

Some Computer Science Issues in Ubiquitous Computing

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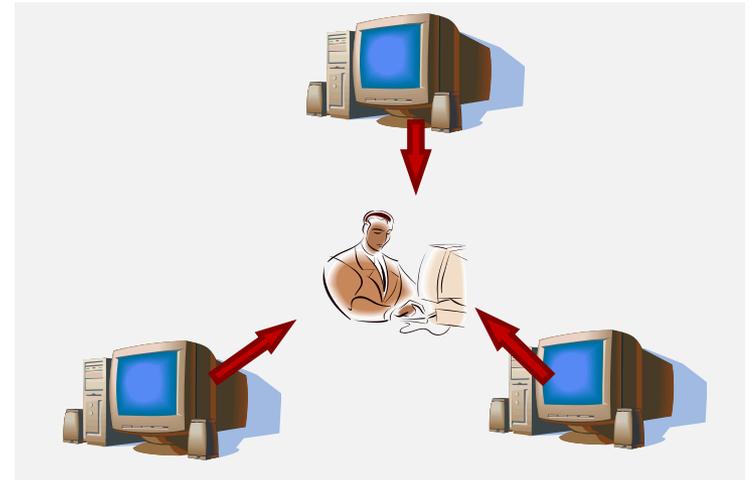
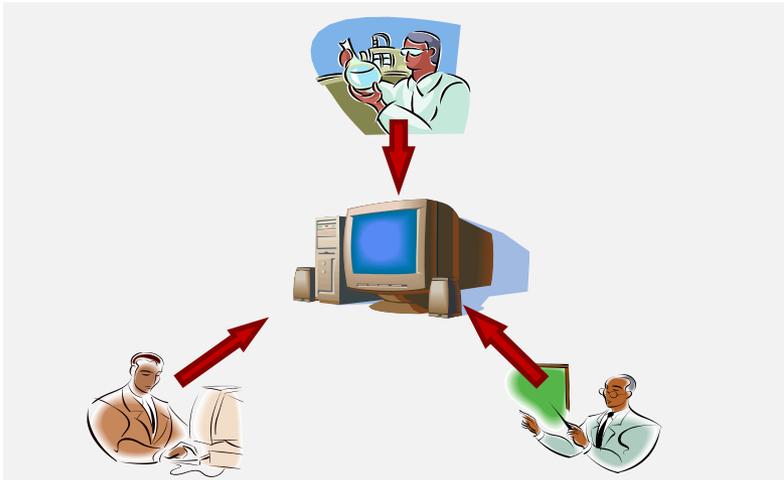
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Introduction

