INTRODUCTION

Interaction design: designing interactive products to support the way people communicate and interact in their everyday and working lives.
UX: how a product behaves and is used by people in the real world(context of use, types of activity, accessibility, cultural differences, user groups

Usability goals: Effectiveness: how good a product is at doing what it is supposed
Efficiency: the way a product support users in carrying out their tasks
safety/satisfaction: protect the user from dangerous conditions and undesirable situations (carrying out unwanted actions accidentally.
Learnability: self-explanatory
Memorability: how easy a product to remember once learned.
Ease of Use (understandability)
Flexibility Robustness
Examples of good design: TiVO remote, Marble answering machine
Interaction types: instructing, conversing, manipulating, exploring

Design Life Cycle:

1. Accept situation (understand the problem)
2. Analyze the problem/situation
3. Define (restate the problem clearly by defining the goal)
4. Ideate (think of the possibilities, come up with options)
5. Select (decide upon the best option by comparing the options on important parameters such as feasibility, risks)
6. Implement (taking the plunge)
7. Evaluate (assess whether or not the solution works and how it could be improved)

DESIGN THINKING

Characteristics: human-centered, collaborative problem solving approach that is creative, interactive and practical.

Design thinking process

1. Empathize
2. define: develop deep understanding of the users, create an actionable point of view which works as foundation for ideation
3. ideate: lateral thinking, sketch, scenario, storyboard
4. prototype
5. test: UX, usability, navigation

observe<->reflect

USER STUDY

User characteristics: age, work profile, familiarity with technology /task, usage, task value perception (particularly relevant to the introduction of new technology)

Finding user needs

- select **Methods**:

1. interviews (structured, semi-structured, unstructured)
   - avoid long, compound questions, jargons or leading questions
   - Intro>warm up>main body>cool-off>closure
2. surveys (online/face-to-face)
   -open/close questions
   -Likert (measure opinions, attitudes, beliefs, can scale from strongly disagree to strongly agree) vs Semantic (bipolar attitudes) scale
   -guidelines (diff versions for diff populations, clear instructions on completion, balance white space and making it compact, promise confidentiality, provide incentive)
3. observations (direct/indirect)

-direct & in the field: ethnography
-direct & controlled environment: Think Aloud techniques
-indirect (diaries, interaction logging, web analytics)

4. **contextual inquiry** (context, partnership)
   - context
   - master (user)-apprentice (designer) model
   - partnership: collaboration between user & designer: observations interpreted together)
   - focus project to understand what to look for
   - Ongoing experience rather than summary
   - Concrete data rather than abstract data
- Select participants & **sampling** (saturated, convenience, random)
- arrange (for contextual inquiry)
- Prepare (plan time, pilot, questions
- Schedule (consider setting, presentation, equipment set-up for interview & observations, consider numbers, cut-offs for surveys)
- Conduct: instructions for participants, follow up unusual responses/ observations/submissions, recording, time/effort, logistics, repeatability, confounding personalities in groups (interview), presentation of 'self' issue (observation), response rate, scales (survey)
- Interpret (for contextual interview): debrief, share findings
- Artifacts: notes, recordings, user journey map, empathy map

Experience Map

a visual representation that illustrates users' flow (within a product or service) their needs, wants, expectations and the overall experience for a particular goal.

- users note their feelings, pain points and the moments of delight
- have several layers, do not focus only on a particular element that triggers action
- usually linear because it describes various aspects of accomplishing particular tasks
- include opportunities for improvements at each journal stage
- may include guiding principles

Complexity: 1 possible path during 1 scenario or cross platform experiences or experiences occurring at different time sessions/scenarios

User Flow

hybrid between traditional flow charts with some visual interfaces included in them. focus on a task to be accomplished by the user and eventual alternative paths

- validate whether the solution's processes are complete
- maybe not linear: contain decision nodes, paths, modes, loops
- main focus on flow through the solution

TASK ANALYSIS & MODELING WORK MODELS

Task analysis: identify the relevant tasks
results: to develop various types of abstractions (scenarios, task models, user and system models)
task modeling: purpose: to build a model which describes the relationships among the various tasks identified
(eg. a task in terms of its subtasks and their temporal relationships, possibly task trees)
user action, interface feedback, interface state

