大数据分析实践

Interactive Data Science

Ubiquitous Computing

Qiong Zeng (曾琼)
qiong.zn@sdu.edu.cn

Research *is creative and systematic work undertaken to increase the stock of knowledge.*

Reminder

Final representation will begin on Dec. 15

Dec. 22	Group Name	Dec. 15	Group Name
1	不想起名队	7	主打一个陪伴队
2	与发际线作队	8	深藏blue队
3	所以爱会消失对不队	9	主打一个参与队
4	啦啦队	10	Climbers
5	都队	11	你什么档次跟我一队
6	啊对对队	12	2023大数据分析卧龙凤雏小队
		13	你说的都队

Experiment: Group Assignment

- Collecting your own data
- Working with a data about a familiar topic
- Working with mobile data
- Visualizing Data

课程目标

After this, you should be able to:

- Be able to describe ubiquitous and pervasive computing and enabling technologies
- Be able to explain the four themes of ubiquitous computing and understand the challenges in each
- Be able to determine the types of data streams that could result from types of ubiquitous computing

Discussion

You have been asked to used prior student data to classify students into three groups: ***High Learners, Medium Learners, and Low Learners*** for the purpose of placing students into the proper math course.

You use your favorite technique and pass the information to the school administrator.

A few days later the administrator tells you that one of the teachers is concerned because her class is all male students.

How do we respond?

- Take it seriously
- Exploratory data analysis

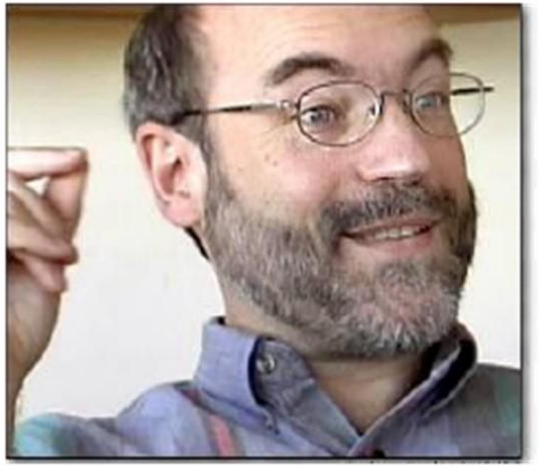
  How many males vs. females
- Follow the steps of the Classifier

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, "The Computer for the 21st Century", Scientific American, 1991

- *The purpose of a computer is to help you do something else.*
- *The best computer is a quiet, invisible servant.*
- *The more you can do by intuition the smarter you are; the computer should extend your unconscious.*
- *Technology should create calm.*



Related Topics

Several terms that share a common vision

- Mark Weiser: Ubiquitous Computing
- IBM: Pervasive Computing
- Context-aware Computing
- Sentient/Affective Computing
- Social-aware Computing
- Wearable Computing

Ubiquitous Computing

- Move beyond desktop machine
- Computing is embedded everywhere in the environment

Nike + iPod interface for running shoes

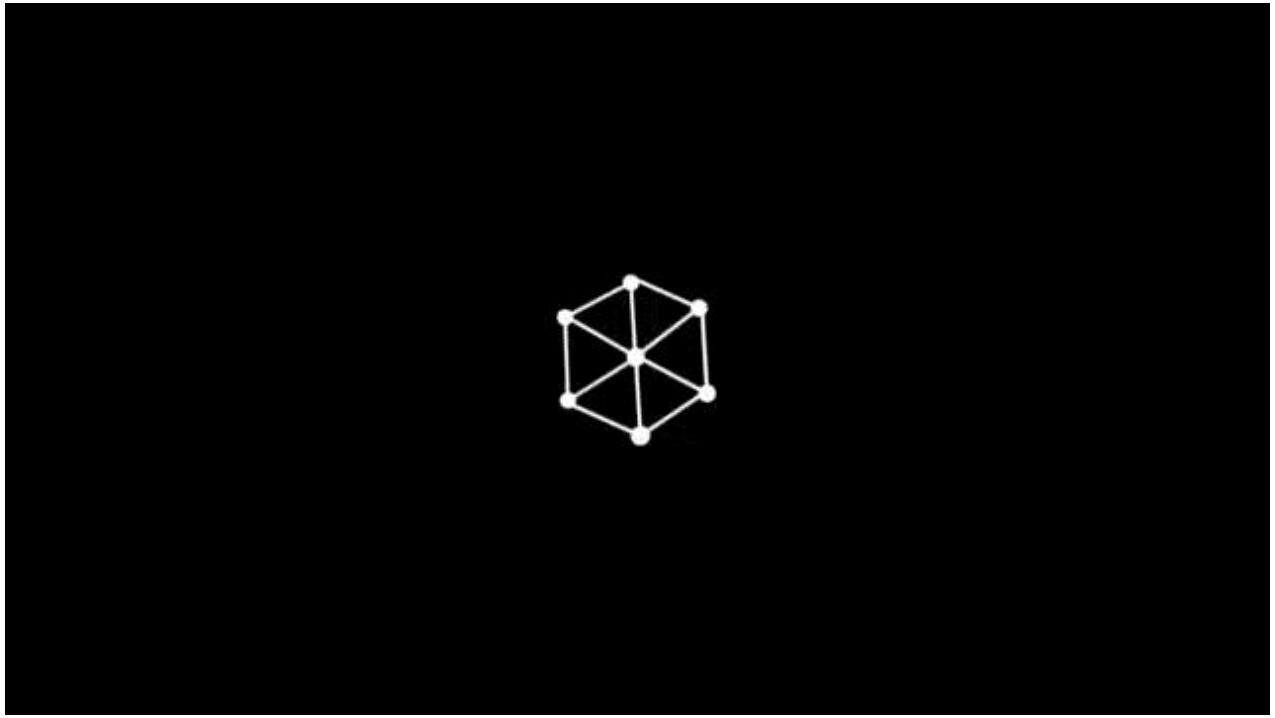
主观题 10分

设置

你期望智能冰箱有哪些神奇的可计算功能?

