Understanding and Conceptualizing Interaction

From Preece, Rogers & Sharp's *Interaction Design*

071010-1
2018년 가을학기
10/03/2018
박경신

Overview

- Explain what is meant by the **problem space**
- Explain how to **conceptualize interaction**
- Describe what a **conceptual model** is and how to begin to formulate one
- Discuss the pros and cons of using **interface metaphors**
- Outline the **core interaction types** for informing the development of a conceptual model
- Introduce **theories, models, and frameworks** as a way of informing interaction design

---

Understanding the Problem Space

- **Problem space** = **real world**
  - You can find users and their needs in the problem space
- **Solution space** (design space) = **designed system**
  - You set up requirements and design products in the solution space

---

Start in the Problem Space

- Resists the temptation to begin at the "nuts and bolts" level of design
- The problem is you can overlook usability and user experience goals
- **Articulate the nature of the problem space first**
- Understand what is currently the user experience and the product and how this is going to be improved and changed

Articulating the Problem Space

- What do you want to create?
- What is the current solution?
- What is the problem with the solution?
- What are your **assumptions**?
- What are your **claims**?

- Typically done as a team effort
  - Members with differing perspective on the problem space can help identify false assumptions and claims

---

What is an Assumption?

- Taking something for granted when it needs further investigation
  - E.g. people will want to watch TV while driving

VOICE MAIL
Delete
47
MPH

http://www.ibiblio.org/jlillie/cooltown/lillie.htm
https://www.youtube.com/watch?v=RUf2-HCNAh4

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 Analysing 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: Assumptions Realistic or Wish-list?

- What are the **assumptions** and **claims** made about 3D TV?
  - 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 Conceptualising

- 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, behaviour, functionality to provide
- But before deciding upon these it is important to develop a **conceptual model**

Conceptual Model

- Need to first think about what the system will going to be to users (how it will appear to users)

- **A conceptual model is:**
  "a high-level description of how a system is organized and operates" (Johnson and Henderson, 2002)
- **Enables**
  ".. designers to straighten out their thinking before they start laying out their widgets" (Johnson and Henderson, 2002)

What is and Why We Need a Conceptual Model?

- Not a description of the user interface but **a structure outlining the concepts and the relationships between them**
- Why not start with the nuts and bolts of design?
  - Architects and interior designers would not think about which color curtains to have before deciding where the windows will be placed in a new building
  - Enables "designers to straighten out their thinking before they start laying out their widgets"
  - Provides a working strategy and a framework of general concepts and their interrelations

---

Components (with a Browser Example)

- **Metaphors and analogies** that are used to convey how to understand what a product is for and how to use it for an activity
  - **Browsing (like internet shopping)**
  - **Bookmaking**
- **Concepts** that people are exposed to through the product
  - Task–domain objects, their attributes, and operations (e.g. saving, revisiting, organizing)
  - **Web pages, links, lists, folders of URLs**
- **Relationship and mappings** between these concepts
  - **A folder contains URLs**
  - **The target of 'saving' is a URL**

It Helps the Design Team

- Orient themselves towards asking questions about how the conceptual model will be understood by users
- Not to become narrowly focused early on
- Establish a set of common terms they all understand and agree upon
- Reduce the chance of misunderstandings and confusion arising later on

---

First Steps in Formulating a Conceptual Model

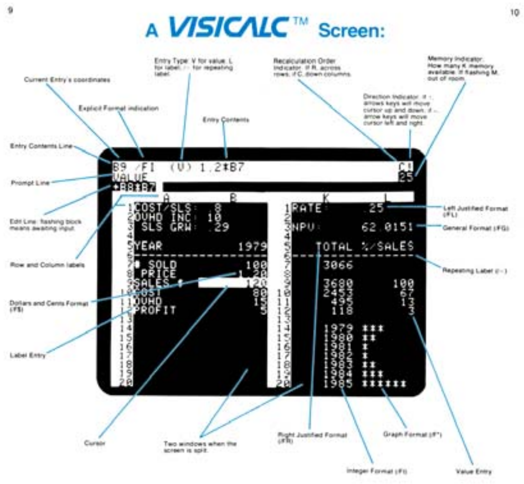
- What will the users be doing when carrying out their tasks?
- How will the system support these?
- What kind of interface metaphor, if any, will be appropriate?
- What kinds of interaction modes and styles to use?
  - **Always keep in mind when making design decisions how the user will understand the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

Conceptual Models

- The best conceptual models are those that appear obvious; **the operations they support being intuitive to use.**
- Most interface applications are actually based on well-established conceptual models.
- We describe them in terms of core activities and objects.
- **Interface metaphors** are intended to provide familiar entities that enable people to readily understand the underlying conceptual model and know what to do at an interface.

