UNIT 5

Software Tools and Interactive Devices

Contents:

Objectives:

The students will:

- Understand the different layers of user interface software.
- Study different interface-building software tools and other specific interaction devices.

Unit Outcomes:

After completion of the unit, the students will be able to,

- Choose between different software tools for building interfaces.
- Select the appropriate devices for interaction based on the application.

1 Introduction:

User interface software is most of the time large, complex, and difficult to implement, debug, and modify. Studies by Myers and Rosson (1992) have found that an average of 48% of the application code is of the user interface, and that about 50% of the implementation time is taken to implement it. So, in order to help design and implement the user interface software, special software systems and tools have been developed. These tools increase the productivity of the developers and many of them are commercial products today.

The initial sections of this chapter discuss the components of User Interface Software, and different kinds of user interface software tools, and the latter part of this section cover the study of different interaction devices, like keyboards and pointing devices. This discussion will also include advanced interfaces which will provide speech and gesture recognition, etc.

2 Components of User Interface Software:

The User Interface software is divided into various layers:

- The windowing system
- The toolkit
- Higher-level tools

Figure 5.1 illustrates the user interface software layers. The detailed functionality of these layers is discussed in **Section 3.**

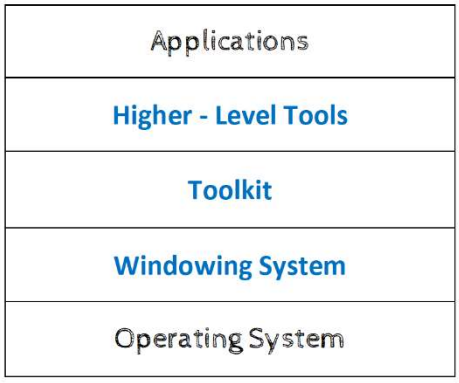

Fig. 5.1 Components of User Interface Software

1. **The Windowing system -** Helps in the separation of the screen into different rectangular regions, called windows. Some operating systems (X system) separate windowing systems into two functional layers: **Window system** and Window **manager.**

   Window system - is the functional or programming interface and provides procedures that allow the application to draw pictures on the screen and get input from the user.

   Window manager - is the user interface and allows the end user to move windows and display the title lines, borders, and icons around the windows.

   NOTE: Macintosh and Microsoft Windows operating systems do not separate these layers.
2. **Toolkit** - contains many commonly used widgets such as menus, buttons, scroll bars, and text input fields.
3. **Higher-level tools** - Help the designer use the toolkit widgets.

3. Software Tools

A software tool is a set of computer programs that are used by developers to create, maintain, debug, or support other applications and programs. It can also be defined as a program that is employed in the development, repair, or enhancement of other programs or of hardware. A software tool can include guidelines and methodologies for interface development.

The software tools that are commonly used in the development of Human-computer Interfaces are given below:

Specification methods

These are methods used to specify a Graphical User Interface.

Interface building tools

These are design methods that help in designing command languages, data-entry sequences, and widgets.

Evaluation tools: Tools to evaluate the correctness and completeness of the programs.

3.1 Specification Methods

These are methods used to specify a Graphical User Interface. The user interface design process becomes easy if the designer describes these interfaces clearly and precisely. There are many formal specification techniques used in software engineering to describe many aspects of software systems but they have not been widely applied to the problem of specifying user interfaces.

3.1.1 Steps in the design of a User Interface:

1. The designer describes and studies a variety of interfaces through a formal specification technique.
2. The required user interface is chosen and before it is built, its performance is predicted by applying a Human performance model derived from empirical data.
3. A prototype or mockup of the user interface can be built directly from the specification using an executable specification language.
4. This mockup can then be used to gather experimental data about the proposed user interface early in the design process.

3.1.2 Specification techniques used to describe human-computer interfaces

The specification techniques for HCI design are divided into two categories based on their underlying formal models:

- State transition diagrams
- Backus Normal Form (BNF).

