Connecting to the Emerging Nervous System of Ubiquitous Sensing

http://www.media.mit.edu/resenv

Prof. J Paradiso

Ireland- 3/12

The Age of Opportunistic Sensing

- Sensor networks are the foot soldiers at the front lines of ubiquitous computing
- At this point, few if any customers will buy an ensemble of "UbiComp" sensors
- They will aggregate from established devices
  - Home security, appliances, utility devices, entertainment…

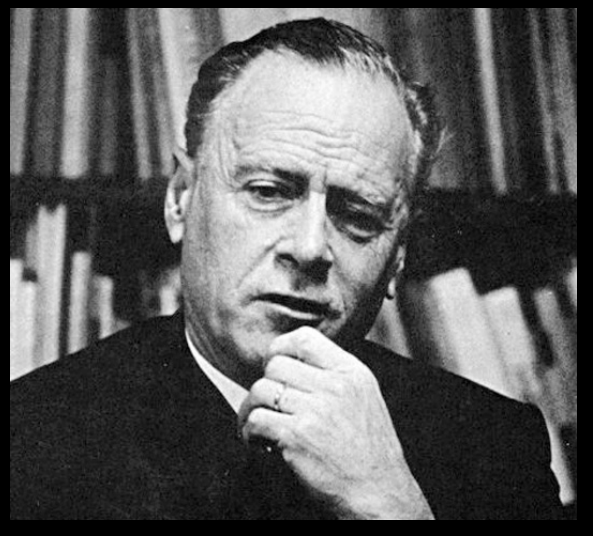
Just as the web sprouted from a networked ensemble of personal computers, true "ubicomp" will arise from an armada of networked devices installed for other purposes.

Marshall McLuhan, 1911-1980

"After three thousand years of explosion, by means of fragmentary and mechanical technologies, the Western world is imploding. During the mechanical ages we had extended our bodies in space. Today, after more than a century of electric technology, we have extended our central nervous system itself in a global embrace, abolishing both space and time as far as our planet is concerned. Rapidly, we approach the final phase of the extensions of man - the technological simulation of consciousness, when the creative process of knowing will be collectively and corporately extended to the whole of human society, much as we have already extended our senses and our nerves by the various media."

Marshall McLuhan - Understanding Media (1964)

Electronic media (a.k.a. television) as an extension of the central nervous system



Augmenting Human Perception

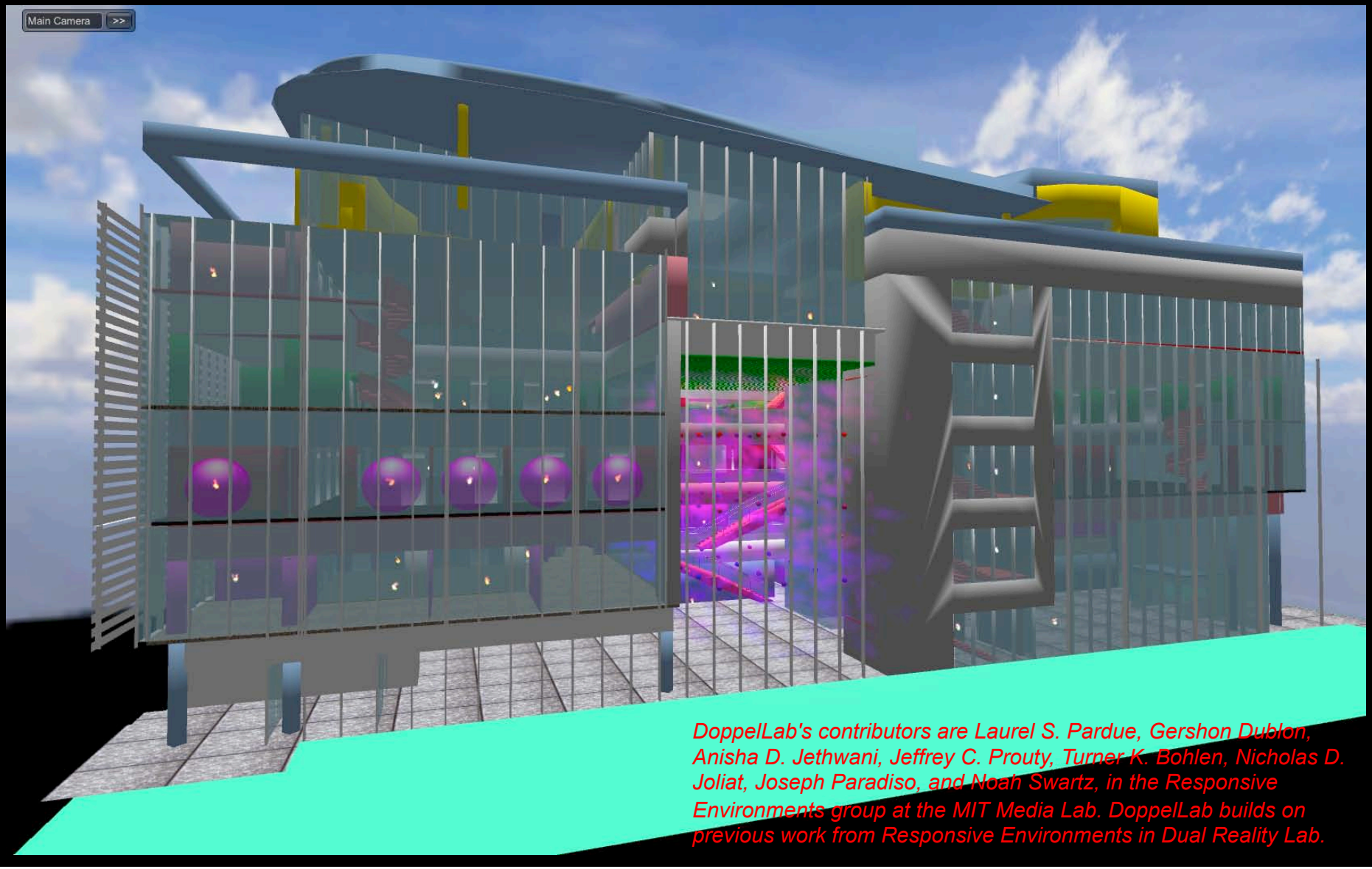
- Digital “Omniscience”
  - DoppelLab, Tricorders, Sensing for Safety
- Smart Environments as Prosthetics
  - HVAC comfort control (sense of comfort)
  - Responsive Lighting (enhancing vision)
- Sense of Proprioception
  - Sensing for Athletics
- Sense of Empathy
  - Socially Interactive Cameras

MIT Media Lab

doppellab

http://doppellab.media.mit.edu

Exploring Dense Sensor Network Data Through A Game Engine



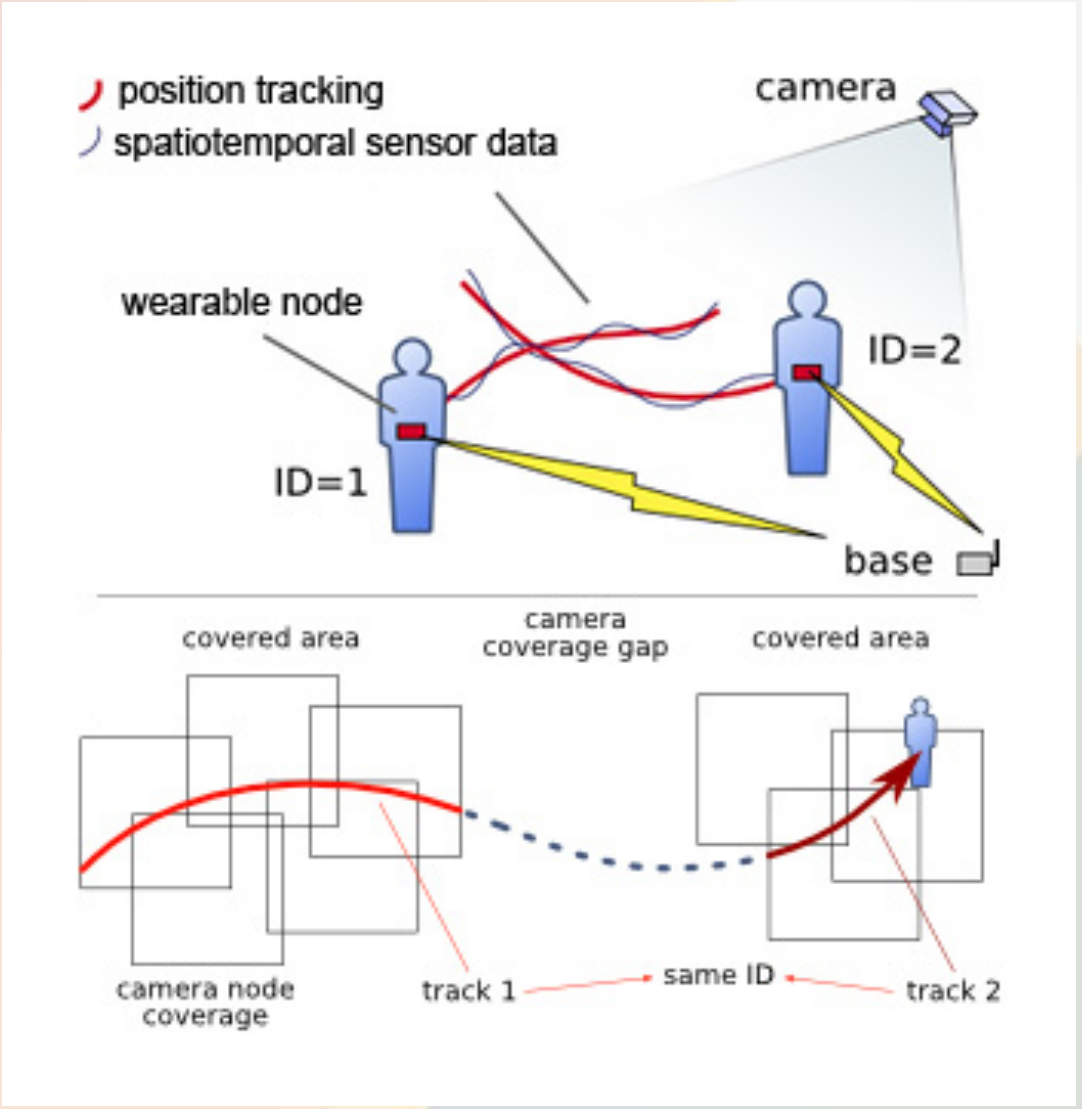
DoppelLab's contributors are Laurel S. Pardue, Gershon Dublon, Anisha D. Jethwani, Jeffrey C. Prouty, Turner K. Bohlen, Nicholas D. Joliat, Joseph Paradiso, and Noah Swartz, in the Responsive Environments group at the MIT Media Lab. DoppelLab builds on previous work from Responsive Environments in Dual Reality Lab.

