UNIT 2

User Interface Design Process

Objectives:

- To explore the different development steps in the Interface design process.
- To understand the importance of Human Characteristics in the Interface design process.
- To study the human considerations in the design of Business Systems.

Contents:

1.0 Introduction

A computer system is built to serve the user and the user interacts with the computer through an interface to use these services. To provide these services in an efficient way, the interface design and the screen design process must always begin with the proper understanding of the system user.

The system users and the developers who build the system are different in terms of their knowledge, skills, and attitude. So, to create a truly usable system, the designer must consider various issues such as understanding how people interact with computers and the related human characteristics, identifying the user's level of knowledge and experience, the characteristics of the user's needs, tasks, and jobs, the user's psychological characteristics, and also the user's physical characteristics.

Figure. 2.1 shows the fourteen steps to be followed in the User Interface Design Process

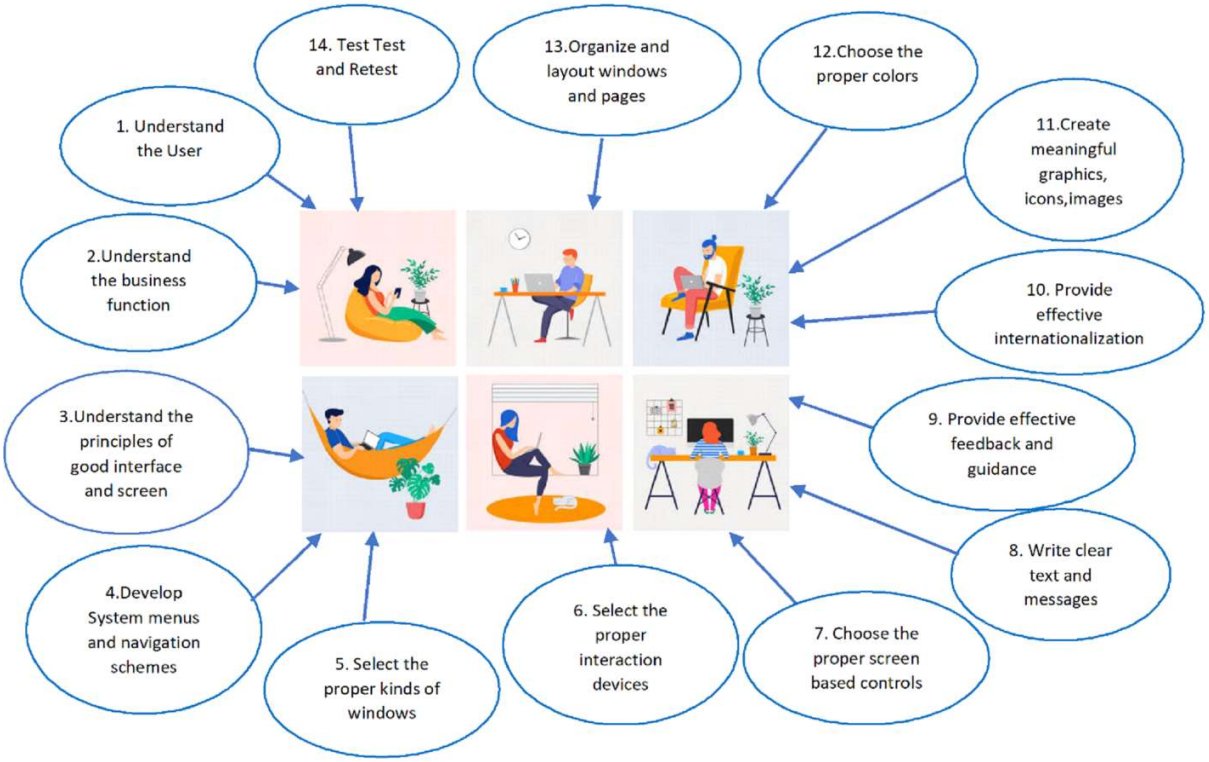

Fig. 2.1 Steps in the User Interface Design Process

In the following sections, we shall study the first two steps to be followed in the Interface Design Process.

1. Understanding the User or Client.
2. Understanding the Business Functions.

As a **first step in the design process**, the designer has to understand how a human interacts with computers, the importance of human characteristics in Design, human Considerations in the design of Business Systems, and human interaction speeds.

As a **second step**, the designer understands the Business Definition and Requirements Analysis, determines the Basic Business Functions, and understands the value of Standards and Guidelines and System Training and Documentation Needs.

2.0 User Interface Design Process - Know your User or Client

In this first step, the designer tries to understand how human beings interact with the computer, the importance of human characteristics in the design such as memory, perception, learning etc., human characteristics in business systems, and human interaction speeds.

First Step in the User Interface Design Process – the interaction of humans with computers

In **understanding how a user interacts** with a computer, the designers consider **four** important factors:

1. The Human Action Cycle
2. Trouble using the computer by the users
3. Responses to Poor Design
4. The tasks performed by the users

2.0.1 The Human Action Cycle

In this regard, Norman, a researcher, presented a psychological model in 1988 to describe how people interact with computer systems and this was then adapted by Stone et al. in 2005.

The model says that **any action performed by a user** can be **cognitive** or **physical** in nature and whenever an action is performed, the **user has a goal** and a **specific objective in mind**.

The action is performed in **three** stages:

1. **Goal formation:** here a goal is formed first and then cognitive activity and an objective is thought about and defined.

   Eg: Let us consider a goal to type and print a letter.

2. **Execution of activities to achieve the goal** – here an execution plan is devised and implemented in three stages, the first two stages are cognitive in nature and the third one is physical.

   Stage 1: Here the general methods to achieve the desired goals are decided upon.

   In the case of typing a letter, a computer's word processing function is required.

Stage 2: Here the action sequence is planned.

Typing a letter requires opening the word processor, retrieving a blank document, and typing the letter.

Stage 3: The actions are performed.

