WORCESTER POLYTECHNIC INSTITUTE

ECE 2799 - Self Care Patch

Team 14

Homework 1 - Needs Assessment & Problem Formulation

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1. Introduction

Long hours of physical inactivity such as sitting in front of our computers is a modern day menace that threatens the physical well-being of many of us, irrespective of age or gender. The so called “modern living style”, the evolution of global economy and the consequent development of computer-based professions is at the root of this problem. At the same time, more and more people are aware of the threats posed to their health precisely because of this life-style and are prepared to make an effort towards changing it. Our device is designed to provide a step towards this direction.

Our objective is to design a wearable health device which aims to help the user live a more healthy lifestyle. The product will potentially aid the user in correcting some unhealthy habits such as poor posture, muscle tension, dehydration, and low physical activity. This will be achieved by collecting measurements and offering the user helpful reminders and statistics about their habits. The user will also be able to view their daily habits and long term progress through a mobile phone app. The device will be in the form of a small patch that will be placed on the back area. It will contain sensors to detect “slouching” (in other words poor posture) and movement (or lack thereof). It will be linked to a smartphone application through a wireless transceiver which will collect analytics and provide personalized advice regarding posture and physical activity.

2. Market Research

In this section, we will discuss our market research. This will include the methods used to perform the research, the relevant results, and the conclusions we have drawn from these results.

2.1 Methods

The two methods used to perform market research for this project were internet research and surveys. First, general research was done using the Google search engine. We looked at the market for similar products and verified that our design was not an exact copy of an existing design. Our internet research findings were then used to create a market research survey specific to our project. The resulting survey gave us the majority of our market information.

Our first step was to search the internet for any similar products. We found some devices with similar functions, such as a product to notify the user when they are slouching, but no products

had the exact same functionality as our proposed device. For example, the “slouching” device stated above does not measure physical activity, which is something that we are planning to do.

The survey was the most useful tool for performing our market research. We surveyed 51 individuals of various ages and genders using Google Forms as a platform. We gathered data on the following topics:

- Hours spent sitting per day
- Interest in the product
- Interest in correcting various habits
- Desired features
- Inhibiting factors
- Expected cost

For the full survey used please see Appendix A. The survey yielded useful information which helped us to determine our market. The results also guided us in defining which features were most important to potential users.

2.2 Results

Through internet research we found some products that were similar to ours, which gives merit to our idea and a platform to build upon. Here is a list of a few items that have similar features to our idea found on Amazon:

- Upright GO Posture Trainer and Corrector for Back
- Posture Corrector
- Ulla Smart Hydration Reminder
- Moisture Analyzer
- DeWin Skin Hydration Tester
- Bluetooth Improve Skin Hydration Sensor and App

References to all of these devices can be found in the References section of this report. These devices are the most relevant to our current idea. The muscle tension and physical activity

applications are not represented in this list as much because there are few to no examples of existing products using these sensors the way we plan on using them. This might be a red flag to let us know that these sensors might not work in the application that we need it to. These issues will be addressed at a later date.

Our device will differ from the devices listed above because we are planning on combining at least two of the four "bad habits" mentioned previously. None of the products above combine more than one health sensor, so we plan on making a device that tackles multiple health concern areas. As a result, we will market this as a "self-care" device that will facilitate the creation of a variety of good habits.

The market research survey also produced very useful results. As shown in Figure 2.1, the majority of individuals surveyed expressed high interest in the product. On this scale, 5 is very interested and 1 is not at all interested. Color represents interest and the numbers on each section represent the number of people.

