UTM
UNIVERSITI TEKNOLOGI MALAYSIA

School of Professional and Continuing Education (SPACE)

Chapter 06 (Design)

Design, Prototyping and Construction (Part 1)

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** (Paper-based)
  - **High fidelity** (software-based)
- 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
  - the examples here come from a 3D printer

Source: PalmPilot wooden model © Mark Richards

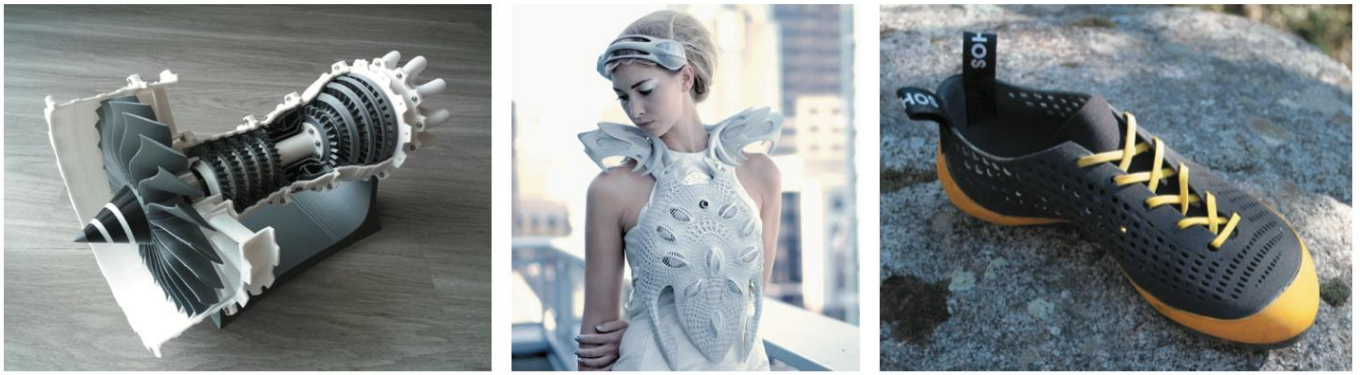
What is a prototype?

(a)

Figure 11.1 (a) Color output from a 3D printer: all the gears and rods in this model were 'printed' in one pass from bottom to top, and when one gear is turned, the others turn too.

Source: (a) The Computer Language Company, Inc., courtesy of Alan Freedman

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

3D Printing Examples

(c)

(c) A teddy bear 'printed' from a wireframe
design http://www.disneyresearch.com/project/printed-teddy-bears/
(c) Courtesy of Scott Hudson, Human–Computer Interaction Institute, Carnegie Mel- lon University.

Watch video: https://www.youtube.com/watch?v=qc-tGbMN9Ms

What is a prototype Interaction Design (ID)?

In interaction design it can be (among other things):

- a series of screen **sketches**
- a **storyboard**, i.e. a cartoon-like series of scenes
- a Powerpoint **slide show**
- a video **simulating** the use of a system
- a **lump** of wood (e.g. PalmPilot)
- a **cardboard** mock-up
- 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

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, interact** with a prototype more easily than a document or a drawing
- Team members can **communicate** effectively
- You can **test out** ideas for yourself
- It encourages **reflection**: very important aspect of design
- Prototypes answer questions, and support designers in **choosing between alternatives**

Fidelity in Prototyping (FP)

- **Fidelity** refers to the **level of detail**
  - **Low fidelity**
    - artists renditions with **many details missing**
  - **High fidelity**
    - prototypes look like the **final product**

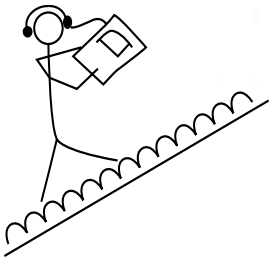
Low-fidelity Prototyping (LFP)

- Uses a medium which is **unlike** the final medium, e.g. paper, cardboard
- Is **quick, cheap** and **easily changed**
- Examples:
  - sketches of screens, task sequences, etc
  - Index cards or sticky notes
  - card-based
  - ‘post-it’ notes
  - storyboards
  - ‘Wizard-of-Oz’

Examples of LFP: Storyboards

- It is a series of **sketches** showing how a user might **progress** through a **task** using the device
- Often used with **scenarios**, bringing more detail, and a chance to **role play**
- Used early in design

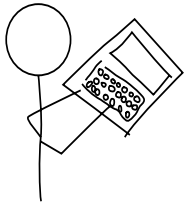
Example 1 LFP : Storyboards



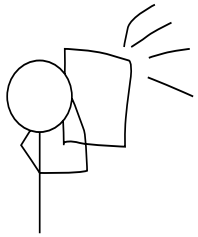
Christina walks up hill; the product gives her information about the site

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

Christina scrambles to the highest point



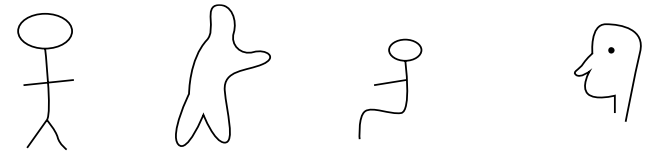
Christina stores information about the pottery trader's way of life in Ancient Greece

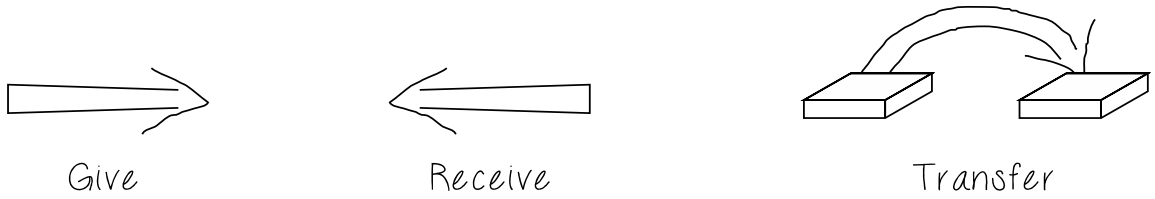


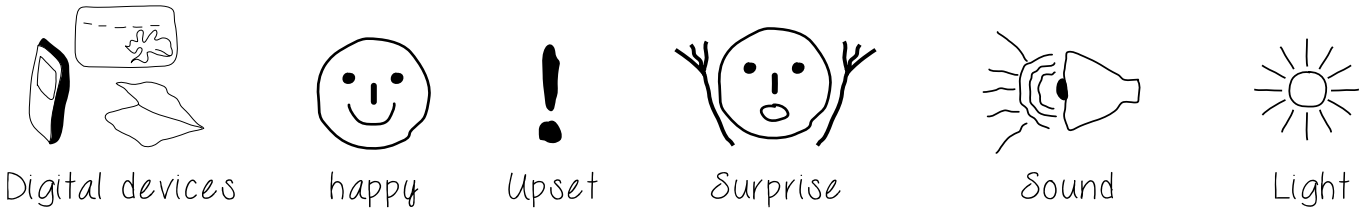
Christina takes a photograph of the location of the pottery market

Examples 2 LFP: Sketching

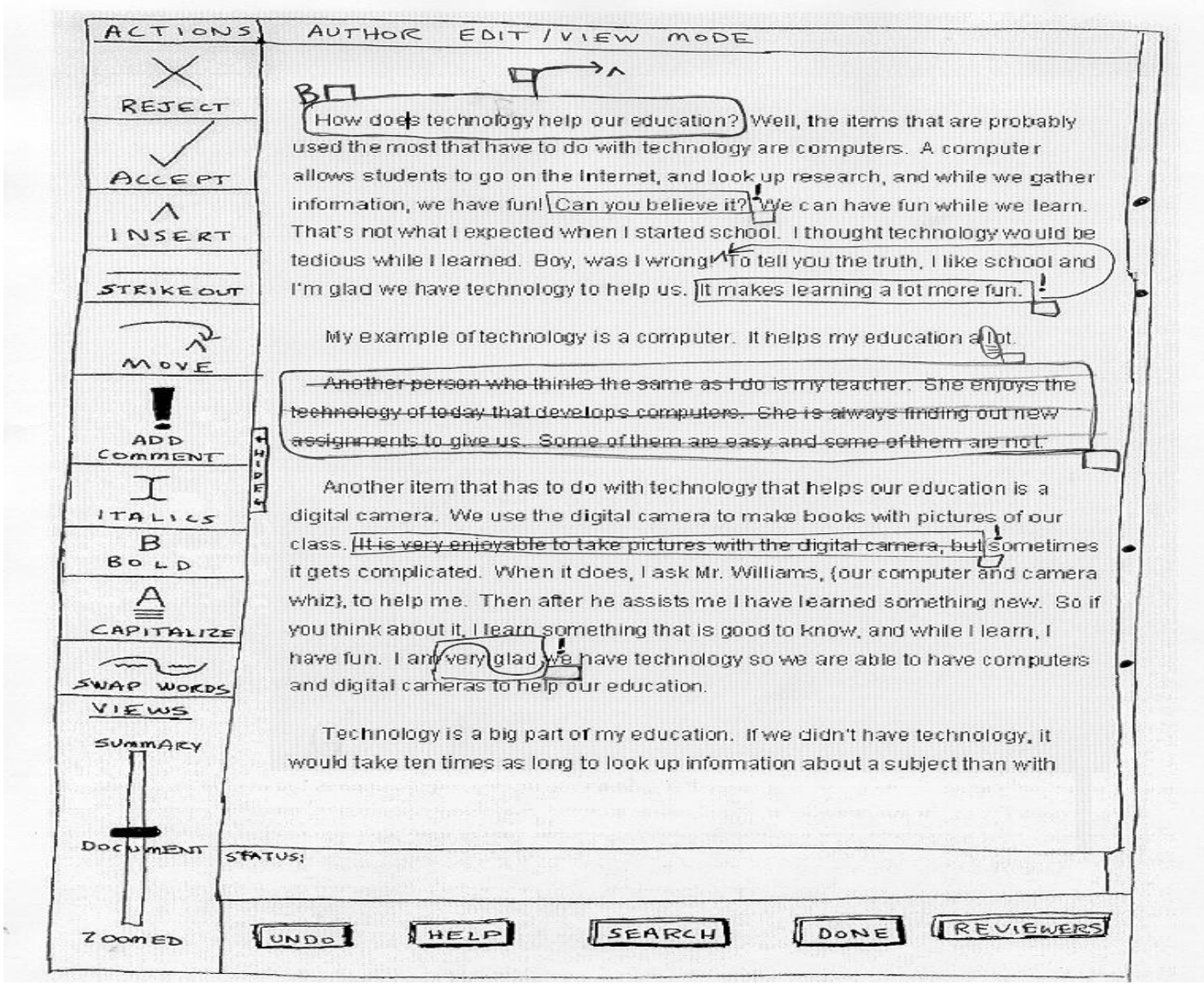
- Sketching is important to low-fidelity prototyping
- Don't be inhibited about drawing ability. Practice simple symbols