The various available computer controls, such as the keyboard and mouse, are used to perform the planned tasks.

3. **Evaluation of the results of the action** - This is a **cognitive phase** that is done in three stages.

   Stage 1: The resulting output is perceived and understood:

   For the application considered above, the results would be, the appearance of the letters and symbols on the screen.

   Stage 2: Interpretation of the outcome is based upon expectations:

   Here the letter is checked for proper format, completeness, and accuracy.

   Stage 3: Results are compared with the set goals:

   Here it is checked if the letter has been printed correctly.

   If the goals are not achieved, the actions will be performed again or the goals can be modified.

NOTE: Interface design should enable the human action cycles for tasks to be performed as quickly and accurately as possible.

2.0.2 Why People Have Trouble with Computers

In the earlier days, programmers, systems analysts, and system designers have taken the responsibility for the design of business computer systems. These people are trained technically but not behaviorally. In recent years, graphic artists have been added to the interface design teams to cater to the development of Web technology. These graphic artists possess extensive technical knowledge in their profession but little training in usability. Therefore, the issues concerning the user's capabilities have rested upon the designer's intuition and his specialized knowledge. All these factors have led to poor interface designs going unnoticed.

A system is difficult to use due to the following factors:

- **Too much flexibility:**

A system that is not well understood is always built with more functions than needed. Such a system results in higher interface complexity. A more complex system requires more learning and this results in less efficient human performance. So as the flexibility of a system increases, its usability decreases.

- **Use of jargon:**

Learning to use a system often requires learning a new language.

- **Non-obvious design**

Unique and new designs cannot be implemented in a conventional way. They need special skills. Also, the outcome of these implementations will not be visible immediately. The overall framework of the system may be invisible and the results cannot always be related to the actions that accomplish them.

- **Fine distinctions:**

Sometimes different actions may accomplish the same thing or different things may result from the same action. These distinctions are minute and difficult to keep track of. Many times, based on the problems faced by the user, some distinctions which are of not much importance are made ignoring some critical distinctions.

- **Disparity in problem-solving strategies**

Most people do not read and follow instructions before taking an action. They follow the trial-and-error method of solving a problem. This leads to many repeated attempts of the actions.

In the earlier computer systems, an error prevention strategy was followed, where a person would not take an action until he or she is confident of the result. In such cases when a person goes wrong, they get stuck in a situation and it becomes difficult to come out of it. So, they need to turn off the computer and restart it.

- **Design inconsistency**

There could be many design inconsistencies which may result in the user requiring to rote or memorize ways to perform the actions when using different designs or systems. So meaningful and conceptual learning is difficult to happen here.

Some of the **design inconsistencies** are described below.

- One common action will have different names on different interfaces as they are designed differently.
  For example, the same action will have different names such as “save” and “keep,” or “write” and “list.”
- The same command may cause different things to happen.
- The same result may be described differently
  For example, “not legal” and “not valid.”
- The same information may be ordered differently on different screens.

2.0.3 Responses to Poor Design

It has been found that in a computer-based system, the magnitude of errors is almost 46 percent for commands, tasks, or transactions. Errors are symptoms of problems and they may lead to two types of user responses: **Psychological** and **Physical.**

Psychological

Some of the psychological responses of people to poor design are **Confusion**, **Annoyance**, **Frustration**, **Panic** or **Stress**, and **Boredom**. These psychological responses diminish user effectiveness because there are severe blocks to concentration.

- **Confusion** – Detailing of content overwhelms the perceived structure. Meaningful patterns are difficult to ascertain, and the conceptual model or underlying framework cannot be understood or established.

- **Annoyance** - Users get annoyed when there are inconsistencies in design, slow computer reaction times, difficulties in quickly finding information, outdated information, and visual screen distractions and obstructions that prevent a task from being completed.

- **Frustration** - Users get frustrated when they are not able to easily convey information to the computer, they are not able to finish a task or an unexpected response cannot be undone. Also, if a system is not flexible the user gets frustrated.

- **Panic or stress** - A complex system is very taxing on a person’s perceptual and cognitive abilities which results in panic and stress. Also, long delays occurring when a user is operating under a deadline or dealing with an angry customer can lead to panic and stress.

- **Boredom** - As opposed to a complex system resulting in stress, an oversimplistic way of doing jobs or tasks can result in boredom in users. This happens because a person's perceptual and cognitive abilities are underused here. Also slow response times or long download times can create boredom.

Physical

People expect that the benefits of the actions are more than the cost or the effort to do it. But when the reverse happens, the following physical reactions are seen in the users.

These physical responses reduce user efficiency and effectiveness because with these responses, the user may not use the system's complete capabilities or they may waste time trying for alternative actions.

- **Abandonment of the system**

The users can reject a system and rely upon other sources of information. In such situations, other information sources must be available. In the earlier days, the managerial and professional personnel in business systems followed this method. Today, with the development of the Web, any user can abandon a system and find information through other sources.

- **Partial use of the system**

Most of the time, only a portion of the system's capabilities are used. Only those operations that are easiest to perform or that provide the most benefits are used and many system aspects go unused.

- **Indirect use of the system**

The manager or other higher authority places an intermediary between the user and the computer.

- **Modification of the task**

Sometimes when a problem is unstructured and the tools are not very flexible, the task is changed to match the capabilities of the system.
Example: Scientific problem-solving.

- **Compensatory activity**

In a system with inadequate features, additional actions are performed.

For Example: Clerical personnel can format information manually to match the structure required by the computer.

- **Misuse of the system**

Sometimes the system integrity may get lost when rules are broken to cope with operational difficulties

- **Direct programming**

When the users have specific needs, they reprogram the system. This is usually done by a sophisticated user.

2.1.4 People and Their Tasks

Workers at home and at business many a time are overworked, fatigued, and continually interrupted by their family members or colleagues.