A Classic Conceptual Model: VisiCalc

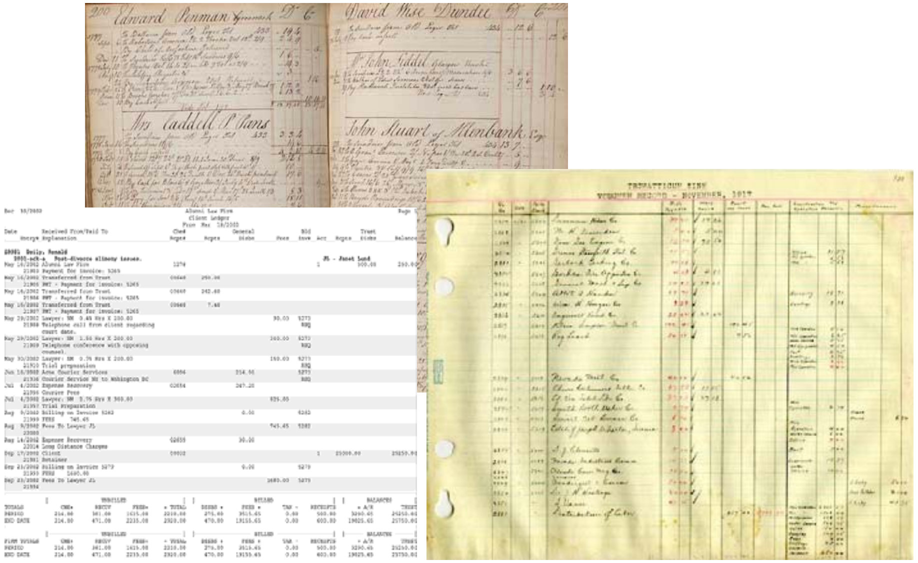
- Conceived by Dan Bricklin and Bob Frankston
- **Based on analogy of ledger sheets** that were used in accounting practice



9
10
A VISICALC™ Screen:
Current Entry's coordinates
Explicit Format indication
Entry Type: V for value, L for label, /- for repeating label.
Entry Contents
Recalculation Order Indicator. If R, across rows; if C, down columns.
Direction Indicator: if - arrow keys will move cursor up and down; if — arrow keys will move cursor left and right.
Memory Indicator: How many K memory available. If flashing M, out of room.
Entry Contents Line
Prompt Line
Edit Line: flashing block means awaiting input.
Row and Column labels
Dollars and Cents Format (/F$)
Label Entry
Left Justified Format (/FL)
General Format (/FG)
Repeating Label (/-)
Cursor
Two windows when the screen is split.
Right Justified Format (/FR)
Graph Format (/F*)
Integer Format (/FI)
Value Entry
B9 /FI (V) 1.2*B7
VALUE
C!
25
A
B
K
L
COST/SLS: .8
OVHD INC: 10
SLS GRW: .29
YEAR 1979
# SOLD 100
PRICE 1.20
SALES $ 120
COST 80
OVHD 15
PROFIT 5
RATE .25
NPV: 62.0151
TOTAL %/SALES
3066
3680 100
2453 67
495 13
118 3
1979 ***
1980 **
1981 *
1982 *
1983 **
1984 ***
1985 ******

https://www.youtube.com/watch?v=Ii3PDjJCCQ4

Ledger Sheets



Key Goals of VisiCalc's Conceptual Model

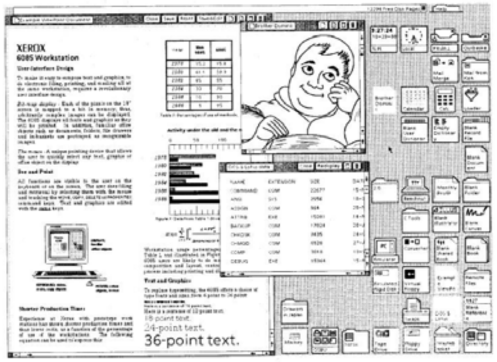
- Create a **spreadsheet** that was **analogous to a ledger sheet** in the way it looked, with columns and rows, that allowed people to **capitalize on their familiarity** with how to use this kind of representation
- **Make the spreadsheet interactive**, by allowing the user to input and change data in any of the cells
- **Have the computer perform a range of a difficult calculations and recalculations** in response to user input
- **Interactivity + Automation**
  - A very successful tool that greatly extends what they could do before

