

# Introduction to User-Centered Design

Lecture 7 – Prototyping part 1

**Eleftherios Papachristos**

Associate Professor at the Department of Design (NTNU)

# Lectures

How will you learn

	date	day	hour	content
1st lecture	24-Aug	Wednesday	12:15-14:00	intro
2nd lecture	29-Aug	Monday	16:15-18:00	Understanding
3rd lecture	07-Sep	Wednesday	12:15-14:00	Understanding
4th lecture	14-Sep	Wednesday	12:15-14:00	Understanding
5th lecture	21-Sep	Wednesday	12:15-14:00	ideation
6th lecture	28-Sep	Wednesday	12:15-14:00	ideation
7th lecture	19-Oct	Wednesday	16:15-18:00	prototyping
8th lecture	24-Oct	Monday	12:15-14:00	prototyping
9th lecture	03-Nov	Thursday	16:15-18:00	evaluation
10th lecture	09-Nov	Wednesday	12:15-14:00	evaluation
Guest lecture	10-Nov	Thursday	14:15-16:00	



Oblig 3 (last)

# Today's lecture

Goals Lecture 7

## What will you learn?

Move from an idea or concept to a specific prototype (specify)

- Definition and purpose of prototypes
- Types of prototypes

# Outline of this lecture

Goals Lecture 7

## Part 1: Summing up activities so far

- Understanding
- Ideation

## Part 1: What is prototyping?

- Basic concepts

## Part 3: Types of prototyping

- Fidelity
- Physical vs screen
- Functionality

