Topic 7: Design, Prototyping and Construction (part 1)

SECV2113 Human-Computer Interaction

Faculty of Computing
Universiti Teknologi Malaysia

01 PROTOTYPING

02 CONCEPTUAL DESIGN

03 CONCRETE DESIGN

04 GENERATING PROTOTYPES

05 CONSTRUCTION

Designing *with* or *for* People?

- Is stakeholder engagement one-way?
- Co-design
  - Emphasises creativity and mutual learning
  - Often multidisciplinary
- Participatory design (Scandinavian version)
  - Stakeholders are design partners
  - Co-operative prototyping is important
- Community-based design
  - Scale in terms of numbers and diversity

PROTOTYPING

Prototyping

- What is a prototype?
- Why prototype?
- Different kinds of prototyping
  - Low fidelity
  - High fidelity
- Compromises in prototyping
  - Vertical
  - Horizontal
- Final product needs to be engineered

What is a Prototype?

- 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

Source: PalmPilot wooden model © Mark Richards

3D Printing Examples

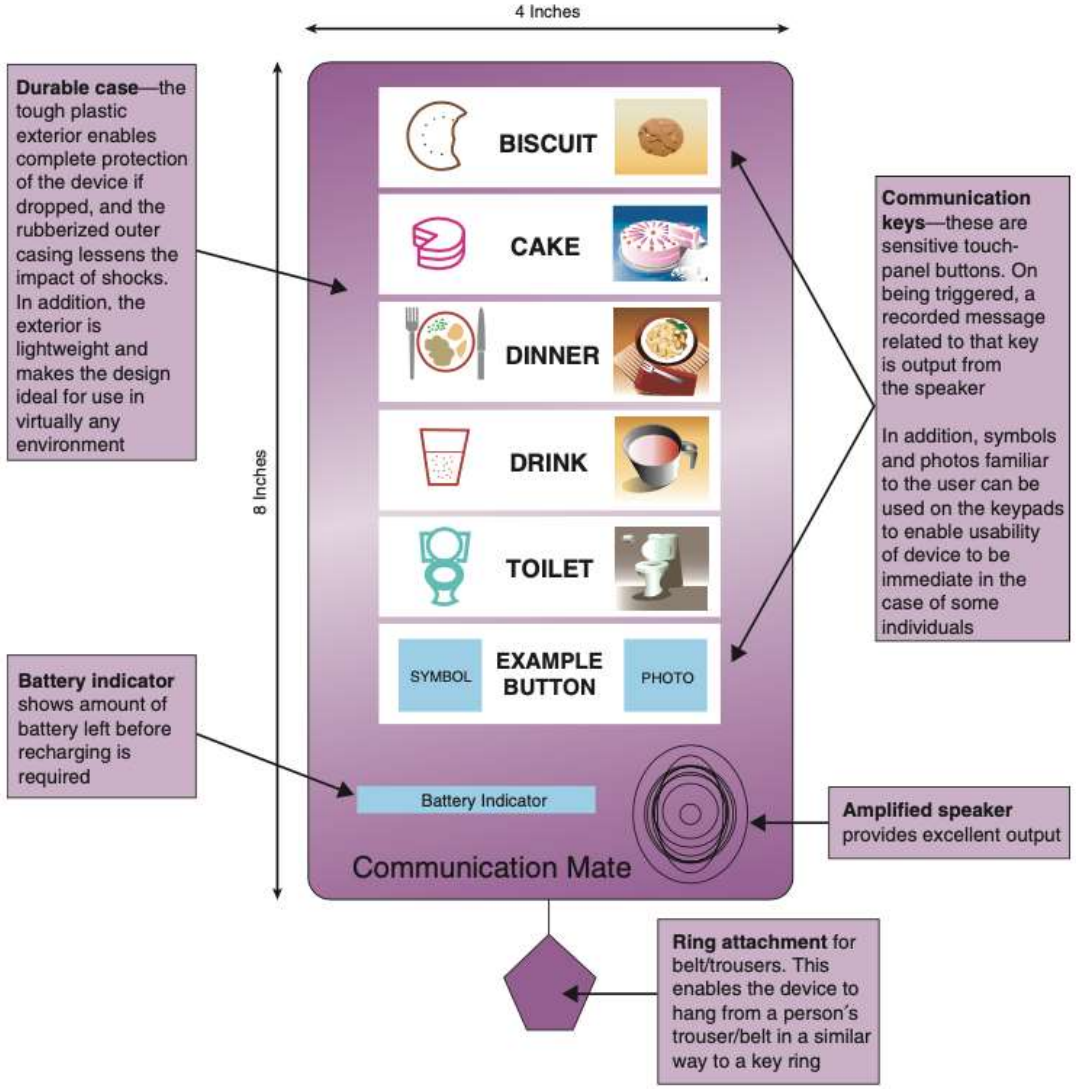
(a) (b) (c)

Examples of 3D printing: (a) model jet engine, (b) Synapse Dress by Anouk Wipprecht: embedded with sensors, the wearer can control the dress's lighting pattern, and (c) custom-made climbing shoes based on a scan of the wearer's feet
Source: (a) Catiav5ftw / MakerBot Industries, LLC / CC BY-NC 4.0, www.thingiverse.com/thing:392115. Licensed under CC-BY-3.0, (b) ANOUK WIPPRECHTSYNAPSE DRESS created for Intel in 2014, www.niccolocasas.com/ SYNAPSE-DRESS, and (c) Photo Credits: ATHOS

What is a Prototype in Interaction Design (ID)?

- Among other things an interaction design prototype can be:
  - A series of screen sketches
  - A storyboard, for example, a cartoon-like series of scenes
  - A PowerPoint slide show
  - A video simulating the use of a system
  - A lump of wood (for instance, the PalmPilot)
  - A loosely connected set of electronic elements
  - An animation of product use
  - A piece of software with limited functionality written in the target language or in another language

Example ID Prototype



A paper-based prototype of a handheld device to support an autistic child
Used courtesy of Sigil Khwaja

What to Prototype?

- Technical issues
- Work flow, task design
- Screen layouts and information display
- Difficult, controversial, critical areas

Why Prototype?

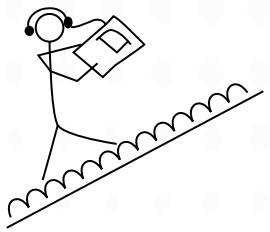
- Evaluation and feedback are central to interaction design
- Stakeholders can see, hold, and interact with a prototype more easily than a document or a drawing
- Team members can communicate effectively
- Ideas can be tested out
- Prototyping encourages reflection: an important aspect of design
- Prototypes answer questions and support designers in choosing between alternatives

Low-fidelity Prototyping

- Uses a medium which is unlike the final medium, for example, paper or cardboard
- Is simple, quick, cheap & easily changed
- Examples:
  - Sketches of screens and task sequences
  - Index cards or sticky notes
  - Storyboards
  - Wizard-of-Oz

Example 1: Storyboards

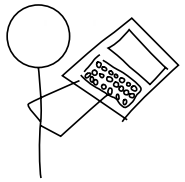
- A series of sketches showing how someone might progress through a task using the product
- Often used with scenarios, bringing in more detail and a chance to role play



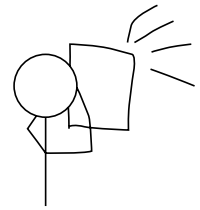
Christina walks up hill; the product gives her information about the site

