Unit III

3 HCI Models and Theories

3.1 User Profiles and Categorization of Users

Q.1 Describe briefly about user profiles.

Ans. :

- User profiling involves gaining an understanding and building a profile of the final users of the system in terms of age, gender, socio economic background, abilities, knowledge, skill sets, frequency, interest and any other relevant information.
- It included the process of establishing knowledge about the users to find out who users are, such as children, elderly, professional, male or female all the possibilities.
- It is important when your interface, website or object has multiple audiences, profiling will reveal potential clashes of interest. For instance, an educational website when viewed by parents, teachers and children will have to cater for each groups' different perspectives.
- The user is whoever is trying to get the job done using the technology. An appreciation of the way people's sensory systems (sight, hearing, touch) relay information is vital to design a first-class product.
- For example, display layouts should accommodate the fact that people can be side tracked by the smallest movement in the outer (peripheral) part of their visual fields, so only important areas should be specified by moving or blinking visuals. And of course,

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people like designs that grab their attention. Designers must decide how to make products attractive without distracting users from their tasks.

Q.2 Explain the following :

a) Designing for diversity

b) Differences between user groups

Ans. :

a) Designing for diversity :

- In this world we have wide range of human abilities, backgrounds, motivations, personalities and intelligence presents major challenges for interactive system designers.
- They need to have an understanding of :
  - Physical characteristics
  - Cognitive and perceptual abilities
  - Personality differences
  - General abilities
- These are all characteristics, which apply to people in general, we shall also consider characteristics, which apply specifically to potential system users.

b) Differences between user groups :

- Consider the design of a check-out system for a large supermarket and the design of a counter system for a high-street building society.
- Talk to the person next to you and make a list of some of the differences between the groups of people who will use each system.
- List also how these differences could affect design decisions about each system.

Q.3 Observe skilled and novice operators in a familiar domain: for example, touch and 'hunt-and-peck' typists, expert and novice game players or expert and novice users of a computer application. What differences can you discern between their behaviors ?

☞ **[SPPU : Dec.-19, End Sem, Marks 5]**

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Ans. :

- The level of experiences between these two groups greatly differs from each other. Skilled or expert operators do better compared to the novice ones (of course).
- A novice operator needs to manage more information when learning a new skill whether a move or a technique for the computer application and consequently possesses less attention ability.
- Novices are more likely to experience anxiety during unfamiliar situations because they have lesser gone through compared to the experts.
- Skilled operators are better able to correct for extraneous influences on motor skill. For example, a skilled game player may have a greater chance of defeating the monster in the game compared to a novice player since he needs to master all the techniques needed to kill the hideous monster in the game.
- Touch typist's yields greater jobs done compared to a hunt-and-peck typists. Skilled operators can separate pertinent cues. They specifically know what information to attend to and are better able to focus in on these cues.
- Captivatingly, expert operators are better able to detect false cues as compared to novice operators. Better to say, expert or skilled operators has longer exposures to these technologies that is why they manage to do their pertinent tasks in an instant.

Q.4 List and explain categorization of users. Explain any two.

Ans. : There are a number of ways to categorize users :

i) Primary and secondary users

ii) 3 D framework

iii) Occupational categories

iv) Simple classification

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Primary and secondary users :

- Primary (direct) user : The person, who actively uses the site. For example airline reservation clerk, Help desk staff.
- Secondary (indirect) user : The person being served by a primary user. For example Airline passenger and Customer, who called the support line.

Simple categorisation of users :

- These are Novice users.
- No syntactic knowledge, little semantic knowledge.
- May have little task knowledge.
- May have anxieties about computer use.
- Knowledgeable intermittent users.
- Can maintain semantic knowledge of task and computer concepts.
- Requirements for consistency of structures in interaction so that user inferences are supported.
- Good help facilities and documentation are required.

Frequent users

- Well trained in semantic and syntactic aspects.
- Rapid response time.
- Brief feedback.
- Abbreviated command sequences.
- Accelerators to move through dialogue sequences.

3.2 Goal and Task Hierarchy Model

Q.5 What is GOMS ? List and explain elements of GOMS.

Ans. :

- The GOMS is an acronym for goals, operators, methods and selection. GOMS is a task analysis technique.
- GOMS is family of user interface modeling techniques.

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- The GOMS model has four components : goals, operators, methods and selection rules.

1. **Goals** - Tasks are deconstructed as a set of goals and subgoals. GOMS the goals are taken to represent a 'memory point' for the user.
2. **Operators** - Tasks can only be carried out by undertaking specific actions. Example : To decide which search engine to use.
3. **Methods** - It represent ways of achieving a goal. Example : drag mouse over field.
4. **Selection rules** - The method that the user chooses is determined by selection rules.

Q.6 Create a GOMS description of the task of photocopying a paper from a journal. Discuss the issue of closure in terms of your GOMS description.

☞ **[SPPU : May-18, End Sem, Marks 9]**

Ans. :

- One possible GOMS description of the goal hierarchy for this task is given below. Answers will vary depending on assumptions about the photocopier used as the model for the exercise.
- In this example, we will assume that the article is to be copied one page at a time and that a cover over the imaging surface of the copier has to be in place before the actual copy can be made.

Goal : PHOTOCOPY-PAPER

Goal : LOCATE-ARTICLE

Goal : PHOTOCOPY-PAGE repeat until no more pages

[**Select Goal :** SELECT-PAGE --> CHOOSE-PAGE-TO-COPY]

Goal : ORIENT-PAGE

OPEN -COVER

POSITION-PAGE

CLOSE-COVER

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PRESS-BUTTON

Goal : VERIFY-COPY

LOCATE-OUT-TRAY

EXAMINE-COPY

Goal : COLLECT-COPY

LOCATE-OUT-TRAY

REMOVE-COPY (outer goal satisfied!)

Goal : RETRIEVE-JOURNAL

OPEN-COVER

REMOVE-JOURNAL

CLOSE-COVER

Selection rules exist **if a spoiled copy was printed. Consider the following :**

Rule 1 : SELECT-PAGE **if last page was copied successfully or start of article.**

Note : The goal SELECT-PAGE is only valid if we are at the start of the article or the last copy was successful. If the last copy was spoiled the we must recopy the current page, so only a re-orientation would be required.

Goal : PHOTOCOPY-PAPER

Goal : LOCATE-ARTICLE

Goal : PHOTOCOPY-PAGE repeat until no more pages

[**Select Goal :** SELECT-PAGE --> CHOOSE-PAGE-TO-COPY]

Goal : ORIENT-PAGE

OPEN -COVER

POSITION-PAGE

CLOSE-COVER

PRESS-BUTTON

Goal : VERIFY-COPY

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LOCATE-OUT-TRAY

EXAMINE-COPY

Goal : RETRIEVE-JOURNAL

OPEN-COVER

REMOVE-JOURNAL

CLOSE-COVER

Goal : COLLECT-COPY

LOCATE-OUT-TRAY

REMOVE-COPY (outer goal satisfied!)

- Closure to Outer Goal, must force user to collect copy last

Q.7 Explain advantages and disadvantages of GOMS.

Ans. : Advantages :

1. Easy to construct a simple GOMS model and saves time
2. Helps discover usability problems.
3. Gives several qualitative and quantitative measures.
4. Less work than usability study.

Disadvantages :

1. Only work for goal directed tasks.
2. Not for the novice user
3. Not ideal for leading edge technology systems
4. Not as easy as heuristics analysis, guidelines.

Q.8 Goals are accomplished by methods consisting of operators which are identified by selection rules. Illustrate this for following goals.

i) To delete a sentence in a graphical text editor.

ii) To close window in a graphical text editor.

☞ **[SPPU : Dec.-17, End sem, Marks 9]**

Ans. : i) to delete a sentence in a graphical text editor :

GOAL : DELETE SENTENCE IN A GRAPHICAL TEXT EDITOR

Method_for_goal: MENU-METHOD-DELETE SENTENCE

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Step 1 : HIGHLIGHT SENTENCE

Step 2 : OPEN MENU

Step 3 : SELECT DELETE-COMMAND

Step 4 : Accomplish_goal MENU-METHOD-DELETE SENTENCE

Method_for_goal: DEL-KEY-METHOD-DELETE SENTENCE

Step 1 : POSITION-CURSOR AT END

Step 2 : PRESS DELETE FOR EACH LETTER

Step 3 : Accomplish_goal DEL-KEY-METHOD-DELETE SENTENCE

Selection_rules_for_goal : DELETE SENTENCE

If [long sentence] Then Accomplish_goal: MENU-METHOD-DELETE SENTENCE

If [short sentence] Then Accomplish_goal: DEL-KEY-METHOD-DELETE SENTENCE

ii) to close window in a graphical text editor

- When we have a window interface that can be closed in either of the two methods: by selecting the 'close' option from the file menu or by selecting the Ctrl key and the F4 key together.
- Model the task of "closing the window in a graphical text editor".
- Here, we have the high level goal of "close window" which can be achieved with either of the two methods: "use menu option" and "use Ctrl+F4 keys".
- This is unlike the previous example where we had only one method for each goal.
- We use the "Select" construct to model such situations (next slide)

  Goal : Close window

  [Select Goal : Use menu method

  Operator : Move mouse to file menu

  Operator : Pull down file menu

  Operator : Click over close option

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Goal : Use Ctrl+F4 method

Operator : Press Ctrl and F4 keys together]

- The select construct implies that "selection rules" are there to determine a method among the alternatives for a particular usage context.
- Example selection rules for the window closing task can be
  - Rule 1: Select "use menu method" unless another rule applies
  - Rule 2 : If the application is GAME, select "use Ctrl+F4 method"
- The rules state that, if the window appears as an interface for a game application, it should be closed using the Ctrl+F4 keys Otherwise, it should be closed using the close menu option.

Q.9 What is cognitive complexity theory ?

Ans. :

- Cognitive complexity theory, introduced by Kieras and Polson, begins with the fundamental premises of goal breakdown from GOMS and enriches the model to offer added predictive power.
- CCT has two parallel descriptions : one of the user's goals and the other of the computer system (called the device in CCT). For the system grammar, CCT apply *generalized transition networks*, a form *of state transition network.*
- The description of the user's goals is based on a GOMS-like goal hierarchy, but is expressed primarily using *production* rules.
- The production rules are a sequence of rules :

  if condition then action

- Where, *condition* is a statement about the contents of working memory. If the condition is true then the production rule is said to fire. An *action* may consist of one or more elementary actions, which may be either changes to the working memory or external actions such as keystrokes.

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- As an example, consider an editing task using the UNIX vi text editor. The task is to insert a space where one has been missed out in the text. The fragment of the associated CCT production rules can be as below.

```
(SELECT-INSERT-SPACE
IF (AND (TEST-GOAL perform unit task)
 (TEST-TEXT task is insert space)
 (NOT (TEST-GOAL insert space))
 (NOT (TEST-NOTE executing insert space)))
THEN ( (ADD-GOAL insert space)
 (ADD-NOTE executing insert space)
 (LOOK-TEXT task is at %LINE %COL) ))
 (INSERT-SPACE-DONE
IF (AND (TEST-GOAL perform unit task)
 (TEST-NOTE executing insert space)
 (NOT (TEST-GOAL insert space)) )
THEN ( (DELETE-NOTE executing insert space)
 (DELETE-GOAL perform unit task)
 (UNBIND %LINE %COL) ))
 (INSERT-SPACE-1
IF (AND (TEST-GOAL insert space)
 (NOT (TEST-GOAL move cursor))
 (NOT (TEST-CURSOR %LINE %COL)))
THEN ( (ADD-GOAL move cursor to %LINE %COL) ))
 (INSERT-SPACE-2
IF (AND (TEST-GOAL insert space)
 (TEST-CURSOR %LINE %COL))
THEN ( (DO-KEYSTROKE 'I')
 (DO-KEYSTROKE SPACE)
 (DO-KEYSTROKE ESC)
 (DELETE-GOAL insert space))
```

- To see how these rules work, imagine that the user has just seen the typing mistake and thus the contents of working memory (w.m.) are,

```
(GOAL perform unit task)
(TEXT task is insert space)
(TEXT task is at 5 23)
(CURSOR 8 7)
```


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- TEXT uses the text of the document that is being edited and CURSOR refers to the placing cursor on the screen. The position (5, 23) is the line and column of the typing error where the space is required. However, the present cursor location is at line 8 and column 7.
- So, the rule fires and its action is performed. This action has no external effect in terms of keystrokes, but adds extra information to working memory.
- The rules in CCT must not represent error-free performance. They can be utilized to explain error phenomena, even if they cannot predict them. The CCT rules are closely related to GOMS-like goal hierarchies; the rules may be generated from such a hierarchy or alternatively, it may analyze the production rules to obtain the goal tree.
- In fact, the CCT rules can characterize more difficult plans than the simple sequential hierarchies of GOMS. However, one should regard CCT as an engineering tool giving one a rough measure of learnability and difficulty combined with a detailed description of user behavior.

Q.10 Discuss the key differences between KLM and (CMN)GOMS.

☞ **[SPPU : May-19, End sem, Marks 9]**

Ans. :

- KLM is related to the GOMS model and can be thought of as a very low-level GOMS model where the method is given.
- The key difference between GOMS and KLM is how time is assigned to cognitive and perceptual operators when it comes to execution time predictions.
- Another major difference is that the goal hierarchy is explicit in GOMS while it was implicit in the KLM.
- The nature of unobservable operators is another important difference. KLM has a single M operator that precedes each cognitive unit of action. In contrast, GOMS assigns no time to such cognitive overhead.

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- In (CMN)GOMS, a hierarchical cognitive (thought) process is assumed, as opposed to the linear thought process of KLM.
- (CMN)GOMS allows us to model the task and user actions in terms of four constructs (goals, operators, methods, selection rules)
- In KLM, only seven operators are defined. In (CMN)GOMS, the notion of operators is not restricted to those seven.
- KLM Contains several simplifying assumption. In (CMN) GOMS, slightly more specified that general GOMS and hierarchical goal structure and methods in program form.

3.3 Linguistic Model

Q.11 Write short note on linguistics models.

Ans. :

- Linguistic models represent the user-system grammar. Understanding the user's behaviour and cognitive difficulty based on analysis of language between user and system.
- Backus–Naur Form (BNF) and Task–Action Grammar (TAG) are used to represent this model.

Backus- Naur Form

- BNF can be used to define the syntax of a language.
- It is based on techniques developed for use with natural languages, but was specifically designed for use with computing languages.
- BNF defines a language in terms of terminal symbols, syntactic constructs and productions.
- Terminal symbols are the elementary symbols of the language, such as words and punctuation marks.
- In the case of computing languages, these may be variable -names, operators, reserved words, etc.
- Syntactic constructs (or non-terminal symbols) are phrases, sentences, etc.

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- In the case of computing languages, these may be conditions, statements, programs, etc.

TAG :

- Task–action grammar (TAG) attempts to deal with some of these problems by including elements such as parametrized grammar rules to emphasize consistency and encoding the user's world knowledge.
- In BNF, three UNIX commands would be described as :

  copy ::= cp + filename + filename | cp + filenames + directory

  move ::= mv + filename + filename | mv + filenames + directory

  link ::= ln + filename + filename | ln + filenames + directory
- No BNF measure could distinguish between this and a less consistent grammar in which

  link ::= ln + filename + filename | ln + directory + filenames
- Consistency of argument order made explicit using a parameter or semantic feature for file operations
- Feature possible values : Op = copy; move; link
- Rules

  file-op[Op] ::= command[Op] + filename + filename |
  command[Op] + filenames + directory

  command[Op = copy] ::= cp

  command[Op = move] ::= mv

  command[Op = link] ::= ln

3.4 Physical and Device Models

Q.12 Explain keystroke-level model.

Ans. :

- The keystroke-level model (KLM) predicts how long it will take an expert user to accomplish a routine task without errors using an interactive computer system

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- The actions are termed keystroke level if they are at the level of actions like pressing keys, moving the mouse, pressing buttons.
- There is a standard set of operators for use in the KLM, whose execution times have been estimated from experimental data.
- The following is a step-by-step description of how to apply the KLM to estimate the execution time required by a specified interface design :

1. Choose one or more representative task scenarios.
2. Have the design specified to the point that keystroke-level actions can be listed for the specific task scenarios.
3. For each task scenario, figure out the best way to do the task or the way that you assume users will do it.
4. List the keystroke-level actions and the corresponding physical operators involved in doing the task.
5. If necessary, include operators for when the user must wait for the system to respond.
6. Insert mental operators for when user has to stop and think.
7. Look up the standard execution time to each operator.
8. Add up the execution times for the operators.
9. The total of the operator times is the estimated time to complete the task.

- The model decomposes the execution phase into five different physical motor operators, a mental operator and a system response operator :
  - **K :** Keystroking, actually striking keys, including shifts and other modifier keys.
  - **B :** Pressing a mouse button.
  - **P :** Pointing, moving the mouse (or similar device) at a target.
  - **H :** Homing, switching the hand between mouse and keyboard.
  - **D :** Drawing lines using the mouse.

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- **M :** Mentally preparing for a physical action.
- **R :** System response which may be ignored if the user does not have to wait for it, asin copy typing.

Q.13 Explain limitations of keystroke-level model.

Ans. :

- It measures only one aspect of performance : time, which means execution time and not the time to acquire or learn a task.
- It considers only expert users. Generally, users differ regarding their knowledge and experience of different systems and tasks, motor skills and technical ability.
- It considers only routine unit tasks.
- The method has to be specified step by step.
- The execution of the method has to be error-free.
- The mental operator aggregates different mental operations and therefore cannot model a deeper representation of the user's mental operations. If this is crucial, a GOMS model has to be used.

Q.14 KLM (key - stroke - level) model predicts expert error - freetask completion time (human performance) with interactive computing systems. Total predicted time for a task is given by the equation. $t_{EXECUTIVE} = t_K + t_P + t_H + t_D + t_M + t_R$. What does each of the above timing represent ? Develop a KLM model and predict time for the completion of the task "Change font and style for the word "KLM" to bold, Arial" using mouse only.

☞ **[SPPU : May-18, Marks 9]**

Ans. :

- A task is broken into a series of subtasks. Total predicted time is the sum of the subtask times :

$$t_{EXECUTE} = t_K + t_P + t_H + t_D + t_M + t_R$$

- Operators :

K → keystroking, P → pointing, H → homing

D → drawing, M → mental prep, R → system response

Task : Change the font and style for word "KLM" to bold, Arial.

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- **Operations :**

Mouse Subtasks	KLM Operators	t_p(S)
Drag across text to select "KLM"	M P [2.5, 0.5]	0.686
Drag pointer to Bold button and click	M P [13, 1]	0.936
Move pointer to Font drop – down button and click	M P [3.3, 1]	0.588
Move pointer down list to Arial and click	M P [2.2, 1]	0.501
	$\Sigma t_p =$	2.71

- **Prediction :**

$$t_{EXECUTE} = 4 \times t_M + \Sigma t_p = 4 \times 1.35 + 2.71 = 8.11 \text{ seconds}$$

- **Operations :**

Keyboard Subtasks
Select text
Convert to boldfaoo
Activate Format menu and enter Font sub – menu
Type a ("Arial" appears at top of list)
Select "Arial"

$$t_{EXECUTE} = 4 \times t_M + 12 \times t_K = 4 \times 1.35 + 12 \times 0.75 = 14.40 \text{ seconds}$$

Use "typing complex codes" ($t_K = 0.75$ s)

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3.5 Norman's 7 Stage Model

Q.15 What are the Norman's seven principles for transforming difficult tasks into simple ones ?