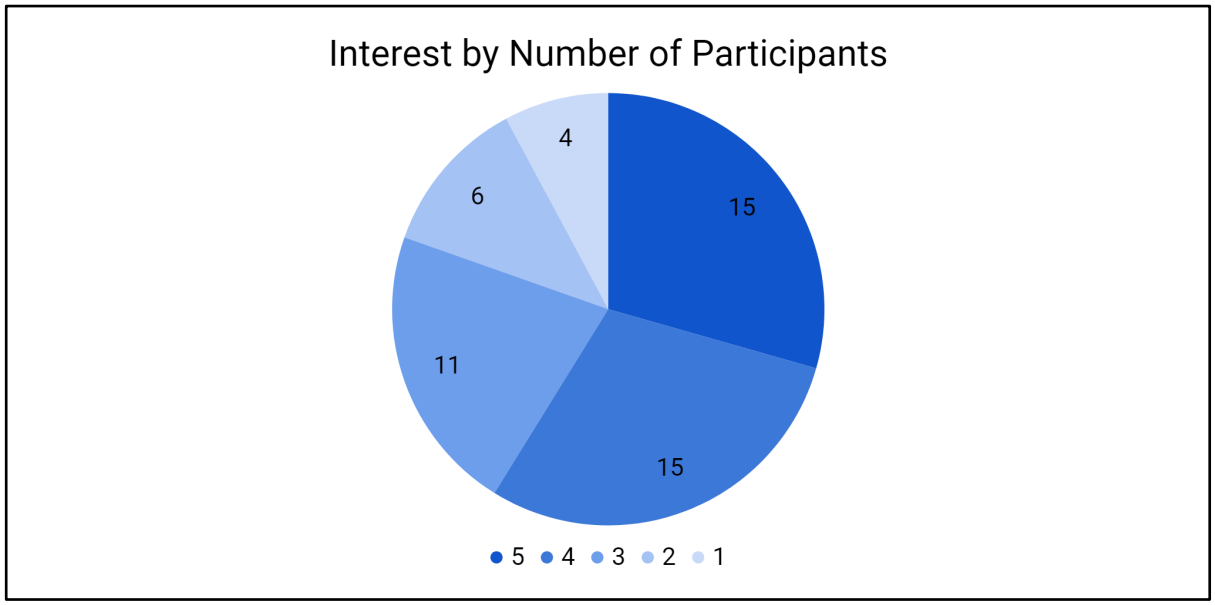

Figure 2.1: Interest Level by Number of Participants

In addition, there is a clear trend between the number of hours spent sitting each day and interest in the product. As shown in Figure 2.2, individuals who spent more time sitting each day expressed greater interest in using the product.

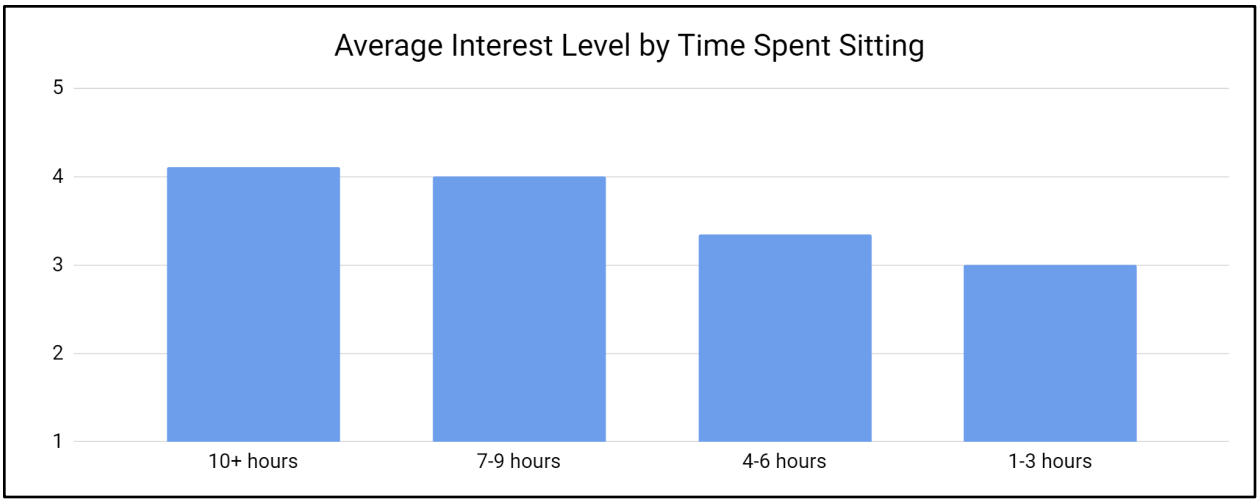

Figure 2.2: Average Interest Level by Time Spent Sitting Per Day

Another important result from the survey was the expected cost of the product. Figures 2.3, 2.4, and 2.5 show what potential users expected to pay for the product based on their interest level. High interest is an interest score of 4–5 out of 5, mid interest is 3 out of 5, and low interest is 1–2 out of 5. These graphs are based on 50 of the 51 responses collected because one respondent did not specify an expected price.

