

Prototyping

Shafiq Urréhman

Where are we: Aim/Learning Outcomes

- Define, prioritize, and communicate **user-friendly design** for interactive systems
- Evaluate and argue for a certain design solution among alternative solutions
- Make a design specification for a user interface
- Construct an interactive interface **prototype** in a computer tool
- Plan, implement and communicate a **usability test**

Where are we: Course info

- 4 – Lectures
 - Introduction to TDDD60/TDP022 & HCD
 - User studies and personas
 - Concept design and interface design
 - Prototyping & User testing
- Inspiration and width
 - Loosely linked to the work in the course
- Practical tips
- May contain some exercises/practical work
- **Do NOT** replace course literature

Where are we: Course info

- **Föreläsningar VT19**
- *Alla PDF från föreläsningarna kommer läggas ut i samband med att föreläsningen hålls.*
- **Introduktion Kursorganisation:** [PDF](#), **Introduktion till HCD:** [PDF](#),
Läshänvisning: Sid 5-11 och 15-37 i Arvola (2014)
- **Användarstudier och Personor:** [PDF](#), Läshänvisning: Sid 39-94 i Arvola (2014)
- **Konceptdesign och gränssnittsdesign:** [PDF](#), Läshänvisning: Sid 85-130 och 143-146 i Arvola (2014)
- **Prototypning:** Läshänvisning: Sid 11-15, 131-134 och 146-148 i Arvola (2014)
- **Användbarhetstest:** Läshänvisning: Sid 134-143 och 151-152 i Arvola (2014)

Where are we: Course info

Examination

➤ 3 assignments .

- UPG1: Concept and literature summary
 - Task with written report. (U, 3.4.5) 1.5 h
- UPG 2 Prototype
 - Assignment with written report (submission) and compulsory oral presentation (U, 3,4,5) 2,5 credits
- UPG 3 individual project/course work
 - Written report & Presentation
 - Each task consists of:
 - Compulsory part (for third) with focus on doing and knowledge of the course material
 - Optional part (for four and five) which involves deeper processing of the course material and the thoughts behind the making
 - More information can be found on the course homepage.

Where are we: Course info

- Deadlines till UPG1

Del A: [Litteratursammanfattning](#). Fredag, 15/2 2019.

Del B: [Koncept](#). Fredag, 15/2 2019.

[Valfri del för högre betyg](#). Fredag 15/3 2019 (slutet av kursen).

- Deadlines till UPG2

Preliminär prototyp- och användbarhetsrapport till opponenter. Fredag 8/3 2019.

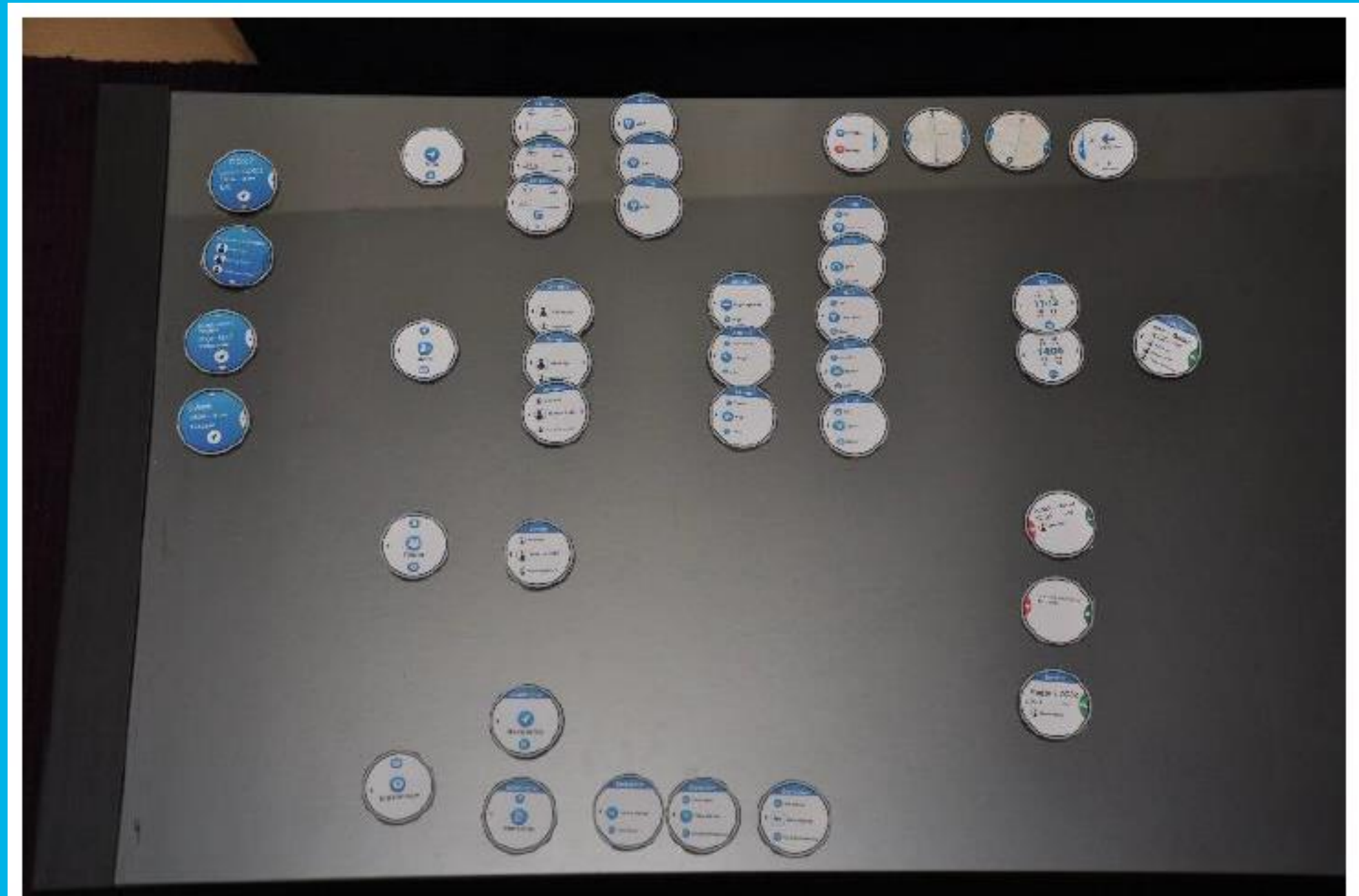
Del A: Prototyp- och användbarhetsrapport. Fredag 15/3 2019.

Del B: Valfri del för högre betyg. Fredag 15/3 (slutet av kursen).

- Deadlines till UPG3 (IP)

Inlämningsuppgift. Fredag 15/3 (slutet av kursen).