Specifications based on state transition diagrams are preferred over BNF, because they more clearly show the sequence of the dialogue as the user sees it.

3.1.3 Language used for specification

Most of the time the designer's natural language such as English is used for specification and they are communicated through sketchpad or blackboard as the medium. But the specifications in natural languages are found to be lengthy, vague, and ambiguous. Hence, Formal, and semi-formal languages are used in areas including mathematics, physics, circuit design, music, etc. These languages have specified

grammar, and effective procedures exist here to determine whether a string adheres to the language.

3.1.4 Different Specification Methods:

Grammars:

- Grammars are useful to specify textual commands or expressions that are understandable

  by a program.
- They provide confirmations for completeness and correctness.
  - These were earlier used with terminal-based interfaces and today are used on interactive systems that need powerful and extensible symbolic expressions.
- Grammars are useful to verify the validity of forms filled in by users on a computer.

  Example: Telephone book entries.

Menu-selection and dialog-box trees:

- These are simple structures that guide the designers in creating a selection style for many applications.
- The specification methods use online drawing tools to construct menu trees so that the designers and users can see the entire tree at one time.

Transition diagrams:

- Transition diagram has a set of nodes that represent system states and a set of links between the nodes that represent possible transitions.
- Each link is labeled with the user action that selects that link and possible computer responses.

State charts:

- It is the representation of a state machine that depicts the flow of control from one state to another.
- These are the extensions of conventional state-transition diagrams in terms of the notions of hierarchy, concurrency, and communication.
- These diagrams convert the language of state diagrams into a highly structured and economical description language.
- They are very compact and expressive.

    - Small diagrams can express complex behavior
- Statecharts along with computerized graphics can help the designer view the description at different levels of detail.
- They can also make very large specifications manageable and understandable.
- Statecharts can be used either as a stand-alone behavioral description or as part of a general design methodology that deals with the system's other aspects, such as functional decomposition and data-flow specification.

3.2 Interface building tools

Some interface-building tools and their functionalities are given below:

- Specification methods: are used in the design of components of the system, such as command languages, data-entry sequences, and widgets.
- Screen-transition diagrams drawn or printed on paper: help in providing an overview of the system.

The above two tools allow user-interface architects, designers, managers, users, and software engineers to discuss and prepare a paper-based design. The paper-based designs are not enough to start the implementation process, as the detailed specification of complete user interfaces requires other software tools as given below:

3.2.1 Interface mockup tools:

- These are tools used to develop a quick sketch of a GUI.
    - Example: Visual Studio .Net, etc.
- In the earlier stages of design, user interface architects create quick sketches showing multiple alternatives in the design. This will allow communication within the design team, and convey to the clients the look of the product.
- User interface mockups can be created with paper and pencil, word processors, or slide show presentation software (such as Microsoft PowerPoint or Apple Keynote).
- Designers can build user-interface prototypes with multimedia construction tools, such as Dreamweaver.
- These programs can quickly generate animated or even interactive programs and be distributed via the Web.

3.2.2 Software Engineering tools:

- These are programming tools to provide user interface management systems.
- Programmers build user interfaces with general-purpose programming languages such as Java, C#, or C++.
- But due to the lack of uniform terminology used to describe the tools and their features, choosing among them is a complex task.

3.2.3 The windowing system layer:

- A **windowing system** is a component of a graphical user interface (GUI) in a desktop environment.
- It supports the implementation of window managers and provides basic support for graphics hardware, and pointing devices such as mice, and keyboards.
- Example: The mouse cursor is drawn by the windowing system.
- It implements graphical primitives such as rendering fonts or drawing a line on the screen.
- It provides an abstraction of the graphics hardware from higher-level elements of the graphical interface such as the window managers.
- It allows the user to work with several programs at the same time. Each program runs in its own window which is a rectangular area of the screen.