All computer users show the following features:

- They may not read the documentation.
- They do not understand how much a computer can help to solve their problems.
- They may not know much about the information available to solve their problems.
- As the system designer are often isolated psychologically and physically from the users' situations, they may not understand the user's technical skills.

2.1 Important Human Characteristics in Design

People are complex organisms with many attributes. These attributes have an important influence on interface design.

Some of the **attributes** that influence the interface design are **perception**, **memory**, **visual acuity**, **foveal and peripheral vision**, **sensory storage**, **information processing**, **mental models**, **movement control**, **learning, skill**, **performance load**, and **individual differences**.

2.2.1 Perception

Perception is the understanding of the elements and objects of our environment. This understanding happens through the physical sensation of our various senses like sight, sound, smell, and so forth.

Perception is influenced by experience and people match the objects and sensations perceived based on the models stored in their memory.

Other **perceptual characteristics** are discussed below:

- **Proximity**

  Objects that are spaced nearby are perceived by our eyes as belonging together.

- **Similarity**

  Objects that have the same color, size, shape, brightness, or orientation are perceived by our eyes as belonging together.

- **Matching patterns**

  Objects of the same shape but different sizes are responded similarly.

- **Succinctness**

  Perfection and simplicity are easier to remember, so people tend to see an object as having some perfect or simple shape.

- **Closure**

  Our perception is synthetic; it establishes meaningful wholes. If something does not quite close itself, such as a circle, square, triangle, or word, we see it as closed anyway.

- **Unity**

  Objects that form closed shapes are perceived as a group.

- **Continuity**

  Shortened lines may be automatically extended.

- **Balance**

  People desire stabilization or equilibrium in their viewing environment so vertical, horizontal, and right-angled objects are visually satisfying.

- **Three-dimensional projection**

  People see objects and patterns in a three-dimensional form when certain visual hints about them are given.

  For Example: an overlapped object, smaller of similar objects, and shaded objects are perceived as farther away.

- **Top-down lighting bias**

  When a light source is present above an object, we interpret shaded or dark areas of that object as shadows. That is, objects with top-down lighting are seen as natural and those with other light orientations are seen as unnatural.

- **Expectancies**

  What we expect influences our perception. So we tend to perceive what we want and not what is there.

  For Example: when we are proofreading a document, a mis-spelled word is missed as we do not see how a word is spelled, but how we expect to see it spelled.

- **Context**

  Perception is also influenced by context, environment, and surroundings.

  For Example: based on the angle of adjacent lines or on the cues given by others about the size of the lines, two drawn lines of the same length may seem to be of the same length or different lengths.

- **Signals versus noise**

  There is a type of perception called figure-ground perception. Here, the **object of interest** is the **figure** or **signal**, and its **background** is known as the **ground**.

  Signals, or figures, are more quickly perceived and understood if they are easily distinguishable from noise, or background, in our sensory environment.

  Noise interferes with the perception of signals if they are like to one another.

NOTE: The main goal in interface design is to utilize our perceptual capabilities so that a screen can be structured in the most meaningful way.

2.2.2 Memory

The difference in the ability to recognize or recall words is an important consideration significant for interface design. Human beings can recall words between 2,000 and 3,000 and can recognize around 100,000 numbers.

During searching tasks, long-term memory can help recognize objects. The power of recognition is more than our power of recall. This phenomenon should be utilized in interface design.

As an example, a list of alternatives can be presented in order to remind about the choices that people can have.

A system can be made more usable if memory loads are reduced. This also reduces the need for mental integration, aid recall, and expand working memory.

Different ways to reduce memory load are discussed below:

- Information should be presented in an organized, structured, familiar, and meaningful way.
- Control over the pace of information presentation should be given to the user.
- As people can remember a few items for only 3 or 4 seconds, all the required information for task performance can be placed in close physical proximity.
- Important items can be recalled faster by placing them at the beginning or end of the listing.
- Information that needs comparison can be placed close by.
- If screen reading speed is required, users should not be given other tasks which require using working memory.
- To make remembering easy, important items can be made unique or distinctive in some manner.
  For Example: Some items can be highlighted for distinction.

2.2.3 Sensory Storage

Information collected from our senses is stored in a buffer known as **Sensory storage**. This storage process happens unconsciously and the information is being constantly replaced by newly gathered stimuli.

So, the sensory storage acts as a radar, which scans the environment for things that are important to pass on to higher memory. Sometimes this process is overwhelmed by surrounding noise. In the presence of such noise, the detection of objects becomes difficult.

In the context of interface design, **noise** can be mapped to **excessive stimulation** to the user. Repeated and excessive stimulation can fatigue the sensory storage mechanism and makes it difficult to distinguish what is important.

So, interface should be designed with **less noise** and **all elements presented should serve a definite purpose.**

2.2.4 Visual Acuity

Visual Acuity is a phenomenon by which our **eye can resolve details** in an object.

An object becomes more distinct when our eyes are fixed on it and become less distinct when we turn our eyes away **This phenomenon is used by interface designers when screen groupings are considered.**

The eye's sensitivity increases for those characters closest to the fixation point (the "0") and decreases for those characters at the extreme edges of the circle of optimum visual acuity.

For the earlier screen resolutions, research suggested a 5-degree diameter circle centered around an eye fixation character on a display as the area near that character (Tullis, 1983). The physical size of the circle which is 5 degrees is critical and not the number of characters. A larger or smaller character size will only decrease or increase the number of viewable characters.

For modern personal computer displays, the recommended viewing distance has been increased to about 24 inches. This increased distance along with variations in font sizes has made the calculation of the exact "chunk" size and a viewable number of characters difficult to calculate. **Most of the time, small visual chunks will exist on screens and these chunks should be considered in the design.**

Also, during the design of patterns for fill-in areas of screens in the case of bars and circles, another feature of the vision, "tremor" must be considered, because our eye is never steady as it sees; it trembles slightly. This tremor improves the detection of edges of objects being looked at, thus improving acuity also it can create problems.

