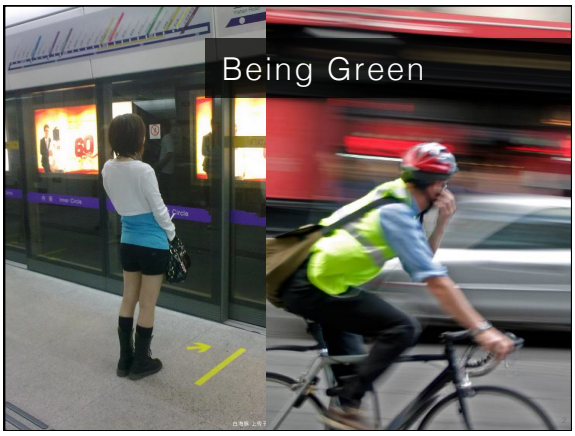
CS 147 - HCI+Design: User Interface Design, Prototyping, & Evaluation
Prof. James A. Landay
Stanford University

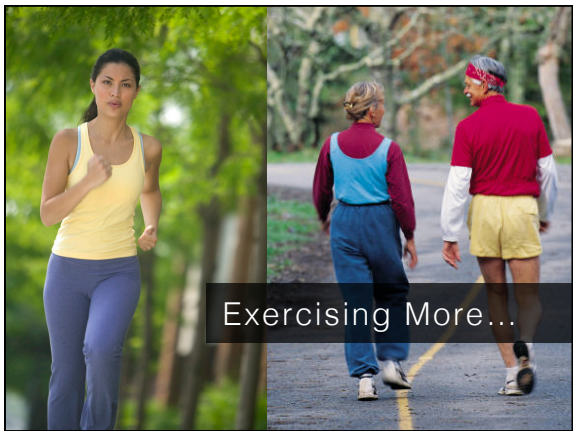
HCI+DESIGN: USER INTERFACE DESIGN + PROTOTYPING + EVALUATION

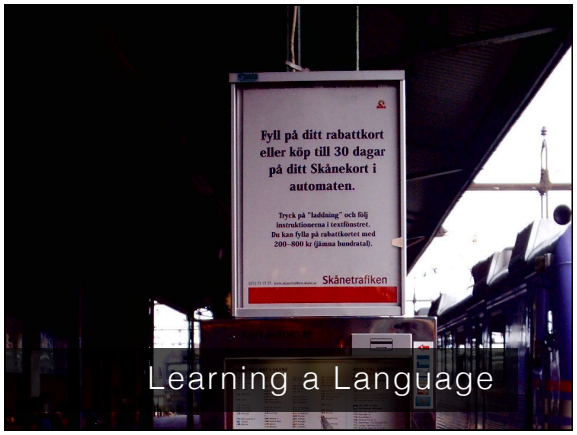
Activity-based Ubiquitous Computing

Prof. James A. Landay
Computer Science Department
Stanford University

Autumn 2014
December 2, 2014







HARD TO CREATE SUCCESSFULLY

WITH PSYCHOLOGY-BASED **HCI**

OR ART STUDIO-BASED **DESIGN**

U B I F I T
Activity-based Application

Consolvo, McDonald, Landay …

Problem: obesity a global epidemic
have hard time fitting exercise into lives

Solution: ambient feedback of activity
uses both self-journaling & inference

Evaluation: 3 months w/ 28 participants
19 participants w/ garden maintained activity & saw **no decrease over holidays**

CHI 2008, UbiComp 2008, CHI 2009

UbiFit Lessons Learned
Over 2 Years of Development & Testing

- Activity inference difficult
  - to collect data for, train, & tune
- Design → coded system = BAD!
  - hard to change & iterate
- Evaluation time consuming
  - 2 full time researchers
- Left "mass of data on the table"
  - no easy way to understand

Activity-based UbiComp
Key Challenges & New Ideas

Physical actions are tedious to record & manage
*Build applications using **action inference***

Must study in situ over extended periods
Use ***new methods & tools*** to improve data collection, analysis & application prototyping

Natural interactions are ambiguous
Improve ***disambiguation*** using dynamic context

Robust Action Inference:
Human Actions from Motion

Choudhury, Lester, Borriello, Landay, Fogarty, Saponas…

> 95% accuracy on smartphones (Android, iPhone, Windows) for walking, running, biking, standing

