
 清华大学计算机学院  
 数字媒体与网络技术

## Human Computer Interaction

Understanding and conceptualizing interaction

1

### Understanding the problem space

- What do you want to create?
  - A new UI for a given problem
  - A new UI and program for a given device
  - A new device for a given task
  - A new way of fulfilling a task
- Why do you want to do so?
- What are your assumptions?
- Will it achieve what you hope it will?

2

### Understanding the problem space

- A problem with trying to solve a design problem beginning at the “nuts and bolts” level is that critical usability goals and user needs may be overlooked.
  - Consider the problem of providing drivers with better navigation and traffic information
  - It is better to make these kind of design decisions after understanding the nature of the problem space.
- Clarifying your usability and user experiences goals is a central part of working out the problem space.
  - Make explicit your implicit assumptions and claims

3


### A framework for analysing the problem space

- Are there problems with an existing product?
  - What are they? List them explicitly!
- Why do you think there are problems?
  - You had them? Everybody has them?
- Why do you think your proposed ideas might be useful?
  - Faster? Easier? More comfortable?
- How would you see people using it with their current way of doing things?
- How will it support people in their activities?
- Will it really help them?

4

### An example


- **Assumptions:**
  - People want to use phones when on the way
  - People need to carry the phone in their pockets
  - People are comfortable with typing in the number
  - People are comfortable with the form of a handset



5

### A counter-example

- What were the assumptions made by smart phone companies when developing WAP services?
- Was it a solution looking for a problem?



6

### Assumptions: realistic or wish-list?

- People want to be kept informed of up-to-date news wherever they are - **reasonable**
- People want to interact with information on the move - **reasonable**
- People are happy using a very small display and using an extremely restricted interface - **not reasonable**
- People will be happy doing things on a smart phone that they normally do on their PCs (e.g. surf the web, read email, shop, bet, play video games) - **reasonable only for a very select bunch of users**

7

### 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**

8

### Conceptual model

- Need to first think about how the system will appear to users (i.e. how they will understand it)
- The most important thing to design is the user's conceptual model.
  - "Every thing else should be subordinated to making that model clear, obvious, and substantial. That is almost exactly the opposite of how most software is designed."

9

### Conceptual model

- A conceptual model is a high level description of:
  - "the proposed system in terms of a set of integrated ideas and concepts about what it should do, behave and look like, that will be understandable by the users in the manner intended"

10

### 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** and **remember** the underlying conceptual model

11

### Conceptual models

- Many kinds and ways of classifying them
- Here we describe them in terms of core activities and objects
- Also in terms of interface metaphors

12

### Conceptual model: example 1

- Considered "appropriate for middle school and high school children"
- 0: find marker for numbers on top side.
- 1: turn the knob to the **right 2 or more whole turns** and stop at the **first number** in your particular combination.
- 2: turn the knob to the **left one whole turn** past the first number, and stop at the **second number** in your combination.
- 3: turn the knob to the **right** ("Warning\*", not a complete whole turn!) and stop at the last number in your combination.
- 4: Pull up on the shackle and turn the latch towards you. **Congratulations**, the lock has been opened!



13

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### Conceptual model: example 2

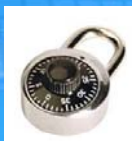
- 0: **Know** that numbers read from **top to bottom**, and **find** marker for numbers
- 1: turn **any** wheel in **any** direction to its correct number
- 2-4: **repeat** for all wheels
- 5: Pull up on the shackle and open



14

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### Conceptual models: examples



- Objects:
  - Body, knob, shackle
- Actions:
  - Turn knob left/right, pull shackle



- Objects:
  - Body, wheels, shackle
- Actions:
  - Turn wheels left/right, pull shackle

15

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### Conceptual models based on activities

- Giving instructions
  - issuing commands using keyboard and function keys and selecting options via menus
- Conversing
  - interacting with the system as if having a conversation
- Manipulating and navigating
  - acting on objects and interacting with virtual objects
- Exploring and browsing
  - finding out and learning things

16

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### 1. Giving instructions

- Where users instruct the 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. CAD, word processors, vending machines
- Main benefit is that instructing supports quick and efficient interaction
  - good for repetitive kinds of actions performed on multiple objects



17

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### 2. Conversing

- Underlying model of having a conversation with another human
- Range from simple voice recognition menu-driven systems to more complex 'natural language' dialogues
- Examples include timetables, search engines, advice-giving systems, help systems



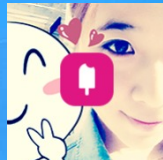
18

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## 2. Conversing

- Recently, much interest in having virtual agents at the interface, who converse with you.



19

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## 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

DEMO

20

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## 3. Manipulating and navigating

- 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
- Exemplified by (i) what you see is what you get (WYSIWYG) and (ii) the direct manipulation approach (DM)
- Shneiderman (1983) coined the term DM, came from his fascination with computer games at the time



22

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## Core principles of DM

- 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



23

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## 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



24

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### 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' (waste extensive screen space)
- Moving a mouse around the screen can be slower than pressing function keys to do same actions

25

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### 4. Exploring and browsing

- Similar to how people browse information with existing media (e.g. newspapers, magazines, libraries, pamphlets)
- Information is structured to allow flexibility in way user is able to search for information
  - e.g. multimedia, web



26

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### Glass Activity

- A company is building a wireless information system to help tourists find their way around an unfamiliar city. What would they need to find out in order to develop a conceptual model?

27

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### Glass Activity

- What do tourists want?
- How to best support the activity of requesting information?

28

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### Conceptual models based on objects

- Usually based on an analogy with something in the physical world
- Examples include books, tools, vehicles
- Classic: Xerox Star Interface based on office objects

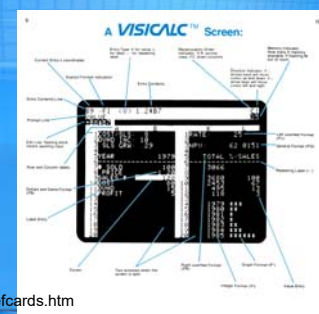


Johnson et al (1989)

29

### Another classic: the spreadsheet (Bricklin)

- Analogous to ledger (分类账) sheet
- Interactive and computational
- Easy to understand
- Greatly extending what accountants and others could do


[www.bricklin.com/history/refcards.htm](http://www.bricklin.com/history/refcards.htm)

### 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

31

### 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
  - e.g. W3 is an ocean. (surfing, drowning in a sea of information)
- 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

32

### 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

33

### 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(不经意地) use bad existing designs and transfer the bad parts over
- Limits designers' imagination in coming up with new conceptual models

34

Thank you.