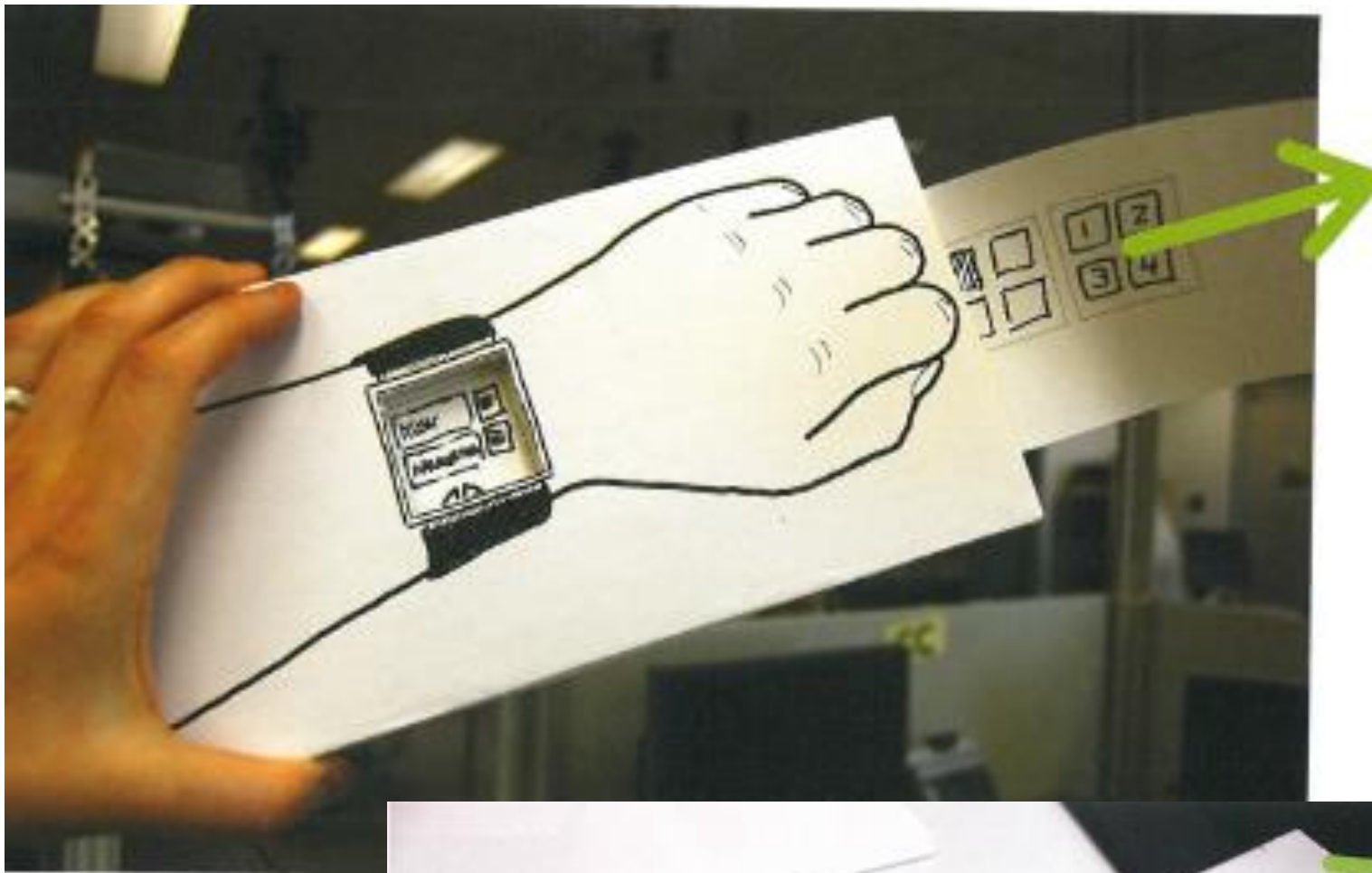
Paper Prototype



Figur 23 - Pappersprototyp översikt

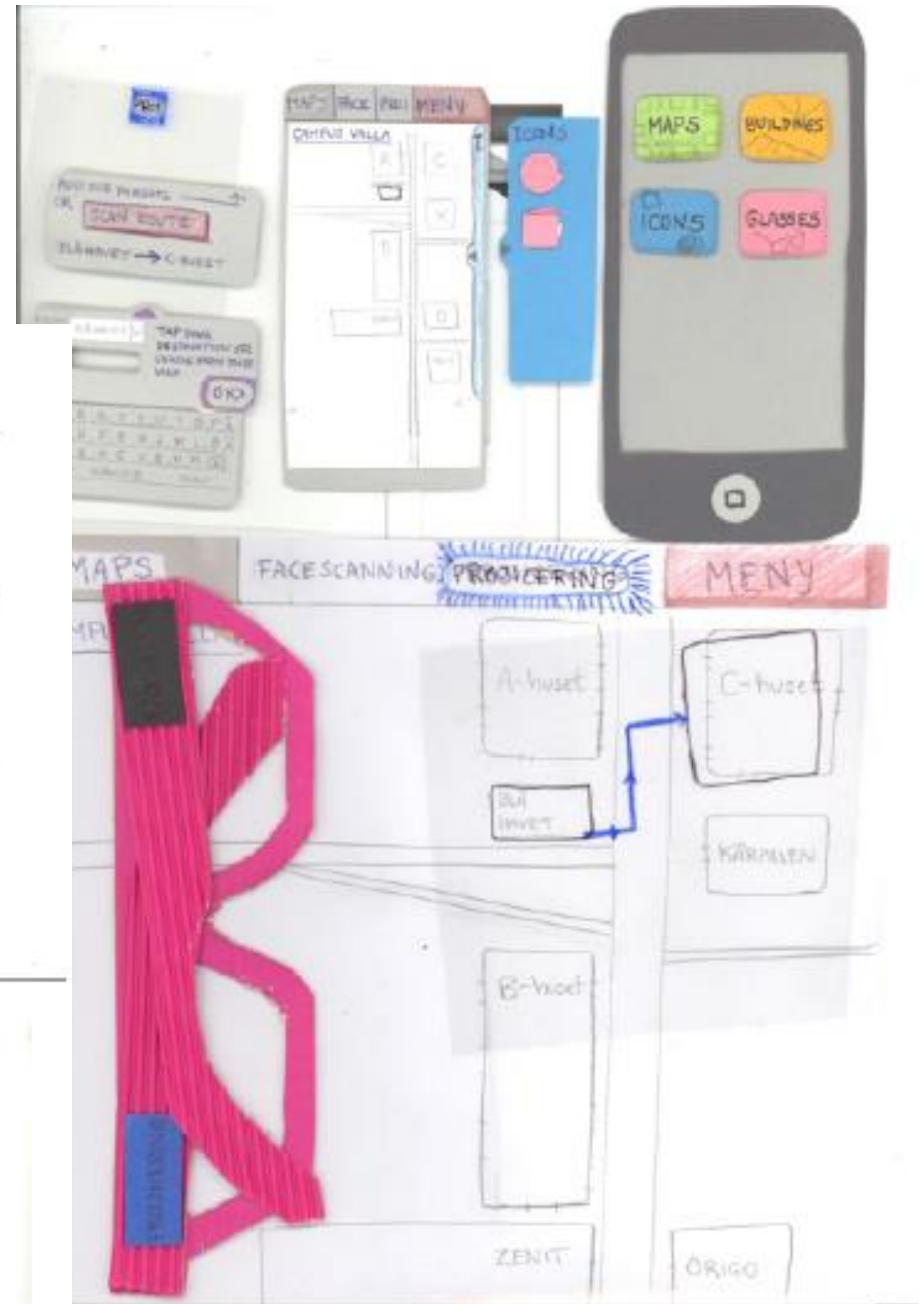
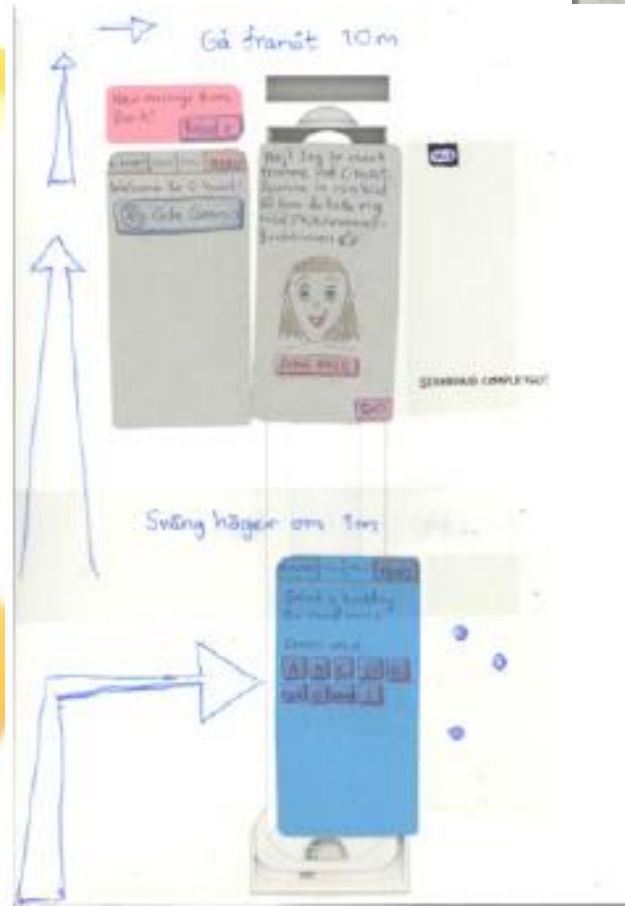
Paper Prototype

The presentation/description 'format' plays a key role ...



Paper Prototype

- The presentation/description 'format' plays a key role ...
- There are mobile phone and other templates that you can print ...

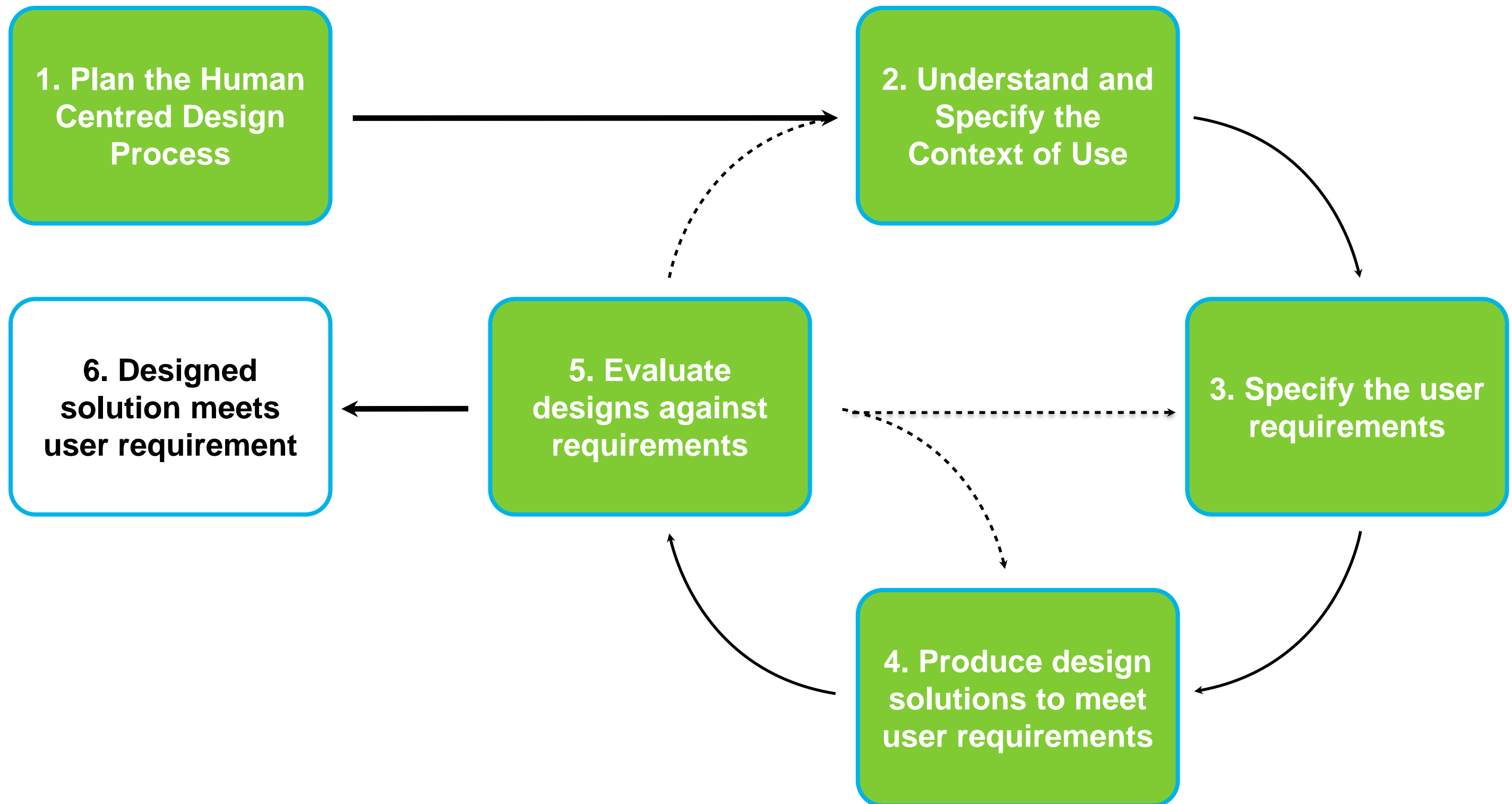


Today's Lecture

Prototyping and construction

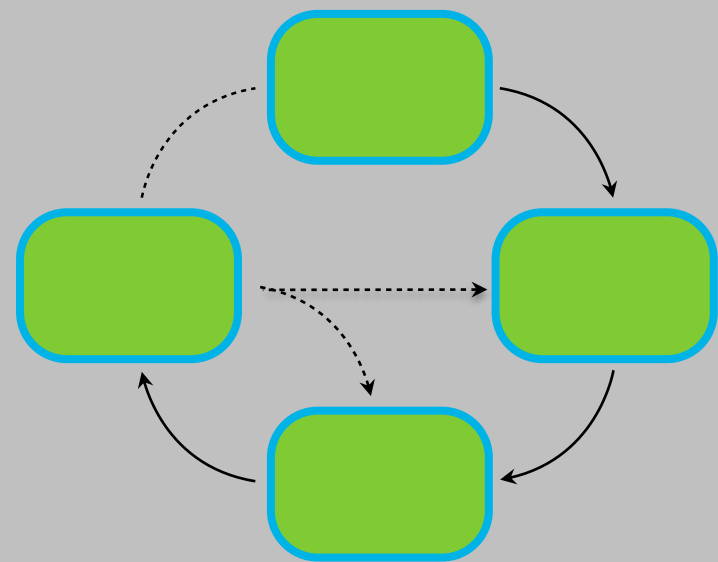
- Why prototype?
- What is a prototype?
- Different kinds of prototyping
 - low fidelity
 - high fidelity
- Compromises in prototyping
 - vertical
 - horizontal
- Construction

ISO HCD Framework

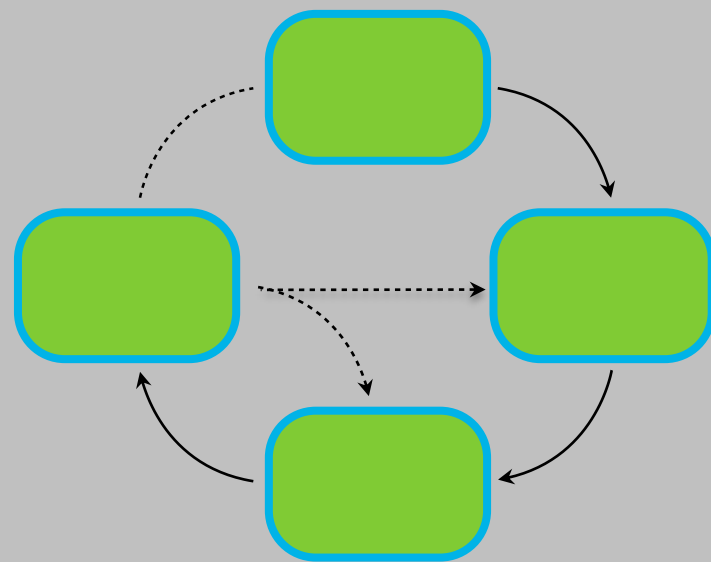


The human-centred design process (ISO 9241-210:2010).