IEEE Pervasive Computing, 7(2), 2008

Activity-based UbiComp
Key Challenges & New Ideas

Physical actions are tedious to record & manage
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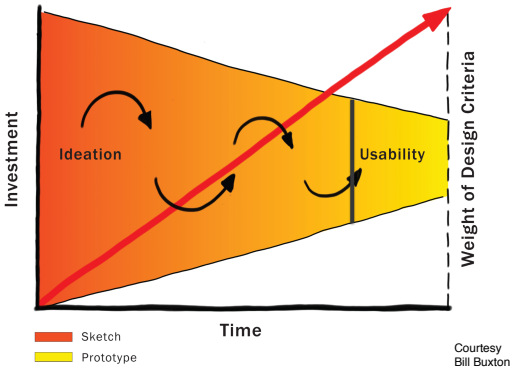
Must study in situ over extended periods
Use ***new methods & tools*** to improve data collection, analysis & application prototyping

Natural interactions are ambiguous
Improve ***disambiguation*** using dynamic context

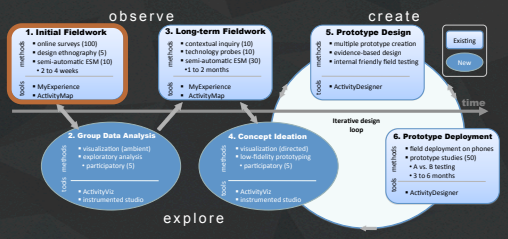
Where does data enter into the criteria?



