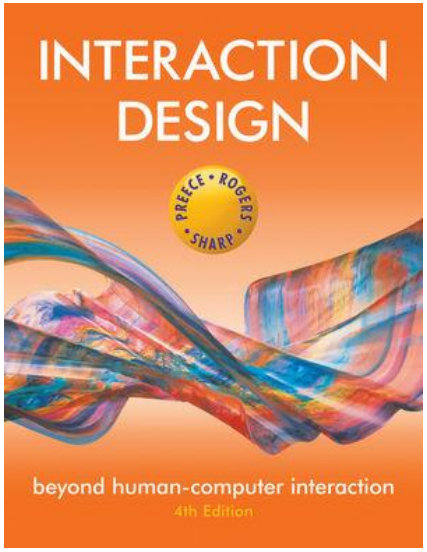


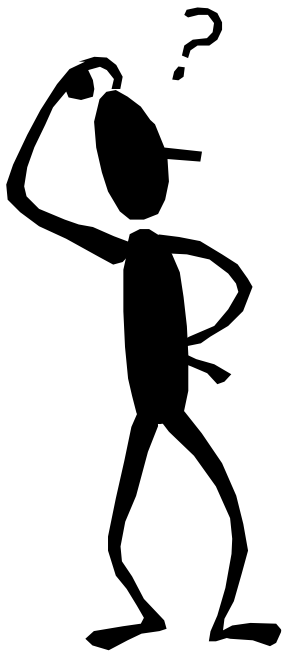
DESIGN, PROTOTYPING and CONSTRUCTION

Lecture 9

Slides adapted by dr Kristina Lapin

Overview

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



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 prototype?

- A prototype is one manifestation of a design
  - that allows stakeholders to interact with it and to explore its suitability
- it is limited
  - a prototype emphasizes one set of product characteristics and de-emphasizes others.

What is prototype?

SANTA CLARA, California: People thought Jeff Hawkins was crazy when they saw him taking notes, checking appointments, and synchronizing a small block of wood with his PC, pretending all the while that the block was a handheld computer.

“If I wanted to check the calendar I'd take it out and press the wooden button.”

Source: “The Philosophy of the Handheld.” Wired Magazine, October 1999.

Jeff Hawkins, Donna Dubinsky, and Ed Colligan (Palm Computing)
http://en.wikipedia.org/wiki/Palm_(PDA)

What is a prototype?

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

(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

What is a prototype?

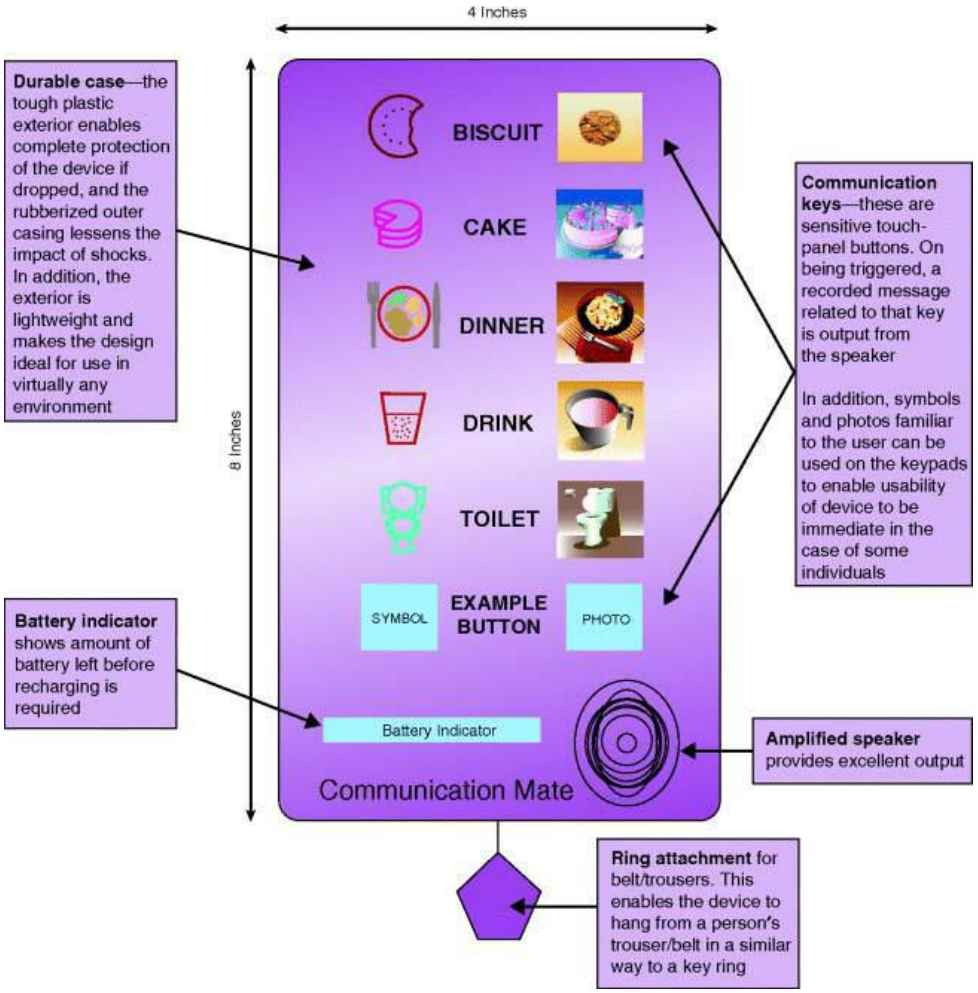
In interaction design it can be (among other things):

- 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 piece of software with limited functionality written in the target language or in another language

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

Prototype for autistic children



- Helps to clarify
  - Whether proposed design will support users in performing their tasks

Service prototypes

- Involve role playing
  - people are an integral part of the prototype as well as the product itself
- Service prototypes are sometimes captured as video scenarios

What to prototype?