Ubiquitous Computing

- Internet refrigerator and cooking appliance
- Download recipes from web directly to device



http://www.dreamlg.com/en/ref/internet/introduction_tv.shtm

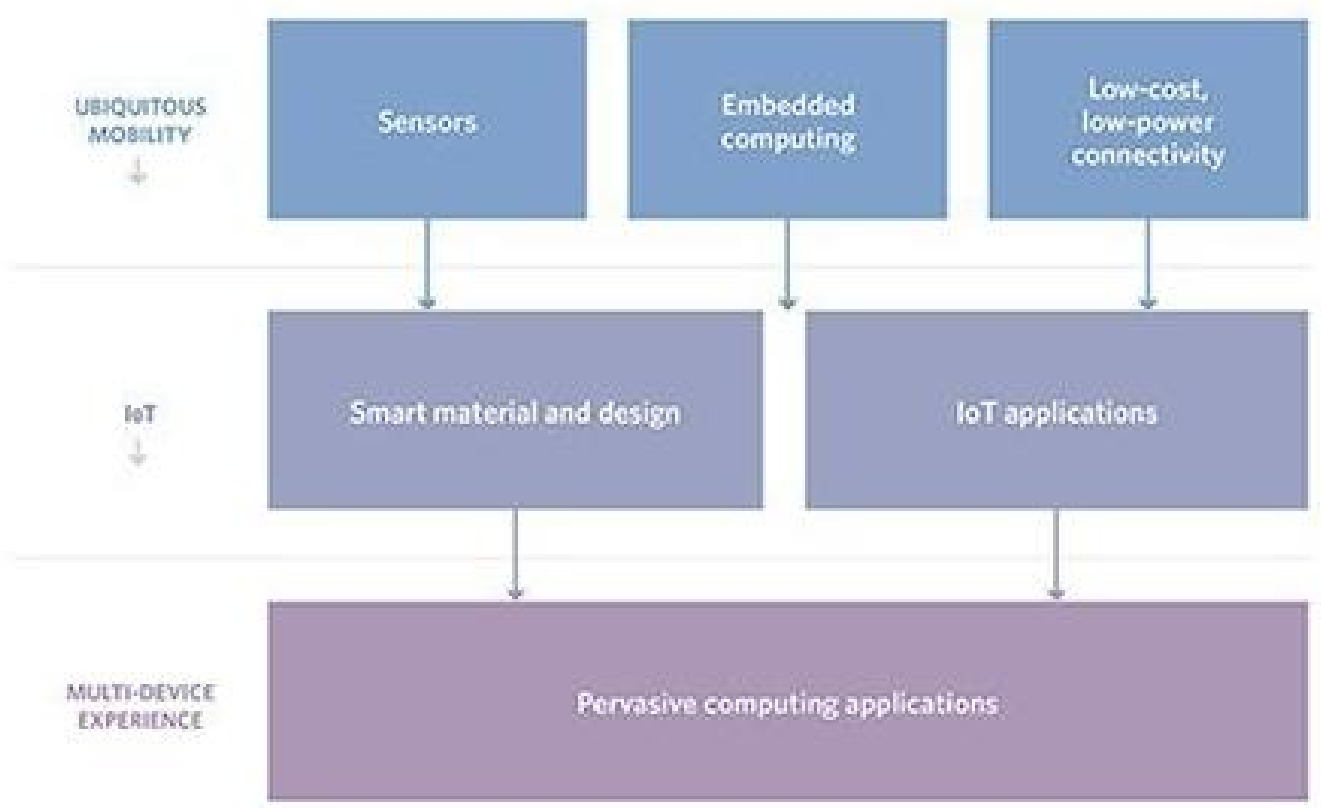
Ubiquitous Computing

- Integration of virtual and physical worlds
- Computing capabilities: any time, any place
- Invisible technology
- The environment is data, giving an enhanced ability to act

Automatic hand soap dispenser

Enabling Technologies

- Smart Objects
- Communication
- Smart Materials



Smart Objects

Real world objects are enriched with information processing capabilities

- Embedded processors
  - in everyday objects
  - small, cheap, lightweight
- Communication capability
  - wired or wireless
  - spontaneous networking and interaction
- Sensors and actuators

Smart Objects

Can remember pertinent events

- They have a memory

Show context-sensitive behavior

- They may have sensors
- Location/situation/context awareness

Are responsive/proactive

- Communicate with environment
- Networked with other smart objects

Communication

Wireless

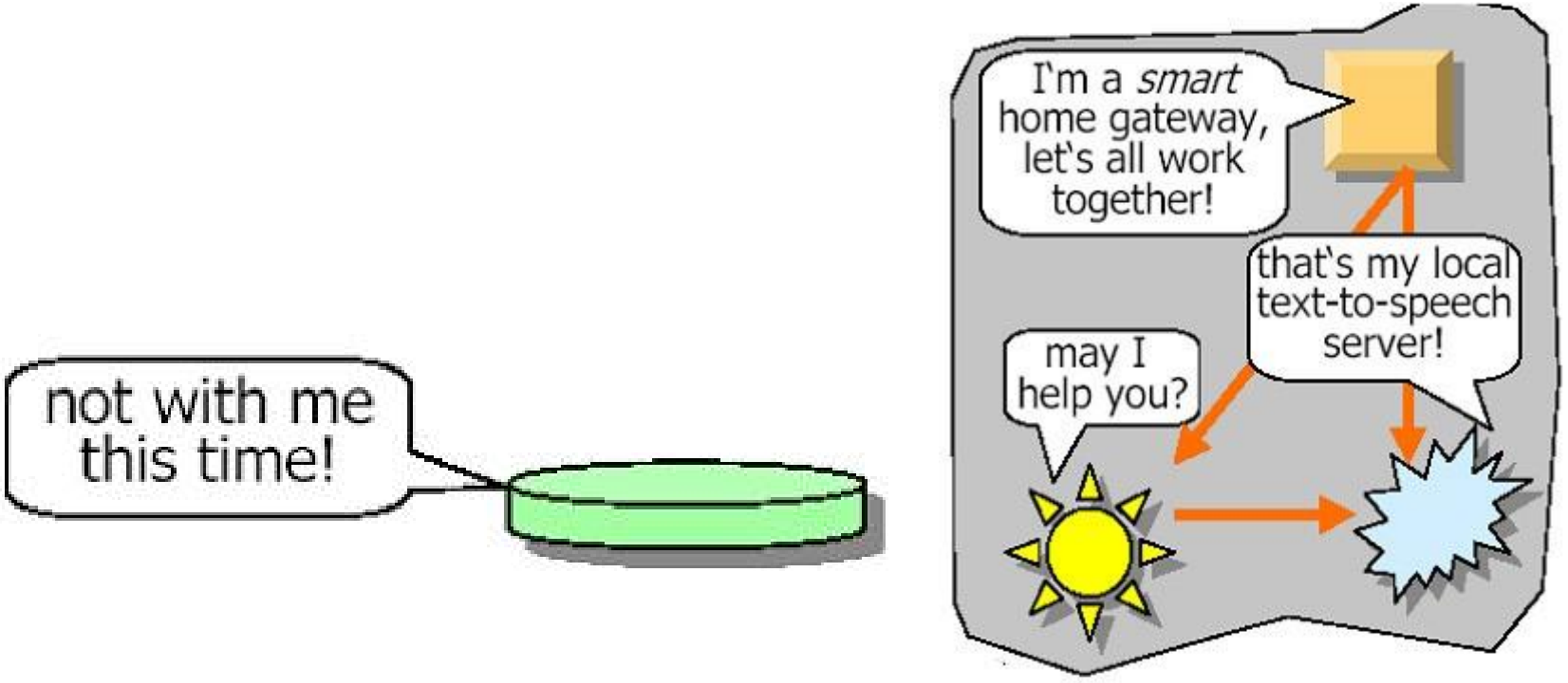
- mobile phone: GSM, GPRS, 3G, 4G, 5G
- wireless LAN (> 100 Mb/s)
- PAN (Bluetooth), BAN

