Introduction

Interfaces in Everyday Use

- ATM
- Library information system
- Phone
- Personal organizer
- Car
- Airline reservation
- Air traffic control

Usable Product

- Important issue
- Combination of
  - Ease of learning
  - High speed of user task performance
  - Low user error rate
  - Subjective user satisfaction
  - User retention over time

Users' Interactions

How do you optimize the users' interactions with a system

- taking into account what people are good and bad at
- considering what might help people with the way they currently do things
- thinking through what might provide quality user experiences
- listening to what people want and getting them involved in the design
- using "tried and tested" user-based techniques during the design process

Interaction with the Computer

- What happens when a human and a computer get together to perform a task
  - task – write a document, calculate a budget, solve a equation, drive a car, catch hippopotamus,…
- Originally: *man-machine interaction*

Why is this important?

1. Computers (in one way or another) now affect every person in society.

   - Increasing % utilize computers in work

2. Product success may depend on ease of use, not necessarily power.

HCI Definitions

- **HCI** – the study of people, computer technology and the ways these influence each other
- **User** – an *individual user*, a *group of users* working together, or a *sequence of users* in an organization, each dealing with some part of the task or process
- **Computer** – any technology ranging from the general *desktop computer* to a *large-scale computer system*, a *process control system* or an *embedded system*
- **Interaction** – any *communication* between a user and computer, be it direct or indirect

Goals of HCI

Allows users to carry out tasks

- Safely
- Effectively
  - *effectiveness*: producing the desired (useful) result
    (Drucker: “doing the right job”)
- Efficiently
  - *efficiency*: ability to achieve a result with a minimum of effort
    (Drucker: “doing the job right”)
- Enjoyably

Measurable Human Factors

- Time to learn commands relevant to a set of tasks
- Speed of performance the benchmark tasks
- Rate of errors in carrying out the benchmark tasks
- Retention over time (how well do users maintain their knowledge after an hour, a day, or a week?)
- Subjective satisfaction (interview or written surveys)

Motivations for HCI in Design

Four primary sources:

- Life-critical system: air traffic, nuclear reactors, power utilities, staffed spacecraft, police or fire dispatch, military operations, and medical instruments
- Industrial and commercial uses: banking, insurance, order entry, inventory management, airline and hotel reservation, car rentals, utility billing, credit-card management, and point-of-sales terminals
- Office, home, and entertainment applications: personal-computing, automated transaction machines, video games,educational packages, information retrieval, e-mail, computer conferencing, and small-business management
- Exploratory, creative, and cooperative systems:electronic encyclopedias, World Wide Web browsing, collaborative writing, business decision making, etc.(DSS)
  - User may be knowledgeable in the task domain but novices in the underlying computer concepts

Two Crucial Errors

- Assume all users are alike (image of an “average” user)
- Assume all users are like the designer

Designer:

- right-hand, female, with computer training, with desire for rapid interaction, using densely packed screens

User:

- left-hand, male, artists, with leisurely and freeform work style

Accommodation of Human Diversity

Understanding the physical, intellectual, and personality differences among users is vital

- Physical abilities and physical workplaces
- Cognitive and perceptual abilities
- Personality differences
- Cultural and international diversity
- Users with disabilities
- Elderly users

Who is Involved in HCI?

HCI – a multi-disciplinary subject

- Psychology and cognitive science
- Ergonomics
- Sociology
- Computer Science and Engineering
- Graphic design

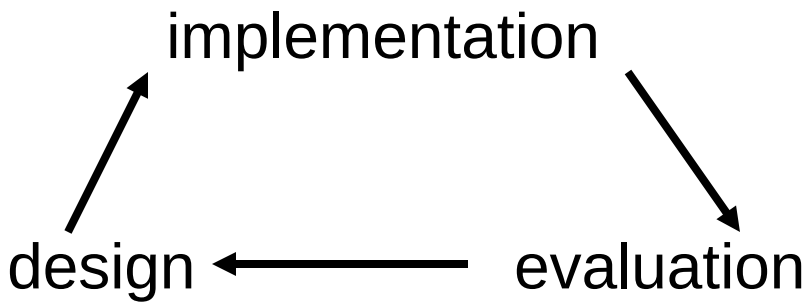
Special Interest Group on Computer-Human Interaction

ACM SIGCHI

http://www.acm.org/sigchi/

UI Design/Develop process

- Analyze use's goals
- Create design alternatives
- Analyze them
- Implement prototype
- Test
- Refine



Interaction Frameworks

Interaction: the communication between the user and the system

Why have a framework?