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

Low-fidelity Prototyping

- 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
  - ‘post-it’ notes
  - storyboards
  - ‘Wizard-of-Oz’

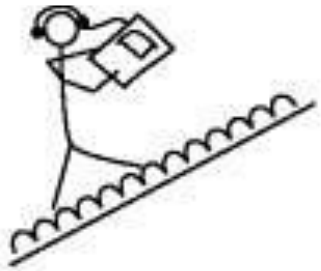
Low-fidelity prototyping

- Can not look like the final product
- May perform only a limited set of functions,
- May only represent the functions and not perform any of them
- Are useful because they tend to be simple, cheap, and quick to produce.

Storyboards

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

Storyboarding



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

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

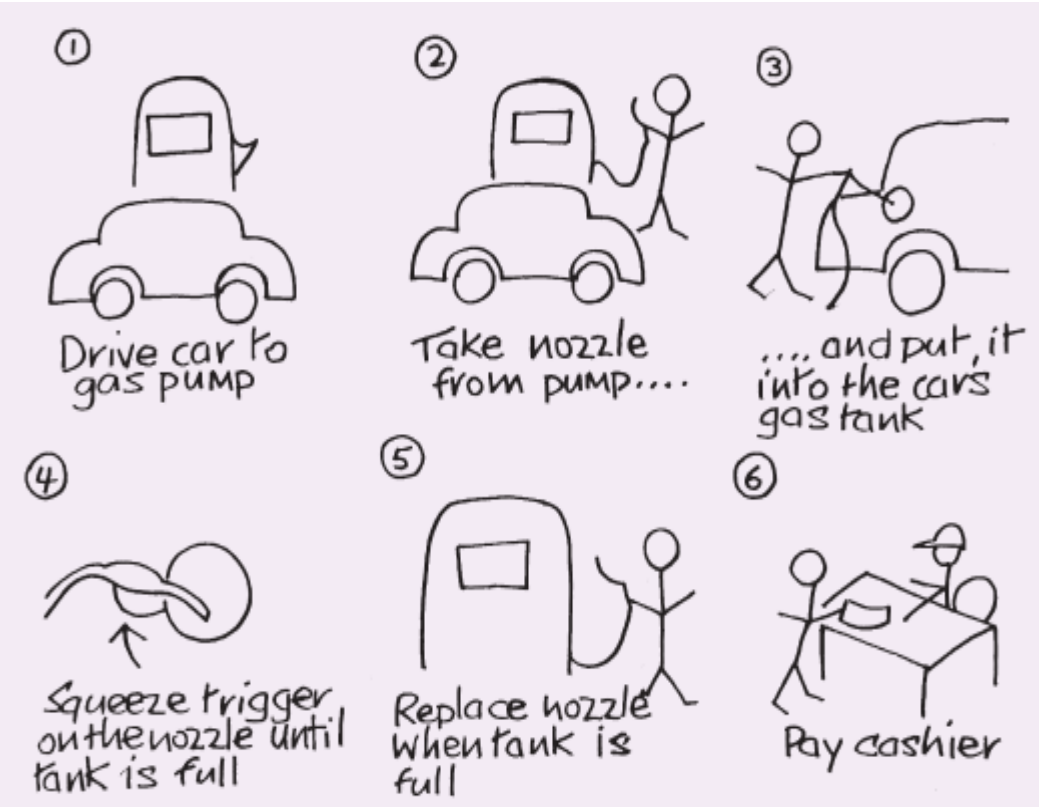


Figure 11.5 A storyboard depicting how to fill a car with gas

Generate storyboard from scenario

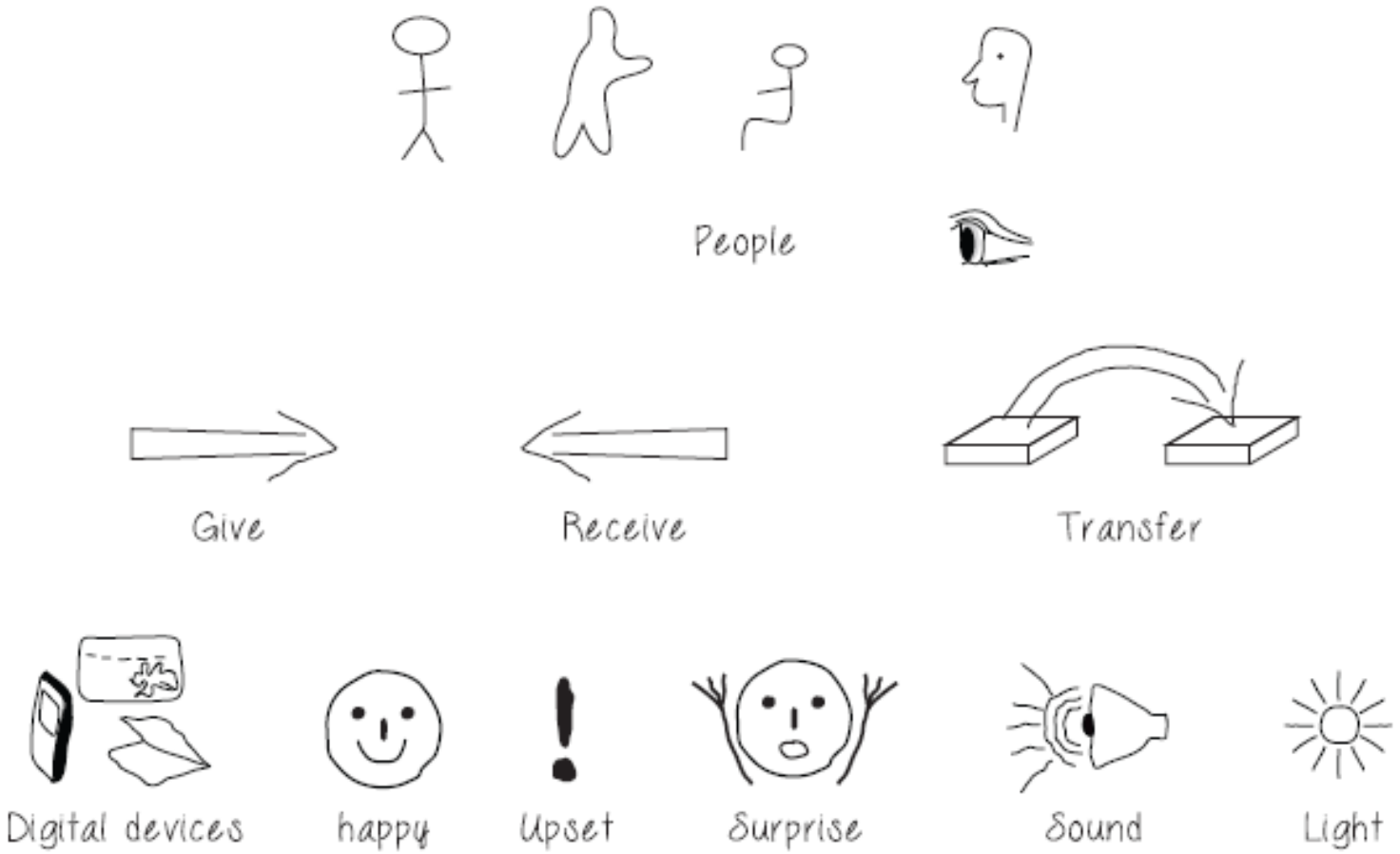


Figure 11.4 Some simple sketches for low-fidelity prototyping

Using scenarios

- Express proposed or imagined situations
- Used throughout design in various ways
  - as a basis for overall design
  - scripts for user evaluation of prototypes
  - concrete examples of tasks
  - as a means of co-operation across professional boundaries
- Plus and minus scenarios to explore extreme cases

Plus scenario example

- The setting is the Lindholm construction site sometime in the future.
- Kurt has access to a portable PC. The portables are hooked up to the computer at the site office via a wireless modem connection, through which the supervisors run the hypermedia application.
- Action: During inspection of one of the caissons[1] Kurt takes his portable PC, switches it on and places the cursor on the required information. He clicks the mouse button and gets the master file index together with an overview of links. He chooses the links of relevance for the caisson he is inspecting.
- Kurt is pleased that he no longer needs to plan his inspections in advance.
  - This is a great help because due to the 'event-driven' nature of inspection, constructors never know where and when an inspection is taking place. Moreover, it has become much easier to keep track of personal notes, reports etc. because they can be entered directly on the spot.