A bluetooth module

Spontaneous Networking

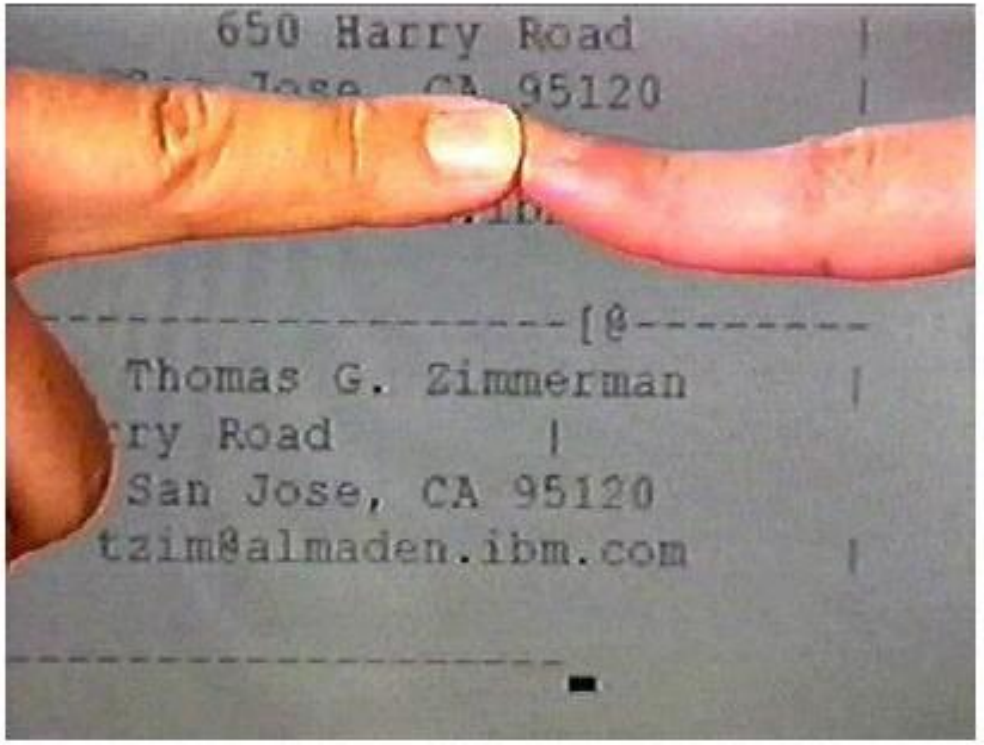
Objects in an open, distributed, dynamic world find each other and form a transitory community

Devices recognize that they “belong together”



Body Area Networks

- **Very low current (some nA), some kb/s through the human body**
- **Possible applications?**
  - Car recognize touch
  - Pay when touching
  - Body interfaces
  - Phone configures itself when it is touched



business card exchange (IBM)

Smart Materials

Beyond smart objects Smart Materials may

- React to inputs
- Store data
- Contain network or computing power

Interactive Map

Foldable and rollable

Foldable Cell Phone

Smart Clothing

Conductive textiles and inks

- print electrically active patterns directly onto fabrics

Sensors based on fabric

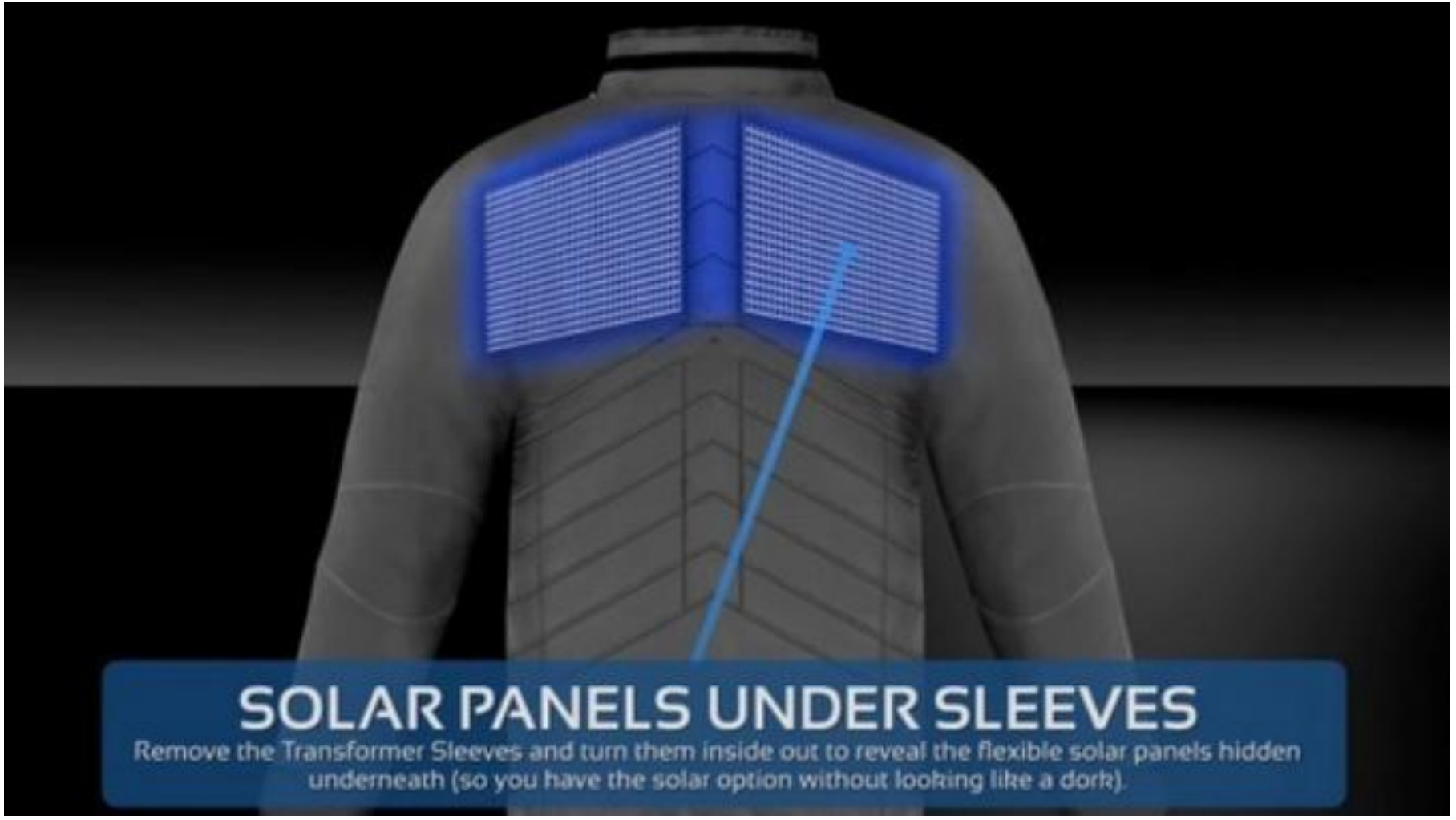
- e.g., monitor pulse, blood pressure, body temperature

Invisible collar microphones

Kidswear

- game console on the sleeve?
- integrated GPS-driven locators?
- integrated small cameras (to keep the parents calm)?