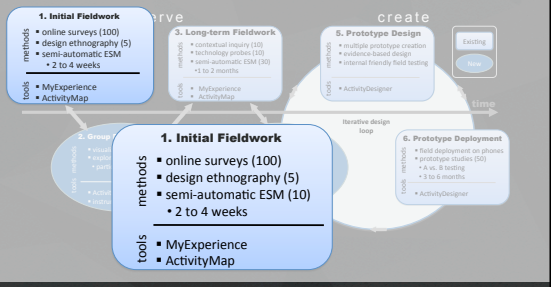
Courtesy Bill Buxton

Analytical Design Studio

Landay, Edge, Kientz, Kolko, Lee, Patel, Philipose, Ramey, Riche, Roesler, Zhao

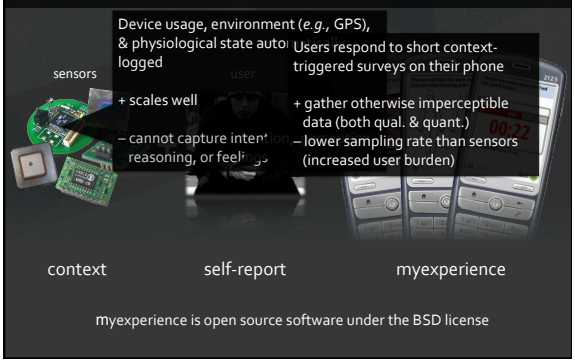


Analytical Design Studio



the myexperience tool

http://myexperience.sourceforge.net



myexperience is open source software under the BSD license

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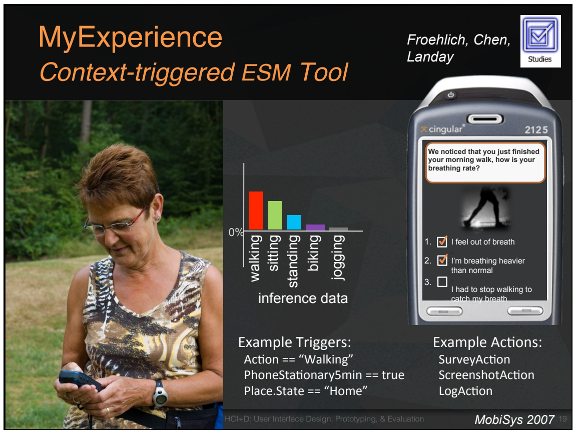
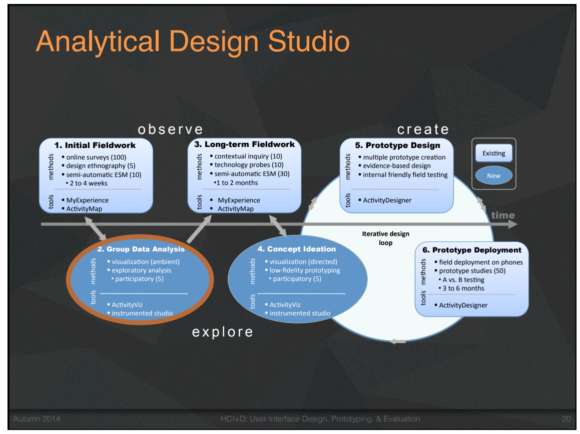
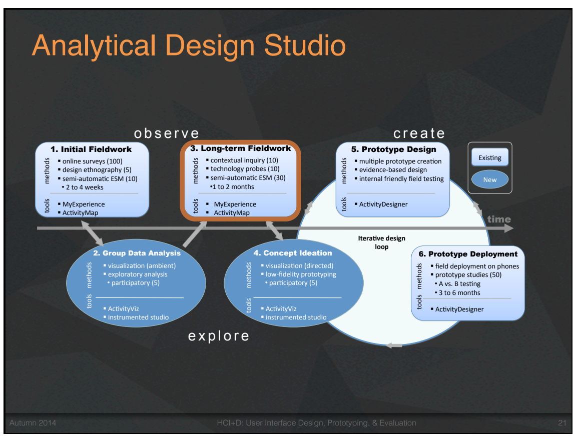
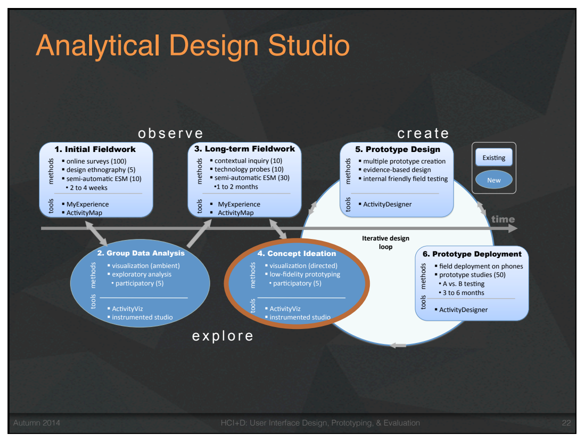
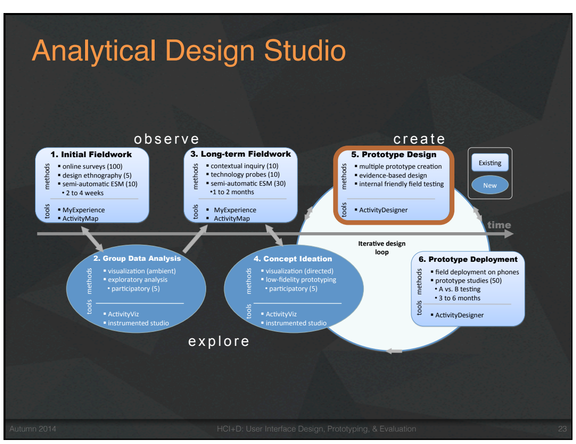
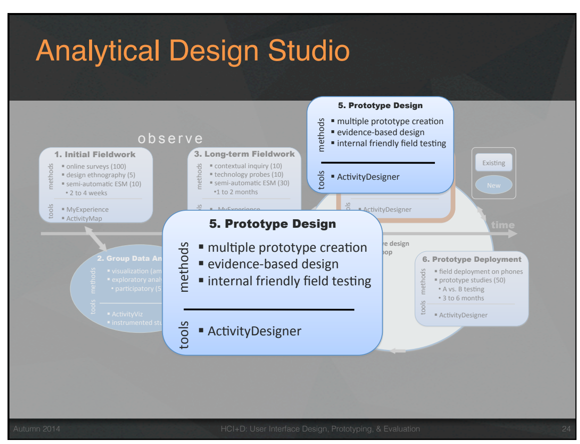








