Project Deliverable B

Need Identification and Design Criteria

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Faculté de Génie - Faculty of Engineering
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Group: C32

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Abstract

This report is to document key information that was gathered from the first client meeting held on January 20th, 2021. The purpose of this meeting was to obtain important information about the client and their needs and to empathize with them so we could better understand their qualms. The reason for this is that when making the design and the eventual product we will keep these problems in mind, integrating workarounds into the design to help alleviate or outright solve the issue. In order to do this, we set up metrics to allow us analyze what can be considered a success, a negligible impact, or a failure. The metrics are not simply not just yes or no, but also come in the form of numerical values with units to set a benchmark for what can be considered a success. At the end we reflected on how the meeting went and how it impacted the process of making the project, we postulated how some things should be asked in the future for further clarity.

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1 Introduction

On January 21st the first client meeting was held and our group met with Dr. Annie Zhong and Dr. Hillel Finestone. During the meeting we discussed what they wanted to see in the product. As well as we asked questions that would aid us in better understanding the situation our clients' patients were in. Questions about how the obstacles their disabilities posed them in their day to day life and how it would work against them operating a standard glucometer. We discussed potential fixes for the issues and brainstormed align side the two clients to see what they thought of the potential fixes. Overall we gained a lot from the meeting. We came out with two major takeaways one expected but one not nearly so. The first was we learnt a lot more about the tribulations of our clients' patients. However, the second take away was a new branch of thought in terms of solving the issue. Instead of modifying the glucometer or creating a new one instead another approach could be tried. The use of an external tool or apparatus could be used to function as a second hand in a place of the one that was inoperable by the clients patients which might prove more or equally as effective but much easier to design.

2 Need Identification and Product Specification Process

2.1 Client statements

- Accurately measures blood glucose level
- Can be easily used with one hand
- Low cost ($100 budget)
- Safe
- Long lasting battery
- Reliable (daily use)
- Make an easy way to interface with the analyzer to keep it on
- Try to make it blind friendly

2.2 Problem Statement

Create a device for recovering stroke patients that can reliably measure blood glucose content, quickly return the measurements and is operated single handedly with ease.

Criteria	Needs	Priority	Explanation
Functionality	- Takes accurate blood glucose content measurements - Quickly returns measurements to the user	3	Naturally it is ideal that the glucometer be able to bring back accurate and quick results to the user, it's imperative that this be a high priority as this is the main function of the glucometer and is important that it be able to do it correctly.
Design	- Glucometer used single handedly - Blind friendly - Durability - Lancing device (If there's one) can be used with simplified steps and with a single hand.	2	The main goal of this project is to be able to design a glucometer that is able to be used by individuals that can only operate one hand, as well as those that have imparied vision. The reason why this is of the highest priority is because even if the device could return one hundred percent accurate results instantly it would mean little to nothing if the device was not usable by the client due to them being not able to operate the device itself. The top of the device should be durable as potential accidental drops might occur from user error and if it were to break it would be very problematic.
Cost-efficient	Less than or equal to a hundred CAD.	4	The cost of the device is important as it is more or less gauges hope many can actually be made. Even if we were to create an automatic, 100% accurate instantaneous result generating device it wouldn't matter if it costs a lot of money to manufacturer.
Reliability	- Long battery life - Memory	5	We want the device to be reliable and part of that would be having a long battery life as well as the ability to store past results for medical check ups or emergencies.
Safety	- Lancing device is safe to use - Clean	1	The safety of the device in regards to the lancer is important as it would be very harmful to the user if it were to go too deep or the lance itself was too big it could cause unintentional damage to the user which could cause some adverse undesirable outcomes.

Table 1: Client needs classification

3 Design Criteria

3.1 Design Criteria interpreted from client needs

Design Specifications	Relation	Value	Units	Verification Method
Functional Requirements				
Quickly returns measurements	$\leq$	5	Seconds	Run it a few times with actual samples and dummy samples and average the time, to see if it achieves a 5 seconds or under time.
Accuracy	$\geq$	95	percent	Run it a few times with actual samples and dummy samples and average it. Then do the same number of tests under the same conditions with an already proven glucometer compare results and adjust and calculate for accuracy.
Memory	$\geq$	100	Logs	It should be able to store past readings. This can be verified by simply checking if the device properly stored them.
Constraints				
Cost	$\leq$	100	CAD	Calculate spendings and see if it goes over the price limit.
Weight (all parts)	$\leq$	100	Grams	Weigh the parts together with a realistic number of lancelets and test papers.
Size (all parts)	$\leq$	6*6*6	Inches	Measure
Non-Functional Requirements				
Accessible use with a singular hand	Yes	N/A	N/A	Obtaining a few test subjects gives them a run down and artificially impairs them through restricting them to using one hand and or blindfolded after giving instructions on how to use it either through a video or a verbal instructions and making sure not to repeat subjects. After testing them asking them how they would rate the experience out of 10 in terms of ease.
Durable for daily use	Yes	N/A	N/A	Drop test & general common sense.