Christina adjusts the preferences to find information about the pottery trade in Ancient Greece

Christina scrambles to the highest point



Christina stores information about the pottery trader's way of life in Ancient Greece

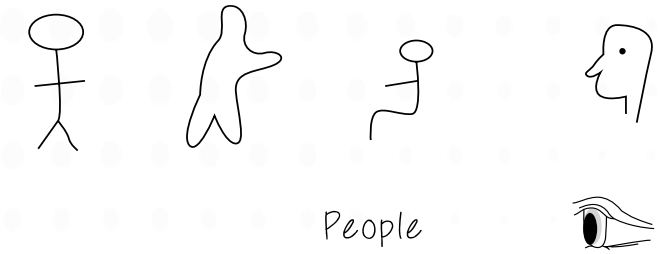


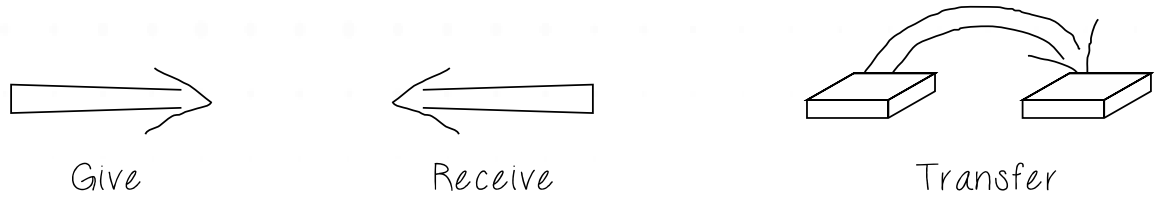
Christina takes a photograph of the location of the pottery market

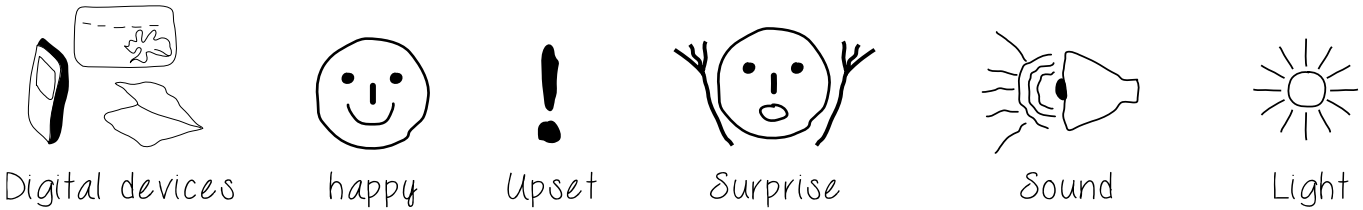
Example 2: Sketching

- Low-fidelity prototyping often relies on sketching

- Don’t be inhibited about drawing ability — Practice simple symbols







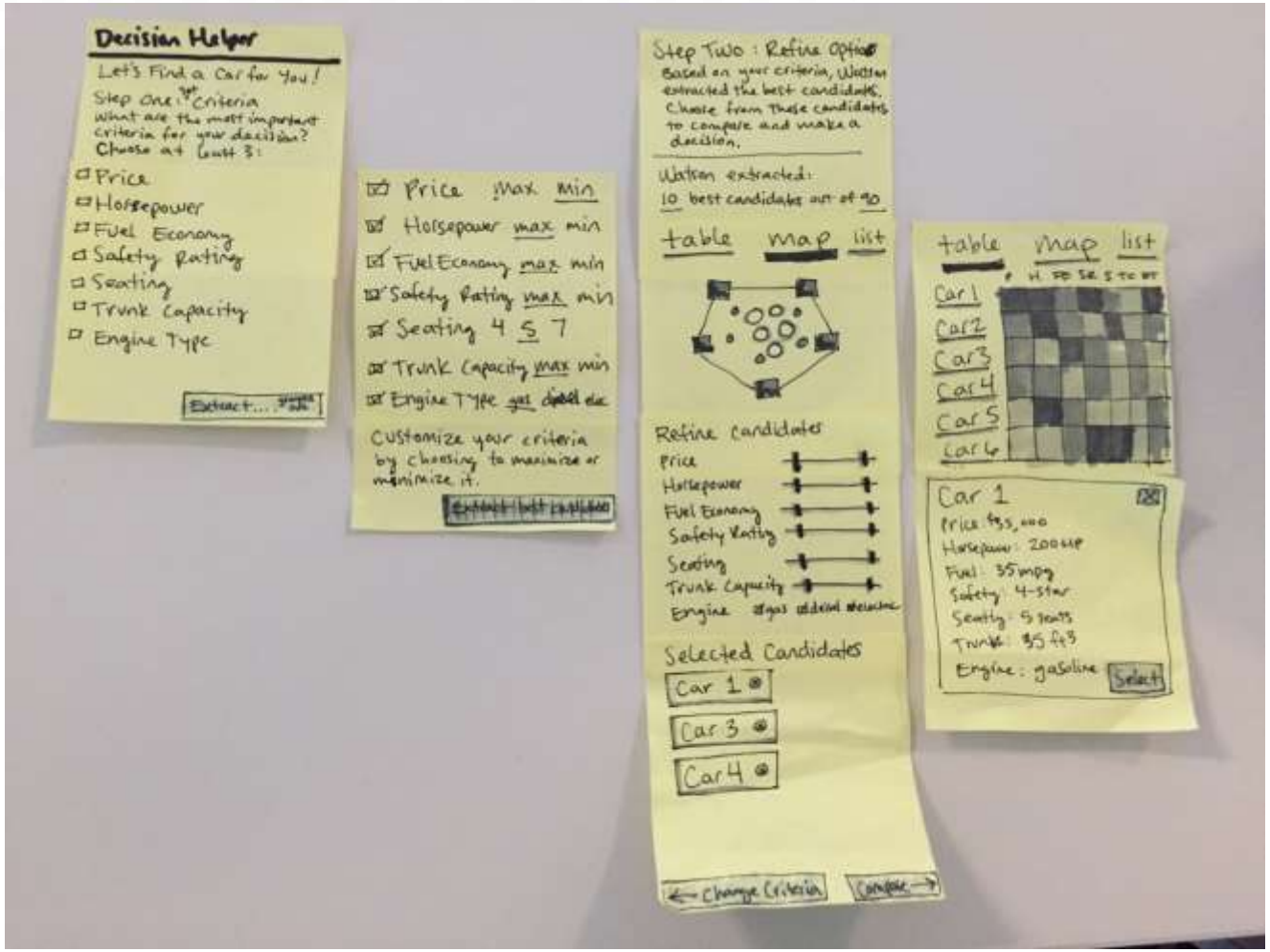
Example 3: Index Cards

- Index cards (3 x 5 inches)
- Each card represents one element of interaction
- In evaluation, can step through the cards