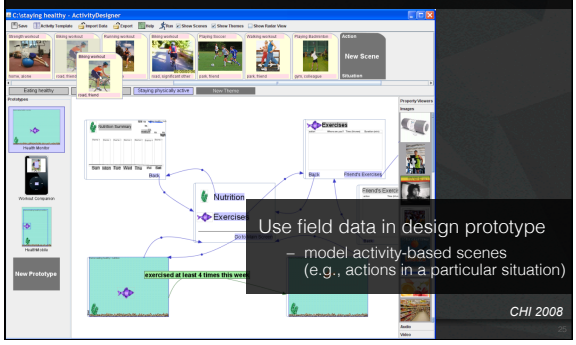




Activity Designer

Informal Prototyping for Activity-based UIs

Li, Landay Studies



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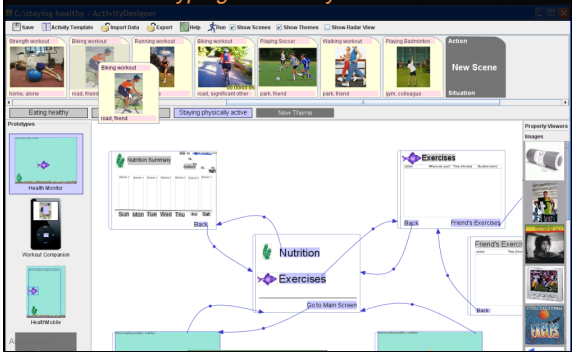
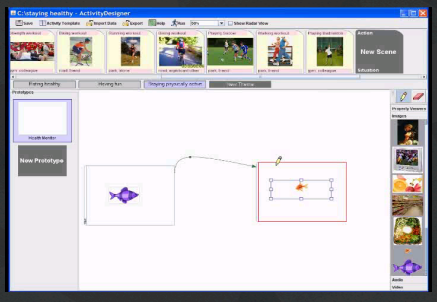


When the user has run in the gym 4 times this week show a goldfish on the display



Activity Designer

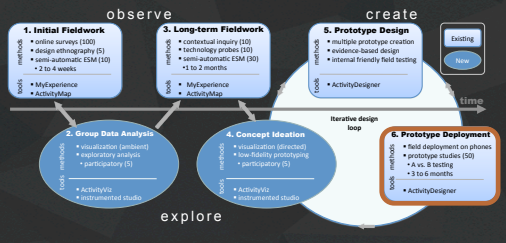
Informal Prototyping for Activity-based UIs

Li, Landay Studies

- Use field data in design prototype
  - model activity-based scenes (e.g., actions in a particular situation)
- Visually create user interface behavior
  - use scenes, actions, & situations directly
- Iterative design
  - Wizard of Oz or field test w/ actual devices
- Fast & fluid design
  - need not be a programmer

CHI 2008

Analytical Design Studio



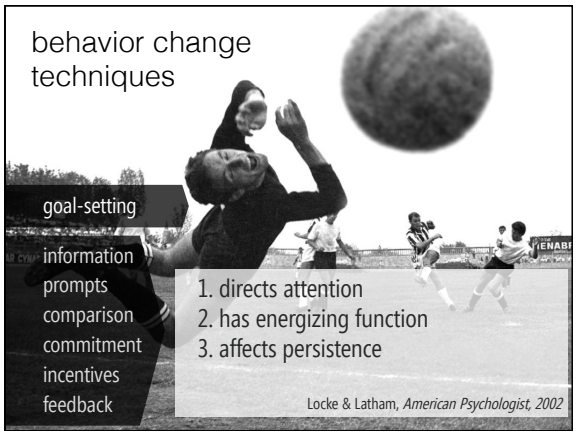
ubigreen

Giving people the tools to reduce resource usage

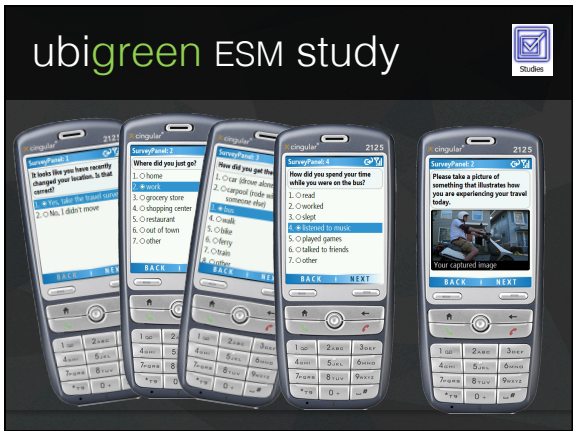
Activity

ubigreen combines **low-cost sensors**, **inference**, & **user feedback** to track resource usage & "reward" green behaviors

envisioned ambient display showing monthly and daily resource usage

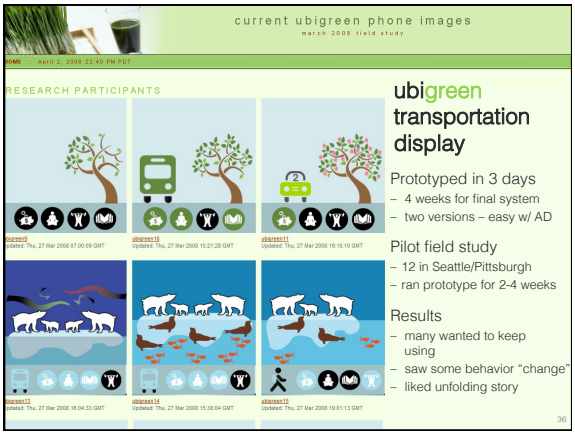

behavior change techniques
goal-setting
information
prompts
comparison
commitment
incentives
feedback
1. directs attention
2. has energizing function
3. affects persistence
Locke & Latham, American Psychologist, 2002