- Paradigm Shift
- What is Ubiquitous Computing?
- Virtual Reality

Paradigm Shift

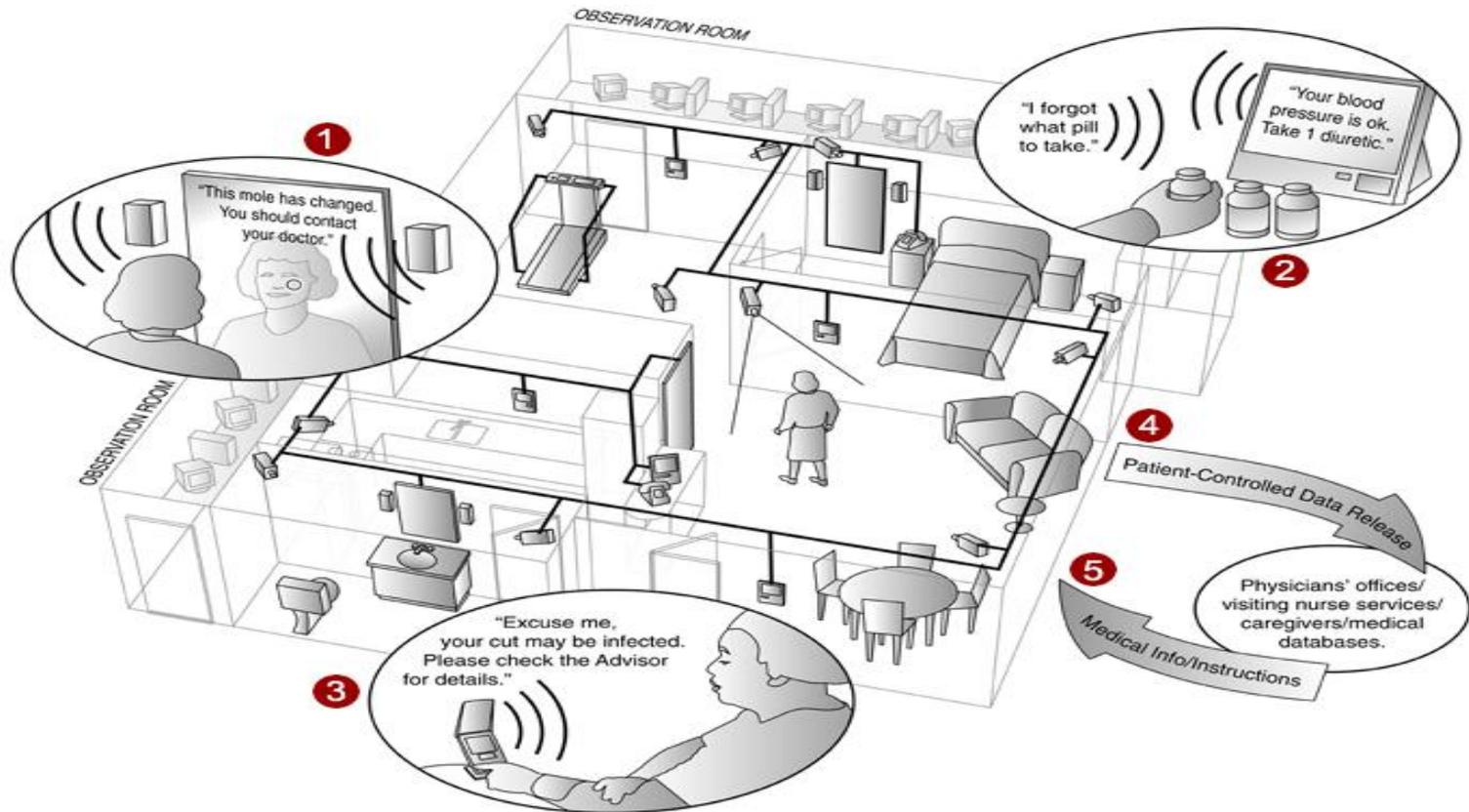
- Traditional computer
- Future computer



- Challenge
 - Create a new kind of relationship of people to computer

What is Ubiquitous Computing?

- Definition



Virtual Reality

- From rising star to fallen angel
 - Believed to enact the principles
 - › Makes it possible for computers to get out of the traditional work way (supports intuitive interaction)
 - Problems
 - › Very expensive to provide sufficiently realistic simulation
 - › Cuts people from real world

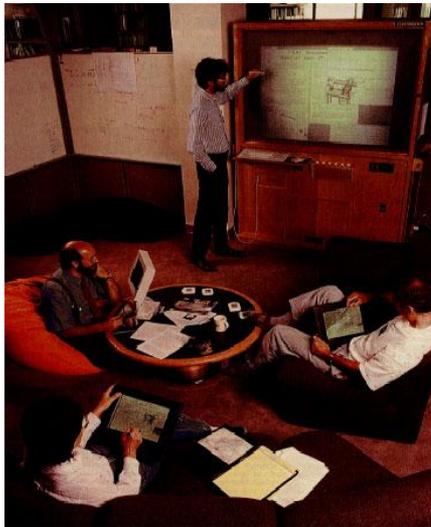
Ubiquitous Issues

- Design Approach
- Hardware Issues
- Network Protocols
- Interaction Substrates
- Applications
- Privacy of Location
- Computational Methods

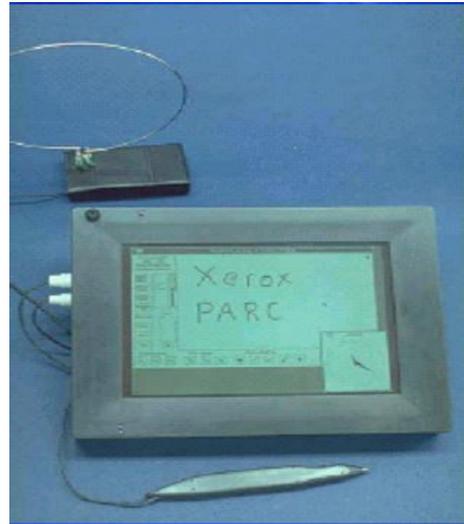
Design Approach

- New artifact
 - Used in everyday life
 - Types

Liveboard



ParcPad



ParcTab



Hardware Issues

- Low power
 - Reduce Power Consumption
 - $Power = Gate\ Capacitance \times Voltage \times Clock\ Frequency$
- Wireless
 - Metric: Bits/sec/meter³
 - Electromagnetic spectrum range
 - Power fall-off r^6
- Pens
 - Casual use, no training, naturalness, simultaneous multiple use
 - PARC devised a new infrared pen