Another Classic Conceptual Model: Star

- The Star Interface: Developed by XeroxPARC in 1981
- Designed as an office system, targeted at workers not interested in computing per se
- To make the computer as invisible to the user as possible
- Several person-years working out a conceptual model
- **"Desktop metaphor"**
  - **Making it seem more familiar, less alien, and easier to learn for office workers**

The Star Interface

- Paper, folders, filing cabinets, and mailboxes were represented as icons
- Dragging a document around
- Dragging a document onto a folder
- Placing a document on a printer



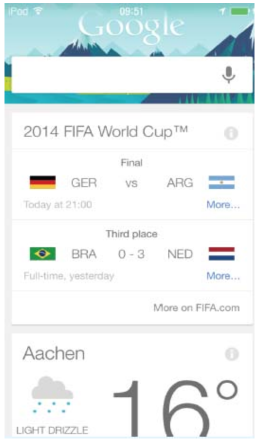
https://www.youtube.com/watch?v=Cn4vC80Pv6Q

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

Material Metaphors

- Google Now Card
- The card is a very popular UI.
- Why? Because it has familiar form factor.
- Material properties are added, giving appearance and physical behavior, e.g. surface of paper.



2014 FIFA World Cup™

Final

GER vs ARG

Today at 21:00 More...

Third place

BRA 0 - 3 NED

Full-time, yesterday More...

More on FIFA.com

Aachen

16°

LIGHT DRIZZLE

How Google fixed its design process and started making beautiful apps
https://www.youtube.com/watch?v=VDNngQjN6o4

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?

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'
  - People find it easier to learn and talk about what they are doing at the computer interface in terms familiar to them
- 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. MS recycle bin placed on desktop
- Can constrain designers in the way they conceptualize a problem space
- Conflict with design principles
  - E.g. Mac trashcan for both deleting and ejecting
- 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

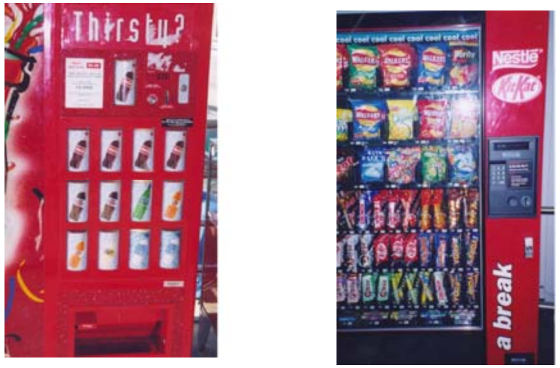
- **Instructing**
  - Issuing **commands** using keyboard and function keys and selecting **options** via menus
- **Conversing**
  - Interacting with a system as if having a **conversation**
- **Manipulating**
  - Interacting with objects in a virtual or physical space by **manipulating** them
- **Exploring**
  - **Moving through** a virtual environment or a physical space

1. Instructing

- Where users instruct a system **by telling it what to do**
  - E.g. tell the time, print a file, save a file, find a photo
- 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?

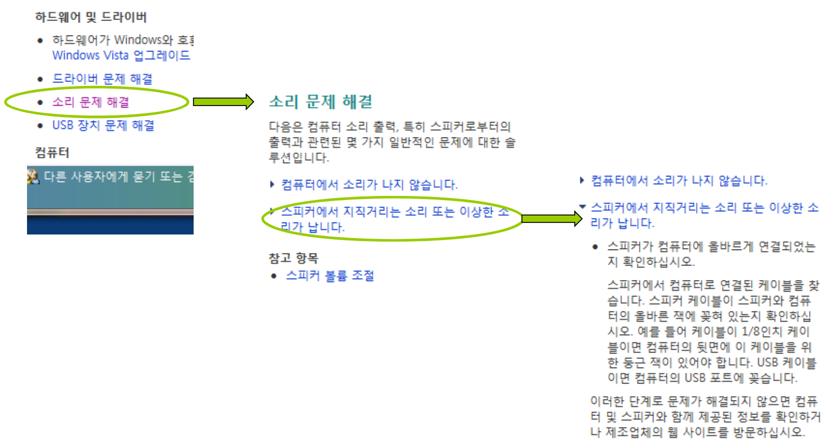
- Using simple instructions



2. Conversing

- Underlying model of **having a conversation** with another human
- Differs from instructing in that it is more like **two-way communication**, with the system acting like a partner rather than a machine that obeys orders
- 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

