

USER EXPERIENCE VS. USER INTERFACE



USER INTERACTION DESIGN

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDO8021	User Interface Design	03	--	--	03	--	--	03

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	<p>Software Engineering concepts and any programming Language</p> <p>Self-learning Topics: Web design languages</p>	02	NA
I	Introduction to Interaction Design	<p>Good and Poor Design, What is Interaction Design, The User Experience, The Process Of Interaction Design, Interaction Design and the User Experience, Necessity of UI/UX</p> <p>Self-learning Topics: Study of Various interactive day to day application</p>	05	CO1
II	Understanding and Conceptualizing Interaction Cognitive aspects and Social, Emotional Interaction	<p>Understanding the Problem Space and Conceptualizing Design, Conceptual Model, Interface Types, Cognitive aspects, Social Interaction and the Emerging Social Phenomena, Emotions and the User Experience, Expressive and Frustrating Interfaces, Persuasive Technologies</p> <p>Self-learning Topics: Study of Various interactive Interface Types</p>	05	CO2

III	Data Gathering, Establishing Requirements, Analysis, Interpretation and Presentation	<p>Establishing Requirements, Five Key Issues, Techniques for Data Gathering, Data Analysis Interpretation and Presentation, Task Description and Task Analysis</p> <p>Self-learning Topics: Any case study of how to gather requirements .(eq.BE Project)</p>	08	CO3
IV	Process of Interaction Design, Prototyping, Construction.	<p>Interaction Design Process, Prototyping and Conceptual Design, Interface Metaphors and Analogies</p> <p>Self-learning Topics: Study of two websites with usability concepts.</p>	07	CO4 / CO5
V	Design rules and Industry standards	<p>Design principles, Principles to support Usability, Standards and Guidelines, Golden rules and Heuristics, ISO/IEC standards .The 15 Rules Every UI/UX Designer Should Know .</p> <p>Self-learning Topics: Study experiments on industry standards and design principles. https://xd.adobe.com/ideas/career-tips/15-rules-every-ux-designer-know/</p>	07	CO5

VI	Evaluation Techniques and Framework	<p>The Why, What, Where and When of Evaluation, Types of Evaluation, case studies, DECIDE Framework, Usability Testing, conducting experiments, Field studies, Heuristic Evaluation and walkthroughs, Predictive models.</p> <p>Self-learning Topics: Evaluation of any GUI with usability principles.</p>	05	CO5/ CO6
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Text Books:

1. Interaction Design, by J. Preece, Y. Rogers and H. Sharp. ISBN 0-471-49278-7.
2. Human Computer Interaction, by Alan Dix, Janet Finlay, Gregory D Abowd, Russell Beale
3. Alan Cooper, Robert Reimann, David Cronin, “About Face3: Essentials of Interaction design”, Wiley publication.
4. Wilbert O. Galitz, “The Essential Guide to User Interface Design”, Wiley publication.

References Books:

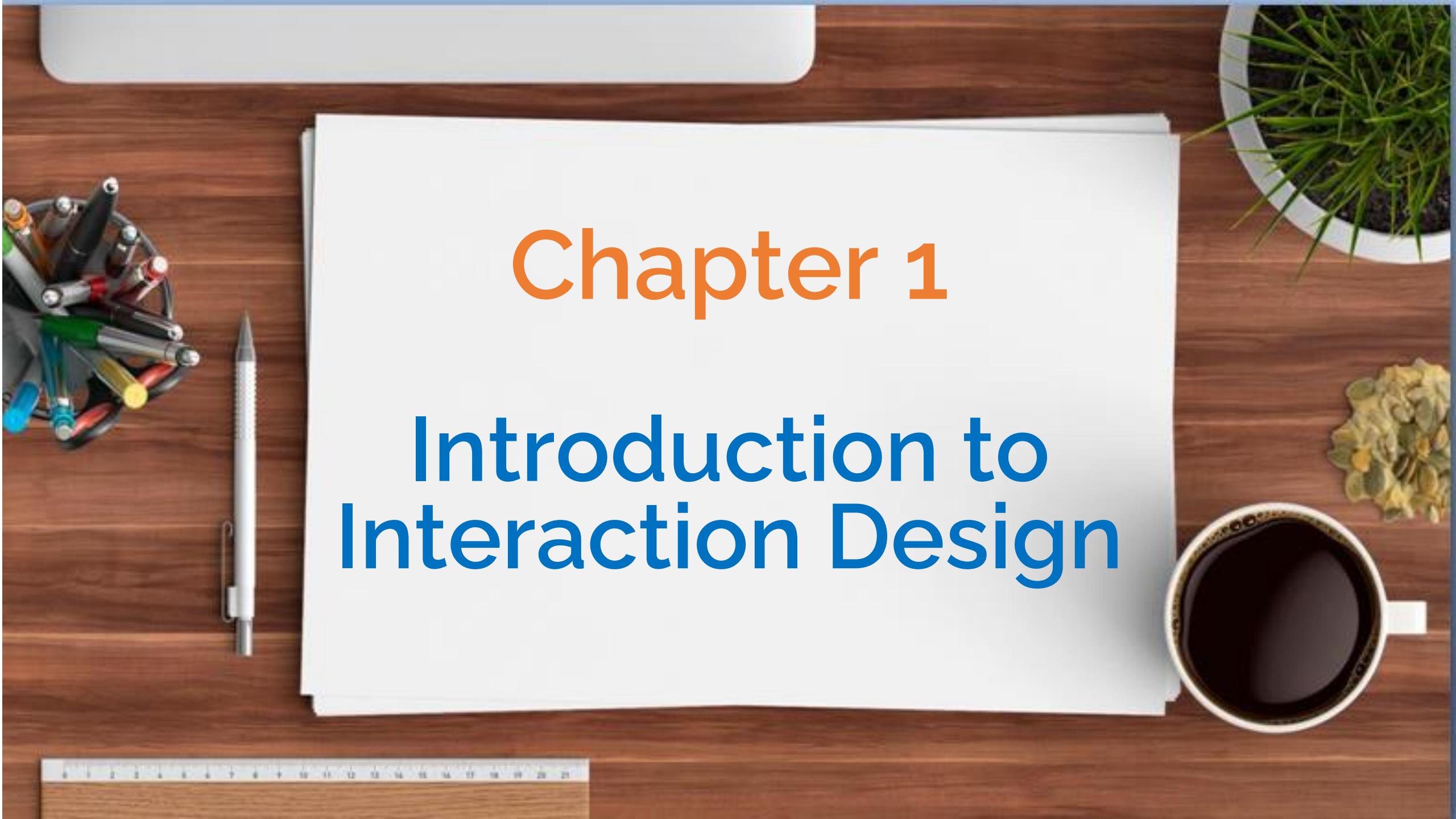
1. The UX Book, by Rex Hartson and Pardha S Pyla
2. Donald A. Norman, “The design of everyday things”, Basic books.
3. Jeff Johnson, “Designing with the mind in mind”, Morgan Kaufmann Publication.
4. UI Design: Key to captivate User Understanding, by Nilakshi Jain, Dhananjay Kalbande

Online References:

1. https://onlinecourses.nptel.ac.in/noc21_ar05/preview
2. <https://nptel.ac.in/courses/124/107/124107008/>
3. <https://nptel.ac.in/noc/courses/noe19/SEM1/noc19-ar10/>
4. <https://nptel.ac.in/courses/107/103/107103083/>
5. <https://www.youtube.com/watch?v=6C2YelmakdY&list=PLW-zSkCnZ-gD5TDFs1eL5EnH2mQ0f9g6B>
6. <https://xd.adobe.com/ideas/process/>

Chapter 1

Introduction to Interaction Design



What is Interaction Design??



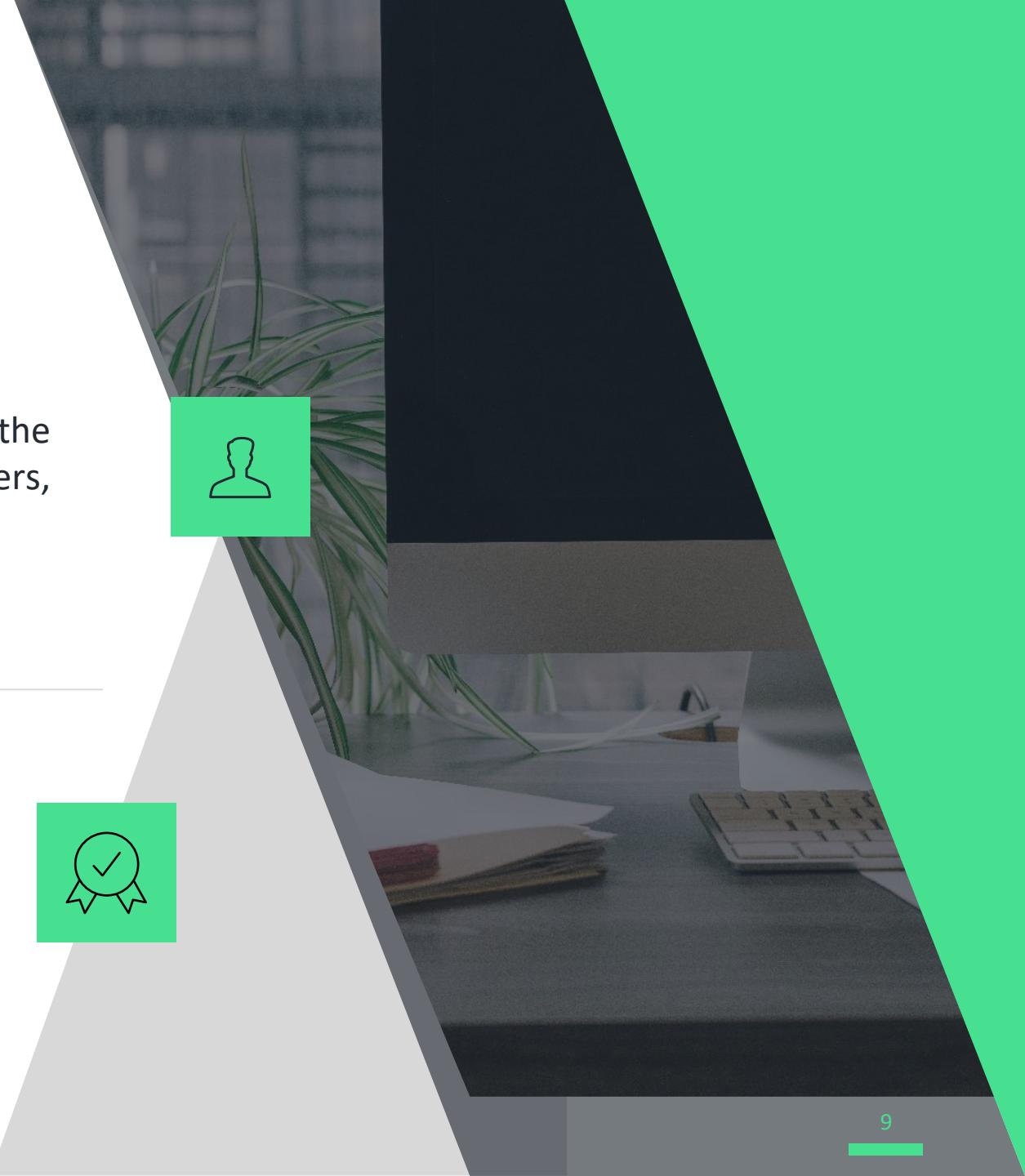
1.1 : Introduction

Introduction

In simple words, INTERACTION DESIGN is the interaction between the clients, that are the users, and the items such as applications and websites.

Definition

“Interaction Design (IxD) defines the structure and behavior of interactive systems. Interaction designers strive to create meaningful relationships between people and the products and services that they use, from computers to mobile devices to appliances and beyond. Our practices are evolving with the world.”





Why User Interaction Design?

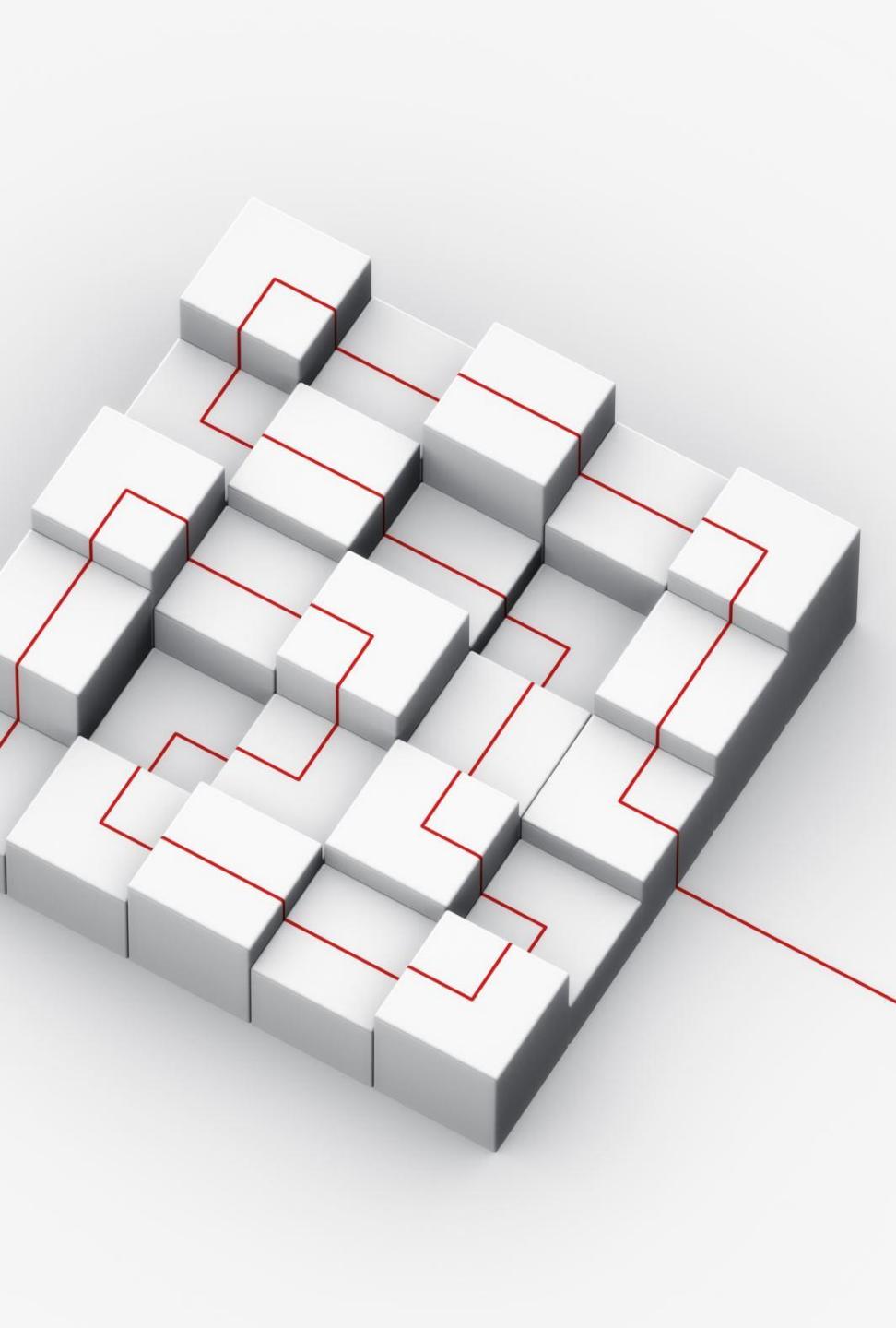
- **Definition:** The process of creating interfaces that provide meaningful and relevant experiences to users.
- **Core Objective:** To bridge the gap between user needs and technology solutions.
- **Why It Matters:**
 - Enhances user satisfaction and loyalty.
 - Drives usability and accessibility.
 - Impacts overall product success and brand perception.

The goal of interaction design is to create products that enable the user to achieve their objectives in the best way possible

Goal of interaction design:-



How many interactive
products we use
everyday?



Aim of Interactive Design :-

- The aim of interaction design is to redress the concern of effective usage of the product by bringing usability into the design process.
- It is about developing interactive products that are easy, effective, and enjoyable to use-from the users perspective.

1.2: Good And Poor Design

Elements of Design

Line
Shape
Direction

Size
Texture
Color

Principles of Design

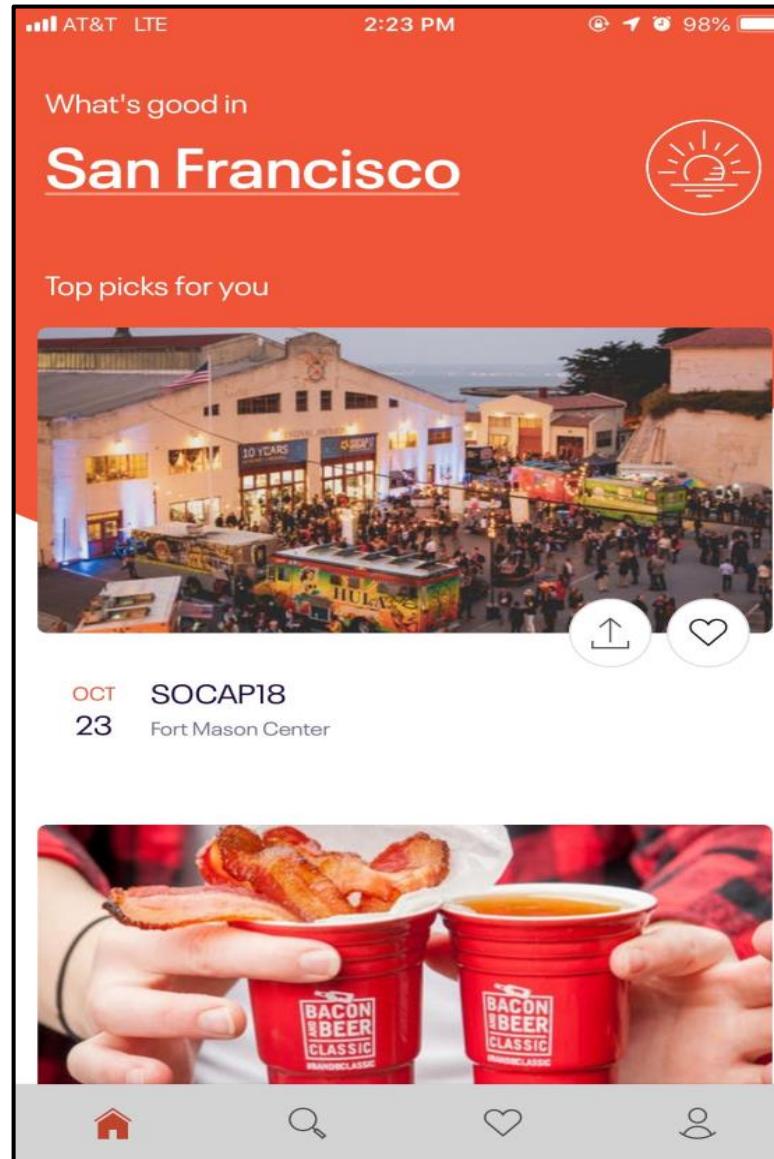
Balance
Alignment
Contrast

Proximity
Repetition
Space

- Elements and Principles of design are important to turn a basic design into a good design which automatically provides a good interaction design.
- Ignorance of any one characteristic can reduce your design to a disaster eventually reducing your chances of a good interaction design and user experience.