- The access via the construction site interface does not force him to deal with complicated keywords either. Instead, he can access the relevant information right away, literally from where he is standing.
- A positive side-effect concerns his reachability. As long as he has logged in on the computer, he is within reach of the secretaries and can be contacted when guests arrive or when he is needed somewhere else on the site.
  - Moreover, he can see at a glance where his colleagues are working and get in touch with them when he needs their help or advice.
- All in all, Kurt feels that the new computer application has put him more in control of things.

[1] Used in building to hold water back during construction.

Example of minus scenario

The setting is the Lindholm construction site sometime in the future.

- Kurt has access to a portable PC. The portables are hooked up to the computer at the site office via a wireless modem connection, through which the supervisors run the application.
- Action: During inspecting one of the caissons Kurt starts talking to one of the builders about some reinforcement problem.
  - They argue about the recent lab tests, and he takes out his portable PC in order to provide some data which justify his arguments.
  - It takes quite a while before he finds a spot where he can place the PC: either there is too much light, or there is no level surface at a suitable height.
- Finally, he puts the laptop on a big box and switches it on.
  - He positions the cursor on the caisson he is currently inspecting and clicks the mouse to get into the master file.
  - The table of contents pops up and from the overview of links he chooses those of relevance – but no lab test appears on the screen.
  - Obviously, the file has not been updated as planned.
- Kurt is rather upset. This loss of prestige in front of a contractor engineer would not have happened if he had planned his inspection as he had in the old days.
- Sometimes. he feels like a hunted fox especially in situations where he is drifting around thinking about what kind of action to take in a particular case.
  - If he has forgotten to log out, he suddenly has a secretary on the phone: “I see you are right at caisson 39, so could you not just drop by and take a message?”
- All in all Kurt feels that the new computer application has put him under control.