Camera + Wearable sensor fusion

Camera (RF Basestations)

Intel Collaboration

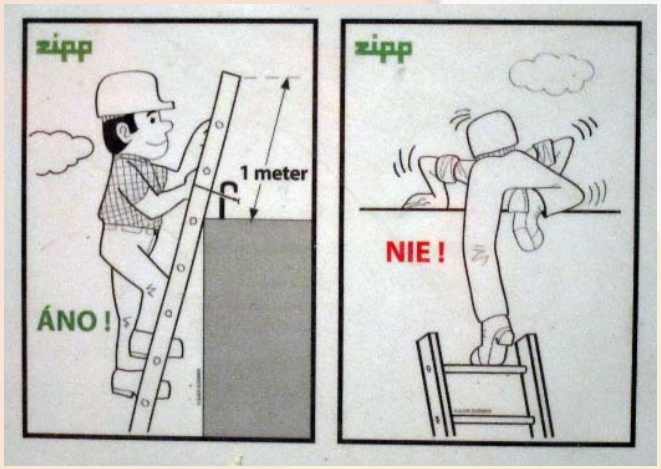
Wearables



New UWB radio will track location at cm-level

Gershon Dublon

Tracking & Activity Recognition for Worker Safety



Instrument building, infrastructure, workers on construction site

Gershon Dublon, Brian Mayton

Tracking & Activity Recognition for Worker Safety

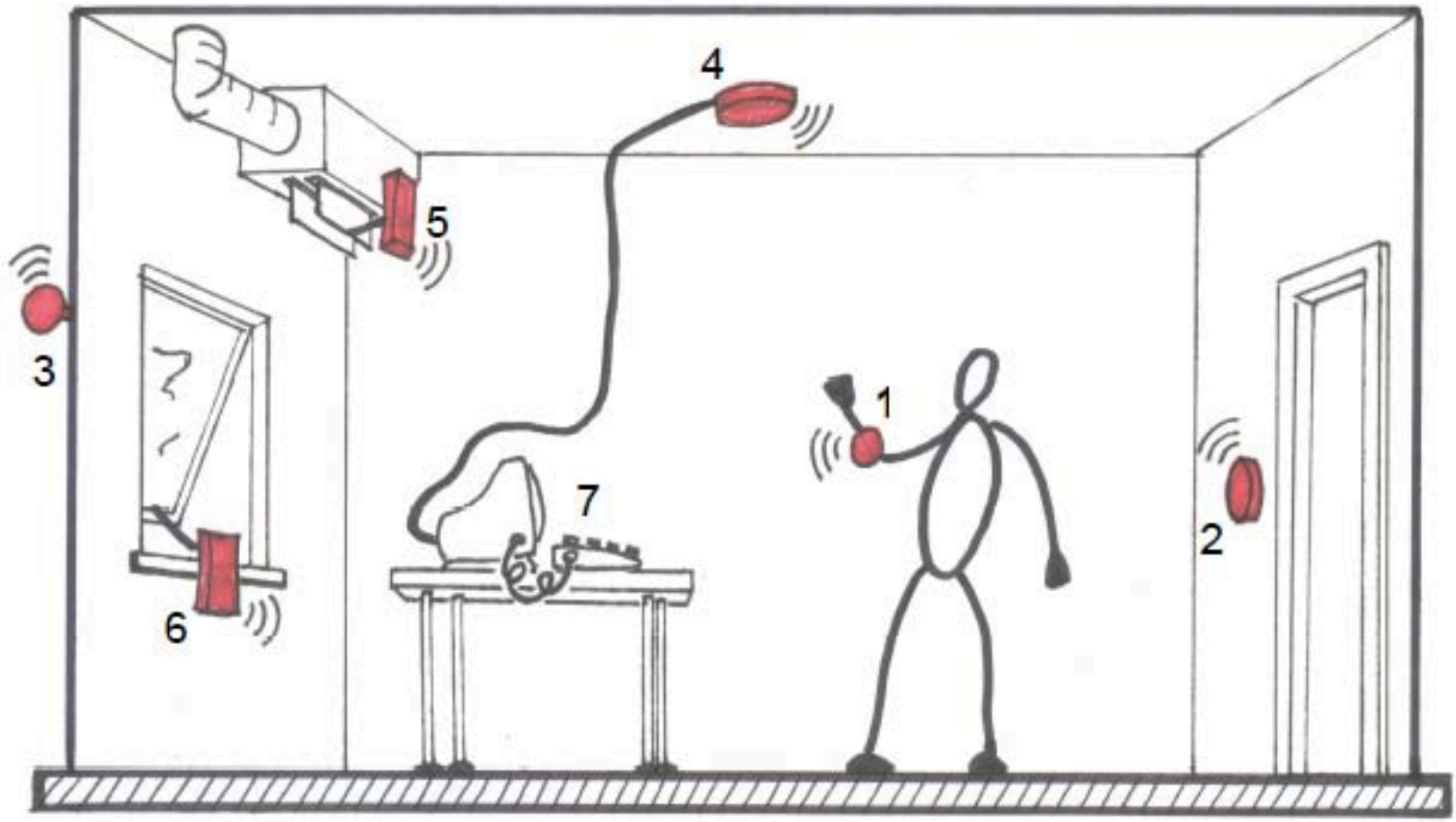
Base Stations *Wearables* *Plant*

Gershon Dublon & Brian Mayton
Resenv Group

Personalized HVAC Control System

Mark Feldmeier and Joseph A. Paradiso
Responsive Environments Group
MIT Media Lab

