

Lecture 4: Interaction & Interfaces

Overview

- Understanding the problem space & conceptualizing design
- Conceptual models
- Interfaces metaphors
- Interaction types
- Interface types
- Natural user interfaces (NUIs)
- Which interface?

Based on material from:

Sharp, H., Preece, J. and Rogers, Y. (2019). *Interaction Design Beyond Human-Computer Interaction*. 5th Ed. Sussex: John Wiley & Sons Ltd.

Learning Outcomes

- Explain what is meant by the problem space
- Explain how to conceptualize interaction
- Discuss the use of interface metaphors as part of conceptual model
- Explain types of interfaces
- Discuss other advance interfaces

Fixed-line phone: location-based
Mobile phone: answer anywhere

Support forms of creativity

- send message
- photo

Recap

- HCI has moved beyond designing interfaces for desktop machines
- About extending and supporting all manner of human activities in all manner of places
- Facilitating user experiences through designing interactions
 - Make work effective, efficient and safer
 - Improve and enhance learning and training
 - Provide enjoyable and exciting entertainment
 - Enhance communication and understanding
 - Support new forms of creativity and expression

Closely related to project

Understanding the Problem Space

Ask users if the product isn't working

- What do you want to create?
- What are your assumptions?
 - Assumption = taking something for granted when it needs further investigation
 - E.g. people will want to watch TV while driving
- Will it achieve what you hope it will?



What is a Claim?

- Stating something to be true when it is still open to question
- e.g. “a multimodal style of interaction for controlling GPS — one that involves speaking while driving — is safe”

Activity: How will enabling robot waiters to
speak to customers enhance their
Lack of emotions experience?



What is the problem being addressed?

Assumption:
require further
investigation
↓
can be true/false

Claim (mostly T):
open to question

- The benefits:
 - the robot could take orders and entertain customers by having a conversation with them
 - could make recommendations for different customers, such as restless children or fussy eaters
- But just assumptions
- The real problem being addressed:

“It is difficult to recruit good wait staff who provide the level of customer service to which we have become accustomed.”

Working through assumptions

- Many unknowns need to be considered in the initial stages of a design project
 - Where do your ideas come from? *Daily needs*
 - What sources of inspiration were used?
 - Is there any theory or research that can be used to inform them?
- During the early ideation process
 - ask questions, reconsider assumptions, and articulate concerns

A Framework for Analyzing the Problem Space

brainstorming

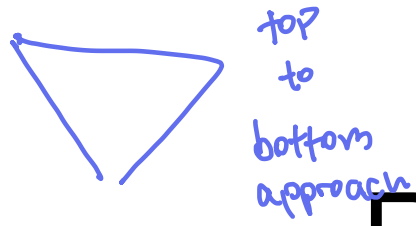
- Are there problems with an existing product or user experience? If so, what are they?
- Why do you think there are problems? *XP users heard from friends*
- How do you think your proposed design ideas might overcome these? *How to solve problems*
- If you are designing for a new user experience how do you think your proposed design ideas support, change, or extend current ways of doing things? *old vending machine | new talking vending machine*

Activity: What are the assumptions & claims made about 3D TV?



Assumptions and claims: how realistic?

- There was no existing problem to overcome
 - what was being proposed was a new way of experiencing TV
- An assumption
 - People would really enjoy the enhanced clarity and color detail provided by 3D
- A claim
 - People would not mind paying a lot more for a new 3D-enabled TV screen because of the new experience



Benefits of Conceptualizing

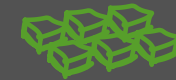
- Orientation *Thinking, no design/writing down*
 - enables design teams to ask specific questions about how the conceptual model will be understood
- Open-minded
 - prevents design teams from becoming narrowly focused early on
- Common ground *mutually agree*
 - allows design teams to establish a set of commonly agreed terms

From Problem Space to Design Space

- Having a good understanding of the problem space can help inform the design space
 - e.g. what kind of interface, behaviour, functionality to provide
- But before deciding upon these it is important to develop a conceptual model



Conceptual Models



- A conceptual model is:
 - a high-level description of how a system is organized and operates
- Enables
 - “designers to straighten out their thinking before they start laying out their widgets”
- Components:
 - Metaphors and analogies – understand what a product is for and how to use it for an activity
 - Concepts that people are exposed to through the product – task-domain objects, their attributes and operations
 - Relationship and mappings between these concepts

First Steps in Formulating a Conceptual Model

- What will the users be doing when carrying out their tasks?
- How will the system support these?
- What kind of interface metaphor, if any, will be appropriate?
- What kinds of interaction modes and styles to use?
 - always keep in mind when making design decisions how the user will understand the underlying conceptual model

Conceptual models

- Many kinds and ways of classifying them
- The best conceptual models are often those that appear
 - obvious and simple
 - the operations they support are intuitive to use

Interface metaphors

- Interface designed to be similar to a physical entity but also has own properties
 - e.g. desktop metaphor, web portals
- Can be based on activity, object or a combination of both
- Exploit user's familiar knowledge, helping them to understand 'the unfamiliar'
- Conjures up the essence of the unfamiliar activity, enabling users to leverage this to understand more aspects of the unfamiliar functionality

Interface Metaphors

- Conceptualizing what we are doing
- A conceptual model instantiated at the interface
 - e.g. the desktop metaphor
- Visualizing an operation
 - e.g. two digital calculators where
 - (a) designed too literally
 - (b) more appropriately for a computer screen



(a)

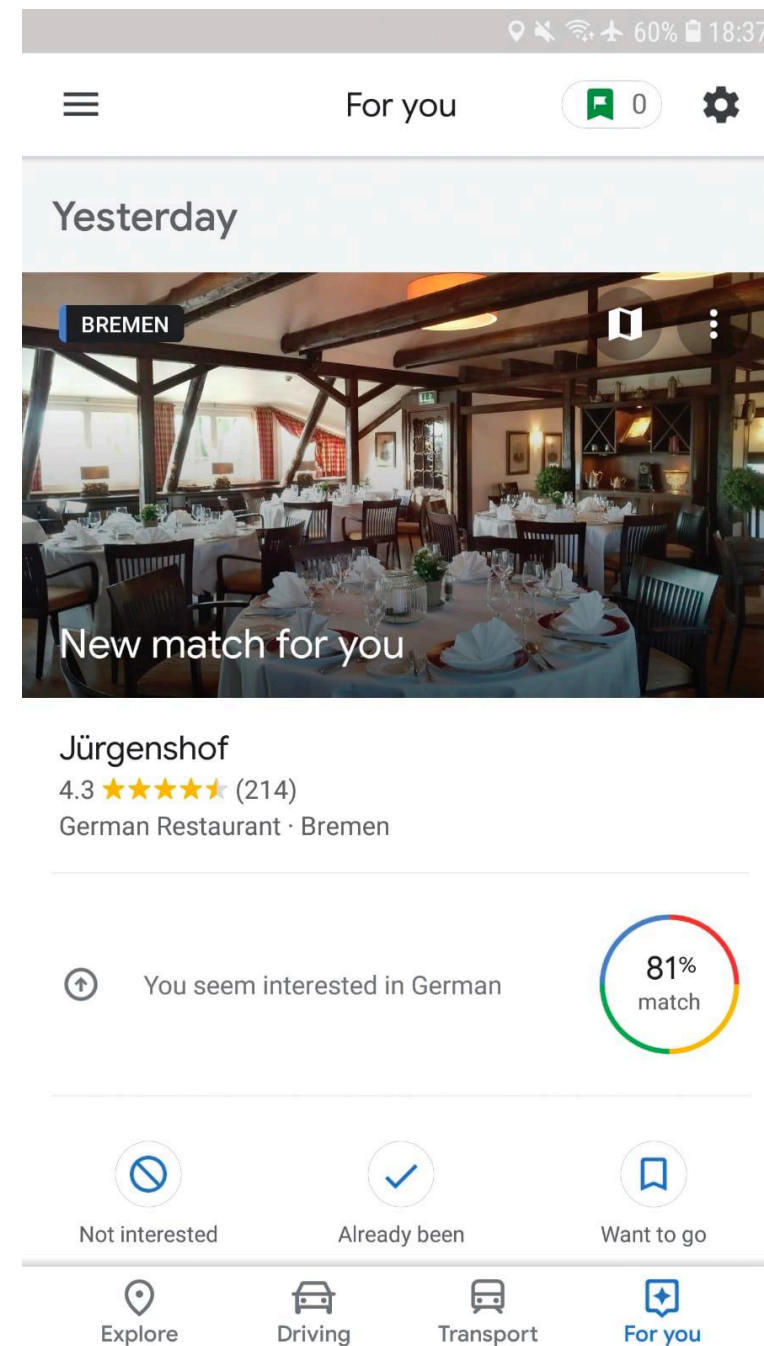
Simple
basic
operation



(b)

