

New Sensor-Based Applications in Emergency Medicine

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Overview

- Sensor-based applications are bandwidth intensive (hSITE relevant)
 - Sensor-based applications are particularly relevant in emergency medicine
 - Real-time, critical, cognitive support
 - Tasks we are carrying out
 - Requirements Analysis
 - Scenario Developing
 - Tool Prototyping and Evaluation
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Requirements Analysis

(Erin Yu, with Mike Carter and Ryan Kealey)

- **Characteristics of Healthcare**
 - None-routine work [1]
 - Mobile [2]
 - Highly collaborative [2,3,5]
 - Context-driven [4]
 - Time-critical
 - Information-rich

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1. Y. Xiao, Artifacts and collaborative work in healthcare: methodological, theoretical, and technological implications of the tangible, *Journal of Biomedical Informatics* 38, p. 26–33 (2005)
 2. J. E. Bardram, C. Bossen, *Mobility Work: The Spatial Dimension of Collaboration at a Hospital*, CSCW, 2005.
 3. *Activity-based Computing*. <http://www.activity-based-computing.org/>
 4. M. A. Muñoz, M. Rodríguez, J. Favela, A. I. Martínez-García, V. M. González, *Context-Aware Mobile Communication in Hospitals*, *IEEE Xplore*, p. 38-46 (2003)
 5. C. Bossen, *The Parameters of Common Information Spaces: the Heterogeneity of Cooperative Work at a Hospital Ward*, CSCW, 2002.

Scenario: Hand-held Test Results





Dr. Geller gets a text message indicating that Krista's ultrasound results are ready to be viewed.

Improving Cognitive Compatibility: Script-Based view of Workflow (Diego Rivera)

- **Rationale**
 - Compared to medical students, expert practitioners often perform better, in part because they developed illness script sets that are triggered when certain illness “attributes” are present.
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Script-Based Procedures

Key Research questions:

Under what conditions can SBPs be useful?

How different are SBPs to traditional work procedures?

How congruent are SBPs across practitioners?

