Introduction

HCI ⇨ A discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them

Reliability ⇨ Actions of a system function as specified

Standardization ⇨ Common UI features across multiple applications

Integration ⇨ Incorporation of a system across application packages

Consistency ⇨ Common action sequences, terms, units, layouts, color, typography within an application

Portability ⇨ Convert data and interfaces across multiple hardware and software environments

Users with Disabilities

- Vision
  - > Blind
  - > Low-Vision
  - > Color Blind
- Hearing
  - > Limited
  - > Deaf
- Mobility
- Learning

Solutions for Users with Disabilities

- Keyboard/Mouse Alternatives
- Font Size
- Color Coding
- Increase Contrast
- Text descriptors for images
- Text-to-Speech
- Screen Magnification
- Speech Recognition

Chapter 05
Interaction Design Basics [Alan Dix]

Design
Achieving goals (purpose) within constraints (materials, standards, platforms)

Tradeoffs
Choosing which goals or constraints can be relaxed so that others can be met

Central Message
The User

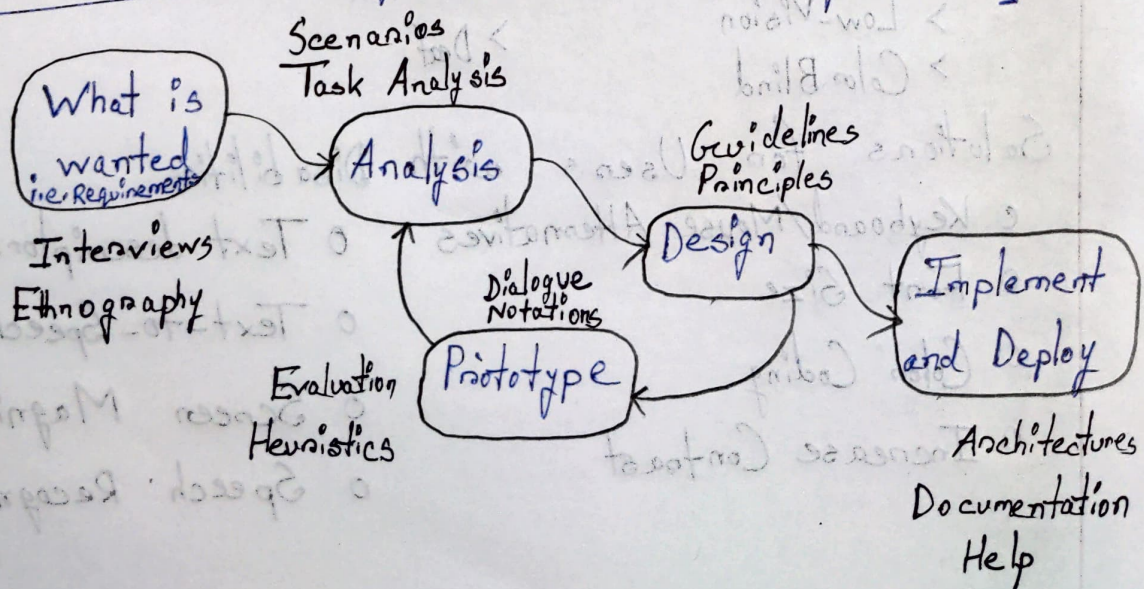
Golden Rule of Design
Understand your materials

In the context of HCI,

Understand Computers
- limitations
- capacities
- tools
- platforms

Understand People
- psychological & social aspects
- human error

The Process of Design: [Interaction Design Process]



Q. What is persona? Give example & explain

Persona

> Description of an example user

> A rich picture/description of an imaginary person who represents the core user group.

