

Smart Shoe for Balance, Fall Risk Assessment and Applications in Wireless Health

UCLA Wireless Health Institute

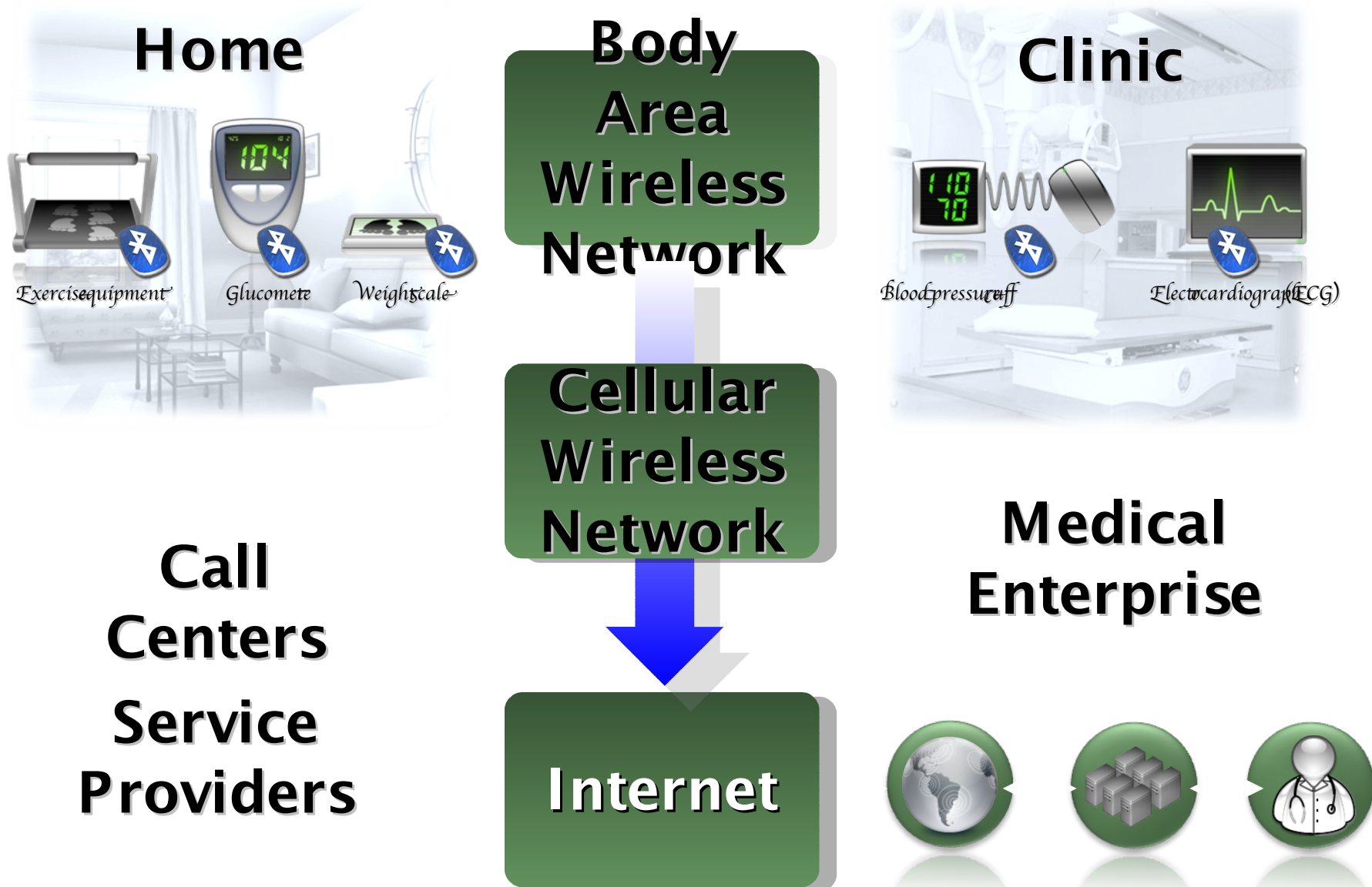
H.Noshadi, S.Ahmadian, F.Dabiri, A.Nahapetian, T.Stathopoulos,
W. Kaiser and M.Sarrafzadeh

