HUMAN-COMPUTER INTERACTION

UNIT-II

The Graphical User Interface – popularity of graphics, the concept of direct manipulation, graphicalsystem, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface.

Introduction to GUI:

A Visual way of interacting with a computer using items such as windows, icons, and menus, used by most modern operating systems.

GUI Stands for **"Graphical User Interface,"** and is pronounced **"gooey."** It refers to the graphical interface of a computer that allows users to click and drag objects with a mouse instead of entering text at a command line. Two of the most popular operating systems, Windows and the Mac OS, are GUI-based. The graphical user interface was first introduced to the public by Apple with the Macintosh in 1984. However, the idea was actually taken from an earlier user interface developed by Xerox.

- A **user interface**is a collection of techniques and mechanisms to interact with something.
- In a ***graphical interface,***the primary interaction mechanism is a pointing device of some kind. This device is the electronic equivalent to the human hand.
- What the user interacts with is a collection of elements referred to as *objects.*

Properties of objects:

- They can be seen, heard, touched, or otherwise perceived.
- Objects are always visible to the user and are used to perform tasks.
- They are interacted with as entities independent of all other objects.
- People perform operations, called **actions, on objects**.
- The***operations***includeaccessingandmodifying objects by pointing, selecting, and manipulating.

The Popularity of Graphics:

- The design and the user interface are changed fundamentally with the invasion of graphics.
- The older text-based screen possessed a **one-dimensional,** text-oriented, form-like quality were replaced by a **three-dimensional** appearance graphical screen.
- Information floated in windows, small rectangular boxes seemed to rise above the background plane.

Features of graphical system are:

- ❖ Windows could also float above other windows.
- ❖ Controls appeared to rise above the screen and move when activated.
- ❖ Lines appeared to be etched into the screen.
- ❖ Information could appear, and disappear, as needed, and in some cases text could be replaced by graphical images called icons.
- ❖ These icons could represent objects or actions.
- ❖ Menus "pop up" on the screen.
- ❖ In the screen body, selection fields such as radio buttons, check boxes, list boxes, drop-down menus and palettes coexisted with the reliable old text entry field.
- ❖ Pointing devices like mouse, joystick were used to choose objects and screen actions.

- ➢ These features have increased the graphics popularity the graphical interface is also known as WIMP interface: windows, icons, menus, and pointers.
- ➢ the graphical screens cause persons information processing capabilities very much effective in comparison with various methods.
- ➢ graphic minimizes the content recording and reframing on screen.
- ➢ it decreases the load on memory.
- ➢ graphical screens allow quicker content movement between computers and users due to visual content.

The Concept of Direct Manipulation:

Direct manipulation refers to the style of communication for graphical systems Characteristics:

- ✓ The system is portrayed as an extension of the real world.
- ✓ Continuous visibility of objects and actions.
- ✓ Actions are rapid and incremental with visible display of results.
- ✓ Incremental actions are easily reversible.

1.The system is portrayed as an extension of the real world: A person is allowed to work in a familiar environment and in a familiar way, focusing on the data, not the application and tools. The physical organization of the system, which most often is unfamiliar, is hidden from view and is not a distraction.

2.Continuous visibility of objects and actions: objects are continuously visible. Reminders of actions to be performed are also obvious. Nelson (1980) described this concept as "virtual reality," a representation of reality that can be manipulated. Hatfield (1981) is credited with calling it "WYSIWYG" (what you see is what you get) and Rutkowski (1982) described it as "transparency,"

3.Actions are rapid and incremental with visible display of results : the results of actions are immediately displayed visually on the screen in their new and current form. Auditory feedback may also be provided. The impact of a previous action is quickly seen, and the evolution of tasks is continuous and effortless.

4.Incremental actions are easily reversible: Finally, actions, if discovered to be incorrect or not desired, can be easily undone.

Problems with direct manipulation:

- The operation may be difficult to conceptualize in the graphical system.
- The graphics capability of the system may be limited.
- The amount of space available for placing manipulation controls in the window border may be limited.
- It may be difficult for people to learn and remember all the necessary operations and actions.