Windows Trouble Shooter



하드웨어 및 드라이버

- 하드웨어가 Windows와 호
  Windows Vista 업그레이드
- 드라이버 문제 해결
- 소리 문제 해결
- USB 장치 문제 해결

컴퓨터

다른 사용자에게 묻기 또는

소리 문제 해결

다음은 컴퓨터 소리 출력, 특히 스피커로부터의 출력과 관련된 몇 가지 일반적인 문제에 대한 솔루션입니다.

- 컴퓨터에서 소리가 나지 않습니다.
- 스피커에서 지직거리는 소리 또는 이상한 소리가 납니다.

참고 항목

- 스피커 볼륨 조절

컴퓨터에서 소리가 나지 않습니다.

스피커에서 지직거리는 소리 또는 이상한 소리가 납니다.

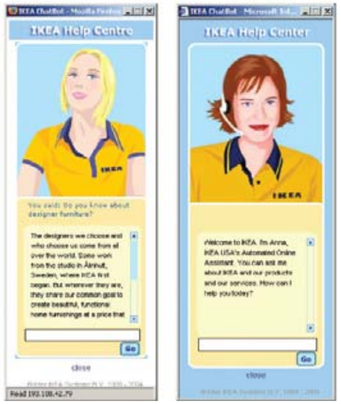
- 스피커가 컴퓨터에 올바르게 연결되었는지 확인하십시오.

  스피커에서 컴퓨터로 연결된 케이블을 찾습니다. 스피커 케이블이 스피커와 컴퓨터의 올바른 잭에 꽂혀 있는지 확인하십시오. 예를 들어 케이블이 1/8인치 케이블이면 컴퓨터의 뒷면에 이 케이블을 위한 둥근 잭이 있어야 합니다. USB 케이블이면 컴퓨터의 USB 포트에 꽂습니다.

이러한 단계로 문제가 해결되지 않으면 컴퓨터 및 스피커와 함께 제공된 정보를 확인하거나 제조업체의 웹 사이트를 방문하십시오.

IKEA Help Center

- Would you talk with Anna?
  - Anna the online sales agent, designed to be subtly different for UK and US customers.
  - What are the differences and which is which?
  - What should Anna's appearance be like for other countries, like Korea?



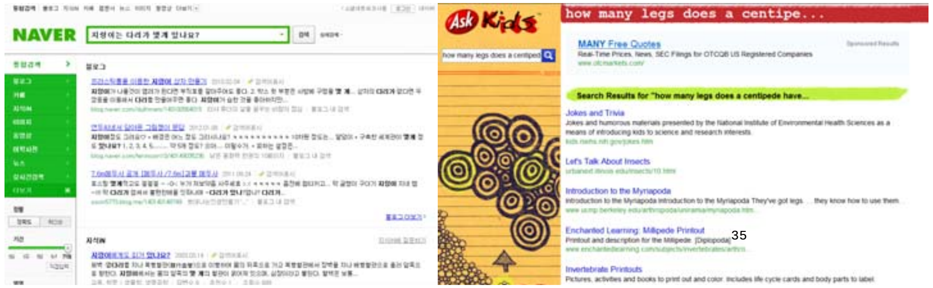
You said: Do you know about designer furniture?

The designers we choose and who choose us come from all over the world. Some work from the studio in Älmhult, Sweden, where IKEA first began. But wherever they are, they share our common goal to create beautiful, functional home furnishings at a price that

Welcome to IKEA. I'm Anna, IKEA USA's Automated Online Assistant. You can ask me about IKEA and our products and our services. How can I help you today?

Cons/Pros 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
  - E.g. child types into a search engine, that uses natural language the question "How many legs does a centipede have?" and the system responds …



MANY Free Quotes
Real-Time Prices, News, SEC Filings for OTCQB US Registered Companies

Search Results for "how many legs does a centipede have...