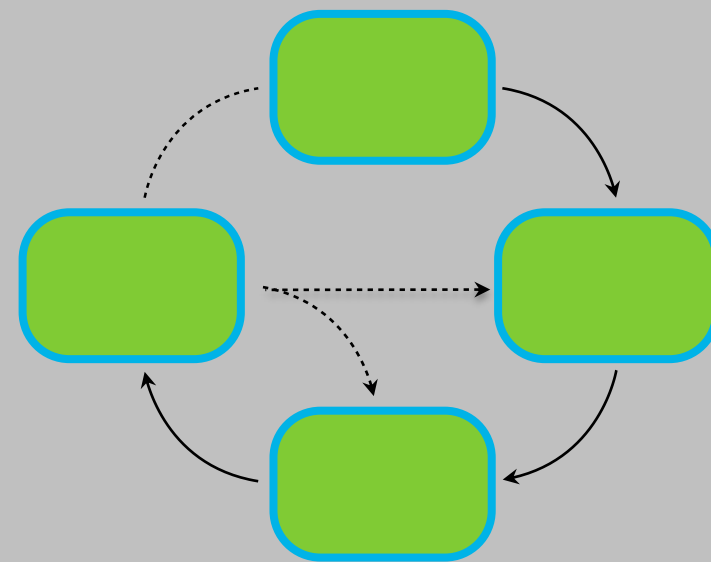
Concept & ideas



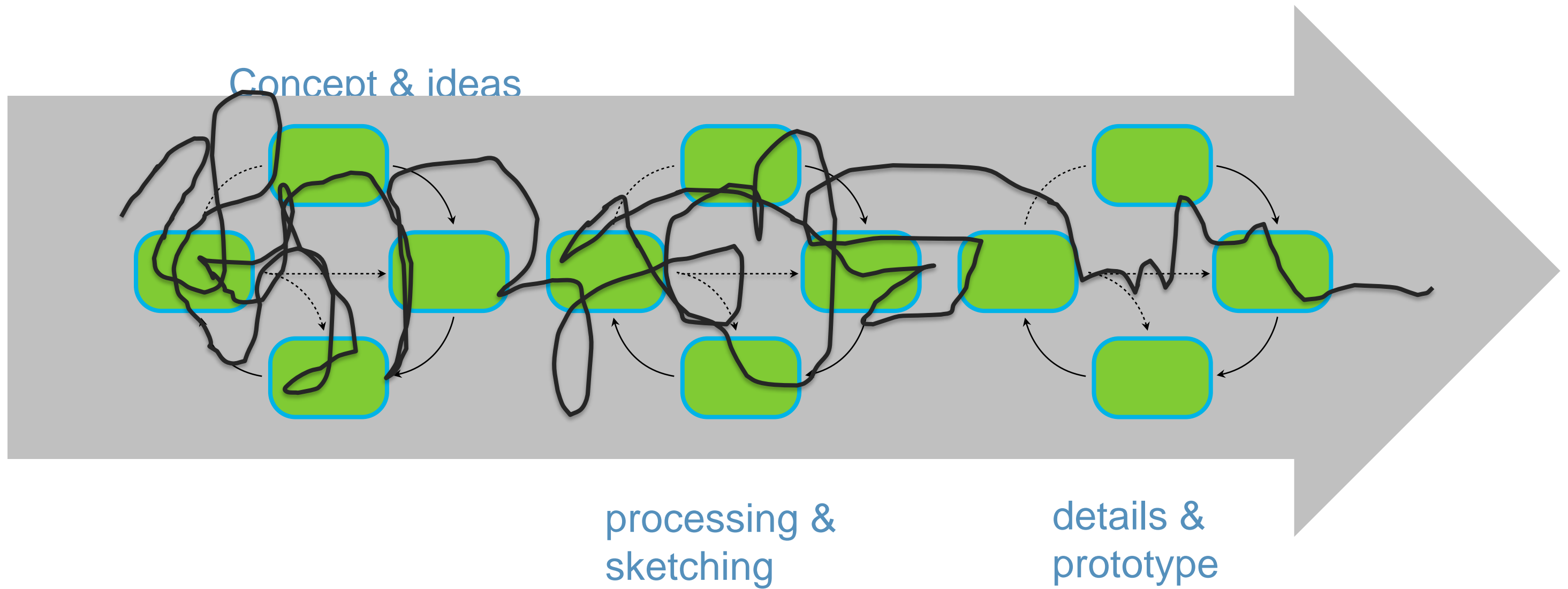
processing &
sketching



details &
prototype



Expectation vs reality



WHY PROTOTYPE?

“...the value of prototypes resides less in the models themselves than in the **interactions they invite.**”

“...innovative prototypes generate innovative teams. The prototype plays a more influential role in creating a team than teams do in creating prototypes.”

Michael Schrage – Serious Play

WHY PROTOTYPE?

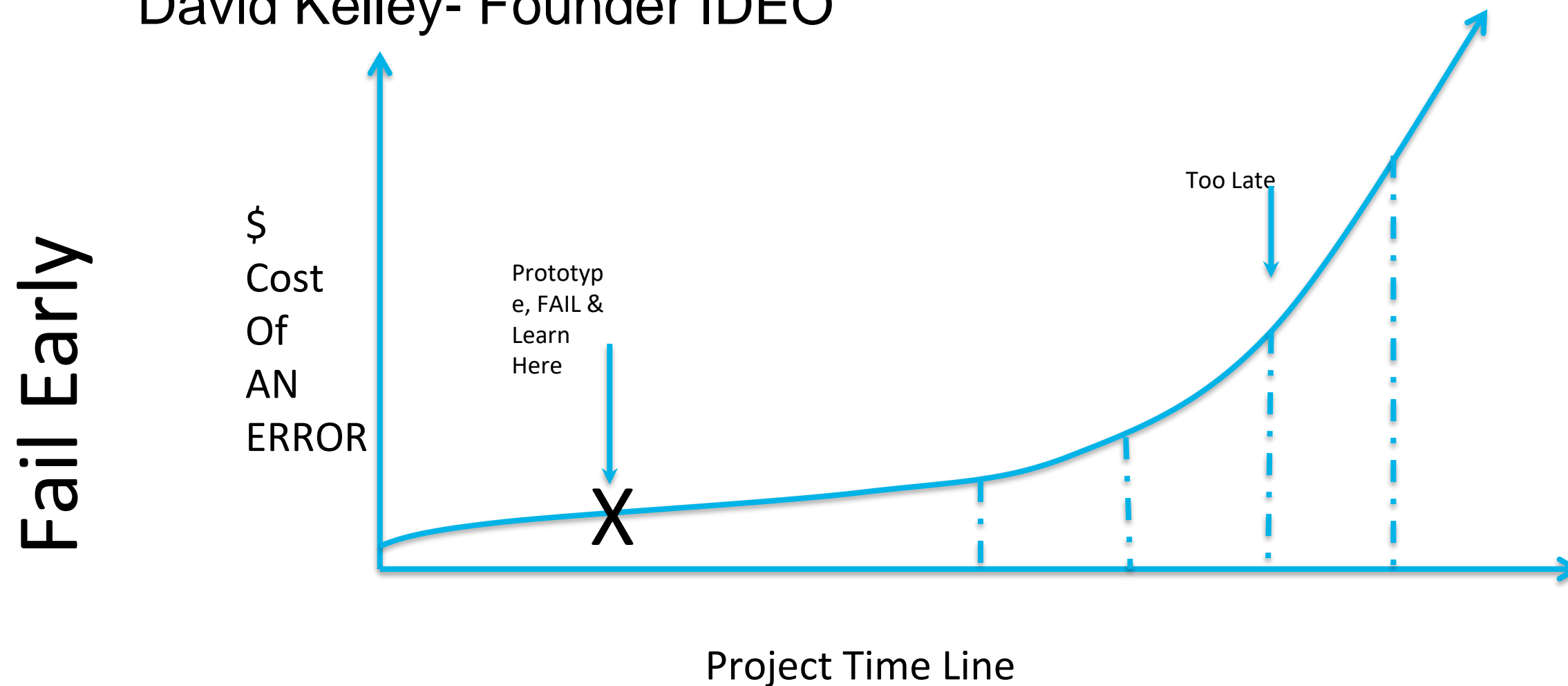
“...Prototypes provide the means for **examining design problems and evaluating solutions**. Selecting the focus of a prototype is the art of identifying the most important open design questions.”

Houde and Hill – What do Prototypes Prototype?

WHY PROTOTYPE?

Enlightened trial and error succeeds over the planning of the flawless intellect

David Kelley- Founder IDEO



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

Prototyp (SAOL)

- originalmodell som utgör mall vid serietillverkning;
normal, likare

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



(c)

Fig. 11.1 c) A teddy bear printed from wireframe ; Interaction design: beyond human-computer interaction



(a)

Fig. 11.1 Colour output from a 3D printer; Interaction design: beyond human-computer interaction

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

What do Prototypes Prototype?

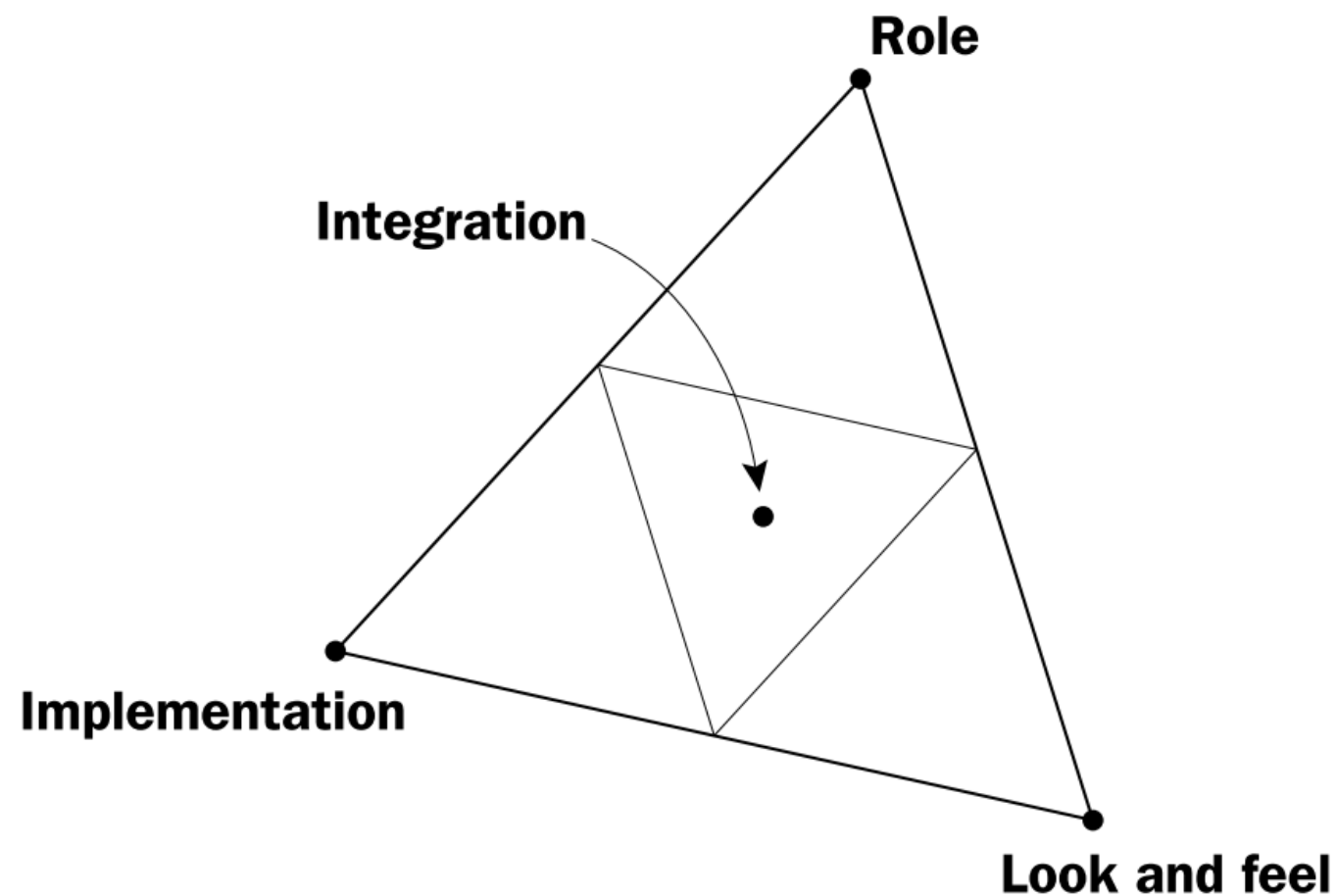


Figure 3. Four principal categories of prototypes on the model.

- **Role** - refers to questions about the function that an artifact serves in a user's life—the way in which it is useful to them.
- **“Look and feel”** - denotes questions about the concrete sensory experience of using an artifact—what the user looks at, feels and hears while using it.
- **“Implementation”** - refers to questions about the techniques and components through which an artifact performs its function—the “nuts and bolts” of how it actually works.

Houde, Stephanie, and Charles Hill. "What do prototypes prototype?." Handbook of Human-Computer Interaction (Second Edition). 1997. 367-381.

What do Prototypes Prototype?

Designer and academic Graham Pullin, in *-Design Meets Disability* (2011):

- feels-like prototype: an ergonomic prototype for physical feeling in hands, etc.
- looks-like prototype: an appearance model for form, color, materials, etc.
- works-like prototype: an engineering prototype for electronics and electromechanical build, etc.
- behaves-like prototype: an experience prototype for interactions. It may have tethers instead of being wireless, or be built larger than the proposed final size, but the fundamental user interactions are well-modeled. (p. 138)

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

Table 11.1 ; Interaction design: beyond human-computer interaction

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 (corresponding 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 manifested	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 interface or the whole navigation interface

Table 11.2 The definition and variables of each manifestation dimension

WHAT CAN BE A PROTOTYPE?

- Sketches
- Diagrams & Frameworks
- Hand Made Constructions
- Machined Constructions
- Virtual Models
- Graphics
- Packaging
- Spaces
- Role Play, Experiences
- Video
- Technical issues
- Work flow, task design
- Screen layouts and information display
- Difficult, controversial, critical areas

Prototyping

- Low fidelity prototypes explore initial concepts and broad ideas.
- High fidelity prototypes help evaluate "look and feel" and functionality.
- The main purpose of prototyping is to evaluate designs with users.

