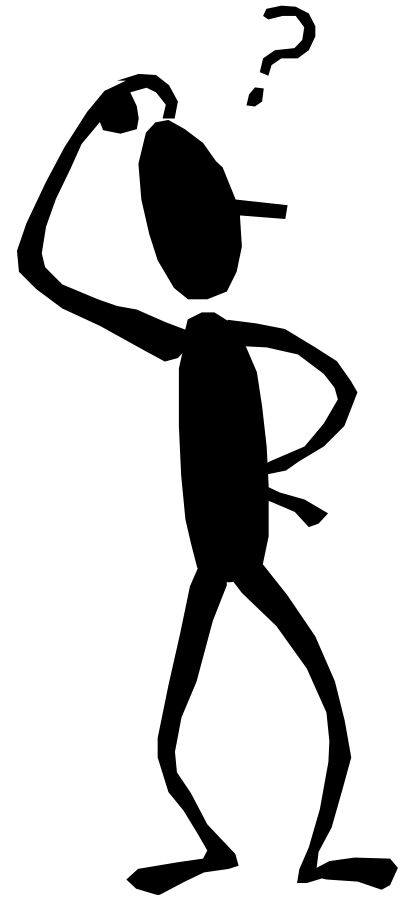


Chapter 12

DESIGN, PROTOTYPING and CONSTRUCTION

Overview

- Prototyping
- Conceptual design
- Concrete design
- Generating prototypes
- Construction



Designing with or for People?

- Is stakeholder engagement one-way?
- Co-design
 - Emphasizes 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

- 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

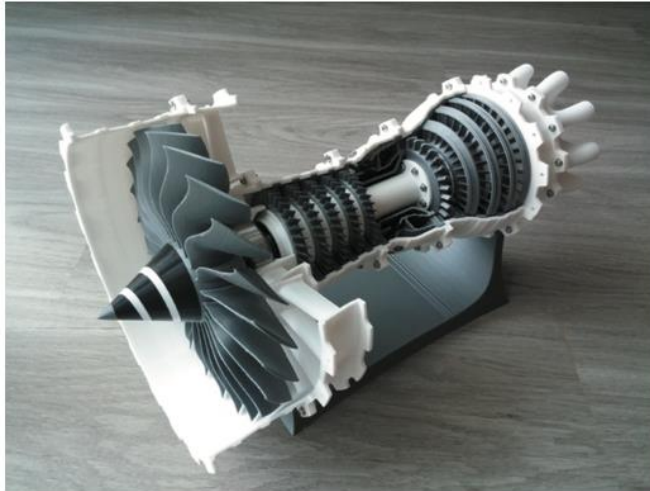
What is a prototype?

