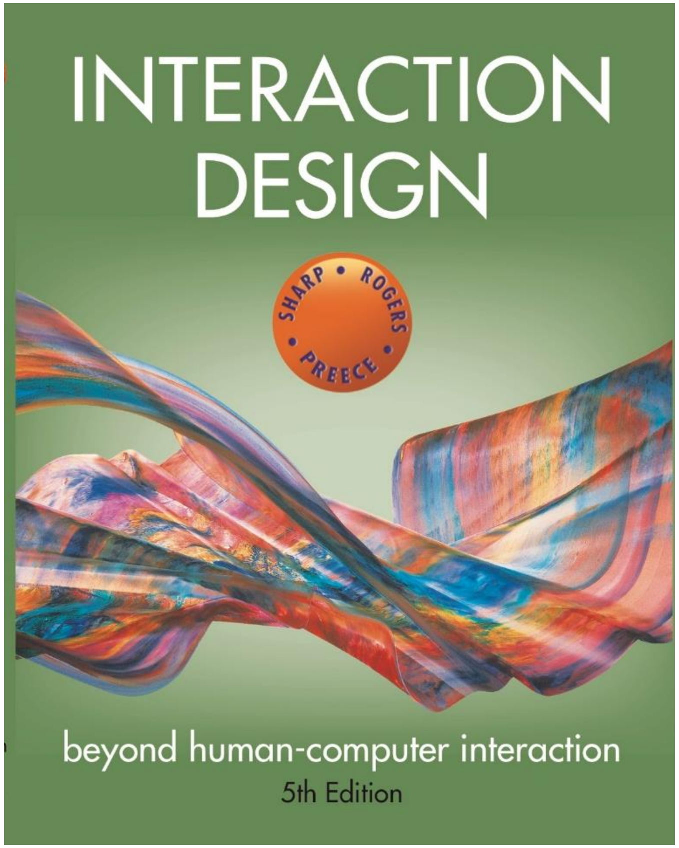


Chapter 7
INTERFACES

Interaction Types

- **Interface type**: defined by the utilized I/O devices (speech-based, standard GUI, multimedia, wearable).

- **Interaction type: defined by the user experience** supported by the HCI design.
  - **Instructing** (command-based)
  - **Conversing** (dialogue-based)
  - **Manipulating** (static interaction with the environment)
  - **Exploring** (dynamic interaction with the environment)

Instructing

- Instructing (command-based)
  – Instructions can be issued in various ways: typing in commands, pressing buttons, selecting options from menus, speech / gesture-based issuing of commands, thought-based issuing of commands (brain interfaces)

– Instruction-based software products: Unix, Windows, Linux, (99% of products).
- Other products: vending machines, audio / video equipment, toys, clocks, cars…



Conversing

- **Conversing (dialogue-based)**
- User has a dialogue with the system by means of speech-based or typed-questions-based interface.
- Simple (speech-based) HCIs: tele-banking, ticket booking, train-times inquiries.
- Advanced HCIs: advisory system, search engines, virtual tutoring.
- **Pros:** more natural **Cons:** HCI tiresome (boring), unable to handle complex questions.

Manipulating

- **Manipulating (static interaction with the environment)**
  – Interacting with objects in physical or virtual environment by selecting, moving, resizing, opening, and closing them.
- Manipulation-based HCI design: direct manipulation GUI (current trend).
- Manipulation-based product design : toys.
- Pros : enables easy learning / remembering, direct results → no need for error messages, incites exploring → mastery →confidence;
- Cons : too slow for experts



Exploring

- Exploring (dynamic interaction with the environment)

 – Moving through physical or virtual environment.

 – Exploration-based designs: fantasy and other
virtual worlds, Computer- Automated Virtual
Enivrement (CAVE), ambiant intelligence (smart
rooms)

- – Pros : natural HCI, opens up 1000s of possibilities;

 - cons :however it case confusion



Paradigms

• Refers to **a particular approach** that has been adopted by a community in terms of shared assumptions, concepts, values and practices

– Questions to be asked and how they should be framed

- Phenomena to be observed

– How findings from experiments are to be analyzed and interpreted

Paradigms in HCI

• The predominant **80s** paradigm was to design user-centred applications for the single user on the desktop

•Shift in thinking occurred in the mid 90s
•Many technological advances led to a new generation of user–computer environments
• e.g., virtual reality, multimedia, agent interfaces, ubiquitous computing

•Effect of moving interaction design 'beyond the desktop' resulted in many new challenges, questions, and phenomena being considered

