Some Computer Science Issues in Ubiquitous Computing

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Communications of the ACM, July 1993

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Introduction
  - Ubiquitous computing

Hardware prototypes

Computer Science of Ubiquitous Computing
  - Hardware components
  - Network protocols
  - Interaction Substrates
  - Applications
  - Privacy of location

Summary
Today’s computers
- Isolated from the overall situation
- Fails to get out of the way of the work
- Too often remains the focus of attention

We want
- The computers to be a tool through which we work
- Thus to disappear from our awareness
Getting the computer out of the way
- Is not a GUI problem
- Is not a multimedia problem

The challenge is
- To create a new kind of relationship of people to computers
- The computer would take the lead in
  • becoming better at getting out of the way
  • Allowing people to just go about their lives
Virtual Reality
- Useful in scientific visualization & entertainment
- Two crucial flaws as a tool for changing everyone’s relationship to computation
  - Can’t provide a simulation at reasonable cost
  - Has the goal of fooling the user-of leaving the everyday physical world behind

Other approach?
- Ubiquitous Computing
By Mark Weiser at Xerox Palo Alto Research Center (PARC) in 1988

The third wave in computing, just now beginning
- The age of *calm technology*
- First were mainframes
- Now, we are in the personal computing era

Enhance computer use by
- Making many computers available *throughout the physical environment*
- While making them effectively *invisible* to the user
VR vs. Ubiquitous Computing

Virtual Reality
- puts people inside a computer-generated world

Ubiquitous Computing
- forces the computer to live out here in the world with people
The physical world comes in all size and shapes

Three different sizes of devices
- Large-size: Liveboard
- Medium-size: Xpad
- Small-size: ParcTab

A pervasive part of everyday life
- With many active at all times
Hardware Prototypes (2/2)

ParcTab

Xpad

LiveBoards
To construct and deploy prototypes
- Need to readdress some of the well-worked areas of existing Computer Science

Organization of a computer system
- Hardware components
- Network protocols
- Interaction substrates
- Applications
- Privacy
Hardware Requirements

- **Low power**
  - Work to reduce power rather than to increase performance

- **Wireless**
  - Permits reuse of the same frequency again
  - Permits transceivers that use low power

- **Infrared Pens**
  - Work over large area (at least 60in*40in)
  - Need not touch the screen
  - Operate from several feet away
Network Protocols

- **Wireless media access**
  - Use Multiple Access Collision Avoidance (MACA)
  - For real-time requirement
    - NCTS(n): suppress other transmissions for (n) bytes
    - Guaranteed bandwidth for voice or video

- **Real-time protocol**
  - To support multimedia applications

- **Mobility support**
  - Device in one region moves other regions
  - IP can’t solve this: Mobile IP
Interaction substrates

- **Tabs**
  - Have a very small interaction area
  - “Touch typing” that uses only a tiny area

- **Liveboards**
  - Using conventional pull-down or pop-up menus requires walking across the room
  - Location-independent interaction is need

- **X-window system**
  - User may move from device to device, and want to bring windows along
  - Window migration tools
Applications

🔹 Tracking the location of people
  - Active Badge system by Olivetti Research Labs in Cambridge
  - Extend this work
    • Using it for updating dynamic maps

🔹 Shared meeting tools
  - Pen-based drawing on a surface
  - Several users simultaneously operate independently on different or same pages
In cellular system
- Traveling pattern of cellular phone user can be deduced from the roaming data
- Much worse in ubiquitous computing

Preserving privacy of location is a key problem
- Accumulation of location information to produce automatic daily diaries of activity at PARC

Never be purely technological solution to privacy
- Social issues must be considered
Summary

Ubiquitous Computing is
- Next-generation computing environment
- Each person is interacting with hundreds of nearby computers essentially *invisible* to user

Explains
- What is new and different about the computer science involved in ubiquitous computing

Understand
- Some of the new *research challenges* in ubiquitous computing