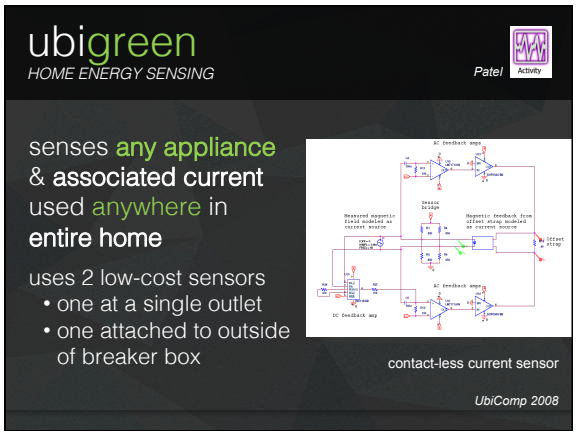

ubigreen
TRANSPORTATION DISPLAY
Froehlich, Dillahu, Klasnja, Consolvo, Harrison, Mankoff, Landay
senses transit behavior via mobile phone
ambient imagery on phone rewards green transit
CHI 2009

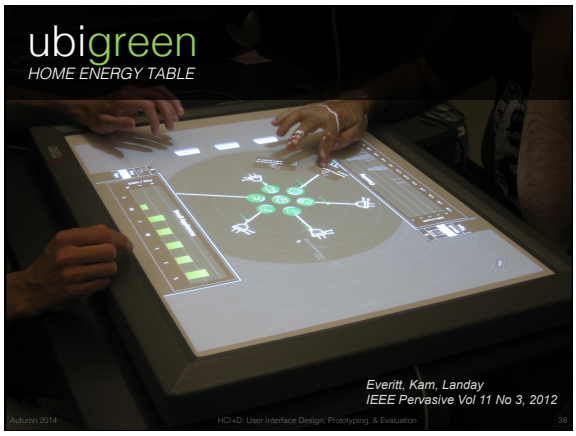

ubigreen ESM study
Studies

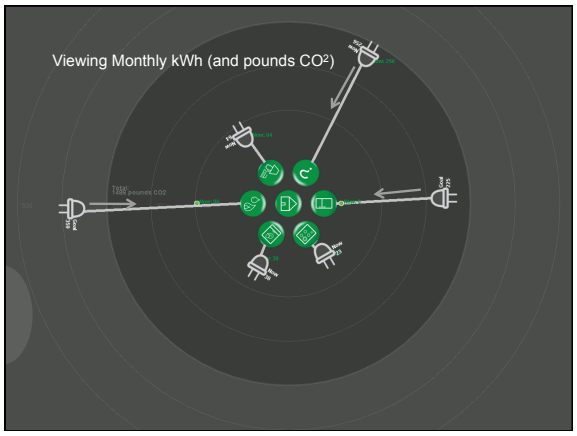

ubigreen design

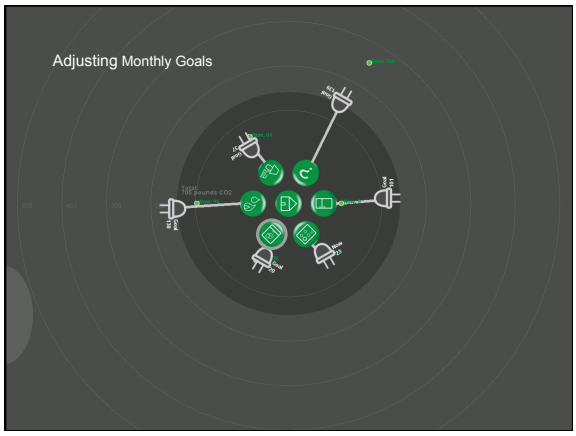

cingular
2125
7:27 PM
03/31/08
T-Mobile
Start
Contacts

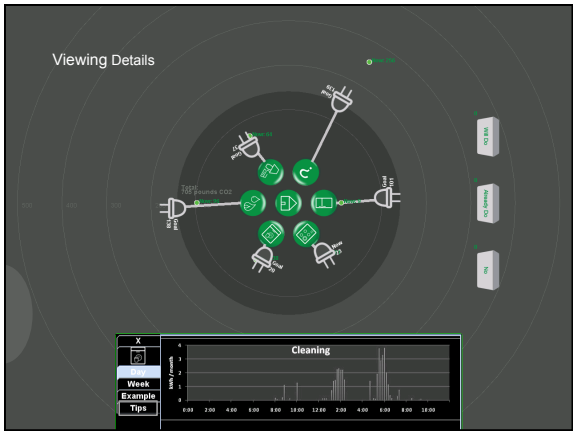

current ubigreen phone images
march 2008 field study
RESEARCH PARTICIPANTS
ubigreen transportation display
Prototyped in 3 days
– 4 weeks for final system
– two versions – easy w/ AD
Pilot field study
– 12 in Seattle/Pittsburgh
– ran prototype for 2-4 weeks
Results
– many wanted to keep using
– saw some behavior "change"
– liked unfolding story

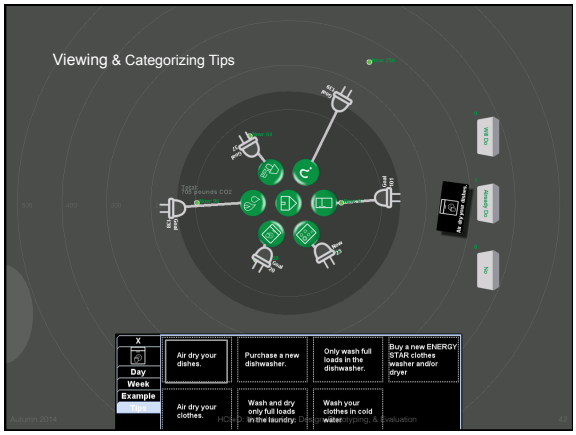

ubigreen
