UNIT 2  ADVANCED METHODS OF COMMUNICATION WITH A COMPUTER

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2.0  INTRODUCTION

Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use. If the interface is well designed, it will allow the systems functionality to support the user’s task. This unit tracks the development path of human computer interaction from the command line mode to hyperlinks, hypermedia, voice user interface etc.

2.1  OBJECTIVES

After going through this unit, you should be able to:

- understand the basics of human computer interface;
- understand different perspectives of human computer interface;
- list different kinds of input and output devices;
- differentiate between menu, pushbuttons, radio-buttons, checkboxes; and
- understand future/advance methods of human computer interaction.

2.2  HUMAN COMPUTER INTERFACE:
Humans communicate with computers in many ways, and the interface between humans and the computers they use is crucial to facilitating this interaction. Earlier the interaction between a computer and human was done through command(s) mode using keyboard. Now we click folder, icons for performing tasks. Graphical User Interfaces (GUI) becomes a key component of application. Human-computer interface (HCI) is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them. From a computer science perspective, the focus is on interaction and specifically on interaction between humans and computers. If the interface is well designed, it will allow the system’s functionality to support the user’s task.

1) **The Human perspective:** HCI design teams must consider several factors in regard to users: what users expect and need, what physical abilities and limitations they may have, how their perceptual systems work, and what they find attractive and enjoyable when they use computers. Users have various preferences, work environments, and physical capabilities, designers must also provide alternative ways for different users to communicate with their computers. Information can be exchanged by voice, keyboard, mouse, or other means.

2) **Interaction:** So, given all these differences between humans and computers, how are we supposed to get along with them and get our work done? In other words, how can we interact with them effectively? In order to come up with a product that’s easy for people to use, software designers apply what they know about humans and computers, and consult with potential users of their products throughout the design process. When they know what their users want and need the product to do, they collaborate with programmers. Programmers know how to write instructions in languages that computers can understand. They also know what computers are capable of doing. The designers and programmers look for a reasonable balance between what can be programmed (written as computer instructions) within the necessary schedule and budget, and what would be ideal for the users. They have users try out any changes to make sure that the product is still easy, efficient, and pleasant to use.

3) **User Interface** (or UI) is one of those jargon terms that you hear from computer salespeople. It's not a hard concept to understand, though. It's simply the parts of a computer and its software that you (the computer user) see, hear, touch, or talk to. It is the set of all the things that allow you and your computer to communicate with each other. For example, if you are reading something on a computer screen, then you're looking at part of a user interface right now. The screen is showing you these words, communicating a message to you. Like any good communication channel, a user interface is a two-way street. You don't want to just see or hear whatever the computer puts in front of you, you also want to tell it what you'd like to do. For instance, to get to this web page, you "asked" your computer to show you pages on a certain subject. You may have used a mouse to point and click on a button or word, or maybe you spoke instructions to the computer. However you express it, everything you tell the computer is input; what it conveys to you is output. The ways you can receive output and give input depend entirely on the user interface. The best user interfaces are the ones you don't have to pay much attention to. They make sense to you and do what you expect them to. When an interface is easy to use, you can spend your time doing your work instead of looking everywhere for the right button or key to press. It's
almost transparent—you can see right through the interface to your own work.

2.3 INTERACTING WITH COMPUTERS

Computers are not like you and me, so to communicate with them, we need some tools or mechanisms. At a basic level, we need something to relay information from the computer to us and from us to the computer. We call these translation aids as **input devices**, **output devices**, and **controls**. Effective communication is not possible without these I/O devices and controls. Let’s understand these basic devices in details

### 2.3.1 Input Devices

Input devices are the hardware components you use to "talk" to a computer. It is a hardware device through which you send information to the computer. Below is a description of different types of computer input devices.

A few examples of commonly used input devices are:

- **Keyboard**: A keyboard is an input device, partially modeled after the typewriter keyboard, which uses an arrangement of buttons or keys, which act as mechanical levers or electronic switches. The keyboard is used to type text and numbers into a word processor, text editor or other program. One of the sample keyboard is shown below:

\[ \text{Figure 1: Keyboard} \]

- **Microphone**: A microphone is a hardware peripheral that allows computer users to input audio into computers.

