# CSC 451 Lecture Notes 4

## Human Computer Interface (General Notes)

## Intended Learning Outcome:

- Ways to design and assess interactive systems.
- Ways to reduce design time through cognitive system and task models.
- Procedures and *heuristics* for interactive system design.

Human Computer Interface (HCI) was previously known as the man-machine studies or man- machine interaction. It deals with the design, execution and assessment of computer systems and related phenomenon that are for human use.

HCI can be used in all disciplines wherever there is a possibility of computer installation. Some of the areas where HCI can be implemented with distinctive importance are mentioned below −

- Computer Science − For application design and engineering.
- Psychology − For application of theories and analytical purpose. Sociology −
- For interaction between technology and organization.
- Industrial Design − For interactive products like mobile phones, microwave oven, etc.

The world's leading organization in HCI is ACM − SIGCHI, which stands for *Association for Computer Machinery − Special Interest Group on Computer–Human Interaction*. SIGCHI defines Computer Science to be the core discipline of HCI. In India, it emerged as an interaction proposal,mostly based in the field of Design.

## Historical Evolution

From the initial computers performing batch processing to the user-centric design, there wereseveral milestones which are mentioned below −

- Earlly computer (e..g.. ENIIAC,, 1946) − Improvement in the H/W technology brought massive increase in computing power. People started thinking on innovative ideas.
- Visual Display Unit (1950s) − SAGE (semi-automatic ground environment), an air defense system of the USA used the earliest version of VDU.
- Development of the Sketchpad (1962) − Ivan Sutherland developed Sketchpad and proved that computer can be used for more than data processing.
- Douglas Engelbart introduced the idea of programming toollkits (1963) − Smallersystems created larger systems and components.
- Introduction of Word Processor,, Mouse (1968) − Design of NLS (oNLine System).
- Introduction of personall computer Dynabook (1970s) − Developed *smalltalk* at XeroxPARC.

- Windows and WIIMP interfaces − Simultaneous jobs at one desktop, switching betweenwork and screens, sequential interaction.
- The idea of metaphor − Xerox star and alto were the first systems to use the concept of metaphors, which led to spontaneity of the interface.
- Direct Manipulation introduced by Ben Shneiderman (1982) − First used in Apple MacPC (1984) that reduced the chances for syntactic errors.
- Vannevar Bush introduced Hypertext (1945) − To denote the non-linear structure of text.
- Multimodality (late 1980s).
- Computer Supported Cooperative Work (1990''s) − Computer mediated communication.
- WWW (1989) − The first graphical browser (Mosaic) came in 1993.
- Ubiquitous Computing − Currently the most active research area in HCI. Sensor based/context aware computing also known as pervasive computing.

# Guidelines in HCI

## Shneiderman's Eight Golden Rules

Ben Shneiderman, an American computer scientist consolidated some implicit facts aboutdesigning and came up with the following eight general guidelines −

- Strive for Consistency. Cater
- to Universal Usability.Offer
- Informative feedback.
- Design Dialogs to yield closure.
- Prevent Errors.
- Permit easy reversal of actions.
- Support internal locus of control.
- Reduce short term memory load.

These guidelines are beneficial for normal designers as well as interface designers. Using these eight guidelines, it is possible to differentiate a good interface design from a bad one. These are beneficial in experimental assessment of identifying better GUIs.

### Norman's Seven Principles

To assess the interaction between human and computers, Donald Norman in 1988 proposed seven principles. He proposed the seven stages that can be used to transform difficult tasks. Following are the seven principles of Norman −

- Use both knowledge in world & knowledge in the head.
- Simplify task structures.
- Make things visible.

- Get the mapping right (User mental model = Conceptual model = Designed model).
- Convert constrains into advantages (Physical constraints, Cultural constraints, Technological constraints).
- Design for Error.
- When all else fails − Standardize.

### Heuristic Evaluation

Heuristics evaluation is a methodical procedure to check user interface for usability problems. Once a usability problem is detected in design, they are attended as an integral part of constant design processes. Heuristic evaluation method includes some usability principles such as Nielsen's ten Usability principles.

#### Nielsen"s Ten Heuristic Principles

- Visibility of system status.
- Match between system and real world.
- User control and freedom.
- Consistency and standards.
- Error prevention.
- Recognition rather than Recall.
- Flexibility and efficiency of use.
- Aesthetic and minimalist design.
- Help, diagnosis and recovery from errors.
- Documentation and Help

The above mentioned ten principles of Nielsen serve as a checklist in evaluating and explaining problems for the heuristic evaluator while auditing an interface or a product.

## Interface Design Guidelines

Some more important HCI design guidelines are presented in this section. General interaction, information display, and data entry are three categories of HCI design guidelines that are explained below.

#### Generall Interaction

Guidelines for general interaction are comprehensive advices that focus on general instructionssuch as:

- Be consistent.
- Offer significant feedback.
- Ask for authentication of any non-trivial critical action.
- Authorize easy reversal of most actions.

