UNIT-V

INTERACTION DEVICES

TOPICS COVERED:

- Keyboards and Keypads
- pointing devices
- speech and Auditory Interfaces

Keyboard Layouts

OWERTY layout

- 1870 Christopher Latham Sholes
- Good mechanical design and a clever placement of the letters that slowed down the users enough that key jamming was infrequent
- Put frequently used letter pairs far apart, thereby increasing finger travel distances

<u>Dvorak layout</u>

- 1920
- reduces finger travel distances by at least one order of magnitude
- Acceptance has been slow despite the dedicated efforts of some devotees
- it takes about 1 week of regular typing to make the switch, but most users have been unwilling to invest the effort

ABCDE style

• 26 Letters of the alphabet laid out in alphabetical order non typists will find it easier to locate the keys

Additional keyboard issues

- IBM PC keyboard was widely criticized because of the placement of a few keys
 - backslash key where most typists expect SHIFT key
 - placement of several special characters near the ENTER key
 - Number pad layout

Keys

- 1/2-inch square keys
- 1/4 inch spacing between keys
- slight concave surface
- matte finish to reduce glare finger slippage
- 40-to 125-gram force to activate
- 3 to 5 millimetres displacement
- tactile and audible feedback important

• certain keys should be larger (e.g. ENTER, SHIFT, CTRL)

Function keys

- users must either remember each key's function, identify them from the screen's display, or use a template over the keys in order to identify them properly
- can reduce number of keystrokes and errors
- Meaning of each key can change with each application
- Placement on keyboard can affect efficient use
- Special-purpose displays often embed function keys in monitor bezel
- lights next to keys used to indicate availability of the function, or on/off status – typically simply labeled F1, F2, etc, though some may also have meaningful labels, such as CUT, COPY, etc.
- Frequent movement between keyboard home position and mouse or function keys can be disruptive to use
- Alternative is to use closer keys (e.g. ALT or CTRL) and one letter to indicate special Function

Cursor movement keys

- up, down, left, right
- some keyboards also provide diagonals
- best layout is natural positions
- inverted-T positioning allows users to place their middle three fingers in a way that reduces hand and finger movement
- cross arrangement better for novices than linear or box
- typically include typamatic (auto-repeat) feature
- important for form-fill-in and direct manipulation
- other movements may be performed with other keys, such as TAB, ENTER, HOME, etc.

Pointing Devices

Pointing devices are applicable in six types of interaction tasks:

Select:

- User chooses from a set of items.
- Used for traditional menu selection, identification of a file in a directory, or marking of a part in an automobile design.

Position:

- user chooses a point in a one-, two-, three-, or higher-dimensional space
- Used to create a drawing, to place a new window, or to drag a block of text in a figure.

Orient: user chooses a direction in a two-, three-, or higher-dimensional space.

Direction may simply rotate a symbol on the screen, indicate a direction of motion for a space ship, or control the operation of a robot arm.

<u>Path</u>:

- User rapidly performs a series of position and orient operations.
- may be realized as a curving line in a drawing program, the instructions for a cloth cutting machine, or the route on a map

Quantify:

- User specifies a numeric value.
- Usually, a one-dimensional selection of integer or real values to set parameters, such as the page number in a document, the velocity of a ship, or the amplitude of a sound.

Text:

- User enters, moves, and edits text in a two-dimensional space.
- The pointing device indicates the location of an insertion, deletion, or change.

Direct-control pointing devices

Light pen

- It enabled users to point to a spot on a screen and to perform a select, position, or another task
- it allows direct control by pointing to a spot on the display
- incorporates a button for the user to press when the cursor is resting on the desired spot on the screen
- lightpen has three disadvantages: users' hands obscured part of the screen, users had to remove their hands from the keyboard, and users had to pick up the lightpen

Touch screen

- allows direct control touches on the screen using a finger
- early designs were rightly criticized for causing fatigue, hand obscuring-the-screen, hand- off-keyboard, imprecise pointing, and the eventual smudging of the display
- lift-off strategy enables users to point at a single pixel
- the users touch the surface
- then see a cursor that they can drag around on the display
- when the users are satisfied with the position, they lift their fingers off the display to activate
- can produce varied displays to suit the task
- are fabricated integrally with display surfaces

Tablet PCs and Mobile Devices:

• Natural to point on the LCD surface

- Stylus
- Keep context in view
- Pick up & put down stylus
- Gestures and handwriting recognition

Indirect pointing devices

- <u>Mouse</u> the hand rests in a comfortable position, buttons on the mouse are easily pressed, even long motions can be rapid, and positioning can be precise
- <u>trackball</u> usually implemented as a rotating ball 1 to 6 inches in diameter that moves a cursor
- **joystick** -- for tracking purposes
- **<u>graphics tablet</u>** a touch-sensitive surface separate from the screen
- <u>touchpad</u> built-in near the keyboard offers the convenience and precision of a touchscreen while keeping the user's hand off the display surface