Indirect Manipulation:

- ❖ Indirect manipulation substitutes words and text, such as pull-down or pop-up menus, for symbols, and substitutes typing for pointing.
- ❖ Most window systems are a combination of both direct and indirect manipulation.

Example:

- ✓ A menu may be accessed by pointing at a menu icon and then selecting it (direct manipulation).
- ✓ The menu itself, however, is a textual list of operations (indirect manipulation).
- ✓ When an operation is selected from the list, by pointing or typing, the system executes it as a command.

GRAPHICAL SYSTEM ADVANTAGES:

- ❖ Symbols recognized faster than text
- ❖ Faster learning.
- ❖ Faster use and problem solving.
- ❖ Easier remembering.
- ❖ More natural.
- ❖ Exploits visual/spatial cues.
- ❖ Fosters more concrete thinking.
- ❖ Provides context.

- Fewer errors.
- Increased feeling of control.
- Immediate feedback.
- Predictable system responses.
- Easily reversible actions.
- Less anxiety concerning use.
- More attractive.
- May consume less space.
- Replaces national languages.
- Easily augmented with text displays.
- Low typing requirements.
- Smooth transition from command language system.

1.Symbols recognized faster than text: symbols can be recognized faster and more accurately than text. An example of a good classification scheme that **speeds up recognition is the icons**. These icons allow speedy recognition of the type of message being presented.

2.Faster learning: a graphical, pictorial representation aids learning, and symbols can also be easily learned.

3.Faster use and problem solving: Visual or spatial representation of information has been found to be easier to retain and manipulate and leads to faster and more successful problem solving.

4.Easier remembering: Because of greater simplicity, it is easier for casual users to retain operational concepts.

5.More natural: symbolic displays are more natural and advantageous because the human mind has a powerful image memory.

6.Exploits visual/spatial cues. Spatial relationships are usually found to be understood more quickly than verbal representations. Visually thinking is believed tobe better than logical thinking.

7.Fosters more concrete thinking. Displayed objects are directly in the high-level taskdomain, or directly usable in their presented form. There is no need mentally todecompose tasks into multiple commands with complex syntactic form. The needfor abstract thinking is therefore minimized.

8.Provides context. Displayed objects are visible, providing a picture of the currentcontext

9.Fewer errors: Reversibility of actions reduces error rates because it is always possible to undo the last step. Error messages are less frequently needed.

10.Increased feeling of control: The user initiates actions and feels in control. This increases user confidence

11.Immediate feedback: The results of actions furthering user goals can be seen immediately. If the response is not in the desired direction, the direction can be changed quickly.

12.Predictable system responses: Predictable system responses also speed learning.

13.Easily reversible actions. The user has more control. This ability to reverse unwantedactions also increases user confidence and hastens system mastery.

14.Less anxiety concerning use. Hesitant or new users feel less anxiety when using thesystem because it is so easily comprehended, is easy to control, and has predictableresponses and reversible actions.

15.More attractive: Direct-manipulation systems are more entertaining, cleverer, and more appealing.

16.May consume less space: Icons may take up less space than the equivalent in words but this is not the case always.

17.Replaces national languages: Icons possess much more universality than text and are much more easily comprehended worldwide.

18.Easily augmented with text displays: Where graphical design limitations exist, direct-manipulation systems can easily be augmented with text displays. The reverse is not true.

19.Low typing requirements: Pointing and selection controls, such as the mouse or trackball, eliminate the need for typing skills.

20.Smooth transition from command language system. Moving from a command languageto a direct-manipulation system has been found to be easy. The reverse isnot true

GRAPHICAL SYSTEM DISADVANTAGES:

The body of positive research, hypotheses, and comment concerning graphical systems is being challenged by some studies, findings, and opinions that indicate that graphical representation and interaction may not necessarily always be better. Indeed, in some cases, it may be poorer than pure textual or alphanumeric displays. Sometimes arcane, and even bizarre.

- Greater design complexity.
- Learning still necessary.
- Lack of experimentally-derived design guidelines.
- Inconsistencies in technique and terminology.
- Working domain is the present.
- Not always familiar.

- Human comprehension limitations.
- Window manipulation requirements.
- Production limitations.
- Few tested icons exist.
- Inefficient for touch typists.
- Inefficient for expert users.
- Not always the preferred style of interaction.
- Not always fastest style of interaction.
- Increased chances of clutter and confusion.
- May consume more screen space.
- Hardware limitations.