- Lessen the amount of information that must be remembered in between actions.Seek
- competence in dialogue, motion and thought.
- Excuse mistakes.
- Classify activities by function and establish screen geography accordingly.
- Deliver help services that are context sensitive.

  Use simple action verbs or short verb phrases to name commands.

**Information Display**

Information provided by the HCI should not be incomplete or unclear or else the application will notmeet the requirements of the user. To provide better display, the following guidelines are prepared−

- Exhibit only that information that is applicable to the present context.
- Don't burden the user with data, use a presentation layout that allows rapid integration of information.
- Use standard labels, standard abbreviations and probable colors.Permit
- the user to maintain visual context.
- Generate meaningful error messages.
- Use upper and lower case, indentation and text grouping to aid in understanding.Use
- windows (if available) to classify different types of information.
- Use analog displays to characterize information that is more easily integrated with this formof representation.
- Consider the available geography of the display screen and use it efficiently.

**Data Entry**

The following guidelines focus on data entry that is another important aspect of HCI −Reduce the

- number of input actions required of the user.
- Uphold steadiness between information display and data input.
- Let the user customize the input.
- Interaction should be flexible but also tuned to the user's favored mode of input.Disable
- commands that are unsuitable in the context of current actions.
- Allow the user to control the interactive flow.
- Offer help to assist with all input actions.
- Remove "mickey mouse" input.

# Interactive System Design

The objective of this chapter is to learn all the aspects of design and development of interactive systems, which are now an important part of our lives. The design and usability of these systems leaves an effect on the quality of people's relationship to technology. Web applications, games, embedded devices, etc., are all a part of this system, which has become an integral part of our lives. Let us now discuss on some major components of this system.

## Concept of Usability Engineering

Usability Engineering is a method in the progress of software and systems, which includes user contribution from the inception of the process and assures the effectiveness of the product through the use of a usability requirement and metrics.

It thus refers to the *Usability Function* features of the entire process of abstracting, implementing & testing hardware and software products. Requirements gathering stage to installation, marketing and testing of products, all fall in this process.

### Goalls of Usability Engineering

- Effective to use − Functional
- Efficient to use − Efficient
- Error free in use − Safe
- Easy to use – Friendly
- Enjoyable in use − Delightful Experience

## Usability

Usability has three components − effectiveness, efficiency and satisfaction, using which, users accomplish their goals in particular environments. Let us look in brief about these components.

- Effectiveness − The completeness with which users achieve their goals.
- Efficiency − The competence used in using the resources to effectively achieve the goals.
- Satisfaction − The ease of the work system to its users.

## Usability Study

The methodical study on the interaction between people, products, and environment based on experimental assessment. Example: Psychology, Behavioral Science, etc.

## Usability Testing

The scientific evaluation of the stated usability parameters as per the user's requirements, competences, prospects, safety and satisfaction is known as usability testing.

## Acceptance Testing

Acceptance testing also known as User Acceptance Testing (UAT), is a testing procedure that is performed by the users as a final checkpoint before signing off from a vendor. Let us take an example of the handheld barcode scanner.

> Let us assume that a supermarket has bought barcode scanners from a vendor. The supermarket gathers a team of counter employees and make them test the device in a mock store setting. By this procedure, the users would determine if the product is acceptable for their needs. It is required that the user acceptance testing "pass" before they receive the final product from the vendor.

## Software Tools

A software tool is a programmatic software used to create, maintain, or otherwise support other programs and applications. Some of the commonly used software tools in HCI are as follows −

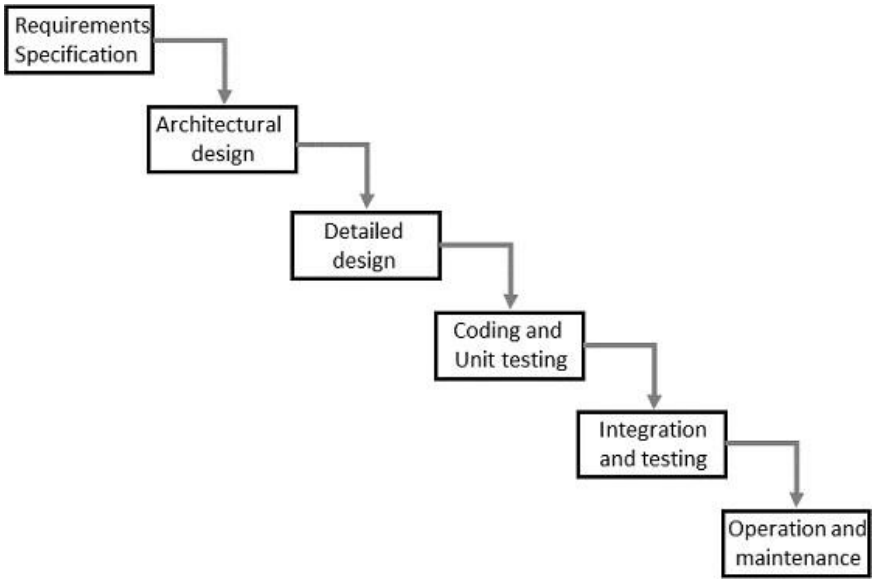
- Specification Methods − The methods used to specify the GUI. Even though these are lengthy and ambiguous methods, they are easy to understand.
- Grammars − Written Instructions or Expressions that a program would understand. They provide confirmations for completeness and correctness.
- Transition Diagram − Set of nodes and links that can be displayed in text, link frequency, state diagram, etc. They are difficult in evaluating usability, visibility, modularity and synchronization.
- Statecharts − Chart methods developed for simultaneous user activities and external actions. They provide link-specification with interface building tools.
- Interface Building Toolls − Design methods that help in designing command languages, data-entry structures, and widgets.
- Interface Mockup Toolls − Tools to develop a quick sketch of GUI. E.g., Microsoft Visio, Visual Studio .Net, etc.
- Software Engineering Toolls − Extensive programming tools to provide user interface management system.
- Evaluation Toolls − Tools to evaluate the correctness and completeness of programs.