Solar Coat – Smart Clothings



Four Themes

1. Automated capture of experiences with easy access
2. Context-aware/sensitive interactions and applications
3. Ubiquitous services independent of devices/platforms
4. Natural/Implicit interfaces

"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, "The Computer for the 21st Century", Scientific American, 1991

1. Automated Capture

Motivation

- Record-taking is hard
- Multiple streams of information need to be captured
- Machines are better at some of these things than we are

Examples

Meeting capture (scribe at Xerox PARC), Mark Weiser

主观题 10分

Data Streams from Meeting/Classroom?

Data Streams from Meeting/Classroom?

White board

Notebooks

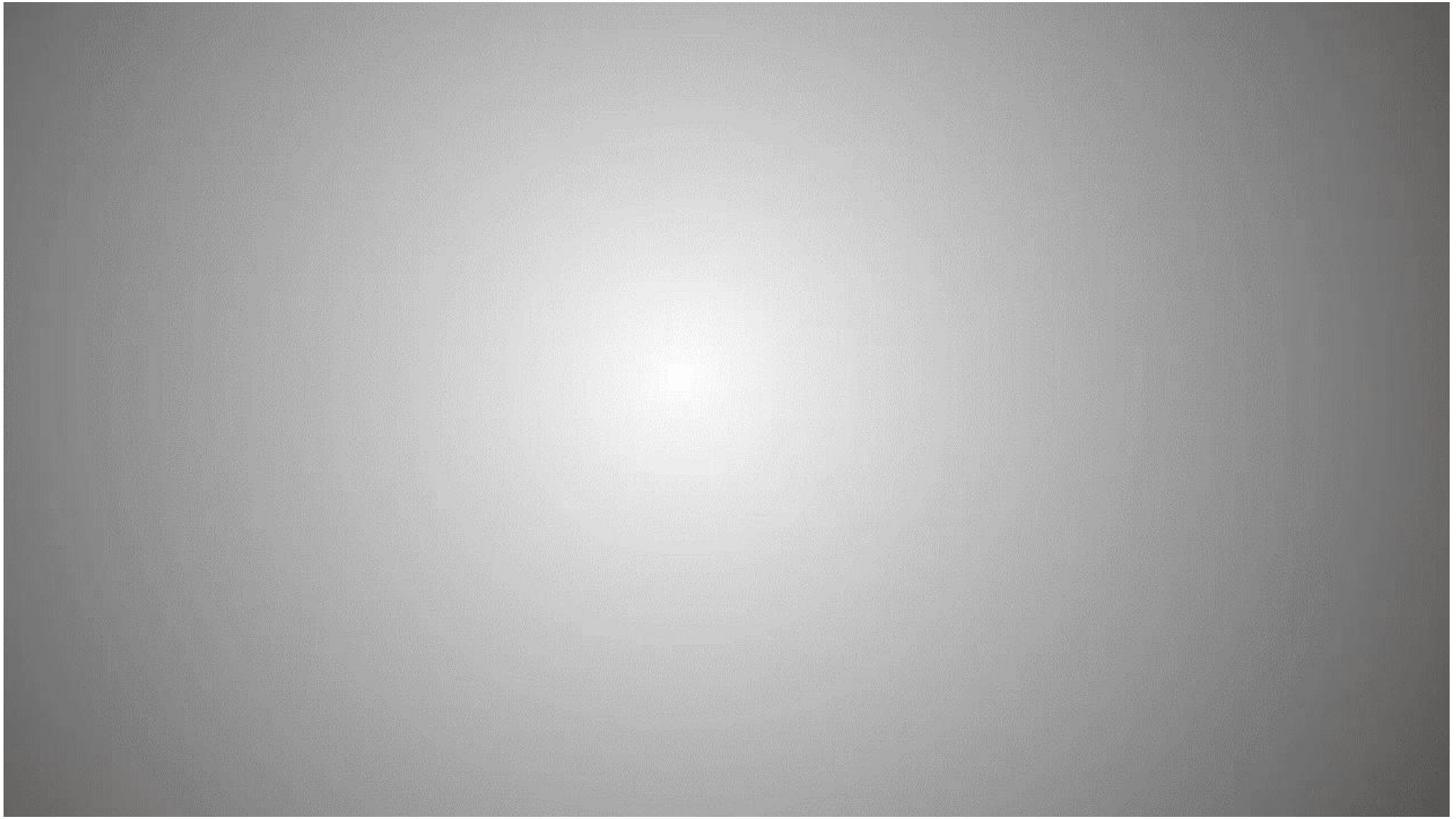
Voices

Movements

Issues

- **Stream integration – At what level?**
  - Very finest level of actions or more coarse?
- **Modifying a record after the fact**
  - Can notes be added later?
- **Networked interaction**
  - Security and privacy issues?

Panopto



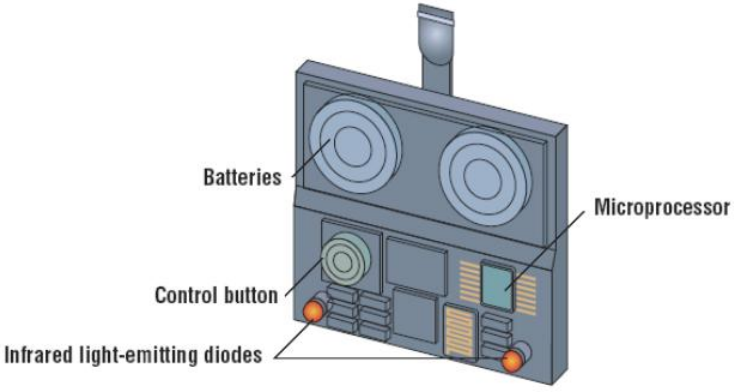
2. Context-Aware Computing

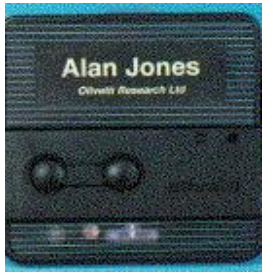
Computing services sense aspects of environment (location, user emotion,…) and tailor provided services