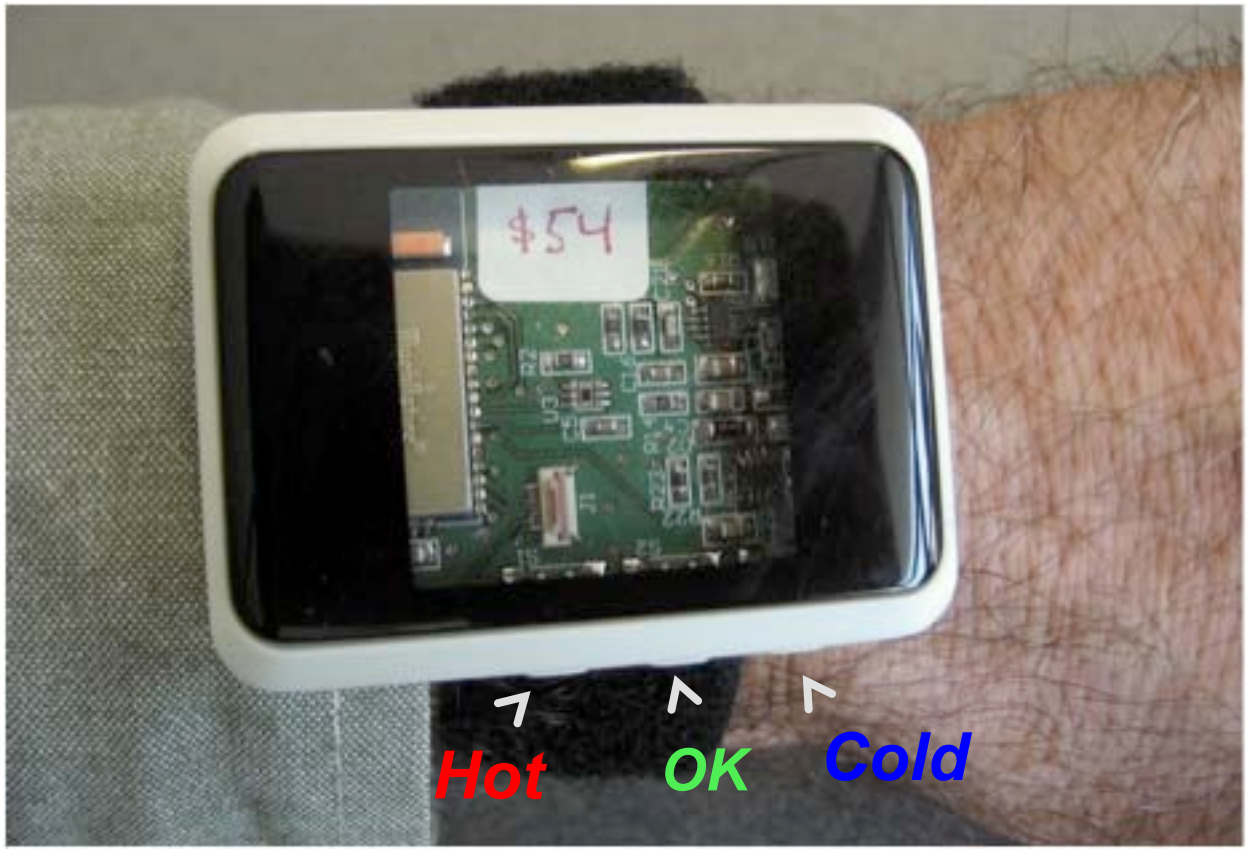
Personal HVAC Comfort Control



Feldmeier, Paradiso, "Personalized HVAC Control System," IOT Tokyo Nov. 30, 2010

Wireless Wearable Monitor

Sensors to infer wearer's comfort
Lasts 2-5 years on a coin cell battery

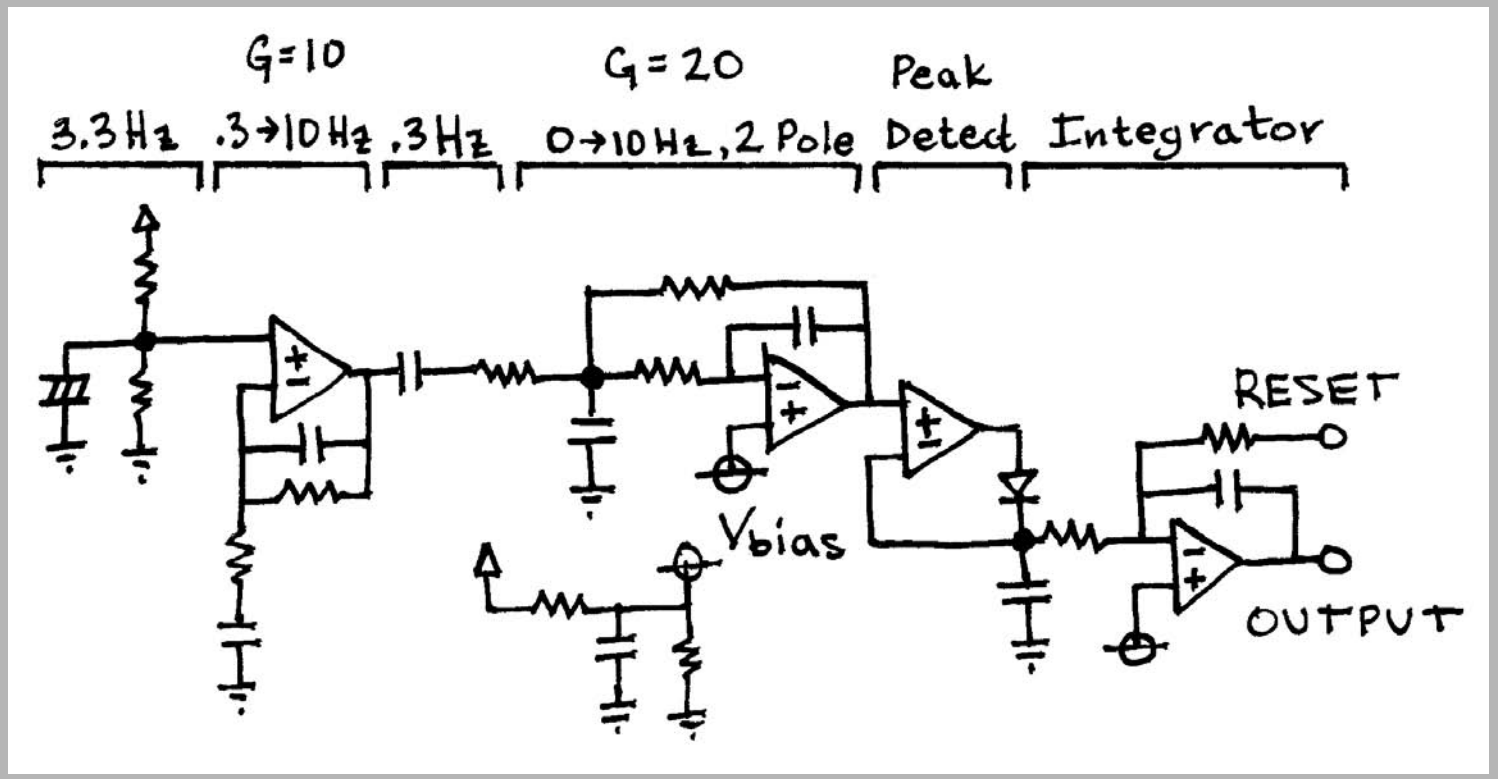


Mark Feldmeier

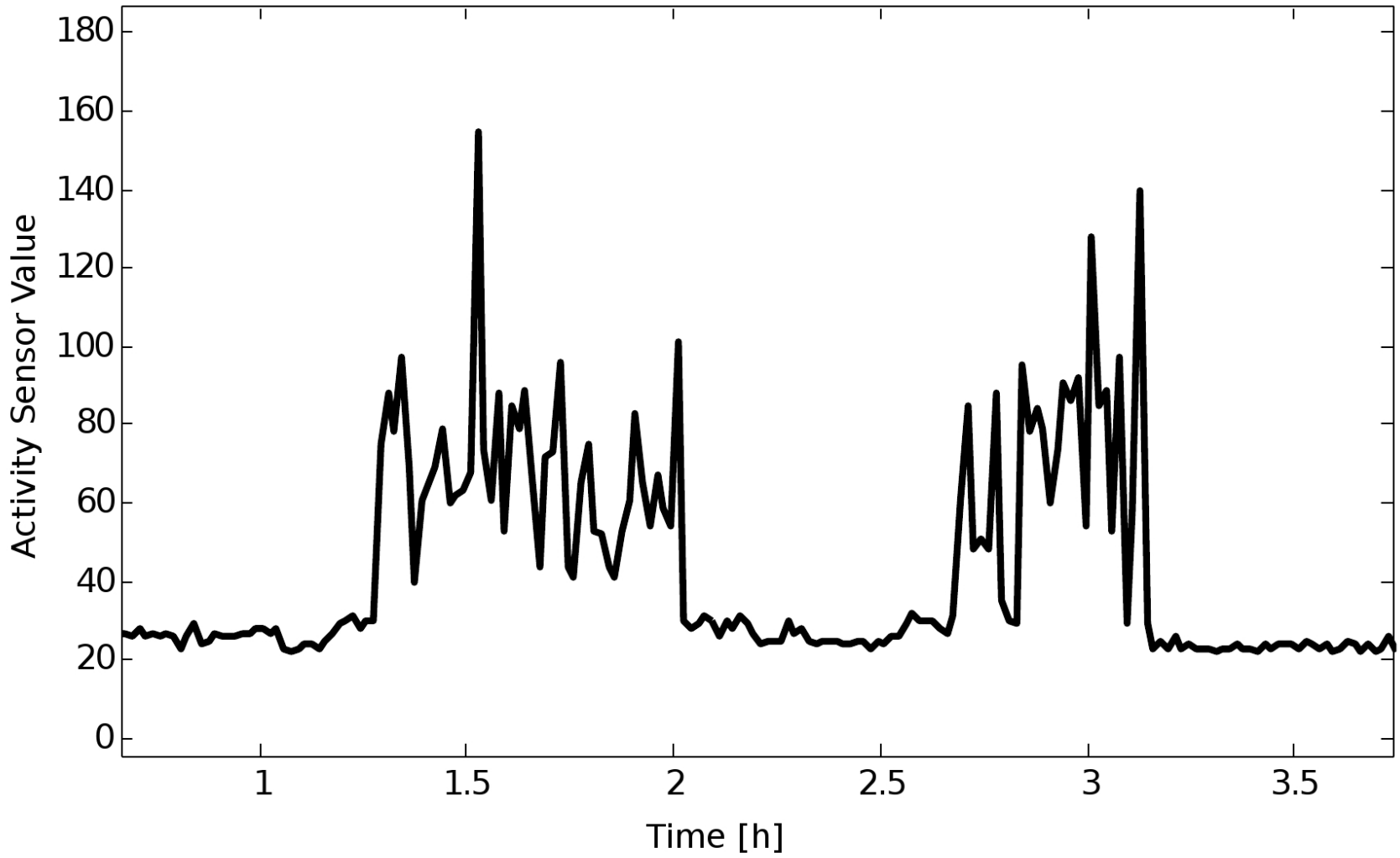
Integrated vibration, T & H, Light @ μW

LOW POWER ACTIVITY SENSOR

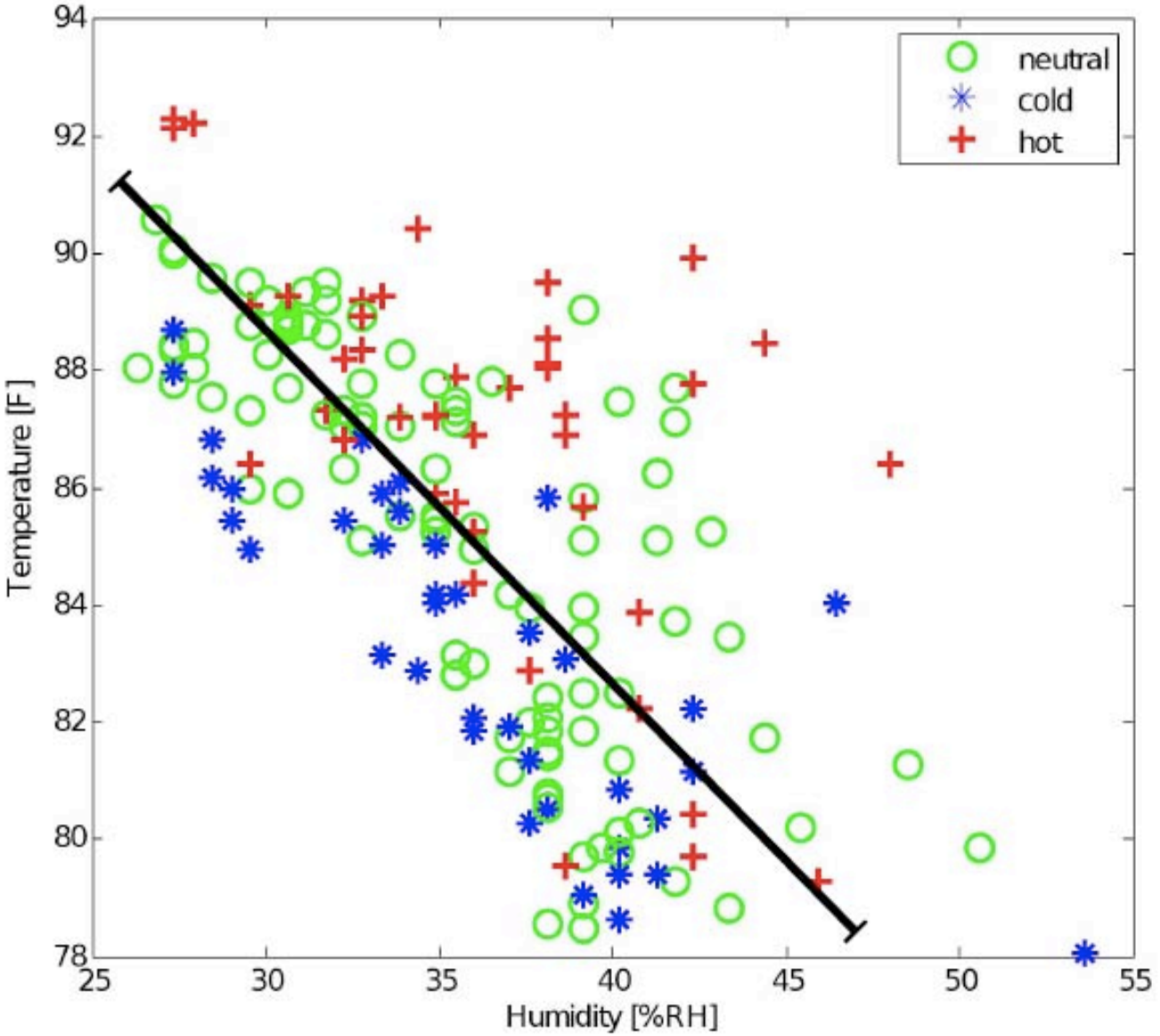
- *Passive, surface mount, piezo element (1:2:4 - x:y:z sensitivity)*
- *.1Hz to 10Hz frequency range*
- *Micro-power op-amps with low cross-over distortion*
- *1 minute integration time with reset*