☞ [SPPU: Aug-17, In Sem, May-19, End Sem, Marks-8]

Ans. :

- Donald Norman's seven stage of interaction are as follows :
  1. Establishing the goal.
  2. Forming the intention.
  3. Specifying the action sequence.
  4. Executing the action.
  5. Perceiving the system state.
  6. Interpreting the system state.
  7. Evaluating the system state with respect to the goals and intentions
- **Stage 1 is Forming a Goal.** This is what you want. As an example, I might want a place that I can relax outside that will not get muddy and that I do not have to move my outdoor furniture around to mow.
- **Stage 2 is Forming the Intention.** This is what would satisfy the goal. A deck would satisfy my goal of place to relax outdoors that will not get muddy or be in the way of mowing.
- **Stage 3 is Specifying an Action.** What do I have to do to achieve the intention ? I would need to build a deck to meet the requirement set in my goal.
- **Stage 4 is Executing the Action.** Here I would do the steps of the action. I would build the deck.
- **Stage 5 is Perceiving the State of the World.** Using the senses to gather information. My finished deck would be off the ground and have my outdoor furniture on it.

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- **Stage 6 is Interpreting the State of the World.** What has changed ? My furniture is off the ground away from the mud and no longer has to be moved to mow the lawn.
- **Stage 7 is Evaluating the Outcome.** Did I achieve my goal ? I can relax outdoors now without worrying about mud or moving furniture. I achieved my goal.

3.6 Cognitive Architectures

Q.16 Explain Interacting Cognitive Subsystems (ICS) model.

Ans. :

- The Interacting Cognitive subsystems model is based on detailed cognitive experimentation which suggests that the human mind works by different subsystems passing information from one to another and copying it in the process.
- In this way, each subsystem has its own memory. Different systems operate with different coding, for instance, verbal, visual, auditory.
- There are higher order systems that translate these coding and integrate the information.
- The architecture of ICS is built up by the coordinated activity of nine smaller subsystems: five peripheral subsystems are in contact with the physical world and four are central, dealing with mental processes..
- Each subsystem has the same generic structure. A subsystem is described in terms of its typed inputs and outputs along with a memory store for holding typed information
- It has transformation functions for processing the input and producing the output and permanently stored information.
- Each of the nine subsystems is specialized for handling some aspect of external or internal processing.

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- An example of a central subsystem is one for the processing of propositional information, capturing the attributes and identities of entities and their relationships with each other.

3.7 Hierarchical Task Analysis (HTA)

Q.17 Consider the activity of making a telephone call. Record the actions in an HTA diagram or textually. Start off simply, assuming you know the number to dial, but then add more complicated situations: finding the number in an address book or what to do when the number is engaged.

☞ [SPPU : May-18, End Sem, Marks 9]

Ans. :

- As with public payphones :

0. make phone call
1. pick up receiver
2. dial number
3. wait for reply
4. talk
5. replace receiver

Plan 0 : 1 – 2 – 3

when answered – 4

when finished – 5

- We now add looking up the number. The form this takes depends on whether we find the number in an address book or a telephone directory.
- If both fail, say if the call is long distance to someone not in a local directory, the telephone operator must be consulted.

0. make phone call

1. find number

1.1 look in address book

1.2 look in phone directory

1.3 ask operator

1.3.1 pick-up receiver

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2. actually call

    2.1 pick-up receiver

    2.2 dial number

    2.3 wait for reply

    2.4 talk

    2.5 replace receiver

Plan 0 : If number unknown – 1

When number found – 2

Plan 1 : if phoning friend – 1.1

If local call – 1.2

if 1.1 or 1.2 fail – 1.3

Plan 2 : 2.1 – 2.2 – 2.3

When answered – 2.4

When finished – 2.5

Finally, we add the case when the phone is engaged. The simplest way to do this is simply to change Plan 2.

Plan 2 : 2.1 – 2.2 – 2.3

If answered – 2.4 then when finished 2.5

If engaged – 2.5

However, looking at the second line it might suggest that we modify 2.4 to have two parts.

0. make phone call

...

2. actually call

2.4 successful call

2.4.1 talk

2.4.2 replace receiver

2.5 failed call

2.5.1 replace receiver

Plan 2 : 2.1 – 2.2 – 2.3

If answered – 2.4

If engaged – 2.5

Plan 2.4 : 2.4 then finished 2.5

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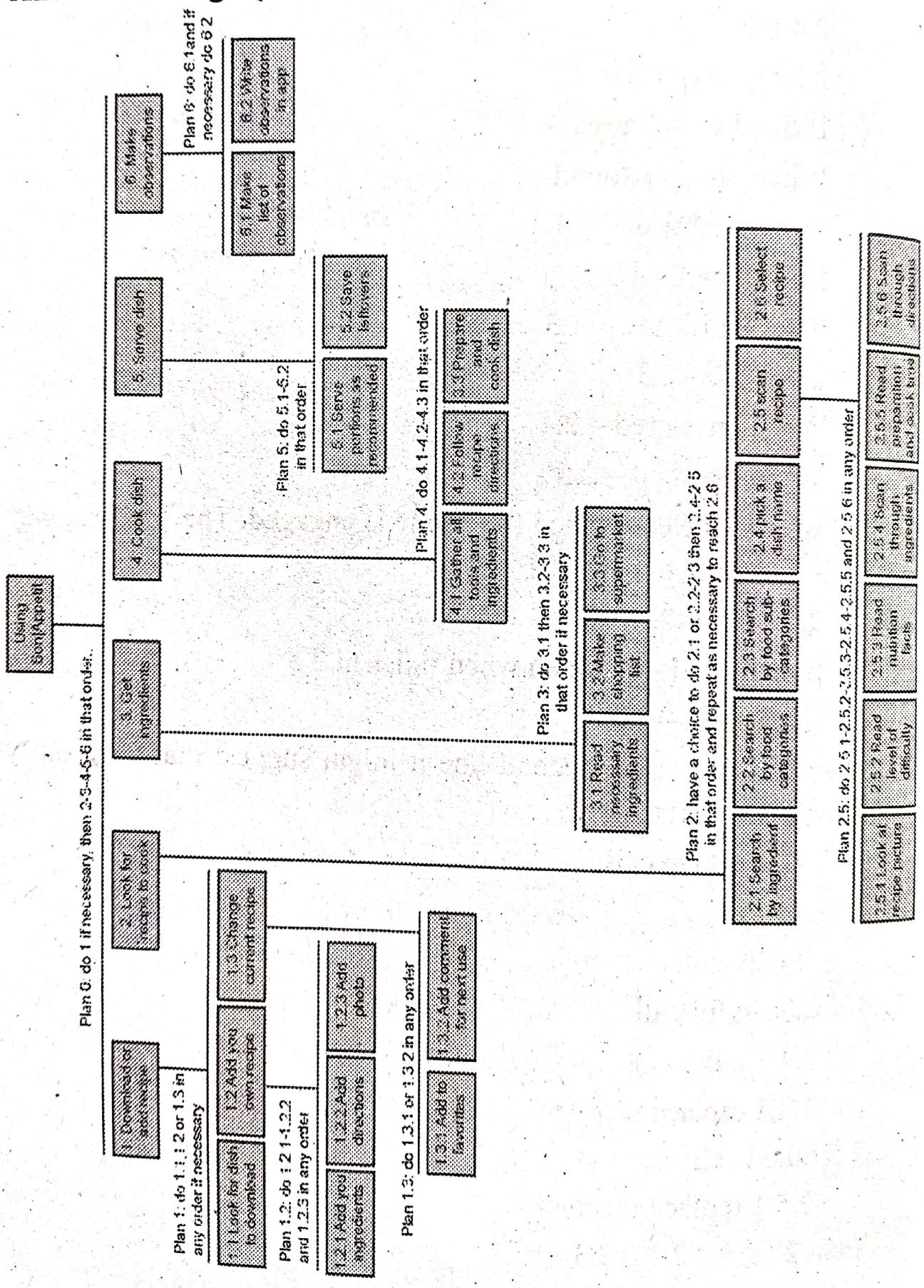
Q.18 A Hierarchical Task Analysis (HTA) provides an understanding of the tasks users need to perform to achieve certain goal. Perform HTA of the task - to cook food (rice). Illustrate using diagram.

☞ **[SPPU : Dec.-17, End sem, Marks 9]**

Ans. : Refer Fig. Q.18.1.



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Q.19 What is hierarchical task analysis ? Explain with example.

Ans. :

- Task analysis is used mainly to investigate an existing situation. Hierarchical task analysis involves breaking a task down into subtasks, then sub-sub-tasks and so on.
- These are grouped as plans which specify how the tasks might be performed in practice.
- HTA focuses on physical and observable actions and includes looking at actions not related to software or an interaction device.
- Start with a user goal which is examined and the main tasks for achieving it are identified. Tasks are sub-divided into sub-tasks.
- Example of Hierarchical Task Analysis

0. In order to buy a DVD
1. locate DVD
2. add DVD to shopping basket
3. enter payment details
4. complete address
5. confirm order

plan 0 : If regular user do 1-2-5.

If new user do 1-2-3-4-5.

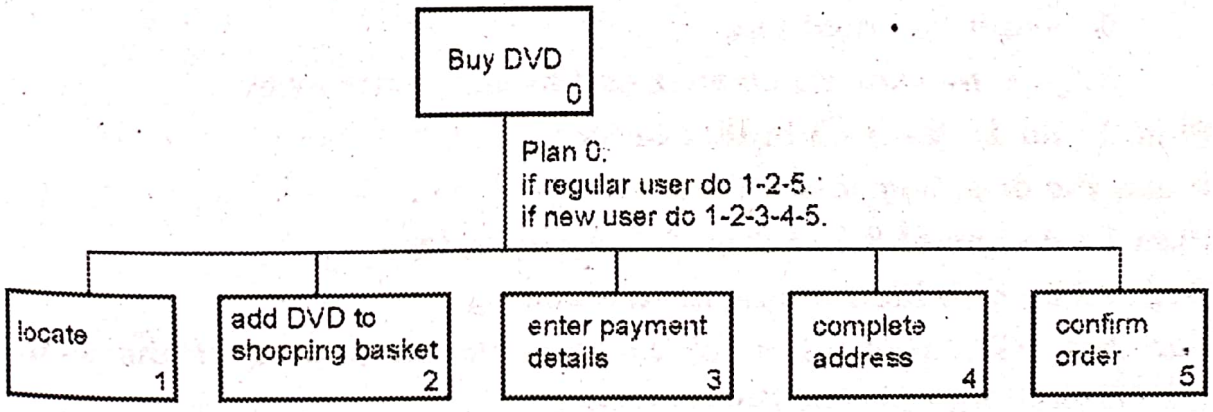

Fig. Q.19.1

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Q.20 Hierarchical task analysis (HTA) is used to describe the interactions between a user and software system. Draw and explain HTA to online bus reservation system.

☞ [SPPU : Dec.-18, End sem, Marks 9]

Ans. :

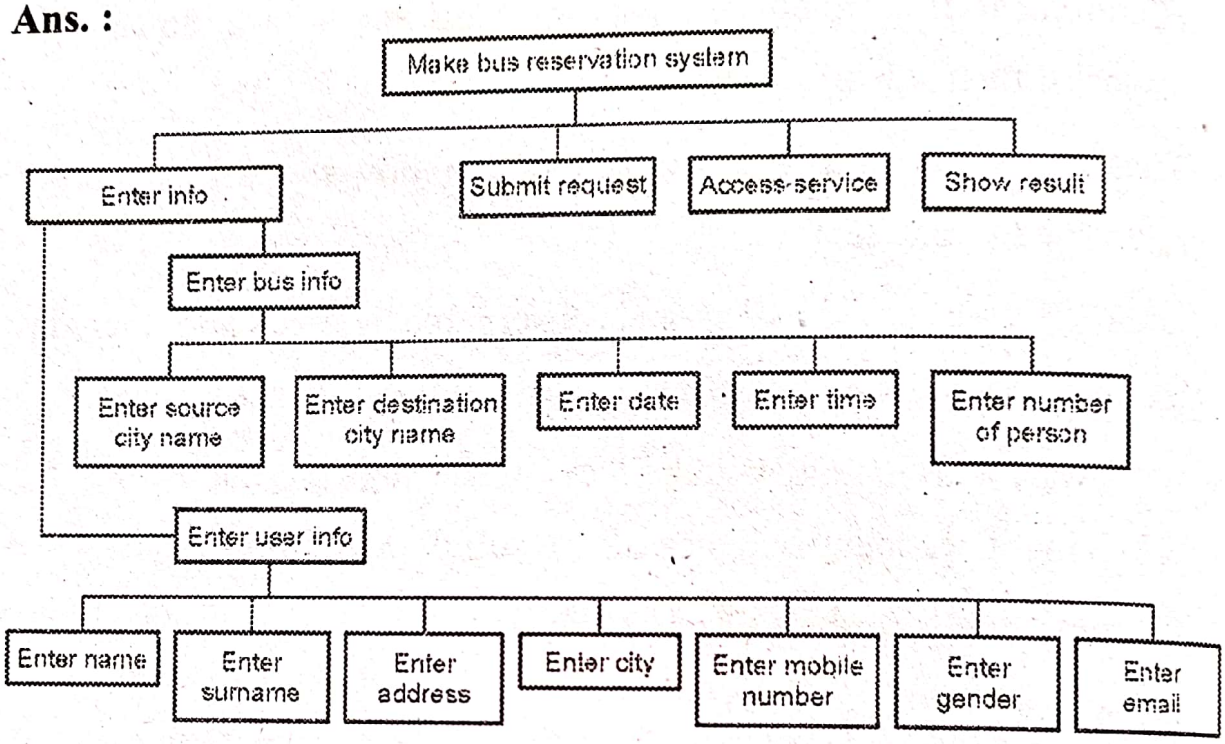

Fig. Q.20.1

Also refer Q.19.

Q.21 In order to clean the house

1. **get the vacuum cleaner out**
2. **fix the appropriate attachment**
3. **clean the rooms**
   - 3.1 **clean the hall**
   - 3.2 **clean the living rooms**
   - 3.3 **clean the bedrooms**
4. **empty the dust bag**
5. **put the vaccum cleaner and attachments away**

Plan 0 : do 1 - 2 - 3 - 5 in that order

When the dust bag gets full do 4

Plan 1 : do any of 3.1, 3.2 or 3.3 in any order

Depending on which rooms need cleaning.

For this HTA description of vaccum cleaning, present the same information in a diagrammatic form.

☞ [SPPU : Dec-19, End Sem, Marks 9]

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Ans. : HTA diagram for vacuum cleaning a house

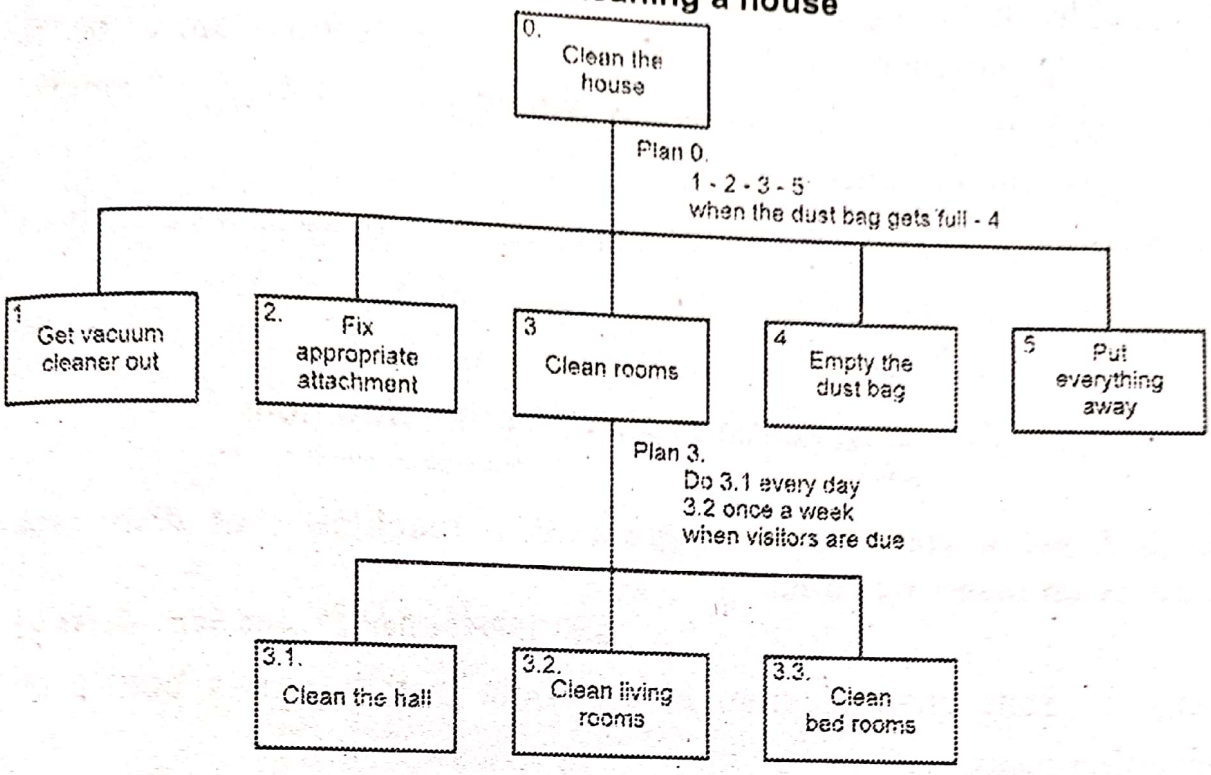

Fig. Q.21.1

3.8 Uses of Task Analysis

Q.22 How the task analysis help in requirements capture and systems design ?

Ans. :

- Task analysis in itself is not a form of requirements capture as it refers to the existing system, not the planned system and it includes many elements which are not part of the system.
- However, it makes a strong contribution toward the complete statement of requirements.
- The original statement of requirements given by a client will mention the new elements required and possibly refer to the existing system and its functionality.
- The task analysis of an existing system can help in two ways :
  1. The analyst can ask 'Which of the existing objects, tasks, etc., should be in the new system ?'.

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2. The formalized presentation of the existing state of affairs may help the client to clarify what the novel features are to be. It may be decided to automate whole tasks or roles or simply specific subtasks.

- As the high-level design of the system progresses, task analysis continues to play a role.

3.9 Diagrammatic Dialog Design Notations

Q.23 Draw a state chart diagram of a machine that dispenses bottles on inserting coins.