1.2.1: Good Design

01

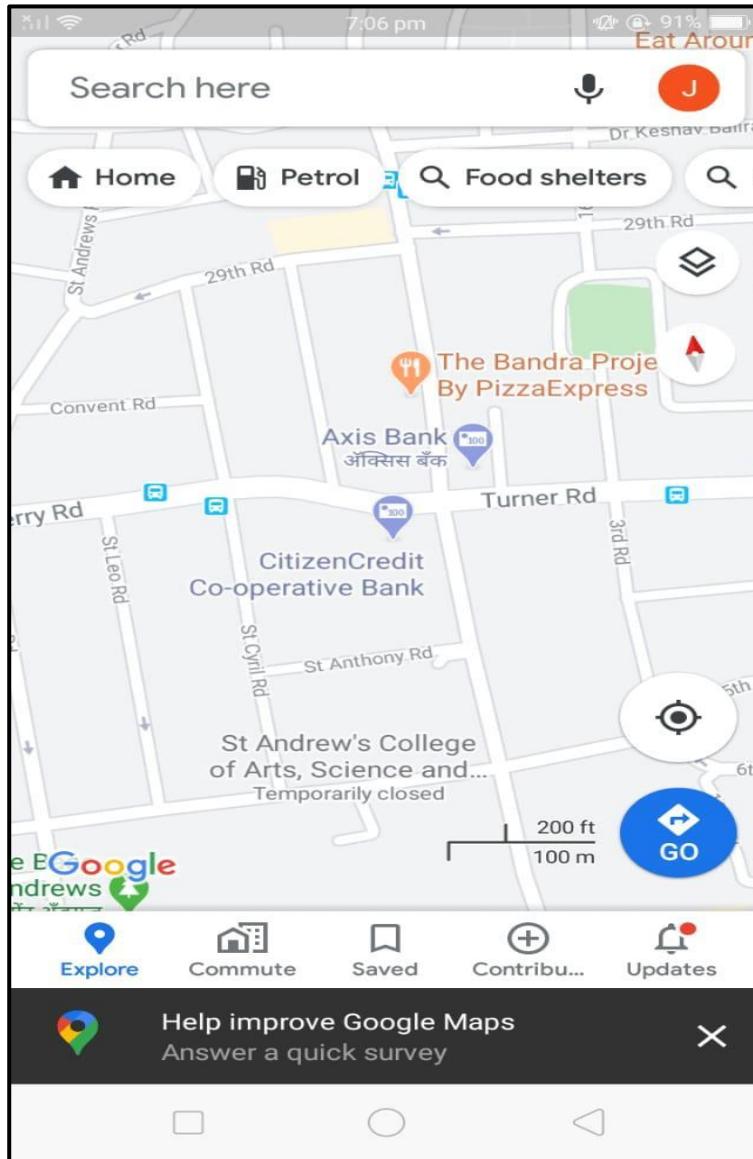


Good Design ✓

1. Design is simple and easy. For good designs, Less is always more.
1. The application has important functionalities such as Like, Share which helps me to do the task in one click.
1. The schematic design is grabbing my attention in the right places. Hence the text, color, size everything is in the right proportion making the interface attractive yet subtle.

1.2.1: Good Design

02



Good Design ✓

1. Balance of its elements is perfect. Two buttons are present and yet it does not hide or overcrowd the map.
1. Alignment is correct. The most important is the search bar and that is present on the top of the screen.
1. Contrast in color for different elements is making the map easier to read.

1.2.2: Bad Design

01



Bad Design X

1. No visual order. One cannot decide where to look. There is a lot of going on that is diverting and indistinct. There are excesses of overwhelming components.
2. No appeal. This is the ideal case of a structure that is both unappealing and not practical. The foundation is too loud and detracts from the usefulness and the objective of the site which is to guide customers to its product.
3. No Balance, Alignment and Pattern. Everything is missing. All the information is dumped haphazardly making it difficult to understand.

1.2.2: Bad Design

02



Bad Design X

1. The image is an example of how if even one element is not proper can cause our design to fall apart.
1. Color Scheme. The colors overlap each other in the worst scene making it almost impossible to read. Other than the color scheme if you observe, unlike the above design it has a grid, is not much crowded and also has navigation links. But due to the wrong choice of color scheme, it looks shabby.

Go to <https://www.menti.com/> and
type code **6683 4711** or scan the QR



Mentimeter

Please enter the code

A text input field containing the survey code "1234 5678".

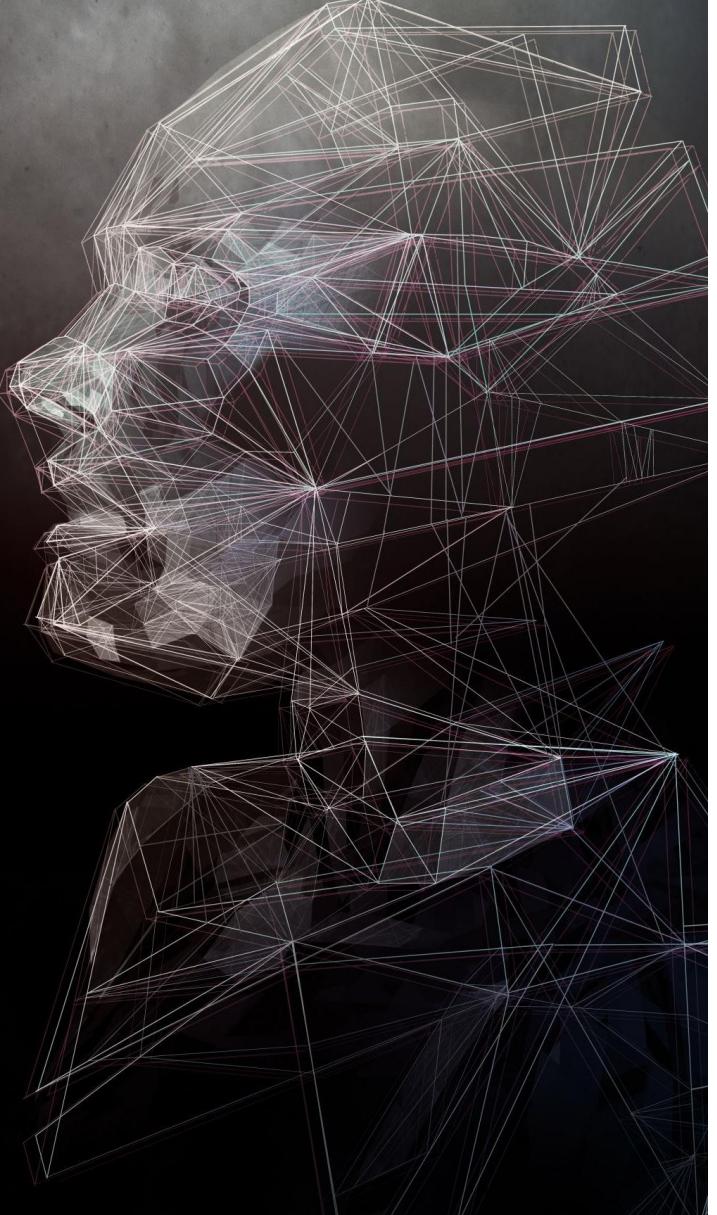
Submit

A blue rectangular button with the word "Submit" in white capital letters.

The code is found on the screen in front of you

Evolution of HCI ‘interfaces’

- **50s** - Interface at the hardware level for engineers - switch panels
- **60-70s** - interface at the programming level - COBOL, FORTRAN
- **70-90s** - Interface at the terminal level - command languages
- **80s** - Interface at the interaction dialogue level - GUIs, multimedia
- **90s** - Interface at the work setting - networked systems, groupware
- **00s** - Interface becomes pervasive
 - RF tags, Bluetooth technology, mobile devices, consumer electronics, interactive screens, embedded technology

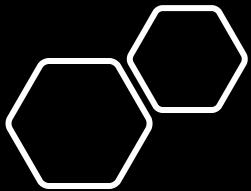


From HCI to Interaction Design

- **Human-computer interaction (HCI)** is:
“concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them” (ACM SIGCHI, 1992, p.6)
- **Interaction design (ID)** is:
“the design of spaces for human communication and interaction”
- Increasingly, more application areas, more technologies and more issues to consider when designing ‘interfaces’

What do professionals do in the ID business?

- **Interaction designers** - people involved in the design of all the interactive aspects of a product
- **Usability engineers** - people who focus on evaluating products, using usability methods and principles
- **Web designers** - people who develop and create the visual design of websites, such as layouts
- **Information architects** - people who come up with ideas of how to plan and structure interactive products
- **User experience designers** - people who do all the above but who may also carry out field studies to inform the design of products



WHAT IS DESIGN

Designing of A product depends on who is going to use the product, how the product is going to be used, where it is going to be used and what kind of users are going to use the product.

Hence a designer has to do something different when he is designing,in the picture the designer has invented a biking jacket with inbuilt signal mechanism. But he has A lot of options to choose from making it A difficult and complicated task for the designer.

To overcome this difficult user has 2 options: assume or understand. By assuming the choices of the user, the designer can only hope for the best.

But by understanding the user, which will guarantee better results, design will have to:

Understand what users are comfortable with

Think of ways that will help the users do their regular jobs more easily.

Using the product should make the user feel satisfied i.E. Quality user experience.

Involving the user in this process and asking for their feedback.

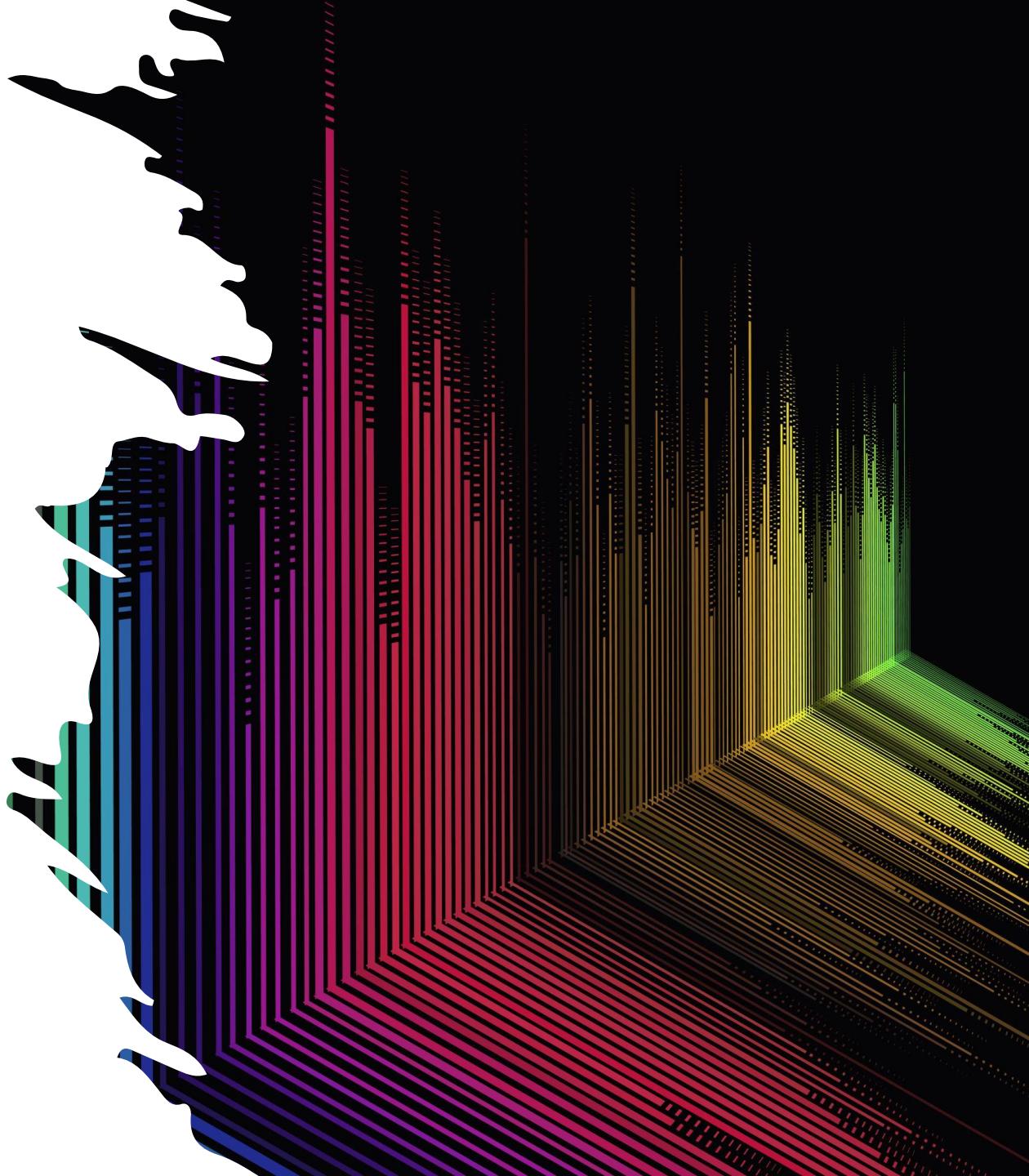
Making use of successful designing techniques.

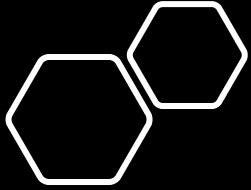
ACTIVITY 1

How does making a phone call differ when using:
a public phone box
a cell phone?

How have these devices been designed to take into account

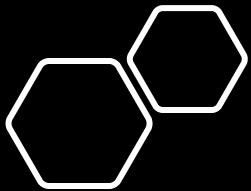
- (a) the kind of users
- (b) type of activity being supported
- (c) context of use





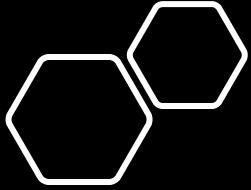
(a) the kind of users

- Public phones are designed to be used by the general public.
- Many have Braille embossed on the keys and speaker volume control to enable people who are blind and hard of hearing to use them.
- Cell phones are intended for all user groups, although they can be difficult to use for people who are blind or have limited manual dexterity.



(b) type of activity being supported

- Most phone boxes are designed with a simple mode of interaction: insert card or money and key in the phone number.
- If engaged or unable to connect the money or card is returned when the receiver is replaced.
- This function enables the making of multiple calls to be more efficient.
- Cell phones have a more complex mode of interaction.
- More functionality is provided, requiring the user to spend time learning how to use them.
- For example, users can save phone numbers in an address book and then assign these to "hotkeys," allowing them to be called simply through pressing one or two keys.



(c) context of use

- Phone boxes are intended to be used in public places, say on the street or in a bus station, and so have been designed to give the user a degree of privacy and noise protection through the use of hoods and booths.
- Cell phones have been designed to be used any place and any time.
- However, little consideration has been given to how such flexibility affects others who may be in the same public place (e.g., sitting on trains and buses).

Chapter 1

Introduction to Interaction Design

What is interaction design??

“designing interactive products to support people in their everyday and working lives.”

- It is about creating user experiences that enhance and extend the way people work, communicate and interact.
- It is about finding ways of supporting people.
- This contrasts with software engineering, which focuses primarily on the production of software solutions for given applications.

1.3.1: 5 Dimensions of Interaction Design

Words envelop content. Easy to understand Words should be used in interaction for button labels,etc.



1D : Words

2D: Visual Representation



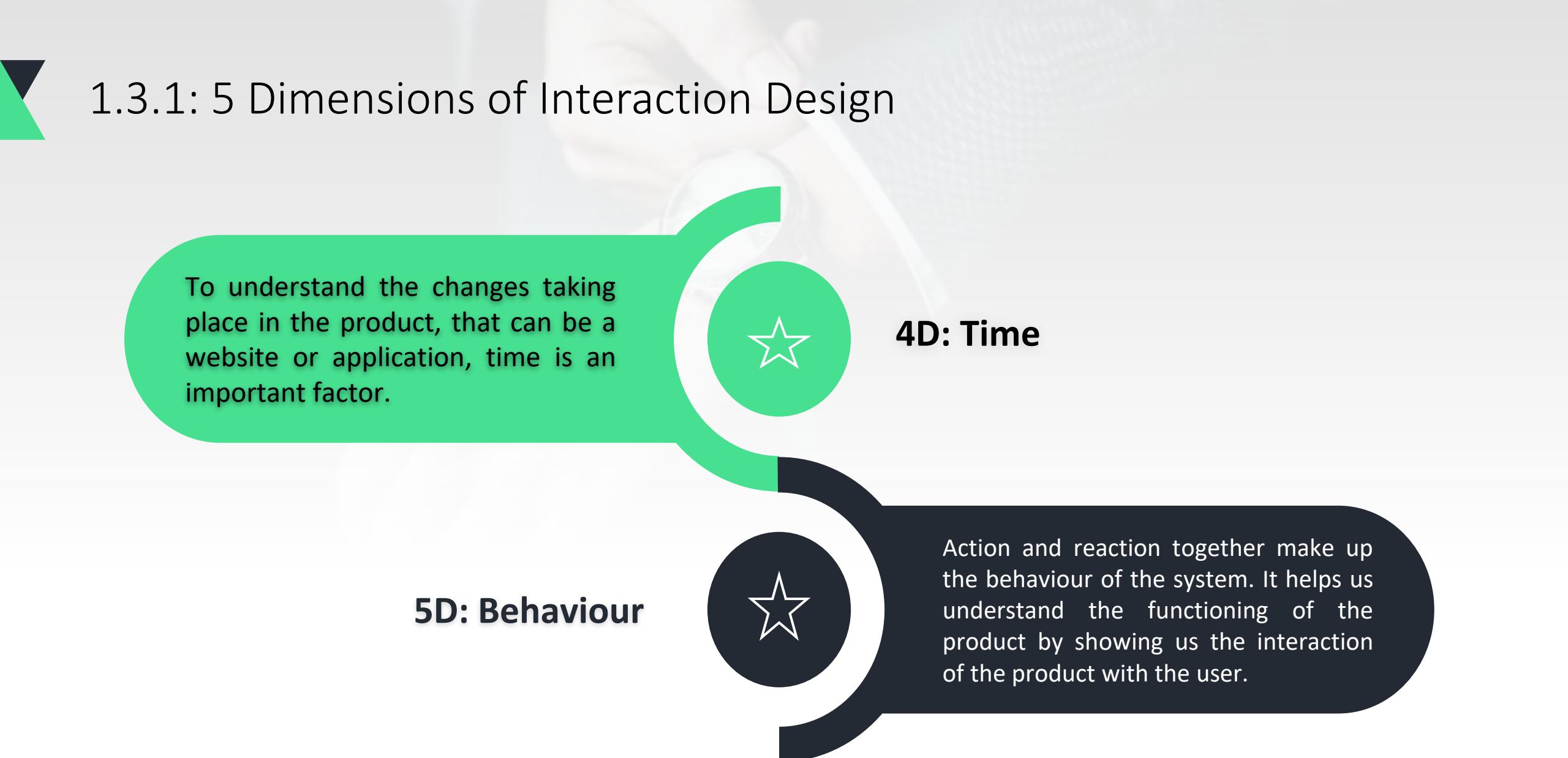
Customers interact with images and different illustrations which are known as Visual Representations. Ex, '?' means help desk

In order to make use of products we need physical objects through which we can access the products and services of our choice. Like, a mouse to click.