Lo-fi Prototypes

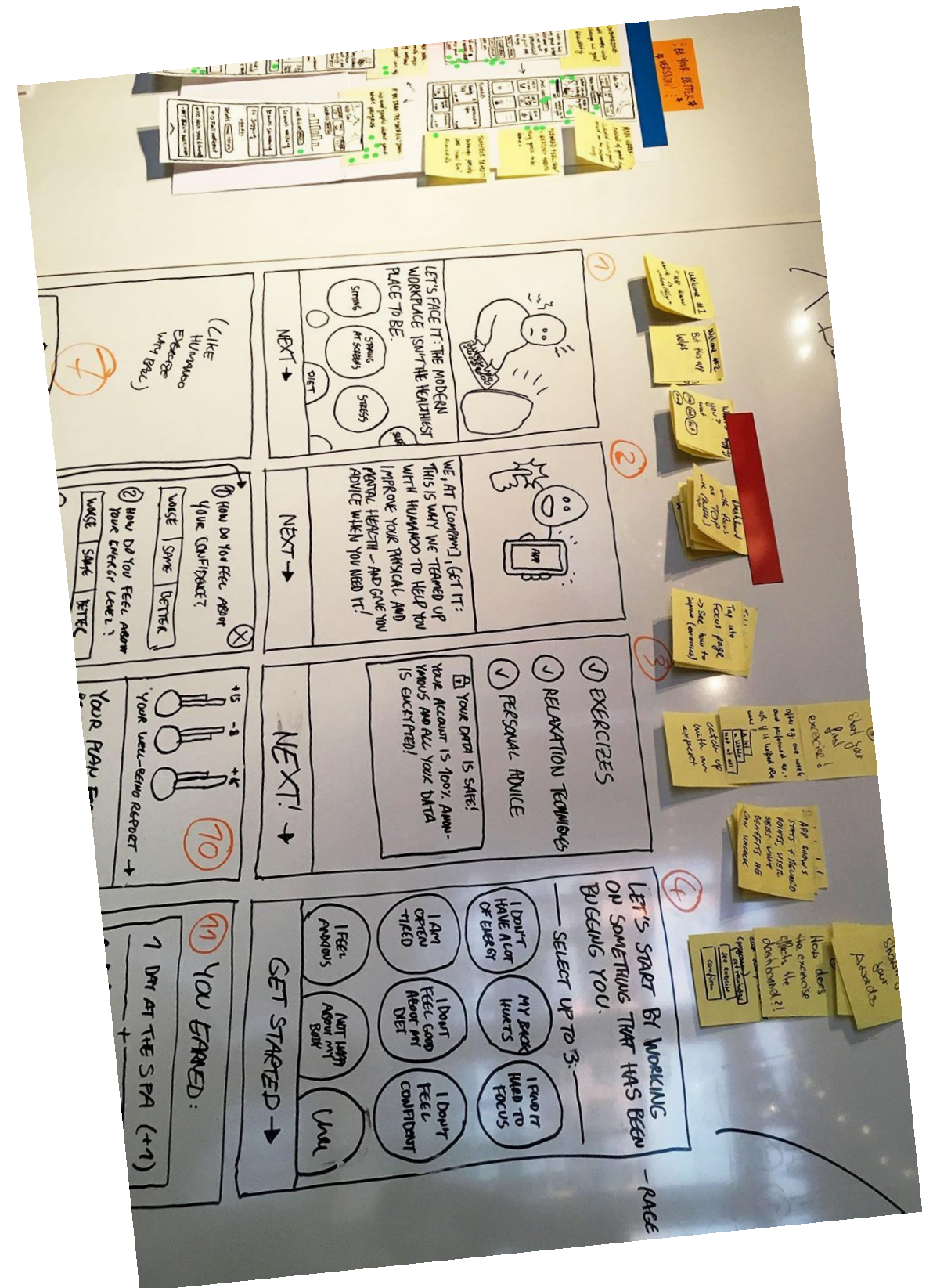
- Usually made from paper or cardboard
- Designed to be produced quickly and thrown away after use
- Focuses on underlying design ideas:
 - Content
 - Form
 - Structure
 - Functionality
 - Navigation

Low-fi 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'

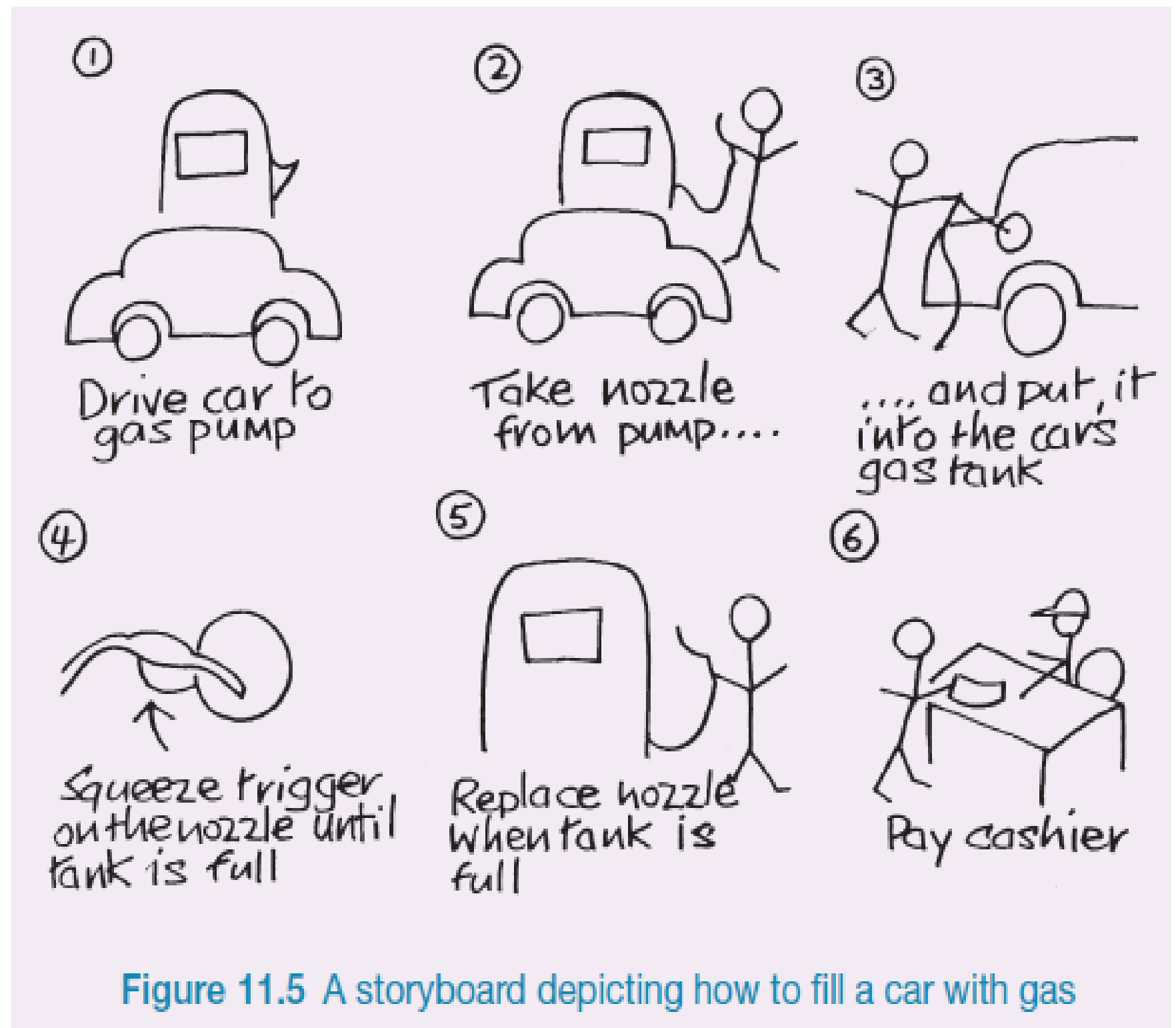
Storyboards

- 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



Sketching

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



Card-based prototypes

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

A hand-drawn card-based prototype for a travel organizer. The card is titled "Travel Organizer" with a globe icon and the date "23 August". The main content is a form with the following questions and input fields:

WELCOME HELEN

Where do you want to go?

What date do you want to travel?

Which form of transport do you want?

Do you need accommodation?

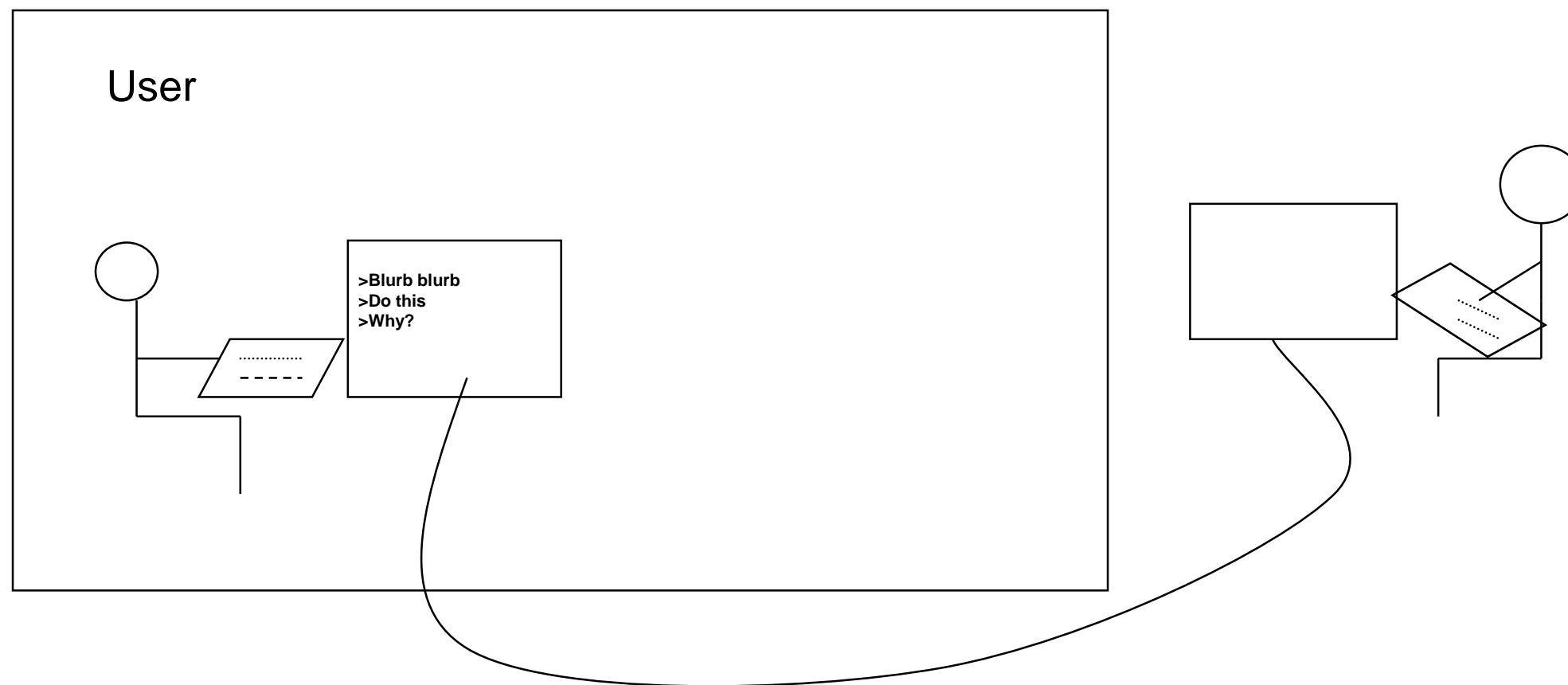
A hand-drawn card-based prototype showing a train timetable and accommodation options. The card is titled "Travel Organizer" with a globe icon and the date "23 August".

Train timetable from Milton Keynes Central
to York
on 16 Sept

Depart	09:09	10:09	same	22:09
Arrive	12:30	13:30	mins past hour	01:30

Accommodation Hotel B & B
 £40 to £150 £20 to £60

'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?

Using Lo-fi Prototypes

- Need to record what happens: take notes, sound record or use video.
- Have 2 designers, one to interact with the user, one to "play computer"
- User points to where they would click next.
- Use a narrative: "You are interested in this shirt, but you want to know what sort of material it's made of. What would you do?"

