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. These asthma exacerbations are typically only diagnosed in clinic, which results in a delayed start to the patient's asthma action plan (AAP). 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. Our team decided to focus on creating one functioning microphone with the ability to distinguish between normal speaking, coughing, and wheezing . Previous attempts have been made to detect these asthma symptoms by introducing multiple microphones directly into a shirt, but problems with interference were encountered due to the numerous elements. These previous attempts resulted in no useable data for future teams to build on. Our team decided to focus on developing a single microphone in order to obtain accurate data that can be built upon as the design progresses.

INTRODUCTION

Background:

- Trachea, bronchus, bronchioles, alveoli
- Inflammation and mucus buildup[1,2]
- Coughing, wheezing, shortness of breath, and chest tightness
- Increase in all asthma patients[3]
- Current methods:
  - *Respirometer*
  - *Thermistor mask*
  - *Stethoscopes*

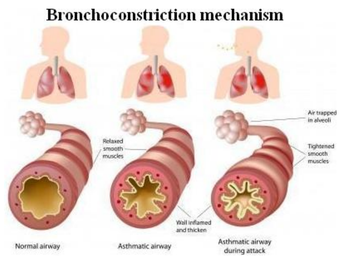

Figure 1: Bronchiole Constriction

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 "Asthma shirt" could not generate usable data--too much interference/ noise

DESIGN CRITERIA

Performance:

- Focus in on one aspect of the shirt
- Listen to lung sounds: coughing, wheezing, respiratory rate; able to distinguish between them accurately
- Be able to collect data for 4 hours

Accuracy:

- Must give precise, reliable data
- Must be able to distinguish between lung sounds and outside noise

FINAL DESIGN

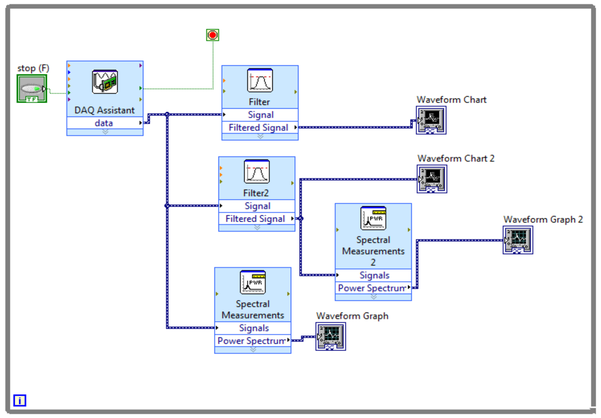

Figure 2: Block Diagram used in LabVIEW to capture the breathing signal

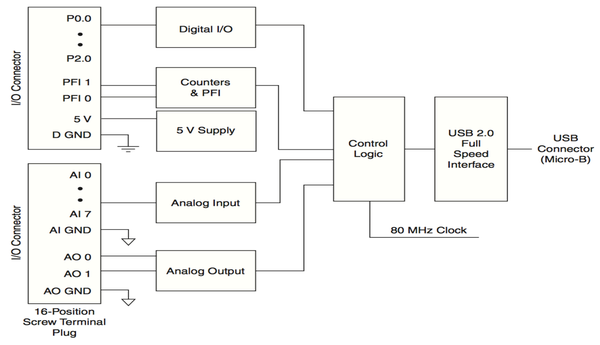

Figure 3: Block Diagram of the NI USB - 6002

RESULTS

Front Panel: Normal Breathing Output

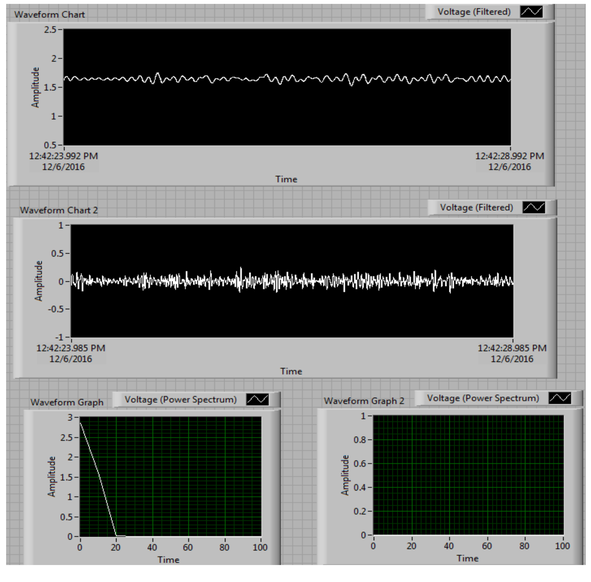

Figure 4: Front Panel display of the output for voltage in the top graphs and frequency in the bottom charts for normal breathing

Front Panel: Coughing Output

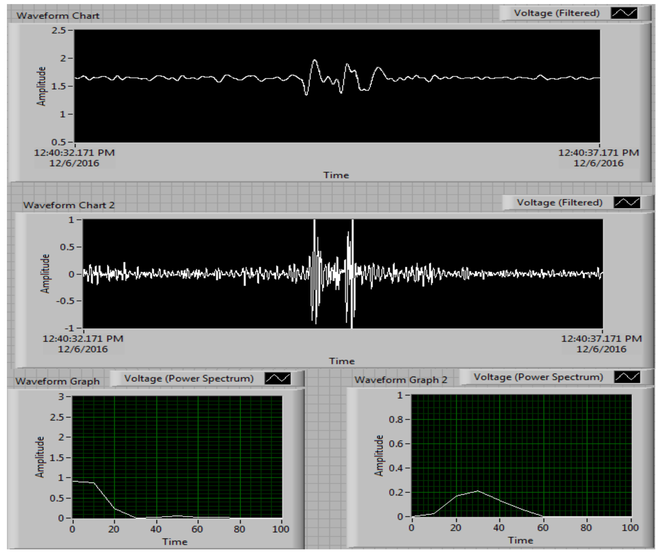

Figure 5: Front Panel display of the output for voltage in the top graphs and frequency in the bottom charts for coughing

FUTURE WORK

- Integrate two microphones into a wearable "asthma shirt"
- Test the device on asthmatics using the IRB protocol
- Create a device with 24/7 monitoring, use Bluetooth for wireless monitoring
- Make device smaller, more comfortable for the patient
- Add resistor bands to measure lung volume/ function

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