Chapter 1

Human Computer Interaction with Wearables

Recap

Slide Human Computer Interaction I:

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

1.1 Design Principles

Slide Design Principles I:

- Visibility
- Consistency
- Familiarity
- Affordance

Visibility: make people see what the system is doing and what options are availaible

Consistency: Be consistent within the system and with other systems the user knows

Familiarity: Use language and symbols that the intendet audience is familiar with

Affordance: Design things so it’s clear what they are there for, make buttons look like buttons

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Slide Design Principles II:

- Navigation
- Control
- Feedback
- Recovery
- Constraints

Navigation: make it easy to move around: provide directions, maps etc.

Control: Make it clear who or what is in control, make people take control, provide a clear mapping with controls and their effect.

Feedback: Give immediate feedback from the system to the people so that they know what effect their actions had.

Recovery: Make sure actions can be Undone

Constraints: Prevent inappropriate actions

Slide Design Principles III:

- Flexibility
- Style
- Convivality

Flexibility: Allow multiple ways to do things, accomodate users with different experience levels

Style: Design should by stylish and attractive

Convivality: System should be polite, friendly and pleasant

Slide Examples:

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

1.2 Theories of HCI

Slide 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

Slide 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

Slide 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

Slide 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?

Slide 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...

Slide 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) ...

Slide 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

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Slide 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)

Slide 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

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actions situated in place and time

user bahavior responsive to other people and environment

i.e. ask for help, study manual

Actions depend on situation: time pressure, safety-critical etc.

distributed cognition: additional information in documents, other people (unlike GOMS)

Slide 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”

1.3 Examples

Slide Examples:

- Design Windowed Applications

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Slide Project WINSPECT:

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

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Slide Winspect:

Image from T. Nicolai

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Summary

Slide Summary:

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