SoundMedicine: A Portable, Smartphone-Based Pneumonia Diagnostic Device

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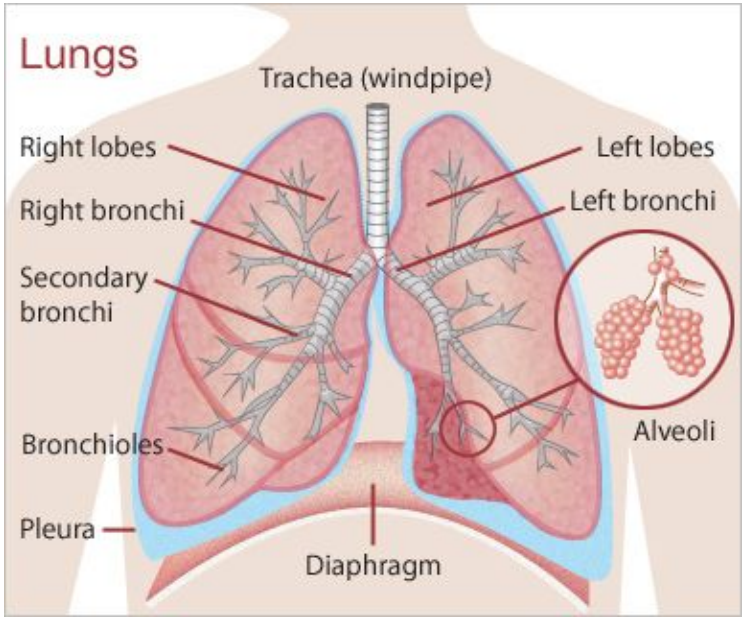
Major Problem: Pneumonia

- Lung Infection
  - fluid in lungs
- 200 million viral cases annually
  - 100 million in children
  - 100 million in adults
- Responsible for deaths in developed and developing countries
- 16% all deaths - children under 5
  - largest cause of child death worldwide
  - significant effect on elderly (65+)



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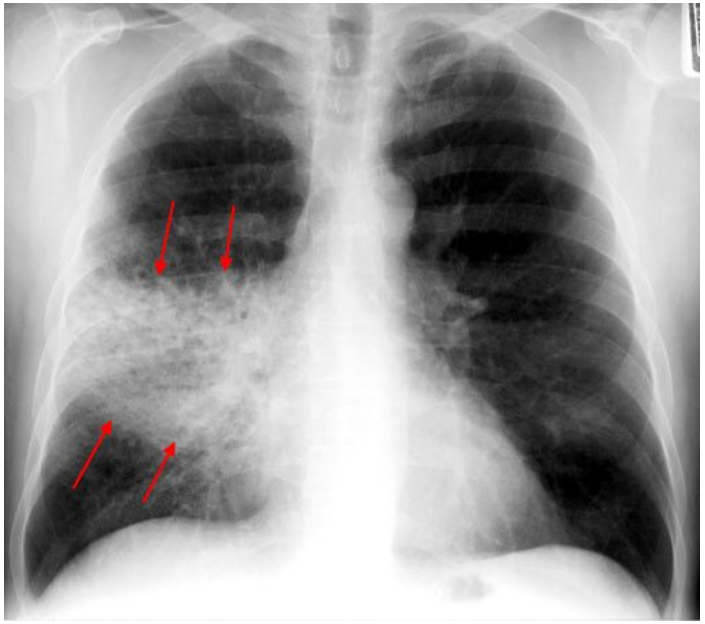
Major Problem: Pneumonia

Preventable and treatable but…

- Expensive diagnosis
- Often mistaken for the common cold
- Low resource, developing countries have:
  - limited access to preventative measures (vaccines, etc.)
  - limited access to treatment



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Aims

Aim 1: Design and build a Sound capturing module

Aim 2: Develop an application to process auditory information and display results/recommendations

Aim 3: Incorporate a method of delivering diagnostic information to a physician

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Particular Problem: Accessibility and Affordability

- Standard procedure includes
  - X-Rays, doctor visits, etc.
  - Expensive
  - Requires a lot of maintenance and training
- Decreases accessibility for proper diagnosis and treatment
  - Drives up mortality rate
- Solution: affordable, portable diagnostic
- Takes advantage of current/popular technology

