INFO3315 Human-Computer Interaction

Lecture 6 – Design and Prototyping – Part I

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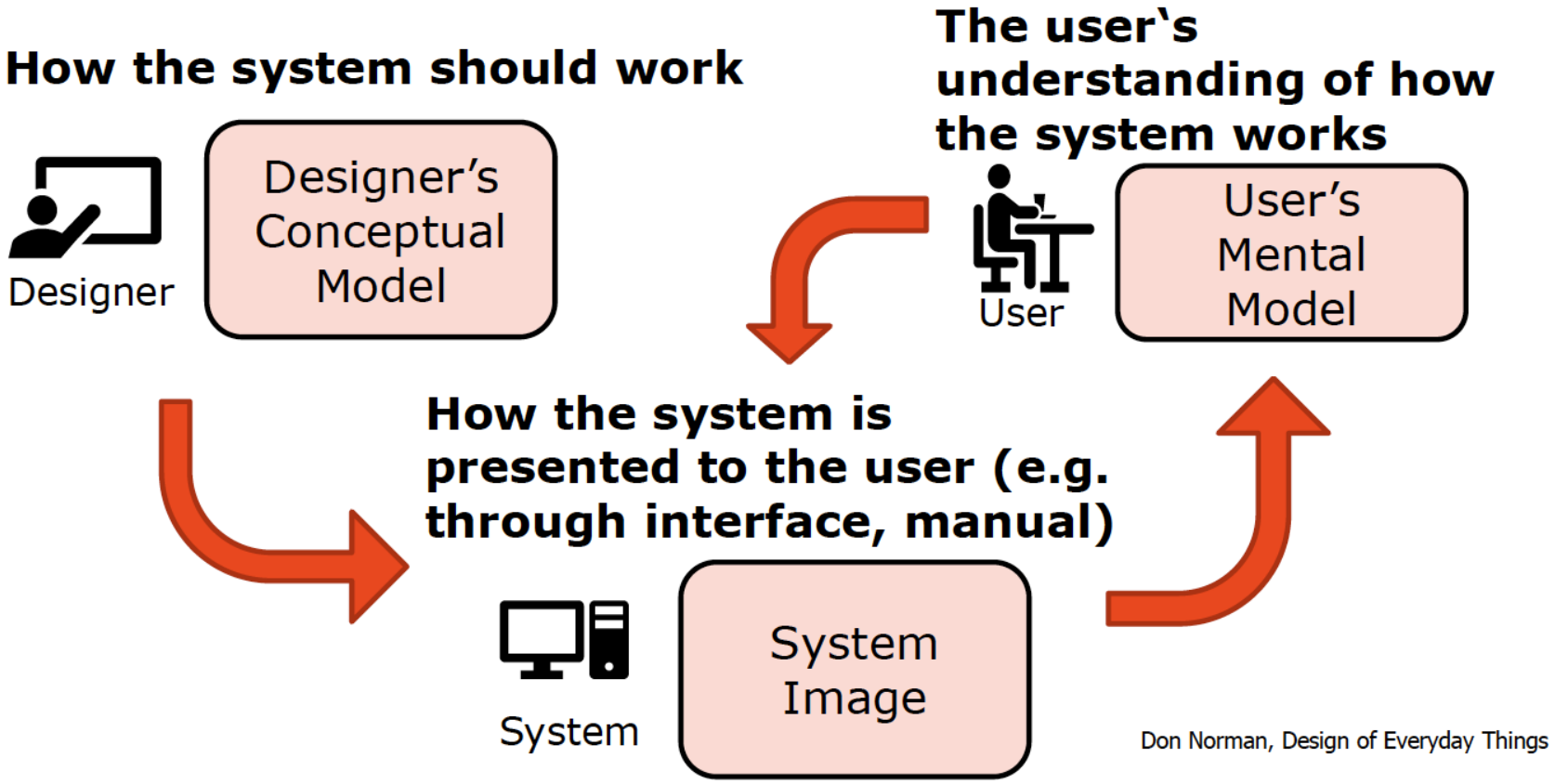
Recap

- Surveys
- Interviews
- Focus groups
- Observations
- Contextual inquiry
- Ethnography
- Studying documentation
- Personas
- Scenarios

From problem space to design

- Having a good understanding of the problem space can help inform the design space
  - For example, what kind of interface, behaviour, functionality to provide
- Before deciding upon these, it is important to develop a conceptual model

Mental model



Conceptual model

- A conceptual model is:
  - "…a high-level description of how a system is organized and operates" (Johnson and Henderson, 2002, p26)
- A conceptual model enables:
  - "…designers to straighten out their thinking before they start laying out their widgets"(Johnson and Henderson, 2002, p28)

Formulating conceptual model

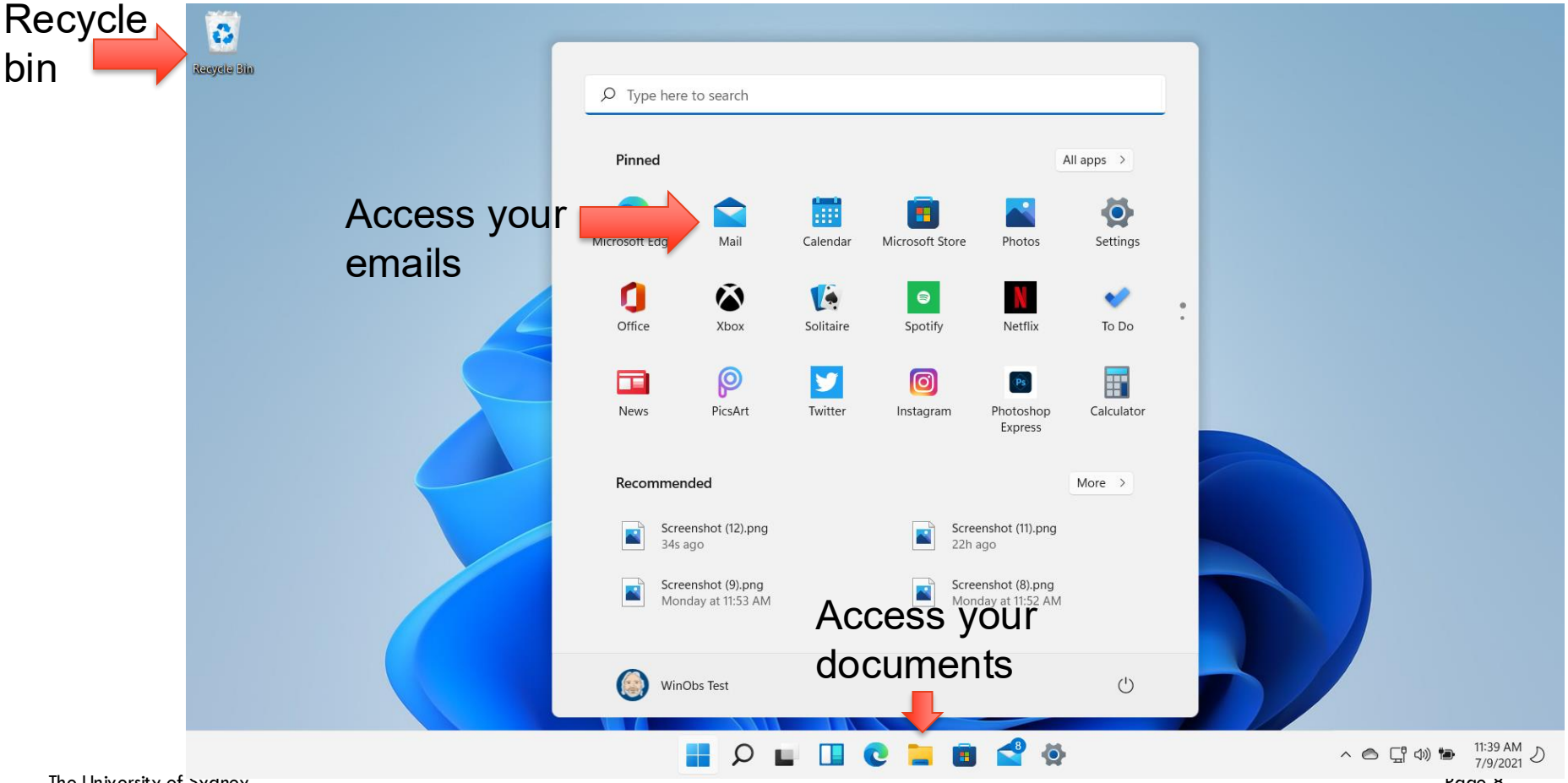
- What will the users be doing when carrying out their tasks?
- How will the system support these tasks?
  - What kind of **interface metaphor**, if any, will be appropriate to help users understand the interface?
  - Which **interaction types** would best support the users' activities?
  - Do different **interface types** suggest alternative design insights or options?

