Conceptual models in interaction design

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Outline

- Problem space analysis
- Conceptual models
- Interface metaphor
- Interaction types
- Paradigms, theories, models, and frameworks
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
Problem space

- What do you want to create?
- What are your assumptions?
- Will it achieve what you hope it will?

Source: after Carroll (2002), Figure 3.1, p. 68.
What is an assumption?

• taking something for granted when it needs further investigation
  – e.g. people will want to watch TV while driving
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
A framework for analyzing the problem space

• Are there problems with an existing product or user experience? If so, what are they?
• Why do you think there are problems?
• How do you think your proposed design ideas might overcome these?
• 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?
Activity

• What are the assumptions and claims made about 3D TV?
Assumptions: realistic or wish-list?

- People would not mind wearing the glasses that are needed to see in 3D in their living rooms - reasonable
- People would not mind paying a lot more for a new 3D-enabled TV screen - not reasonable
- People would really enjoy the enhanced clarity and color detail provided by 3D - reasonable
- People will be happy carrying around their own special glasses - reasonable only for a very select bunch of users
Benefits of conceptualizing

• **Orientation**
  – 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**
  – 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, behavior, functionality to provide
- But before deciding upon these it is important to develop a conceptual model
Conceptual model

- **A conceptual model is:**
  - “a high-level description of how a system is organized and operates” (Johnson and Henderson, 2002, p 26)

- **Enables**
  - “designers to straighten out their thinking before they start laying out their widgets” (p 28)
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 (e.g. saving, revisiting, organizing)

- **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
• We describe them in terms of core activities and objects
• Also in terms of interface metaphors
Interface metaphors
Interface metaphors

• Conceptualizing what we are doing, e.g. surfing the web

• A conceptual model instantiated at the interface, e.g. the desktop metaphor

• Visualizing an operation,
  – e.g. an icon of a shopping cart for placing items into
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 of this to understand more aspects of the unfamiliar functionality
Benefits of interface metaphors

• 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
Problems with interface metaphors

- 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
Interaction types

- **Instructing**
  - issuing commands and selecting options
- **Conversing**
  - interacting with a system as if having a conversation
- **Manipulating**
  - interacting with objects in a virtual or physical space by manipulating them
- **Exploring**
  - moving through a virtual environment or a physical space
1. Instructing

- 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
Which is easiest and why?
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
Conversing

- Apple agent vision (1987!)

http://www.youtube.com/watch?v=HGYFEI6uLy0
You asked: how many legs does a centipede have

Jeeves knows these answers:

Ask Where can I see an image of the human arm and leg muscles (cut views) ?

Ask Where can I find the free online arcade game Centipede ?

Ask Why does my leg or other limb fall asleep?

Ask Where can I find advice on controlling the garden pest millipedes and centipedes ?
Would you talk with Anna?
Pros and cons of conversational model

- Allows users, especially novices and technophobes, to interact with the system in a way that is familiar
  - makes them feel comfortable, at ease and less scared

- Misunderstandings can arise when the system does not know how to parse what the user says
3. Manipulating

- Involves dragging, selecting, opening, closing and zooming actions on virtual objects.
- Exploits 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).
Direct Manipulation

• 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
Differences?

Mac darbalkas (1987)

Pirmasis iPad interfeisas (2010)

Mac OS X darbalkas (2005)
Manipuliavimas fiziniais objektais (PicoCrickets)
Why are DM interfaces so enjoyable?

- 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
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
WIMP: window metaphor

- Computer screen shows parallel processes
Icons

• Help to recognise how to use the object
• First metaphors – Xerox Star
• 1980 – 1990: active research
Icon design

- Metaphors
  - Similarity
  - Typical exemplars
  - Symbolical
Pirmosios piktogramos

(a) EXIT
(b) Talk, Hangup
(c) Icons
(d) Icons
Šiuolaikinės piktogramos
Horton’s icon checklist

• Understandable
• Familiar
• Unambiguous
• Memorable
• Informative
• Few
• Distinct
• Attractive
• Legible
• Compact
• Coherent
• Extensible

