Course: Human Computer Interface (HCI)

Week 7: Human Centered Design & Evaluation

Lecturer: Martha Gichuki

Course Description

- The course begins with an introduction to Human Computer Interface (HCI) concepts, i.e. the human (brain, human visual system, visual perception and optical illusions), the computer and the interface perspectives.
- Theories and principles to design for attention will be covered and thereafter psychological and social interaction to address use of cognition and use of proper language and metaphors (menus).
- User-centered design and human-centered design will be covered in detail to understand how the two terminologies are similar and how they differ.
- Architectures for user interfaces mainly Graphical User Interface will lead the course coverage to user experience, universal design, design principles, heuristics and golden design rules.
- Information retrieval and utilization architectures will then be connected to designing rich interactive systems using styles that enhance usability (web and mobile) and easy navigation.
- User experience and support will be covered as we look into methods of evaluating interactive systems

Learning outcomes Week 7: Human Centered Design & Evaluation

At the end of the lecture, you will be able to:

(i) Define basic human-centered design and evaluation concepts

(ii) Describe the typical human centered design methodologies

(iii) Describe mental models for human centered design and evaluation processes

HUMAN-CENTERED DESIGN AND EVALUATION

Recall from lecture 1, 2 & 3 the three components of HCI which provide the base on which to do the actual interface design are the user, the computer and the ways the two work together.

1. ***User*** - This is could be an individual user or a group of users working together and the way in which people's sensory systems (sight, hearing, touch) relay information is vital.

2. ***Computer*** - The computer refers to any technology such as desktop computers, large scale computer systems, mobile phones etc. When website design is the technology focus of interface design, then the website itself is "the computer".

3. ***Interaction*** – Human beings and machines differ and HCI ensures that the two components interact successfully. To achieve a usable system, there is a need to apply what our knowledge about humans and computers, and engage likely users of the system throughout the design process.

It is important to involve users during interactive systems design process for the following reasons: -

a) To manage their expectations

b) To create a sense of ownership of the systems by the users

c) To identify user's special needs

d) To understand user's tasks

Major Concerns of Human Computer Interaction

HCI has a number of concerns when it comes to the issue of human centered design. These include:

- ✓ Methodologies & processes: dealing with interfaces design
- ✓ Methods of implementing interfaces
- ✓ Techniques to evaluate and compare interfaces
- ✓ Developing new interfaces & interaction techniques
- ✓ Developing descriptive & predictive models: theories of interaction

Interaction design

This is designing interactive products to support people in their everyday and working lives[1]. The activities performed during interaction design include: -

i. User involvement,

ii. Building the systems,

iii. Building prototypes which are early samples or models built to test a concept or process or to act as a thing to be replicated or learned from or template.

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). Pg. 35

iv. Iterating the process - repeating to achieve desired goal/target/result. The results from an iteration are used as the starting point for the next iteration[2].

- ✓To allow users recover from mistakes, designers can use features such as undo/redo, go previous/back, ok/cancel and confirmation prompts among others.
- ✓Poor interface design of interactive systems leads to a number of costs such as financial, loss of lives, time and loss of trust/loyalty to the system among others.

2. 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). Pg. 35 -36

Usability Testing or evaluation

A. Usability testing

- ✓This is an irreplaceable usability practice used to evaluate a product by testing it on users to give direct input on how real users use the system.
- ✓Usability testing measures the usability, or ease of use, of a specific object or set of objects.

✓Usability testing measures human-made product's capacity to meet the intended purpose. Examples of such products include foods, consumer products, web sites or web applications, computer interfaces, documents, and devices[3].

B. Usability evaluation is aimed at developing products that are effective, easy and enjoyable to use and generally products that are aesthetically pleasing.

3. 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). Pg. 144-150

Knowledge and Mental models

- ✓ While designing interfaces, it is important to apply the theory of knowledge representation and mental models.
- ✓ This involves understanding *what users know about the system* and *how they can infer the system functionality from the provided interface.* This brings out the following advantages: -

i. Possibility to predict and improve the learning curve

ii. Reducing user errors

iii. Ease of use of that system

iv. Design interfaces that support the acquisition of appropriate user model.

Methods of organizing knowledge

Several ways that are used when organizing knowledge include[4]:

- ✓ **Schema** - a network of general knowledge based on *previous experience*, that enables us to behave appropriately in different situations.
- ✓ **Script** - a special type of a schema that describes a characteristic scenario of behaviour in a particular setting.

4. 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). Pg. 55

Knowledge Representation methods

Knowledge is represented in a number of ways such as:

a) *Analogical representations*: picture-like images such as a person's face, a car etc.

b) *Propositional representations*: language-like statements such as "a cat has four legs."

✓Connectionist theorists believe that analogical and propositional representations are complementary, and as such designers should combine both methods while designing interfaces.

Mental models

- ✓Different users form different conceptions or mental models about their interactions and have different ways of learning and keeping knowledge.
- ✓Mental models provide a general explanation of the human thought based on the assertion that humans represent the world they interact with through mental models.
- ✓Individuals hold working models of certain phenomenon in order to understand them[5].

5. 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). Pg 15

Types of mental models

(i) Structural models - these define the facts that the user has about *how a certain system works*.