3D: Physical Object or Space

1.3.1: 5 Dimensions of Interaction Design



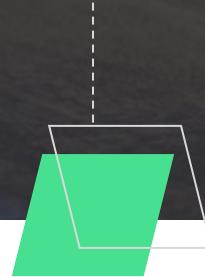
To understand the changes taking place in the product, that can be a website or application, time is an important factor.

4D: Time

5D: Behaviour

Action and reaction together make up the behaviour of the system. It helps us understand the functioning of the product by showing us the interaction of the product with the user.

1.3.2: Key Characteristics of Interaction Design



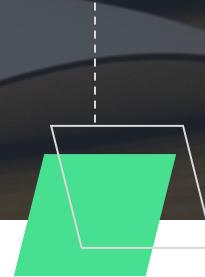
User Involvement

User involvement is extremely important and takes place at every step of the interaction design process



Usability Goals and User Experience Goals

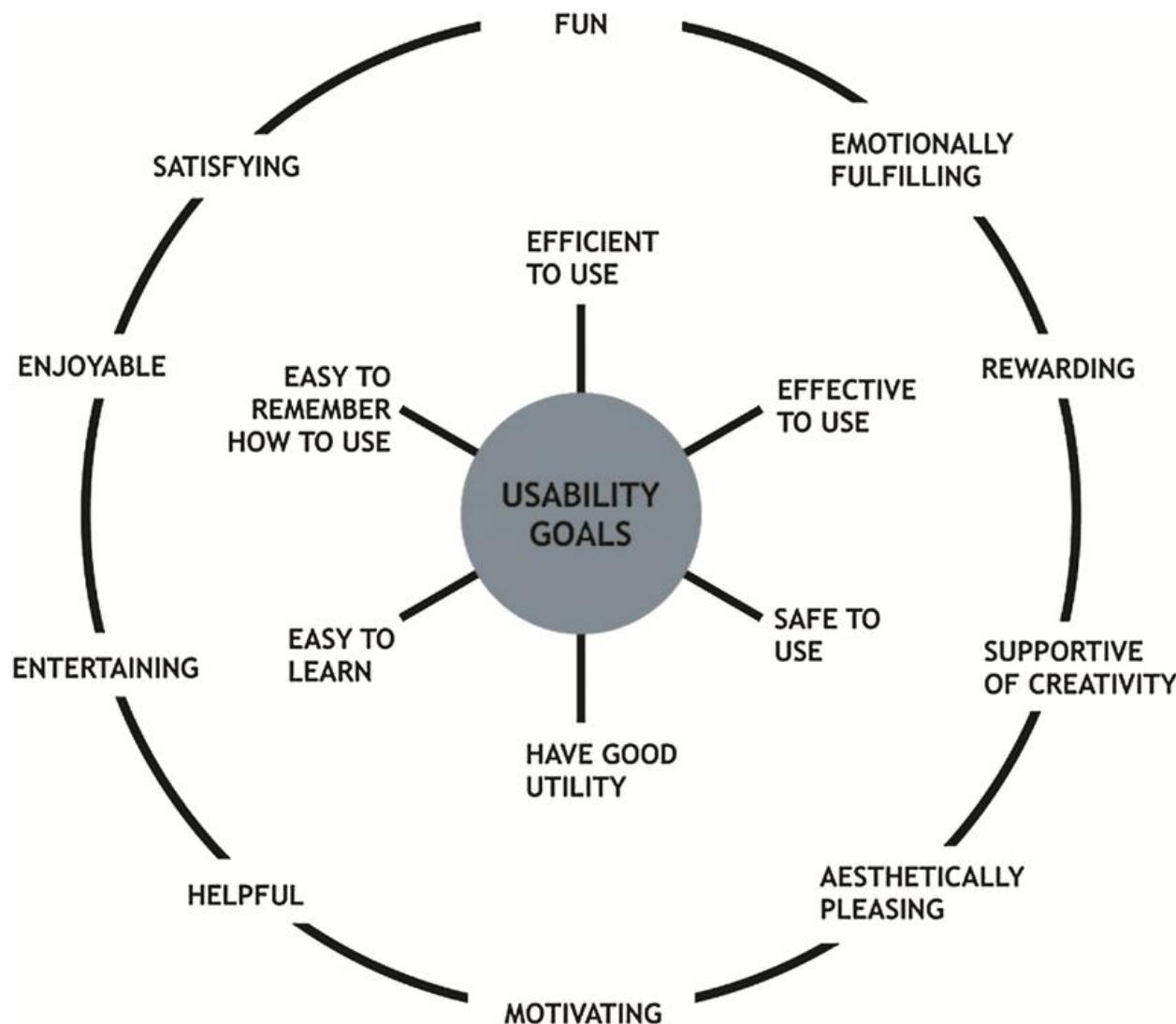
- Usability goals and user experience goals should be discussed and agreed upon at first.
- It should be documented at the starting of the process so that no confusion arises in the end.



Iteration

- Iteration through the four activities is inevitable
- Interaction design is an **ITERATIVE PROCESS**.

1.3.3: Usability Goals and User Experience Goals



1.3.3.1: Usability Goals

- Usability alludes to guaranteeing that interactive products should not be difficult to learn, successful to utilize, and fun from the client's point of view.
- Users should be able to complete their work or activities at school, office by advancing the interaction between users and products.
- Usability aims are formed by asking questions.

01



02



03



04



05



06



Effectiveness

Efficiency

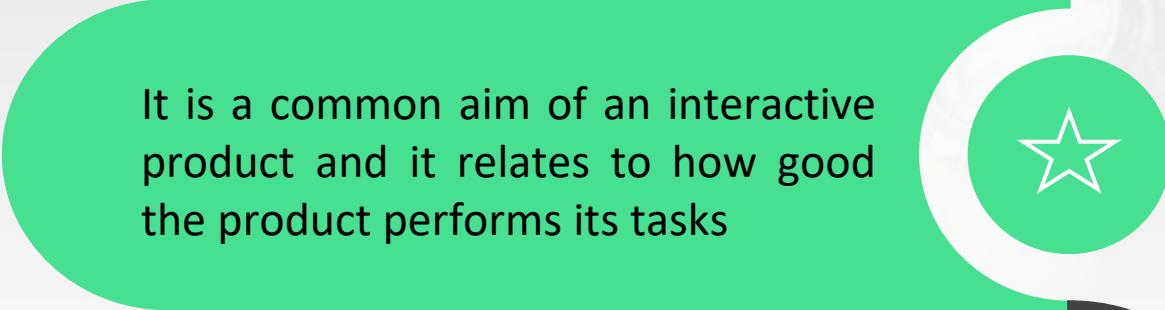
Safety

Utility

Learnability

Memorability

1.3.3.1: Usability Goals



It is a common aim of an interactive product and it relates to how good the product performs its tasks

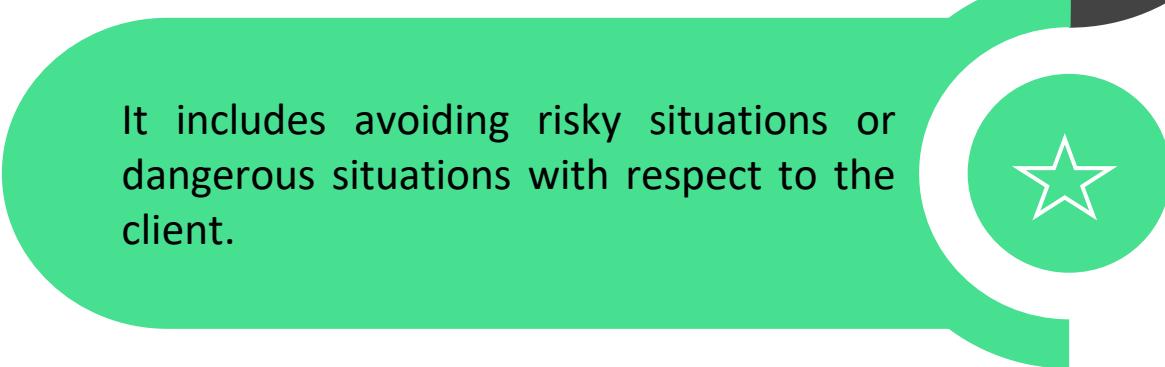


Effectiveness

Efficiency



It refers to how good performance the product has. It means that the product is performing its task in the right way and giving the desired output.



It includes avoiding risky situations or dangerous situations with respect to the client.



Safety

1.3.3.1: Usability Goals



It refers to the extent at which users are being able to perform their task correctly because the system is working perfectly with respect to functionalities.

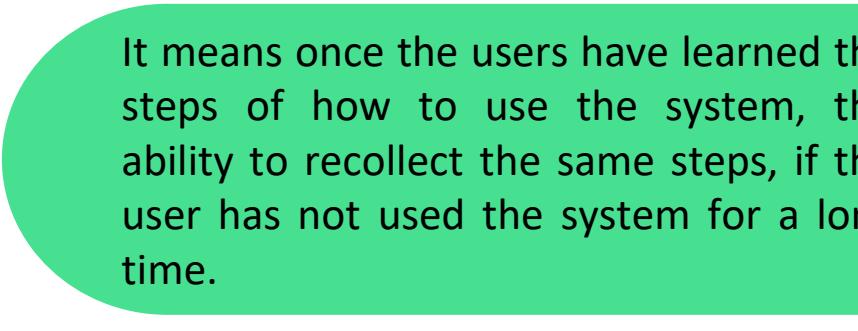


Utility

Learnability



It refers to use of the system, whether it is easy or difficult.



It means once the users have learned the steps of how to use the system, the ability to recollect the same steps, if the user has not used the system for a long time.



Memorability

1.3.3.2: User Experience Goals

- Most of these are abstract feelings, which tell us how the client feels about the product.
- It is related more to the experience the user has while interacting with the product instead of whether the system is working or not
- While the terms used to depict usability objectives include a little but definite set, a lot more terms are utilized to portray the multifaceted idea of the client experience.

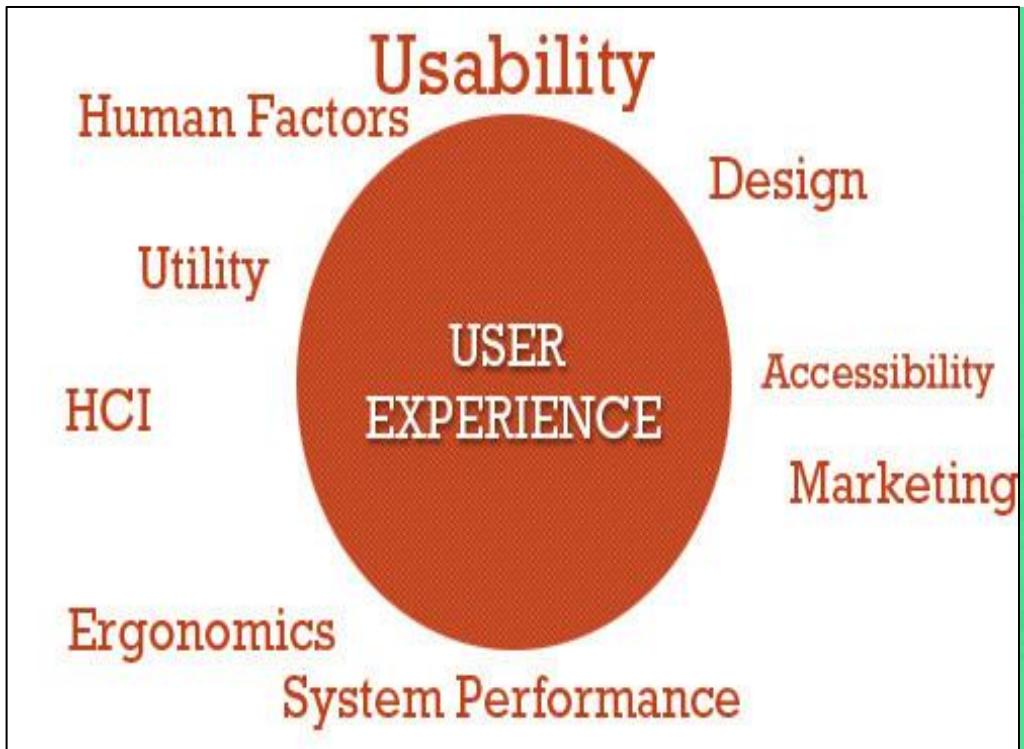


Goals :

1. **Satisfying**
2. **Enjoyable**
3. **Fun**
4. **Entertaining**
5. **Helpful**
6. **Motivating**
7. **Aesthetically pleasing**
8. **Support creativity**
9. **Rewarding**
10. **Emotionally fulfilling**



1.4: User Experience



- User experience is one of the factors that can cause the product to fail or be a success in the market.
- Often UX is considered as only the usability of the product which is a misconception.
- Usability is just a part of UX.
- User experience in layman terms means the overall experience of a person using a product such as a website or computer application, especially in terms of how easy or pleasing it is to use.

1.4.1: Seven factors that influence User Experience

- Seven factors that influence User Experience have been mentioned below.
- These factors are used to find out whether the user experience is good or not.
- It helps us decide in which area is the improvement needed.

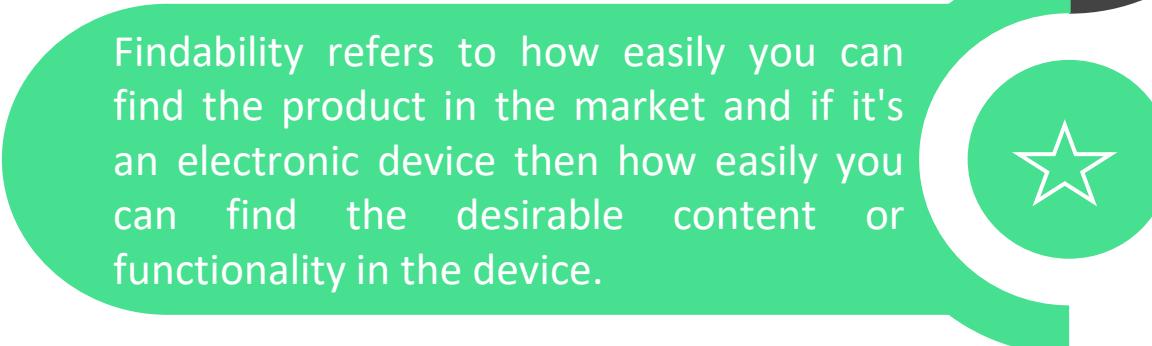




A product can be successful only if it is useful in some way to someone.



Useful



Usable



Usability refers to the functioning of the system



Findable

Findability refers to how easily you can find the product in the market and if it's an electronic device then how easily you can find the desirable content or functionality in the device.



Credibility means the trust users have in the product that has been created.



Credible

Desirable



Desirability increases the probability of success of the product in the market.



Accessibility means your product is accessible by all of the population i.e. by common people as well as people who have special needs.

Accessible

Valuable

Value should be one of the prominent factors when it comes to buying a product.