Wireless Health

- The convergence of wireless, microsensor technologies with medical sciences
 - Fundamental advance in healthcare quality and accessibility
- Deliver healthcare
 - Adapted to each individual
 - Continuous and global
- Wireless Health Institute
 - Leadership at UCLA
 - Campus-wide collaboration
 - Industry and community partners

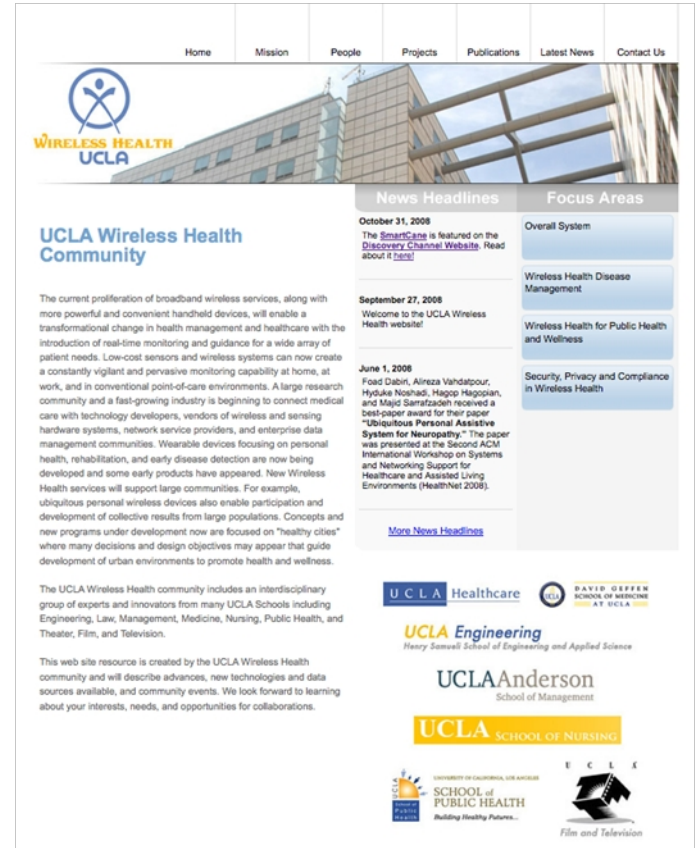


Wireless Health Vision



Wireless Health Institute

- Campus Community
 - School of Medicine
 - Medical Center
 - School of Engineering
 - School of Nursing
 - School of Public Health
 - College of Letters & Science
 - Anderson School of Management
- Unique approach
 - End-to-end integration from sensing to medical informatics to call center
 - Develop and verify new healthcare methods and services
 - Establish standards for efficacy, reliability, interoperability, and security



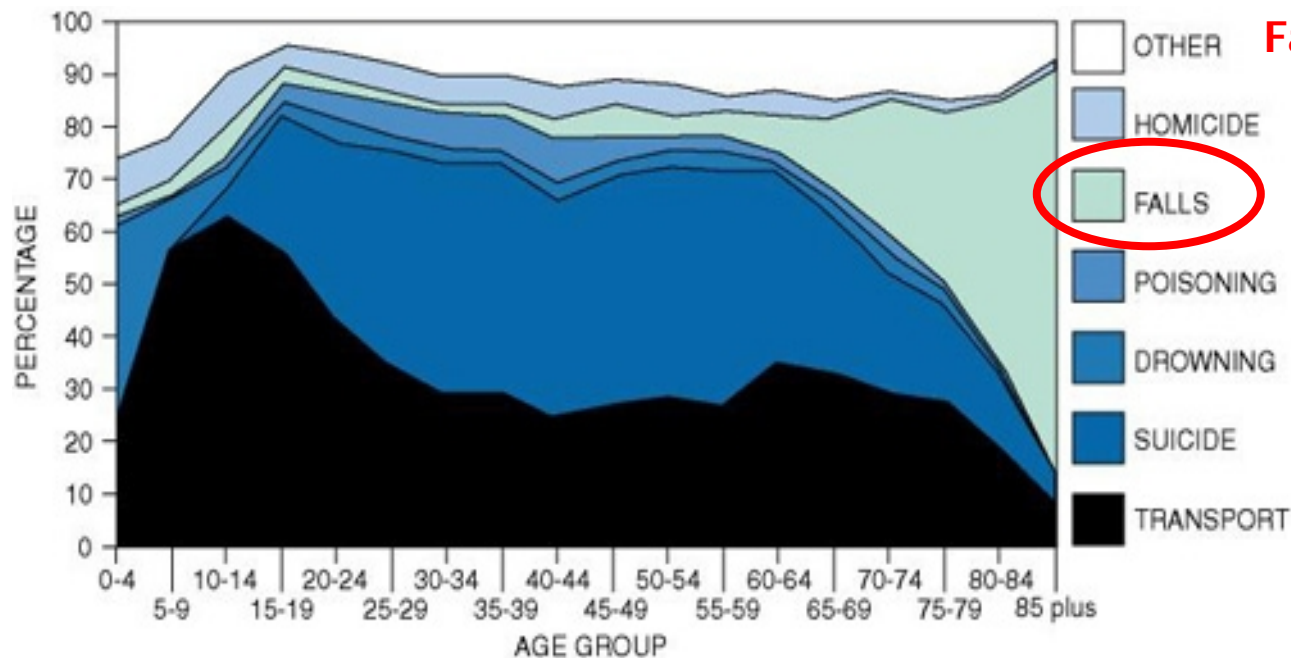
Why Preventing Falls?