Generate card-based prototype from use case

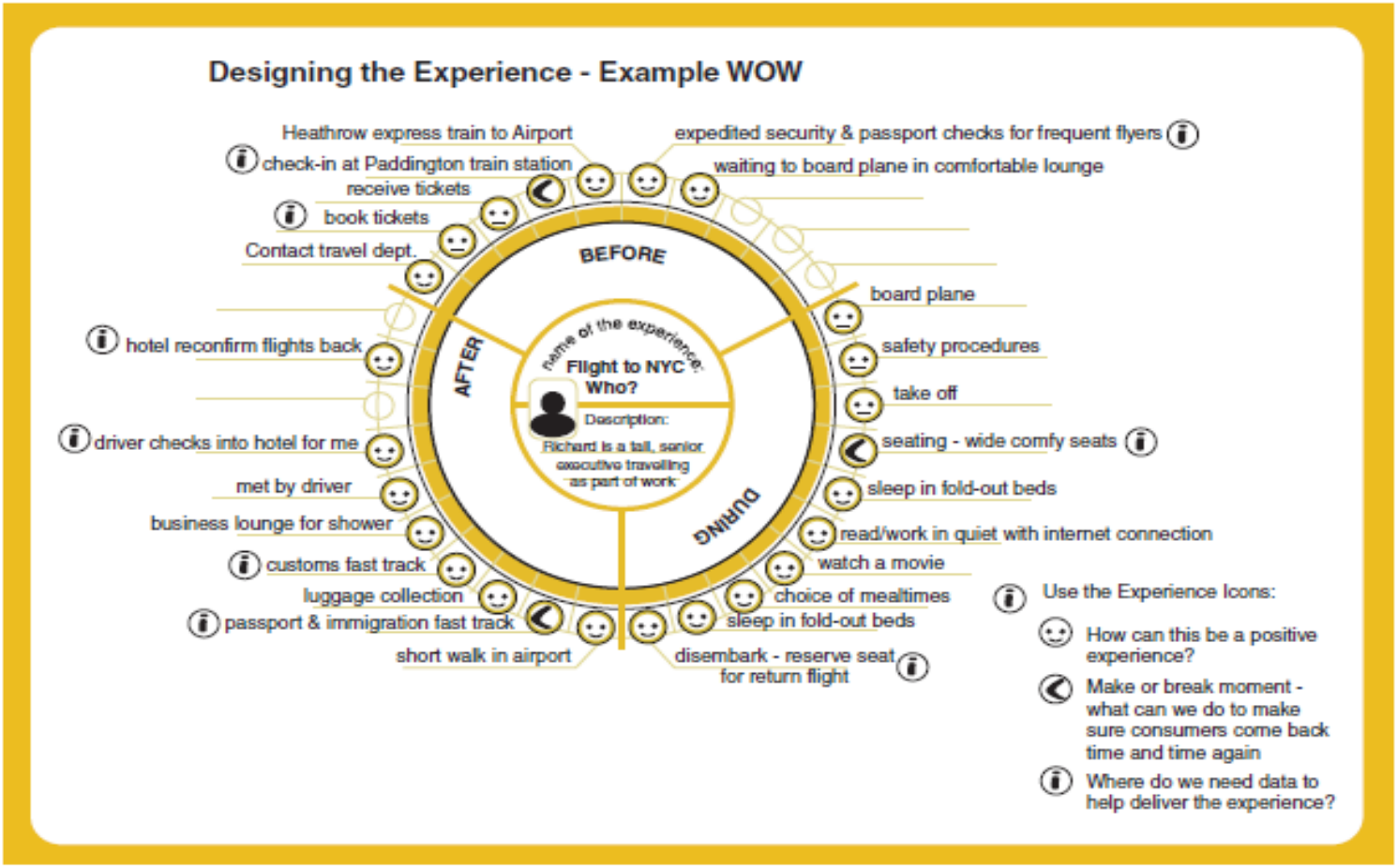
Figure 11.6 Prototype developed for cell phone user interface

Explore the user's experience

- Use personas, card-based prototypes or stickies to model the user experience
- Visual representation called:
  - design map
  - customer/user journey map
  - experience map
- Two common representations
  - wheel
  - Timeline

Video: Experience Mapping For UX Design | Fresh Tilled Soil

An experience map drawn as a wheel

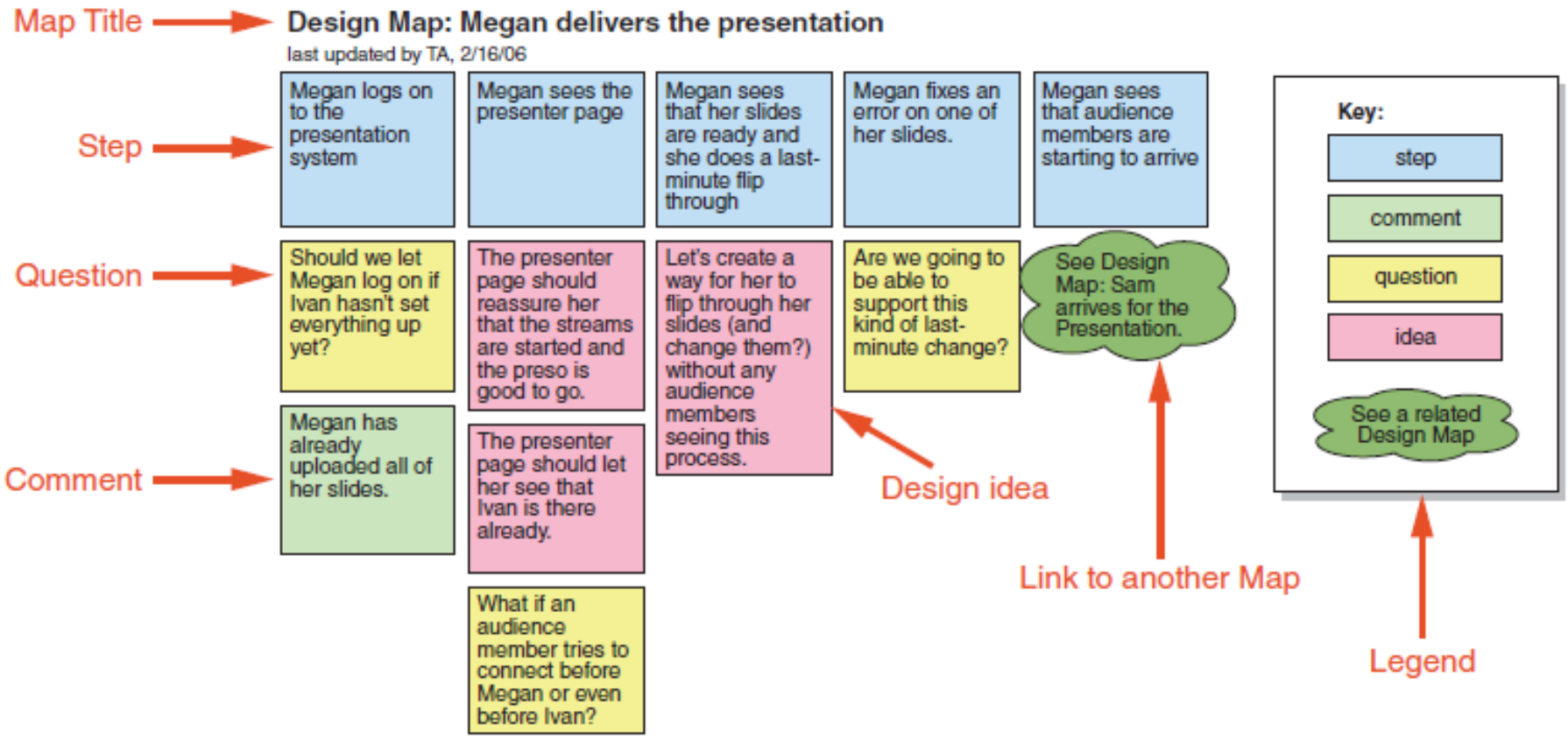


(a)

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.