## HCI and Software Engineering

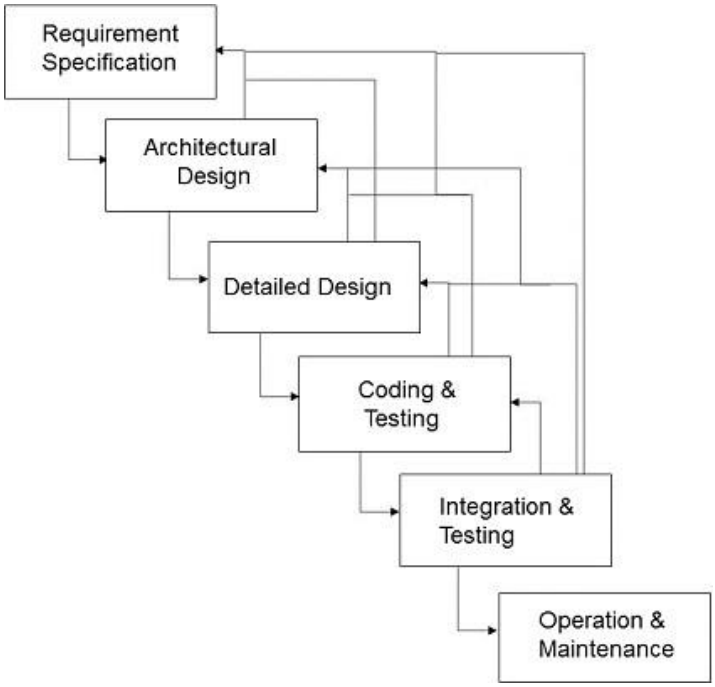
Software Engineering is the study of designing, development and preservation of software. It comes in contact with HCI to make the man and machine interaction more vibrant and interactive.

Let us see the following model in software engineering for interactive designing.

**The Waterfall Method**




**Interactive System Design**




The uni-directional movement of the waterfall model of Software Engineering shows that every phase depends on the preceding phase and not vice-versa. However, this model is not suitable for the interactive system design.

The interactive system design shows that every phase depends on each other to serve the purpose of designing and product creation. It is a continuous process as there is so much to know and users keep changing all the time. An interactive system designer should recognize this diversity.

## Prototyping

Prototyping is another type of software engineering models that can have a complete range of functionalities of the projected system.

In HCI, prototyping is a trial and partial design that helps users in testing design ideas without executing a complete system.

Example of a prototype can be Sketches. Sketches of interactive design can later be produced into graphical interface. See the following diagram.


Interface of a proposed system


A sketch of the interface

The above diagram can be considered as a Low Fiidelliity Prototype as it uses manual procedureslike sketching in a paper.

A Medium Fidelity Prototype involves some but not all procedures of the system. E.g., first screenof a GUI.

Finally, a Hi Fidelity Prototype simulates all the functionalities of the system in a design. This prototype requires, time, money and work force.

## User Centered Design (UCD)

The process of collecting feedback from users to improve the design is known as *user centereddesign* or UCD.