Schneiderman:

- high level task ->multiple middle level tasks->atomic actions
- frequency of use: frequent ->visible->at the top in menu hierarchy rare->deeper in menu hierarchy
- user-task matrix: exposing frequency & importance by user, indicate which tasks are primarily the responsibility of a single user group and which ones cross groups
  (design for lowest common denominator, intermediate skilled user, expert user)

WORK MODEL (graphical summaries, multiple views)

- flow model: captures communication & coordination from a single individual's perspective
- Cultural model (myths/ symbols/ rituals/ power structures/ organizational structures) Captures culture & policy that constraints how an individual's task is carried out
- sequence model: captures the detailed steps performed to accomplish a task
- physical model: captures how the physical environment supports or gets in the way of completing a task [structure of environment]
- Artifact model: captures the artifacts that are created and used in carrying out the task [physical things]
- consolidate model
- Other models
  - The Day in the Life
  - The relationship model: the imp relationships in the user's life as it relates to the target activity - cleaned up version of the model captured in the interview
  - the collaboration model: who interacted with whom to achieve what, what was shared, done or discussed
  - the identity model: different observations of sources of pride, self-esteem, value that emerged during the interview, may come up with names for coherent identity elements that are relevant to the project focus

AFFINITY DIAGRAM

- sift through large volumes of mixed data, (such as facts, ideas from brainstorms, user opinions, needs, insights and design issues)
- bundle & group information into common themes to identify key issues from the collected data
- bottom-up
  - timeline
    (1. 30-60mins: sort notes into top-level categories 2. 30-60mins: sort each of those categories into subcategories 3. 20-40mins: summarize those categories 4.10-20mins: determine priorities
- when: during information interpretation session with users/ Define phase
- hierarchy: individual note-> group (blue)-> second group (pink)-> area of concern (green)
- don't write labels in third person, too abstract, jargon, pre-defined categories, force a label on a group, bury distinctions that are potentially important to the design, worry about putting affinity note in the right place, find a keyword in the note & assume it belong in that category, take a lot of time in the initial step of getting all note up

Persona [primary research (contextual interview) + empathy + realistic +singular (has little in common with other personas) + objectives (product-relevant high-level goals) + number + applicable (practical tool to make design decisions)]

- elements: name, age, gender, image, tag line (what the persona does/ considers relevant in his life), experience, skills, context in which interact with product (voluntariness of use, frequency of use, preferred device), goals, concerns, brief scenario (indicate attitudes), alternative products
- benefits: concreteness, personal engagement, helps us create scenarios, ideal for sharing visualization of design target, persona increases shared team understanding (help designers determine what functionalities the system need to include meet users' needs, and for design of prototype & interface, with the support of scenarios, help designers focus on user needs and achieve a design that suits the users; personas are also used in evaluation, when designing tasks personas play the role in designing them similar to that in scenario design. Recruiting participants for usability studies can also be made easier with personas. Consider personas as templates for prospective recruits, common traits across several personas or a persona's distinct characteristics might be useful screening criteria for some if not all of study participants)

Scenario

- elements: actor, setting, goals, actions (events)
- structure: the beginning presents the actor & what the persona wants to achieve
  - the middle: what the persona does, eg. the navigation & information offered. persona's motivation for pushing the goal
  - the end: whether succeeds in intentions
  - producing a scenario can take place in a shared setting and as an act of communication
- benefits:
  - scenarios are specific and use a language that is easily understood and accessible for both users and designers
  - the scenario enables a design process focused on use and explains vividly why an interaction is necessary
  - enables an understanding of the experiences that most likely results in a successful accomplishment of the user's goals and it offers a task-oriented decomposition
- downsides:
  - create obsession with details and bias people away from the big picture
  - create a false sense of assurance that all aspects are covered by a small number of scenarios
  - the scenario design tradition lacks evidence of how data is gathered and on which basis the scenarios are formed

Storyboard: A sequence of sketches that capture a scenario, each sketch shows a moment of time/a single scene

Prototyping

why?