Network Protocols

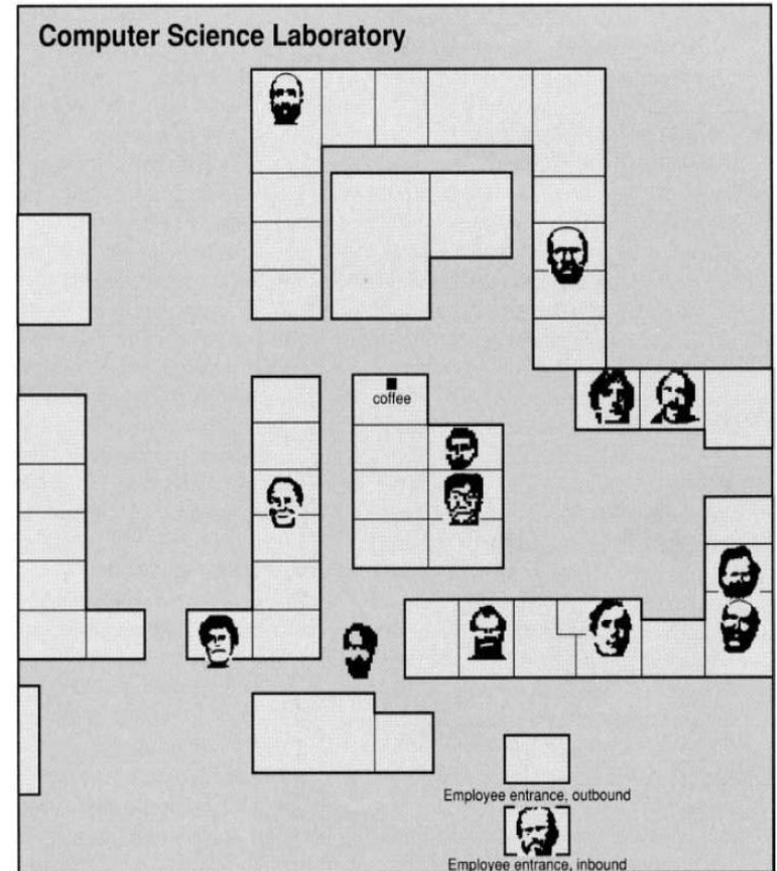
- MACA (Multiple Access with Collision Avoidance)
 - Used to avoid “*Hidden terminal*”
 - Fairness
 - › Same back-off parameter for all neighbor stations
 - › NCTS(n) (Not Clear To Send)
- Other network issues
 - Gb networks for real time data
 - › Important for multimedia data
 - Mobility
 - › Existing IP dose not support mobility
 - › Virtual IP
 - › Mobile IP

Interaction Substrates

- Different interaction area
 - Tab (small), liveboard (huge)
- X–Window system
 - Designed for network
 - Does not provide mobility
 - › To solve this problem, Jacobi developed new X–window toolkit
- Different bandwidth
 - Vary from *Kbps* to *Gbps*
 - Use low bandwidth

Applications

- Locating people
 - Data acquired from:
 - › Logins to workstations/terminals
 - › An Active badge system
 - Useful for
 - › Automatic call forwarding
 - › Shared Drawing Tools
- Shared draw
 - Data Representation
 - › Tivili-Object based
 - › Slate-Pixel based
 - UI Issues
 - › How to handle multiple cursors?
 - › Use gestures or not?
 - › Use an ink based or character recognition model of pen input?



Privacy of Location

- Location information
 - Important for routing
 - Need to be protected
- Solutions
 - Central DB of location
 - › Privacy controls can be centralized
 - › But one break-in there reveals all
 - › Transmission of the location information to a central site
 - › Centrality is unlikely to scale worldwide
 - Storing information about each person at that person's PC
 - › Programs must query the PC, and proceed through whatever security measures the user has chosen to install

Computational Methods

- Cache sharing problem
 - Classical distributed computing problem
 - Processing power $>$ Link speed
 - › Pages are often compressed
 - Compare online algorithm with offline algorithm
 - › Offline algorithm is better than online

Summary

- Conclusion

Conclusion

- What is ubiquitous?
- Issues of ubiquitous computing
 - Tab, Pad, Liveboard
 - Ubicomp is likely to provide a framework for interesting and productive work for many more years
 - Have much to learn about the details