Chapter 6

Interfaces

Overview

- Interface types
  - highlight the main design and research issues for each of the different interfaces
- Consider which interface is best for a given application or activity

Interface type	See also
1. Command-based	
2. WIMP and GUI	
3. Multimedia	WIMP and web
4. Virtual reality	Augmented and mixed reality
5. Information visualization	Multimedia
6. Web	Mobile and multimedia
7. Consumer electronics and appliances	Mobile
8. Mobile	Augmented and mixed reality
9. Speech	
10. Pen	Shareable, touch
11. Touch	Shareable, air-based gesture
12. Air-based gesture	Tangible
13. Haptic	Multimodal
14. Multimodal	Speech, pen, touch, gesture, and haptic
15. Shareable	Touch
16. Tangible	
17. Augmented and mixed reality	Virtual reality
18. Wearable	
19. Robotic	
20. Brain–computer	

Table 6.1 The types of interfaces covered in this chapter

1. Command-based

- Commands such as abbreviations (e.g. ls) typed in at the prompt to which the system responds (e.g. listing current files)
- Some are hard wired at keyboard, others can be assigned to keys
- Efficient, precise, and fast
- Large overhead to learning set of commands

Second Life command-based interface for visually impaired users

Research and design issues

- Form, name types and structure are key research questions
- Consistency is most important design principle
  - e.g. always use first letter of command
- Command interfaces popular for web scripting

2. WIMP and GUI

- Xerox Star first WIMP -> rise to GUIs
- Windows
  - could be scrolled, stretched, overlapped, opened, closed, and moved around the screen using the mouse
- Icons
  - represented applications, objects, commands, and tools that were opened when clicked on
- Menus
  - offering lists of options that could be scrolled through and selected
- Pointing device
  - a mouse controlling the cursor as a point of entry to the windows, menus, and icons on the screen

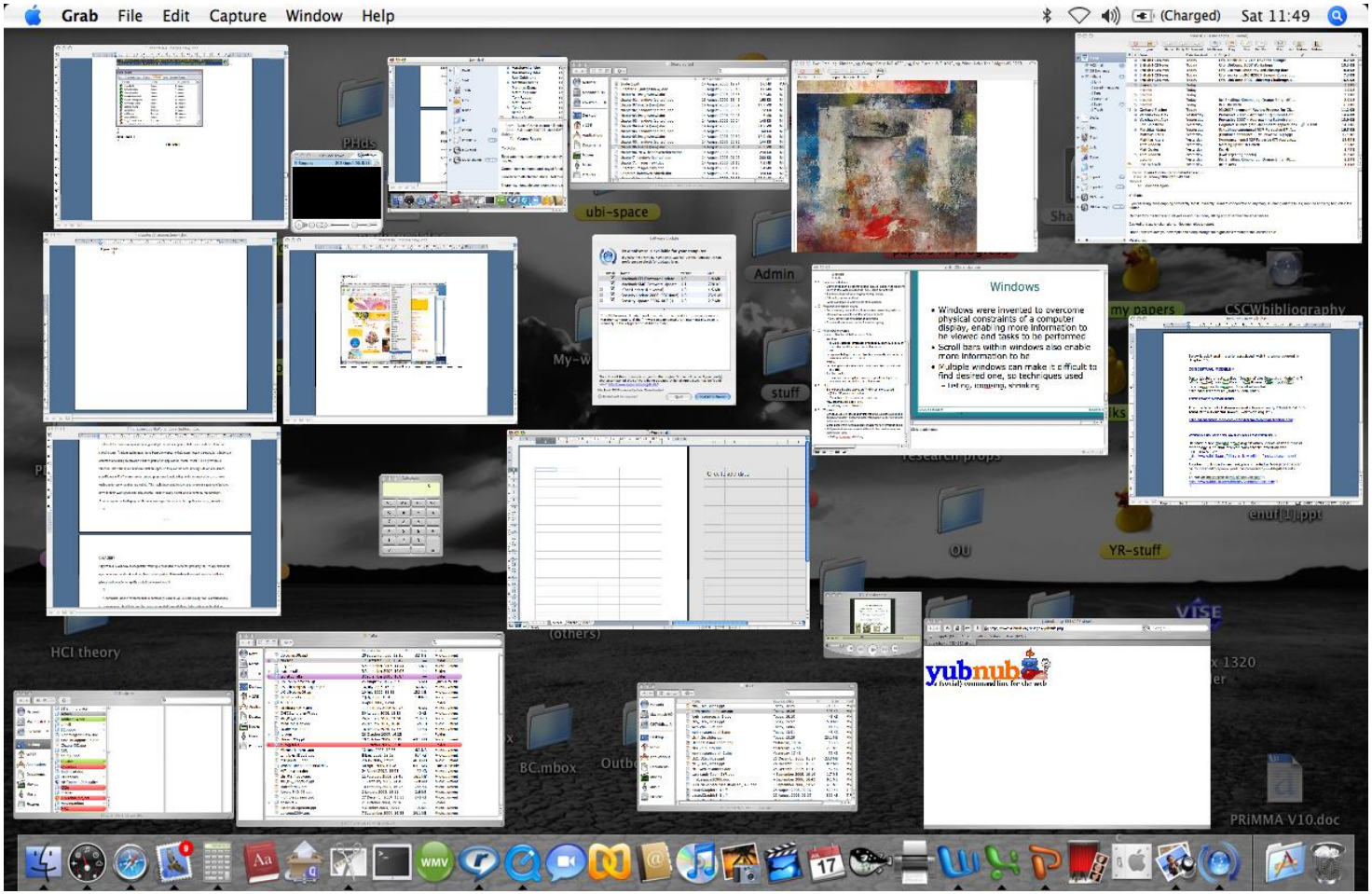
GUIs

- Same basic building blocks as WIMPs but more varied
  - Color, 3D, sound, animation,
  - Many types of menus, icons, windows
- New graphical elements, e.g.
  - toolbars, docks, rollovers

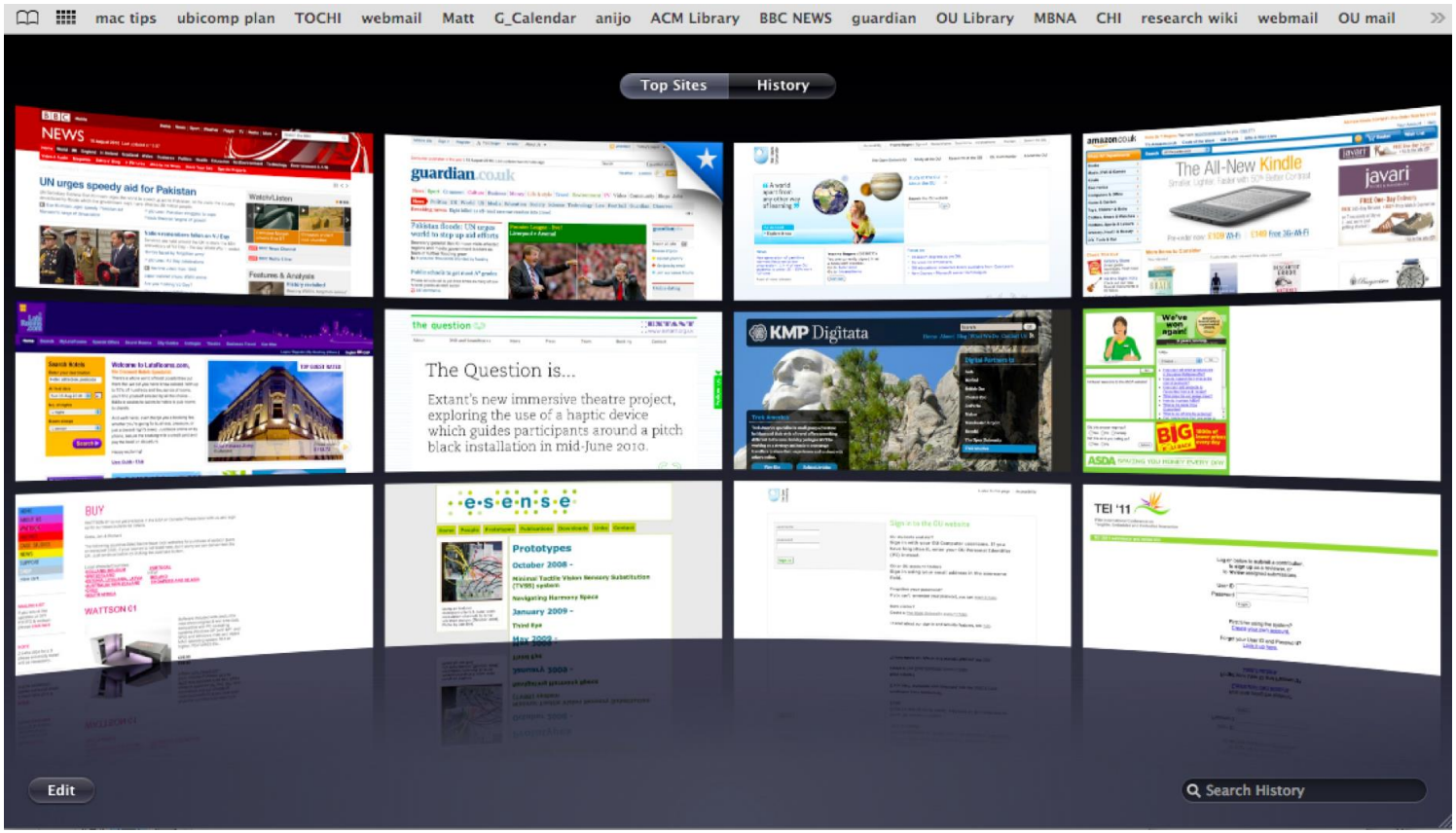
Windows

- Windows were invented to overcome physical constraints of a computer display
  - enable more information to be viewed and tasks to be performed
- Scroll bars within windows also enable more information to be viewed
- Multiple windows can make it difficult to find desired one
  - listing, iconising, shrinking are techniques that help