1. getting user feedback early in the design process
2. minimize miscommunication between designers
3. selling an idea internally
4. uncovers problematic design choices before they are committed to code
5. gauging technical feasibility
6. generally results in a better interaction design

Advantages:

1. fast, cheap, easy, collaborative, anywhere
2. not bound by HW, SW limitations

Disadvantages:

1. hard for geographically distributed teams
2. requires imagination

Eg. 1. wireframe (visual representation of an intended layout, content, page-level design, few static pages, good for evaluating content placement, not good useful in communicating heavily dynamic process), wire flows can illustrate interactions/navigation, document the process of a user working through a common task on the product. At each step in the flow, a simple wireframe or high fid screen mp shows the screen available to users. ArrowL: indicate specific UI component where the user takes action and points to another wireframe image of what happens as a result of that interaction. The second node can in the same page, such as content change, feedback. Wireflow a good tool to collaborate within team. members ideate and write down task flows, the group then discusses options, and the UX person sketches each step in a wire flow style to visualize potential options.
2. composition (static prototypes with focus on graphic design, including colors, fonts, layouts, media; good for getting client's feedback on anesthetic choices
3. Wizard of OZ (OZ paradigm): human wizard simulates system response, interprets user input according to an algorithm, controls computer to simulate appropriate output, uses real or mock interface.

- demo prototypes (a wide range of functions but little detail) -horizontal vs functional prototype (few functions implemented deeply) -vertical
- parallel prototyping leads to better design results than serial prototyping owing to more divergence and increased self efficacy
- low-fidelity prototyping while defining a solution for: testing different ideas and concepts easily and easy; making changes to design or shift design

directions quickly; establishing manageable client's expectations and minimizing distractions

INTERACTION DESIGN PRINCIPLES

Norman's Action model

Norman's seven stages of action

1. forming the goal, forming the intention
2. specifying the action
3. executing the action
4. perceiving the system state
5. interpreting the system state
6. evaluating the system state

Gulf of execution: the distance from the user to the physical system, mismatch between the user's intentions and allowable actions
intentions -> action specification -> interface mechanism

Gulf of evaluation: the distance from the physical system to the user, mismatch between the system's representation and the user's expectations
interface display -> interpretation -> evaluation

Bridging the gulfs can reduce cognitive effort required to perform tasks.

Shneiderman's Golden Rules

1. strive for consistency
2. cater to universal usability
3. offer informative feedback
4. design dialogs to yield closure
5. prevent errors
6. permit easy reversal of actions
7. keep users in control
8. reduce short-term memory load

- Consistency (consistent terminology of prompts, menus, commands, help messages, consistent color, layout, capitalization, fonts)
- Familiarity (familiar language & symbols, metaphor for conceptual understanding)
- take advantages of conventions
- Affordance (attribute of an object that allows an individual to perform an action, physical properties of the object provides visual cues to its function)
- Visibility (hide non-essential functions until needed)
- Feedback (the state of the system should be clearly visible to the user - in an unambiguous form, modest for frequent and minor actions, substantial for infrequent and major actions)
- Constraints (limit actions or choices to reduce errors. restrict inputs. focus on available functions
- Recovery (relieve user's anxiety; enhance user efficiency)
- design dialogue to yield closure (sequences of actions should be organized into groups with a clear indication of beginning, end & grouping of sequences of actions, informative feedback at the completion group of actions
- create a clear visual hierarchy (important is larger, bolder)
- break pages up into clearly defined areas
- make it obvious what is clickable
- reduce cognitive load (Krug's second law of usability: It doesn't matter how many times I have to click, as long as each click is mindless, unambiguous choice, avoid confusing drop down menus, non-intuitive naming/buttons/links not underlined or not distinguishable)
- go on the content diet (busyness, background noise)
- use photos to convey messages, guide the user where to look at, evoke desired emotional response
- gestures, fat finger rule

EVALUATION

circle: ongoing development-> problem analysis-> conceptual design & planning->development->formative evaluation->summative evaluation->ongoing dev
process of systematically collecting data that informs us about what it is like for a particular user or group of users to use a product for a particular task in a certain type of environment.