*** Walk into conference room, my email is projected on a big screen there*

Examples

- Active Badge & PARCTab
- Shopping assistant
- Cyberguide
- Perception system for recognizing user moods from their facial expressions
- House where position is sensed and temperature adjusted automatically

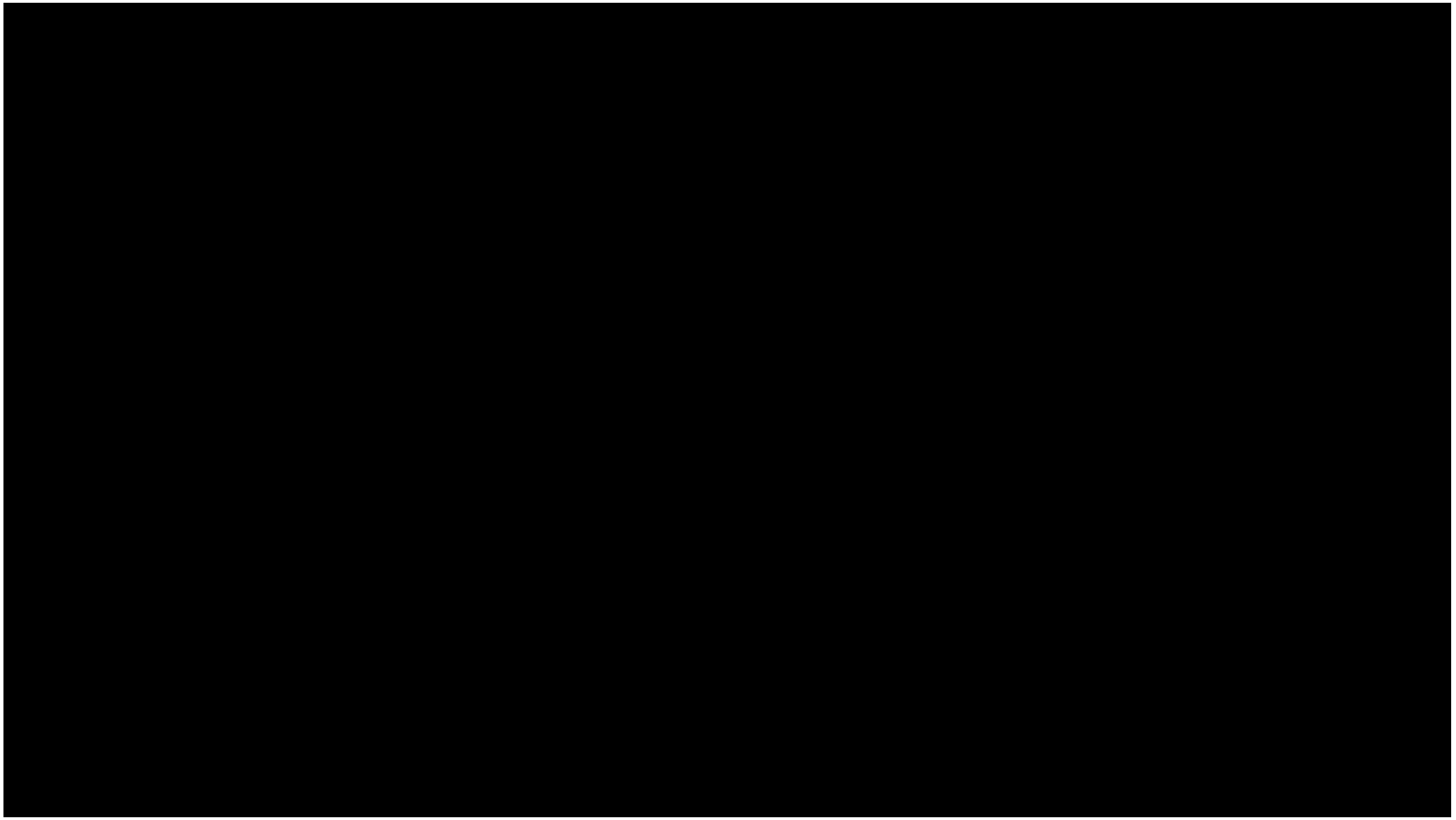




RealityCheck

Blending Virtual Environments with Situated Physical Reality

Augmented Reality



Augmented Reality Views for Occluded Interaction

Augmented Reality Views for Occluded Interaction

Klemen Lilija University of Copenhagen, Denmark
Henning Pohl University of Copenhagen, Denmark
Sebastian Boring University of Copenhagen, Denmark
Kasper Hornbæk University of Copenhagen, Denmark

music: Greenish Blue by Golden Grey

European Research Council
Established by the European Commission

UNIVERSITY OF COPENHAGEN

Issues

- Registration, registration, registration
- How to integrate all the different aspects of context?
- What about the loss of privacy?

3. Ubiquitous Services

- Care about service, not application
- Want to receive a message using whatever device is handy nearby
- Message is tailored to work according to device

Issues

- What is software infrastructure for integration?
- Do we get it by just adopting some standard?