- 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

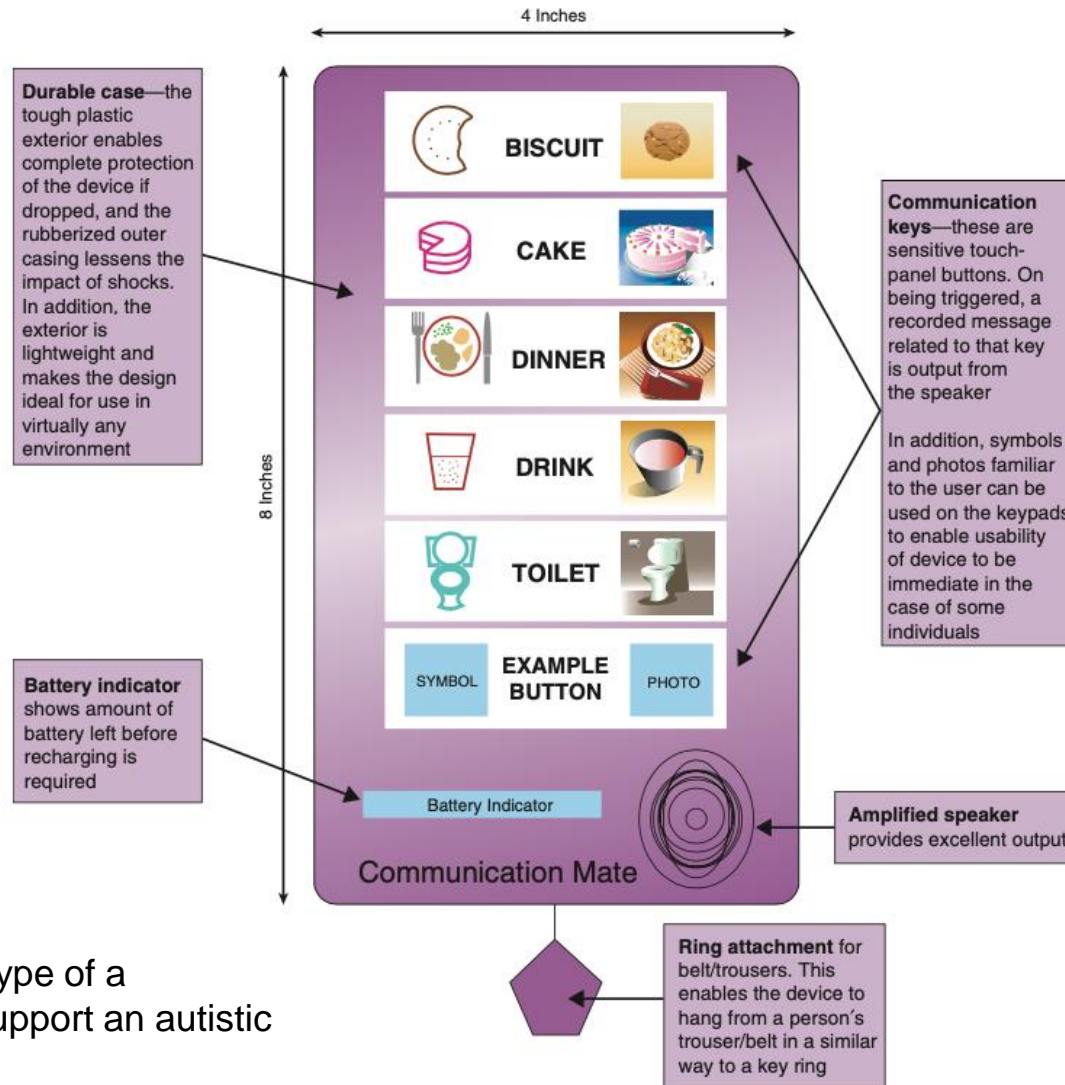
Source: (a) Catiav5ftw / MakerBot Industries, LLC / CC BY-NC 4.0, www.thingiverse.com/thing:392115. Licensed under CC-BY-3.0, (b) ANOUK WIPPRECHTSYNAPSE DRESS created for Intel in 2014, www.niccolocasas.com/ SYNAPSE-DRESS, and (c) Photo Credits: ATHOS

What is a prototype in interaction design?

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 interaction design prototype



A paper-based prototype of a handheld device to support an autistic child

Used courtesy of Sigil Khwaja

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

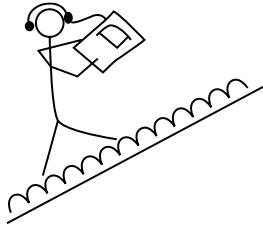
Low-fidelity Prototyping

- 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

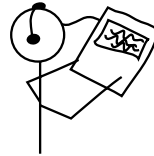
Storyboards

- 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

Example storyboard



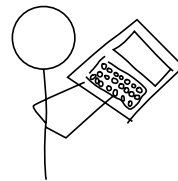
Christina walks up hill; the product gives her information about the site



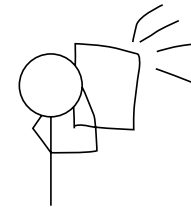
Christina adjusts the preferences to find information about the pottery trade in Ancient Greece