- **Greater design complexity**: Controls and basic alternatives must be chosen from a pile of choices numbering in excess of 50. This design potential may not necessarily result in better design unless proper controls and windows are selected. Poor design can undermine acceptance.
- **Learning still necessary**: The first time one encounters many graphical systems, what to do is not immediately obvious. A severe learning and remembering requirement is imposed on many users because meanings of icons or using pointing device have to be learned.
- **Lack of experimentally-derived design guidelines:** today there is a lack of widely available experimentally-derived design guidelines. Earlier only few studies to aid in making design decisions were performed and available for today now. Consequently, there is too little understanding of how most design aspects relate to productivity and satisfaction.
- **Inconsistencies in technique and terminology**: Many differences in technique, terminology, and look and feel exist among various graphical system providers, and even among successive versions of the same system. So the user has to learn or relearn again while shifting to next terminology.
- **Not always familiar**: Symbolic representations may not be as familiar as words or numbers. Numeric symbols elicit faster responses than graphic symbols in a visual search task.
- **Window manipulation requirements**: Window handling and manipulation times are still excessive and repetitive. This wastes time
- **Production limitations**: The number of symbols that can be clearly produced using today's technology is still limited. A body of recognizable symbols must be produced that are equally legible and equally recognizable using differing technologies. This is extremely difficult today.

- **Few tested icons exist**: Icons must be researched, designed, tested, and then introduced into the marketplace. The consequences of poor or improper design will be confusion and lower productivity for users.
- **Inefficient for touch typists**: For an experienced touch typist, the keyboard is a very fast and powerful device.
- **Not always the preferred style of interaction**: Not all users prefer a pure iconic interface. User will also prefer alternatives with textual captions.
- **Not always fastest style of interaction:** graphic instructions on an automated bank teller machine were inferior to textual instructions.
- **May consume more screen space**: Not all applications will consume less screen space. A listing of names and telephone numbers in a textual format will be more efficient to scan than a card file.
- **Hardware limitations**: Good design also requires hardware of adequate power, processing speed, screen resolution, and graphic capability.

Characteristics of the Graphical User Interface

- **Sophisticated Visual Presentation**
  - Visual presentation is the visual aspect of the interface.
  - It is what people see on the screen.
  - The graphical system permits displaying lines, including drawings and icons.
  - Permits the displaying of a variety of character fonts, including different sizes and styles.
  - The display of 16 million or more colors is possible
  - Permit animation and the presentation of photographs and motion video.
  - The graphical system provides to its user several useful, simple, meaningful. Visual elements like windows, Menus files or programs are denoted by icons screen based controls, cursor
- **Pick-and-Click Interaction**
  - ”pick” defines the motor activity of a user to pick out an element of a graphical screen on which an action is to be taken.
  - “click” represents the signal to carry out an action.
  - the pick and clock technique is carried out with the help of the mouse and its buttons. (mouse pointer for picking and mouse click is clicking).
  - the keyboard is an another technique.

❖ **Restricted Set of Interface Options**

- ❑ WYSIWYG.

❖ **Visualization**

- Effective visualizations can facilitate mental insights, increase productivity, and foster faster and more accurate use of data.

❖ **Object Orientation**

- Objects are what people see on the screen.
- They are manipulated as a single unit.
- A well-designed system keeps users focused on objects, not on how to carry out actions.
- Objects can be composed of subobjects.
- For example, an object may be a **document.** The document's subobjects may be a paragraph, sentence, word, and letter.

IBM's System Application Architecture Common User Access Advanced Interface Design Reference (SAA CUA) (IBM, 1991) breaks objects into three meaningful classes: **data, container, and device.**

- **Data objects present information**. This information either text or graphics, normally appears in the body of the screen.
- **Container objects** are objects to hold other objects. They are used to group two or more related objects for easy access and retrieval. There are three kinds of container objects: the workplace, folders, and workareas.
- The workplace is the desktop, the storage area for all objects.
- Folders are general-purpose containers for long-term storage of objects.
- Workareas are temporary storage folders used for storing multiple objects currently being worked on.
- **Device objects** represent **physical objects in the real world**, such as printers or trash baskets.
- **Microsoft Windows** specifies the characteristics of objects depending upon the relationships that exist between them.
- These relationships are called **collections, constraints, composites, and containers.**
- **A collection** is the simplest relationship—the objects sharing a common aspect.
- **A constraint** is a stronger object relationship.