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

Low vs High fidelity

Type	Advantages	Disadvantages
Low-fidelity prototype	<ul style="list-style-type: none"> Lower development cost Evaluates multiple design concepts Useful communication device Addresses screen layout issues Useful for identifying market requirements Proof of concept 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> More resource-intensive to develop Time-consuming to create Inefficient for proof-of-concept designs Not effective for requirements gathering

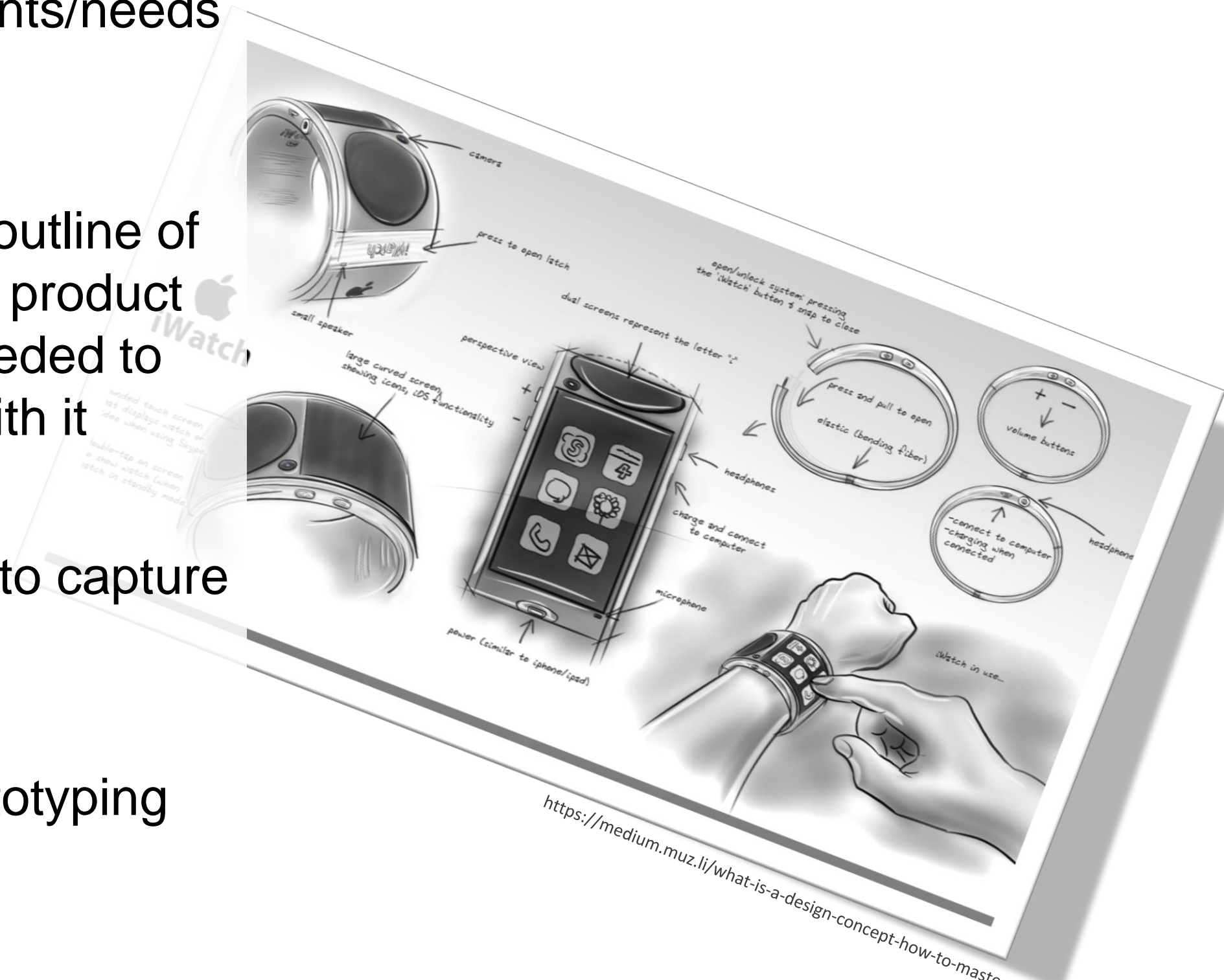
Table 11.3 Advantages and disadvantages of low- and high-fidelity prototypes

Compromises in prototyping

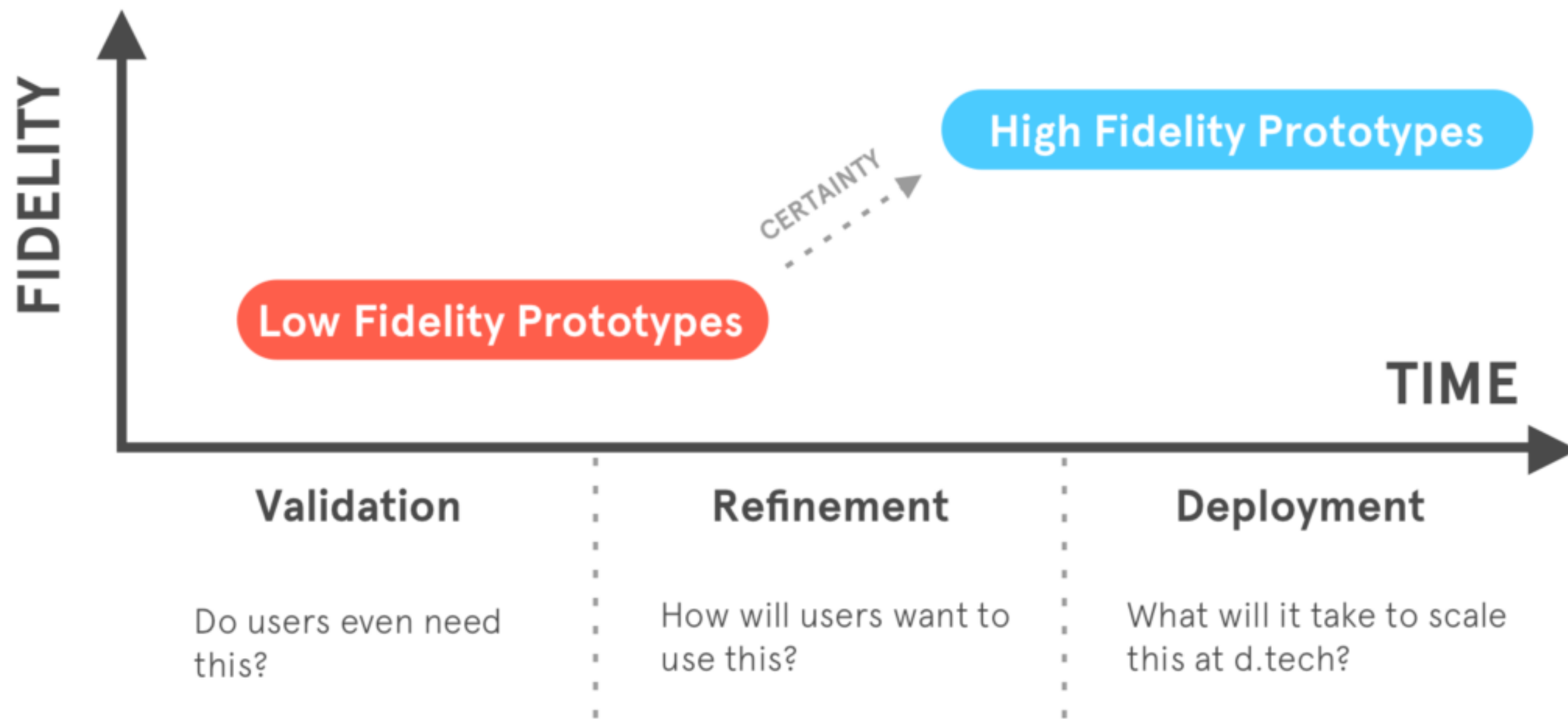
- All prototypes involve compromises
- For software-based prototyping maybe there is a slow response? sketchy icons? limited functionality?
- Two common types of compromise
 - **horizontal**: provide a wide range of functions, but with little detail
 - **vertical**: provide a lot of detail for only a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

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



Fidelity and Learning





Välkommen andan123!



LiU-kort



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?



Apple iBooks use a familiar and understandable metaphor of a pine-wood bookshelf to give the user an understanding of what is being shown and to be able to relate to 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.



Google+ Snapseed help overlay showing meaning of symbols as well as gestures

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.”