[SPPU : Dec-17, End Sem, Marks 9]

Ans. : State chart diagram for machine that dispenses bottles on inserting coins :

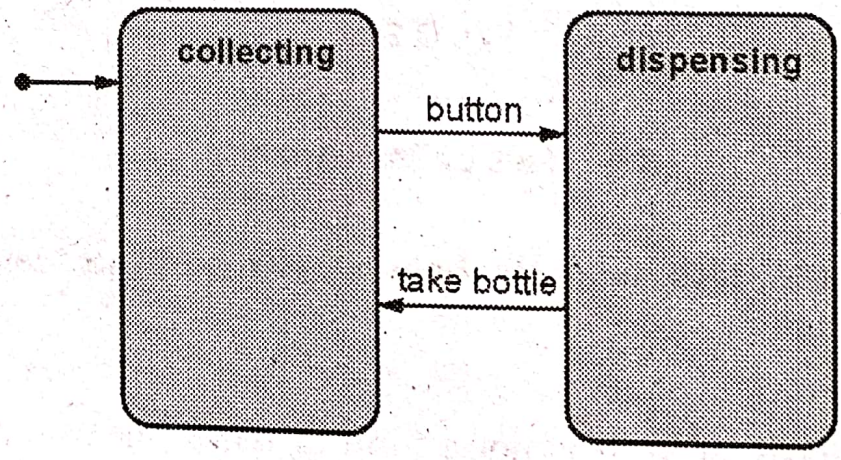

Fig. Q.23.1

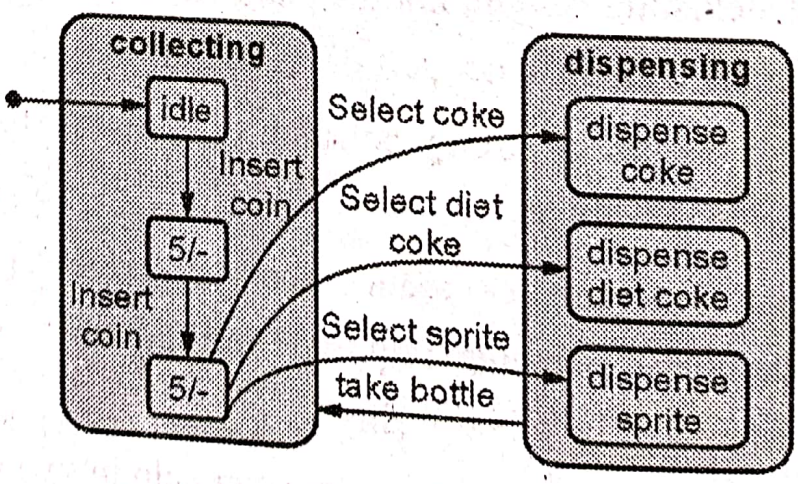

Fig. Q.23.2

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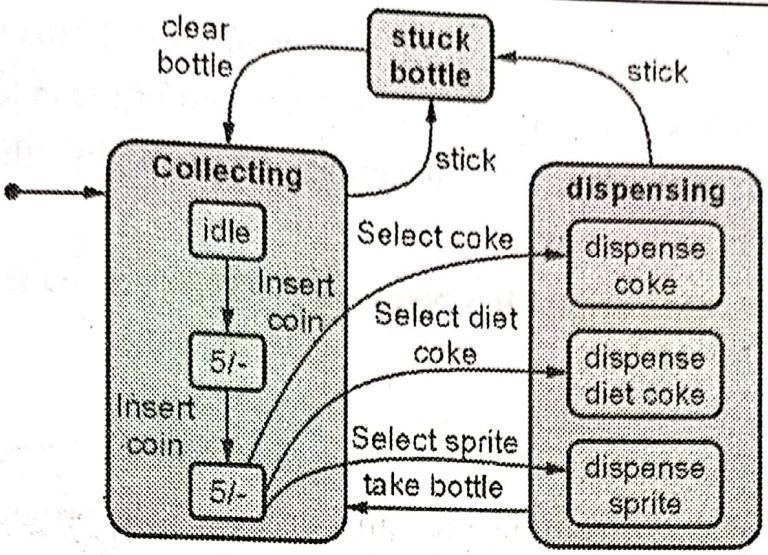

Fig. Q.23.3

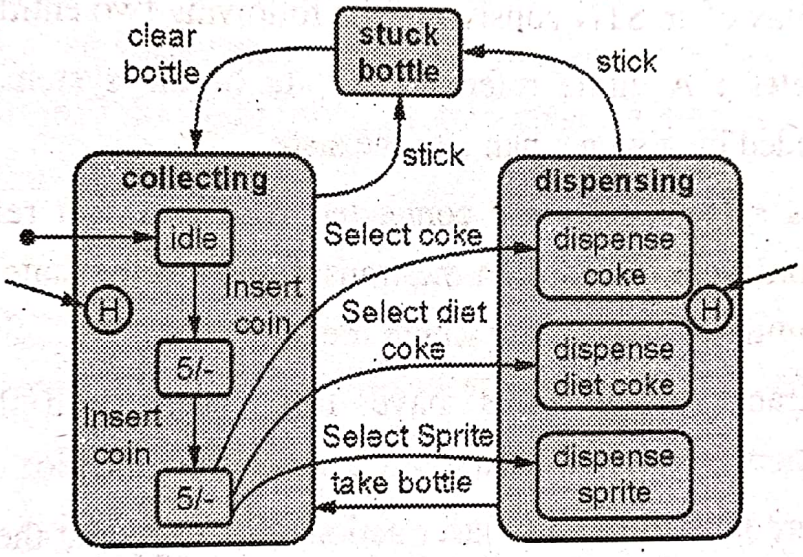

Fig. Q.23.4

Q.24 What is dialog ? How it is represent in computer language ?

Ans. :

- Dialog is a conversation between two or more parties.
- The dialog has a more specific meaning, namely the structure of the conversation between the user and the computer system.

Computer language at three levels :

- **Lexical :** Lowest level and the shape of icons on the screen and the actual keys pressed. In human language, the sounds and spellings of words.
- **Syntactic :** The order and structure of inputs and outputs. In human language, the grammar of sentence construction.

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- **Semantic :** The meaning of the conversation in terms of its effect on the computer's internal data structures and/or the external world. In human language, the meaning ascribed by the different participants to the conversation.

Q.25 Explain State Transition Networks (STNs) ? How it is used for dialog description ?

Ans. :

- State Transition Network (STN)s are the most spontaneous, which knows that a dialog fundamentally denotes to a progression from one state of the system to the next.
- The syntax of an STN consists of the following two entities :
  1. **Circles :** A circle refers to a state of the system, which is branded by giving a name to the state.
  2. **Arcs :** The circles are connected with arcs that refers to the action/event resulting in the transition from the state where the arc initiates, to the state where it ends.
- State transition networks have long been used for dialog description. Between the states are arrows, the transitions.
- These are labeled with the user actions that triggered the particular transition and the response the system makes.
- Fig. Q.25.1 shows state transition network for menu-driven drawing tool.

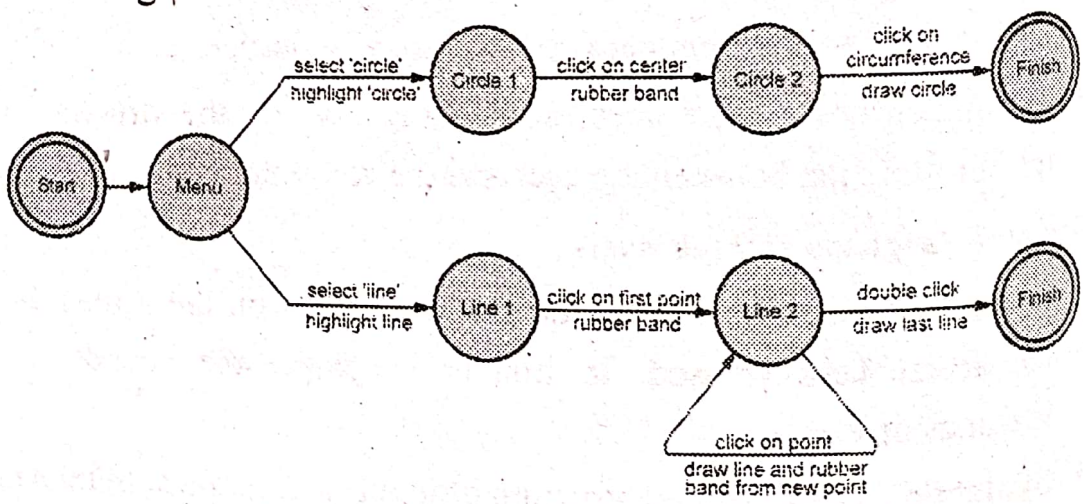

Fig. Q.25.1 : State transition network for menu-driven drawing tool

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- We shall have a "start" state. From this "start" state, we shall go to a "menu" state, where we are shown the menu options.
- If we select the circle option, we go to a "circle" state. Otherwise, we select the "line" option and go to the "line" state.
- While at the "circle" state, we select a point as the circle center, which takes us to the "center" state. In the "center" state, we select the circle periphery and double click to indicate the end of input (the "finish" state). At this stage, the circle is displayed.
- While at the "line" state, we select a point as the beginning of the line. Then, we select another point to denote the last point on the line and transit to "point 2". At this stage, a line is displayed between the two points.
- We can select another point, while at "point 2" to draw another line segment between this point and the point last selected. We can actually repeat this as many times as we want, to draw line of arbitrary shape and size.
- When we perform a double click, it indicates the end of input and the dialog comes to the "finish" stage.

Q.26 Write short note on petri nets model.

Ans. :

- Petri net is a simple model of active behavior, which has four behavior elements such as – places, transitions, arcs and tokens.
- Petri nets provide a graphical explanation for easy understanding.

1. **Place :** This element is used to symbolize passive elements of the reactive system. A place is represented by a circle.
2. **Transition :** This element is used to symbolize active elements of the reactive system. Transitions are represented by squares/rectangles.
3. **Arc :** This element is used to represent causal relations. Arc is represented by arrows.

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4. **Token :** This element is subject to change. Tokens are represented by small filled circles.

- Tokens can play the following roles :
  1. A physical object, for example a product, a part, a drug, a person.
  2. An information object, for example a message, a signal, a report.
  3. A collection of objects, for example a truck with products, a warehouse with parts or an address file.
  4. An indicator of a state, for example the indicator of the state in which a process is or the state of an object.
  5. An indicator of a condition: the presence of a token indicates whether a certain condition is fulfilled.
- Fig. Q.26.1 shows Petri nets model.

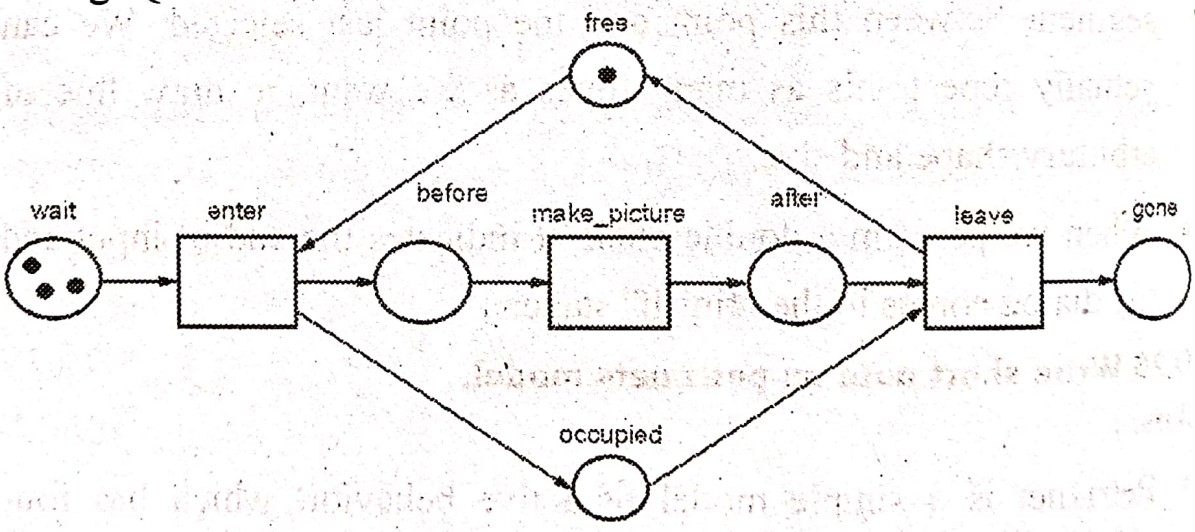

Fig. Q.26.1 : Petri nets model

- A transition can be used to represent things such as,
  1. An event (e.g., starting an operation, the switching of a traffic light from red to green)
  2. A transformation of an object, like adapting a product, updating a database or updating a document
  3. A transport of an object : for example, transporting goods or sending a file

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Q.27 Use a state diagram to describe the dialogue between the system and the user. Note any additional issues this raises about the system that need to be resolved in the design.

[SPPU : May-19, End Sem, Marks 9]

Ans. : Individual speech acts can contribute to a conversation. The basic structure of conversations can then be seen as instances of generic conversations. One example of such a generic structure is a Conversation for Action (CfA). This is shown as a state diagram in Fig. Q.27.1.

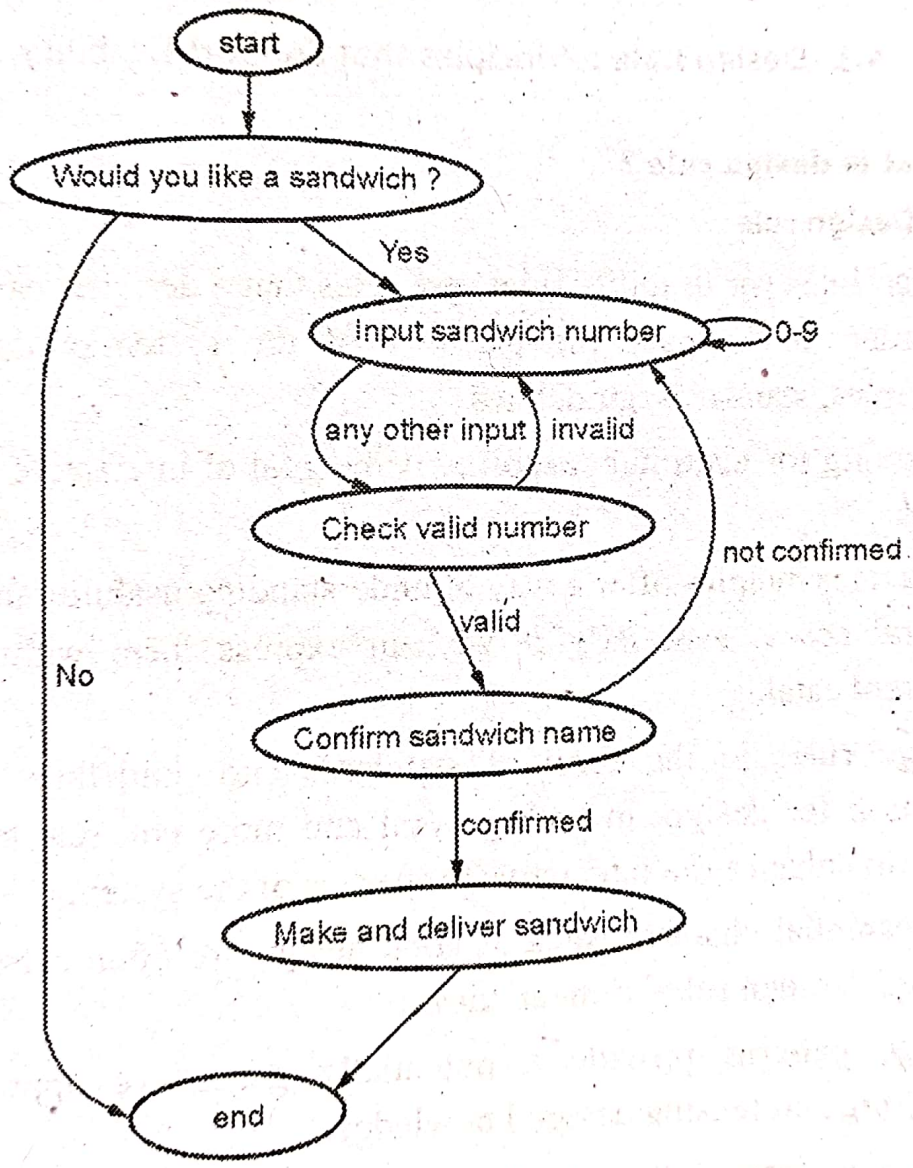

Fig. Q.27.1

END ...

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Unit IV

4 Design Process

4.1 Design Rule : Principles that Support Usability

Q.1 What is design rule ?

Ans. : Design rule

- Design rules (or usability rules) are rules that a designer can follow in order to. Increase the usability of the system/product e.g., principles, standards, guidelines.
- Designing for maximum usability is the goal of interactive systems design.
- Abstract principles offer a way of understanding usability in a more general sense, especially if we can express them within some coherent catalog.
- Design rules in the form of standards and guidelines provide direction for design, in both general and more concrete terms, in order to enhance the interactive properties of the system.
- The essential characteristics of good design are often summarised through 'golden rules' or heuristics.
- Design patterns provide a potentially generative approach to capturing and reusing design knowledge.

Q.2 What is learnability, flexibility and robustness in context of usability ? It has been suggested that consistency could be considered a major category of interactive principles, on the same level as learnability, flexibility and robustness. If this had been the case, discuss the principles that would appear in support of consistency ?

☞ **[SPPU : Dec.-17, End sem, Marks 8]**

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Ans. :

- The consistency, it can take many forms, because it is usually referred to in relation to some other feature of the interaction between user and system. There are consistency related to the following principles :
- Familiarity - consistency with respect to prior real-world experience.
- Generalizability - consistency with respect to experience with the same system or set of applications on the same platform.
- In addition, we could interpret some other principles as contributors to consistency :
- Affordance - consistency with understood intrinsic properties of an object, so a soft button on the screen should allow us to always 'push' on it to select some action :
- Predictability - consistency of system response with user's expectation, given the user has some information about past interaction history.
- Substitutivity - consistent permission from system to allow use of equivalent values for input and output.
- Commensurate effort - consistency of effort with respect to doing and undoing tasks.
- Response time stability - consistency of system response for similar actions.
- Some other principles for consistency from the text and elsewhere :
- Consistency can be relative to the form of input/output expressions relative to the user's conceptual model of the system. An example in the text involves using keys whose relative positions are similar to commands for the systems (any set of four typewriter keys that form a diagonal to indicate up, down, left and right information for an input command).
- Consistency can be with respect to social or cultural conventions (e.g., using red to indicate stop or hot, green for go, blue for cool).

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Q.3 Define the following : Learnability, Predictability, Generalizability and Consistency.

Ans. :

- Learnability concerns the features of the interactive system that allow novice users to understand how to use it initially and then how to attain a maximal level of performance.
- Predictability is a user-centered concept; it is deterministic behavior from the perspective of the user. It is not enough for the behavior of the computer system to be determined completely from its state, as the user must be able to take advantage of the determinism.
- The generalizability of an interactive system supports this activity, leading to a more complete predictive model of the system for the user. We can apply generalization to situations in which the user wants to apply knowledge that helps achieve one particular goal to another situation where the goal is in some way similar. Generalizability can be seen as a form of consistency.
- Consistency relates to the likeness in behavior arising from similar situations or similar task objectives. Consistency is probably the most widely mentioned principle in the literature on user interface design.

Q.4 What is task migratability ?

Ans. :

- It is transfer of control for execution of tasks between system and user. It should be possible for the user or system to pass the control of a task over to the other or promote the task from a completely internalized one to a shared and cooperative venture.
- Hence, a task that is internal to one can become internal to the other or shared between the two partners. Example of task migratability is spell checking. It is equipped with a dictionary, you are perfectly able to check your spelling by reading through the entire paper and correcting mistakes as you spot them.

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- This task is perfectly suited to automation, as the computer can check words against its own list of acceptable spellings.
- It is not desirable, to leave this task completely to the discretion of the computer, as most computerized dictionaries do not handle proper names correctly, nor can they distinguish between correct and unintentional duplications of words.
- In those cases, the task is handed over to the user. The spell-check is best performed in such a cooperative way.
- In safety-critical applications, task migratability can decrease the likelihood of an accident. For example, on the flight deck of an aircraft, there are so many control tasks that must be performed that a pilot would be overwhelmed if he had to perform them all.