See example [slide-17]

Scenario

> Stories for design

> Step-by-Step Walkthrough

Scenarios are used to:

① Communicate with others

② Validate other models

③ Express dynamics

Linearity

Scenarios - One linear path through system

Pros
- Life & time are linear
- Easy to understand

Cons
- No choices or special conditions
- Miss the unintended

∴ Use several scenarios

Navigation Design

Local Structure ⇨ Single Screen

Global Structure ⇨ Whole Site/App

Levels of Interaction

① Widgets - Textfield, Button

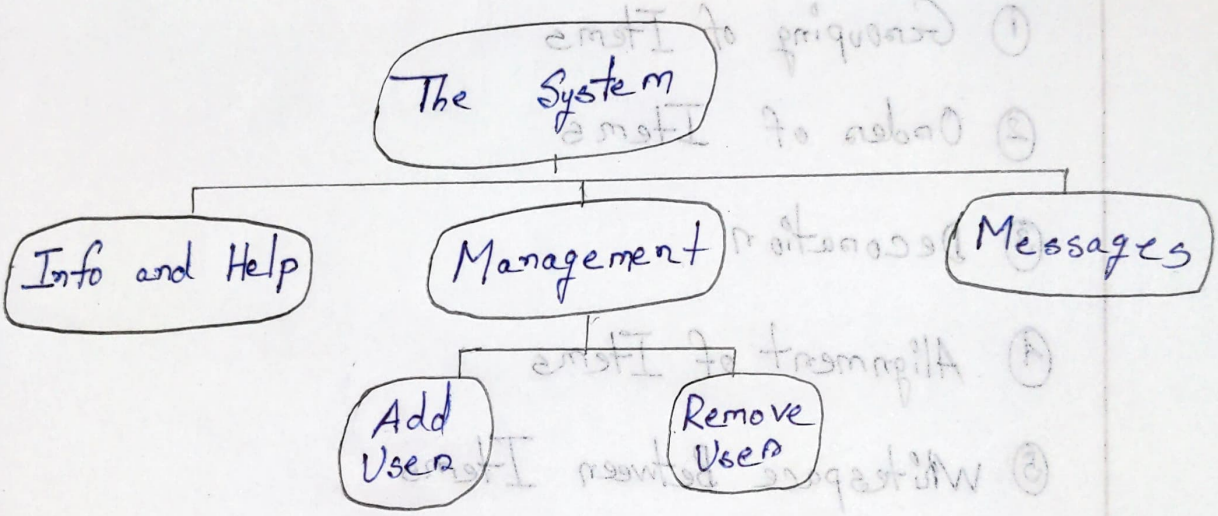
② Screen Design - Single Page Layout

③ Navigation Design - Entire Website/App Structure

④ Environment - Other apps, OS, Web, Browser

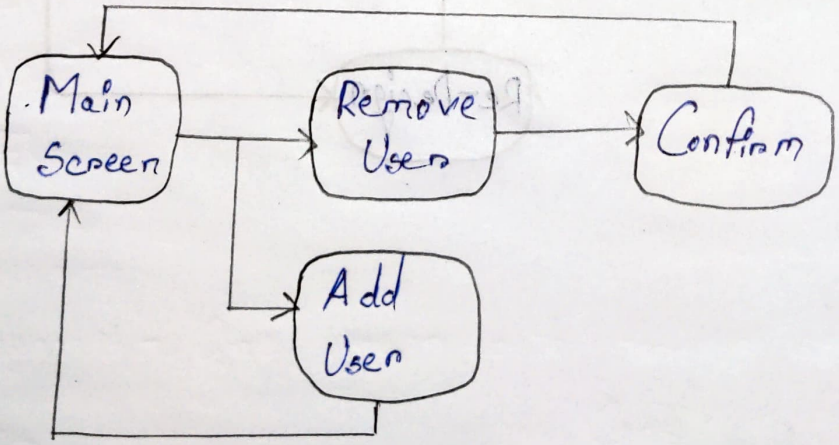
Global Structure

Hierarchical Diagram ⇨ Entire App Structure / Layout of all pages



Network Diagram ⇨ Show different paths through a system

Eg: Add/Remove a User



More task-oriented than Hierarchical Diagrams

Chapter 09 [Alan Dix]

Evaluation Techniques

in an HCI perspective

Tests

- Functionality
- Security
- Usability (UI/HCI) ✓✓

Goals of Evaluation

1. Assess extent of system functionality
2. Assess effect of interface on user
3. Identify specific problems

Analytical Evaluation: Experts carry it out

Empirical Evaluation: Evaluated based on ~~d~~ mass-data from common users

Task-Centered Design

Design focused on real, complete, representative tasks

Q. How to evaluate a design without users?

Cognitive Walkthrough (proposed by Polson et al.)