UbiComp

- Would radically change the way people think about and interact with computers
- Computers would be designed to be embedded in the environment
- Major rethink of what HCI is in this context

New thinking

- How to enable people to **access and interact with information in their work, social, and everyday lives**

- Designing user experiences for people using interfaces that are part of the environment **with no controlling devices**

- What form to provide contextually-relevant information to people at appropriate times and places

- Ensuring that information, that is passed around via interconnected displays, devices, and objects, **is secure and trustworthy**

20 interface types covered

1. Command
2. Graphical
3. Multimedia
4. Virtual reality
5. Web
6. Mobile
7. Appliance
8. Voice
9. Pen
10. Touch
11. Gesture
12. Haptic
13. Multimodal
14. Shareable
15. Tangible
16. Augmented Reality
17. Wearables
18. Robots and drones
19. Brain–computer interaction
20. Smart

Interface types

- Many, many kinds now

  1980s interfaces

  - Command
  - WIMP/GUI

  1990s interfaces

  - Advanced graphical (multimedia, virtual reality, information visualization)
  - Web
  - Speech (voice)
  - Pen, gesture, and touch
  - Appliance

  2000s interfaces

  - Mobile
  - Multimodal
  - Shareable
  - Tangible
  - Augmented and mixed reality
  - Wearable
  - Robotic

Command interfaces

- 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, e.g., delete
- Efficient, precise, and fast
- Large overhead to learning set of commands

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

WIMP 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

GUI

- 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

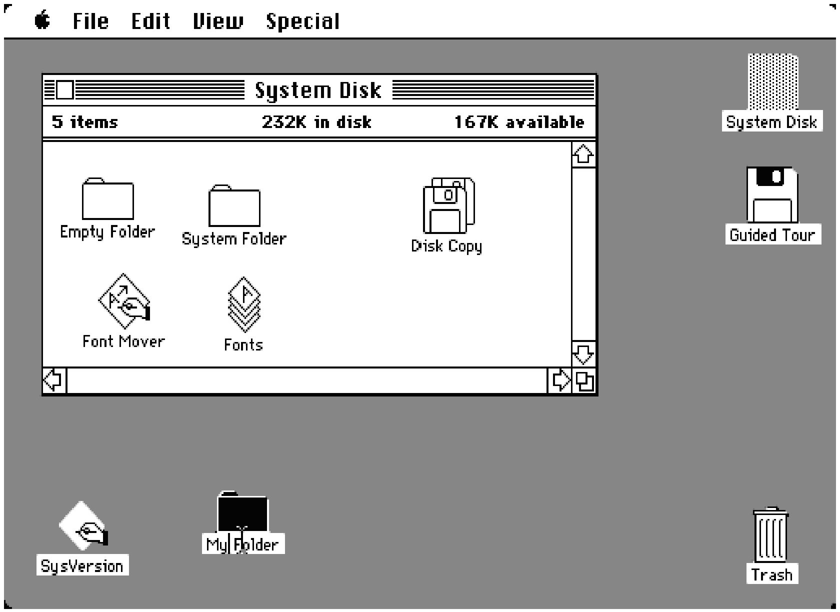
windows

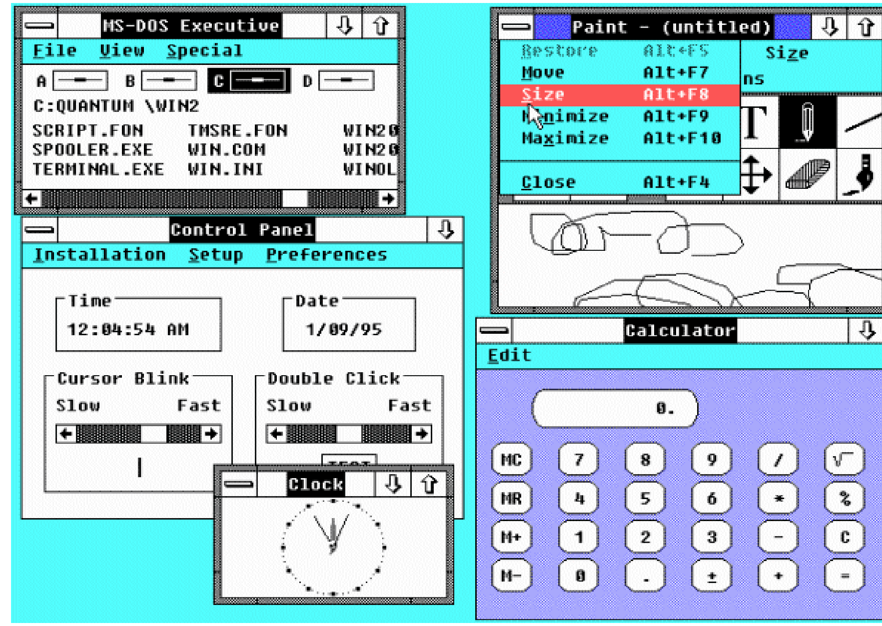
- Windows were invented to overcome physical constraints of a computer display, enabling more information to be viewed and tasks to be performed