Christina scrambles to the highest point



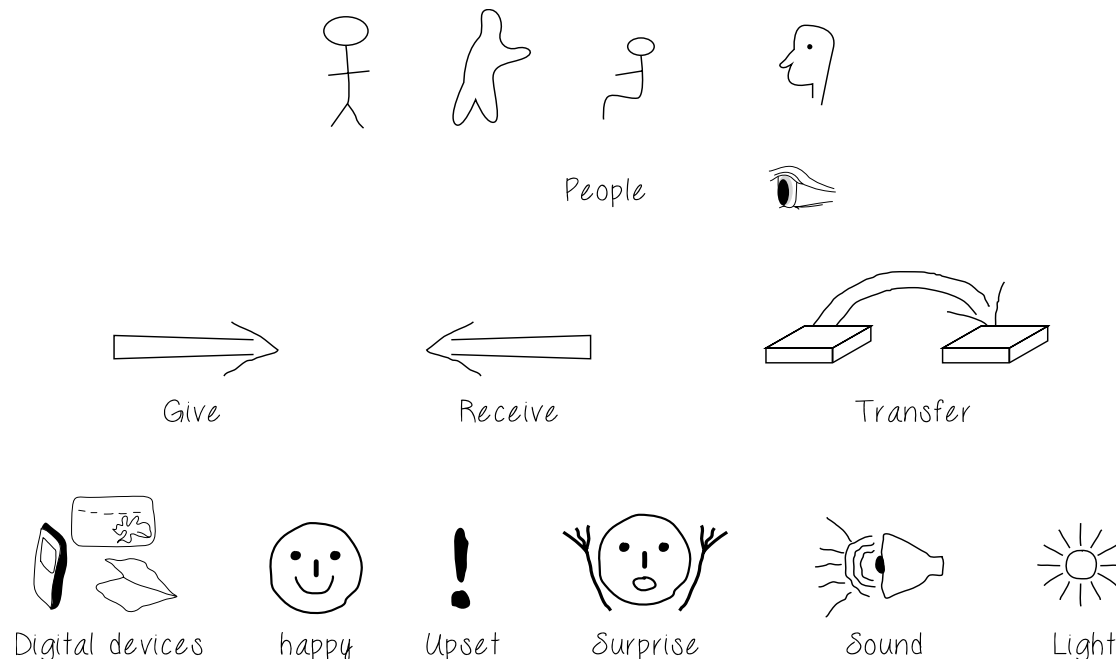
Christina stores information about the pottery trader's way of life in Ancient Greece



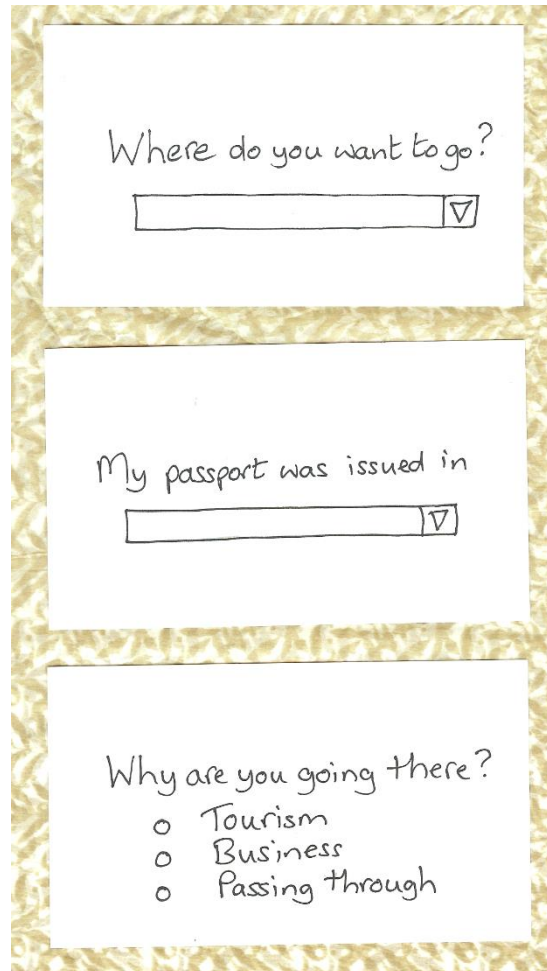
Christina takes a photograph of the location of the pottery market

Sketching

- Low-fidelity prototyping often relies on sketching
- Don't be inhibited about drawing ability — Practice simple symbols