- Evaluates design on how well it supports user in learning task
- Usually performed by expert
- Identify problems based on psychological principles
- Requires some expertise in cognitive psychology

For each task, walkthrough considers

1. What impact will interaction have on user?
2. What cognitive processes are required?
3. What learning problems may occur?

How Cognitive Walkthrough Works

① Imagine people's thoughts and actions when they use an interface for the first time

② Select a task

③ Try to formulate a believable story about each action a user has to take to do the task.

④ Motivate each of the user's actions, relying on the user's general knowledge and on the prompts/feedback provided by the interface.

If a believable story cannot be formulated about an action, then a problem has been located in the interface

Q. UI given. Task given. Conduct Cognitive Walkthrough

slide-9

Steps of Cognitive Walkthrough

① Select tasks

② Write down desired path

③ 4 questions to ask

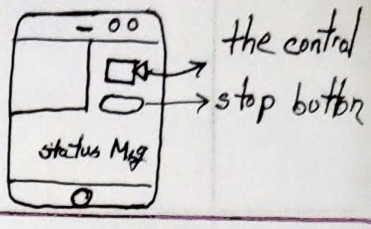
Q1 ⇨ Will the user realistically be trying to do this action?

Q2 ⇨ Is the control for the action visible? → usually a button

Q3 ⇨ Is there a strong link between the control and the action?

Q4 ⇨ Is feedback appropriate? (Feedback from UI after user presses/clicks on control)

Note Q4 cannot be answered, as this example is in pen and paper



Example:

Task ⇨ Record & Upload a Video

S1: Record Video

Q1 Yes

Q2 Yes

Q3 Yes

Q4 No, blinking red light, or a status message can be shown

S2: Stop Video

Q1 Yes

Q2 Yes

Q3 No, provide text, image or hint on button

Q4 No, stop blinking light or not show status message

S3: Upload Video

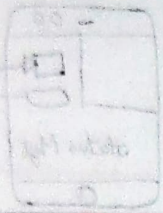
Q1 Yes

Q2 No, an upload button can be placed under stop button

Q3 No, follow suggestion of Q2

Q4 No, a progress bar and a "Upload Complete" status message can be displayed

Justification after Yes may be needed, if it is not obvious from UI



Pros & Cons

Pros

- No need for users
- Explicit account of user's task
- Suggestions for improvement
- Quick and Inexpensive
- Can be carried out at any phase

Cons

- Expertise skills required
- Tends to focus on words and graphics
- No consideration for frequency and severity of problem
- Artificial context

Q. Write down Set of Heuristics of Nielsen
[Memory Nielsen's Set of Heuristics]

Heuristic Evaluation:

- Usability criteria (heuristics) are identified
- Design examined by experts to see if heuristics are violated
- A group of experts evaluate the design individually and then aggregate opinions
- Severity level assigned to each problem
- False Alarm/Positive : Problem stated by one or more experts, but later justified (that it is not a problem) by other experts.

Heuristics ⇨ General principles for interaction design

Q. Why 3-5 experts evaluate design

① 85% of problems can be identified by 3-5 experts (More than 3-5 experts not beneficial according to Cost-Benefit analysis)

② Every evaluator does NOT find every problem.

③ Design is subjective. Opinions of multiple (more than one) experts required

Heuristic Evaluation Process

① Select system and tasks to review
② Select heuristic set
③ Inspect interface alone
④ Communicate and aggregate findings
⑤ Categorize and Prioritize findings to be effectively reported

Severity Rating of HE

Severity of a usability problem is a combination of three factors Frequency, Impact, Persistence

- Frequency ⇨ Number of times the problem occurs
- Impact ⇨ Difficulty faced by users to overcome the problem
- Persistence ⇨ Continuity of the problem (one-time or repeated)