HOME ENERGY SENSING
Patel
Activity
senses any appliance
& associated current
used anywhere in
entire home
uses 2 low-cost sensors
• one at a single outlet
• one attached to outside of breaker box
contact-less current sensor
UbiComp 2008


ubigreen
HOME ENERGY TABLE
Everitt, Kam, Landay
IEEE Pervasive Vol 11 No 3, 2012


Viewing Monthly kWh (and pounds CO²)


Adjusting Monthly Goals


Viewing Details
Cleaning
Day
Week
Example
Tips


Viewing & Categorizing Tips
Air dry your dishes.
Purchase a new dishwasher.
Only wash full loads in the dishwasher.
Buy a new ENERGY STAR clothes washer and/or dryer
Air dry your clothes.
Wash and dry only full loads in the laundry.
Wash your clothes in cold water.

ubigreen

HOME WATER SENSING

Froehlich, Fogarty, Patel

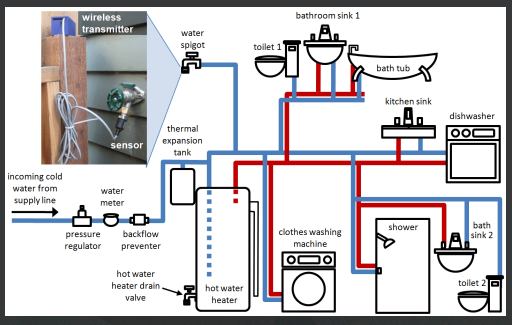
Activity

senses flow & fixture-level activity (e.g., particular toilet, dishwasher) using easy-to-install sensors