- Scroll bars within windows also enable more information to be

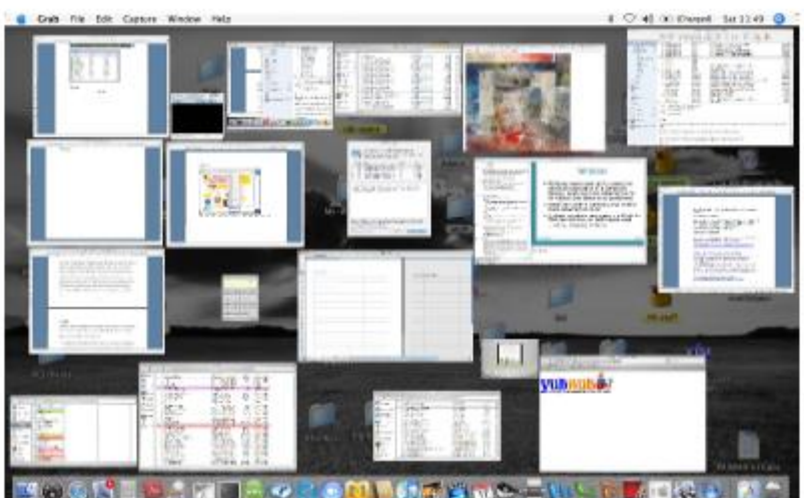
- Multiple windows can make it difficult to find desired one, so techniques used
  - Listing, iconising, shrinking

Windows





Apple's shrinking windows



Selecting a country from a scrolling window

Research and design issues

- Window management

– enabling users to move fluidly between different windows (and monitors)

- How to switch attention between them to find information needed 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

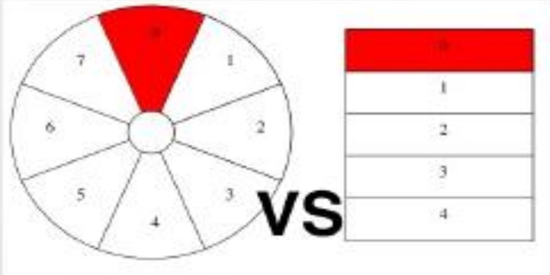
Expanding menus

- 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

Menu shapes

iPod flat menu structure

Cascading menu



Pie Menu

Menu Research and design

- 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
Ergonomics of human-system interaction

Icons

- 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 populate every application and operating system
  – represent desktop objects, tools (e.g., paintbrush), applications (e.g., web browser), and operations (e.g., cut, paste, next, accept, change