3.2.4 The GUI toolkit layer:

- GUI toolkits are user interface program libraries that provide the designers with common widgets, such as windows, scroll bars, pull-down or pop-up menus, data-entry fields, buttons, and dialog boxes.
- Sometimes a GUI tool kit library is available with a programming language. Here an experienced programmer can have great flexibility in the interface design.
- Some toolkits are available without interactive support. These require time for programmers to gain proficiency.

  Example: Microsoft Windows Forms (Winforms) is a cross-platform toolkit, Apple Macintosh Toolkit (SwiftUI), and Unix X Toolkit (Xtk).

3.2.5 Higher Level Tools:

Programming at the toolkit layer is difficult, so higher-level tools are used. These have components operating at different times, the **design time component** helps in user interface design, the **run time component** can be used when the end-user is using a program, also the **after-run time component** can be used to evaluate and debug the user interface program.

3.3 Evaluation Tools

Testing and evaluating a User Interface (UI) Software is an important step before deploying it because a user interface adds to the quality of all the applications running on a system. A UI can make or break an application. There are many visual UI testing tools to evaluate the user experience and bridge the design gaps.

UI testing helps in evaluating all the features of an interface that the user uses to interact with the system. The benefits of testing a UI are given below:

- Look into the system from the perspective of the end-user.
- Verifies if all the components of the UI are adhering to their design criteria.
- Increases the quality and dependability of the UI software.

Some of the testing tools that are available for testing a UI are Lambda, Selenium, Cypress, Playwright, Puppeteer, Protractor, Eggplant, etc.

4 Features of User Interface Building tools

Some important features of Interface Building tools are as given below:

- **User interface independence**
  1. Separate interface design from the internals
  2. Enable multiple user interface strategies
  3. Enable multiple platform support
  4. Establish the role of the user interface architect
  5. Enforce standards
- **Methodology and notation:**
  1. Develop design procedures.
  2. Find ways to talk about design
  3. Create a project management

- **Rapid prototyping:**
  1. Try out ideas very early
  2. Test, revise, test, revise
  3. Engage end users, managers, and customers
- **Software support:**
  1. Increase productivity
  2. Offer constraint and consistency checks
  3. Facilitate team approaches
  4. Ease maintenance

5.1 Interaction Devices

Since 1960, there has been steady progress in processor speeds and storage capabilities and to match these the input and output devices also have advanced in their features. Earlier ten-character-per-second teletypes have been replaced by high-speed mega-pixel graphical displays. Pointing devices like mice and touchscreens have been added to free users from keyboards. Today gestural input, two-handed input, three-dimensional pointing, voice input/output, and wearable devices have been developed to meet the needs of varied users.

5.2 Keyboards and Keypads

For textual data entry, keyboards are used. Keyboard size and packaging can provide different user satisfaction and usability. Large keyboards are used in a professional environment whereas a small keyboard is used when a user requires to enter data and manipulate objects simultaneously. Very tiny keyboards and touchscreens are used where there is limited text entry such as in mobile phones.

5.2.1 Keyboard Layouts

In 1870, Christopher Latham Shole designed a keyboard layout that became successful because of two features: the mechanical design and the placement of the letters. The letter placement slowed down the users and avoided the frequent jamming of the keys. The layout of the keyboard is known as **QWERTY** layout and in this layout, the frequently used letter pairs were placed far apart increasing finger traveling distances.

A second layout was developed later to reduce the finger traveling distance called as **Dvorak** layout. This layout increased the typing speeds of experts from 150 words per minute to 200 words per minute and reduced errors. But this layout was not successful as this advantage did not outweigh the efforts be put by the users in learning a new non-standard keyboard.

A third layout called the **ABCDE style** layout was developed with the 26 alphabets placed in alphabetical order. The non-typists found it easier to use but the experts did not find it advantageous over the already standard QWERTY layout.

