Graphical User Interface

Unit 1

What is Graphical User Interface(GUI)?

- GUI is a system that allows creation and manipulation of user interfaces using windows, menus, icons, dialog boxes, etc.
- Common features of GUI are :
- Pointing devices such as mouse.
- Point and shoot functionality with screen menus that appear or disappear under pointing-device-control.
- Icons that represent files, directories and other application and system entities.
- Dialog boxes, button, sliders, check boxes and many other graphical metaphors that let the programmer and user tell the computer what to do and how to do it.

Evolution of Human and Machine Interaction

- Earlier, the primary means of communication with computers was command based interfaces. In this, the users have to learn a large set of commands to get their job done. In earlier computer systems paper tapes, cards and batch jobs were the primary means of communicating these commands to the computers.
- Later, timesharing systems allowed the use of CRT terminals to interact/communicate with the computer. In this, the sharing of computer resources like CPU and peripherals was a burden.
- Batch systems and time sharing led to the command based interfaces. Users had to memorize commands and options or consult a large set of user manuals.
- Mainframe and minicomputer systems required a large set of instruction manuals on how to use the system.
- Early users of computes were engineers. Later computers were introduced to new class of users secretaries, managers and non-managers. These class of users were not interested in learning the computer technology. The command-based interface created a computer phobia among these users.

- To make life easier for the end -user, a large collection of devices have been invented to control, monitor and display information. The early peripherals where, keyboards and the video terminal. Later, pointing devices and windowing systems were developed. Some of the pointing devices were mouse and joystick.
- In the 70s, researchers designed powerful new workstations armed with graphical user-interfaces.

Terms commonly used with Graphical User Interfaces

1. Pointing devices : It allows users to point at different parts of the screen. It can be used to invoke a command from a set of commands in a menu. They can also be used to manipulate objects on the screen. This can be done by :

- Selecting objects on the screen.
- Moving objects around the screen
- Merging several objects into another object

Some of the pointing devices used are light pen, joystick, mouse and touch sensitive screen.

Mouse is the commonly used one because of optimal coordination of hand and is easier to track the cursor on the screen.

2. Pointer : A symbol that appears on the display screen that can be moved to select objects and commands. A pointer is usually a small angled arrow.

3. Bit Mapped Displays :Bit displays are replacing character-based display screens as memory chips get denser and cheaper. Bit-mapped display made up of tiny dots (pixels) are independently addressable and much finer resolution than character displays. Bit mapped displays advantage is the manipulation capabilities for vector and raster graphics which provides information in the final form on paper for (also called as WYSIWYG "What You See Is What You Get").

4. Windows : When a screen is split into several independent regions, each one is called a window. Several applications can display results simultaneously in different windows. The end-user can switch from one application to another or share data between applications. Windows can be displayed in tiled or over-lapped form. Users can organize the screen by resizing the window or moving related windows closer.

5. Menus : Menu displays a list of commands available within an application. From this menu, the user can select operations such as File, Edit or Search. A menu can be used to provide a list of items. Each menu item can be either a word or an icon representing a command or a function. A menu item can be invoked by moving the cursor on the menu item and selecting the item by clicking the mouse. When a menu item is invoked it could cause other menus, called pull-down menus, to appear. Pull-down menus (Figure 4) are used to present a group of related commands or options for a menu item. Pull-down and pop-up menus display option commands available for each selection.

6. Dialogs : Dialog boxes allow more complex interaction between the user and the computer. Dialog boxes employ a collection of control objects such as dials, buttons, scroll bars and editable boxes. Dialog boxes are primarily used to collect information from the user or to present information to the user. Dialog boxes are also used to indicate error message in the form of alert boxes. Dialog boxes use a wide range of screen control elements to communicate with the user.

7. Icons : Icons are symbolic representation of any system/ user-defined object such as file, folder, address, book, applications and so on. Different types of objects are represented by a specific type of icon. Documents representing folders are represented by a folder icon. A folder icon contains a group of files or other folder icons. Double clicking on the folder icon causes a window to be opened displaying a list of icons and folder icons representing the folder's contents.