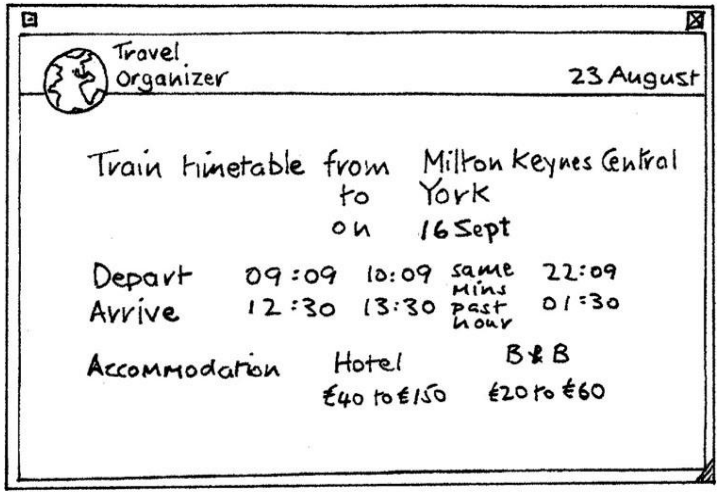
An experience map drawn as a timeline



(b)

Figure 11.19 Continued

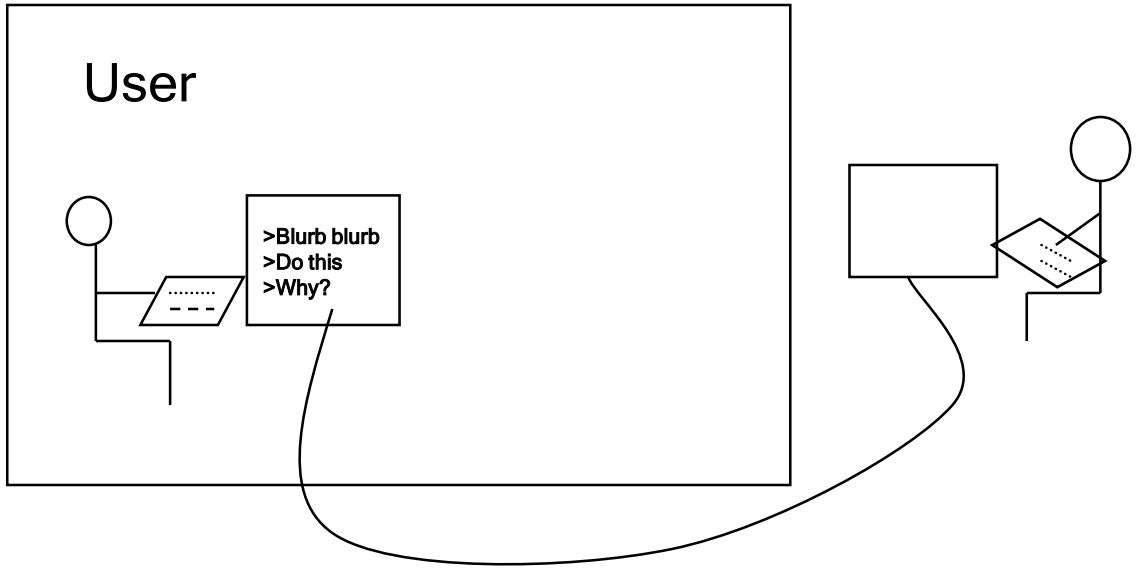
Card-based prototypes



- Index cards (3 X 5 inches)
- Each card represents one screen or part of screen
- Often used in website development

‘Wizard-of-Oz’ prototyping

- The user 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
- What is ‘wrong’ with this approach?



High-fidelity prototyping

- 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

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

Filtering dimensions of prototyping

Filtering dimension	Example variables
Appearance	size; color; shape; margin; form; weight; texture; proportion; hardness; transparency; gradation; haptic; sound
Data	data size; data type (e.g., number; string; media); data use; privacy type; hierarchy; organization
Functionality	system function; users' functionality need
Interactivity	input behavior; output behavior; feedback behavior; information behavior
Spatial structure	arrangement of interface or information elements; relationship among interface or information elements – which can be either two-or three-dimensional, intangible or tangible, or mixed

Manifestation dimensions of prototyping

Manifestation dimension	Definition	Example variables
Material	Medium (either visible or invisible) used to form a prototype	Physical media, e.g. paper, wood, and plastic; tools for manipulating physical matters, e.g. knife, scissors, pen, and sand-paper; computational prototyping tools, e.g. Macromedia Flash and Visual Basic; physical computing tools, e.g. Phidgets and Basic Stamps; available existing artifacts, e.g. a beeper to simulate a heart attack
Resolution	Level of detail or sophistication of what is manifested (corres-ponding to fidelity)	Accuracy of performance, e.g. feedback time responding to an input by a user (giving user feedback in a paper prototype is slower than in a computer-based one); appearance details; interactivity details; realistic versus faked data
Scope	Range of what is covered to be mani-fested	Level of contextualization, e.g. website color scheme testing with only color scheme charts or color schemes placed in a website layout structure; book search navigation usability testing with only the book search related inter-face or the whole navigation interface

Table 11.2 The definition and variables of each manifestation dimension

When to use?