Chapter 1

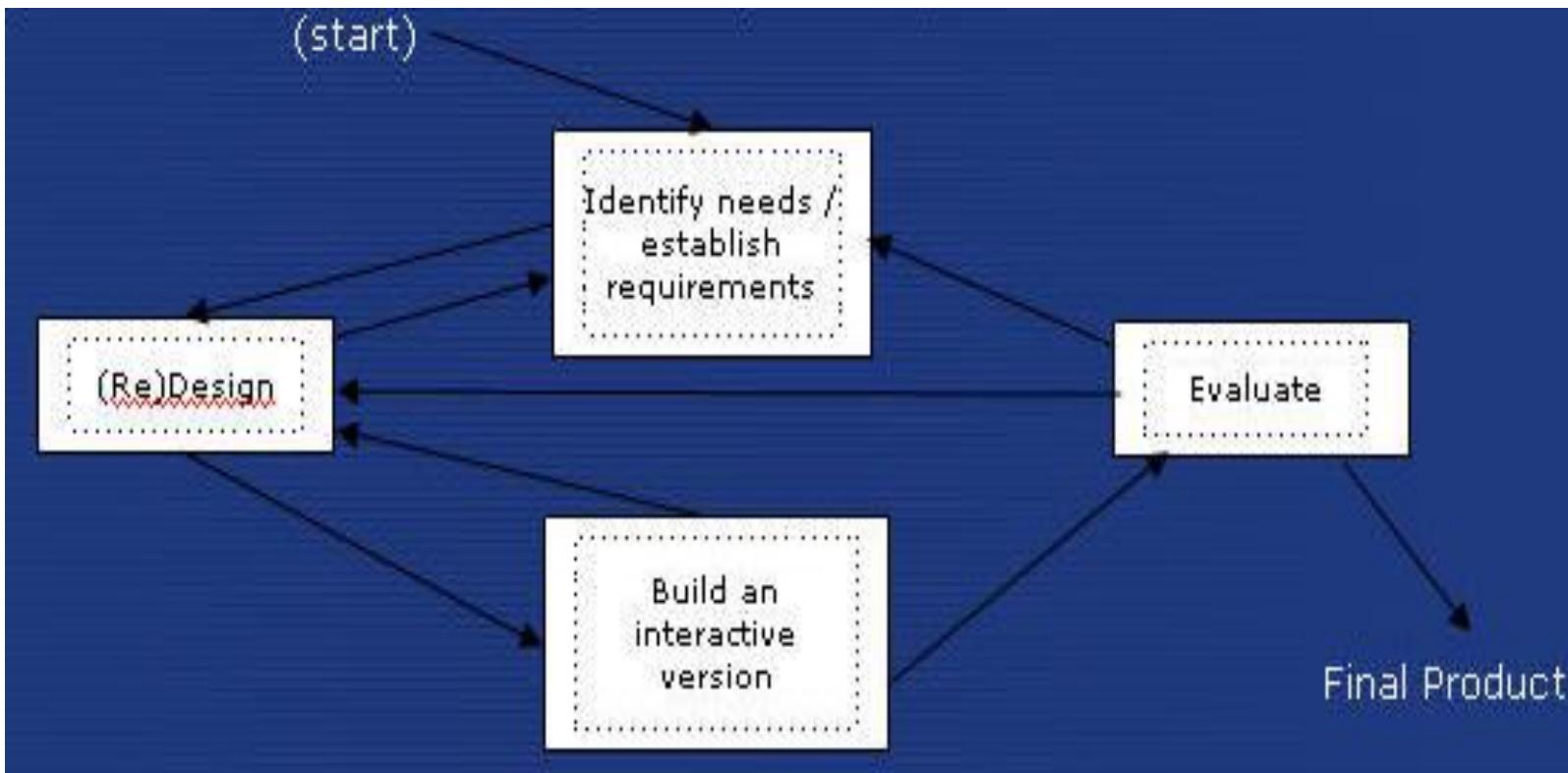
Introduction to Interaction Design



What is involved in the process of interaction design

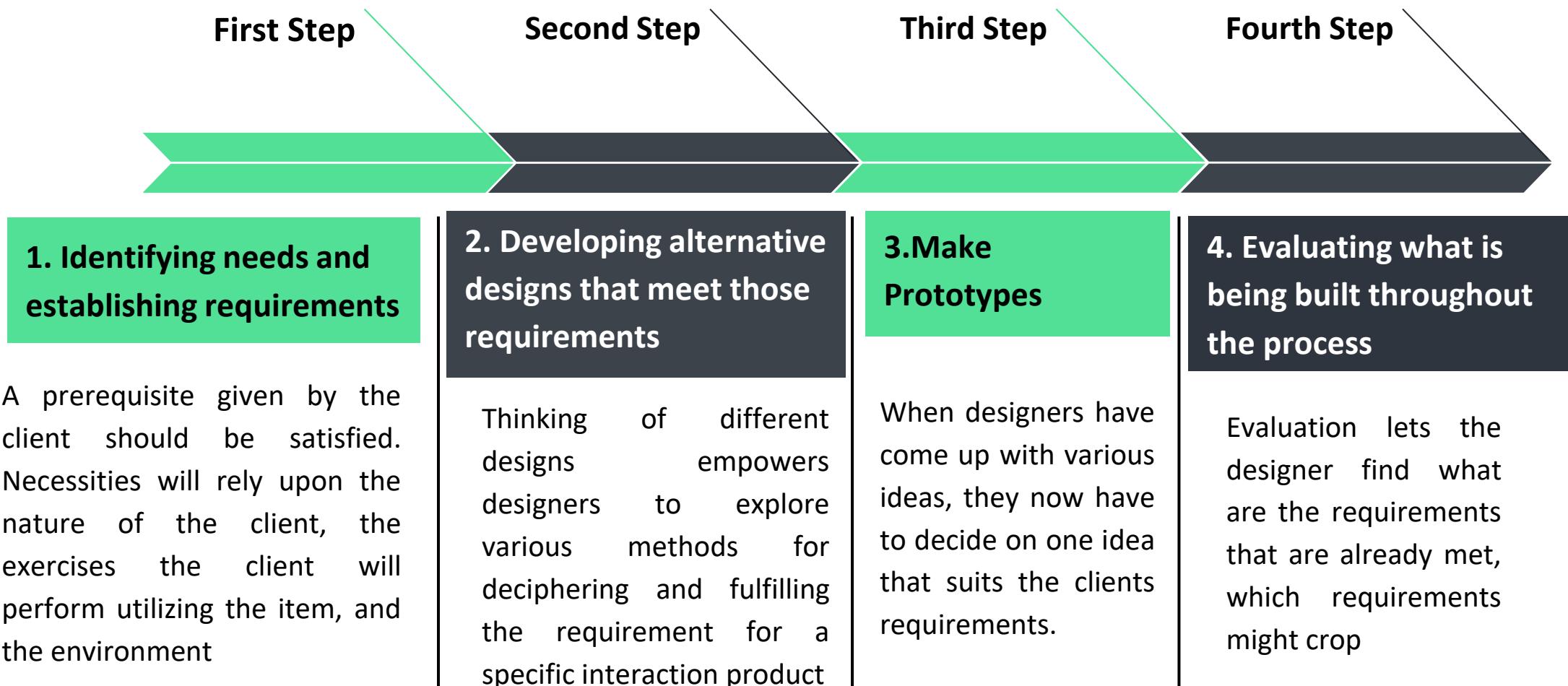
- Identify needs and establish requirements
- Develop alternative designs
- Build interactive prototypes that can be communicated and assessed
- Evaluate what is being built throughout the process

1.5: Process of Interaction Design



It is used to make products with best interaction design experience so that users are satisfied and are attracted to such products.

1.5: Process of Interaction Design



Identifying needs and establishing requirements:

- A prerequisite given by the client should be satisfied.
- It is important that the product developed satisfies the functionality as well as the interaction is upto the point.
- Necessities will rely upon the nature of the client, the exercises the client will perform utilizing the item, and the environment wherein the client associates with the item.
- In the case of a telephone or remote control, requirements are formed by the need to utilize the gadget (for example cell phone) to do certain activities(to make calls), given the size and portability of the client's hands (greater than standard or fingerless) and the clients physical environment

Developing alternative designs that meet those requirements:

- Thinking of different designs empowers designers to explore various methods for deciphering and fulfilling the requirement for a specific interaction product.
- This is a very vital part of the process.
- In the telephone and remote control model, this action started when you began writing down different ways for the controls.

Make Prototypes:

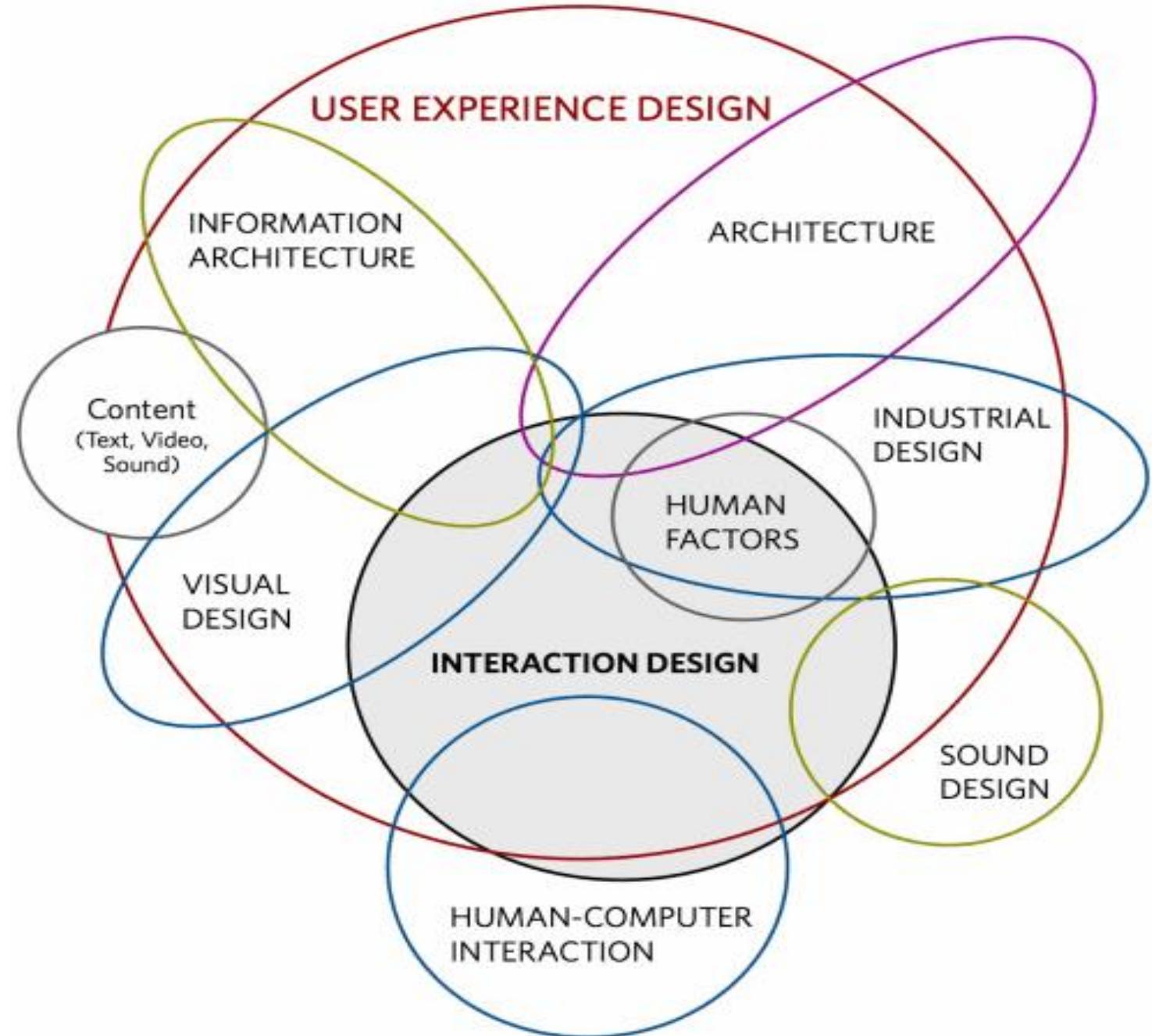
- When designers have come up with various ideas, they now have to decide on one idea that suits the clients requirements.
- For this the designers have to build a prototype of the most suitable idea they find for the client.
- It is often a rough model used for experimenting purposes before finalizing the end product.
- In the case of the telephone or remote control, as you thought of various structures, you were additionally prototyping them by drawing the other interfaces you thought of.
- Prototyping can likewise be utilized to research about various parts of a design.

Evaluating what is being built throughout the process:

- Evaluation lets the designer find what are the requirements that are already met, which requirements might crop up after sometime but the client has not yet asked for, what are the limitations of the idea they have chosen and how to overcome these limitations.

- Users should be involved through the development of the project
- Specific usability and user experience goals need to be identified, clearly documented and agreed at the beginning of the project
- Iteration is needed through the core activities

1.6: Interaction Design and User Experience



1.6: Interaction Design and User Experience

The way the designer thinks about the client interaction with the product is the key difference between IxD and UX.

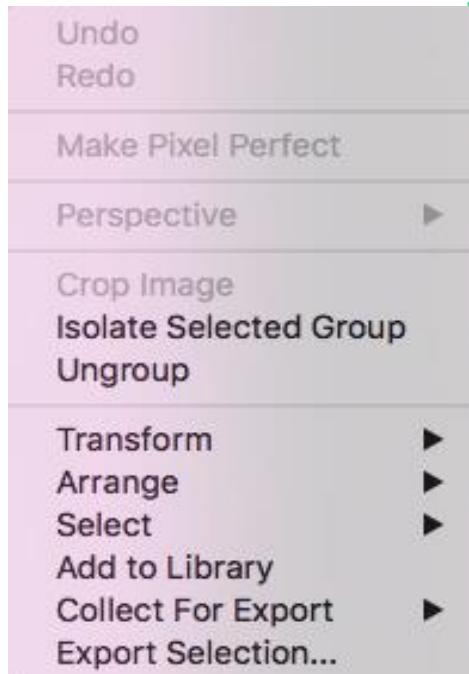
Interaction designers concentrate only on the moment when users interact with the product. Enriching the interaction experience is the final goal.

However, for User experience designers this moment is just a part of the process. As user experience design is a sum of all the user facing needs.

1.6: Design Principles

01

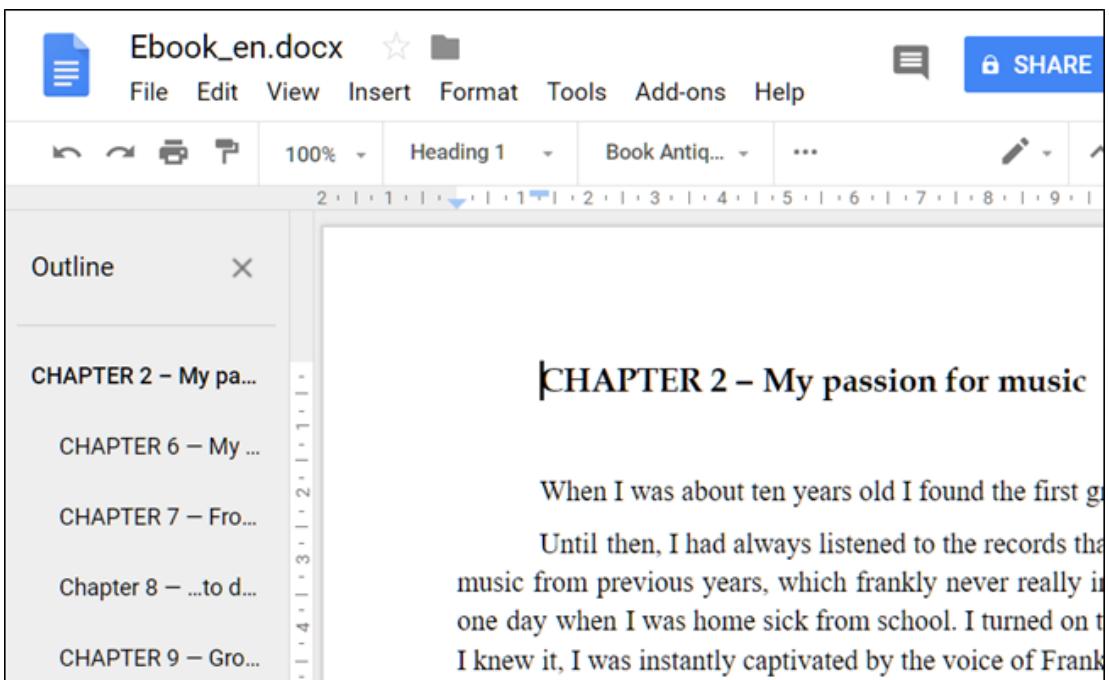
Constraint



- It is a principle where the user is provided with fewer options because the user might not satisfy some conditions yet.
- As shown in the figure some options are available whereas the grey text are options that are not available because the user does not satisfy some conditions.

02

Discoverability



- The ability to discover something easily is known as **discoverability**.
- It is important because finding functions should be easy and simple instead of complicated
- To change font the user goes to the font section, to insert an image he goes to Insert section as shown in Figure 1.16. This makes the user feel safe and gives a sense of authority on what he is doing.

03

Feedback

Success! Your submission appears on this page. The submission confirmation number is 6bea1c58-0631-4d7a-beda-be3272898dc0. Copy and save this number as proof of your submission. [View all of your submission receipts in My Grades.](#)

Review Submission History: RDDEV_ip914885 Essay 1

The screenshot shows a submission history for an assignment titled "RDDEV_ip914885 Essay 1". The submission was made on 04/09/18 at 14:50. The grade is listed as "- /100". The submission file is titled "Enrolling participants on your course.pdf". On the left side of the screen, there is a sidebar with sections for "Technology Enhanced Learning" and "Blackboard Guides", and a "Control Panel" menu.

- It refers to a response a user receives after completion of his actions which let him know whether the actions have been completed successfully or not.
- Feedback should be provided in the form of dialogue boxes or pop ups that show after task completion.
- For example in the figure below, we can see the document has been submitted as below **SUBMISSION** on the right hand side a document is visible. If it was not visible the user would have then decided to repeat the process again.

04

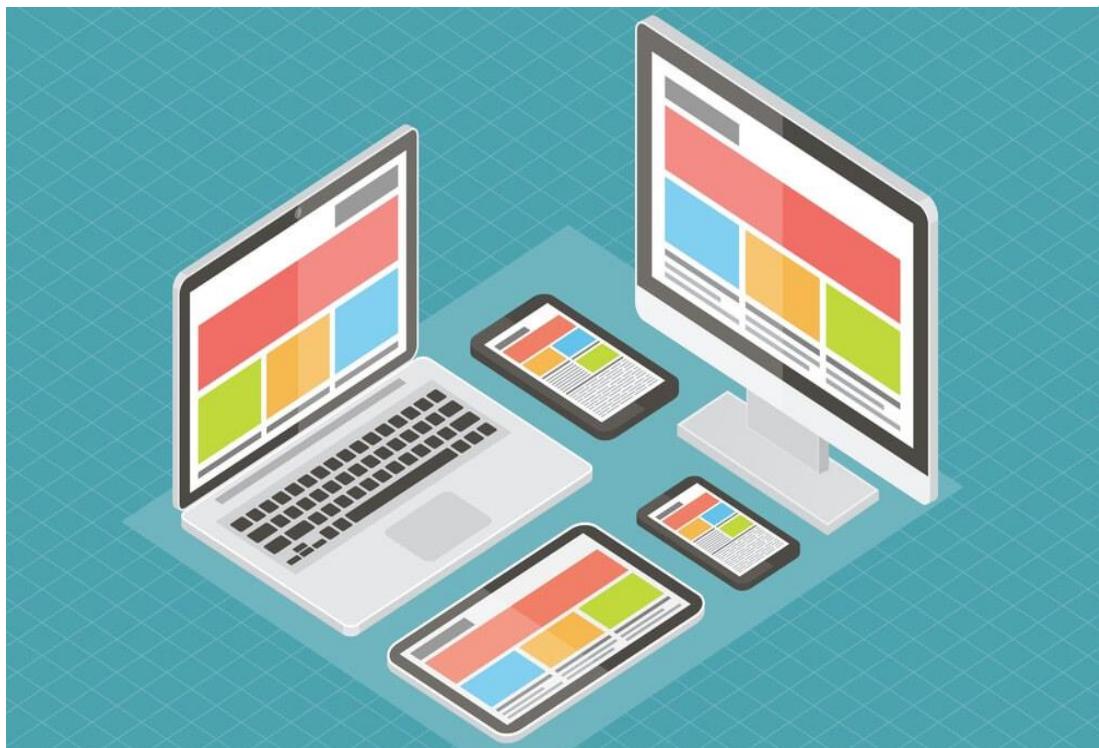
Visibility

The screenshot shows a payment checkout interface. At the top, a green header bar contains the text "Checkout". Below it is a horizontal progress bar with four steps: "Delivery" (red), "Confirmation" (red), "Payment" (red), and "Finish" (gray). Under each step, there is a small circular icon and a label: "Pay £340.00 with credit card" next to a VISA logo, and "Pay £340.00 with PayPal" next to a PayPal logo. Below these are input fields for "Cardholder's Name" (with placeholder "8") and "Card Number" (with placeholder "8"). Further down are fields for "Valid thru" (MM / YY) and "CVV / CVC" (with placeholder "8"). A small note states: "* CVV or CVC is the card security code, unique three digits number on the back of your card separate from its number." At the bottom left is a "Back" button, and at the bottom right is a red "Next Step" button.

- Visibility refers to the ability of keeping the mechanism of the product as transparent as possible to the user.
- Visibility refers to the ability of keeping the mechanism of the product as transparent as possible to the user.
- Thus the user now clearly knows where he is and this relieves him of the stress of the unknown environment

05

Consistency



- It refers to the same layout, functionality, color scheme and all properties in respect to the product are the same in every device.
- This helps the users to calm down their nerves and do their jobs in a better way.
- This helps in a trustful relation between the product and users as whatever is happening is exactly as they expected.

06

Affordance



- It is an attribute that tells us about how the use of a particular product takes place.
- An example of poor affordance is the Norman Doorway.
- In this doorway, similar handles are present on both sides. This makes the user confused as to which handle is for PULL and PUSH.
- Solution for this can be either label the handles as PUSH or PULL or do not keep a handle on the PUSH side as shown in figure.

Activity :-

Below are a number of proposed interactive products. What do you think are the key usability goals and user experience goals for each of them?

- (a) a mobile device that allows young children to communicate with each other and play collaborative games
- (b) a video and computer conferencing system that allows students to learn at home
- (c) an Internet application that allows the general public to access their medical records via interactive TV
- (d) a CAD system for architects and engineers
- (e) an online community that provides support for people who have recently been bereaved

Usability Goals and User Experience Goals



- (a) Such a collaborative device should be easy to use, effective, efficient, easy to learn and use, fun and entertaining.
- (b) Such a learning device should be easy to learn, easy to use, effective, motivating and rewarding.
- (c) Such a personal system needs to be safe, easy to use and remember how to use, efficient and effective.
- (d) Such a tool needs to be easy to learn, easy to remember, have good utility, be safe, efficient, effective, support creativity and be aesthetically pleasing.
- (e) Such a system needs to be easy to learn, easy to use, motivating, emotionally satisfying and rewarding.