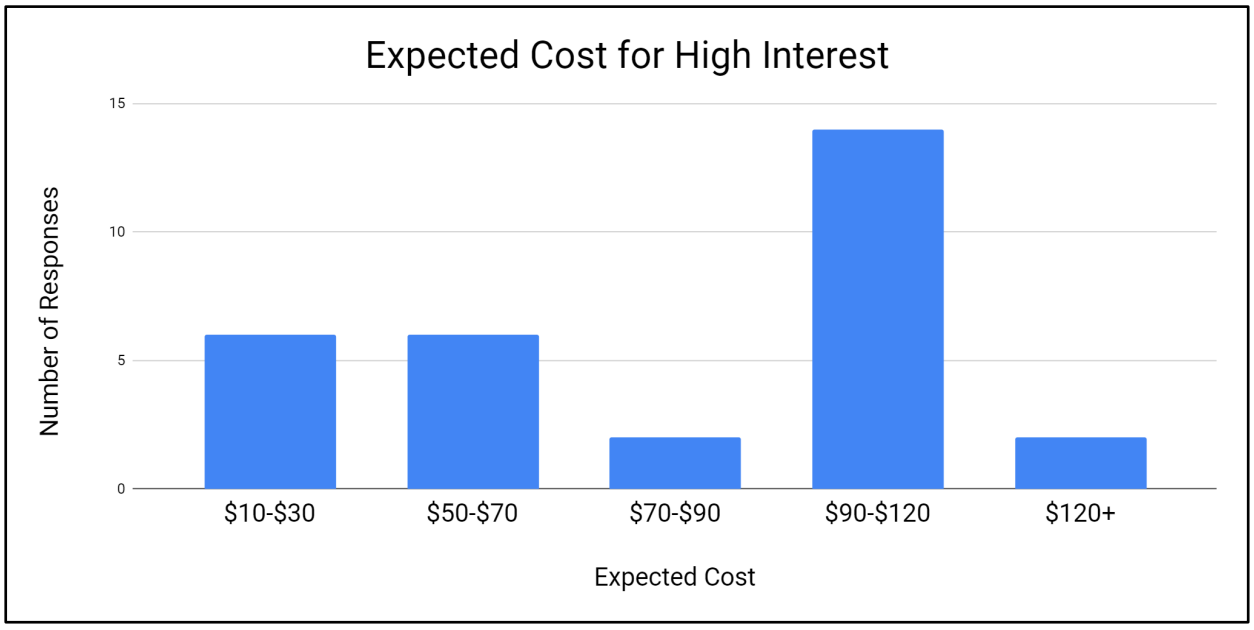

Figure 2.3: Expected Cost for High Interest Individuals

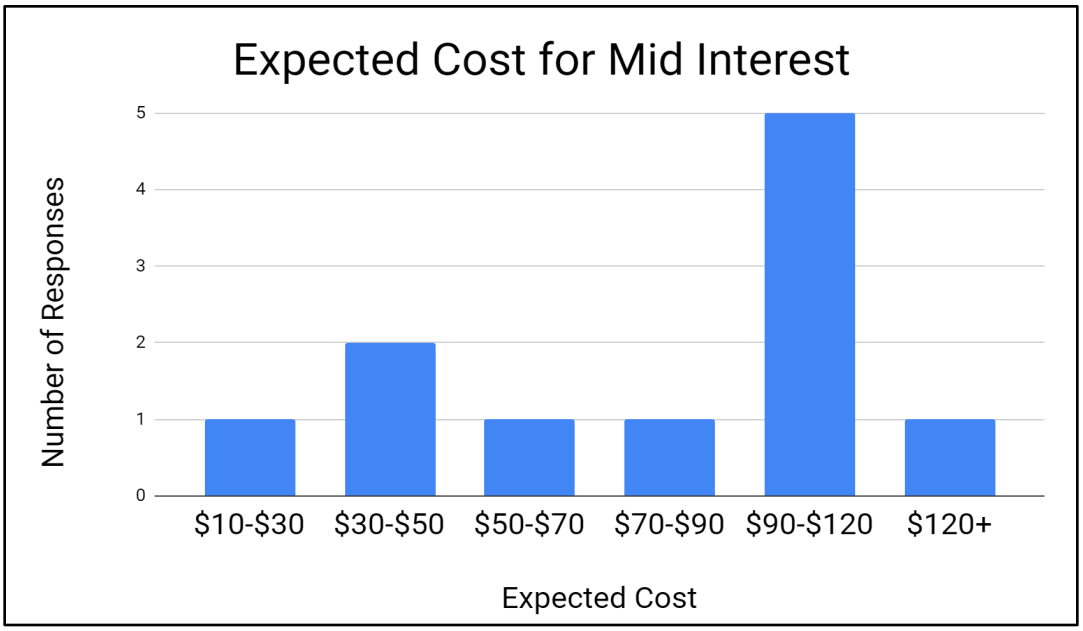

Figure 2.4: Expected Cost for Mid Interest Individuals

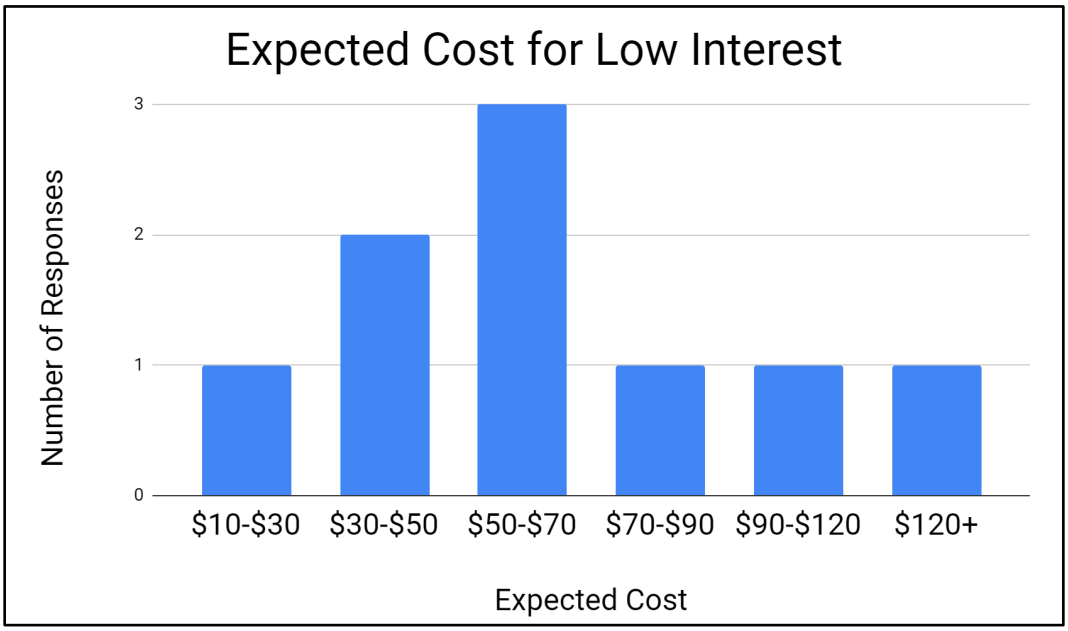

Figure 2.5: Expected Cost for Low Interest Individuals

For mid and high interest individuals, who would be our primary market, the typical expected product cost is $90–$120.

In addition to interest and cost, we also gathered information on customer requirements and preferences. These results will be discussed in section 3 of this report.

2.3 Conclusions

Collectively, the results of our market research have led to the following conclusions.

- The overall interest in this product is fairly high, suggesting that there is a viable market for this product
- The target market of this product consists mainly of individuals who spend a significant amount of time each day sitting
- We did not observe any particular age group or gender to be more interested in the product than others
- $90–$120 would be an appropriate price for the product

3. Customer Requirements

The information derived from our market research not only provided an understanding of the extent of consumer interest for our product, and therefore an indication of whether a market for our device exists, but it also clarified the specifics of what customers are looking for in the product. The following are the customer requirements for our device:

- Durable
- Long lasting battery life
- Cost of approximately $90–$120 (or less)
- Small and compact
- Comfortable
- Aesthetically pleasing
- Lightweight
- Accurate
- Easy to use
- Waterproof

Meeting as many of these requirements as possible should increase customers' desire for and satisfaction with the product.

Besides the explicit requirements mentioned above, there are a few implied specifications that also need to be considered during the product design process. More precisely, the consumer will expect the product to be safe and execute at least one of the proposed functionalities. The main customer requirement in terms of the device's functionality is to help users adjust a number of bad habits (i.e. low physical activity, poor posture, dehydration and muscle tension). Based on the responses to the market research survey, low physical activity and poor posture are the habits customers are most interested in fixing. The functions proposed to fulfill this requirement as well as the other requirements listed above are described analytically in the "Product Requirements" section.