- **Mouse**: An input device that allows an individual to control a mouse pointer in a graphical user interface (GUI).
State of the Art Practices in Information Technology

Figure 2: Mouse

- **Optical Scanner**: Hardware input device that allows a user to take an image and/or text and convert it into a digital file, allowing the computer to read and/or display the scanned object.

- **WebCam**: A camera connected to a computer or server that allows anyone connected to the Internet to view still pictures or motion video/moving video of a user. There are millions of webcams around the world that allow you to view other people, places, and even events. One of popular Logitech webcam is described below in the diagram.

Figure 3: Webcam

- **Digital Camera**: A type of camera that stores the pictures or video it takes in electronic format instead of to film. There are several features that make digital cameras a popular choice when compared to film cameras. First, the feature often enjoyed the most is the LCD display on the digital camera. This display allows users to view photos or video after the picture or video has been taken.

- **Touch Screens**: A touch screen is a display which can detect the presence and location of a touch within the display area. The term generally refers to touch or contact to the display of the device by a finger or hand.
2.3.2 Output Devices

Any machine capable of representing information from a computer to the user is called as output device. Since most information from a computer is output in either a visual or auditory format, the most common output devices are the monitor and speakers. Some of the common output devices are listed below:

- **Monitor**: it is also called a video display terminal (VDT) a monitor is a video display screen and the hard shell that holds it (as show in diagram below). In its most common usage, monitor refers only to devices that contain no electronic equipment other than what is essentially needed to display and adjust the characteristics of an image. Monitors display images and text which are made up of small blocks of coloured light called pixels. The resolution of the screen improves as the number of pixels is increased.

- **Printer**: It is an external hardware device responsible for taking computer data and generating a hard copy of that data. Printers are one of the most used peripherals on computers and are commonly used to print text, images, and/or photos. The two main types of printer are impact and non-impact.
• **Projector**: It is a hardware device that enables an image, such as a computer screen, to be projected onto a flat surface (as shown in the diagram below). These devices are commonly used in meetings and presentations as they allow for a large image to be shown so everyone in a room can see.

• **Plotters**: Plotters are used to produce graphs or diagrams. Plotters can be of two types: Pen plotters and Electrostatic plotters. Pen plotters have an ink pen attached to draw the images, and electrostatic plotters work similarly to a laser printer. A diagram of a plotter is mentioned below.
• **Speakers**: A speaker gives you sound output from your computer. Some speakers are built into the computer and some are separate.

![Speakers Image](image1)

**Figure 9: Speakers**

• **Headphones**: Headphones give sound output from the computer. They are similar to speakers, except they are worn on the ears so only one person can hear the output at a time.

![Headphone Image](image2)

**Figure 10: Headphone**

### 2.3.3 Controls

Controls are the software elements, usually shown on a display, which you use to set preferences and make choices. Like such hardware controls as knobs and dials, they can be used to control many different things. Some familiar controls include:

• **Menus**: In a graphical user interface (GUI) for a personal computer system, an improved method and apparatus for accessing and executing commands associated with user applications. Menu can be both static as well as dynamic.
- **Pushbuttons**: In a window or dialog box, a rectangular control that, when clicked, immediately causes an action to be performed. Push buttons can be labeled with text, graphics, or both.

![Pushbutton](image)

**Figure 12: Pushbutton**

- **Radio buttons**: A radio button or option button is a type of graphical user interface element that allows the user to choose only one of a predefined set of options.

![Radio button](image)

**Figure 13: Radio button**

- **Sliders**: A control enabling users to choose among a continuous range of allowable values. Slider controls can be horizontal or vertical.

![Sliders](image)

**Figure 14: Sliders**

- **Checkbox**: A check box is a type of graphical user interface element that allows the user to choose more than one of a predefined set of options.

![Checkbox](image)
Check Your Progress 1

1) Discuss various kinds of perspectives of Human computer interface.

2) Discuss any four types of input devices used for human computer interaction.

3) What is output device? Explain any four kind of output devices used for human computer interaction.