Q.5 Explain the following terms
i) Predictability ii) Synthesizability
iii) Familiarity iv) Consistency

☞ **[SPPU : Dec.-18, End sem, Marks 8]**

Ans. :

i) **Predictability :** Support for the user to determine the effect of future action based on past interaction history. Predictability of an interactive system means that the user's knowledge of the interaction history is sufficient to determine the result of his future interaction with it.

ii) **Synthesizability :** Support for the user to assess the effect of past operations on the current state.

iii) **Familiarity :** The extent to which a user's knowledge and experience in other real-world or computer based domains can be applied when interacting with a new system. Familiarity has to do with a user's first impression of the system. Effective use of the affordances that exist for interface objects can enhance the familiarity of the interactive system.

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iv) **Consistency :** Likeness in input–output behavior arising from similar situations or similar task objectives. Consistency relates to the likeness in behavior arising from similar situations or similar task objectives. Consistency is probably the most widely mentioned principle in the literature on user interface design.

Q.6 Describe any four usability goals of internet explorer.

☞ [SPPU : May-19, End sem, Marks 8]

Ans. :

- Goals are needed that help to ensure usability :
  1. Ascertain users' needs
  2. Ensure proper reliability
  3. Promote appropriate standardization, integration, consistency and portability
  4. Complete projects on schedule and within budget
- Offer a graphical interface to the document, controlled by the mouse. Hypertext links are shown by highlighting the text that acts as the link in an alternative colour and are activated by clicking on the link.
- Allows users to view and navigate web pages on the Internet. Internet Explorer is the most widely used browser in the world.
- Nonstandard behaviours include support for vertical text, support for a variety of image effects and page transitions and support for embedding EOT fonts in webpages. The favicon feature allows web pages to specify a 16 × 16 pixel image for use in bookmarks.
- The browser contains most of the functionality required to view a web document, supporting text and graphics in an integrated package, special file formats and media, including some movie formats, may require additional plug-ins or helper applications.

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4.2 Design Standards and Design Guidelines

Q.7 What is the definition of usability as per ISO 9241 standard ? Effective applications are both consistent within themselves and consistent with one another. Discuss that in context of Microsoft Office products.

☞ [SPPU : May-18, End Sem, Marks 8]

Ans. :

- **Usability :** The effectiveness, efficiency and satisfaction with which specified users achieve specified goals in particular environments.
- **Effectiveness :** The accuracy and completeness with which specified users can achieve specified goals in particular environments.
- **Efficiency :** The resources expended in relation to the accuracy and completeness of goals achieved.
- **Satisfaction :** The comfort and acceptability of the work system to its users and other people affected by its use.
- The strength of a standard lies in its ability to force large communities to abide, the so-called authority.
- The authority of a standard (or a guideline, for that matter) can only be determined from its use in practice.
- Some software products become de facto standards long before any formal standards document is published, for example, the X windowing system).
- Usability test of Microsoft word :

  Task 1 : Create New Document

  Task 2 : Save Document under Custom Title

  Task 3 : Choose Custom Font

  Task 4 : Paragraph Formatting

  Task 5 : Creating Table of Contents

  Task 6 : Add Page Numbers

  Task 7 : Upload/Format Image

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Q.8 Explain basic categories of the Smith and Mosier guidelines. Also explain guidelines for data entry.

Ans. :

- Basic categories of the Smith and Mosier guidelines are as follows :
  1. Data entry
  2. Data display
  3. Sequence control
  4. User guidance
  5. Data transmission
  6. Data protection
- Smith and Mosier (1986) guidelines for data entry :
  1. Consistency of data-entry transactions : Similar sequences of actions should be used under all conditions.
  2. Minimal input actions by user : Greater productivity, fewer chances for error.
  3. Minimal memory load on users : Should not be required to memorize lengthy lists of commands.
  4. Compatibility of data entry with data display.
  5. Flexibility for user control of data entry.

Q.9 Explain Shneiderman's eight golden rules of interface design.

Ans. :

- Shneiderman's eight Golden rules are as follows :

1. **Strive for consistency :** Consistent sequences of actions should be required in similar situations; identical terminology should be used in prompts, menus and help screens; and consistent commands should be employed throughout.
2. **Enable frequent users to use shortcuts :** As the frequency of use increases, so do the user's desires to reduce the number of interactions and to increase the pace of interaction. Abbreviations,

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function keys, hidden commands and macro facilities are very helpful to an expert user.

3. **Offer informative feedback :** For every operator action, there should be some system feedback. For frequent and minor actions, the response can be modest, while for infrequent and major actions, the response should be more substantial.
4. **Design dialog to yield closure :** Sequences of actions should be organized into groups with a beginning, middle and end. The informative feedback at the completion of a group of actions gives the operators the satisfaction of accomplishment, a sense of relief, the signal to drop contingency plans and options from their minds and an indication that the way is clear to prepare for the next group of actions.
5. **Offer simple error handling :** As much as possible, design the system so the user cannot make a serious error. If an error is made, the system should be able to detect the error and offer simple, comprehensible mechanisms for handling the error.
6. **Permit easy reversal of actions :** This feature relieves anxiety, since the user knows that errors can be undone; it thus encourages exploration of unfamiliar options. The units of reversibility may be a single action, a data entry or a complete group of actions.
7. **Support internal locus of control :** Experienced operators strongly desire the sense that they are in charge of the system and that the system responds to their actions. Design the system to make users the initiators of actions rather than the responders.
8. **Reduce short-term memory load :** The limitation of human information processing in short-term memory requires that displays be kept simple, multiple page displays be consolidated, window-motion frequency be reduced and sufficient training time be allotted for codes, mnemonics and sequences of actions.

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4.3 What is Interaction Design ?

Q.10 What is design ? What is the golden rule of design ? Illustrate the process of interaction design.

☞ [SPPU : May-18, Dec-17, End Sem, Marks 8]

Ans. :

- Design means achieving goals within constraint.
- Interaction design is the practice of designing interactive digital products, environments, systems and services.
- The golden rule of design are as follows :

1. **Understand your materials :** In the case of a physical design this is obvious. But for the chair with a steel frame and one with a wooden frame. They are very different : often the steel frames are tubular or thin L or H section steel.

   - In contrast wooden chairs have thicker solid legs. If you made a wooden chair using the design for a metal one it would break; if you made the metal one in the design for the wooden one it would be too heavy to move.
   - For Human-Computer Interaction the obvious materials are the human and the computer. That is we must :
   - Understand computers : Limitations, capacities, tools, platforms
   - Understand people : Psychological, social aspects, human error.

Interaction design process :

- Fig. Q.10.1 shows Interaction design process.
- **Requirements :** What is wanted ? The first stage is establishing what exactly is needed. There are a number of techniques used for this in HCI : interviewing people, videotaping them, looking at the documents and objects that they work with, observing them directly.

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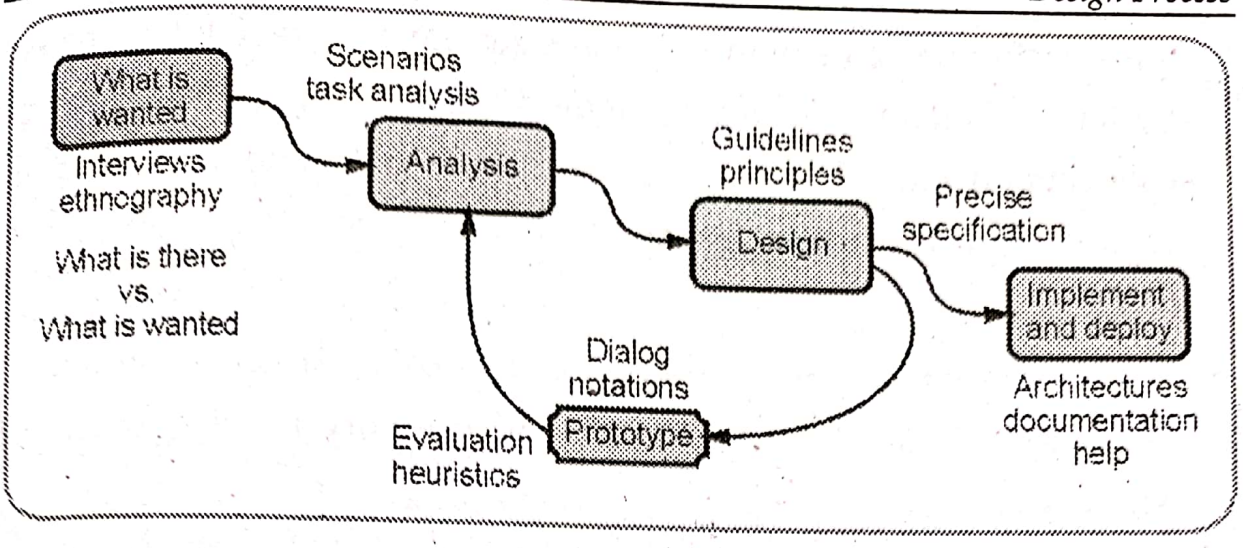

Fig. Q.10.1

- **Analysis :** The results of observation and interview need to be ordered in some way to bring out key issues and communicate with later stages of design.
- **Design :** There are numerous rules, guidelines and design principles that can be used to help Iteration and prototyping Humans are complex and we cannot expect to get designs right first time. We therefore need to evaluate a design to see how well it is working and where there can be improvements.
- **Iteration and prototyping :** Humans are complex and we cannot expect to get designs right first time. We therefore need to evaluate a design to see how well it is working and where there can be improvements.
- **Implementation and deployment :** This will involve writing code, perhaps making hardware, writing documentation and manuals - everything that goes into a real system that can be given to others.

Q.11 Explain different stages in the design.

Ans. :

- **Concept design :** Every possible approaches are sketched out. The validity of each sketches is verified following the usability requirements and the goals agreed. At the end, the best approach is selected.

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- **Interaction design :** In this step, the structure of the UI must be set by naming interaction flows. Method : e.g. Affinity diagramming, each action can be written on a Post-It note and organised in clusters. The Post-It notes are then rearranged to simplify user tasks.
- **Screen design :** Creating rough designs of the screens' structure. These layouts are linked together and usability test is performed with a user.
- **Testing :** A user is asked to follow a realistic scenario/tasks on the sketched out prototype.

Q.12 Write short note on process on interaction design with respect to following points : i) Basic activities ii) Characteristics

☞ **[SPPU : May-19, End Sem, Marks 8]**

Ans. : i) Basic activities

- Interaction design involves four basic activities :
  1. Identifying needs and establishing requirements.
  2. Developing alternative designs that meet those requirements.
  3. Building interactive versions of the designs so that they can be communicated and assessed.
  4. Evaluating what is being built throughout the process.
- These are permeated with three principles :
  1. Involve users early in the design process and evaluation of the artifact
  2. Define quantifiable and measurable usability criteria
  3. Iteration is inevitable
- Key characteristics of the interaction design process are explicit incorporation of user involvement, iteration and specific usability criteria.
- Before you can begin to establish requirements, you must understand who the users are and what their goals are in using the device.

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- Looking at others' designs provides useful inspiration and encourages designers to consider alternative design solutions, which is key to effective design.
- Usability criteria, technical feasibility and users' feedback on prototypes can all be used to choose among alternatives.
- Prototyping is a useful technique for facilitating user feedback on designs at all stages.

ii) Characteristics

1. It changes situations by shaping and deploying artifacts.
2. It explores possible futures.
3. It frames the problem in parallel with possible solutions.
4. It requires thinking through "sketching" and other "tangible representations"
5. It addresses instrumental, technical, aesthetic and ethical aspects throughout the process.

Q.13 Write a scenario for music player design ?

☞ **[SPPU : May-19, End Sem, Marks 8]**

Ans. :

- Interaction design is about creating interventions in often complex situations using technology of many kinds including PC software, the web and physical devices.
- Scenarios are rich design stories, which can be used and reused throughout design :
  1. They help us see what users will want to do
  2. They give a step-by-step walkthrough of users' interactions: including what they see, do and are thinking.
- The main work of music player is to read the audio file, the file decoding and information display. Therefore, the overall design of an music player can be divided into the following three processing stages :
  a) Accessing audio files, mainly including the transmission mode and the choice of storage media.

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b) Decoding audio files, the main decoding scheme is the choice of soft or hard to decode.

c) Audio file information display, including the selection of the display, mainly to add more features and gorgeous interface to increase the user experience.

- The design includes physical artifacts the scenarios can be used as a script to act out potential patterns of use.
- Scenarios can be used to : communicate with others - other designers, clients or users. It is easy to misunderstand each other whilst discussing abstract ideas. Concrete examples of use are far easier to share.
- Validate other models A detailed scenario can be 'played' against various more formal representations such as task models or dialog and navigation models.
- Express dynamics Individual screen shots and pictures give you a sense of what a system would look like, but not how it behaves.

4.4 User Focus, Scenarios

Q.14 How to get to know the system users ? Explain various methods adopted in user - centered design. What are the people directly or indirectly affected by a student registration system ?

[SPPU : May-18, End Sem, Marks 8]

Ans. :

- User Centered Design (UCD) is an approach to interactive system development that focuses specifically on making systems or applications easy to use.
- The purpose of User Centred Design (UCD) is to involve end users in the development process of the product or system in a way that the prototypes and designs and finally the products or systems would meet the needs and requirements of the users as well as possible.

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- Usability can be defined as the measure of the quality of a user's experience when interacting with a product or service.
- Usability is recognized as one of the most important characteristics of systems and products. Usable systems are easy to learn, efficient to use, not error prone and satisfactory in use.
  1. With close user involvement, products are more likely to meet users' expectations and requirements. This leads to increased sales and lower costs incurred by customer services.
  2. Systems designers tailor products for people in specific contexts and with specific tasks, thereby reducing the chances of situations with a high risk of human error arising. UCD leads to safer products.
  3. Putting designers in close contact with users means a deeper sense of empathy emerges. This is essential in creating ethical designs that respect privacy and the quality of life.
  4. By focusing on all users of a product, designers can recognize the diversity of cultures and human values through UCD - a step in the right direction towards creating sustainable businesses.
- People directly or indirectly affected by a student registration system are university, college, teacher, student, parents, timetable scheduler etc.

Q.15 A scenario is an idealized but detailed description of a specific instance of human - computer interaction (HCI). Scenarios specify how users carry out their tasks in specified context. Write scenarios for purchasing an airline ticket.

Note - Generate scenarios to cover a wide range of situations, not just the most common ones. Include problem situations that will test the system concept, not just straightforward scenarios.

☞ **[SPPU : Dec.-17, May-18, End Sem, Marks 8]**

Ans. :

- Scenarios are the core of any usability test as you have to correctly communicate your participants, what you want them to do during the test. Well crafted task scenario helps you focus on designing around the real needs of the user and removes artificiality from the test.

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- As you can see, above scenario makes the task much more realistic as we have provided user only a scenario which requires users to complete 3 different tasks-
  1. Signup/login on the app
  2. Search for flight as per the schedule
  3. Book the flight
- A good scenario -
  1. Short but enough information to perform the task
  2. Use user's language, not the product's
  3. Simple and clear
  4. Should address your tasks and concerns

1. Short but enough information to perform the task :

- Time needed to read and understand the task has to be minimized as much as possible. Having a long written task scenarios may require users to spend undue time in reading and understanding what they have to do during the test which may indirectly influence the overall time and effort to complete the task.
- You have to find a balance in keeping the scenario short and relieving enough information to perform the task. It is also suggested to communicate the task with users as the way you talk and not sound very scientific.

2. Use user's language, not the product's :

- Main aim of conducting usability test is to understand how a user will use it in their real environment without getting any support from external audience.
- So, providing users with the enough detail is important but it should be in the language that user can relate to and not the one which is used in product.
- For example, You may have Icons, menu options or labeled button, in your UI. Concern could be to see if users choose right Icons, menu options or labeled button to complete a task or not.

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3. Simple and Clear :

- You will get desired result if and only if your task scenario is clear to your users that means they have no ambiguity in understanding what you want them to do.

4. Should address your tasks and concerns :

- Every scenario we create has to address one or more tasks and each task should be intended to address one or more concerns we have with the app/ website.
- It's must to have scenarios that are aligned with your business goals, for example, if your concern is to improve sales in your e-commerce portal, you would probably be interested in knowing whether it's easy for your customers to find and purchase a given product or not.

Q.16 Write short note on user focus.

Ans. :

- User focus is a never ending process because there is so much to know and because the users keep changing.
- An interactive system designer should consider the human factors that characterize users.
- User characteristics vary with age, gender, physical and cognitive abilities, personality, education, cultural or ethnic background and goals.
- An interactive system designer should recognize this diversity. Systems used by several communities of users.
- Designer faces real challenge to cater to the need of each community. Designers must characterize users and situations as precisely and completely as possible.
- Over time many people are affected directly or indirectly by a system and these people are called stakeholders.
- Tracing the tenuous links between people could go on forever and user need to draw boundaries as to whom you should consider. This depends very much on the nature of the systems being designed.

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- When designing a system it is easy to design it as if you were the main user : you assume your own interests and abilities.
- People may also be able to tell you about how things really happen, not just how the organization says they should happen. To encourage users to tell you this, you will need to win their trust, since often the actual practices run counter to corporate policy.
- A professional in any field is very practiced and can do things in the domain. An academic in the same field may not be able to do things, but she knows about the things in the domain. These are different kinds of knowledge and skill.
- Sometimes people know both, but not necessarily so. The best sports trainers may not be the best athletes, the best painters may not be the best art critics.
- Because of this it is important to watch what people do as well as hear what they say. This may involve sitting and taking notes of how they spend a day, watching particular activities, using a video camera or tape recorder.
- It can be done in an informal manner or using developed methods such as ethnography or contextual inquiry.
- Another way to find out what people are doing is to look at the artifacts they are using and creating. Look at a typical desk in an office. There are papers, letters, files, perhaps a stapler, a computer, sticky notes.
- One method that has been quite successful in helping design teams produce user focused designs is the persona. A persona is a rich picture of an imaginary person who represents your core user group.

4.5 Navigation Design and Screen Design

Q.17 What is navigation design ? Explain its local structure.

Ans. :

Navigation Design : Imagine yourself using a word processor. You interact at several levels :

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- **Widgets** help you know how to use them for a particular selection or action.
- **Screens or windows** - To understand the logical grouping of buttons.
- **Navigation within the application** - To understand where you are in the interaction.
- **Environment** - You swap between applications, perhaps cut and paste.
- In the web we have less control of how people enter a site and on a physical device we have the same layout of buttons and displays no matter what the internal state (although we may treat them differently). Just in case you haven't already got the idea, the place to start when considering the structure of an application is to think about actual use :
  1) Who is going to use the application ?
  2) How do they think about it ?
  3) What will they do with it ?
- This can then drive the second task - thinking about structure.
- We will consider two main kinds of issue :
  1) Local structure : Looking from one screen or page out
  2) Global structure : Structure of site, movement between screens.

Local structure

- Much of interaction involves goal-seeking behavior. In an ideal world if users had perfect knowledge of what they wanted and how the system worked they could simply take the shortest path to what they want.
- At each point in the interaction they can make some assessment of whether they are getting closer to their (often partially formed) goal.

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- To do this goal seeking, each state of the system or each screen needs to give the user enough knowledge of what to do to get closer to their goal. To get you started, here are four things to look for when looking at a single web page, screen or state of a device.
  1. Knowing where you are
  2. Knowing what you can do
  3. Knowing where you are going - or what will happen
  4. Knowing where you've been - or what you've done
- The screen, web page or device displays should make clear *where you are* in terms of the interaction or state of the system. Some websites show 'bread crumbs' at the top of the screen, the path of titles showing where the page is in the site. Trade-off between appearance and ease of use may mean that this is the right thing to do, but you should take care before confusing the user needlessly.
- You need to know *where you are going* when you click a button or *what will happen*. It is better if users do not have to use this 'try it and see' interaction. Icons are typically not self-explanatory and should always be accompanied by labels or at the very least tooltips or some similar technique.
- Special care has to be taken if the same command or button press means something different in different contexts. system needs to give some *feedback* to say what has happened.

