Course: Human Computer Interface (HCI)

Week 12 - Conceptual Model Activities & Evaluation Techniques

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Lecture Learning Outcomes

At the end of this lecture, the learner will be able to:

(i) Define conceptual models and the guiding design principles
(ii) Describe various activities involved in conceptual model development
(iii) Describe the principle of visibility, feedback and mapping to evaluate conceptual models

Introduction:

In order to understand how to use things or products, we need conceptual models of how they work, therefore conceptual models are critical to good design[1].

Good design is also an act of communication between the designer and the user, except that all the communication comes from the appearance of the device itself. Devices must explain themselves including their location and operation of the controls required through a conceptual model. There is a natural relationship between the device location and the operation they control, therefore, users always know which control does what and this is called *natural mapping*[2].

When designers fail to provide a conceptual model, users will be forced to make up their own, and the ones they make up are likely to be wrong.

[1] The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg. 7
[2] The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg.8

Guiding Design Principles

(i) ***Feedback***

Feedback is critical in design and it is given by showing the *effect of an action*.

Without feedback, users will always wonder whether anything has happened or not. They start asking: was the button pushed hard enough? has the machine stopped working? etc.[3]

Without feedback, users turn equipment off at improper times or restart unnecessarily, losing all their recent work. Or they repeat a command and end up having the operation done twice, often to their disadvantage.

(ii) ***Constraints***

The surest way to make something easy to use, with few errors, is to make it impossible to do otherwise i.e., to constrain the choices.

Example: to prevent users from inserting batteries or memory cards into their cameras the wrong way, thus possibly harming the electronics, design them so that they fit only one way, or make it so they work perfectly regardless of how they were inserted[4].

Failure to design with constraints is one reason for all those warnings and attempts to give instructions: all those tiny diagrams on the camera, in obscure locations, often in the same color as the case and unreadable. This means that if instructions have to be pasted on something (push here, insert this way, turn off before doing this), it is badly designed.

(iii) ***Affordances***

Good designers make sure that appropriate actions are perceptible and inappropriate actions invisible.

Affordance signals convey messages about their possible uses, actions, and functions. A flat plate affords pushing, an empty container affords filling, and so on. Affordances can signal how an object can be moved, what it will support, and whether anything will fit into its crevices, over it, or under it. Where do we grab it, which parts move, and which parts are fixed? Affordances suggest the range of

[3] The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg. 7-8
[4] The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg. 7-8, 28

possibilities, constraints limit the number of alternatives. The thoughtful use of affordances and constraints together in design allows users to determine the proper course of action.[5]

PROVIDE A GOOD CONCEPTUAL MODEL

A good conceptual model allows users to predict the effects of their actions. Without a good model users operate by routine, blindly; they carry out operations as they were told to do them; they can't fully appreciate why, what effects to expect, or what to do if things go wrong. As long as things work properly, users can manage to carry on with their tasks. When things go wrong, however, or when they encounter a novel situation, then they need a deeper understanding, a good model.

For everyday things, conceptual models need not be very complex. After all, scissors, pens, and light switches are pretty simple devices. Users do not have to understand the underlying science of each device in existence, but only the relationship between the controls and the outcomes. If the model presented to users is inadequate, wrong or nonexistent, users can have challenges.

Communication in Conceptual Models.

The design model is the designer's conceptual model and the user's model is the mental model developed through interaction with the system.

The system image results from the physical structure that has been built including the documentation, instructions, and labels.

Designers expect user model to be identical to the design model, but the designer doesn't talk directly with the user[6]. All communication takes place through the system image and if the system image does not make the design model clear and consistent, then users will end up with the wrong mental model as shown in figure 1.

[5] The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg. 8
[6] The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg. 32

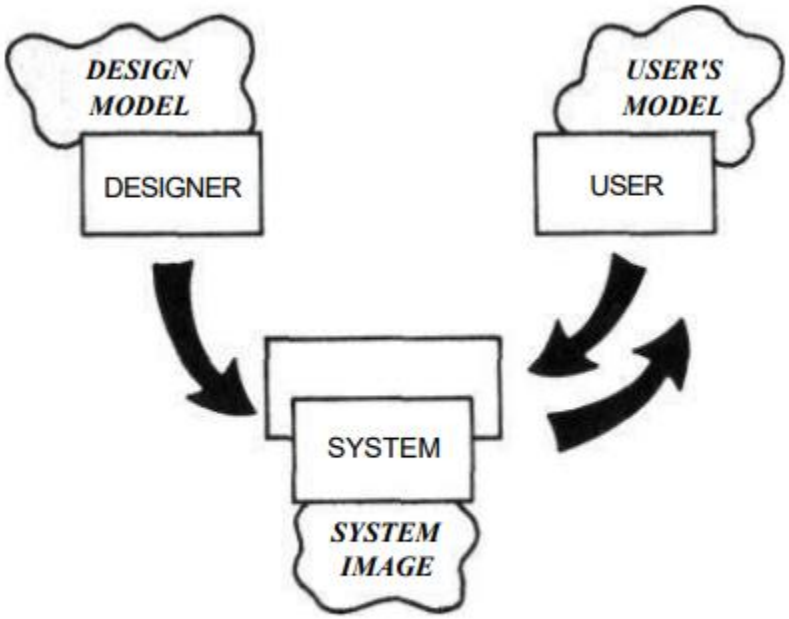

Figure1: communication from system image to the design model and mental model. Adopted from: The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg. 32

Conceptual models are important in the design of mental models, i.e., the models' people have of themselves, others, the environment, and the things with which they interact with.