Rating Scale

0 to 4

0 ⇨ Not a usability problem

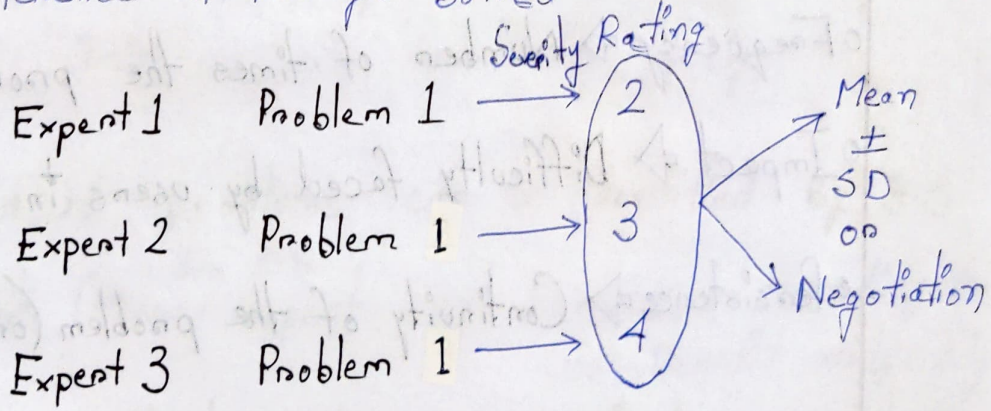
1 ⇨ Cosmetic problem. Need not be fixed unless extra time available on project

2 ⇨ Minor usability problem. Fixing this given low priority

3 ⇨ Major usability problem. Fixing this given high priority

4 ⇨ Usability catastrophe. Must fix before product release

How Difference in Ratings Solved



Pros and Cons of HE

Pros

1. Relatively inexpensive
2. Expert skills not mandatory
3. Can be used early, but more efficient later

Cons

1. Evaluator effect
2. Not as effective as usability testing
3. Solutions not always readily suggested
4. Prone to false alarms

See video in slide

Memorise

Nielsen's 10 Heuristics:

1. **Visibility of System Status**
   Provide users timely and appropriate feedback about system's status
2. **Match between System and Real World**
   Information should be organized naturally and logically based on what the users are accustomed to seeing in the real world
3. **User Control and Freedom**
   Users should have the ability to go back and fix mistakes without hassle
4. **Consistency and Standards**
   User controls, icons, terminology and error messaging should be consistent throughout the interface. Industry standards should be applied where appropriate
5. **Error Prevention**
   Prevent user errors by identifying typical problem areas for users and redesigning them
6. **Recognition rather than Recall**
   Reduce memory load of users by presenting familiar icons, actions and options whenever possible
7. **Flexibility and Efficiency of Use**
   Provide accelerators for expert users to more efficiently complete tasks, without affecting novice users
8. **Aesthetic and Minimalistic Design**
   Avoid displaying excessive information and design elements, as they will visually compete with more relevant information
9. **Help Users to Recognize, Diagnose and Recover from Errors**
   Present error messages that gives users instructions about how to recover from errors
10. **Help and Documentation**
    Help, documentation and user support should be easy to search and instructions easy to follow.

~~Problem No~~ ~~Where~~ ~~Problem~~ ~~Violated Heuristics~~ ~~Severity Rating~~

Example of Heuristic Evaluation (Format only)

Problem No.	Where	Problem	Violated Heuristics	Severity Rating	Possible Design Solution	Relation With
P1	Fig 1(a)	No back button	H3 H4	3	Add back button	—
P2	Fig 2(c)	...	H2	2	...	P1 Problem 1

Evaluating through User Participation

① Laboratory Studies

- Advantages
  - > specialist equipment available
  - > controlled environment uninterrupted
- Disadvantages
  - > lack of context
  - > difficult to observe several users cooperating
- Appropriate
  - > In dangerous or impractical system locations
  - > For constrained, single-user tasks
  - > To allow controlled manipulation of use

② Field Studies

- Advantages
  - > Natural environment
  - > Context retained
  - > Longitudinal studies possible
- Disadvantages
  - > distractions
  - > noise
- Appropriate
  - > Where context is crucial