The card metaphor

- The card is a very popular UI
- Why?: Has familiar form factor
- Can easily be flicked through, sorted, and themed
- Can structure content into meaningful chunks
 - similar to how paragraphs are used to chunk a set of related sentences into distinct sections
- Material properties giving appearance of surface of paper



Interface Metaphors (cont)

- Benefits:
 - Makes learning new systems easier
 - Helps users understand the underlying conceptual model
 - Can be very innovative and enable the realm of computers and their applications to be made more accessible to a greater diversity of users

Interface Metaphors (cont)

consider are we limiting
ourselves from making it
universal?

- Problems:
 - Break conventional and cultural rules
 - e.g. recycle bin placed on desktop
 - Can constrain designers in the way they conceptualize a problem space
 - Conflict with design principles
 - Forces users to only understand the system in terms of the metaphor
 - Designers can inadvertently use bad existing designs and transfer the bad parts over
 - Limits designers' imagination in coming up with new conceptual models

Activity

- Describe the components of the conceptual model underlying most online shopping websites, e.g.
 - Shopping cart
 - Proceeding to check-out
 - 1-click
 - Gift wrapping
 - Cash till

next week

⑤ Interaction Types

- ① • Instructing
 - issuing commands and selecting options, speaking aloud commands, gesturing, pressing buttons
- ② • Conversing
 - interacting with a system as if having a conversation
- ③ • Manipulating
 - interacting with objects in a virtual or physical space by manipulating them
- ④ • Exploring
 - moving through a virtual environment or a physical space
- ⑤ • Responding
 - the system initiates the interaction and the user chooses whether to respond

Interaction Types (cont)

- user tell system what to do

- **1) Instructing** user command

good for repetitive instructions

- Where users instruct a system and tell it what to do
 - e.g. tell the time, print a file, save a file
- Very common conceptual model, underlying a diversity of devices and systems
 - e.g. word processors, VCRs, vending machines
- Main benefit is that instructing supports quick and efficient interaction
 - good for repetitive kinds of actions performed on multiple objects

Interaction Types (cont)

- Which is easiest and why?



1



2

more
convenient
users can
see what
purchase

Interaction Types (cont)

voice - recognition

Hey Siri

Ig chatGPT too

customer service chatbox

- **2) Conversing**

- Underlying model of having a conversation with another human
- Range from simple voice recognition menu-driven systems to more complex 'natural language' dialogs
- Examples include timetables, search engines, advice-giving systems, help systems
- Also virtual agents, toys and pet robots designed to converse with you

Pros and cons of conversational model

- Allows users, especially novices to interact with a system in a way that is familiar to them
- can make them feel comfortable, at ease and less scared
- Misunderstandings can arise when the system does not know how to parse what the user says
- e.g. voice assistants can misunderstand what children say

ez

- Slang
- dialect



**“If you’d like to press 1, press 3.
If you’d like to press 3, press 8.
If you’d like to press 8, press 5...”**

**Jon
&
Vinny’s**

Interaction Types (cont)

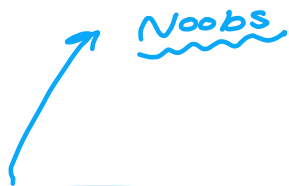
- 3) Manipulating
 - Involves dragging, selecting, opening, closing and zooming actions on virtual objects
 - Exploit's users' knowledge of how they move and manipulate in the physical world
 - Can involve actions using physical controllers (e.g. Wii) or air gestures (e.g. Kinect) to control the movements of an on screen avatar
 - Tagged physical objects (e.g. balls) that are manipulated in a physical world result in physical/digital events (e.g. animation)

Interaction Types (cont)

- Direct Manipulation (DM) *look him up?*
- Shneiderman (1983) coined the term DM, came from his fascination with computer games at the time
 - Continuous representation of objects and actions of interest
 - Physical actions and button pressing instead of issuing commands with complex syntax
 - Rapid reversible actions with immediate feedback on object of interest

*Zoom into thing
and it happens!
Zoom on save, it will
save*

Benefits of Direct Manipulation

- 
- **Novices** can learn the basic functionality quickly
 - Experienced users can work extremely rapidly to carry out a wide range of tasks, even defining new functions
 - Intermittent users can retain operational concepts over time
 - Error messages rarely needed
 - Users can immediately see if their actions are furthering their goals and if not do something else
 - Users experience less anxiety
 - Users gain confidence and mastery and feel in control

Disadvantages of Direct Manipulation

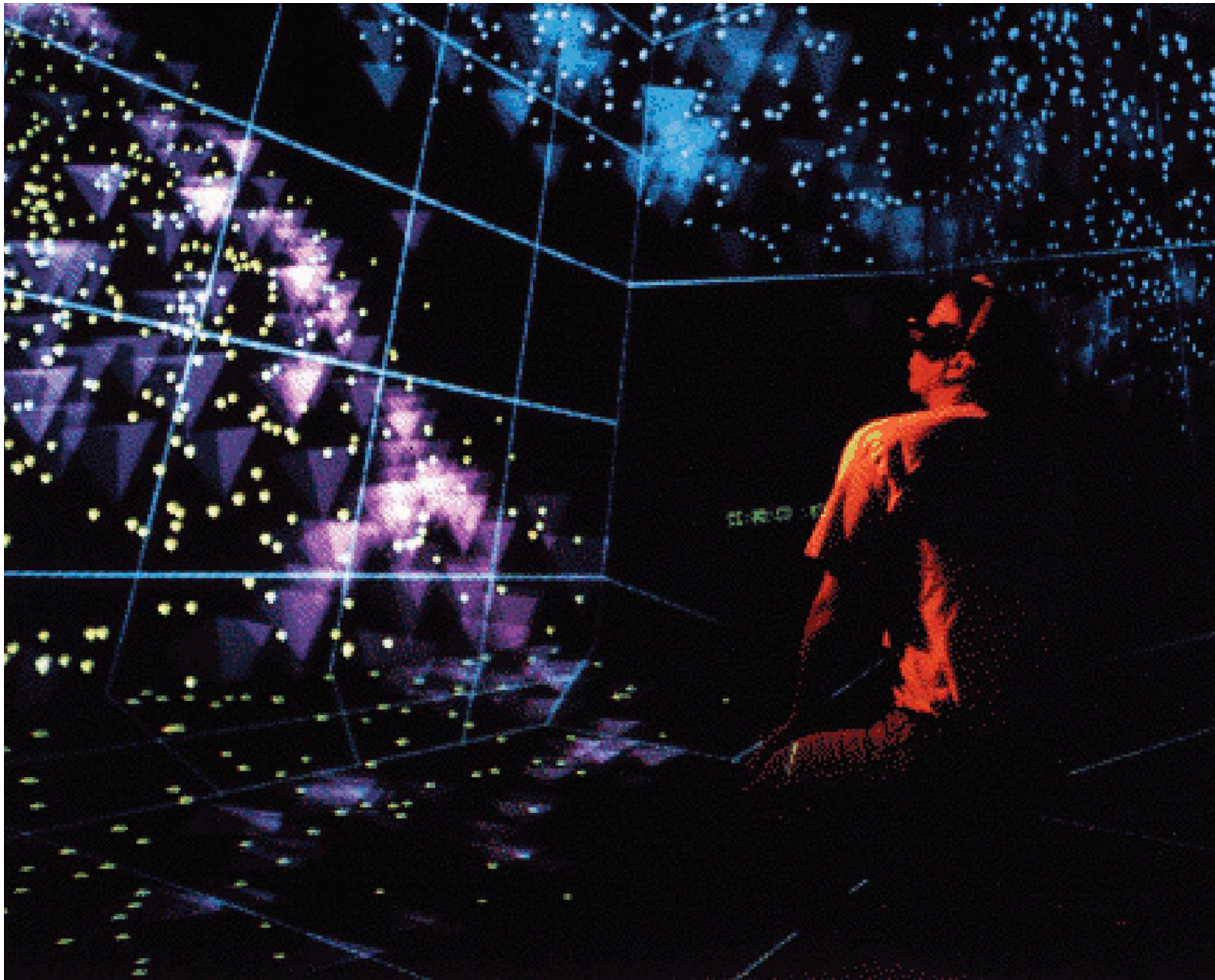
- What are the disadvantages with DM?
- Some people take the metaphor of direct manipulation too literally
- Not all tasks can be described by objects and not all actions can be done directly
- Some tasks are better achieved through delegating
 - e.g. spell checking
- Can become screen space 'gobblers'
- Moving a mouse around the screen can be slower than pressing function keys to do same actions