For Example: Patterns of closely spaced lines or dots are seen to shimmer and this shimmer can be distracting and disturbing. So, patterns for fill-in areas of screens must be carefully chosen to avoid this visual distraction.

2.2.5 Foveal and Peripheral Vision

Two more visual characteristics help the interface designers to design screens to aid visual search and also to help in improving the attention of the user.

Foveal vision is used to focus directly on an object, whereas peripheral vision helps us to sense the area surrounding it. Limitations in the visual acuity make this surrounding area unclear.

But Foveal and peripheral vision maintain a cooperative and competitive relationship.

- Cooperatively, peripheral vision aids a visual search, but can also be distracting. Also, it provides hints to where the eye should go next in the visual search of a screen.
  For Example: Patterns, shapes, and alignments peripherally visible can guide the eye in a systematic way through a screen.
- Competitively, peripheral vision can compete with a foveal vision for attention.
  For Example: Information about the periphery is passed on to our information-processing system along with foveal information. This can be termed visual noise.

Researchers Mori and Hayashi [1993] evaluated **the effect of window areas on foveal and** peripheral relationships.

They concluded the following:

- Whenever there are peripheral windows, the performance on a foveal window deteriorates
- The performance degrades more if the information in the peripheral is dynamic or moving.
- During interface designs, the positive nature of peripheral vision should be utilized and its negative aspects should be avoided.

2.2.6 Information Processing

Important information collected by our senses must be processed in a meaningful way. According to Lind, Johnson, and Sandblad (1992), this information is processed on two levels and these **two levels function simultaneously**.

Higher Level

- This level is identified with our **consciousness** and **working memory**.
- It is **limited, slow,** and **sequential**.
- Used for **reading** and **understanding**.
- Perform **reasoning** and **problem-solving**.

Lower Level

- It processes **familiar** information **along with** the higher level.
- Its capacity is **unknown**.
- Happens **without conscious effort**.
- **Perceives the physical form** of the information.

As an example, **looking** at is **lower level** and **seeing** at a **higher level**. Similarly, **perceiving** at is **lower level** and **reading** at a **higher level.**

Processing a Screen by the User:

When a new system or screen is presented to a user, all the components such as its title, the controls, and other information it contains are looked at consciously. Here **a higher level of information processing happens.**

As familiarity grows, only a glance is needed to identify the screen components. The shape and structure can help the user identify the correct screen needed in that context. Now **the lower level of information processing happens.**

Screen Design Issues:

- A visually distinct screen contributes more to the user experience.
- A cluttered screen jammed with a lot of information, needs more time to read and understand.

Interference:

It is a phenomenon by which higher-level processing is obstructed. It occurs when perception and cognition are exposed to conflicting mental processes. Interference should be resolved for better and faster learning of the components presented to a user.

Types of Interferences:

Lidwell et al. (2003) has proposed the following **types of Interferences:**

Stoop interference:

Is caused when one aspect of a stimulus triggers a mental process that conflicts with another aspect of the same stimulus.

Example: Naming the color of two words with different colors takes more time than understanding their meaning.

Example: A Stop sign displayed in green and a Go sign in red will also create a mental conflict.

Proactive interference:

This is caused when there a person's existing memories interfere with learning.

Example: Interference happens when a person applies his native language grammar when learning a new language.

Example: Interference happens a computer user applies the old interaction procedures for a new system.

Retroactive interference:

This is the reverse of Proactive interference. It is caused when Learning interferes with existing memories.

Example: Learning a new musical instrument after having learned one.
Example: Learning to use a new computer system after having memorized the usage of one.

Minimizing interference:

This can be done by avoiding designs that create conflicting mental processes in the following way:

- Color and code combinations should be avoided.
- A person's mental model should be understood before designing.
- Decision-making time increases if options are presented to the user. So, during the design of time-critical tasks, the response times can be reduced by minimizing the number of options for the user.

2.2.7 Mental Models:

People develop **mental models of things** and **also of other people with whom they interact, based on, their previous life experience** and **their culture**. These models are **gradually developed** and they enable a person **to do actions or predict them as required**.

In the same way, a person who has used a computer system has formed a mental model of it. He has expectations and preconceptions based on his previous usage. If the new system conforms to the mental models a person has developed, the model gets reinforced and the system's use feels more comfortable, else interference occurs, and learning the new system becomes difficult. So, while designing, **a user's mental models should be identified and understood**.

2.2.8 Movement Control

Based on what we see and perceive, an action is taken or response is made. In computer systems, this response is a movement such as pressing keyboard keys, moving the screen pointer by pushing a mouse or rotating a trackball, or clicking a mouse button.

Fitts' Law:

This law was put forth in 1954 and is used in screen designs.

This law states that "the time to acquire a target is a function of the distance to and size of the target" i.e the bigger the target is, or the closer the target is, the faster it will be reached.

The **implications in screen design** are as follows:

- Provide large objects for important functions.
- Take advantage of the "pinning" actions of the sides, top, bottom, and corners of the screen.

2.2.9 Learning

People learn new things by coding the long-term memory information which is present in the short-term memory.

Earlier studies say that learning a computer system is the same as learning happening in other areas and people prefer to be active, explore, and use a trial-and-error approach in the learning process. **If the learning time is reduced, the performance increases.**

Studies have found that people are very sensitive to even minor changes in the user interface, and this makes **transferring them from one system to another difficult**.

In the context of user interfaces, **learning benefits the users** in the following ways:

- Prediction of the location of the common screen or page elements before they are displayed as studied by Bernard (2002) and Byrne et al.(1999).
- Movement of the mouse pointer to the area of an expected target before the target appears on the screen by experienced users.

2.2.10 Skill

Skills in human beings help them to perform an action in the correct time sequence with the required precision. Human effort can be saved when our actions and work pace result in optimum efficiency. This is achieved by learning to use shortcuts, working at a higher speed, and having easier access to information or data.