- Instability is the major cause of morbidity in elders
- Falling is second cause of accidental death in the US
- Detecting precursors to a fall can be used as early warning



Why Preventing Falls?

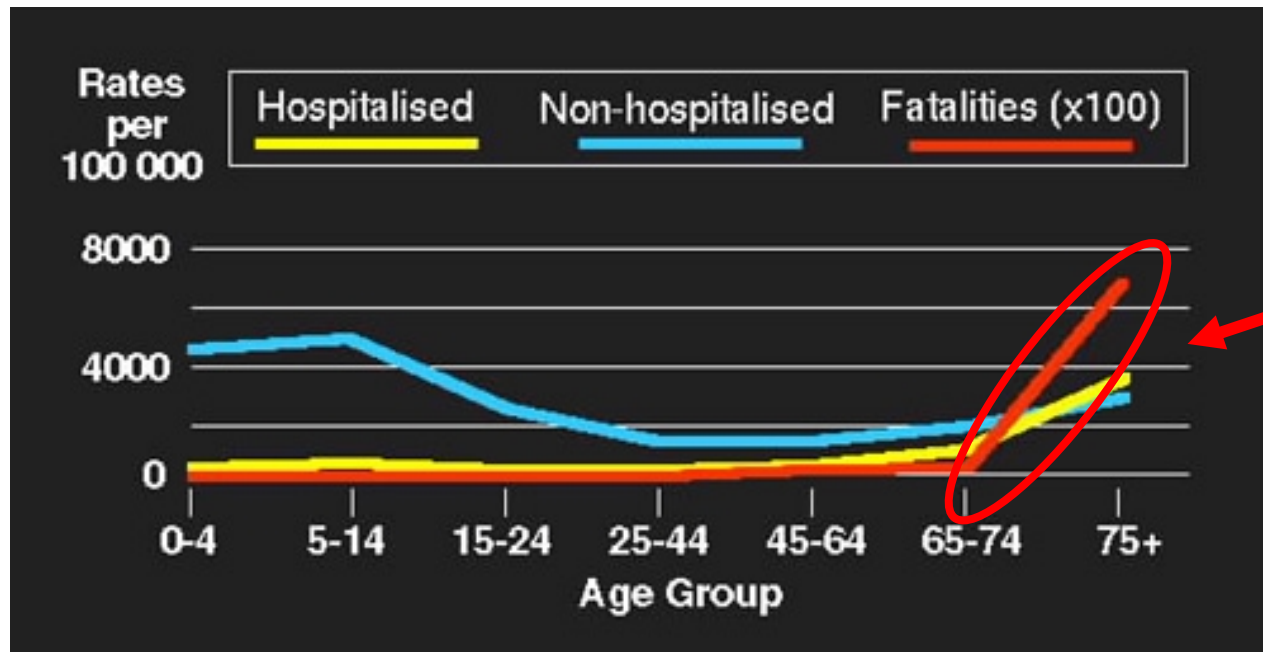
- 75% of the victims of falls are Elders
- Falls are responsible for 70% of accidental deaths in persons 75 and older
- 5% of hospitalization and 40% of nursing home admission rate are related to fall



Higher ratio of
Falls after age 65

Why Preventing Falls?