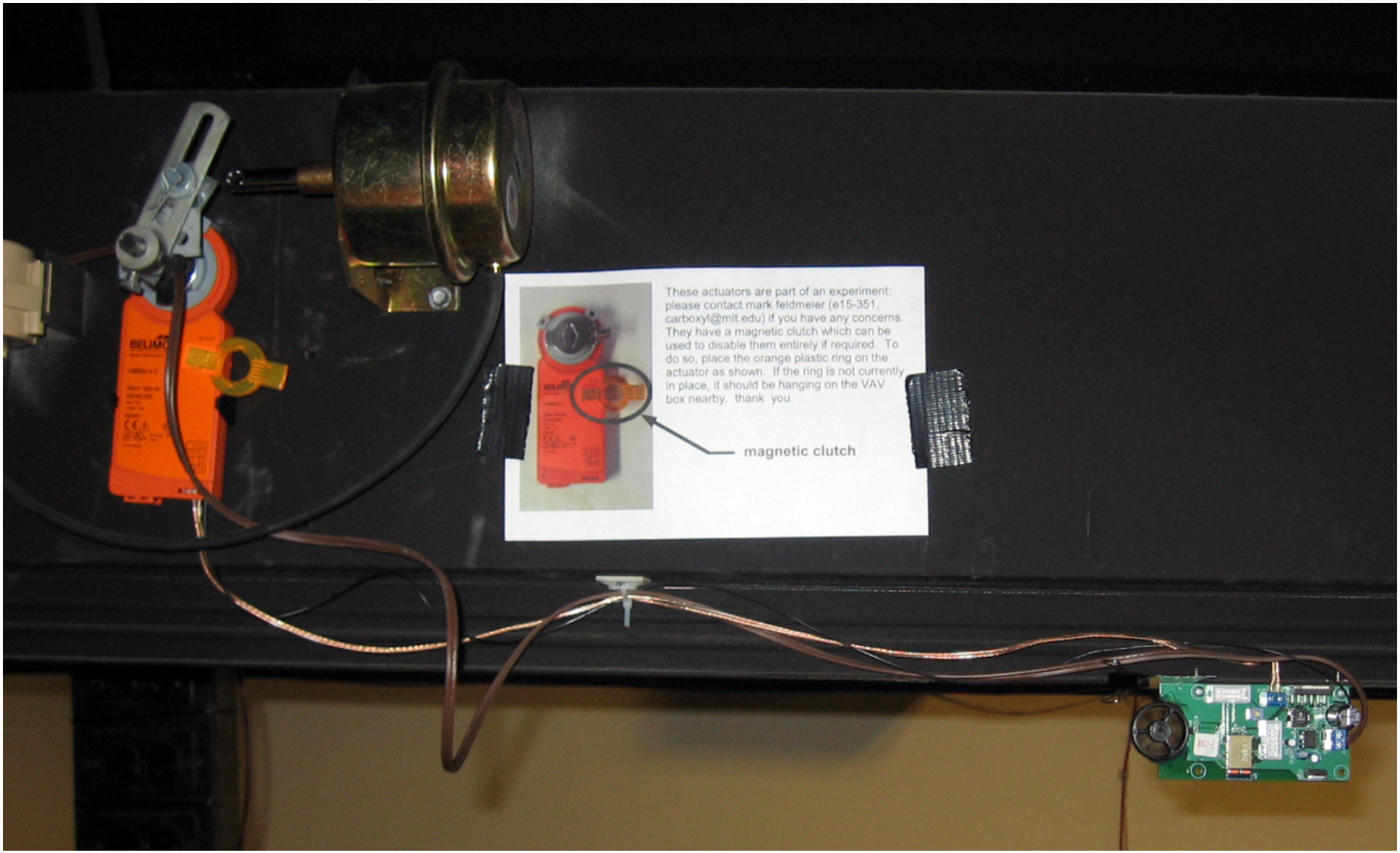
LOW POWER ACTIVITY SENSOR



Learning Comfort

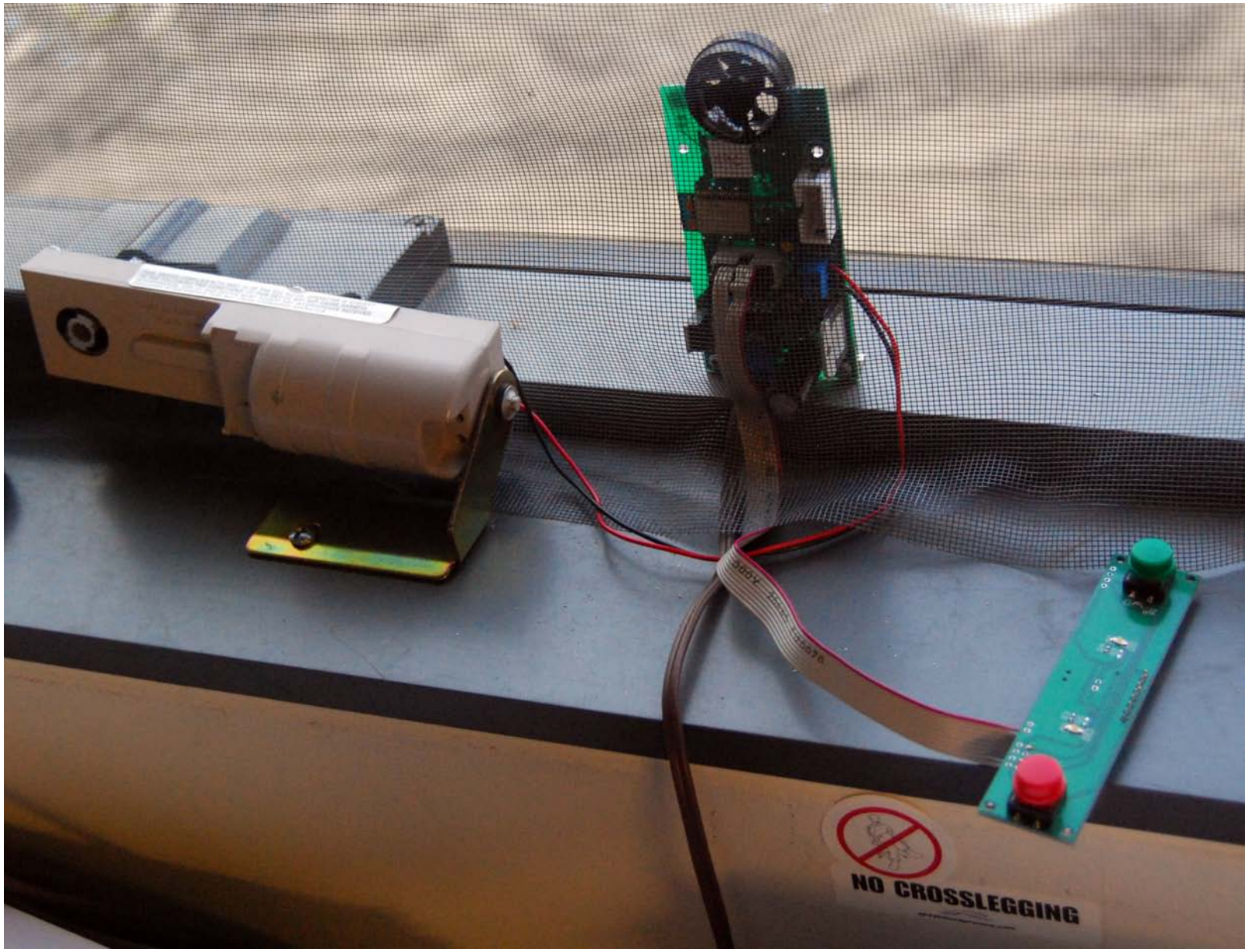


Ceiling HVAC Damper Control

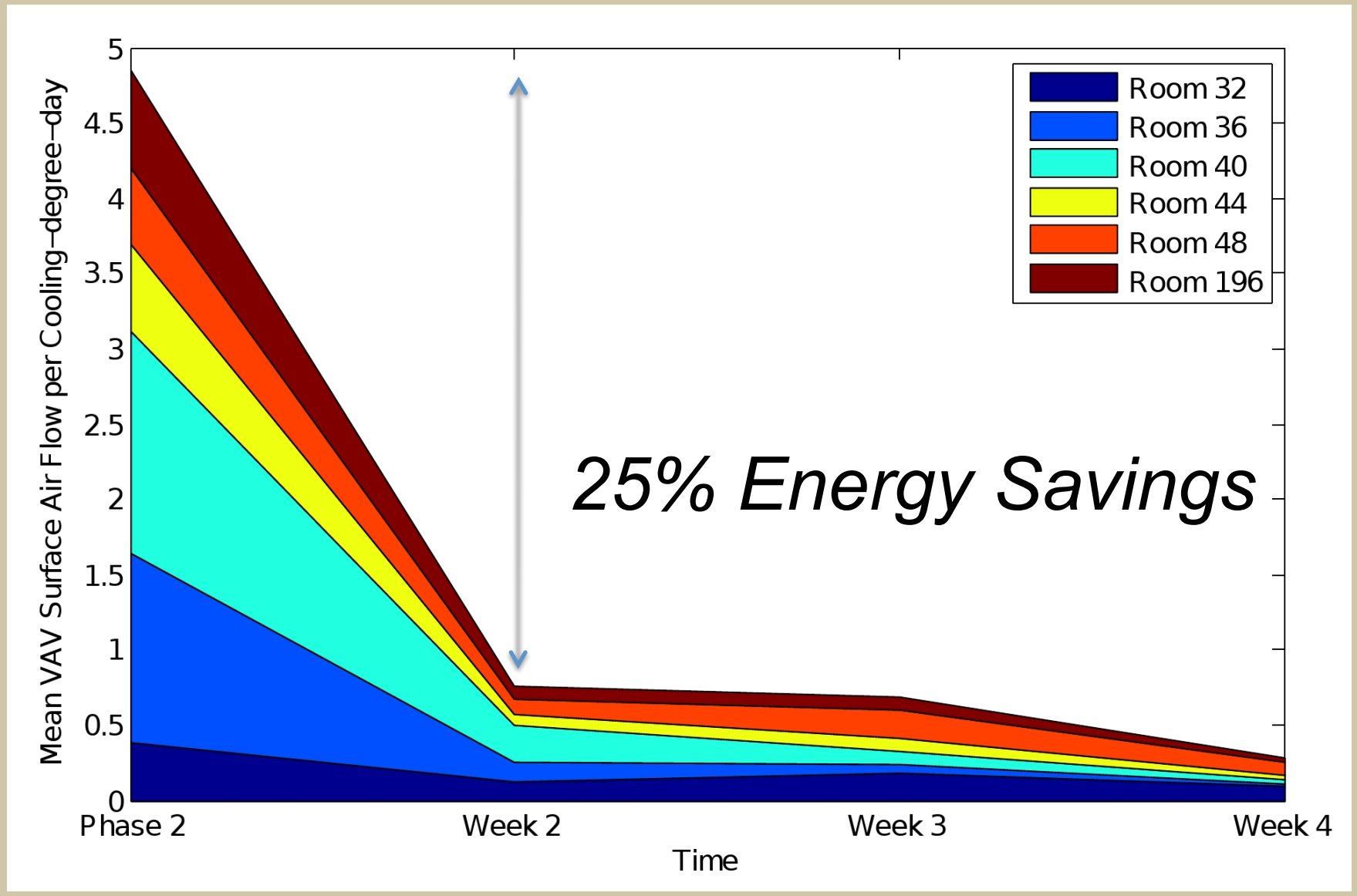


Measure temperature, humidity, airflow, PIR motion