The design of a system and its screen should **allow the development of increasingly skillful performance.**

2.2.11 Performance Load

The **degree of effort** that is used to **perform any activity** is known as **performance load**.

Performance load is of two types:

- Cognitive
- Kinematic

Cognitive load:
It is the **amount of mental activity** required to perform a task or achieve an objective.

- This load is reduced in computer users by the use of Graphical user interfaces,
- Menus, icons, and other graphical components have replaced commands reducing memory load.

Cognitive Load can be reduced by,

- Providing only necessary information on the screens.
- Properly formatting and grouping information.
- Providing hints or help to recognize objects and not recall them.
- Automating tasks that require extensive memory.

Kinematic load:

It is the **degree of physical activity or effort** necessary to perform a task or achieve an objective.

- This load is reduced on computer users where user effort in keying the data is substituted by a simple mouse click.

Kinematic load can be reduced by,

- Reducing the number of steps to accomplish tasks.
- Minimizing the control actions and movements.
- Automating repetitive tasks.

2.2.12 Individual Differences

Human beings are different in their characteristics such as looks, feelings, motor abilities, intellectual abilities, learning abilities and speed, and so on. These individual differences complicate the design of user interfaces. The interfaces must be designed to suit the widely varying characteristics to satisfactorily and comfortably learn the task or job, or use the Web site.

The earlier designs considered the lowest abilities of people or selecting people with the minimum skills necessary to perform a job.

But today advancements in technology have helped the designers to customize the jobs to suit a specific group of users with a specific skill level.

2.3 Human Considerations in the Design of Business Systems

In addition to the human characteristics considered for interface designs in section 2.2, Mayhew [1992] proposed **a set of user/task characteristics that need to be considered in the design.**

These are summarized under **four categories** as discussed below:

- Knowledge/Experience of the User.
- JOB/TASK/NEED of the User.
- Psychological Characteristics.
- Physical Characteristics.

2.3.1 Knowledge/Experience of the User

The **different areas of** knowledge and experience of the user to be considered in the interface design are:

- Knowledge about the usage of Computer.
- Experience of interacting with a system.
- Experience using similar applications.
- Experience or knowledge about the task.
- Experience of some other systems used to do the same task.
- Education level of the user.
- Typing Skill of the user.
- Native Language or Culture of the user.

2.3.2 Job, Task, and Need of User

Based on the place where the interface is used and its need, the design issues are:

Type of System use

- Mandatory or discretionary use of the system.

Frequency of Use

- Continual, frequent, occasional, or once-in-a-lifetime

Task or Need Importance

- High, moderate, or low importance

Task Structure

- Repetitiveness or predictability of tasks being automated

Job Category

- Executive, manager, professional, secretary, clerk.

Lifestyle For Web e-commerce systems

- Hobbies, recreational pursuits, and economic status.

2.3.3 Psychological Characteristics

The following characteristics of the user are to be considered in the interface design:

Attitude

- Positive, neutral, or negative feeling toward job or system.

Motivation

- Low, moderate, or high due to interest or fear.

Patience

- Patience or impatience expected in accomplishing a goal.

Expectations

- Kinds and reasonableness.

Stress

- Level High, some, or no stress generally resulting from task performance.

Cognitive Style

- Verbal or spatial, analytic, or intuitive, concrete or abstract.

2.3.4 Physical Characteristics

Age

- Young, middle-aged, or elderly.

Gender

- Male or female.

Handedness

- Left, right, or ambidextrous.

Disabilities

- Blind, defective vision, deafness, motor handicap.

2.4 Human Interaction Speeds

Many researchers have studied **the interaction speeds** during the following **communication methods in humans.** These are measured in **words per minute**

- **Reading –** here the speeds can differ during prose text, proofreading on paper or monitor, listening to an audio or speaking to a computer.
- **Keying –** speeds are different for a fast and average typist.
- **Computer –** speeds differ for transcription and composition tasks.
- **Typing –** speeds differ for memorized text and copying.
- **Hand printing** - speeds differ for memorized text and copying

2.4.1 Performance Vs Preference

Interaction speeds are considered in the interface design process based on the performance and preferences of the users.

4. People sometimes choose an interface design feature that may yield poor performance. Different devices used for interaction, text color, and display types may lead to different performances.

   Eg: Pointing devices choice may be a mouse, a cursor, or alternative menu interaction techniques, Use of color, or two-dimensional versus three-dimensional displays.

4. Preferences are affected by familiarity, aesthetics, novelty, and perceived effort in feature use.
4. Users are not aware of the many human mechanisms responsible for the speed and accuracy of human-computer interaction.
4. Designers should explain the importance of a feature used in the design which improves performance.

2.4.2 Methods for gaining an Understanding of Users

Gould in 1988 suggested the following methods which the interface designer has to understand the User, his environment of work, and his requirements before designing a system.

- The user location should be visited to understand the user's work environment.
- Discuss the problems, difficulties, and requirements of the users directly.
- Observe the users while working or performing a task.
- In addition to the above, the designers can videotape users working or performing a task to study their problems.
- Also study the work organization where the system may be installed.
- User opinions can be obtained by preparing surveys and questionnaires.
- Establish testable behavioral target goals to give management a measure for what progress has been made and what is still required.

3.0 Second Step in the User Interface Design Process – Understand the Business Function

In the **previous section**, the first step in the system design has been discussed, where we tried to **understand the user of the system**.

In **this section,** we will study the **business functions** with the help of the following steps.

- The business definition is created and requirement analysis is done.
- Basic business functions are determined.
- The activities are described through task analysis.
- A conceptual model of the system is developed.
- Design standards are established.
- Design goals for system usability established.
- Training and documentation needs are defined.

3.1 Business Definition and Requirements Analysis

In this phase, the need for the system is established. Then based on the input from users, and marketing, the product is described.

