

Sensors + Monitoring = Care Anywhere

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Overview

- One-Time Interventions
 - Costly and incomplete Solutions
- Sensors and ubiquitous measurement
 - Better for Screening and Monitoring Chronic Conditions
- Project 1
 - Ambulatory Gait Analysis of Falls Risk
- Project 2
 - Fingertip Assessment of Sleep Apnea at Home
- Conclusions

One Time Interventions



Heroic vs. Stoic Healthcare

- Healthcare systems designed for heroic life saving interventions are not well suited to managing chronic conditions
- Improving Lives is just as important as saving Lives
- Much of future healthcare will make poor television viewing
- Continuous monitoring of health status is boring but essential
- Not just vital signs but monitoring for specific conditions
- E.g., falls risk and sleep apnea

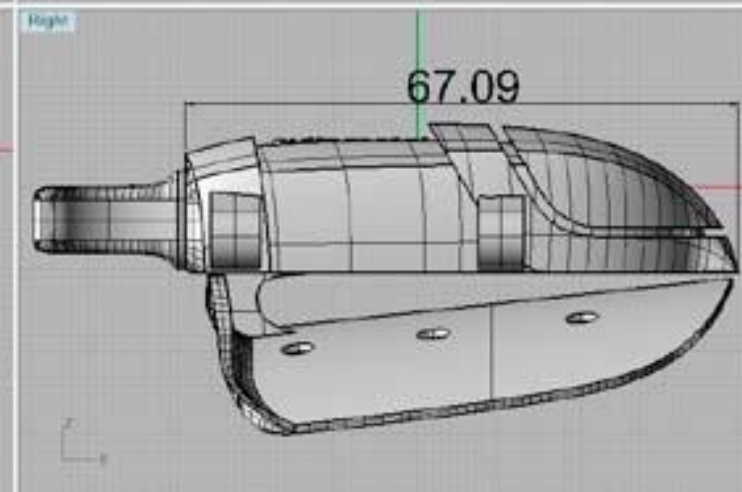
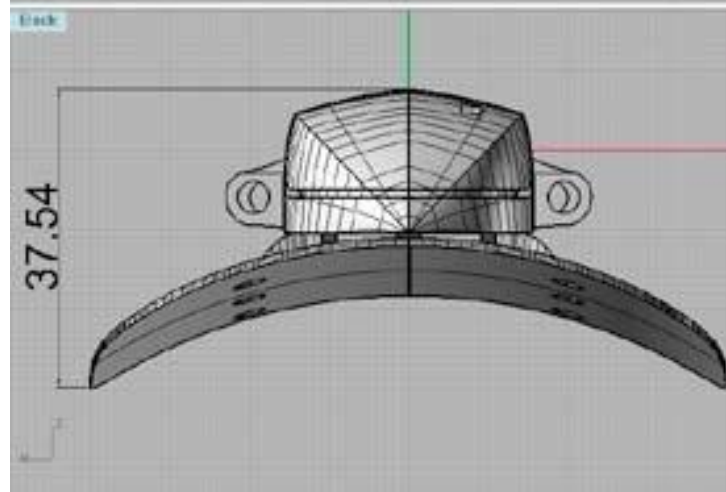
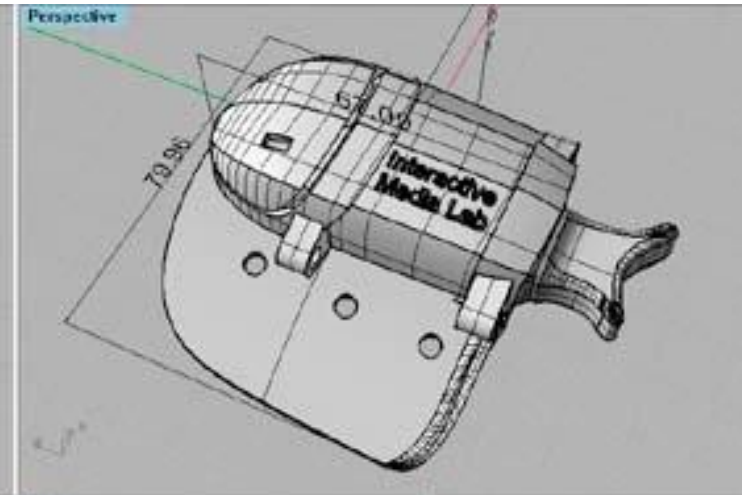
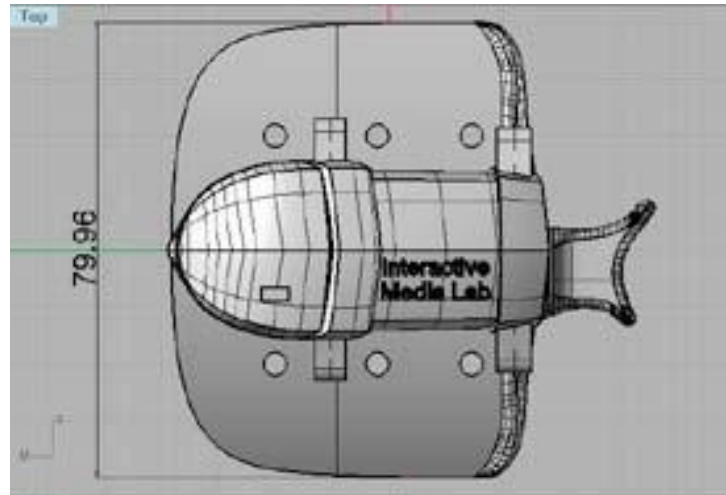
Project 1. Falls

