Sensors: Abundant, Ubiquitous & Invisible

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Sensors

Our window to the world
Each sensor adds a little more detail
Our primary five senses...
...come with limits:

- In number
- In bandwidth
- In memory
- In networks
Sensors are exponentiating.
World Population
6.3 Billion  6.8 Billion  7.2 Billion  7.6 Billion
Connected Devices
500 Million  12.5 Billion  25 Billion  50 Billion
Connected Devices Per Person
0.08  1.84  3.47  6.58
Source: Cisco IBSG, April 2011
Today’s phone have plenty of sensors
- Accelerometer
- Magnetometer
- Gyroscope
- Barometer
- Humidity
- GPS
- WiFi
- Bluetooth
- NFC
- 3G/4G/LTE

- Fingerprint
- Touch screen
- Buttons
- Microphones
- Ambient Light
- Optical Prox
- Front Cam
- Back Cam
Wearables proliferate.
Networks of networks.
Sensors become uncountable.
Are we better informed?

We know:

- Weather in Cape Town
- Wait time at Space Mountain
- Traffic on Interstate 101
- Water Temp in Ocean Beach
- Ski Conditions in Tahoe
- Gas left in my car
- Temperature in my house
Are we better informed?

The data is too vast to comprehend.
“Data is the new natural resource.”
– Ginni Rometty
CEO, IBM
Its 62°. Its mostly sunny. Humidity is 63%. Bookshelf is 73% full. Milk is 3 days from expiration. Printer cartridge has 732 pages left. Gas tank has 4 gallons left. Fridge has 9 eggs left. Right front tire has 42 psi. Gmail has 273 unread emails. Phone bill is due in 3 days. You walked 3451 steps today.
Example:
The gas gauge.
Abundant sensors are not enough. We need the right information at the right time.
Sensors:

Abundant

Ubiquitous

Invisible
Ubiquity.
The wearable.

Devices now go everywhere.
The interface is vanishing.

Our effort is minimal.
Device effort is considerable.

The Third Wave

http://techdiem.com/2013/03/13/meet-homo-erectus-connect
The wearable

- But they’re just ‘toys’! Right?

- A vanishing point...

- This is the interface, cleverly disguised as jewelry.
Wearables

- Comfortable locations?
  - A half dozen or so.

- Highly constrained
  - Very light, very tiny, very low power, limited wireless
Wearables: Wrist

- Tracks activity
  - We use arms a lot
- Notifications
  - 10 seconds closer than a phone.
Wearables: Ear

- Audio speaker
  - Direct to ear (private)
- Audio microphone
  - Direct to user (private)
  - Always-on Siri?
Wearables: Eyewear

- Tracks head motion
  - We look where we think
  - Camera for what we see

- Notifications
  - 2 seconds closer. Zero wait.
  - Augmented Reality overlay.

- Audio speaker:
  - Direct to ear (private)

- Microphone:
  - Focused on user (private)

- Glamourous!?
Handset

- Old fashioned? Yes.
- But it's 3G/4G capable
  - Aggregation for wearables
  - Long haul wireless
- Lot of pixels; big screen
- Large storage
- Powerful processors
IOT: Internet of Things

- Sensors in the home
  - Context at home

Nest Thermostat

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IOT: Beacons

- Indoor positioning
  - Context goes shopping

Yellow T-shirt
It goes great with the jeans you like!
Trend is everywhere

- Mobile devices are travelling with us.

Ubiquitous Computing
Ubiquitous Computing

“The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.”

- Mark Weiser, Scientific American ’91
  CTO, Xerox PARC
Good Interface disappears

The point is not to have “no interface”, but to have an interface that we don’t notice.

Tesla Model S Door Handle

Nest Thermostat
Good Interface

Devices need to read people well enough that their natural actions/words are understood.

Google Now

Apple Siri
Good Interface

- The purpose of these devices is to serve you. To assist.

- Capt. Jean-Luc Picard
Context
Context

It’s a black box with limited view out to the real world.
Context: Voice

- Primary communication for humans

- Early efforts:
  - Siri / Google Now
  - Need stateful VR
  - “The usual”

- Need always-on audio
  - First efforts with MotoX
Context: Touch

- Babies learn touch early
- iPhone perfected it
**Context: Location**

- Home
- Freeway
- Work
- Coffee shop
- Grocery store
- Gym
- Garden
Context: Activity

- Standing
- Walking
- Sitting
- Sleeping
- Running
- Driving
- Watching
- Resting
- Exercising
- Playing
- Laying down
- Reading
Context: Online

- Online breadcrumbs tell a great deal about a person.
• What we choose to see, describes us as well.

Context: Visual
Abundant:

Too much data overwhelms.

Need contextual results.
Ubiquitous:

Broader information yields richer results.
Invisible:

Minimal interfaces serve simply.
Questions?

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