



HUMAN-COMPUTER INTERACTION

THIRD
EDITION

DIX
FINLAY
ABOWD
BEALE



ubiquitous computing
and
augmented realities

ubiquitous computing and augmented realities

- ubiquitous computing
 - filling the real world with computers
- virtual and augmented reality
 - making the real world in a computer!

Challenging HCI Assumptions

- What do we imagine when we think of a computer?

*"The most profound technologies
are those that disappear."*

Weiser

Ubiquitous Computing

- Any computing technology that permits human interaction away from a single workstation
- Implications for
 - Technology defining the interactive experience
 - Applications or uses
 - Underlying theories of interaction

Scales of devices

- Weiser proposed
 - Inch
 - Foot
 - Yard
- Implications for device size as well as relationship to people

Device scales

- Inch
 - PDAs
 - PARCTAB
 - Voice Recorders
 - smart phones
- Individuals own many of them and they can all communicate with each other and environment.

Device scales

- Foot
 - notebooks
 - tablets
 - digital paper
- Individual owns several but not assumed to be always with them.



Device scales

- Yard
 - electronic whiteboards
 - plasma displays
 - smart bulletin boards
- Buildings or institutions own them and lots of people share them.



Defining the Interaction Experience

- Implicit input
 - Sensor-based input
 - Extends traditional explicit input (e.g., keyboard and mouse)
 - Towards “awareness”
 - Use of recognition technologies
 - Introduces ambiguity because recognizers are not perfect

Multi-scale and distributed output

- Screens of many sizes
 - (very) small
 - (very) large



- Distributed in space, but coordinated

The output experience

- More than eye-grabbing raster displays
 - Ambient: use features of the physical environment to signal information
 - Peripheral: designed to be in the background
- Examples:
 - The Dangling String
 - The Water Lamp (shown)

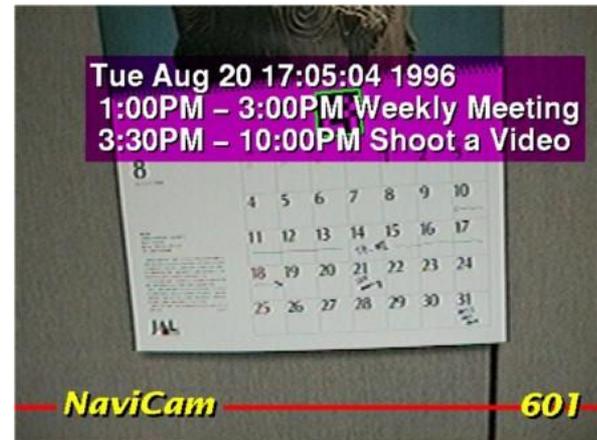


Merging Physical and Digital Worlds

- How can we remove the barrier?
 - Actions on physical objects have meaning electronically, and vice versa
 - Output from electronic world superimposed on physical world



A “digital” desk



An augmented calendar

Application Themes

- Context-aware computing
 - Sensed phenomena facilitate easier interaction
- Automated capture and access
 - Live experiences stored for future access
- Toward continuous interaction
 - Everyday activities have no clear begin-end conditions



ambient wood

- real wood! ... filled with electronics
- light and moisture meters
 - recorded with GPRS location
 - drawn on map later
- 'periscope'
 - shows invisible things
 - uses RFID
- triggered sound





City - shared experience

- visitors to Mackintosh Interpretation Centre
 - some on web, some use VR, some really there
- interacting
 - talk via microphones
 - 'see' each other virtually
- different places
- different modalities
- shared experience