- Approx. 30% of people over 65 fall each year
- Roughly 20% of falls require medical attention
- Falls are number one reason for ER visits by the elderly
- 10% of falls result in fractures
- Falls are a huge burden on the healthcare system and a major health risk

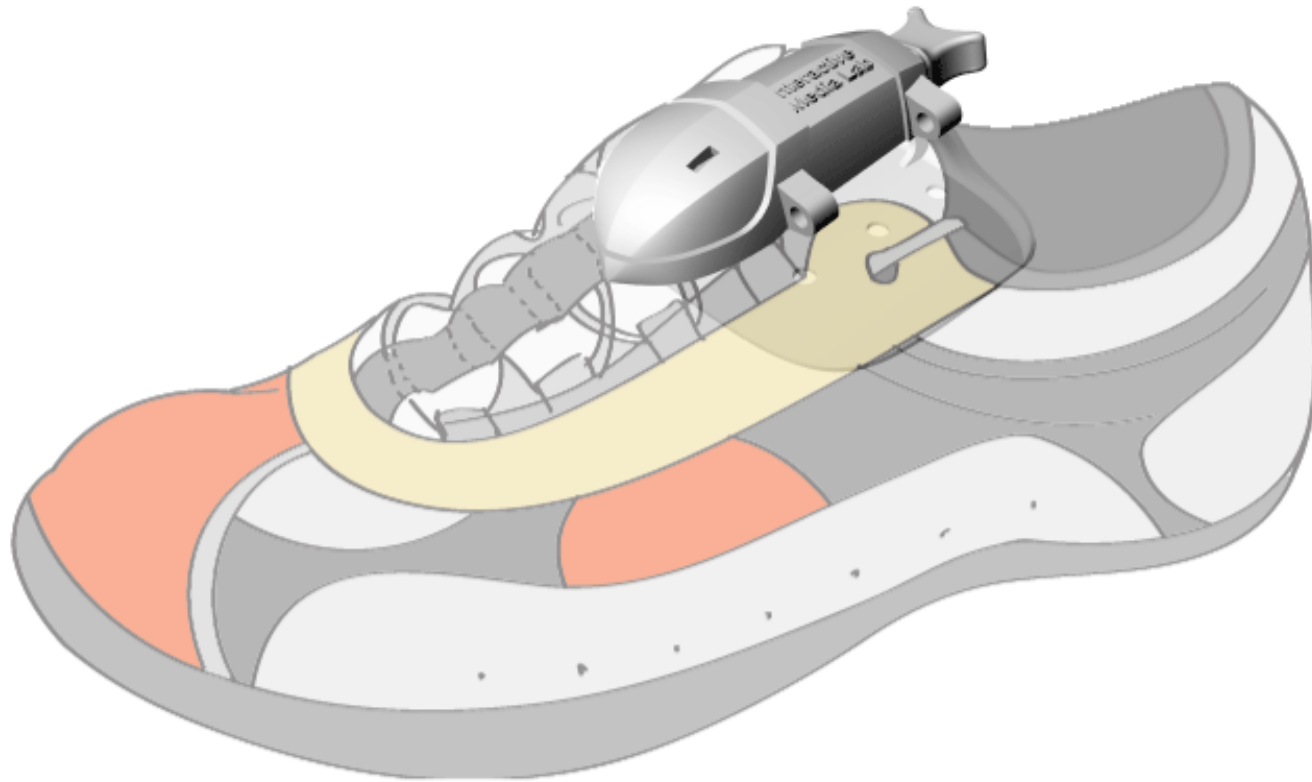
Falls Risk Factors

- **Frailty (low strength, balance)**
- Low Vision
- Environment Factors (e.g., Lighting, obstacles, etc.)
- Cognitive impairment
- ...

Previous Sensor Package



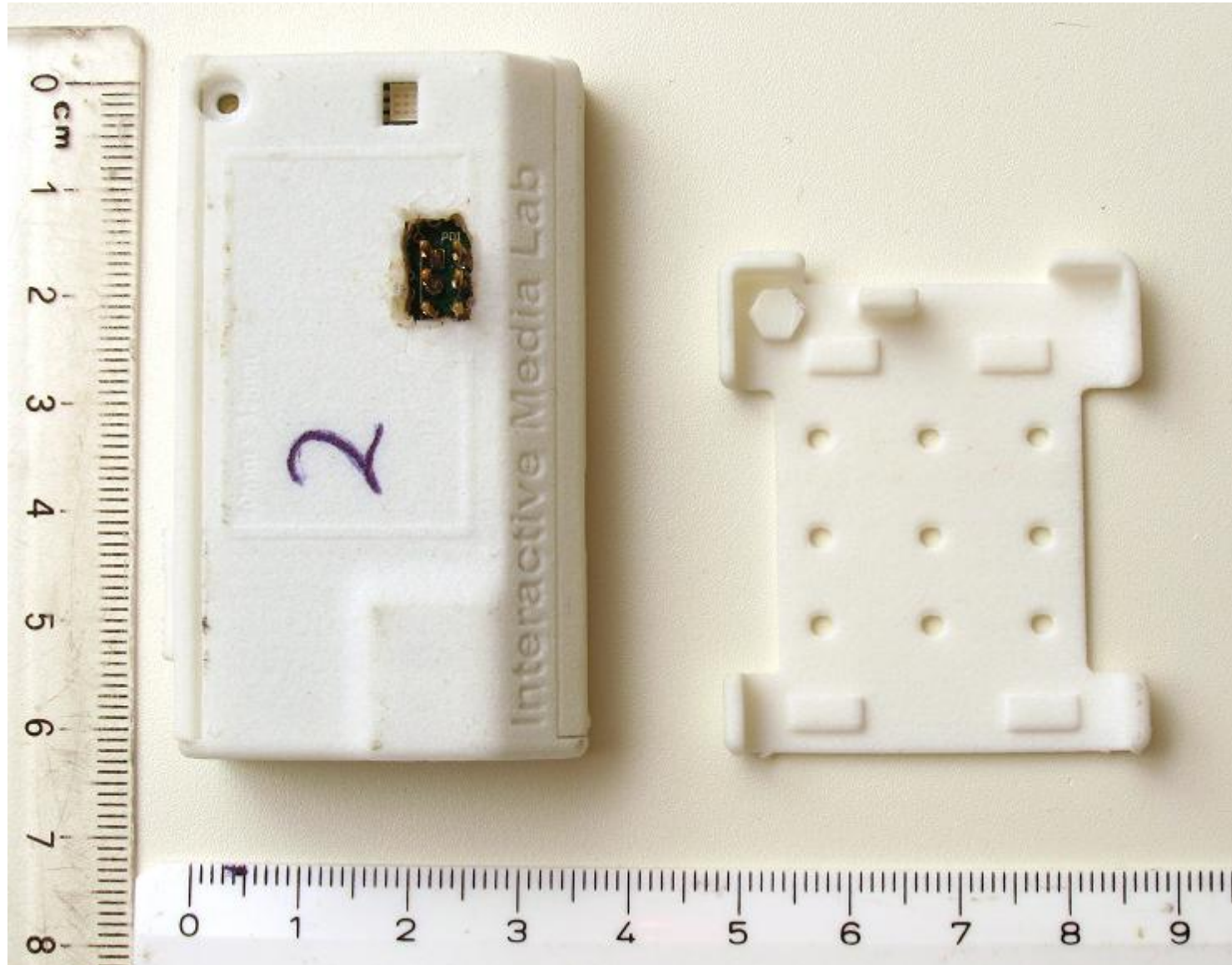
What we designed for...