Interface metaphors

- Interface is designed to be similar to a physical entity but also has own properties
  - For example, desktop metaphor, and web portals
- Can be based on activity, object, or a combination of both
- Exploit user's familiar knowledge, helping them to understand 'the unfamiliar'

Interface metaphors

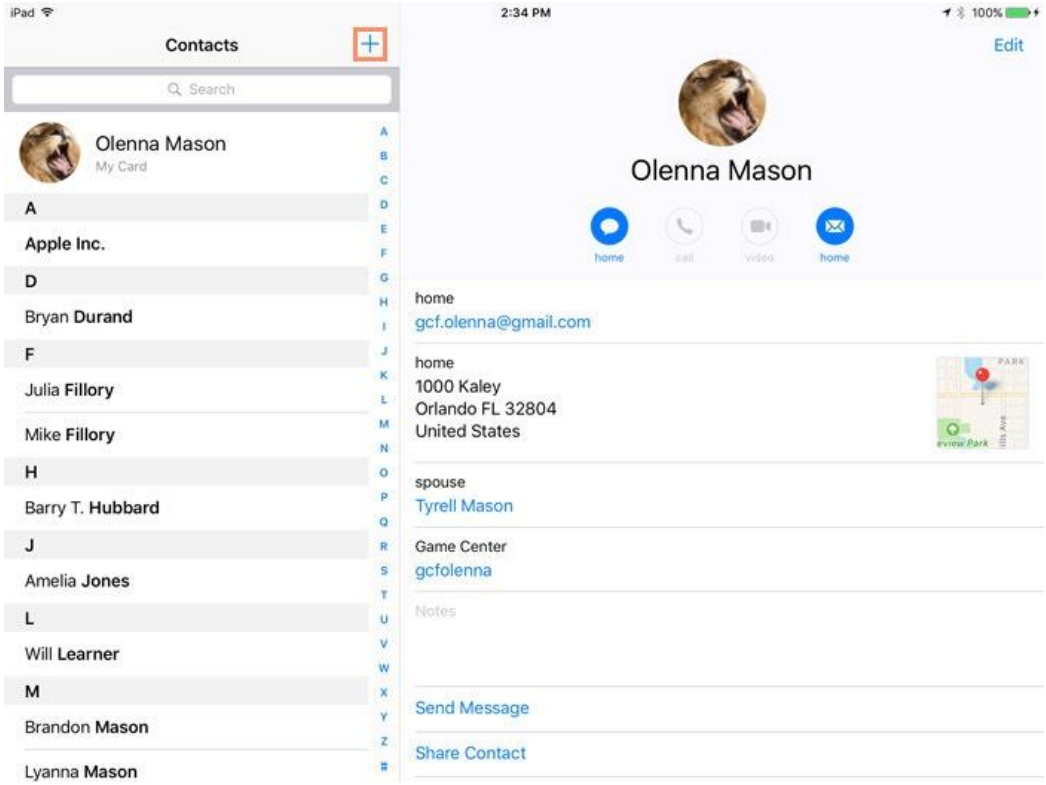
- Modern desktop interfaces use a real desktop/office space as a metaphor



https://www.itprotoday.com/windows-and-user-productivity/windows-11-interface-and-visual-changes-enterprise-users

Interface metaphor – contacts book





https://en.wikipedia.org/wiki/Telephone_directory#/media/File:Telefonbog_ubt-1.JPG
https://edu.gcfglobal.org/en/ipadbasics/contacts/1/

Interface metaphors

- Conceptualising what users are doing
  - Example: browsing the Internet
- A conceptual model instantiated at the interface
  - Example: the desktop metaphor
- Visualising an operation
  - Example: an icon of a shopping cart into which the user places items

Choosing an interface metaphor

1. Understand functionality
    - What is the purpose of the system?
    - What should the system do?
2. Identify potential problem areas
    - Which of the product that will be problematic to users?
    - Why do users have difficulty with these areas?
3. Generate metaphors
    - Analyse users' description of relevant activities
4. Evaluate suitability of metaphor

Evaluate metaphors

- How much structure does it provide?
- How much is relevant to the problem?
- Is it easy to represent?
- Will the audience understand it?
- How extensible is it?

Interface metaphors – Advantages

- Makes it easy to learn new systems
- Helps to better understand the conceptual model
- Supports a diverse set of users
- Strengthens innovation



Interface metaphors – Disadvantages

- Constrains the conceptual design to metaphors
  - e.g., No search function in real books, what about e-books?
- Limit the user to understand the system in terms of metaphors
- Poor designs can be used as the metaphor
- Relying on metaphors might interfere coming up with new conceptual models
- Sometimes may break conventional and cultural rules
  - e.g., recycle bin placed on the desktop



Interaction types

- Ways a person interacts with a product or application.
- Five main types:
  - Instructing
  - Conversing
  - Manipulating
  - Exploring
  - Responding

Instructing

- Tell system what to do.
- Examples:
  - Typing in commands
  - Selecting Menus
  - Speaking commands
  - Gesturing
  - Pressing buttons
  - Combination of function keys



Credit: https://youtu.be/xuMqD4Mulvg



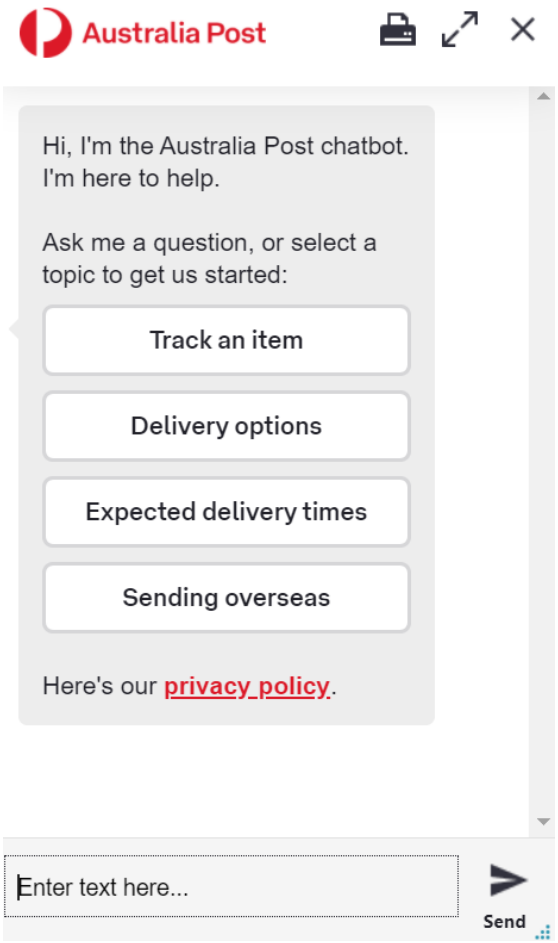
Conversing

- Users have a dialog with a system
- Similar to how we talk to each other
- System acts as the partner
- Simple menu-based dialogues to complex voice recognition
- Audio or text-based dialogues
  - Apple – Siri, Amazon – Alexa
- Virtual Agents



https://i.pinimg.com/originals/74/5b/da/745bdab2d5542e6a35624b8de6d9cc35.jpg

Conversing – Examples





"If you'd like to press 1, press 3.
If you'd like to press 3, press 8.
If you'd like to press 8, press 5..."

Source: © Glasbergen. Reproduced with permission of Glasbergen Cartoon Service

Manipulating

- Rely on manipulating objects
  - Moving, selecting, dragging, opening, and closing digital elements
  - With extensions to zooming in and out, stretching, and shrinking
- Based on users experience with real objects (affordances)
- Early guidance for graphical user interfaces (GUI) was *direct manipulation* (DM) introduced by Ben Shneiderman.