There are four sub-phases in the implementation of this phase

- Information Collection Techniques
- Defining the Domain
- Considering the Environment
- Possible Problems in Requirements Collection

3.1.1 Information Collection Techniques

There are two main techniques that have been suggested by Keil and Carmel (1995), Popowicz (1995), and Fuccella et al. (1999), for collecting Information: **Direct** and **Indirect**.

- **Direct method**

  Here requirements are collected through face-to-face meetings with users.

- **Indirect method**

  This method makes use of an intermediary, someone or something, between the users and the developers.

Requirement Analysis

- The developer should have knowledge of the policies and work culture of the organization being studied.
- The developer should understand the current system or process before the new system replaces it.

Direct Methods

There are **nine direct methods** proposed to collect information from the potential users

1. **Individual Face-to-Face Interview**

   Here a questionnaire can be prepared for the user which can get information about the following:

   - Activities performed to complete a task and methods used to perform those activities.
   - Any interactions exist with other people or systems.

   Website developers have the following **questions** for the users:

   - Suggestions are taken from the user after presenting a site outline or proposal.
   - Description of the usefulness of the proposed website is taken from the user.
   - Users are enquired about the features of other websites liked or disliked by them.

- Users are told to describe the way tasks should be accomplished on the website.

2 Telephone Interview or Survey

- This method is not very useful, but a **planned** and **well-structured** interview that is **informed well in advance** can get enough information from the user.
- But these interviews are **less expensive**

3 Traditional Focus Group

- Here a small group of users (8 to 12) and a moderator together discuss the requirements.
- The questions from the moderator help him to get information on users' experiences, attitudes, beliefs, and desires, and to obtain their reactions to ideas or prototypes.
- A video recording of the discussion can provide insights into the user needs for all developers.

The Focus group should do the following:

- Objectives of the session should be established.
- Typical users or potential users should be selected as participants.
- A skilled moderator should be chosen to facilitate discussion on the relevant topics.
- Take good notes and clarify issues using the session recording.

4. Facilitated Team Workshop

- This provides a less formal discussion
- They can also provide useful information in less time.

5. Observational Field Study

- Here the designers visit the sites of work and observe the activities of the client users.
- They study the environment of the office or home for some time.

- This provides a good insight into tasks being performed, the working environment and conditions, the social environment, and working practices
- It can be time-consuming and expensive.
- Sometimes this observation can disturb the user and change his performance and behavior
- Video recording of the observation sessions provide a permanent record and permit a later detailed task analysis.

6. Requirements Prototyping

- A demonstration model, or very early prototype, is presented to users for their comments concerning functionality and to clarify requirements.

7. User-Interface Prototyping

- A demonstration model, or early prototype, is presented to users to uncover user interface issues and problems.

8. Usability Laboratory Testing

Verbal description about the nature of the work is given by the users to the designers. But these are not always clear, so the designers test their product by in a laboratory by carefully observing its usage and understanding how they use it. They test the results. If there are any errors, they are corrected.

Indirect Methods

These methods have some advantages but can create three main problems:

- Messages may be filtered or distorted either intentionally or unintentionally.
- The intermediate person may pass an incomplete or incorrect message due to a lack of understanding of the user's needs,
- There could be a political reason for the user and developer not getting directly connected.

There are **twelve indirect methods** proposed to collect information from the potential users:

1. MIS Intermediary

- Here the mediating person may be from the Management Information Services department. He defines the user goals and requirements to the designer.
- The disadvantage here is that the mediating person may not have the in-depth knowledge of all the user requirements.

2. Paper Survey or Questionnaire

- Here a questionnaire or survey is given to the user in the form of short answer or multiple-choice questions.
- The questions will be framed by experienced designers.
- The questions may help in finding the user's attitudes, feelings, or expressions but the actual tasks and behaviors cannot be understood.

3. Electronic Survey or Questionnaire

- A questionnaire or survey is given to a set of users via e-mail or the Web.
- This survey is less expensive and faster that the paper survey.

4. Electronic Focus Group

- Here the collection of information and advantages are similar to the traditional focus group but the information is obtained electronically by e-mail or a Web site.
- The group discussion is less influenced by group dynamics.
- The participation from all the people in the group is even.
- More information can be collected in a shorter time.
- The disadvantage is that the depth and richness of face-to-face discussions does not exist.

5. Marketing and Sales

- Here the needs of the users is collected by the company representatives who visit the sites regularly so is inexpensive.
- But the business representatives may not have the knowledge of the nature of customers, the business, and the requirements.

- The representatives may filter needed information or add some unimportant information.

6. Support Line

- Here the information collection is only when there are problems, so the sources are customer care team, help-desk and so on.

7. E-Mail, Bulletin Boards, or Guest Book

- Here the information collection is in the form of problems, questions, and suggestions by users posted to a bulletin board, a guest book, or through e-mail are collected and evaluated.
- Here also the focus is only on problems.
- This information depends on the recommendations generated by the users who are most of the time unhappy users.
- This method is an inexpensive method.

8. User groups

- Here the information in the form of Improvements suggested by customer groups is taken periodically the software usage is evaluated.
- If properly organized, the user groups can provide a lot of important information,

9. Competitor Analysis

- Reviews of competitor's products, or Web sites, can also be used to gather ideas.
- The designers can perform this evaluation or, even better, users can be asked to perform the evaluation

10. Trade Show

- Expert customers attending a trade show will be exposed to a prototype, so they can provide a superficial view of the important features.

11. Other Media Analysis

- Here the information on the media in the form of print or broadcast or other process in which it is resented may be used to collect ideas and design requirements.

12. System Testing

- Here, the system test results which give the new requirements can be gathered, evaluated, and implemented if needed.

3.1.2 Defining The Domain

The domain knowledge about the system to be developed can be collected from domain experts or partially by reviewing documentation from the old manual process or the current computer system.

3.1.3 Considering the Environment

- The environment where the system is going to be used is considered before the system design.
- Physical environment considers issues like lighting, temperature, and other issues.
- Safety environment considers health issues and hazards.
- Social environment considers issues related to user's interaction with each other.
- Organizational environment the integration all the people in the network and the technology.