Examples 2 LFP: Sketching



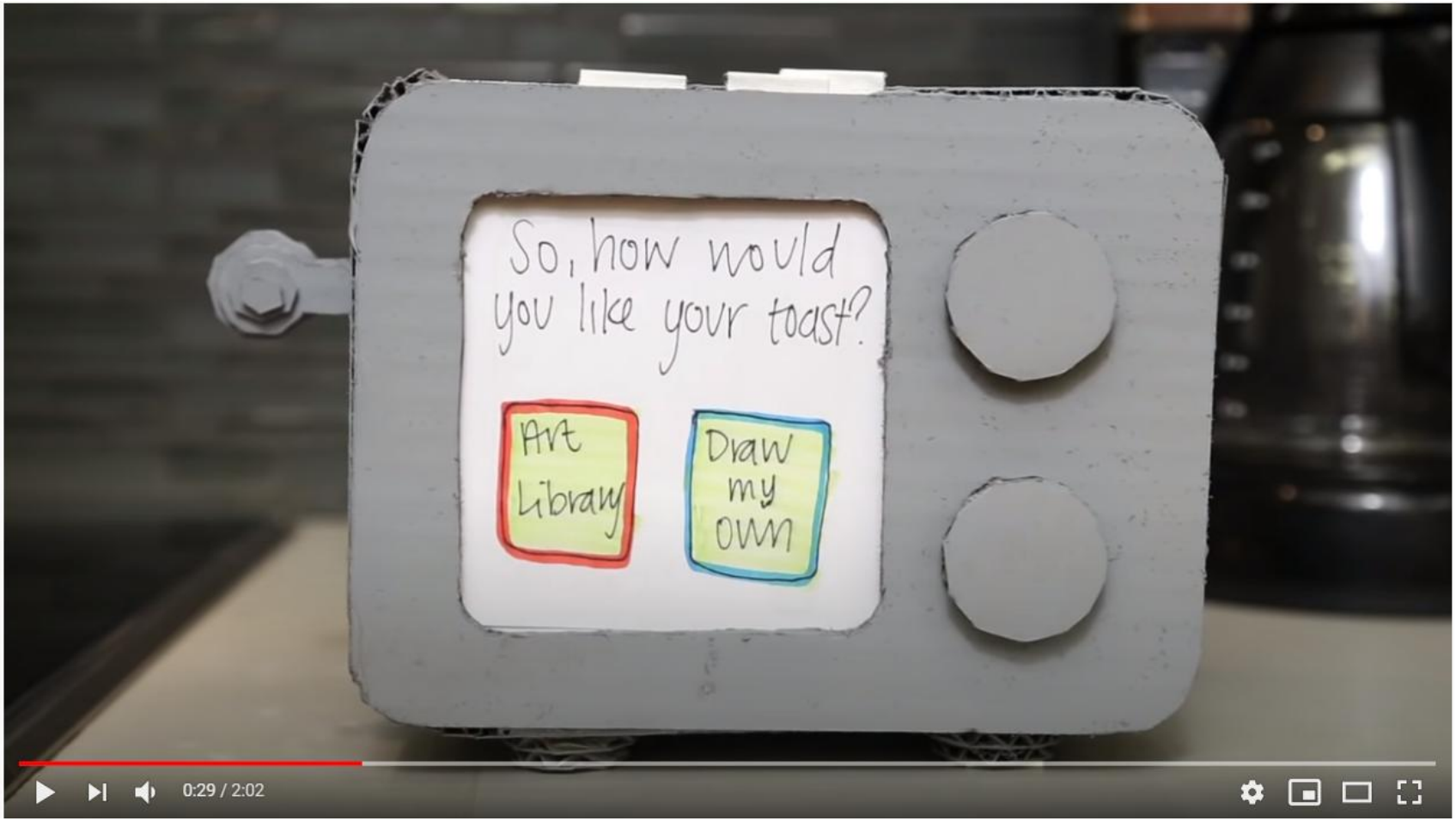
Examples 2: Sketching / paper prototypes

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

Examples 3 LFP: Index Cards prototypes

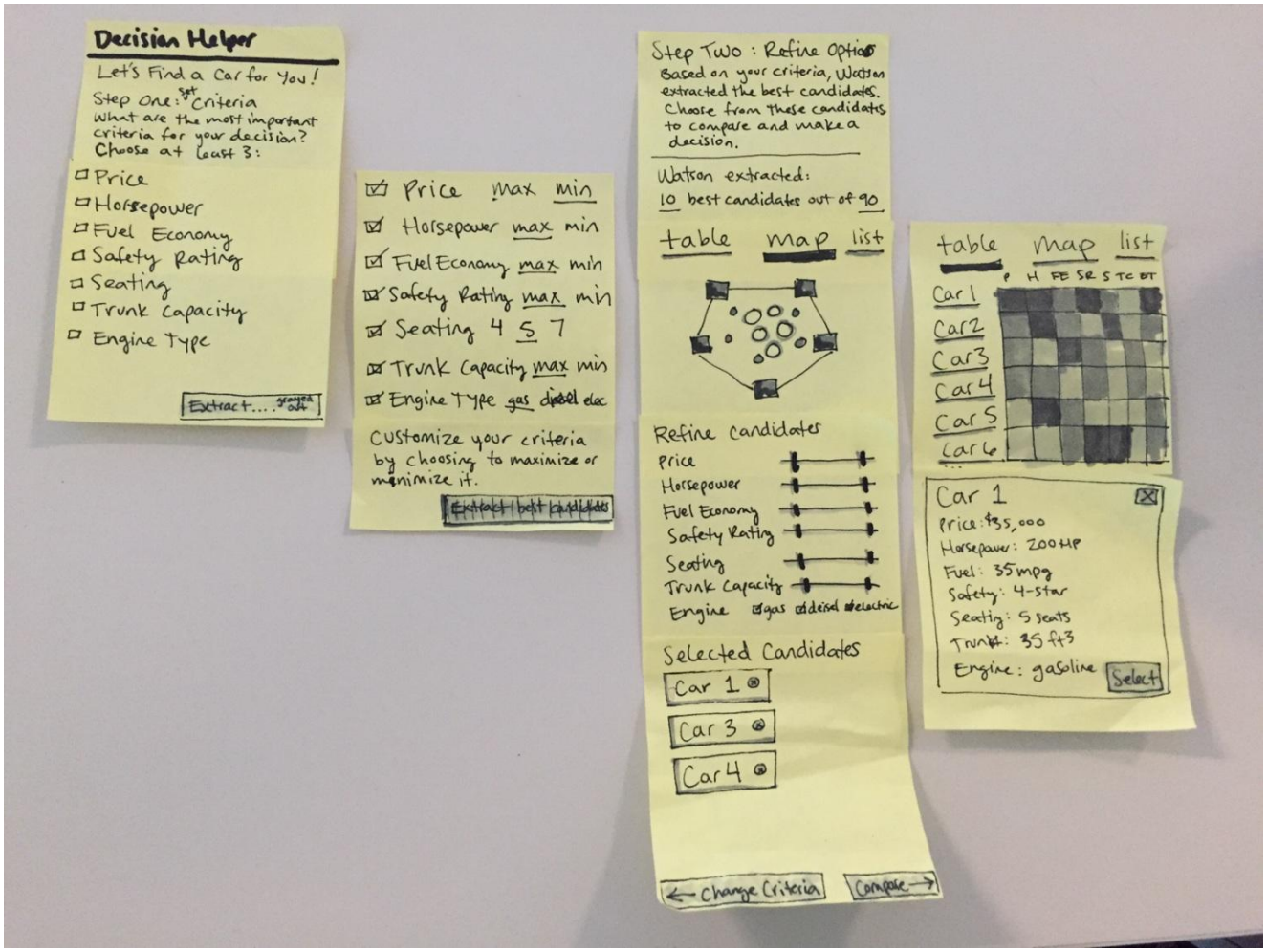
- Index cards (3 X 5 inches)
- Each card represents one screen or part of screen
- Often used in website development
- In evaluation, can step through the cards

Examples 3 LFP: How to make a Card-based prototypes



https://www.youtube.com/watch?v=k_9Q-KDSb9o

Examples 4 LFP: ‘Post-it’ notes



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

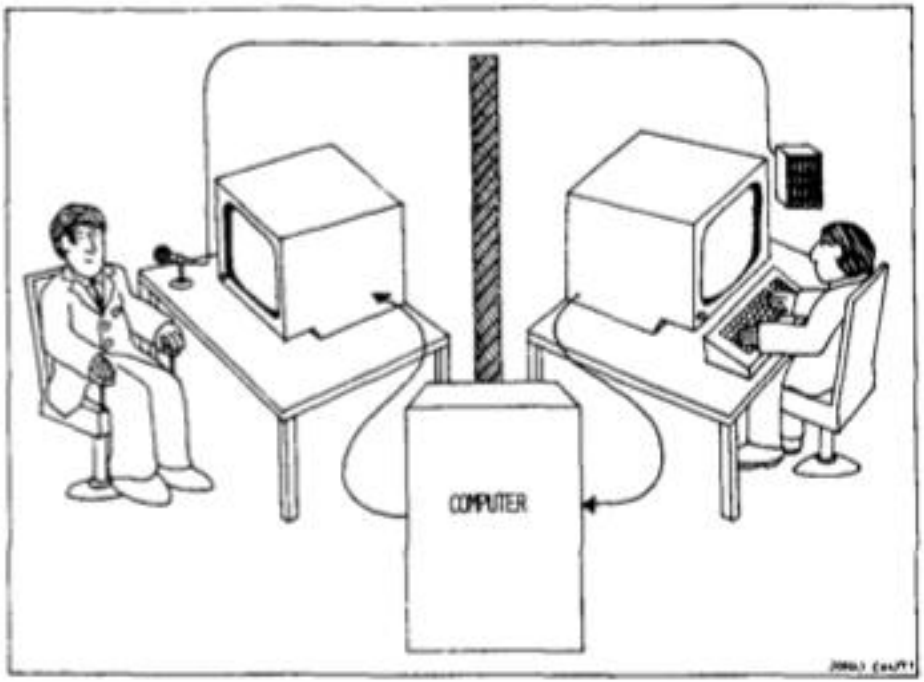
Source: https://www.oreilly.com/ideas/prototyping-physical-digital-products

Examples of LFP: Storyboard and Paper Prototype

- GMail Art
  - https://www.youtube.com/watch?v=MDr5VcIw38U
- Paper Prototype Angry Bird
  - https://www.youtube.com/watch?v=ZwWq7zIdBwQ
- UA&P Portal Storyboard (with scenario example)
  - https://www.youtube.com/watch?v=Z6UUH5CtQP4 –
- Order Food on Train Storyboard (with scenario example)
  - https://www.youtube.com/watch?v=k7gxq0lRHQk
- UA&P Usability Test for Portal Paper Prototype
  - https://www.youtube.com/watch?v=G_oOmk-1TAw

Examples 5 LFP: ‘Wizard-of-Oz’ prototyping

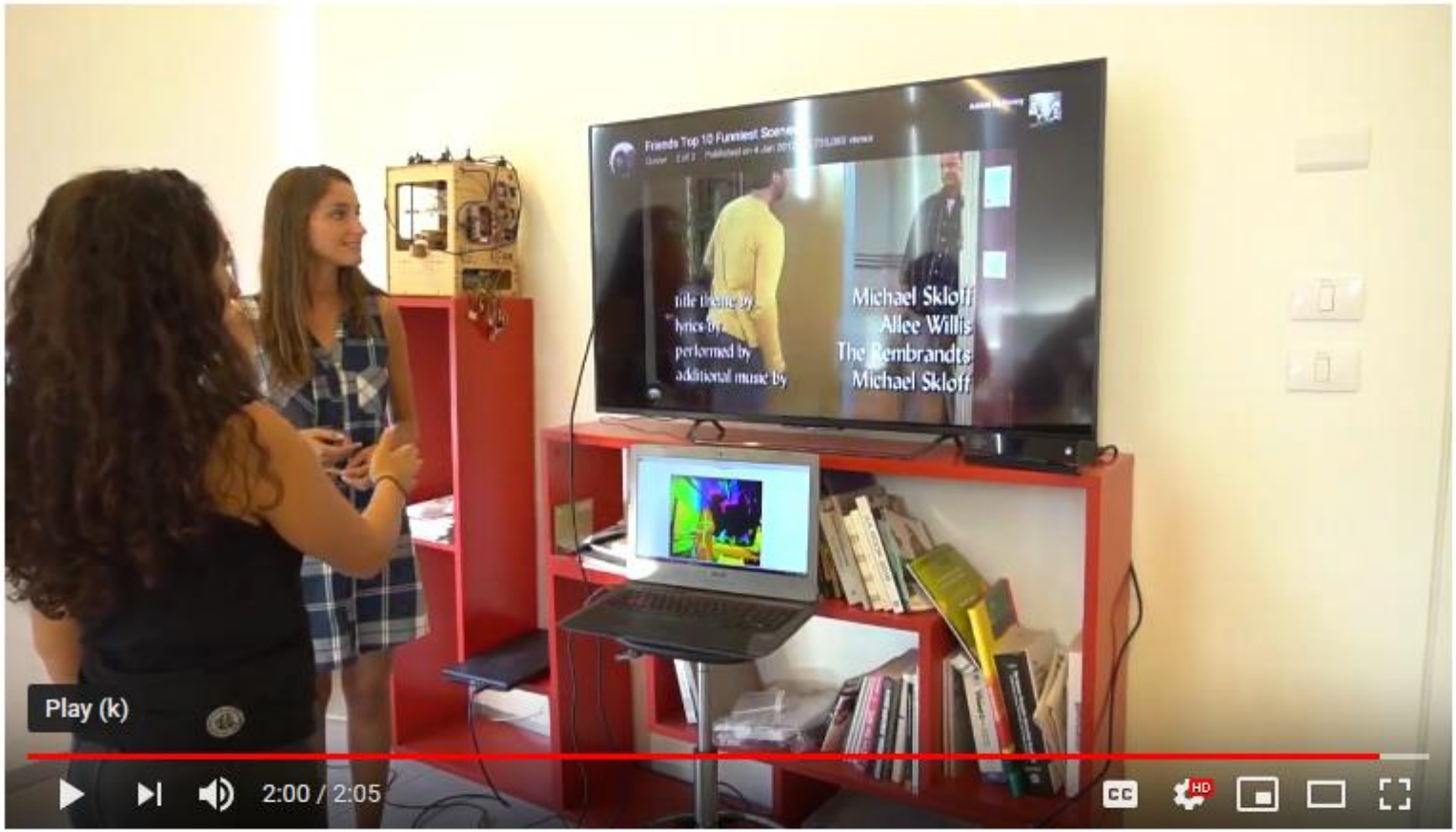
- The users **thinks** they are **interacting** with a computer, but a **developer** is **responding** to output rather than the system.
- Usually done early in design to understand users’ expectations