- **A composite exists** when the relationship between objects becomes so significant that the aggregation itself can be identified as an object.
- **A container** is an object in which other objects exist.
- These relationships help define an object's type.
- Another important object characteristic is **persistence**.
- **Persistence** is the **maintenance of a state once it is established**.
- An object's state (for example, window size, cursor location, scroll position, and so on) should always be automatically preserved when the user changes it.

- **Use of Recognition Memory**

Continuous visibility of objects and actions encourages use of a person's more powerful Recognition memory. The "out of sight, out of mind" problem is eliminated

- **Concurrent Performance of Functions**

Graphic systems may do two or more things at one time. Multiple programs may runsimultaneously. When a system is not busy on a primary task, it may process backgroundtasks (cooperative multitasking).

When applications are running as truly separatetasks, the system may divide the processing power into time slices and allocateportions to each application (preemptive multitasking). Data may also be transferredbetween programs. It may be temporarily stored on a "clipboard" for later transfer orbe automatically swapped between programs

The Web User Interface:

- A web refers to a pool of information where users can access unlimited amount of data by means of web interfaces.
- Designing of web interfaces involves design of movement of data and presenting the data in a much understandable way which is easily accessible to the users.

Difficulties in designing web interfaces

- Html, a commonly used language for designing web interfaces. It is easy for technical users but not for ordinary users
- Movement in web browser in the pre-GUI is required "command" area to be memorized and movement system and structure were hidden under dark and black screen. Whereas GUIs removed the "command" area by menus associated with task.
- There are two types of movement in browser "forward" and "backward".

- The steps involved when dealing with forms like filling, sending and resetting needs interactive methods.

The Popularity of the Web:

- Web has completely changed computing.
- Web permits users throughout the world to interact, access content, publish and heard.
- The web permits the individual to control display and presentation of web pages.

CHARACTERISTICS OF A WEB INTERFACE:

CONCEPT	GUI	WEB
Devices	• User hardware variations limited • User hardware characteristics well defined & Screens appear exactly as specified.	• User hardware variations enormous. • Screen appearance influenced by hardware bein used.
User Focus	• Data and applications	• Information and navigation
Data Information	• Typically created and used by known and trusted sources. • Properties generally known. • Typically placed into system by users or known people and organizations. • Typically organized in a meaningful fashion.	• Full of unknown content. • Source not always trusted. • Often not placed onto the Web by users o known people and organizations. • Highly variable organization. • Privacy often suspect
User Tasks	• Install, configure, personalize, start, use, and upgrade programs. • Open, use, and close data files. • Fairly long times spent within an application..	• Link to a site, browse or read pages, fill ou forms, register for services, participate i transactions, download and save things. • Movement between pages and sites very rapic Familiarity with many sites not established.
User's Conceptual Space	• Controlled and constrained by program.	• Infinite and generally unorganized.

resentation lements	•Windows, menus, controls, data, tool bars, messages, and so on. •Many transient, dynamically appearing and disappearing. •Presented as specified by designer. Generally standardized by toolkits and style guides	• Two components, browser and page. • Within page, any combination of text, image audio, video, and animation. • May not be presented as specified by th designer dependent on browser, monitor, an user specifications. • Little standardization
lavigation	•Through menus, lists, trees, dialogs, and wizards. Not a strong and visible concept. •Generally standardized by toolkits and style guides.	•Through links: bookmarks, and typed URL Significant and highly visible concept. •Few standards.
ontext	•Enables maintenance of a better sense of context. Restricted navigation paths. •Multiple viewable windows.	•Poorer maintenance of a sense of context. Single page entities. •Unlimited navigation paths.
nteraction	•Interactions such as clicking menu choices, pressing buttons, selecting list choices, and cut/copy/paste occur within context of active program.	•Basic interaction is a single click. This can caus extreme changes in context, which may not b noticed.
esponseTime	•Nearly instantaneous.	•Quite variable
isual Style	•Typically prescribed and constrained by toolkit. •Visual creativity allowed but difficult &Little significant personalization.	•a more artistic, individual, and unrestricte presentation style. •Complicated by differing browser and displa capabilities, and bandwidth limitations.
ystem apability	•Unlimited capability proportional to sophistication of hardware and software.	•Limited by constraints imposed by the hardware browser, software, client support.