4) Define controls and explain any two popular controls used in human computer interaction.

2.4 HCI DEVELOPMENT AND ITS APPLICATIONS

The goal of this section is to provide background for this report in terms of some of the major themes and influences that have shaped the field of HCI. In addition, an attempt is made to project some current trends into the near future.

2.4.1 Universal Access to Large and Complex Distributed Information

As the "global information infrastructure" expands at unprecedented rates, there are dramatic changes taking place in the kind of people who access the available information and the types of information involved. Virtually all entities (from large corporations to individuals) are engaged in activities that increasingly involve accessing databases, and their livelihood and/or competitiveness depend heavily on the effectiveness and efficiency of that access. As a result, the potential user community of database and other information systems is becoming startlingly large and rather non-technical, with most users bound to remain permanent novices with respect to many of the diverse information sources they can access. It is therefore urgently necessary and strategically critical to develop user interfaces that require minimal technical sophistication and expertise by the users and support a wide variety
of information-intensive tasks.

Information-access interfaces must offer great flexibility on how queries are expressed and how data are visualized; they must be able to deal with several new kinds of data, e.g., multimedia, text, documents, the Web itself; and they must permit several new styles of interaction beyond the typical, two-step query-specification/result-visualization loop, e.g., data browsing, filtering, and dynamic and incremental querying. Fundamental work is being conducted on visual query languages, user-defined and constraint-based visualizations, visual metaphors, and generic and customizable interfaces, and advances seem most likely to come from collaborations between the HCI and database research communities.

2.4.2 Virtual Machines

A virtual machine is a type of computer application used to create a virtual environment, which is referred to as virtualization. Virtualization allows the user to see the infrastructure of a network through a process of aggregation. It is one of the latest developments in the field of human computer interaction. Virtualization may also be used to run multiple operating systems at the same time. Through the help of a virtual machine, the user can operate software located on the computer platform.

Through the use of the hardware virtual machine software, the user has a seemingly private machine with fully functional hardware that is separate from other users. Hardware virtual machine software also makes it possible for users to boot and restart their machines quickly, since tasks such as hardware initialization are not necessary.

2.4.3 Command Line Interfaces

This is next most important development in the field of Human computer interface. A command-line interface (CLI) is a mechanism for interacting with a computer operating system or software by typing commands to perform specific tasks. This text-only interface contrasts with the use of a mouse pointer with a graphical user interface (GUI) to click on options, or menus on a text user interface (TUI) to select options.

This method of instructing a computer to perform a given task is referred to as "entering" a command: the system waits for the user to conclude the submitting of the text command by pressing the "Enter" key (a descendant of the "carriage return" key of a typewriter keyboard). A command-line interpreter then receives, analyses, and executes the requested command. Upon completion, the command usually returns output to the user in the form of text lines. This output may be an answer if the command was a question, or otherwise a summary of the operation.

```c
C:\cse Example.cs
```

Figure 16: Command Line interfaces

2.4.4 Hypertext

Hypertext is text which is not constrained to be linear. Hypertext is text which contains links to other texts. The term was coined by Ted Nelson around 1965, for example. Apparently Ted Nelson was the first to use this term too. Hypertext is a concept, not a product.
When you select an object, you can see all the other objects that are linked to it. You can move from one object to another even though they might have very different forms. Hypertext links can access numerous types of material, for example, educational material such as course syllabi and resources, explanatory notes for a Web-based document, sources for references, explanatory notes, and commentaries by other writers, links to other relevant resources or publications, graphics, sound, video. The term "hypertext" is being replaced by "hyperlink," since text is not the only kind of link. By simply clicking, the user can be taken to a new bit of information, a new Web page or multimedia such as sound, graphics or video.

Hypertext systems are particularly useful for organizing and browsing through large databases that consist of disparate types of information. There are several Hypertext systems available for Apple Macintosh computers and PCs that enable you to develop your own databases. Such systems are often called authoring systems.

Assumes that one starts reading the piece of text marked A. Instead of a single next place to go, this hypertext structure has three options for the reader: Go to B, D or E.