Our space age design didn't fit!



New Prototype



Another View



Wearing the prototype



Current Status

- Working Prototype (6 copies)
- New Fabrication Run end of Summer
- Distribution to interested researchers (TRI, University of Edmonton, Bridgepoint)
- Distribution to industry (e.g., Centric Health)
- Use of open source model for development of applications and signal processing code

Project 2. Sleep Apnea

- Common and under-diagnosed sleep disorder
- Periods of interrupted or shallow breathing during sleep
- Affects quality of life
 - E.g., extreme fatigue and poor concentration
- May lead to serious medical conditions
 - Cardio/cerebrovascular problems

Project Goals

- A screening tool for sleep apnea
- A post - diagnosis tool for current sleep apnea patients to monitor their apnea daily and track the effectiveness of their current treatment.

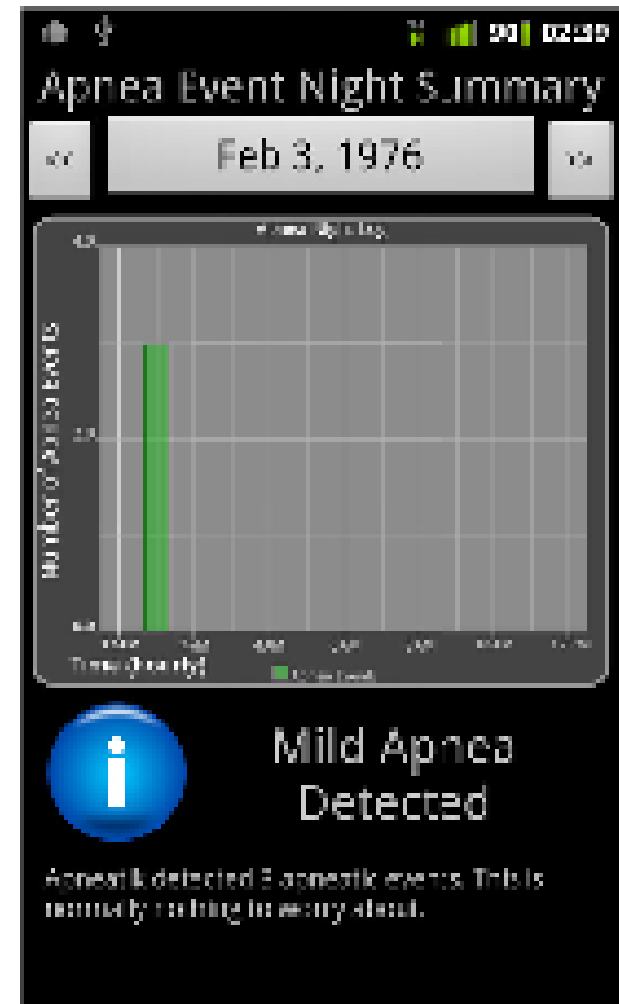
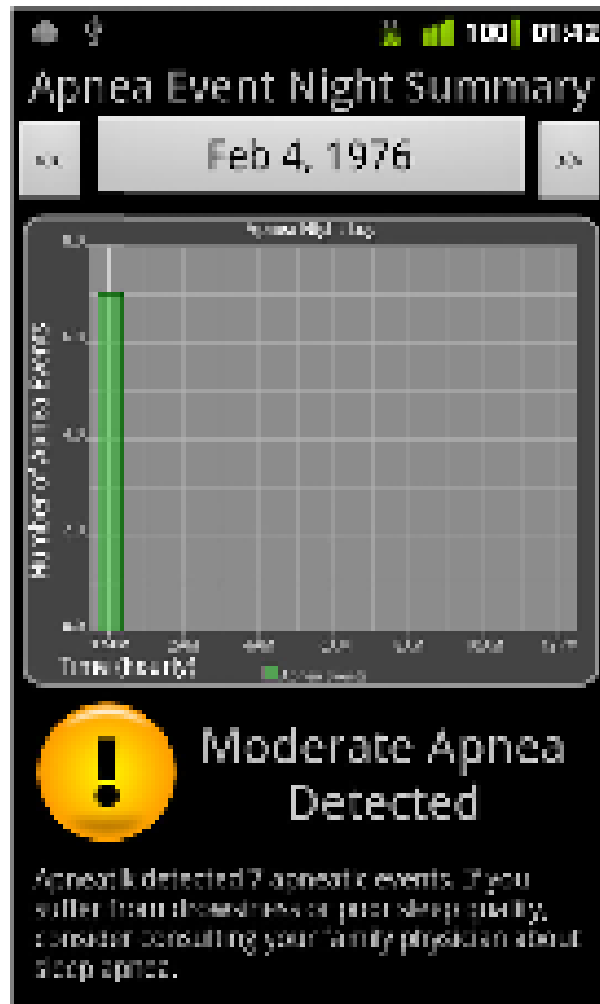
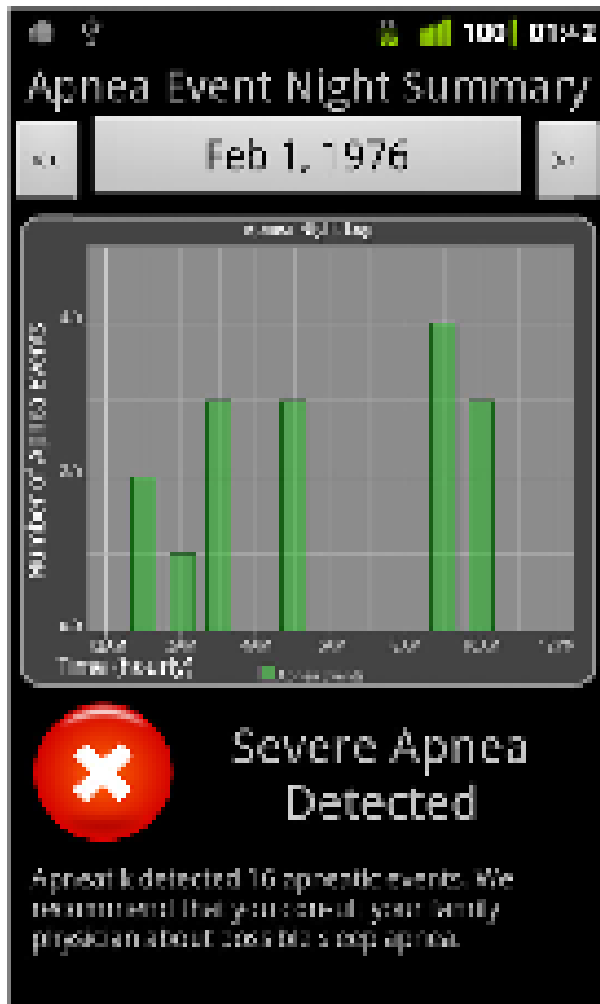
Previous Work

- Student project by Phil Lam, Regina Leung, and Thuva Sivayogan
- Credit: Following two slides are from the student report