- types:
  - controlled settings involving users: usability testing & experiments
  - natural settings involving users: field studies
  - any setting not involving users: inspections, heuristics, walkthroughs, models and analytics

Nielsen's Heuristics

H1 Visibility of System status
Appropriate feedback within reasonable time
eg. progress bar, plainly labeled and numbered multi-step checkout process

H2 Match between System and Real World
Information follows real-world vocabulary
eg. icons relevant to culture

H3 User Control and freedom
undo/redo, clear exit than an extended dialog

H4 Consistency and standards
eg. the match between main menu and its content's tile, sequences actions, color, layout, position, font, capitalization, terminology, langu

H5 Error prevention
eliminate error-prone conditions, confirmation before commit (eg. autofill, add-to cart confirm)

H6 Recognition rather than recall
objects, options to be visible
eg. menu rather than command, default values, externalize visualization, generic actions (drag objects), date format

H7 Flexibility and efficiency of use
allow users to tailor frequent actions
(shortcuts, type-ahead, bookmarks, hot link, history, advanced settings, one-click buy)

H8 Anesthetic and minimalist design
relevant and needed information to be designed
eg. focus mode, google search

H9 Help users recognize, diagnose, recover from errors
error messages to be simple, indicate problem, suggest a solution, actions reversible

H10 Help and documentation
easy to search, related to user's tasks, concrete steps (context-sensitive, ordered, organized

Expert Evaluation
severity indicator: (when averaged across evaluators, designers have a ranked list of problems to address)
4. usability catastrophe - imperative to fix before product release
3. Major usability problem: imp to fix, high prior
2. Minor usability problem
1Cosmetic problem only: no need unless time
Pros: experts will typically have knowledge of application domain &/ UI guidelines, there're fewer ethical & practical issues to consider
Cons: Sometimes difficult&expensive to find certified experts, have bias due to preconceptions

Usability Testing

- user reports experience with the task, motivation, aware, informed, ability to interact with interface
- (what, how, where, data, nature, finding, think-aloud,/prompts) objective/ participant characteristics/ method/ task list/ environment&equipment, facilitator role, data collected & evaluation measures, report/pre (expenses claim form)
- Usability metrics: 1.successful task completion; % of tasks that participant complete correctly 2.critical euros: errors that block the user from completing a task successfully 3.non-critical errors: errors that recovered by the participant and doesn't affect their ability to successfully complete a task 4.error-free rate: % of participants who complete a task successfully without any errors 5. time on task:? the amount of time it takes participants to complete a task successfully 6. task level satisfaction: flag a difficult task, evaluate how the participant felt about the overall experience
- types of tasks: 1. important / frequently performed 2. evaluators predict users will have difficulties 3.enable a more through examination of the system 4. examine the re-designed areas 5. relate to newly-added features
- task design: 1. actionable 2. avoid cues 3. description unambiguous 4. appropriate level of details 5. independent task or figure out task dependencies
- think aloud (concurrent: unnatural, hard to talk if concentrated on task, retrospective: : verbalizing at a higher level, more relaxed)
- eye-tracking (visual attention of individuals when performing specific tasks captured in terms of fixation & saccades, gaze plot: show s &f, heat map: amount of/ length of fixation)
- A/B testing (test diff product alternatives, a direct test with the market, almost everuhings affects user behavior can be A/B tested, eg. website analytics, observe user behavior, construct a hypothesis aimed at making conversions, A/B test the hypothesis, analyze test data & draw conclusions (which variations derived the highest satisfaction

Controlled experiments
Experiment condition: a setup that one subject should undergo to measure the dependent v
order effect: learning, fatigue, sequence effects
Counterbalancing: full, Latin Square
6 participants/ experiment condition

Cognition: 1) Experiential/fast thinking: state of mind in which we perceive, act and react to an event around us intuitively and effortlessly 2) Reflective/slow thinking: involves mental effort, attention, judgement, and decision making

Design implications for Attention:
1. make information salient when it needs attending to, humans better at detecting movement in peripheral vision. Eg. bouncing icons, flashing indicator lights
2. use techniques that make things stand out like color, ordering, spacing, underlying, sequencing and animation.
3. Avoid cluttering the interface with too much information
4. search engines and form fill-ins that have simple and clean interfaces are easier to use.