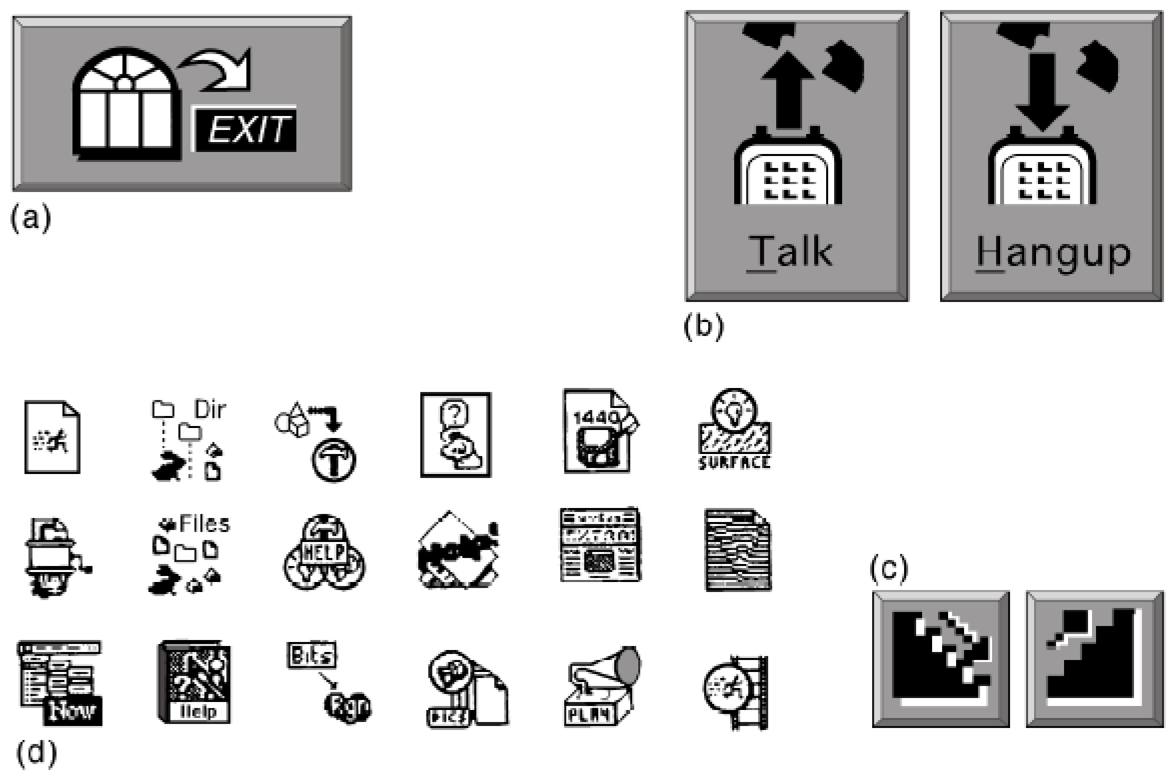
Icons

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

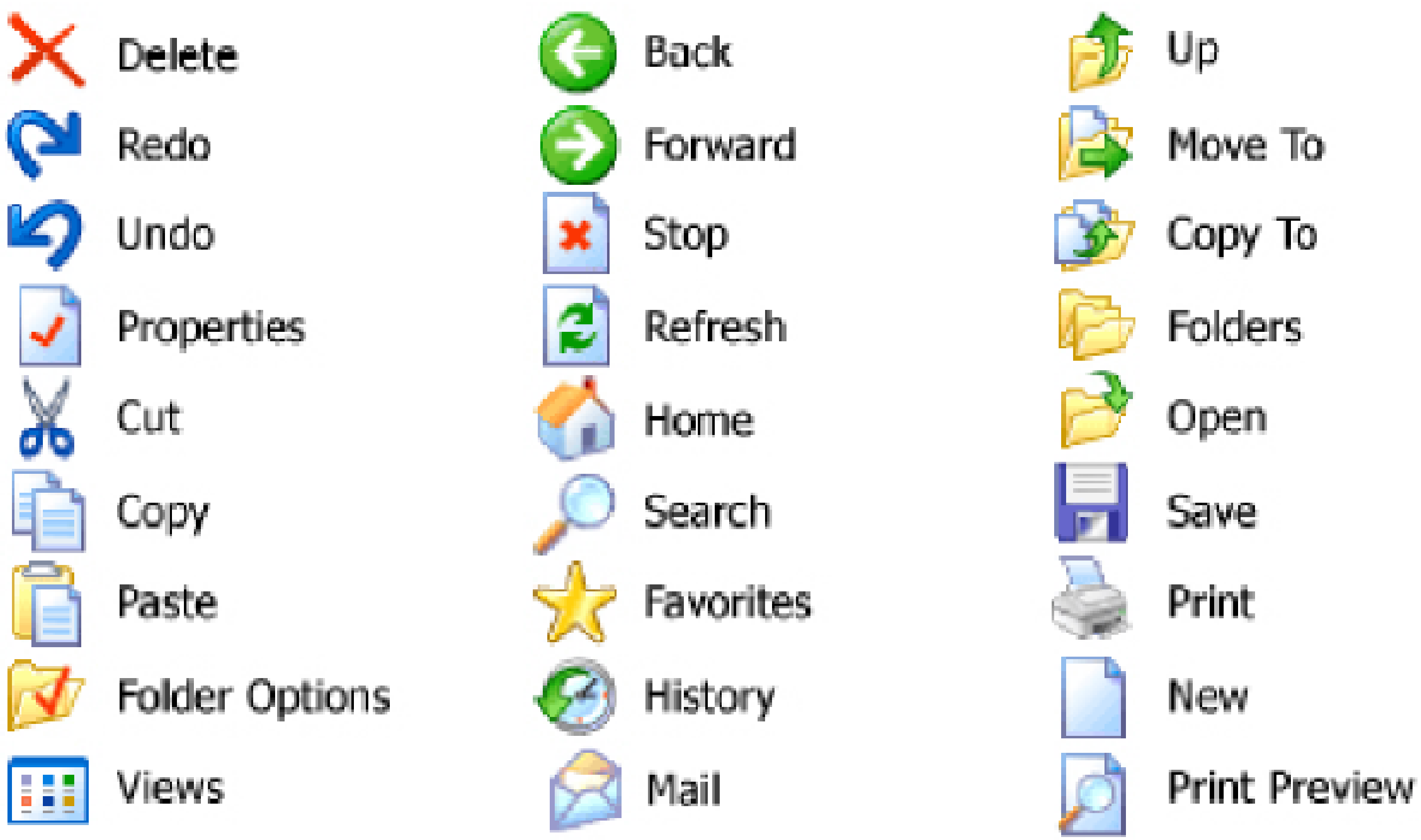
Early icons



EXIT
(a)
Talk
Hangup
(b)
Dir
1440
SURFACE
Files
HELP
New
Help
Bits
Rgn
PLAY
(c)
(d)

Newer icons

Simple icons plus labels



Research and design issues

- There is a wealth of resources now so do not have to draw or invent 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

Advanced Graphical UI

- Advanced graphical interfaces exist now that extend how users can access, explore, and visualize information
  – e.g. interactive animations, multimedia, virtual environments, and visualizations

- Some designed to be viewed and used by individuals

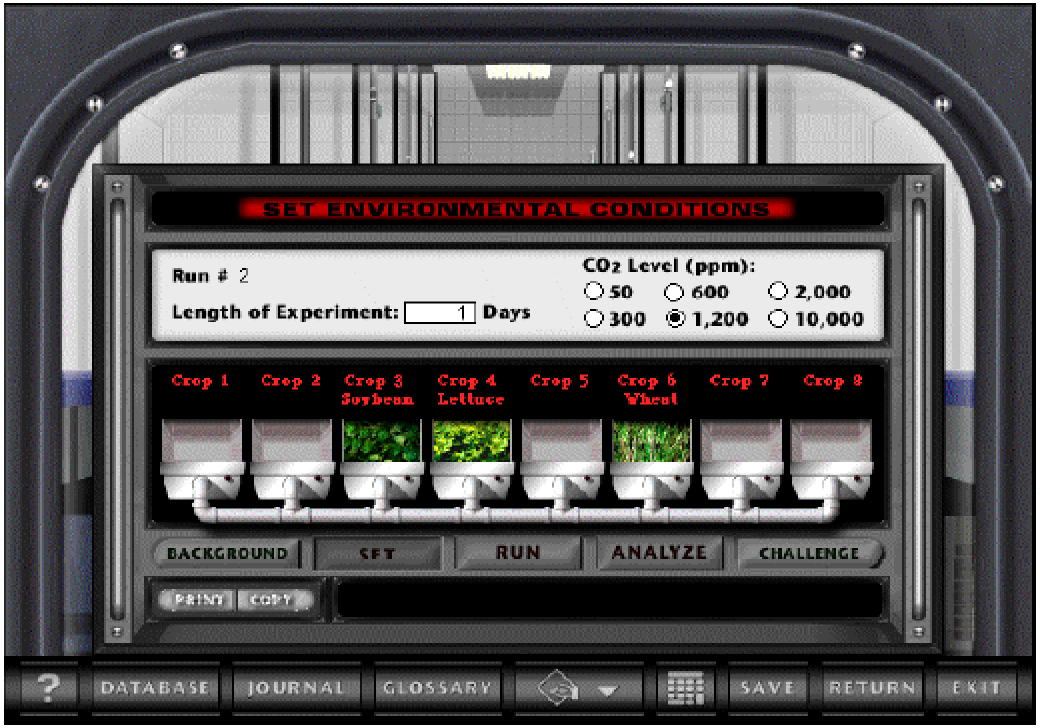
- Others by users who are collocated or at a distance

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



students will adjust plant growth conditions in environmentally - controlled growth chambers to achieve
crop production sufficient for their crew's food, water,

http:/a/wndw wai.rc.otf.edu/bioblast/bioproject/bbfsoftwareoverview.html

Pros and Cons

- Facilitates rapid access to multiple representations of information
- Can provide better ways of presenting information than can either one alone
- Can enable easier learning, better understanding, more engagement, and more pleasure
- Can encourage users to explore different parts of a game or story
-

Virtual reality and virtual environments

- 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 the objects they represent, c.f. 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

Research and Development

- 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

Speech interfaces

- 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

Research and Design

- 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?