Allows contextualisation, presents a global view

Donald Norman's Interaction framework

- user establishes the goal
- formulates intention
- specifies actions at interface
- executes action
- perceives system state
- interprets system state
- evaluates system state with respect to goal

Some systems are harder to use than others

- Gulf of Execution - user's formulation of actions may be different to those actions allowed by the system

- Gulf of Evaluation - user's expectation of the changed system state may be different to the actual presentation of this state

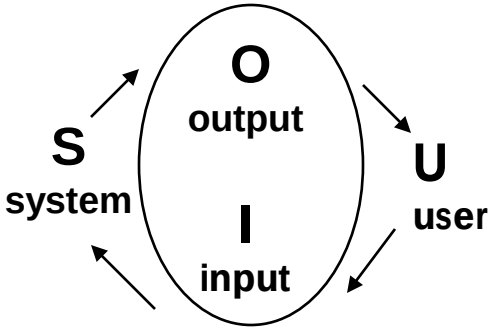
Norman's model concentrates on user's view of the interface only

Interaction Frameworks (const.)

Extended by Abowd and Beale:

their interaction framework has 4 parts

- user
- input
- system
- output



Each has its own unique language. Interaction necessitates translation between languages; problems in interaction occur when translation between one language and the next is difficult, or impossible.

User intentions translated into actions at the interface, translated into alterations of system state, which in turn are reflected in the output display, which is interpreted by the user.

These are general frameworks for understanding interaction

- not restricted to electronic computer systems
- identifies all the major components involved in interaction
- allows comparative assessment of systems
- an abstraction

Two Views of Interaction

- Interaction *with*
  - Software system is a tool or machine
  - Interface is a usability-engineered membrane
  - Human-as-processor & -interpreter models
- Interaction *through*
  - Software is a medium used to interact with task objects or other people
  - Interface plays a role in social context
  - Human-as-interpreter & -actor models

Ergonomics

Study of the physical characteristics of interaction.
Also known as human factors.

Considers things such as

- arrangement of controls and displays
  e.g. controls grouped cording to function, or frequency of use, or sequentially
- surrounding environment
  e.g. seating arrangements adaptable to cope with all sizes of user
- health issues
  e.g. physical position, environmental conditions (temperature, humidity), lighting, noise
- use of colour
  e.g. use of red for warning, green for okay, awareness of colour-blindness

etc.

Ergonomics good at defining standards and guidelines for constraining the way we design certain aspects of systems.

Interaction styles

Interaction can be seen as a dialogue between the computer and the user. Some applications have very distinct styles of interaction.

We can identify some common styles

- command line interface
- menus
- natural language
- question/answer and query dialogue
- form-fills and spreadsheets
- WIMP

Command line interface

Way of expressing instructions to the computer directly. Can be function keys, single characters,short abbreviations, whole words, or a combination.

- Suitable for repetitive tasks
- Better for expert users than novices
- Offer direct access to system functionality
- Command names/abbreviations should be meaningful

Typical example: the Unix system

Menus

Set of options displayed on the screen

Options visible so demand less recall - rely on recognition so names should be meaningful

Selected by using mouse, numeric or alphabetic keys

Often options hierarchically grouped: sensible grouping is needed

Menu systems can be

- purely text based, with options presented as numbered choices, or
- can have graphical component, with menu appearing in box and choices made either by typing initial letter, or moving around with arrow keys

Restricted form of full WIMP system

Natural language

An attractive option: familiar

speech recognition or typed natural language can be used

Problems

- vague
- ambiguous

One solution - try to understand a subset

Query interface

Question/answer interfaces - user is led through interaction via a series of questions.

Suitable for novice users but restricted functionality.

Often used in information systems.

Query languages (e.g. SQL) used to construct queries to retrieve information from database.

Effective use requires understanding of database structure and language syntax, hence requires some expertise.

Form-fills and spreadsheets

Form-filling interfaces primarily for data entry or data retrieval. Screen like paper form. Data put in relevant place. Requires good design and obvious correction facilities.

Go-faster Travel Agency
Bookings

Please enter details of journey:
Start from: York
Destination: Pittsburgh
Via: Birmingham
First Class/Second Class/Bargain
Single/Return
Seat Number:

Spreadsheets - VISICALC first; Lotus 1-2-3, Excel common today - sophisticated variation of form-filling.