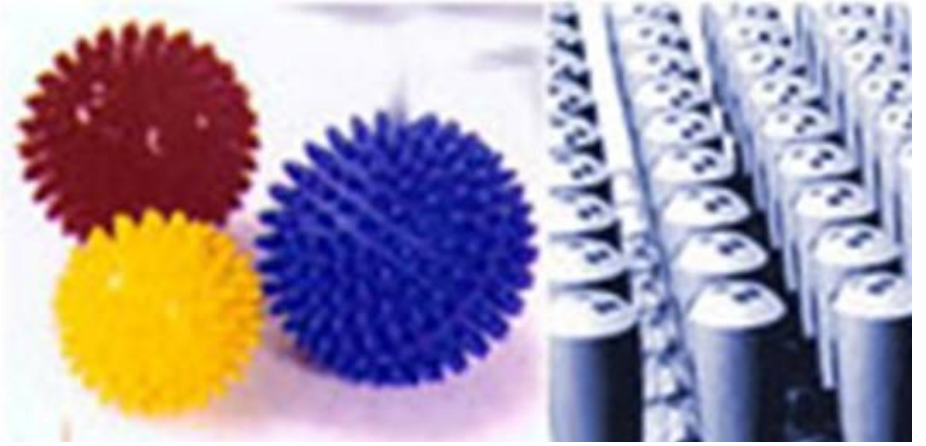
4. Natural/Implicit Interfaces

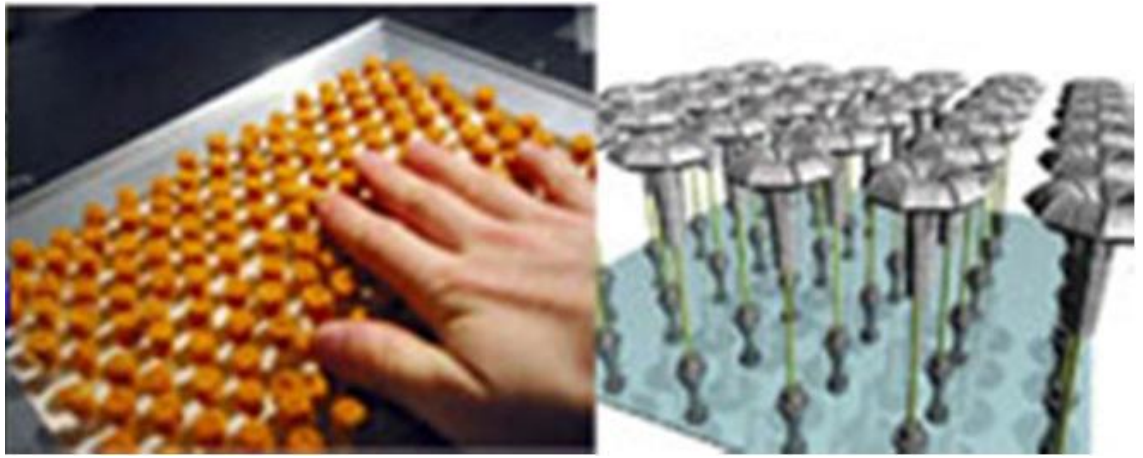
Computer interfaces and devices are more natural interaction tools

- Pen input
- Speech
- Gesture
- Tangible interfaces

Examples

- Pen applications
- Speech applications
- Gesture pendant
- Chris Harrisons work at CMU





Gesture Pendant

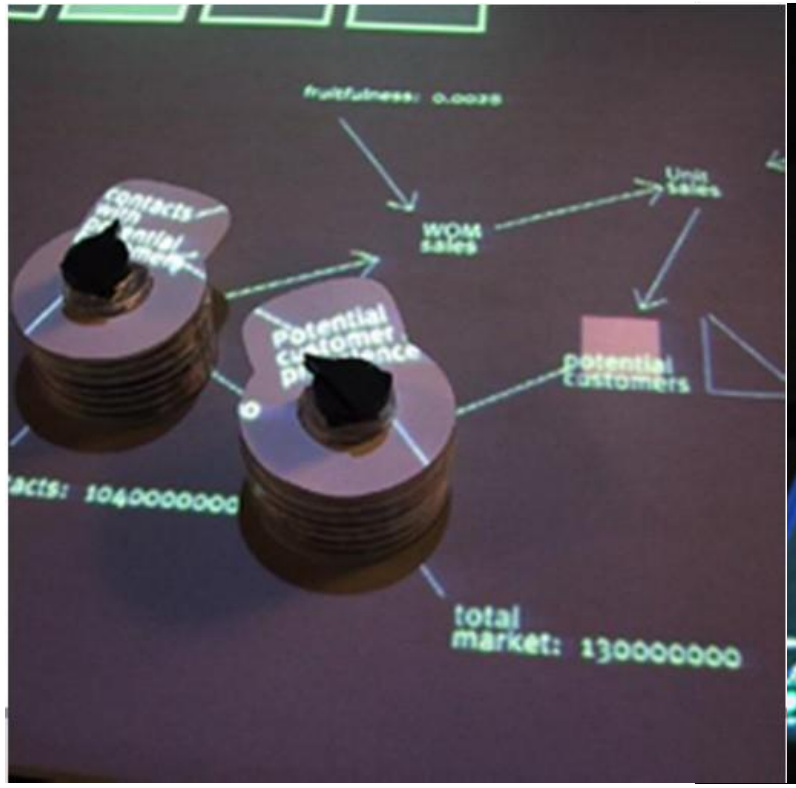
Personal Ambient Displays

Personal Ambient Displays are small, physical devices worn to display information to a person in a subtle, persistent, and private manner. They can be small enough to be carried in a pocket, worn as a watch, or even adorned like jewelry. In our implementations, information is displayed solely through tactile modalities such as heating and cooling, movement and vibration, and change of shape.

Pins and Super Cilia Skin

Super Cilia Skin is a multi-modal interactive interface, conceived as a computationally enhanced membrane coupling tactile-kinesthetic input with tactile and visual output. An array of individual actuators (cilia) use changes in orientation to display images or physical gestures as physical or tactile information.

Workbenches



SandScape

SandScape is a tangible interface for designing and understanding landscapes through a variety of computational simulations using sand. Users view these simulations as they are projected on the surface of a sand model that represents the terrain. The users can choose from a variety of different simulations that highlight either the height, slope, contours, shadows, drainage or aspect of the landscape model. The users can alter the form of the landscape model by manipulating sand while seeing the resultant effects of computational analysis generated and projected on the surface of sand in real-time.

Issues

- Errors are more likely (handwriting recognition, speech, …) produced. How to discover and correct them?

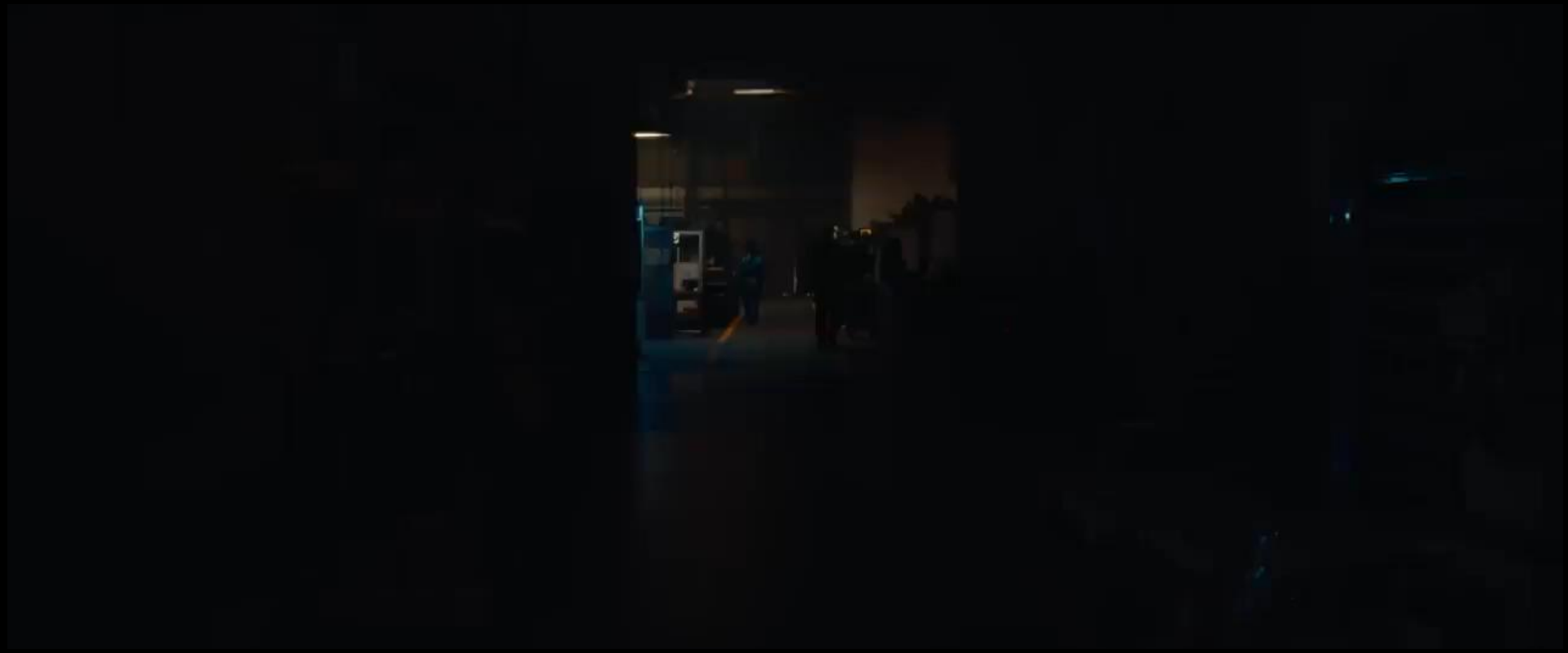
- Is there truly value added?