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Approach: Sound Capturing Module

- Research phone popularity & specs (dimensions, microphone location)
- Create designs - CAD
- Prototype/Test designs, materials
  - 3D Printing
  - Contact manufacturers

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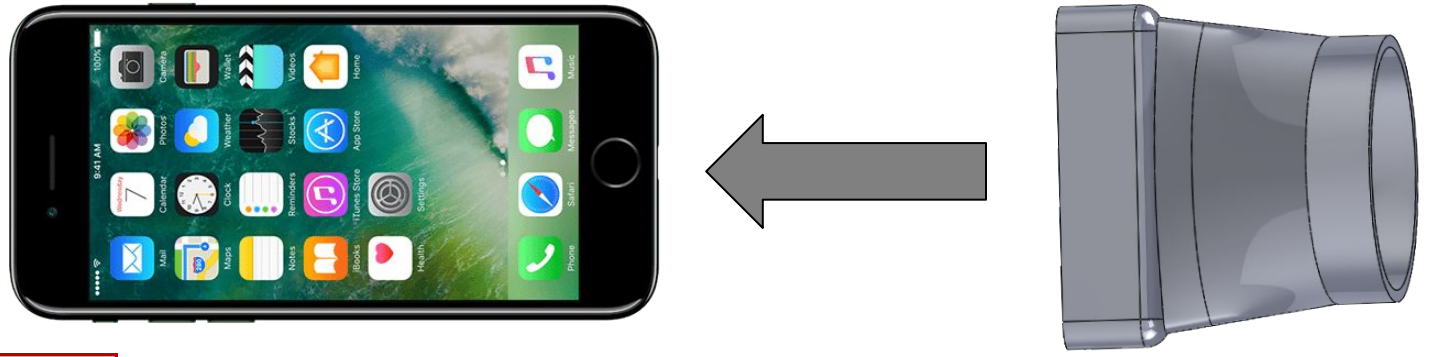
Functional Requirements

The Sound Capturing Module

- Adaptable to multiple smartphones
- Acquire lung sounds ranging from 60 Hz - 2,000 Hz
- Elastic and durable material
- Inexpensive to manufacture
- High Signal to Noise Ratio