8. Desktop Metaphor : The metaphors has brought the computer closer to the natural environment of the end-user. The physical metaphor is a way of saying that the visual displays of a computer system should present the images of real physical objects. the wastepaper basket icon can be used to discard objects from the system by simply dragging the unwanted objects into the dustbin, as in real life. The desktop metaphor probably has been the most famous paradigm. It has large set of potential users. In a desktop metaphor, users are not aware of applications.

9. The 3D GUI : The desktop metaphor GUI is 2% D. It is 2D because its visual elements are two-dimensional: they lie in the xy plane, are defined in 2D coordinates, are flat and contain only planar regions (areas). It is 2% D because where visual elements overlap they obscure each other according to their priority. In a 3D GUI the visual elements are genuinely three-dimensional: they are situated in xyz space, are defined in terms of 3D coordinates, need not be flat and may contain spatial regions (volumes).

Functionality of GUI

- The development environment for most GUTS consists of four major components:
- A windowing system,
- An imaging model,
- An application program interface (APT),
- and A set of tools and frameworks for creating interfaces and developing integrated applications.

Windowing system : It allows programs to display multiple applications at the same time. It includes programming tools for building movable and resizable windows, menus, dialog boxes and other items on the display. Some GUIs contain proprietary windowing systems, such as Macintosh. Others use common windowing system such as X-window or simple X.

Imaging model : It defines how fonts and graphics are created on the screen. Imaging models handle, for example, typeface and size in a word processor and lines in a drawing program. Some GUIs support more than one imaging model.

API is a set of programming language functions that allow the programmer to specify how the actual applications control the menus, scroll bars and icons that appear on the screen. Like in windowing models, APIs align with particular GUIs.

GUI development environments can include toolkits and frameworks. Most of these toolkits are based on object-oriented approach.

GUI Design Consideration: Psychological Factors

- The three factors to be considered in the design of a good GUI are :

- Visual Acuity : Visual acuity is the ability of the eye to resolve detail. This refers to the amount of information one can put on the screen. The retina of the eye can only focus on a very small portion of a computer screen at any one time. This is because, at a distance greater than 2.5 degrees from the point of fixation, visual acuity decreases by half. At a normal viewing distance of 19 inches, 5 degrees translates into about 1.7 inches Assuming a standard screen format, 1.7 inches is an area about 14 characters wide . This is the amount of information that a user can take in at any one time, and it limits the effective size of icons, menus, dialog boxes, etc. If the user must constantly move his eyes across the screen to clearly focus, the GUI design is causing a lot of unnecessary and tiring eye movement.

- Information Limits : Once the user has a desired fixation point, there is a limit to the amount of information that the person can process at one time. A GUI design rule of thumb is that the range of options or choices should never be more than five or six.

- Gestalt Principle : The Gestalt Principle states that people use a top-down approach to organizing data. This principle can influence how one should organize graphical information on the screen. The Gestalt school of GUI designers have attempted to identify criteria that cause people to group certain items together in a display. Proper grouping results in a necessary redundancy of selection information that aids the user. For example, if the user knows where one item in a group is on a screen, he will expect other like items to be there also.

GUI Design Consideration

- The Rule of 1.7 directly leads to the conclusion that a good GUI would use a lot of icons. Unfortunately, too many randomly placed icons violate the limits of absolute memory. Using the Gestalt Principle, one can group like items together using factors like color to add more informational dimensions. Too many colors, however, destroy the global visual grouping of the items. The user then begins to concentrates on the GUI. Any primary cognitive task attention devoted to the interface may interfere with the primary task . One can derive basis GUI standards from basic human factors, however. These standards are the presentation of information, the grouping of information, and information sequencing.

Amount of Information Presented : The amount of information to present is the most basic GUI design considerations. H.E. Dunsmore showed that making screens less crowded improves screen clarity and readability. GUI designers usually follow the guidance that the interface should display only what the user needs to perform the current operation. Empirical researchers show that limiting the information to that necessary for the user reduces errors and time to perform tasks. Errors and performance time increase as the GUI presents more information.

- A well-designed screen can reduce the time needed to perform a task by as much as 40%. Ways to conserve screen space are:
- Appropriate use of abbreviations :