3.1.4 Possible Problems in the requirements collection

The requirement collection may be hindered due to the following reasons:

- The number of users and customers involved may be less.
- Management and coordination during requirement collection may be less.
- Participants may not communicate properly
- Difficulties may be faced during the collection of relevant information.
- People with relevant information may not be available due to heavy workload.

3.2 Determining the Basic Business Functions

The Basic Business Functions are determined in order to understand and describe **the functionality of the product.** These functions are determined by performing the following **tasks**.

- Understanding the User's work
- Developing conceptual models

3.2.1 Understanding User's work

In this phase of the interface design, **the aims and goals of the people using the system** are described in order to provide the necessary functionality.

Task Analysis:

- Helps in meeting the goals of the users.
- Makes the designer understand the functionality of the computer.
- Describe the user activities and the ways of performing them.
- Uses the mental model of the user.
- Provides information concerning workflows such as,
    - The interrelationships between people, objects, and actions
    - The user's conceptual frameworks.

Mental Models: Enable a person to understand, explain and do things
These are a representation of a person's understanding of,

- Their own self
- Other people
- The environment
- Things with which they interact.

Performing a Task Analysis:

Performed by breaking down the user's activities to the individual task level. **Goal** is to find out **why** and **how** user's do the jobs manually which are to be automated.

- Knowing **why** establishes **work goals.**
- Knowing **How** provides the **details of actions to be performed**.

Figure 2.2 shows the task analysis phase in the development of a business system where the system designer tries to understand all the user tasks and interactions through direct observation of the working environment, taking interviews and questionnaire and making measurements of the required system parameters.

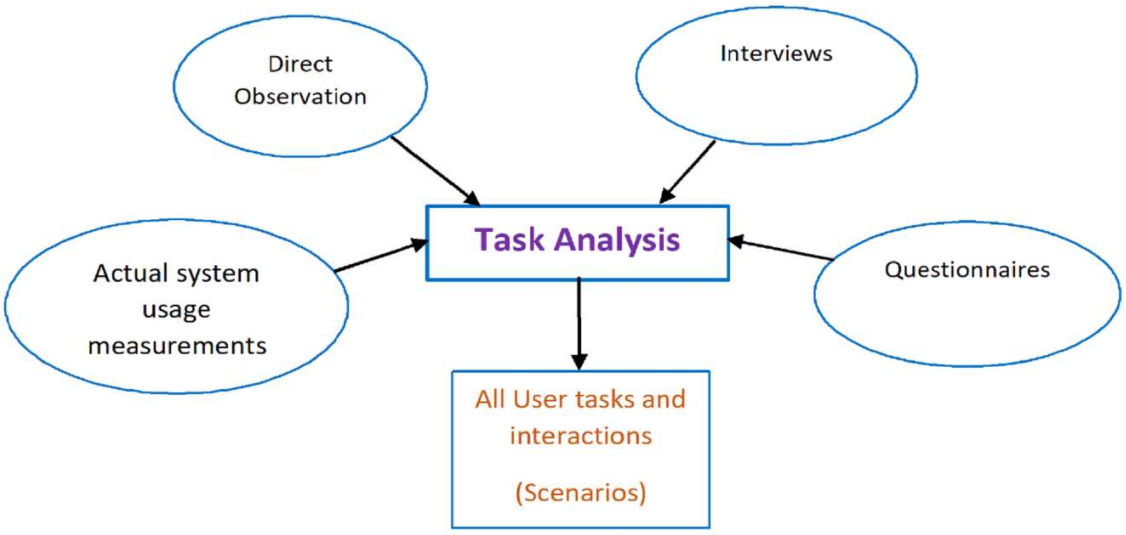

Fig. 2.2 Performing Task Analysis

Scenarios:

- These are descriptions of all the actions taken by the users while completing a task.
- They help the designers to conclude and reason about, the effect of the activities and their flow on interface design.
- Their accuracy can be verified by testing them with users.
- They can be used throughout the conceptual design process to guide and evaluate iteratively the completeness of the requirements.
- Scenarios can also be refined throughout the conceptual design process.

According to researcher Straub's article in 2004, scenarios play a very important role at several levels in the early stages of conceptual design:

- They provide a "real world" task level description of the motivation and events that trigger tasks and workflow as users navigate to task completion.
- They provide a connection between developers working on different modules of the interface.
- They provide a common ground for communicating the needs of the users to the developers who will then create a system model.

3.2.2 Developing conceptual models

A conceptual model is a **framework** which shows the **system's functions**. This model is the **output** of the **task analysis** stage.

- This model describes how the interface will present objects, the relationships between objects, the properties of objects, and the actions that will be performed.
- The model is based on the user's existing mental model.
- The conceptual model when presented to a user, a new useful system mental model is created.
- The system mental model is based upon the system's behavior, which include factors like system inputs, actions, outputs (including screens and messages), and its feedback and guidance characteristics.

Guidelines for Designing Conceptual Models

The model should reflect the user's mental model.

- Draw physical analogies or present metaphors.
- Comply with expectancies, habits, routines, and stereotypes.
- Provide action-response compatibility.
- Make invisible parts and processes of a system visible to create a correct mental model.
- Provide proper and correct feedback.
- Avoid anything unnecessary or irrelevant.
- Provide design consistency.
- Provide documentation and a help system that will reinforce the conceptual model.
- Promote the development of both novice and expert mental models.

3.2.3 The User's New Mental Model

When a new system is implemented and presented to a user, the person interacts with the new system and its interface and tries to understand the system based upon the existing mental model.

The user's mental model gets reinforced and a feeling of the user's mental model is reinforced interface intuitive is developed if the designer has correctly reflected the user's mental model in design.