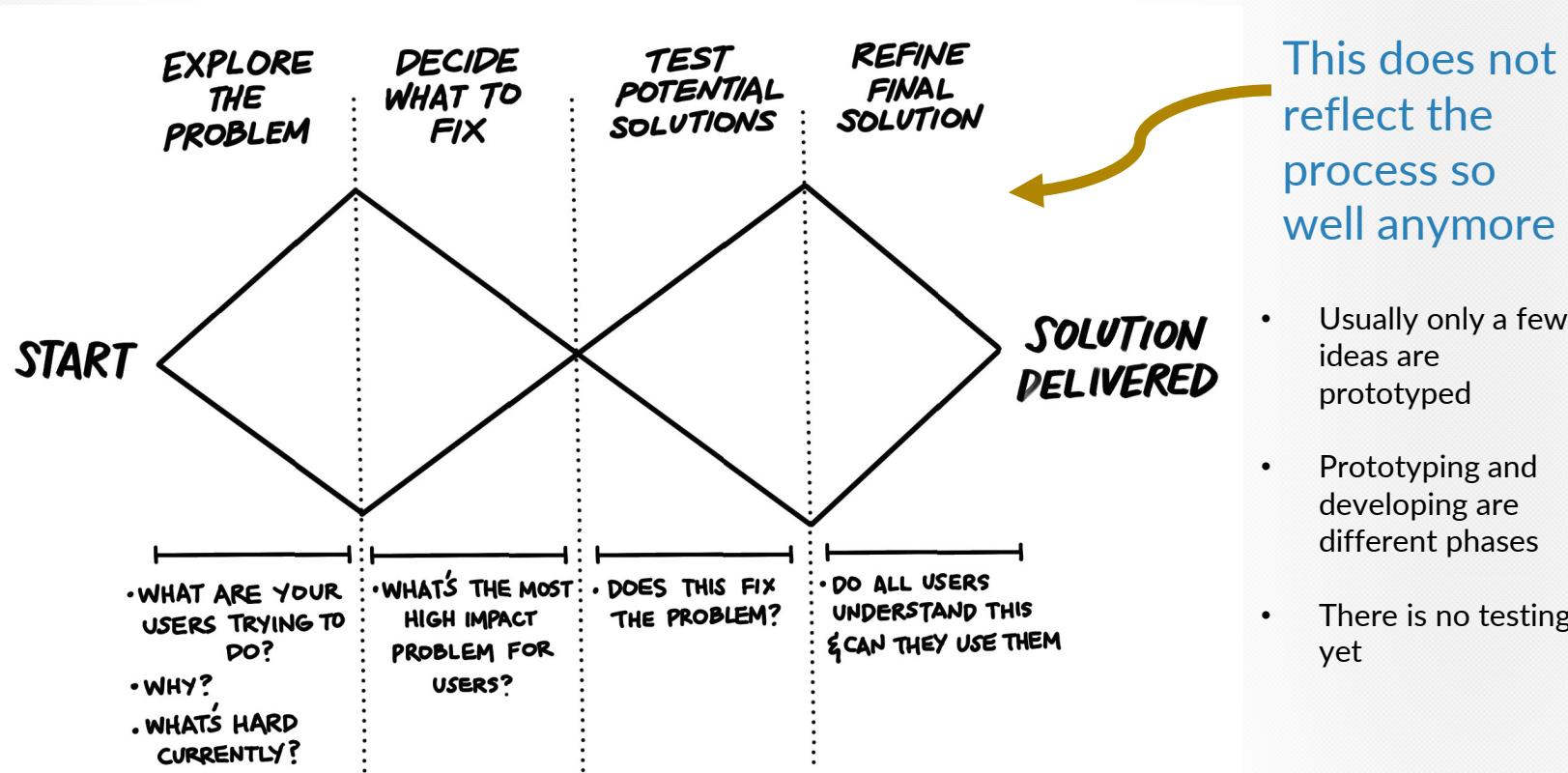
## Part 1

# 1 Summing up activities so far

Understanding  
Ideation

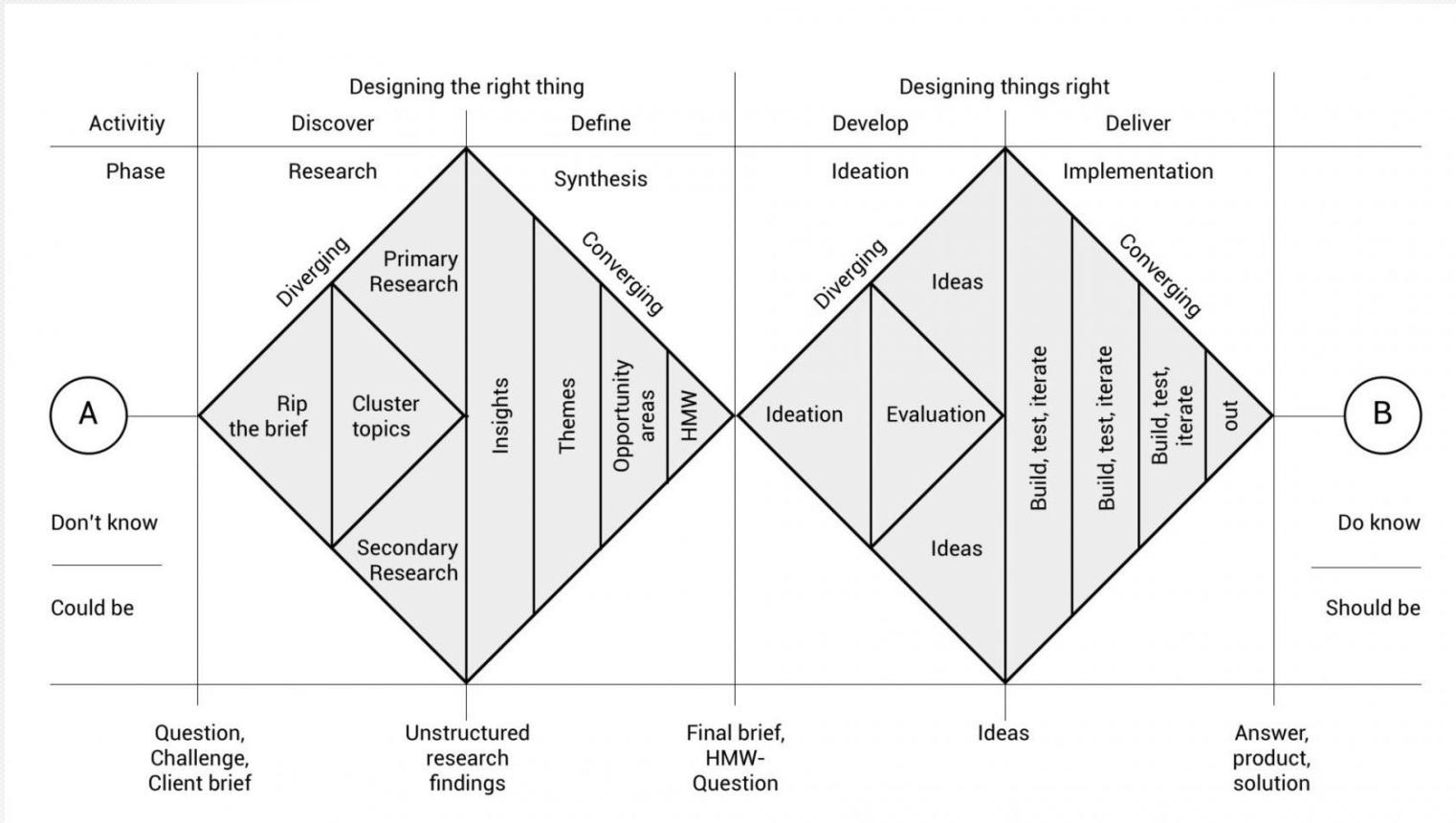
# Where are we in the process

process



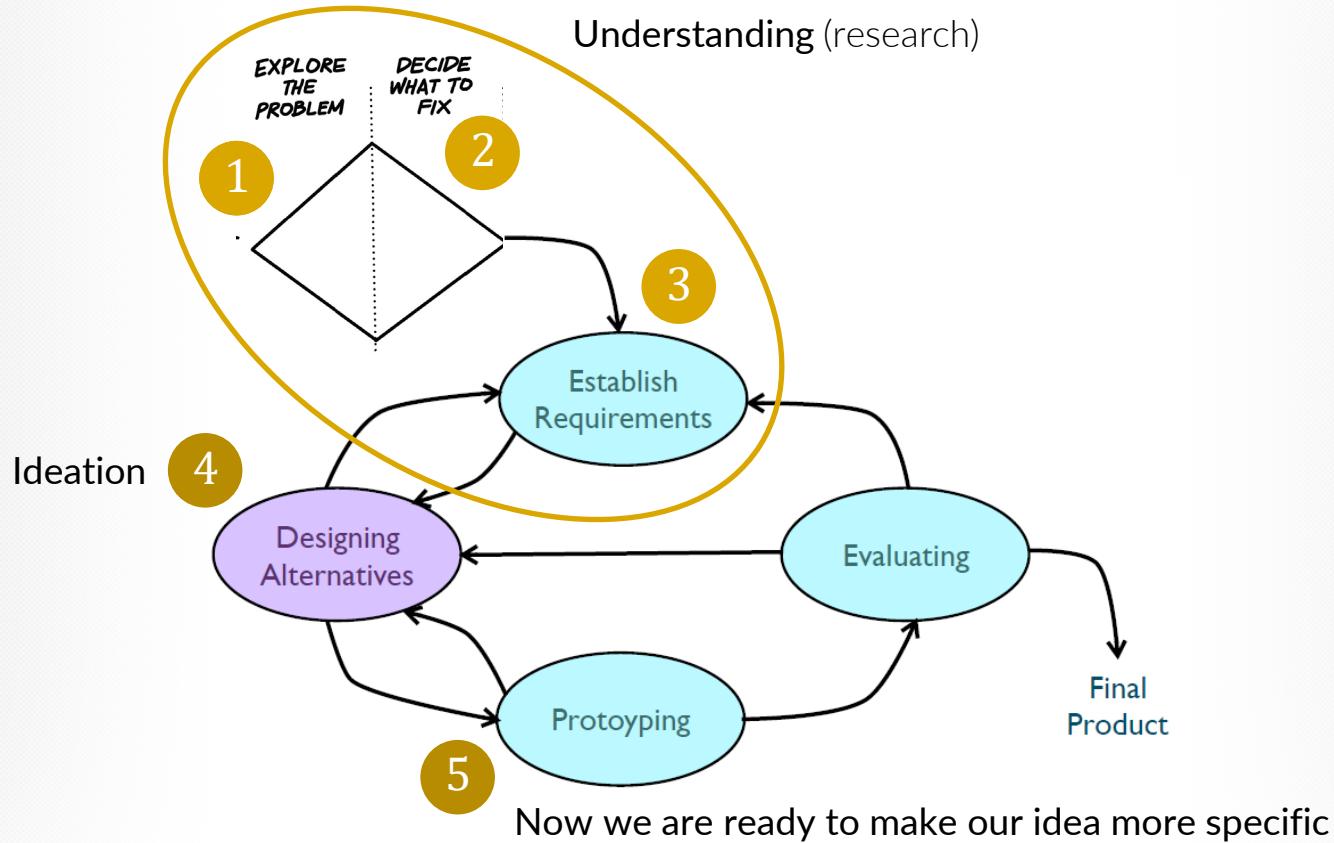
# Where are we in the process

## process



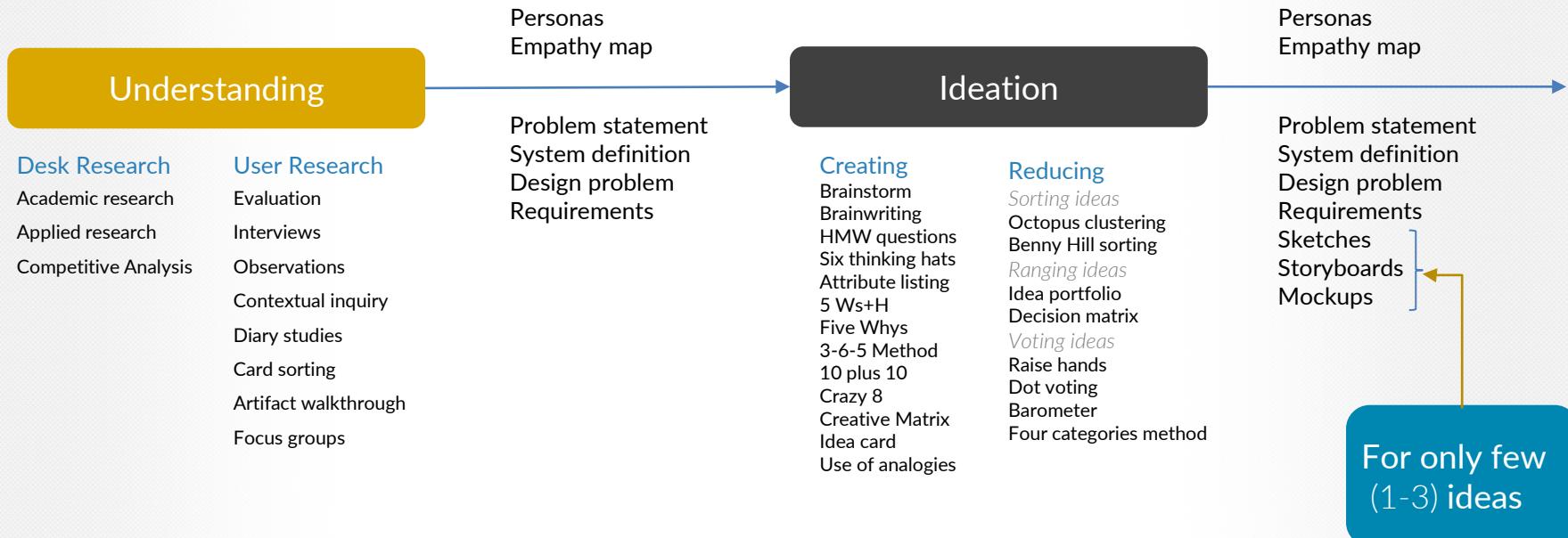
# Where are we in the process

process



# Where are we in the process

process



# Where are we in the process

process

Personas  
Empathy map



Prototyping

Prototype(s)

Evaluation

Problem statement  
System definition  
Design problem  
Requirements  
Sketches  
Storyboards  
Mockups

Type of prototype  