Examples 5 LFP: ‘Wizard-of-Oz’ Prototyping

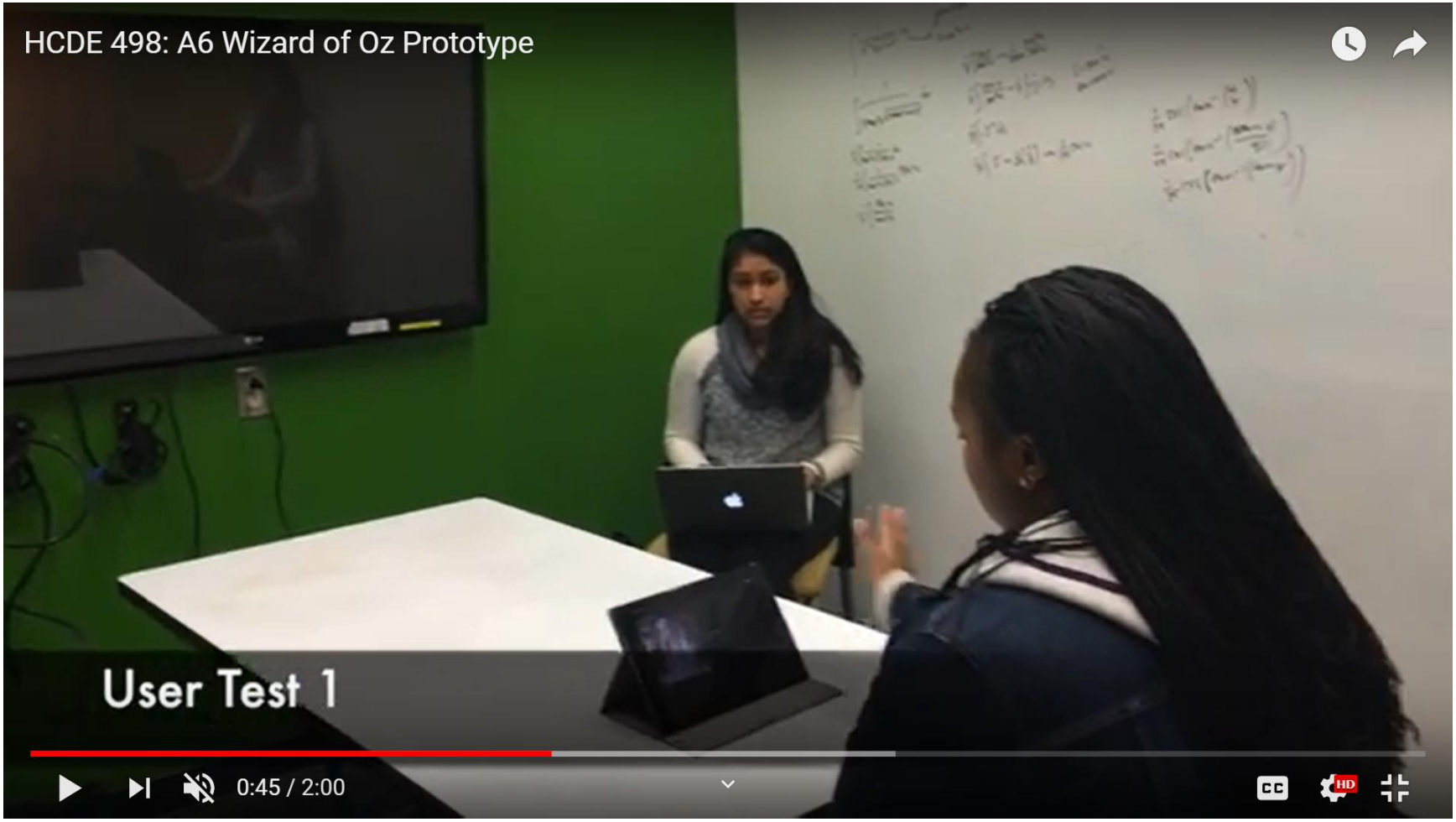
Source: https://www.youtube.com/watch?v=QX9cjsYBihc

Examples 5 LFP: ‘Wizard-of-Oz’ prototyping



Source from https://www.youtube.com/watch?v=WtrO6b_oUYI

Examples 5 LFP: ‘Wizard-of-Oz’ prototyping

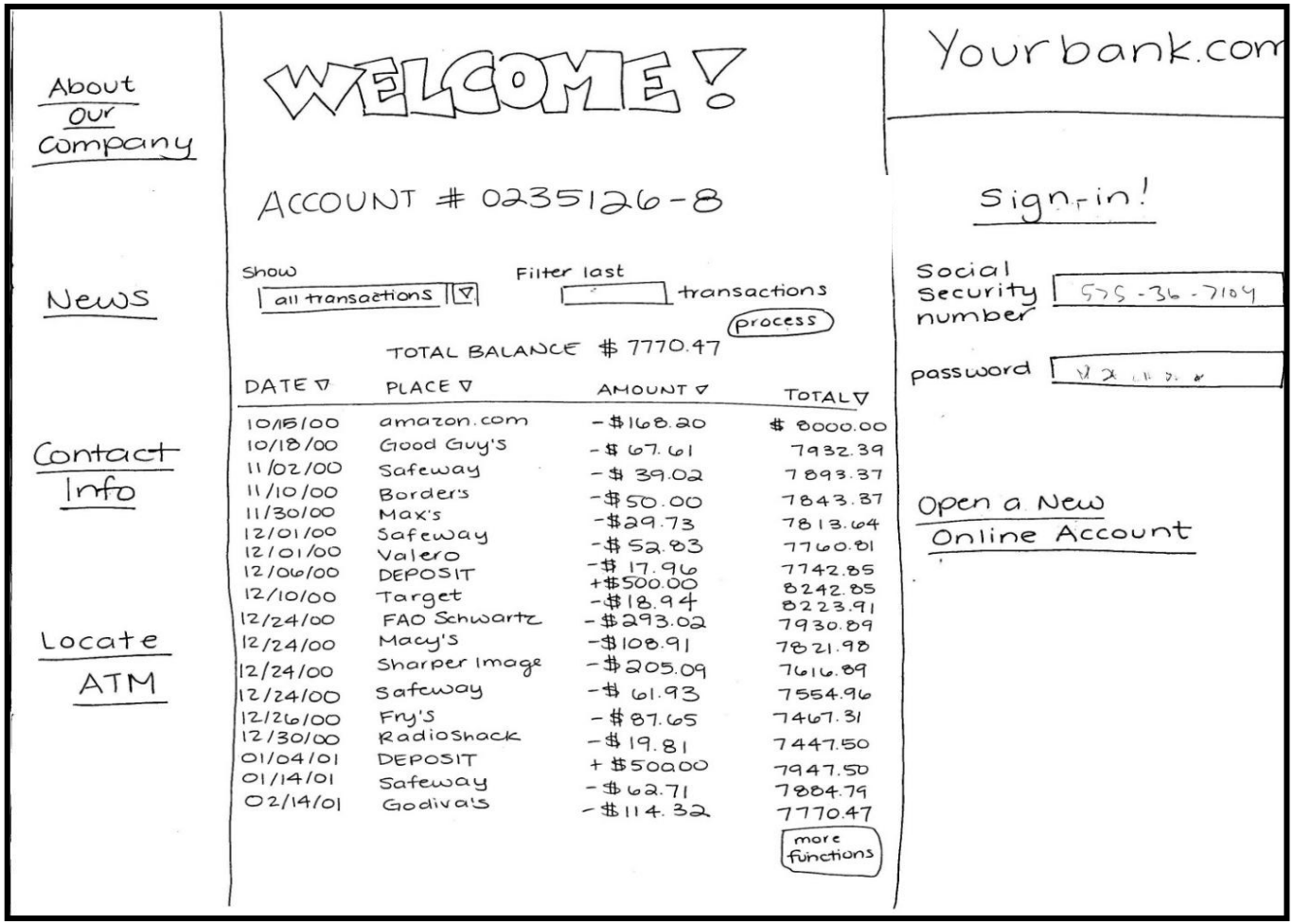


Source: https://www.youtube.com/watch?v=mDRq9LisRn0

High-fidelity prototyping (HFP)

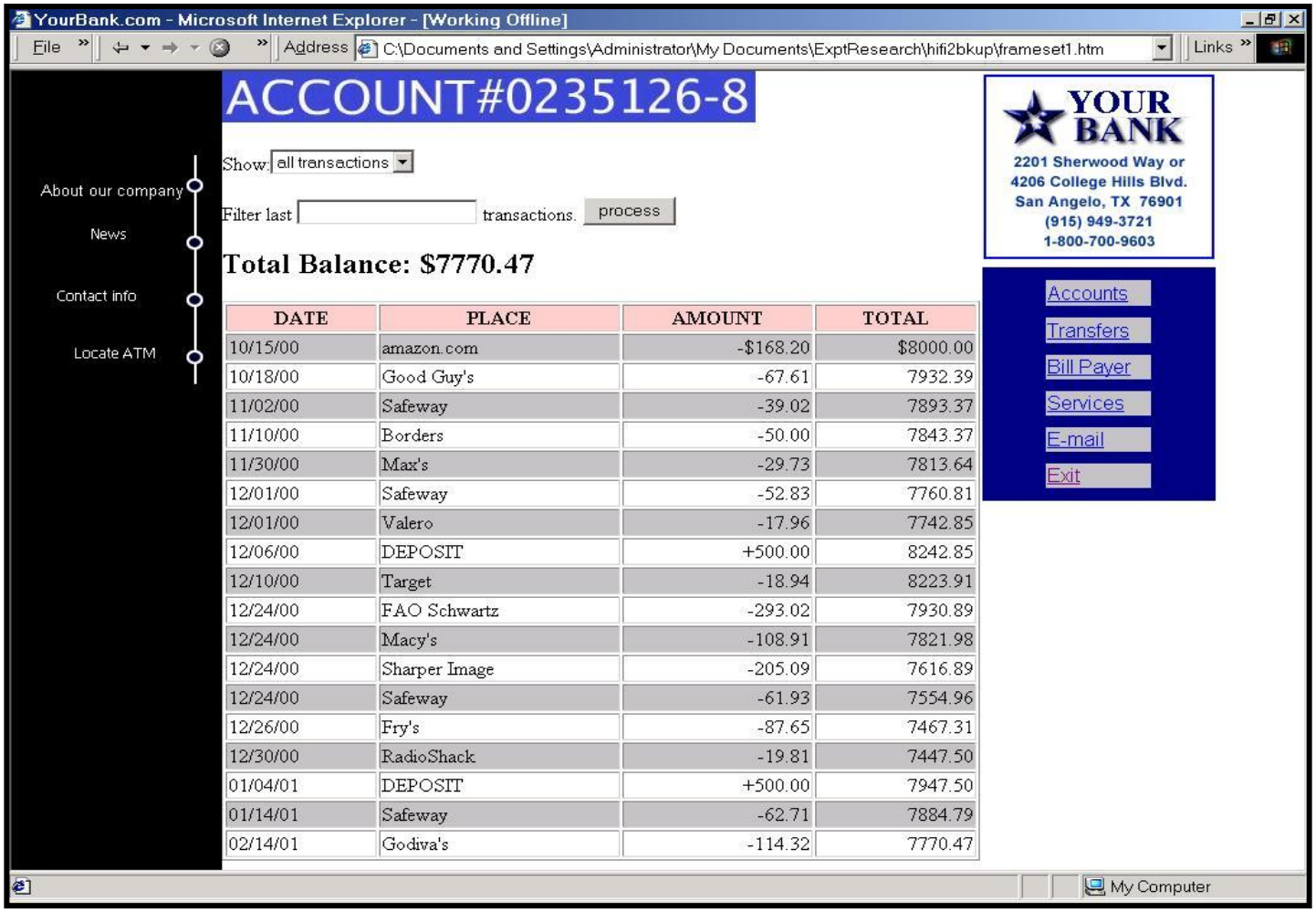
- Uses materials that you would expect to be in the **final product**
- Prototype **looks more like the final system** than a low-fidelity version
- High-fidelity prototypes can be developed by integrating existing hardware and software components
- Danger that users think they have a complete system…….see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