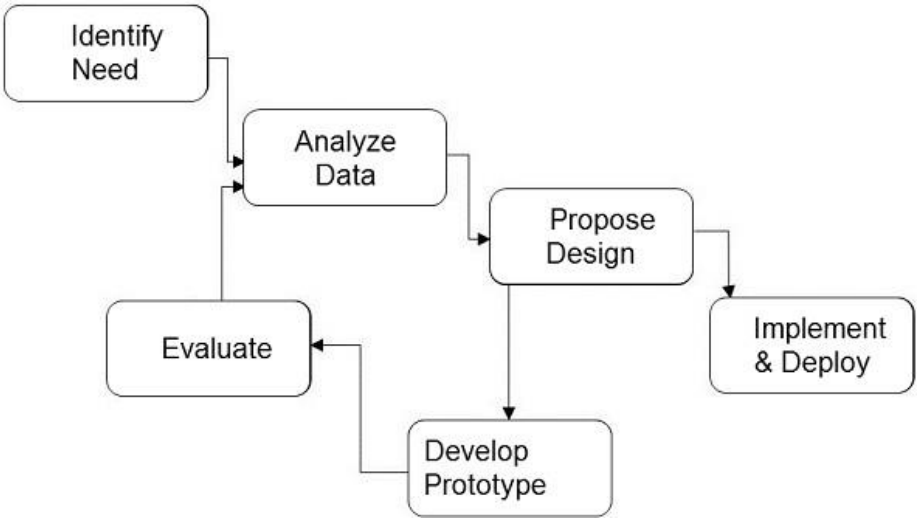
### UCD Drawbacks

- Passive user involvement.
- User's perception about the new interface may be inappropriate.Designers may
- ask incorrect questions to users.

**Interactive System Design Life Cycle (IISLC)**

The stages in the following diagram are repeated until the solution is reached.

**Diagram**




## GUI Design & Aesthetics

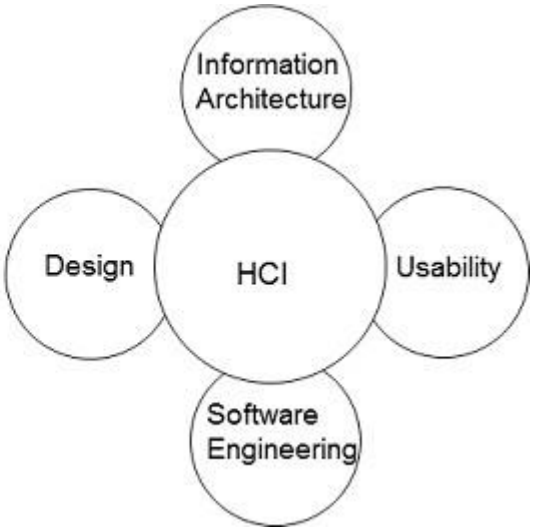
Graphic User Interface (GUI) is the interface from where a user can operate programs, applications or devices in a computer system. This is where the icons, menus, widgets, labels exist for the users to access.

It is significant that everything in the GUI is arranged in a way that is recognizable and pleasing to the eye, which shows the aesthetic sense of the GUI designer. GUI aesthetics provides a character and identity to any product.

## HCI Analogy

Let us take a known analogy that can be understood by everyone. A film director is a person who with his/her experience can work on script writing, acting, editing, and cinematography. He/She can be considered as the only person accountable for all the creative phases of the film.

Similarly, HCI can be considered as the film director whose job is part creative and part technical. An HCI designer have substantial understanding of all areas of designing. The following diagram depicts the analogy −


# Interactive Devices

Several interactive devices are used for the human computer interaction. Some of them are known tools and some are recently developed or are a concept to be developed in the future. In this note, we will discuss on some new and old interactive devices.

## Touch Screen

The touch screen concept was prophesized decades ago, however the platform was acquired recently. Today there are many devices that use touch screen. After vigilant selection of these devices, developers customize their touch screen experiences.

The cheapest and relatively easy way of manufacturing touch screens are the ones using electrodes and a voltage association. Other than the hardware differences, software alone can bring major differences from one touch device to another, even when the same hardware is used.

Along with the innovative designs and new hardware and software, touch screens are likely to grow in a big way in the future. A further development can be made by making a sync between the touch and other devices.

In HCI, touch screen can be considered as a new interactive device.

## Gesture Recognition

Gesture recognition is a subject in language technology that has the objective of understanding human movement via mathematical procedures. Hand gesture recognition is currently the field of focus. This technology is future based.

This new technology magnitudes an advanced association between human and computer where no mechanical devices are used. This new interactive device might terminate the old devices like keyboards and is also heavy on new devices like touch screens.

## Speech Recognition

The technology of transcribing spoken phrases into written text is Speech Recognition. Such technologies can be used in advanced control of many devices such as switching on and off the electrical appliances. Only certain commands are required to be recognized for a complete transcription. However, this cannot be beneficial for big vocabularies.

This HCI device help the user in hands free movement and keep the instruction based technologyup to date with the users.

## Keyboard

A keyboard can be considered as a primitive device known to all of us today. Keyboard uses an organization of keys/buttons that serves as a mechanical device for a computer. Each key in a keyboard corresponds to a single written symbol or character.

This is the most effective and ancient interactive device between man and machine that has givenideas to develop many more interactive devices as well as has made advancements in itself such as soft screen keyboards for computers and mobile phones.

## Response Time

Response time is the time taken by a device to respond to a request. The request can be anythingfrom a database query to loading a web page. The response time is the sum of the service time and wait time. Transmission time becomes a part of the response time when the response has to travel over a network.

In modern HCI devices, there are several applications installed and most of them functionsimultaneously or as per the user's usage. This makes a busier response time. All of that increasein the response time is caused by increase in the wait time. The wait time is due to the running ofthe requests and the queue of requests following it.

So, it is significant that the response time of a device is faster for which advanced processors areused in modern devices.