- installed at a single point

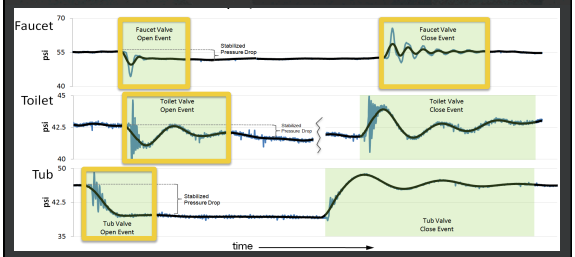
UbiComp 2009, Pervasive 2011

HYDROSENSE



PIPES TRANSMIT INFO

HYDROSENSE

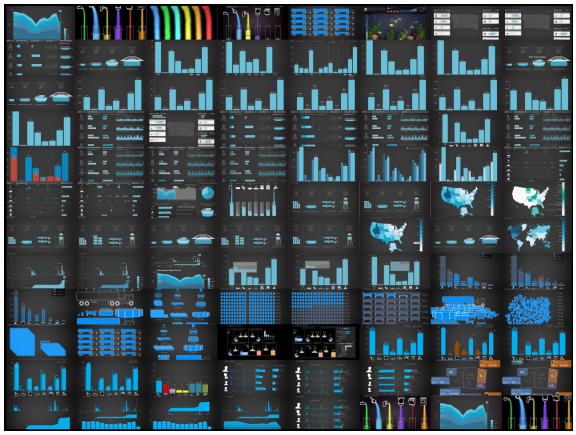


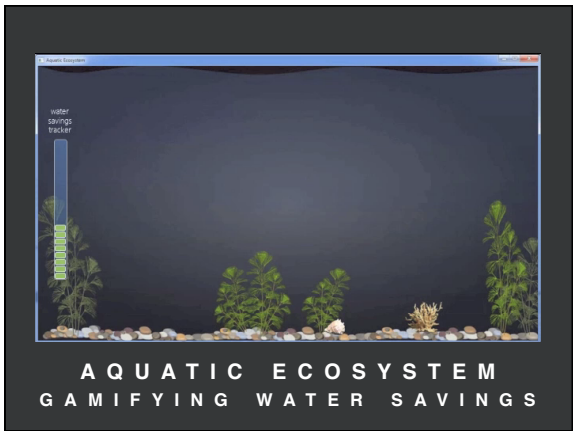
UNIQUE PRESSURE TRANSIENTS

HYDROSENSE

UNIQUE PRESSURE TRANSIENTS

Froehlich, et. al. CHI 2012





Administriva

- Midterm almost graded (Thur at latest)
- Pitch slide & poster due tonight
  - CA will give quick feedback so you can revise
  - put both on your web site
- Thur/Fri studio
  - present pitch (revise for evening)
  - demo app
- Fri Project Fair
  - 90 guests RSVPd (2/3 industry)
  - arrive 10 minutes early if pitching to line up
  - dress appropriately
- Writeup due Sat. at 6 PM

CS 194H

- Tue/Thur 2:15-4:05 PM
- Tue Lecture
- Thur Studio assignments & team time
- No midterm or final
- Counts for senior project (by pre-approved appeal)
- Please sign-up now if taking so we can get appropriate CA assignments

Activity-based UbiComp

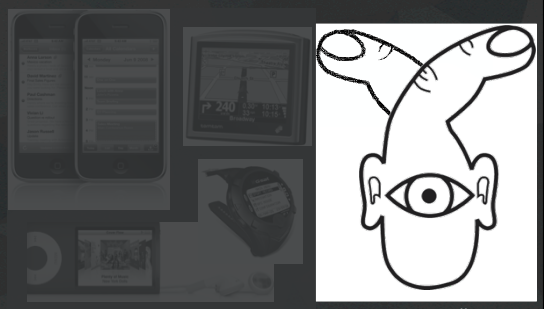
Key Challenges & New Ideas

Physical actions are tedious to record & manage
Build applications using ***action inference***

Must study in situ over extended periods
Use ***new methods & tools*** to improve data collection, analysis & application prototyping

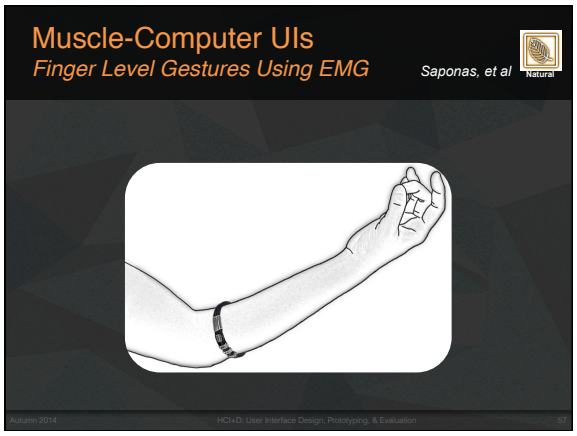
Natural interactions are ambiguous
Improve ***disambiguation*** using dynamic context