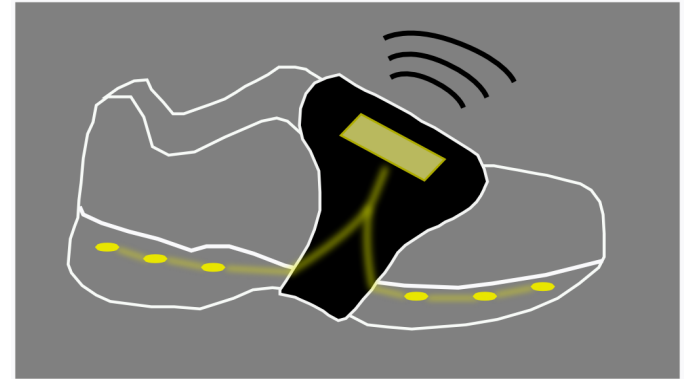
- Hospitalization after falls cost health systems from \$ 25,000 to \$ 75,000
- Cost of imbalance in united states is about 20 billion and by 2020 this cost will be increased to approximately 32 billion



400 k to 800 k of
Fatalities due to
Falling

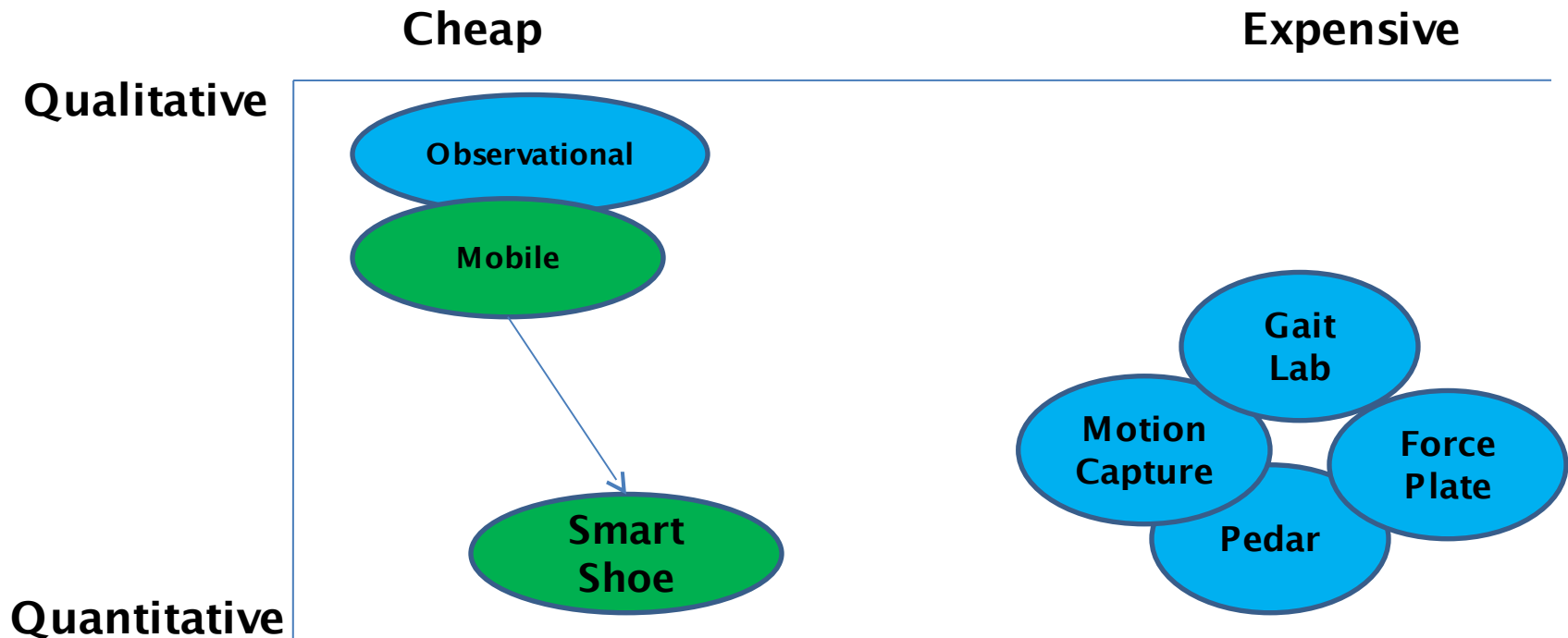
Bringing Balance Everywhere

- Smart Shoe
 - Electronic Shoe + Software
 - Portable
 - Affordable
 - Multipurpose
(Doctors, Elderly, Runners and...)
- Measuring imbalance using variety of techniques
 - Insight into users daily walking patterns
 - Personalization
 - Context