# Design Process & Task Analysis

### HCI Design

HCI design is considered as a problem solving process that has components like planned usage, target area, resources, cost, and viability. It decides on the requirement of product similarities to balance trade-offs.

The following points are the four basic activities of interaction design −

- Identifying requirements
- Building alternative designs
- Developing interactive versions of the designs
- Evaluating designs

**Three principles for user-centered approach are −**

- Early focus on users and tasks
- Empirical Measurement
- Iterative Design

## Design Methodologies

Various methodologies have materialized since the inception that outline the techniques for human–computer interaction. Following are few design methodologies −

- **Activity Theory −** This is an HCI method that describes the framework where the human- computer interactions take place. Activity theory provides reasoning, analytical tools and interaction designs.
- **User-Centered Design −** It provides users the center-stage in designing where they get the opportunity to work with designers and technical practitioners.
- **Principles of User Interface Design −** *Tolerance, Simplicity, Visibility, Affordance, Consistency, Structure* and *Feedback* are the seven principles used in interface designing.
- **Value Sensitive Design −** This method is used for developing technology and includesthree types of studies **−** *conceptual, empirical* **and** *technical***.**
    - *Conceptual* investigations works towards understanding the values of the investorswho use technology.
    - *Empiricall* investigations are qualitative or quantitative design research studies thatshows the designer's understanding of the users' values.
    - *Technical* investigations contain the use of technologies and designs in the conceptual and empirical investigations.

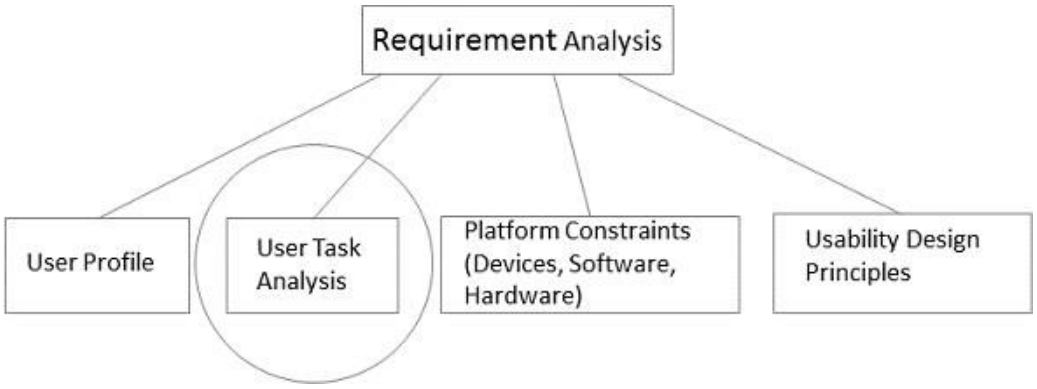
## Participatory Design

Participatory design process involves all stakeholders in the design process, so that the end result meets the needs they desire. This design is used in various areas such as software design, architecture, landscape architecture, product design, sustainability, graphic design, planning, urban design, and even medicine.

Participatory design is not a style, but focus on processes and procedures of designing. It is seenas a way of removing design accountability and origination by designers.

## Task Analysis

Task Analysis plays an important part in User Requirements Analysis.




Task analysis is the procedure to learn the users and abstract frameworks, the patterns used in workflows, and the chronological implementation of interaction with the GUI. It analyzes the ways in which the users partition the tasks and sequence them.

### What iis a TASK?

Human actions that contributes to a useful objective, aiming at the system, is a task. Task analysis defines performance of users, not computers.

### Hierarchical Task Analysis

Hierarchical Task Analysis is the procedure of disintegrating tasks into subtasks that could be analyzed using the logical sequence for execution. This would help in achieving the goal in the best possible way.

### Techniques for Analysis

- **Task decomposition − Splitting tasks into sub-tasks and in sequence.**
- **Knowledge-based techniques − Any instructions that users need to know.**

**‘User’ is always the beginning point for a task.**

- **Ethnography − Observation** of users’ behavior in the use context.
- **Protocol analysis −** Observation and documentation of actions of the user. This is achieved by authenticating the user’s thinking. The user is made to think aloud so that theuser’s mental logic can be understood.

## Engineering Task Models

Unlike Hierarchical Task Analysis, Engineering Task Models can be specified formally and are moreuseful.

### Characteristics of Engineering Task Modells

- Engineering task models have flexible notations, which describes the possible activitiesclearly.
- They have organized approaches to support the requirement, analysis, and use of task models in the design.
- They support the recycle of in-condition design solutions to problems that happenthroughout applications.
- Finally, they let the automatic tools accessible to support the different phases of the designcycle.

## Concur Task Tree (CTT)

CTT is an engineering methodology used for modeling a task and consists of tasks and operators. Operators in CTT are used to portray chronological associations between tasks. Following are the key features of a CTT −

- Focus on actions that users wish to accomplish.
- Hierarchical structure.
- Graphical syntax.
- Rich set of sequential operators.