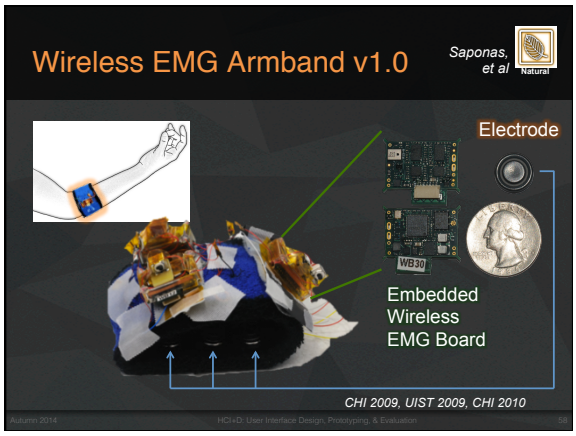
"How the computer sees us"



Igoe & O'Sullivan


Buttons & Touchscreens Insufficient
Hands Busy
Physically Active


Muscle-Computer UIs
Finger Level Gestures Using EMG
Saponas, et al


Wireless EMG Armband v1.0
Saponas, et al
Electrode
Embedded
Wireless
EMG Board
CHI 2009, UIST 2009, CHI 2010


Real-Time Classification of
Free Space & Hands Busy Gestures
Saponas, et al
Pinch
Mug
Bag
Participants achieved 85-90% accuracy
CHI 2009, UIST 2009, CHI 2010

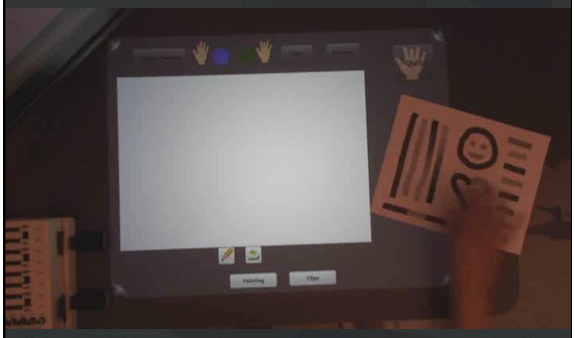

Wireless Air Guitar Hero

Augmenting Interactive Surfaces with Muscle-Computer Input

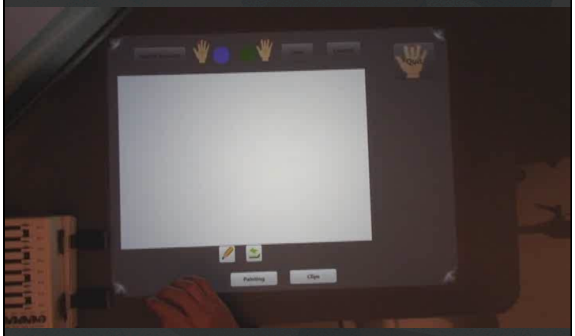
Benko, Saponas, Morris, & Tan

TableTop 2009

Pressure Sensing



Finger Identification



Off-Surface Interactions

Muscle-Computer UIs
Finger Level Gestures Using EMG

Saponas, et al

Use the appropriate recognizer based on the activity context

Continuous Language Learning

Edge, et al

CHI 2011

OsmoSys
Concept Video

Human-Computer Interaction Group
Microsoft Research Asia

ambivibe
ambient virbotactile displays

Meaningful vibration patterns based on
- amplitude
- duration
- rhythm of pulses

Cauchard, Vink & Landay

concept video
autonomous wandering interface

 Vink, Cauchard, & Landay

Want to Get Involved in Research?

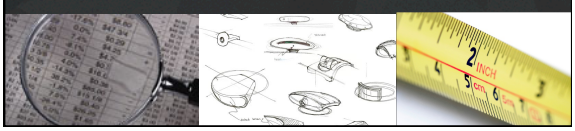
Ambivibe: Ambient Vibro-tactile Displays
Aim: Use vibrations to communicate with mobile devices
Applications: Health, Technology, Mobile, Behavior change…
Skills: iOS or Android, C

AWI: Autonomous Wandering Interfaces
Aim: Create interaction techniques for drones
Applications: Mobile, Gaming, Navigation…
Skills: C or Java, Kinect or OpenCV

Send resume + 1/2 paragraph with interests to:
cauchard@cs.stanford.edu

Activity-Based UbiComp Summary

Solve high value problems, improving our lives by using
- inference: actions & high level activities
- tools: for visualization, design, & user studies
- natural UIs: improve recognition using context




TEAM TIME
Autumn 2014
HCI+D: User Interface Design, Prototyping, & Evaluation
73