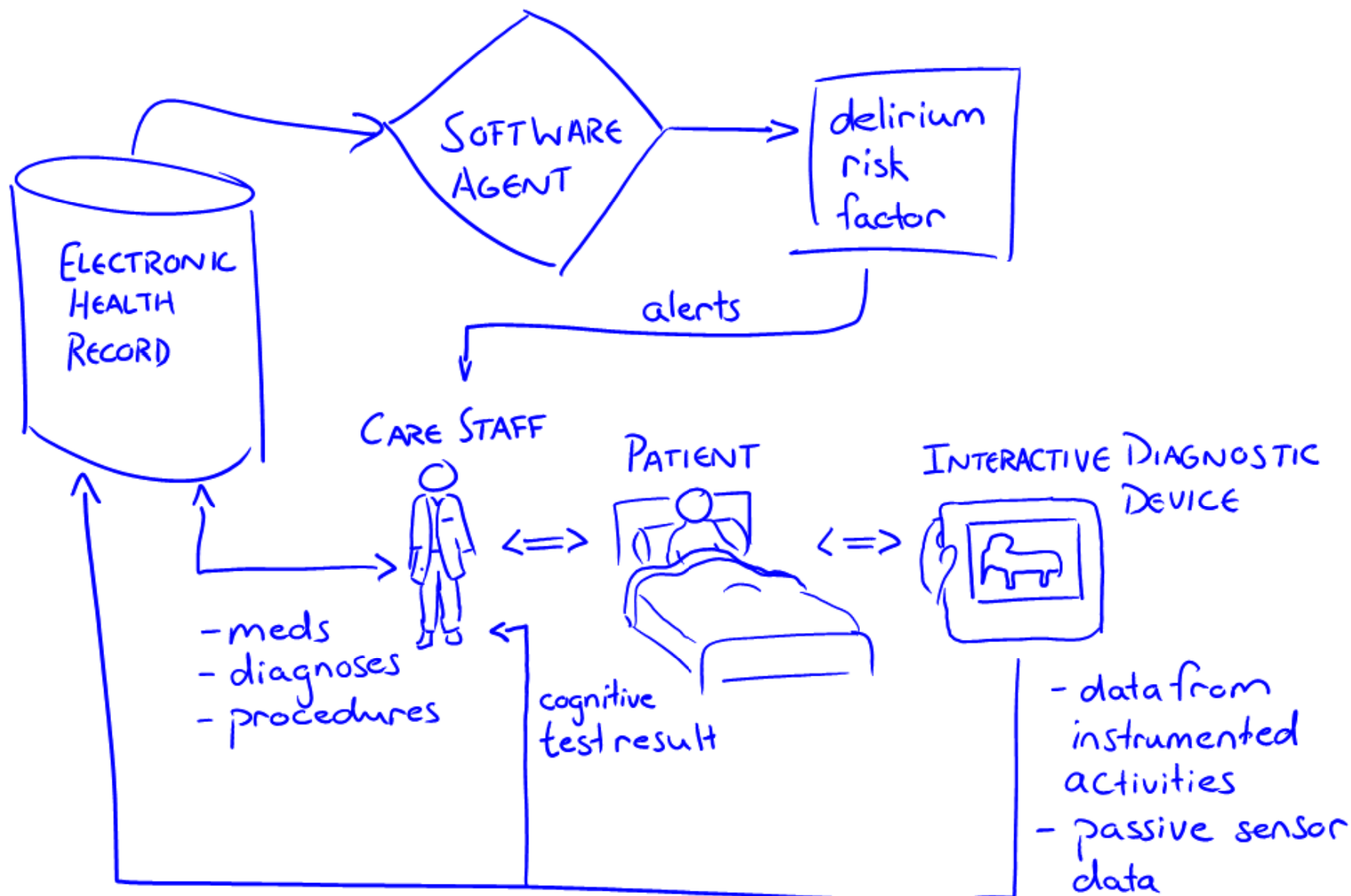
How to deploy SBPs to minimize disruptions and to ensure adoption?

RFID-Based Activity Tracking

(Hao Shi with Jim Cordy)

- Readers in Rooms or Near Equipment
- Transmission of Sensed TagIDs to Intranet/Cloud
- Triangulation/inference of Tag location/Proximity
- Inference of Activity and Interruptability
- Modification of Device behaviour based on inferred activity and workload
 - Accepting Calls, notifying test results, etc.
- Anticipated use of Machine reasoning developed by Robin Cohen and her group

