UNIT - V

Software tools, Interaction Devices

Software tools – Specification methods, interface – Building Tools.
Interaction Devices – Keyboard and function keys – pointing devices – speech recognition digitization and generation – image and video displays – drivers.

SPECIFICATION METHODS:

- Design requires a good notation to record and discuss alternate possibilities:
  - The default language for specifications in any field is natural language, e.g., English
  - Communication medium, e.g., sketchpad, or blackboard
- Natural-language specifications tend to be:
  - lengthy
  - vague
  - ambiguous
- Therefore, often are difficult to prove:
  - correct
  - consistent
  - complete
- Backus-Naur Form (a.k.a. Backus Normal Form or BNF)
  - high-level components are described as non terminal
  - specific strings are described as terminals
- Grammars Example

  <Telephone book entry>:= <Name><Telephone number>
  <Name> ::=< Last name>, <First name>
  <Last name> ::=< string>
  <First name> ::=< string>
  <String> ::=< character>|<character><string>
  <Character>:= A|B|C|D|E|F|G|H|I|J|K|L|M|N|O|P|Q|R|S|T|U|V|W|X|Y|Z
  <Telephone number>:= (<area code>) <exchange>-<local number>
  <Area code> ::=< digit><digit><digit>
  <Exchange> ::=< digit><digit><digit>
  <Local number>:= <digit><digit><digit><digit><digit>:= 0|1|2|3|4|5|6|7|8|9
- Examples of acceptable entries

  WASHINGTON, GEORGE (301)555-1234
  MUTTON, STU (726)768-7878 -A, Z (999)111-1111
- Multiparty grammars

  <Session> ::=< U: Opening><C: Responding>

<U: Opening>:= LOGIN <U: Name>
<U: Name> ::=< U: string>
<C: Responding>:= HELLO [<U: Name.]
U: User C: Computer

- Multiparty grammars are effective for text oriented command sequences
- **Transition Diagram**
  - a set of *nodes* that represents system states and a set of *links* between the nodes that represents possible transitions
- State Charts

INTERFACE-BUILDING TOOLS:
Features of Interface-Building Tools.

- User Interface Independence
  - Separate interface design from internals
  - Enable multiple user interface strategies
  - Enable multiple platform support
  - Establish user interface architect role
  - Enforce standards
- Methodology & Notation
  - Develop design procedures
  - Find ways to talk about design
  - Create project management
- Rapid Prototyping
  - Try out ideas very early
  - Test, revise, test, revise,
  - Engage end users, managers, and others
- Software Support
  - Increase productivity
  - Offer some constraint & consistency checks
  - Facilitate team approaches
  - Ease maintenance

User interface mockup tools:

- Examples
  - Paper and pencil
  - Word processors
  - Slide-show software
  - Macromedia Director, Flash mix, or Dreamweaver
- Visual Editing
  - Microsoft Visual Studio
  - Borland J Builder

Finding the right tool is a tradeoff between six main criteria:

- Part of the application built using the tool.
- Learning time
- Building time
- Methodology imposed or advised
- Communication with other subsystems
- Extensibility and modularity

INTERACTION DEVICES:

Keyboard Layouts:

QWERTY 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

Dvorak layout:

- 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 no 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
- wrist and hand placement

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 millimeters displacement
- tactile and audible feedback important
    - certain keys should be larger (e.g. ENTER, SHIFT,CTRL)
    - some keys require state indicator, such as lowered position or light indicator (e.g. CAPS LOCK)
    - key labels should be large, meaningful, permanent
    - some "home" keys may have additional features, such as deeper cavity or small raised dot, to help user locate their fingers properly (caution - no standard for this)

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 typeamatic (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.

Keyboard and keypads for small devices

- Wireless or foldable keyboards
- Virtual keyboards
- Cloth keyboards
- Soft keys
- Pens and touch screens

Pointing Devices

Pointing devices are applicable in six types of interaction tasks:

1. 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.

2. 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.

3. 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 spaceship, or control the operation of a robot arm.