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

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

Mood boards

- Visual stimuli are gathered that capture of how you feel about the design
  - photographs, images
  - textures
  - shapes
  - colors
  - headline styles
  - quotation styles
- Attached to the pinboard

http://viget.com/inspire/perspectives-on-mood-boards

Mood boards

- Stimulate ideas
- Provide inspiration for color scheme
- Do not represent the design, only inspires thoughts
- Can be created and discussed with stakeholders

http://viget.com/inspire/perspectives-on-mood-boards

DEVELOPING INITIAL CONCEPTUAL MODEL

Is there a suitable 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

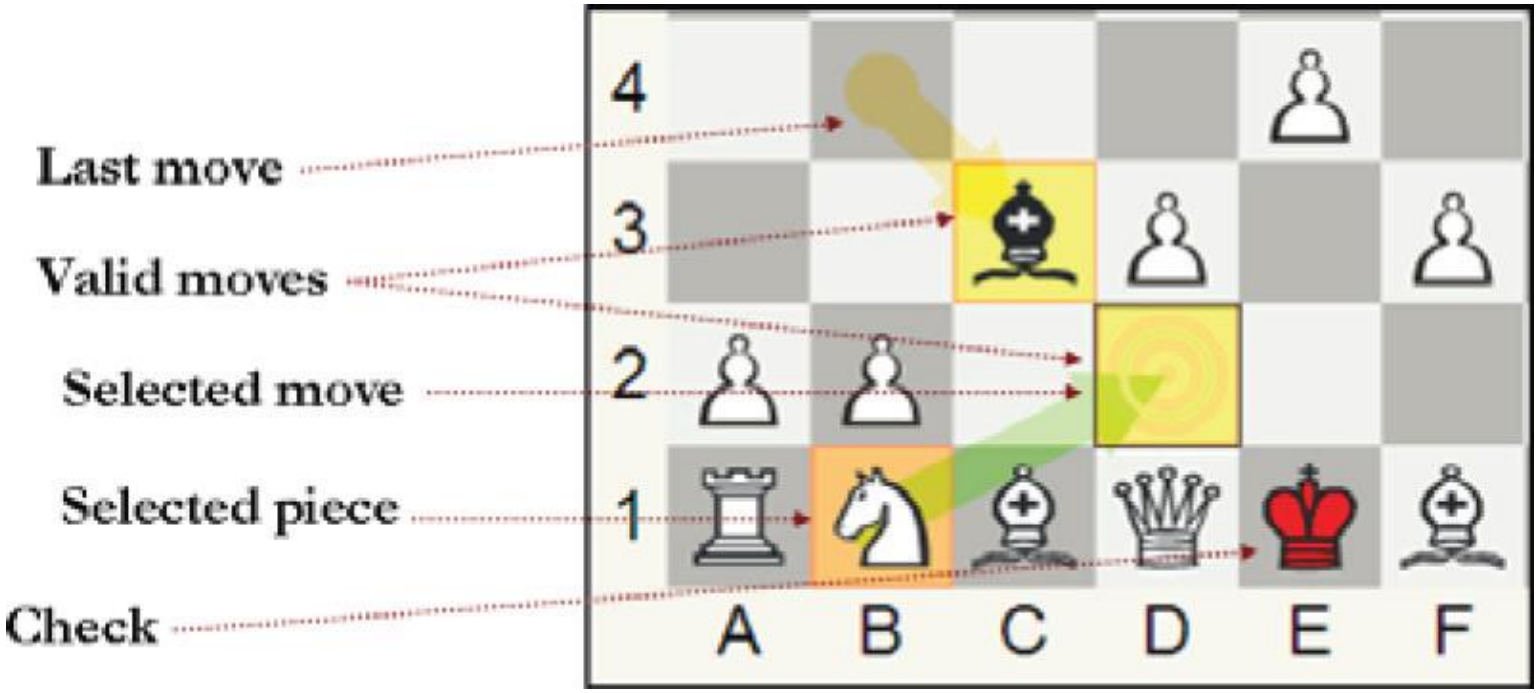
- What functions will the product perform?
  - What will the product do and what will the human do (task allocation)?
- How are the functions related to each other?
  - Sequential or parallel?
  - Categorisations, e.g. all actions related to privacy on a smartphone
- What information is needed?
  - What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

Concrete design

- Many aspects to concrete design
  - Color, icons, buttons, interaction devices etc.
- User characteristics and context
  - Accessibility, cross-cultural design
- Cultural website guidelines

  successful products “are … bundles of social solutions. Inventors succeed in a particular culture because they understand the values, institutional arrangements, and economic notions of that culture.”

Designing universally accessible games



Visual hints for players of UA-Chess with mild memory or cognitive impairments (Grammenos ir kt., 2009)

Using Hofstede's dimensions in interaction design

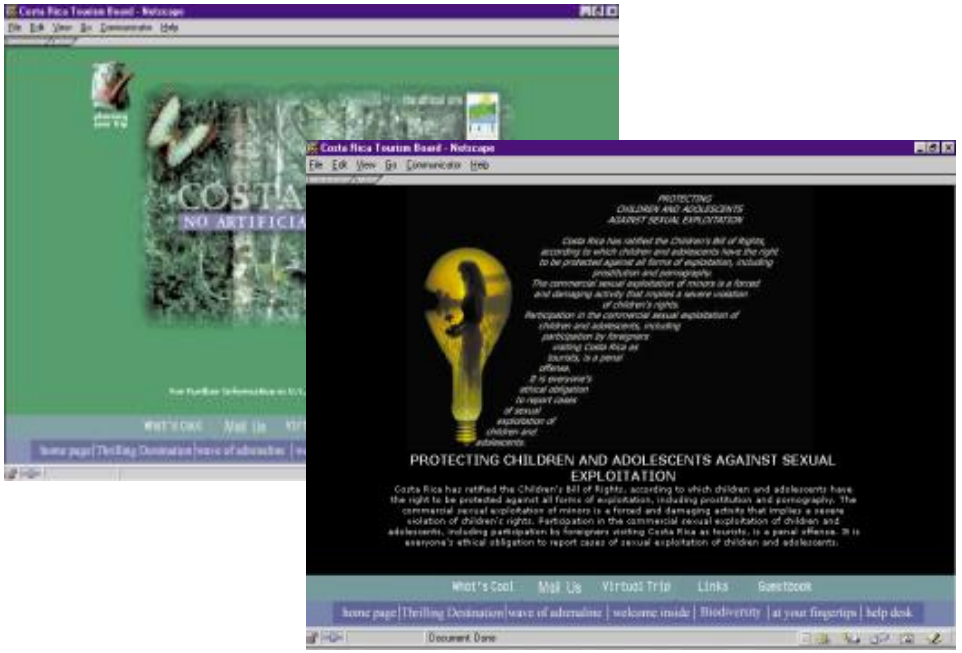
- Geert Hofstede has characterized national culture differences
- Four dimensions
  - power distance (PD),
  - individualism (IND),
  - masculinity-femininity (MAS),
  - uncertainty avoidance (UA).
- Michael Bond added 5th dimension
  - time orientation

Implementation of power distance

High power distance: Malaysian Unversity website.

