Design of Interactive Systems (DIS)

Lecture 2: Essentials of Designing Interactive Systems

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Recap: Grading Policy

Type of Evaluation	% Contribution in Grade
Class Participation	5 [attendance and responses in class]
Paper Presentation	5 [all groups need to present]
Assignment	20 [4 assignments]
Mid-sem	15
End-sem	25
Project	30+Bonus (5) [group of 3 students] [3 intermediate project reports and evaluation]

Course schedule

Week	Lecture Topic
1	Essential of Designing Interactive Systems: Introduction
2	Essential of Designing Interactive Systems: Usability and Experience Design
3	Foundations of Designing Interactive Systems: Memory and Attention
4	Foundations of Designing Interactive Systems: Cognitive and Action
5	Techniques for Designing Interactive Systems: Evaluation and Task Analysis
6	Techniques for Designing Interactive Systems: Visual and Multimodal Interface Design
7	Context of Designing Interactive Systems: Web-based Systems and Social Media
8	Context of Designing Interactive Systems: Agents, Avatars, and Collaborative Environments
9	Project & Research Paper Discussion
10	Project & Research Paper Discussion
11	Project & Research Paper Discussion
12	Project & Research Paper Discussion
13	Project & Research Paper Discussion

Fitts's Law

Fitts's law

Fitts's law is a mathematical formula which relates the time required to move to a target as a function of the distance to the target and the size of the target itself, say moving a pointer using a mouse to a particular button. It is expressed mathematically as follows:

$$T_{(\text{time to move})} = k \log_2(D/S + 0.5)$$

where $k \sim 100$ ms, D is the distance between the current (cursor) position and the target, and S is the size of the target.

Thus one can calculate the time to move a distance of 15 cm to a button of size 2 cm as

$$T = 100 \log_2\left(\frac{15}{2} + 0.5\right)$$

$$= 0.207 \text{ seconds}$$

Fitts's law describes motor control. The smaller the target and the greater the distance, the longer it will take to hit the target. Fitts's law can also be used to calculate how long it would take to type this sentence or, more importantly, a number of time-critical operations such as hitting the brake pedal of a motor car, or the likelihood of hitting <OK> rather than <Cancel> or, more worryingly, <Fire> or <Detonate>.

People: Psychological Difference

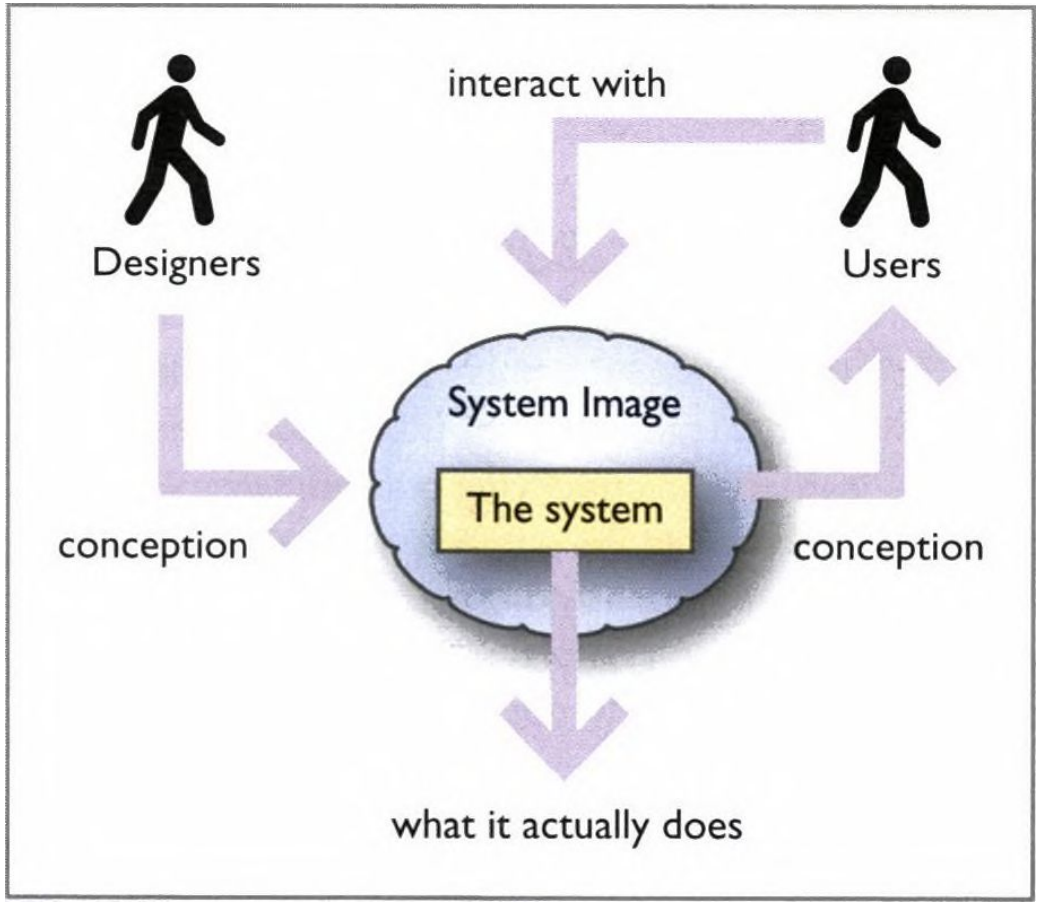
- Designers should design for people with poor ability by providing good signage and clear directions
- Language differences are of course crucial to understanding, and cultural differences affect how people interpret things
- Some people can find their way around environments better than others, or mentally rotate objects more quickly and accurately.
- Some are good at words, others are good at numbers.
- There are differences in personality, emotional make-up and ability to work under stress.