Assuming that one decides to go to B, then to C or to E, C and from E, one can go to D. Since it is also possible to go directly from A to D, this example shows that there may be several different paths that connect two elements in a hypertext structure.

Hypertext presents several different options to the readers, and the individual reader determines which of them to follow at the time of reading the text. This means that the
author of the text has set up a number of alternatives for reader to explore rather than a single stream of information.

2.4.5 Hypermedia

It is defined as an extension to hypertext that supports linking graphics, sound, and video elements in addition to text. The World Wide Web is a partial hypermedia system since it supports graphical hyperlinks and links to sound and video files. New hypermedia systems under development will allow objects in computer videos to be hyperlinked. This contrasts with the broader term multimedia, which may be used to describe non-interactive linear presentations as well as hypermedia. It is also related to the field of Electronic literature. Hypermedia may be developed a number of ways. Any programming tool can be used to write programs that link data from internal variables and nodes for external data files. Multimedia development software such as Adobe Flash, Adobe Director, Macromedia Authorware, and MatchWare Mediator may be used to create stand-alone hypermedia applications, with emphasis on entertainment content.

2.4.6 Graphical User Interfaces

Graphical user interfaces make computing easier by separating the logical threads of computing from the presentation of those threads to the user, through visual content on the display device. This is commonly done through a window system that is controlled by an operating system’s window manager. The WIMP (Windows, Icons, Menus, and Pointers) interface is the most common implementation of graphical user interfaces today. The appeal of graphical user interfaces lies in the rapid feedback provided by the direct manipulation that a GUI offers. Direct manipulation interfaces provide the following features:

- Modems come in a variety of configurations.
- The robustness of the direct manipulation interface for the desktop metaphor is demonstrated by the documents and folders being visible to the user as icons that represent the underlying files and directories. With a drag-and-drop style command, it is impossible to make a syntactically incorrect operation. For example, if a user wants to move a file to a different folder, the move command itself is guaranteed to be syntactically correct; and even though the user may make a mistake in placing the file in the wrong place, it is relatively easy to detect and recover from those errors. While
Advanced Methods of Communication with A Computer

the document is being dragged, continual visual feedback is provided to the user, creating the illusion that the user is actually working in the desktop world.

Figure 19: Graphical User Interfaces

2.4.7 Voice User Interfaces

*Voice User Interfaces* (VUIs) use speech technology to provide people with access to information and to allow them to perform transactions. VUI development was driven by customer dissatisfaction with touchtone telephony interactions, the need for cheaper and more effective systems to meet customer needs, and the advancement of speech technology to the stage where it was robust and reliable enough to deliver effective interaction. With the technology finally at the stage where it can be effectively and reliably used, the greatest challenge remains in the design of the user interface.

A Voice User Interface is what a person interacts with when using a spoken language application. Auditory interfaces interact with the user purely through sound. Speech is input by the user, and speech or nonverbal audio is output by the system.

VUIs are comprised of three main elements:

1) Prompts, also known as system messages, are the recorded or synthesized speech played to the user during the interaction.

2) Grammars are the possible responses users can make in relation to each prompt. The system cannot understand anything outside of this range of possibilities.

3) Dialog logic determines the actions the system can take following a user’s response to a prompt.

Aside from speech recognition systems, other speech technologies include Text-to-Speech (TTS) Synthesis and Speaker Verification. Speaker Verification involves collecting a small amount of a person’s voice to create a voice template, which is used to enroll a person into a system and then compare future conversation. Text-to-Speech technology, on the other hand, synthesizes text into speech.
2.4.8 Other User Interfaces

Many other paradigms for human-computer interaction exist. Perhaps one of the best known paradigms is the World Wide Web. The web itself did not provide any technological breakthroughs, because all the required functionality, such as transmission protocols, hypertext and distributed file systems, already existed. The breakthrough came with the advent of a browser and HTML, which enabled easy access to information on the internet, first through academia and then through business and leisure circles.

The unpredicted shift of focus to the Internet, intranets, and the World-Wide Web has ended a period in which the focus was on the interaction between an individual and a computer system, with relatively little attention to group and organizational contexts. Computer-mediated human communication raises a host of new interface issues. Additional challenges arise in coordinating the activities of computer-supported group members, either by providing shared access to common on-line resources and letting people structure their work around them.