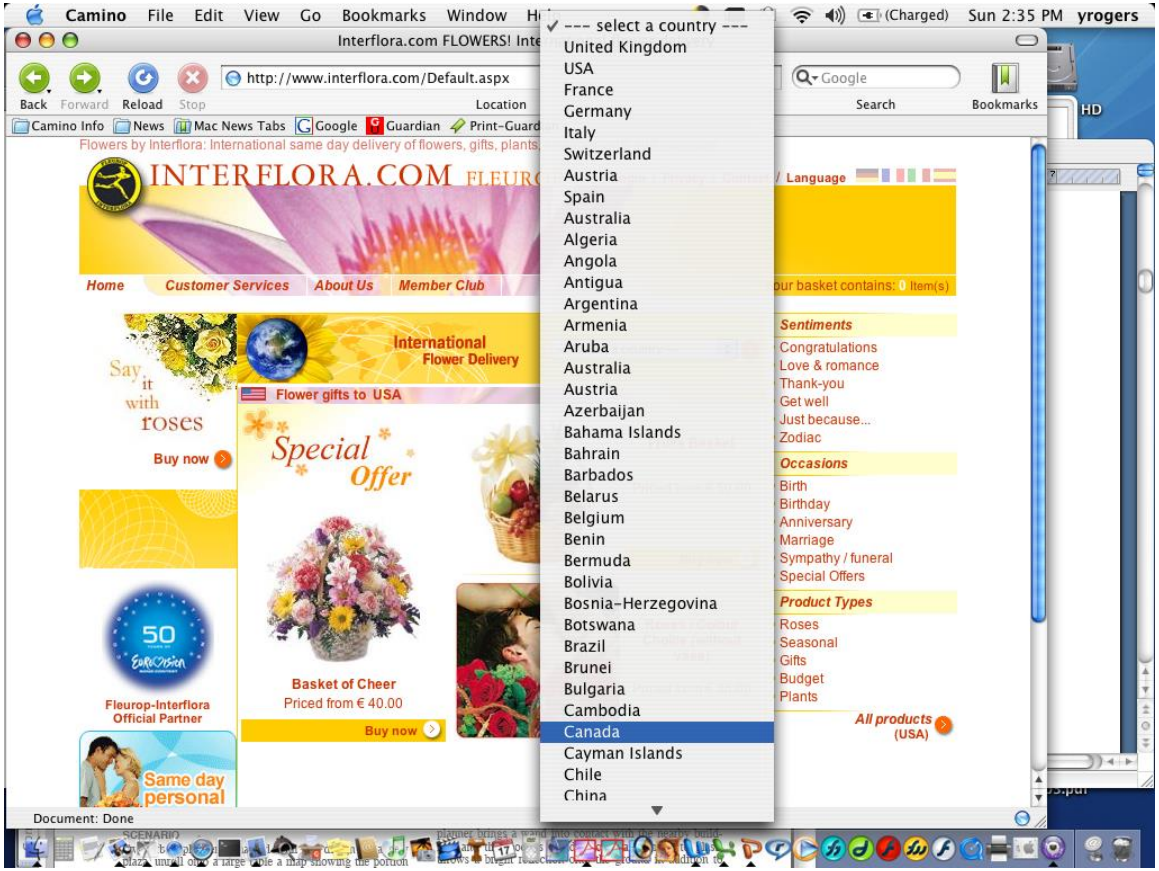
Apple's shrinking windows



Safari panorama window view



Selecting a country from a scrolling window



Is this method any better?

F	G	H	I	J
Fiji	Gabon	Haiti	Iceland	Jamaica
Finland	Germany	Holland	India	Japan
France	Gibraltar	Honduras	Indonesia	Jordan
French Guyana	Greece	Hong Kong	Iran	
French Polynesia	Greenland	Hungary	Ireland	
	Guadeloupe		Israel	
	Guam		Italy	
	Guatemala		Ivory Coast	

Research and design issues

- Window management
  - enables users to move fluidly between different windows (and monitors)
- How to switch attention between windows without getting distracted
- Design principles of spacing, grouping, and simplicity should be used

Menus

- A number of menu interface styles
  - flat lists, drop-down, pop-up, contextual, and expanding ones, e.g., scrolling and cascading
- Flat menus
  - good at displaying a small number of options at the same time and where the size of the display is small, e.g. iPods
  - but have to nest the lists of options within each other, requiring several steps to get to the list with the desired option
  - moving through previous screens can be tedious

iPod flat menu structure

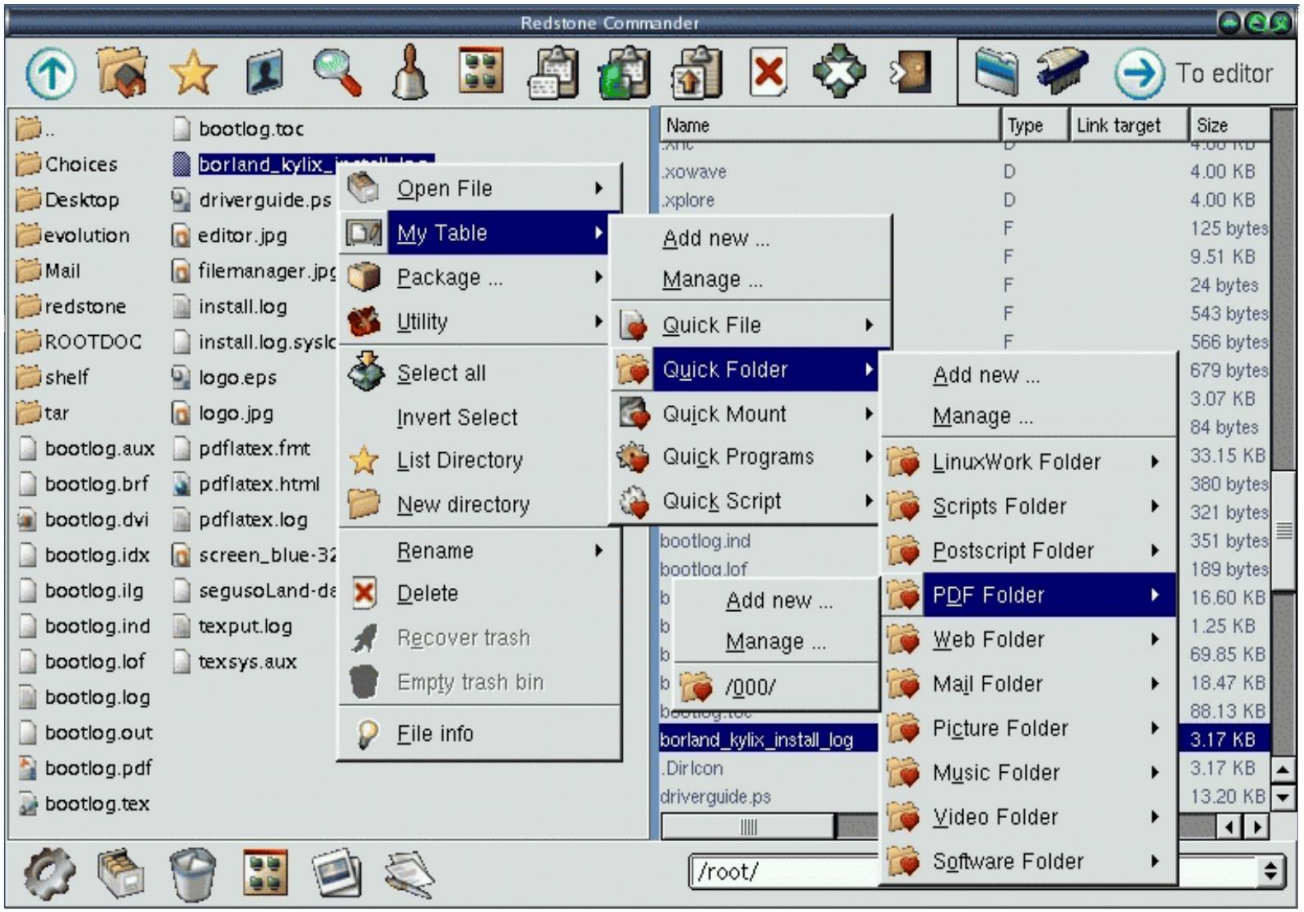
A sequence of options selected shown in the 4 windows

www.rainbow.gr/images/ rainbow/news/press/menu.jpg

Expanding menus

- Enables more options to be shown on a single screen than is possible with a single flat menu
- More flexible navigation, allowing for selection of options to be done in the same window
- Most popular are cascading ones
  - primary, secondary and even tertiary menus
  - downside is that they require precise mouse control
  - can result in overshooting or selecting wrong options