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

Generate storyboard from scenario

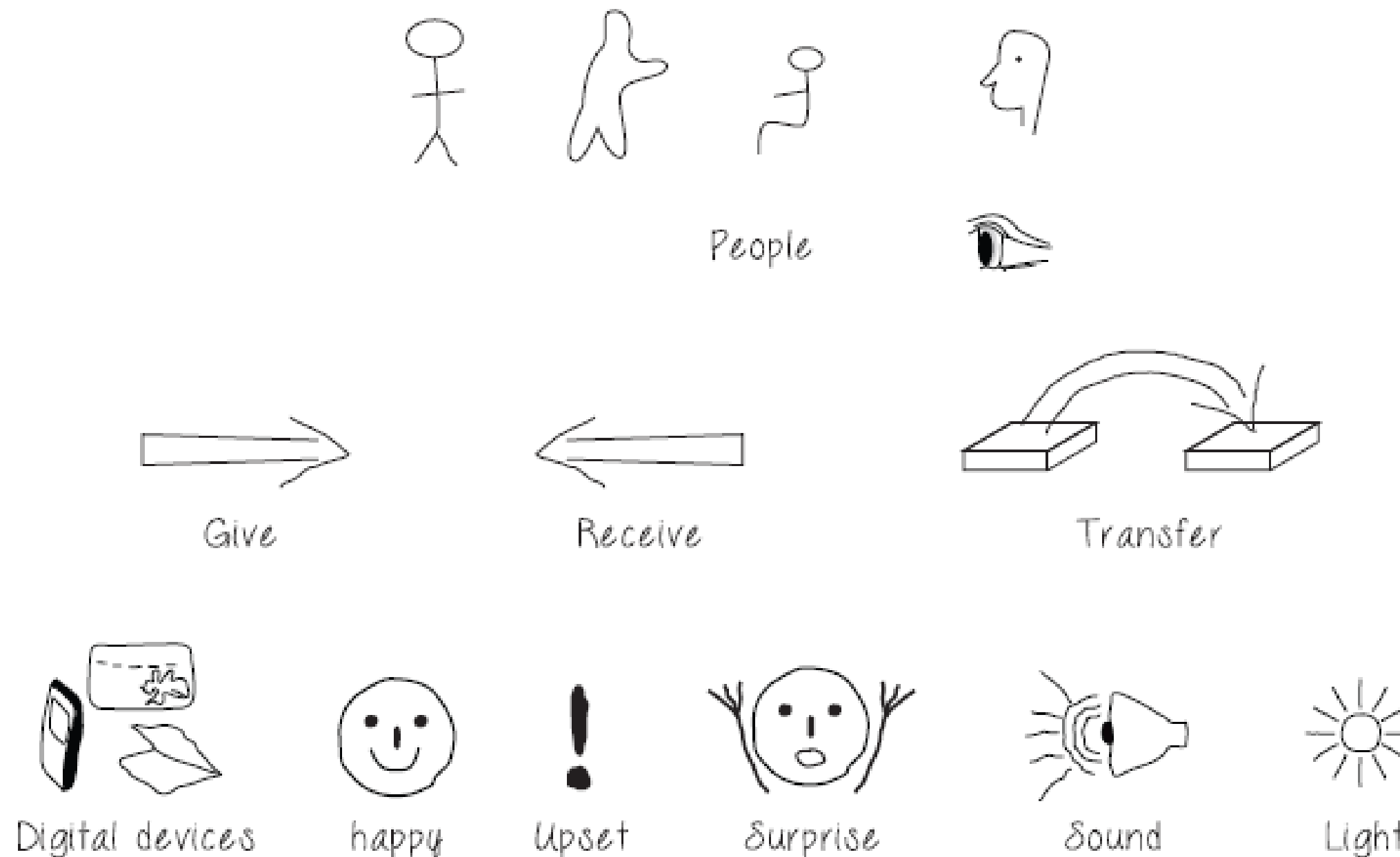


Figure 11.4 Some simple sketches for low-fidelity prototyping

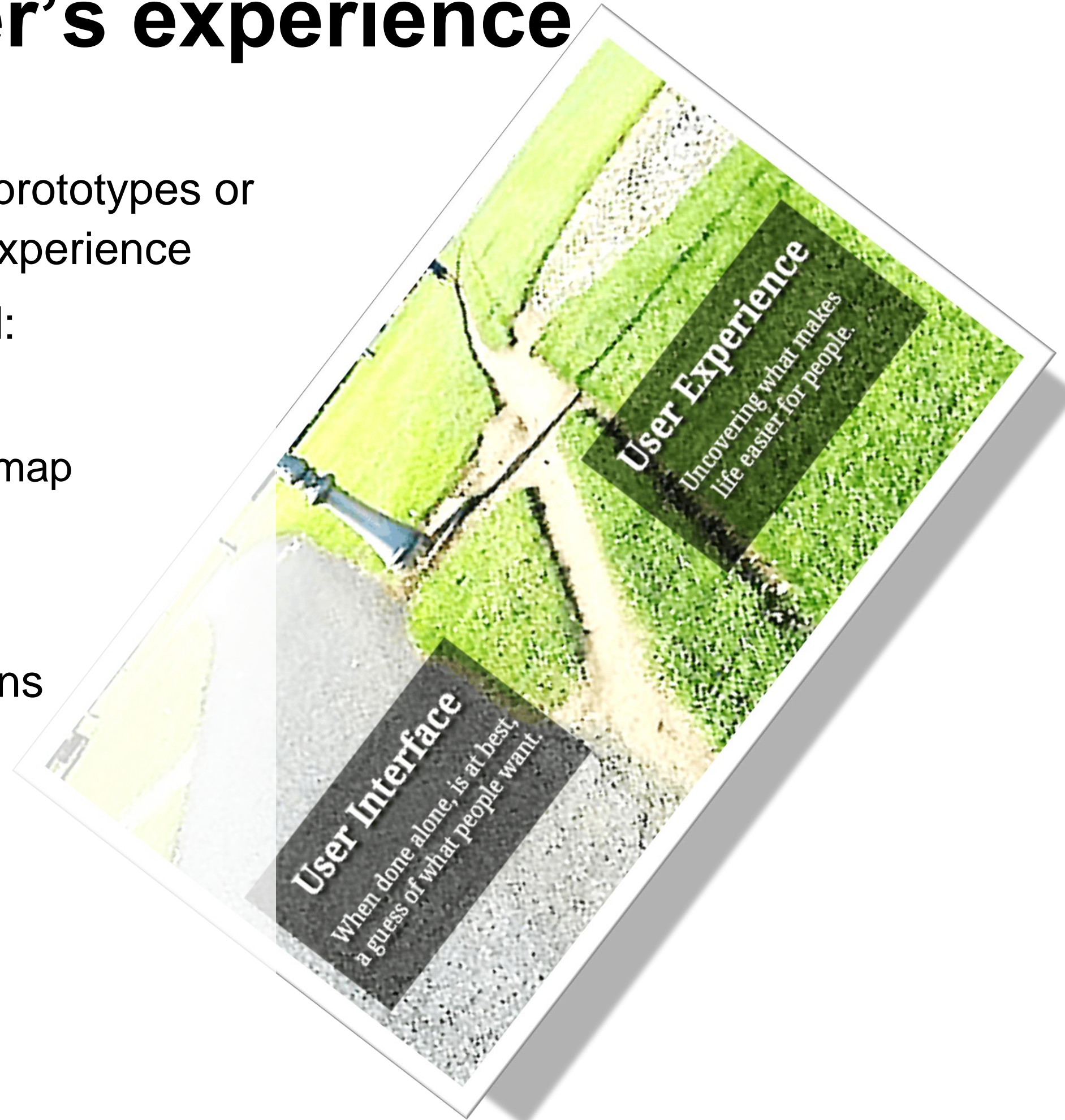
Generate card-based prototype from use case



Fig. 11.6 Prototype developed for cell phone User Interface5; Interaction design: beyond human-computer interaction

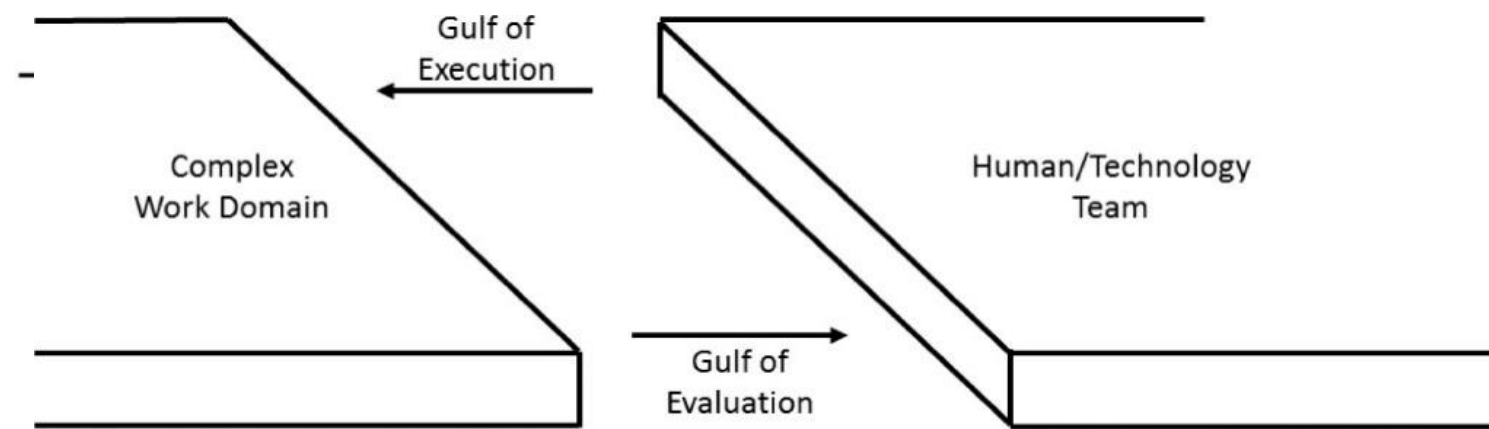
Explore the user's experience

- 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



Human system Coupling

Hutchins, Hollan, and Norman's Gulf of Evaluation and Gulf of Execution



A. Integration of Humans and Technology

An experience map drawn as a wheel

[LEGO's experience wheel](#)

Designing the Experience - Example WOW

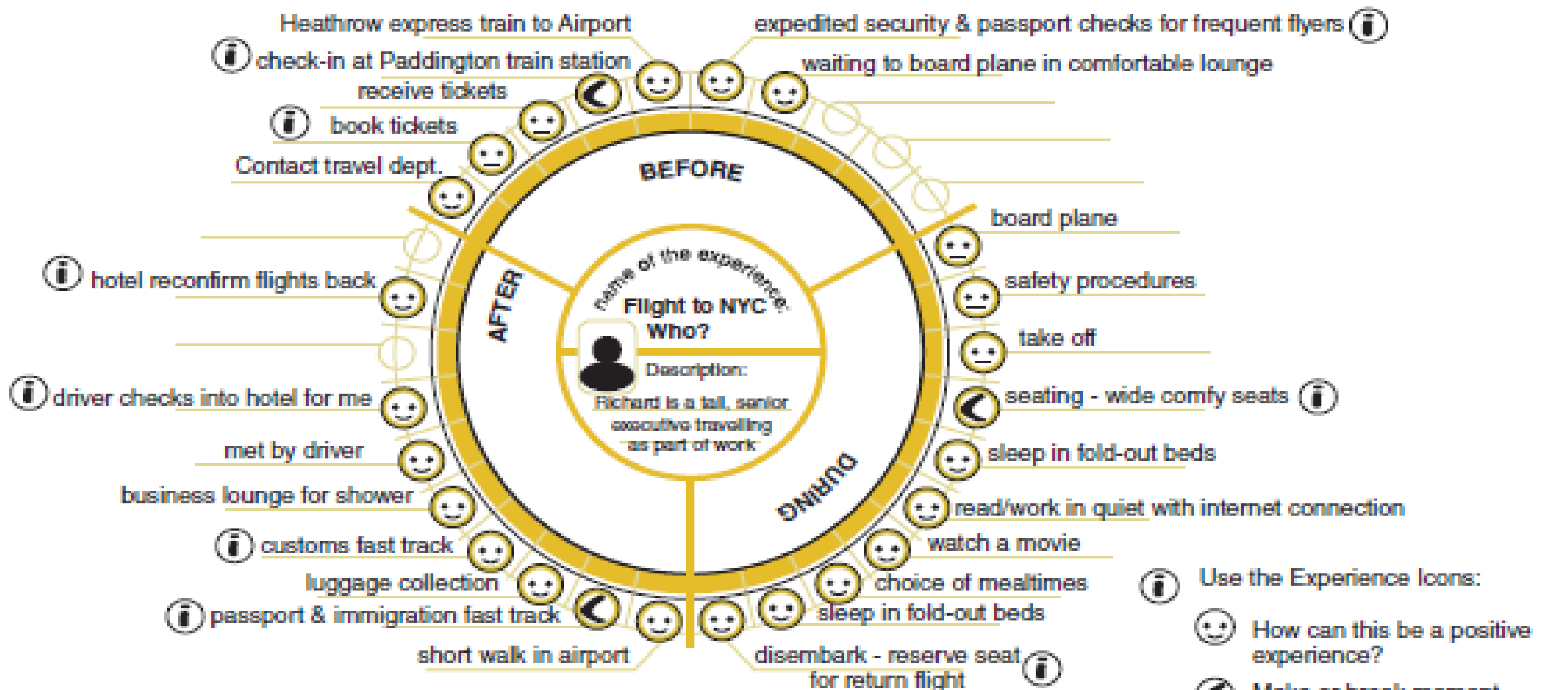


Fig. 11.19 An experience map using a wheel representation ;
Interaction design: beyond human-computer interaction

An experience map drawn as a timeline

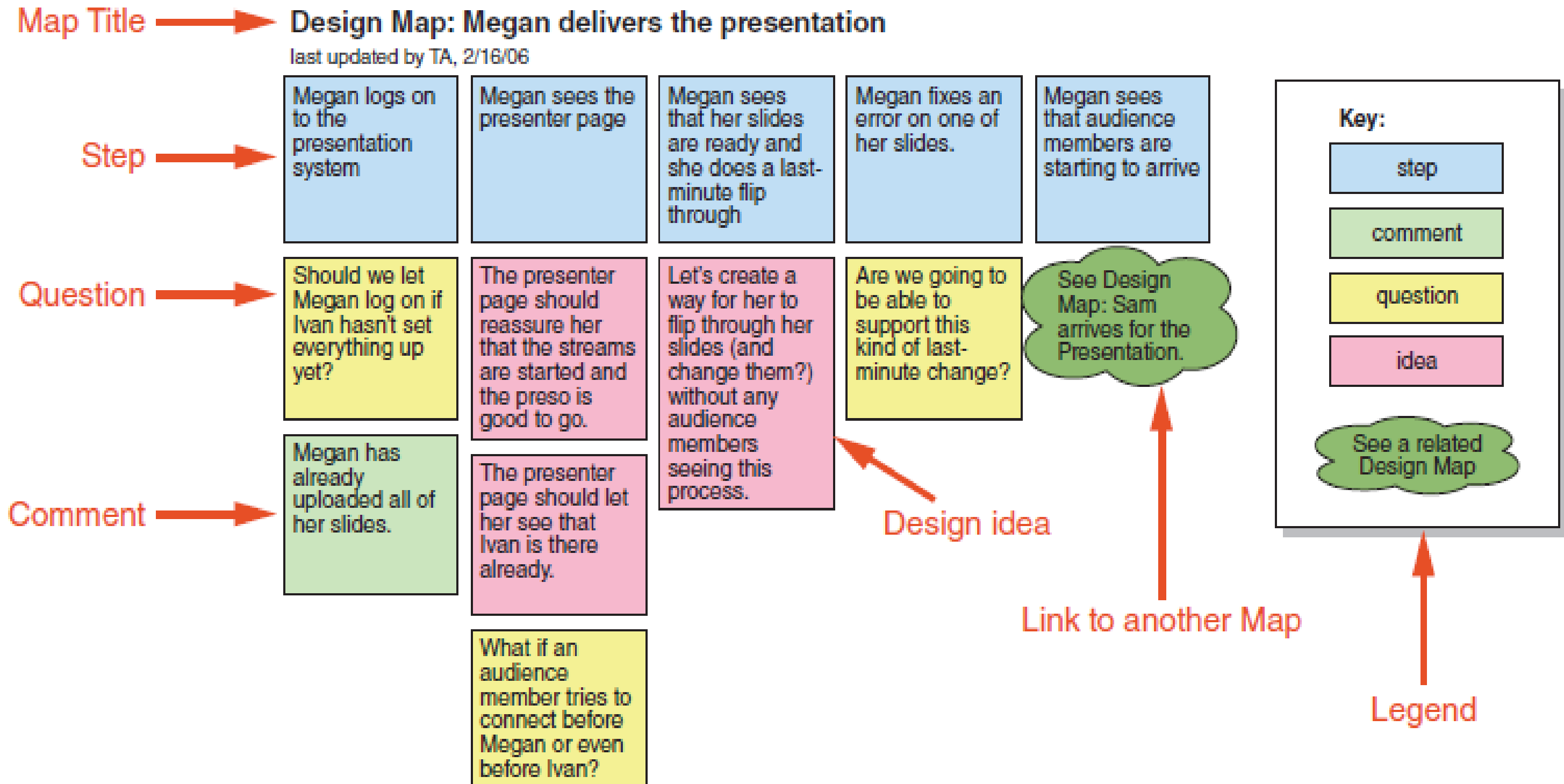


Fig. 11.19 : b) An example timeline design map illustrating how to capture different issues; Interaction design: beyond human-computer interaction