Experimental Evaluation

Controlled evaluation of specific aspects of interactive behavior

> Participants

Chosen to match the expected user population as closely as possible

> Variables

- Independent Variable (IV) Eg: interface style, number of menu items

  Characteristic changed to produce different conditions

- Dependent Variable (DV) Eg: time taken, number of errors

  Characteristics measured in the experiment

> Hypothesis

- Prediction of Outcome Eg: Error rate will increase as font size decreases
  - framed in terms of IV & DV
- Null hypothesis Eg No change with font size
  - states no difference between conditions
  - aim is to disprove this

> Experimental Design

- Within Groups Design

  Each subject performs experiment under each condition

- Between Groups Design

  Each subject performs experiment under only one condition

Observational Methods:

Think Aloud :

Participant or User instructed to vocalize their thoughts when performing a task

Cooperative Evaluation

Elaborate discussion between Client or User and Designer or Evaluator.

Protocol Analysis

Collecting and analyzing user actions (via paper and pencil, audio, video, computer logging, user notebooks etc)

Automated Analysis

Utilizing automated tools in accessibility evaluation

Post-task Walkthrough

Participant or User questioned on a task just completed

Query Techniques

① Interview

3 types

① Structured
Fixed set of questions

② Semi-Structured
Fixed set of questions. Additional questions may be asked depending on answers

③ Unstructured
Set of questions not fixed

Interview collects Qualitative Data

Advantages	Disadvantages
- issues can be explored fully	- subjective
- can be varied to suit context	- time-consuming

② Questionnaire

Questionnaire collects Qualitative / Quantitative Data

Advantages	Disadvantages
- quick and reaches large user group	- less flexible
- can be analyzed more rigorously	- less probing

Q. What are the criterias for choosing an Evaluation Method

Q. Scenario given. Choose an Evaluation Method and Justify

Memorise

Choosing an Evaluation Method

Depends on the following factors

① Current Stage/Process of System ⇨ Design Vs Implementation

② Style of Evaluation ⇨ Laboratory Vs Field

③ Level of Objectiveness ⇨ Subjective Vs Objective

④ Type of Measures ⇨ Qualitative Vs Quantitative

⑤ Level of Information ⇨ High Level Vs Low Level

⑥ Level of Interference ⇨ Obtrusive Vs Unobtrusive

⑦ Resources Available ⇨ Time, Subjects Equipment, Expertise

6 guidelines to focus on your essential message (No need to memorize)

Produce Design Solutions Figure X

Content Design

No book reference Available in net

Information Foraging

A concept that humans, like animals hunting for food, search for and consume information in a way that minimizes effort and maximizes benefit

Information Scent

A term that describes how people evaluate the options presented when they are looking for a specific information. Information scent helps users assess whether their path exhibits cues related to the desired outcome.

Information Architecture

The practice of organizing and presenting information in human-friendly ways, in order to transform information into structured knowledge

No need to memorise

6 guidelines to focus on your essential messages

Understand each guideline

① Give people only what they need

- Less is more.
- Only display the relevant information that end users want to see

② Cut! Cut! Cut! And Cut again!

- Present required information as concisely as possible
- Remove any unnecessary content

③ Start with the key point

- Present the most important information first

④ Break down walls of words

- Divide content into sections (Eg: paragraphs to lists)
- Avoid dense texts

⑤ Market by using useful information

- Promote using only important, concise and catchy information

⑥ Layer Information

- Divide information, keeping most important content first and least important content last

Q. Scenario Given. List 15 concepts and apply Card Sorting

See Card Sorting YT video in slide

Card Sorting:

A technique that helps discover how people understand and categorize information

Steps

1. List concepts/items (Card Creation)
2. Group related concepts/items
3. Name groups
4. Construct hierarchy (if required)

