Exploratory Research

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Agenda

- CTG Mission

- Essential Computing Vision

- Intel Research Themes

- New Research Areas

- Closing Remarks

Research at Intel

St. Petersburg

Seattle

Hillsboro

Berkeley

Santa Clara

Chandler

Pittsburgh

Guadalajara

Braunschweig

Moscow

Barcelona

Haifa

Beijing

Shanghai

Bangalore

- **Nearly 1000 researchers**
- **15 locations worldwide**
- **Innovative research models**

Corporate Technology Group Mission

- Conduct world-class research

- Deliver innovative technologies from concept to product adoption

- Collaborate with industry via standards, alliances and evangelism

- Engage worldwide for the best research and technology

CTG Focus Areas

Tera-Scale Computing

Scalable computing for the future

Energy-Efficient Platforms

Workload-driven, optimal energy usage

Wireless

Mobile Broadband and Advanced Wireless Platforms

Carry Small, Live Large

Ultra-mobile platforms and usage models

Exploratory Research around the World

★ Seattle

★ Oregon

★ **Network of Open Research Lablets**
★ **Co-located with top Universities**
★ **Connection to Research Community**
★ **Internal Research**

Israel ★   **India** ★

Seattle ★
Pittsburgh ★
Folsom ★
Oregon ★
Berkeley ★
Santa Clara

★ Pittsburgh

★ Berkeley

Intel Research Mission
"Drive off-roadmap, high-impact exploratory research vital to Intel"

(intel)

"Essential"

Essential Computing

Simplifying and enriching all aspects of work and daily life

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Personal Awareness
"Empower me to achieve the goals I value most"

Richly Communicative
"Easily form and enrich relationships"

Essential Computing

Physicality
"Actuating everyday objects"
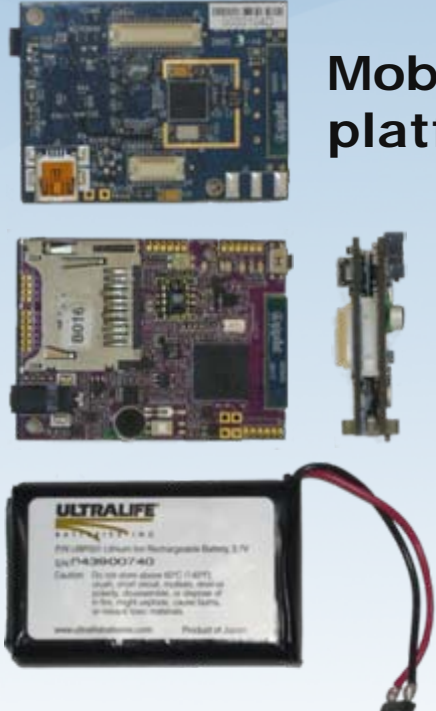
Concealing Complexity
"Technology that just works"

Data Rich
"Unleashing Internet-scale data"

Biosensors
"Coupling Bio and Info Systems"

(intel)

Mobile Sensing Platform

Fitness device

Mobile sensing platform

Battery

Multi modal sensor integration to detect activity, emotion, intent and engagement levels

(intel)

Human Activity Recognition

- Goal: Improve variety, detail, dev time and accuracy of human activity recognition by 10-100x