Jokes and Trivia
Jokes and humorous materials presented by the National Institute of Environmental Health Sciences as a means of introducing kids to science and research interests.

Let's Talk About Insects

Introduction to the Myriapoda
Introduction to the Myriapoda Introduction to the Myriapoda They've got legs. ... they know how to use them.

Enchanted Learning: Millipede Printout
Printout and description for the Millipede. (Diplopoda)

Invertebrate Printouts
Pictures, activities and books to print out and color. Includes life cycle cards and body parts to label.

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)

Direct Manipulation

- Ben Shneiderman (1983) coined the term **"Direct Manipulation"**, came from his fascination with computer games at the time
  - Proposes that digital objects be designed so they can be interacted with analogous to how physical objects are manipulated
  - Assumes that direct manipulation interfaces enable users to feel that they are directly controlling the digital objects
- Core principles of Direct Manipulation
  - **Continuous representation** of objects and actions of interest
  - **Physical actions** (e.g. button pressing) instead of issuing commands with complex syntax
  - Rapid reversible actions with **immediate feedback** on object of interest

---

Why are Direct Manipulation 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 Direct Manipulation?

- 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

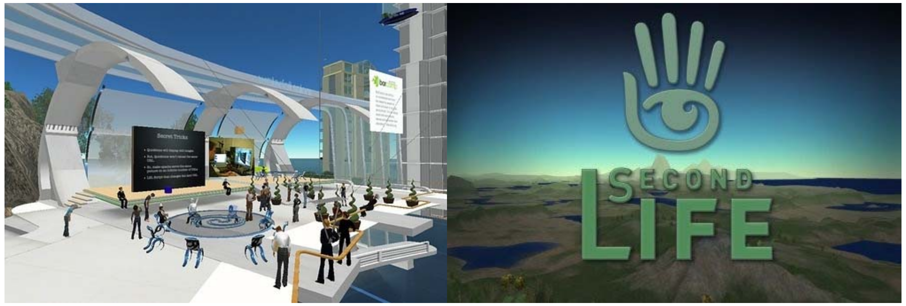
---

4. Exploring

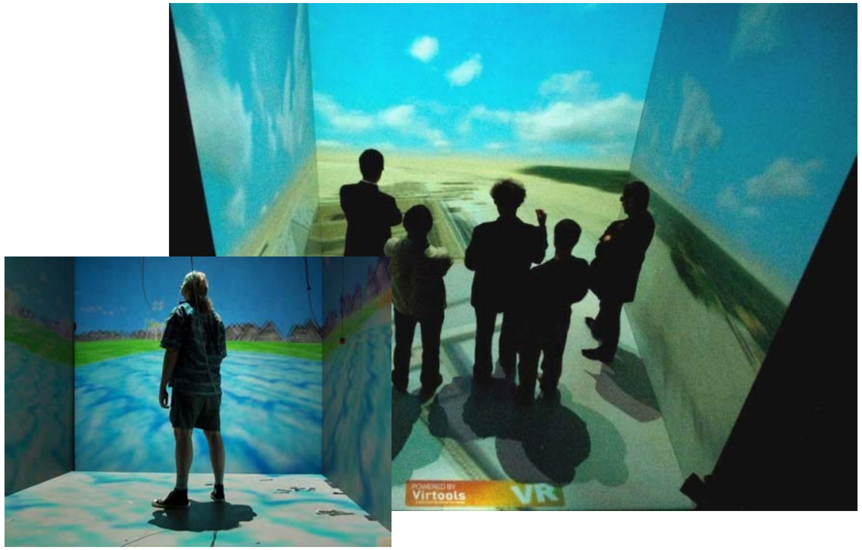
- Involves users **moving through** virtual or physical environments
- Examples include
  - 3D desktop virtual worlds where people navigate using mouse around different parts to socialize (e.g. Second Life)
  - CAVEs where users navigate by moving whole body, arms, and head
  - Context-ware system (i.e., physical environments with embedded sensor technologies) that present digital information to users at appropriate places and times