From :
Low-Fidelity Prototype(LFP)



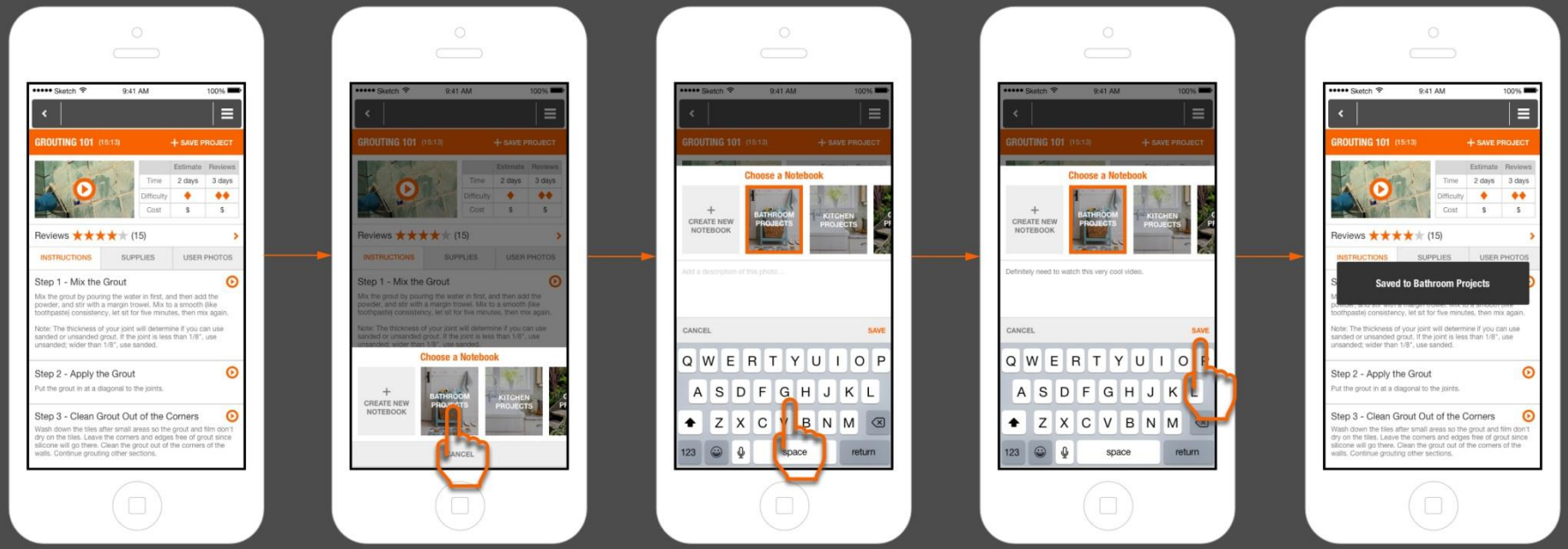
LFP also called as a wireframe design

Convert to:
High-Fidelity Prototype(HFP)



DATE	PLACE	AMOUNT	TOTAL
10/15/00	amazon.com	-$168.20	$8000.00
10/18/00	Good Guy's	-67.61	7932.39
11/02/00	Safeway	-39.02	7893.37
11/10/00	Borders	-50.00	7843.37
11/30/00	Max's	-29.73	7813.64
12/01/00	Safeway	-52.83	7760.81
12/01/00	Valero	-17.96	7742.85
12/06/00	DEPOSIT	+500.00	8242.85
12/10/00	Target	-18.94	8223.91
12/24/00	FAO Schwartz	-293.02	7930.89
12/24/00	Macy's	-108.91	7821.98
12/24/00	Sharper Image	-205.09	7616.89
12/24/00	Safeway	-61.93	7554.96
12/26/00	Fry's	-87.65	7467.31
12/30/00	RadioShack	-19.81	7447.50
01/04/01	DEPOSIT	+500.00	7947.50
01/14/01	Safeway	-62.71	7884.79
02/14/01	Godiva's	-114.32	7770.47

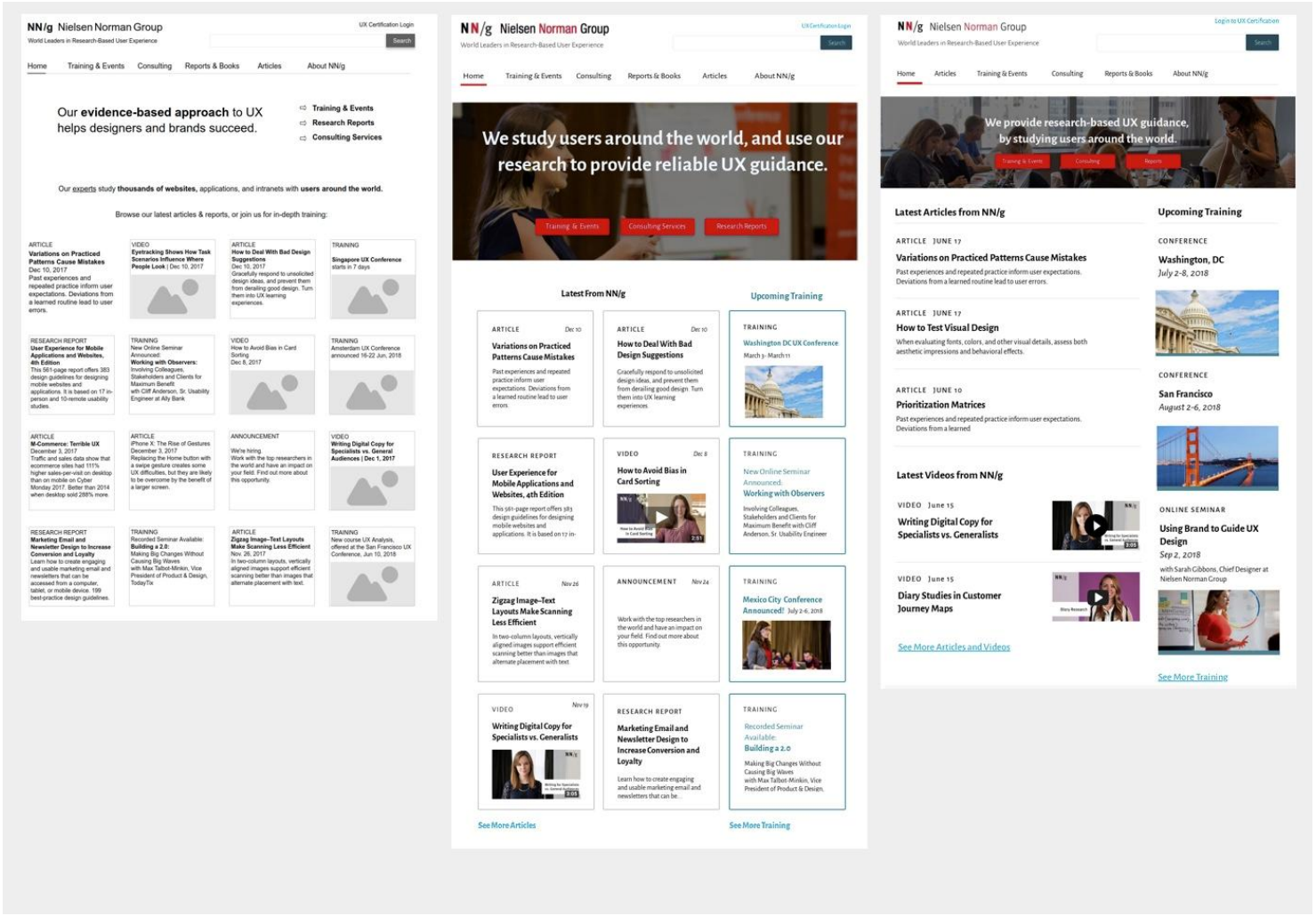
Examples of HFP: Mobile App



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.

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

Evolution of Prototypes (Low to High Fidelity Prototype)

- **Example :** iPhone ColorMood Designer from Low Fidelity to High Fidelity Prototype.
  - https://www.youtube.com/watch?v=V8LNDqMIapY

Advantages & Disadvantages

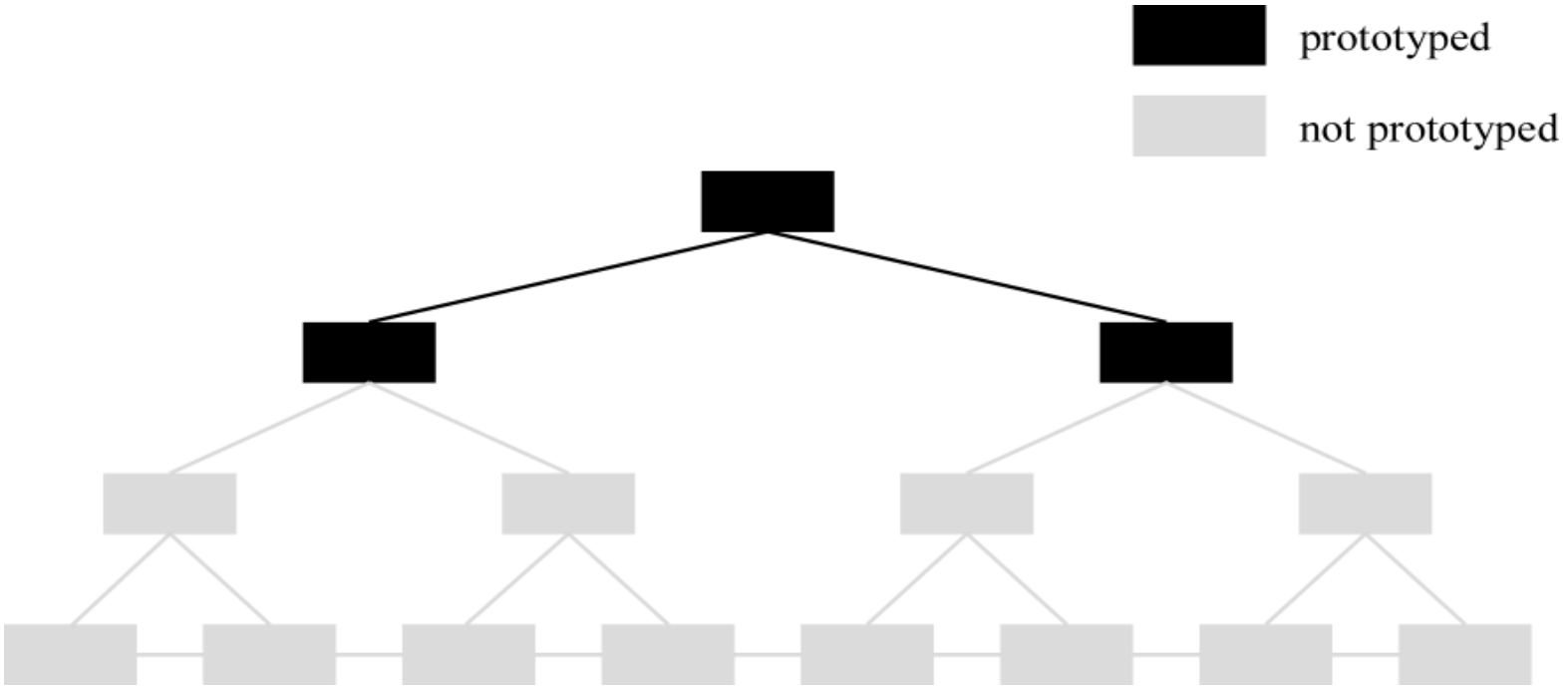
Type	Advantages	Disadvantages
Low-fidelity prototype	Lower development cost Evaluates multiple design concepts Useful communication device Addresses screen layout issues Useful for identifying market requirements Proof of concept	Limited error checking Poor detailed specification to code to Facilitator-driven 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