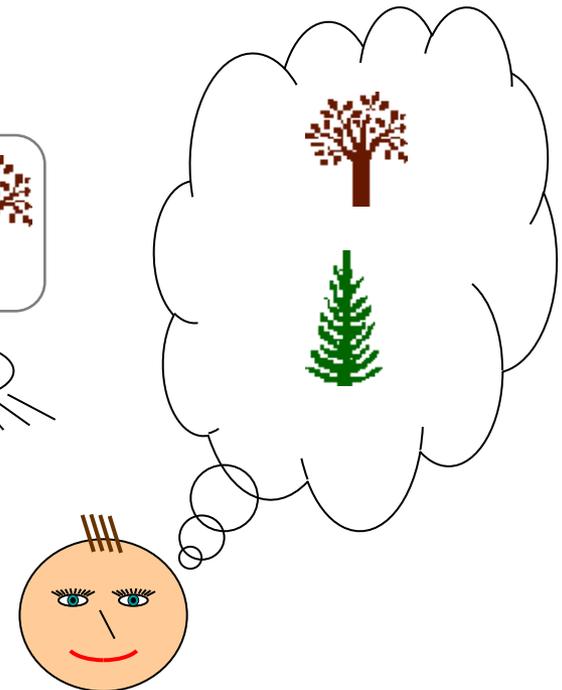
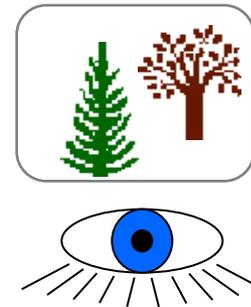
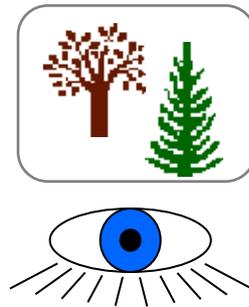


virtual reality technology

- headsets allow user to “see” the virtual world
- gesture recognition achieved with DataGlove (lycra glove with optical sensors that measure hand and finger positions)
- eyegaze allows users to indicate direction with eyes alone
- whole body position sensed, walking etc.

VR headsets

- small TV screen for each eye
- slightly different angles
- 3D effect



immersion

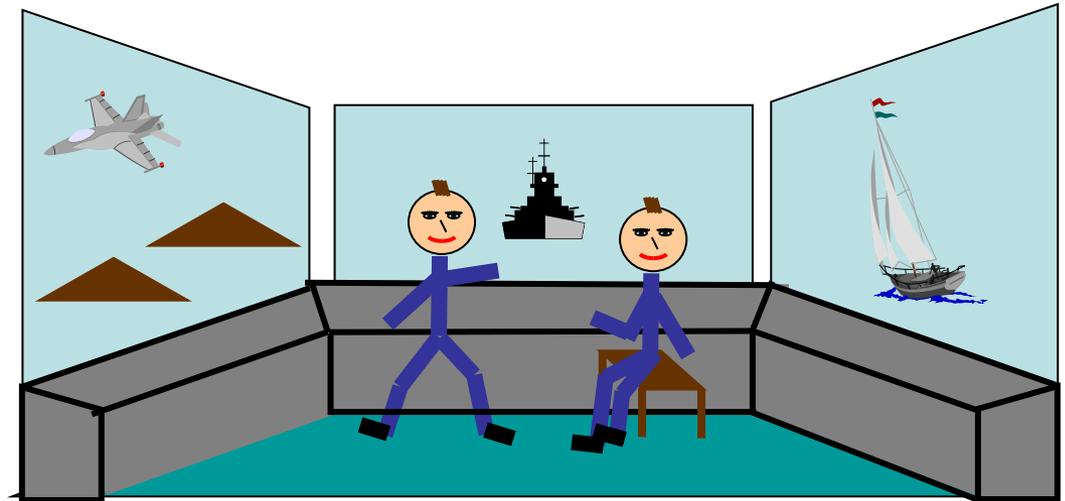
- VR
 - computer simulation of the real world
 - mainly visual, but sound, haptic, gesture too
 - experience life-like situations
 - too dangerous, too expensive
 - see unseen things:
 - too small, too large, hidden, invisible
 - e.g. manipulating molecules
- the experience
 - aim is immersion, engagement, interaction

on the desktop

- headset VR
 - expensive, uncomfortable
- desktop VR
 - use ordinary monitor and PC
 - cheap and convenient
- in games ...