Continuous Control of Damper

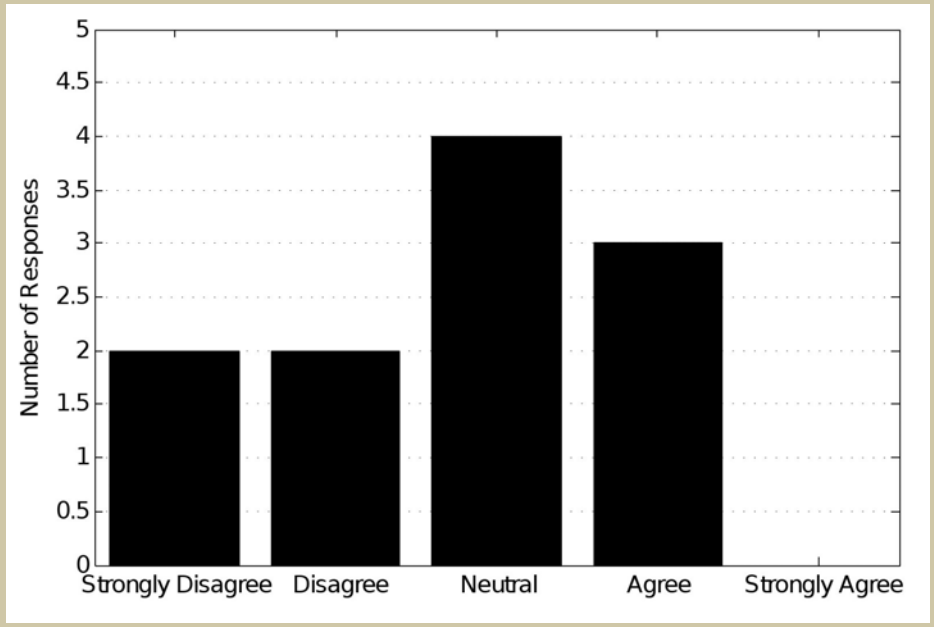
Open/Close Windows



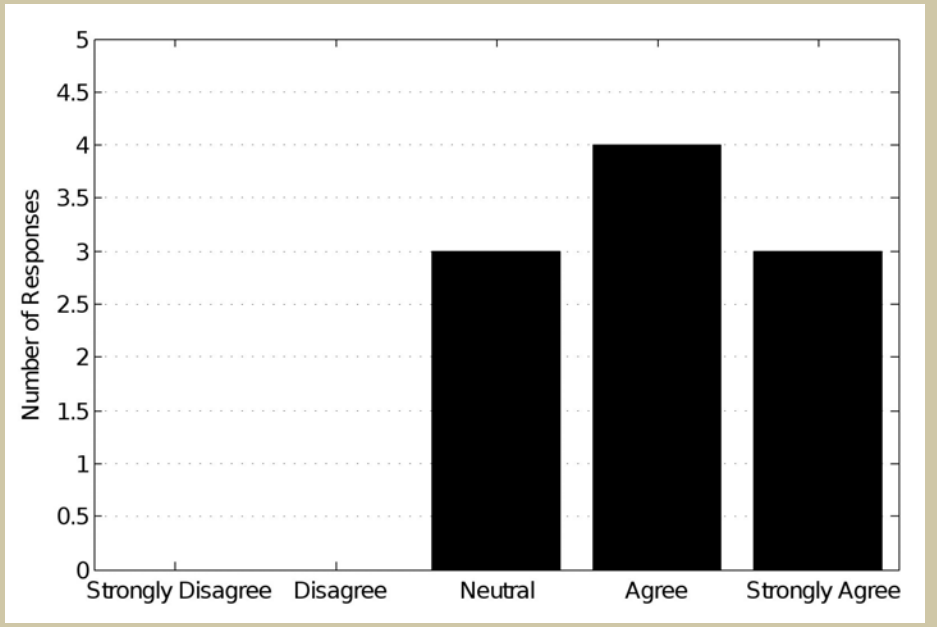
- *Average chilled air usage per cooling-degree-day*



- *Survey Responses: “Overall, I am satisfied with the comfort level in my office.”*