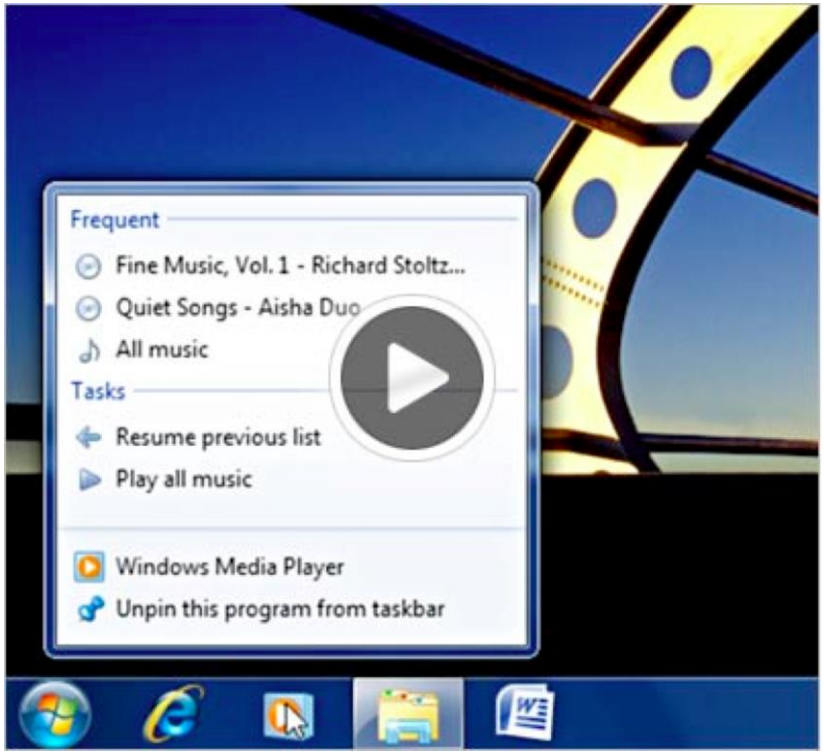
Cascading menu



Contextual menus

- Provide access to often-used commands that make sense in the context of a current task
- Appear when the user presses the Control key while clicking on an interface element
  - e.g., clicking on a photo in a website together with holding down the Control key results in options 'open it in a new window,' 'save it,' or 'copy it'
- Helps overcome some of the navigation problems associated with cascading menus

Windows Jump List Menu



Research and design issues

- What are best names/labels/phrases to use?
- Placement in list is critical
  - Quit and save need to be far apart
- Many international guidelines exist emphasizing depth/breadth, structure and navigation
  - e.g. ISO 9241

Icon design

- Icons are assumed to be easier to learn and remember than commands
- Can be designed to be compact and variably positioned on a screen
- Now pervasive in every interface
  - e.g. represent desktop objects, tools (e.g. paintbrush), applications (e.g. web browser), and operations (e.g. cut, paste, next, accept, change)

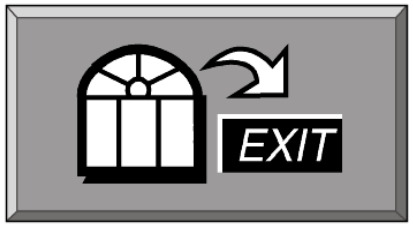
Icons

- Since the Xerox Star days icons have changed in their look and feel:
  - black and white -> color, shadowing, photorealistic images, 3D rendering, and animation
- Many designed to be very detailed and animated making them both visually attractive and informative
- GUIs now highly inviting, emotionally appealing, and feel alive

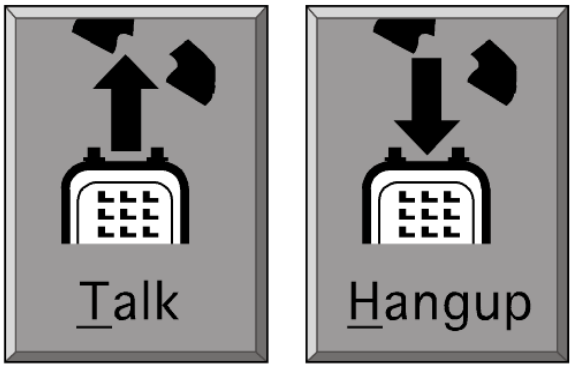
Icon forms

- The mapping between the representation and underlying referent can be:
  - similar (e.g., a picture of a file to represent the object file),
  - analogical (e.g., a picture of a pair of scissors to represent 'cut')
  - arbitrary (e.g., the use of an X to represent 'delete')
- Most effective icons are similar ones
- Many operations are actions making it more difficult to represent them
  - use a combination of objects and symbols that capture the salient part of an action

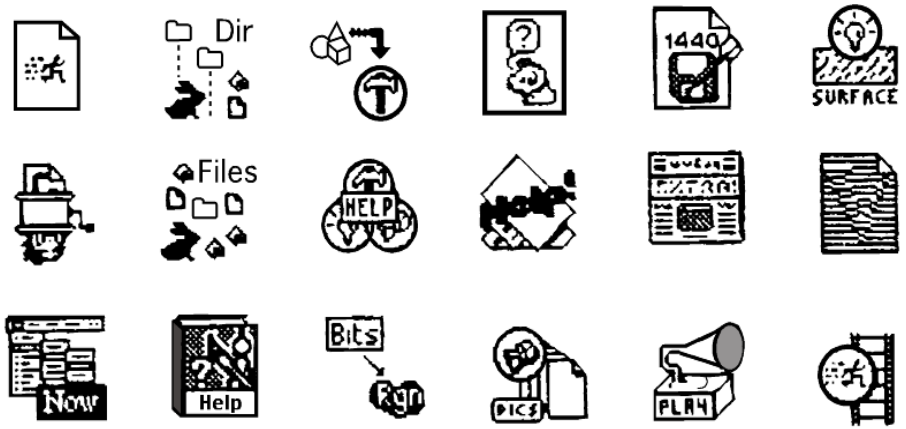
Early icons



(a)



(b)



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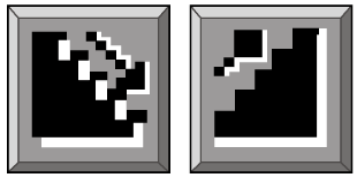
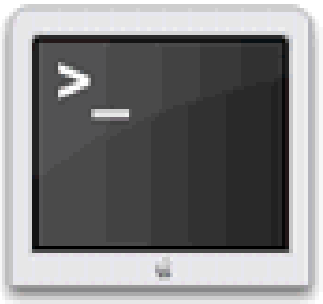


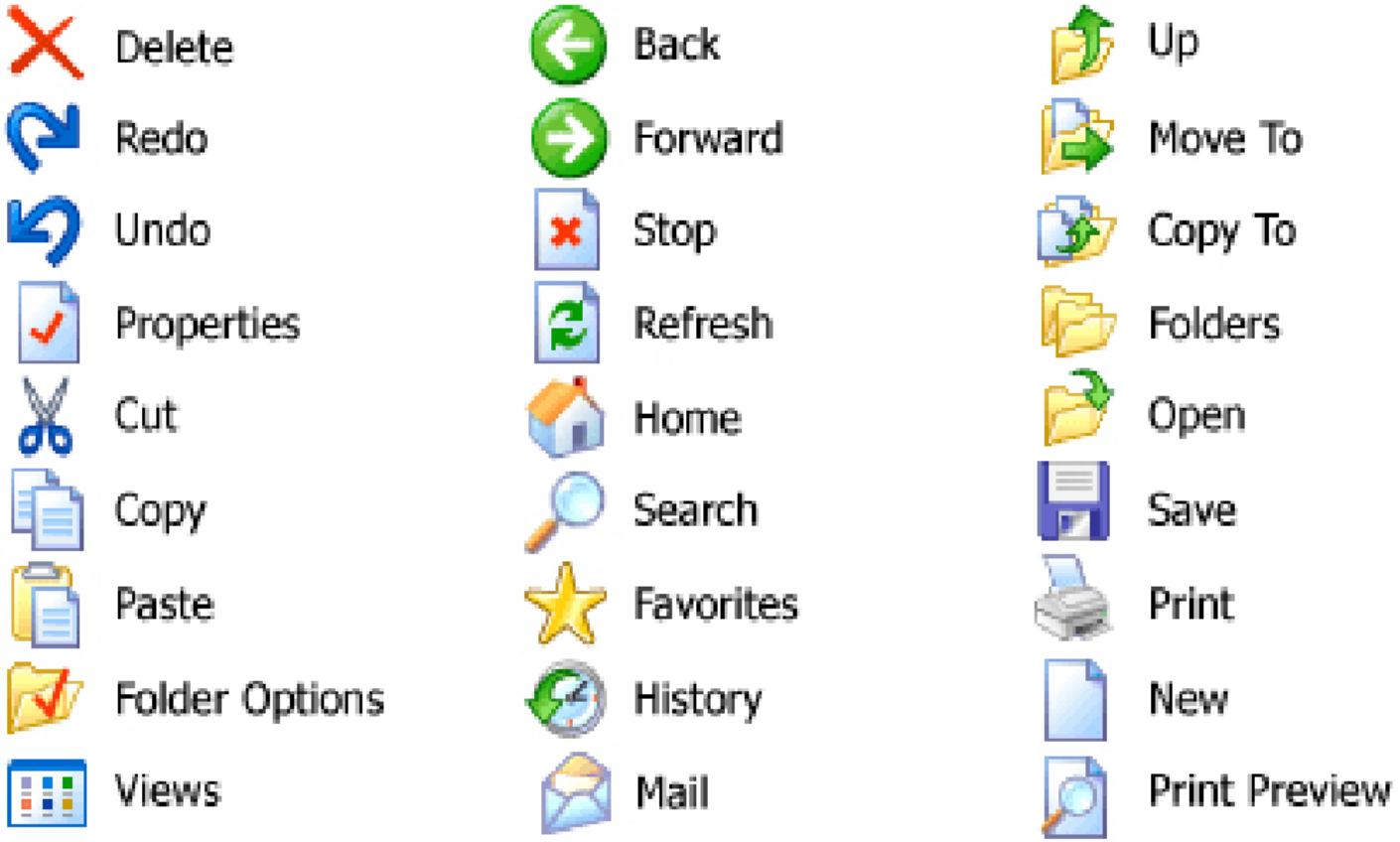
Newer icons








Simple icons plus labels



Activity

- Sketch simple icons to represent the operations to appear on a digital camera LCD screen:
  - Delete last picture taken
  - Delete all pictures stored
  - Format memory card

Toshiba's icons

- Which is which?
- Are they easy to understand
- Are they distinguishable?
- What representation forms are used?
- How do yours compare?

