

Continuous Monitoring of Asthma Control

Preliminary Product Design Specifications

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Date: Friday, September 23rd, 2016

Function:

The function of our product will be to continuously monitor asthma patients. Oftentimes, patients who undergo asthma exacerbations do not notice the effects under two days after they have started. For example, FEV1 (forced expiratory volume in one second) oftentimes drops 20% before the patient realizes any change. Our product will be able to detect these changes and alert the patient to start their asthma action plan (AAP) and hopefully prevent emergency medical attention.

Client requirements:

- The client does not want use to try and tackle the entire “asthma shirt” but rather start on just part of it
- The first focus of the project is to design a device to monitor lung sounds (breathing, coughing, wheezing, etc.)
- The client suggested using a stethoscope inspired microphone system to capture the sounds, but the team will explore other options as well.
- The sound acquisition device will most likely need to be set up to an arduino and probably a complementary circuit system.
- There are not any “thresholds” or previously determined measurements for this type of data, so we will have to try and figure those out on our own
- The primary focus for this semester is not to necessarily have a complete, finished product by the end, but rather prove that this type of work is really plausible.

Physical and Operational Characteristics

a. *Performance requirements:* The microphone must accurately detect sound differences in asthma symptoms such as wheezing and coughing. Typical FEV1 will drop almost 20% before symptoms are felt by the patient. Our microphone will detect these symptoms before the patient’s FEV1 drops to this level.

b. Safety: Safety is not huge concern with this device because there is very low potential for danger. The only safety concern for this will be ensuring that the microphone's circuit does not short, and cause any harm to the patient that is using it.

c. Accuracy and Reliability: The microphone must accurately detect the changes in sound of these asthma symptoms while maintaining a consistent threshold for detection. It must also not interpret outside noise as a false asthma symptom.

d. Life in Service: Due to the fact that this is continuous monitoring of asthma symptoms, there will be no limit on the microphones life in service. It will only end if there is another technology that is more effective than this microphone.

e. Shelf Life: Preferably the product wouldn't be affected by sitting around not being used since there is no organic material on it to spoil. It should mostly consist of polymers and rubber for the microphone.

f. Operating Environment: The device will have to be able to operate smoothly while being on or near the skin. This means it should be water resistant up to the point of being considered sweat proof.

G. Ergonomics: The device needs to be able to fit comfortably against the skin so as not to be uncomfortable.

H. Size: The size of the device doesn't matter as much as proof of concept at this point in the design process.

I. Weight: The main concern is that the patient will be able to wear the shirt. This means that the product will need to be light enough to wear without much discomfort. Our focus is on data collection so the weight will be addressed later.

J. Materials: Since the microphones will be placed against the skin, they must be sweat and water resistant.

K. Aesthetics, Appearance, and Finish: The primary goal is functionality. Aesthetics will only be addressed as a concern at the end of the project if there is time.

Production Characteristics

a. Quantity: We will need to develop the recording system for one shirt. This design will likely incorporate 2 microphones.

b. Target Product Cost: Currently, there are no similar products like the one we are working on in which to compare the expected cost. There was a group who worked on this project last year and were able to develop a similar shirt for just under \$300. We were not given an explicit budget during our first client meeting, but we hope to keep a similar or lower cost than the previous group.

Miscellaneous

- a. *Standards and Specifications: As of now this product will not need FDA approval but if it is implemented in the future for diagnosis it will.*
- b. *Customer: As of now our customer wants us to just focus on the microphone. Our customer does not mind if outside noise is picked up by the microphone, as long as a good 10-15 minute period of lung sounds can be heard in a 24 hour period. The microphone must be able to distinguish between wheezing and normal lung sounds. It must also be able to send this information to an arduino to be saved and used for analysis.*
- c. *Patient-related concerns: If the microphone in the shirt can not filter out outside noises the patient may worry about their privacy. There will have to be a system implemented so the patient's privacy may be protected. Another concern will be on how to properly wash the shirt. The patient most likely will not want to wear the same shirt all the time.*
- d. *Competition: As of now there are no similar items that exist. The closest thing is wearable technology like fitbits and hexoskin shirts but those have nothing to do with asthma.*