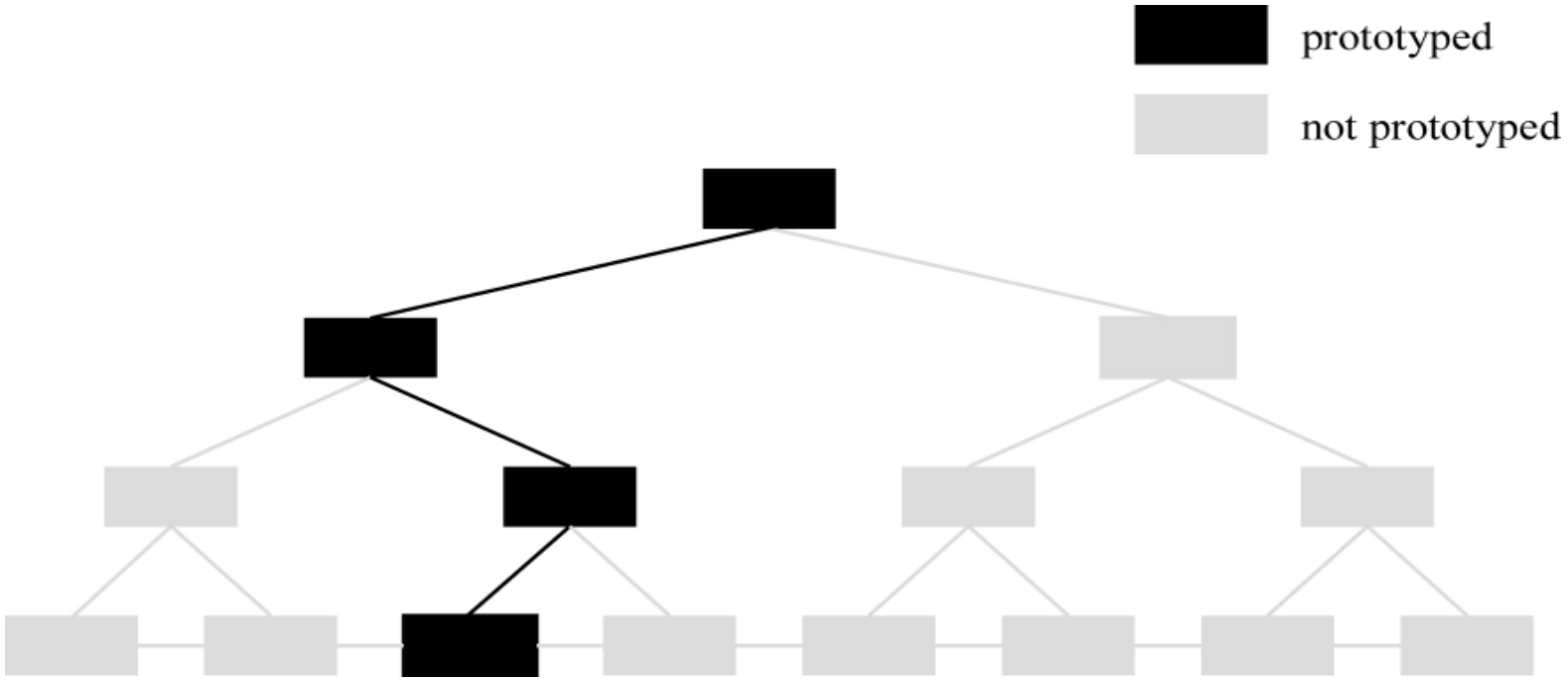
- All prototypes involve compromises
- For software-based prototyping maybe there is a slow response? sketchy icons? limited functionality?
- Two common types of compromise
  - **horizontal**: provide a **wide range** of functions, but with **little detail**
  - **vertical**: provide a lot of **detail** for only a **few functions**
- Compromises in prototypes mustn't be ignored. Product needs engineering

Horizontal Prototype: Broad but only Top-Level



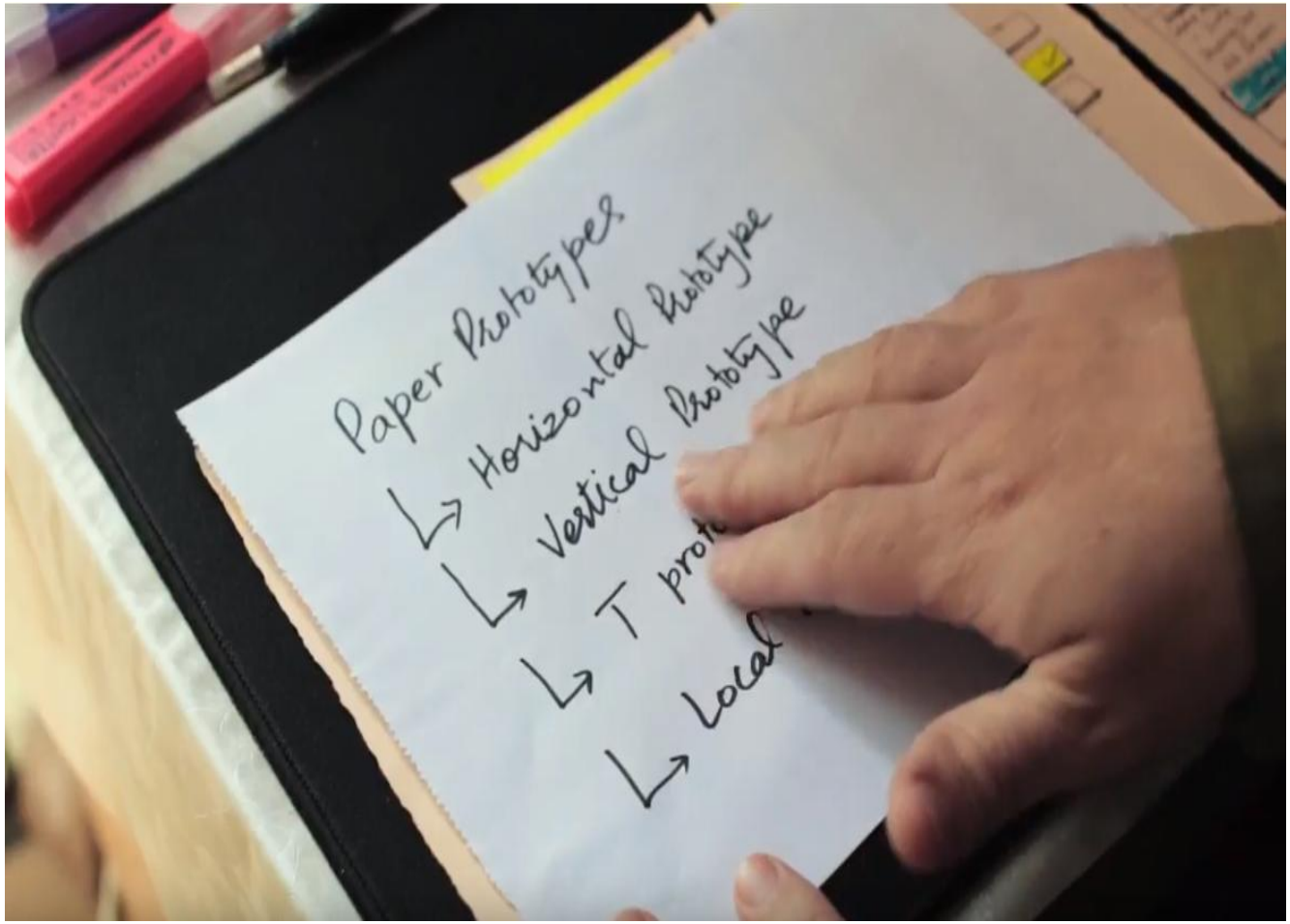
provide a **wide** range of functions, but with **little detail**

Vertical Prototype: Deep, but only Some Functions



full functionality and performance of a “slice” or small part of the system

Examples of compromises: Horizontal and vertical



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

CONCEPTUAL DESIGN

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Conceptual design

- Transform 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
- Mood board may be used to capture feel
- Consider alternatives: prototyping helps

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 or exploring
- Do different interface types provide insight?
  - shareable, tangible, augmented reality, etc.

Expanding the initial conceptual model

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

CONCRETE DESIGN

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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

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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