command and control

- scenes projected on walls
- realistic environment
- hydraulic rams!
- real controls
- other people
- for:
 - flight simulators
 - ships
 - military



augmented reality (AR)

- images projected over the real world
 - aircraft head-up display
 - semi-transparent goggles
 - projecting onto a desktop
- types of information
 - unrelated – e.g. reading email with wearable
 - related – e.g. virtual objects interacting with world
- issues
 - registration – aligning virtual and real
 - eye gaze direction



applications of AR

maintenance

- overlay instructions
- display schematics

examples

- photocopier engineers
 - registration critical arrows point to parts
- aircraft wiring looms
 - registration perhaps too hard, use schematic

applications of VR

- simulation
 - games, military, training
- VR holidays
 - rainforest, safari, surf, ski and moon walk
... all from your own armchair
- medical
 - surgery
 - scans and x-rays used to build model then 'practice' operation
 - force feedback best
 - phobia treatment
 - virtual lifts, spiders, etc.

information and data visualisation

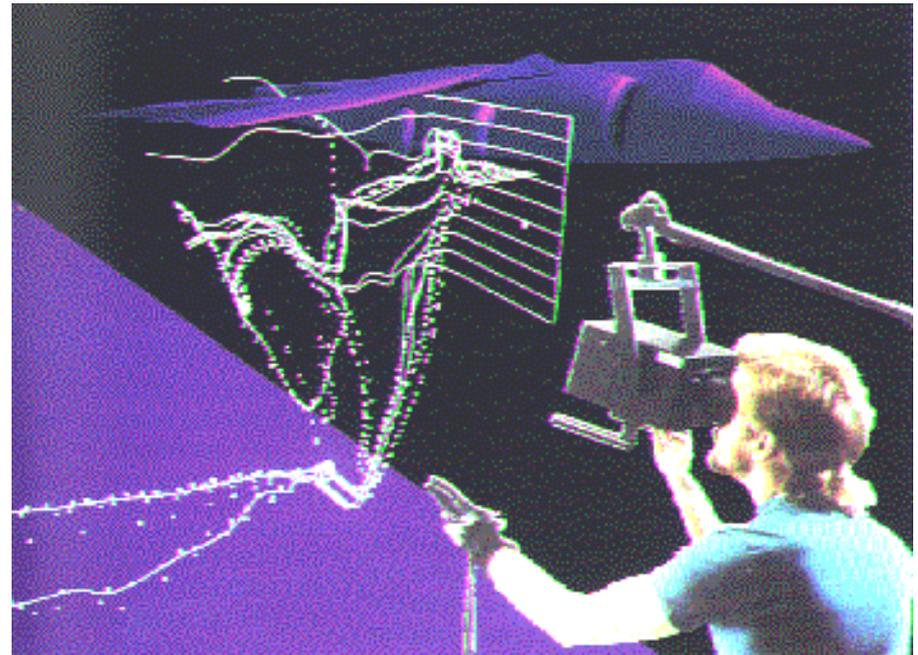
VR, 3D and 2D displays
scientific and complex data
interactivity central

scientific and technical data

- number of virtual dimensions that are 'real'
- three dimensional space
 - visualise invisible fields or values
 - e.g. virtual wind tunnel
- two dimensional space
 - can project data value up from plane
 - e.g. geographic data
 - N.B. viewing angle hard for static visualisation
- no 'real' dimensions
 - 2D/3D histograms, scatter plots, pie charts, etc.

virtual wind tunnel

- fluid dynamics to simulate air flow
- virtual bubbles used to show movements
- 'better' than real wind tunnel ...
 - no disruption of air flow
 - cheaper and faster