Wearable Computing

- Computation devices accompany you, rather than you seeking them out

- Google Glass

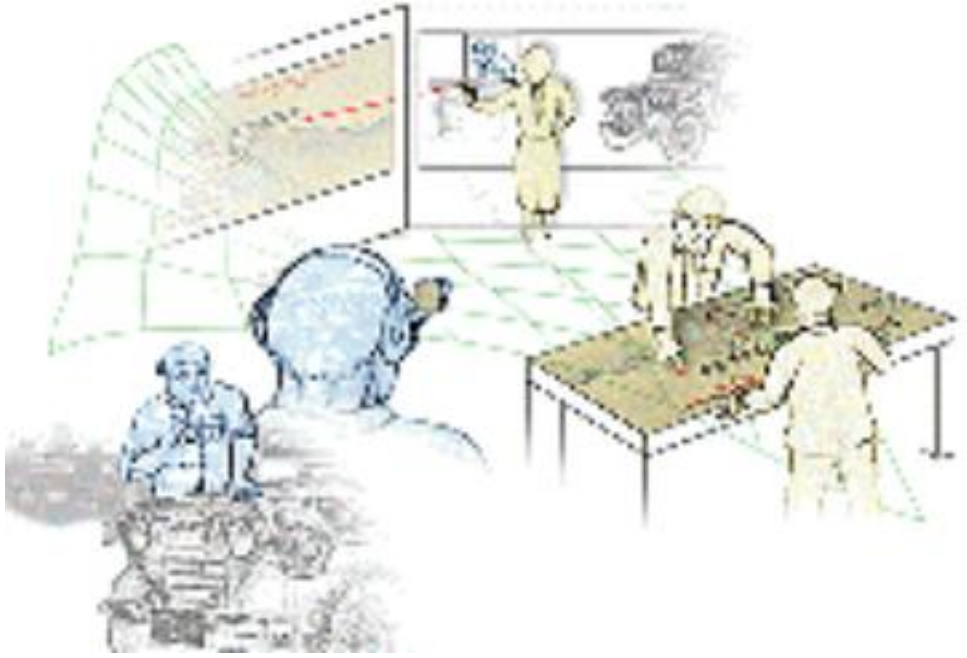
未来已来：AR + LLM



Project Aura

Aura (Carnegie Mellon University)

- Distraction-free (Invisible) Ubiquitous Computing.
- Early 2000’s



What is the most valuable computing resource?

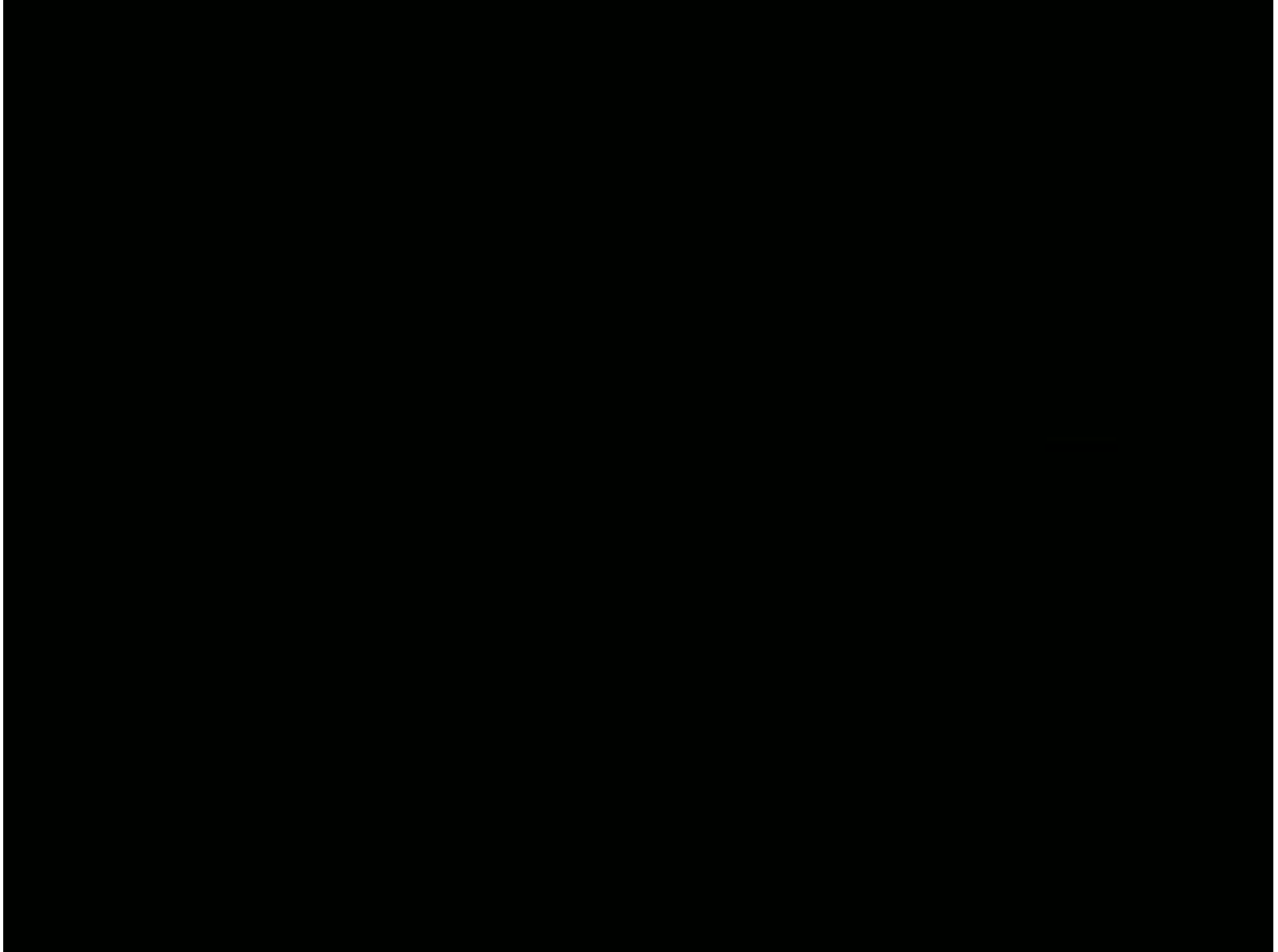
- Processing power?
- Data Storage?
- ???