Form Factor and Use



Presentation of Feedback



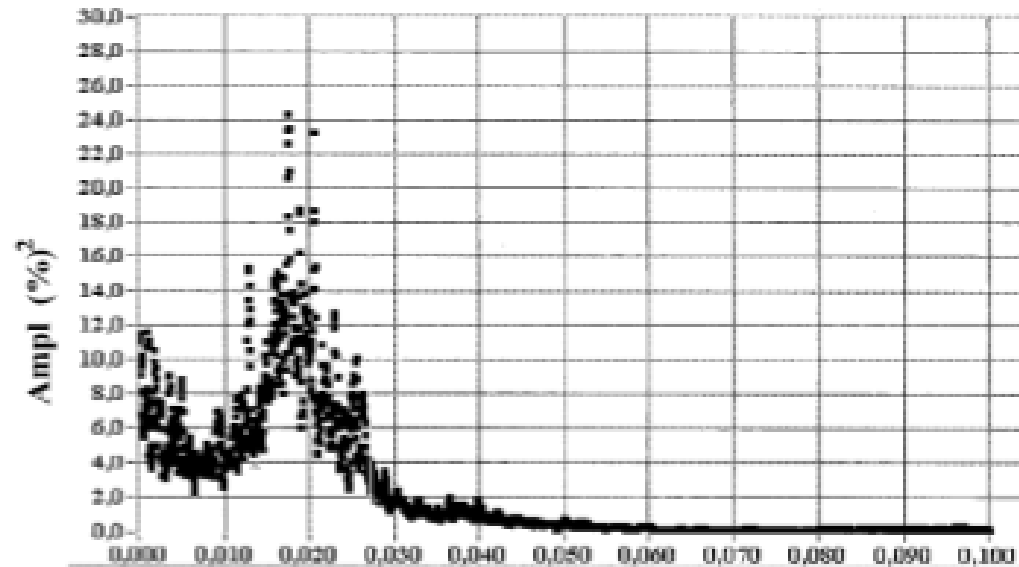
Results

- Accelerometer based approach didn't work sufficiently well
 - A lack of motion doesn't mean that you have sleep apnea, neither does too much motion
 - Amount of motion doesn't correlate with blood oxygen level
- Next Attempt: Pulse oximetry!

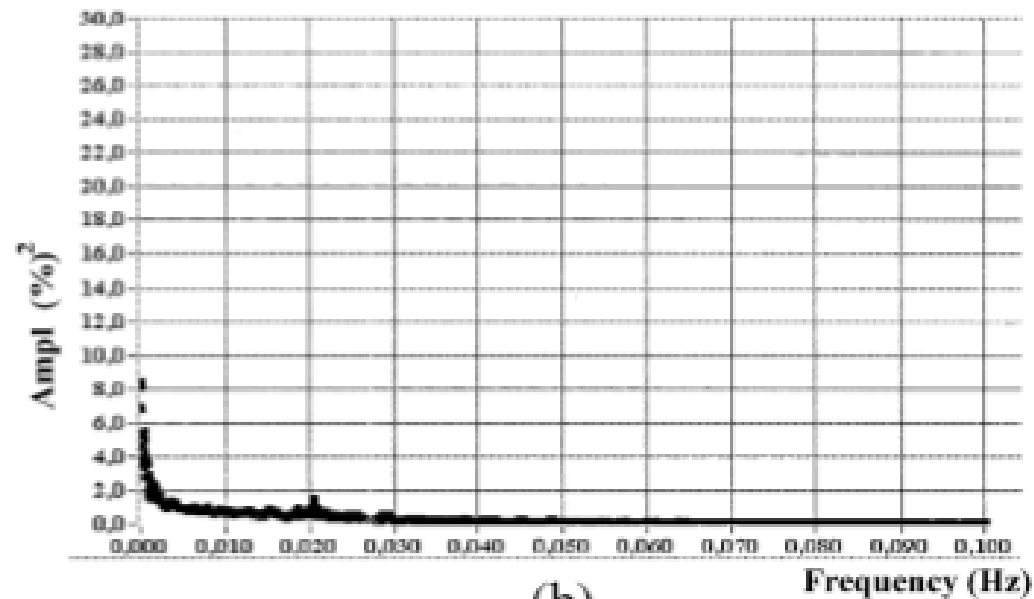
Why Pulse Oximetry?

- According to recent research with hundreds of patients.....
- Results with pulse oximetry alone agree almost 90% with the gold standard sleep lab

Diagnosticity of Pulse Oximetry FFT



(a)



(b)

Proposed Prototype

- Super cheap (<\$10)
- Use smart phone as UI, CPU, Networking and Power source
- Finger tip mounted
- Used for prescreening of sleep apnea
 - With follow up clinical screening if indicated

Like this but cheaper!



Conclusions

- Sensors can provide powerful offsite and continuous monitoring of chronic conditions such as sleep apnea and risk of falling/frailty
- Continuous monitoring can provide large and valuable collections of data that can be used to update screening algorithms and diagnostic criteria
- Effective implementation of sensor-based monitoring applications requires careful matching of form-factors, usages, and read-outs to user lifestyle and ergonomic requirements