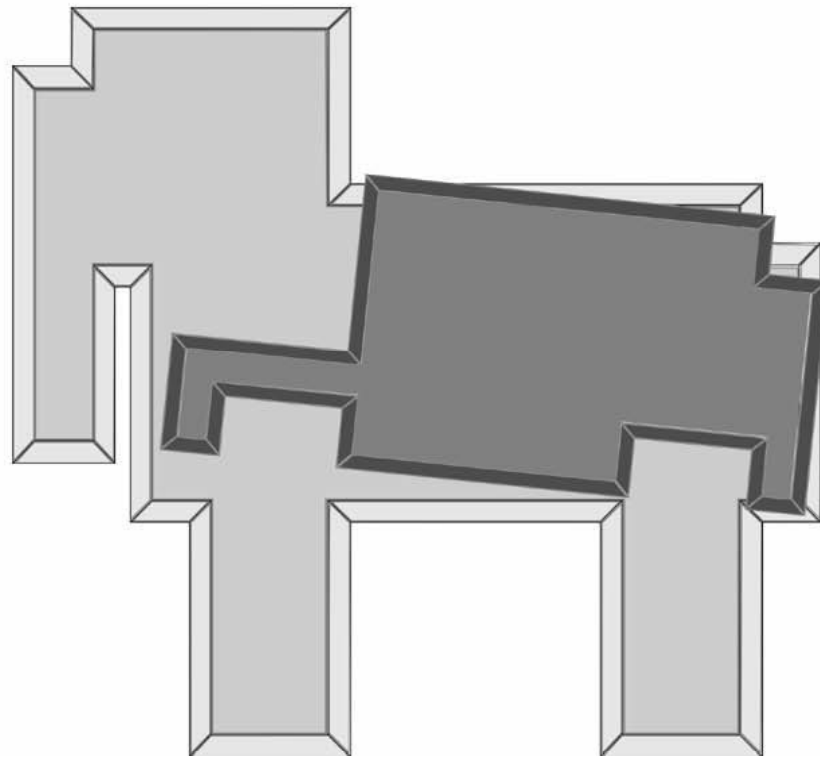
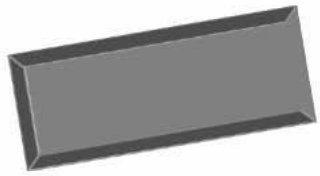
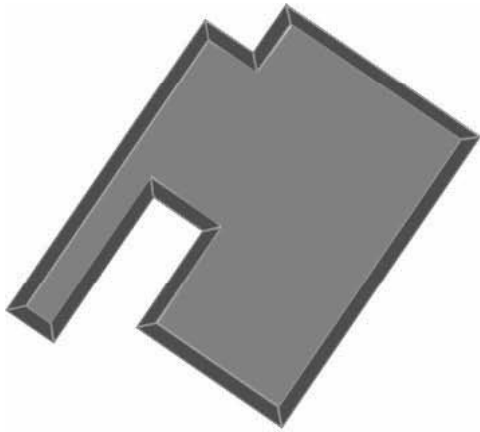
Delirium Risk Assessment (Phil Lam with Dr. Jaques Lee)



Strategy: Game-based Cognitive Assessment + Movement Sensing

- Accelerometers track hyperactive/hypoactive behaviour (risk factor)
- Wiimote game provides quick CAM-like assessment of cognitive function
- Not interested in accurate single-point estimation
- Interested in quick detection of dangerous trends

