Human Computer Interaction

UNIT-2

Lecture 1:

Introduction: Model-based Design

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Objective

Evaluation: tests the usability, functionality and acceptability of an interactive system.

- Occurs in laboratory, field/or in collaboration with users.
- Evaluate both design and implementation.
- Should be considered at all stage in the design life cycle.

Evaluation may be done by:

- The designer for assessing early design and prototypes.
- Usability expert of the working prototype or implementation

GOALS OF EVALUATION

- To assess the extent and accessibility of the system's functionality.
- To assess users' experience of the interaction.
- To identify any specific problems with the system.

Evaluation through expert analysis

4 approaches to expert analysis considered:

- Cognitive Walkthrough
- Heuristic evaluation
- The use of model
- Use of previous work

- In ISLC, we have learned about the process involved in interactive system design. We have learned that interactive systems are designed following the ISLC.
- Consisting of the stages for requirement identification, design, prototyping and evaluation
- Highly iterative

Objective

- The iterative life cycle is time consuming and also requires money (for coding and testing)
- It is always good if we have an alternative method that reduces the time and effort required for the design life cycle
- Model-based design provides one such alternative

- Suppose you are trying to design an interactive system
- First, you should identify requirements (“know the user”) following methods such as contextual inquiry
  - Time consuming and tedious process
- Instead of going through the process, it would have been better if we have a “model of the user”

Idea of a Model

- A ‘model’ in HCI refers to “a representation of the user’s interaction behavior under certain assumptions”

- The representation is typically obtained from extensive empirical studies (collecting and analyzing data from end users)

  – The model represents behavior of average users, not individuals

- By encompassing information about user behavior, a model helps in alleviating the need for extensive requirement identification process
  - Such requirements are already known from the model
- Once the requirements have been identified, designer ‘propose’ design(s)
- Typically, more than one designs are proposed
  - The competing designs need to be evaluated

- This can be done by evaluating either prototypes (in the early design phase) or the full system (at the final stages of the design) with end users.

  -End user evaluation is a must in user centered design

- Like requirement identification stage, the continuous evaluation with end users is also money and time consuming.

- If we have a model of end users as before, we can employ the model to evaluate design.

  –Because the model already captures the end user characteristics, no need to go for actual users.

- A model is assumed to capture behavior of an average user of interactive system
- User behavior and responses are what we are interested in knowing during ISLC
- Thus by using models, we can fulfill the key requirement of interactive system design (without actually going to the user)
  - Saves lots of time, effort and money

Types of Models

- We need to follow two broad categorization of the models used in HCI
  - Descriptive/prescriptive models: some models in HCI are used to explain/describe user behavior during interaction in qualitative terms. An example is the Norman's model of interaction (already discussed in the previous lecture). These models help in formulating (prescribing) guidelines for interface design

Types of Models

- Predictive engineering models: these models can "predict" behavior of a user in quantitative terms. An example is the GOMS model (to be discussed later in this unit), which can predict the task completion time of an average user for a given system. We can actually "compute" such behavior.

Predictive Engineering Models

- The predictive engineering models used in HCI are of three types
  - Formal (system) models
  - Cognitive (user) models
  - Syndetic (hybrid) model

Formal (System) Model

- In these models, the interactive system (interface and interaction) is represented using ‘formal specification’ techniques

  – For example, the interaction modeling using state transition networks

- Essentially models of the ‘external aspects’ of interactive system (what is seen from outside)

- Interaction is assumed to be a transition between states in a ‘system state space’

  – A ‘system state’ is characterized by the state of the interface (what the user sees)

Formal (System) Model

- It is assumed that certain state transitions increase usability while the others do not
- The models try to predict if the proposed design allows the users to make usability-enhancing transitions

  – By applying ‘reasoning’ (manually or using tools) on the formal specification.

Cognitive (User) Models

- These models capture the user's thought (cognitive) process during interaction

  – For example, a GOMS model tells us the series of cognitive steps involved in typing a word

- Essentially models are the 'internal aspects' of interaction (what goes on inside user's mind)

- Usability is assumed to depend on the 'complexity' of the thought process (cognitive activities)

- Higher complexity implies less usability

Cognitive (User) Models

- Cognitive activities involved in interacting with a system is assumed to be composed of a series of steps (serial or parallel)
  - More the number of steps (or more the amount of parallelism involved), the more complex the cognitive activities are
- The models try to predict the number of cognitive steps involved in executing 'representative' tasks with the proposed designs
  - Which leads to an estimation of usability of the proposed design

Syndetic (Hybrid) Model

- In this model, both the system (external aspect) and the cognitive activities (internal aspect) are combined and represented using formal specification

- The model is rather complex and rarely used.

Cognitive Models in HCI

- Although we said before that cognitive models are models of human thinking process, they are not exactly treated as the same in HCI

- Since interaction is involved, cognitive models in HCI not only model human cognition (thinking) alone, but the perception and motor actions also (as interaction requires 'perceiving what is in front' and 'acting' after decision making).

- Thus cognitive models in HCI should be considered as the models of human perception (perceiving the surrounding), cognition (thinking in the 'mind') and motor action (result of thinking such as hand movement, eye movement etc.)

Cognitive Models in HCI

- In HCI, broadly three different approaches are used to model cognition
  - Simple models of human information processing
  - Individual models of human factors
  - Integrated cognitive architectures

Simple Models of Human Information Processing

- These are the earliest cognitive models used in HCI
- These model complex cognition as a series of simple (primitive/atomic) cognitive steps

  – Most well-known and widely used models based on this approach is the GOMS family of models

- Due to its nature, application of such models to identify usability issues is also known as the "cognitive task analysis (CTA)"

Individual Models of Human Factors

- In this approach, individual human factors such as manual (motor) movement, eye movement, decision time in the presence of visual stimuli etc. are modeled

  – The models are basically analytical expressions to compute task execution times in terms of interface and cognitive parameters

- Examples are the Hick-Hyman law, the Fitts' law

Integrated Cognitive Architectures

- Here, the whole human cognition process (including perception and motor actions) is modeled
  - Models capture the complex interaction between different components of the cognitive mechanism unlike the first approach
  - Combines all human factors in a single model unlike the second approach
- Examples are MHP, ACT-R/PM, Soar

Model-based Design Limitations

- As we mentioned before, model-based design reduce the need for real users in ISLC
- However, they can not completely eliminate the role played by real users
- We still need to evaluate designs with real users, albeit during the final stages
  - Model-based design can be employed in the initial design stages

Model-based Design Limitations

- The present models are not complete in representing average end user (they are very crude approximations only)
- The models can not capture individual user characteristics (only models average user behavior)