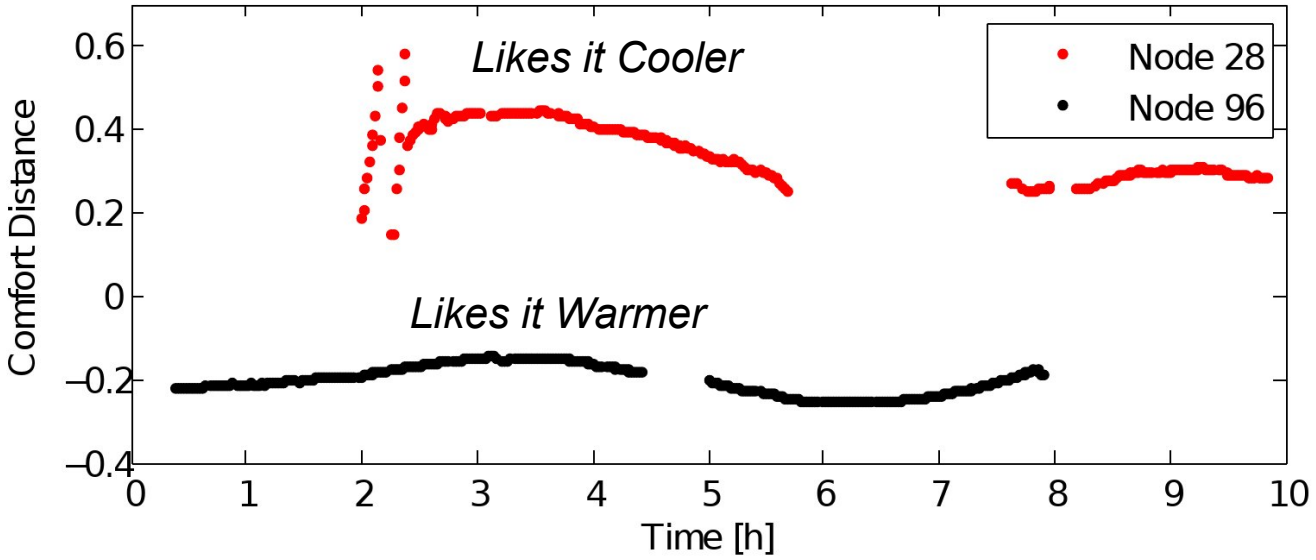


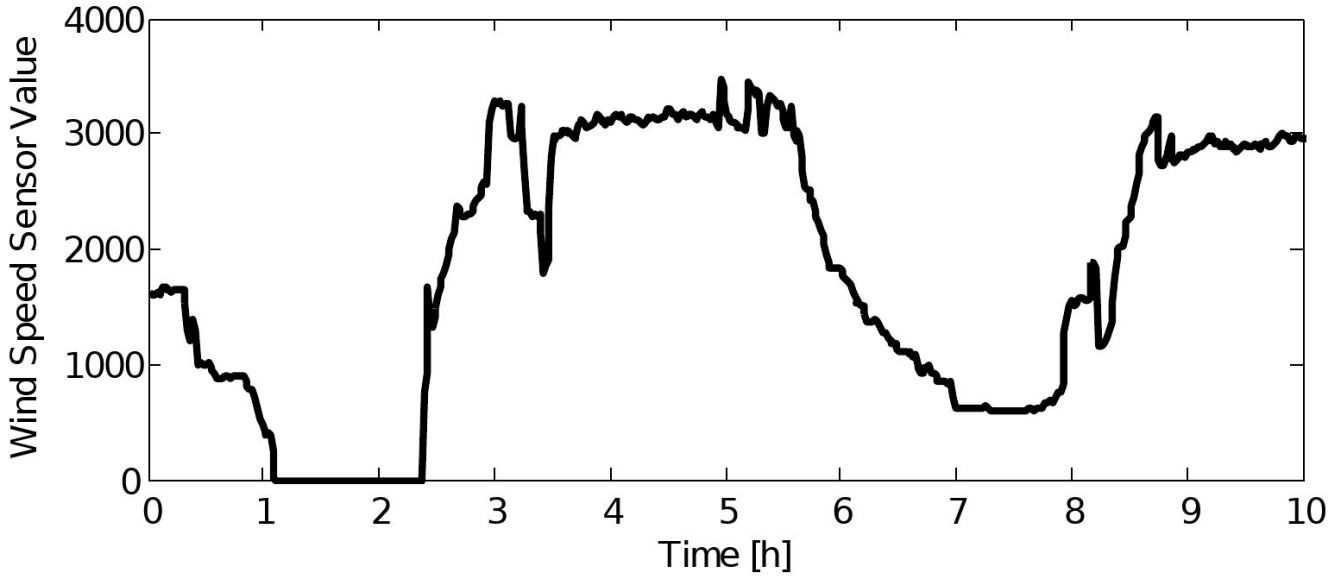
- *Before*



- *After*

Mediating Conflicting Demands





More Cool Air

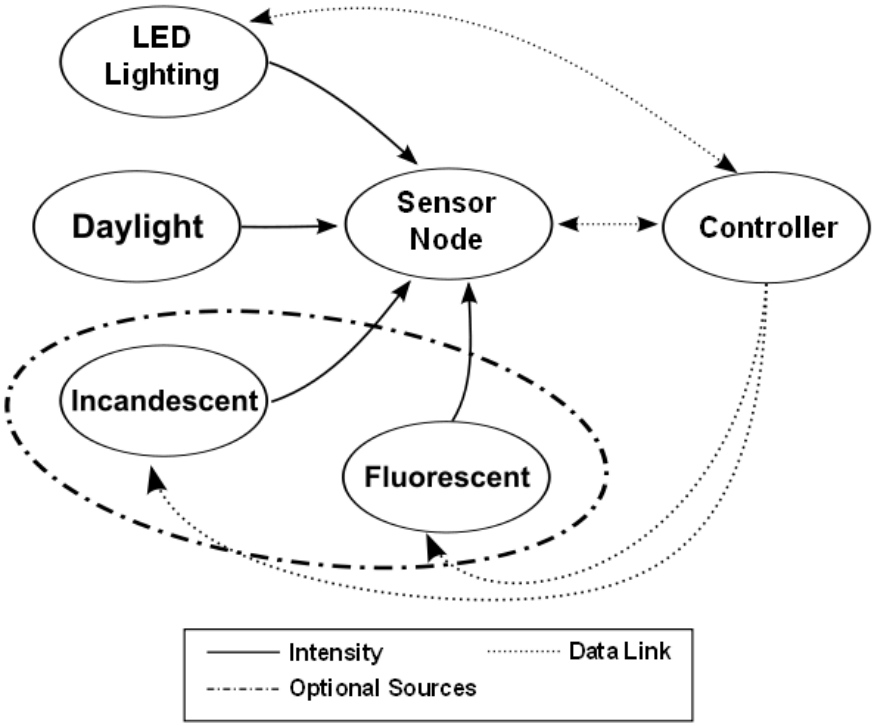
Less Cool Air

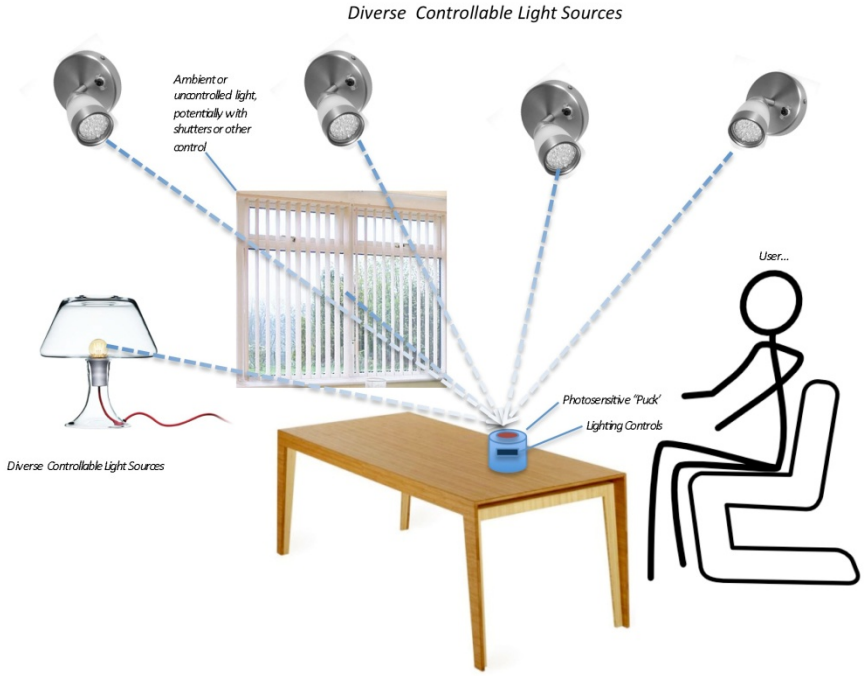
How do I turn on the lights?