Fidelity  
Functionality  
Physical prototype  
Prototyping software

Part 2

## 2 What is prototyping

# What are Prototypes?

There is confusion around terminology

Sketches

Wireframes

Functional prototypes

Low-fidelity  
prototypes

Non-functional prototypes

High-fidelity  
prototypes

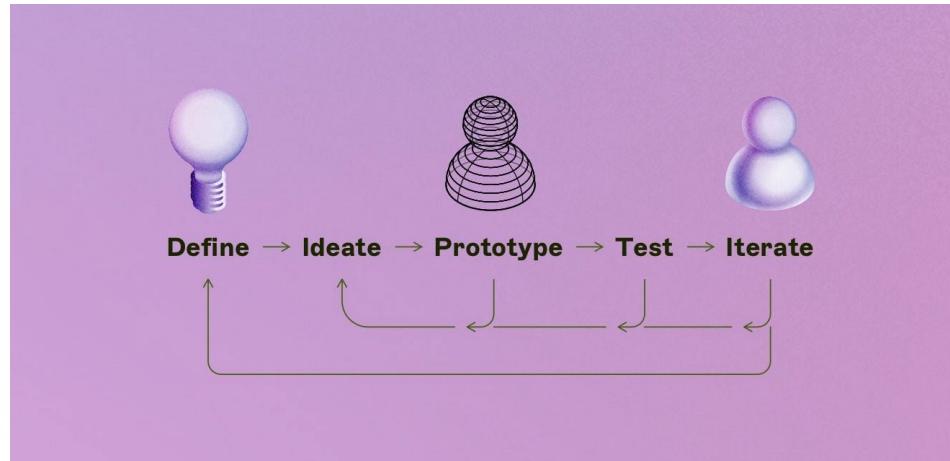
# What are Prototypes?

Prototyping

Describe, Define, Refine, Specify

A prototype is an early model of an object you build to test a design. Prototypes are drafts of your final version, focusing on functionality and giving your stakeholders a clear picture of your final product.