Low power distance: Dutch Educational website.

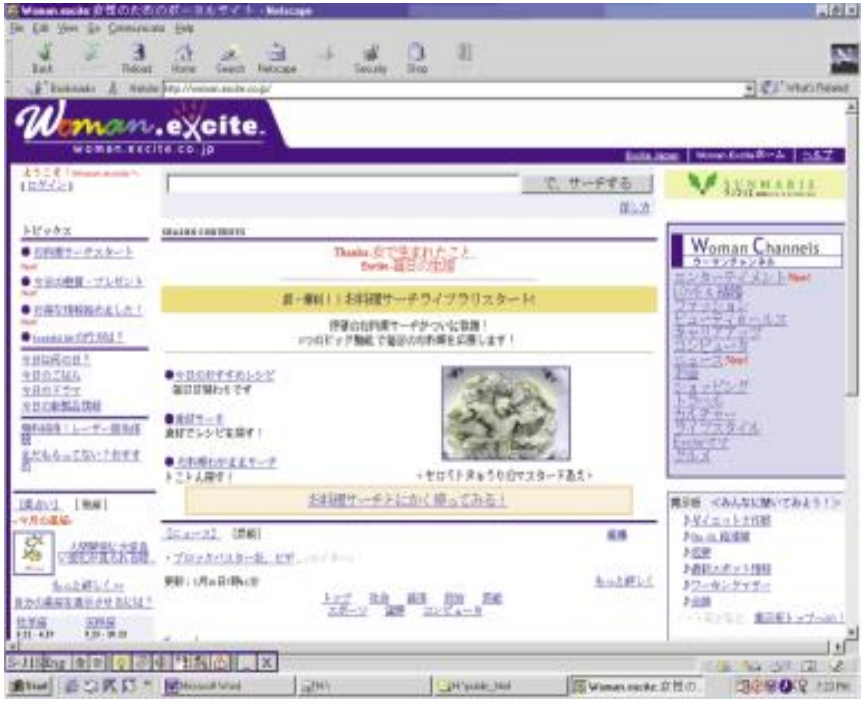
Individualism vs. Collectivism



High individualist value: US National Park website, an emphasis on the visitor, his/her goals, and possible actions in coming to the park.

Low individualist value: Costa Rican National Park website. an emphasis on nature, downplays the individual ourist, and uses a slogan to emphasize a national agenda.

Masculinity vs. Femininity (MAS)



High masculinity website: Excite.com for women in Japan

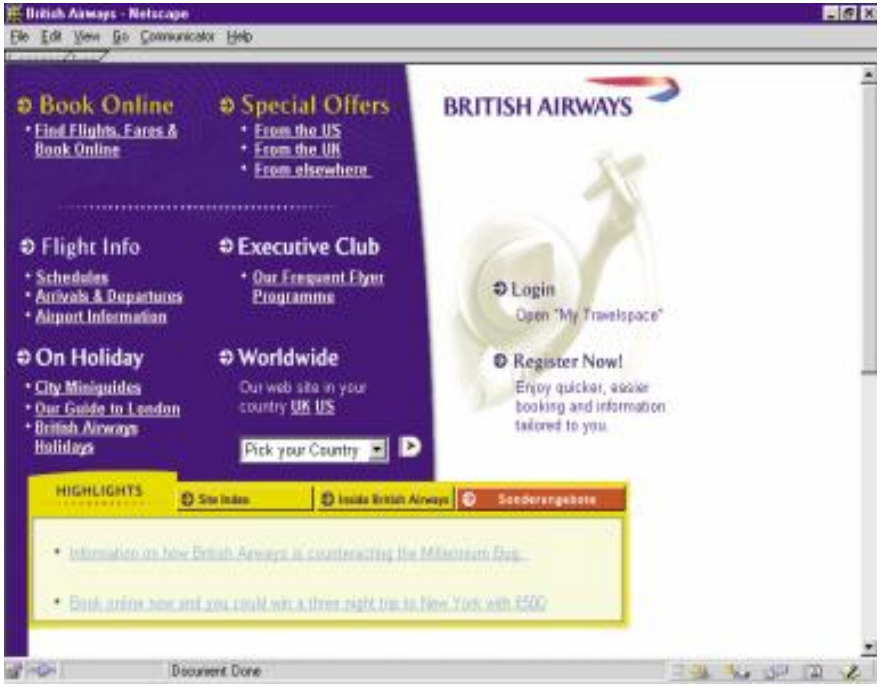
Low masculinity website: Swedish Excite.com.

Masculinity vs. Femininity (MAS)

Medium masculinity website: ChickClick.com in the USA.

Uncertainty Avoidance

High uncertainty avoidance: Sabema Airlines website from Belgium. Figure



Low uncertainty avoidance: British Airways website from United Kingdom.

Long- vs. Short-Term Time Orientation

Low Long-term orientation: website form Siemens Germany

High Long-Term Orientation: website from Siemens in China.