Aura Thesis

The most precious resource in computing is human attention.

Aura Goals:

- Reduce user distraction.
- Trade-off plentiful resources of Moore's law for human attention.
- Achieve this scalably for mobile users in a failure-prone, variable-resource environment.



Project Aura

The Airport Scenario

Jane wants to send e-mail from the airport before he

- She has several large enclosures
- She is using a wireless interface

- She has many options.
  - Simply send the e-mail
    - *Is there enough bandwidth?*
  - *Compress the data first*
    - *Will that help enough?*
  - Pay extra to get reserved bandwidth
    - *Are reservations available?*
  - Send the “diff” relative to older file
    - *Are the old versions around?*
  - Walk to a gate with more bandwidth
    - *Where is there enough bandwidth?*

Other Scenarios of Ubiquitous Computing

Buy drinks by Friday

- Take out the last can of soda
- Swipe the can's UPC label, which adds soda to your shopping list
- Make a note that you need soda for the guests you are having over this weekend

Other Scenarios of Ubiquitous Computing

Buy drinks by Friday (2)

- Approach a local supermarket
- AutoPC informs you that you are near supermarket
- Opportunistic reminder: “If it is convenient, stop by to buy drinks.”

Other Scenarios of Ubiquitous Computing

Buy drinks by Friday (3)

- Friday rolls around and you have not bought drinks
- Deadline-based reminder sent to your smart phone texting app

Other Scenarios of Ubiquitous Computing

Buy drinks by Friday (4)

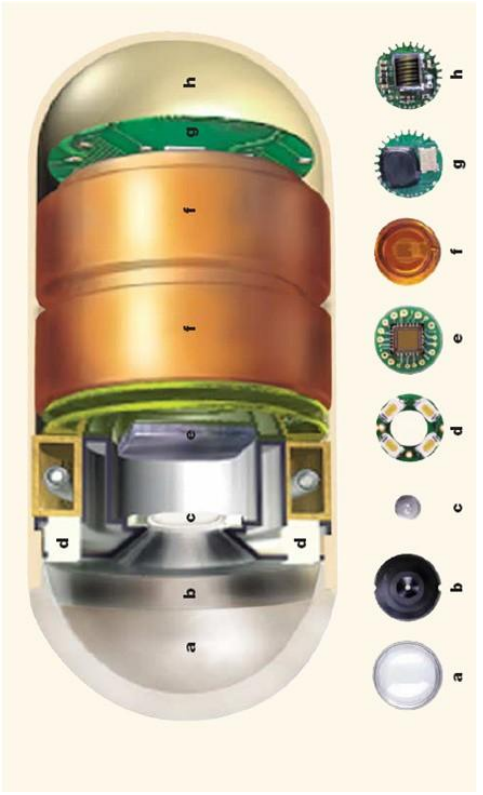
Smart Refrigerator integrates:

- Email
- Video messages
- Web surfing
- Food management
- TV
- Radio
- Virtual keyboard
- Digital cook book
- Surveillance camera
- Virtual grocery ordering! – orders drinks

Other Scenarios

Edible computers: The pill-cam

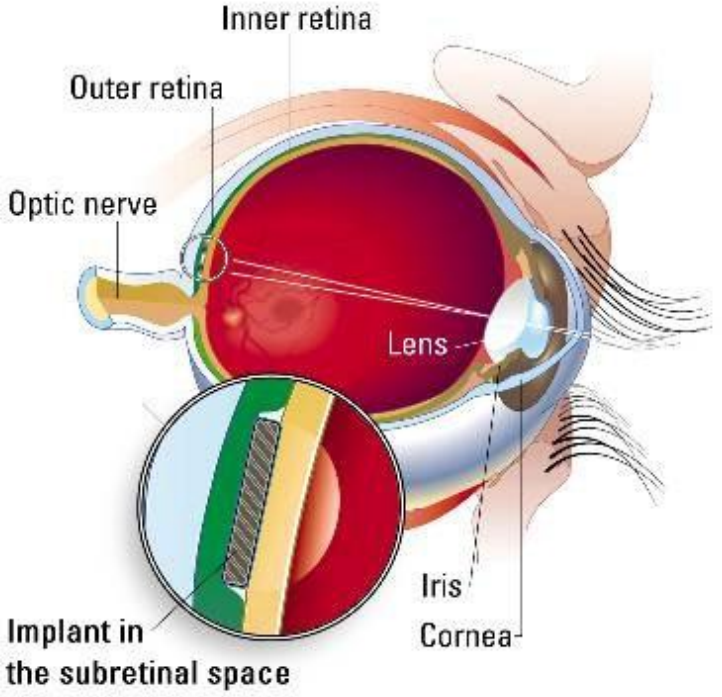
- Miniature camera
- Diagnostic device
- It is swallowed

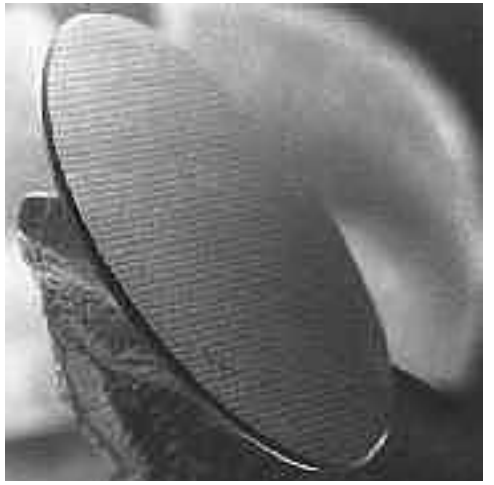


Other Scenarios

Artificial Retina

- Direct interface with nervous system
- Whole new computational paradigm (who's the computer?)





Other Scenarios

Smart Dust

- Nano computers that couple:
  - Sensors
  - Computing
  - Communication

- Grids of motes (“nano computers”)

- **How do we store the data?**
- **What should we keep?**

主观题 10分

设置

Group Discussion:

Choose a ubicomp application and discuss.

作答

- Collecting your own data
- Working with a data about a familiar topic
- Working with mobile data
- Visualizing Data

Thank You