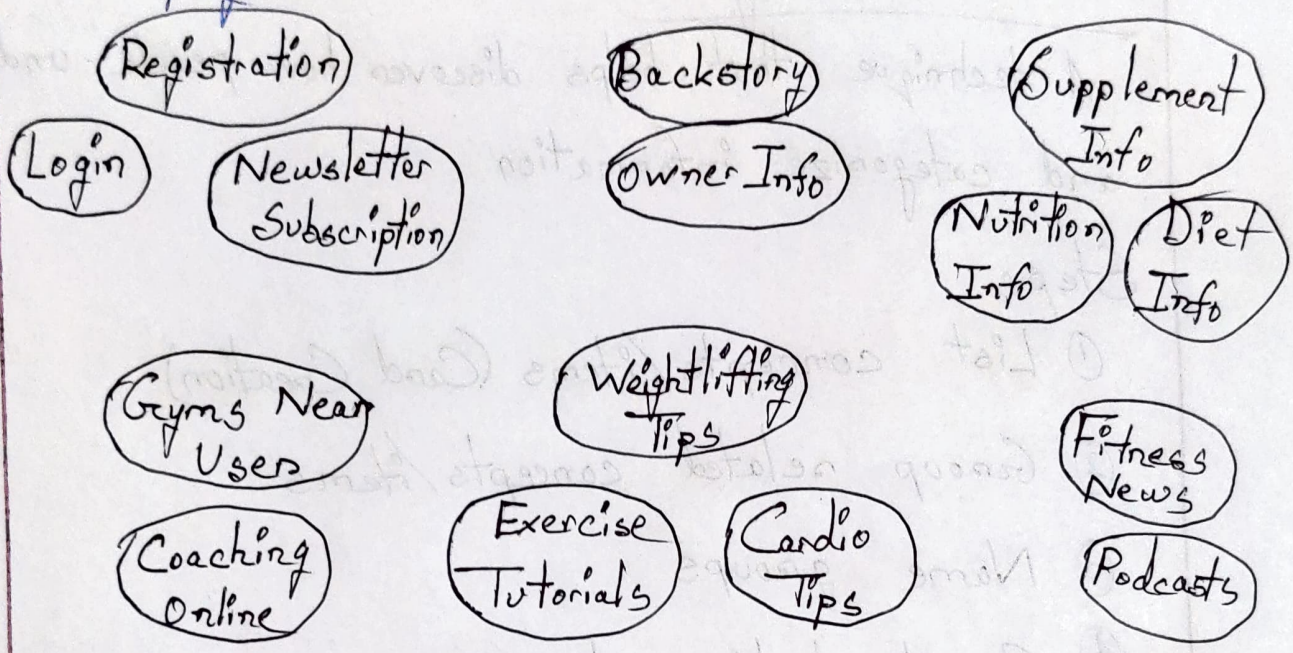
Example

A Fitness/Weightlifting website. Apply card sorting to create an Information Architecture