Generate storyboard from scenario

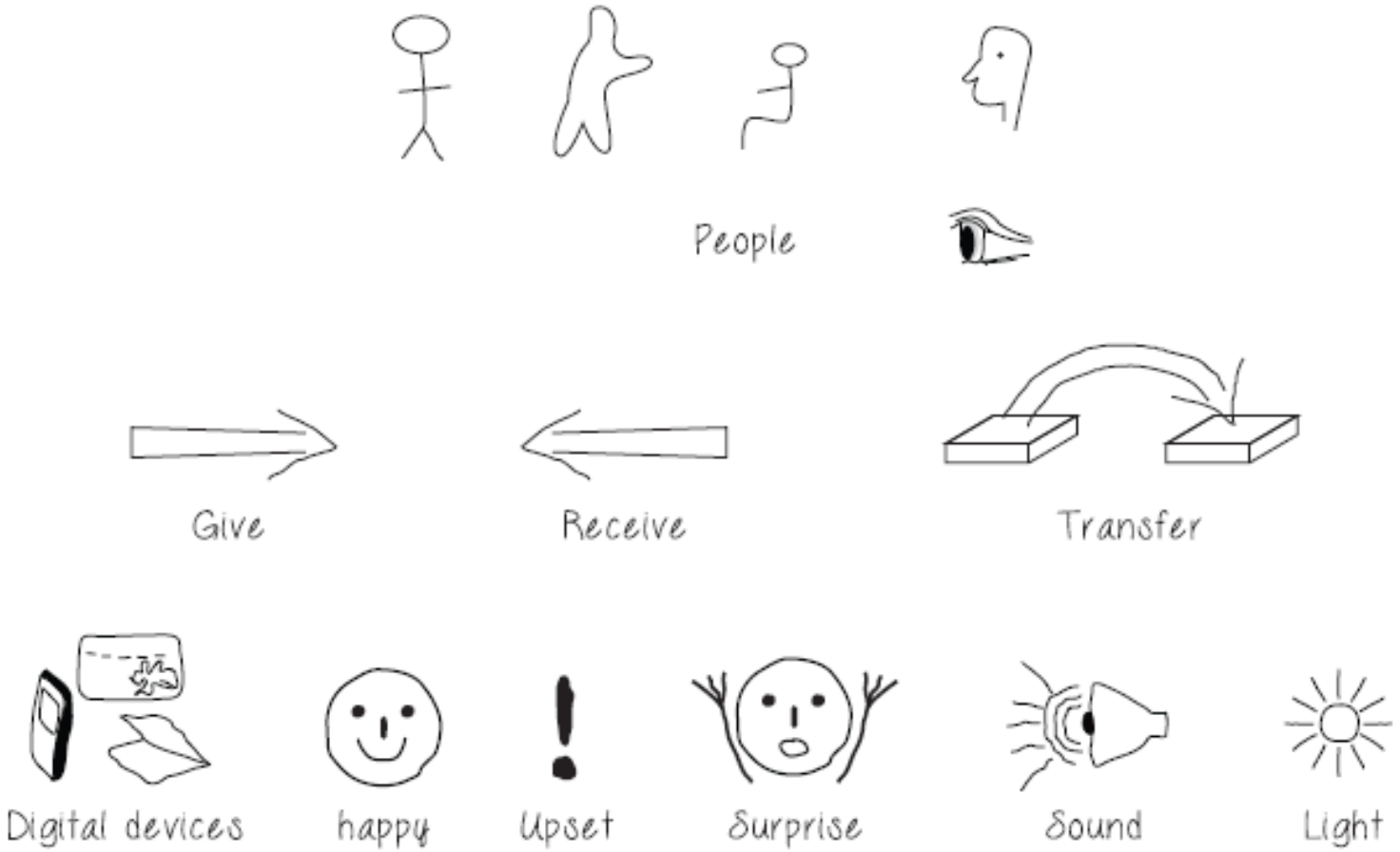
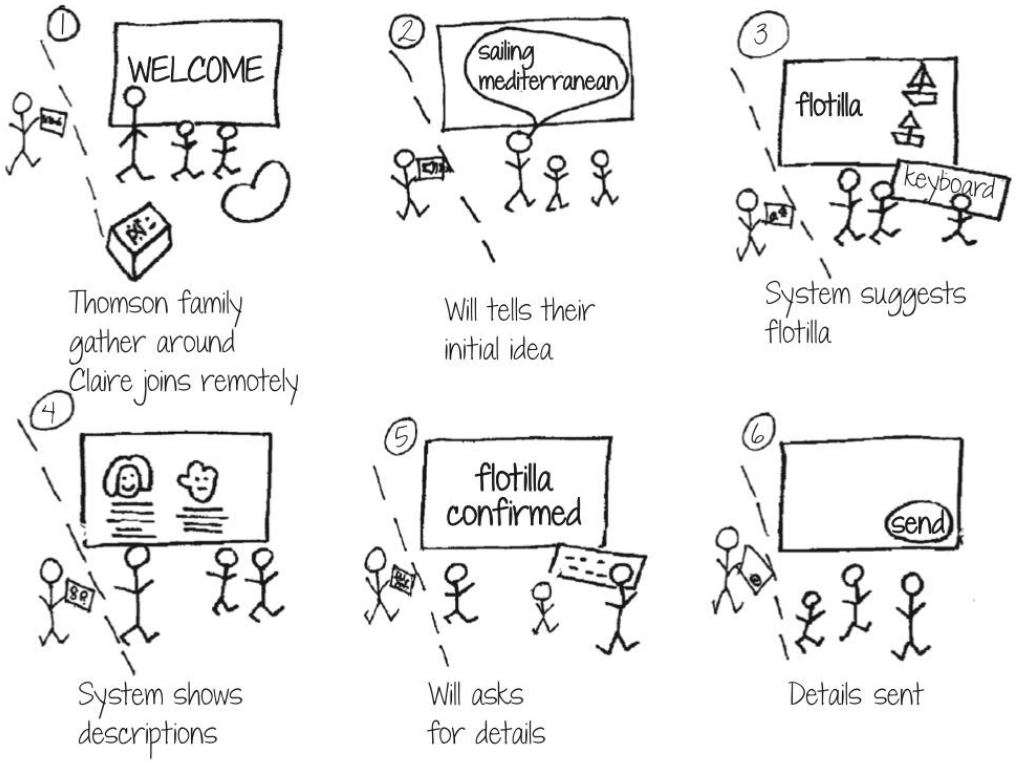
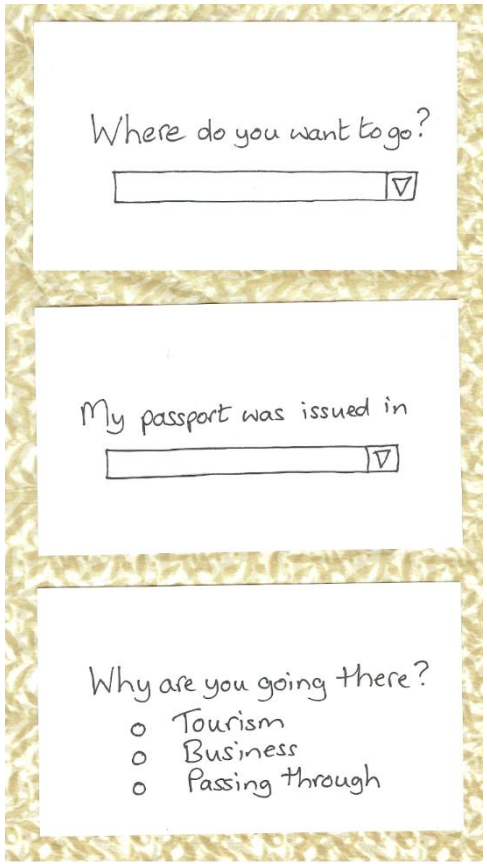


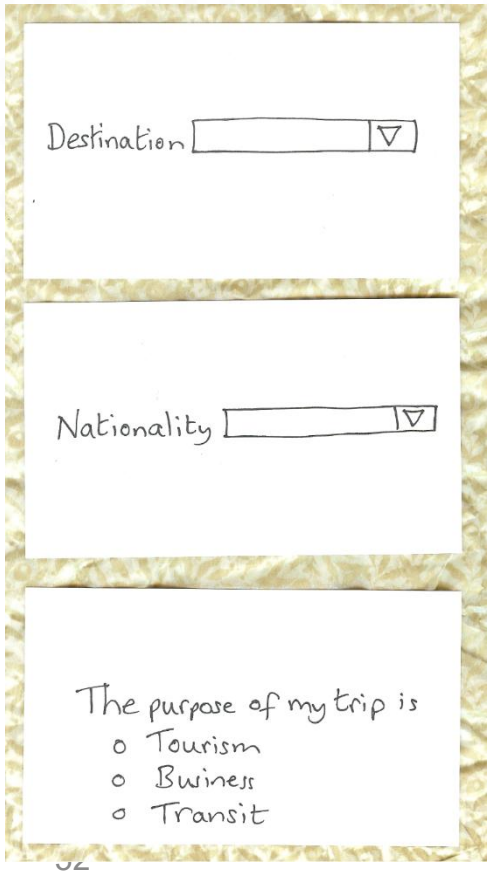
Figure 11.4 Some simple sketches for low-fidelity prototyping

Generating Storyboard



Generating Card-based Prototype



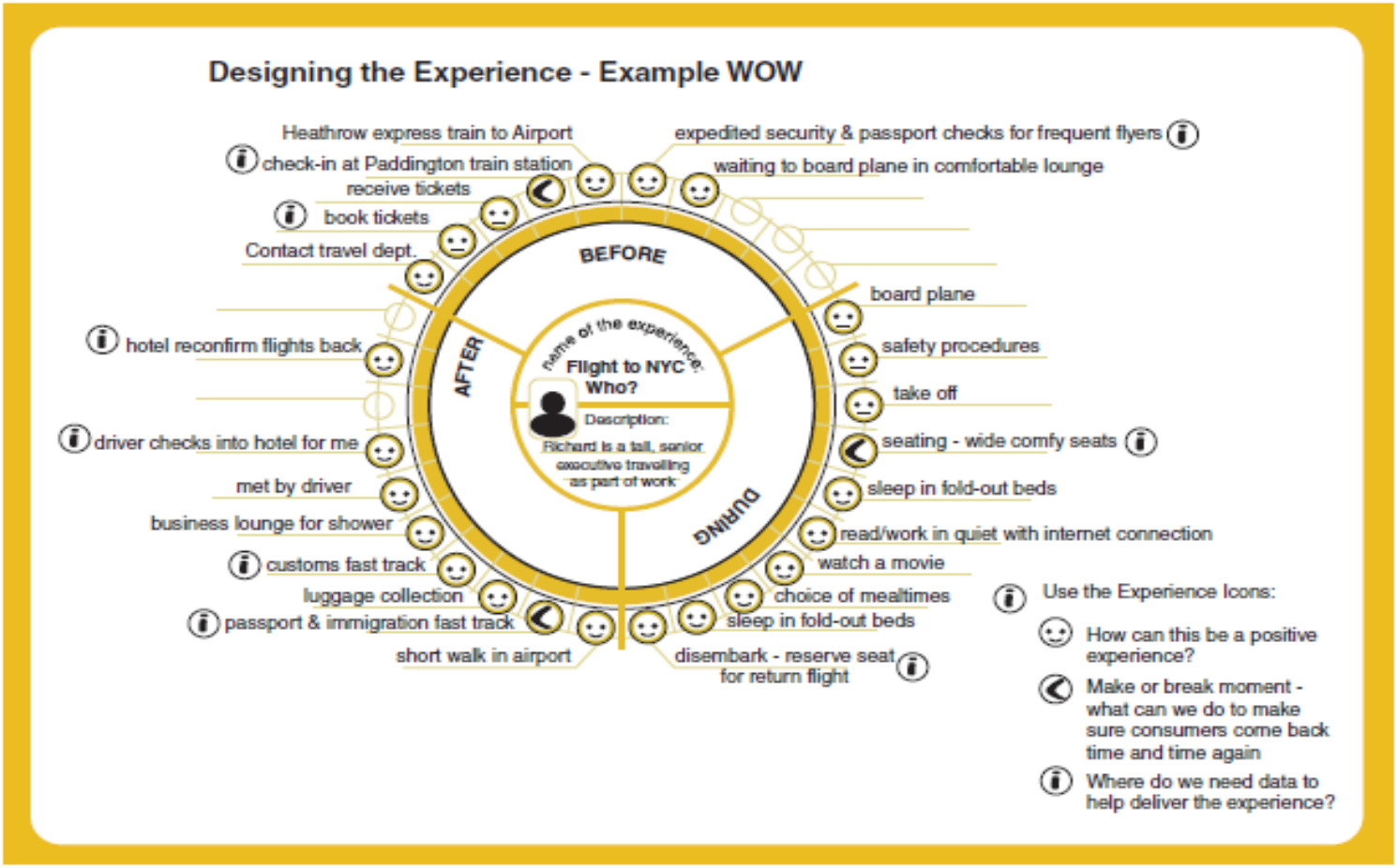


EXPLORE THE USER'S EXPERIENCE

Explore the user's experience

- Combination of **personas**, **prototypes**, or stickies to model the overall **experience**
- Visual representation called:
  - design map
  - customer/user journey map
  - 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

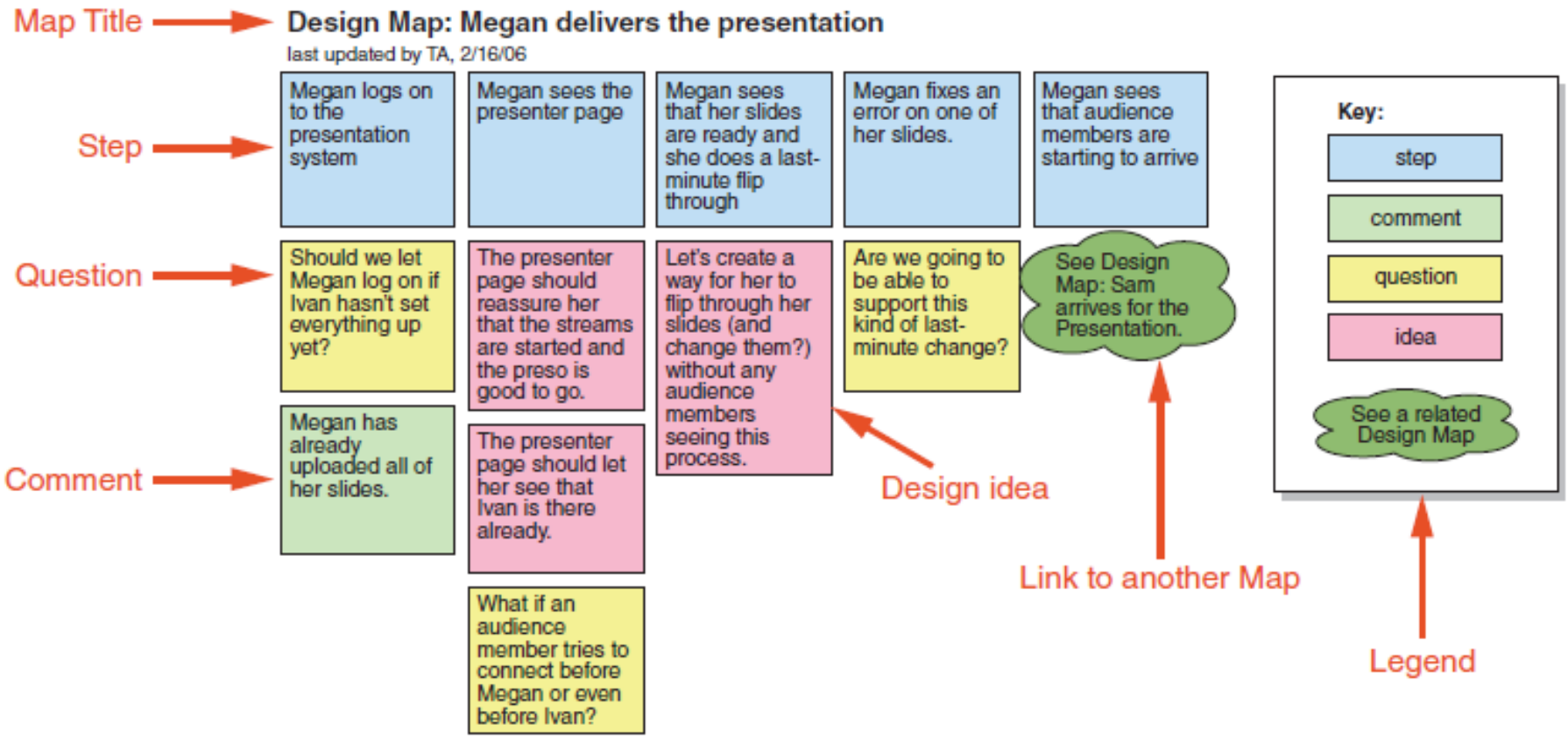


(a)

Figure 11.19 (a) An experience map using a wheel representation. (b) An example timeline design map illustrating how to capture different issues.