Computer keyboards use the calculator layout for the numeric key placement. For disabled users, the designers have considered the typing process differently and reduced the finger and wrist movements. The KeyBowl's orbiTouch keyless keyboard has replaced the keys with two inverted bowls for the placement of the user's hands and with small wrist and finger movements selects the letters and cursor.

The latest approach is to use pointing devices such as mice, touchpads, or eye trackers for data entry.

5.2.2 Keys

A lot of research has been undertaken on the keyboard keys and after thorough testing, the following key features are implemented on today's keyboards.

- The keys have concave surfaces for proper contact.
- The keys are of a matte finish to reduce glare and slipping of the finger.
- The keys use a 40–125 gram force and a displacement of 1 to 4 millimeters for better typing speeds and low error rates.
- When the key is pressed, it gives a very light click giving tactile and audible feedback to the user.
- Keys like the space bar, Enter key, Shift key and Ctrl keys should be larger than the others to allow easy and reliable access.
- Other keys such as Caps Lock and Num Lock should indicate the pressed state with an embedded light.
- The placement of the cursor-movement keys should be properly done for rapid and error-free use.

5.2.3 Function Keys

There are twelve function keys F1 to F12 on the keyboard. These keys are used to perform different functions. These key presses cause the operating system to command the interpreter or an application to perform certain actions on the screen.

On a Laptop, the Fn key must be pressed along with other keys from F1 to F12 for use.

5.3 Pointing Devices

These devices unlike keyboards, use a pointer to point to certain items to select them. These are very convenient during the use of computer-assisted design tools, drawing tools, or air-traffic control systems where complex information is displayed on the screen. Here the users can avoid learning commands and typographic errors on a keyboard are reduced.

Pointing devices are very useful for small devices and large wall displays.

Pointing devices can be categorized based on **two factors**:

- Diversity of tasks, the variety of devices, and the strategy of using them.
- Physical attributes like type of movement (linear or rotational), the dimensionality of movement (1,2, 3…), and positioning (relative or absolute).

In the following sections on pointing devices, the discussion will be focused on tasks and the degree of directness.

5.3.1 Pointing Tasks: Pointing devices are used for the following types of interaction tasks:

- **Select**: Here users choose from a set of items.
  Example: Choosing a part in automobile design
- **Position:** Here users point to an item in a one, two, or three-dimensional space.
  Example: Dragging and dropping a block of text in a figure.
- **Orient:** Here users choose a direction in a one, two, or three-dimensional space.
  Example: Rotating a symbol on a screen.
- **Path:** Here the users perform a series of positioning and orientation operations.
  Example: Drawing a curved line.
- **Quantity:** Here users specify a numeric value.

Example: Setting a parameter like a page number in a document.

- **Gesture:** Users indicate to perform an action through a simple gesture.

  Example: Swipe motion to turn a page forward or backward.

- **Text:** Here users can enter, move or edit the text in a two-dimensional space.

  Example: Indicating the location of an insertion or deletion.

5.3.2 Types of Pointing Devices

There are two basic categories of pointing devices:

- Direct-control
- Indirect-control

Direct-control Pointing Devices:

These devices direct control the screen surface. These are easy to learn and use.

- **Lightpen**
  - Here users point a tethered (connected to the computer) pen at a screen.
  - A button on the pen is pressed to point to objects or it is used to write or draw on the screen.
  - Users need to learn to use and it is very fragile.
- **Touchscreen**
  - Here touch is the interface mechanism.
  - The keyboard is eliminated and it is integrated into the applications.
  - Very user-friendly for novice users.
  - As they are robust, they are used in public-access kiosks and mobile applications.
- **Stylus**
  - A stylus is also known as a **stylus pen**.
  - It is a small pen-shaped instrument whose tip position on a monitor can be detected.
  - It is used to draw or make selections by tapping.
  - These are based on touchscreen technology.

Indirect Controlled Pointing Devices:

These devices offer indirect control away from the screen surface. These take time to learn and use. The usage of these devices needs to locate the device and demand more cognitive processing and hand-eye movement to bring the cursor to the desired location.