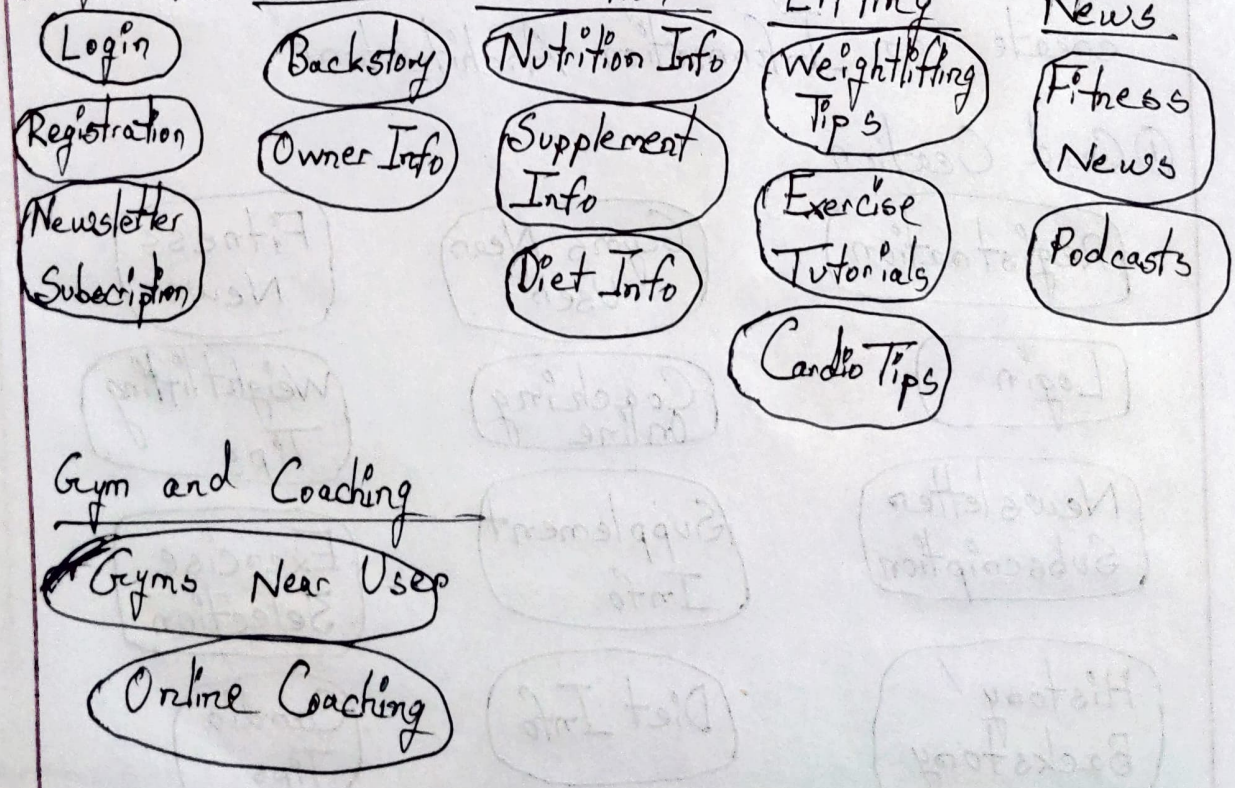
① Card Creation

- Registration
- Login
- Newsletter Subscription
- History/Backstory
- Owner Info
- Gyms Near User
- Coaching Online
- Supplement Info
- Diet Info
- Nutrition Info
- Fitness News
- Weightlifting Tips
- Exercise Tutorials
- Cardio Tips
- Podcasts

② Grouping



③ Group/Category Labeling



Universal Design

The process of designing products so that they can be used by as many people as possible in as many situations as possible

Can be achieved by 02 ways

① To have built in redundancy

② To be compatible with assistive technologies

Universal Design Principles

North Carolina State University (NCSU) proposed seven general principles of universal design

① Equitable use ⇨ Suitable for use by all people (with any disabilities)

② Flexibility in use ⇨ Accomodate a wide range of individual preferences/abilities

③ Simple and intuitive to use ⇨ Easy to understand regardless of user's experience, knowledge or language skills

④ Perceptible information ⇨ Communicate necessary information regardless of user's sensory abilities

⑤ Tolerance for error ⇨ Minimizes hazards, & consequences of accidental actions

⑥ Low physical effort ⇨ Can be used comfortably with minimum fatigue

⑦ Size and space for approach and use ⇨ Appropriate size and space is provided for use regardless of user's body size & mobility

Applicable for embedded systems

Q. System described/illustrate. Evaluate in the context of Universal Design.

Problem No	Problem	Where	Violated Principle	Affected User Group	Redesign Solution
1	No audio feedback	submit form feature	P1 (list principles beforehand)	Blind People	Provide audio feedback Eg: Speech saying "Form Submitted"

Standards 12 parts. Understand Don't Memorise

Q. What is "broad brush" design rules Each Schneider & Norman's Principles. No need to memorise

Memorise Nielsen's 10 heuristics. Understand

Multi-modal Systems

Systems that provide access to information through more than one mode of interaction

Difference between Multi-modal and Multi-media systems

Multi-modal System	Multi-media System
① Uses more than one mode of interaction	① Uses a number of different media to communicate information
② Focuses on how users can interact with the system	② Focuses on how information is presented to the user
③ Provides more than one mode of input (Eg, touch, voice, gesture)	③ Usually provides only one mode of input
④ Enhances equitability and flexibility of use	④ Enhances content presentation and engagement
Eg: A website that incorporates audio commands and feedback	Eg: A website with text, images and video clips

Auditory Icons vs Earcons

Auditory Icons	Earcons
① Natural sounds used to represent different types of objects or actions	① Synthetic sounds that represent an event or convey other information
② Easier recognition as auditory icons are based on familiarity with real-world natural sounds	② Requires learning, as the mapping between sound and action is arbitrary
③ Limited by the availability of appropriate natural sounds	③ More flexible, as new sounds can be created to represent any action or object
Eg: Sound of smashing to represent deleting an item	Eg: A high-pitched beep sound to represent an error

See Slide - 37 [Users with Disabilities]

Design Rules

Definition ⇨ Rules that a designer can follow in order to increase the usability of the software product.