Direct manipulation – Core principles



- Continuous representation of the objects and actions of interest



- Rapid reversible incremental actions with immediate feedback about the object of interest



- Physical actions and button pressing instead of issuing commands with complex syntax

Manipulating – Examples



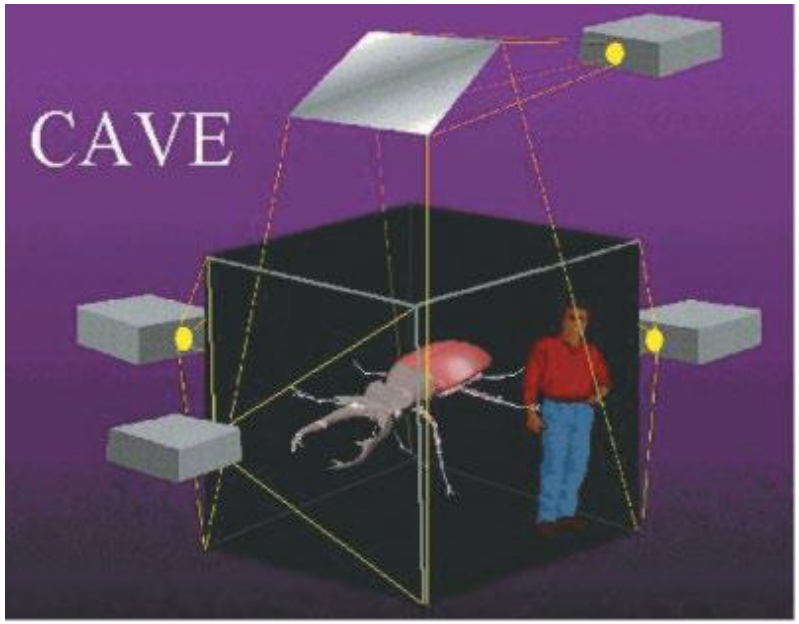
http://4.bp.blogspot.com/_tDehER7Tf30/S-13CC-smXI/AAAAAAAAAm4/1r6hfhljuOo/s1600/press_rgb_touch-water+LR2.jpg

More examples

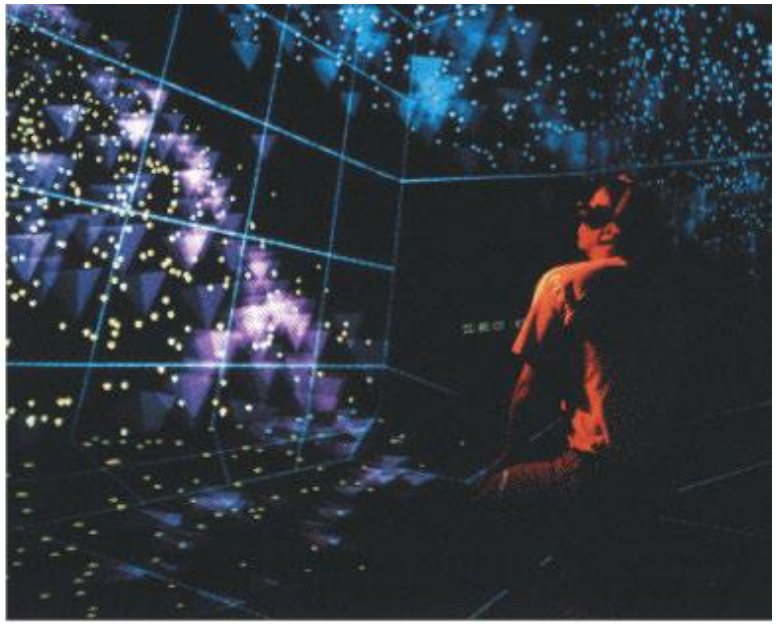
- Bowling on Wii
  - https://youtu.be/tFrZpOag0Yk
- Tangible Media
  - https://youtu.be/IvtfD_rJ2hE

Exploring

- Involves users moving through virtual or physical environments
- Similar to how we explore physical spaces
- Now even more popular with VR – Immersive and entertaining



(a)

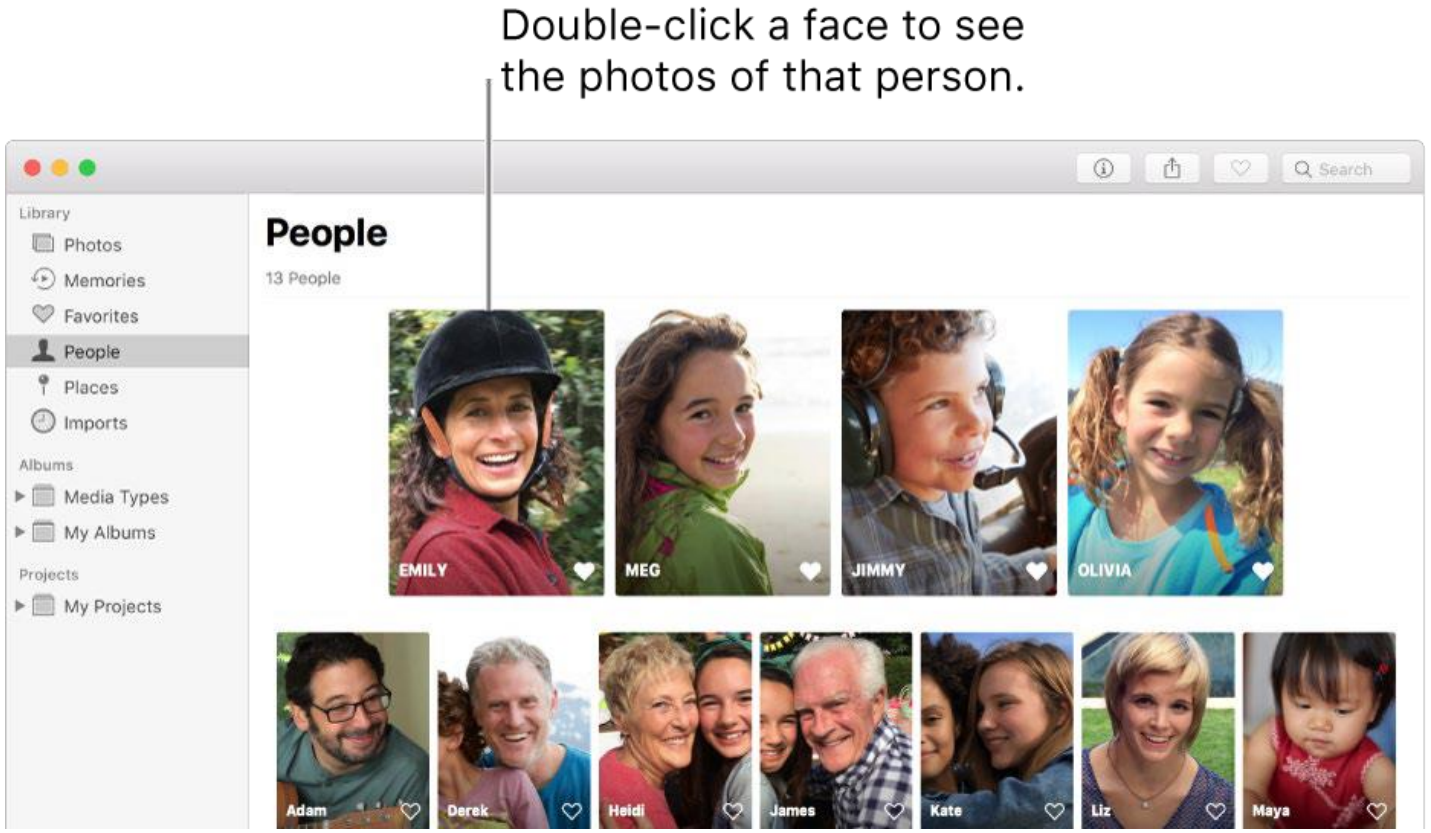


(b)

Preece et. al., Interaction Design, 5th Edition.

Responding

- The system takes the initiative to alert, describe, or show the user something of interest
- Relevance to the time or context