Interaction Types (cont)

playing around

- 4) Exploring

- Involves users moving through virtual or physical environments
 - users can explore aspects of a virtual 3D environment
 - physical environments can also be embedded with sensors that when detect the presence of someone will trigger digital or physical events to happen
- Many examples of virtual environments, including cities, parks, buildings, rooms, and datasets
 - enable users to fly over them and zoom in and out of different parts



Virtual environment



Responding

- System takes the initiative to alert user to something that it “thinks” is of interest
 - pandemic location-based app, alerts that area has covid-19 cafes*
- Does this by:
 - driving: GPS tells camera is close (speeders)*
 - detecting the location and/or presence of someone in a vicinity and notifies them on their phone/watch,
 - what it has learned from their repeated behaviors
- Examples:
 - alerts the user of a nearby coffee bar where some friends are meeting
 - user’s fitness tracker notifies them of a milestone reached
- Automatic system response without any requests made by the user

Which Conceptual Model is Best?

- Direct manipulation is good for 'doing' types of tasks, e.g. designing, drawing, flying, driving, sizing windows
- Issuing instructions is good for repetitive tasks, e.g. spell-checking, file management
- Having a conversation is good for children, computer-phobic, disabled users and specialised applications (e.g. phone services)
- Hybrid conceptual models are often employed, where different ways of carrying out the same actions is supported at the interface - but can take longer to learn

Conceptual Models: Interaction and Interface



- Interaction type:
 - what the user is doing when interacting with a system, e.g. instructing, talking, browsing or other
- Interface type:
 - the kind of interface used to support the mode, e.g. speech, menu-based, gesture

Woah Interface Types

know 5 really
well, like robot

rest read
through

- How to design interfaces for different environments, people, places and activities
- Different kinds of interfaces that have been developed, including:
 - 1) Command-based
 - 2) WIMP and GUI
 - 3) Multimedia
 - 4) Virtual Reality
 - 5) Information Visualization
 - 6) Web
 - 7) Consumer Electronic & App
 - 8) Mobile
 - 9) Speech
 - 10) Pen
 - 11) Touch
 - 12) Air-based gestures
 - 13) Haptic
 - 14) Multimodal
 - 15) Shareable
 - 16) Tangible
 - 17) Augmented & Mixed Reality
 - 18) Wearables
 - 19) Robots
 - 20) Brain-computer

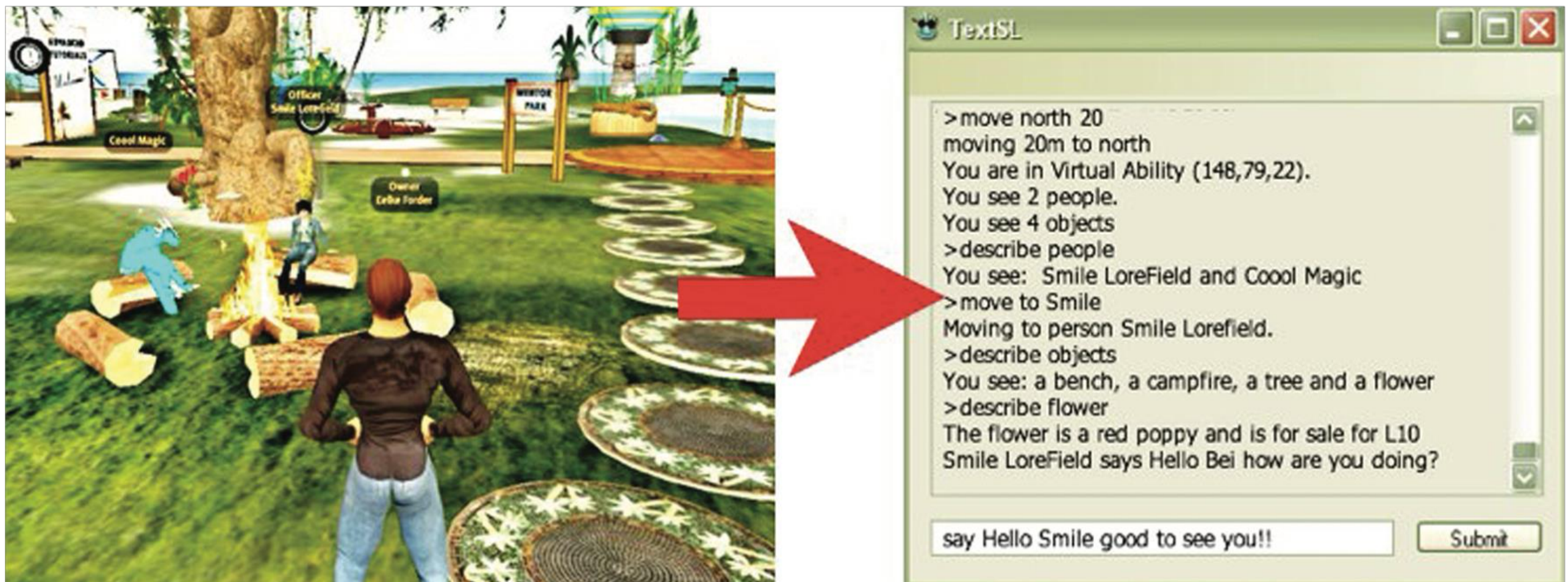
apple watch

+	-
track my health data	frustrating buttons

1. Command-based

- Early interfaces required the user to type in commands such as abbreviations (e.g. ls) typed in at the prompt to which the system responds (e.g. listing current files using a keyboard)
- Some are hard wired at keyboard (e.g. delete, enter, undo); others can be assigned to keys (e.g. F11=print)
- Efficient, precise, and fast
- Large overhead to learning set of commands

