Future Integrated Sensors in Wireless Health

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Wireless Health

Home
- Exercise equipment
- Glucometer
- Weight Scale

Body Area and Local Area Wireless

Clinic
- Blood Pressure
- ECG

Medical Enterprise

Service Providers

Wired/Wireless WAN Network

Internet

Wired/Wireless WAN Network
Wireless Health: Fundamental and Broad-Based Motivations

• Motivation: Healthcare delivery
  – Provides the first means for assuring outcomes in the field
  – Provides the first means for establishing “dosage response curve” for specific subject behaviors (for example, activity)
  – Provides the first in-community advance diagnostics
  – Provides direct method for reducing rate of hospitalization both primary and readmission
Wireless Health: Fundamental and Broad-Based Motivations

• Motivation: Business
  – “World’s largest accessible market” : Robert McCray (WLSA)

• Business sectors
  – Healthcare: Cost of healthcare delivery
  – Telecomm: Platform and service providers
  – Microelectronics: Sensor, embedded through enterprise computing, and communication systems.
  – Information Technology: Data source of unprecedented value
Wireless Health: Integrated Sensor Elements

• Integration
  – Sensors:
    • Physical, environmental, and physiological
  – Sensor Information processing
    • Sensor fusion exploiting individualized subject training and classification of subject state
    • Directly addresses sensing uncertainty
  – Embedded computing and body area networks
    • Performance optimized under energy constraints
  – Enterprise computing
    • Signal Search Engine (SSE)
  – Critical inspiration and support
    • Dr. John Cozzens (NSF-CISE)
    • Professor Gregory Pottie
    • Dr. Bruce Dobkin
Wireless Health: Diverse Impact Today

- **Stroke Rehabilitation**
  - Predicted 1T annual cost
  - Critical need to *guide* activity as primary intervention

- **Solution today**
  - 15 countries and 300 subjects
  - Low cost sensing
  - High performance computing supporting sensor fusion
  - Individual subject models
Wireless Health: Diverse Impact Today

• Acute international need
  – Pressure Ulcers
    • Result from excessive, extended application of pressure to tissue
    • Appear in nursing home, clinic, or residential life
  – National Cost
    • Over 50,000 mortalities in US
    • Over 2M Medicare hospital days annually
    • New regulatory impact
Wireless Health: Diverse Impact Today

- Wireless Health Solution: SEM Scanner:
  - First evidence based pressure ulcer detection system
  - Measures subepidermal moisture (SEM)
  - Sensing of tissue dielectric properties
  - Now serving nursing home and clinic communities
  - Wireless guidance and compliance assurance
Wireless Health: Diverse Impact Today

- **Human Performance**
  - First in-field measurement of biomechanical *efficiency* metrics
  - Wireless *foot* motion sensing
  - Real time data processing and delivery

- **New Vision**
  - *Worldwide, real-time television broadcast*
  - 2012 Los Angeles Marathon
  - Race winner: Simon Njoroge

- **Broad Impact**
  - Commercial introduction soon
  - Many disciplines
Wireless Health: Future Integrated Sensors

• New technology world
  – Perhaps our largest and most valuable ever
  – Dedicated to advancing human condition and performance

• Unprecedented system engineering challenges:
  – System integrity at global scale
    • Compliance with usage and guidance
    • Assurance of many requirements of sensor fusion
  – Massive and diverse data return
    • Signal Search Engine
    • Prediction of outcomes
  – Resource efficiency
    • Cost, energy, usage
    • Optimization objectives vary with each application