# Dialog Design

A dialog is the construction of interaction between two or more beings or systems. In HCI, a dialogis studied at three levels −

- Lexical − Shape of icons, actual keys pressed, etc., are dealt at this level.
- Syntactic − The order of inputs and outputs in an interaction are described at this level.
- Semantic − At this level, the effect of dialog on the internal application/data is taken careof.

## Dialog Representation

To represent dialogs, we need formal techniques that serves two purposes −It

- helps in understanding the proposed design in a better way.
- It helps in analyzing dialogs to identify usability issues. E.g., Questions such as “does thedesign actually support undo?” can be answered.

## Introduction to Formalism

There are many formalism techniques that we can use to signify dialogs. In this chapter, we will discuss on three of these formalism techniques, which are −

- The state transition networks (STN)
- The state charts
- The classical Petri nets

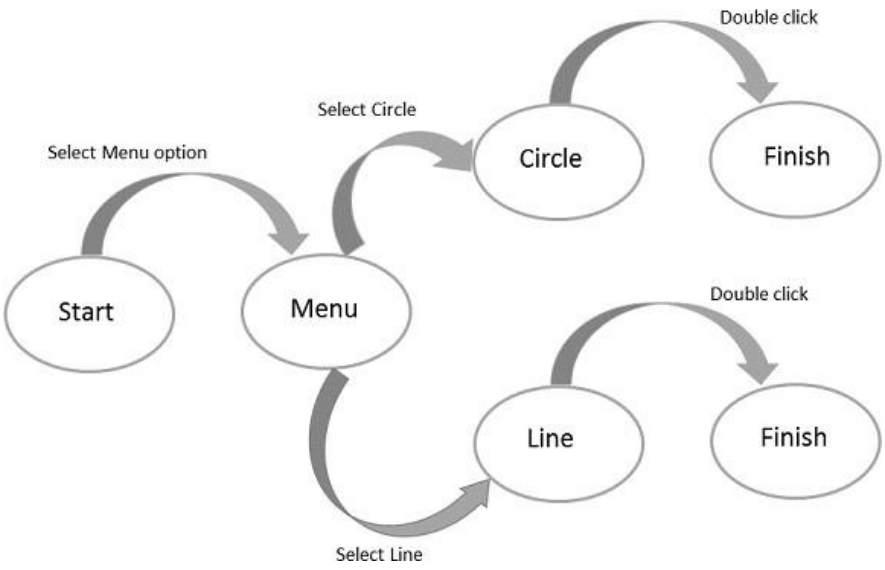
### State Transition Network (STN)

STNs 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 −

- Ciirclles − A circle refers to a state of the system, which is branded by giving a name to thestate.
- 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.

### STN Diagram




### StateCharts

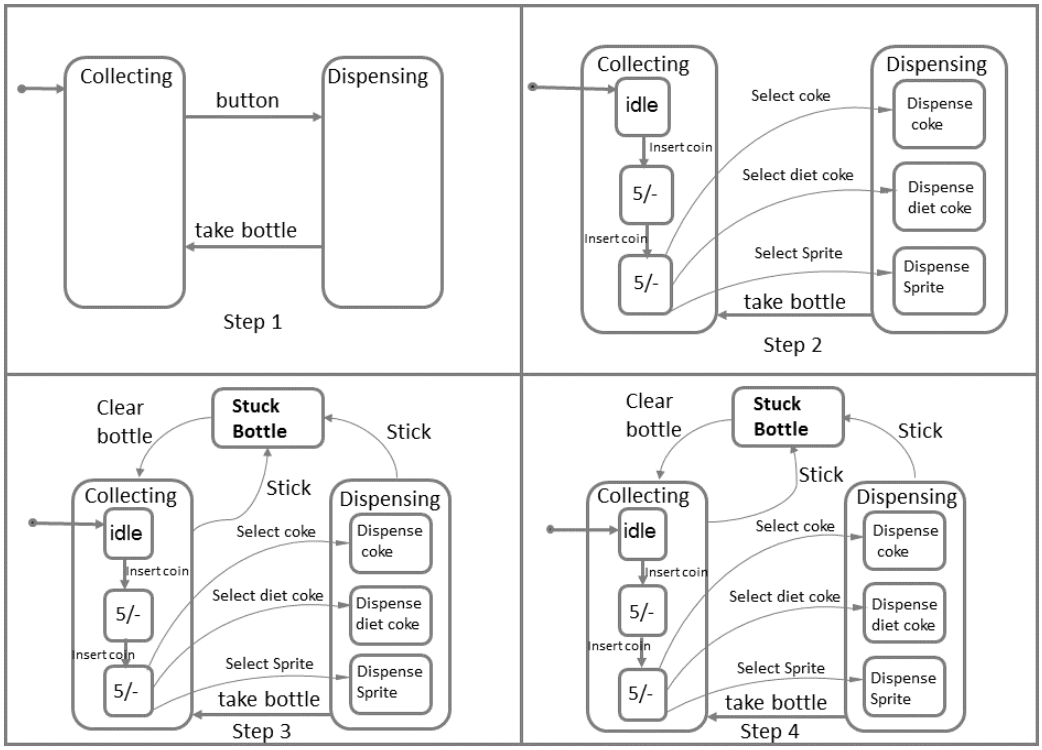
StateCharts represent complex reactive systems that extends Finite State Machines (FSM), handle concurrency, and adds memory to FSM. It also simplifies complex system representations.StateCharts has the following states −

- Active state − The present state of the underlying FSM.
- Basic states − These are individual states and are not composed of other states.
- Super states − These states are composed of other states.