Virtual World

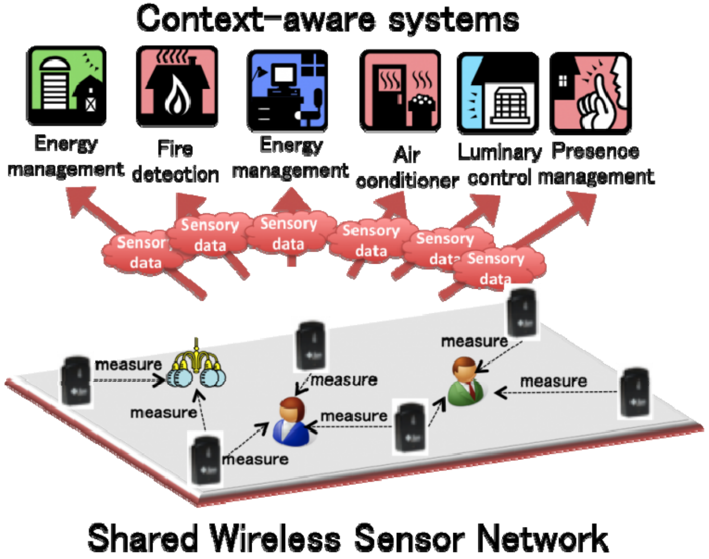
- Second Life


SECOND
LIFE

CAVE


POWERED BY
Virtools
VR

Context-Aware


Context-aware systems
Energy management
Fire detection
Energy management
Air conditioner
Luminary control
Presence management
Sensory data
Sensory data
Sensory data
Sensory data
Sensory data
Sensory data
measure
measure
measure
measure
measure
measure
measure
Shared Wireless Sensor Network

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

Many Kinds of Interface Types Available

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

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….

Visions

- A driving force that frames research and development
- Invites people to imagine what life will be like in 10, 15, or 20 years time
  - E.g. Apple's 1987 Knowledge Navigator https://youtu.be/HGYFEI6uLy0
  - Smart Cities, Smart Health
- Provide concrete scenarios of how society can use the next generation of imagined technologies
- Also raise many questions concerning privacy and trust

Theory

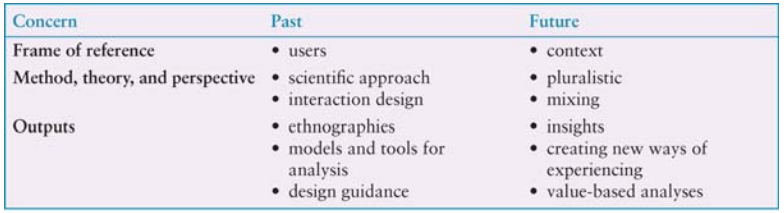
- **Explanation** of a HCI phenomenon
  - E.g. information processing that explains how the mind, or some aspect of it, is assumed to work
- Can help identify factors
  - E.g. cognitive, social, and affective, relevant to the design and evaluation of interactive products

Models

- A **simplification** of some aspect of HCI phenomenon for better understanding and prediction
  - Intended to make it easier for designers to predict and evaluate alternative designs
  - Abstracted from a theory coming from a contributing discipline, e.g. psychology, e.g. keystroke model

Framework

- A set of interrelated **concepts**, specific **questions** for 'what to look for', and **principles** to consider
- Many in interaction design
  - E.g. Norman's conceptual models, Benford's trajectories
- **Provide advice on how to design**
  - E.g. steps, questions, concepts, challenges, principles, tactics and dimensions



Concern	Past	Future
Frame of reference	• users	• context
Method, theory, and perspective	• scientific approach • interaction design	• pluralistic • mixing
Outputs	• ethnographies • models and tools for analysis • design guidance	• insights • creating new ways of experiencing • value-based analyses

Table 2.1 A new framework for human–computer interaction (Rogers, 2009)

Summary

- Important to have a good understanding of the **problem space**
- Fundamental aspect of interaction design is to develop a **conceptual model**
- Decisions about **conceptual design** should be made before commencing and physical design
- **Interface metaphors** are commonly used as part of the conceptual model
- **Interaction types** (e.g., **conversing, instructing**) provide a way of thinking about how best to support the activities users will be doing when using a product or service
- **Paradigms, visions, theories, models and frameworks** can also shape a conceptual model

Reference

- Preece, Rogers & Sharp, Interaction Design: Beyond Human-Computer Interaction, Chapter 2, http://www.id-book.com
- Context-Aware Systems http://www.honiden.nii.ac.jp/sites/default/files/SharedWSN.png