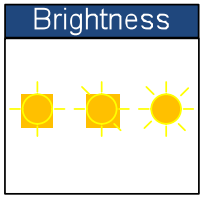
E14 Classroom

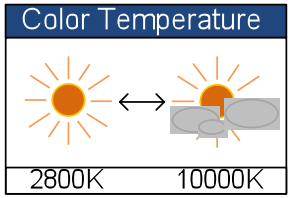
Efficient Sensor-Enabled Lighting

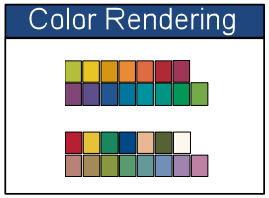
Matt Aldrich, Nan Zhao, and Joe Paradiso

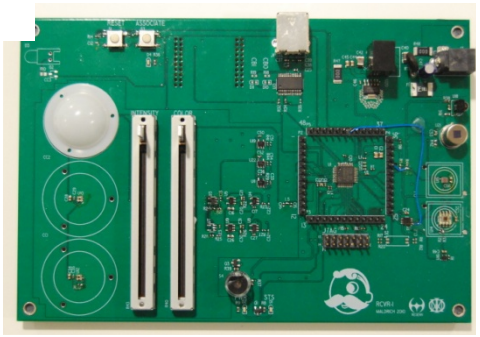


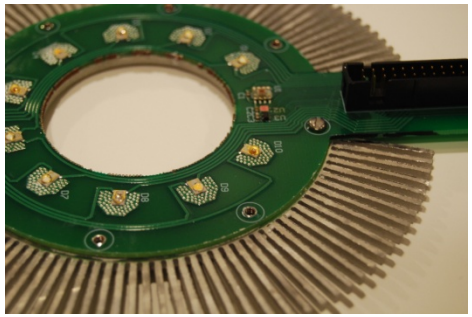




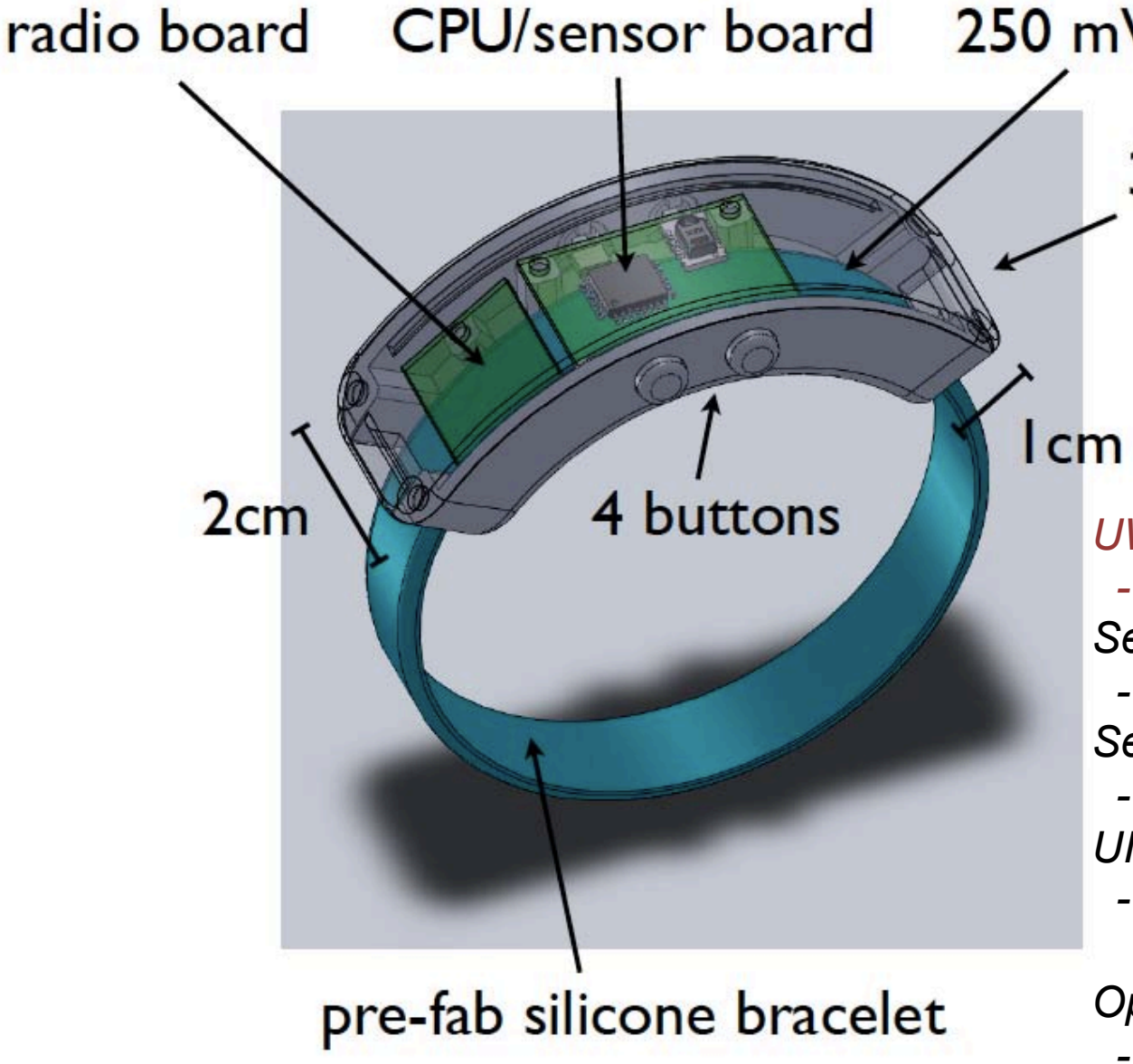








The WristQui (under development)



UWB Radio
- *cm-level positioning*

Sensors for comfort control
- *net activity, T/H*

Sensors for lighting control
- *synchronous light, color*

UI capability
- *buttons, capacitive slider, compass, IR*

Open doors, inductively recharge
- *battery lasts days or weeks…*

WristQui Hits a Viral Nerve….

wristque

About 24,300 results (0.14 seconds)

WristQue wireless bracelet offers smart home motion control ...
www.slashgear.com/**wristque**-wireless-bracelet-offers-smart-...

by Chris Davies · in 12,585 Google+ circles · More by Chris Davies
17 Jan 2012 – A sensor-packed wireless wristband could individually control home and office HVAC systems and, one day, act as a motion-sensing interface ...

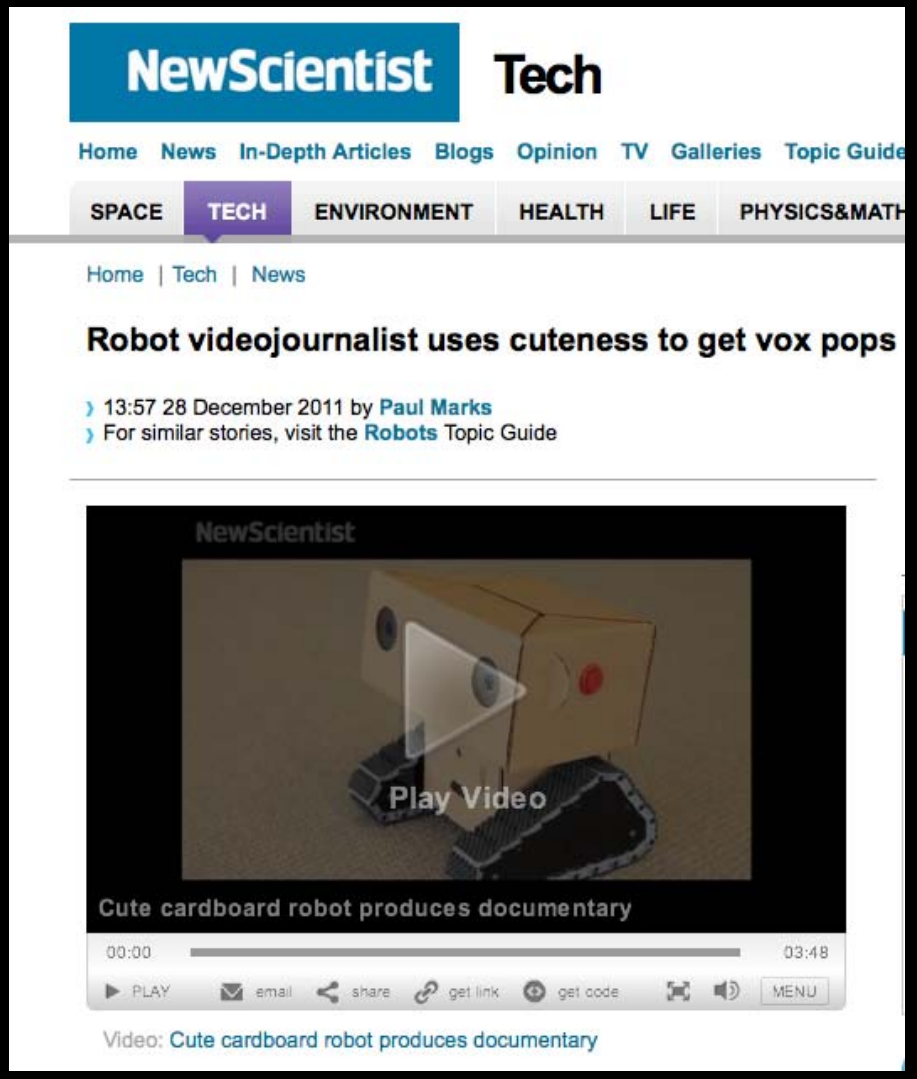
Wristband Lets You Control Office Temperature : Discovery News
news.discovery.com › Tech News
22 Jan 2012 – **WristQue** plugs you into smart buildings and allows you to adjust temperature and lighting levels from your wrist.

Wristband plugs you into smart buildings - tech - 16 January 2012 ...
www.newscientist.com/.../mg21328476.100-wristband-plugs-you-int...
16 Jan 2012 – That's one of the ideas behind **WristQue**, a project at the Massachusetts Institute of Technology that aims to create a low-power wristband ...