- grid of cells, each of which can contain a value or a formula
- formula can involve values of other cells e.g. sum of all cells in this column
- user can enter and alter data and spreadsheet will maintain consistency and ensure formulae are correct

WIMP Interface

- Windows, Icons, Menus, Pointers (or windows, icons, mice, and pull-down menus)
- Default style for majority of interactive computer systems today, especially PCs and desktop machines

Windows

Areas of the screen that behave as if they were independent terminals

- can contain text or graphics
- can be moved or resized
- can overlap and obscure each other, or can be

  laid out next to one another (tiled)
- scrollbars allow the user to move the contents of the window up and down or from side to side
- title bars describe the name of the window

Icons

Small picture or image, used to represent some

object in the interface, often a window. Windows

WIMP Interface (cont.)

Icons

Small picture or image, used to represent some

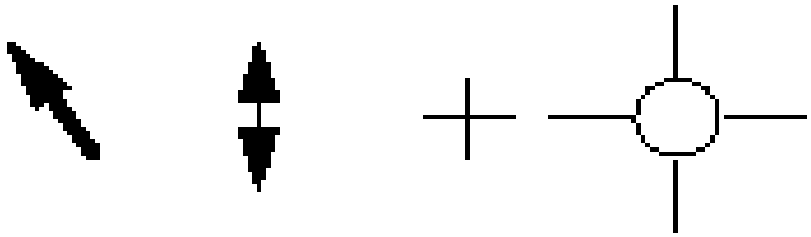
object in the interface, often a window. Windows can be closed down to this small representation (iconised) allowing many windows to be accessible.

Icons can be many and various - highly stylized or realistic representations

Pointers

Important component, since WIMP style relies on pointing and selecting things such as icons and menu items.

- usually achieved with mouse
- joystick, trackball, cursor keys or keyboard shortcuts are also used
- wide variety

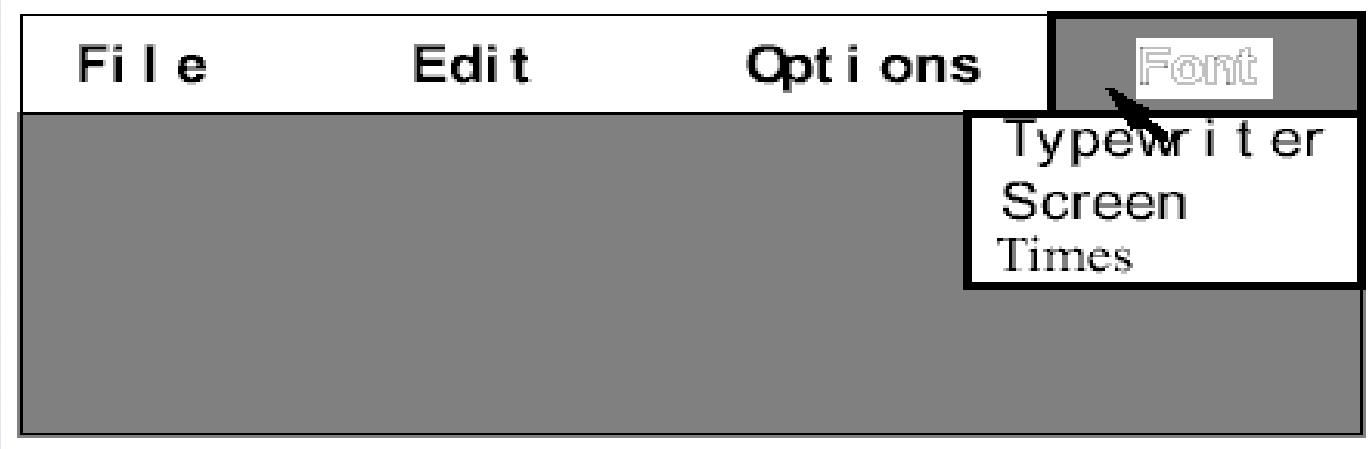


WIMP Interface (cont.)

Menus

Choice of operations or services that can be performed offered on the screen.

Required option selected with pointer



WIMP Interface (cont.)

- problem - menus can take up a lot of screen space
- solution - use pull-down or pop-up menus
  - pull-down menus are dragged down from a single title at the top of the screen
  - pop-up menus appear when a particular region of the screen (maybe designated by an icon) is clicked on

Some menus are pin-up menus - they stay on the screen until explicitly requested to go away. Another type is the fall-down menu - similar to the pull-down, but the bar doesn't have to be explicitly selected.

- also cascading menus - one menu selection opens another menu adjacent to it, and so on.
- pie menus - menu options arranged in a circle. Easier to select item (larger target area) and quicker (same distance to any option)

Keyboard accelerators sometimes offered – key combinations that have same effect as selecting the menu item

General problem: what to include in menus at all, and how to group items.