Bringing Balance Everywhere

- Proposed SmartShoe takes advantage of data modeling to shift the accuracy and influence capability of mobile platform

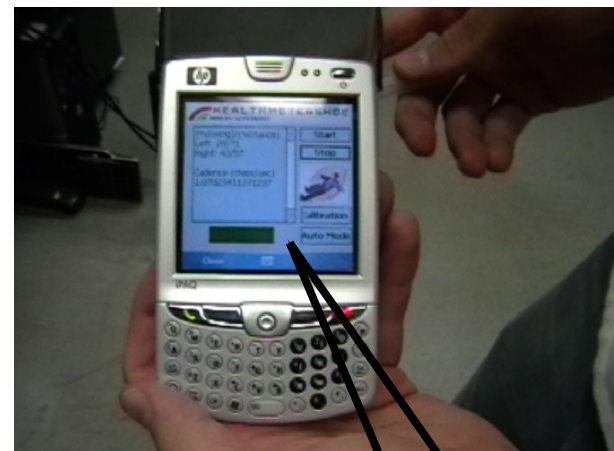
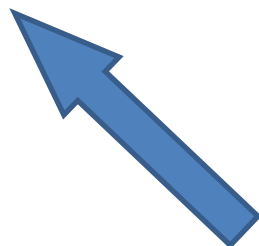
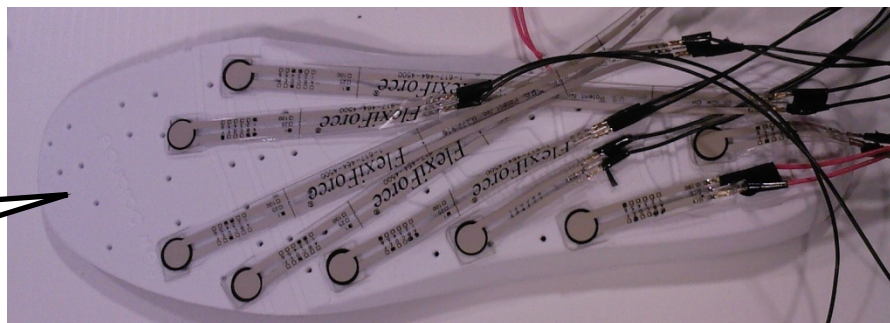


Architecture



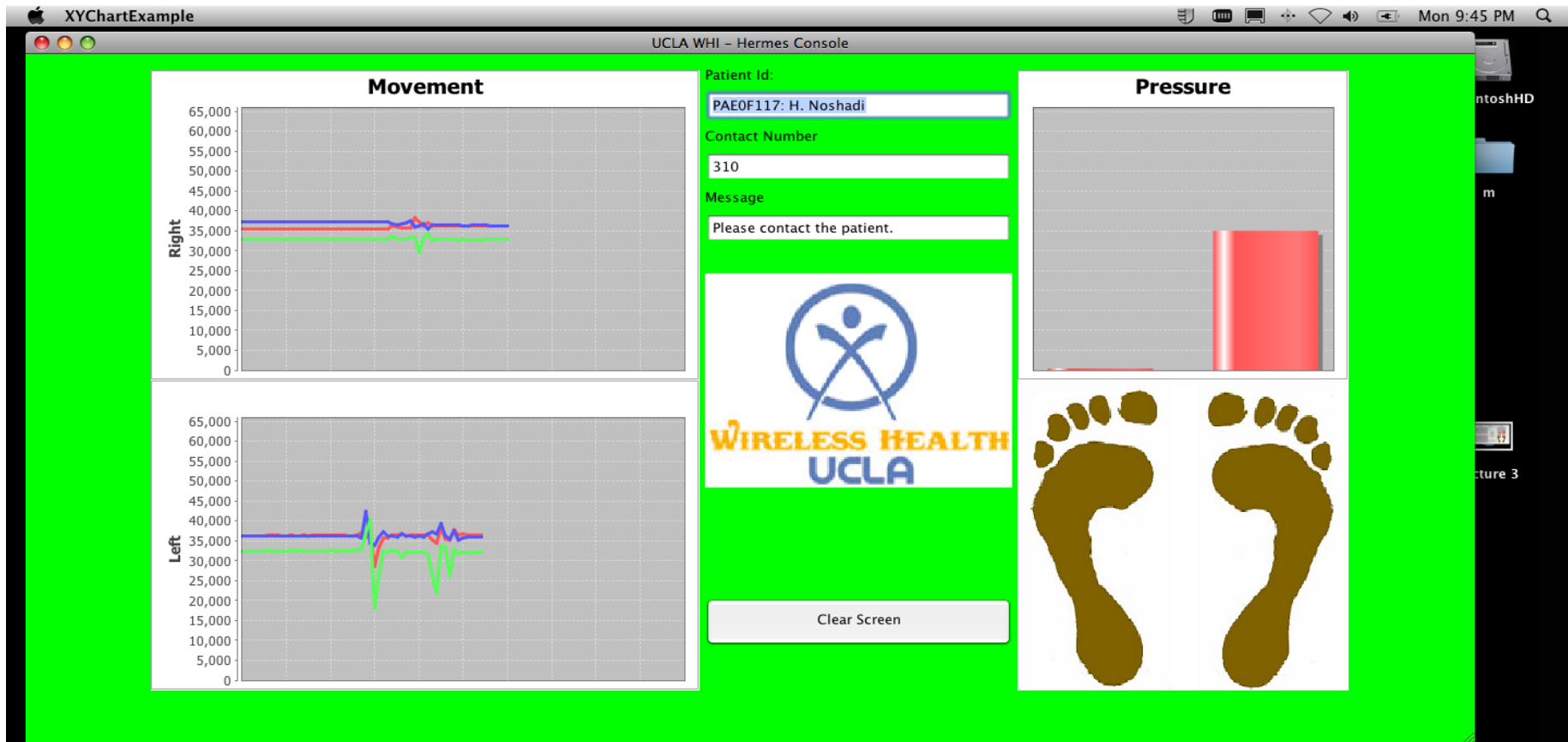
Processing unit
Radio/Bluetooth
Interface
3 -gyro
3 x-accel