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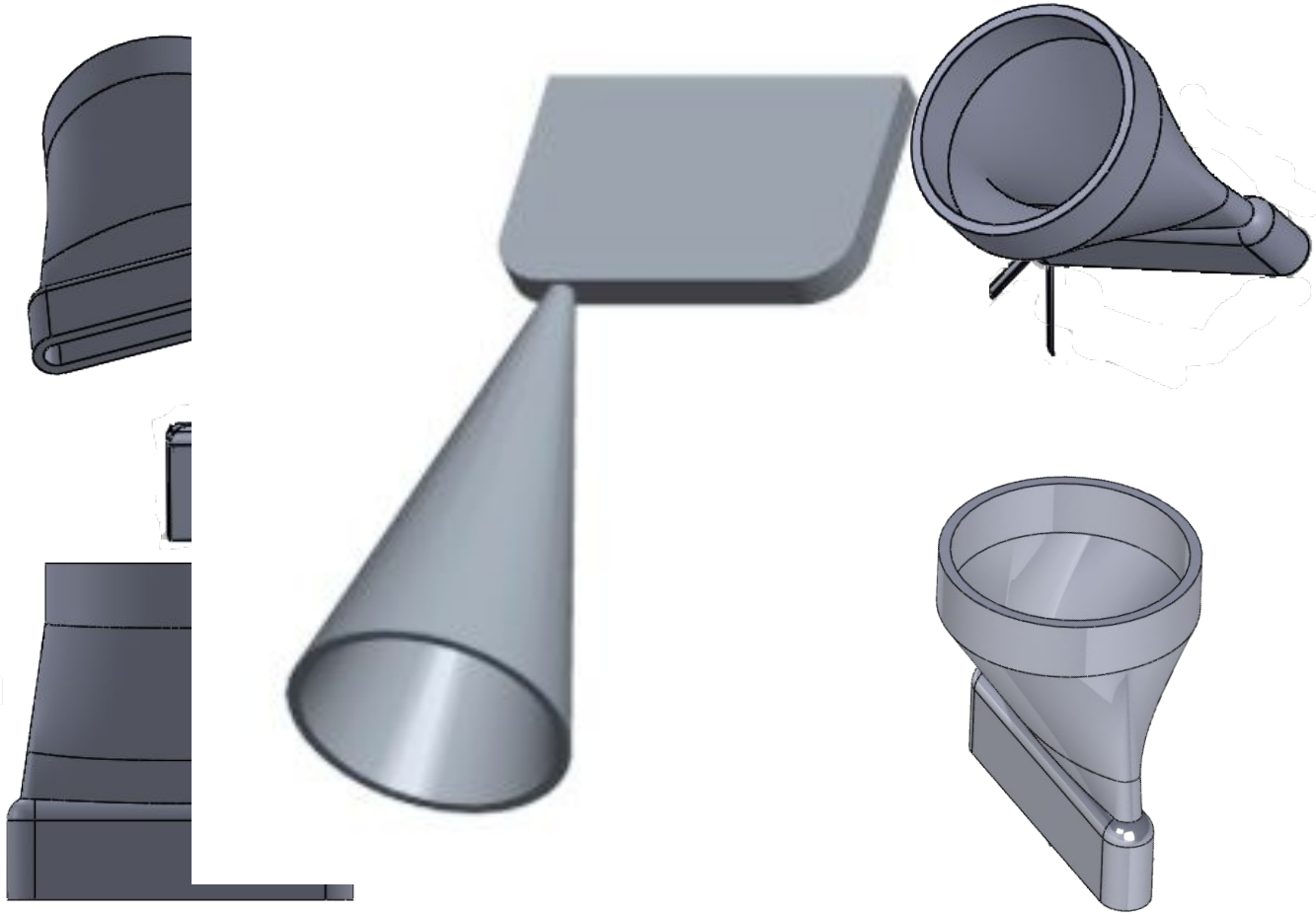
Evolution of Prototype



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Approach: Smartphone Application

- Develop code for sound processing and packaging
- Develop user interface to instruct user, display results/data
- Send data with a provided email

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Functional Requirements

The Application

- Four main functions:
  - Record accelerometer and audio data
  - Filter the audio data to reduce noise
  - Package all the data into a single wav-file
  - Email collected data

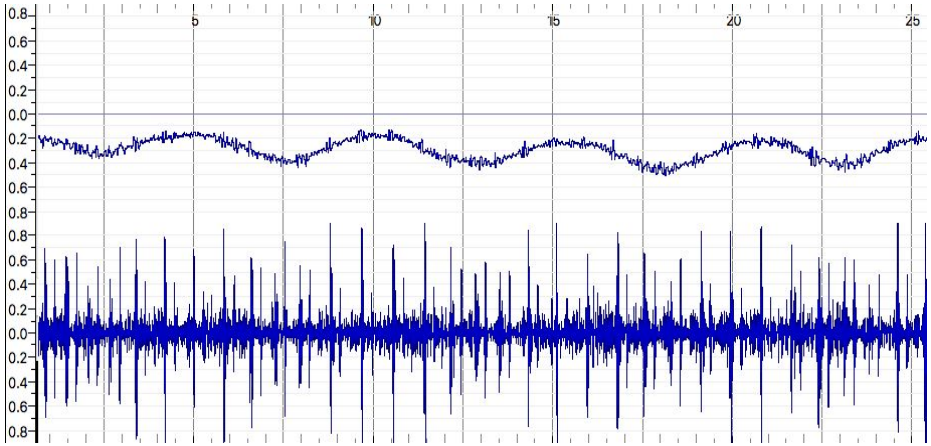

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Image created using Sonic Visualizer (app)

