CONTINUOUS MONITORING OF ASTHMA CONTROL

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ABSTRACT

This project entails creating an efficient and accurate method of continuously monitoring asthma symptoms in severe asthmatic patients. Currently, the symptoms of an asthma exacerbation are not sensed by the patient until days after the exacerbation has begun. Delayed diagnosis of an exacerbation results in a delayed start to the patient's asthma action plan (AAP). This can mean extra trips to the clinic or hospital for something that was treatable at home only a few days prior. The implementation of a continuous asthma monitoring shirt will alert patients to begin their AAP before needing to make unnecessary trips to the hospital, thus saving a large portion of hospital resources that are being used on asthma related visits. Last semester, the team was able to create a working microphone that was able to distinguish between normal speaking and coughing. Now, the team has focused on expanding the system to two redesigned microphones incorporated into a chest band that are able to accurately distinguish between normal speaking and coughing using frequency ranges. This diagnostic technique can further be used to find each patient's unique range, and can also be expanded for different asthma symptoms, such as wheezing.

INTRODUCTION

Background:

- Chronic disease where bronchioles constricts
- Inflammation and mucus buildup [1], [2]
- Coughing, wheezing, shortness of breath, and chest tightness
- Increase in all asthma patients [3]
- Current methods:
  - *Spirometer*
  - *Stethoscopes*

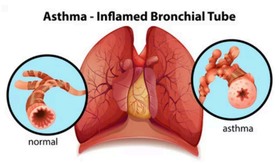

Figure 1: Normal vs Asthmatic airways

Motivation:

- 26 million people, $60 billion annually in the US [4]
- Top 10% have worse, more intense and frequent symptoms; Account for disproportionate amount of costs, hospital admissions, & emergency services [3]
- Symptoms might not be felt for up to 2 days-- can take up to a month to return to normal lung function
- The previous device contained one microphone and was not wearable

DESIGN CRITERIA

Performance:

- Make smaller, less bulky, and more ergonomic
- Use two microphones, make device wearable

Accuracy:

- Precisely collect lung sound data
- Distinguish from talking, movement, and ambient noise
- Determine frequency ranges for each sound

FINAL DESIGN

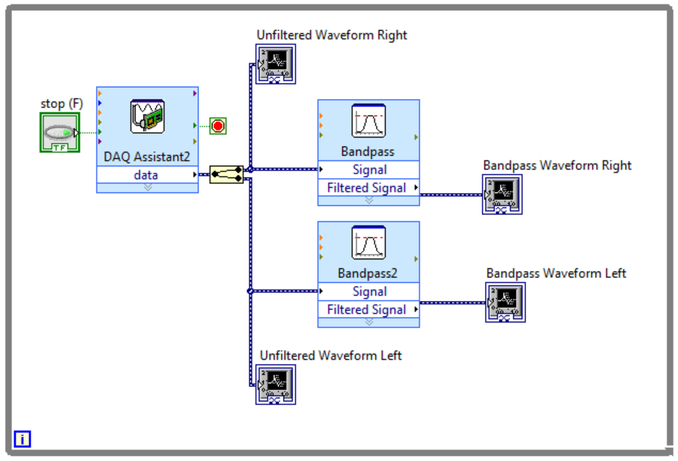

Figure 2: Block Diagram for displaying the real time output of the filtered and unfiltered from both the left and right microphones

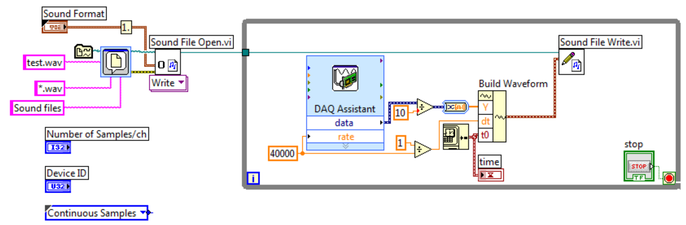

Figure 3: Block Diagram for writing a .wav file with output from the microphone system