WeeCAM



Sensor-Based Evaluation of Neuro-Rehab

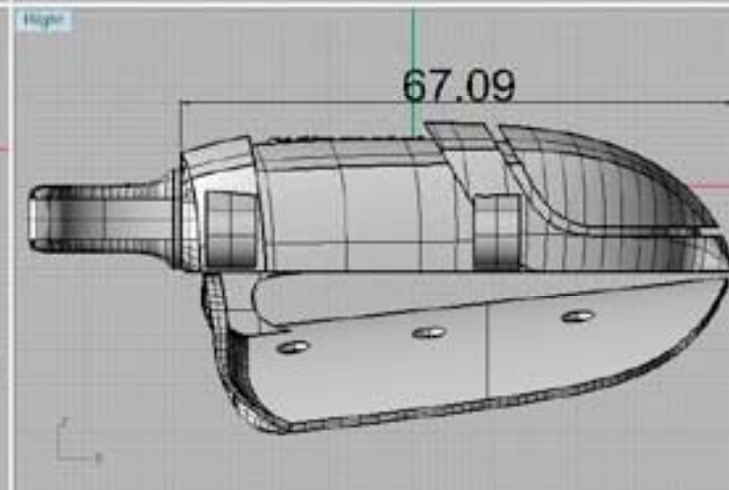
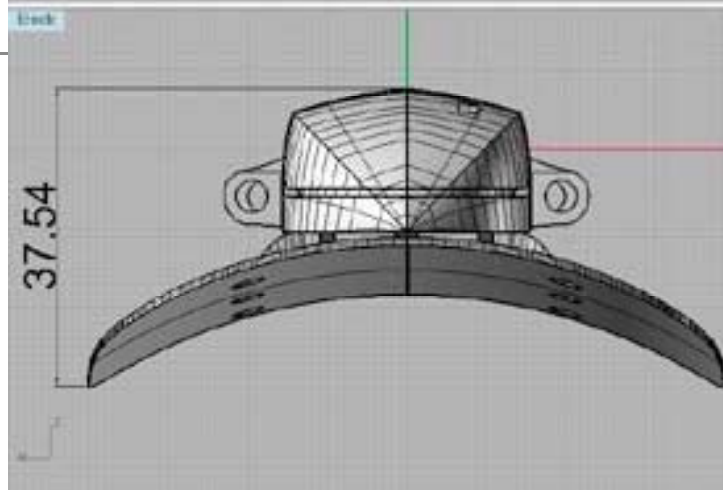
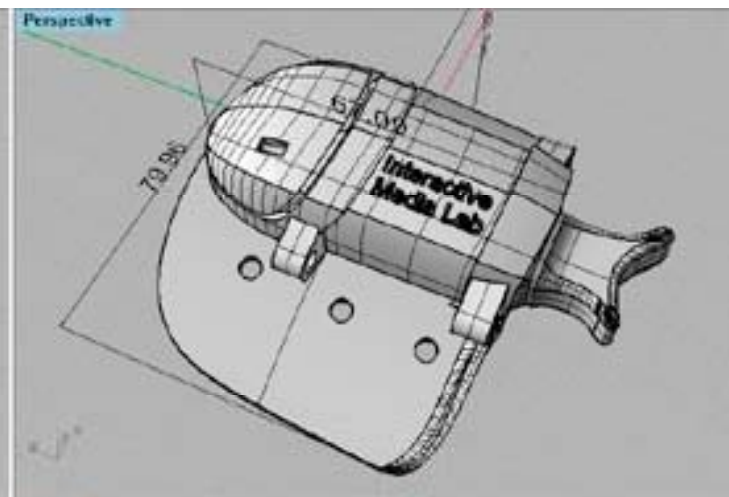
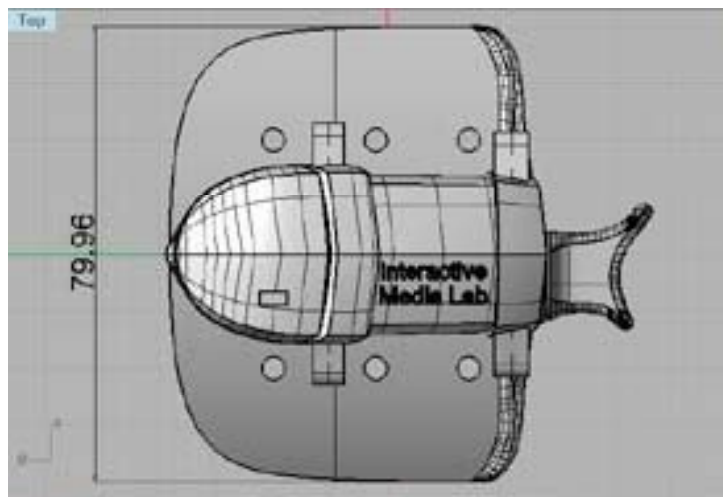
(Anito Ko with Dr. Tammy Sieminowski)

- Recovery from Brain or Stroke Injury
 - Ambulatory Gait Analysis over six weeks
 - Evaluation of Reduction in Gait Abnormality as a measure of recovery
 - Comparison with Existing Clinical Measures
 - Relative Effectiveness of Gait Abnormality Measure across Different Diagnoses
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- Experiment at Bridgepoint Hospital this summer
 - Shoe mounted sensor package developed by Phil Lam

Targetted Ambulatory Gait Analysis

- Inference of gait features from combination of gyroscope and accelerometer data
- Use of clock to synchronize left and right feet
- Small package mounted on top of patient's shoe/slipper)
 - (no need to wear purpose built shoes)
- Targetted features (using findings in research literature)
 - Stride length variability (suspected cognitive component)
 - Foot flat (vertical) acceleration (aging related)
 - Stride width (disease related, e.g., Parkinsons)

Sensor Package



Conclusions

- Five Projects (students)
 - Reduction of Cognitive Load
 - New Scenarios and Processes
 - Script-Based Procedures
 - Sensor-Based
 - Prevention
 - Evaluation
 - Management of Context
 - Collaboration
 - Three Hospitals
 - Multiple Physicians