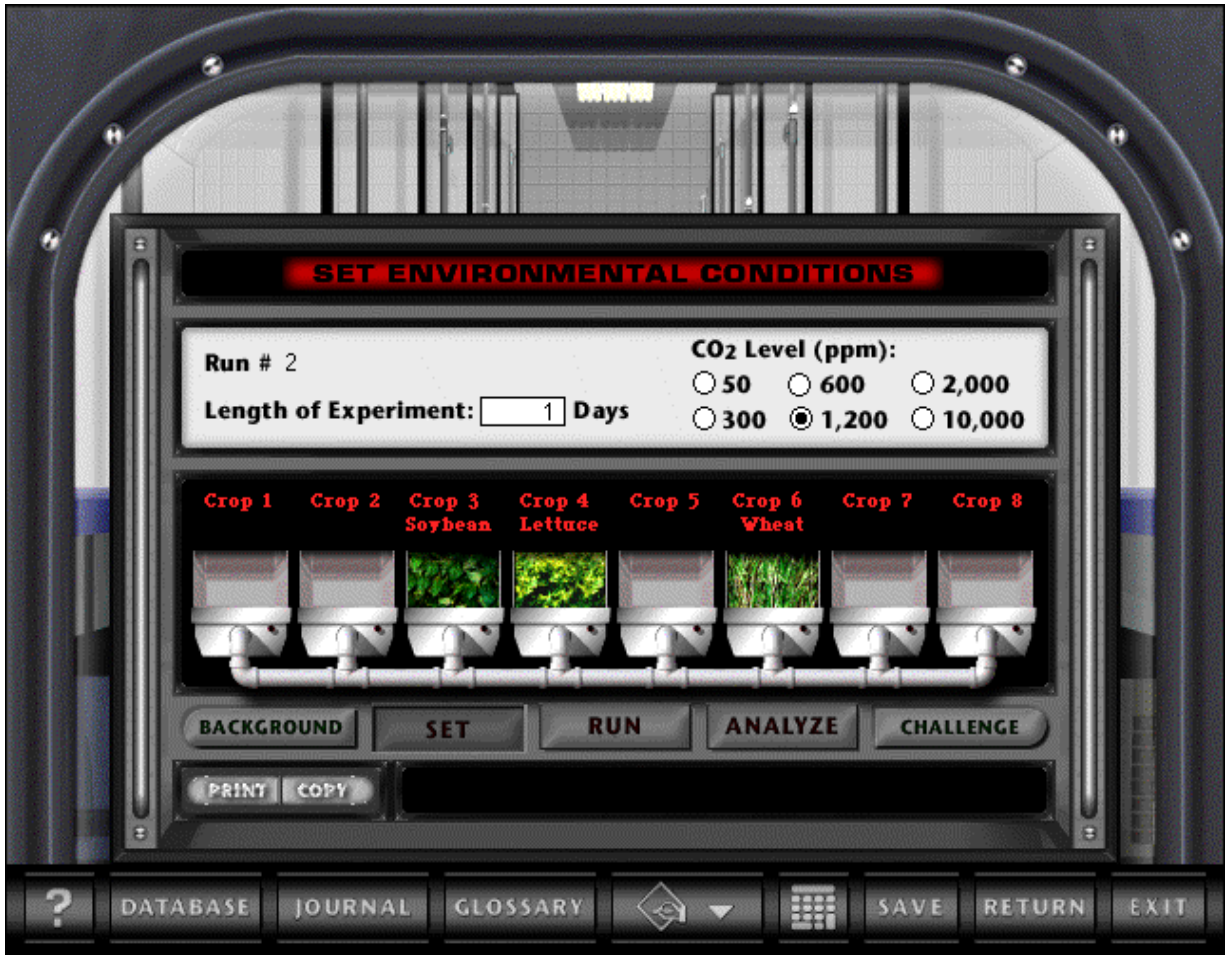
Research and design issues

- There is a wealth of resources now so do not have to draw or invent new icons from scratch
  - guidelines, style guides, icon builders, libraries
- Text labels can be used alongside icons to help identification for small icon sets
- For large icon sets (e.g. photo editing or word processing) use rollovers

3. Multimedia

- Combines different media within a single interface with various forms of interactivity
  - graphics, text, video, sound, and animations
- Users click on links in an image or text
  -> another part of the program
  -> an animation or a video clip is played
  ->can return to where they were or move on to another place

BioBlast multimedia learning environment



Pros and cons

- Facilitates rapid access to multiple representations of information
- Can provide better ways of presenting information than can any media alone
- Can enable easier learning, better understanding, more engagement, and more pleasure
- Can encourage users to explore different parts of a game or story
- Tendency to play video clips and animations, while skimming through accompanying text or diagrams

Research and design issues

- How to design multimedia to help users explore, keep track of, and integrate the multiple representations
  - provide hands-on interactivities and simulations that the user has to complete to solve a task
  - Use 'dynalinking,' where information depicted in one window explicitly changes in relation to what happens in another (Scaife and Rogers, 1996).
- Several guidelines that recommend how to combine multiple media for different kinds of task

4. Virtual reality

- Computer-generated graphical simulations providing:
  - "the illusion of participation in a synthetic environment rather than external observation of such an environment" (Gigante, 1993)
- provide new kinds of experience, enabling users to interact with objects and navigate in 3D space
- Create highly engaging user experiences

Pros and cons

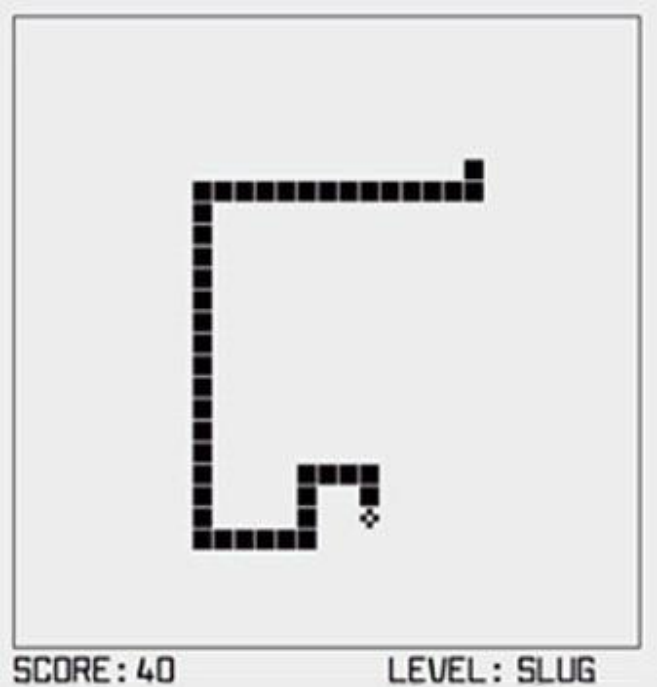
- Can have a higher level of fidelity with objects they represent compared to multimedia
- Induces a sense of presence where someone is totally engrossed by the experience
  - "a state of consciousness, the (psychological) sense of being in the virtual environment" (Slater and Wilbur, 1999)
- Provides different viewpoints: 1st and 3rd person
- Head-mounted displays are uncomfortable to wear, and can cause motion sickness and disorientation

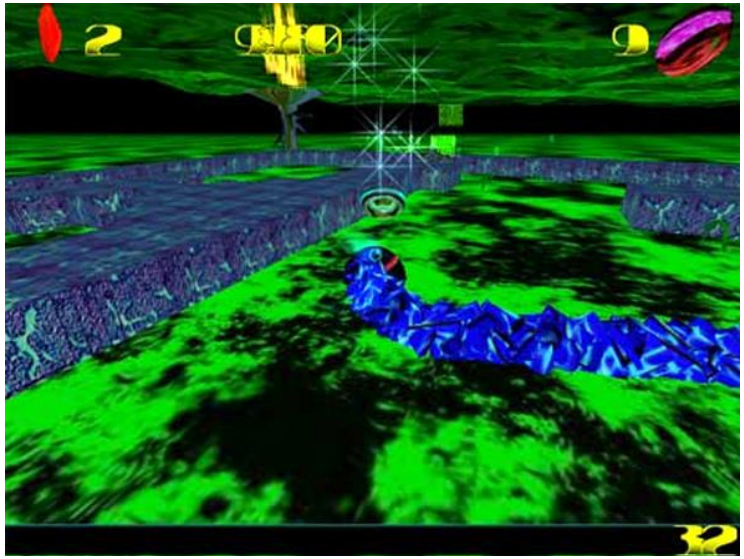
Virtual Gorilla Project

Research and design issues

- Much research on how to design safe and realistic VRs to facilitate training
  - e.g. flying simulators
  - help people overcome phobias (e.g. spiders, talking in public)
- Design issues
  - how best to navigate through them (e.g. first versus third person)
  - how to control interactions and movements (e.g. use of head and body movements)
  - how best to interact with information (e.g. use of keypads, pointing, joystick buttons);
  - level of realism to aim for to engender a sense of presence

Which is the most engaging game of Snake?