People form mental models through experience, training, and instruction.

The mental model of a device is formed largely by interpreting its perceived actions and its visible structure. When the system image is incoherent or inappropriate, the user cannot use the device easily. If it is incomplete or contradictory, there will be errors. If the conceptual model is wrong, it is impossible to set the controls. If the number of possible actions exceeds the number of controls, there is apt to be difficulty.

Activities involved in conceptual model development

A. Instructing

Examples include commands in Microsoft Disk Operating System (MS DOS) or Unix, control keys and menu options in windows.

Benefit:

- ✓ quick and efficient for repetitive actions.

Drawback:

- × Users have to remember a large set of command names

B. Conversing

Examples include help facilities, search engines, voice or natural language-based system

Benefit:

- ✓ friendly for novice users

Drawbacks:

- × Misunderstandings for Natural Language Processing (NLP) are likely to occur
- × Repetition and inefficiency e.g., phone-based systems
- × Too much expectation e.g., intelligent or animated agents.

C. Manipulation and navigation

Benefits:

- ✓ Users can learn basic functions rapidly
- ✓ Easy to remember how to use
- ✓ Usually, no error messages
- ✓ Users receive immediate responses
- ✓ Users feel in control

Drawback:

- × Expecting reactions like the physical ones

D. Exploring and browsing (based on activities)

Examples include CD-ROMs, web pages and conceptual models based on objects and focusing on particular object such as spreadsheets (MS Excel)

THE PRINCIPLE OF VISIBILITY

A device is easy to use when the set of possible actions is visibility and where the controls and displays apply natural mappings. The principles are simple but rarely incorporated into design. Good design takes time to plan and is thoughtful. It takes conscious attention to the needs of the user and sometimes the designer gets it right[7]

The problems caused by inadequate attention to visibility are all demonstrated with a simple appliance: *the dial-up telephone handset*[8].

What is bad about the design of this telephone? There was no visible structure and the mappings were arbitrary: there was no relationship between user actions and the results to be accomplished. The controls had multiple functions and good feedback was lacking, so users were never sure whether the desired result had been obtained. The system was not understandable; its capabilities were not obvious and the link between user intentions, required actions and the results were completely arbitrary. Whenever the number of possible actions exceeds the number of controls, there is likely to be challenges. The telephone system had twenty-four functions and only fifteen controls, all of which were not labeled for specific action[9].

THE PRINCIPLE OF MAPPING

In general terms, mapping refers to a general relationship between two things, in this case we are referring to the relationship between the controls and their movements and the results in the world.

If we consider the mapping relationships involved in steering a car, in order to turn the car to the right, one turns the steering wheel clockwise (so that its top moves to the right). The user must identify two mappings here: one of the many controls affects the steering, and the steering wheel must be turned in either direction. The wheel and the clockwise direction are natural choices meaning they are visible, closely related to the desired outcome and they provide immediate feedback[10].

[7] The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg. 33-39
[8] The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg. 33-39
[9] The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg. 33-39
[10] The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg. 39-43

By bringing together physical analogies and cultural standards, natural mappings lead to immediate understanding. The mapping is easily learned and always remembered. For example, a designer can use spatial analogy: to move an object up, move the control up. To control an array of lights, arrange the controls in the same pattern as the lights.
Similarly, a louder sound can mean a greater amount since amount can be related to loudness; adding more shows incremental increases[11].

Other natural mappings follow from the principles of perception and allow for the natural grouping or patterning of controls and feedback. Mapping problems are many and this is one of the fundamental causes of difficulties.

THE PRINCIPLE OF FEEDBACK

Feedback refers to sending information back to the user; mainly information about what action has actually been done and the accomplished result.

Feedback is a popular concept in the science of control and information theory. In human communication, it would be difficult to talk to someone when one cannot even hear their own voice, or another scenario is drawing a picture with a pencil that leaves no mark: there would be no feedback[12].

Why are the modern telephone systems so difficult to learn and to use? Basically, the problem is that the systems have more features and less feedback.[13]

[11] The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg. 39-43
[12] The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg. 43-44
[13] The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg. 43-44

Content Covered in Week 12 - Conceptual Model Activities & Evaluation Techniques

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(ii) We have described various activities involved in conceptual model development

(iii) We have described the principle of visibility, feedback and mapping to evaluate conceptual models

References

1. Human-computer interaction (3rd ed.), Dix, A., Finlay, J., Abowd, G., & Russell, B. New Jersey: Prentice Hall. ISBN-10: 0130461091, ISBN-13: 978-0130461094, (2004).
2. Designing for Effective Human/Computer Interaction (4th ed.), Schneiderman, B., Plaisant, C.: Pearson Education, Inc.: ISBN 0-321-19786-0, (2005).
3. The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002).
4. Designing the user interface: Strategies for effective human-computer interaction (5th ed.), Shneiderman, B., Plaisant, C., Cohen, M., & Jacobs, S. New Jersey: Prentice Hall. ISBN-10: 0321537351, ISBN-13: 978-0321537355, (2009).