Activity :-

- For website designer it has been proposed that designers go through all of their design elements and remove them one by one. If a design works just as well without an element, then remove it. Do you think this is a good design principle? If you have your own website, try doing this and seeing what happens. At what point does the interaction break down?

Comments:-

Simplicity is certainly an important design principle. Many designers try to cram too much into a screenful of space, making it unwieldy for people to find what they are interested in. Removing design elements to see what can be discarded without affecting the overall function of the website can be a salutary lesson. Unnecessary icons, buttons, boxes, lines, graphics, shading, and text can be stripped, leaving a cleaner, crisper, and easier-to-navigate website. However, a certain amount of graphics, shading, colouring , and formatting can make a site aesthetically pleasing and enjoyable to use. Plain vanilla sites with just lists of text and a few hyperlinks may not be as appealing and may put certain visitors off returning. The key is getting the right balance between aesthetic appeal and the right amount and kind of information per page.



Happy Learning

Chapter 2

Understanding and
Conceptualizing Interaction
Cognitive aspects and
Social, Emotional Interaction

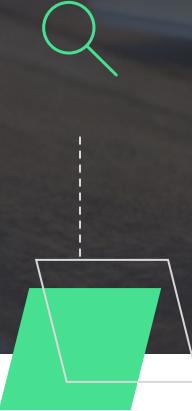
2.1 : Introduction

Inference

Interaction Design is an Iterative task inclusive of refining the design and hence its more of an artistic work which is not to be completed within a few hours or a day but instead requires practice and learning.



2.2 : Understanding The Problem Space And Conceptualizing Design



Introduction

While designing we come up with features that we think the product should have but in practical cases the features we think it should have, and the features that it actually should have are drastically unaligned



Understanding

We ask question such as :

1. What is actually needed by the user ?
2. Why is there a need to create such a product?
3. What is that element that is missing in a regular way of doing stuff or by using the products already available ?
4. How will the product help do a job better ?



Benefits

- Establish a common ground of understanding for all.
- Widen the scope and perspective of the design team.
- Better establish the conceptual model based on the user's needs.
- Avoid wastage of resources on developing what is not required.

Understanding the Problem Space and Conceptualizing Design" typically refers to a phase in the design or development process where you analyze the problem, define the challenges, and begin brainstorming potential solutions



Understanding the Problem Space

- This involves deeply analyzing the problem and its context to gain clarity on what needs to be solved.
- **Key Steps:**
- **Define the Problem:** Clearly state what the problem is and why it exists. Understand the root cause instead of just the symptoms.
- **Stakeholder Analysis:** Identify and understand the needs, goals, and expectations of all stakeholders (e.g., end users, clients, developers, etc.).
- **Contextual Research:** Explore the environment where the problem exists. This might involve market research, competitor analysis, or field observations.
- **Identify Constraints:** Outline technical, financial, regulatory, or time-related limitations that could affect the solution.

Tools & Techniques:

Surveys and interviews

User journey mapping

Problem framing tools like
"How Might We" questions

Conceptualizing the Design

- After understanding the problem, you move into brainstorming potential solutions and generating ideas.
- **Key Steps:**
- **Ideation:** Use techniques like brainstorming, mind mapping, or design sprints to generate multiple ideas. Encourage creativity without judgment in the early stages.
- **Prioritize User Needs:** Focus on solutions that address the pain points or opportunities identified in the problem space.
- **Sketch Prototypes:** Create rough sketches or low-fidelity prototypes to visualize potential solutions and get early feedback.
- **Evaluate Feasibility:** Narrow down ideas based on their feasibility, impact, and alignment with project constraints.

Tools & Techniques:



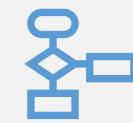
Brainstorming frameworks



Rapid prototyping tools



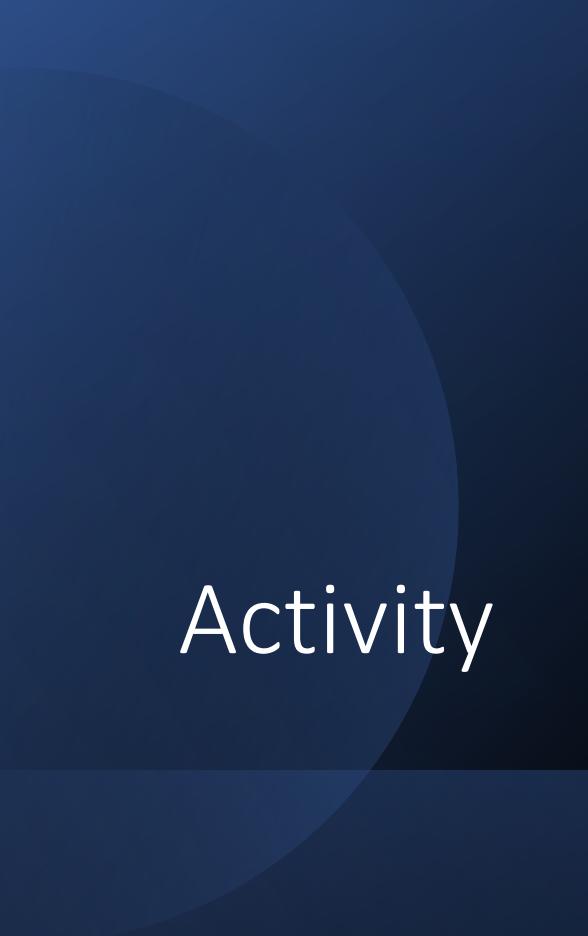
Personas and scenarios to validate ideas



Affinity diagrams to organize ideas

Deliverables from This Phase

- A well-defined problem statement
- Insights from user research or stakeholder input
- A list of prioritized design concepts
- Low-fidelity prototypes or sketches for early validation



Activity

- For your final year project topic , identify problem space, understand design present it in following points
 - well-defined problem statement
 - Insights from user research or stakeholder input
 - A list of prioritized design concepts
 - Low-fidelity prototypes or sketches for early validation

2.5.1 : Cognitive Aspects (Cognition)

- Cognition Meaning : “The mental action or process of acquiring knowledge and understanding through thought, experience, and the senses.”
- There are two types of cognition on is fast and the slow.
- Cognition can also be described as the following kinds of processes.

01



Attention

02



Perception

03



Memory

04



Learning

07



Reading,
speaking and
listening

06



Problem solving

2.5.2 : Cognitive Aspects

01

Attention

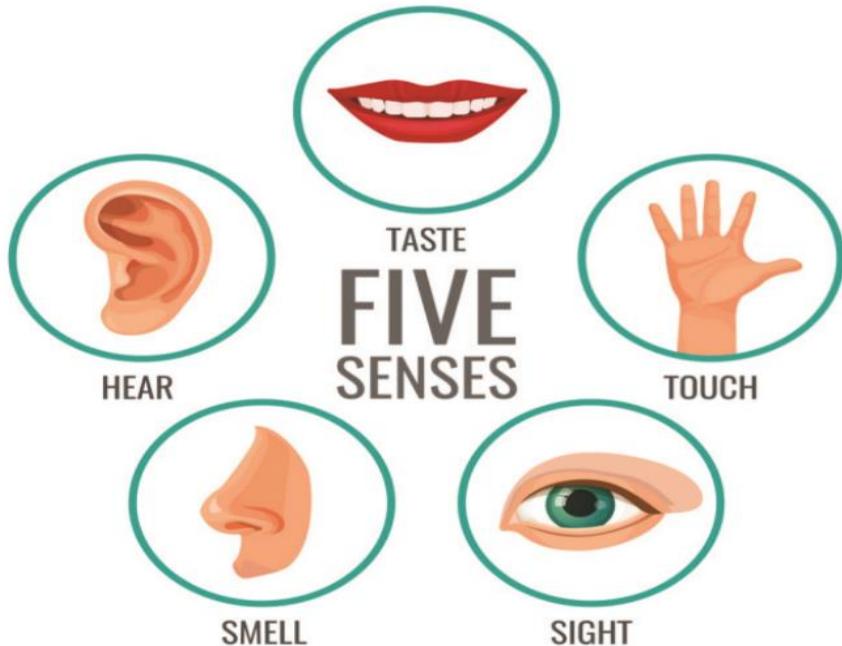


- It is a process of selecting one particular process from many process and concentrate on one process.
- A person can only focus on one task but can rapidly switch between this task
- following aspects that need to be focused upon:
 - Goal: It is the current intention and pursuit of the user and defines what the user intends to do
 - Information Presentation: Plays a vital role in what the user will perceive

2.5.3 : Cognitive Aspects

02

Perception



- Perception refers to how via different senses (Sight, Taste, Touch, Smell, Hear, Proprioception etc).
- Person gains information about the environment that is being comprehended by the brain
- To enable a user to perceive the content easily, It is recommended to keep white bank space between the content.

2.5.4 : Cognitive Aspects

03

Memory



- Memory allows people to store their gained knowledge and experience.
- Memory can be of two types short term and long term.
- Short term memory is used to store information that is more relevant in present and in immediate future
- Long term memory lasts for longer time, such information serves to be vital for the person in distant future.

2.5.5 : Cognitive Aspects

04



Learning

It easier to actually do practical and learn rather than reading instructions in the manual.

Interactivity highly aids learning as the user begins to interact with the product.

Dynalinking can be defined as “Abstract representations are linked together with a more concrete illustration of what they stand for.”

2.5.6 : Cognitive Aspects

05

Reading, speaking, and listening



- Humans have the ability to process and understand natural language this may be in the form of reading, writing or listening, Understanding which is a key factor.
- Meaning not only depends on the literal words used but also the context, stress and tone used
- It is important to develop applications that use these cognitive properties efficiently and provide alternative wherever necessary.

2.5.7 : Cognitive Aspects

06

Problem solving, planning, reasoning, and decision making



- It is a long term cognition also called reflective cognition.
- It takes time to process and involves processes such as problem solving, planning, reasoning, and decision making.
- While designing enough information be provided to users they can make a good decision, and solution with minimal time and effort.

Chapter 2

Understanding and
Conceptualizing Interaction
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2.4 : Interface Types



Introduction

- It is very important to choose the right interface for the right task of the product.
- It is not necessary to use only one interface.
- Provide multiple ways of doing the same thing.
- Following slides explain 20 Interfaces and their study based on aspects on the right.

Aspects :

1. Understandability
2. Practice required
3. Speed of doing tasks
4. Enjoyability
5. Popularity among users
6. Cost of interface equipment
7. Long term usability
8. Optimal conveyability
9. Integration effort
10. Physical user effort
11. Cognitive effort
12. Aesthetic appeal
13. Learning curve
14. Skill required
15. Relativity to regular life

2.4.1 : Command-based Interface

The users have to type the commands and shall receive outputs on the terminal although it's not the easiest interface as the user here need to remember all the commands and the syntax.

```
jacob@Jacobs-MBP:~$ uri          authorize;
Aborted: by user
[ok][2017-09-04 11:43:49]

[edit]
jacob@Jacobs-MBP% show
Possible completions:
aaa      - AAA management
alias    - Create command alias.
cli      - Display cli information
commit   - Display configuration changes
environments - A group of environments
facilities - This is a collection of helper functions available in the system
nacm     - Access control
parser   - Display parser information
processing - Processing functions that provide extension points for issuance and validation
profiles -
rollback -
session  - Global default CLI session parameters
user     - User specific command aliases and default CLI session parameters
webui    - Web UI specific configuration
jacob@Jacobs-MBP% show environments environment
```

Advantages

- Speed of doing tasks
- Popularity among users
- Cost of interface equipment
- Long term usability
- Integration effort
- Physical effort

Disadvantages

- Understandability
- Practice required
- Enjoyability
- Optimal conveyability
- Cognitive effort
- Aesthetic appeal
- Learning curve
- Skill required
- Relativity to regular life

2.4.2 : WIMP (Windows, Icons, Menus and Pointing Devices) and GUI Interface

This is the most common and widely preferred kind of interface that you may see in your personal computers and in many softwares. The inclusion of colours, images, Iconography etc made it easy and fun to use.



Advantages

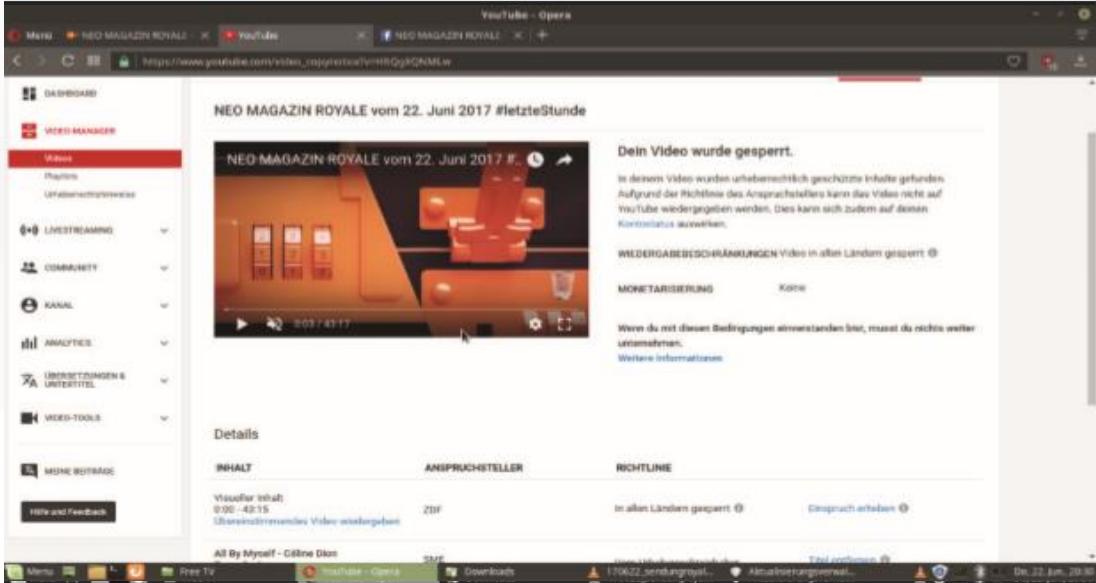
- Understandability
- Practice required
- Enjoyability
- Popularity among users
- Cost of interface equipment
- Long term usability
- Optimal conveyability
- Integration effort
- Cognitive effort
- Aesthetic appeal
- Learning curve
- Skill required
- Relativity to regular life

Disadvantages

- Speed of doing tasks
- Physical user effort

2.4.3 : Multimedia Interface

Multimedia, tends to combine different media namely, graphics, text, video, sound, and animations, and links them with various varieties of interactivity. help the user to explore different parts on the screen. Ex: Audio, Images, Animations, Illustrations.



Advantages

- Understandability
- Practice required
- Enjoyability
- Popularity among users
- Optimal conveyability
- Physical user effort
- Cognitive effort
- Aesthetic appeal
- Learning curve
- Skill required
- Relativity to regular life

Disadvantages

- Speed of doing tasks
- Cost of interface equipment
- Long term usability
- Integration effort

2.4.4 : Virtual reality Interface

It tries to morph reality and make the user experience reality virtually by means of superimposing media such as audio video in a 3D live environment. It is a generic term to experience interaction with the artificial world.



Advantages

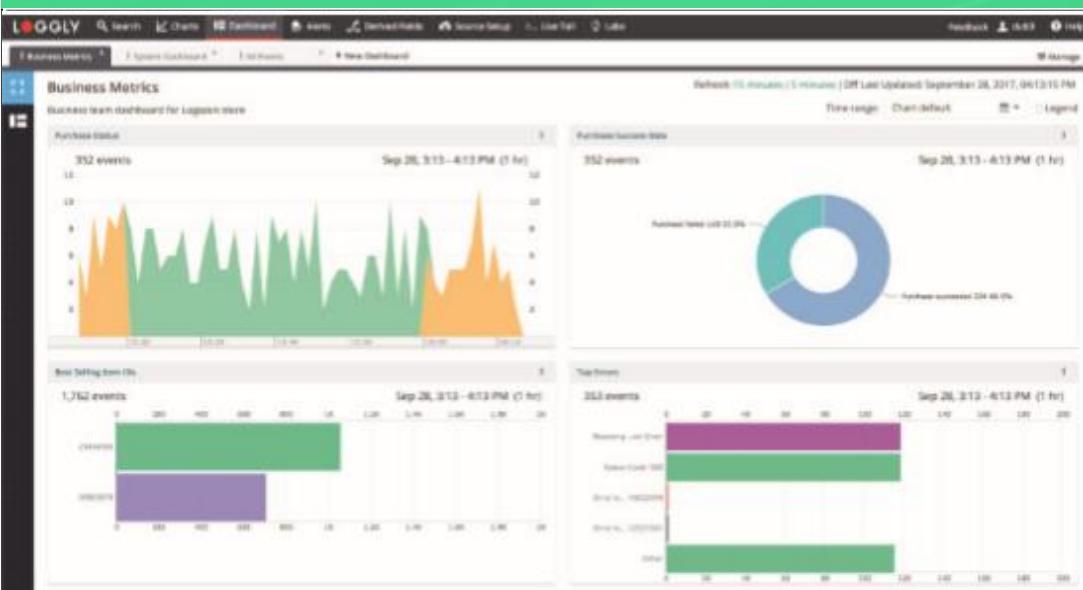
- Understandability
- Practice required
- Speed of doing tasks
- Enjoyability
- Optimal conveyability
- Physical user effort
- Aesthetic appeal
- Learning curve
- Skill required
- Relativity to regular life

Disadvantages

- Popularity among users
- Cost of interface equipment
- Long term usability
- Integration effort
- Cognitive effort

2.4.5 : Information visualization and dashboards Interface

When Huge statistical data is to be displayed to the user, it becomes very important to enable the end user to observe the key factors, patterns and trends. This is possible by proper visualization of data to gain more insight about it.



Advantages

- Speed of doing tasks
- Popularity among users
- Cost of interface equipment
- Long term usability
- Optimal conveyability
- Physical user effort
- Aesthetic appeal

Disadvantages

- Understandability
- Practice required
- Enjoyability
- Integration effort
- Cognitive effort
- Learning curve
- Skill required
- Relativity to regular life

2.4.6 : Web Interface

While designing Web Interfaces following:

- Download and loading time of web pages.
- Proper, quick and Obvious navigation.
- Spaced Content without cluttering.
- Use consistent typography and color scheme.
- Creating Responsive and reactive web pages



Advantages

- Understandability
- Practice required
- Enjoyability
- Popularity among users
- Cost of interface equipment
- Long term usability
- Optimal conveyability
- Integration effort
- Physical user effort
- Cognitive effort
- Aesthetic appeal
- Skill required

Disadvantages

- Speed of doing tasks
- Learning curve
- Relativity to regular life

2.4.7 : Consumer electronics and appliances Interface

07

Most people use them to get things done in a short period of time, and then move to other jobs rather than spending time reading through manual and playing around with the interface.



Advantages

- Understandability
- Practice required
- Speed of doing tasks
- Popularity among users
- Cost of interface equipment
- Long term usability
- Integration effort
- Physical user effort
- Cognitive effort
- Aesthetic appeal
- Learning curve
- Skill required
- Relativity to regular life

Disadvantages

- Enjoyability
- Optimal conveyability

2.4.8 : Mobile Interface

Mobile devices have become very common, it has become an integral part of our everyday lives. Handheld devices differ very much from PCs and laptops, in size, portability etc. Designers need to think carefully about what kind of dedicated controls to provide.