4. Path:

- 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.

5. 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.

6. Text:

- User enters, moves, and edits text in a two-dimensional space. The
- Pointing device indicates the location of an insertion, deletion, or change.
- More elaborate tasks, such as centering; margin setting; font sizes; highlighting, such as boldface or underscore; and page layout.

Direct-control pointing devices light pen

- 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
- light pen 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 light pen

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

- mouse
  - 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
- trackball
  - usually implemented as a rotating ball 1 to 6 inches in diameter that moves cursor
- joystick
  - are appealing for tracking purposes
- Graphics tablet
  - A touch-sensitive surface separate from the screen
- Touchpad
  - built-in near the keyboard offers the convenience and precision of a touch screen while keeping the user's hand off the display surface
- Human-factors variables
  - speed of motion for short and long distances
  - accuracy of positioning

  - error rates
  - learning time
  - user satisfaction
- Other variables
  - cost
  - durability
  - space requirements
  - weight
  - left- versus right-hand use
  - likelihood to cause repetitive-strain injury
  - compatibility with other systems

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
- Fit's Law
  - Index of difficulty = log2 (2D /W)
  - Time to point = C1 + C2 (index of difficulty)
  - C1 and C2 and constants that depend on the device
  - Index of difficulty is log2 (2*8/1) = log2(16) = 4bits
  - 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)

Novel devices

- Foot controls
- Eye-tracking
- Multiple-degrees-of-freedom devices
- Data Glove
- Hap tic feedback
- Bimanual input
- Ubiquitous computing and tangible user interfaces
- Handheld devices

Speech and auditory interfaces

- Speech recognition still does not match the fantasy of science fiction:
  - demands of user's working memory
  - background noise problematic
  - 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- to98-percent reliability for 20 to 200-wordvocabularies
  - 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
- Continuous-speech recognition
  - 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 user scan
    - receive messages
    - replay messages
    - reply to caller
    - forward messages to other users, delete messages
    - archive messages
- Systems are low cost and reliable.
- Voice information systems

- 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
- Voicemail
- Handheld voice recorders
- Audio books
- Instructional systems

- Speech generation
  - Michaels 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, audio libation, and music

- Sound feedback can be important:
  - to confirmations
  - 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
- Electronic ink
  - Paper like resolution
  - Tiny capsules with negatively and positively charged particles
- Braille displays
  - Pins provide output for the blind

- Large displays
  - Informational wall displays
  - Interactive wall displays
  - Multiple desktop displays
- Heads-up and helmet mounted displays
  - A heads-up display can, for instance, project information on a partially silvered widescreen of an airplane or car
  - A helmet/head mounted display (HMD) moves the image with the user
  - 3D images

Mobile device displays

- Currently mobile devices used for brief tasks, except for game playing
- Optimize for repetitive tasks
- Custom designs to take advantage of every pixel
- Data Lens allows compact overviews
- Web browsing difficult
- Okay for linear reading, but making comparisons can be difficult

ANIMATION, IMAGE, AND VIDEO

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

Printers

- Important criteria for printers:
  - Speed
  - Print quality
  - Cost
  - Compactness
  - Quiet operation
  - Use of ordinary paper (fan folded or single sheet)
  - Character set
  - Variety of typefaces, fonts, and sizes

  - Highlighting techniques (boldface, underscore, and soon)
  - Support for special forms (printed forms, different lengths, and soon)
  - Reliability
- dot-matrix printers
  - print more than 200 characters per second, have multiple fonts, can print boldface, use variable width and size, and have graphics capabilities
- inkjet printers
  - offer quiet operation and high-quality output
- thermal printers or fax machines
  - offer quiet, compact, and inexpensive output on specially coated papers
- laser printers
  - operate at 30,000 lines per minute
- color printers
  - allow users to produce hardcopy output of color graphics, usually by an inkjet approach with three colored and black inks
- photographic printers
  - allow the creation of 35-millimeter or larger slides (transparencies) and photographic prints