Q.18 If the user has perfect knowledge of what they wanted (goal) and how the system worked (task) interaction becomes effective and satisfying. In designing navigation for a website page each screen needs to give the user enough knowledge of what to do to get closer to their goal. Discuss four important questions that drive a webpage navigation design for achieving the above motto.

☞ **[SPPU : Dec.-17, End sem, Marks 8]**

Ans. : Navigation Design

Local structure - Single screen (From one screen looking out)

What are the issues or concerns of local structure ?

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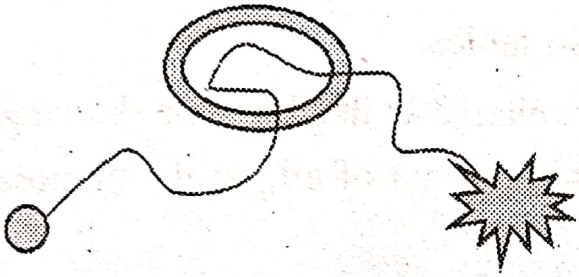
Q.1 knowing where you are

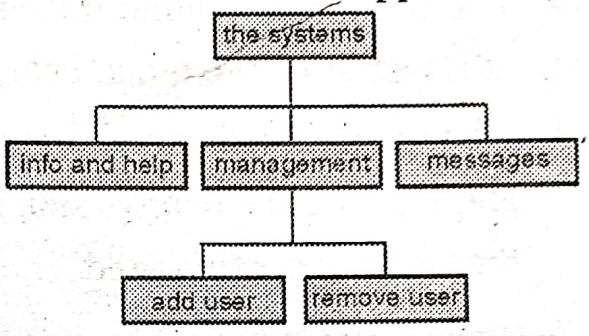
Q.2 knowing what you can do

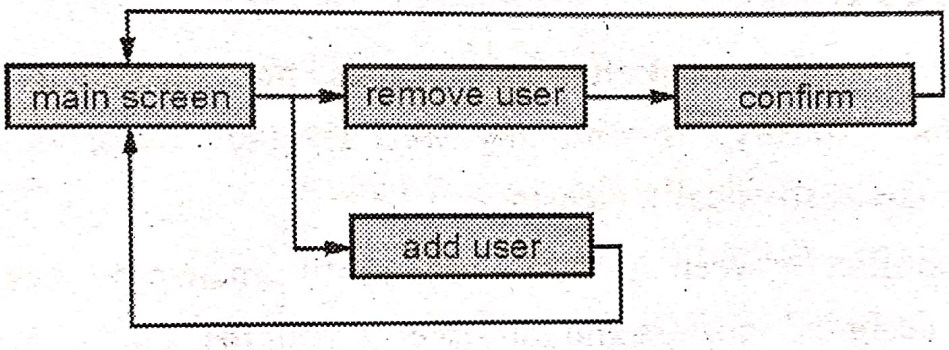
Q.3 Knowing where you are going or what will happen

Q.4 knowing where you've been or what you've done

Global structure - Whole site (between screens within the application)







Q.19 Write short note on wider still.

Ans. :

- Each sits amongst other devices and applications and this in turn has to be reflected within our design.
- This has several implications :
  1. **Style issues :** We should normally conform to platform standards, such as positions for menus on a PC application, to ensure consistency between applications. For example, on our proposed personal movie player we should make use of standard fast-forward, play and pause icons.
  2. **Functional issues :** On a PC application we need to be able to interact with files, read standard formats and be able to handle cut and paste.
  3. **Navigation issues :** We may need to support linkages between applications, for example allowing the embedding of data from one application in another or, in a mail system, being able to

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double click an attachment icon and have the right application launched for the attachment.

Q.20 While design screen, which of the appropriate appearance are considered ?

Ans. : Presenting Information :

- The way of presenting information on screen depends on the kind of information: text, numbers, maps, tables.
- Technology available to present it : character display, line drawing, graphics, virtual reality; and, most important of all, on the purpose for which it is being used.

Aesthetics and utility

- Remember that a pretty interface is not necessarily a good interface. Ideally, as with any well-designed item, an interface should be aesthetically pleasing.
- The conflict between aesthetics and utility can also be seen in many 'well designed' posters and multimedia systems.
- In particular, the backdrop behind text must have low contrast in order to leave the text readable; this is often not the case and graphic designers may include excessively complex and strong backgrounds because they look good. The results are impressive, perhaps even award winning, but completely unusable.

Making a mess of it : Color and 3D

- The increasing use of 3D effects in interfaces has posed a whole new set of problems for text and numerical information.

Localization / Internationalization

- The process of making software suitable for different languages and cultures is called localization or internationalization.

Q.21 What is screen design ?

Ans. :

- Screen design refers to the graphic design and layout of user interfaces on displays.

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- The basic principle at the screen level reflect those in other areas of interaction design :

  1. Ask 2. Think 3. Design

- It is a sub-area of user interface design but is limited to monitors and displays.
- In screen design, the focus is on maximizing usability and user experience by making user interaction as simple and efficient as possible.

Q.22 Explain the following with respect to screen design :

a. Layout b. Grouping structure c. White space

Ans. :

a. Layout :

- Layout is the arrangement of items on the screen. Like items are grouped into areas. Fig. Q.22.1 shows grouping related items in an order screen.

Billing details:		**Delivery details:**	
Name:		Name:	
Address:		Address:	
Order No:		Deliver date & time:	
Order Details:			
Name of Item	*Quantity*	*Price*	*Cost*
Book	2	210 /-	420/-

Fig. Q.22.1

- Areas can be further subdivided and each area is self-contained. Areas should have a natural intuitive flow.
- Users from western nations tend to read from left to right and top to bottom. Users from other regions may have different flows.
- Number of visual tools are available to help us suggest to the user appropriate ways to read and interact with a screen or device.

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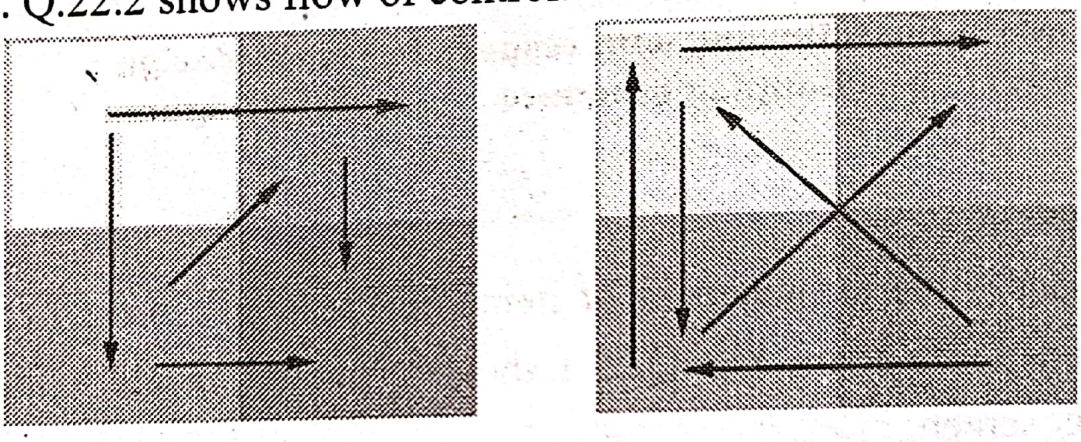
b. Grouping and structure :

- Logical things are physically grouped together. This may involve multiple levels of structure. Above figure shows a potential design for an ordering screen.
- Group data by the natural sequence of use.
- Flow of control : how users progress through a screen when doing their work.
- Fig. Q.22.2 shows flow of control.



Which flow of control is correct?

Fig. Q.22.2

- Flow of control means that the focus of activity moves across a screen or page while the user performs a certain task.
- Flow of control is important for (1) efficiency in performing a task (2) transparency and understandability of a screen or page.
- For Western cultures the natural flow is from left to right and from top to bottom.

c. White space :

- One way to make an element within an item stand out in a list UI design is to simply leave it alone literally.
- White space is one of the best ways to isolate the important elements in a list item. Doing this draws the user's attention more easily. Essential role in screen layout. Use margins to draw eye around design.

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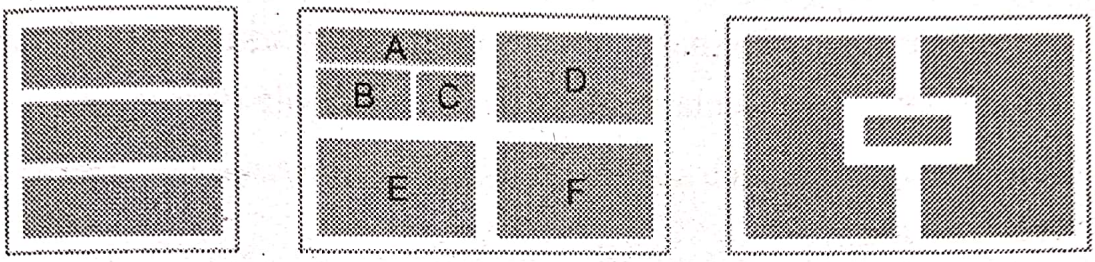
- White space is the area between design elements. It is also the space within individual design elements, including the space between typography glyphs (readable characters).
- Despite its name, white space does not need to be white. It can be any color, texture, pattern or even a background image.
- Fig. Q.22.3 shows use of white space.



(i) Space to separate (ii) Space to structure (iii) Space to highlight

Fig. Q.22.3

- Try to integrate figure and ground. Object should be scaled proportionally to its background.
- Don't crowd controls together because crowding creates spatial tension and inhibits scanning.
- The advantages of using whitespace :
  1. Increased content legibility
  2. More interaction
  3. Ability to highlight call to actions
  4. Act as a separator.

4.6 Prototyping Techniques and Wire-Framing

Q.23 What is a prototype ? Explain different types of rapid prototyping techniques.

[SPPU : Dec.-17, May-18, End Sem, Marks 8]

Ans. :

- A **prototype** is an example that serves as a basis for future models. Prototyping gives designers an opportunity to research new

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alternatives and test the existing design to confirm a product's functionality prior to production.

- Prototyping is an example of what is known as a hill-climbing approach.
- **Rapid prototyping** is an instructional design approach that combines the design, developmental and evaluation phases. It is a non-linear approach that produces a sample working model that is a scaled-down representative version of the whole course.
- Three main approach of prototyping are throw-away, incremental and evolutionary.

Types of rapid prototyping :

- Storyboard, paper prototype, wireframes and mock up review form are the types of rapid prototyping.

1. **Storyboard :** It is a graphical depiction of the outward appearance of the intended system, without any accompanying system functionality. Storyboards do not require much in terms of computing power to construct.

- Storyboarding allows you to check your design is on target with expectations before investing time in developing.
- Modern graphical drawing packages now make it possible to create storyboards with the aid of a computer instead of by hand.

2. **Paper prototype :** Easy and fast to do. It helps you think of specifics. Usually good as a first round prototype. It can still do usability testing, even with paper.
3. **Wireframe :** Wireframes are the first stage of the design process and help us to understand the key user journeys, information structuring, modes of interaction and functionality.

- Wireframes or 'page schematic' are a basic outline or skeleton of your key website pages, drawn to show the elements of a page, their relationships, position and their relative importance.

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- They indicate the information types present, navigation, signposting, branding and content areas. They are black and white schematics presented either in PowerPoint or as a clickable web prototype.

4. **Mock-up** is a scale or full-size model of a design or device, used for design evaluation, promotion. A mockup is a prototype if it provides at least part of the functionality of a system and enables testing of a design. Mock-ups are used by designers mainly to acquire feedback from users.

Q.24 Write short note on wire-framing.

Ans. :

- The interaction modeling and interface options can be put together concretely using the so-called wire-framing process.
- Wire-framing originated from making rough specifications for website page design and resembles scenarios or storyboards.
- Usually, wire-frames look like page schematics or screen blueprints, which serve as a visual guide that represents the skeletal framework of a website or interface. It depicts the page layout or arrangement of the UI objects and how they respond to each other.
- Wireframes can be pencil drawings or sketches on a whiteboard or they can be produced by means of a broad array of free or commercial software applications.

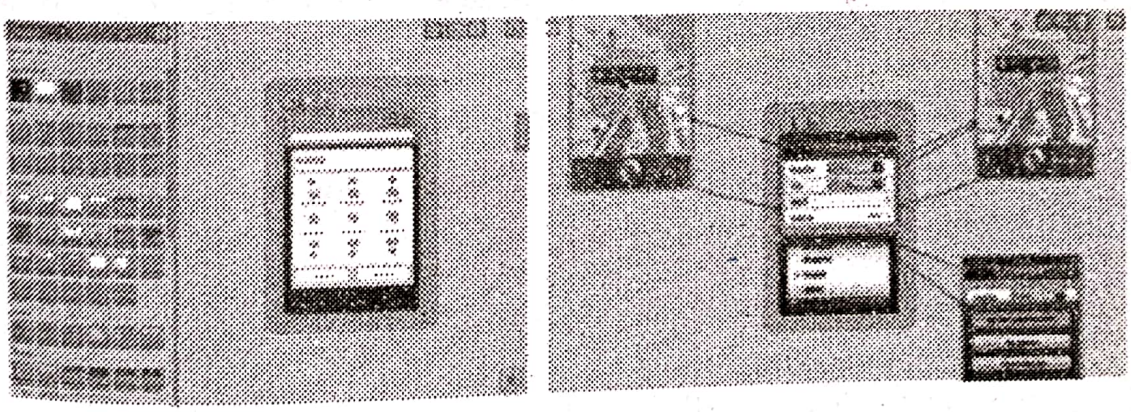

Fig. Q.24.1 : An example of a wire-framing tool

- Fig. Q.24.1 shows such a wire-framing tool. Wireframes produced by these toolscan be simulated to show interface behavior and

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depending on the tools, the interface logic can be exported for actual code implementation (but usually not).

- Note that there are tools that allow the user to visually specify UI elements and their configuration and then automatically generate code. Regardless of which type of tool is used, it is important that the design and implementation stages be separated.
- Through wire-framing, the developer can specify and flesh out the kinds of information displayed, the range of functions available and their priorities, alternative sand interaction flow.

Q.25 Explain problems with prototyping.

Ans. :

- The main problem with prototyping is that no matter how cheaply designers try to make their prototypes and how committed they are to throwing them away, they still have to make design decisions about how to present their prototypes.
- These decisions can then become ingrained into the final product. There is a factor to consider called 'design inertia' which describes how designers, once having made a design decision, are rather reluctant to relinquish that decision, admit it is wrong and change it.
- This is another reason why good designers put off big decisions as much as possible, knowing that if they make a small mistake early on it is easier and cheaper to rectify than a big early mistake.
- Rapid prototyping is about exposing bad design decisions as soon as possible after they have been made.
- Guidelines and usability engineering are more about trying to get the designer not to make mistakes in the first place.
- Design inertia is therefore much more prevalent in rapid prototyping development than it is in other user centred design processes. Because prototypes do not get thrown away in iterative design processes then design inertia is even more prevalent.

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- Furthermore in spotting usability problems by user testing, the designer knows that there is a problem, but not necessarily what causes that problem or how to fix it. Rapid prototyping identifies symptoms, not illnesses and not cures.

Q.26 Explain Hill climbing approach with prototyping ?

☞ **[SPPU : Dec.-18, End sem, Marks 8]**

Ans. :

- Hill climbing is a mathematical optimization heuristic method used for solving computationally challenging problems that have multiple solutions.
- It is an iterative method belonging to the local search family which starts with a random solution and then iteratively improves that solution one element at a time until it arrives at a more or less optimized solution.
- Prototyping is an example of what is known as a hill-climbing approach.
- A prototype is an early sample, model or release of a product built to test a concept or process or to act as a thing to be replicated or learned from.
- It is a term used in a variety of contexts, including semantics, design, electronics and software programming.
- A prototype is designed to test and try a new design to enhance precision by system analysts and users.
- When you're creating a prototyping strategy, it's important to think about the cost of change over time.
- For physical products like a car, a toaster, the cost of making changes rises dramatically over time throughout the design process and even more significantly upon release.
- With desktop software that gets distributed on, say, a CDROM, the cost rises aren't quite so dramatic, but it's still pretty significant,

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harder to make changes as you go throughout the design process and much more difficult once you've shipped it out to consumers.

- Web sites and other forms of software as a service, make it much easier to make changes over time.
- But the costs and difficulty of making changes is still increasing for a number of reasons. Fig. Q.26.1 shows hill climbing approach.

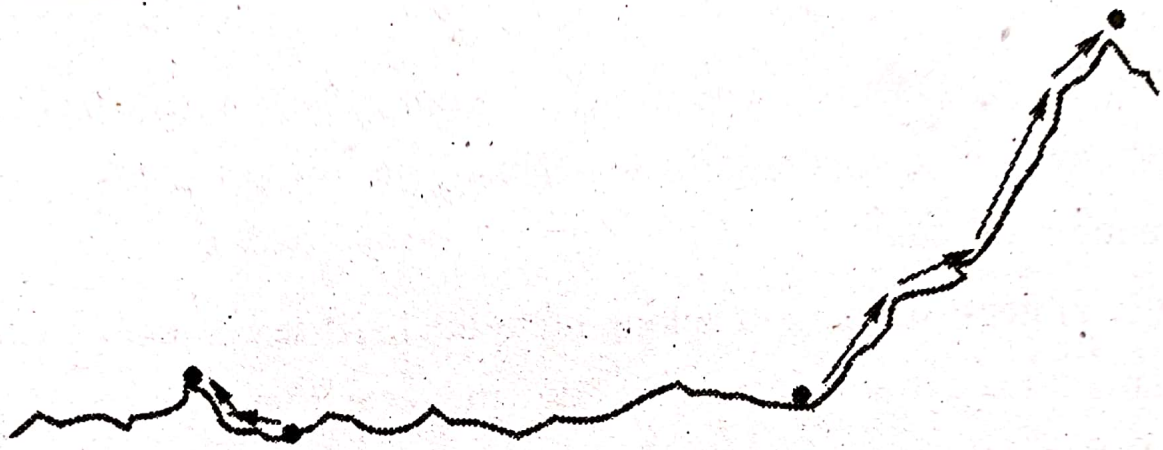

Fig. Q.26.1 : Hill climbing approach

Problems :

1. May hit a local maximum, not global one
2. Need good starting point, but how to find ?

- Standard mechanism for finding best starting point : use experienced designers, try different designs.
- According to Norman, current UCD processes achieve good design. For inspirational great design, new ways to find starting points may be needed.

4.7 Understanding the UI Layer and Its Execution Framework

Q.27 Explain user interface layer with its execution framework.

Ans. :

- The UI layer refers to a set of software that operates above the core operating system (and underneath the application). It encapsulates and exposes system functions for :
  - Fluid input and output (I/O)

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- Facilitation of development of I/O functionalities (in the form of an application programming interface/library [API] or toolkit)
- Run-time management of graphical applications and UI elements often manifested as windows or graphical user interface (GUI) elements (in the form of separate application often called the window manager)

- Since most interfaces are graphical, the UI layer uses a two- or three-dimensional (2-D or 3-D) graphical system based on which GUI elements are implemented.
- Thus, to summarize, the UI layer is largely composed of (a) An API for creating and managing the user interface elements (e.g., windows, buttons, menus) and (b) A window manager to allow users to operate and manage the applications through its own user interfaces.
- As shown in Fig. Q.27.1 the user interacts with the window/GUI-based applications using various input and output devices. At the same time, aside from the general applications, the user interacts with the computer and manages multiple application windows/tasks.
- The window manager is regarded as both an application and API. User applications are created using the APIs that represent abstracted I/O-related functionalities of the UI layer, such as those for window managing (resizing, iconifying, dragging, copy and paste, etc.), GUI elements and widgets (windows, menus, buttons, etc.) and basic windowing (creating/destroying window, deactivating window, etc.).

