Wearable Computing

Holger Kenn

Universität Bremen

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Design Principles

Theories of HCI

Examples
Human Computer Interaction I

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

Holger Kenn
Wearable Computing
Design Principles I

- Visibility
- Consistency
- Familiarity
- Affordance
Design Principles II

- Navigation
- Control
- Feedback
- Recovery
- Constraints
Design Principles III

- Flexibility
- Style
- Conviviality
Theories of HCI

- Is PACT a Theory?
- PACT is best practice approach for requirement 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-Theories 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

▶ 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
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 mapping 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 paragraph...
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 simpler in 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