What a Prototype Is (and Is Not)

- A simulation of the end product. It is not the end product
- Interactive model with different degree of detailing. It does not always look like the end product
- Tests how smoothly and consistently the product's usage flow is
- Provides insights on user interaction
- Tests feasibility and usability before writing any code
- Provides unexpected discoveries and innovations

<https://www.cs.cmu.edu/~bam/uicourse/Buxton-SketchesPrototypes.pdf>

Construction

- Taking the prototypes (or learning from them) and creating a whole
- Quality must be attended to: usability (of course), reliability, robustness, maintainability, integrity, portability, efficiency, etc
- Product must be engineered
 - Evolutionary prototyping
 - ‘Throw-away’ prototyping

<https://prototypeinfo.com/evolutionary-prototyping-and-throw-away-prototyping/>

Tools for Prototyping

- Allows easy modification of interface details or functionality
- Allow manipulation of prototype components
- For evolutionary prototypes, allow reuse of code
- Not constrain the designer to default styles for interface objects

Three basic types of tools




- Hot spot-based tools that take prepared interface drawings / images where you then add interactivity. e.g. InVision, POP, Flinto, Keynote, Powerpoint
- State-based tools with interface components e.g. UXPin, Axure RP, proto.io, Pixate, Atomic, Indigo Studio, Fluid UI, Origami Studio, etc
- Code tools that receive and load dynamic data: e.g. Framer, LiveCode, Interface Builder, Visual Studio Express, Qt Creator, Noodl, etc



Prototyping Tools with Pros and Cons

- **Time to create prototype:** How long it took me to create the prototype once the tool was up and running (this was largely influenced by ease of use and learnability); shorter times were rated more favourably.
- **Fidelity:** How well I could simulate the intended interactivity of my prototype with the tool (scrolling, transitions, flow between pages and states, overall display and appearance).
- **Collaboration/sharing:** Quality of features for sharing the prototype with others and/or working collaboratively on the prototype.
- **Usability testing:** Quality of features for conducting usability testing with the prototype.
- **Support:** Amount and quality of tutorials, help documentation, libraries (UI elements, widgets, icons), templates, etc.

Emily Schwartzman @ Coopers

	UXPIN Collaborative prototyping tool for web and mobile Last updated: May 16	40-80 mins	Average	High	Good	Good	Low	Good
	IRISE Agile requirements and prototyping for teams Last updated: Feb 28	40-80 mins	Good	High	Average	High	Good	High
	INDIGO STUDIO Robust prototyping tool for web, desktop and mobile apps Last updated: Feb 1	40-80 mins	Good	Average	Good	High	High	High
	HOTGLOO Prototyping tool for interactive and responsive wireframes Last updated: Feb 1	40-80 mins	Low	Average	Low	Average	None	Average
	SOLIDIFY Click-through prototyping tool for user testing Last updated: Feb 1	15-30 mins	Good	High	High	Good	Average	Average
	PROTOSHARE Collaborative prototyping tool for web and mobile apps Last updated: Feb 1	40-80 mins	Good	High	Average	High	Low	Good
	PROTO.IO Prototyping tool for mobile devices Last updated: Feb 1	>80 mins	Average	High	Average	Good	High	Average
	JUSTINMIND Prototyping tool for web and mobile apps Last updated: Feb 1	40-80 mins	Good	Good	Good	High	High	Good

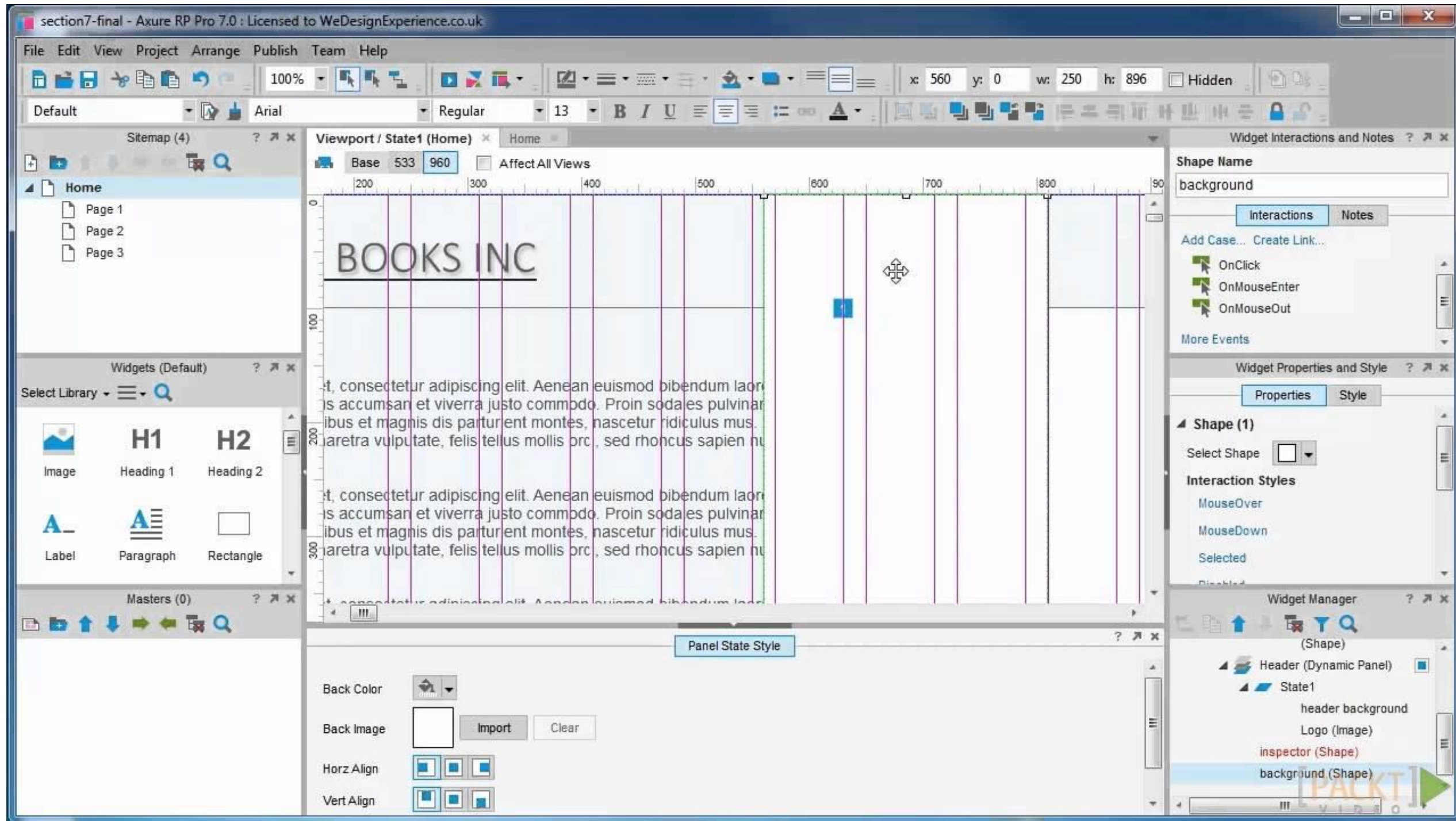
Prototyping Tools with Pros and Cons

Table : <http://www.prototypingtools.co/>

- **Interactions/gestures:** Quality of features for adding gesture-specific interactivity to the prototype.
- **Animations:** Quality of features for adding animated behaviours to screen transitions and individual elements within a screen.
- **Device testing:** Quality of features for testing the prototype on other devices.
- **Adaptation:** *Always choose a tool that you can easily analyse and adapt.*
- **Usage:** *check how well it fits with your design process and other tools you regularly use.*
- **Easiness of Use and Comfort:** *It should reduce the number of steps required for a designer to complete a task rather than increasing it.*
- **Price:** *Be careful while choosing tools and not be blinded by the features.*

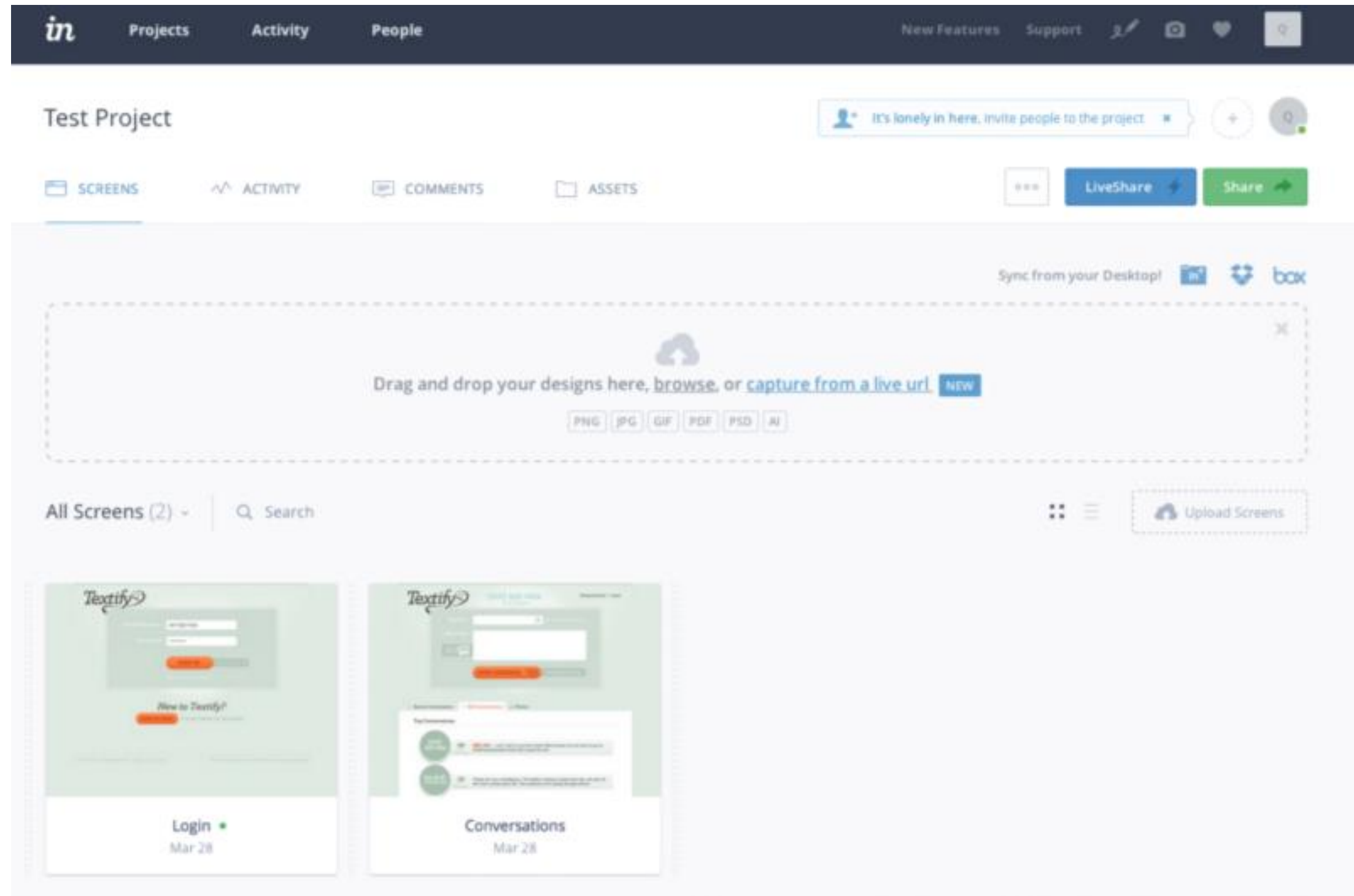
NAME	RUNS ON	PROTOTYPE FOR	GESTURES	TRANSITIONS	DESIGN	FREE TRIAL	PRICING
Antetype	macOS	Any	X	X	✓	30 days	\$189.99
App Cooker	iPad	iOS	✓	✓	✓	No	\$19.99
Atomic	Web	Any	✓	✓	✓	30 days	From \$0/mo.
Avocado	macOS	Android, iOS	✓	✓	X	Unlimited	Free
Axure	macOS, Windows	Any	X	✓	✓	30 days	From \$289
Briefs	macOS	iOS	X	✓	✓	Feature limited	\$199
Canvas Flip	Web	Android, iOS, Web	✓	✓	X	14 days	From \$0/mo.
Codiqa Web	Web	Mobile	✓	X	✓	Feature limited	From \$16/mo.
Codiqa Desktop	macOS, Windows	Mobile	✓	X	✓	7 days	From \$79
Concept.ly	Web	iPad, iPhone, Web	X	X	X	No	From \$0/mo.
Demonstrate	iOS	iPhone	✓	✓	X	No	Free
Evolus Pencil	Linux, macOS, Windows	Any	X	X	✓	Unlimited	Free