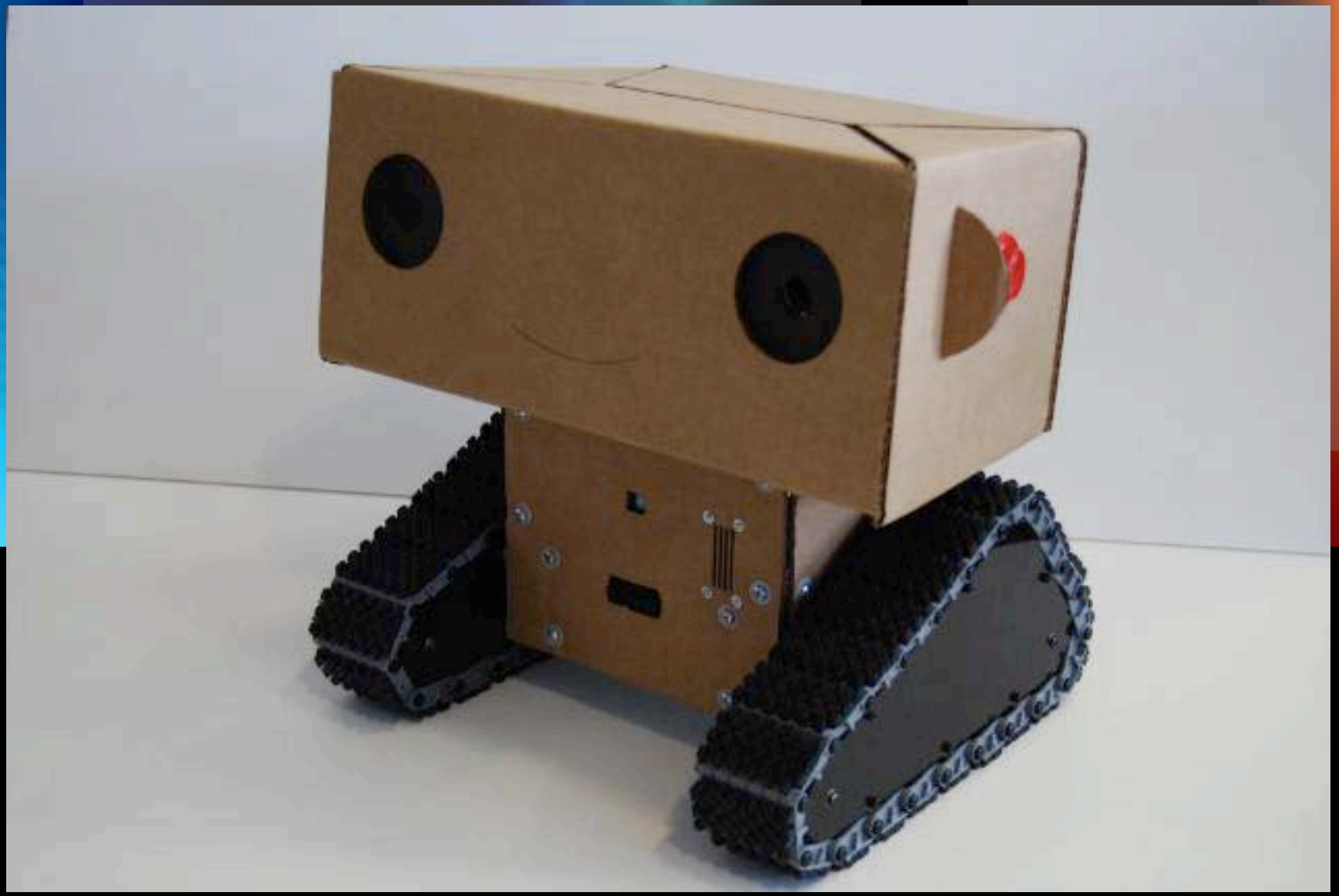
WristQue Wristband Has Been Designed To Control Your Smart ...
www.geeky-gadgets.com/**wristque**-wristband-has-been-designed-to-c...
17 Jan 2012 – MIT researchers Have been working on a new concept wristband called the **WristQue**, which has been created to allow you to interact with ...

Cold? With a Tap on The **WristQue**, You Could Change The ...
bostinno.com/.../cold-with-a-tap-on-the-**wristque**-you-could-change-t...
18 Jan 2012 – Called **WristQue**, the low-power wristband works with sensors embedded in buildings to monitor how you feel, and then helps adjusts their ...

Boxie – an interactive robotic camera



Boxie – Pull Stories from People

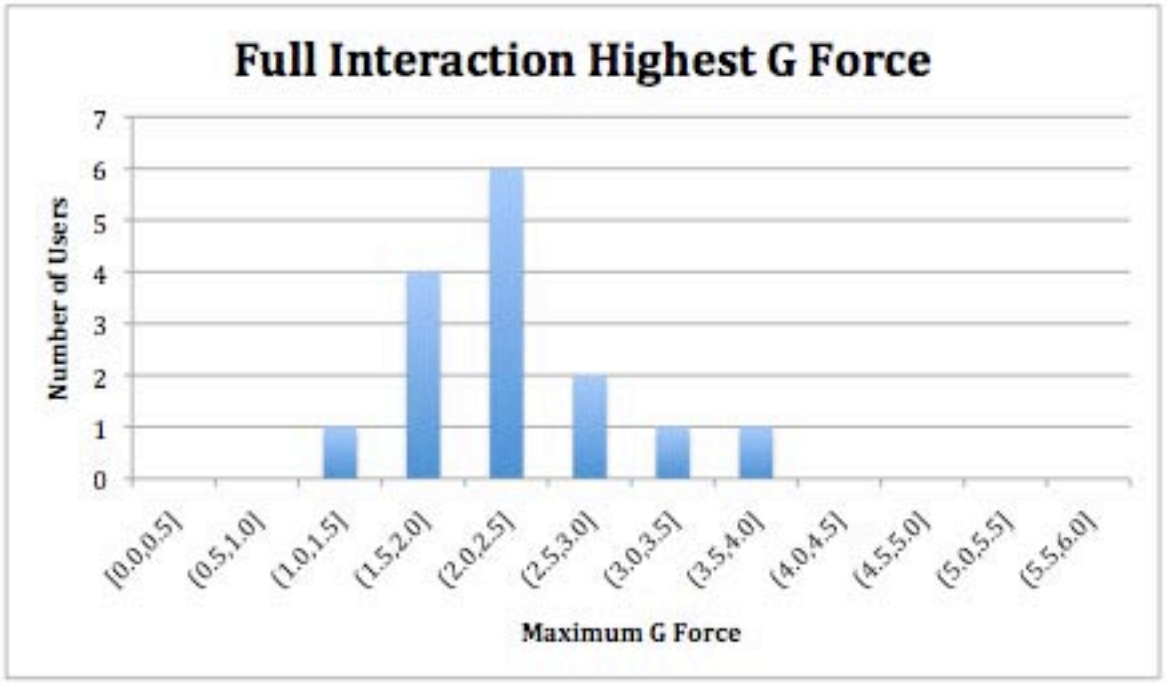


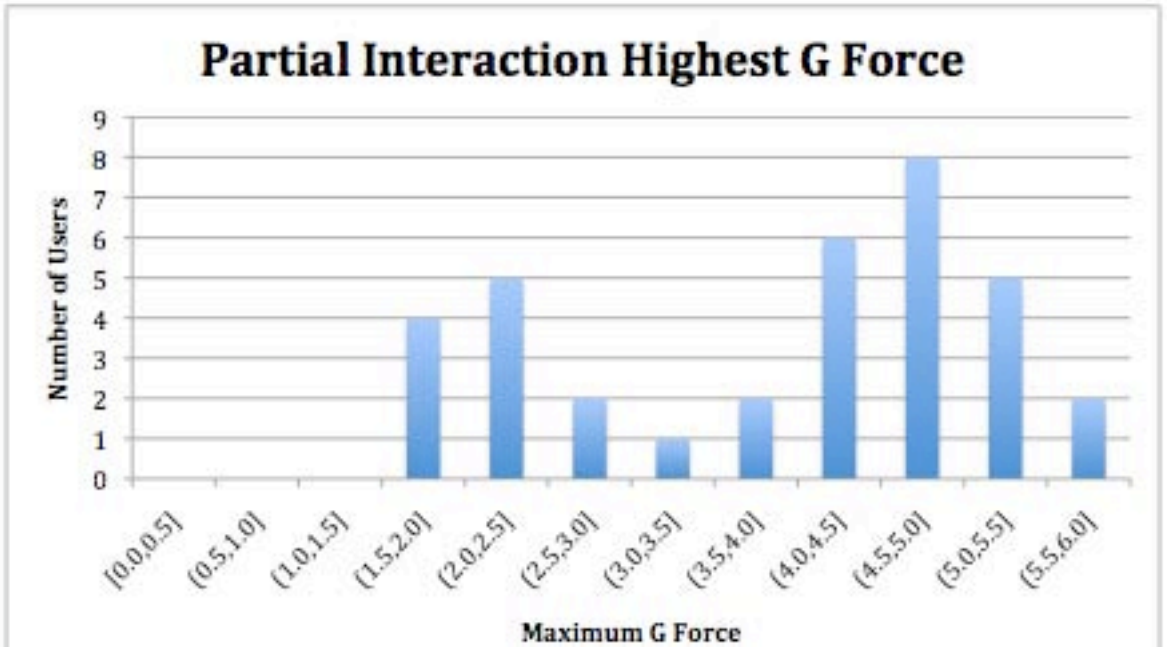
Interactive Camera…

Rough Handling…

People completing interaction:

People not competing interaction





Summary

- Sensors are getting out there, piggybacking on commercial products
- Once affordances are shared across devices, we're living in an ecology of devices & applications
  - This will happen fast once started
  - Phase transition into true Ubicomp
- A prime challenge for our community is how to interface humans to this electronic nervous system