5. Information visualization

- Computer-generated interactive graphics of complex data
- Amplify human cognition, enabling users to see patterns, trends, and anomalies in the visualization (Card *et al,* 1999)
- Aim is to enhance discovery, decision-making, and explanation of phenomena
- Techniques include:
  - 3D interactive maps that can be zoomed in and out of and which present data via webs, trees, clusters, scatterplot diagrams, and interconnected nodes

Research and design issues

- whether to use animation and/or interactivity
- what form of coding to use, e.g. color or text labels
- whether to use a 2D or 3D representational format
- what forms of navigation, e.g. zooming or panning,
- what kinds and how much additional information to provide, e.g. rollovers or tables of text
- What navigational metaphor to use

6. Web

- Early websites were largely text-based, providing hyperlinks
- Concern was with how best to structure information at the interface to enable users to navigate and access it easily and quickly
- Nowadays, more emphasis on making pages distinctive, striking, and pleasurable

Usability versus attractive?

- Vanilla or multi-flavor design?
  - Ease of finding something versus aesthetic and enjoyable experience
- Web designers are:
  - "thinking great literature"
- Users read the web like a:
  - "billboard going by at 60 miles an hour" (Krug, 2000)
- Need to determine how to brand a web page to catch and keep 'eyeballs'

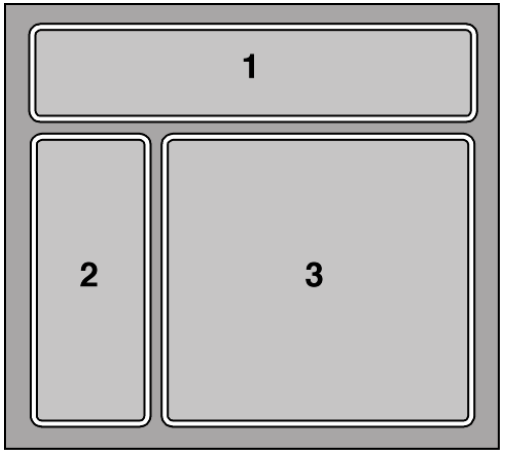
In your face ads

- Web advertising is often intrusive and pervasive
- Flashing, aggressive, persistent, annoying
- Often need to be 'actioned' to get rid of
- What is the alternative?

Research and design issues

- Need to consider how best to design, present, and structure information and system behavior
- But also content and navigation are central
- Veen's design principles

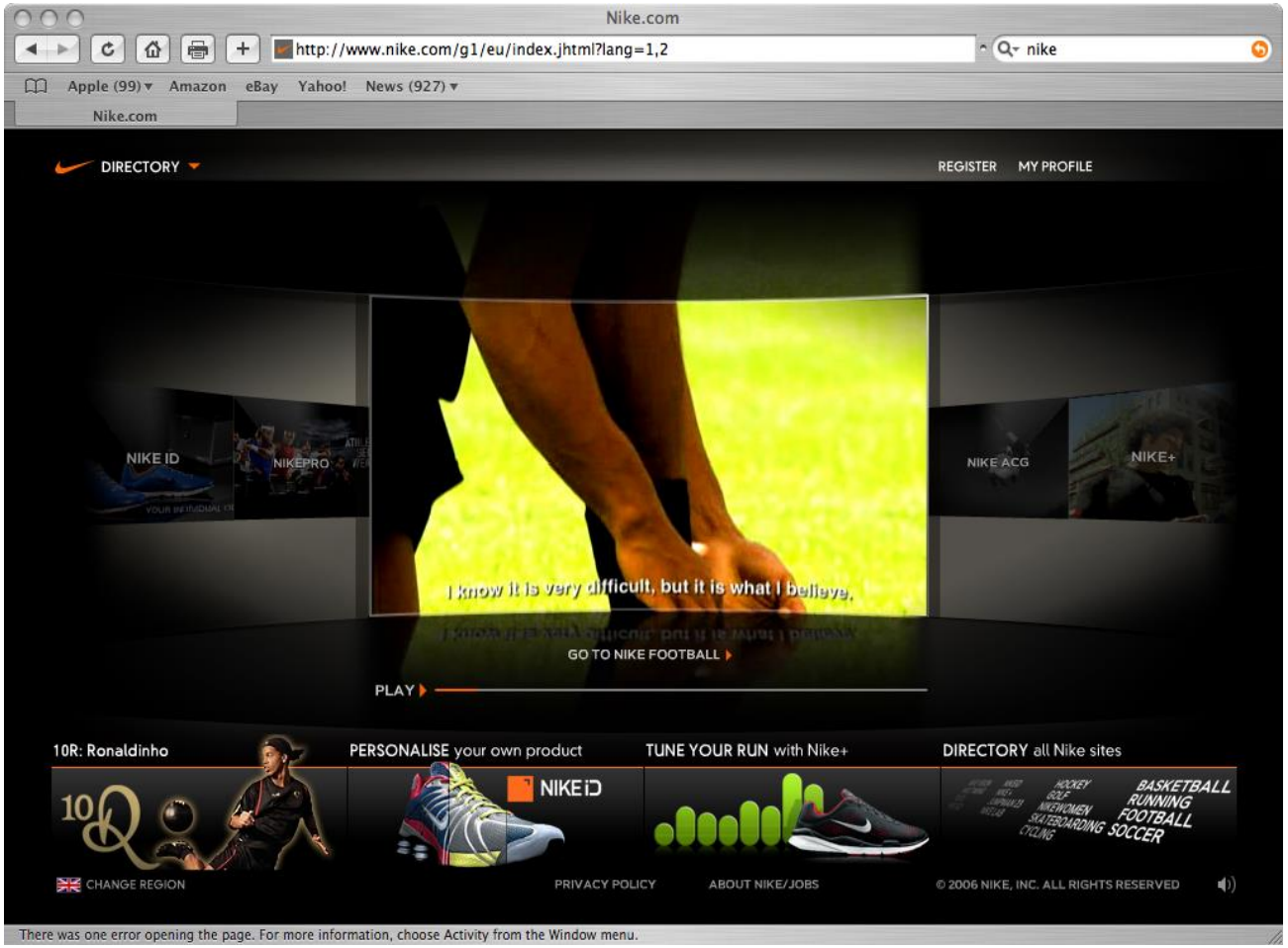
(1)Where am I?
(2)Where can I go?
(3) What's here?



Activity

- Look at the Nike.com website
- What kind of website is it?
- How does it contravene the design principles outlined by Veen?
- Does it matter?
- What kind of user experience is it providing for?
- What was your experience of engaging with it?

Nike.com


Nike.com
http://www.nike.com/g1/eu/index.jhtml?lang=1,2
nike
Apple (99)
Amazon
eBay
Yahoo!
News (927)
Nike.com
DIRECTORY
REGISTER
MY PROFILE
NIKE ID
NIKEPRO
NIKE ACG
NIKE+
I know it is very difficult, but it is what I believe.
GO TO NIKE FOOTBALL
PLAY
10R: Ronaldinho
PERSONALISE your own product
TUNE YOUR RUN with Nike+
DIRECTORY all Nike sites
BASKETBALL
RUNNING
FOOTBALL
SOCCER
CHANGE REGION
PRIVACY POLICY
ABOUT NIKE/JOBS
© 2006 NIKE, INC. ALL RIGHTS RESERVED
There was one error opening the page. For more information, choose Activity from the Window menu.

7. Consumer electronics and appliances

- Everyday devices in home, public place, or car
  - e.g. washing machines, remotes, photocopiers, printers and navigation systems)
- And personal devices
  - e.g. MP3 player, digital clock and digital camera
- Used for short periods
  - e.g. putting the washing on, watching a program, buying a ticket, changing the time, taking a snapshot
- Need to be usable with minimal, if any, learning

A toaster

Research and design issues

- Need to design as transient interfaces with short interactions
- Simple interfaces
- Consider trade-off between soft and hard controls
  - e.g. buttons or keys, dials or scrolling