Mental Model

- The understanding and knowledge that we possess of something is often referred to as a ‘mental model’
- If people do not have a good mental model of something they can only perform actions by rote
- A key design principle is to design things so that people will form correct and useful mental models of how they work and what they do.
- People develop mental models through interacting with systems, observing the relationship between their actions and the behaviours of the system and reading any manuals or other forms of explanation that come with a system.

Mental Model

As Norman set out in his classic exposition of the issues (Norman, 1986), designers have some conception of the system they have produced.



Nature of Mental Models of Interactive Systems (Norman, 1983).

- Mental models are incomplete. People will understand some parts of a system better than others.
- People can ‘run’ (or try out) their models when required, but often with limited accuracy.
- Mental models are unstable - people forget details.
- Mental models do not have firm boundaries: similar devices and operations get confused with one another.
- Mental models are unscientific, exhibiting ‘superstitious’ behaviour.
- Mental models are parsimonious. People are willing to undertake additional physical operations to minimize mental effort, e.g. people will switch off the device and start again rather than trying to recover from an error.

Person: Social Differences

- People make use of systems, products and services for very different reasons.
- They have different motivations for using systems.
- These motivations change at different times.
- Experts use a system regularly and learn all sorts of details, whereas a beginner will need to be guided through an interaction.
- There are also people who do not have to use a system, but who the designer would like to use the system.
- Designing for homogenous and heterogenous group of people.

Activities

- There are many characteristics of activities that designers need to consider.
- Used for very simple tasks as well as highly complex, lengthy activities, so designers need to be careful when considering the characteristics of activities.
- 10 important characteristics of activities that designers need to consider.
  - Temporal aspects (items 1-4)
  - Cooperation (5)
  - Complexity (6)
  - Safety-critical (7 and 8)
  - The nature of the content (9 and 10).

Context

- Activities always happen in a context, so there is a need to analyse the two together.
- Three useful types of context are distinguishable:
  - the organizational context, the social context and the physical circumstances under which the activity takes place.
- Sometimes it is useful to see context as surrounding an activity. At other times it can be seen as the features that glue some activities together into a coherent whole.