- **Mouse**
  - It is of low cost and widely available.
  - Here the hand rests comfortably and at the press of a button, the items are selected.
  - Long motions can be done by moving the forearm.
  - There are three types of mouse technologies: physical, optical, and acoustic.
  - The mouse may incorporate a wheel and additional buttons for scrolling and web browsing.
- **Trackball**
  - It is also known as an upside-down mouse.
  - It has a rotating ball to move the cursor on the screen.
  - There are used in control panels of air-traffic control or museum information systems and video game controllers.
- **Joystick**
  - It is also called a **flight stick**, consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling.
  - They have been used for a long time in aircraft-control devices and computer games.
  - They are used for tracking purposes or to guide an object on the screen.
  - They need a small displacement to move the cursor and the user can easily change directions.
- **Trackpoint**
  - It is a small-sized joystick fixed within the keyboard between the letters G and H.
  - It has a rubber tip that is unmovable, and sensitive to finger pressure.

- Users can control the cursor with their fingers with their hands resting on the keyboard.
- It is useful for word processor applications where the user needs to switch between the keyboard and the pointing device.

- **Touchpad**
  - It is a touchable surface of a minimum of 5 X 8 centimeters area.
  - Users can make quick movements with their fingertips.
  - Long distance traversals can be made without lifting their fingers.
  - It is often built below the keyboard and is suitable for portable computers.
- **Graphics tablet**
  - It is also a touch-sensitive surface larger than the touchpad and is separate from the screen and can be placed on the desk or lap of the user.
  - Useful for users who do not need a lot of data entry and can remain away from using the keyboard.
  - It can be operated by a finger, pencil or stylus using electronics, acoustic or contact position sensing.
  - Wireless pens are also available with the graphics tablet.

6 Speech and Auditory Interfaces

With the help of speech and auditory interfaces, users can interact with computers with the help of speech. This has become possible with the progress in hardware technology. But practical applications can be successful only if the cognitive load on the users and error rates are less.

Technical problems with speech recognition are being solved and algorithms are being improved. But the designers have found that voice commanding demands more of the user's working memory than hand/eye coordination that happens during normal interaction with the keyboard or any other pointing device. Studies by Ashcraft in 2005 observed that two cognitive tasks planning and problem-solving can proceed in parallel during hand/eye coordination but is not possible while speaking. Also, the variations in speech performance and background noise make speech recognition more challenging.

But due to the availability of telephone and compact speech processing chips, speech store and forward and speech generation are predictable, low cost and widely available.

6.1 Use of Auditory interfaces:

The auditory interfaces are used in the following contexts:

- For users with vision impairments
- For hand-free interaction
- When mobility is required
- When user's eyes are occupied
- During a condition when the keyboard cannot be used

6.2 Challenges of designing interfaces for speech output:

- Slow pace of speech output
- Ephemeral nature of speech
- Difficulty in scanning and searching

6.3 Challenges of designing speech recognition systems:

- Cognitive load is more compared to pointing devices
- Interference from environmental noise
- Variation in recognition across different users and time.

6.4 Technologies used by Speech Systems:

- Discrete-word recognition
- Continuous-speech recognition
- Voice information systems
- Speech generation
- Non-speech auditory interface

6.4.1 Discrete-word recognition:

- The devices with discrete-word recognition capability can recognize individual words spoken by a person.
- Accuracy is 90 to 98% for 100 – 10,000-word vocabulary.

- There are two types of discrete-word recognition systems:
- Speaker dependent:
    - This system is pre-trained for a specific user by repeating the words in the vocabulary.
    - They have higher recognition accuracy but require training time.
    - Used in customized applications
- Speaker-independent:
    - Low recognition accuracy but training time needed.
    - Have more scope of usage in commercial products.