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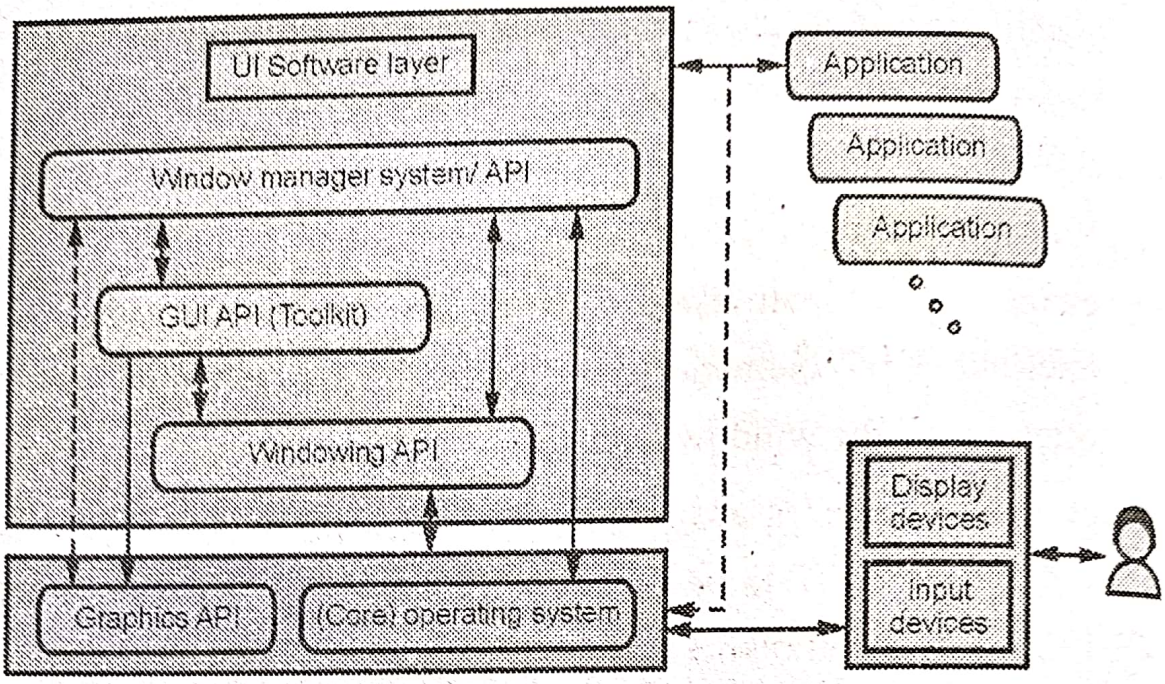

Fig. Q.27.1 : User interface software layer for a window-based multitasking UI

4.8 Model- View-Controller (MVC) Framework

Q.28 What is MVC framework ? Explain its components.

Ans. :

- The Model-View-Controller (MVC) is an architectural pattern that separates an application into three main logical components: the model, the view and the controller.
- Each of these components are built to handle specific development aspects of an application. MVC is one of the most frequently used industry-standard web development framework to create scalable and extensible projects.
- A standard design pattern of graphical user interfaces that is used at many levels, including overall application design and individual visual components.

MVC Components :

- Interface architecture is decomposed into three parts :
  1. **Model :** manages data and its manipulation
  2. **View :** manages the presentation of the data
  3. **Controller :** manages user interaction

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- Fig. Q.28.1 shows MVC architecture.
- Model is decoupled by View. View and Controller know all about model. In practice, View and Controller are often coupled. View knows to send events to Controller.

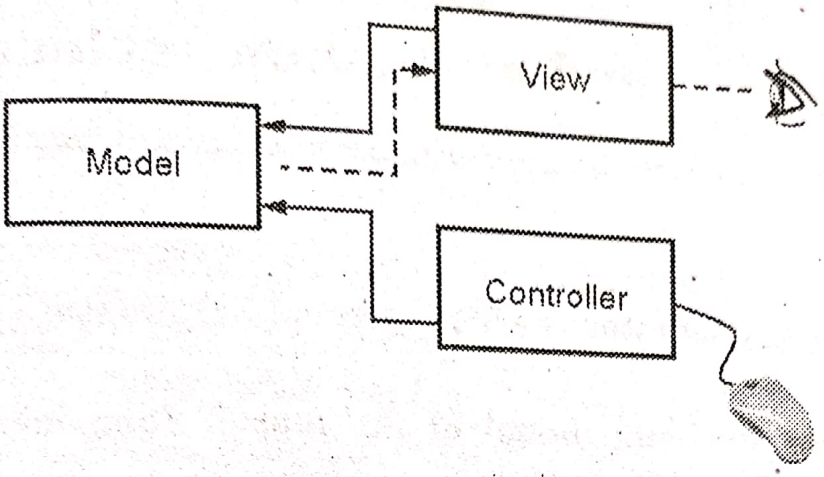

Fig. Q.28.1

- Controller knows about view modern widget toolkits use MVC throughout. Simple widgets (e.g., buttons, checkboxes, scrollbars) usually contain a default model within themselves.
- **Model :** Model component corresponds to all the data-related logic that the user works with. This can represent either the data that is being transferred between the View and Controller components or any other business logic-related data.
- **View :** The View component is used for all the UI logic of the application. For example, the Customer view will include all the UI components such as text boxes, dropdowns, etc. that the final user interacts with.
- **Controller :** Controllers act as an interface between Model and View components to process all the business logic and incoming requests, manipulate data using the model component and interact with the Views to render the final output.
- For example, the customer controller will handle all the interactions and inputs from the customer view and update the database using the customer model. The same controller will be used to view the customer data.

END ...

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Unit V

5 HCI Guidelines and Evaluation Techniques

5.1 User Interface Management System (UIMS)

Q.1 Explain Seeheim model of the logical components of user interface management system.

Ans. : The logical components of a UIMS were identified as :

1. **Presentation :** The component responsible for the appearance of the interface, including what output and input is available to the user.
2. **Dialog control :** The component which regulates the communication between the presentation and the application.
3. **Application interface :** The view of the application semantics that is provided as the interface.

- Fig. Q.1.1 shows Seeheim model of the logical components.

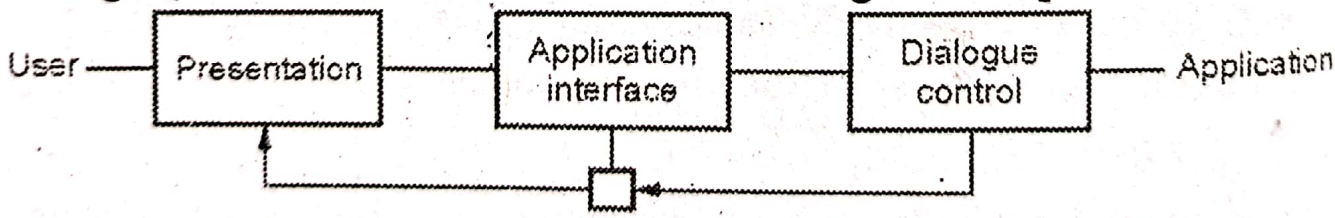

Fig. Q.1.1 : Seeheim model of the logical components

- The Seeheim workshop proposed a new model, which can be characterized by two principles :
  1. The application program shall be separated from the user interface;
  2. The user interface shall be decomposed into three components: the presentation component, the dialogue component and the application interface component

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- The three components of the Seeheim model were interpreted for some time as the lexical, syntactic and semantic components of a language analyzer.
- In effect, the presentation handles low-level aspects comparable to tokens, while the dialogue component ensures that proper commands are specified by a set of tokens and the application interface describes the semantics of the application.
- This interpretation has been the motivation for using language description techniques to build user interfaces : we will describe a number of UIMSs which use such techniques.

Q.2 Explain advantages of constructing user interfaces with a UIMS.

Ans. :

1. UIMS improves the efficiency with which user interface designers can use their skills.
2. UIMS speeds the incremental process of creating a user interface.
3. UIMS makes it possible to create prototypes that can be discussed with the end user.
4. UIMS can adapt to different user profiles.
5. UIMS makes the integration of new application functionalities easier.
6. UIMS allows the application to be portable, while the user interface can be tailored to the particular environment.
7. UIMS can ease the debugging of interactive applications.

Q.3 List and explain various implementation techniques used for dialog modeling in UIMS.

Ans. :

1. **Menu networks :** The communication between application and presentation is modeled as a network of menus and submenus. To control the dialog, the programmer must simply encode the levels of menus and the connections between one menu and the next submenu or an action.

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2. **Grammar notations :** The dialog between application and presentation can be treated as a grammar of actions and responses and, therefore, described by means of a formal context-free grammar notation.
3. **State transition diagrams :** State transition diagrams can be used as a graphical means of expressing dialog.
4. **Event languages :** Event languages are similar to grammar notations, except that they can be modified to express directionality and support some semantic feedback.
5. **Constraints :** Constraints systems are a special subset of declarative languages. Constraints can be used to make explicit the connection between independent information of the presentation and the application.

5.2 Goals of Evaluation

Q.4 What is evaluation ?

Ans. :

- It is needed to assess the designs and test systems to ensure that they actually behave as user expects and meet user requirements. This is the role of evaluation.
- Evaluation should not be thought of as a single phase in the design process. Ideally, evaluation should occur throughout the design life cycle, with the results of the evaluation feeding back into modifications to the design.

Q.5 List the factors that distinguishing evaluation techniques.

Ans. :

- There are eight factors that distinguish different evaluation techniques and therefore help us to make an appropriate choice.
- These are :
  1. The stage in the cycle at which the evaluation is carried out
  2. The style of evaluation

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3. The level of subjectivity or objectivity of the technique
4. The type of measures provided
5. The information provided
6. The immediacy of the response
7. The level of interference implied
8. The resources required.

Q.6 Explain goals of evaluation.

Ans. : Main goals of evaluation are as follows :

1. **To assess the extent and accessibility of the system's functionality :** This includes not only making the correct functionality available within the system, but making it clearly reachable by the user in terms of the actions that the user needs to take to carry out the task. It also includes matching the use of the system to the user's expectations of the task.
2. **To assess users' experience of the interaction :** This includes considering features such as how easy the system is to understand, its usability and the user's satisfaction with it. It may also include his enjoyment and emotional response, particularly in the case of systems that are aimed at leisure or entertainment.
3. **To identify any specific problems with the system :** This is correlated to both the functionality and usability of the design. It is specifically concerned with identifying trouble-spots which can then be rectified.

5.3 Categorization of Evaluation Techniques

Q.7 Explain various category of evaluation techniques.

Ans. :

- Depending on the setting, user participation and control level, evaluations is classified into three large categories. They are as follows :

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a) **Controlled user settings :** The activity of the users is controlled by hypotheses and measurements or compliance. Usability tests and experiments are the main methods. Example : usability labs and research laboratories

b) **Natural user settings :** User activities can be determined little or no control how in the real world the product would be used. Field studies are the main method used in-wild studies, for instance. Examples include online communities and products used in public places.

c) **Any settings that do not include users directly :** The most obvious usability problems are criticized by consultants and investigators for, predicted and model aspects of the interface. Methods cover inspections, heuristics, pathways, models and analysis.

Q.8 Design an experiment to test whether adding color coding to an interface will improve accuracy. Identify your hypothesis, participant group, dependent and independent variables, experimental design, task and analysis approach.

☞ **[SPPU : Dec-17, May-18, End Sem, Marks 8]**

Ans. : The following is only an example of the type of experiment that might be devised.

1. **Participants :** Taken from user population.
2. **Hypothesis :** Color coding will make selection more accurate.
3. **IV (Independent Variable) :** Color coding.
4. **DV (Dependent Variable) :** Accuracy measured as number of errors.
5. **Design :** Between-groups to ensure no transfer of learning (or within-groups with appropriate safeguards if participants are scarce).
6. **Task :** The interfaces are identical in each of the conditions, except that, in the second, color is added to indicate related menu items. Participants are presented with a screen of menu choices

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(ordered randomly) and verbally told what they have to select. Selection must be done within a strict time limit when the screen clears. Failure to select the correct item is deemed an error. Each presentation places items in new positions. Participants perform in one of the two conditions.

7. **Analysis :** t test.

5.4 DECIDE

Q.9 What is DECIDE evaluation framework ?

Ans. : DECIDE is a framework that is used to guide evaluation.

1. Determine the goals the evaluation addresses.
2. Explore the specific questions to be answered.
3. Choose the evaluation paradigm and techniques to answer the questions.
4. Identify the practical issues.
5. Decide how to deal with the ethical issues.
6. Evaluate, interpret and present the data.

Q.10 Explain various styles of evaluation.

Ans. :

1. **Laboratory studies :** Performed under laboratory conditions. Laboratory studies do not have the overhead of installing or updating a system in a real work site, so they permit rapid cycles of user feedback and prototyping.

Advantages :

a. Specialist equipment available

b. Uninterrupted environment

Disadvantages :

a. Lack of context

b. Difficult to observe several users cooperating

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2. **Field studies :** Conducted in the work environment or in "the field". Field studies are done in natural settings. The aim is to understand what users do naturally and how technology impacts them.

Advantages :

a. Natural environment

b. Context retained

c. Longitudinal studies possible

Disadvantages :

a. Distractions, interruptions

b. Noise

5.5 Heuristic Evaluation

Q.11 Explain Nielsen's ten heuristics.

☞ **[SPPU : Dec-17, May-18, End Sem, Marks 8]**

Ans. : Nielsen's ten heuristics are :

1. **Visibility of system status :** The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.
2. **Match between system and the real world :** The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.
3. **User control and freedom :** Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.
4. **Consistency and standards :** Users should not have to wonder whether different words, situations or actions mean the same thing. Follow platform conventions.

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5. **Error prevention :** Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.
6. **Recognition rather than recall :** Minimize the user's memory load by making objects, actions and options visible. The user should not have to remember information from one part of the dialogue to another.
7. **Flexibility and efficiency of use :** Accelerators unseen by the novice user, may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.
8. **Aesthetic and minimalist design :** Dialogues should not contain information which is irrelevant or rarely needed.
9. **Help users recognize, diagnose and recover from errors :** Error messages should be expressed in plain language, precisely indicate the problem and constructively suggest a solution.
10. **Help and documentation :** Eventhough it is better if the system can be used without documentation, it may be necessary to provide help and documentation.

Q.12 Discuss Heuristic evaluation.

Ans. :

- A third expert-based approach is the use of models. Certain cognitive and design models provide a means of combining design specification and evaluation into the same framework.
- For example, the GOMS (goals, operators, methods and selection) model predicts user performance with a particular interface and can be used to filter particular design options. Similarly, lower-level modeling techniques such as the keystroke-level model provide predictions of the time users will take to perform low-level physical tasks.

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- Design methodologies, such as design rationale, also have a role to play in assessment at the design stage. Design rationale provides a framework in which design options can be evaluated.
- Dialog models can also be used to estimate dialog sequences for problems, such as unreachable states, circular dialogs and complexity. Models such as state transition networks are useful for evaluating dialog designs prior to implementation.

5.6 Cognitive Walkthrough

Q.13 The cognitive walkthrough is a formalized way of imagining peopel's thoughts and actions when they use an interface for the first time. During a cognitive walkthrough the evaluator needs to ask four questions as below.

i) Is the effect of the action the same as the user's goal at that point ?

ii) Will users see that the action is available ?

iii) Once users have found the correct action, will they know it is the one thy need ?

iv) After the action is taken, will users understand the feedback they get ?

Given below is an action sequence for creating a customized voicemail message on an iPhone.

1) Tap Voicemail
2) Tap Greeting
3) Tap Custom
4) Tap Record and speak your greeting.
5) When you finish, tap Stop.
6) To listen to your greeting, tap Play.
7) To re-record, repeat steps 4 and 5.
8) Tap Save.

Imagine an iPhone interface and create a report of the cognitive walkthrough for the above mentioned task in context with the review questions.

☞ [SPPU : May-18, End Sem, Marks 8]

Ans. :

- Formalized way of imagining people's thoughts and actions when they use an interface for the first time.
- First select a task that the design is intended to support.

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- Then try to tell a believable story about each action a user has to take to do the task.
- To make the story believable, you have to motivate each of the user's actions, relying on the user's general knowledge and on the prompts and feedback provided by the interface. If you can't tell a believable story about an action, then you've located a problem with the interface.
- Question assumptions about what the users will be thinking
- Identify controls that may be missing or hard to find
- Note inadequate feedback.
- Suggest difficulties with labels and prompts.
- Vocabulary Problem : On a piece of paper write the name you would give to a program that tells about interesting activities occurring in some major metropolitan area.
- Focus most clearly on problems that users will have when they first use an interface, without training.
- Not a technique for evaluating the system over time (e.g., how quickly a user moves from beginner to intermediate).
- Most effective if designers can really create a mental picture of the actual environment of use.
- Prior to doing a walkthrough, you need four things :
  1. You need a description of a prototype of the interface. It doesn't have to be complete, but it should be fairly detailed. Things like exactly what words are in a menu can make a big difference.
  2. You need a task description (for a representative task).
  3. You need a complete, written list of the actions needed to complete the task.
  4. You need an idea of who the users will be and what kind of experience they'll bring to the job.

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Q.14 Explain cognitive walkthrough.

Ans. :

- Heuristic evaluation can be carried out on a design specification so it is useful for evaluating early design. But it can also be used on prototypes, storyboards and fully running systems. It is a flexible, relatively cheap approach. Hence it is often considered a *discount usability* technique.
- The general idea behind heuristic evaluation is that several evaluators independently review a system to come up with probable usability problems.
- Each evaluator assesses the system and notes violations of any of heuristics that would indicate a probable usability problem.
- The evaluator also assesses the severity of each usability problem, based on four factors : how common is the problem, how easy is it for the user to overcome, will it be a one-off problem or a persistent one and how seriously will the problem be perceived ? These can be combined into an overall severity rating on a scale of 0-4 :

  0 = I don't agree that this is a usability problem at all

  1 = Cosmetic problem only : need not be fixed unless extra time is available on project

  2 = Minor usability problem : fixing this should be given low priority

  3 = Major usability problem : important to fix, so should be given high priority

  4 = Usability catastrophe : imperative to fix this before product can be released (Nielsen)
- Nielsen recommends the use of ten heuristics given below as providing the most effective coverage of the most common usability problems,

  1. **Visibility of system status** : Always keep users informed about what is going on, through appropriate feedback within

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2. **Match between system and the real world** : The system should speak the user's language, with words, phrases and concepts familiar to the user, rather than system-oriented terms.
3. **User control and freedom** : Users often choose system functions by mistake and need a clearly marked 'emergency exit' to leave the unwanted state without having to go through an extended dialog. Support undo and redo.
4. **Consistency and standards** : Users should not have to wonder whether words, situations or actions mean the same thing in different contexts.
5. **Error prevention** : Make it difficult to make errors.
6. **Recognition rather than recall** : Make objects, actions and options visible. The user should not have to remember information from one part of the dialog to another.
7. **Flexibility and efficiency of use** : Allow users to tailor frequent actions.
8. **Aesthetic and minimalist design** : Dialogs should not contain information that is irrelevant or rarely needed.
9. **Help users recognize, diagnose and recover from errors** : Error messages should be expressed in plain language (no codes), precisely indicate the problem and constructively suggest a solution.
10. **Help and documentation** : Few systems can be used with no instructions so it may be necessary to provide help and documentation.