With a continued interaction with the system, the user's concept of the system will get influenced and his or her mental model may be modified. Refinement of this mental model, is aided by well-defined distinctions between objects and by being consistent across all aspects of the interface.

Documentation and training will be provided when a gap exists between the conceptual model and the mental model the user would bring to the new system.

Design Standards or Style Guides

In interface design, design standards describe the appearance and behavior of the interface. They provide guidance on the proper use of system components also define the interface principles, rules, guidelines, and conventions that must be followed in detailed design. Design standards or guidelines help in achieving design consistency.

Benefits of Design Standards or Style Guides to the users

- Allow faster performance.
- Reduce errors.
- Reduce training time.
- Foster better system utilization.
- Improve satisfaction.
- Improve system acceptance.
- Reduce development and support costs.

Benefits of Design Standards or Style Guides to the developers

- They are valuable to system developers because they
- Increase visibility of the human-computer interface.
- Simplify design.
- Provide more programming and design aids, reducing programming time.
- Reduce redundant effort.
- Reduce training time.
- Provide a benchmark for quality control testing

Some Commercial Style Guides

- Apple Human Interface Guidelines for the Macintosh
  http://developer.apple.com/documentation/UserExperience/Conceptual/OSXHIGuidelines
- IBM Ease of Use Web site
  www-03.ibm.com/easy/page/558
- Microsoft Windows XP User Interface Guidelines
  http://www.microsoft .com
- Sun Microsystems Java Look and Feel Design Guidelines
  http://java.sun.com/products/jlf/ed2/book/HIGTitle.html

Summary:

This unit provides us with a set of guidelines for the interface design process which include fourteen development steps typically followed in creating graphical system's or Web site's screens and pages. In this unit, the two chapters discuss about the first two steps which include, knowing the user and understanding the business functions respectively.

MCQs [All 1 mark]

Q1. Which one of the following is not a factor that a designer considers to understand how users interact with a computer?

a. The Human Action Cycle
b. Trouble using the computer by the users
c. Knowledge of the user about the hardware of the system
d. The tasks performed by the users

Q2. Which of the following is not a psychological response of people to poor design?

a. Confusion
b. Annoyance
c. Errors during tasks.
d. Frustration

Q3. Which of the following is not a physical response of people to poor design?

a. Abandonment of the system
b. Compensatory activity
c. Modification of the task
d. Boredom

Q4. Which of these is not an attribute influencing interface design?

a. Perception
b. Memory
c. Visual acuity
d. Experience of the user

Q5. Which of the following is not a psychological characteristic of the user to be considered in the interface design?

a. Attitude
b. Patience
c. Age
d. Cognitive Style

Q6. Which of the following is not a physical characteristics of the user to be considered in the interface design?

a. Gender
b. Stress
c. Handedness
d. Disability

Q7. Web interface design is complex because,

a. Design language has limited objects and interaction styles
b. Browser navigation takes time
c. Information architecture and work flow cannot be standardized.
d. All the above

Q8. Which of the following is not a characteristic of Web Interface

a. Responsiveness
b. Reactive
c. Security
d. Reliability

Q9. Which of the following statements is false about Web page design

a. User hardware variations are limited.

b. User focus is on navigation and information

c. Data is not private

d. Response time depends on transmission speeds.

Q10. Which of the following statements is false about Web pages

a. Fixed page size.

b. Page rendering is slow

c. Page resolution is less

d. Pages are viewed randomly

Q11. Which of the following is / are the principles of User Interface Design

a. Accessibility

b. Availability

c. Configurability

d. All the above

State whether the following statements are True or False [All 1 mark]

Q1. There are two types of responses by the user to a poor design: Psychological and Physical.

Q2. As the flexibility of a system increases, its usability decreases.

Q3. Use of Jargon makes it difficult to use a system.

Q4. Interaction speeds are considered in the interface design process based on the performance and preferences of the users.

Q5. The main goal of a Web Page Design is to collect and process data.

Q6. The main goal of a Web Application Design is to provide information.

Descriptive Questions:

Q1. What are the two steps followed by the designer in the interface design process? [2M]

Q2. Briefly explain the four factors considered by the designers in understanding how a user interacts with a computer. [8M]

Q3. What are the three stages in which human action is performed while interacting with a computer? [6M]

Q4. Explain any three factors causing difficulty in using a computer system. [6M]

Q5. List the design inconsistencies leading to poor usability of a system. [4M]

Q6. Discuss the physical and psychological user responses to poor design. [8M]

Q7. Explain any four important human characteristics or attributes influencing interface design. [8M]

Q8. What are the methods used in interface design to reduce the memory load on the users [5M]

Q9. Explain any four types of interferences obstructing the higher-level processing in the context of the screen design. [8M]

Q10. In the context of user interfaces, how does learning benefit the user? [2M]

Q11. What is performance load in the context of screen design? List the two types of performance loads and briefly explain how they can be reduced. [5M]

Q12. Discuss the four user characteristics to be considered in the design of business systems. [8M]

Q13. Compare performance with preference in the context of interaction speed considerations during the interface design process. [4M]

Q14. What are the sub-phases in the business definition and analysis phase of the business system design? [2M]

Q15. Explain any four direct methods of information collection techniques during business system design. [8M]

Q16. Explain any four indirect methods of information collection techniques during business system design. [8M]

Q17. Explain the two tasks involved in determining the business functions. [8M]

Q18. What are design standards and guidelines? What are their benefits to the users and designers? [6M]

Answers to MCQs:

1	2	3	4	5	6	7	8	9	10	11
c	c	d	d	c	b	D	b	a	A	d

Answers to True/False Questions:

1	2	3	4	5	6
T	T	T	T	F	F

References:

[1] Wilbert O. Galitz, “The Essential Guide to User Interface Design”, 3rd Edition, Wiley

[2] https://pixabay.com/images/search/human%20computer%20interaction/ (Fig. 2.1)

[3] https://developer.mozilla.org/en-US/docs/Glossary/World_Wide_Web