### Illustration

> For each basic state b, the super state containing b is called the ancestor state. A super stateis called OR super state if exactly one of its sub states is active, whenever it is active.

Let us see the StateChart Construction of a machine that dispense bottles on inserting coins.




The above diagram explains the entire procedure of a bottle dispensing machine. On pressing thebutton after inserting coin, the machine will toggle between bottle filling and dispensing modes. When a required request bottle is available, it dispense the bottle. In the background, another procedure runs where any stuck bottle will be cleared. The 'H' symbol in Step 4, indicates that a procedure is added to History for future access.

### Petrii Nets

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.

- **Pllace −** This element is used to symbolize passive elements of the reactive system. Aplace is represented by a circle.
- **Transition −** This element is used to symbolize active elements of the reactive system. Transitions are represented by squares/rectangles.
- **Arc −** This element is used to represent causal relations. Arc is represented by arrows.
- **Token −** This element is subject to change. Tokens are represented by small filled circles.

## Visual Thinking

Visual materials have assisted in the communication process since ages in form of paintings, sketches, maps, diagrams, photographs, etc. In today's world, with the invention of technology andits further growth, new potentials are offered for visual information such as thinking and reasoning. As per studies, the command of visual thinking in human-computer interaction (HCI) design is still not discovered completely. So, let us learn the theories that support visual thinking in sense-making activities in HCI design.

An initial terminology for talking about visual thinking was discovered that included concepts suchas visual immediacy, visual impetus, visual impedance, and visual metaphors, analogies and associations, in the context of information design for the web.

As such, this design process became well suited as a logical and collaborative method during thedesign process. Let us discuss in brief the concepts individually.

### Visual Immediacy

It is a reasoning process that helps in understanding of information in the visual representation. The term is chosen to highlight its time related quality, which also serves as an indicator of how well the reasoning has been facilitated by the design.

### Visual Impetus

Visual impetus is defined as a stimulus that aims at the increase in engagement in the contextual aspects of the representation.

### Visual Impedance

It is perceived as the opposite of visual immediacy as it is a hindrance in the design of the representation. In relation to reasoning, impedance can be expressed as a slower cognition.

### Visual Metaphors,, Association,, Analogy,, Abduction and Blending

- When a visual demonstration is used to understand an idea in terms of another familiar idea it is called a visual metaphor.
- Visual analogy and conceptual blending are similar to metaphors. Analogy can be definedas an implication from one particular to another. Conceptual blending can be defined as combination of elements and vital relations from varied situations.

The HCI design can be highly benefited with the use of above mentioned concepts. The concepts are pragmatic in supporting the use of visual procedures in HCI, as well as in the design processes.

## Direct Manipulation Programming

Direct manipulation has been acclaimed as a good form of interface design, and is well received by users. Such processes use many source to get the input and finally convert them into an outputas desired by the user using inbuilt tools and programs.

“Directness” has been considered as phenomena that contribute majorly to the manipulation programming. It has the following two aspects.

- Distance
- Direct Engagement

### Diistance

Distance is an interface that decides the gulfs between a user’s goal and the level of explanation delivered by the systems, with which the user deals. These are referred to as the *Gullff off Executtiion* and the *Gulf of Evaluation*.

### The Gulf of Execution

The Gulf of Execution defines the gap/gulf between a user's goal and the device to implement thatgoal. One of the principal objective of Usability is to diminish this gap by removing barriers and follow steps to minimize the user’s distraction from the intended task that would prevent the flow of the work.

### The Gulf of Evaluation

The Gulf of Evaluation is the representation of expectations that the user has interpreted from thesystem in a design. As per Donald Norman, *The gulf is small when tthe system provides information aboutt itts sttatte iin a form tthatt iis easy tto gett,, iis easy tto interpret,, and matches tthe way the person thinks off the system.*

### Direct Engagement

It is described as a programming where the design directly takes care of the controls of the objects presented by the user and makes a system less difficult to use.

The scrutiny of the execution and evaluation process illuminates the efforts in using a system. Italso gives the ways to minimize the mental effort required to use a system.

### Problems with Direct Manipulation

- Even though the immediacy of response and the conversion of objectives to actions has made some tasks easy, all tasks should not be done easily. For example, a repetitive operation is probably best done via a script and not through immediacy.
- Direct manipulation interfaces finds it hard to manage variables, or illustration of discrete elements from a class of elements.