Hofstede's model limitations

- Globalisation influences the people habids around the world
- Recent research challenge the findings
  - European Americans are not more individualistic than people from other ethnic groups
  - Hofstede's model does not help explain cultural differences in affordance
  - It does not seem to apply to technology acceptance

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

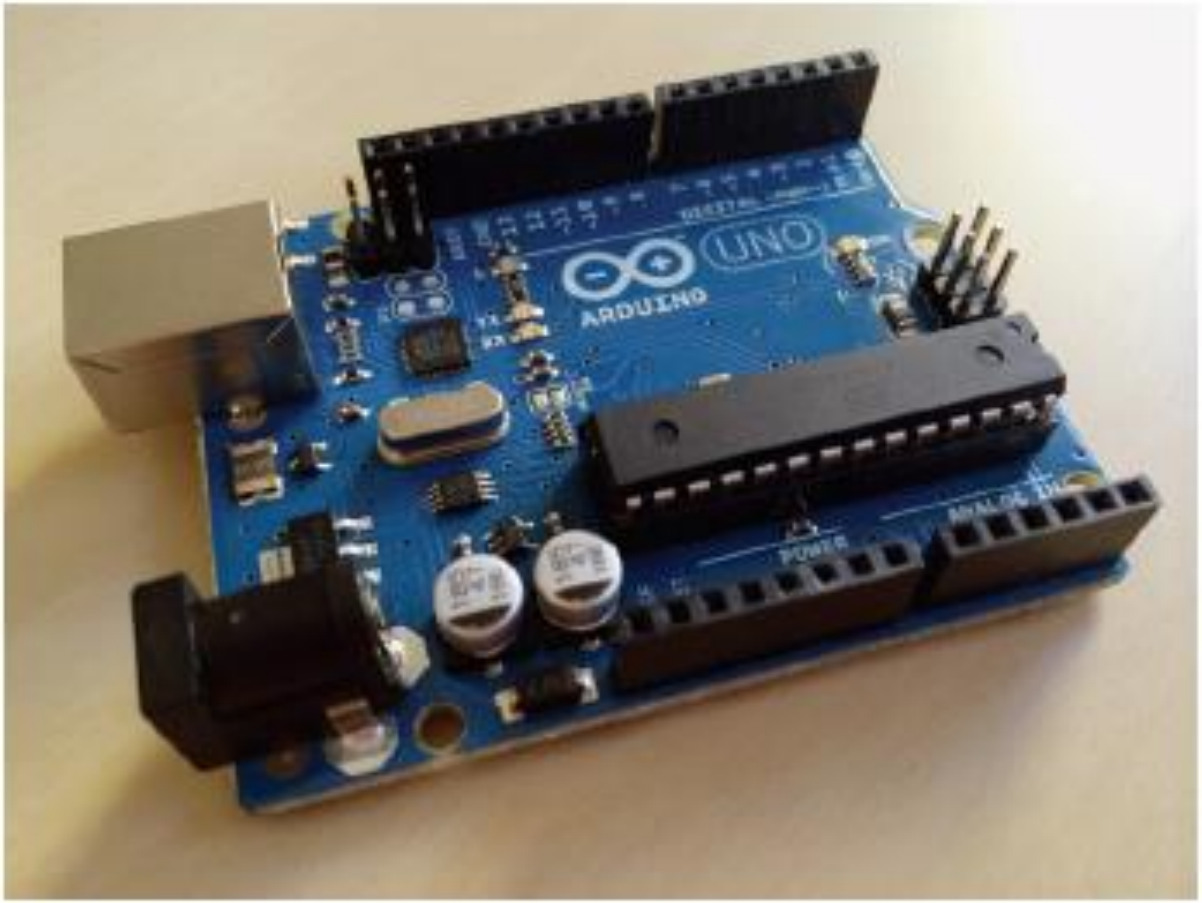


Figure 11.22 The Arduino board

Source: Courtesy of Nicolai Marquardt

LilyPad toolkit

- A set of sewable electronic components for building fashionable clothing and other textiles
- The Engduino® is a teaching tool based on the Arduino LilyPad, it has
  - 16 multicolour LEDs
  - a button,
    - which can be used to provide visual feedback, and simple user input.
  - a thermistor
    - That senses temperature
  - a 3D accelerometer
    - that measures accelerations, and
  - an infrared transmitter/receiver
    - can be used to transmit messages from one Engduino® to another.

Physical computing kits: MaKey MaKey toolkit

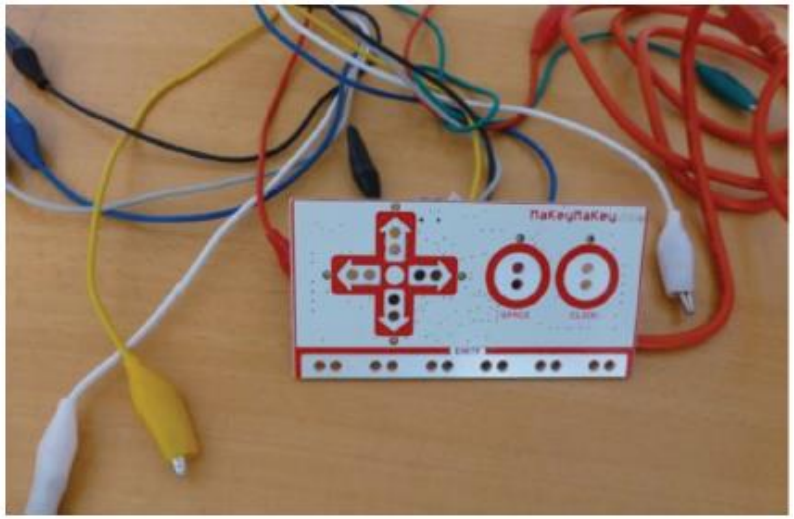


Figure 11.24 The MaKey MaKey toolkit

- Comprises a printed circuit board with an
  - Arduino microcontroller
  - alligator clips
  - a USB cable
- There are six inputs
  - the four arrow keys,
  - the space bar,
  - a mouse click

Demonstration video from the **http://www.codeme.io /**

Physical computing kits

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, e.g. iOS
- Includes: IDE, documentation, drivers, sample code, application programming interfaces (APIs)
- Makes development much easier
- Microsoft's Kinect SDK has been used in research

Summary

- Different kinds of prototyping are used for different purposes and at different stages
- Prototypes answer questions
- The final product must be engineered appropriately
- Two aspects of design: conceptual and concrete
- To generate conceptual design, consider interface metaphors, interaction types and interface types
- Storyboards can be generated from scenarios
- Card-based prototypes can be generated from use cases
- Physical computing kits and SDKs facilitate transition from design to construction