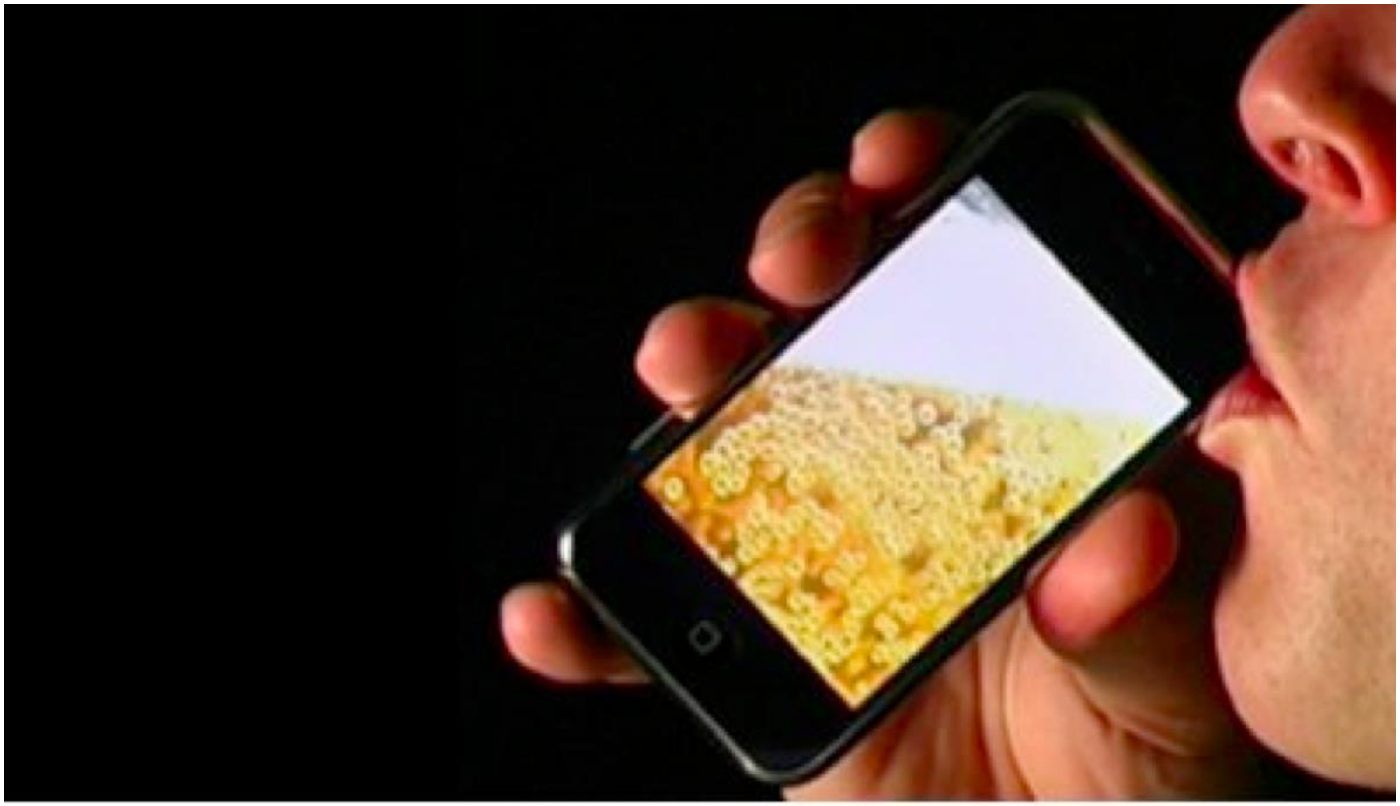
8. Mobile

- Handheld devices intended to be used while on the move
- Have become pervasive, increasingly used in all aspects of everyday and working life
- Applications running on handhelds have greatly expanded, e.g.
  - used in restaurants to take orders
  - car rentals to check in car returns
  - supermarkets for checking stock
  - in the streets for multi-user gaming
  - in education to support life-long learning

The advent of the iPhone app

- A whole new user experience that was designed primarily for people to enjoy
  - many apps not designed for any need, want or use but purely for idle moments to have some fun
  - e.g. iBeer developed by magician Steve Sheraton
  - ingenious use of the accelerometer that is inside the phone

iBeer app

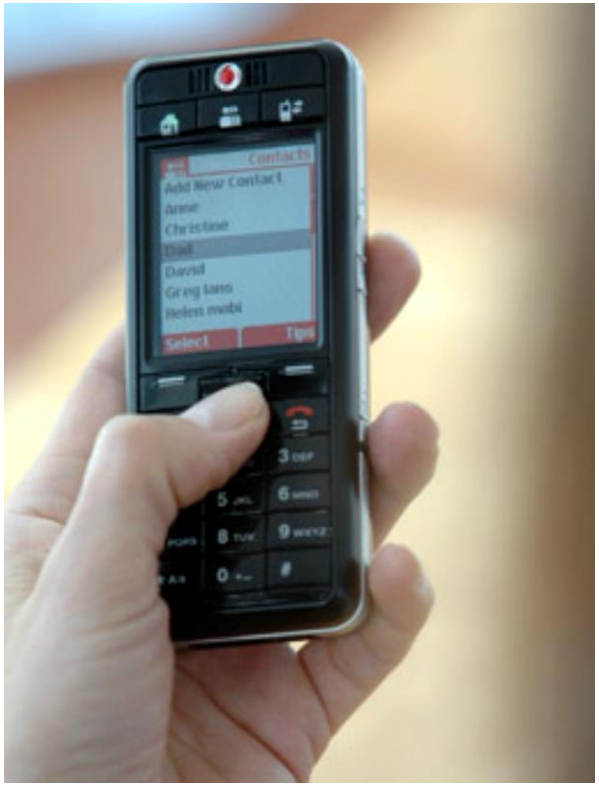


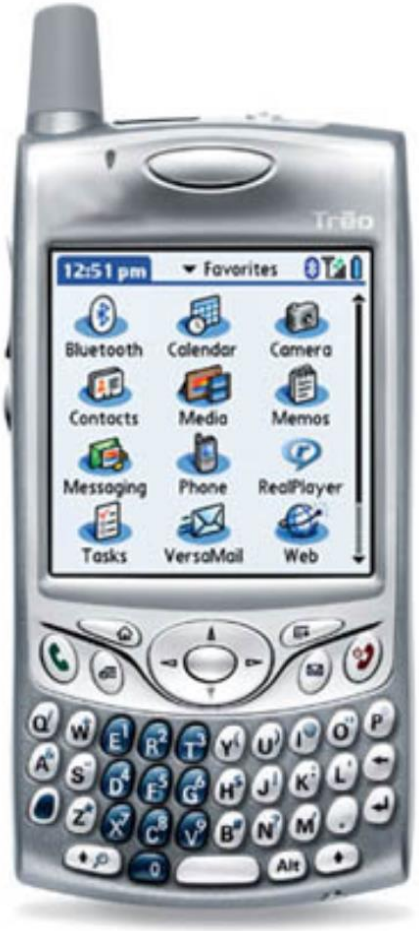
QR codes and cell phones

Mobile challenges

- Small screens, small number of keys and restricted number of controls
- Many smartphones now use multi-touch surface displays
- Innovative physical designs including:
  - roller wheels, rocker dials, up/down 'lips' on the face of phones, 2-way and 4-way directional keypads, softkeys, silk-screened buttons
- Usability and preference varies
  - depends on the dexterity and commitment of the user

Simple or complex phone for you and your grandmother?





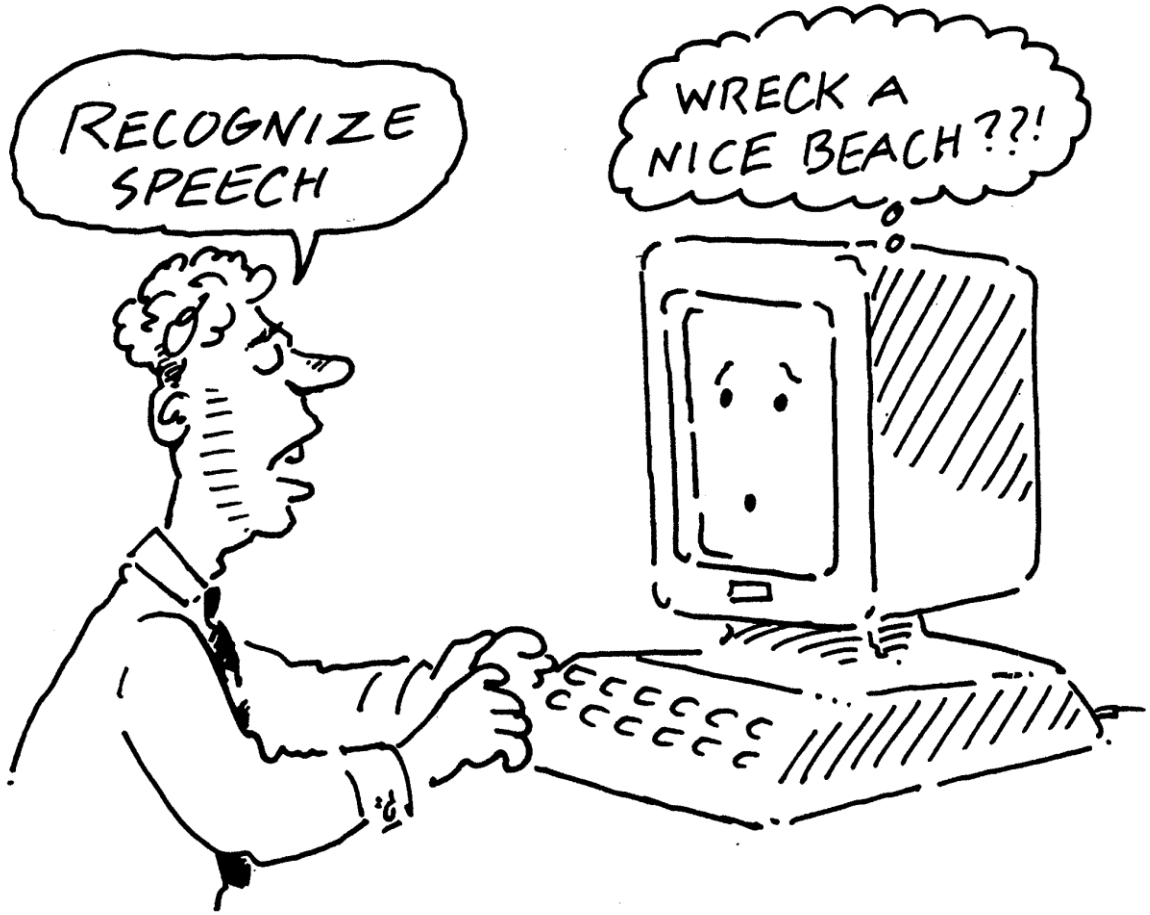
Research and design issues

- mobile interfaces can be tricky and cumbersome to use for those with poor manual dexterity or 'fat' fingers
- Key concern is designing for small screen real estate and limited control space
    - e.g. mobile browsers allow users to view and navigate the internet, magazines etc., in a more streamlined way compared with PC web browsers

9. Speech

- Where a person talks with a system that has a spoken language application, e.g., timetable, travel planner
- Used most for inquiring about very specific information, e.g. flight times or to perform a transaction, e.g. buy a ticket
- Also used by people with disabilities
  - e.g. speech recognition word processors, page scanners, web readers, home control systems

Have speech interfaces come of age?