Authority and Generality

Authority is the indication of whether or not the rule must be followed, or if it is only suggested

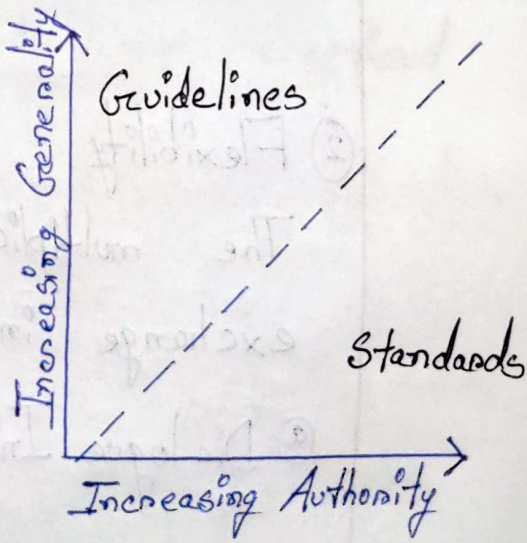
Generality is the indication of whether the rule can be applied to many design situation or if it is focused on a more limited application situation

Types of Design Rules

① Principles
- ▷ Abstract design rules
- ▷ low authority
- ▷ high generality

② Standards
- ▷ Specific design rules
- ▷ high authority
- ▷ limited application

③ Guidelines
- ▷ lower authority
- ▷ more general application



- Memorise Learnability, Flexibility & Robustness
- Understand sub-principles of each [Read Alan Dix book pg-261]

Principles to Support Usability

① Learnability

The ease with which new users can begin effective interaction and achieve maximal performance

Principles of Learnability

ⓐ Predictability – determining effect of future actions based on past interaction history

ⓑ Synthesizability – assessing effect of past actions on current state

ⓒ Familiarity – correlation between user's prior knowledge and knowledge required for effective interaction

ⓓ Generalizability – extending specific interaction knowledge to new situations

ⓔ Consistency – likeness in behavior arising from similar situations or similar task objectives

② Flexibility

The multiplicity of ways the user and system can exchange information

ⓐ Dialogue Initiative – freedom from system imposed constraints on input dialogue

ⓑ Multithreading – ability of system to support user interaction for more than one task at a time

(e) Task migratability - Passing responsibility of task execution between user and system

(d) Substitutivity - Allowing equivalent input and output values to be substituted

(c) Customizability - Modifiability of the user interface by user or system

adaptability ↵ ↳ adaptivity

(3) Robustness

The level of support provided to the user in determining successful achievement and assessment of goal-directed behavior

(a) Observability - Allowing user to evaluate the internal state of the system from its user interface

(b) Recoverability - Ability of user to take corrective action once an error has been recognized

(c) Responsiveness - Measure of the rate of communication between system and user

(d) Task Conformance - Degree to which the system services support all of the user's tasks

HCI Standards [slide-18]

ⓐ Effectiveness : The accuracy and completeness with which specified users can achieve specific goals

ⓑ Efficiency : The resources expended in relation to the accuracy and completeness of achieved goals

ⓒ Satisfaction: The comfort and acceptability of the system to its users

Broad brush design rules :

Broad brush design rules refer to high-level, general principles that guide the design of user interfaces and interaction systems.

They provide general guidance rather than specific instructions. The term "broad brush" implies that these rules cover a wide range of design aspects at a high level.

Study (Understand Points, Don't Memorise) Schneiderman's and Norman's rules from Alan Dix Book pg- 283

HCI Design Patterns:

An approach to reusing knowledge about successful design solutions.

Characteristics

1. capture design practice, not theory
2. capture common properties of good examples of design
3. represent design knowledge at varying levels
4. are intuitive and readable
5. are generative and therefore assists development of complete designs