Course Overview

- Introduction
- Understanding Users and Their Tasks
- Principles and Guidelines
- **Interacting with Devices**
- Interaction Styles
- UI Design Elements
- Visual Design Guidelines
- UI Development Tools
- Iterative Design and Usability Testing
- Project Presentations & Selected Topics
- Case Studies
- Recent Developments in HCID
- Conclusions

Chapter Overview
Interacting with Devices

- Agenda
- Motivation
- Objectives
- Input Devices
  - Survey
  - Characteristics
  - Performance
  - Advantages and Problems
- Output Devices
  - Survey
  - Characteristics
  - Performance
  - Advantages and Problems
- Important Concepts and Terms
- Chapter Summary

Agenda

- Review Homework 2
- Review Midterm
- Topic: Interacting with Devices
- Hand in: Project Documentation Part 1
- Check Team Affiliations
- Hand out: Homework 3

I/O Alternatives

- List two alternatives to the screen as main computer output and the keyboard as main computer input device
  - what are the consequences for HCID?
- Screen
  - Alternative 1:
  - Alternative 2:
- Keyboard
  - Alternative 1:
  - Alternative 2:

Information transfer rates

- Information transfer rates of popular I/O devices
  - output
    - computer screen
    - laser printer
    - loudspeakers
  - input
    - keyboard
    - mouse
    - microphone (speech input)
    - scanner
    - digital camera

Motivation

- the devices used for input and output determine the nature and capacity of information transferred between human and computer
- characteristics of the I/O devices influence user interface design to a large degree
- the choice of an inappropriate or inadequate design will diminish the performance of the task
- combinations of I/O devices can increase the usability of a system

Objectives

- identify the main I/O devices used in computer systems
- know the important characteristics of these devices
- evaluate the suitability of I/O devices for particular purposes or tasks
- be able to select an appropriate combination of I/O devices for a specific task

Input and Output Devices

- I/O devices are *hardware* elements
  - connect the physical human effectors (hands, vocal cords) to the input channels of computers
  - are the channels through which users and software communicate
- task demands, such as the need for hands-free or silent operation, affect the choice of input and output devices to use

Controls

- usually *software* elements shown on the display
  - used to set preferences and make choices
  - some familiar controls:
    - menus
    - radio buttons,check buttons, toggles, sliders
  - some hardware controls:
    - contrast, brightness, etc. on screens
    - volume on speakers
- some controls are used for both input and output
  - show users choices or current setting
  - allow users to operate the control
    - example: printer control

Input Devices

- purpose
  - entering data into a computer system
  - issuing instructions (commands) to a computer
- input device
  - transforms data from the user into a form that a computer system can process
    - together with appropriate software (device drivers)

Overview Input Devices

- need to specify the objects and actions of interaction
  - what should be done
  - how can it be done
- logical equivalence of input devices
  - e.g. mouse and cursor keys can be used for the same input tasks

Categories of Input Devices

- keys and buttons
  - keyboards
    - most common (QWERTY, Dvorak, chord, alphabetic)
  - keypads (numeric, telephony, calculator)
  - buttons - discrete entry device
  - function keys
  - cursor keys

Categories of Input Devices (cont.)

- pointing devices
  - light pen
  - mouse
  - touch screen
  - trackball
  - puck in rink
  - pen and tablet (as used in PDAs)
  - joystick
  - thumb wheel (used in new cell phones)
  - footmouse
  - tadpole (combination mouse and joystick)

Categories of Input Devices (cont.)

- audio - voice/speech
  - microphone
- visual - digital input devices
  - scanners
  - digital cameras and charged-coupled devices (CCDs)

Keyboards as Input Devices

- QWERTY keyboard
- Dvorak keyboard
- alphabetical keyboard
- chord keyboard
- numeric keypad

QWERTY Keyboard

- uses the most common arrangement of alpha and numerical keys.
- required when input data are variable
- many users are trained for using it
- very slow for untrained users
- not designed for 10-finger typing
- keys are distributed strangely
- left hand has to work harder than the right

Dvorak Keyboard

- layout is arranged according to the frequency of letter patterns and sequences in the English language.
- users trained with QWERTY need retraining
- not much of a critical mass for it.

Alphabetical Keyboard

- arrangement of keys in alphabetical order
- suitable for untrained users
  - slower than the QWERTY or Dvorak keyboards
- in general, avoid its use for PC applications
  - confusing for most users

Chord Keyboard

- several keys are pressed simultaneously
  - allows the input of many characters or even words with few keys
  - comes in several variations
- very fast for trained users
  - used in court, parliament
  - requires training to use and to read output
  - can be coupled with a Braille or speech-output device

Numeric Keypad

- calculator
  - number keys, arithmetic operator keys, decimal point, Enter.
- telephone
  - 0 to 9, *, #,
  - no letters q or z
    - except on some newer cellular phones
- inconsistent design
  - 1-2-3 vs. 7-8-9 in the top row
- good for entering numerical data
- both can be very fast, easy to use