Second Life command-based interface for visually impaired users



Research & 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

2a. WIMP

- 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

Simple smartwatch menus with 1, 2 or 3 options



2b. GUI

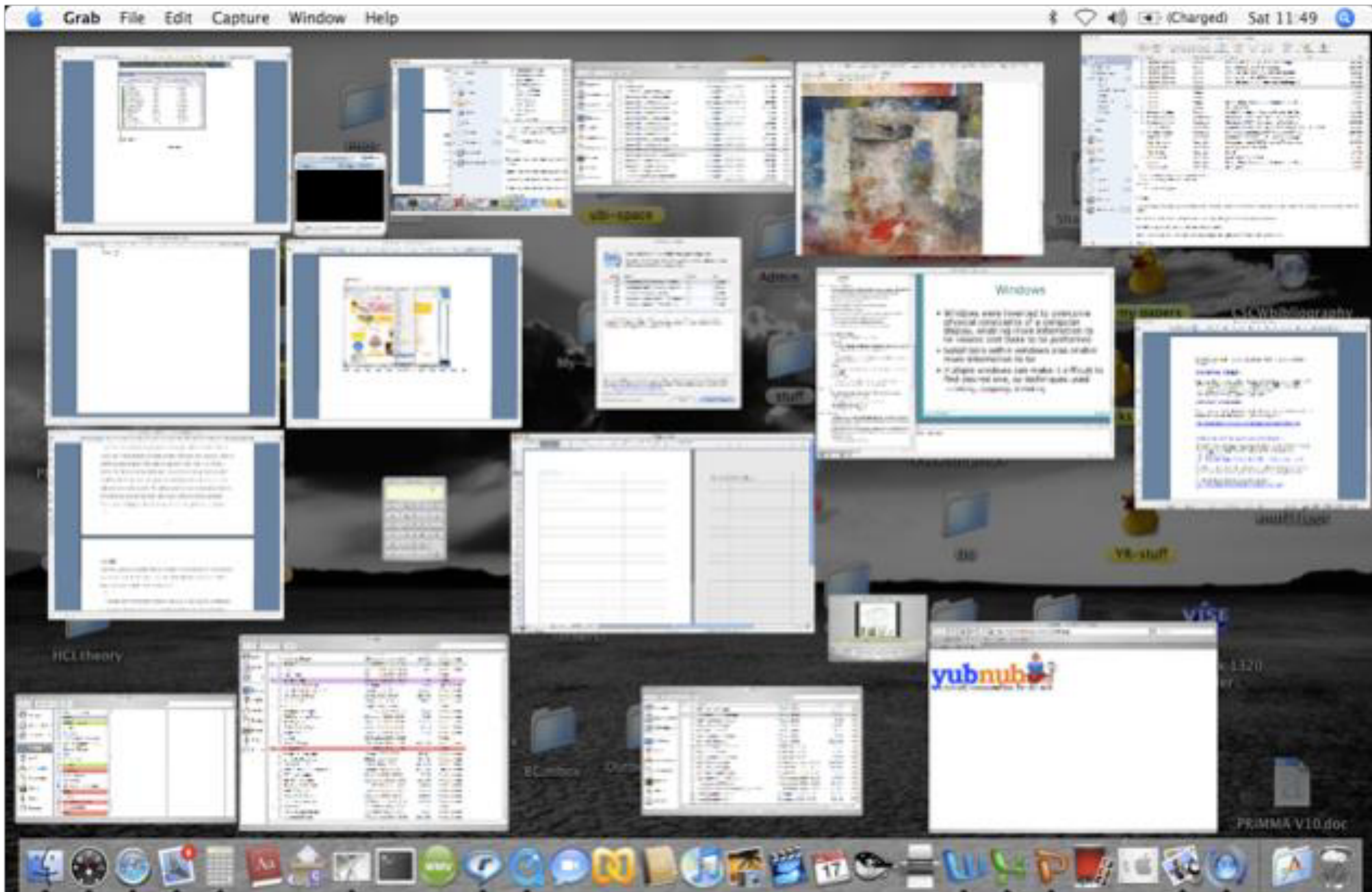
- Same basic building blocks as WIMPs but more varied
 - Colour, 3D, sound, animation,
 - Many types of menus, icons, windows
- New graphical elements, e.g.
 - toolbars, docks, rollovers



i - Window design

- 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, tabbing, iconizing, shrinking and thumbnails are techniques that help

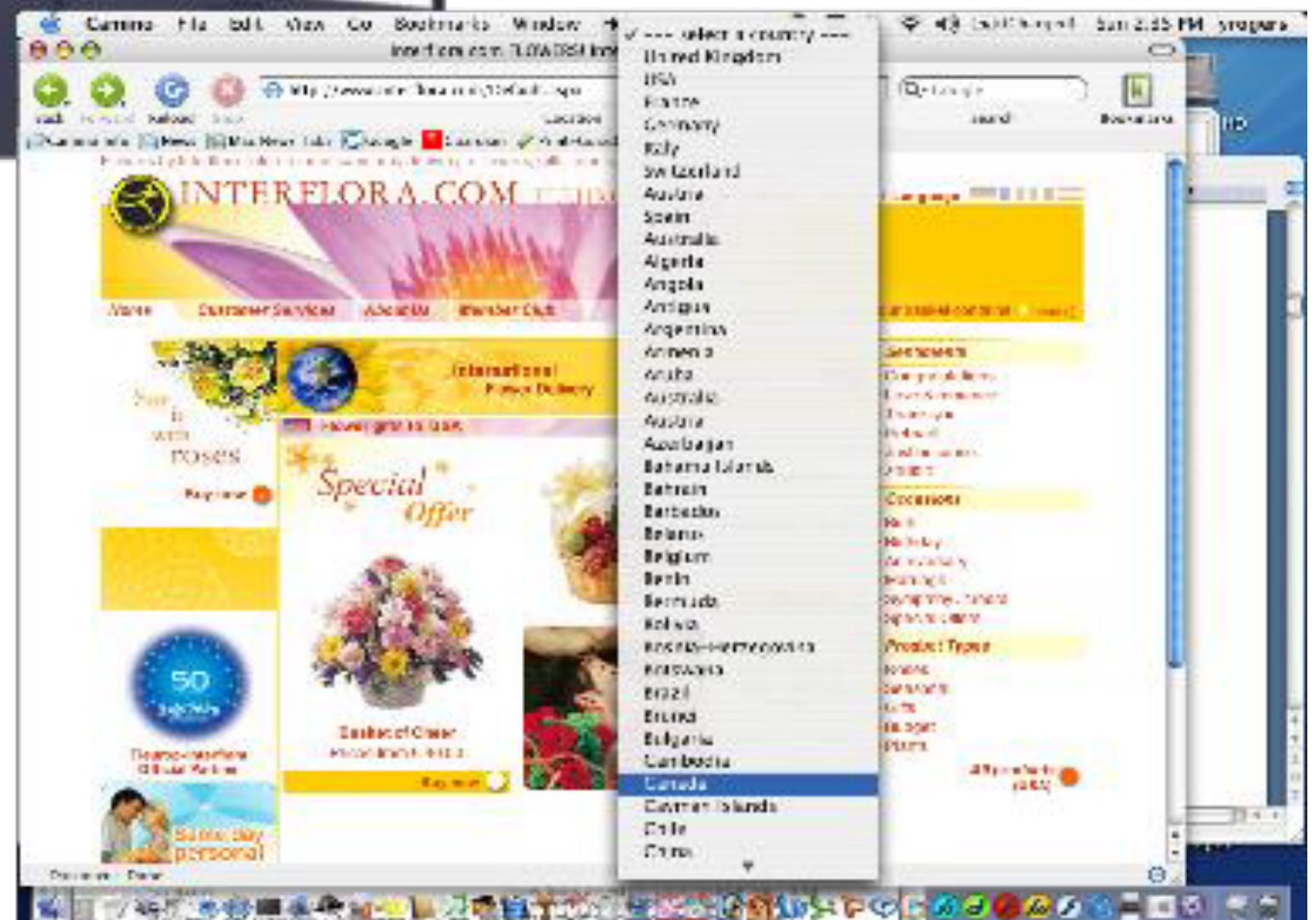
Apple shrinking windows



Safari panorama window view



Selecting a country from
a scrolling window



Is this method any better?