Pressure
Sensors in
the insole



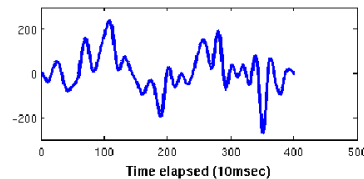
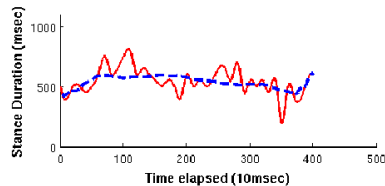
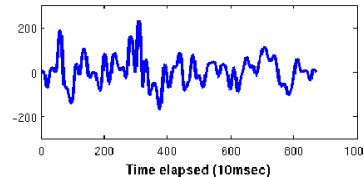
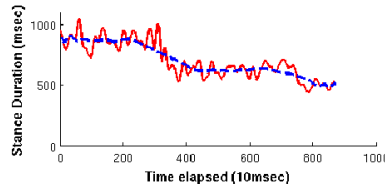
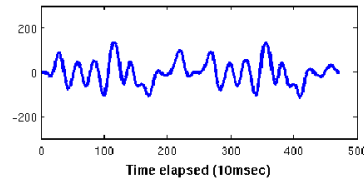
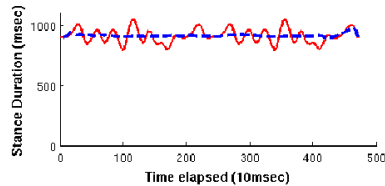
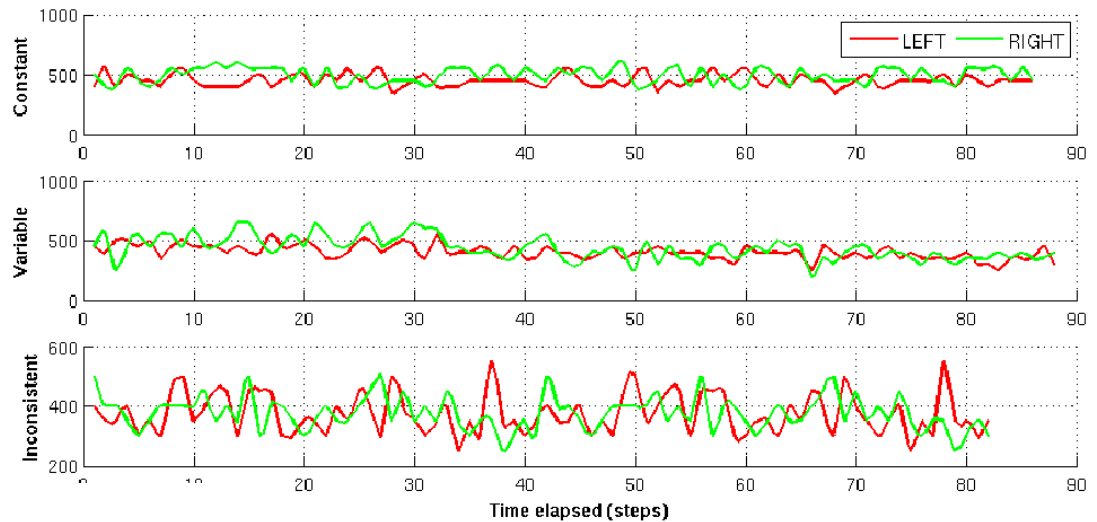
Fall
Risk