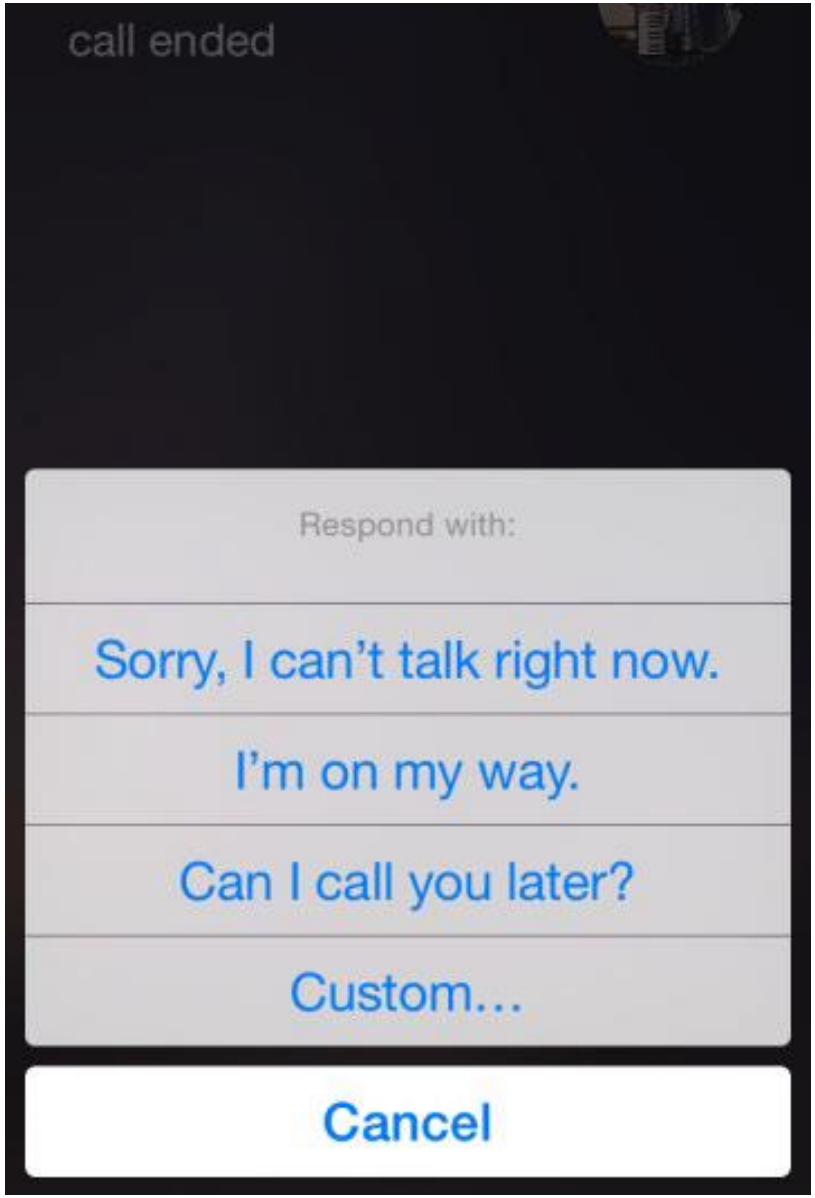


https://help.apple.com

Responding



Netflix



Phone app on iOS

Interaction types

- Instructing
  - For repetitive tasks: Managing files, writing.
- Conversing
  - Good for interactive phone services, users with disabilities, special use cases such as children or elderly
- Manipulating
  - Many applications
- Exploring
  - Immersive environments, VR, AR, Tele-existence
- Responding
  - Contextual applications, suggestions, recommendations

Choosing an interaction type

- Depends on the application domain and product being developed.
- Different parts of the interaction will be associated with different interaction types.

Interface types

- Many different types of input and output methods available.
- Interface type is **NOT** the same as interaction type.
  - Interaction type – what the user is doing when interacting with the system
  - Interface type – interface used by the user to support the interaction e.g. command, menu-based, gesture, voice etc.
- Many different interface types.

Choosing interface types

- Choose the most appropriate or a combination.
- Can be influenced by product constraints that arises from requirements.
  - Input and output technology influenced by user and environment requirements.
  - Example: Noisy factory setting with workers wearing gloves.
- Opportunity for innovation

Expand initial conceptual model

- What functions will the product perform?
  - What will the product do and what will the human do?
- How are the functions related to each other?
  - Sequential or parallel?
  - Categorisations: all actions related to privacy on a smartphone
- What information is needed?
  - What data is needed to perform the task?
  - How is this data to be transformed by the system?

Object/Operation analysis

- A list of:
  - User-visible **object**-types in the application
    - Extract nouns from scenario or story
- **Attributes** of each object-type
- **Operations** that users can perform on each object-type
  - Extract verbs from scenario or story
- Exclude objects like buttons, menus, buffers etc.

Object/Operation analysis

- Example: Calendar App

Objects	Attributes	Operations
Calendar	owner, current focus	examine, print, create, add event, delete event
Event	name, description, date, time, duration, location, repeat, type (e.g., meeting)	examine, print, edit (attributes)
To-Do item	name, description, deadline, priority, status	view, print, edit (attributes)
Person	name, job-description, office, phone	send email, view details

- More info: https://boxesandarrows.com/conceptual-models-in-a-nutshell/

Envisionment

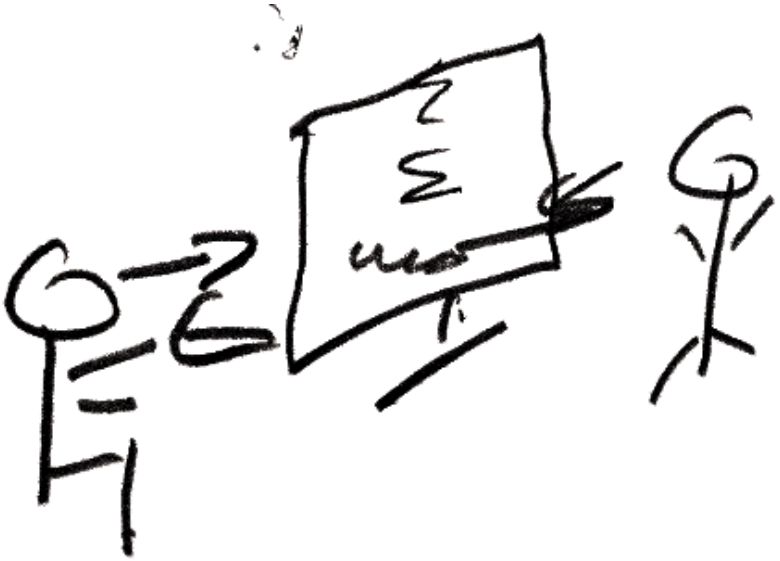
- Concerns with making ideas visible and externalising thoughts.
- Needed to represent design work to ourselves and to others.
- Occurs throughout development as the designer generates multiple design solutions and whittles them down to a final product.
- Different representations of design ideas are useful at different stages for different audience.

Example representations

- Sketches
- Storyboards
- Wireframes
- Prototypes

Sketches

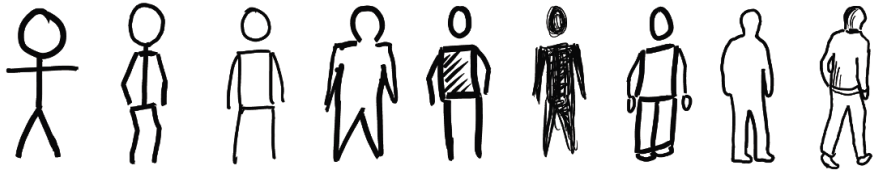
- The art of sketching is something that all designers should practice.
- Ideas and thoughts can be quickly visualised – either to yourself, or to others – and explored.
- Don't worry about artistic skills.
- Should be quick, timely, inexpensive, disposable and plentiful
  - Allow quick test of new ideas during brainstorming
  - Reduce attachment to design



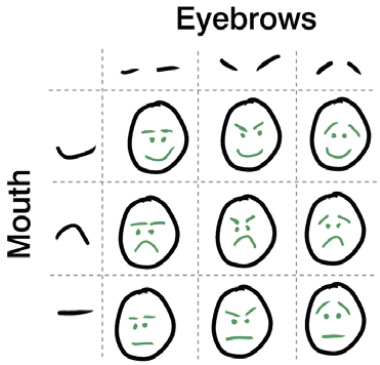
Credit: Sketching User Experiences : The Workbook by Saul Greenberg, Bill Buxton, Sheelagh Carpendale, and Nicolai Marquardt

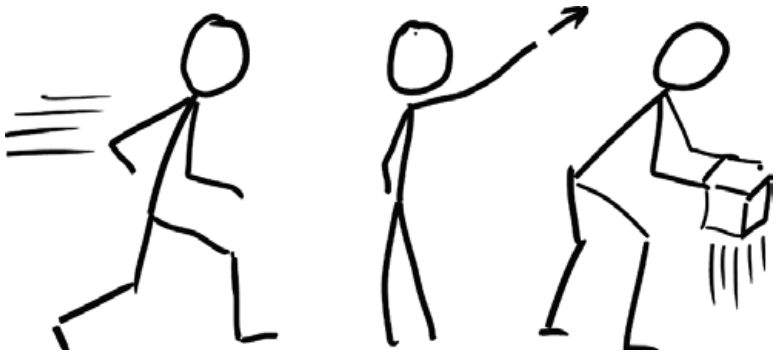
Sketching vocabulary

- Serves as the basic elements of most sketches
  - Basic elements – lines, rectangles, circles, triangles.
  - People
    - Basic people
    - Emotions
    - Activities
  - Objects
    - Digital devices
    - Documents
    - Tools
    - Physical objects









Credit: Sketching User Experiences : The Workbook by Saul Greenberg, Bill Buxton, Sheelagh Carpendale, and Nicolai Marquardt

Sketching vocabulary – Objects

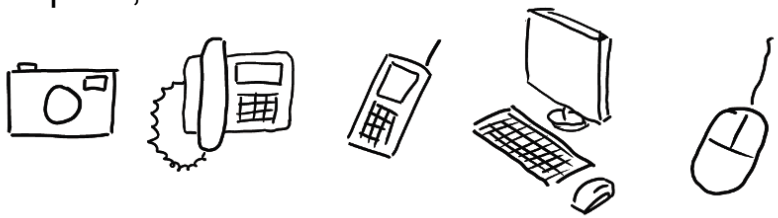
Tools: pencils, pen, magnifying glass, wrench, scissors