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

Research & 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
- Which terms to use for menu options (e.g. “Front” versus “bring to front”)
- Mega menus easier to navigate than drop-down ones

ii- Menus design

- *Flat list* - good for showing large number of options at the same time when display is small
- *Drop down* – show more options on same screen
 - e.g. cascading
- *Pop-up* – when press command key for relevant options
- *Contextual* – provide access to often used commands associated with a particular item
- *Collapsible* – toggle between + and - icons on a header to expand or contract its contents
- *Mega* – all options shown using 2D drop-down layout

Template for a Collapsible Menu

Section 1

XX
XX
XX
XXXXXXXXXXXX

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXX

Section 2

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXX

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXX



Section 1

Section 2

Section 3

Section 4

Section 5

A Mega Menu

[Create an account](#)
[Sign in](#)

[Home & Garden](#)
[Furniture & Lights](#)
[Electricals](#)
[Worren](#)
[Men](#)
[Beauty](#)
[Baby & Child](#)
[Sport & Leisure](#)
[Gifts](#)
[Offers](#)

Furniture by Room

[Bedroom](#)
[Living Room](#)
[Dining Room](#)
[Kitchen](#)
[Bathroom](#)
[Children's](#)
[Nursery](#)
[Home Office](#)
[Hallway](#)
[Garden](#)

Furniture by Type

[Beds](#)
[Mattresses](#)
[Wardrobes](#)
[Bedside Tables](#)
[Chests of Drawers](#)
[Dressing Tables](#)
[Headboards](#)
[Bookcases, Shelving Units & Shelves](#)
[Office Desks](#)
[Office Chairs](#)
[Bathroom Cabinets](#)

[Sofas & Armchairs](#)
[Sofa Beds](#)
[Coffee Tables](#)
[Side Tables](#)
[Console Tables](#)
[TV Stands](#)
[Cabinets & Sideboards](#)
[Dining Tables](#)
[Dining Chairs](#)
[Dining Furniture Ranges](#)
[Bar Chairs & Stools](#)

Lighting

[View all Lighting](#)
[Ceiling Lighting](#)
[Wall Lighting](#)
[Desk & Table Lamps](#)
[Floor Lamps](#)
[Ceiling & Lamp Shades](#)
[Lino, Fairy & Novelty Lights](#)
[SAD & Wake Up Lighting](#)
[Cabinet Lighting](#)
[Light Bulbs](#)
[Lighting & Electrical Accessories](#)

Lighting By Room

[Garden & Outdoor Lighting](#)
[Bathroom Lighting](#)
[Kitchen Lighting](#)
[Children's Lighting](#)

Don't Miss

[New in Lighting](#)
[New in House by John Lewis](#)
[New in Made to Order Upholstered Beds](#)
[Bring the outdoors in: Conservatory Furniture](#)
[Try our new Sofa Discovery Set](#)
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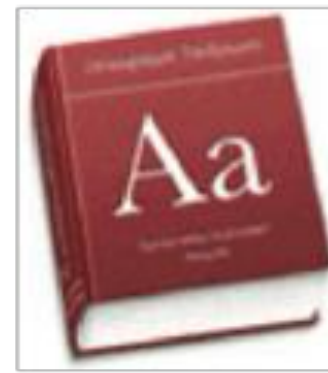
iii – Icon design

- 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)
- 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

2 types of Icon Styles



Flat 2D Icons for Smartphone and Smartwatch



(a)



(b)

Research & design issues

- There is a wealth of resources for creating icons
 - guidelines, style guides, icon builders, libraries, online tutorials
- 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) can use the hover function

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

3. Multimedia (cont)

- 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 & 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
 - provide quizzes, electronic notebooks, and games
- 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

Virtual gorilla project



4. Virtual Reality (cont)

- Pros and Cons

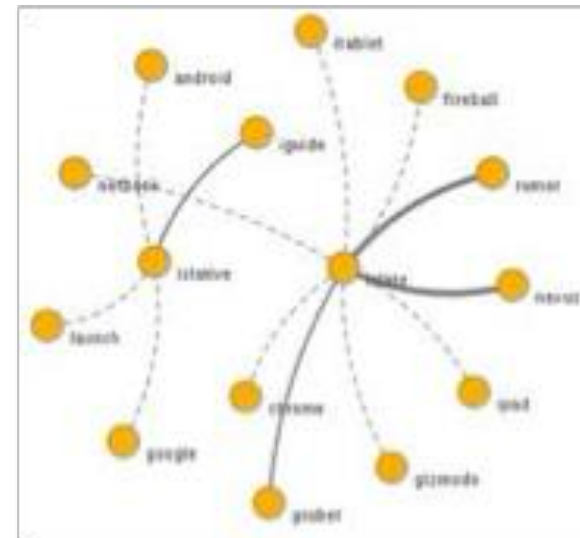
- Can have a higher level of fidelity with objects they represent compared to multimedia
- Induces a sense of presence where someone is totally engrossed by the experience
 - “a state of consciousness, the (psychological) sense of being in the virtual environment” (Slater and Wilbur, 1999)
- Provides different viewpoints: 1st and 3rd person
- Head-mounted displays are uncomfortable to wear, and can cause motion sickness and disorientation
- Lighter VR headsets now available (e.g. HTC Vive) with more accurate head tracking

Research & 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

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 & 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

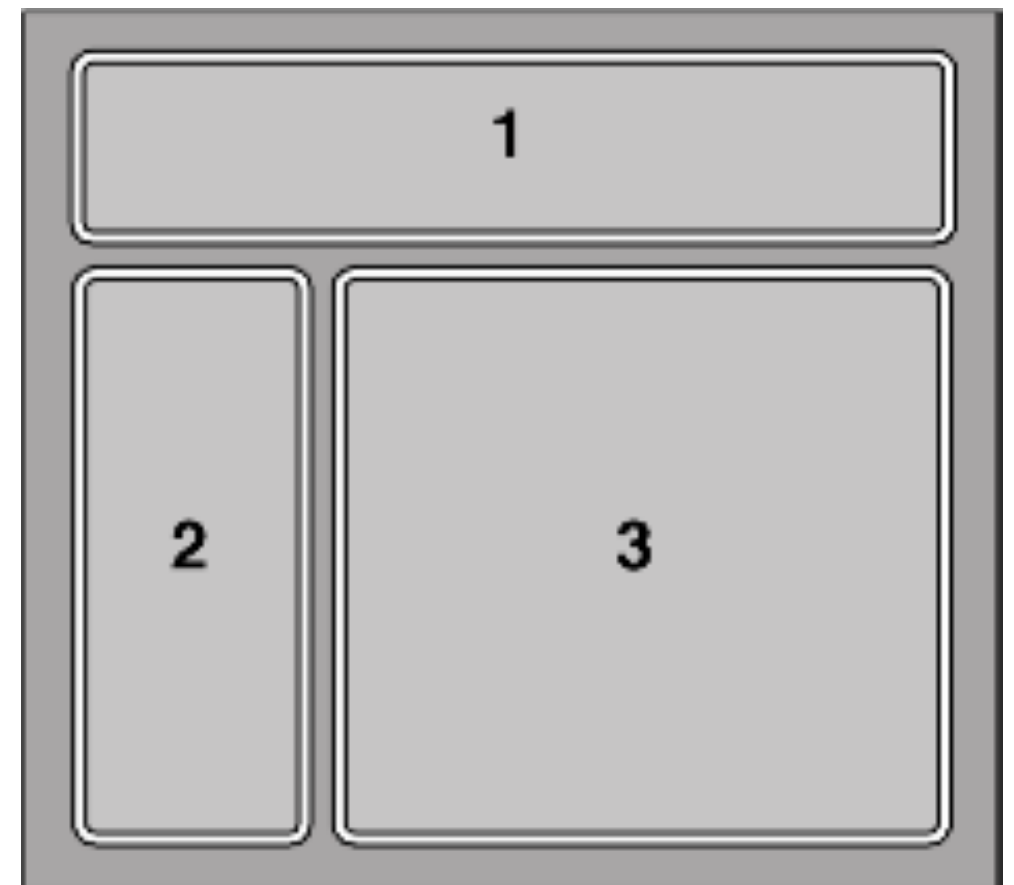


Usability VS Attractive?