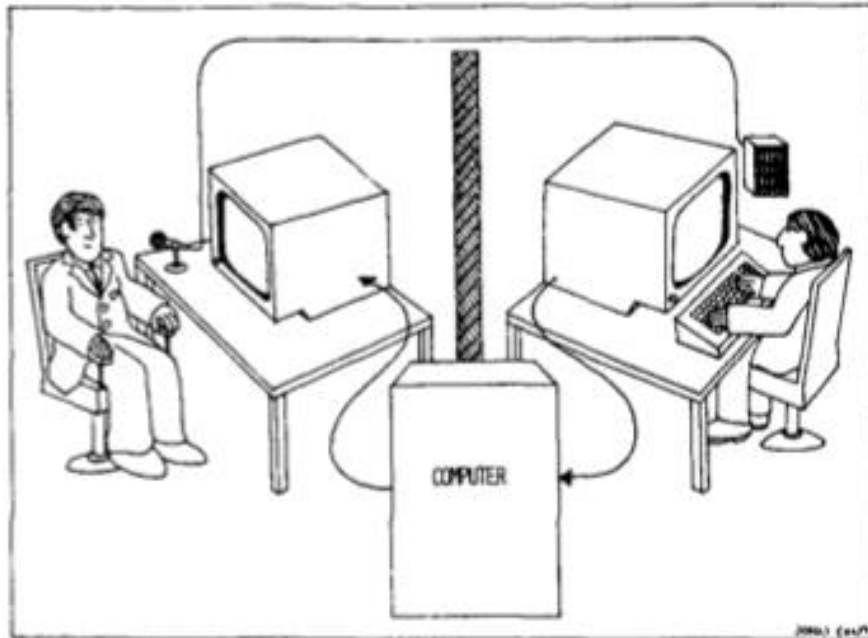
Prototyping with index cards



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

Wizard-of-Oz prototyping

- 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



- What ethical issues are there with this approach?

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

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

Conceptual design

- A conceptual model is an outline of what people can do with a product and what concepts are needed to understand how to interact with it
- Immerse in the data to understand problem space and current requirements
- Creativity and brainstorming techniques
- Mood board may capture desired feel
- Consider alternatives: scenarios and prototyping help

Building scenarios



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, and 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?
 - Categorizations, 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

- 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
- Localization and internationalization
 - Language, navigation, icons, and metaphor
 - Indigenous knowledge and perspectives

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

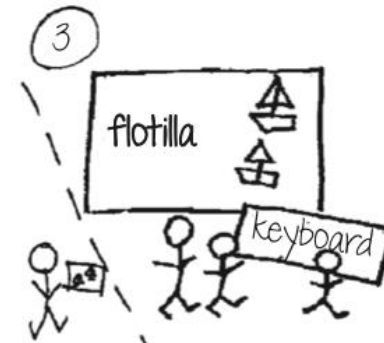
Generating storyboard



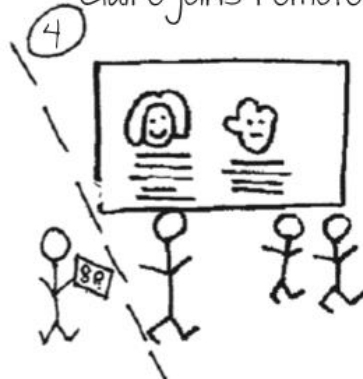
Thomson family
gather around
Claire joins remotely



Will tells their
initial idea



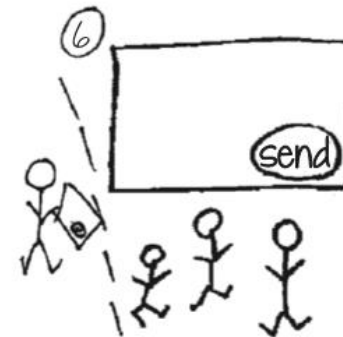
System suggests
flotilla



System shows
descriptions



Will asks
for details



Details sent

Generating card-based prototype

Where do you want to go?

My passport was issued in

Why are you going there?