Example 4: Post-it Notes

- Low-fidelity paper prototypes don't look like the final product

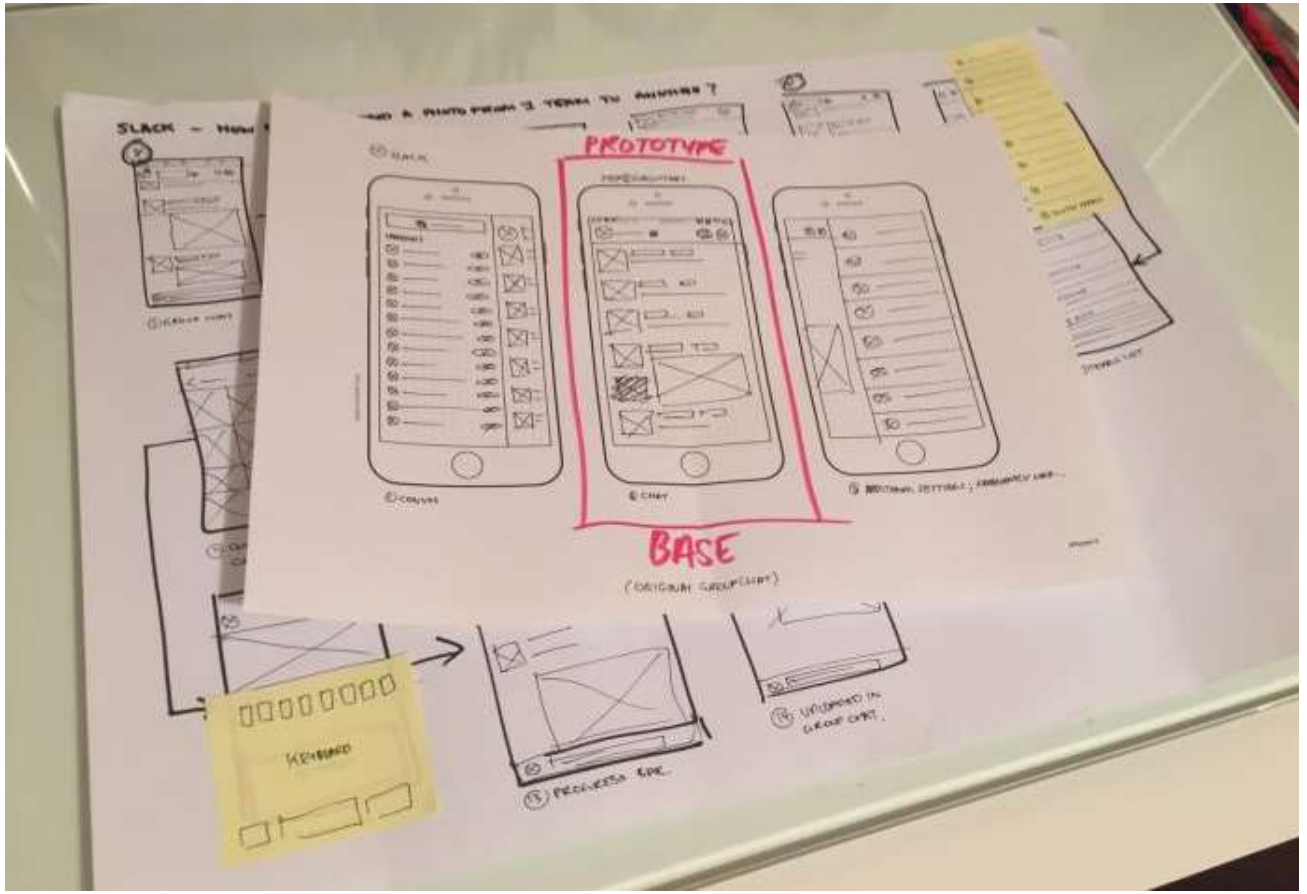
Source: https://www.oreilly.com/ideas/prototyping-physical-digital-products



Example 5: Wireframe/Paper

- Paper prototypes can assist in documentation. Notes and revisions will support designers and developers when they will create an actual product

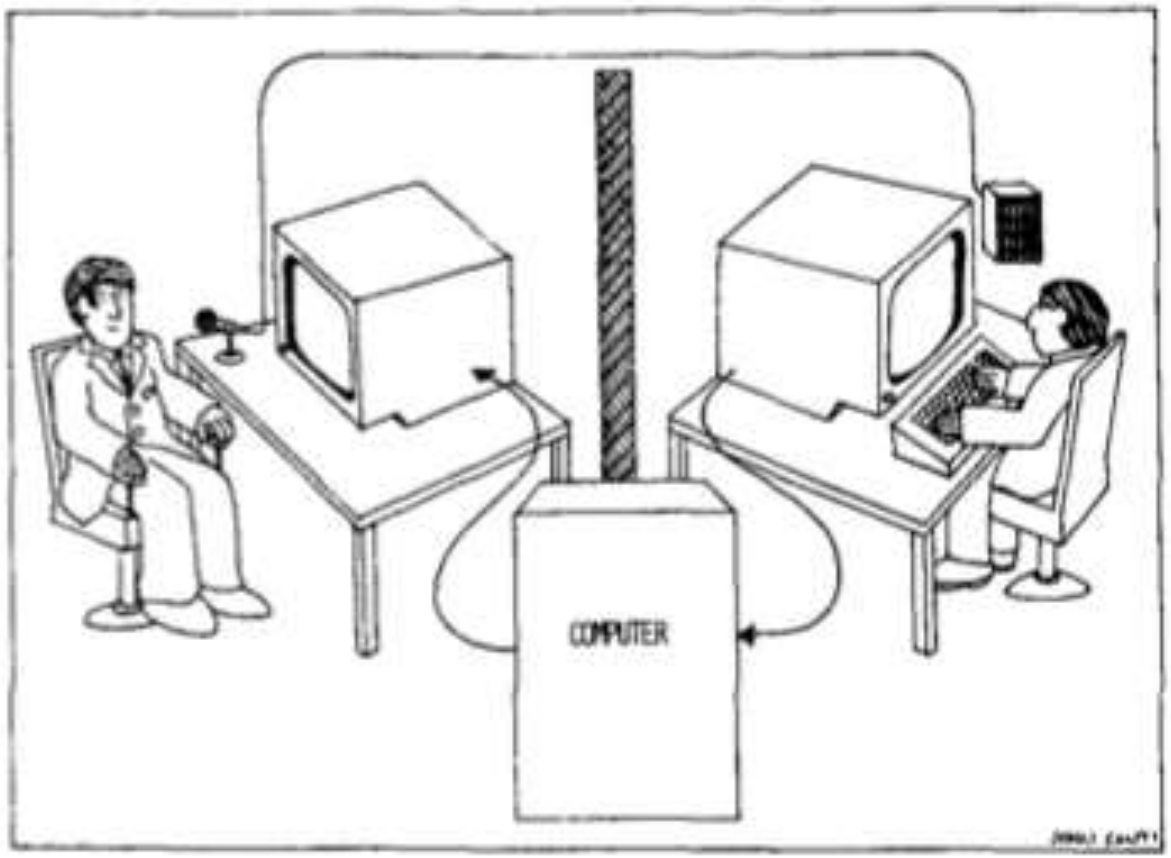
Source: https://theblog.adobe.com/prototyping-difference-low-fidelity-high-fidelity-prototypes-use



Example 6: Wizard-of-Oz

- The participant thinks they are interacting with a computer, but a human is responding to output rather than the system