Possible additional features suggested by market research survey responders include the following:

- Heart rate monitor
- Clock functionality (including the ability to set alarms)
- Exercise/activity coaching

These functions are not necessarily required for user satisfaction as they are merely suggestions which could potentially add value to the product. We may consider adding one or more of these features after the core requirements are met, if time and resources allow.

4. Product Requirements

The information gathered from our market research and the feedback from potential customers yielded an extensive list of desirable features. However, not all of them are feasible for the device we have in mind. Based on the project constraints, we have chosen to implement 2 of the 4 core functionalities which were initially proposed—low physical activity and poor posture correction. Even with these two functionalities, our device is currently unique in the market to the best of our knowledge.These were chosen based on the market research survey results. We may choose to implement a third core functionality after the others are complete if time and resources allow. In addition to delivering the core functionalities, there are many other product requirements based on the customer requirements. Listed below are the requirements that will most likely appear in our final prototype.

1. **Accurate sensors to measure posture and low physical activity**

   Accurate sensors are the most important part of this product because without them the device would have no purpose. Additionally, if the sensors are calibrated inaccurately, it could provide incorrect data influencing the customer to perform unhealthy tasks or annoy the customer with an overactive interface.

2. **Total cost of production less than the $90–$120**

   Since the customers require the product to cost somewhere from $90–$120, the cost of production must be less than this in order to make a profit.

3. **Compact, flexible, and comfortable design**

   It is clear from our research that the only way people will use this product is if it is comfortable enough to wear all the time and small/flexible enough so as not to interfere with daily movements.

4. **Long battery life**

   It would be frustrating for a user to have to remove the device and charge it all the time, especially since we want it to be unobtrusively integrated with the user's body in such a way that they almost forget it is there. As a result, a long battery life and hardware requiring little power are very important features.

5. **Durable and waterproof**

   The product needs to be durable so it does not break or wear out quickly. Since the customer will be wearing this device for many hours at a time it should theoretically be able to withstand whatever their bodies would normally be able to withstand. As a result, it would be beneficial to have the device be waterproof or at least water resistant in case they get stuck in the rain or some other unexpected situation occurs where the device gets wet.

6. **Intuitive user interface**

   A well made user interface is a must for any device and for this product we will have both a physical and computerized interface. On the device itself, there will be an on/off switch and a vibrator to notify the user when they need to correct their posture. There will also be a smart phone app that will interface with the device. It is important that the application be intuitive to navigate. Additionally, the data needs to be presented in a way that gives a clear message and provides tips to enhance health based on the sensors' readings.

7. **Aesthetically pleasing design**

Based on the customer requirements, the device should be as aesthetically pleasing as possible. This includes not only the physical design of the device itself, but also the appearance and layout of the connected smart phone application.

Based on all of the product requirements, we would like the final physical device to look similar to the concept art shown in Figure 4.1.