ntegration	•Seamless integration of all applications into the platform environment a major objective. •Toolkits and components are key elements in accomplishing this objective	•Apparent for some basic functions within mos Web sites (navigation, printing, and so on.) •Sites tend to achieve individual distinction rathe than integration.
Reliability	•Tightly controlled in business systems, proportional to degree of willingness to invest resources and effort	•Susceptible to disruptions caused by user telephone line and cable providers, Interne service providers.

Printed Pages versus Web Pages :

CONCEPT	PRINTED PAGES	WEB PAGES
Page size	• Large and fixed in size.	• Web pages are small and variable • Varies according to the user's browser, monitor.
Page rendering (availability)	• Printed pages are presented as complete entities, and their entire contents.	• Web pages elements are often rendered slowly. • Dozens of seconds may be consumed waiting for a page to completely appear.
Page layout	• The format of printed page is precise keeping. • The user focused on it.	• The format of web page is estimated with less designing principles and features of user's technologies.
Page resolution	• The intent of print characters is fast and useful as we can read the document fast.	• The purpose of screen character is not much useful and is rendered slowly.
User focus	• The printed pages provides well furnished complete information	• The web pages provide separate information in pieces to the users.

Page navigation	• Navigating printed materials is as simple as page turning	• Navigating the Web requires innumerable decisions concerning
Interactivity	• Design allows the users to move their eyes over fixed content	• Web page design permits the users to use their hands for scrolling, pointing, etc.,
Page independence	• The pages are dependent on one another.	• Independent

The Merging of Graphical BusinessSystems and the Web:

CHARACTERISTICS	INTRANET	INTERNET
Users	• The users of intranets, being organization employees	• Internet sites are used by customers
Tasks	• An intranet is used for an organization's everyday activities	• The Internet is mainly used to find information.
Type of information	• An intranet will contain detailed information needed for organizational functioning	• The Internet will usually present more stable information
Amountofinformation	• An intranet site will be much larger than an organization's,InternetSite	• An internet site will be much larger than an organization's Intranet site.

Extranets :

- An extranet is similar to the intranet which is partially accessed by the authorized users.
- The **main server** is placed **behind a firewall**, which helps in providing a controlled access between the intranet and internet.
- Only the authorized people are allowed to access intranet.
- Various levels of access are provided to individuals and outside users.
- Depending upon the username password the access can be made.

Principles of User Interface Design

Principles for the Xerox STAR

- **The illusion of manipulable objects** according to this principle selection and manipulable displayed objects must be created.
- **Visual order and viewer focus**
- **Revealed structure**
- **Consistency**
- **Appropriate effect or emotional impact**
- **A match with the medium**

The illusion of manipulable objects: Displayed objects that are selectable and manipulable must be created. A design challenge is to invent a set of displayable objects that are represented meaningfully and appropriately for the intended application. It must be clear that these objects can be selected,

Visual order and viewer focus: Effective visual contrast between various components of the screen is used to achieve this goal. Animation is also used to draw attention, as is sound. Feedback must also be provided to the user.

Revealed structure: The distance between one's intention and the effect must be minimized. The relationship between intention and effect must be tightened and made as apparent as possible to the user.

Consistency: Consistency aids learning. Consistency is provided in such areas as element location, grammar, font shapes, styles, and sizes, selection indicators, and contrast and emphasis techniques.

Appropriate effect or emotional impact: The interface must provide the appropriate emotional effect for the product and its market. Is it a corporate, professional, and secure business system? Should it reflect the fantasy, wizardry, and bad puns of computer games?

A match with the medium: The interface must also reflect the capabilities of the device on which it will be displayed. Quality of screen images will be greatly affected by a device's resolution and color-generation capabilities.