2.5 FUTURE/ADVANCE METHODS OF COMMUNICATION WITH A COMPUTER

Future or advance methods of communication with computer are described below:

1) Ubiquitous communication Computers will communicate through high speed local networks, nationally over wide-area networks, and portably via infrared, ultrasonic, cellular, and other technologies.

2) Mass availability of computer graphics Computer graphics capabilities such as image processing, graphics transformations, rendering, and interactive animation will become widespread as inexpensive chips become available for inclusion in general workstations.

3) Mixed media Systems will handle images, voice, sounds, video, text, and formatted data. These will be exchangeable over communication links among users.
4) **High-bandwidth interaction:** The rate at which humans and machines interact will increase substantially due to the changes in speed, computer graphics, new media, and new input/output devices. This will lead to some qualitatively different interfaces, such as virtual reality or computational video.

5) **Large and thin displays** New display technologies will finally mature enabling very large displays and also displays that are thin, light weight, and have low power consumption. This will have large effects on portability and will enable the development of paper-like, pen-based computer interaction systems very different in feel from desktop workstations of the present.

6) **Group interfaces** Interfaces to allow groups of people to coordinate will be common (e.g., for meetings, for engineering projects, for authoring joint documents). These will have major impacts on the nature of organizations and on the division of labor. Models of the group design process will be embedded in systems and will cause increased rationalization of design.

7) **Information Utilities** Public information utilities (such as home banking and shopping) and specialized industry services (e.g., weather for pilots) will continue to proliferate. The rate of proliferation will accelerate with the introduction of high-bandwidth interaction and the improvement in quality of interfaces.

One consequence of the above developments is that computing systems will appear partially to dissolve into the environment and become much more intimately associated with their users' activities.

### Check Your Progress 2

1) **What is virtual machine?**
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2) **Explain the role of Command Line interface in HCI development.**
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3) **Explain hypertext and hypermedia.**
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4) **Explain advance methods of communication with computers.**
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2.6 SUMMARY

In this unit we have learnt about different perspectives of communication with computer. Humans communicate with computers in many ways, and the interface between humans and the computers they use is crucial to facilitating this interaction. Different perspectives of human computer interface are human perspective, computer’s persona, user interface and interactions etc. To communicate with computers, we require different kind of input and output devices are available. Controls are the software elements, usually shown on a display, which you use to set preferences and make choices. Some familiar controls include menus, pushbuttons, radio buttons, sliders etc.

In this unit, we have also learnt about the evolution of User Interfaces and importance of Human computer interface. There are various future or advance methods of communication with computer which are evolving at a very fast pace like Ubiquitous communication, Mass availability of computer graphics, Mixed media Systems and Large and thin displays etc.

2.7 ANSWERS/SOLUTIONS

Check Your Progress 1

1) i) **The Human Perspective**: HCI design teams must consider these factors in regard to users: what users expect and need, what physical abilities and limitations they may have, how their perceptual systems work, and what they find attractive and enjoyable when they use computers. When humans interact with computers, they bring to the encounter a lifetime of experience.

   ii) **The Computer's Persona**: A computer carries on its business in a much less obvious way. The information a computer contains and the operations it performs are represented inside the computer in a form that we can't directly observe - binary digits encoded as two levels of electrical charge. What a computer displays or presents does not arise naturally from what it is doing inside. Any feedback the user might need must be explicitly planned out and programmed.

   iii) **Interaction**: So, given all these differences between humans and computers, how are we supposed to get along with them and get our work done? In other words, how can we interact with them effectively? In order to come up with a product that's easy for people to use, software designers apply what they know about humans and computers, and consult with potential users of their products throughout the design process. When they know what their users want and need the product to do, they collaborate with programmers

   iv) **User Interface**: User Interface (or UI) is one of those jargon terms that you hear from computer salespeople and other techno-geeks, but that you may have never heard defined. It's not a hard concept to understand, though. It's simply the parts of a computer and its software that you (the computer user) see, hear, touch, or talk to. It is the set of all the things that allow you and your computer to communicate with each other. For example, if you are reading this on a computer screen, then you're looking at part of a user interface right now. The screen is showing you these words, communicating a
message to you.