RESULTS

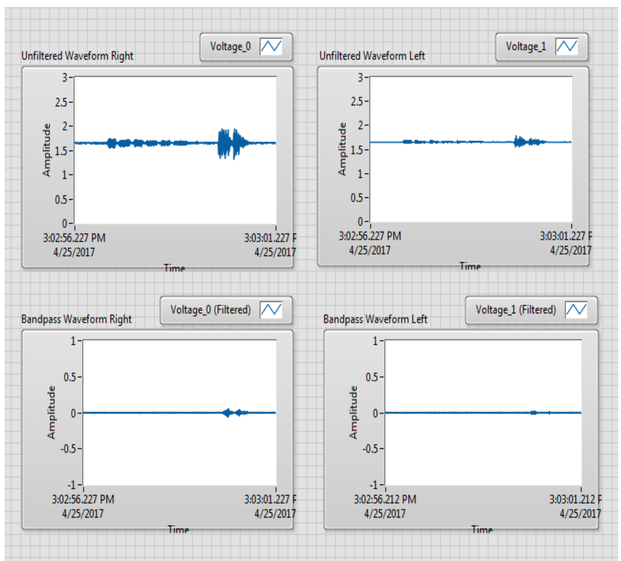

Figure 4: Front Panel from the block diagram in Figure 2. Showing the filtered and unfiltered outputs while the test subject is talking and coughing

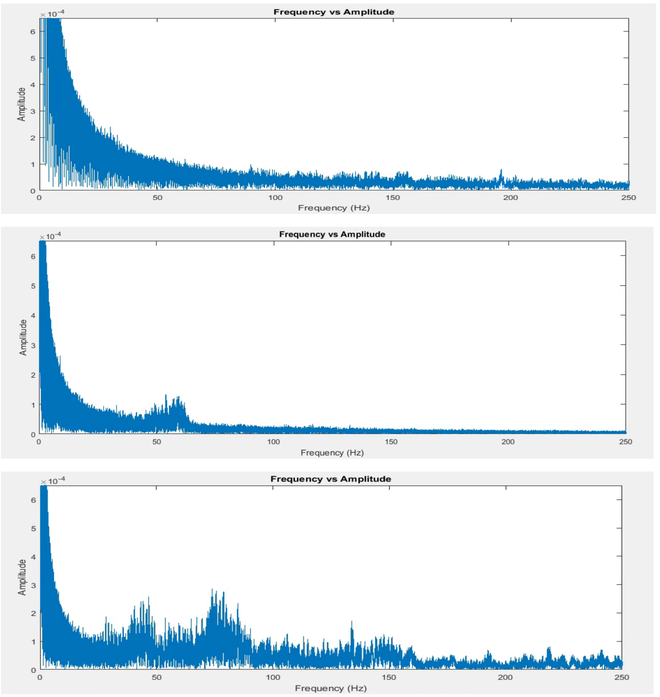

Figure 5: These graphs displays frequency results collected from a subject during breathing, talking, and coughing from top to bottom

FUTURE WORK

- Repeat the process to isolate and detect wheezing
- Test the device on asthmatics using the IRB protocol
- Integrate device into a shirt that can be worn long term
- Use Bluetooth for wireless monitoring, 24/7 monitoring
- Add resistor bands to measure lung volume/ function

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[2] Kim, Harold, Mazza, Jorge, (Nov 2011). Allergy, Asthma, and Clinical Immunology. Available: https://aacijournal.biomedcentral.com/articles/10.1186/1710-1492-7-S1-S2
[3] S Holgate and R Polosa MD. (2006, Aug 26). The Mechanisms, Diagnosis, and Management of Severe Asthma in Adults [Online]. Available: http://www.sciencedirect.com/science/article/pii/S014067360669288X
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