Keyboard Design

- some aspects governed by ISO 9241 rec. standard
  - key size
    - width: 12-15 mm, minimum surface area 110 mm^2
  - key travel
    - key displacement: 1.5 - 6.0 mm
  - force required to depress key
    - defined in terms of newtons
    - minimum force: 0.14 n
    - limits: 0.25 n - 1.0 n, ideal 0.5 - 0.8 n
- feedback
  - types: kinesthetic (movement), tactile (feel), auditory, visual (on display)
  - all important, but tactile feedback is especially critical

---

Special Keys and Facilities

Device	Description	Key Features/Remarks
Cursor control keys	Four keys with arrows showing the direction in which a cursor on the screen will move when the key is pressed	Used for moving around a screen display.
"Soft" function keys or control keys	Keys that are pressed in combination with other keys (e.g., <control>).	Keys are programmed to perform an action. Good for commonly used functions, and for providing rapid execution of commands. Can be difficult to remember. No standard arrangement.
"Hard" function keys	Labeled keys that perform a specific function (e.g., <page down>).	Cursor keys and the <enter> key are examples. Less obscure than soft keys since they are usually explicitly labeled.
Scroll bars and arrows	Characteristics of a window that enable the user to move the contents of a window up or down.	Scrolling facilities can be provided through the use of cursor keys and function keys, or by clicking a pointing device such as a mouse on a scroll bar or arrow.
Screen buttons	Areas of the screen that perform a function on selection. Sometimes also called soft keys or soft buttons.	Usually labeled boxes or circles. Can be pressed or clicked.

Scanners as Input Devices

Device	Description	Key Features/Remarks
Bar code reader	Pen- or gun-like device that reads black and white printed or magnetic bar code. Can also be embedded under a counter.	Suitable where the amount of data is limited, and is not subject to rapid change. Example: supermarkets.
Optical character reader (OCR)	Device that reads characters automatically.	Can handle a variety of data. Characters need to be well formed (i.e., hand-written characters may be misinterpreted).
Document scanner	High-speed scanner that reads whole pages.	Used for inputting large amounts of text, diagrams, and pictures.
Magnetic ink character recognition (MICR)	Device that interprets characters with the use of special ink.	Similar to OCR, but more reliable. Used mostly in banks (e.g., see the bottom of your check book).
Optical mark reader (OMR)	Device that detects the position of marks made on documents.	Specially designed forms are required so that the marks are correctly located. Example: Course evaluation sheets

---

Pointing Devices

Device	Description	Key Features/Remarks
Dataglove	Wired glove that allows the wearer to grasp objects in 3D space.	Used for manipulating objects and gesturing. Now being studied for virtual environments.
Footmouse	A form of pedal that pivots.	The direction that the pedal is moved in causes a cursor on the screen to move correspondingly. Useful when hands are otherwise occupied or for physically challenged users.
Gesture Devices	Small transmitting device held by the user, employed together with a receiving device associated with the computer.	The receiving device places the position and movement of the transmitting device in space. Facial gestures may be used in combination with speech.
Graphics tablet	Flat panel that is placed on a table near the computer display. The tablet surface represents the display.	Movement of a stylus across a surface causes a cursor to move across the screen or a line to be drawn. Very good for graphical input.
Joystick	Small stick that can be moved in any direction within a fixed socket.	Often used for cursor-positioning tasks where precision is required. Requires a high level of concentration to use. Fine control is limited.

Pointing Devices (cont.)

Device	Description	Key Features/Remarks
Light pen	Pen that emits a light beam when a button is pressed.	Good for pointing and simple input. Has to be used against a vertical plane, not very accurate, difficult to use if grip is weak.
Mouse	Continuous input device with one or more buttons for discrete input. Unlike the trackball or joystick, it is not fixed, so the user can move it around on a flat surface.	Most common and popular. Highly versatile. May be tethered or wireless (radio, infrared); mechanical (rollers), optical (requires a special pad). Objects are manipulated by pressing control button(s) embedded in the mouse.
Pen and notepad	A pen is used with a small electronic notebook. Data can be entered using familiar techniques involving menus, forms, etc.	Most impressive feature is ability to input free-hand drawings and handwriting. Must be taught to recognize hand writing. Some gesture recognition is possible.
Touch screen	Special screen that detects the position of a finger touching it.	Stationary. Needs frequent cleaning. Very easy to use. Not very accurate
Trackball	Rotatable ball embedded in a surface in a fixed socket. Similar to a mouse turned upside down.	Can be moved by drawing the fingers or the palm of the and over the surface or by flicking. Requires little force. Fast, and does not require a good grip for accurate use.
Digital Image/Video	Digital image or video camera.	Ability to capture images or video.

[Mustillo]

Mouse as Input Device

- How many buttons are optimal?
  - ongoing human factors debate

1 (Apple)

  - easier to double click a single button to select an item than to remember which button points and which extends

2 (Xerox, Microsoft)

  - one to point and the other to extend (special commands)
  - largest population among mouse species

3 (most workstations)

  - more functions directly available
  - confusing at first; gets easier with practice
    - novice or infrequent users often forget which button does what

[Mustillo]

Mouse Control

- advantages
  - works in small spaces
  - can adjust granularity of movement
  - inexpensive
  - user can keep eye on display
  - direct relationship between hand and cursor movement on the dimensions of direction, distance, and speed
  - diagonal and continuous movement, spaced control
- problems