Table 2: Design Criteria interpreted from client needs

3.2 Benchmarking products and results

Legend:

- Green: 3 points
- Yellow: 2 points
- Red: 1 point

Devices	**Weight**	**Device #1**	**Device #2**	**Device #3**
Name	N/A	Freestyle Libre (Flash Glucometer)	Contour NEXT EZ (standard)	Prodigy Voice Glucometer (spoken results)
Link	N/A	Click me	Click me	Click me
Image	N/A	Figure 1	Figure 2	Figure 3
Accuracy	5	92.8%	Roughly 99%	Roughly 99%
Memory	3	32 readings	30 days of readings	450 readings, up to 90 days
Result time	4	Does test every 30 minutes and returns results to an NFC device as soon as it is taped to the sensor	Within 5 seconds	Within 7 seconds
Cost (CAD)	3	Reader:89.85; Fourteen day sensor: 89.85	Kit with 100 tests:68.50; 100 tests:50	Reader 57.31 (uses standard paper)
Weight	3	Reader: 65g; Sensor: 5g	Total kit: 50 grams	50 grams, battery: 61.5
Size	3	95 x 60 x 16 mm	160 x 117 x 84 mm	110 x 65 x 20 mm
Accessibility	5	The omission of a lancelet is helpful but the process of applying the sensor may be difficult.	Standard glucometer.	Very the use of physical buttons with tactile feedback and auditory response makes this very usable for the visually imapred.
Durability	4	Good	Okay	Good
Total	90	71	70	83

Table 3: Design Criteria interpreted from client needs

4 Target Specifications

Our final product will cost less than or equal to 100 CAD in total with all parts. Acceptably have a 95%+ accuracy with a result return rate of within 10 seconds of analysis initiation. It should be able to be easily used while not being able to see and or use only one hand. And store up to at least a 100 past readings. In an ideal situation we will be able to create a design that weighs less than a 100 grams as well as be small enough to fit into a small bag and do at least 500 tests before recharge.

Design Criteria	**Acceptable Specifications**	**Ideal Specifications**
Accuracy	92%-95%	95%+
Result Time	Under a minute	Less than 10 seconds
Accessibility of use	5-10 steps	Under 5 steps
Cost (CAD)	100$ - 140$	Under 100$
Weight	Less than 150 grams	Less than 75 grams
Memory	Stores at least a day worth of data	Stores a week worth of data or more

Table 4: Ideal and acceptable target specifications

5 Conclusion

In conclusion, the meeting overall was very helpful in helping our group decipher what we should focus on as well as learning and gaining a more expansive view on how to approach the problem. The clients emphasized the points that trouble them the most with the standard glucometers and gave us feedback when we discussed potential solutions. We will be designing multiple new designs to help solve the issue as well as postulating new questions to ask to further our understanding in upcoming client meetings. We then made our design criteria that we will use to judge and rank solutions in accordance with the needs emphasized by the client during the meeting. Accessibility was given the highest priority since this product is targeted towards patients who suffer from poor dexterity due to strokes. Accuracy and processing time were considered just as important because why would anyone use a measurement device if it did not measure accurately and quickly. We classified the other criteria based on other interpretations of our client needs. Benchmarking on 3 products was also done based on the established constraints and criteria. The FressStyle Libre is definitely one of the more innovative ones. However, it is a new untested technology. Some users report that it's inaccurate compared to standard glucometers and it's a lot more expensive than traditional solutions. The Contour NZXT came on the bottom of the list as it is just a standard glucometer, although it's a very good and accurate one at that, it just doesn't make itself accessible to cater to our specific customer demographic. The Prodigy voice glucometer shows the most promise as it includes features that assist its physically compromised users. Auditory response and buttons with tactile feedback make it a good product for the visually impaired and others who may need assistance in operating a glucometer. Thus, the benchmarking results support a concept of design that is centered about being user friendly. Our goal is to make our design as accessible as it could ever be. With that in mind. We set our target specifications which support the development of an accurate easy to use solution with a minimal number of steps.

References

[1] Abbott Laboratories Corporation,
https://www.freestyle.abbott/ca/en/products/libre.html

[2] Ascensia Diabetes Care,
https://www.contournext.com/products/contour-next-ez/

[3] Prodigy Diabetes Care,
https://www.prodigymeter.com/consumers/diabetic-supplies
/prodigy-voice-talking-glucose-meter/

A Product Figures

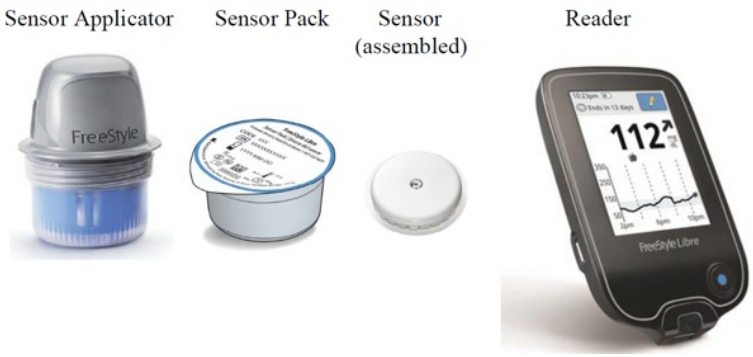

Figure 1: Freestyle Libre

Figure 2: Contour NEXT EZ

Figure 3: Prodigy Voice Glucometer