Important Applications:

- Used to control wheelchairs, operate equipment, or use computers by people with disabilities like paralysis or unable to use their hands due to an injury.
- Telephone-based information services to provide weather, sports, stock market report, or other information.
- Other applications still under the research and development stage are speech recognition in military aircraft, training labs, medical operating rooms, and offices.

6.4.2 Continuous-speech recognition

- These systems enable users to dictate letters and compose reports verbally for automatic transcription.
- They also enable automatic scanning and retrieval from radio and television programs, lectures, telephone calls for specific words and topics.
- Major challenges for designing such systems are recognizing the boundaries between spoken words, different accents, variable speaking rates, disturbing background noise and tone change due to emotions.

6.4.3 Voice Information Systems

- These systems are also known as Interactive Voice Response (IVR) and use voice for communication.
- These are commonly used to provide telephone-based information about some government services and tourist sites.

- They provide voice prompts to guide users about flight timings, can help reserve tickets, and so on.
- These systems offer services at a lower cost.
- These are also used in personal voicemail systems where spoken messages are stored and forwarded when a user enters a command.
- Today small handheld voice note takers are available which are a digitized version of audio recorders. These can store one hour of voice-quality notes.

Example: Audio tours in museums and audio books.

6.4.4 Speech Generation:

- It a technology used to produce human speech artificially.
- Speech generation and digitized speech segments are used when messages are simple and short, messages are to be given at a particular time, and require an immediate response.
- This technology has been used to produce inexpensive, compact, and reliable systems for automobile navigation, internet services, utility control rooms, and games.
- They are used to give spoken warnings in cockpits and control rooms.
- These systems are advantageous to users when their visual channels are overloaded, they need to move around and when the environment is too bright to see a message on a display.

Non-speech auditory interfaces

- The non-speech auditory outputs include audio tones and information presented as a combination of sound and music.

  Example: Teletypes in the earlier days used a bell tone to alert the users of an incoming message or the paper had run out.
- Non-speech audio messages can communicate to the computer user without interfering with an application

  Example: Today's computers use a range of tones to indicate warnings or the completion of a task.
- There are **three types** of sounds created for generating different types of outputs:

1. **Auditory icons**: Familiar sounds

   These are used to reinforce the visual experience in a graphical user interface, such as a door opening, liquid pouring or a ball bouncing in games.
2. **Earcons**: Unfamiliar sounds which are to be learned to understand their meaning.

   These are used to draw the attention of the users with a sharp rising tone as used in mobile devices or in a control room.
3. **Cartoonified**: These are familiar sounds used in a different way to add realism and engage users in a powerful way as in cartoon animations.

- For blind users and telephonic usage, auditory web browsers are being developed, where the users can hear text and labels which will help them make selections by key entry.
- Music is being added to user interfaces to heighten the drama and draw attention, to set the mood, or to relax users.
- Music can also be added to video games, educational packages, home-control applications, etc.
- Today music is being composed by computers using the Musical-instrument digital interface (MIDI) hardware and software.

7 Display Technology

Electrically operated display devices have developed from electromechanical systems for the display of text, to all-electronic devices capable of full-motion 3D color graphic displays. Monochrome plasma displays were developed in 1964 for computer screens. In 1968 light emitting diodes were used to display textual information in large public displays. In 1971 Liquid crystal displays (LCDs) were developed and used in calculator displays and wrist watches. In 1987 optical micro-electro-mechanical technology was developed that uses a digital micromirror device by Texas Instruments. Using this technology, the first DLP-based projector was introduced by Digital Projection Ltd in 1997.

The first electronic displays, the Raster-scan cathode ray tube (CRTs)s were commercially developed in 1922. They were used for TV and computer screens. Full-

color plasma displays were developed in 1995 and were used for TV screen displays. Light Emitting Diodes came into existence in 1962 and were available in only red color. In the earlier days, they were used for signboards on highways, destination displays on vehicles, etc. Today they are available in many colors and are used for large public displays.