Get me a human operator!

- Most popular use of speech interfaces currently is for call routing
- Caller-led speech where users state their needs in their own words
  - e.g. "I'm having problems with my voice mail"
- Idea is they are automatically forwarded to the appropriate service
- What is your experience of speech systems?

Format

- Directed dialogs are where the system is in control of the conversation
- Ask specific questions and require specific responses
- More flexible systems allow the user to take the initiative:
  - e.g. "I'd like to go to Paris next Monday for two weeks."
- More chance of error, since caller might assume that the system is like a human
- Guided prompts can help callers back on track
  - e.g. "Sorry I did not get all that. Did you say you wanted to fly next Monday?"

Research and design issues

- How to design systems that can keep conversation on track
  - help people navigate efficiently through a menu system
  - enable them to easily recover from errors
  - guide those who are vague or ambiguous in their requests for information or services
- Type of voice actor (e.g. male, female, neutral, or dialect)
  - do people prefer to listen to and are more patient with a female or male voice, a northern or southern accent?

10. Pen

- Enable people to write, draw, select, and move objects at an interface using lightpens or styluses
  - capitalize on the well-honed drawing skills developed from childhood
- Digital pens, e.g. Anoto, use a combination of ordinary ink pen with digital camera that digitally records everything written with the pen on special paper

Pros and cons

- Allows users to quickly and easily annotate existing documents
- Can be difficult to see options on the screen because a user's hand can occlude part of it when writing
- Can have lag and feel clunky

11. Touch

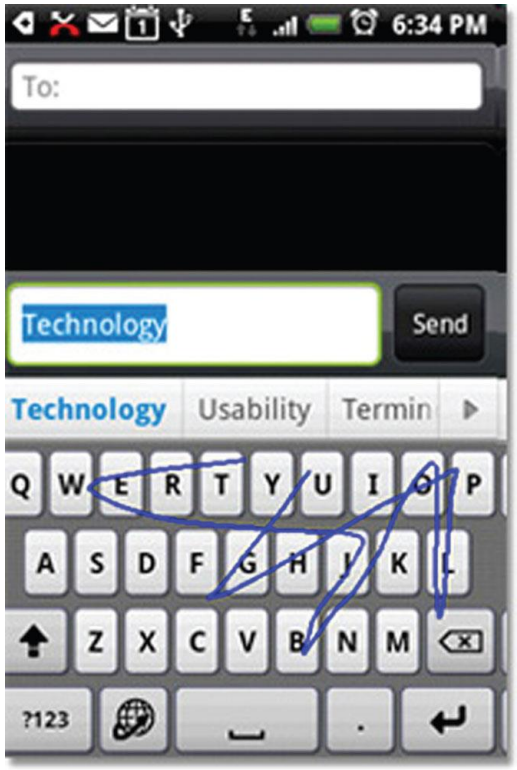
- Touch screens, such as walk-up kiosks, detect the presence and location of a person's touch on the display
- Multi-touch support a range of more dynamic finger tip actions, e.g. swiping, flicking, pinching, pushing and tapping
- Now used for many kinds of displays, such as Smartphones, iPods, tablets and tabletops

Research and design issues

- More fluid and direct styles of interaction involving freehand and pen-based gestures
- Core design concerns include whether size, orientation, and shape of touch displays effect collaboration
- Much faster to scroll through wheels, carousels and bars of thumbnail images or lists of options by finger flicking
- More cumbersome, error-prone and slower to type using a virtual keyboard on a touch display than using a physical keyboard

Research and design issues

- Will finger-flicking, stroking and touching a screen result in new ways of consuming, reading, creating and searching digital content?

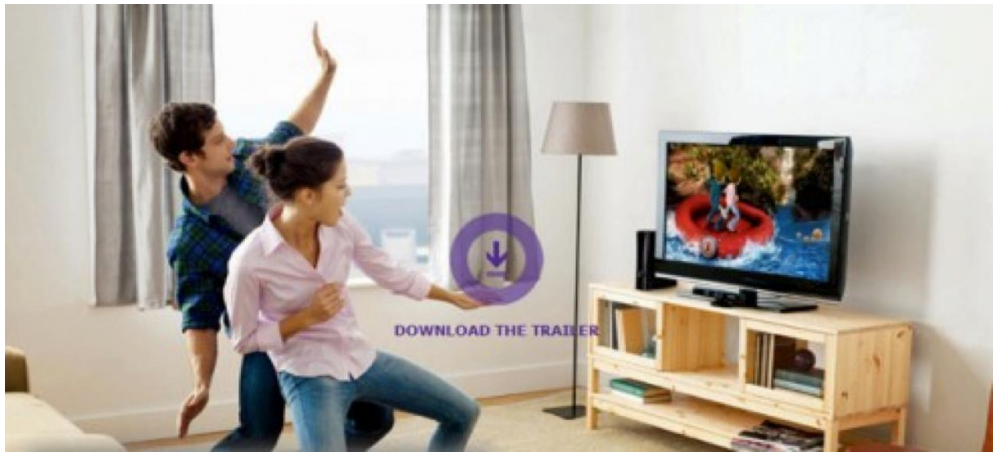


12. Air-based gestures

- Uses camera recognition, sensor and computer vision techniques
  - can recognize people's body, arm and hand gestures in a room
  - systems include Kinect and EyeToy
- Movements are mapped onto a variety of gaming motions, such as swinging, bowling, hitting and punching
- Players represented on the screen as avatars doing same actions

Home entertainment

- Universal appeal
  - young children, grandparents, professional gamers, technophobes



Research and design issues

- How does computer recognize and delineate players' gestures?
  - Deictic and hand waving
- Does holding a control device feel more intuitive than controller free gestures?
  - For gaming, exercising, dancing

13. Haptic

- Tactile feedback
  - applying vibration and forces to a person's body, using actuators that are embedded in their clothing or a device they are carrying, such as a cell phone
- Can enrich user experience or nudge them to correct error
- Can also be used to simulate the sense of touch between remote people who want to communicate

Realtime vibrotactile feedback

- Provides nudges when playing incorrectly
- Uses motion capture
- Nudges are vibrations on arms and hands

Research and design issues

- Where best to place actuators on body
- Whether to use single or sequence of ‘touches’
- When to buzz and how intense
- How does the wearer feel it in different contexts?

14. Multi-modal

- Meant to provide enriched and complex user experiences
  - multiplying how information is experienced using different modalities, i.e. touch, sight, sound, speech
  - support more flexible, efficient, and expressive means of human–computer interaction
  - Most common is speech and vision

Research and design issues

- Need to recognize and analyse speech, gesture, and eye gaze
- what is gained from combining different input and outputs
- Is talking and gesturing, as humans do with other humans, a natural way of interacting with a computer?

15. Shareable

- Shareable interfaces are designed for more than one person to use
  - provide multiple inputs and sometimes allow simultaneous input by co-located groups
  - large wall displays where people use their own pens or gestures
  - interactive tabletops where small groups interact with information using their fingertips
  - e.g. DiamondTouch, Smart Table and Surface

A smartboard

DiamondTouch Tabletop

Advantages

- Provide a large interactional space that can support flexible group working
- Can be used by multiple users
  - can point to and touch information being displayed
  - simultaneously view the interactions and have same shared point of reference as others
- Can support more equitable participation compared with groups using single PC

The Drift Table

Research and design issues

- More fluid and direct styles of interaction involving freehand and pen-based gestures
- Core design concerns include whether size, orientation, and shape of the display have an effect on collaboration
- horizontal surfaces compared with vertical ones support more turn-taking and collaborative working in co-located groups
- Providing larger-sized tabletops does not improve group working but encourages more division of labor

