Dual Reality
The Convergence of Virtual Worlds and Sensor Networks

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Things That Think Consortium Meeting
Dinner Break Out Session
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What characterizes us as human?

- thumbs
- bipedalism
- big brains
- language
- written language
- media
Relations to Media

CONSUME

COMMUNICATE

CREATE
Relations to Media

CONSUME
- books
- newspapers
- television

COMMUNICATE
- radio station
- printing press
- internet

CREATE
- movie
- novel
- website

higher barrier to entry

lower
What's Next?

CONSUMPTION made easy by broadcast television

COMMUNICATION made easy by the Internet

CREATION made easy by ??????

The answer comes in two parts.
Sensor Networks

the dream:  
- small
- ubiquitous
- cheap
- wireless
- invisible
- robust

the reality:  
- expensive
- unreliable
- research only
- obtrusive
- unmaintainable
- no killer app
- privacy concerns
Virtual Worlds

Many attempts, many failures

Potential to be as revolutionary as the WWW

Example: Second Life by Linden Lab

Key attributes:
- shared immersive experience
- persistent state
- market economy
- creative medium
Taxonomy of Reality

- Virtual Reality (all simulated)
- Mixed Reality (some real, some simulated)
- Augmented Reality (all real, some simulated)
- Reality (all real)

mono realities
Dual Reality

Two complete realities that can influence and leak into each other by means of ubiquitous sensor/actuator networks.
Perception = Reality Distortion

Dual Reality accommodates distorted versions of reality as well as the actual version.
Dual Reality Lab
Plug Sensor Network

Microcontroller
- 48 MHz
- 32 bit
- 64 KB flash
- 16 KB SRAM

4 Independent Outlets With Current Sensors & Digitally Controlled Switches

1.5W Speaker

Volume Control

Expansion Port
- SPI
- analog-to-digital
- PWM
- GPIO
- and more

USB 2.0

LED Indicators

Control Button

Microphone

Vibration Detector

2.4 GHz 500 kbps Wireless Transceiver

Input Voltage Sensor & Over-voltage Protection

JTAG Debugging & Programming Interface

Light Sensor
Why a Power Strip?

- always plugged in; no batteries to change
- familiar and ubiquitous
- well defined, yet broad usage scenario
- lots of interesting data
- perfect as a network backbone for other nodes
Multimodal Sensing

Plugging in a halogen lamp

Light

Sound

Current

Seconds (data sampled at 8kHz)
Rhythm of a Building
In Situ Sensor Network Browsing

• Inspired by *Star Trek*’s Tricorder
• 3D compass for orientation
• Wifi, Bluetooth, Plug radio, touchscreen
• Live updates from Plugs with ability to zoom in and out
• Point-and-browse
Example Applications

• telepresence
  – intentional: in-world teleconference
  – ambient: distributed water cooler

• avatar body language

• sensor movies and narrative generation

• alumni tours of campus as they remember it
What’s Next?

CONSUMPTION made easy by broadcast television

COMMUNICATION made easy by the Internet

CREATION made easy by virtual worlds & sensor nets
Sensor networks expand our senses across both time and space.

Virtual worlds are a forum in which to use these new senses.

If virtual worlds are the canvas, then sensor networks are the pallette.