2) Four input devices are described below:

   **Keyboard:** A keyboard is an input device, partially modeled after the typewriter keyboard, which uses an arrangement of buttons or keys, which act as mechanical levers or electronic switches. The keyboard is used to type text and numbers into a word processor, text editor or other program.

   **Mouse:** An input device that allows an individual to control a mouse pointer in a graphical user interface (GUI).

   **Optical Scanner:** Hardware input device that allows a user to take an image and/or text and convert it into a digital file, allowing the computer to read and/or display the scanned object. A scanner is commonly connected to a computer USB, Firewire, Parallel or SCSI port.

   **WebCam:** A camera connected to a computer or server that allows anyone connected to the Internet to view still pictures or motion video of a user.

3) Any machine capable of representing information from a computer to the user is called as output device. Some of the common output devices are listed below:

   - **Monitor:** It is also called a video display terminal (VDT) a monitor is a video display screen and the hard shell that holds it. Monitors display images and text which are made up of small blocks of colored light called pixels.

   - **Printer:** It is an external hardware device responsible for taking computer data and generating a hard copy of that data. Printers are one of the most used peripherals on computers and are commonly used to print text, images, and/or photos.

   - **Projector:** It is a hardware device that enables an image, such as a computer screen, to be projected onto a flat surface.

   - **Speakers:** A speaker gives you sound output from your computer. Some speakers are built into the computer and some are separate.

4) Controls are the software elements, usually shown on a display, which you use to set preferences and make choices. Some familiar controls include:

   - **Menus:** In a graphical user interface (GUI) for a personal computer system, an improved method and apparatus for accessing and executing commands associated with user applications. Menu can be both static as well as dynamic.

   - **Pushbuttons:** In a window or dialog box, a rectangular control that, when clicked, immediately causes an action to be performed. Push buttons can be labeled with text, graphics, or both.

**Check Your Progress 2**

1) A virtual machine is a type of computer application used to create a virtual environment, which is referred to as virtualization. Virtualization allows the user to see the infrastructure of a network through a process of aggregation. It is one of the latest developments in the field of human computer interaction. Virtualization
may also be used to run multiple operating systems at the same time.

2) A command-line interface (CLI) is a mechanism for interacting with a computer operating system or software by typing commands to perform specific tasks. This text-only interface contrasts with the use of a mouse pointer with a graphical user interface (GUI) to click on options, or menus on a text user interface (TUI) to select options.

3) Hypertext: Hypertext is text which is not constrained to be linear. Hypertext is text which contains links to other texts. Hypertext links can access numerous types of material, for example, educational material such as course syllabi and resources, explanatory notes for a Web-based document, sources for references. Hypertext systems are particularly useful for organizing and browsing through large databases that consist of disparate types of information.

**Hypermedia**: It is defined as an extension to hypertext that supports linking graphics, sound, and video elements in addition to text. The World Wide Web is a partial hypermedia system since it supports graphical hyperlinks and links to sound and video files. New hypermedia systems under development will allow objects in computer videos to be hyperlinked.

4) i) **Ubiquitous communication** Computers will communicate through high speed local networks, nationally over wide-area networks, and portably via infrared, ultrasonic, cellular, and other technologies.

ii) **Mass availability of computer graphics** Computer graphics capabilities such as image processing, graphics transformations, rendering, and interactive animation will become widespread as inexpensive chips become available for inclusion in general workstations.

iii) **Mixed media Systems** will handle images, voice, sounds, video, text, and formatted data. These will be exchangeable over communication links among users.

iv) **High-bandwidth interaction**: The rate at which humans and machines interact will increase substantially due to the changes in speed, computer graphics, new media, and new input/output devices. This will lead to some qualitatively different interfaces, such as virtual reality or computational video.

### 2.8 FURTHER READINGS


2) “Data and computer communications”, William Stallings Ed. 8, Prentice Hall.

**References Website:**