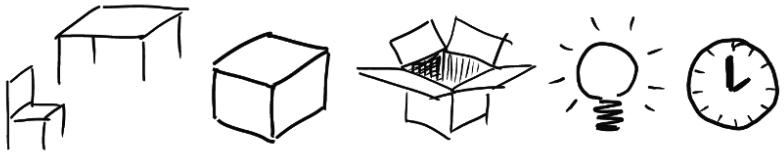
Documents: paper, books, photos, piles



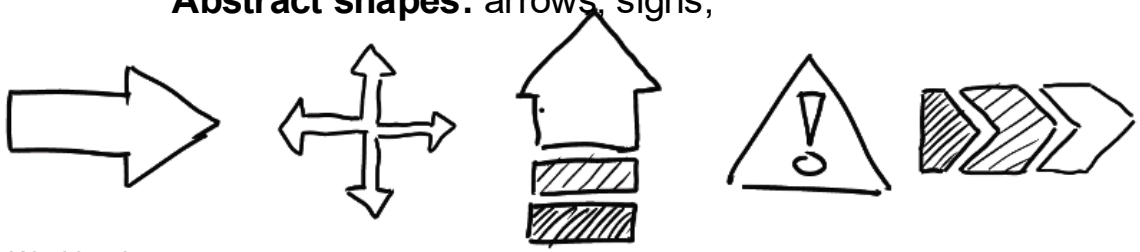
Digital devices: camera, cell phone, computer, mouse



Physical objects: tables, chair, light bulb, clock



Abstract shapes: arrows, signs,



Credit: Sketching User Experiences : The Workbook by Saul Greenberg, Bill Buxton, Sheelagh Carpendale, and Nicolai Marquardt

What to sketch?

- Depends on the purpose of presentation
- Is it to envision:
  - Context of use by users? – Storyboard
  - Users view of the interface throughout task? – Wireflow
  - A snapshot of the interface? – Wireframe

Storyboard

- Sequence of actions or events the user and the product go through to achieve goal
- Allows you to get a feel for the 'flow' of the experience
  - Snapshot of key moment in an interaction
  - User journey on how the product will be used

Storyboard example – Snapshot



Credit: Sketching User Experiences : The Workbook by Saul Greenberg, Bill Buxton, Sheelagh Carpendale, and Nicolai Marquardt

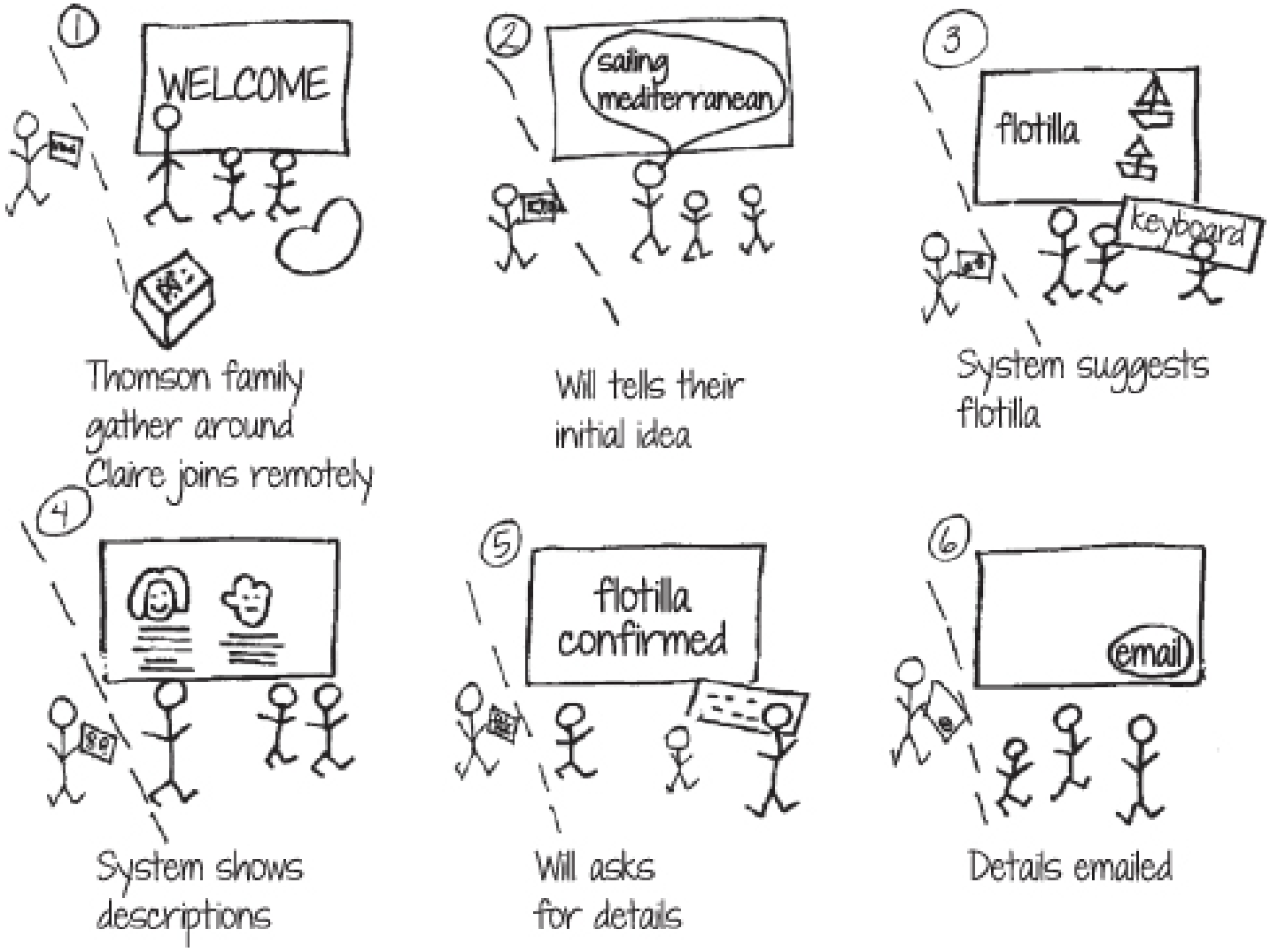
Storyboard example - User journey

- Can be generated from a scenario by:
  - Breaking the scenario into a series of steps (3-7 steps)
  - Creating one scene in the storyboard for each step
- Every sketch is labelled with 1 short description
  - Concisely describes the depicted setting
- The context of the interaction is visible
  - i.e. user and the machine part of the activity
- Correct level of details in the sketches
  - Relevant aspects visible but not everything sketched in detail

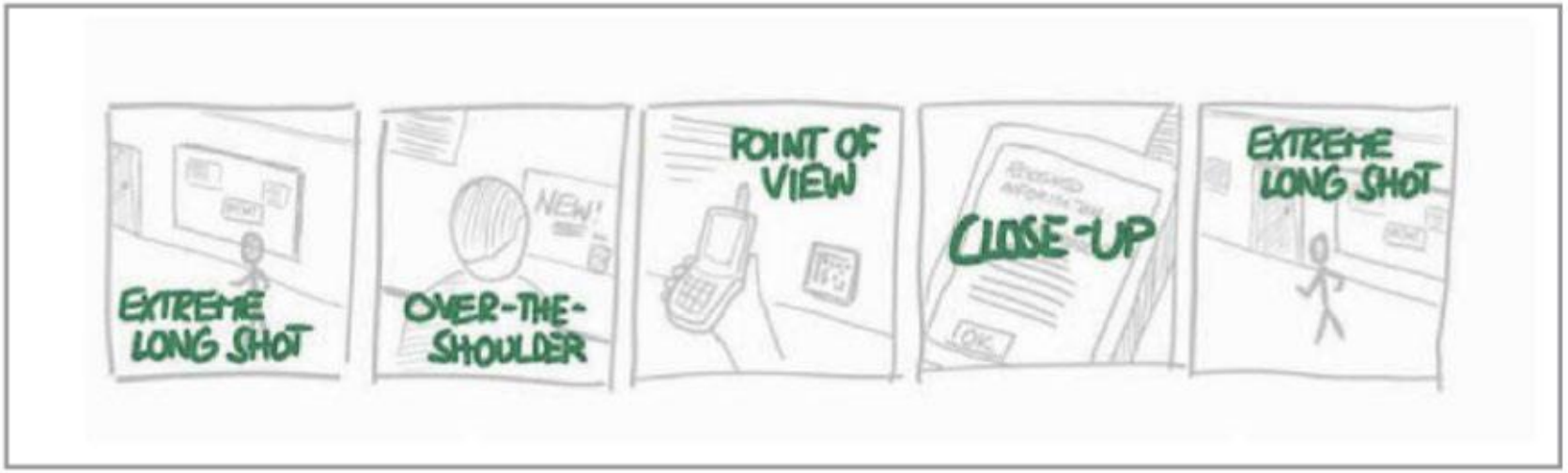
Example – Travel organiser

- Will, Sky, and Eamonn gather around the organiser, but Claire is at her mother's house.
- Will tells the organiser their initial idea of a sailing trip in the Mediterranean.
- The system's initial suggestion is that they consider a flotilla trip, but Sky and Eamonn aren't happy.
- The travel organiser shows them some descriptions written by young people about flotilla trips.
- Will confirms this recommendation and asks for details.
- The travel organiser emails details of the different options.