Mobile interfaces

- Handheld devices intended to be used
- while on the move, e.g., PDAs, cell phones
- • 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

Challenges

- Small screens, small number of keys and restricted number of controls
- • Innovative 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 for these control devices varies
- – depends on the dexterity and commitment of the user

Research and Design

- Despite many advances mobile
- interfaces can be tricky and
- cumbersome to use, c.f.GUIs
- • Especially for those with poor
- manual dexterity or ‘fat’ fingers
- • Key concern is designing for small
- screen real estate and limited
- control space

Shareable interfaces

- 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., Mitsubishi's DiamondTouch and Sony's Smartskin

A smartboard

DiamondTouch Tabletop

Advantage

- 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

Research and Design

- 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

Tangible interfaces

- 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 colour are mixed on an adjacent wall

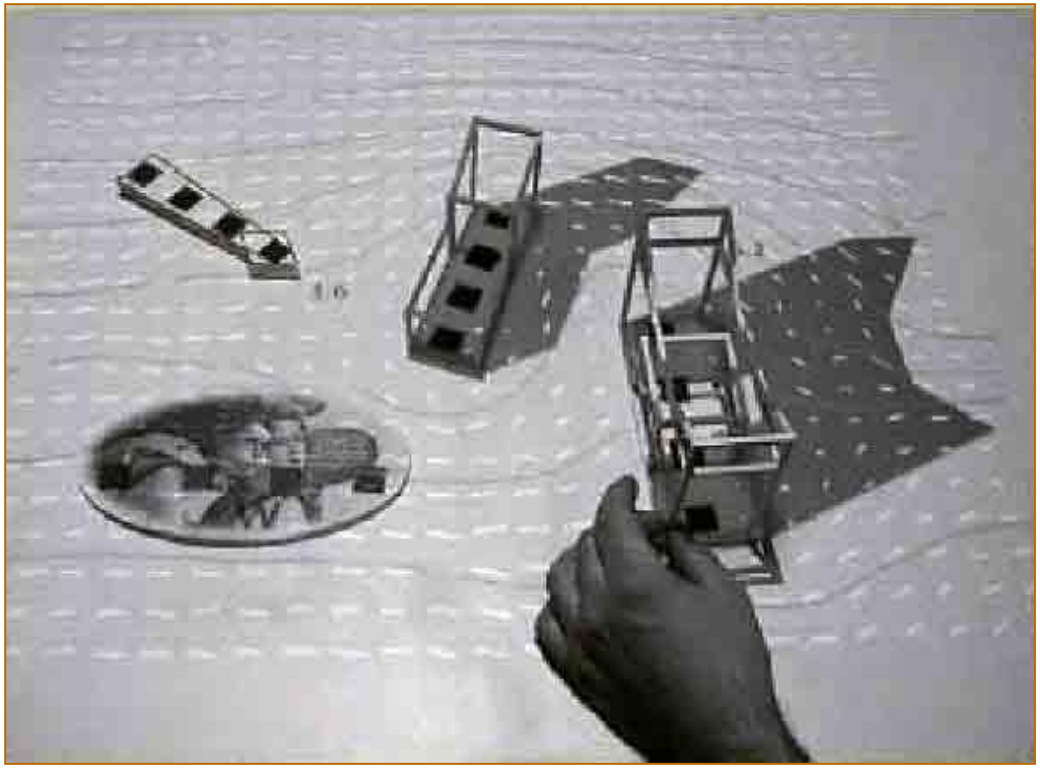
Faciliates creativity and collaborative exploration

Examples: Flow Blocks

Depict changing numbers and lights embedded in the blocks

Vary depending on how they are connected together

Examples: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

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

Wearable interfaces

- First developments was head- and eyewear-mounted cameras that enabled user to record what seen and to access digital information
- Since, jewelery, 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 and tour guides

Steve Mann - pioneer of wearables

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?

Robotic interfaces

- 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 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 behaviours (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)?

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.
- Much system development will continue for the PC platform, using advanced GUIs, in the form of multimedia, web-based interfaces, and virtual 3D environments
  - Mobile interfaces have come of age
  - Increasing number of applications and software toolkits available
  - 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, and tangible

- Many new design and research questions need to be considered to decide which one 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