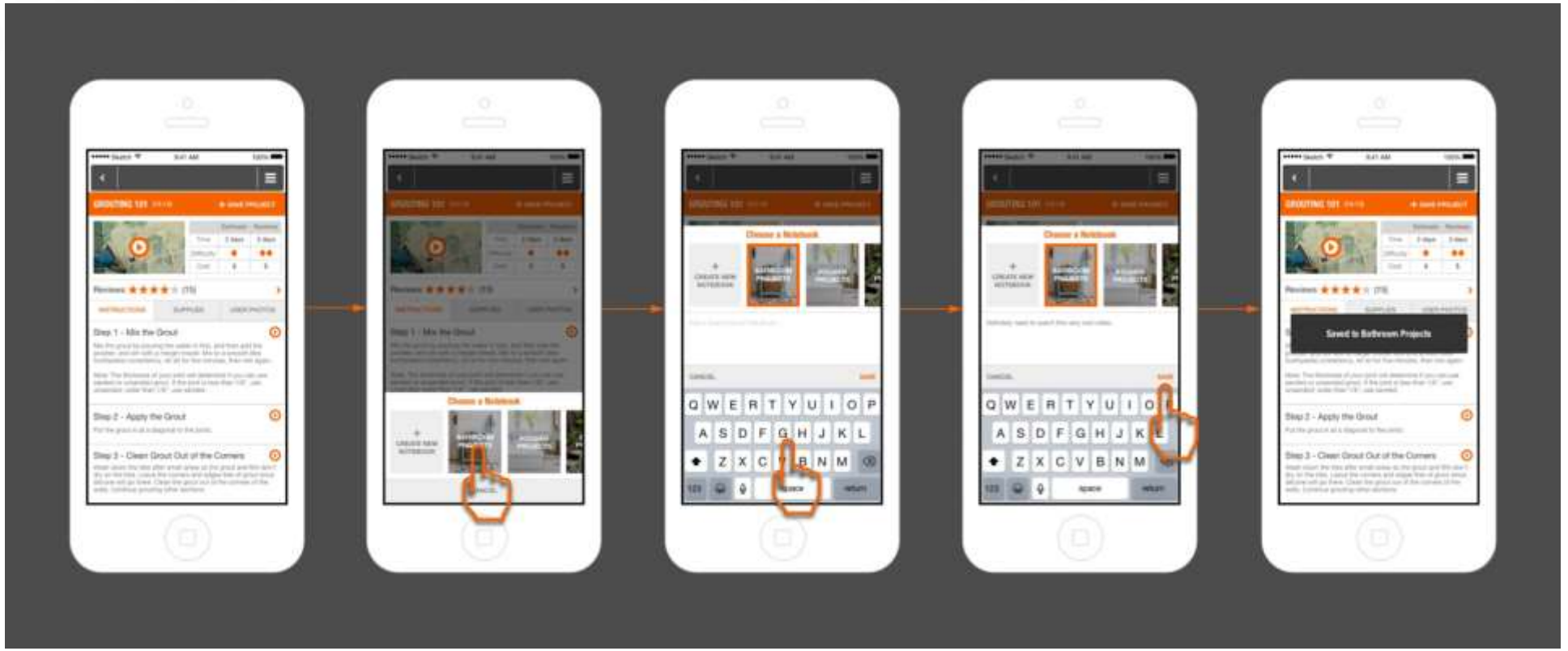
- Usually done early in design to understand peoples' expectations



High-fidelity Prototyping

- Uses materials that would be in the final product
- Prototype looks more like the final system than a low-fidelity version
- High-fidelity prototypes can be developed by integrating existing hardware and software components
- Danger that people think they have a complete system…see compromises

Example: Mobile App

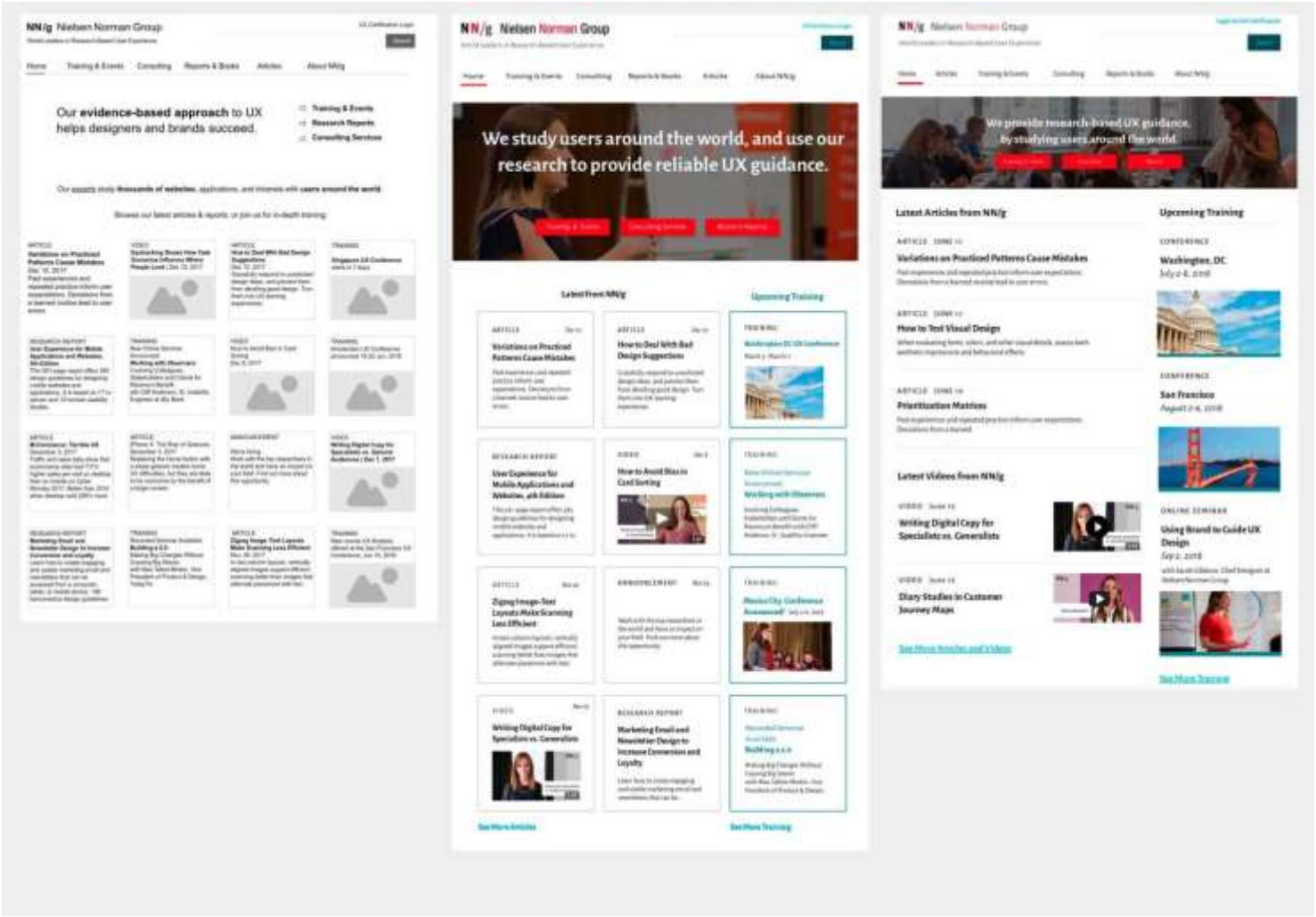


In the design process of high-fidelity prototyping, you need to work closely with the interaction designers to design a product as simple and easy to use as possible

Source: https://www.mockplus.com/blog/post/different-stages-of-prototyping

Evolution of Prototypes

- Iterative design process evolved from black–and–white wireframes for content planning to multiple versions of high-fidelity visual mockups created with cloud-based prototyping tools