Example – Travel organiser



Storyboard example – User journey



Based on: Sketching User Experiences : The Workbook by Saul Greenberg, Bill Buxton, Sheelagh Carpendale, and Nicolai Marquardt

Wireframes

- View of a single screen or interaction page
- Outlines structure and layout of the page
- Help to plan the layout and interaction patterns
- Different level of details
  - Lo-fi: No graphical design elements e.g. images, colours, typography

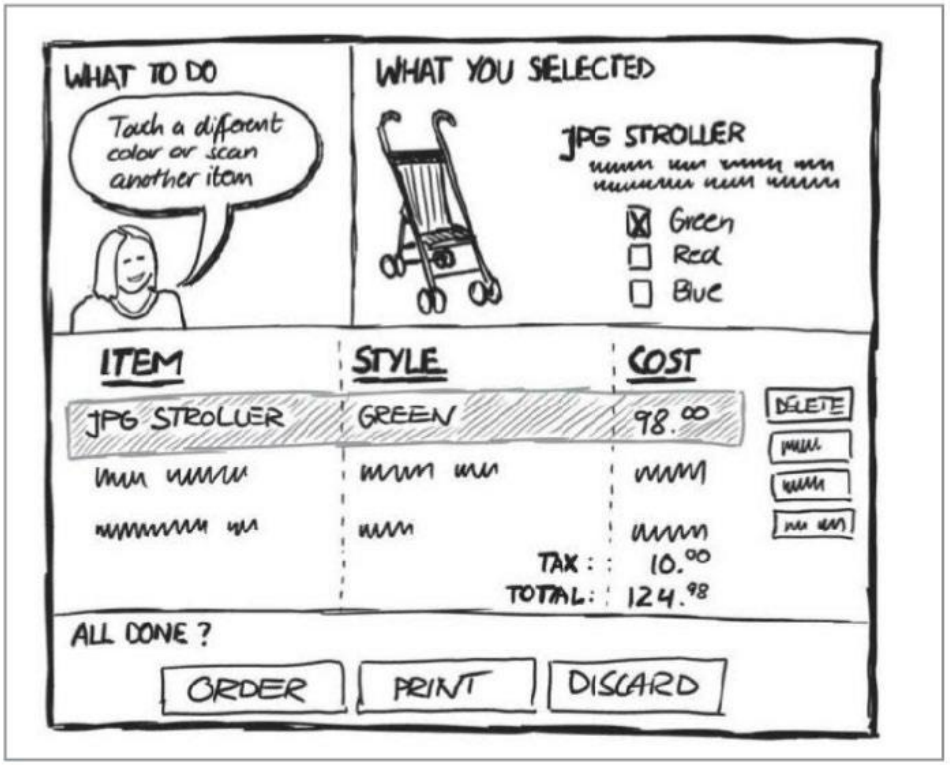


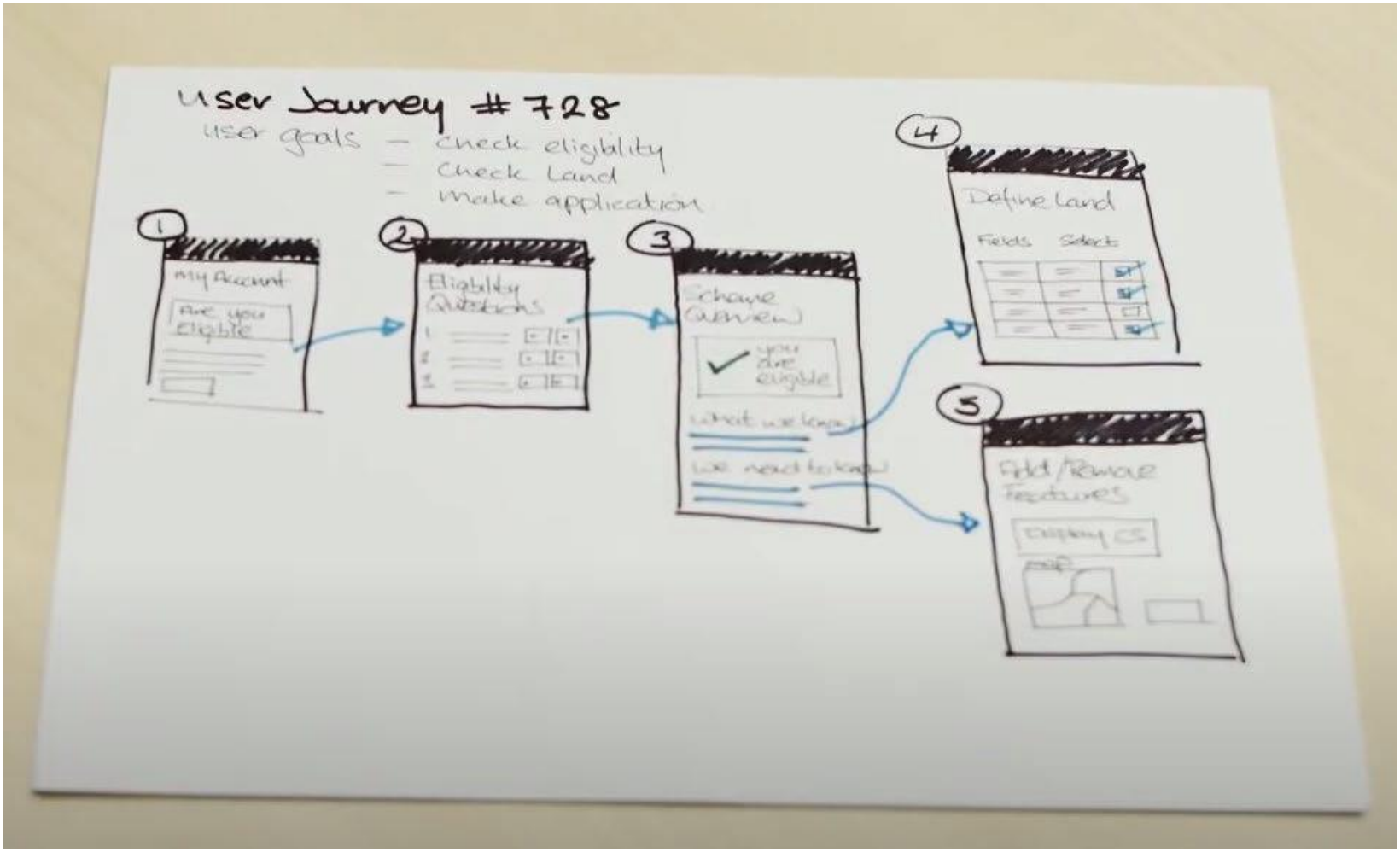
Figure 8.1 A sketch for the interface to an interactive shopping service

Source: Benyon(2019) - Chapter 8.2, Pg. 185

Wireflow

- Series of wireframes to show pages, logic and actions required to complete the goal
- Document flow of design in the context of common user tasks
- Combination of wireframes and flowchart.
- Hand-drawn or with tool