Advantages

- Understandability
- Speed of doing tasks
- Enjoyability
- Popularity among users
- Cost of interface equipment
- Long term usability
- Optimal conveyability
- Integration effort
- Physical user effort
- Cognitive effort
- Aesthetic appeal
- Skill required
- Relativity to regular life

Disadvantages

- Practice required
- Learning curve

2.4.9 : Speech Interface

Also called as voice user interface is where a person is talking to a device that has a spoken language program and natural language processing capabilities, such as a train timetable, travel planner, Notifier, or a digital assistant.



Advantages

- Understandability
- Practice required
- Speed of doing tasks
- Enjoyability
- Cost of interface equipment
- Long term usability
- Cognitive effort
- Aesthetic appeal
- Learning curve
- Skill required
- Relativity to regular life

Disadvantages

- Popularity among users
- Optimal conveyability
- Integration effort
- Physical user effort

2.4.10 : Pen Interface

10

When creating products which involve illustrative inputs from the user alone mouse becomes insufficient, Pen-based devices allow people to sketch, draw shapes and figures also select, swipe and move widgets on an interface.



Advantages

- Understandability
- Practice required
- Speed of doing tasks
- Enjoyability
- Cost of interface equipment
- Long term usability
- Optimal conveyability
- Integration effort
- Cognitive effort
- Aesthetic appeal
- Learning curve
- Relativity to regular life

Disadvantages

- Popularity among users
- Physical user effort
- Skill required

2.4.11 : Touch Interface

The users have to type the commands and shall receive outputs on the terminal although it's not the easiest interface as the user here need to remember all the commands and the syntax.



- Understandability
- Practice required
- Speed of doing tasks
- Enjoyability
- Popularity among users
- Long term usability
- Optimal conveyability
- Integration effort
- Cognitive effort
- Aesthetic appeal
- Learning curve
- Skill required
- Relativity to regular life

Disadvantages

- Cost of interface equipment
- Physical user effort

2.4.12 : Air-based gesture Interface

As camera, IR sensors developed, it became easier to integrate them in devices and use them to capture gestures of the users, this makes it possible to accurately recognize people's body, arm, and hand gestures, etc.



Advantages

- Speed of doing tasks
- Enjoyability
- Popularity among users
- Cost of interface equipment
- Long term usability
- Cognitive effort
- Aesthetic appeal
- Learning curve
- Skill required
- Relativity to regular life

Disadvantages

- Understandability
- Practice required
- Optimal conveyability
- Integration effort
- Physical user effort

2.4.13 : Haptic Interface

13

This kind of interface is majorly used along with other interfaces and works in background and in most cases in this interface the user interacts with the product in subconscious manner, it is majorly used to provide feedback and notification in terms of vibrations.



Advantages

- Speed of doing tasks
- Enjoyability
- Popularity among users
- Cost of interface equipment
- Long term usability
- Integration effort
- Physical user effort
- Cognitive effort
- Aesthetic appeal
- Learning curve
- Skill required
- Relativity to regular life

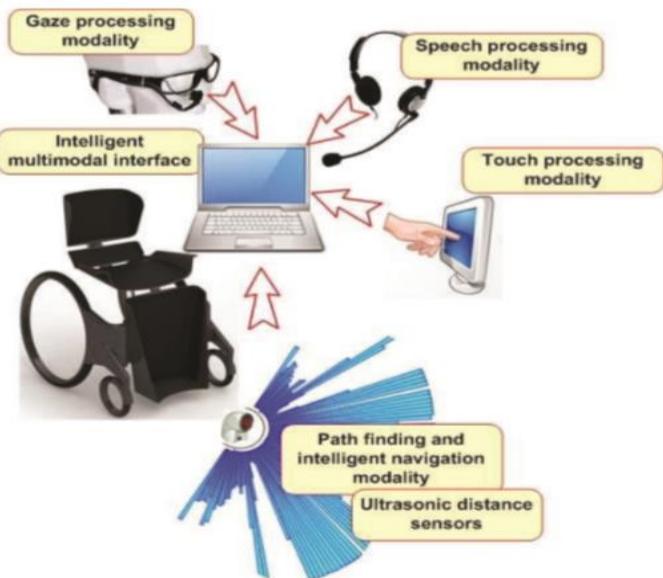
Disadvantages

- Understandability
- Practice required
- Optimal conveyability

2.4.14 : Multimodal Interface

14

A Multimodal Interface is a combination of multiple interfaces, which provide the users with different kinds of ways to interact with the product depending upon the users preference and the situation. These various ways of interaction are called modalities.



Advantages

- Speed of doing tasks
- Enjoyability
- Popularity among users
- Long term usability
- Optimal conveyability
- Integration effort
- Aesthetic appeal
- Relativity to regular life

Disadvantages

- Understandability
- Practice required
- Cost of interface equipment
- Physical user effort
- Cognitive effort
- Learning curve
- Skill required

2.4.15 : Shareable Interface

Shareable interfaces provide interactivity with multiple users at once and in the same time taking simultaneous inputs from multiple users provide outputs to all the users.



Advantages

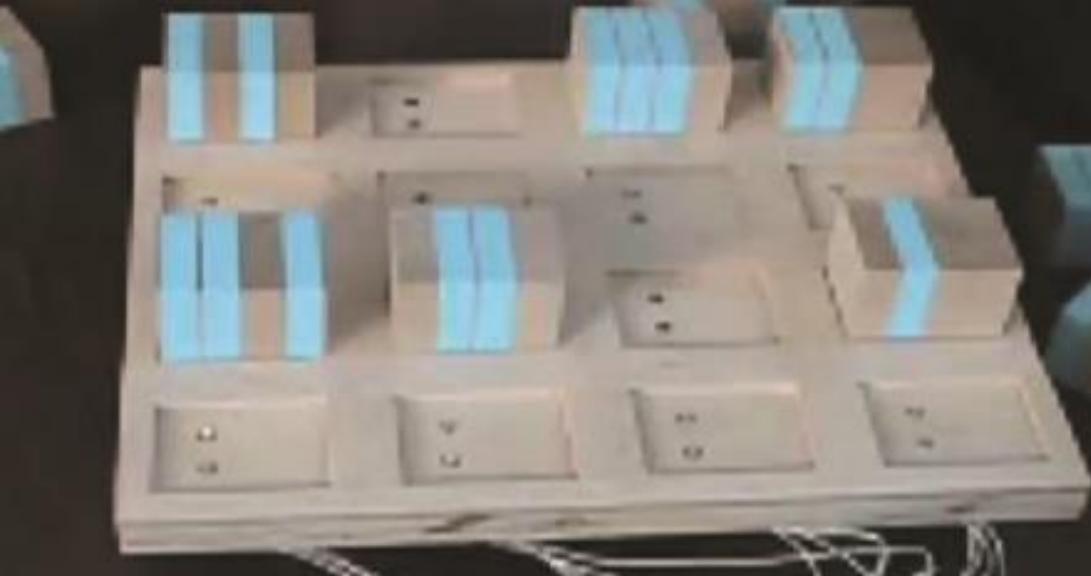
- Practice required
- Speed of doing tasks
- Long term usability
- Optimal conveyability
- Physical user effort
- Skill required

Disadvantages

- Understandability
- Enjoyability
- Popularity among users
- Cost of interface equipment
- Integration effort
- Cognitive effort
- Aesthetic appeal
- Learning curve
- Relativity to regular life

2.4.16 : Tangible Interface

In Tangible Interfaces Sensors are embedded in to physical objects which can be handled by the user, the user can change the configuration arrangement or activities moving or pressure becomes sensory inputs and outputs are in from color, vibration, or sound, etc.



Advantages

- Practice required
- Enjoyability
- Long term usability
- Integration effort
- Aesthetic appeal
- Relativity to regular life

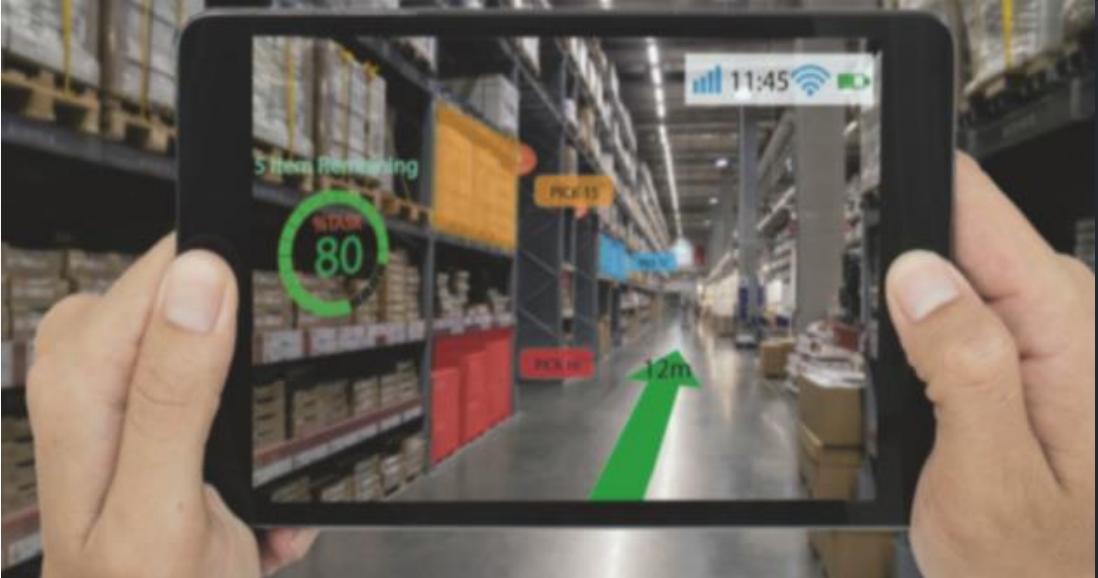
Disadvantages

- Understandability
- Speed of doing tasks
- Popularity among users
- Cost of interface equipment
- Optimal conveyability
- Physical user effort
- Cognitive effort
- Learning curve
- Skill required

2.4.17 : Augmented and mixed reality Interface

17

Augmented and mixed reality Interfaces act as a bridge between physical and digital world, this is done by superimposing virtual reality upon real life physical objects, and providing a view of the real world with added virtual representation of the objects.



Advantages

- Understandability
- Practice required
- Speed of doing tasks
- Enjoyability
- Popularity among users
- Cost of interface equipment
- Long term usability
- Optimal conveyability
- Integration effort
- Physical user effort
- Cognitive effort
- Aesthetic appeal
- Learning curve
- Skill required
- Relativity to regular life

Disadvantages

- Speed of doing tasks
- Popularity among users
- Cost of interface equipment
- Long term usability
- Integration effort

2.4.18 : Wearable Interface

18

Now it's possible to integrate small computers in wearables such as spectacles, lenses, clothes etc, which can provide us information that is relevant in our day to day application we can interact with the information with minimal effort on the go



Advantages

- Understandability
- Practice required
- Speed of doing tasks
- Popularity among users
- Cost of interface equipment
- Optimal conveyability
- Cognitive effort
- Aesthetic appeal
- Learning curve
- Skill required
- Relativity to regular life

Disadvantages

- Enjoyability
- Long term usability
- Integration effort
- Physical user effort

With this robots that can interact with users, robots and drones keep a great potential in aiding users in wide range of activities that ranges from as simple as everyday's task to more sophisticated and challenging activities.



Advantages

- Understandability
- Practice required
- Speed of doing tasks
- Enjoyability
- Long term usability
- Optimal conveyability
- Physical user effort
- Cognitive effort
- Aesthetic appeal
- Learning curve
- Skill required
- Relativity to regular life

Disadvantages

- Popularity among users
- Cost of interface equipment
- Integration effort

2.4.20 : Brain–computer interaction (BCI) Interface

20

Using this interface brain can directly communicate with the device give direct instructions to it and similarly interpret the signals received directly in the brain and eliminate the middle link of our physical and sensory capabilities.



Advantages

- Understandability
- Practice required
- Speed of doing tasks
- Popularity among users
- Cost of interface equipment
- Long term usability
- Integration effort
- Learning curve

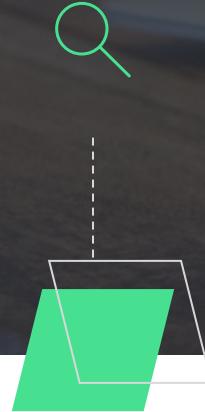
Disadvantages

- Enjoyability
- Optimal conveyability
- Physical user effort
- Cognitive effort
- Aesthetic appeal
- Skill required
- Relativity to regular life

Chapter 2

Understanding and
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2.3 : Conceptual Model



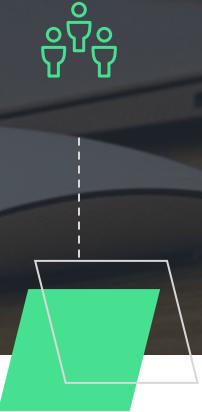
Concepts

This refers to the operations or activities or may a mere concept which is associated with the product. Sometimes they can be new to the user and it is essential that the user understands it thoroughly in order to use the product.



Metaphors

- It provides an analogy of common understanding of what the particular product or the component in the product does.
- Also involvement of metaphors develops the interest of the user as the user can now relate to the product more.



Relation

- The concepts can be related with each other as well as interleaved with metaphors to be readily understandable by the user.
- If the concepts of the product are deeply related to each other in an obvious manner it becomes easier for the users to contemplate them and get used to it.

2.3.1 : Users Tasks and Goals represented in hierarchical structure:

01

GOMS Model

- **GOAL:** This element defines what the user wants to achieve, and also possible methods by which these goals can be achieved.
- **OPERATORS:** Placed at the lowest analysis level, methods that satisfy goals are made up of operators (User/System Actions).
- **METHODS:** There can be multiple ways of performing a task i.e satisfying a goal, all these ways need to be analysed.
- **SELECTIONS:** Used to make the choices in the GOMS model as there can be multiple ways to perform a particular task.

Example

GOAL: CLOSE-WINDOW
[

SELECT GOAL : BUTTON-METHOD

- MOVE-MOUSE-TOP-RIGHT
- HOVER-OVER-CROSS-ICON
- CLICK-CROSS-ICON

SELECT GOAL : KEYBOARD-METHOD

- PRESS-ALT-KEY
- PRESS-F4-KEY
- RELEASE-BOTH-KEYS

2.3.1 : Users Tasks and Goals represented in hierarchical structure:

02

Cognitive Complexity Theory Model

- It was introduced by Kieras and Polson in the 1990s, this model builds on the GOMS model and enhances the model to provide more predictability.
- CCT does provide a detailed description of every task but the disadvantage is, description becomes enormous and difficult to analyse.
- Production rules have the format:

IF condition **THEN** action

AND can be used to add multiple conditions as stated below

Example

(SELECT-CLOSE-WINDOW

IF (AND TEST-GOAL close window
NOT(TEST-GOAL minimize window)
NOT(TEST-NOTE executing close window))

THEN(DO-Close-window DELETE-NOTE
executing close window)

IF (AND TEST-GOAL close window
NOT(TEST-GOAL minimize window)
TEST-NOTE executing close window)

THEN(DELETE-GOAL close window)

2.3.2 : Grammatical and Linguistic:

01

BNF Model

- BNF stands for (Backus Naur Form) which uses a linguistic approach to describe dialogue grammar in form of rules.
- It uses two types of descriptors terminal, which are lowest level of user action and cannot be subdivided further.
- non-terminal descriptors, which are higher level descriptors and can be divided into further subtasks.
- The | operator is used to generate multiple output from the same description.

Example

create-line ::= select-line + choose-multiple-points + choose-last-point

select-line ::= position-mouse + CLICK-MOUSE

choose-multiple-points ::= choose-point | choose-point + DRAG-TO-DESIREDPOINT + CLICK-POINT

choose-point ::= DRAG-TO-DESIRED-POINT + CLICK-POINT

position-mouse ::= MOVE-NEAR-LINE-ICON + HOVER-OVER-LINE-ICO

2.3.2 : Grammatical and Linguistic:

02

Task-action Grammar Model

- This model is build up on BNF model, TAG model enhances BNF by parameterising grammatical rules, which impart more consistency
- Also called as TAG Model.
- non-terminal descriptors, which are higher level descriptors and can be divided into further subtasks.
- The | operator is used to generate multiple output from the same description.

Example

BNF Model:

Moving ::= 'mv' + file_name + file_name | 'mv' + file_names+ directory

Copying ::= 'cp' + file_name + file_name | 'cp' + file_names+ directory

TAG Model:

file-operation[Op] := commands[Op] + file_name + file_name | command[Op] + file_names+ directory

commands[Op=move] := 'mv'

commands[Op=copy] := 'cp'

2.3.3 : Device or physical level:

01

Keystroke level Model

- It provides prediction based on time required for execution of tasks using the system's facilities & user's performance.
- KLM model only considers the small tasks that require less than about twenty seconds.
- 7 different physical motor operators:
 - K == actually pressing the keys
 - B == actually pressing the mouse button
 - P == MOving the mouse or pointing i
 - H == Switching between input devices
 - D == Using the mouse to draw a line
 - M == Thinking and preparing
 - R == Ignoring system response if the user need not wait for it.

Example

All the operators are assigned estimate time such as:

K == 0.12 sec

B == 0.20 sec

H == 0.40 sec

M == 1.35 sec

These times can be added up to evaluate, users performance.

Example a method for typing a word.

$$\text{Type} = H + M + K$$

$$\text{Type} = 0.40 + 1.35 + 0.12 = 1.87 \text{ sec}$$

2.6 : Social Interaction And The Emerging Social Phenomena

- With increase in development of technology there has been considerable increase in social interaction.
- We interact socially everyday in our life, through devices such as mobile phones and platforms such as Facebook, Whatsapp, Instagram etc.
- Social Interaction gives us immense power to connect to other people and exchange ideas, thoughts and information, It's subtypes are explained below:

01



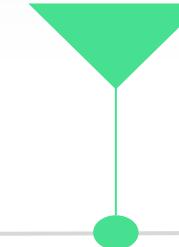
Face-to-Face
Conversations

02



Remote Conversations

03



Telepresence

04



Co-presence

2.6.1 : Social Interaction And The Emerging Social Phenomena

01

Face-to-Face Conversations



Conversation is effortless and comes easily to most people but is a collaborative effort.

Usually they start the conversation with greetings and then the participants take turns asking questions.

