Wearable Computing

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Design Principles

Theories of HCI

Examples

Human Computer Interaction I

- PACT: People, Actions, Context, Techonology
- Design Principles (in fast forward mode...)

Design Principles I

- Visibility
- Consistency
- Familiarity
- Affordance

Design Principles II

- Navigation
- Control
- Feedback
- Recovery
- Constraints

Design Principles III

- Flexibility
- Style
- Convivality

Theories of HCI

- Is PACT a Theory?
- PACT is best practice approach for requrement analysis, but can't say if a system built performs well
- Lack of predictive power: PACT is an approach for requirement analysis
- Low-level theories: Input, Output
- . . . cannot predict the performance of a complete system
- HCI-Theroies needed

Levels of analysis theory

- Four levels of analysis: conceptual, Semantic, Syntactic, lexical
- conceptual: describes the user's mental model. (Text Processing with Word/Latex/Page Maker)
- semantic: meanings of user actions: delete a paragraph
- syntactic: select paragraph with mouse, select "delete" from menu
- lexical: move mouse cursor, click, press function key,...
- Clean top-down-approach: good for designers
- ...but less relevant today, as systems are very complex

Stages of action theory

- Explanatory thesis of HCI, Norman (1988)
- 7 Stages (“executed” in a cyclic way by the user):
  1. Forming the goal
  2. Forming the intention
  3. Specifying the action
  4. Executing the action
  5. Perceiving the system state
  6. Interpreting the system state
  7. Evaluating the outcome

Stages of action theory

- Norman suggests four principles of good design:
  1. State and action alternatives should be visible
  2. Good conceptual model with consistent system image
  3. The interface should include good mappingm that reveal the relationships between the stages
  4. Users should receive continuous feedback
- Question: is this applicable to wearable computing?

GOMS

- Originated from CMU: Decompose user actions into small measurable steps
- GOMS: Goals, Operators, Methods, Selection rules
  1. Goals and subgoals: Edit text, delete paragraph
  2. Operators: Move mouse, press mouse button, check if mouse cursor is at the end of a paragraph but also: recall file name, search for menu option
  3. Methods (to reach goal): Move mouse, click button, press delete to delete a paragraph
  4. Selection rules (select one of many methods): Delete Paragraph with “delete” key, use “delete” menu entry, use multiple “backspace” to delete paragrpah...

keystroke-level models

- Also from CMU, same idea as GOMS, but simplified
- Predict (error-free) task time by summing up time for elementary actions
- keystrokes, mouse moves, thinking, waiting, . . .
- uses a simplified “human processor” model
- good for modeling error-free tasks performed by experts
- does not model errors, learning, problem solving . . .
- Other GOMS-Derivatives: NGOMSL (Kieras, 1988), CPM-GOMS (used to predict performance of extremely skilled users) . . .

Consistency

- Idea: Make consistency checkable
- Use a grammar to describe the user interaction
- Reisner (1981) action grammar: UI with simpler grammar is easier to learn
- Payne and Green (1986) Task Action Grammars: multiple levels: (lexical, syntactical, semantic consistency), Completeness check

Widget-level theories

- Instead of decomposing along elementary tasks, use decomposition of high-level UI toolkits
- Create model based on widgets and predict user performance based on widgets used
- Interface model emerges from implementation task, estimates of perceptual complexity and motoric skills needed emerges as well
- Goal: develop well-established UI patterns (with predictive model of user performance attached)

Context-of-use theories

- Problem with previous models: based on “lab” experiments
- The real world has context, not only HCI
- Suchman(1987) Plans and Situated Action
- Mobile (and wearable!) computing: physical space becomes relevant
- (Dourish, 2002) social/psychological space also has to be considered

Object Action Interface Model

- descriptive and explanatory model
- can also be used to guide design
- Observation: syntax becomes simplerin modern GUI systems
- Object Action Design: Decompose Objects and Actions
- Objects may include “real world objects”, Tasks may include “common activities”

Examples

- Design Windowed Applications
- Website Design
- Other things (like Wearables)

Project WINSPECT

- TZI & Stahlwerke Bremen (Steelmill)
- Topic: Wearable Solution for inspection of industrial cranes

Winspect

Image from T. Nicolai

Winspect

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Summary

- Design Principles
- Theories
  - Levels-of-analysis
  - Stages-of-action
  - GOMS
  - Widget-level
  - Context-of-use
  - Object Action Interface models