WheezeSense Algorithm – Home Monitoring Device for Pediatric Asthma
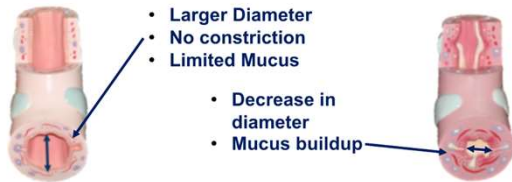
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Problem

- Asthma affects over **6.1 million children** and is the **third leading cause** in hospitalization
- 83,200 ED visits from an asthma attack or episode are **"potentially preventable"**
- A **key symptom** of asthma is **wheezing** caused by mucus buildup and narrowing of bronchial tubes

- Larger Diameter
- No constriction
- Limited Mucus

- Decrease in diameter
- Mucus buildup

Normal Breathing: 100-1000Hz, 10dB   Wheezing: 250-500 Hz, 18.9dB

Objective: Given a sound input, WheezeSense will detect the **onset of asthma** through the **sound of wheezing** using a **wheeze detection algorithm** created by the team.
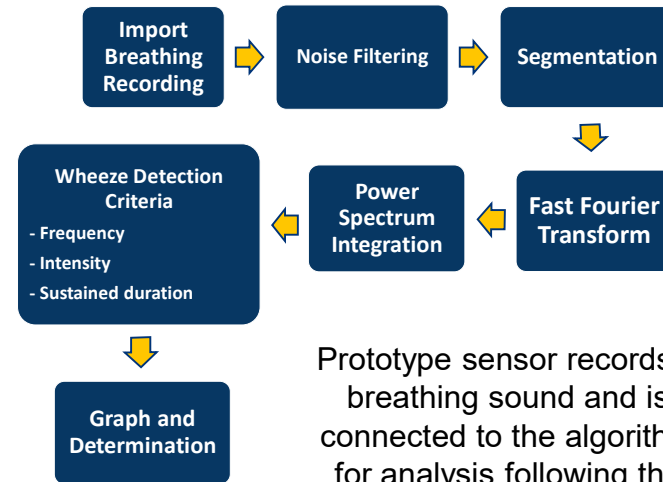
Solution Design

Import Breathing Recording → Noise Filtering → Segmentation

Wheeze Detection Criteria
- Frequency
- Intensity
- Sustained duration

← Power Spectrum Integration ← Fast Fourier Transform

Graph and Determination

Prototype sensor records a breathing sound and is connected to the algorithm for analysis following the solution pathway

Testing

Tests in Simulation Lab

– Newborn & Toddler manikins programmed to simulate wheezing

– Operator chooses manikin conditions unknown to team and will confirm or deny determination

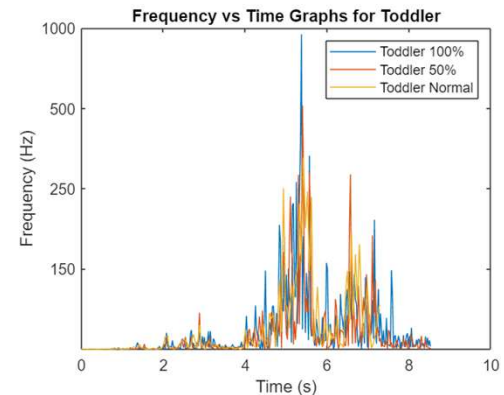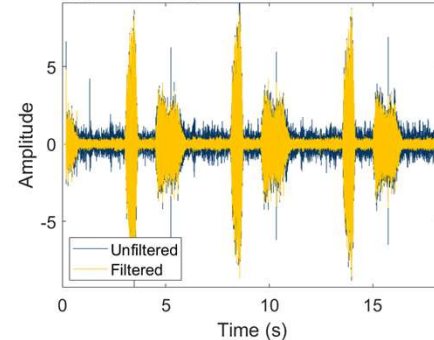| Requirement	Met: Y/N/TBD
R1 – Code outputs graph with determination of healthy or wheezing	Y
R2 – Algorithm filters <150 & >1000 Hz	Y
R3 – The sensor taking in sound input and creates an audio recording	Y
R4 – False positive rate ≤ 10%	Y

Results & Impact

Toddler Wheezing Audio Unfiltered and Filtered

Frequency vs Time Graphs for Toddler
- Toddler 100%
- Toddler 50%
- Toddler Normal

Parents/Caregivers: Gives parents peace of mind and helps to provide knowledge for when to administer medication or go to the ED.

Doctors/Health Care Professionals: Provides comprehensive patient history based on recorded wheeze data.

Insurance/Monetary Value: Saves money by eliminating preventable ED visits.