Every day mobile phones: innovation platform for aging in place?

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Borrows greedily from joint work with Jeff Burke, Jeff Goldman, Mark Hansen, Minyoung Mun, Mohammad Rahimi, Sasank Reddy, Ruth West
Many technologies emerging that will be integrated into wellness systems for the aging...eventually

Some years out: robotic mobility devices (wheel chair), implantable sensors, at home diagnostics (biomarkers for disease, ingested drug detection, etc.)


Key characteristics:

- Incrementally deployable/adoptable
- Legible and easy to learn/use
- Respectful

http://www.battelle.org/solutions
Important precedents for transformational approaches

Eric Dishman (Intel, 2004):
“...personal technologies to help detect disease early and support compliance... consumer-oriented healthcare paradigm that is optimized for aging in place...”

- Personalized systems to support at home adherence with care plan
- Support for informal caregiving
- Automatic data collection
- Mine for “wellness/disease” signatures

Nicole Spelhaug’s, Mayoclinic.com:
Widely-used, Expert-based, Internet system, personalized through search:
- Informal, yet informed, caregiving
- Informed patients to reinforce and incentive adherence
- Aggregation of “disease signature” information
Leveraging mobile devices to support more effective care for aging in place

Automatic data collection from consumer grade devices
(mobility, automatic images, acoustic signatures)

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Legible presentation via Web based applications

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Consumer-oriented (incrementally adoptable, affordable, and usable), individualized, solutions
Why leverage mobile phones?

- Over $2 \times 10^9$ users worldwide of mobile phones
- Increasingly capable devices
  - digital images, location (GPS, cell tower), bluetooth connected sensors,
  - automatic-geocoding
  - programmed/user-initiated/server-initiated capture
- Server-side processing and presentation of personal data
  - Legible, individualized, and respectful access to data
  - Flexible configurations
Rationale and precedent for leveraging mobile devices

If you can’t go to the field with the sensor you want…
go with the sensor you have! (Anon)

The power of the Internet, the reach of the phone (Voxiva)
Activity and Mobility

- Observe patterns and trends in indicative activities:
  - timing and frequency of trips to store, social activities, exercise routines
  - daily patterns of time spent in kitchen, dining area, TV room, bath/bedroom...
- Outdoor: time series of GPS and cell tower data points, combined with map matching
- Indoors: accelerometers and bluetooth stumbling
Dietary intake/nutrition/eating habits

- Say 'cheese' to fridge camera

- Indirect measures of eating-related activities: time spent in kitchen and dining area (using “bluetooth stumbling” and accelerometer data), shopping patterns

- Motion-triggered webcam over sink to observe discarded food
Medication adherence

- Partners: Hypertension medication experiment
  “…50% of patients with chronic disease do not take the medication as prescribed…”
  
  [Link: http://www.connected-health.org]

- Also achievable with “close approximation”: home PC with $70 webcam or camera phone ??
Social interaction

- Estimate frequency, duration, trends in human communication
  - Program phone to automatically capture short audio snippets
  - Process locally/on-server to detect patterns of interactive communication (distinguish from TV, Radio; phone, in person)
- Observe aggregate data to identify sudden or significant changes in social contact and interaction
- Parsimonious system might be configureable to not capture communication content.

http://www.kt.tu-cottbus.de/speech-analysis/
Can incremental, affordable, pragmatic innovations, improve the way we approach aging in place?

- Adoption pathways for informal caregiver/aging should:
  - **Scales down**: offer improved quality of life with incremental deployment (consumer benefits do not depend upon adoption by providers/institutions)
  - **Scale up**: assimilate technology advances and broader adoption as they emerge...
    - Future devices: glucose monitoring, Smart Cane (Kaiser), biomarkers, ...
    - Future smarts: computer vision, machine learning...that learn more **and** less...more of what is important, less of what is intrusive.

- Liberate Consumer health care from the mercy of rollout by the health care providers:
  - **Individually deployable personal data streams**

- Most of the challenges are not technical, but they are