- Research Challenges
  - Sensor Systems
    - iBracelet
    - Mobile Sensing Platform
    - WISP
    - Wireless Shake Sensor
  - Sensemaking - machine learning
    - Rich statistical models of daily life
    - Fast algorithms for inference
  - Understanding of application domain requirements and structure
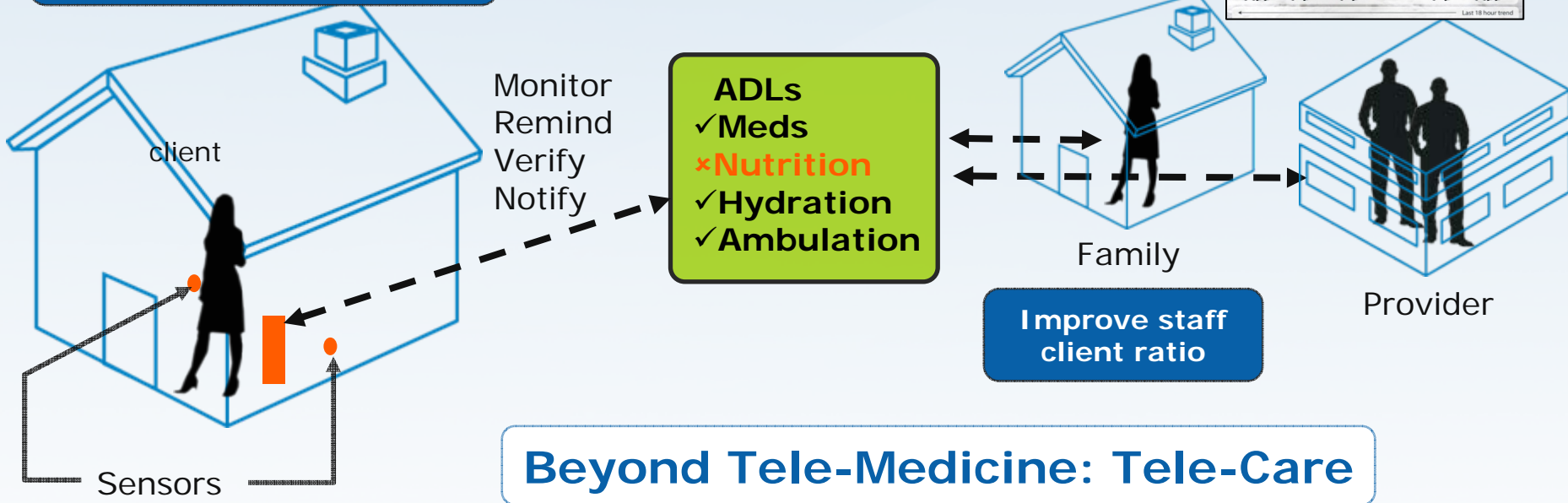
Sensor Systems
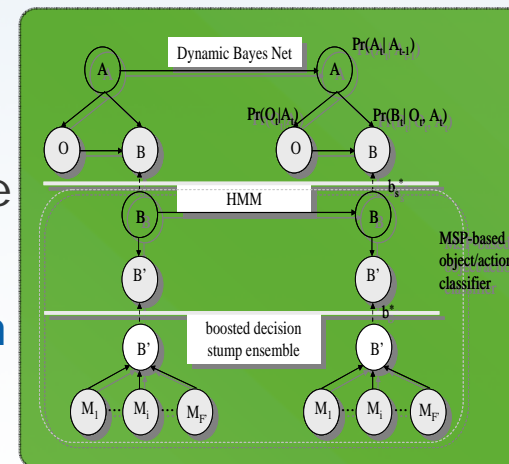
"running"
"sitting"
"climbing s"
"eating"
"busy"

Technology for Long-Term Care
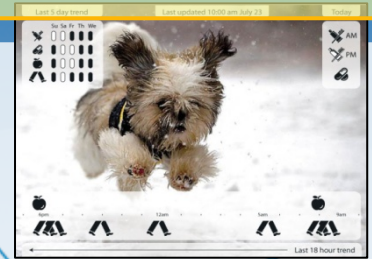
Perform more tasks themselves using reminders

Get 24x7 data, increase respite

client

Monitor
Remind
Verify
Notify

ADLs
✓Meds
×Nutrition
✓Hydration
✓Ambulation

Family

Provider

Improve staff client ratio

Sensors

Beyond Tele-Medicine: Tele-Care

- Health and Wellness in the Home: Multi-party view
- High Level monitoring, communication, wellness support
- Automation to improve quality, reduce intrusiveness, reduce cost

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UbiFit: Personal Fitness

- **Challenge:**
  - **Use on-body sensing and personal displays to encourage regular physical activity**

- **Approach:**
  - **Physical Activity Recognition + Persuasive Technologies**

Communicates Data about Physical Activities
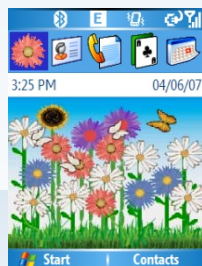
Glanceable Display

+
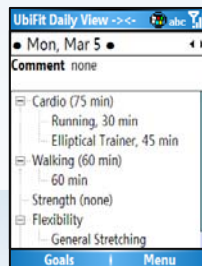
Interactive Application

+

Fitness Device

Intuitive Interfaces

The glanceable display runs on the background screen of mobile phones, so it's frequently seen by the individual

In-active week

Variety in routine

Light activity week

Recent goal met

Recent goal met

Goals met

- strength
- cardio
- flexibility
- walk
- this week's goal met
- recent goal met

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Personal Robotics

- Robots that are safe and effective in everyday home and office environments

  "Robot, get me the {soda, eyeglasses, pacifier, remote}..."

- Research Challenge: Uncertainty!
  - Industrial Robots: Deploy and program to engineer environmental uncertainty away; safety zones address unpredictability
  - Personal Robots: Must function in natural, uncertain human environments

- Examples: Pre-touch Sensing, Perception, Localization, Navigation

EF Sensors
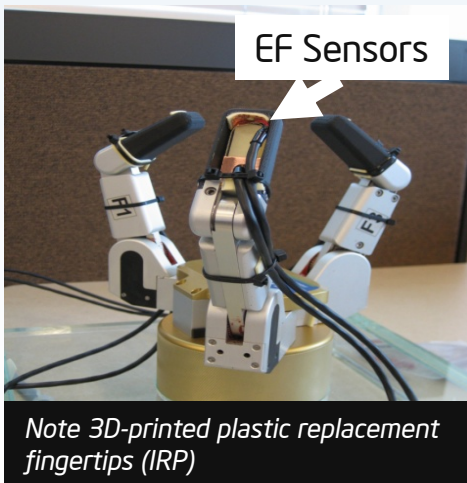
Note 3D-printed plastic replacement fingertips (IRP)