Sourcehttps://www.nngroup.com/articles/case-study-iterative-design-prototyping/

Advantages and Disadvantages

Type	Advantages	Disadvantages
Low-fidelity prototype	Lower development cost Evaluates multiple design concepts Useful communication device Addresses screen layout issues Useful for identifying market requirements Proof of concept	Limited error checking Poor detailed specification to code to Facilitator-driven Limited utility after requirements established Limited usefulness for usability tests Navigational and flow limitations
High-fidelity prototype	Complete functionality Fully interactive User-driven Clearly defines navigational scheme Use for exploration and test Look and feel of final product Serves as a living specification Marketing and sales tool	More resource-intensive to develop Time-consuming to create Inefficient for proof-of-concept designs Not effective for requirements gathering

Table 11.3 Advantages and disadvantages of low- and high-fidelity prototypes

Compromises in Prototyping

- Prototyping involve compromises
- For software-based prototyping, maybe there is a slow response? sketchy icons? limited functionality?
- In-the-wild prototypes are operational but not necessarily robust
- Two common types of compromise:
  - **Horizontal:** wide range of functions, with little detail
  - **Vertical:** a lot of detail for only a few functions
- Other common compromise: robust vs changeable
- Beware of compromises in prototypes as final product needs to be engineered

Read more:
https://www.youtube.com/watch?v=HJmK_wuZWp4

CONCEPTUAL DESIGN

Conceptual Design

- Transforms user requirements/needs into a conceptual model
- A conceptual model is an outline of what people can do with a product and what concepts are needed to understand and interact with it
- Understand problem space and current requirements; empathize with users
- Creativity and brainstorming techniques
- Mood board may capture desired feel
- Consider alternatives: scenarios and prototyping helps

Building Scenarios

Emphathising with Users – The Third Age Suit

Source: Ford Motor Company

Choosing an Interface Metaphor

- Interface metaphors combine familiar knowledge with new knowledge in a way that will help the user understand the product.
- Three steps:
  - understand functionality → identify potential problem areas → generate metaphors
- 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?

Considering Interaction and Interface Types

- Which interaction type?
  - How the user invokes actions
  - Instructing, conversing, manipulating, exploring, or responding

- Do different interface types provide insight?
  - Shareable, tangible, augmented reality, and so forth

Expanding the Initial Conceptual Model

- What functions will the product perform?
  - What will the product do and what will the user do?
- How are the functions related to each other?
  - Sequential or parallel?
  - Categorisations, for example, 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?

CONCRETE DESIGN

Concrete Design

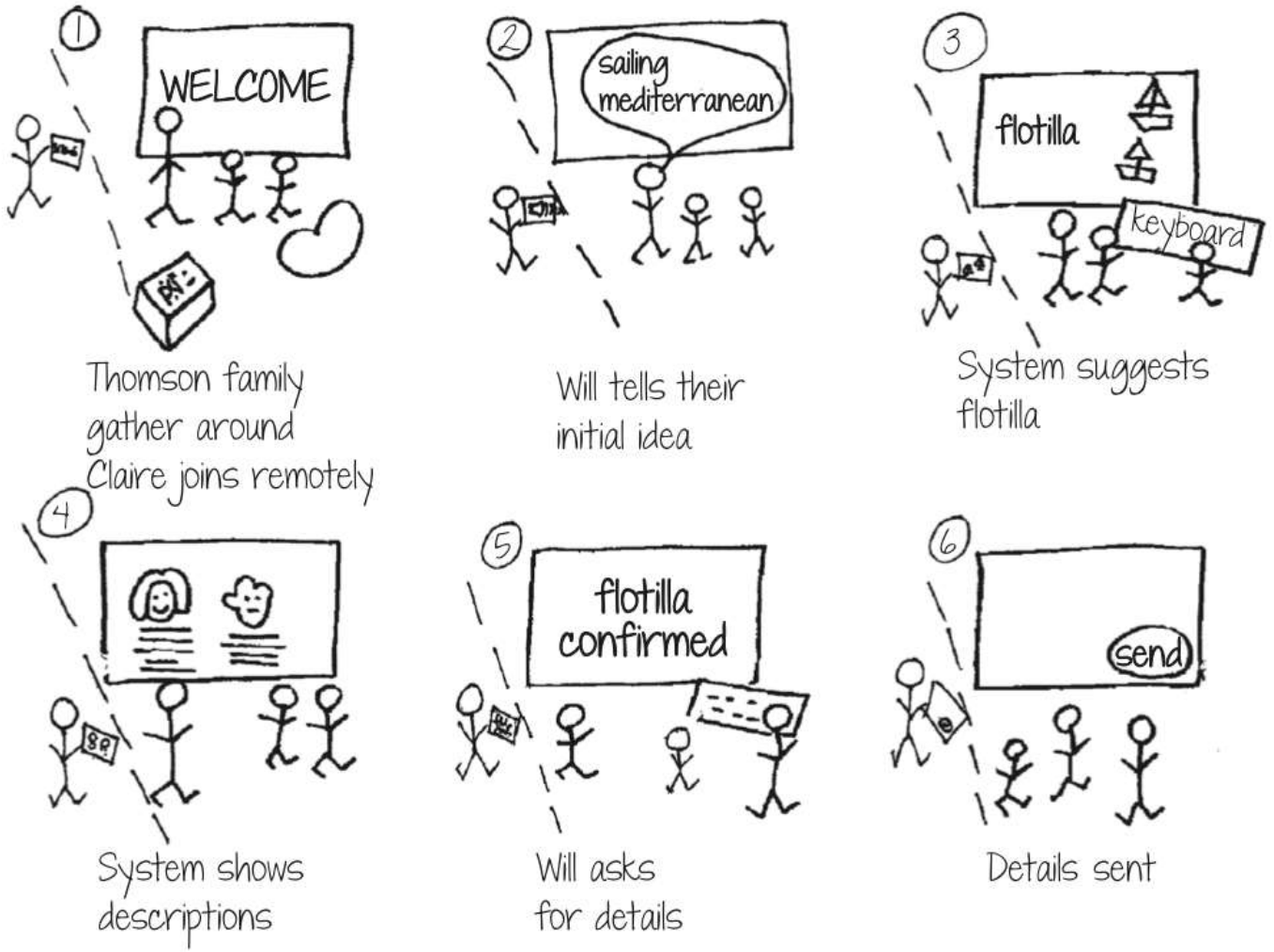
- Difference between conceptual and concrete is emphasis
- Many aspects to concrete design
  - Color, icons, buttons, interaction devices, and so on
- User characteristics and context
  - Inclusiveness, input, and output modes
- Accessibility
  - Web Content Accessibility Guidelines
- Localisation and internationalisation
  - Language, navigation, icons, and metaphor
  - Indigenous knowledge and perspectives

GENERATING PROTOTYPES

Generating Prototypes

- Generate a storyboard from a scenario
  - Break down scenario into steps
  - Create a scene for each step
- Sketching out a storyboard prompts designers to think about design issues
- Generate a card-based prototype from a storyboard or from a use case
  - Consider each step in the use case – what interaction element is needed
  - Draw a card that captures it