Example – Wireflow



Source: https://youtu.be/LskLyDOSfAc

Example – Wireflow

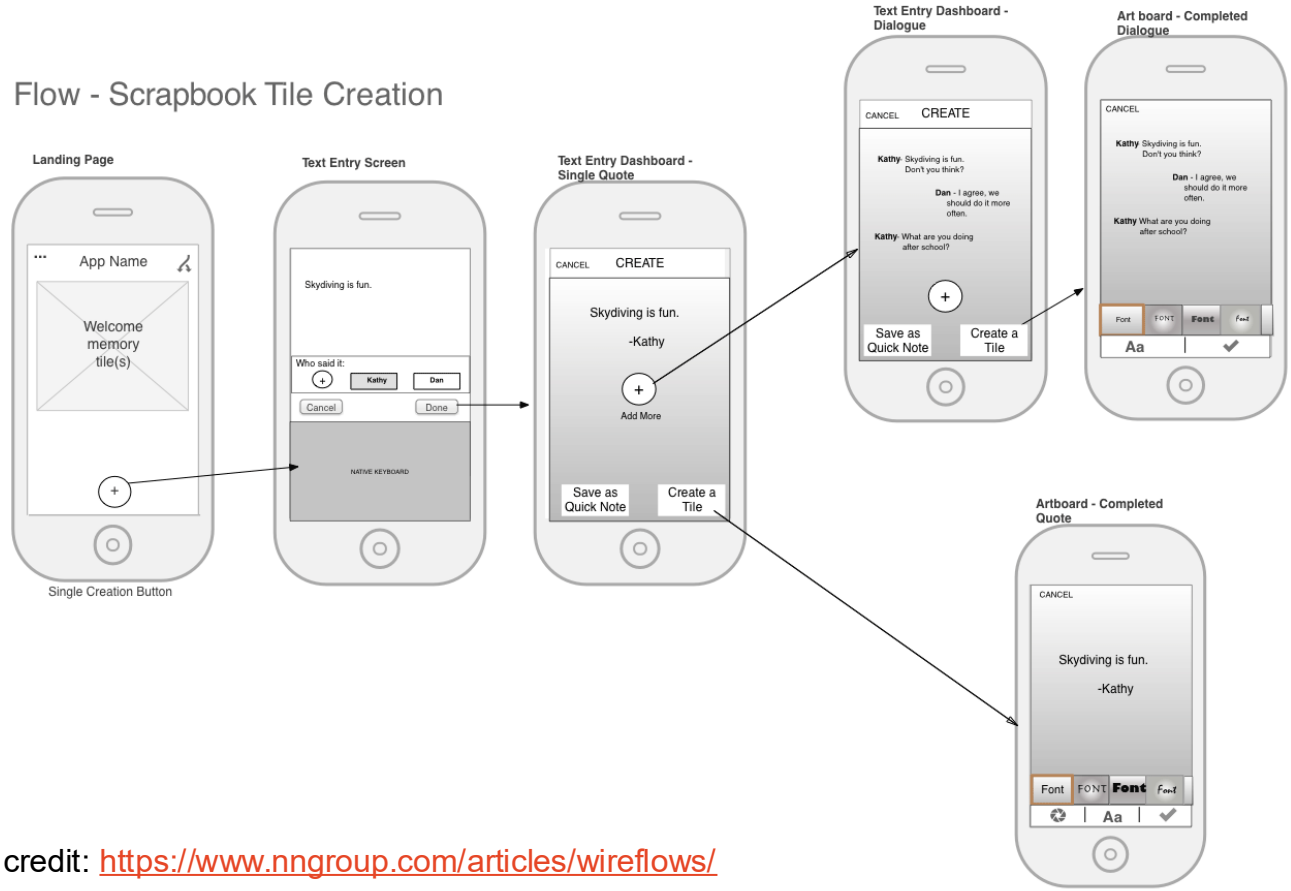


Image credit: https://www.nngroup.com/articles/wireflows/

Week 6 In-Class Quiz

- 4 questions
- 5 mins

Prototypes

- One manifestation of a design that allows stakeholders to interact with it
- In other design fields, a prototype is a small-scale model:
  - A miniature car
  - A miniature building or town
- May be made of something as simple as paper, cardboard or other suitable material, or it may be developed using a sophisticated software package.
- Two types:
  - Low fidelity (lo-fi)
  - High fidelity (hi-fi)

Prototypes

- **Lo-fi**
- Capture early design thinking and should aid brainstorming process
- Quick and easy to produce (no commitment)
- Examples:
  - Sketches of screens
  - Index cards/post-its
  - Wizard of Oz

- **Hi-fi**
- Similar in look and feel with anticipated final product
- Detailed evaluation of the main design elements (content, visuals, interactivity, functionality and media)
- Example:
  - Hi-fi prototyping tool
  - GUI Builder

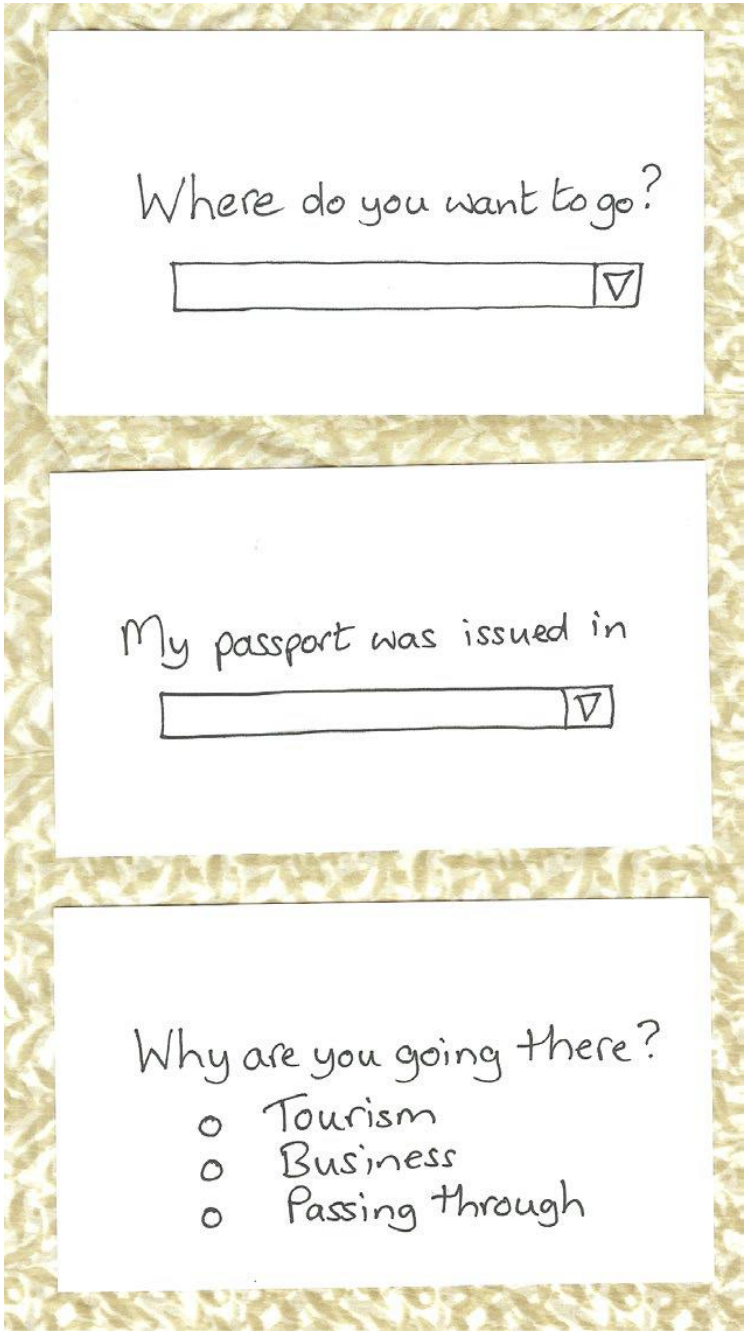
Prototypes

Type	Advantages	Disadvantages
Low-fidelity prototype	• Quick revision possible • More time can be spent on improving the design before starting development • Evaluates multiple design concepts • Useful communication device • Proof of concept	• Limited error checking • Poor detailed specification for development • Facilitator-driven • Limited usefulness for usability tests • Navigational and flow limitations
High-fidelity prototype	• (Almost) complete functionality • Fully interactive • User-driven • Clearly defines navigational scheme • Use for exploration and test • Look and feel of intended product • Serves as a "living" or evolving specification • Marketing and sales tool	• More resource-intensive to develop • Time-consuming to modify • Inefficient for proof-of-concept designs • Potential of being mistaken for the final product • Potential of setting inappropriate expectations

Source: Preece et al. Interaction design (2019) – Chapter 12.2, Pg. 431

Paper prototypes

- Index cards (3 x 5 inches)
- Sketch sheet templates
  - Empty frame that can be printed
  - https://sketchsheets.com/
- Each card represents one element of interaction
- In evaluation, can step through the cards



Advantages of paper prototypes

- Enables non-technical people to interact easily with the design team (no technology barrier for suggestions)
- Produced quickly – focus on design ideas and not details
- Flexibility – parts of the prototype adjustable so that it can be quickly 'redesigned'
- Sticky notes to represent parts of the screen where user can move elements around
- Example:
- https://www.youtube.com/watch?v=yafaGNFu8Eg&ab_channel=UXPlayground