Organic LED (OLED) displays came into existence in 2003. These are being used for computer monitors, and portable systems such as smartphones and handheld game consoles. Electronic Papers were developed using electronic ink technology in 2004. These are also called as electronic ink, e-ink, or electrophoretic display. They mimic the appearance of ordinary ink on paper and can be used to read text in direct sunlight without any fading of the image.

7.2 Large Displays:

Today computer displays are used everywhere from desktops to mobile devices, projectors, and large televisions. All these displays can be integrated together for increased productivity.

Large displays are categorized into three types:

- **Informational wall displays** provide a shared view to users from a distance. These are used in control rooms to monitor system processes and components.

  Example: Military command and control operations, and emergency response situations.
- **Interactive wall displays** allow users to go to the display and interleave interaction and discussion among participants during a presentation.
- **Multiple desktop displays** allow users to connect their computers to multiple-desktop displays and view many windows and documents at the same time and within a reach of the mouse.

  Example: They help in comparing documents, software debugging or reasoning based on many information sources.

7.3 Heads-up and helmet-mounted displays:

LCD displays in monochrome and color are used in small portable monitors used along with a computing device. These devices that can be worn on the body are known as wearable computers.

Applications:

- A heads-up display projects information on the windscreen of a car or airplane.
- Helmet-or-head-mounted displays (HMD) are used in virtual reality or augmented reality applications.

7.4 Mobile device displays

Mobile devices are small handheld portable computers. Today mobile devices are used for communication, entertainment, and access to information. Some of the examples of mobile devices are smartphones, tablets, laptop computers, smartwatches, e-readers, and handheld gaming consoles, and wrist watches.

According to their use, mobile devices are classified into four types:

- General purpose work

  Example: RIM blackberry or Pocket PC
- General purpose entertainment

  Example: Apple iPod with multimedia features.
- General purpose communication and control.

  Example: Mobile Phones
- Targeted devices doing only a few tasks.

  Example: United Parcel Service drivers' device known as Delivery Information Acoustic Device (DIAD)

7.4.1 Design Issues for Mobile Device Displays:

Most of the applications for mobile devices are custom designed so that every pixel displayed is useful.

Some of the important design issues for mobile device displays are:

- To improve readability for users with poor eyesight, the font size should be adjustable.

- On small screens all data should be made accessible quickly and allow users to request more information.
- Reading on small screens may be improved with rapid serial visual presentation (RSVP) where the text is presented at a constant speed.
- With the growing diversity of devices, the designers of mobile device applications should find an interaction style that can be adapted to multiple screen sizes and can be adapted to different input mechanisms like a keyboard or touch screens.

8 Summary

This unit content is theoretically divided into three sections. The first part of the discussion deals with the software tools to design, develop and test the interface software. The second part deals with the simple devices used to interact with a computer and speech recognition and audio output interfaces. The third section discusses advanced display technologies.

As interface software forms the major part of a computer system software, its design and development consume time. In order to reduce this, a number of software tools are made available. Some important tools are studied in this section. In order to get an understanding of their purpose and usage, the components of a windows system is discussed first and then the steps to design an interface software are dealt with. The different specification methods to describe the interface and languages used for specification are studied. In the latter part of the first section, the interface mockup tools and software engineering tools and their features are studied.

In the initial part of the second section, the keyboards, keypads, and pointing devices are discussed. In the later part of this section, the speech and auditory interfaces which are being used commonly today are discussed. Here the challenges and technologies used for their implementation are discussed.

In the third section, large display devices and their categories are discussed. Also the heads-up and helmet mounted display devices are explored. The later part of this section deals with mobile device displays and their design issues.

