Sleep Apnea Detection Device

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Sleep Apnea Description

- Defined as an episode where breathing ceases for at least 10 seconds while asleep
- Often occurs in obese patients
- Higher risk after anesthesia
- Effects >18 Million Patients
- Causes cerebral hypoxia
  - Damages memory centers in the brain
Primary Objective

- Develop a device that detects moderate to severe sleep apnea and promptly alerts the patient and nurse.
Performance Criteria

- Stand alone system, does not require external apparatus
- No False Positives or false negatives
- Comfortable
  - Light weight
  - No mask
- Cheaper than current products
- Immediate alert
Experiment Block Diagram

- Pathway to alert

Characterize Sleep Apnea ➔ Isolate Respiration ➔ Detect Tracheal Sounds ➔ Monitor Breathing Rate ➔ Detection of Apnea ➔ Alert
Solution Description

- An inexpensive, acoustic apnea detector attached above the suprasternal notch by medical adhesive
- Instantaneous alert system activated upon detection
Solution Specifics

- The device will consist of:
  - A air coupled microphone on the bottom to detect tracheal sounds
  - Internal water resistant circuitry and battery
    - To keep the device from shorting out
  - A speaker for alerting the patient
  - LED status lights
Factors

- Comfort of Patient
  - Minimized Weight
  - Minimized Size

- Filters extraneous noise
  - Reduce false positives and negatives

- Low cost
  - Possibly disposable
Collected Data

Background Noise

Tracheal Breath Sound
Cost Analysis

- Microphone .................................. $ 4.00
- Air Coupling Chamber ........... $ 5.00?
- Circuitry, Processor ............... $40.00?
- Alarm ........................................ $ 4.00
- Battery ........................................ $ 2.00?

$ 55.00
Past Work

- Researched and found microphone and speaker
- Found adhesive for attaching device to body
- Constructed of microphone system using stethoscope
- Found literature on target breath frequency range
- Analyzed frequency content of respiration
Current Work:

- Designing bandpass filter based on frequency content
- Designing processor for alarm system
- Powering the apparatus
The Recording Device
Future Work

- Construct a bandpass filter for circuit
- Find circuit components
- Order processor
- Construct air-coupled amplifier
Validation

- Compare measured tracheal frequencies with those found in literature

Fig. 1. Illustration of frequency-based features on PSD.

(Golabbakhsh, M, 2004)
Validation (continued)

- Compare frequencies across multiple microphones
  - Build identical recording devices
- Test variability of frequency with body mass
  - Determine how body mass affects detection
References