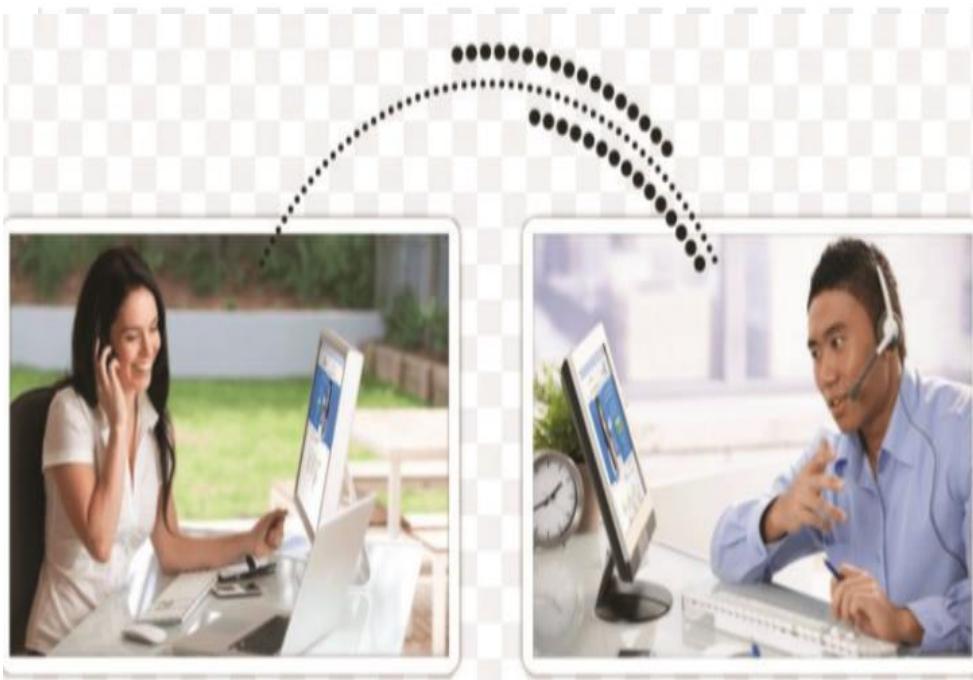
Face to face conversation may also involve expressions, figure of speeches, tone and context.



2.6.2 : Social Interaction And The Emerging Social Phenomena

02

Remote Conversations



- Remote conversation dates back to the 19th century when Alexander Graham Bell invented the telephone.
- It enables people to connect within minutes whenever required and with advanced facilities such as call record, hold, and conferencing.
- Remote conversion is very similar to face-to face conversation except that in reality the communicators are physically located in remote places.

2.6.3 : Social Interaction And The Emerging Social Phenomena

03



Telepresence

- It's true that Face-To-face communication is the best kind of communication but we also need to accept that it's not possible for all to be present always.
- It allows the users to feel that they are actually interacting with real events and people.
- Example is of the people's bot that enables people to attend events, with their audio and video feed, on a mobile bot.

2.6.4 : Social Interaction And The Emerging Social Phenomena

04

Co-presence



- Co-presence is interaction of users actually present at the site sharing the same device and working on it collectively.
- Examples of such devices are smart boards and surfaces that support multitouch.
- While designing such interfaces we must consider the following aspects: physical coordination , Control distribution and awareness.

2.7 : Emotions And The User Experience

We have wide range of options of products but we enjoy using only select few, because of our emotions for some brand.



Brand

Emotional Interaction



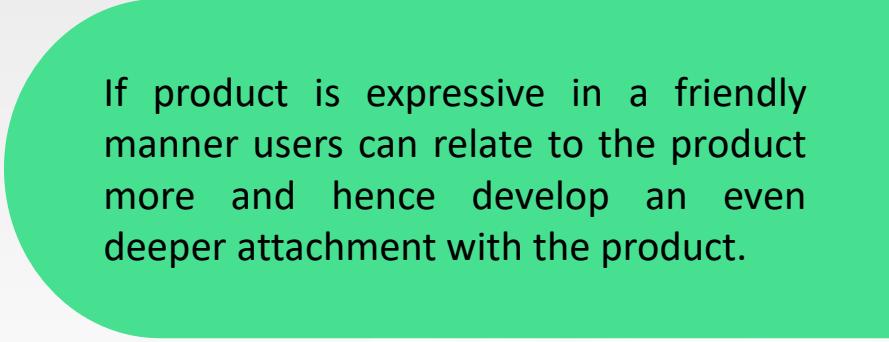
Understanding how a product affects our emotions like what makes us happy, sad, frustrated, annoyed, anxious, motivated, irritated, etc

People feelings, intentions and need changes along with the market trends, latest technology and the fashion changes



Change

2.8 : Expressive And Frustrating Interfaces

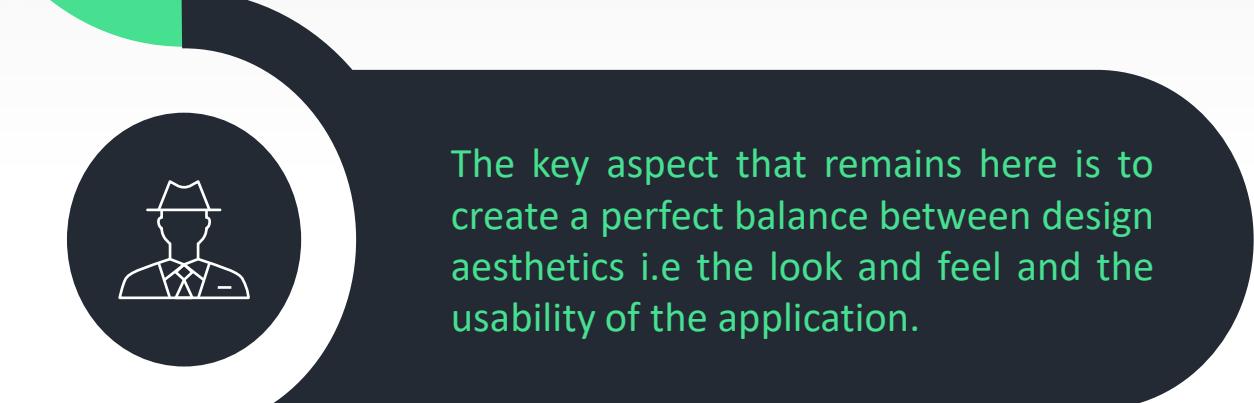


If product is expressive in a friendly manner users can relate to the product more and hence develop an even deeper attachment with the product.



Expressiveness

Inference



The key aspect that remains here is to create a perfect balance between design aesthetics i.e the look and feel and the usability of the application.

2.8.1 : Expressive And Frustrating Interfaces

01

Expressive Interfaces



- Design of aesthetically pleasing and expressive interfaces has become one of central concern to interaction design.
- Some ways in which the product can be expressive in a positive manner:
 - Icons
 - Animations
 - Sound, Haptics etc.
- Example Mac: A simple smiling icon that conveyed a sense of Happiness.

2.8.2 : Expressive And Frustrating Interfaces

02

Frustrating Interfaces



- In many cases the user may find difficulty in using and understanding the product.
- User does not understand they might get irritated and this shall lead to loss of productivity and a bad user experience.
- Interfaces which are designed poorly bring a fool out of the user and hence lead to a bad user experience.

Chapter 3

**Data Gathering Establishing
The Requirements,
Analysis Interpretation And
Presentation**

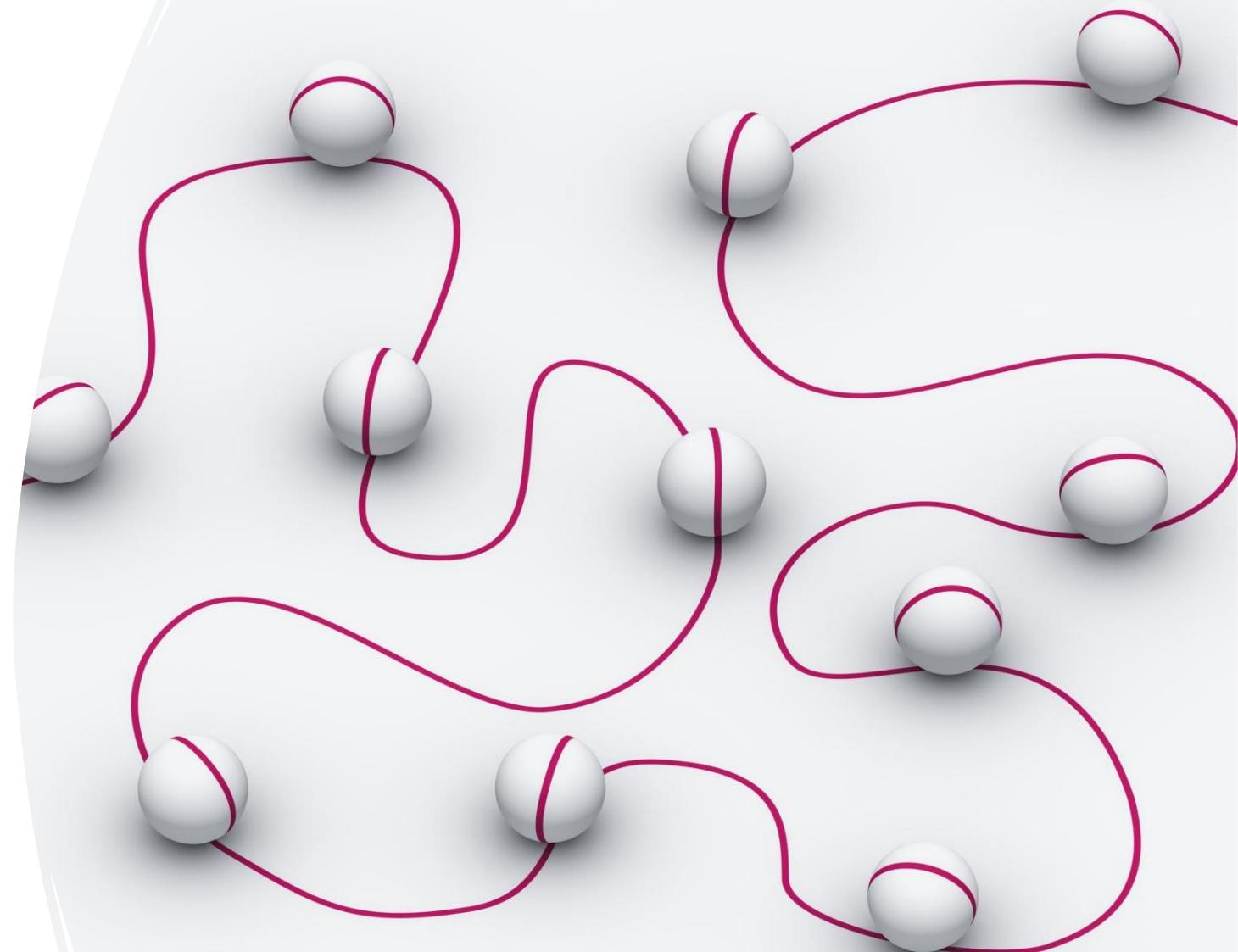


3.1 : Introduction

- User Interaction Design (UID) tasks can vary based on their purpose:
 - **Replacing or Refreshing a System:** Some UID tasks aim to update or improve an existing system.
 - **Developing a New Product:** Others focus on creating an entirely new and innovative product.
 - **Defining Requirements:**
 - Some projects begin with a set of predefined requirements.
 - Others must establish these requirements from scratch.

Iterative Nature of Interaction Design

- **Key Insights:**
- Requirement gathering is not just a wish list of features.
- Activities of design, requirement gathering, and evaluation are interwoven.
- Design evolves through multiple assessment and update cycles.





User Interaction Design follows an **iterative process**, meaning different activities are interconnected rather than sequential.

- **Requirement Gathering is Not a Simple Wish List**
 - It involves in-depth research and user feedback.
 - Users' needs evolve over time, requiring continuous updates.
- **Interwoven Activities:**
 - **Requirement Gathering** → Understanding what users need.
 - **Design Process** → Creating solutions while refining requirements.
 - **Evaluation & Testing** → Assessing the design and making improvements.
 - These steps repeat in a loop until the design meets user needs.
- **Evolution Through Iteration:**
 - Initial designs are rarely perfect.
 - Continuous assessment and refinement improve usability and functionality.



3.2 : Establishing Requirements

3.2.1 : What, How and Why ?

What does one mean by requirements ?

- Dictionary meaning of the word **requirement** is ‘a thing that is compulsory, a necessary condition’. In design requirements mean exactly the same.
- A design requirement is a necessary criterion/thing needed for designing the proposed system.
- Requirements need clarification, refinement, completion, re-scoping

- For example : Website download time should be short enough.
- Here this is not a requirement as ‘short’ is a very relative term. How short? 5 secs? Requirements should be oddly specific.
- There are two main questions that help to identify the requirements.
 - What do users ‘want’?
 - What do users ‘need’?
- **Requirement analysis** focuses on the tasks that regulate the needs or criteria to meet the new/ altered product or project, keeping in mind the potentially conflicting requirements/ ideas of the various stakeholders, analyzing, documenting, validating and managing software or system requirements.

How to achieve the aims/ objectives ?

- The process to achieve the defined aims is not a one time thing. It is an iterative process of the following phases.
 - a. Data gathering phase
 - b. Data analysis phase
 - c. Requirements determination phase
- All of the above activities are iterative for e.g. Once you start to analyse your collected information it is quite possible to feel the data is insufficient and needs to be again collected and this is where the cyclic nature of data gathering, analysis and requirement analysis can be seen.

Why do we need the requirement activity ?

The **Requirement activity** is “ the phase of identifying needs and establishing requirements ”.

It is a notion that failure occurs usually for “unclear objectives and requirements” while critical success occurs most often for “clear, detailed requirements”.

For e.g. Pratik thought of baking a cake for his mother on her birthday. Little did he know he lacked whipped cream for the cake. This would not have happened if he had made a requirement activity.

3.2.2 : Types of Requirements

Requirements can broadly be divided into two types:

- **Functional requirements** are those requirements that help us to know the abilities of a system.
- **Non-functional requirements** are those requirements that help us to know the conditions and the background details of the system's performance environment

Non-functional requirements can be further divided as:

Data requirements: The characteristic trait like type, size, amount, accuracy, storage, etc are data requirements.

Environmental requirements: These requirements are the constraints in which the proposed system is to function in.

Physical requirements – These requirements are the physical quantities like lighting, noise, etc. of the operational environment.

Social requirements– These requirements deal with the need of communication between the stakeholders involved.

Non-functional requirements can be further divided as:

Organizational requirements – These deal with the organization level needs For example, hierarchy of the management, user support, facilities or resources for training.

Technical requirements – These requirements deal with the technical aspects.

User requirements –These deal with the characteristics of the intended user group.

Usability requirements –These are the requirements that need to be taken care of for making the system usable by the user without much inconvenience.

Example: Suppose City A has proposed a self-service barista so that users are allowed to pay for their food (bread, sandwiches, drinks) using a credit system, e.g., payment is settled via their City A or cards. Suggest one key functional, data, environmental, physical, user and usability requirement for the proposed system.

Types of requirements in the Barista Case Study :

Functional: The system/ software will calculate the Total Cost of the items cart.

Data: The prices should be available with the system.

Environmental: The users will have goods and a tray to deal with in a fast-paced line.

Physical: The physical setup will be very noisy and with a lot of discussions and chattering.

User: Generally, teenagers and young people frequently make use of the barista, so the technology part is convenient for them.

Usability: The system is to function in a barista so it should be made sure it is efficient and people are going to have to deal with it very often

3.3 : Five key issues faced during Data Gathering

During Data gathering every session has to be prearranged and executed slowly. The five key issues related to data gathering techniques are as follows :

- **Setting Goals** : Goals are the driving force which help us to channelize our efforts in the right direction. Establishing goals would make it easier for deciding on how to analyze data after data collection.
- **Identifying Participants** : In Data gathering it is crucial to decide from whom to gather data from. It is also necessary to decide the number of participants that are needed to gather data from.
- **Relationship with participant** : The relation between the information gatherer and the information supplier should be clear and strictly professional. A data consent form must be signed to make the relationship clear.

3.3 : Five key issues faced during Data Gathering

- **Triangulation** : Investigate the data collected with at least two perspectives. The data that is collected needs to be from different origins or it has to be ensured that they are gathered by different people who are making use of contrasting sampling techniques. Different data gathering techniques can also be implemented to ensure triangulation.
- **Pilot Study** : Pilot studies are small-scale, preliminary studies which aim to investigate whether critical components of a main study will be feasible. A pilot study aims at answering the question “can the full-scale study be conducted in the way that has been planned or should some component(s) be altered? ”.

Chapter 3

**Data Gathering Establishing
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3.4 : Techniques for Data Gathering

Data can basically be recorded using either of these methods.

- **Notes**: Running notes are recorded by the data collector during the interaction with the data provider. This method is cheap but limited to the writing speed of the collector.
- **Audio**: The data collector records the conversation between him and the data provider. This method is also cheap, difficult to match with other protocols like recording sensitive topics of the discussion. In this method consent is a critical thing.
- **Video**: This mode of data gathering is by far the most accurate one but needs special equipment. Also the user may feel uncomfortable for being under camera during the conversation. It can also be costly to store the whole video recordings as compared to the other modes.

Each method has a few advantages and a few disadvantages hence blending two modes of data gathering can be used like:

Notes + Still Camera/ Photograph

Audio + Still Camera/ Photograph

Comparing data collection techniques

Constraints	Notes + Still Camera	Audio + Still Camera	Video
Equipment	Note making items like pen, paper is readily available	Camcorder and good headphones for voice interpretation	Editing softwares are expensive
Flexibility of use	Very flexible, unobstructive	Flexible, relatively obstructive	Needs positioning to focusing camera lens, even portable versions can be bulky
Disturbance to user	Minimal	Pretty less disturbing but recording backup can be annoying	Very disturbing
Data completeness	Not complete as the scribe notes only what is important	A very vague picture is portrayed as its semi complete	Most complete method especially if more than one camera is used but coordination of video is needed
Reliability of data	Reliability is low, can be little reliable if the human recording knows what is he recording	High but external voice can muffle what is being asked for	Highly reliable but also is affected by the camera positioning
Analysis	Simple to put data into written format (transcribe), rich description can be provided	Critical discussion can be identified. Transcription is needed for detailed analysis.	Crucial happenings can be picked and scanned, and the permanent record can be revisited.

3.4.1 : Questionnaires



- A questionnaire is a series of questions designed to extract specific information.
- Questions in a questionnaire may require different kinds of answers like YES/NO, choice of answers depending on the way the user has previously answered, comment on any question or statement raised.
- This is frequently used in conjunction with other techniques as it can give quantitative or qualitative data. Questionnaires can be distributed and collected by paper, email & web.
- The advantage of an electronic questionnaire is that data collection is easy as the data goes into a database & this makes it easy to analyse.

Questionnaire design:

- The order of the questions can impact the answer of the user hence there should not be any leading questions.
- It is recommended to consider having different versions of the questionnaire for different populations e.g: It should be considered that not everyone can have time to fill a long questionnaire so they can be provided a short questionnaire for quick information gathering.
- Clear instructions should be provided clear as to how to complete the questionnaire.
- Maintain a balance between using white space and keeping the questionnaire simple yet compact.

Questionnaire format:

- ‘Yes’ or ‘No’ checkboxes that offer one option as the user’s answer.
- Checkboxes that offer many options.
- Rating scales (3, 5, 7 & 9 point scales are commonly used).
- Semantic scales is the scale that asks people to rate a product, company, brand within the frames of a multi-point rating options. These survey answering options are grammatically on opposite adjectives at each end.
- Open-ended responses are the questions where the answer is completely based on the user’s perspective about the question.

Web-based questionnaires:

A web based questionnaire is developed from the paper version of the questionnaire. It is like a soft copy of the printed/ handwritten questionnaire. The advantages of web based questionnaire are :

- Responses from user are generally received quickly
- No printing cost as its free
- Data analysis becomes easy as responses are stored in databases
- Time required for data analysis is reduced heavily
- Errors in the questions can be corrected easily

The disadvantages of web based questionnaire:

- Individuals may respond more than once which can lead to redundancy during data analysis
- Lower response rate than paper questionnaires

3.4.2 : Interview



Interview forums for talking to people can be in the form of face-to-face or telephone interviews.