- Vanilla or multi-flavor design?
 - Ease of finding something versus aesthetic and enjoyable experience
- In your face ads
 - Web advertising is often intrusive and pervasive
 - Flashing, aggressive, persistent, annoying
 - What is the alternative?

Research & 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 ballwatch.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?

7. Consumer electronics & 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



Research & 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

supports daily life activities

- 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



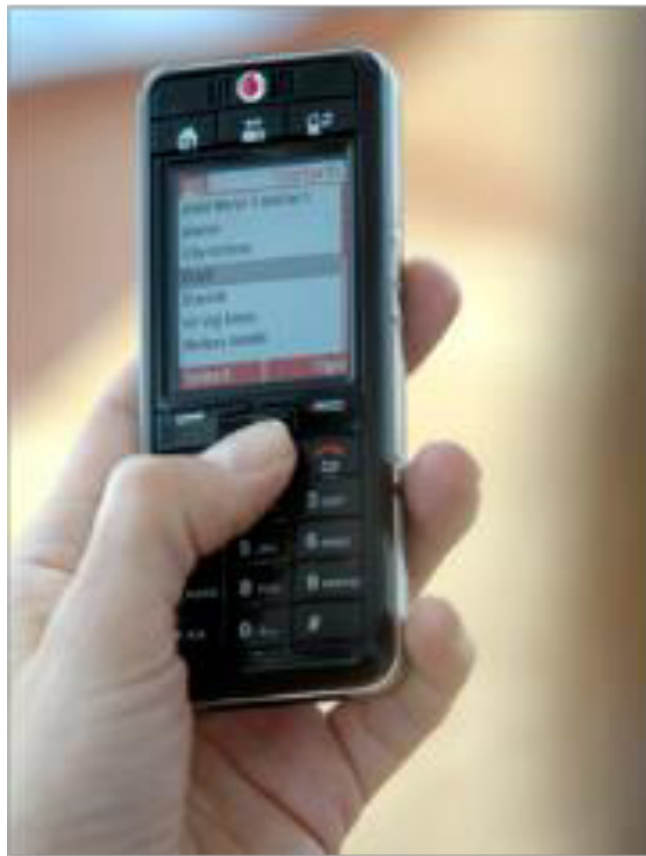
Mobile Challenges

Basketball players having trouble w/ small screen

- 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?



Research & 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

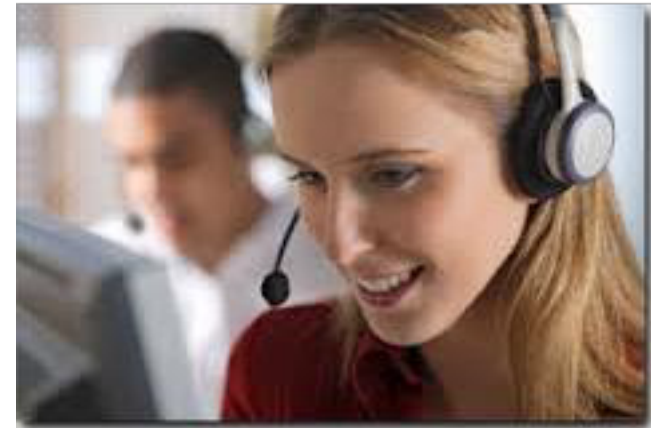
9. Speech

- 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



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

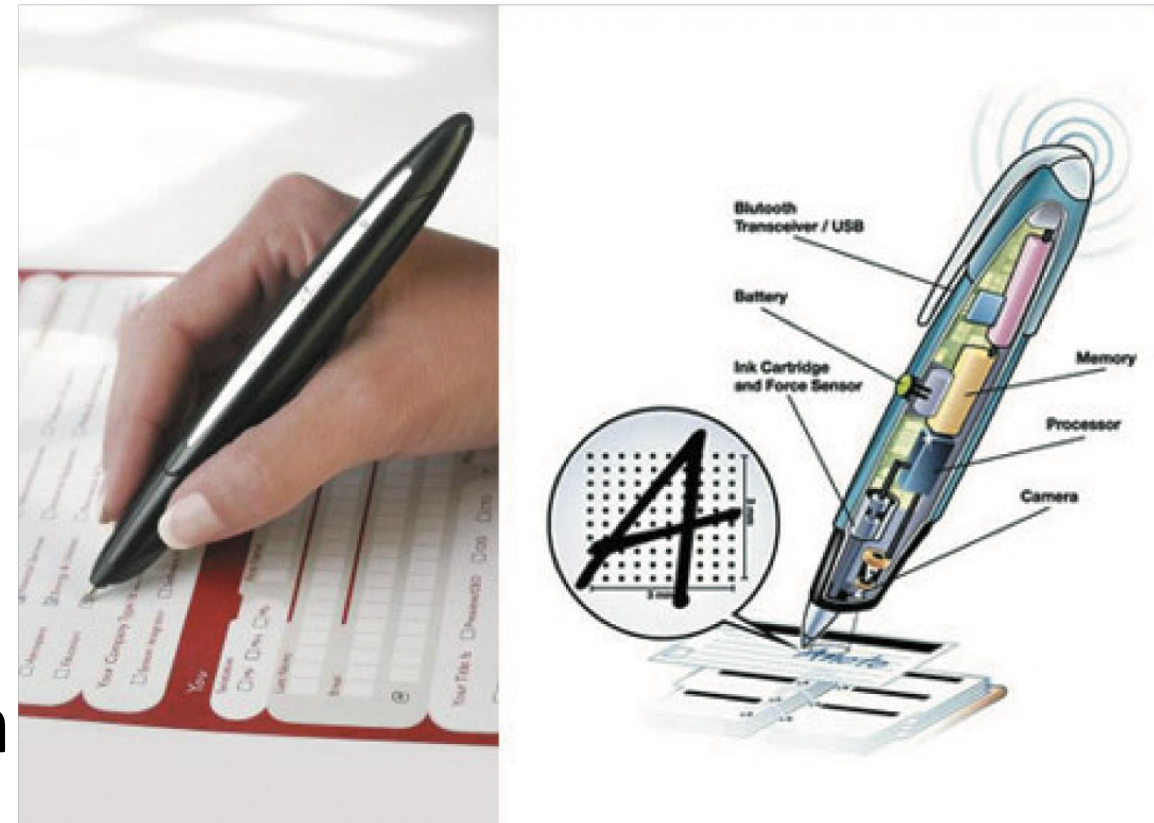
- Directed dialogs are where the system is in control of the conversation
- Ask specific questions and require specific responses
- More flexible systems allow the user to take the initiative:
 - e.g. “I’d like to go to Paris next Monday for two weeks.”
- More chance of error, since caller might assume 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 & 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



10. Pen (cont)

- 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 & 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

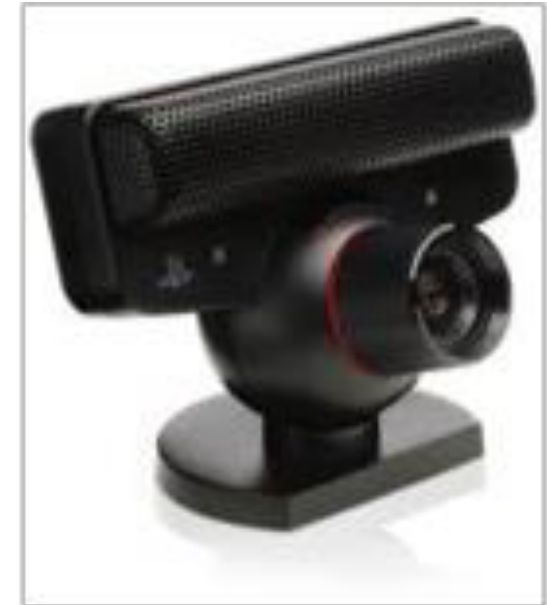
Research & design issues (cont)