Source: (a) http://www.ux-lady.com/experience-maps-user-journey-and-more-exp-map-layout/ (b) Adlin, T. and Pruitt, J. (2010) *The Essential Persona Lifecycle: Your guide to building and using personas*. Morgan Kaufmann p. 134.

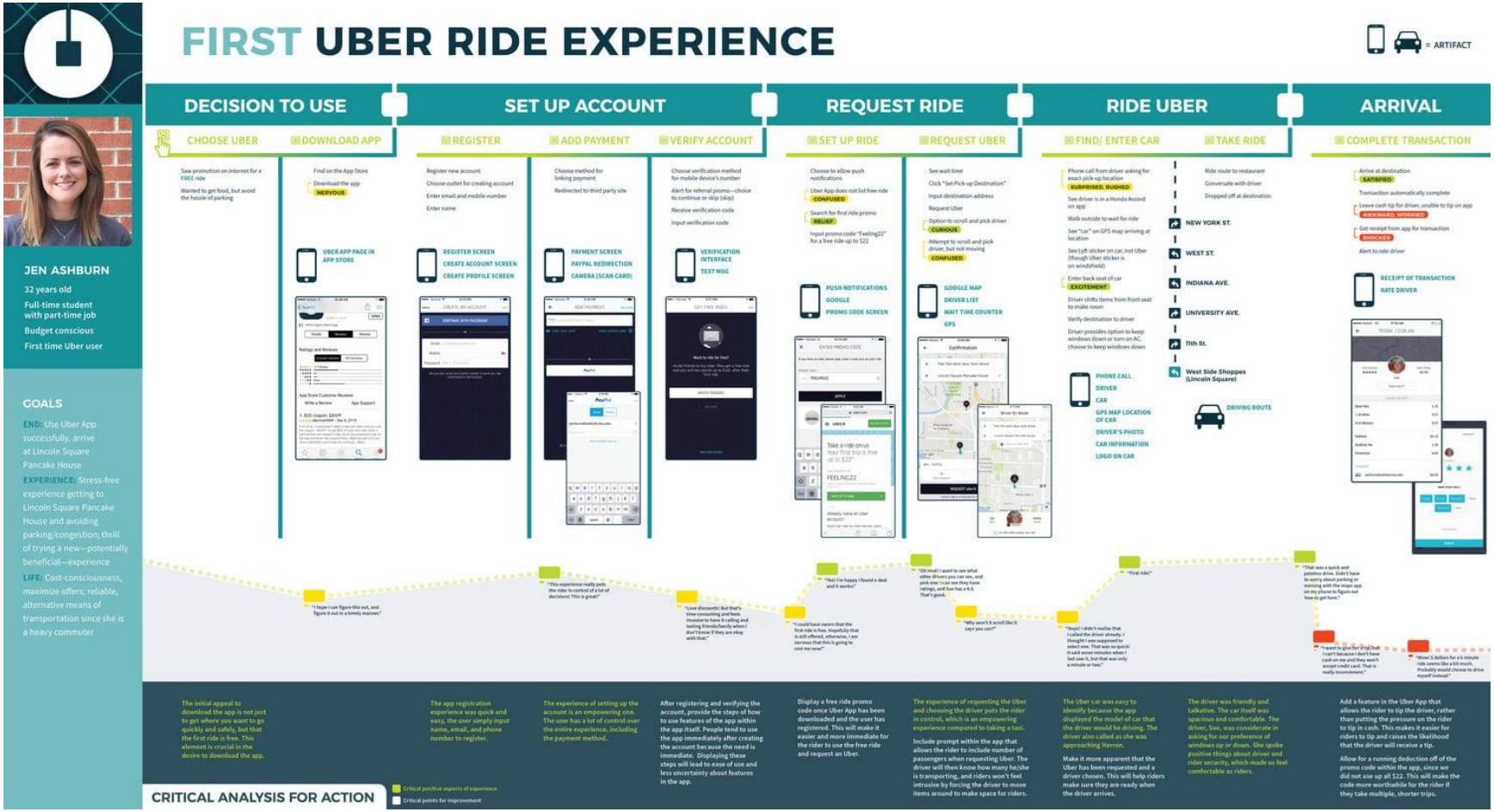
An experience map drawn as a timeline



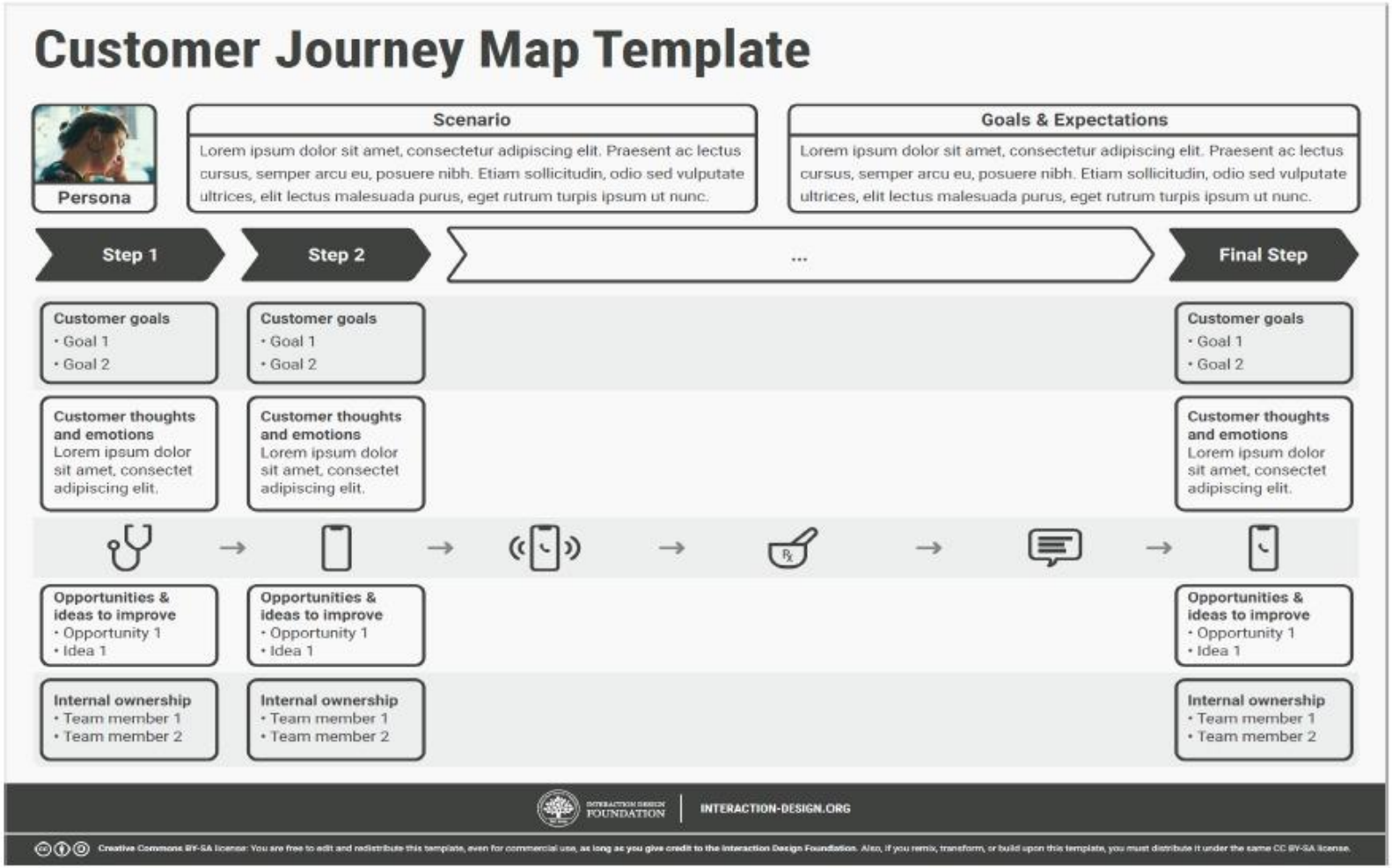
(b)

Figure 11.19 Continued

User Journey Map



Customer Journey Map



CONSTRUCTION

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Construction: physical computing

- Build and code prototypes using **electronics**
- Toolkits available include
  - Arduino
  - LilyPad (for fabrics)
  - Senseboard
  - MaKey MaKey
- Designed for use by wide range of people

Physical computing kits: Arduino Board

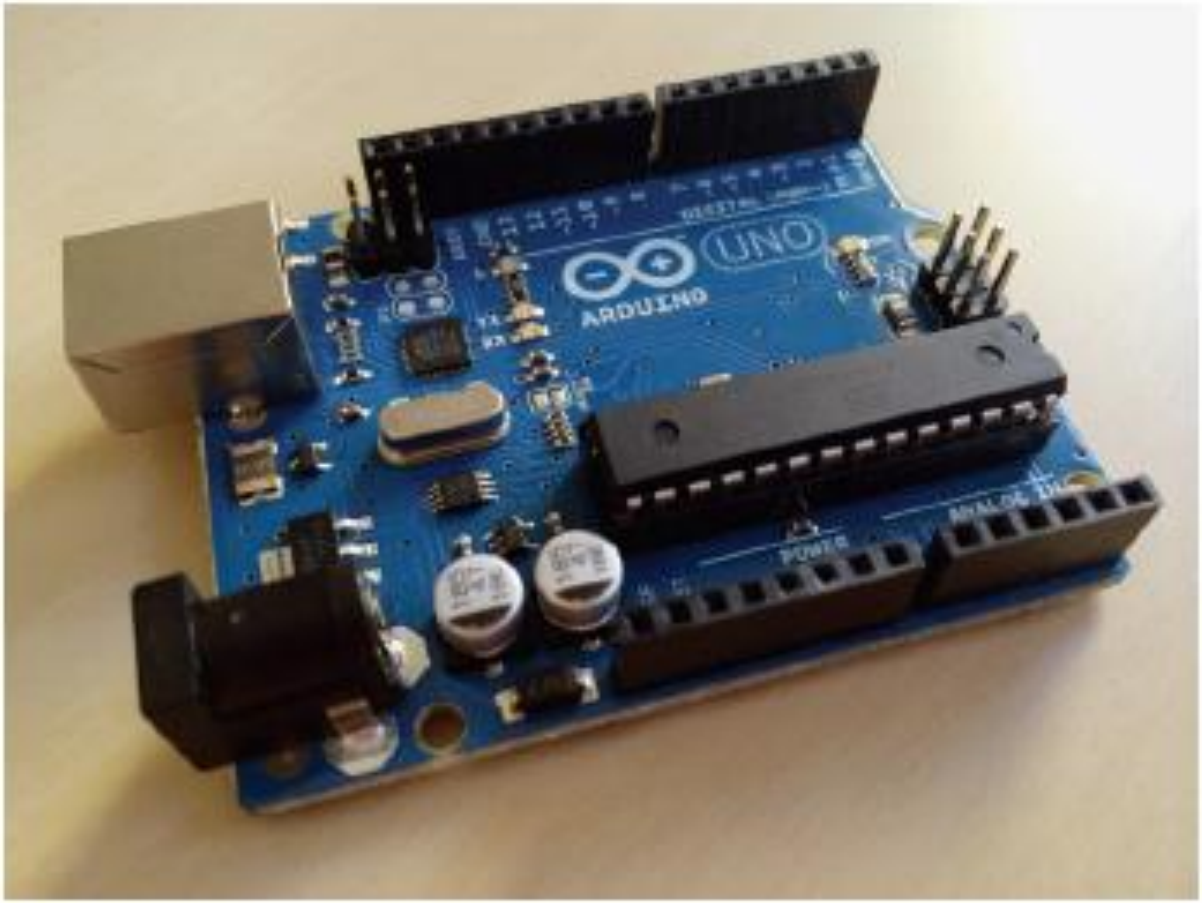
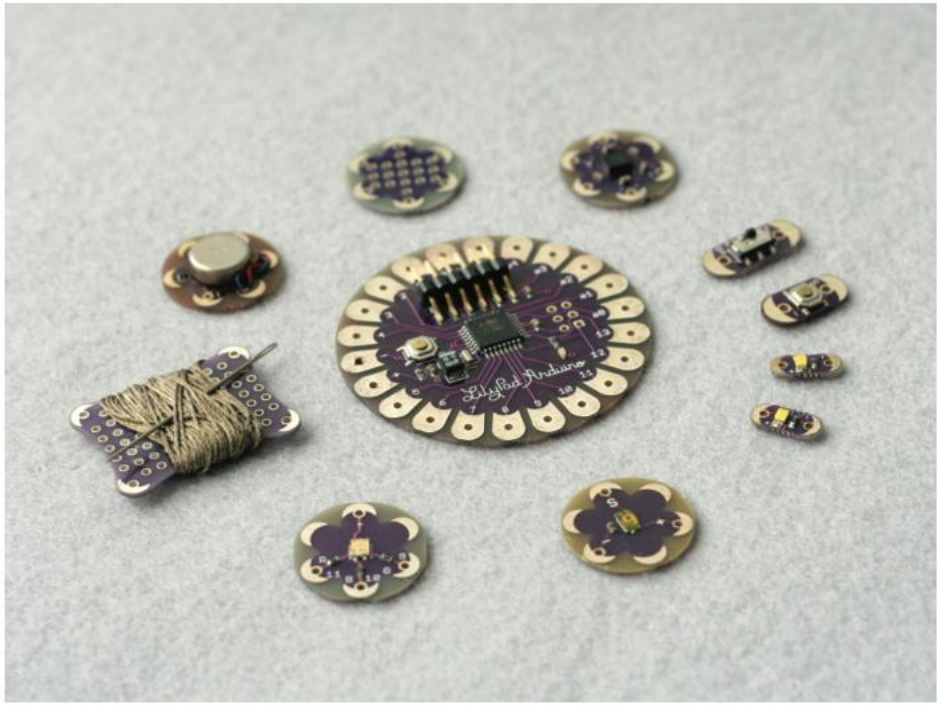