Q.15 Complete the congnitive walk-through example for the video remote control design.

☞ **[SPPU : Dec-19, End Sem, Marks 9]**

Ans. :

- Cognitive walkthrough is a detailed review of a sequence of actions, in this case, the steps that an interface will require the user to perform in order to accomplish some known task.

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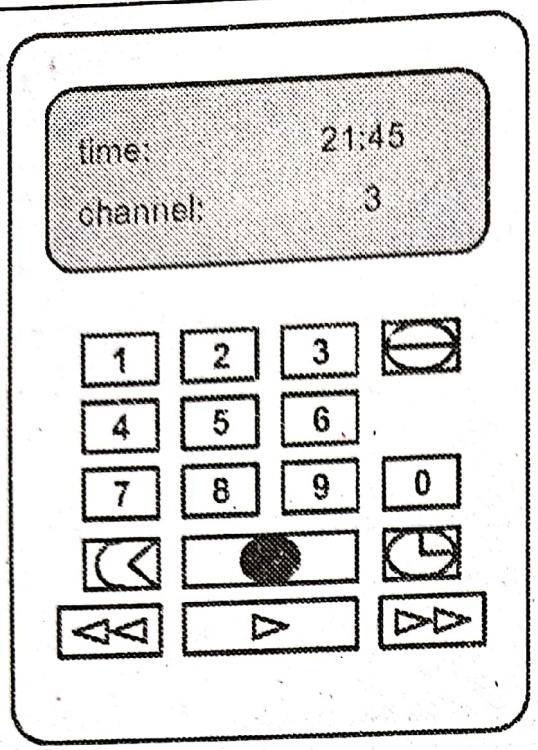

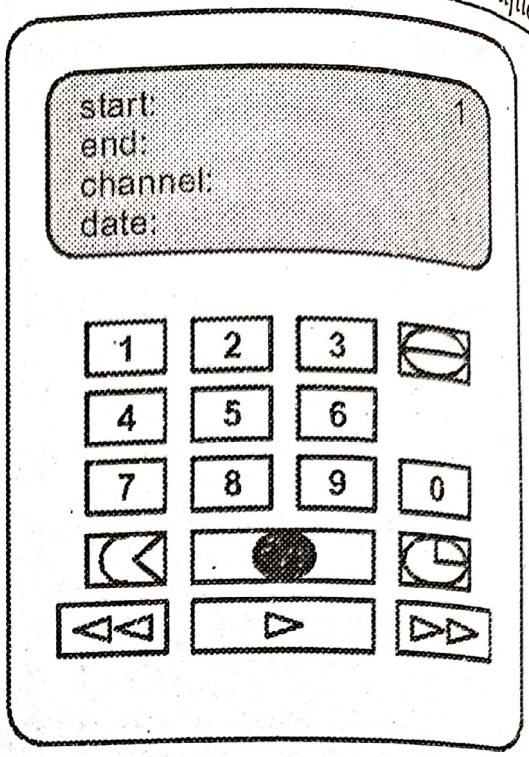

- The evaluators go through each step and provide a story about why that step is not good for new users.
- To do so, you need four things : a prototype of the system, a description of the task the user is to perform on the system, a complete written list of the actions needed to complete the task with the system and an indication of who the users are and what kind of experience and knowledge the evaluators can assume about them.
- In terms of the user's action (UA) and the system's display or response (SD). The initial display is as the left-hand picture in Figure.
  - UA 1 : Press the 'timed record' button
  - SD 1 : Display moves to timer mode. Flashing cursor appears after 'start:'
  - UA 2 : Press digits 1 8 0 0
  - SD 2 : Each digit is displayed as typed and flashing cursor moves to next position
  - UA 3 : Press the 'timed record' button
  - SD 3 : Flashing cursor moves to 'end:'
  - UA 4 : Press digits 1 9 1 5

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- SD 4 : Each digit is displayed as typed and flashing cursor moves to next position
- UA 5 : Press the 'timed record' button
- SD 5 : Flashing cursor moves to 'channel:'
- UA 6 : Press digit 4
- SD 6 : Digit is displayed as typed and flashing cursor moves to next position
- UA 7 : Press the 'timed record' button
- SD 7 : Flashing cursor moves to 'date:'
- UA 8 : Press digits 2 4 0 2 0 5
- SD 8 : Each digit is displayed as typed and flashing cursor moves to next position
- UA 9 : Press the 'timed record' button
- SD 9 : Stream number in top right-hand corner of display flashes
- UA 10 : Press the 'transmit' button
- SD 10 : Details are transmitted to video player and display returns to normal mode

- Having determined our action list we are in a position to proceed with the walkthrough. For each action we must answer the four questions and tell a story about the usability of the system.
  - Beginning with UA 1 :
  - UA 1: Press the 'timed record' button
  - Question 1 : Is the effect of the action the same as the user's goal at that point ?
  - The timed record button initiates timer programming. It is reasonable to assume that a user familiar with VCRs would be trying to do this as his first goal.
  - Question 2 : Will users see that the action is available ?
  - The 'timed record' button is visible on the remote control.

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- Question 3 : Once users have found the correct action, will they know it is the one they need ?
- It is not clear which button is the 'timed record' button. The icon of a clock is a possible candidate but this could be interpreted as a button to change the time. Other possible candidates might be the fourth button down on the left or the filled circle. In fact, the icon of the clock is the correct choice but it is quite possible that the user would fail at this point. This identifies a potential usability problem.
- Question 4 : After the action is taken, will users understand the feedback they get ?
- Once the action is taken the display changes to the timed record mode and shows familiar headings (start, end, channel, date). It is reasonable to assume that the user would recognize these as indicating successful completion of the first action.

5.7 Usability Testing

Q.16 Write short note on usability testing.

Ans. :

- It is a testing of product by the actual user. It is to improve usability of product. It shows how users are doing their tasks using this product. Testers can observe as well as record the participants, can analyze the data obtained and to the changes accordingly.
- This usability testing focuses on requirements, empirical measurement and iterative design.
- Many iterations are performed before final product release in public. It is just like rehearsals for any play. Previously this usability testing was performed in laboratory by the experts which were good in user interface design and testing.
- This laboratory requires more cost so replaced by mobile usability testing kits.

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- Another many techniques for usability testings are think aloud technique. In this technique user is asked to perform all the steps of actions. In videotaping, designers can get true review about the participants and problems in the design.
- In interviews and user satisfaction questionnaires, designer enable to evaluate the users.
- Through usability testing designer can get more information about time required to learn a specific function, speed of task performance, types and rate of errors, user retention of commands, over time, subjective user satisfaction.
- Even this testing is continued after product get released. After release, testing through the interviews and focus groups. This gives an important information about problems with functionality and user satisfaction. Data logs can be performed the testing.
- This usability testing is having same limitations as it is not covering all features of interface. As it is testing in laboratory only rather than actual environment.

END ...

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6 Future Trends

6.1 Ubiquitous Computing

Q.1 Write short note on ubiquitous computing.

Ans. :

- Ubiquitous computing (ubicomp) is a post-desktop model of human-computer interaction in which information processing has been thoroughly integrated into everyday objects and activities.
- More formally Ubiquitous computing is defined as "machines that fit the human environment instead of forcing humans to enter theirs."
- All models of ubiquitous computing share a vision of small, inexpensive, robust networked processing devices, distributed at all scales throughout everyday life and generally turned to distinctly common-place ends.
- For example, a domestic ubiquitous computing environment might interconnect lighting and environmental controls with personal biometric monitors woven into clothing so that illumination and heating conditions in a room might be modulated, continuously and imperceptibly.
- Context-aware/awareness originated as a term from ubiquitous computing or pervasive computing which sought to deal with linking changes in the environment with computer systems.

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- Context aware systems are concerned with 3A :
  1. Acquisition of context (e.g. using sensors to perceive a situation),
  2. Abstraction and understanding of context (e.g. matching a perceived sensory stimulus to a context) and
  3. Application based on the recognized context (e.g. triggering actions based on context)
- Active context awareness : "An application automatically adapts to discovered context by changing the application's behavior"
- Passive context awareness : "An application presents the new or updated context to an interested user or makes the context persistent for the user to retrieve later"
- Contextual information is a set of data, gathered from sensors, applications and users, that conforms to a context model and provides a snapshot that approximates the real-world context at a given point in time.
- Context-aware computing issues :
  1. Context is most useful in dynamic, mobile environments. But what is the relevant information in various situations ?
  2. Mobility results in continuous updates of context information. How can we efficiently manage this ?
  3. How can we share context ?
  4. How do we handle uncertainty of context information ?
  5. How do we ensure privacy control and management of context information ?
  6. How do we reach a common understanding of implications and semantics of (shared) context information ?
  7. How to effectively use context with resource restrictions ?
  8. How to exploit the past context or context history ?

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Q.2 What is an implicit interaction ?

Ans. :

- Observing communication between humans, we can see that a lot of information is only exchanged implicitly. The way people interact with each other and also the situation in which they interact carries information that is often implicitly exploited in the exchange of messages.
- While in a conversation the behaviour of participants as well as what happens in the surrounding environment supplies valuable information that is often vital for the understanding of messages.
- In many cases the robustness of human-to-human communication is based on the implicitly introduced contextual information, such as gestures, body language and voice.
- Another example is redundancy between body language (e.g. nodding) and spoken languages (e.g. the word 'yes'). This implicitly introduced knowledge is also used to disambiguate information, e.g. in a discussion with a student pointing at a computer the term 'sun' has a different meaning than the same term when on the beach together with friends; a more in depth discussion is given in.

Q.3 Explain case study of Ambient Wood.

Ans. :

- The Ambient Wood project, carried out as part of the equator project, set out to provide an augmented learning experience for children in an outdoor environment.
- Using a variety of devices, the children gathered information about the woodland habitats performing basic scientific enquiry and hypothesis testing.
- In a wood near Sussex University a group of school children gather for a day of activities. The children divide into pairs and each pair are given a PDA, a light and moisture probe and a small walkie-talkie so that they can communicate with a facilitator.

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- The probe can be pointed into the air, placed into the ground, pressed against the bark of trees or even poked into noses - and produces a simple display of the light and moisture levels on its screen.
- Although the children do not realise this at the time, all the readings they make are being recorded through a wireless network and the probes are equipped with GPS so that the location of each reading is also recorded.
- As the children walk through the wood they pass near wireless beacons. Passing these may trigger messages and information to appear. Passing one beacon they hear a strange slurping sound - a massively amplified recording of a butterfly sucking nectar!
- At one point in the wood the children find a strange contraption shaped rather like an old hat-rack or a small metallic twiggy tree. This is the 'periscope'. It is used for seeing things that are normally unseen.
- The form of the device was designed by partners from the Royal College of Art trying to capture some of the sense of symbiosis between technology and the organic environment of the wood.
- Inside the hood of the periscope is a small computer screen and this is controlled by the 'handles' of the periscope. Moving the handles from side to side pans a virtual view of the wood. Twisting them makes the image move up and down. This is a rather odd mix of virtual and augmented realities.
- The periscope is set in the real environment and portrays a virtual view of the environment, but you can only see the real environment 'round the side of' not through the image. Children would walk behind the periscope and expect that their friends could see them in the virtual image. Although our lives are filled with technology, we are still cognitively 'built' for the real world and find it hard to adjust to these half-real situations.

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- The computers communicate via standard wireless networks (802.11b) as used in many offices, airports, etc. This is fairly standard technology, but the wood is not a standard environment: the natural environment of the wood is inimical to wireless networks.
- The wood seems a very open environment compared to the walls and ceilings of a building, but the leaves and wood of the trees are 90% water and water absorbs the radio waves.
- It is impossible to have just a few wireless base stations that talk to everything and all the computers had to be set up to relay wireless messages to one another. Even then they had to be placed below the leaf canopy as in summer the leaves blot out radio transmission at even very short range.
- Ambient Wood's technology doesn't just depend on computers, behind the scenes also a group of technicians were constantly working to keep the various aspects of the wood running, not least literally running around between outside sessions replacing the batteries in the many, many devices. The wood doesn't come equipped with mains electricity.

Q.4 Discuss about toward multi-scale and distributed output.

Ans. :

- The incorporation of ubiquitous computing capabilities into everyday life also requires novel output technologies and techniques. Output is no longer completely in the form of self-contained desktop/laptop visual displays that demand our attention.
- A variety of sizes or scales of visual displays, both smaller and larger than the desktop, are being distributed throughout the environments.
- The trend toward peripheral output has been explored for a particular class of displays, called ambient. Ambient displays need minimal attention and cognitive effort and are thus more easily integrated into a persistent physical space.

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- One of the first ambient displays, the Dangling String. The Dangling String shares many features with successive efforts in ambient displays. A data resource drives the conceptual representation such that the output can be monitored by the user's peripheral perception.

Q.5 What do you mean seamless integration of physical and virtual worlds ?

Ans. :

- An essential feature of ubicomp technology is that it attempts to combine computational artifacts smoothly with the world of physical artifacts.
- Researchers have suggested methods for using objects in the physical world to manipulate electronic objects, creating so-called graspable or tangible user interfaces.
- Sensors attached to devices themselves provide ways for physical manipulations of those devices to be interpreted appropriately by the applications running on those devices.

Q.6 What is context-aware computing ?

Ans. :

- Location of identifiable entities (usually people) is a very regular piece of context used in ubicomp application development. The main general applications have been GPS-based car navigation systems and handheld 'tour guide' systems that differ the content displayed (video or audio) by a handheld unit given the user's physical location in an exhibit area.
- There is more to context than position (where) and identity (who). Although a full definition of context remains an exclusive research challenge, it is clear that in addition to who and where, context awareness involves :
  1. **When** with the exception of with time as an index into a captured record or summarizing how long a person has been at a particular location, most context driven applications are unaware of the passage of time.

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2. **What** way of interpreting the 'what' of context is to see it as the focus of attention of one or more people during a live event. Knowledge of the focus of attention at a live event can inform a better capture of that event.
3. **Why** even more challenging than perceiving 'what' a person is doing is understanding 'why' they are doing it. Sensing other ways of contextual data that could give an indication of person's affective state.

- There are several of indoor positioning schemes as well, with conflicting characteristics in terms of cost, range, granularity and requirements for tagging and no particular solution is likely to ever meet all requirements

Q.7 Explain evaluation challenges for ubicomp.

Ans. :

- Formative and summative evaluation of ubicomp systems is hard and represents a real challenge for the ubicomp community.
- It is not clear that all the measures can apply universally across activities when we move away from structured and paid work to other activities.
- The shift away from the world of work means that there is still the question of how to apply qualitative or quantitative evaluation methods.
- The technology used to create ubicomp systems is often on the cutting edge and it is difficult to create reliable and robust systems that support some activity on a continuous basis.

6.2 Design Thinking

Q.8 What is design thinking ?

Ans. : The design thinking process is nonlinear to users, to challenge assumptions, to redefine issues and to create innovative prototype and testing solutions. Design thinking is an iterative process. It is best to tackle problems that are not clearly defined or unknown through five phases - sympathise, define, ideate, prototype and test.

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Q.9 Explain five stages of design thinking.

Ans. : Stages are as follows :

- **Stage 1 :** Empathize - Research on users' needs. We should gain an insight into the problem, typically by researching users. Empathy, like design thinking, is crucial to a humane design process, because it enables own assumptions about the world to be set apart and real insight into users and their requirements.
- **Stage 2 :** Define - State users' needs and problems : The time has come to collect information during the stage of empathy. We then analyse and synthesise observations to determine the key problems identified by us and our team. These terms are referred to as problem statements. We can build people to help keep your efforts personally focused before thinking.
- **Stage 3 :** Ideate - Challenge assumptions and create ideas : We are now willing to generate thoughts. With a sound knowledge background in the first two phases, we can start thinking outside the box, find alternative ways to view the problem and find innovative solutions to the problem statement. Brainstorming here is especially helpful.
- **Stage 4 :** Prototype - Start to create solutions : This is a testing phase. The objective is to determine the best solution possible for each problem. To examine the ideas generated, team should produce some cheap, scaled-down versions of the product. This might just involve prototyping paper.
- **Stage 5 :** Test - Try solutions out assessors test the prototypes rigorously. Design thinking is iterative even if this is the final phase : Teams often redefine the results or more problems. We can therefore come back to earlier phases to make additional iterations, changes and refining - to find alternatives or to rule them out.

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6.3 Finding Things on Web

Q.10 What is graphical user interface ?

Ans. :

- Graphical User Interface (GUI) is an interface or interactive system, that allows professionals to accomplish tasks on their computers through images and icons, rather than text command systems.
- Graphical user interfaces appear in computers, tablet devices and mobile devices. These graphical user interfaces can often be optimized to provide a more positive user experience.
- User interface is a collection of techniques and mechanisms to interact with somethings. In graphical interface, the primary interaction mechanism is a pointing device of same kind.
- User interacts with collection of elements referred to as objects. They can be seen, heard, touch.

Q.11 What is Hypertext ? Explain.

Ans. :

- Hypertext is text which contains links to other texts. The term was coined by Ted Nelson around 1965. HyperMedia is a term used for hypertext which is not constrained to be text: it can include graphics, video and sound. Apparently Ted Nelson was the first to use this term too.
- Hypertext consists of nodes connected by links to form networks or webs. Depending on the system, a node can be restricted to one medium (text, graphics, sound, animation or video) or can include multiple media.
- Links can be unidirectional or bidirectional, labeled or typed and can store other information, such as author and creation date.
- Anchors are points or regions in a node to which a link attaches, often represented by a button or other marking that indicates a navigational possibility.

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- When a user navigates to a new node, a new window may open or the existing window may expand to incorporate the new information.
- Like hypertext, multimedia began with experiments in the 1960s and 1970s that matured into vigorous commercial activity in the 1980s and 1990s.

Q.12 List the main standard components of web.

Ans. :

- The main standard components of web :
  1. HyperText Markup Language (HTML)
  2. Uniform Resource Locators (URLs)
  3. HyperText Transfer Protocol (HTTP)

Q.13 Describe static web content.

Ans. :

i. **The message and the medium :** On the web documents, users want to see the information and to retrieve it, which have an influence on design. The proper copy of information does not have the same inbuilt hypertext and active capabilities as the web page.

ii. **Text :** The text information on web can be presented with different fonts, styles, colors, sizes in order to make the text more attractive and readable as per the importance of text in the context.

iii. **Graphics :** There are number of sites on web that contain archives of graphical images, icons, backgrounds and so on. There are also paint and image manipulation packages available on almost all computer systems and scanners and digital cameras, where available, enable the input of photographs and diagrams.

iv. **Movies and Sound :** Movies and Sound are both available to users of the web and hence to the page designers. It is made available with the help of different file formats.

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Q.14 Discuss dynamic web content.

Ans. :

i. **The active web :** This type involves complex forms of interactions on web. The actual content may be fixed, but the user can change the form of presentation. The web pages can be generated from database contents and the database information can be updated through the web.

ii. **Fixed content - local interaction and changing view :** Probably the most overestimated aspect of the web in recent years has been java. In fact, Java can be used to write server-end software and platform independent standalone programs.

iii. **Search :** The user's keywords are submitted to the server using an HTML form; they are compared against pre-prepared indexes at the server.

iv. **Dynamic content :** The content of the web pages reacts to and is updateable by the web user in dynamic web context. The user interacts through a web browser with a web server. The Java Servlet Pages (JSP) and Java Enterprise Beans (JEB) is used for this purpose. There is use of 'business logic' in data processing for e.g. online banking. These Java enterprise beans takes data from corporate database using JDBC connections.

