace labs and will be made out of cheap enough materials to maximize the overall project budget for the final prototype.

Test Plan

The factors that need to be tested include whether or not the box can contain all the electrical components necessary for our device to function. We designed it in SOLIDWORKS so that the dimensions are large enough to contain the electrical components snugly; securely. We cannot fully complete this test because one of our key components (the blood oximeter) is still in shipment. Once the part arrives, we will be able to finalize testing. One of the primary objectives of this device is trying to achieve a high level of discretion. To test this, we will create the external components of the device; including the wooden box (designed with SOLIDWORKS), the compression sock, and the velcro strapping in between them. We will not need the electrical components to complete this section of the test because the electrical components are a subspace for the wooden case.

The procedure:

Step 1: Design and create the box from SOLIDWORKS

We will design a box with a snug volumetric interior which will translate into a discrete overall presence. The snug interior allows for securement of the electrical components, lowering risk of damage through everyday movement. Using Simulation Solutions in SOLIDWORKS allows us to virtual test potential movement of components as a result of real world motion. Our design will keep our components secure and stable for the device's life time; allowing for the calibrated oximeter to read effectively.

Our box will be laser cut from balsa or poplar; a process greatly hastened through the seamless software interactions of SOLIDWORKS. Laser cut box components will be riveted together for assembly.

Step 2: Ergonomic and size testing

After the design and creation stage, our team will test the device thoroughly by wearing the devices for hours everyday, at home and on campus. The team will be reporting on ergonomics and the general discretion of the device. Discretion will be tested alongside a variety of clothing and footwear. Any interference from different fabrics and footwear will be noted. The team will look for any potential bulkiness whether from the device itself or a combination of the device and clothing choices. Everyday testing environments allow us to replicate the client use and aim for the discretion desired. Simple things like resting one's feet on a coffee table can give us important insight into comfort and excessive bulk.

Step 3: attachment and detachment testing

Our device relies on velcro strapping as our attachment method. The velcro will be tested in everyday use (step 2) but more intensive and environment focused testing will be conducted. The differing environmental testing will bring in everyday factors such as moisture, temperature, dust and the fatigue of the user. In the events our findings call for adjustments, we are ready with wider velcro straps to implement more surface area of adhesion.

Step 4: establishing stopping criteria:

Our prototype 1 is used mainly to receive feedback from users as well as testing the many physical aspects that our product has. The objective of this prototype as previously outlined is to develop a working physical model of our product while ensuring the user specified criteria are met. If the product does not meet certain criteria, more work will be done to ensure user satisfaction. If the criteria are met then these would also serve a stopping criteria and would tell

us that the product so far is feasible and acceptable. As decided by the group prototype 1's stopping criteria are as follows: The device is

-Aesthetically pleasing

-Wearable while completing everyday activities and jobs

-Concealable and does not stick out from pants/cloths

-Holds all electrical arduino parts including battery pack

-Does not look like an opioid detection system

-Has the ability of being taken on and off with ease

-Can properly hold the required BOL sensors

Test results so far:

After performing some tests on the already made features of our prototype 1, we determined that we have chosen a good and effective method of storing all the Arduino related electrical components as well as making prototype 1 user friendly.

TABLE Ⅱ

Pass: Successfully passed the requirement and meets our standard of this prototype

Fail: Does not meet our standard for this prototype and needs further work

Tbt: To be determined through testing

Number of requirements	**Requirements**	**Pass/Fail**
1.	Has to fit all of our parts	TBT
2.	Can't be too big and bulky	Pass
3.	Ability to attach and detach the casing with ease	Pass
4.	Be comfortable enough to meet customer needs.	TBT

The next prototype will involve putting all wiring onto a prototype breadboard and creating an

algorithm to program both the bluetooth Ble sensor as well as the MAX30100 Heart Rate & Oximetry sensor. This will likely be done with the help of online documentation of other people using these parts with similar Arduino projects.

User testing

This is the first test that will evaluate the comfort - the critical design aspect - of our product. This process will require us to make a prototype resembling the weight and proportions of our hardware box to properly assess the fit and functionality of our product. We will use feedback and data from different users to organize a prioritized table of what improvements need to be made. It will be key to get many different types of users to test our prototype in order to gain a variety of different preferences and needs that we will then be able to incorporate into our design. The possible areas of failure for this prototype could be either if users do not provide us with workable feedback or if we aren't able to implement the feedback into our design.

The procedure for this test is as follows:

Ask a variety of students and/or recovering users to try on our product (preferably people with some sort of affiliation to the university or our class)

1. We will introduce ourselves, give background information on our project and team. Ask open ended questions and listen actively.
2. Have them try on the sock and ask the following questions:
    a. Does the device stay in place while moving (i.e. does it twist, slide or rub)
    b. Does the device feel heavy or bulky? Does it impair mobility?
    c. How good does the product look? Does it fit under pants/shoes? (Scale of 1-10)
    d. Is the "one size fits all" concept feasible? Is the device too tight or loose?
    e. Recommendations and feedback.

Conclusion

Our first prototype has been successful, having an actual model that is wearable helped us as a group understand key concepts and functional capabilities that will be looked into further for the second round of prototyping such as the compartment for the parts and how they will all fit together.Moving forward, collaboration of the team is going to be the most important thing as the deadline for design day draws closer. We will need good communication to understand what the big concepts are that we need to have fully completed before adding non functional requirements. We will be having more meetings to ensure we are all up to date on how each of our tasks is panning out in case adjustment must be made from another part in the project.