Practical issues

- If a paper prototype is to be handled by many people, it needs to be tough enough to survive.
- Amount of details – depends on purpose of evaluation.
  - Sufficient for someone to be able to use the prototype without help

Faking interaction

- How the prototype is implemented is limited only by your imagination, by time and the materials readily at hand.
- Two approaches:
  - Wizard of Oz – simulate interaction during testing
  - Video prototype – communicate ideas

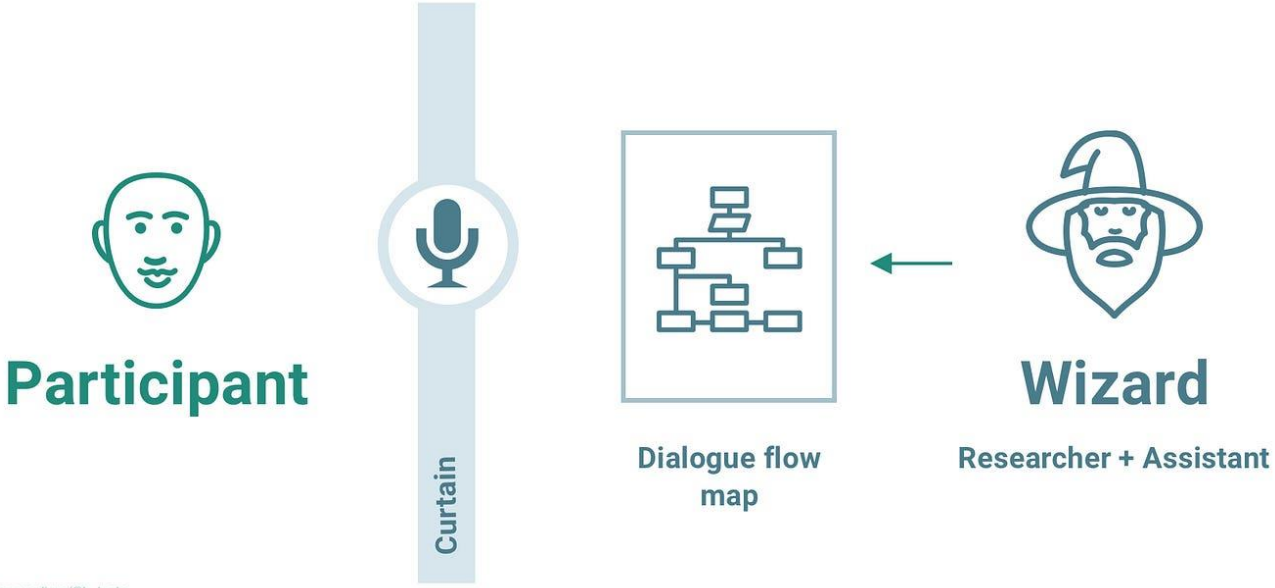


Wizard of Oz

- The user thinks they are interacting with a computer, but a human is responding to output rather than the system
- HCI research examples:
  - Voice Assistant simulation:
    - S. Jayasiriwardene, B. Tag, A. Withana, Z. Sarsenbayeva (2025). More Than Words: The Impact of Voice Assistant Personality Traits on Failure Mitigation, In Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (**IMWUT, UbiComp'25**), vol 9, issue 3, Article No.: 91, pp 1–33.
    - https://dl.acm.org/doi/10.1145/3749518
  - Autonomous vehicle – robo-taxi
    - Meurer et al. (2020). A Wizard of Oz Study on Passengers' Experiences of a Robo-Taxi Service in Real-Life Settings. In Proceedings of the 2020 ACM Designing Interactive Systems Conference (pp. 1365-1377).
    - https://dl.acm.org/doi/abs/10.1145/3357236.3395465

Wizard of Oz – Examples

- Self-service Checkout Kiosk:
  - https://www.youtube.com/watch?v=d8SEFSpBYzY&ab_channel=thesmallone29
- Blood testing Kiosk:
  - https://www.youtube.com/watch?v=_g4GGtJ8NCY&ab_channel=lukenwarm



Video prototype

- Communication tool to explain how the prototype is 'used' in real-life
- Early stages of design – Fake interaction by manually replacing screens using mock-ups of the interface
  - Example: Smartphone/laptop with paper wireframe
- Later stages of design – communicate what product looks like and can do
- Focus on information to be conveyed not video editing/acting skills

What is needed?

- Camera – smartphone/laptop camera
- Actors – teammates/family/friends
- Realistic setting
- Mock-up model
- Video editing software
  - Tip: Record and edit later to remove unwanted bits



https://www.studiobinder.com/blog/what-is-an-art-director-in-film-job-description/

How to: Video prototype

- Create storyboard – task, motivation of use, user's behaviour
- Record video of an actor interacting with the model as though it were fully functional
- Edit video to remove the faking or only select the needed frames

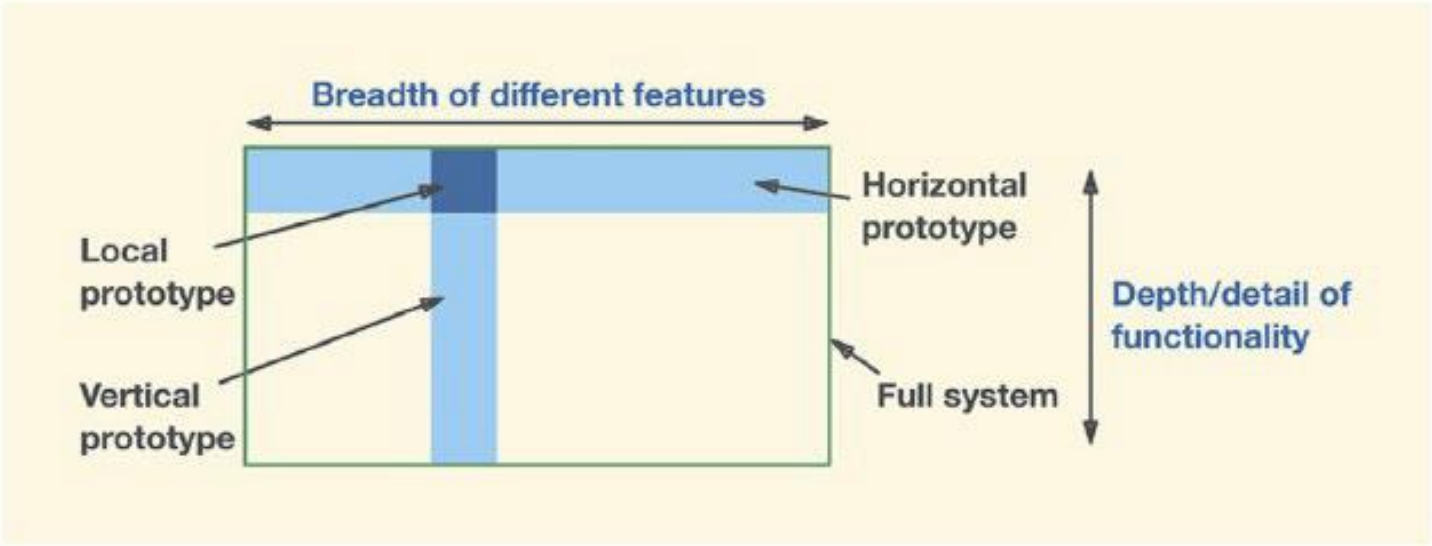
- Video prototype examples: https://tinyurl.com/5n6eb94u

Compromises in prototyping

- All prototypes involve compromises.
- Idea of prototype: Intention is to produce something quickly to test an aspect of the product.
- The best prototype is one that, in the simplest and most efficient way, makes the possibilities and limitations of a design idea visible and measurable.

Compromises in prototyping

- Two common types of compromise:
- **Horizontal**: Provides a wide range of functions, but with little detail
- **Vertical**: Provides a lot of detail for only a few functions



Hartson, R., & Pyla, P. (2019). The UX book : Agile UX design for a quality user experience (Second edition). Morgan Kaufmann, an imprint of Elsevier.

Summary

- Conceptual models
- Interface metaphors
- Interaction types
- Many different envisionment techniques.
- Sketching is a powerful tool that is quick and cheap.
- Prototype is a manifestation of the design that users can interact.
- Prototyping – making decisions to balance trade-offs:
  - Fidelity – how 'finished' it is perceived (content/appearance/functions)
  - Depth or breadth

Required reading

- Preece, J., Rogers, Y., & Sharp, H. (2019). Interaction design: beyond human-computer interaction (5th edition.). Wiley. Chapter 3.5, 7.2, 12.3 -12.4
- Preece, J., Rogers, Y., & Sharp, H. (2019). Interaction design: beyond human-computer interaction (5th edition.). Wiley. Chapter 12.5