Technologies

- Medium that interactive system designers work with.
- Designers need to be aware of various possibilities for input, output, communication and content.
- Input devices are concerned with how people enter data and instructions into a system securely and safely.
- Technologies for displaying content to people rely primarily on the three perceptual abilities of vision, hearing and touch

Communication

- Communications between people and between devices is an important part of designing interactive systems.
- Issues such as bandwidth and speed are critical.
- Wireless communication is becoming much more common and often a wireless ‘hub’ is attached to an Ethernet network.
- Short-range communications directly between one device and another (i.e. not using the Internet) can be achieved using a technology called Bluetooth.

Content

- Content concerns the data in the system and the form it takes.
- The content that a technology can support is also critical.
- Good content is accurate, up to date, relevant and well presented.
- ‘Streamy’ outputs such as video, music and speech have different characteristics from ‘chunky’ media such as icons, text or still photographs.
- Animations are also popular ways of presenting content.

Scoping a problem with PACT

- The aim of human-centered interactive systems design is to arrive at the best combination of the PACT elements with respect to a particular domain.
- Designers want to get the right mix of technologies to support the activities being undertaken by people in different contexts.
- A PACT analysis is useful for both analysis and design activities: understanding the current situation, seeing where possible improvements can be made or envisioning future situations.

Example: PACT Analysis

- Developing a system controlling access to university laboratories:
  - People
    - Students, lecturers and technicians are the main groups.
  - Activities
    - The overall purpose of the activity is to enter some form of security clearance and to open the door.
  - Contexts
    - Physically the activity takes place indoors, but people might be carrying books and other things that makes doing anything complicated quite difficult.
  - Technologies: A small amount of data has to be entered quickly

Chapter 3

- **Chapter 1**: Designing interactive systems: a fusion of skills
- **Chapter 2**: PACT: a framework for designing interactive systems
- **Chapter 3**: The process of human-centred interactive system design
- Chapter 4: Usability
- **Chapter 5**: Experience Design
- **Chapter 6**: The Home Information Centre (HIC): a case study in designing interactive systems

Process of Human-Centered Interactive System Design

- Design is a creative process
- It is about conscious change and communication between designers and the people who will use the system.
- Different design disciplines have different methods and techniques for helping with this process
- Different design disciplines have different constraints: stand alone or fit with legacy system