16. Tangible

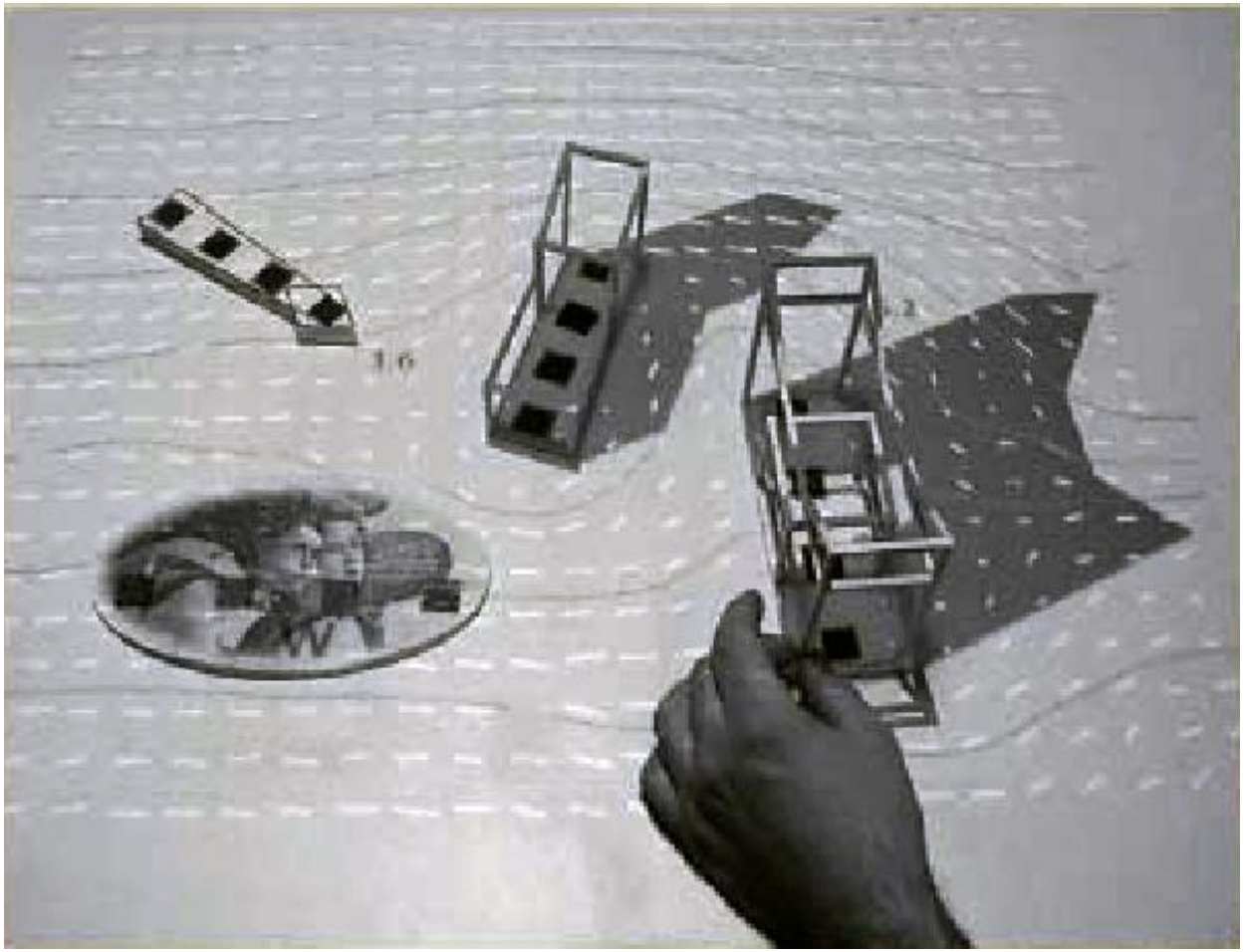
- Type of sensor-based interaction, where physical objects, e.g., bricks, are coupled with digital representations
- When a person manipulates the physical object/s it causes a digital effect to occur, e.g. an animation
- Digital effects can take place in a number of media and places or can be embedded in the physical object

Examples

- Chromarium cubes
  - when turned over digital animations of color are mixed on an adjacent wall
  - faciliates creativity and collaborative exploration
- Flow Blocks
  - depict changing numbers and lights embedded in the blocks
  - vary depending on how they are connected together
- Urp
  - physical models of buildings moved around on tabletop
  - used in combination with tokens for wind and shadows -> digital shadows surrounding them to change over time

Flow blocks

Urp



Benefits

- Can be held in both hands and combined and manipulated in ways not possible using other interfaces
  - allows for more than one person to explore the interface together
  - objects can be placed on top of each other, beside each other, and inside each other
  - encourages different ways of representing and exploring a problem space
- People are able to see and understand situations differently
  - can lead to greater insight, learning, and problem-solving than with other kinds of interfaces
  - can facilitate creativity and reflection

Research and design issues

- Develop new conceptual frameworks that identify novel and specific features
- The kind of coupling to use between the physical action and digital effect
  - If it is to support learning then an explicit mapping between action and effect is critical
  - If it is for entertainment then can be better to design it to be more implicit and unexpected
- What kind of physical artifact to use
  - Bricks, cubes, and other component sets are most commonly used because of flexibility and simplicity
  - Stickies and cardboard tokens can also be used for placing material onto a surface

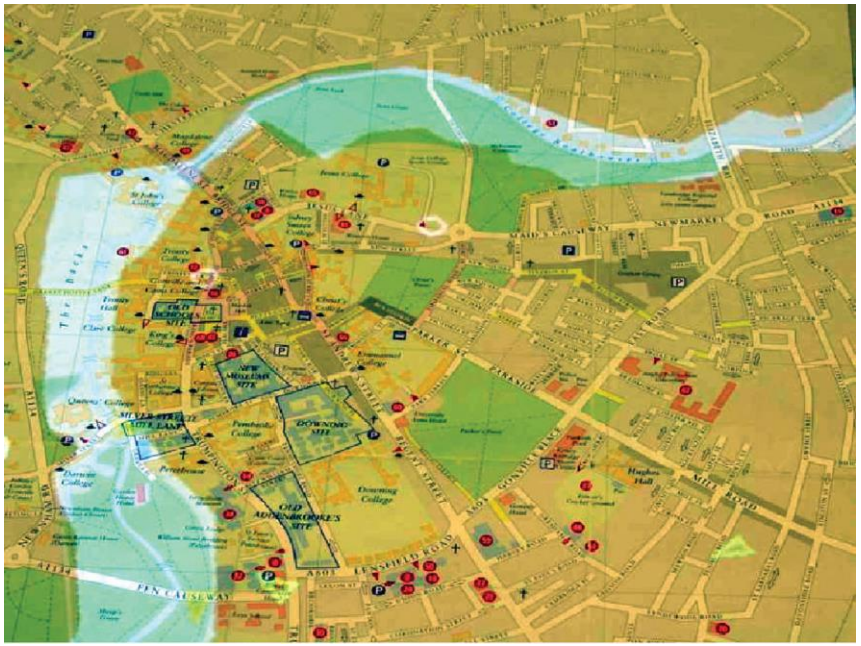
17. Augmented and mixed reality

- Augmented reality - virtual representations are superimposed on physical devices and objects
- Mixed reality - views of the real world are combined with views of a virtual environment
- Many applications including medicine, games, flying, and everyday exploring

Examples

- In medicine
  - virtual objects, e.g. X-rays and scans, are overlaid on part of a patient's body
  - aid the physician's understanding of what is being examined or operated
- In air traffic control
  - dynamic information about aircraft overlaid on a video screen showing the real planes, etc. landing, taking off, and taxiing
  - Helps identify planes difficult to make out

An augmented map



‘Smart’ augmented reality?

- Smartphone apps intended to guide people walking in a city
  - arrows and local information (e.g. nearest McDonalds) are overlaid on a picture of the street the person is walking in
  - Will this mean people spending most of their time glued to their smartphone rather than looking at the sites?

Research and design issues

- What kind of digital augmentation?
  - When and where in physical environent?
  - Needs to stand out but not distract from ongoing task
  - Need to be able to align with real world objects
- What kind of device?
  - Smartphone, head up display or other?

18.Wearables

- First developments were head- and eyewear-mounted cameras that enabled user to record what was seen and to access digital information
- Since, jewellery, head-mounted caps, smart fabrics, glasses, shoes, and jackets have all been used
  - provide the user with a means of interacting with digital information while on the move
- Applications include automatic diaries, tour guides, cycle indicators and fashion clothing

Steve Mann - pioneer of wearables

Steve Mann's "wearable computer" and "reality mediator" inventions of the 1970s have evolved into what looks like ordinary eyeglasses.

Research and design issues

- Comfort
  - needs to be light, small, not get in the way, fashionable, and preferably hidden in the clothing
- Hygiene
  - is it possible to wash or clean the clothing once worn?
- Ease of wear
  - how easy is it to remove the electronic gadgetry and replace it?
- Usability
  - how does the user control the devices that are embedded in the clothing?

19. Robots

- Four types
  - remote robots used in hazardous settings
  - domestic robots helping around the house
  - pet robots as human companions
  - sociable robots that work collaboratively with humans, and communicate and socialize with them – as if they were our peers

Advantages

- Pet robots are assumed to have therapeutic qualities, being able to reduce stress and loneliness
- Remote robots can be controlled to investigate bombs and other dangerous materials

Research and design issues

- How do humans react to physical robots designed to exhibit behaviors (e.g. making facial expressions) compared with virtual ones?
- Should robots be designed to be human-like or look like and behave like robots that serve a clearly defined purpose?
- Should the interaction be designed to enable people to interact with the robot as if it was another human being or more human-computer-like (e.g. pressing buttons to issue commands)?

20. Brain-computer

- Brain–computer interfaces (BCI) provide a communication pathway between a person's brain waves and an external device, such as a cursor on a screen
- Person is trained to concentrate on the task, e.g. moving the cursor
- BCIs work through detecting changes in the neural functioning in the brain

Brainball game

Which interface?

- Is multimedia better than tangible interfaces for learning?
- Is speech as effective as a command-based interface?
- Is a multimodal interface more effective than a monomodal interface?
- Will wearable interfaces be better than mobile interfaces for helping people find information in foreign cities?
- Are virtual environments the ultimate interface for playing games?
- Will shareable interfaces be better at supporting communication and collaboration compared with using networked desktop PCs?

Which interface?

- Will depend on task, users, context, cost, robustness, etc.
- Mobile platforms taking over from PCs
- Speech interfaces also being used much more for a variety of commercial services
- Appliance and vehicle interfaces becoming more important
- Shareable and tangible interfaces entering our homes, schools, public places, and workplaces

Summary

- Many innovative interfaces have emerged post the WIMP/GUI era, including speech, wearable, mobile, brain and tangible
- Many design and research questions need to be considered to decide which to use
- An important concern that underlies the design of any kind of interface is how information is represented to the user so they can carry out ongoing activity or task