- Tourism
- Business
- Passing through

Destination

Nationality

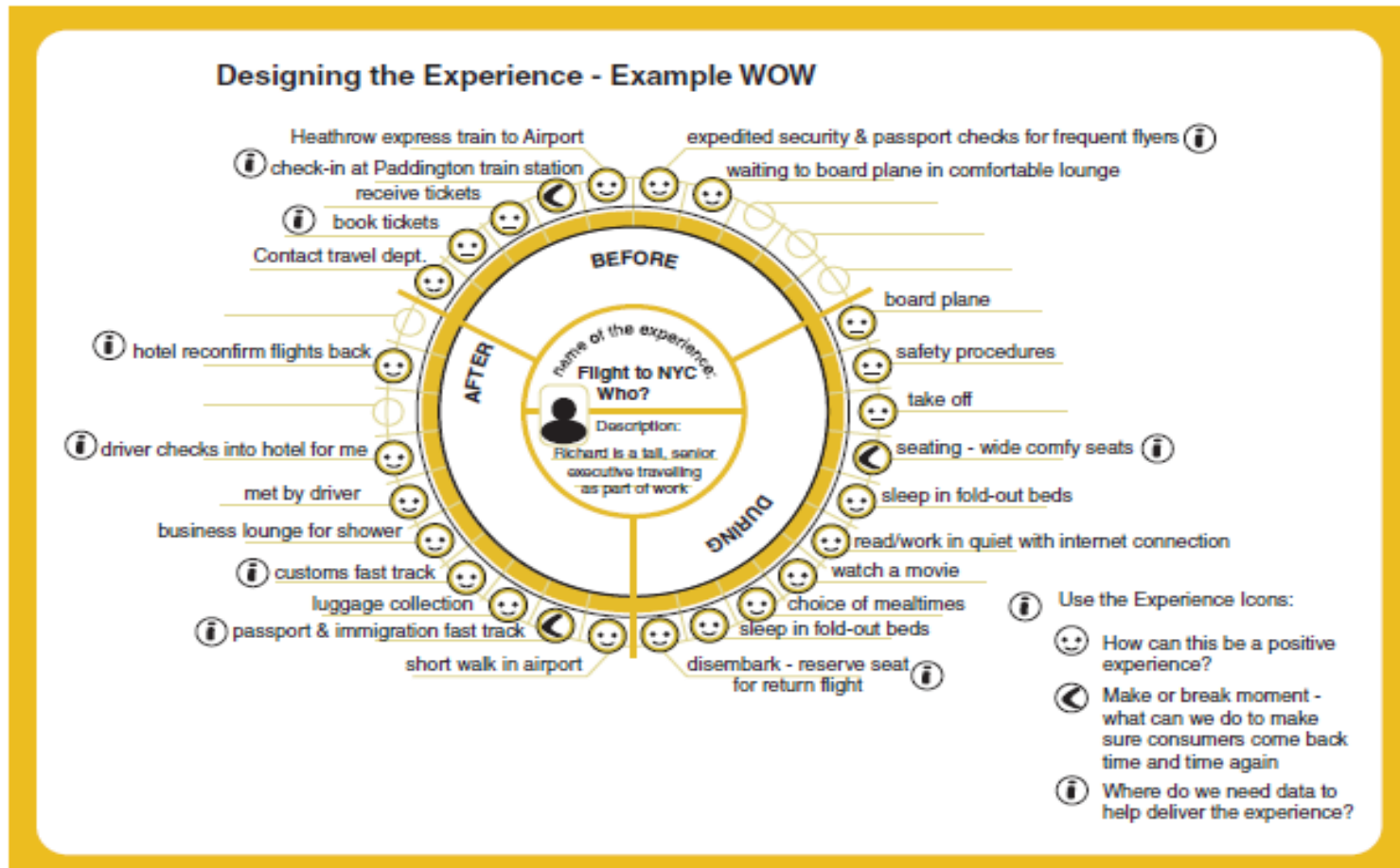
The purpose of my trip is

- Tourism
- Business
- Transit

Mapping the overall experience

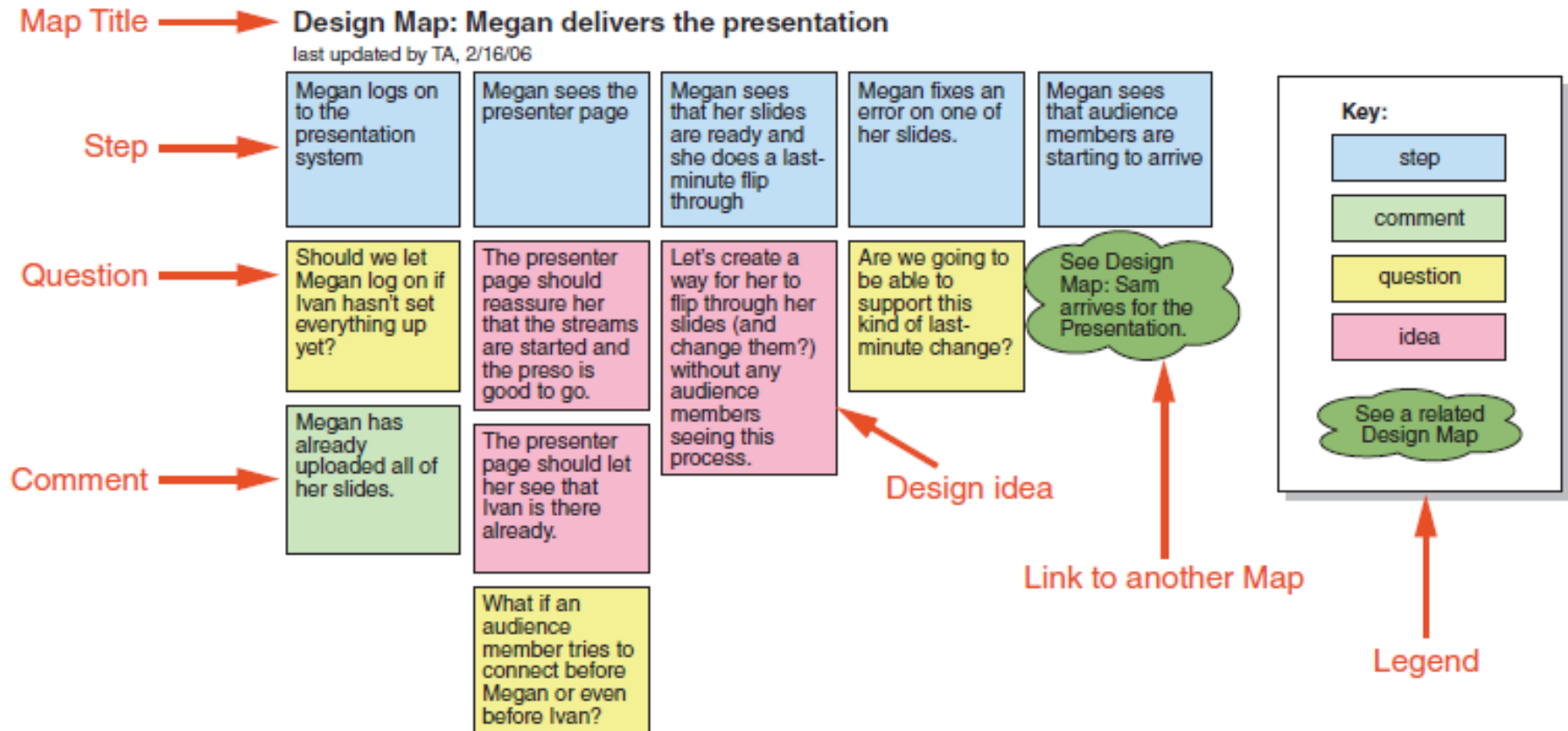
- Combination of personas, prototypes, or stickies to model the overall experience
- Visual representation called:
 - Design map
 - Customer journey map
 - Experience map
- Two common representations
 - Wheel
 - Timeline
- User flows focus on screen content and design, particularly used for mobile devices

An experience map drawn as a wheel



Source: [LEGO](#)