Types of Interviews based on their structure

- **Unstructured Interview-** These interviews are not directed by a script. They are rich in content but not replicable.
- **Structured Interview-** These interviews are tightly scripted, often like a questionnaire. They are replicable but may lack in richness of the content.
- **Semi-structured Interview-** These interviews are those in which the interviewer has a script but he is free to break the scripted flow and indulge in discussion with the interviewee. The interviewer can be flexible and ask questions out of the script. They can provide a good balance between richness and replicability.

Types of Interview Questions:

Broadly an interviewer can ask two forms of questions:

- **Closed ended questions** are easiest to analyse, and may be done by computer as the outcomes/ answers of the user are known to be either of some fixed results as they have a predefined answer format.
- **Open ended questions** are where the user has to give his perspective which can not be guaranteed into any fixed result and these questions do not have a predefined answer format.

In an interview there are a few things that should be **avoided** like :

- Asking long questions
- Using compound sentences (split the question into two).
- Avoid using jargons that the interviewee may be unaware of and make it difficult for him to answer.
- Leading questions are not allowed. Example: Questions like Why do u like Kohli and not Dhoni should not be asked as it restricts the interviewee from answering independently.

Common steps for interview:

- **Introduction** – The interviewer introduces himself, explains the goals of the interview, reassures about the ethical issues, seeks consent for recording, presents an informed consent form (stating the purpose of the test, explaining the fact that it is being video-recorded, promises confidentiality and professionalism, etc.)
- **Warm-up** - The interviewer keeps the first few questions easy & non-threatening as an ice breaker.
- **Main body** – The interviewer starts with his scripted questions presenting questions in a logical sequence.
- **Cool-off period** – The interviewer includes a few easy questions to soothe the tension at the end of the interview
- **Closure** – The interviewer thanks the interviewee and affirms him, signaling the end of the interview and switches the recorder off.

3.4.3 : Group Interview

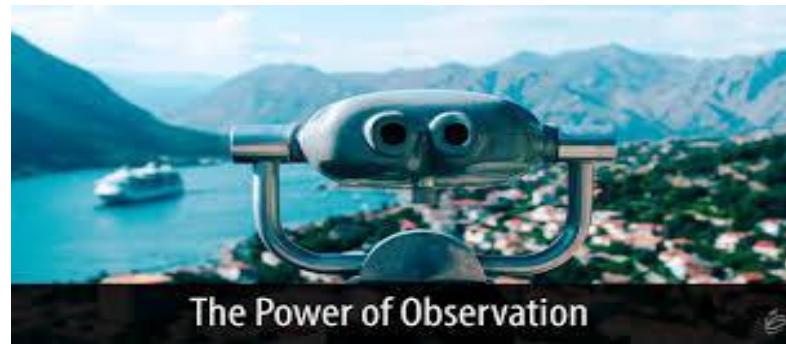


- A group interview is when we gather a group of stakeholders together for discussion on a particular topic.
- It is commonly also called a focus group and workshop.
- Majority of the projects stakeholders have conflicting ideas. So a group interview is good at gaining a general agreement on highlighting areas of conflict and disagreement. Typically there are three to ten participants in a group interview as they provide a diverse range of opinions.
- An interviewer is needed to manage and ensure everyone contributes to the discussion and also to make sure that the discussion is not dominated by one person. Prime duty of the interviewer is to ensure that the agenda of the interview is covered.

FOCUS GROUPS VS. INTERVIEWS

PROS	CONS
<ul style="list-style-type: none">Diversity & enrichment of interviewees' profiles and responsesCheaper light analysis of answersConfirms insights obtained through other qualitative methodologiesEasy to organize in a B2C setting	<ul style="list-style-type: none">In-depth analysisHigher potential for insightsPossibility to use coding and performance statistical analysisUse of robust insights as the fundamental of a quantitative surveyLess bias than with a focus group <p>Disproportionate speaking time Lower average speaking time Moderator's bias is hard to prevent Difficult to organize in a B2B setting</p>

3.4.4 : Observation



- Explaining to the interviewer how an interviewee achieves a task can be very vague and poor in content and is not of much help for analysis either.
- So rather than asking how they did it the interviewer can just observe them do the task himself.
- The interviewer spends time with the stakeholders in their day-to-day tasks, observing them work in its natural setting.
- By observing the interviewer gains insights into the stakeholder's tasks.
- Observations are rich in data and can help understand the extent of the tasks being performed.
- Observations can be passive (listening and watching only) or active (asking questions to the subject of the interview who is being observed)
- There are broadly three types of observations:
 - Controlled Observation
 - Naturalistic Observation
 - Participant Observation

- **Controlled Observation** : Controlled observations are probably going to be done in a brain research lab. The scientist chooses where the perception will happen, at what time, with which members, in what conditions and uses an institutionalized methodology. Members are arbitrarily dispensed to every free factor gathering. Instead of composing a point by point depiction of all conduct watched, it is frequently simpler to code conduct as indicated by a formerly concurred scale utilizing a conduct plan (for example leading an organized perception).
- **Naturalistic Observation** : Naturalistic observation is an examination strategy generally utilized by clinicians and other social researchers. This procedure includes contemplating the unconstrained conduct of members in a regular environment. The analyst just records what they find in the manner they can. In unstructured perceptions, the analyst records all pertinent conduct without framework. There might be a lot to record and the practices recorded may not really be the most significant so the methodology is normally utilized as a pilot study to perceive what sort of practices would be recorded.
- **Participant Observation** : Participant observation is a variation of the abovementioned (common perceptions) yet here the scientist participates and turns out to be a piece of the gathering they are concentrating on to get a more profound knowledge into their lives. In the event that it were looked into by creatures we would now not exclusively be considering them in their regular territory yet be living close to them too! Member perceptions can be either spread or plain. Undercover is the place the examination is completed 'under spread'.

3.4.5 : Studying Documentation



- Document works like user manuals, regulations, stakeholder's work diaries can provide ample data for analysis. These are great to understand the work in focus and also inferring background details of the subject.
- Talking of the regulations governing a task.
- Although this form of data gathering can be very rich in content it should not be used in isolation i.e,The user may write stuff in the document but may not follow the documented work.
- An advantage over other techniques is that it does not waste the stakeholder's time.

3.4.6 : Research Similar Products



- The best way to learn is by evaluating others mistakes and finding solutions to the drawbacks present in the field of study.
 - Researching similar products will provide alternative designs and help in gathering requirements as well.

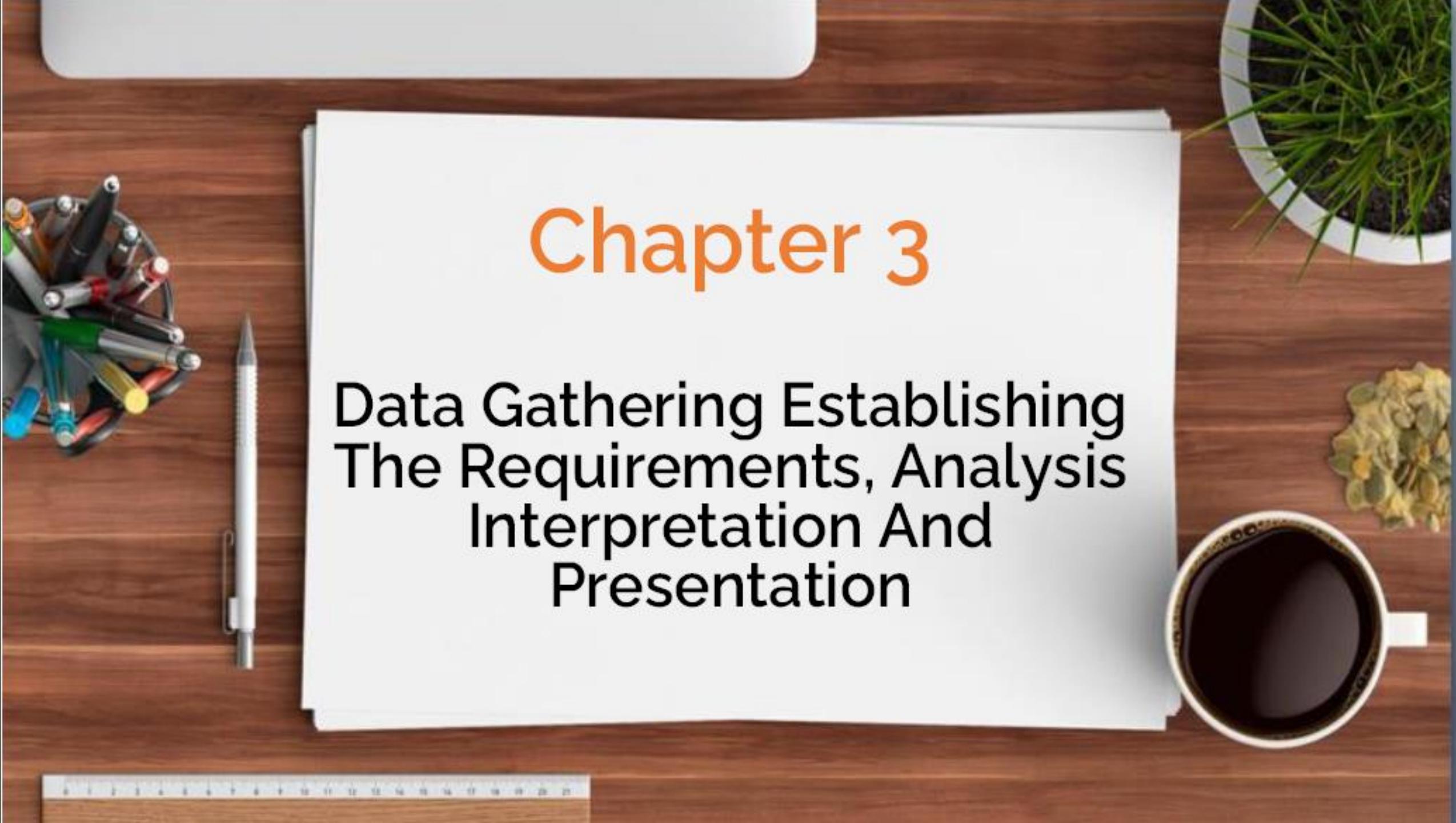


Comparison of Data Gathering Techniques

Technique	Good for	Kind of data	Plus	Minus
Questionnaires	Answering specific questions	Quantitative and qualitative data	Can reach many people with low resource	The design is crucial. Response rate may be low. Responses may not be what you want
Interviews	Exploring issues	Some quantitative but mostly qualitative data	Interviewer can guide interviewee. Encourages contact between developers and users	Time consuming. Artificial environment may intimidate interviewee
Focus groups and workshops	Collecting multiple viewpoints	Some quantitative but mostly qualitative data	Highlights areas of consensus and conflict. Encourages contact between developers and users	Possibility of dominant characters
Naturalistic observation	Understanding context of user activity	Qualitative	Observing actual work gives insight that other techniques cannot give	Very time consuming. Huge amounts of data
Studying documentation	Learning about procedures, regulations, and standards	Quantitative	No time commitment from users required	Day-to-day work will differ from documented procedures

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3.5 : Data Analysis

- The type of data analysis that can be done on the collected data is dependent on the goals foreseen during the data gathering stage, and also the data gathered.
- For the data analysis stage there are only three approaches.
 - qualitative analysis approach
 - quantitative analysis approach
 - combination of both, qualitative and quantitative
- This may consist of tasks like characterizing patterns/ trends or deducing plain numerical values like ratio, average, or percentage.

3.5 : Data Analysis

- The preliminary analysis phase is led by some more elaborated analysis which uses integrated frameworks and postulates to back the analysis.
- Rendering the conclusions generally runs synchronic with the analysis, but there are various ways to interpret the results and it is crucial to ensure that the data supports the conclusions.
- The investigator's mindset being biased can influence the findings and this can be very critical.

3.5.1 : Qualitative and Quantitative Data

- The form of collected data in the form of numerals or numbers or in numeric format is called **Quantitative data**.
- Example, the number of users who use iOS in a town, the number of errors a machine finds in a humanly cut diamond, or the salary hike given to employees by a company.
- **Qualitative data** is the type of data that can not be stated in numeric terms.
Example, the explanations, remarks quoted by the interviewees, diagrams of activity, and snippets.

3.5.1 : Qualitative and Quantitative Data

- Qualitative data can also be expressed in numerical format but it loses its meaning. There is a myth that certain forms of data gathering techniques can only be used for quantitative data and others can only be used for qualitative data. Every data gathering technique mentioned previously can be used to collect both types of data.
- While any comment field is a form is qualitative data. For an observation, quantitative data can be recorded as the number of people who eat salads with lunch or the number of students who practice Mathematics daily. While blogs about the presence of depression are examples of qualitative data.

3.5.1 : Qualitative and Quantitative Data

- Quantitative analysis makes use of digital techniques to calculate the numeric values of fields.
- Example: A quantitative analysis might have a conclusion that an average African male is 5 feet 9 inches tall and weighs 169 pounds with an average age of 45 years. Qualitative analysis is directed at finding the nature of a field of study and can be formulated by patterns and trends. Example, to describe the same mass of people, a qualitative analysis might conclude that the average African male is very tall, heavy , and Middle-aged

Qualitative VS Quantitative Data

QUANTITATIVE DATA

ANSWERS "WHAT" "WHERE"
"HOW" "WHEN" AND "WHO"

Based on numbers

Larger sample size

Statistical analysis

Objective

Closed-ended questions

To validate hypothesis

QUALITATIVE DATA

ANSWERS "WHY"
(WHICH IS VERY IMPORTANT)

Based on opinions and experiences

Smaller sample size

Interviews & observation

Subjective

Open-ended questions

To generate hypothesis
or develop ideas

3.5.1.1 : Interview

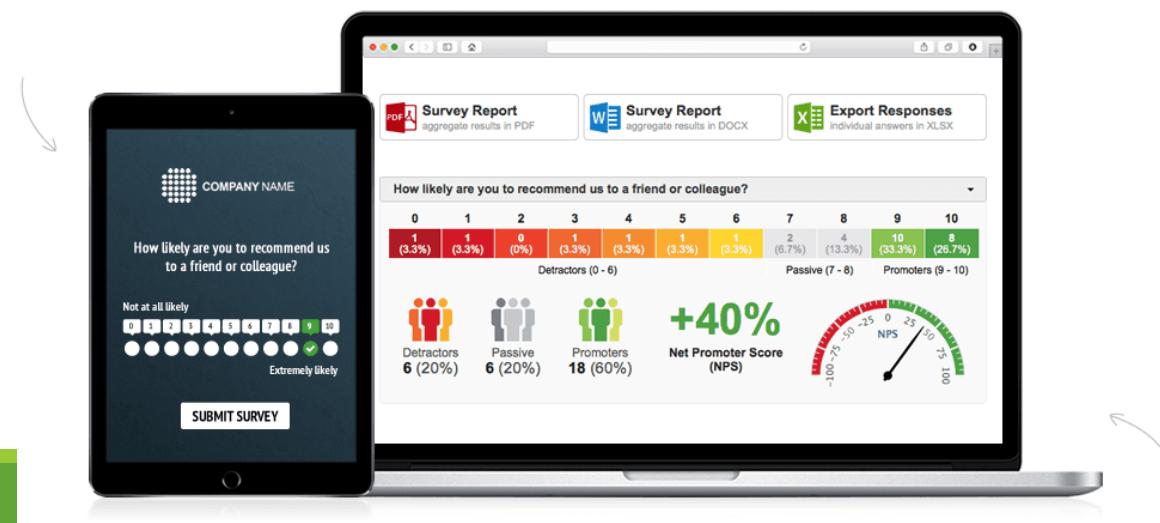
- Usually unprocessed data that is gathered during an interview resides as audio recordings and/ or notes written by the interviewer.
- These scribes have to be processed and expanded at the earliest after the interview to ensure that the interview is crisp in the interviewer's memory and the short scribes can be expanded with ease.
- The voice recordings recorded during the interview can function as an aid, or they can be transcribed later on for a further detailed analysis.
- Transcription takes substantial effort, as the speaking speed of the interviewee normally is faster than the typing speed or writing speed of the interviewer, another problem can be that the voice recordings may lack in quality and information.

3.5.1.1 : Interview

- Many times the interviewer video records the interview, especially when the interviewee is to execute some work. Post interview the audio can be taken from the video and transcribed during or after the discussion.
- Closed questions ordinarily are considered as quantitative data and examined making use of easy quantitative analysis techniques.
 - Example, Questions like Which is your favorite car ? can be used to categorize the data on the basis of car popularity.
- More complicated statistical techniques are required to identify the relation between question responses.
- Generally open questions are used to collect qualitative data for analysis which can be made use of to identify trends or repetitions in responses.

3.5.1.2 : Questionnaire

- Unprocessed data collected from questionnaires comprises the user's responses to the queries asked, and the format may be on paper or it can be an online form, the responses are mostly stored in a database so that it can be easily used for processing.
- It may be inevitable to process the responses by cleaning datasets where the user has misinterpreted the question. The data can be filtered according to the user's entries, (Example: Everyone over 80 kgs,or to evaluate the user's response to a game).
- This helps the analysis to be carried out on small chunks of data, aiding the evaluator to conclude on obligatory goals.
- It is made simple by making use of an elemental tool like a spreadsheet.
- Closed questions are more likely to be evaluated quantitatively and open questions qualitatively.



3.5.1.3 : Observation

- Such sort of information gathering procedure results in bringing about an expansive scope of crude information which includes eyewitness scribes, despite everything photos, information logs, verbally process chronicles, video and sound accounts.
- This crude information helps scaling a vivid scenario, however it can likewise make it hazardous to dissect except if an organized model is embraced.
- Introductory information preparation here incorporates expanding the written scribes, and translating components like the sound and video accounts also the verbal process conventions.
- Onlookers scribes are well on the way to be broken down utilizing subjective methodologies, on the same hand the photographs provide us with the contextual information.

3.5.1.3 : Observation

- Data / System records and a few components of the perceiver's scribes could be examined quantitatively.
- For the whole time during the preliminary refining, the trends and repetitions in the dataset can be predicted.
- Making note of such initial notions can be very valuable to be used as a model for the further, more detailed analysis.
- Although we should not only trust these preliminary findings as we may get inadvertently biased and draw conclusions.

Data gathered techniques and distinctive preliminary processing steps taken

	Usual Raw Data	Example of Qualitative Data	Example of Quantitative Data	Initial Processing steps
Interviews	Audio recordings, Interviewer Notes and Video recordings	Responses to open questions, Video, Respondent's opinions	Age, job role, years of Experience and responses to closed questions	Transcription of Recordings and Expansion of notes
Questionnaires	Written responses, online Databases where responses are stored	Responses to open questions, And comments and opinions of the respondent	Age, job role, years of experience. Responses to closed questions	Clean up data. Filter into different data sets
Observations	Observer's notes, photographs, audio and video recordings, data logs, think-aloud	Records of behavior, description of a task as it is Undertaken and the copies of Informal procedures	Demographics of participants, time spent on a task and the number of people involved in an activity	Expansion of notes, transcription of Recordings and Synchronization between data recordings