Process of Human-Centered Interactive System Design

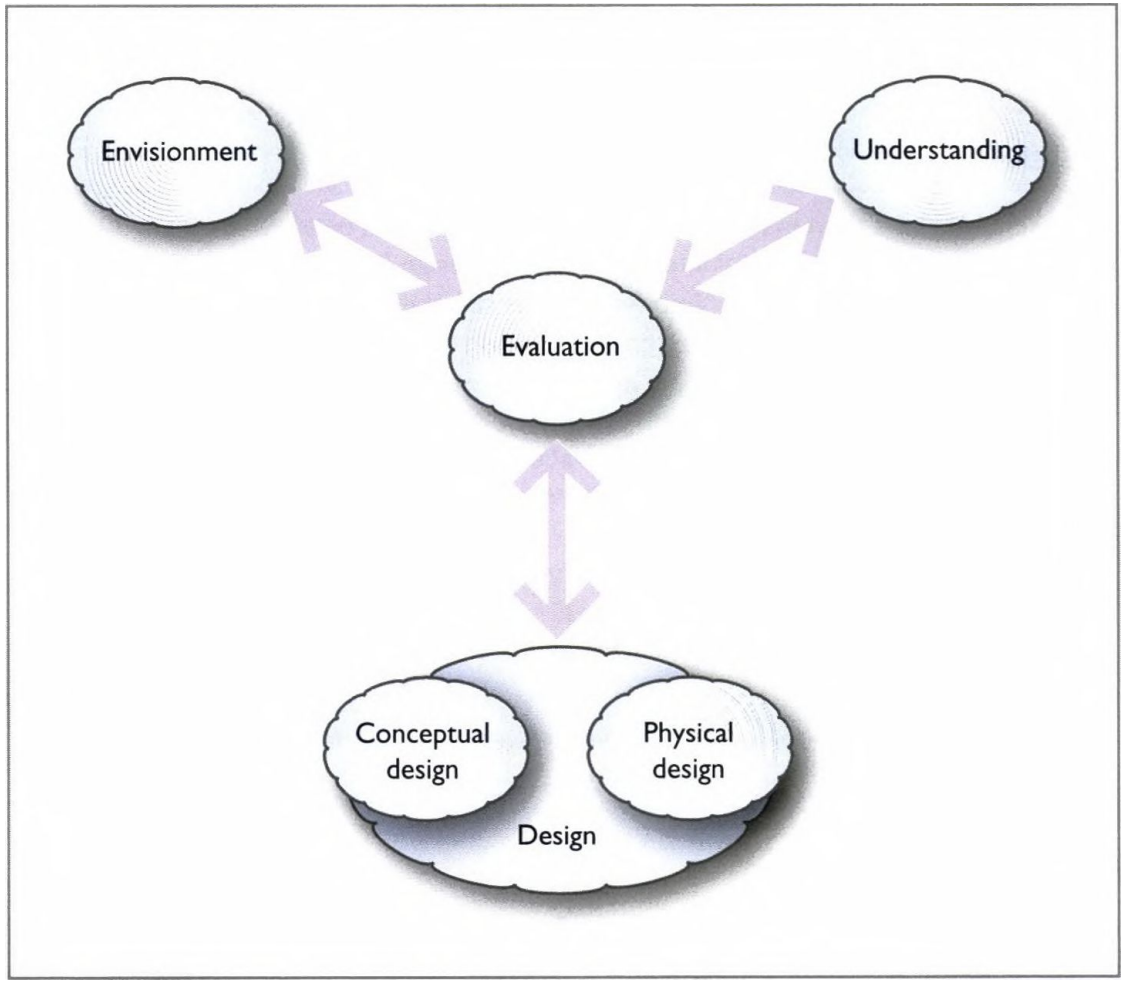
- What is involved in interactive systems design?
- Four processes involved in design:
  - understanding, design, envisionment, evaluation
- Centrality of evaluation in human-centred design
- Scenario-based design approach
- Develop scenarios and personas

Design Process for DIS

- Activities involved in the design process
- “Design has three activities: understand, observe and visualize.” David Kelley
- Understand: design is messy; understand this
- Observe: observe how their products will be used; design is about users and use
- Visualize: visualize which is the act of deciding what it is

Four Activities in Design Process

- Evaluation is central
- The process can start at any point
- The activities can happen in any order