Figure 11.22 The Arduino board

Source: Courtesy of Nicolai Marquardt

Physical Computing Kits: Lilypad Arduino



Source: Courtesy of Leah Beuchley

Physical Computing Kits: MaKey MaKey

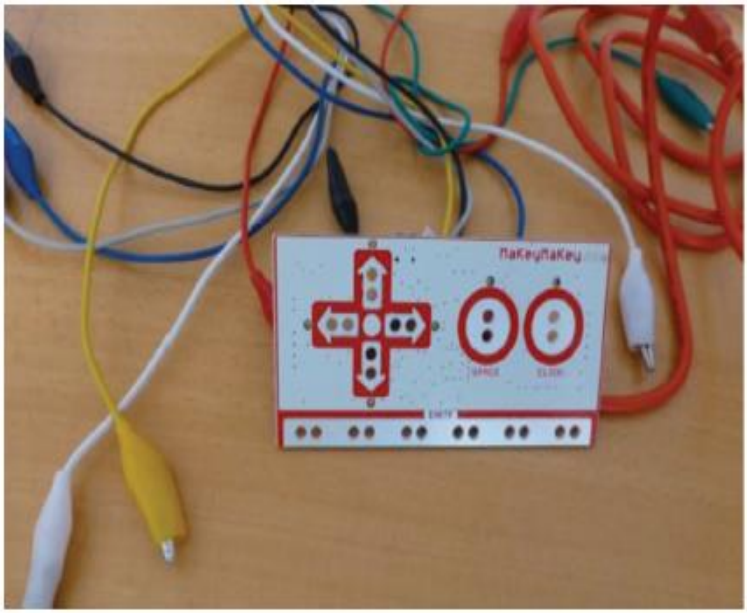
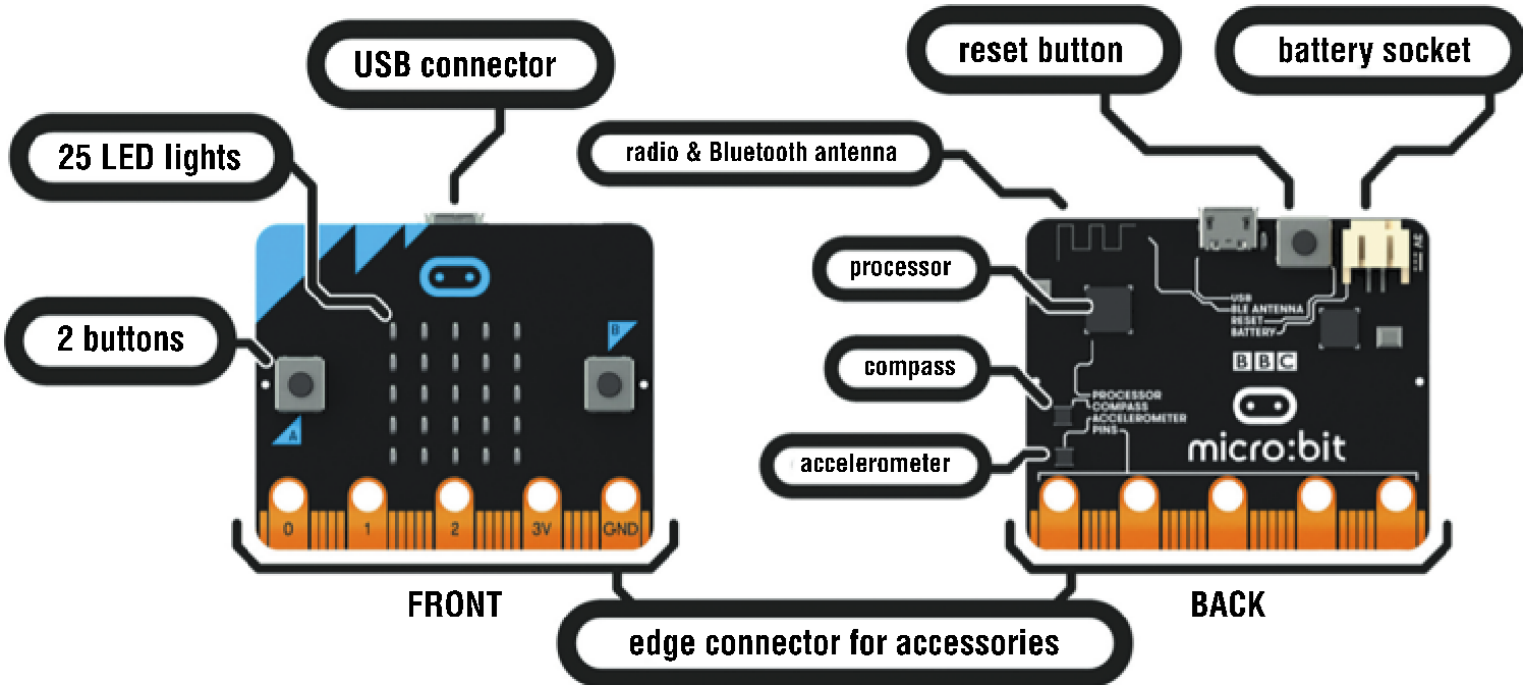


Figure 11.24 The MaKey MaKey toolkit

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

Physical computing kits: Micro:bit



The BBC micro:bit

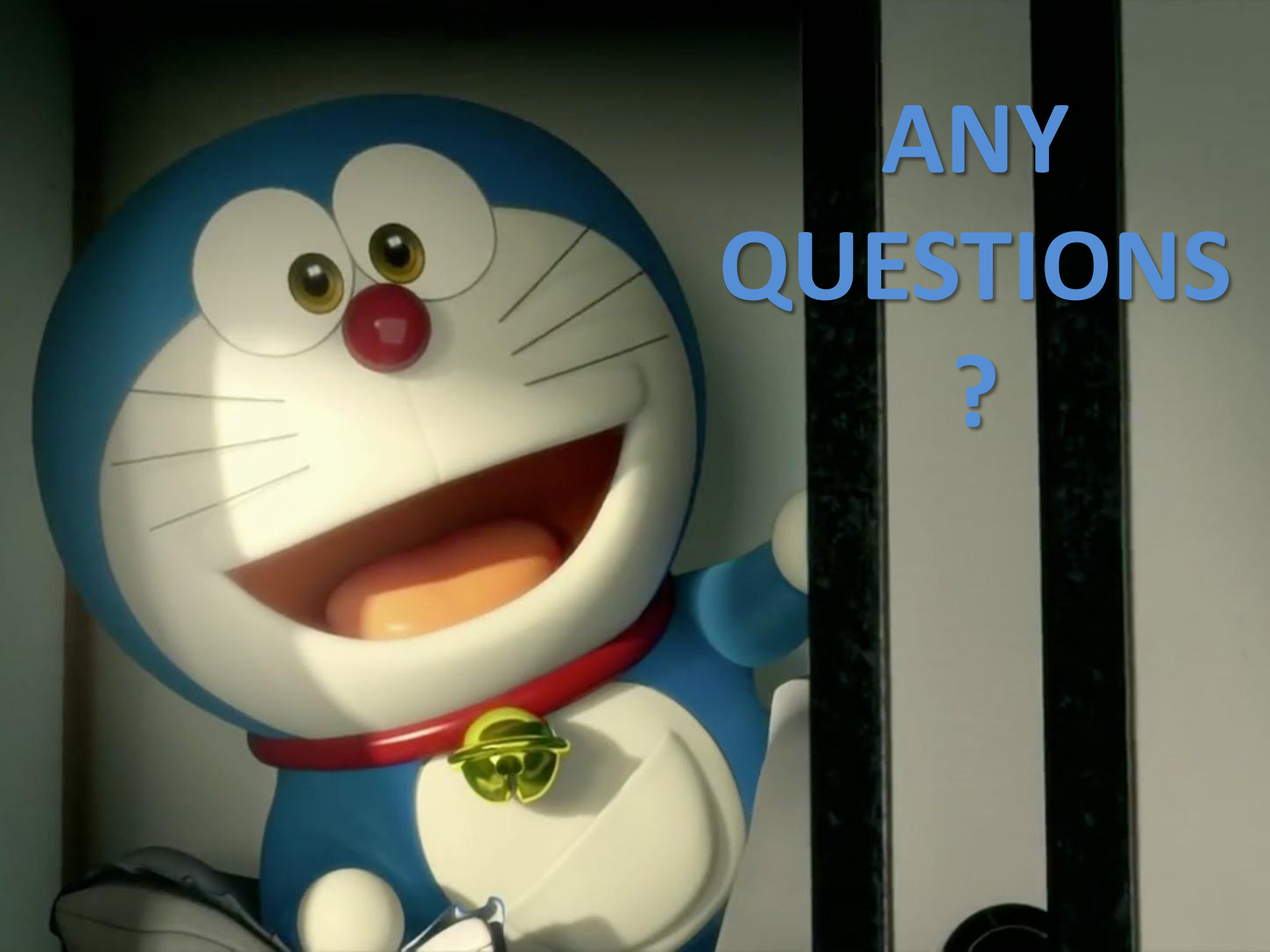
Source: micro:bit. Used courtesy of Micro:bit Foundation

Construction: SDKs

- Software Development Kits
  - programming tools and components to develop for a specific platform, e.g. iOS
- Includes: IDE, documentation, drivers, sample code, 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


ANY
QUESTIONS
?

- **The 10 best prototyping tools for UI/UX designers [2025 Update]**
  - https://www.uxdesigninstitute.com/blog/best-prototyping-tools-for-ux-designers/?utm_source=chatgpt.com