Comparison of pointing devices

Some results

- direct pointing devices faster, but less accurate
- graphics tablets are appealing when user can remain with device for long periods without switching to keyboard
- mouse is faster than isometric joystick
- for tasks that mix typing and pointing, cursor keys a faster and are preferred by users to a mouse
- muscular strain is low for cursor keys

Fitts' Law

- Index of difficulty = $\log 2 (2D / W)$
- Time to point = C1 + C2 (index of difficulty)
- C1 and C2 and constants that depend on the device
- Index of difficulty is $\log 2 (2*8/1) = \log 2(16) = 4$ bits
- A three-component equation was thus more suited for the high-precision pointing task:
- Time for precision pointing = C1 + C2 (index of difficulty) + C3 log2 (C4 / W)

Speech and auditory interfaces

- Speech recognition still does not match the fantasy of science fiction:
 - \circ demands of user's working memory
 - background noise problematic
 - o variations in user speech performance impacts effectiveness

• most useful in specific applications, such as to benefit handicapped users

• Discrete word recognition

- recognize individual words spoken by a specific person; can work with 90- to 98-percent reliability for 20-to-200-word vocabularies
- Speaker-dependent training, in which the user repeats the full vocabulary once or twice
- Speaker-independent systems are beginning to be reliable enough for certain commercial applications
- been successful in enabling bedridden, paralyzed, or otherwise disabled people
- also useful in applications with at least one of the following conditions:
 - speaker's hands are occupied
 - mobility is required
 - speaker's eyes are occupied
 - harsh or cramped conditions preclude use of keyboard
- voice-controlled editor versus keyboard editor
 - lower task-completion rate
 - lower error rate
- use can disrupt problem solving

• <u>Continuous-speech recognition</u>

- Not generally available:
 - difficulty in recognizing boundaries between spoken words
 - normal speech patterns blur boundaries
 - many potentially useful applications if perfected

• Speech store and forward

- Voice mail users can
 - receive messages
 - replay messages
 - reply to caller
 - forward messages to other users, delete messages
 - archive messages

• Systems are low cost and reliable.

• <u>Voice information systems</u>

- Stored speech commonly used to provide information about tourist sites, government services, after-hours messages for organizations
- Low cost
- Voice prompts
- Deep and complex menus frustrating
- Slow pace of voice output, ephemeral nature of speech, scanning and searching problems
- Voice mail
- Handheld voice recorders
- Audio books
- Instructional systems

Speech generation

- Michaelis and Wiggins (1982) suggest that speech generation is "frequently preferable" under these circumstances:
 - The message is simple.
 - The message is short.
 - The message will not be referred to later.
 - The message deals with events in time.
 - The message requires an immediate response.
 - The visual channels of communication are overloaded.
 - The environment is too brightly lit, too poorly lit, subject to severe vibration, or otherwise unsuitable for transmission of visual information.
 - The user must be free to move around.
 - The user is subjected to high G forces or anoxia

• Audio tones, aldolization, and music

- Sound feedback can be important:
 - to confirm actions
 - offer warning
 - for visually-impaired users

- music used to provide mood context, e.g. in games
- can provide unique opportunities for user, e.g. with simulating various musical instruments

Displays – Small and Large

- The display has become the primary source of feedback to the user from the computer
 - The display has many important features, including:
 - Physical dimensions (usually the diagonal dimension and depth)
 - Resolution (the number of pixels available)
 - Number of available colors, color correctness
 - Luminance, contrast, and glare
 - Power consumption
 - Refresh rates (sufficient to allow animation and video)
 - Cost
 - Reliability

Usage characteristics distinguish displays:

- Portability
- Privacy
- Saliency
- Ubiquity
- Simultaneity

Display technology

- Monochrome displays
 - are adequate, and are attractive because of their lower cost
- RGB shadow-mask displays
 - small dots of red, green, and blue phosphors packed closely
- Raster-scan cathode-ray tube (CRT)
 - electron beam sweeping out lines of dots to form letters
 - refresh rates 30 to 70 per second
- Liquid-crystal displays (LCDs)
 - voltage changes influence the polarization of tiny capsules of liquid crystals
 - flicker-free
 - size of the capsules limits the resolution
- Plasma panel
 - rows of horizontal wires are slightly separated from vertical wires by small glass-enclosed capsules of neon-based gases
- Light-emitting diodes (LEDs)

- certain diodes emit light when a voltage is applied
- arrays of these small diodes can be assembled to display characters.

Animation, image, and video

- Accelerated graphics hardware
- More information shared and downloaded on the web
- Scanning of images and OCR
- Digital video
- CD-ROMs and DVDs
- Compression and decompression through MPEG
- Computer-based video conferencing