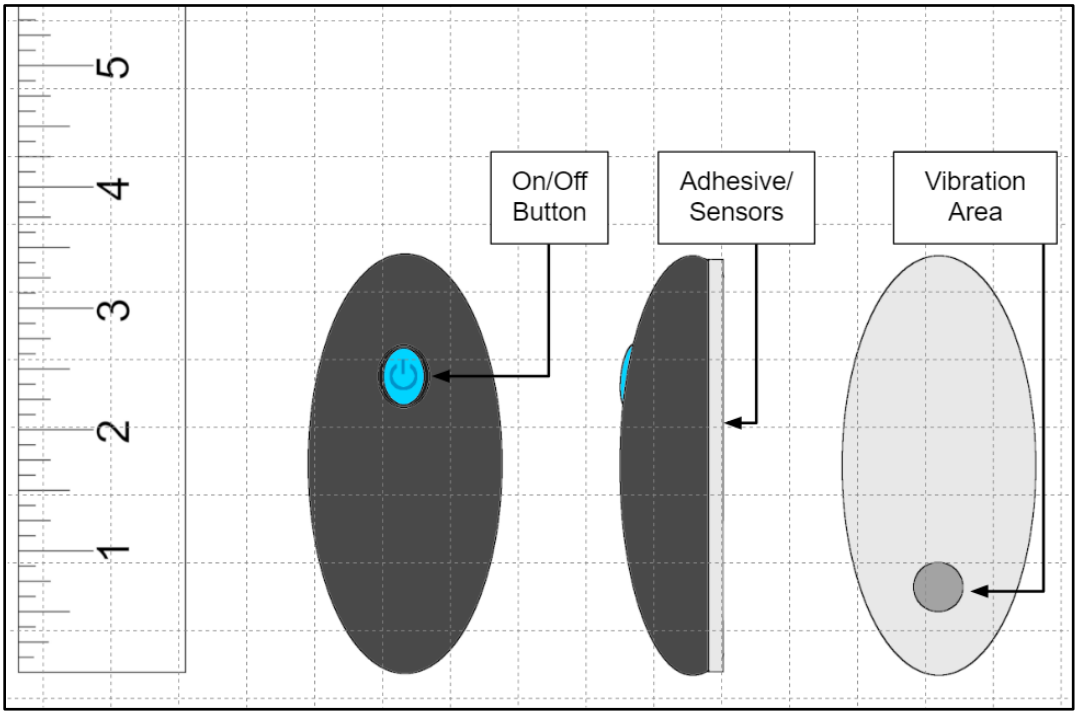

Figure 4.1: Concept Art of Product

Like the physical device, the app will be simple and intuitive. It will include easy-to-read graphs displaying user statistics and progress over time.

5. Product Specifications

The following are the product specifications that were mustered through technical research based on the product requirements:

- ON/OFF Button
- Posture sensor
- Physical Activity Sensor

- Vibrating Motor
- Wireless Transceiver
- Battery
- Microprocessor
- Small Plastic Casing
- Adhesive

One of the customer requirements stated above was making the device easy to use. Therefore, the only direct interaction that will exist between the customer and our device will be one button, which will turn the device on or off. In order to satisfy the requirement regarding the ability and accuracy of measuring posture, we will include a posture sensor, whereas for measuring physical activity we will provide a physical activity sensor. A small plastic casing will be incorporated to satisfy the customer's need concerning compactness and comfortability. Moreover, our device will have low power consumption so it can run longer on existing battery technology and thereby, meet the requirement set by the customers regarding long battery life.

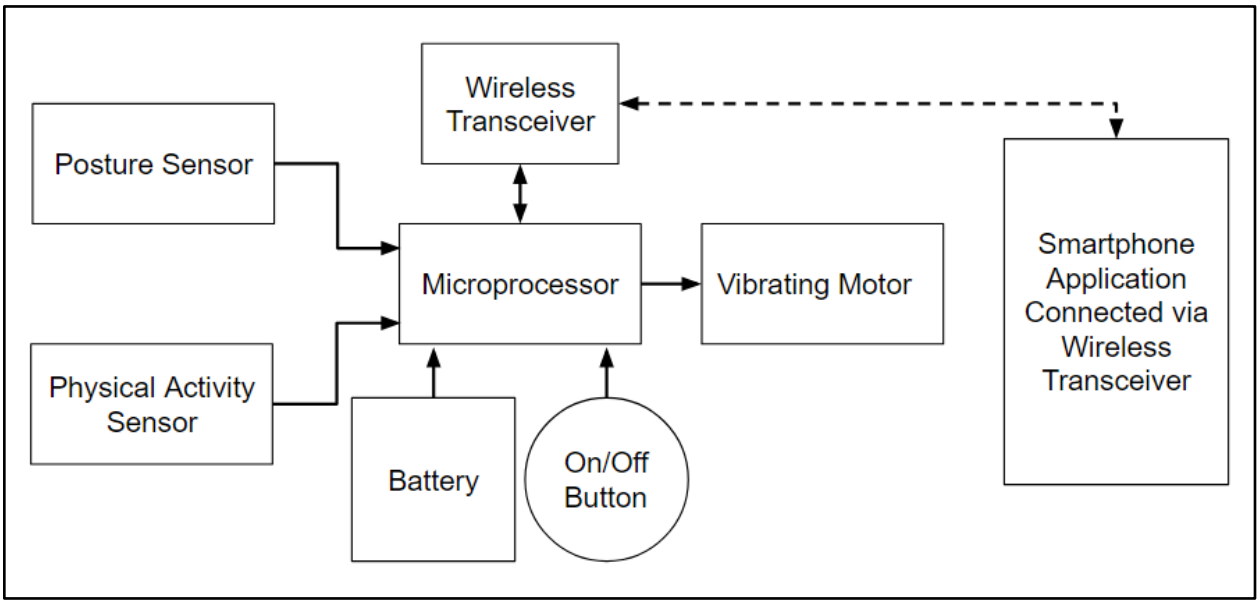

Figure 5.1: Block Diagram of the Product

Each part that belongs in our block diagram (Figure 5.1) performs a discrete functionality that aims to ameliorate the overall customer experience. The microprocessor is the brain of our