Intel Confidential

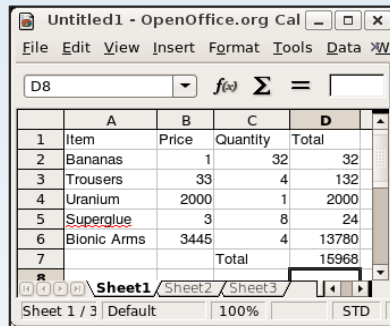# Mash, Mash, Mashups everywhere

- Flexibly combine information from web sites
- Composition and adaptation "creates" new information or perspective (Ex: correspondence)
- Early impact of semantic web technologies...
- Problem: Mashups today built by "computing experts"

Personal, Community Mashups (?MyMashup?)

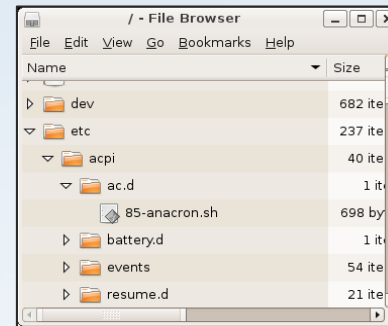**Spreadsheet** **Browser** **File System** **Functional Language**

λ

Intel Mash Maker Technology

- Browsing to create mashups (<u>Not</u> programming)
- Enable personal and shared published mashups
- Employ sophisticated parameterization and composition (spreadsheet and functional language technologies)
- Powerful implications for user interfaces -- context as a parameter

Intel MashMaker Technology

Technology Preview at http://mashmaker.intel.com

- ## Unleashing the power of Internet-scale Data

  – Demonstrated power of massive data in increasing # of applications – search, language translation, ads, seismic modeling, imaging, bioinformatics, etc.

  – Personal and focused applications are the next generation of value – local and personal sensors, biosensors, image, etc.

  – Machine learning coupled with powerful compute-intensive transformations, reductions, and queries and mixed data sharing
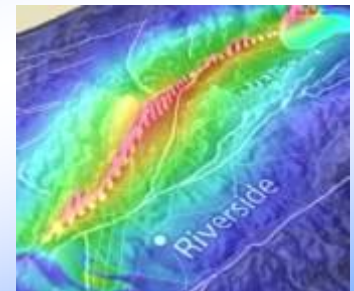

Drug Discovery

Comparative Genomics

Sensing and Inference

Real-time Disaster Damage Assessment

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Biosensors

- Transistors growing in capability as biological sensors
  - Sensitivity, control, understanding of surface chemistry
- Potential for a shift from Optical detection (dominant) to Electrical detection, and much greater capabilities
- Research Approach
  - Building Biosensors based on direct electrical detection
  - Studying scale-up, chemistry, control
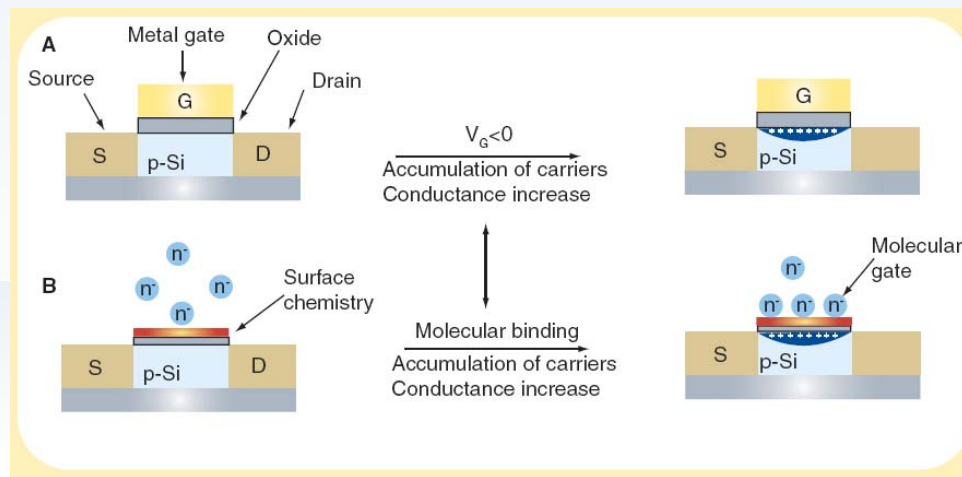
Applications:
- Sequencing
- Peptides
- Higher level Analytes

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Exploratory Research: pushing the Envelope

- **Essential Computing: Simplifying and Enriching All Aspects of Work and Daily life**
  - Broad range of Exploratory research
  - Sensing, Inference are key elements
  - Applications in consumer, health, and even Robotics!

- **To Learn More:**

  www.intel.com/research/exploratory

Questions?