Perception: how information is acquired from the world and transformed into experiences
1. icons, sounds, speech, tactile feedback, text distinguishable
2. Bordering & spacing are effective visual ways of grouping information.Grouping using a border is better than color contrast

Memory: encoding (filtering, processing) and retrieving information (influenced by context)
people good at remembering visual cues but bad at arbitrary materials
1. don't overload users' memories with complicated procedures for carrying out tasks,
2. design interfaces that promote recognition rather than recall
3. provide users with various ways of encoding information to help them remember (categories, color flagging, time stamping
4. provide external representations at the interface that reduce memory load and facilitate computational offloading (information visualizations)

Learning
1. Design interfaces that encourage exploration
2. design interfaces that constrain and guide learners
3. dynamically linking concepts and representations can facilitate the learning of complex materials

Mental models: users develop an understanding of a system through learning about and using it. Depend on incomplete facts, past experiences and are constantly evolving. what users know/ believe about a system. A mental model is internal to each user's brain and different users might construct diff mental models of the same interface. People make mistakes when interacting with a product often because their mental model is different to the designer's mental model. designers know too much, form wonderful model of their own creations, leading them to believe that each feature is easy to understand. Users' mental models of the UI are likely to be somewhat more deficient, making it more likely to make mistakes and find the design difficult to use. Mental models differ between countries and cultures. If designers understand users' mental models, he can stimulate these models within his designs to make them more usable and intuitive. Designers can tap into users' mental models so that their products communicate their functions through their form. Mental models provide the designer with a shortcut when developing UI for user. User can focus on their task rather than complex learning of new models.

interaction cost calculation: time user takes in reading/scrolling/ looking around to find relevant information/ comprehending information presented/clicking or touching (without making mistakes)/typing a command, page loads and waiting time, attention switches/ memory load(the information that users must remember to complete their task), additional costs (the time takes in setting and formulating a goal or intention or retrieving information from his memory)

whether low or high fidelity: budget (time money), project phase (require detailed communication of a mature design?exploratory phase: identifying business requirements, testing tithe scope, divergent ideas-quick nature of low mockups, allow more design iterations, generative phase: details on a design idea/evaluating full implementation of an interaction, mock-ups are communication device form intent for the application, greater fidelity of interactive mock-ups provides a more informative mechanism), UI interaction complexity: design need to be shown rather than described? static mock-ups show when interaction begins or ends, but must describe what happens in between. Standard interactions like simple links, buttons, menus easily described. but animation, gestures, non-standard behavior cannot. high mp make such behavior explicit, removing guesswork by viewers. UI workflow complexity: with many navigation choices: confusing. The design affordances provided to help users maintain sense of place within the workflow may best be demonstrated through and interactive mockup. Responsive design: need respond fluidly to changing form factors? UI transitions between screen sizes imp to design> interactive mp to show these transitions. Audience sophistication: audience have difficulty understanding the design? what final application and its relationship to the intended environment->high People can get distracted by details. Communicate broad ideas such as navigational model, page layouts, task flow,)
Indicators: icons, specific colors/font/pop-up, sound, highlight
data analysis: at the end of user study: affinity diagram, work models, task hierarchy development, statistical techniques; at the end of every user evaluation; severity indicator analysis, think aloud verbalization coding & analysis, user feedback analysis
data collected for task-based think-aloud: qualitative: verbalizations, audio recordings, observations: notes, video recording; quantitative: measures such as time to complete task, errors made while carrying out the task
sandwich robot: inclusion/exclusion criteria, numbers targeted, mode of conducting, what to carry, how many evaluators, what measured)Gestalt PrinciplesFigure-Ground Principle, Similarity,Proximity, common region, Continuity, Closure: when we look at a complex arrangement of visual elements, we tend to look for a single, recognizable pattern, focal point
Other principles:
color difference, color contrast, size, scale, emphasis, hierarchy, symmetry
To ensure Unity & Harmony proximity, similarity, repetition, rhythm