Monitoring Software



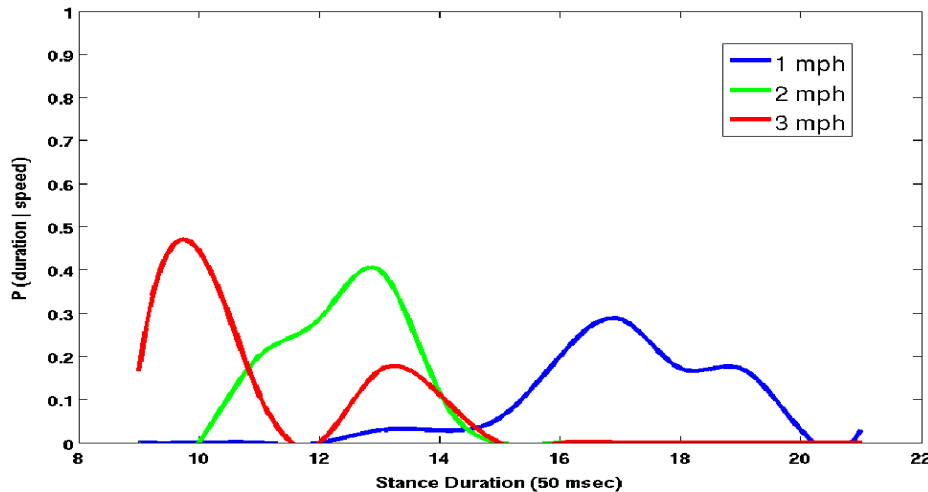
Fall Risk Analysis

Variability of a temporal feature (swing phase) In three different walking patterns computed by Hermes



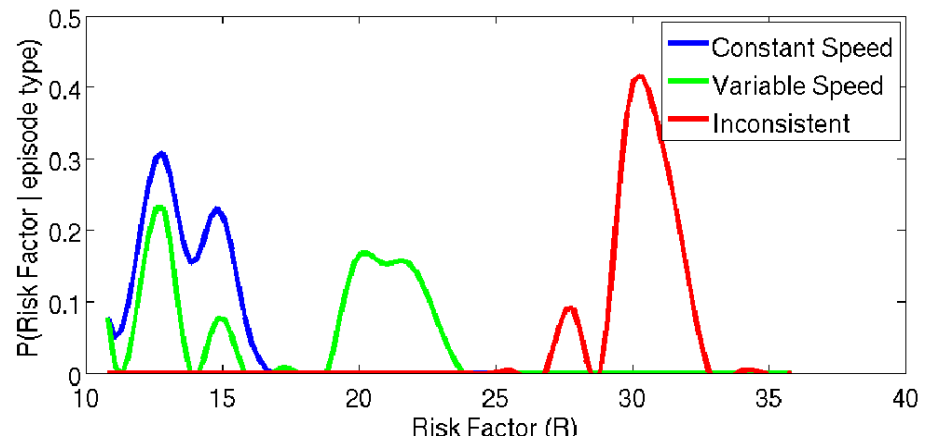
Trend and variance of swing for three different walking patterns computed by SmartShoe. By removing the trend line from original signal, the variability is isolated and the variance is computed

Fall Risk Analysis



Distribution of temporal features at various speed shows sensitivity in detecting variance in 1mph

Distribution of computed risk factors shows effectiveness of computed risk value, where inconsistent walk always has higher risk value compare to normal walk



Thank You