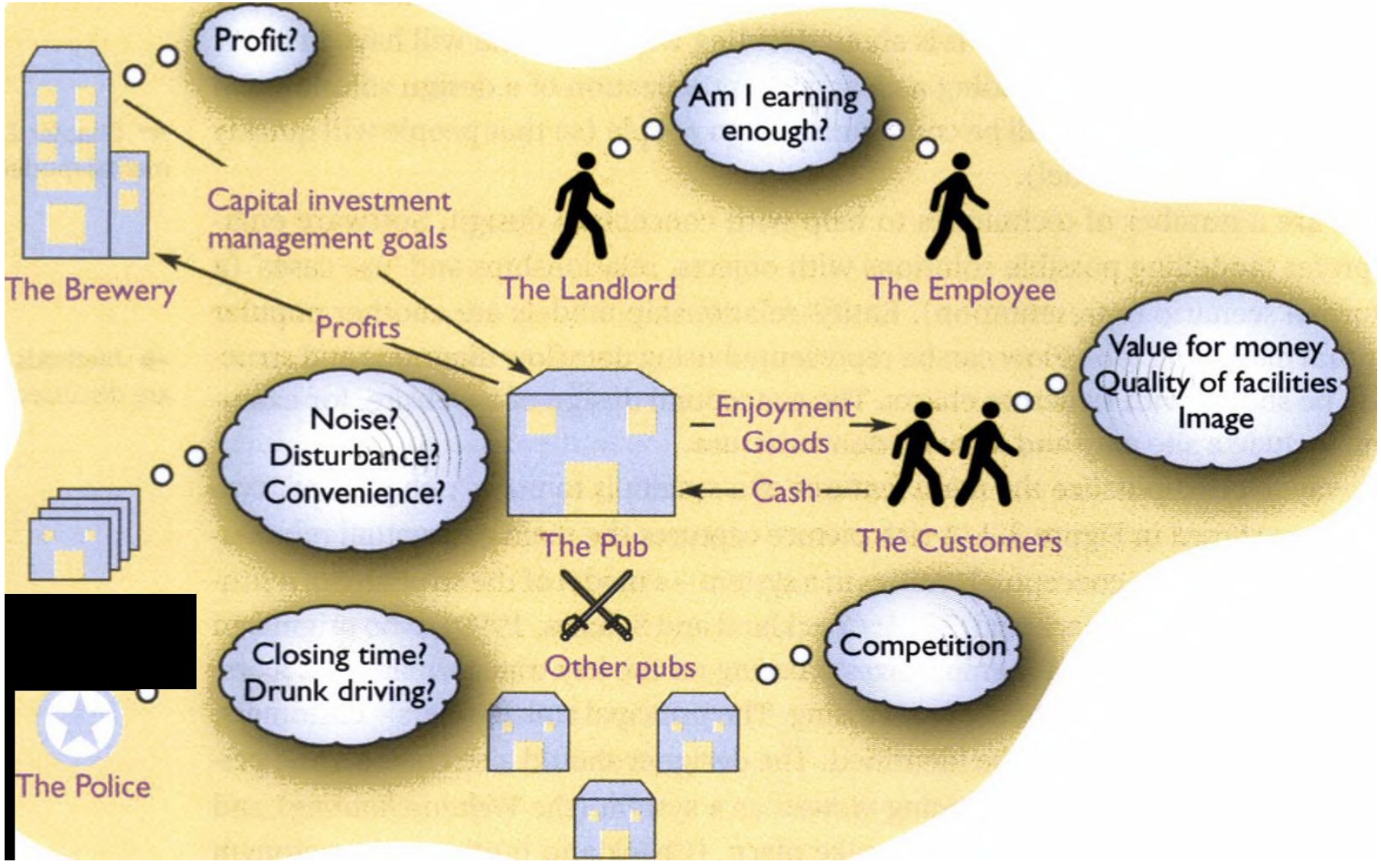
Understanding

- Understanding is concerned with
  - what the system has to do
  - what it has to be like
  - how it has to fit in with other things
- Understanding is requirement of system
- Designers need to research range of people, activities, contexts relevant to the domain
- Requirements are both functional and non-functional

Design

- Design activities concern both conceptual design and physical design
- **Conceptual design** is about designing a system in the abstract, **physical design** is concerned with making things concrete
- Conceptual design: ‘Use Cases’ and ER models
- The key feature of conceptual design is to keep things abstract - focus on the ‘what’ rather than the ‘how’

Conceptual Design: Rich Pictures



Physical Design

- Physical design is concerned with how things are going to work and with detailing the look and feel of the product.
- Physical design is about structuring interactions into logical sequences and about clarifying and presenting the allocation of functions and knowledge between people and devices.
- Physical design is concerned with taking this abstract representation and translating it into concrete designs.

Physical Design: Components

- Three components:
  - operational design: specifying how everything works and how content is structured and stored
  - representational design: fixing on colours, shapes, sizes and information layout.
  - design of interactions: allocation of functions to human agency or to technology and with the structuring and sequencing of the interactions.

Envisionment

- Designs need to be visualized both to help designers clarify their own ideas and to enable people to evaluate them.
- Envisionment is concerned with finding appropriate media in which to render design ideas
- The medium needs to be appropriate for the stage of the process, the audience, the resources available and the questions that the designer is trying to answer.

Evaluation

- Evaluation is tightly coupled with envisionment because the nature of the representation used will affect what can be evaluated.
- evaluation criteria will also depend on who is able to use the representation.
- Sometimes this is simply the designer checking through to make sure something is complete and correct.
- It could be a list of requirements that is sent to a client
- an abstract conceptual model that is discussed with a colleague, or a formal evaluation of a functional prototype by the future system users.