Q.15 Explain characteristics and disadvantages of the graphical user interface.

Ans. : Characteristics :

- A graphical system possesses a set of defining concepts. Included are sophisticated visual presentation, pick-and click interaction, a restricted set of interface options, visualization, object orientation, extensive use of a person's recognition memory and concurrent performance of functions.
- In a GUI multiple windows with different information can simultaneously be displayed on the user screen.

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- Iconic information representation and symbolic information manipulation is possible in a GUI. Symbolic information manipulation such as dragging an icon representing a file to a trash can be deleting is intuitively very appealing and the user can instantly remember it.
- A GUI usually supports command selection using an attractive and user-friendly menu selection system.
- In a GUI, a pointing device such as a mouse or a light pen can be used for issuing commands. The use of a pointing device increases the efficacy issue procedure.
- Visualization is a cognitive process that allows people to understand information that is difficult to perceive, because it is either too voluminous or too abstract.
- Object orientation: A graphical system consists of objects and actions. Objects are what people see on the screen as a single unit.
- Pick-and-click interaction : The primary mechanism for performing this pick-and-click is most often the mouse and its buttons. The user moves the mouse pointer to the relevant element (pick) and the action is signaled (click). Pointing allows rapid selection and feedback.
- Actions : A series of actions may be performed on a selected object. Performing a series of actions on an object also permits and encourages system learning through exploration

Disadvantages :

1. Greater design complexity
2. May consume more screen space
3. Good design also requires hardware of adequate power, processing speed, screen resolution and graphic capability.
4. Inefficient for touch typists: For an experienced touch typist, the keyboard is a very fast and powerful device.

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5. Not always the preferred style of interaction: Not all users prefer a pure iconic interface. User will also prefer alternatives with textual captions.
6. Not always fastest style of interaction : Graphic instructions on an automated bank teller machine were inferior to textual instructions.

Q.16 Why graphics is popular ?

Ans. :

- A graphical screen bore scant resemblance to its earlier text-based colleagues. Older text-based screen possessed a one dimensional.
- Graphic screens assumed a three-dimensional look. Controls appeared to rise above the screen and move when activated. Information could appear and disappear, as needed.
- Text could be replaced by graphical images called icons. These icons could represent objects or actions.
- Selection fields such as radio buttons, check boxes, list boxes and palettes coexisted with the reliable old text entry field.
- Objects and actions were selected through use of pointing mechanisms. It increased computer power. User's actions to be reacted to quickly, dynamically and meaningfully.
- Graphic presentation is much more effective than other presentation methods. Properly used, it reduces the requirement for perceptual and mental information recoding and reorganization and also reduces the memory loads.
- It permits faster information transfer between computers and people by permitting more visual comparisons of amounts, trends or relationships; more compact representation of information.
- Graphics also can add appeal or charm to the interface and permit greater customization to create a unique corporate or organization style.

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6.4 Augmented Reality, Virtual Reality

Q.17 What is augmented reality ?

Ans. :

- Augmented Reality (AR) is an enhanced version of the real physical world achieved by means of technology-driven digital visual elements, sound or other sensory stimuli. The trend among mobile computers and business applications in particular is growing.
- With the increasing collection and analysis of data, one of the primary purposes of increased reality is to highlight certain characteristics of the physical world, improve its realisation and gain intelligent and accessible insight that can be applied to real world applications. Such large data can inform decision-making by enterprises and gain insights into, inter alia, consumption habits.

Q.18 Define virtual reality.

Ans. : Virtual reality is a high-end user-computer interface that involves real time simulation and interactions through multiple sensorial channels. These sensorial modalities are visual, auditory, tactile, smell and taste.

Q.19 Explain about virtual reality on the desktop and in the home.

Ans. :

- Virtual reality has been made possible by the advent of very fast high-performance computers. Despite the exponential rise in processor speeds, high-resolution immersive VR is still not available for mass-market applications and many systems are primarily research projects.
- Desktop virtual reality is a lower-cost alternative. In desktop virtual reality, 3D images are presented on a normal computer screen and manipulated using mouse and keyboard, rather than using goggles and data-gloves.

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- Many readers may have used such systems on personal computers or games consoles: flight simulators or interactive games such as DOOM.
- Virtual Reality Markup Language (VRML) can include static 3D objects, which the user can navigate around looking at different aspects and dynamic objects that move about and react when 'touched' by the mouse cursor.
- Internet-based VR systems are also available that allow greater interactivity and collaboration with other remote users.

6.5 Challenges in Designing Interfaces for Smart Homes

Q.20 What is a smart home ?

Ans. :

- A smart home is a house which is equipped with connected devices that can be programmed and controlled remotely via a smartphone or computer. For example, a smart home enables remote control of lighting, temperature, multi-media, security, window and doors and many other functions.
- The most common smart devices include : Lighting, Heating, Power controls (switches and smart plugs), Energy monitors, Security and Home entertainment systems.
- Smart homes use home automation technologies to provide home owners with feedback and information by monitoring aspects of the home and providing smart, programmable controls.
- For example, a smart refrigerator may be able to catalogue its contents, suggest menus, recommend healthy alternatives and order replacements as food is used up. Smart devices can even take care of feeding the cat and watering the plants, even when the owner is not at home.

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Q.21 Explain about home automation.

Ans. :

- Home automation is the automatic control of electronic devices in your home. These devices are connected to the Internet, which allows them to be controlled remotely.
- Interconnected devices enable to intelligently monitor and control smart homes in a future Internet of Things.
- Energy saving applications, for example, control indoor climate and electricity usage by employing context information to switch off appliances (e.g., lights, computers), reduce room temperature, close windows or stop warm water circulation.
- Home automation works on three levels :
  1. **Monitoring :** Monitoring means that users can check in on their devices remotely through an app. For example, someone could view their live feed from a smart security camera.
  2. **Control :** Control means that the user can control these devices remotely, like planning a security camera to see more of a living space.
  3. **Automation :** Finally, automation means setting up devices to trigger one another, like having a smart siren go off whenever an armed security camera detects motion.

Q.22 Explain benefits of smart home technology.

Ans. : Benefits are as follows :

- **Remote monitoring :** Smart devices enable real-time monitoring when we are away from home, providing useful data and increased security.
- **Interconnectivity :** Linking devices can improve their functionality and enable them to work together to deliver coordinated results.
- **Safety :** Smart devices can trigger alerts when certain events happen, improving the safety of the home.

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- **Fault detection :** Smart devices can monitor home for leaks and flooding and provide real-time alerts to avoid costly damage.
- **Motion detection :** By activating only when motion is detected, this technology saves time, battery life, memory, storage and energy.
- **Security :** By linking motion detection, cameras, alarms and security services smart technology provides increased home security.
- **Energy saving :** Smart devices can educate users about the home's energy consumption and production from renewables, helping to increase efficiency, reduce carbon emissions and costs.

Q.23 What are the challenges in designing interfaces for smart homes ?

Ans. : Challenges

- **Does your smart home understand you ? :** It must still be added that, while communication to people is a natural activity, adaptation is slow. Even though the early adopters with Google or Echo devices have built their homes and could not imagine life without a smart kitchen, smart safety and intelligent climate control, the majority of them, including me, still get used to how voice is integrated in our homes.
- **What to look out for as visual designers ? :** This is a great opportunity for us, designers, to transition from screen to voice and to start creating products that are much easier to use, to make people's lives easier by changing the way they perform everyday tasks. Not to mention spending more time with other people rather than interacting with all sorts of devices. So how can we design smart products that improve users' wellbeing at home ? And what additional competencies should we have in order to keep up with the evolving tech ?
    - For starters, we have to find out the users' needs and give them a solution within the overall design. Think of it this way: the user has a problem, what kind of solutions can we create to solve it ?

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- Use cases can help define the ways users might interact with a smart device.
- Besides the usual team, other professionals such as electricians or architects might come into the picture whom you should consult the feasibility of the product within the home.
- It should be an iterative process, but it should be considered that changes on a physical object might be more expensive, that's why the discovery phase should be very thorough.
- Defining the personas is a good way to find out the tone of voice of the product.

- **The best smart home devices will hear what people say :** But there are multiple conditions that have to be considered when defining the way people will speak to the device. As mentioned earlier, the users might have an accent or speak from far away. They might get interrupted or might cough during a command. But there could be many other similar factors that can challenge the device's understanding of what the users meant. Not to mention the countless ways they can express one command. There could be a very technical persona who would tell a command in great detail whereas another could be more vague. The device should be able to execute the action even if the user didn't give all the information that was needed to do so. It has to draw a conclusion from the context. Try to understand the intent then confirm it with a number of questions. So instead of making the user repeat the same command, make the device ask for the missing information instead. This will result in a more natural conversation. Also, the AI should let the user know that the command has been confirmed and executed.
- **Thinking like a user is key for a smooth experience :** It is very important to define how they would like to get from A to B. Building up as many flows as possible of the whole process between the user and a device takes time and it shouldn't be

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rushed. The device will fail multiple times but that's totally okay, this is the way it will be improved. So when defining the structure of speech, the main things to consider are the following : what people say, what they actually mean and what the result should be. After defining the persona and all their potential ways to communicate, the device's persona should be tailored accordingly. Is it friendly ? Does it match the company brand ? Does it sound pleasant ? Moving on with the competences, designers should also have a solid knowledge of system design and awareness of consistency. If the designed product has a built-in Alexa for example, it should follow the guidelines to keep consistent experience with what people are already used to. Unless user tests prove otherwise. Even though the main interaction with smart devices will be based on voice, they need to have a screen or some sort of visual indicators. The best way to decide whether the device needs a screen or if just a simple LED light will be enough, is to test it with users.

- **Communication should feel natural with smart home products :** People are used to getting feedback, seeing a reaction when talking to someone. Thus smart devices need to show somehow that they can hear the user or indicate that they are waiting for a command or processing it. Another important factor is being able to turn off the device's microphone, as most people are very concerned about their privacy. They still feel uncomfortable by having a device in the house that hears everything. This might be one of the reasons why adaptation is so slow. So having an indicator that shows when the device is turned on is one of the most important features. If the product has a screen, it is important to show the main functions of the device rather than the built-in voice AI's functionality. Another important factor is to separate the visual controls from the voice experience. Also, keep in mind that people might stand far from the device so the elements on the

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screen should be of a size that can be easily viewed from a distance. This means that it shouldn't be overcrowded. It should be clean and to the point containing only the necessary elements. Here's an interesting case study about Google Home Hub's visual experience.

6.6 Smart Device and Handheld Device

Q.24 What is smart device ? Explain its characteristics.

Ans. :

- An smart device is an electronic device, which usually can operate interactively and autonomously with other devices or network systems through various wireless protocols such as Bluetoothe, Zigböe, NFC, WiFi, LiFi, 5G, etc.
- Smart phones, intelligent vehicles, smart thermostats, smart doorbells, intelligent locks, smart fridges, phablets and tablets, clever smart bands, smart key chains, false and many others are noticeable types of smart devices.
- This term could also mean a device which has certain characteristics of omni-present computing, including artificial intelligence, although not necessarily.
- Smart devices typically consist of a hardware layer (including a signalling radio), a network layer (through which systems interact) and a use layer (through which end users deliver commands).
- It has following characteristics :
  1. A set of system hardware and software IT resources. This set is usually static fixed at design time.
  2. Dynamic component-oriented resource extensions and plug-ins (Plug and play) of some hardware resources.
  3. Remote external service access and execution.
  4. Local, internal autonomous service execution.

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5. Access to specific external environments: human interaction, physical world interaction and distributed ICT / virtual computing interaction.

- Common types of smart devices include :
  1. Tab and pad type smart devices that often act as personalised smart mobile devices.
  2. Smart environment devices.

Q.25 What are handheld devices ?

Ans. : Handheld device is a pocket-sized computing device with a display screen and input/output interface like an external or touch screen keyboard. Going by this definition of handheld devices and gadgets many appliances can qualify to be called handheld, like a mobile phone, PDA, mobile PC, handheld game consoles and so on.

Q.26 Discuss about handheld device format apps.

Ans. :

- Mobile apps are very different; the width and height of elements are set by points. The layout does have the ability to wrap, but not re - stack or re - arrange unless it's specifically coded to do so for a particular device size and that can lead to way too much development effort.
- Modern handheld - format devices also continue to use some of the same basic layout patterns employed in these early systems.

1. Stack

- Primary pattern used by non - game mobile application is stack. It is handheld device. Narrow and tall form factor of smartphones and other handheld mobile device dictates a list - like display for most types of content or control.
- Fig. Q.26.1 shows mobile apps use a stack layout pattern including content, control and navigation elements.

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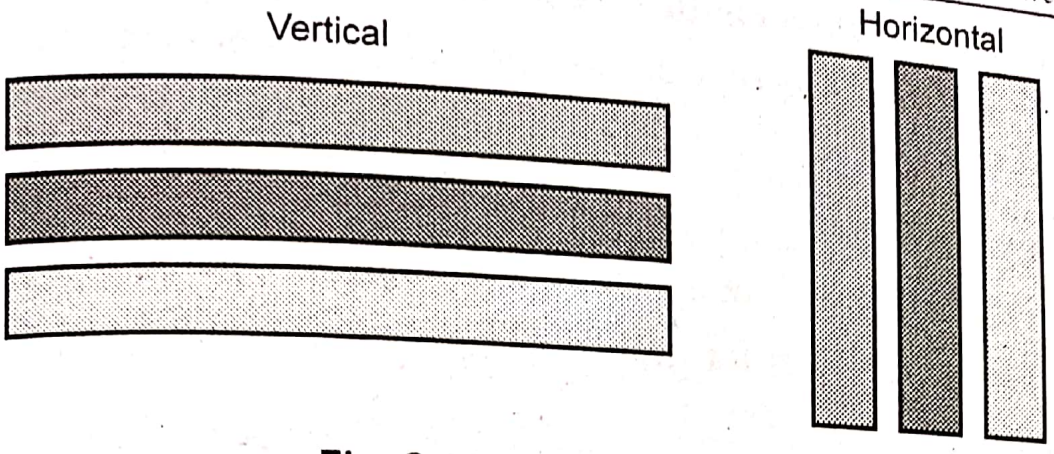

Fig. Q.26.1 : Stack layout

- Stacks are vertically organized structures with a content area, usually arranged in a list or grid. Most iOS, Android and Windows Phone apps follow this top - level pattern.
- Stack layout positions child elements in a stack either horizontally or vertically based on the orientation property.

2. Screen carousels

- Alternative to top - level pattern and used in dashboard like display. It has multiple instances or variants between which the user can quickly navigate via a swipe gesture to the left or right. The iOS weather app is an example of screen carousels.
- Carousels may or may not have top or bottom bars associated with them, but they usually do have a page marker widget that shows the user's place in the carousel content.
- Carousels don't provide circular flow, but rather disallow further swiping at the far left and right.

3. Orientation and layout

- Latest mobile devices can detect their screen orientation i.e. portrait or landscape. This help the app to rearrange its layout to better suit the current orientation. The majority of apps stick with portrait orientation even when rotated.
- For list - and grid - based content browsing assuming portrait orientation is a good because users usually operate the phone one - handed in portrait orientation. For applications such as photo or video capture and editing, it makes sense to allow rotation to landscape orientation, since the medium itself can be in that orientation.

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Q.27 List and explain challenges in HCI design for mobile devices.

Ans. : Challenges in HCI design for mobile devices are of hardware and software.

Hardware challenges

- Due to the limitations of size and weight for portability purpose, the interface design for mobile devices comes with more hardware challenges.
- These challenges include limited input facilities, limited output facilities and designing for mobility.
- There are 3 main inputs in current mobile device : Keyboard, Stylus on the touch screens and Scroll wheel
- The keyboard allows a user to hit a key to perform a task or navigate through the mobile menu functionalities; the stylus with the touch screen allows a user to hit the screen to do the task; the scroll wheel can be scrolled and pushed by a user to do a task and also navigate through the menus and submenus.
- The design of keyboards for mobile devices has been a challenge because the space for key installation on a mobile device is limited.
- Touch input would be problematic if the screen of a mobile device is small and that would lead a user's fingers to occlude the graphical elements he wishes to work with.
- Scroll wheel can be used to navigate a mobile device menu in one direction, either horizontally or vertically. It can also be used as a push button to do a specific task to support the use of one hand to interact with the mobile device.
- Limited output facilities : The small-sized screen is one of the mainly and most commonly used output facilities for mobile devices. Designing the screen for outputting is a trade-off challenge that needs to be experimentally studied to find out which is the efficient and most effective size of the screen that can be used for the different types of mobile devices.

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Software challenges

- System of menus : Taking a successful design from a desktop and apply it to a mobile device without a clear understanding of the translation inputs and outputs can lead to an ineffective interaction design.
- The mainly and widely used alternative is the use of hierarchical menus. With a hierarchal menu, a user can select a menu item that can then open another submenu; and so on until the user reaches the desired function he or she is aiming to reach.
- Navigating and browsing: to display information that is well suited for larger screens, the information has to be segmented into many small presentation units that can fit into the small screen of mobile devices. And this makes it difficult to effectively organize information and help users navigate to and from the information they want.
- Images and Icon: display of graphical content described by raster and vector graphics on mobile devices to allow appropriate and resource-saving implementations.

Q.28 How to choose breakpoints ?

Ans. :

- Do not define breakpoints based on device classes.
- Defining breakpoints based on specific devices, products, brand names or operating systems that are in use today can result in a maintenance nightmare. Instead, the content itself should determine how the layout adjusts to its container.
- Create breakpoints based on content, never on specific devices, products or brands.
- Design for the smallest mobile device first; then progressively enhance the experience as more screen real estate becomes available.
- Keep lines of text to a maximum of around 70 or 80 characters.

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- Pick major breakpoints by starting small.
- Design the content to fit on a small screen size first, then expand the screen until a breakpoint becomes necessary. This allows you to optimize breakpoints based on content and maintain the least number of breakpoints possible.
- Pick minor breakpoints when necessary.

6.7 Smart Wrist Watch, Future of HCI

Q.29 Write short note on smart wrist.

Ans. :

- A smartwatch is a wearable computer in the form of a watch; modern smartwatches provide a local touch screen interface for daily use, while an associated smartphone app provides for management and telemetry.
- While early models could perform basic tasks, such as calculations, digital time telling, translations and game-playing, 2010s smartwatches have more general functionality closer to smartphones, including mobile apps, a mobile operating system and WiFi / Bluetooth connectivity.
- Some smartwatches function as portable media players, with FM radio and playback of digital audio and video files via a Bluetooth headset. Some models, called watch phones, have mobile cellular functionality like making calls.
- While internal hardware varies, most have an electronic visual display, either backlit LCD or OLED. Some use transflective or electronic paper, to consume less power. They are generally powered by a rechargeable lithium-ion battery.
- Peripheral devices may include digital cameras, thermometers, accelerometers, pedometers, heart rate monitors, altimeters, barometers, compasses, GPS receivers, tiny speakers and micro SD cards, which are recognized as storage devices by many other kinds of computers.

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- Software may include digital maps, schedulers and personal organizers, calculators and various kinds of watch faces. The watch may communicate with external devices such as sensors, wireless headsets or a heads-up display.
- Like other computers, a smartwatch may collect information from internal or external sensors and it may control or retrieve data from, other instruments or computers. It may support wireless technologies such as Bluetooth, Wi-Fi and GPS.
- For many purposes, a "watch computer" serves as a front end for a remote system such as a smartphone, communicating with the smartphone using various wireless technologies. Smartwatches are advancing, especially their design, battery capacity and health-related applications. Health-related applications include applications measuring heart rate, SpO2, workout etc.

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