system. It is used to process the sensor values the product receives from the posture and the physical activity sensors. Furthermore, it instructs the wireless transceiver and the vibrating motor to perform a specific task. The transceiver is used to transmit information gathered from the system's sensor to the user's phone. More precisely, the data will be sent to the product's phone app where they will be processed, resulting to the display of statistics regarding posture and physical activity. Statistics will be stored with the intent of helping users track their progress. The vibrating motor, acts as a reminder for the users, in order to improve their posture whenever they are slouching. Finally, a battery is used to power up our system.

6. Conclusion

We have accumulated background information on our idea of designing a device that could correct a variety of bad habits. Our design involves a device that is easy to use and consists of at least two sensors feeding information to a microprocessor that integrates with a vibrating motor and communicates with a mobile app. From our market research it is evident that the device must be simple to use, comfortable, and not interfere with clothing or movement. Additionally, the research showed that people are most interested in fixing their posture and increasing their physical activity. As a result, these two factors are going to be the ones we initially address.

From our initial research it appears that some of our prospective sensors are riskier than others. Some combinations of sensors are not viable due to things like the physical location of the device on the body. For example, in order to measure posture the device must have a relatively specific location on the back. This location would not be applicable to measure physical activity with a heart rate monitor because such a signal could not be measured on the back. Additionally, the size and comfortability of our product will be difficult to achieve because the materials available to us have size constraints. We will need to do more research in this area in order to uncover what is available in the microelectronics field.

In order to reduce some risk we are conducting some product research to determine which of the habits we are looking to correct work the best together in terms of sensors. Although our current plan is to implement the two most popular features, posture and low physical activity correction, we may find unexpected challenges with these and need to change which habits we focus on. Based on customer preference for the different functionalities, it is apparent that as long as the device contains at least one of these functions the customers will be sufficiently satisfied

with the product. The desirability of each of the four bad habits were so close that we have the freedom to change our minds about which sensors we use based on the risk each one presents when we start prototyping.

Another possible risk in relation to the sensors is that the device does not work accurately enough. It is very important that our sensors are very accurate because the problem we are trying to solve relies on good data. As a result, we will choose the sensors the will give us the most accurate data in the location of choice.

Finally, due to time and money our prototype might not be as small as it could be with a custom integrated circuit. What we might do is conduct the critical research, synthesis, and analysis for making the final salable product, but not purchase the physical components.

Appendix A -- Customer Survey Questions

1. How old are you?
2. Gender
    a. Female
    b. Male
    c. Other
    d. Prefer Not to say
3. Approximately how many hours a day do you spend sitting?
    a. 1-3 hours
    b. 4-6 hours
    c. 7-9 hours
    d. 10+ hours
4. Do you own wearable technology (such as a FitBit, etc.)?
5. How interested would you be in this product?
6. What habits would you be interested in correcting?
    a. Poor Posture
    b. Muscle Tension
    c. Dehydration
    d. Low Physical Activity
    e. Other
7. Are there any other features you would like to see on such a device?
8. Is there any reason you would not use a device like this?
9. How much do you expect this product to cost?
    a. $10-$30
    b. $30-$50
    c. $50-$70
    d. $70-$90
    e. $90-$120
    f. $120+

References

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"Posture Corrector for Women, Adjustable Back Posture Corrector for Men, Effective Comfortable Best Back Brace for Posture under Clothes, Back Support Posture Brace for Shoulder and Back Pain Relief," *Amazon*. [Online].

"Posture Corrector for Women, Adjustable Back Posture Corrector for Men, Effective Comfortable Best Back Brace for Posture under Clothes, Back Support Posture Brace for Shoulder and Back Pain Relief," *Amazon*. [Online].

"Upright GO Posture Trainer and Corrector for Back | Strapless, Discrete, Easy to Use | Complete with App and Training Plan | Back Health Benefits and Confidence Builder | Improved Posture in No Time," *Amazon*. [Online].

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