✓ ***advantage*** - knowledge of how a device or system works can predict the effect of any possible sequence of actions

× ***Drawbac***k-constructing such a model in mind is cumbersome.

ii. Functional models, also known as *task-action mapping models*, are procedural knowledge about *how to use the system*.

✓ ***advantage*** - they can be constructed from *existing knowledge* about a similar domain or system.

× ***Drawback-***while structural models are context free, functional models are *context sensitive*.

A number of design factors to be considered by HCI designers *to help users achieve productive mental models* include: -

i. **Pointers:** Certain object properties *provide clues* on how these objects will be used and manipulated.

ii. **Simplicity:** Simple interfaces that are transparent enough for the users allow them to concentrate on the actual tasks at hand. Frequently accessed functions should be easily accessible.

iii. **Familiarity:** Mental models are built upon prior knowledge and users are familiar with the old. One way of applying the familiarity factor within the system is to use metaphors in user interface design. Frequently use of the system builds user trust and helps accomplish a large number of tasks.

iv. **Availability:** Recognition is always better than recall and an efficient interface should always provide cues and visual elements to relieve the user from the memory load necessary to recall the functionality of the system.

v. **Flexibility:** Users should be able to use any object, in any sequence, at any time.

vi. **Feedback**: Complete, continuous and fast feedback helps users assess the system correctness as they carry out their tasks.

Applying Mental Models in HCI

From the HCI perspective, users form mental models by interacting with a certain computer system.

The content and structure of mental models are influenced by selecting which information about a certain system is presented to the user and how it is presented.

The interpretation of these models specifies how users interact with that system.

Some major questions in this domain arise such as:

(i) To what extent does the form of representation used in the interface affect the way the user solves a certain problem?

(ii) Is it possible to develop interfaces that facilitate problem solving and support creativity?

(iii) Does a graphical programming environment support innovation because it provides information in a format that is closer to the user's mental representation of the problem?

Mental Models in HCI:

Several models relating to different models of users, designers and systems exist and they affect the way users interact with a system. These are[6]: -

A. *User's model of the system* which is the model constructed at the users' side through their interaction with the target system,

B. *System's model of the user* which is the model constructed inside the system as it runs through different sources of information such as profiles, user settings, logs, and even errors.

6. The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg 54

C. *Conceptual model* which is an accurate and consistent representation of the target system held by the designer or an expert user, and

D. *Designer's model of the user's model* which is basically constructed before the system exists by looking at similar systems or by cognitive models or task analysis[7].

7. The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg. 58

- ✓ **Several factors influence the way these models are built and maintained.**
- ✓ The factors can be understood from both the user perspective and from the designer perspective.
- ✓ However, it is important that all these factors work together to encourage building the *same* model.

From ***the users' side***, the concern is about:

- ✓ their physical and sensory abilities,
- ✓ their previous experience dealing with similar systems,
- ✓ their domain knowledge
- ✓ the ergonomics and environments in which users live.

From ***the designers' side***,

- ✓the need is to influence the user's model to perceive the conceptual model underlying the relevant aspects of the system.
- ✓This can be accomplished using metaphors, graphics, icons, language, documentations and tutorials.

Theories relating to Perception in HCI

- ✓While designing visual displays in computer systems, it is crucial to understand the ways humans recognize visual information[8].

8. The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg 63

✓ Several theories explain human perception including:

A. ***Constructivist theorists*** believe that seeing is an active process in which our view is constructed from both information in the environment and previously stored knowledge. Perception involves the intervention of representations and memories. What we see is not a replica or copy; rather a model that is constructed by the visual system through transforming, enhancing, distorting and discarding information.

B. ***Ecological theorists*** believe that perception is a process of '*picking up*" information from the environment, with no construction or elaboration needed. Users intentionally engage in activities that cause the necessary information to become apparent. Users explore objects in the environment.

Evaluation in HCI

- ✓ Evaluation is an important part in the overall phases of design process since it ensures that the system being developed *behaves as expected* and *fulfills user requirements*.
- ✓ This allows the evaluation developer to know the system weaknesses, modify and improve the systems performance before deployment to the end users.
- ✓ Three important goals achieved through evaluating systems are: -

(i) to assess the extent and accessibility of the system's functionality,

(ii) to assess user's experience of the interaction

(iii)to identify any problems with the system.

Execution versus Evaluation Gulfs[9]

Two gulfs exist in this interaction framework, which are the source of the difficulties in an interaction.

A. Gulf of Execution.

- ✓It is the difference between the actions that a user intends to take and what the system allows the user to perform.

- ✓Systems in which the intended user actions don't easily map into those allowed by the system, have a *wide gulf of execution*.

9. The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg. 213

B. Gulf of Evaluation.

- ✓ It is a reflection of how well user expectations and intentions have been met by the system.
- ✓ It is the *difference between the user's goals and what the system allows them to do.*
- ✓ It describes how user actions can be accomplished directly.
- ✓ Users can bridge this gap by changing the way they think and carrying out the tasks as the systems dictates.
- ✓ Designers can bridge this gap by designing the input characteristics that match the users' psychological capabilities[10].

10. The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002). Pg. 65

Content Covered in Week 7: Human Centered Design & Evaluation

(i) We have defined basic human-centered design and evaluation concepts

(ii) We have described the typical human centered design methodologies

(iii) We have discussed the mental models for human centered design and evaluation processes

Course Text Books

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).