Generating Storyboard

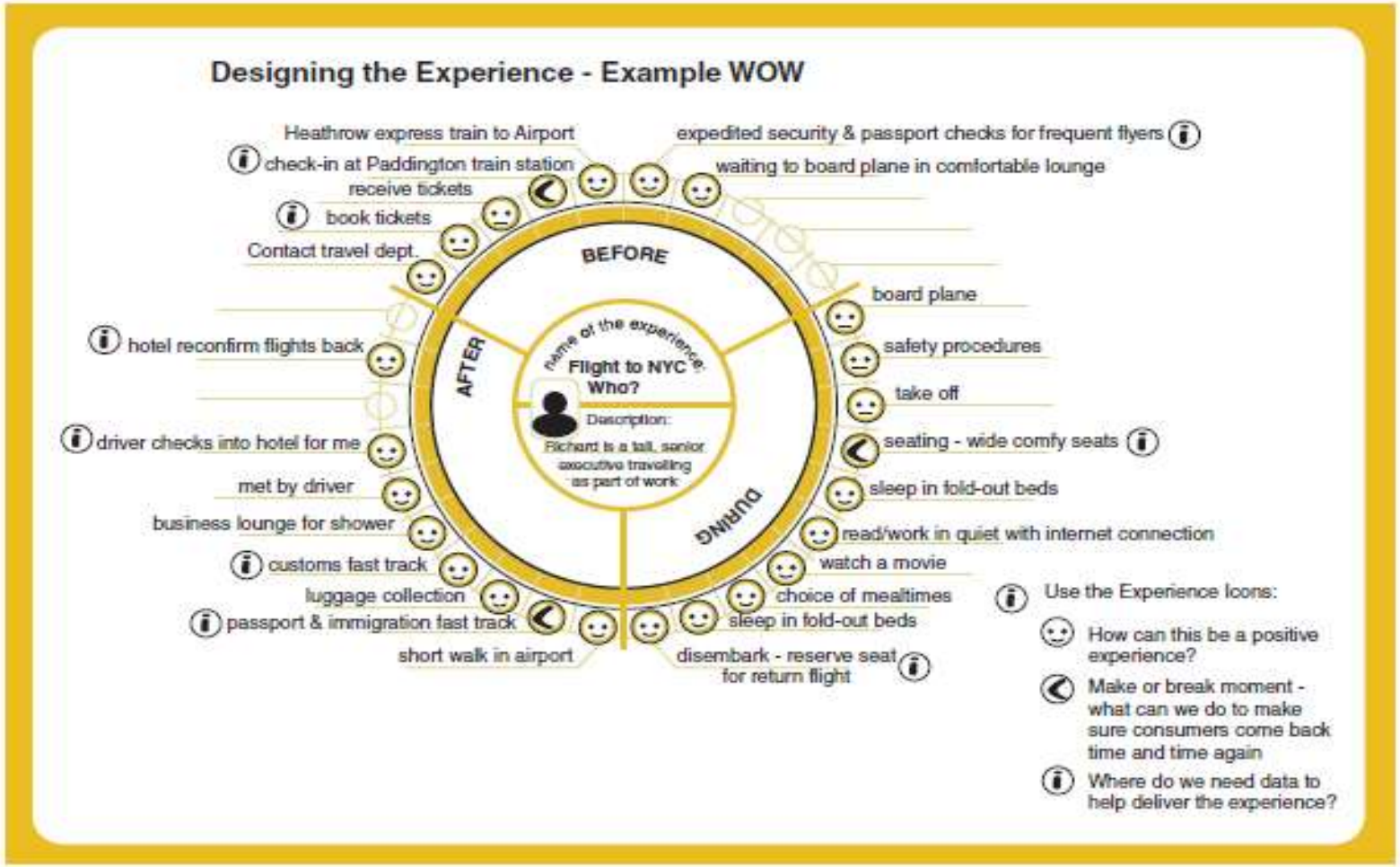


Generating Card-based Prototype

Mapping the Overall Experiences

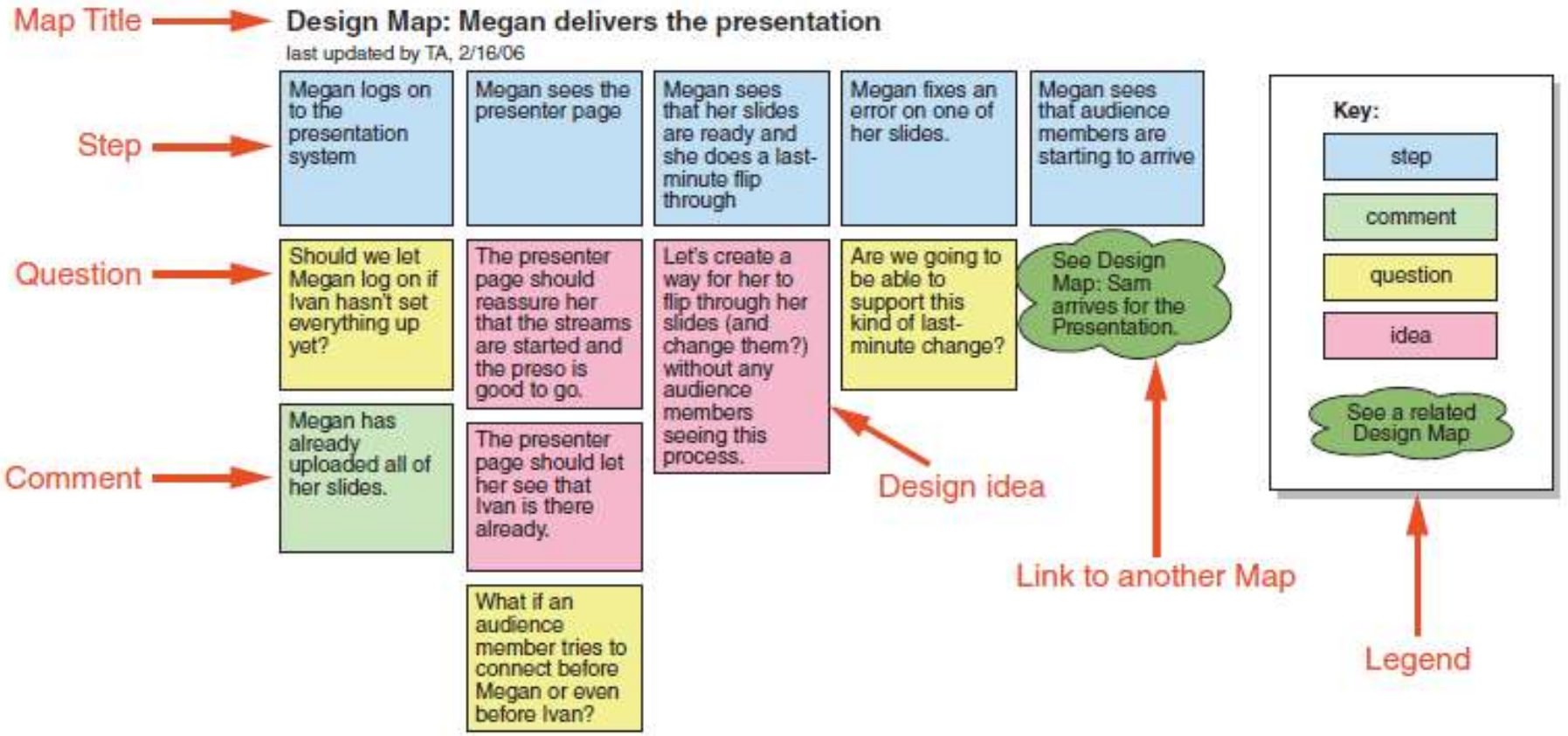
- Combination of personas, prototypes, or stickies to model the overall experience
- Visual representation called:
  - Design map
  - Customer journey map (see part 2)
  - Experience map
- Two common representations
  - Wheel
  - Timeline
- User flows focus on screen content and design, particularly used for mobile devices