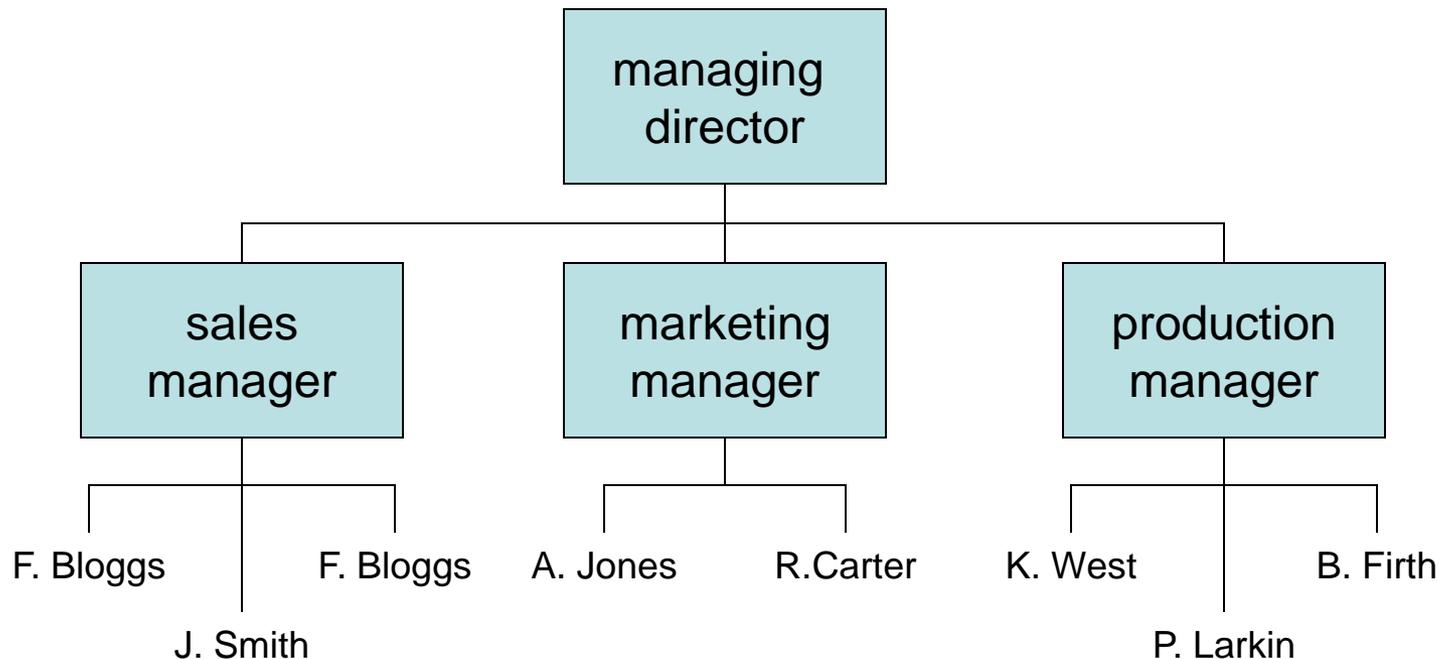


structured information

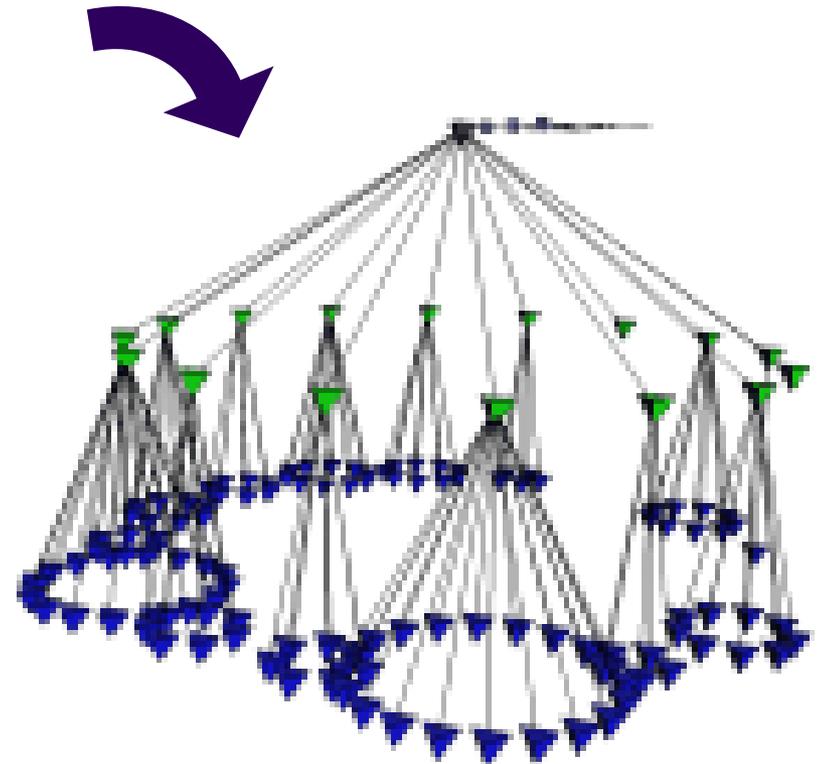
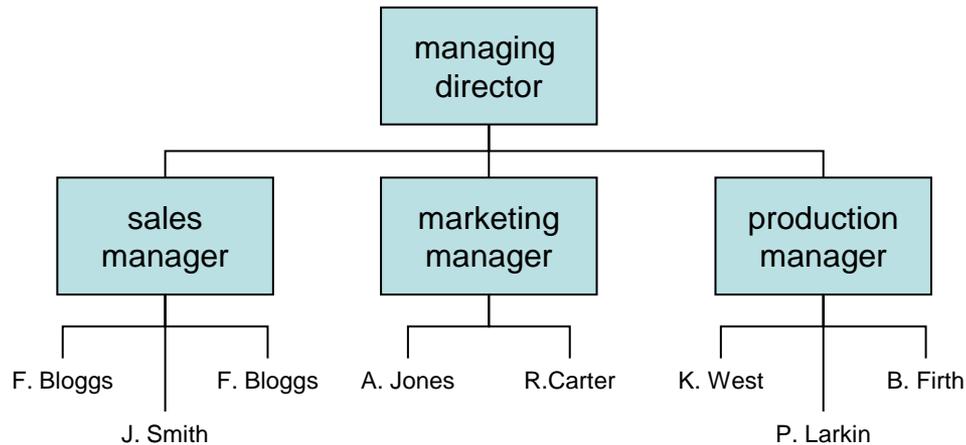
- scientific data – just numbers
- information systems ... lots of kinds of data
- hierarchies
 - file trees, organisation charts
- networks
 - program flow charts, hypertext structure
- free text ...
 - documents, web pages

visualising hiererchy

- 2D organisation chart
 - familiar representation
 - what happens when it gets wide?



wide hierarchies ... use 3D?



- cone trees (Xerox)
- levels become rings
- overlap 'OK' in 3D

time and interactivity

- visualising in time
 - time dimension mapped to space
 - changing values: sales graphs, distance-time
 - events: Gantt chart, timelines, historical charts
 - e.g. Lifelines – visualising medical and court records
- using time
 - data dimension mapped to time
 - time to itself: fast/slow replay of events
 - space to time: Visible Human Project
- interactivity
 - change under user control
 - e.g. influence explorer

between two worlds

- ubiquitous computing
 - computers fill the real world
 - virtual reality and visualisation
 - real world represented in the computer
 - augmented reality, ambient displays ...
 - physical and digital intermingled
- ... maturity
- VR and visualisation – commonplace
 - AR, ubiquity ... coming fast!