Social and Organizational Context

Interaction affected by social and organizational context

- other people - desire to impress, competition, fear of failure
- motivation - fear, allegiance, ambition, self-satisfaction
- inadequate systems cause frustration and lack of motivation

Introduction to Usability paradigms and principles

Concerns

- How can an interactive system be developed to ensure its usability?
- How can the usability of an interactive system be demonstrated or measured?

Approaches

- Paradigms for usability
  - examples of successful interactive techniques
- Principles for usability
  - theoretically driven from psychological, computational and sociological knowledge

Paradigm

- Definition - Webster's New Universal Unabridged Dictionary, Barnes & Nobel, 1996:

  par·a·digm (par'a dim', -dim), *n,*

  from Greek *paradeiknyai*

  An example serving as a model; pattern.

- Your world paradigm is the model you use to understand your world. It allows you to make sense of what you see happening around you
  - For example, if you believe in black magic, then you will tend to attribute everything that happens to you as the result of a curse

Paradigms for usability

Paradigms for usability Historical perspective on interactive system design

Time-sharing

- 40s and 50s – explosive technological growth (mechanical relays – vacuum electron tubes – transistors – integrated chips)
- 60s – need to channel the power (equivalent explosion of HCI); J.C.R. Licklider at Advanced Research Project Agency in US DD
- time-sharing idea: single computer supporting multiple users
- truly interactive exchange between programmer and computer

Paradigms (cont.)

Video Display Units

- mid-1950s – researchers were experimenting with images and VDU
- display screens could provide more suitable medium than paper
- earliest applications of display screen images – in US Air Force project
- 1962 – MIT: Ivan Sutherland's Sketchpad program realized images
- one person's contribution could drastically change the history of computing
- the visual patterns could be stored in the computer's memory like any others data
- a model for totally new ways of operating computers:
    - by changing something on the *display screen* it was possible to change something in the *computer's memory*

Paradigms (cont.)

Programming toolkits

- Douglas Engelbart at Stanford Research Institute
- 1950’s, University of California at Berkeley: use computer technology to complement human-solving activity
- 1963, research team at Stanford Research Institute – augmenting man's intellect
- Engelblat’s teams ideas: word processing, mouse
- 1968, ONLine System - ONL/Augment - system demonstration the right *programming toolkit* provides building blocks to producing complex interactive systems (bootstrapping idea)
- power of programming toolkits: small, well-understood components can be composed in fixed ways in order to create large tools

Paradigms (cont.)

Personal computing

- MIT, 70s – Papert's LOGO language for simple graphics programming by children
- A system is more powerful as it becomes easier to user
- Alan Kay: Future of computing in small, powerful machines dedicated to the individual
- Kay together with team at Xerox Palo Alto Research Center – the Dynabook as the ultimate hand-held personal computer

Paradigms (cont.)

Window systems and the WIMP interface

- humans can pursue more than one task at a time
- windows used for dialogue partitioning, to"change the topic"
- 1981 – Xerox Star first commercial window in system
- windows, icons, menus and pointers now familiar interaction mechanisms

Paradigms (cont.)

The metaphor

relating computing to other real-world activity is effective teaching technique

- LOGO's turtle dragging its tail
- file management on an office desktop
- word processing as typing
- financial analysis on spreadsheets
- virtual reality – user inside the metaphor

Problems

- some tasks do not fit into a given metaphor
- cultural bias

Paradigms (cont.)

Direct manipulation

1982 – Shneiderman describes the appeal of graphically-based interaction

- visibility of objects
- incremental action and rapid feedback
- reversibility encourages exploration
- syntactic correctness of all actions
- replace language with action

- the world of interest is explicitly represented and there is no intermediary between user and world

1984 – Apple Macintosh

The direct manipulation interface for the desktop metaphor:

- documents and folders are made visible to the user as icons
- illusion that the user is actually working in the world of desktop and not just using the metaphor to help him understand

- No longer a clear distinction between input and output:

What You See Is What You Get (WYSIWYG) !

Paradigms (cont.)

Hypertext

- 1945 – Vannevar Bush and the *memex*
  - key to success in managing explosion of information
  - mid 60s – Nelson describes hypertext as non-linear browsing structure
  - *hypermedia* and *multimedia* – non liner storage of all forms of electronic media
  - Nelson's Xanadu project (publishing & Information retrieval system) still a dream today

Multi-modality for interaction

- a mode is a human communication channel
- emphasis on simultaneous use of multiple channels for input and output

Computer Supported Cooperative Work

- CSCW removes bias of single user/single computer system
- Can no longer neglect the social aspects
- Electronic mail is most prominent success