An experience map drawn as a timeline

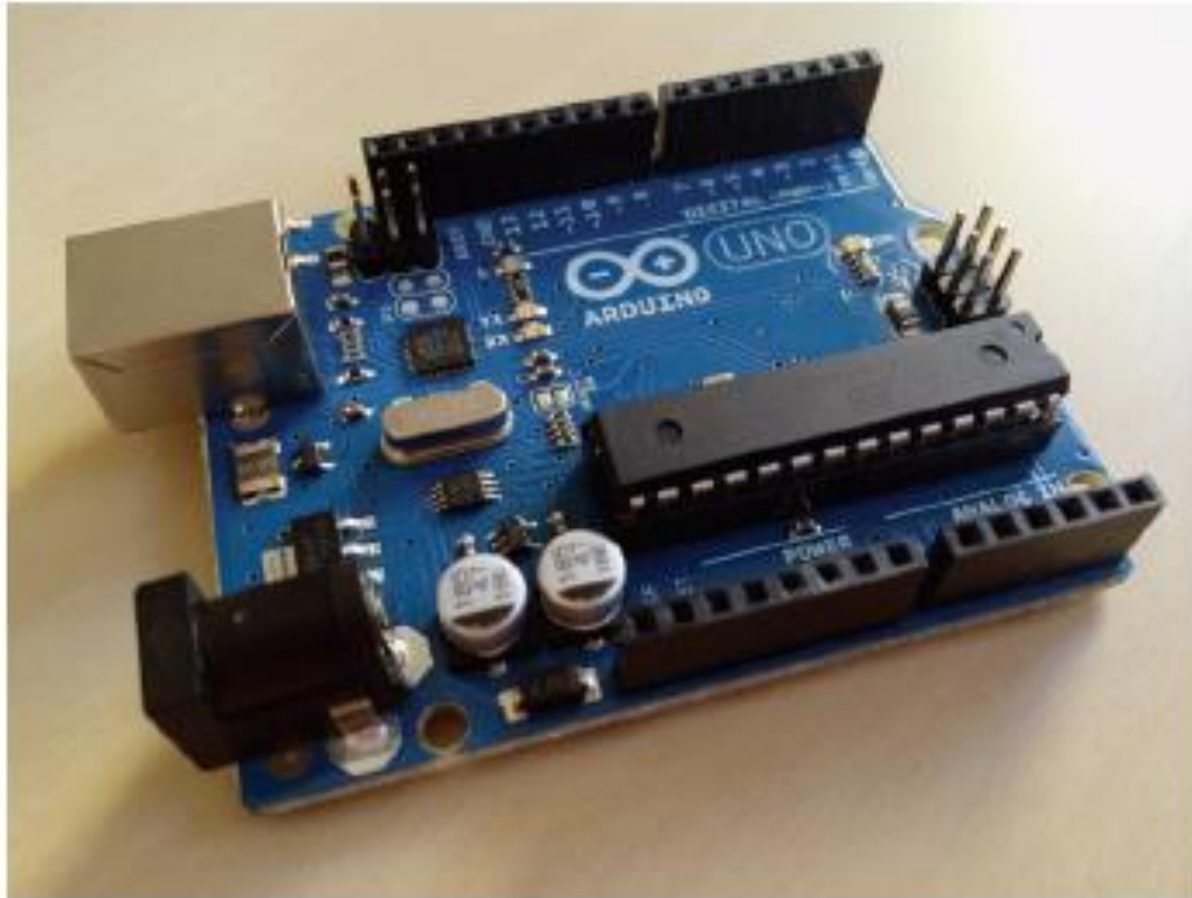


Source: Adlin and Pruitt (2010), p134. Used courtesy of [Morgan Kaufmann](#).