- 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

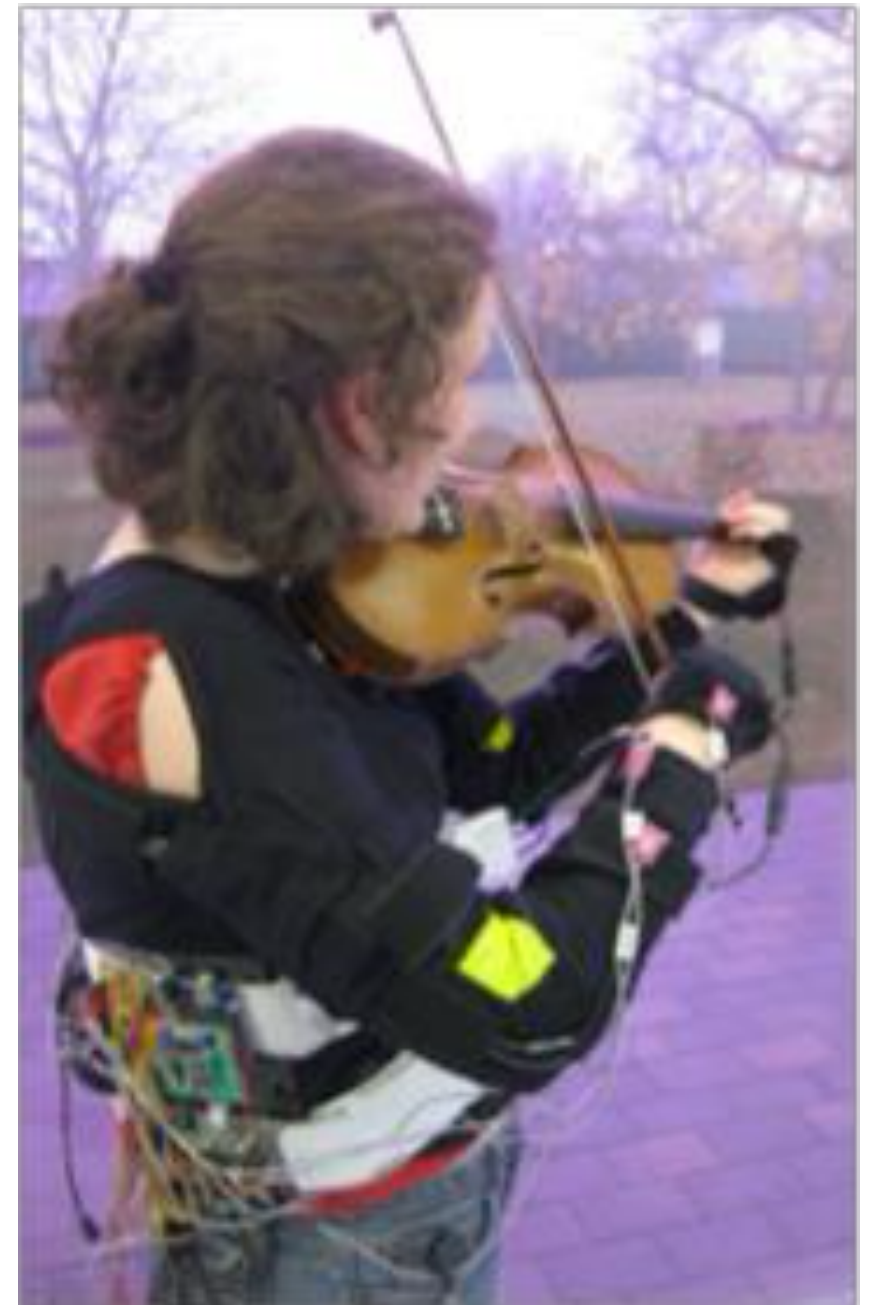


Research & design issues

- 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
 - Use motion capture
- 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