- Direct manipulation interfaces may not be accurate as the dependency is on the user rather than on the system.
- An important problem with direct manipulation interfaces is that it directly supports the techniques, the user thinks.

## Item Presentation Sequence

In HCI, the presentation sequence can be planned according to the task or application requirements. The natural sequence of items in the menu should be taken care of. Main factors in presentation sequence are −

- Time
- Numeric ordering
- Physical properties

A designer must select one of the following prospects when there are no task-related arrangements−

- Alphabetic sequence of terms
- Grouping of related items
- Most frequently used items first
- Most important items first

## Menu Layout

- Menus should be organized using task semantics.
- Broad-shallow should be preferred to narrow-deep.
- Positions should be shown by graphics, numbers or titles.
- Subtrees should use items as titles.
- Items should be grouped meaningfully.
- Items should be sequenced meaningfully.
- Brief items should be used.
- Consistent grammar, layout and technology should be used.
- Type ahead, jump ahead, or other shortcuts should be allowed.
- Jumps to previous and main menu should be allowed.
- Online help should be considered.

**Guidelines for consistency should be defined for the following components**

- Titles
- Item placement
- Instructions
-
-

Error messages

Status reports

## Form Fill-in Dialog Boxes

Appropriate for multiple entry of data fields −

- Complete information should be visible to the user.The display should resemble familiar paper forms.
  Some instructions should be given for different types of entries.

**Users must be familiar with**

- Keyboards
  - Use of TAB key or mouse to move the cursor
  - Error correction methods
  - Field-label meanings
  - Permissible field contents
  - Use of the ENTER and/or RETURN key.

**Form Fill-in Design Guidelines −**

- Title should be meaningful.
- Instructions should be comprehensible.
- Fields should be logically grouped and sequenced.
- The form should be visually appealing.
- Familiar field labels should be provided.
- Consistent terminology and abbreviations should be used.
- Convenient cursor movement should be available.
- Error correction for individual characters and entire field's facility should be present.
- Error prevention.
- Error messages for unacceptable values should be populated.
- Optional fields should be clearly marked.
- Explanatory messages for fields should be available.
- Completion signal should populate.

## CHARACTERISTICS OF THE GRAPHICAL USER INTERFACE

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

**Sophisticated Visual Presentation:**

Visual presentation is the visual aspect of the interface. It is what people see on the screen.

- The sophistication of a graphical system permits displaying lines, including drawings and icons.
- It also permits the displaying of a variety of character fonts, including different sizes and styles.
- The display of 16 million or more colors is possible on some screens. Graphics also permit animation and the presentation of photograph and motion video.

The meaningful interface elements visually presented to the user in a graphical System include windows (primary, secondary, or dialog boxes), menus (menu bar, pull down, pop-up, cascading), icons to represent objects such as programs or files, assorted screen-based controls (text boxes, list boxes, combination boxes, settings, scroll bar and buttons), and a mouse pointer and cursor.

-- The objective is to reflect visually on screen the real world of the user as realistically, meaningfully, simply, and clearly possible.

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**Restricted Set of Interface Options:** The array of alternatives available to the user is what is presented on the screen or may be retrieved through what is presented on the screen, nothing less, nothing more. This concept fostered the acronym WYSIWYG.

**Pick-and-Click Interaction:** Elements of a graphical screen upon which some action is to be performed must first identified.

- The motor activity required of a person to identify this element for a proposed action is commonly referred to as pick, the signal to perform an action as cue.
- 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. The hand and mind seem to work smoothly and efficiently together.

- The secondary mechanism for performing these selection actions is the keyboard most systems permit pick-and-click to be performed using the keyboard as well.

**Visualization:** 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

Presenting specialized graphic portrayals facilitates visualization.

The best visualization method for an activity depends on what People are trying to learn from the data.

The goal is not necessarily to reproduce a really graphical image, but to produce one that conveys the most relevant information.

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

**Object Orientation:** A graphical system consists of objects and actions. Objects are what people see on screen. They are manipulated as a single unit.

- Objects can be composed of sub objects. For example, an object may be a document. The document's sub objects may be a paragraph, sentence, word, and letter.

- A collection is the simplest relationship-the objects sharing a common aspect.

- A collection might be the result of a query or a multiple selection of objects. Operations can be applied to a collection of objects.

- A constraint is a stronger object relationship. Changing an object in a set affects some other object in the set.

- A document being organized into pages is an example of a constraint. A composite exists when the relationship between objects becomes so significant that the aggregation itself can be identified as an object.

- Examples include a range of cells organized into a spreadsheet, or a collection of words organized into a paragraph.

- A container is an object in which other objects exist. Examples include text in a document
- or documents in a folder.

A container often influences the behavior of its content. It may add or suppress certain properties or operations of objects placed within it, control access to its content, or control access to kinds of objects it will accept. These relationships help define an object's type. Similar traits and behaviors exist in objects of the same object type.

Another important object characteristic is persistence. Persistence is the maintenance of a state once it is established. An object's state (for example, window size, cursor location, scroll position, and so on) should always be automatically preserved when the user changes it.

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