An experience map drawn as a Wheel



Source: LEGO

An experience map drawn as a Timeline



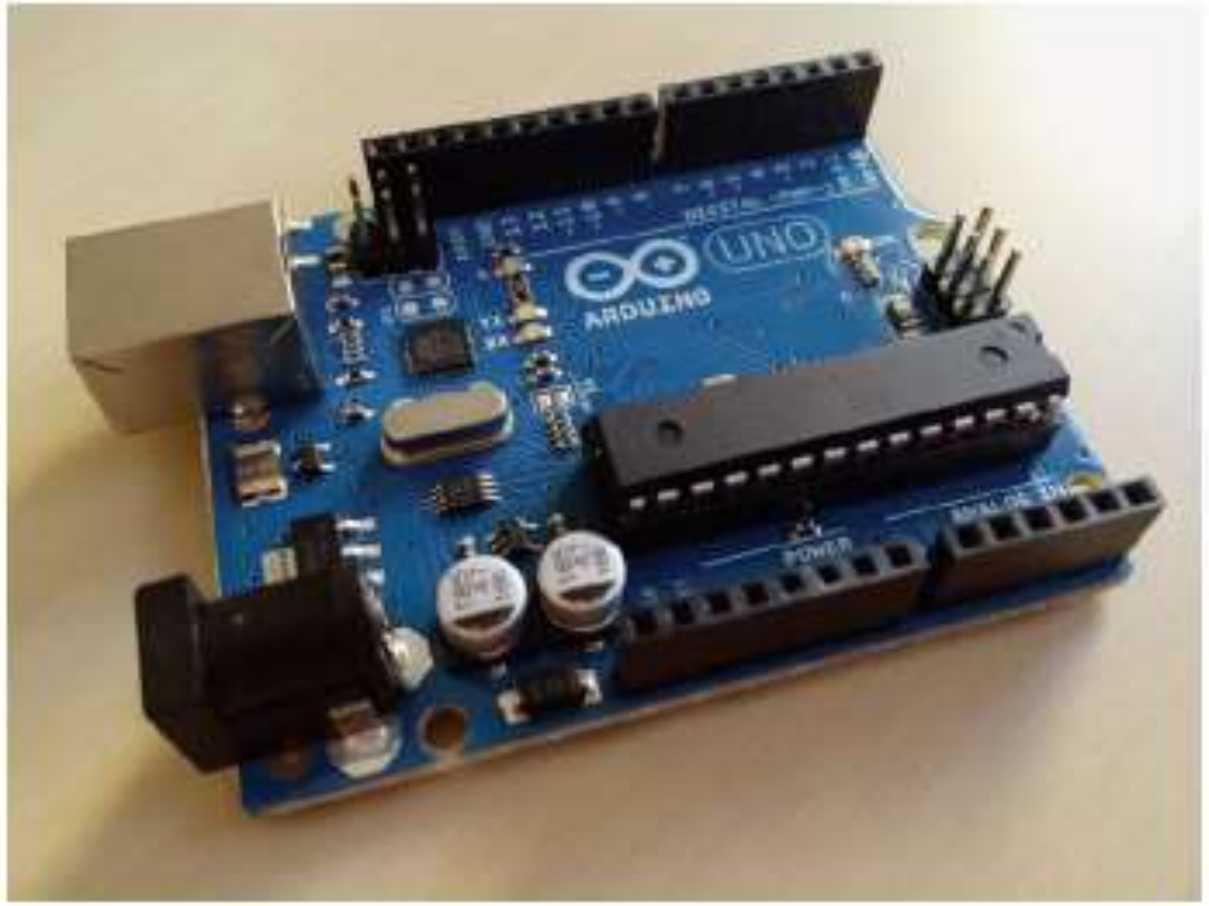
Source: Adlin and Pruitt (2010), p134. Used courtesy of Morgan Kaufmann.

CONSTRUCTION

Construction: Physical Computing

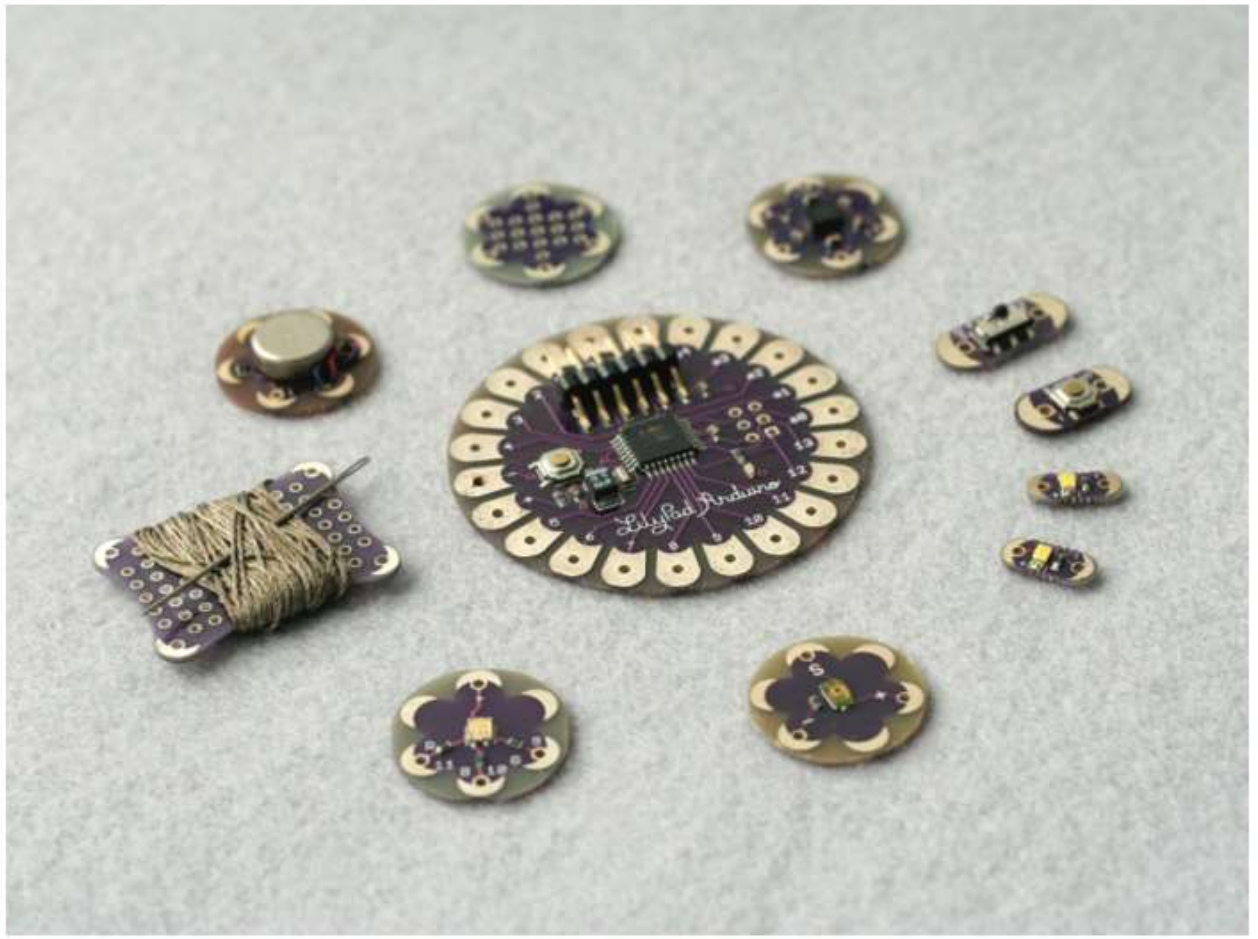
- Build and code prototypes using electronics
- Toolkits available include
  - Arduino
  - LilyPad (for fabrics)
  - Raspberry Pi
  - BBC micro:bit
  - MaKey MaKey
- Designed for use by a wide range of people