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

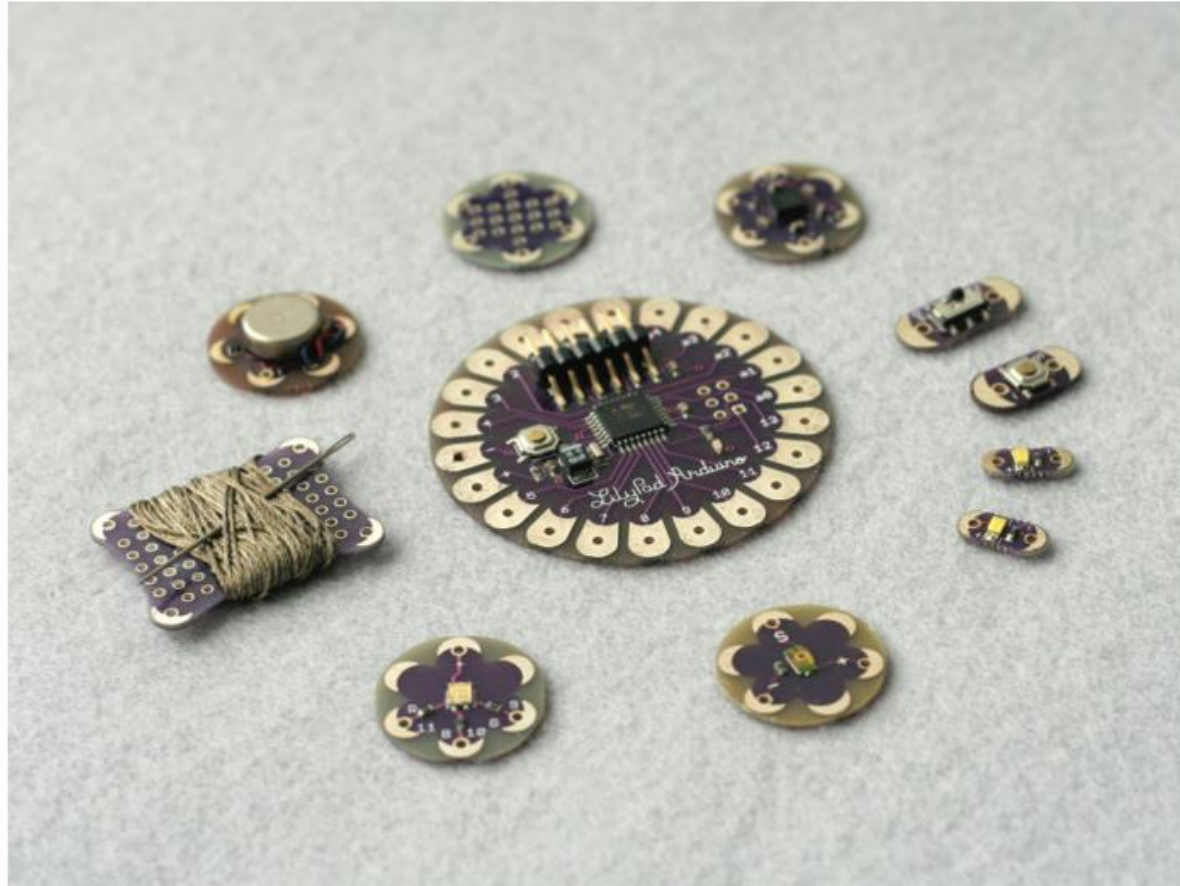
Physical computing kits ⁽¹⁾



The Arduino board

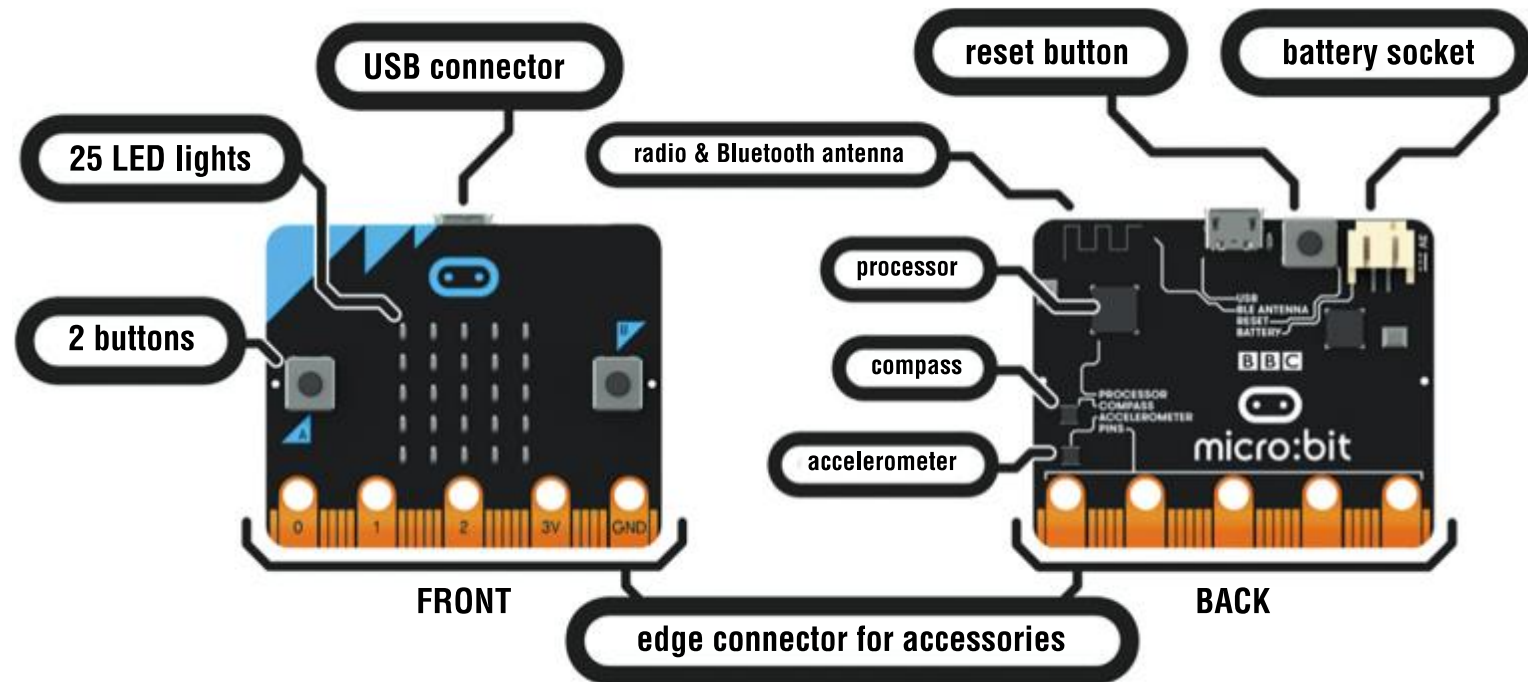
Source: Used courtesy of Dr. Nicolai Marquardt

Physical computing kits ⁽²⁾



The Lilypad Arduino kit *Source:* Courtesy of Leah Beuchley

Physical computing kits ⁽³⁾



The BBC micro:bit

Source: [micro:bit](https://microbit.org/). Used courtesy of Micro:bit Foundation

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

Summary (*continued*)

- 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