General Principles of user interface design:

The design goals in creating a user interface are described below. They are fundamental to the design and implementation of all effective interfaces, including GUI and Web ones. These principles are general characteristics of the interface, and they apply to all aspects.

Aesthetically Pleasing: provide visual appeal by following these presentation and graphic design principles:

- Provide meaningful contrast between screen elements.

- Create groupings.
- Align screen elements and groups.
- Provide three-dimensional representation.
- Use color and graphics effectively and simply.

Clarity: The interface should be visually, conceptually, and linguistically clear, including:

- Visual elements, Functions, Metaphors ,Words and text

Compatibility : Provide compatibility with the following:

- The user, The task and job, The product
- Adopt the user's perspective .

Comprehensibility : A system should be easily learned and understood. A user should know the following:

- What to look at
- What to do
- When to do it
- Where to do it
- Why to do it
- How to do it

— The flow of actions, responses, visual presentations, and information should be in a sensible order that is easy to recollect and place in context.

Configurability : Permit easy personalization, configuration, and reconfiguration of settings.

- Enhances a sense of control.
- Encourages an active role in understanding.

Consistency : A system should look, act, and operate the same throughout. Similar components should:

- Have a similar look.
- Have similar uses.
- Operate similarly.

— The same action should always yield the same result.

— The function of elements should not change &The position of standard elements should not change.

— In addition to increased learning requirements, inconsistency in design has a number of other prerequisites and by-products, including:

— More specialization by system users.

— Greater demand for higher skills &More preparation time and less production time.

Control: The user must control the interaction.

- Actions should result from explicit user requests.
- Actions should be performed quickly.
- Actions should be capable of interruption or termination.
- The user should never be interrupted for errors.

— The context maintained must be from the perspective of the user.

— The means to achieve goals should be flexible and compatible with the user's skills, experiences, habits, and preferences.

— Avoid modes since they constrain the actions available to the user.

— Permit the user to customize aspects of the interface, while always providing a proper set of defaults.

Directness : Provide direct ways to accomplish tasks.

- Available alternatives should be visible.
- The effect of actions on objects should be visible.

Efficiency : Minimize eye and hand movements, and other control actions.

- Transitions between various system controls should flow easily and freely.
- Navigation paths should be as short as possible.
- Eye movement through a screen should be obvious and sequential.

— Anticipate the user's wants and needs whenever possible.

Familiarity : Employ familiar concepts and use a language that is familiar to the user.

— Keep the interface natural, mimicking the user's behavior patterns.

— Use real-world metaphors.

Flexibility : A system must be sensitive to the differing needs of its users, enabling a level and type of performance based upon:

- Each user's knowledge and skills.
- Each user's experience &Each user's personal preference.
- Each user's habits &The conditions at that moment.

Forgiveness : Tolerate and forgive common and unavoidable human errors.

— Prevent errors from occurring whenever possible.

— Protect against possible catastrophic errors.

Predictability : The user should be able to anticipate the natural progression of each task.

- Provide distinct and recognizable screen elements.
- Provide cues to the result of an action to be performed.

— All expectations should be fulfilled uniformly and completely.

— When an error does occur, provide constructive messages.

Recovery : A system should permit:

- Commands or actions to be abolished or reversed.
- Immediate return to a certain point if difficulties arise.

— Ensure that users never lose their work as a result of:

- An error on their part.
- Hardware, software, or communication problems.

Responsiveness : The system must rapidly respond to the user's requests.

— Provide immediate acknowledgment for all user actions:

- Visual, Textual, Auditory.

Simplicity : Provide as simple an interface as possible.

— Five ways to provide simplicity:

- Use progressive disclosure, hiding things until they are needed.

— Present common and necessary functions first &Prominently feature important functions.

— Hide more sophisticated and less frequently used functions.

- Provide defaults &Minimize screen alignment points.
- Make common actions simple at the expense of uncommon actions being made harder.
- Provide uniformity and consistency.

Transparency : Permit the user to focus on the task or job, without concern for the mechanics of the interface.

- Workings and reminders of workings inside the computer should be invisible to the user.

Trade-Offs : Final design will be based on a series of trade-offs balancing often-conflicting design principles.

— People's requirements always take precedence over technical requirements.