Paprastos ir lengvai atskiriamos piktogramos su antrašte

- Delete
- Redo
- Undo
- Properties
- Cut
- Copy
- Paste
- Folder Options
- Views
- Back
- Forward
- Stop
- Refresh
- Home
- Search
- Favorites
- History
- Mail
- Up
- Move To
- Copy To
- Folders
- Open
- Save
- Print
- New
- Print Preview
Menu

• Hierarchical menu
Cascading menu
Context menu

- Actions are grouped by objects
Pointers

- Cursors
- Collaborative tools – more than one cursor
Microsoft Bob desktop metaphor
Microsoft Bob desktop
4. Exploring

- Involves users moving through virtual or physical environments

- Physical environments with embedded sensor technologies
  - Context aware
Virtual world
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 specialized 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
Many kinds of interface types available...

- Command
- Speech
- Data-entry
- Form fill-in
- Query
- Graphical
- Web
- Pen
- Augmented reality
- Gesture

(for more see chapter 6)
Which interaction type to choose?

- Need to determine requirements and user needs
- Take budget and other constraints into account
- Also will depend on suitability of technology for activity being supported
- This is covered in course when designing conceptual models
Paradigm

• Inspiration for a conceptual model
• General approach adopted by a community for carrying out research
  – shared assumptions, concepts, values, and practices
  – e.g. desktop, ubiquitous computing, in the wild
Examples of new paradigms

- Ubiquitous computing (mother of them all)
  - Pervasive computing
  - Wearable computing
  - Tangible bits, augmented reality
  - Attentive environments
  - Transparent computing
  - and many more....
Gestalt principles

PSYCHOLOGICAL PRINCIPLES AND INTERFACE DESIGN
Intuitive perception guidelines: Gestalt laws

- Proximity
- Continuity
- Part-whole
- Similarity
- Closure
- Simplicity
- Simmetry
- Parallel
Gestalt laws

- Proximity
Proximity to organize buttons

Equal distances in Windows Vista

Buttons in OS X ir SpiderOak cloud
Similar type file as blocks

Unordered files – difficult to understand
Continuity

- Scrollbar refers to the invisible part
  - indicates that about 80% is visible
Closure

- we perceive as a connection
  - bit it is not continuous
Principles for memory and attention

• **Short-term memory**
  – George Miller (1956):
    • short-time memory is limited to $7 \pm 2$ small chunks=
  – Cowan (2002): $4 \pm 1$

• **Chunked dialogs**
Principles for memory and attention

- **Time limitations**
  - memories in short-term memory persist for only 30 sec.,
  - Important information should be more persistent
Principles for memory and attention

- **Recognition**
  - menu shows available options
  - images help selection
Principles for memory and attention

• Recall
  – autocomplete help to recall the names
    • airports
Principles for memory and attention

- colours
  - maximum 5 + 2
  - use central and peripheral colours
  - do not use simultaneous high-chroma, spectral colours
  - Use familiar consistent codings with appropriate references
Information design

• Goal – present large amount of data in easily understandable form

   – the proper representation helps to solve the problem
Harry Beck’s London underground rail network
Information design

- gestalt laws
Wurman, Understanding USA (2000)

http://designarchives.aiga.org/#/entries/%2Bid%3A83/_/detail/relevance/asc/0/7/83/understanding-usa-website/1
Interaktive visualizations

- Ben Shneiderman
  - overview first
  - zoom and filter
  - then details on demand
Film finder, Ahlberg, Shneiderman (1994)
Film finder, Ahlberg, Shneiderman (1994)
ConeTree

- 3D file system tree
smartMoney.com

- stock market
- colours – changes in values
- blocks – companies
- mousing over the block
  - shows name,
- clicking
  - details
Vizualus tezaurus

http://www.visualthesaurus.com/
Reading

• P Preece Jennifer, Yvonee Rogers, Helen Sharp. Interaction design: Beyond human – computer interaction. John Wiley & Sons
  – conceptual models

• David Benyon. Designing Interaction Systems: A comprehensive guide to HCI and interaction design.