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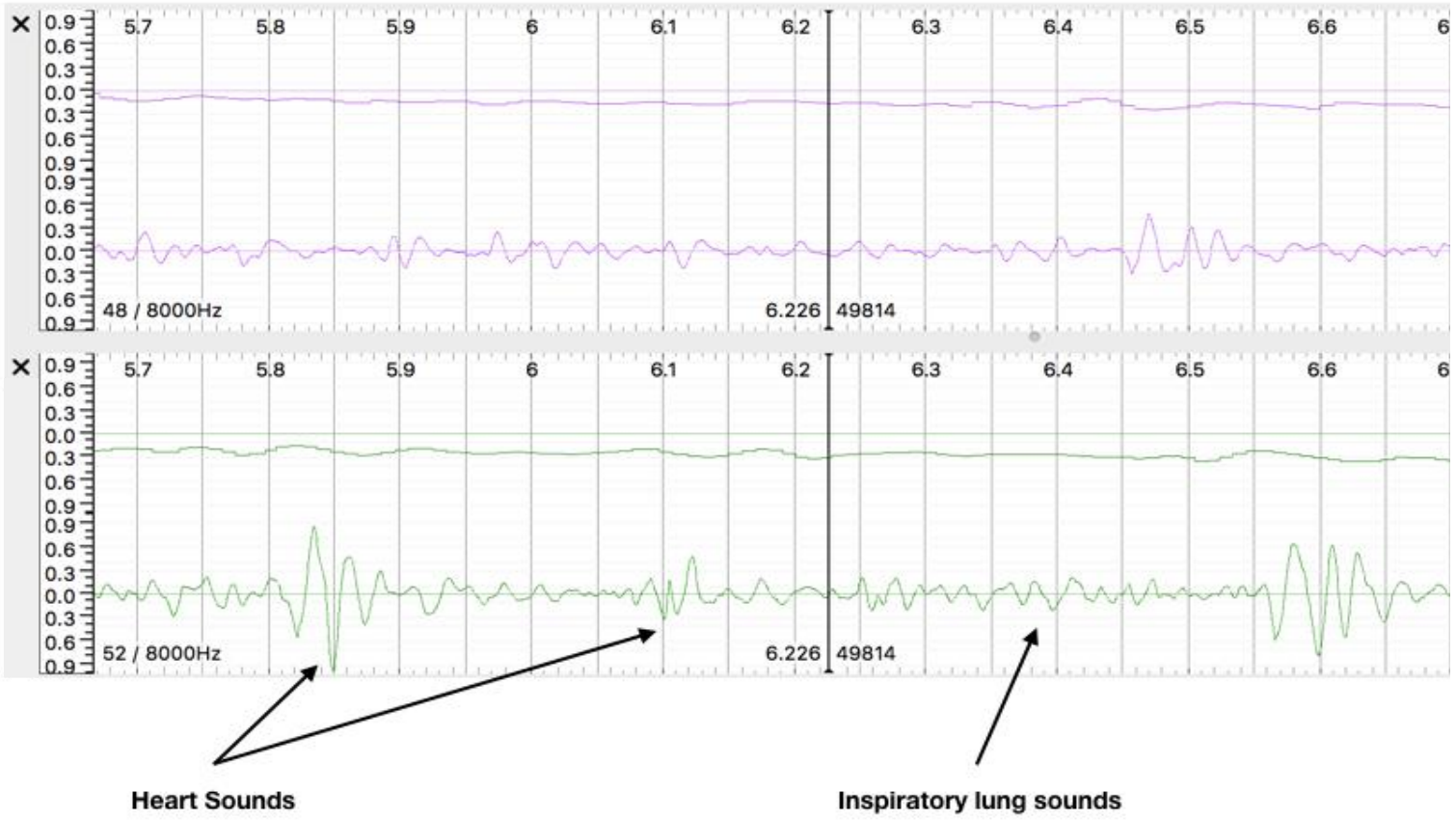
Audio recording at Maximum Inspiration

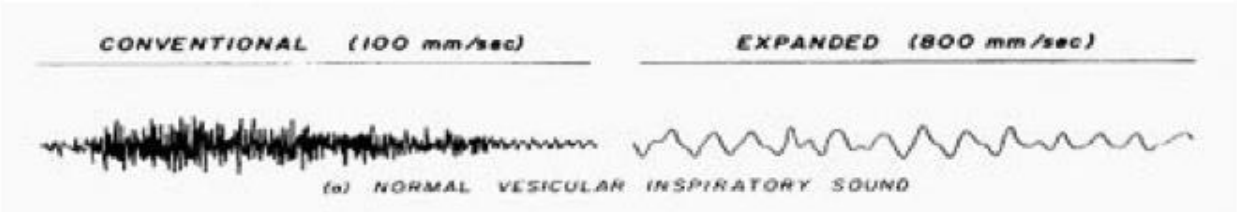
Without Bell:

Difficult to distinguish heart and lung counts

With Bell:

Heart and lung sounds are easily distinguishable





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images from, sonic visualizer (app), stethographics.com

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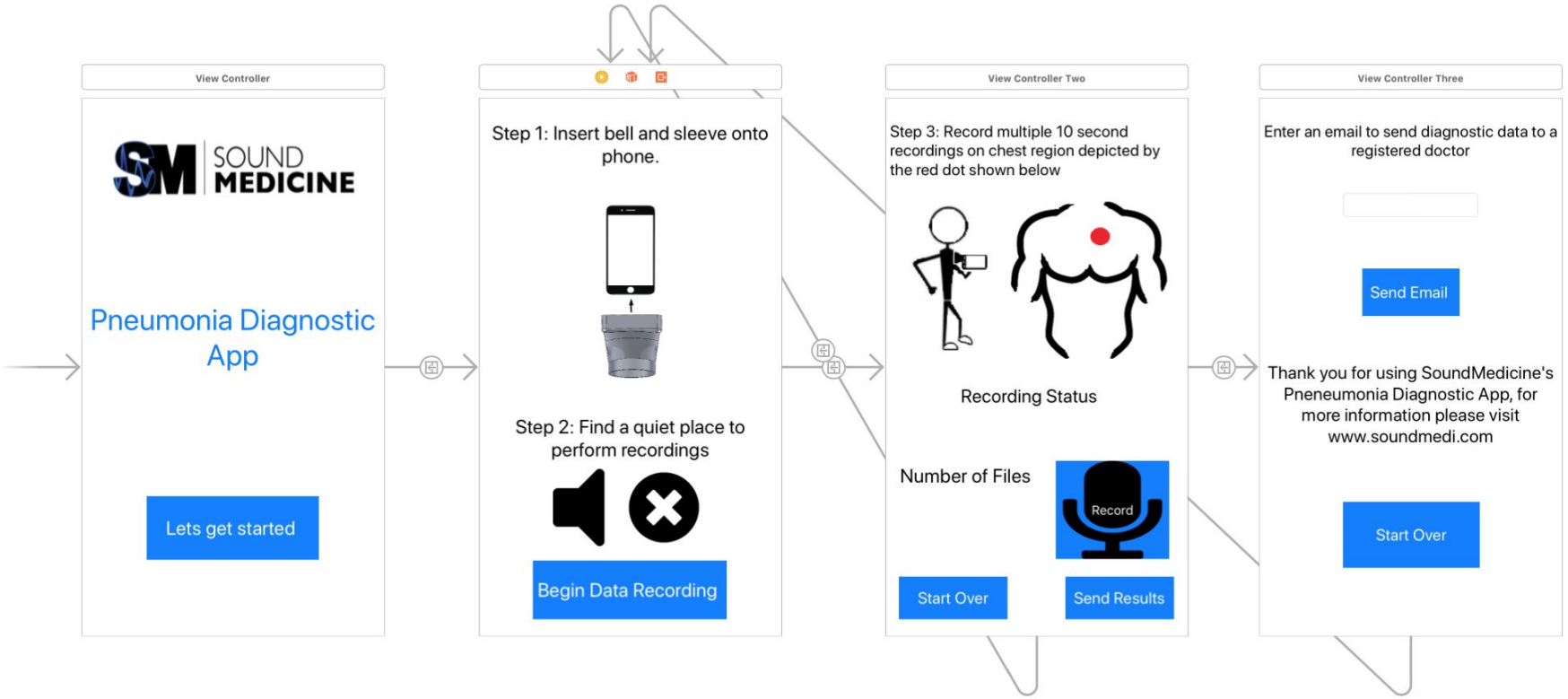
User Interface



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