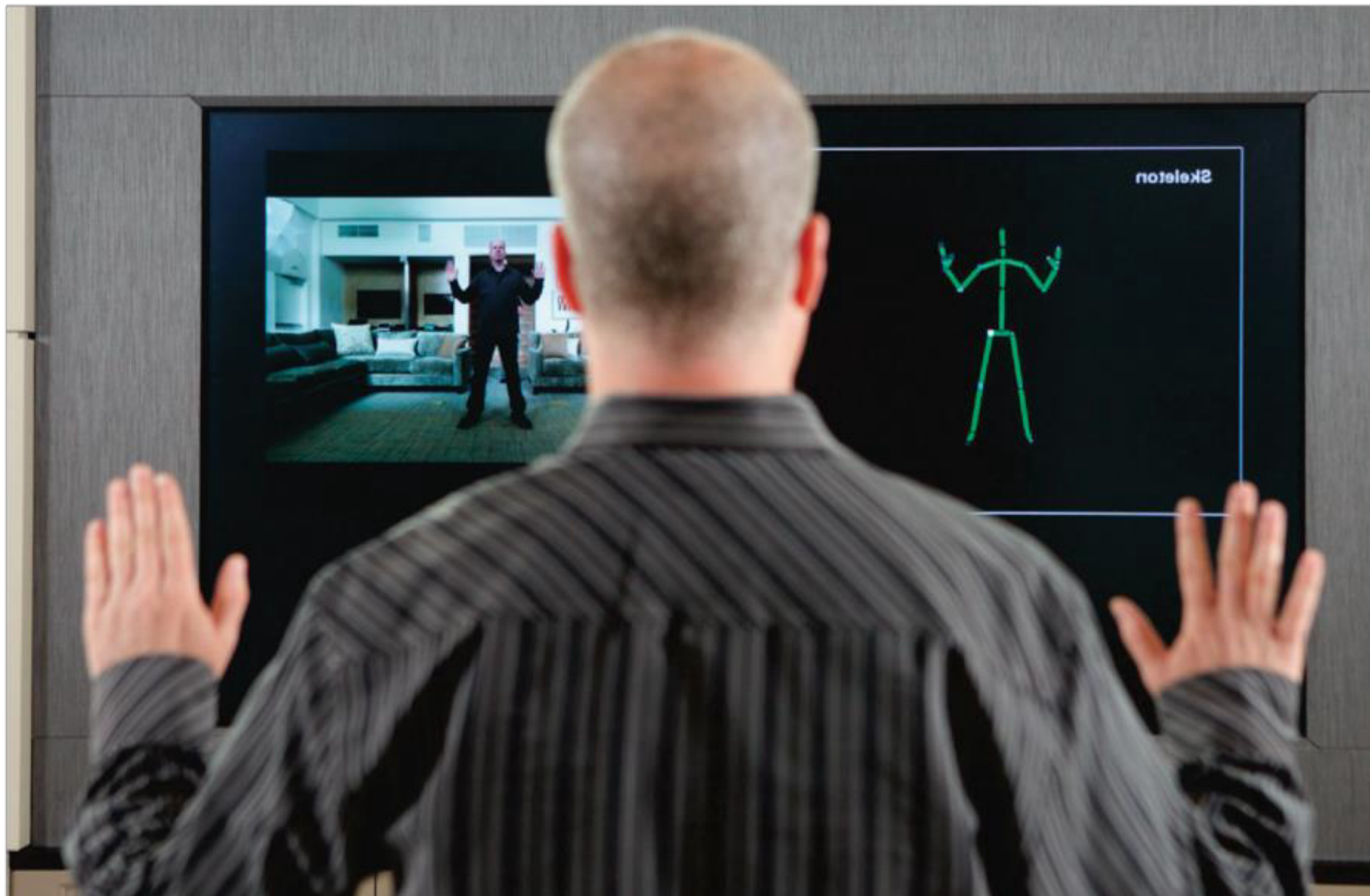
Research & design issues

- 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

- 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

Tracking a Person's Movements

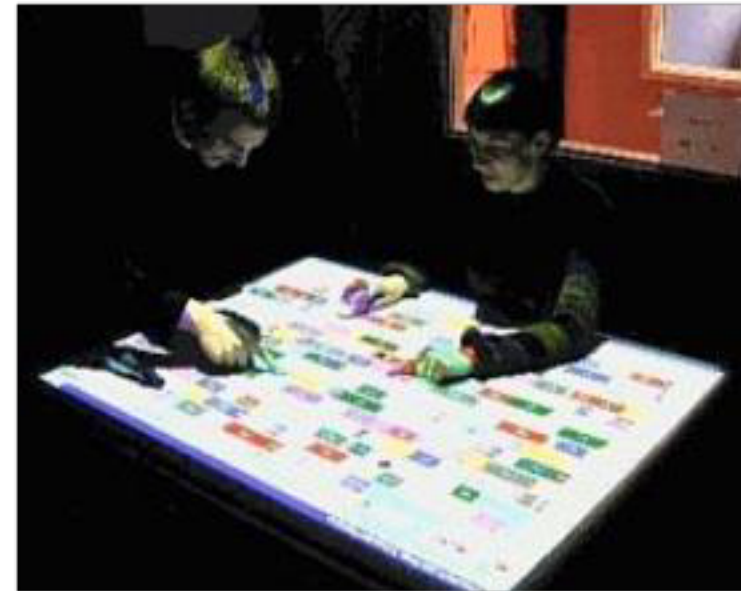


Research & design issues

- 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



- 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 PCCc

Research & 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
 - facilitates 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



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 & 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 artefact 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 & 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 – X-ray and scans); in air traffic control (helps identify planes difficult to make out)



Research & design issues

- What kind of digital augmentation?
 - When and where in physical environment?
 - 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. Wearable

- 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

Google Glass: short-lived



Figure 6.32 Google Glass

Source: <https://www.google.co.uk/intl/en/glass/start/>.

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Research & 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



Drones

- Unmanned aircraft that are controlled remotely and used in a number of contexts
 - e.g. entertainment, such as carrying drinks and food to people at festivals and parties;
 - agricultural applications, such as flying them over vineyards and fields to collect data that is useful to farmers
 - helping to track poachers in wildlife parks in Africa
- Can fly low and stream photos to a ground station, where images can be stitched together into maps
- Can be used to determine the health of a crop or when it is the best time to harvest the crop

Drone in vineyard



Figure 6.34 A drone being used to survey the state of a vineyard

Source: Courtesy of Discover Sonoma County Wine

<http://www.latimes.com/business/la-fi-drones-agriculture-20140913-story.html#page=1>.

Research & design issues

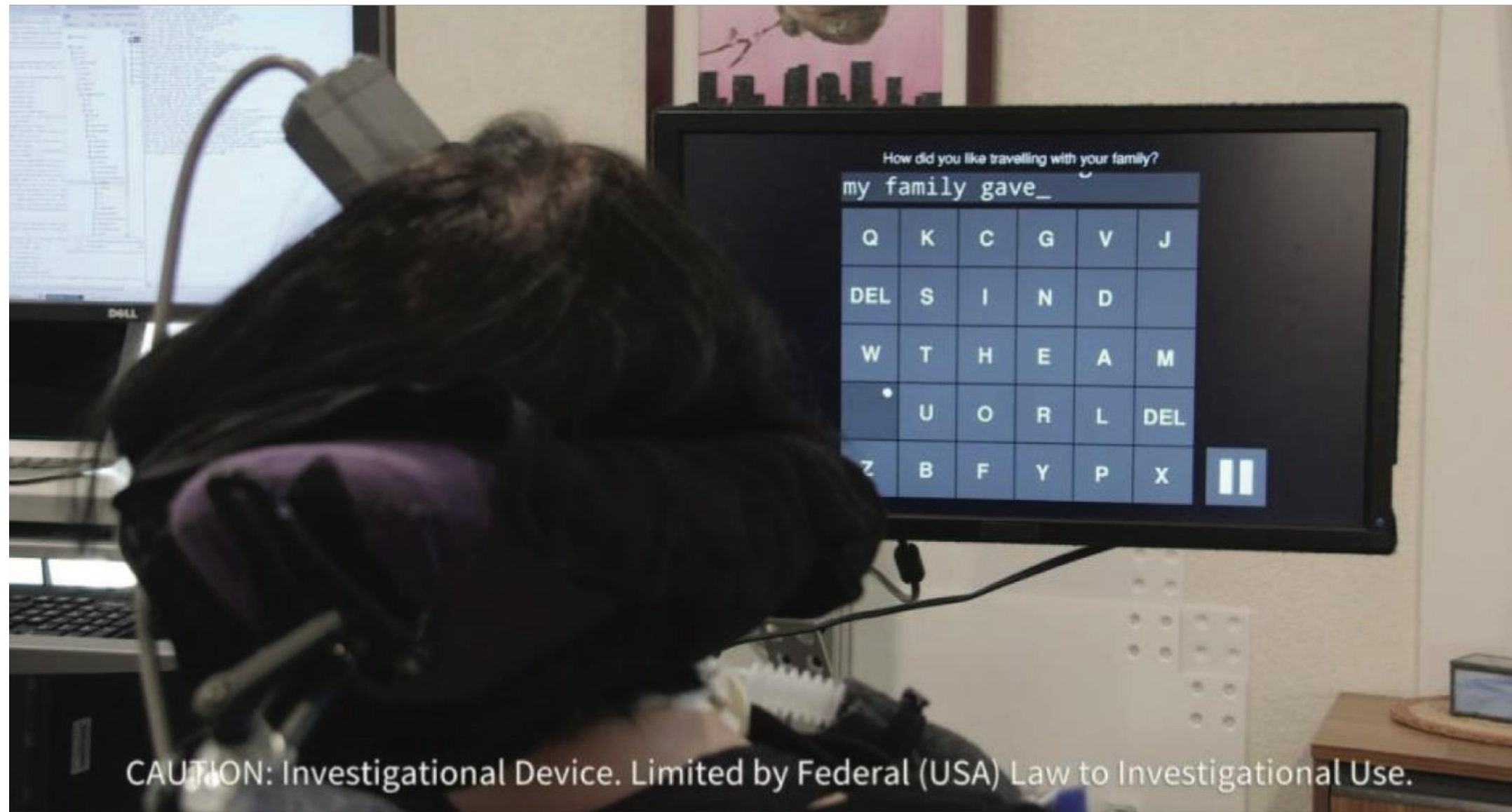
- How do humans react to physical robots designed to exhibit behaviors (e.g. making facial expressions) compared with virtual ones?
- Should robots be designed to be human-like or look like and behave like robots that serve a clearly defined purpose?
- Should the interaction be designed to enable people 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



A brain-computer interface being used by a woman who is paralyzed to select letters on the screen



Natural User Interfaces (NUIs)

- A NUI is one that enables user to interact with a computer in the same ways they interact with the physical world through using voice, hands & bodies
- E.g. instead using a keyboard..
 - speak to machines
 - stroke their surfaces
 - gesture at them in the air
 - dance on mats that detect feet movements
 - Smile to get reaction
 - Etc..
- But, how natural are NUIs?

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? (cont)

- 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

- Important to have a good understanding of the problem space
- Fundamental aspect of interaction design is to develop a conceptual model
- Interaction modes and interface metaphors provide a structure for thinking about which kind of conceptual model to develop
- Interaction styles are specific kinds of interfaces that are instantiated as part of the conceptual model
- Many innovative interfaces have emerged post the WIMP/GUI era, including speech, wearable, mobile, brain and tangible
- 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 on-going activity or task