Physical Computing Kits: Arduino Board



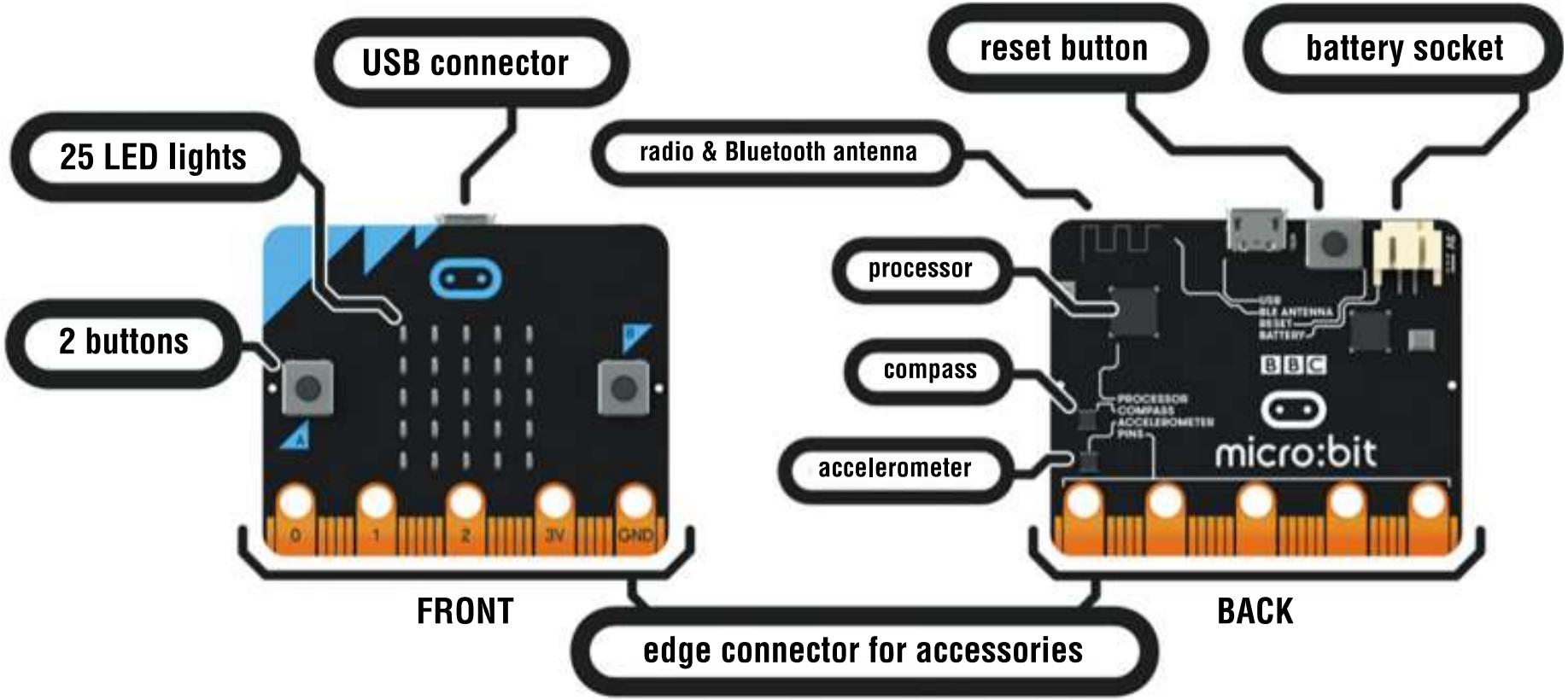
Source: Used courtesy of Dr. Nicolai Marquardt

Physical Computing Kits: Lilypad Arduino



Source: Courtesy of Leah Beuchley

Physical Computing Kits: Micro:bit



Source: micro:bit. Used courtesy of Micro:bit Foundation

Physical Computing Kits: MaKey MaKey

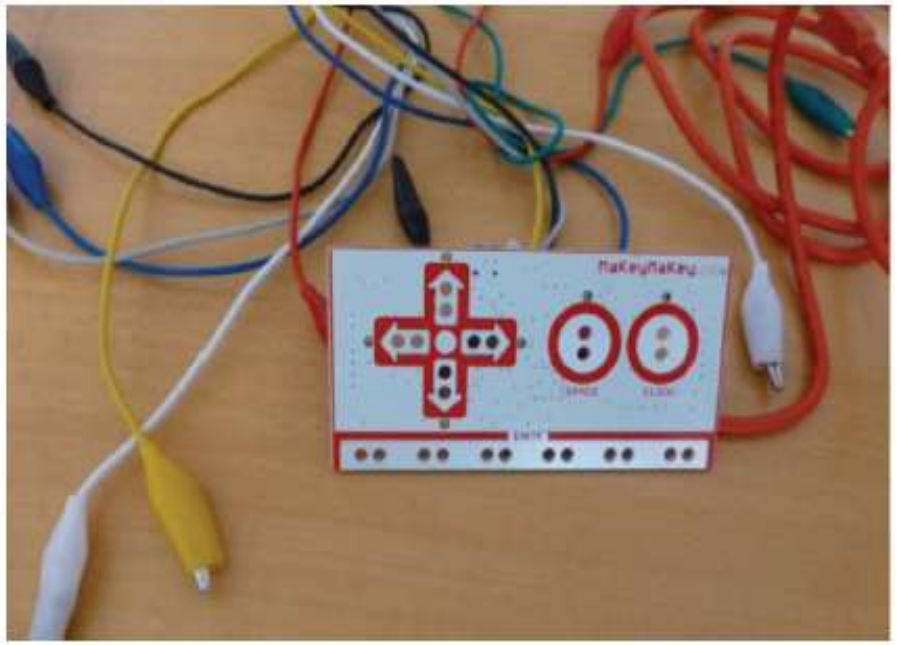


Figure 11.24 The MaKey MaKey toolkit

Figure 11.25 A group of retired friends playing with a MaKey MaKey toolkit

Construction: SDKs

- Software Development Kits
  - Programming tools and components to develop for a specific platform, for example, iOS
- Includes: IDE, documentation, drivers, sample code, and application programming interfaces (APIs)
- Makes development much easier
- Examples:
  - Amazon’s Alexa Skills Kit for voice-based services
  - Apple’s ARKit for augmented reality

Summary

- Prototyping may be low fidelity (such as paper-based) or high fidelity (such as software-based)
- Ready-made software and hardware helps create prototypes
- Two aspects to design: conceptual and concrete
- Conceptual design develops an outline of what people can do and what concepts are needed to understand the product.
- Concrete design specifies design details, for example, layout or navigation
- Three approaches to develop an initial conceptual model: interface metaphors, interaction styles, and interface styles.
- Expand an initial conceptual model by considering whether product or user performs each function, how those functions are related, and what information is required to support them
- Scenarios and prototypes can be used to explore design ideas
- Physical computing kits and software development kits facilitate the transition from design to construction