Questions based on Unit 5 topics

Descriptive Questions:

1. What are the components of User interface Software? Briefly describe them. [6 marks]
2. List the steps used in the design of a User Interface Software. [2 marks]
3. List the specification techniques used to describe an HCI. [2 marks]
4. Briefly explain the specification methods used to describe an HCI [6 marks]
5. Write a short note on interface-building tools. [8 marks]
6. What are the important features of interface-building tools? [5 marks]
7. How are pointing devices different from keyboards? List the categories of pointing devices. [4 marks]
8. What are the tasks performed by pointing devices? [6 marks]
9. Discuss the direct-controlled pointing devices giving examples. [6 marks]
10. Discuss the indirect-controlled pointing devices giving examples. [6 marks]
11. Discuss speech and auditory interfaces [4 marks]
12. What are the contexts when auditory interfaces are useful? [4 marks]
13. List the challenges of designing speech recognition and speech output interfaces. [5 marks]
14. Briefly explain the technologies used by speech systems. [8 marks]
15. Discuss the different categories of large displays. [6 marks]
16. What are the designs issued in mobile device displays. [5 marks]

Fill in the blanks: [1 mark each]

1. A windowing system helps in the separation of the screen into different rectangular regions, called _____.
2. The two functional layers of the operating system (X) are _____and _____.
3. A _____is a set of computer programs that are used by the developers to create, maintain, debug, or support other applications and programs.
4. _____methods are used to specify a Graphical User Interface.

5. _____ are useful to specify textual commands or expressions that are understandable by a program.
6. A _____ is a component of a graphical user interface (GUI) in a desktop environment.
7. _____ sounds are familiar sounds used in a different way to add realism and engage users in a powerful way as in animations.

True/False Questions [1 mark each]

1. Specification methods are design methods that help in designing command languages, data-entry structures, and widgets. State whether true or false.
2. With reference to the design issues in mobile device displays, reading on small screens may be improved with rapid serial visual presentation (RSVP) where the text is presented at a constant speed. State whether true or false
3. RIM blackberry or Pocket PC is used for general-purpose entertainment. State whether true or false
4. Cognitive load in speech recognition systems is less compared to pointing devices. State whether true or false
5. Trackball is also called an upside-down mouse. State whether true or false

MCQs: [1 mark each]

1. The specification technique/techniques used to describe an HCI are:
   a. State transition diagrams
   b. Backus normal form
   c. Both a and b
   d. Only a
2. The different specification methods used are:
   a. Dialog box trees
   b. Transition trees
   c. State charts
   d. All the above
3. Features of interface building tools are:
   a. User interface independence

b. Methodology and notation
c. Rapid prototyping
d. All the above

4. The layouts of the keyboard are:
   a. QWERTY
   b. Dvorak
   c. ABCE style
   d. All the above
5. The keys use a _____ gram force.
   a. 40 – 50
   b. 40 – 125
   c. 50 – 150
   d. 40 – 200
6. Dragging and dropping a block of text in a figure is ___ type of interaction task performed by a pointing device.
   a. Selection
   b. Positioning
   c. Orientation
   d. None of the above
7. The task where the users perform a series of positioning and orientation operations is a _____type of interaction task performed by a pointing device.
   a. Positioning
   b. Orientation
   c. Path tracing
   d. None of the above
8. Which of these is not a direct controlled pointing device?
   a. LightPen
   b. Mouse
   c. Touchscreen
   d. Stylus

9. Which of these is not an indirect-controlled pointing device?
    a. Lightpen
    b. Joystick
    c. Trackball
    d. Touchpad
10. The technologies used for speech recognition are:
    a. Discrete-word recognition
    b. Continuous-speech recognition
    c. Voice information systems
    d. All the above

Answers to fill in the blanks:

1	2	3	4	5	6	7
Windows	Window System and Window Manager	Software Tool	Specification	Grammars	Windowing System	Cartoonified

Answers to True/False questions:

1	2	3	4	5
T	T	F	F	T

Answers to MCQs:

1	2	3	4	5	6	7	8	9	10
c	d	d	d	b	b	c	b	a	d

9 References:

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