Human Computer Interaction - HCI

Theory and Applications

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Introduction

Introduction

- HCI researches the design and use of computer technology, focused on the interfaces between people (users) and computers
- HCI objectives
  - Observe the ways in which humans interact with computers
  - Design technologies that let humans interact with computers in novel ways
- Intersection of
  - Computer Science
  - Behavioral Sciences
  - Design
  - Media Studies
  - Several other fields

Ways of Interaction

- Humans interact with computers in many ways
- Interface between humans and computers is crucial to facilitating this interaction
  - Desktop Applications
  - Internet Browsers
  - Handheld Computers
  - Voice User Interfaces (VUI)
  - etc.

Definition

Definition

- ‘a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them‘
- Seeks to improve human–computer interaction
- Focus on user satisfaction

Unexpected Problems

Unexpected Problems

- Poorly designed human-machine interfaces can lead to many unexpected problems
- Accidents' investigations concluded that the design of the human-machine interface was at least partly responsible for some disasters
- 6 Disasters Caused by Poorly Designed User Interfaces [1]

[1] https://www.cracked.com/article_19776_6-disasters-caused-by-poorly-designed-user-interfaces.html

Goals for Computers

Goals for Computers

- HCI studies the ways in which humans make, or do not make, use of computational artifacts, systems and infrastructures
- Much of the research in the field seeks to improve HCI by improving the usability of computer interfaces
  - How usability is to be precisely understood
  - How it relates to other social and cultural values and when it is
  - When it may not be a desirable property of computer interfaces is increasingly debated

Research in HCI - 01

- Designing new computer interfaces
- Implementing interfaces, e.g., by means of software libraries.
- Evaluating and comparing interfaces with respect to their usability and other desirable properties
- Studying human computer use and its sociocultural implications more broadly

Research in HCI - 02

- Determining whether or not the user is human or computer
- Models and theories of human computer use as well as conceptual frameworks for the design of computer interfaces
- Perspectives that critically reflect upon the values that underlie computational design, computer use and HCI research practice

Related Fields

Related Fields

Three areas of study have substantial overlap with HCI

- Personal Information Management (PIM)
- Computer-Supported Cooperative Work (CSCW)
- Human Interaction Management

Personal Information Management

- studies how people acquire and use personal information (computer based and other) to complete tasks

Computer-Supported Cooperative Work

- emphasis is placed on the use of computing systems in support of the collaborative work

Human Interaction Management

- extend the scope of CSCW to an organizational level and can be implemented without use of computers

Design

Design

Principles

Principles

- User interacts directly with hardware for the human input and output such as displays
- Graphical User Interface (GUI)
- User interacts with the computer over this software interface using the given input and output (I/O) hardware
- Software and Hardware must be matched
- Processing of user input is fast enough
- Latency of the computer output is not disruptive to the workflow

Design

Experimental Design Principles

Experimental Design Principles

When evaluating a current user interface, or designing a new user interface, it is important to keep in mind the following experimental design principles:

- Early focus on user(s) and task(s)
- Empirical Measurement
- Iterative Design

Empirical Measurement

- Test the interface early on with real users who come in contact with the interface on a daily basis
- Results may vary with the performance level of the user and may not accurately depict the typical HCI
- Establish quantitative usability specifics such as:
  - number of users performing the task(s)
  - time to complete the task(s)
  - number of errors made during the task(s)

Iterative Design

- After determining the users, tasks, and empirical measurements to include, perform the following iterative design steps:
  1. Design the user interface
  2. Test
  3. Analyze results
  4. Repeat
- Repeat the iterative design process until a sensible, user-friendly interface is created.

Display Design

Display Design

- Displays are human-made artifacts designed to support the perception of relevant system variables and to facilitate further processing of that information
- Before a display is designed, the task that the display is intended to support must be defined (e.g. navigating, controlling, decision making, learning, entertaining, etc.)
- A user or operator must be able to process whatever information that a system generates and displays
- Information must be displayed according to principles in a manner that will support perception, situation awareness, and understanding

Thirteen Principles of Display Design

- Christopher Wickens et al. defined 13 principles of display design in their book An Introduction to Human Factors Engineering.
- These principles of human perception and information processing can be utilized to create an effective display design.
- Potential Benefits
    - Reduction in errors
    - Reduction in required training time
    - Increase in efficiency
    - Increase in user satisfaction

Thirteen Principles of Display Design - Notes

- Certain principles may not be applicable to different displays or situations
- Some principles may seem to be conflicting
- There is no simple solution to say that one principle is more important than another
- The principles may be tailored to a specific design or situation
- Striking a functional balance among the principles is critical for an effective design

Thirteen Principles of Display Design

Perceptual Principles

Perceptual Principles

1. Make displays legible (or audible)
2. Avoid absolute judgment limits
3. Top-down processing
4. Redundancy gain
5. Similarity causes confusion

Thirteen Principles of Display Design

Mental Model Principles

Mental Model Principles

6. Principle of Pictorial Realism
7. Principle of the moving part

Thirteen Principles of Display Design

Principles based on Attention

Principles based on Attention

8. Minimizing information access cost or interaction cost
9. Proximity Compatibility Principle
10. Principle of Multiple Resources

Thirteen Principles of Display Design

Memory Principles

Memory Principles

11. Replace Memory with Visual Information
12. Principle of Predictive Aiding (Proactive Actions)
13. Principle of Consistency

Brain Computer Interface

- Direct communication pathway between an enhanced or wired brain and an external device
- BCI allows for bidirectional information flow
- BCIs are often directed at
    - Research
    - Mapping
    - Assisting
    - Augmenting
    - Repairing Human Cognitive or Sensory-Motor functions

BCI Demos

- 10 Real Life Examples Of BCI Devices That You Can Control With Your Thoughts [2]
- Decoding Brain-Computer Interfaces [3]
- Brain-Computer Interface - Mysteries of the Brain [4]
- The Link [5]

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[2] https://www.analyticsindiamag.com/10-times-companies-made-inexpensive-consumer-based-bci-devices-

[3] https://www.networkmiddleeast.com/85343-decoding-brain-computer-interfaces

[4] https://www.youtube.com/watch?v=7t84lGE5TXA

[5] https://www.youtube.com/watch?v=HhXg6568I3E

Summary

Summary

- Definition
- Importance
- Goals for Computers
- 13 Principles
- BCI

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