Axure



<https://www.youtube.com/playlist?list=PLTgRM0cmRb3NEqMtKgk-3McDPmHqyH4SM>

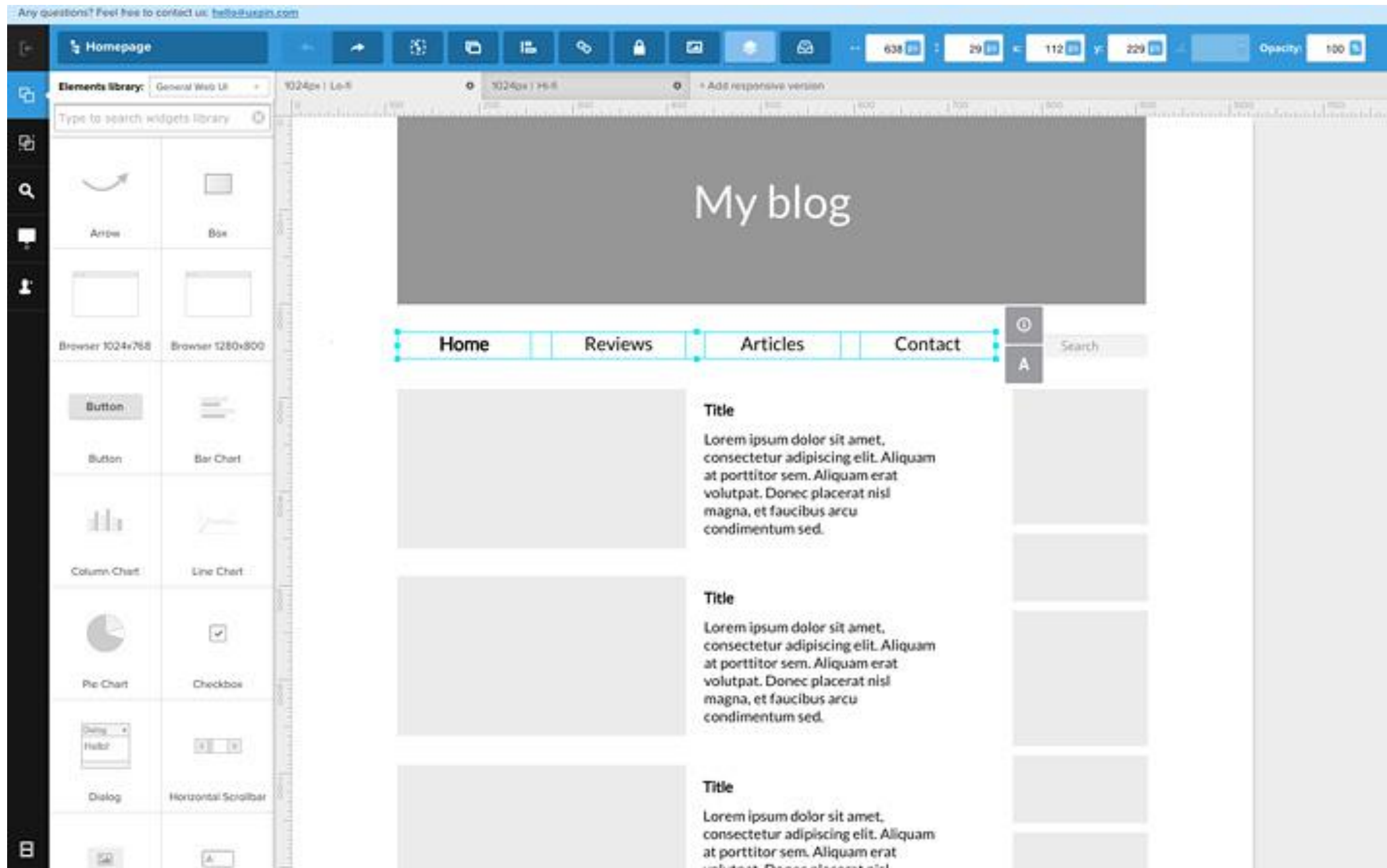
InVision



<https://www.youtube.com/watch?v=zNoBmjg-NnQ>

<http://www.invisionapp.com/>

UXPin



Principle

principle

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Principle makes it easy to design animated and interactive user interfaces. Whether you're designing the flow of a multi-screen app, or new interactions and animations, Principle helps you create designs that look and feel amazing.

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<https://www.youtube.com/watch?v=KWGBGTGryFk>

Form

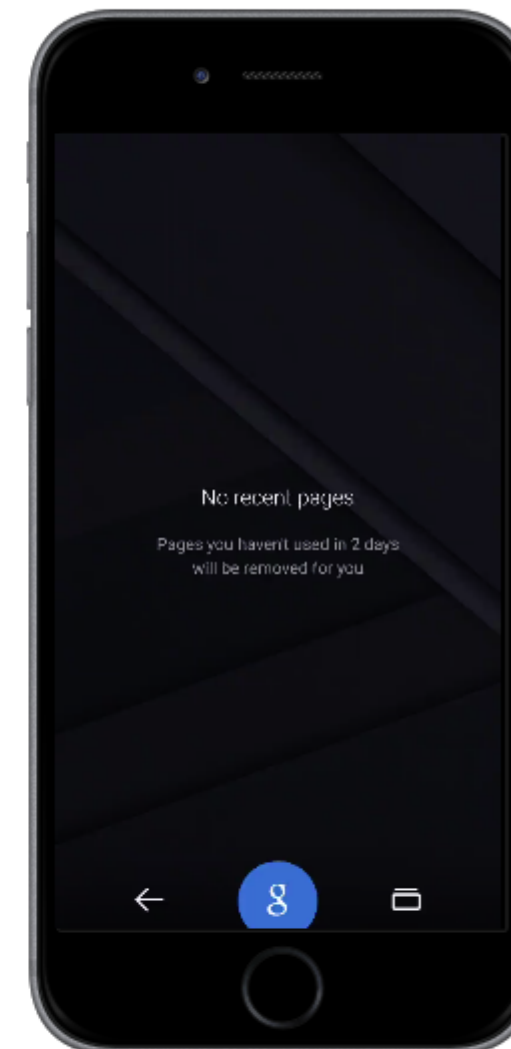
Instant Native Prototypes

Build and customize native prototypes directly on device.

[Getting Started](#) [Community](#)

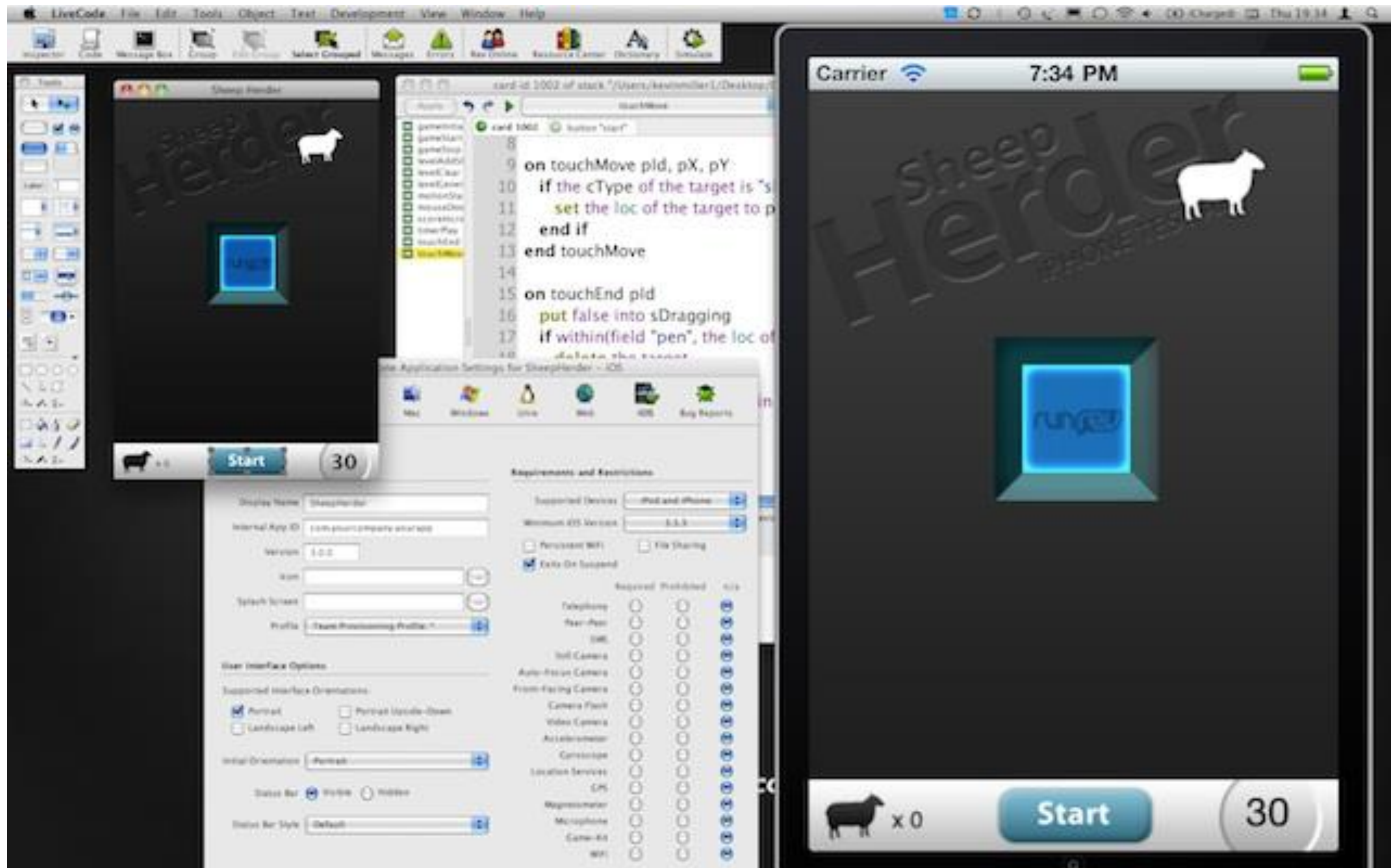
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LiveCode



Video Prototypes

- Linear illustrations of how users use the intended system
- Can build on paper prototypes, physical models, existing software and images from actual environments
- Start with a scenario and make a picture script for the movie
- Move around parts of the image script to assemble sequences of clips
- Filming the rock in the right order based on the image script, so you do not have to cut so much

Screencast- aka- Skärminspelningsprototyp

- Movies showing the user interface

Flash

Powerpoint or Keynote with finishing in MovieMaker, iMovie or AfterEffects.

- View a feature that can't be done with papers, models, the Trolley of Oz, or analoge video prototypes
- Start with an image script!
- Can be done with stops in each step

Further Reading

- <http://www.inuse.se/blogg/tre-propttypverktyg-du-inte-far-missa/>
- <https://blog.prototypr.io/the-7-best-prototyping-tools-for-ui-and-ux-designers-in-2016-701263ae65e8#.225h06t6s>
- <http://www.cooper.com/prototyping-tools>
- https://medium.com/@msds_branding/5-fantastic-ux-prototyping-tools-part-1-3a4d05f8801f
- <http://ms-ds.com/our-thinking/insights/5-best-ux-prototyping-tools-part-two>
- <https://uxmag.com/articles/comparing-popular-layer-based-and-code-based-prototyping-tools>
- <https://uxmag.com/articles/comparing-four-popular-page-based-interactive-prototyping-tools>

Summary

- Different kinds of prototyping are used for different purposes and at different stages
- Prototypes answer questions
- Two aspects of design: conceptual and concrete
- To generate conceptual design, consider interface metaphors, interaction types and interface types

- Set up user information
- Prototypes enough but no more
- Choose prototyping tools based on needs

Reference

- Houde, S., and Hill, C., What Do Prototypes Prototype?, in Handbook of Human-Computer Interaction (2nd Ed.), M. Helander, T. Landauer, and P. Prabhu (eds.): Elsevier Science B. V: Amsterdam, 1997.
- Chapter 11 in Preece, J., Rogers, Y. and Sharp, H., 2015. *Interaction design: beyond human-computer interaction*. John Wiley & Sons.

Questions