<https://medium.com/sketch-app-sources/what-is-a-design-prototype-the-complete-guide-f79cce54c50e>



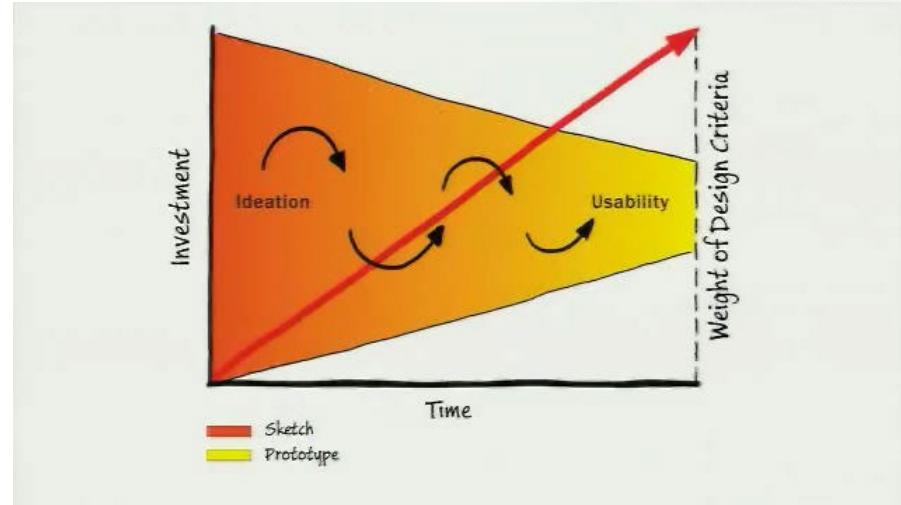
# Sketching vs prototypes

General introduction

Sketches and prototypes have a different purpose

However

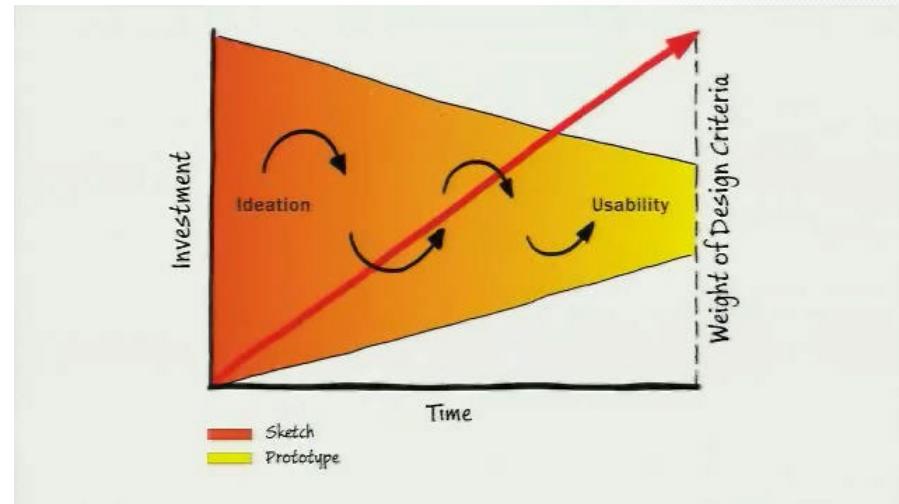
- It is not as clear cut when one ends, and the other begins in the process
- By just looking at a sketch sometimes it is hard to say if it is intended as a paper prototype



# Sketching vs prototypes

General introduction

<u>SKETCH</u>	<u>PROTOTYPE</u>
EVOCATIVE	→ DIDACTIC
SUGGEST	→ DESCRIBE
EXPLORE	→ REFINE
QUESTION	→ ANSWER
PROPOSE	→ TEST
PROVOKE	→ RESOLVE
TENTATIVE	→ SPECIFIC
NONCOMMittal	→ DEPICTION



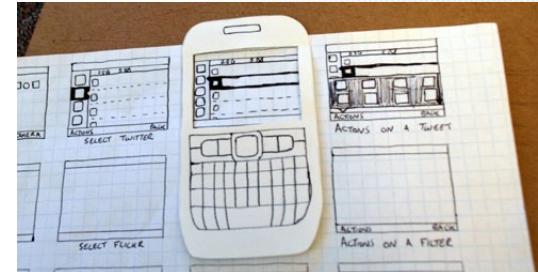
Reasons for prototyping:  
communication, reflection, alternatives, evaluation

# Real product vs Prototypes

General introduction

Prototypes are drafts of your final version, not the final version

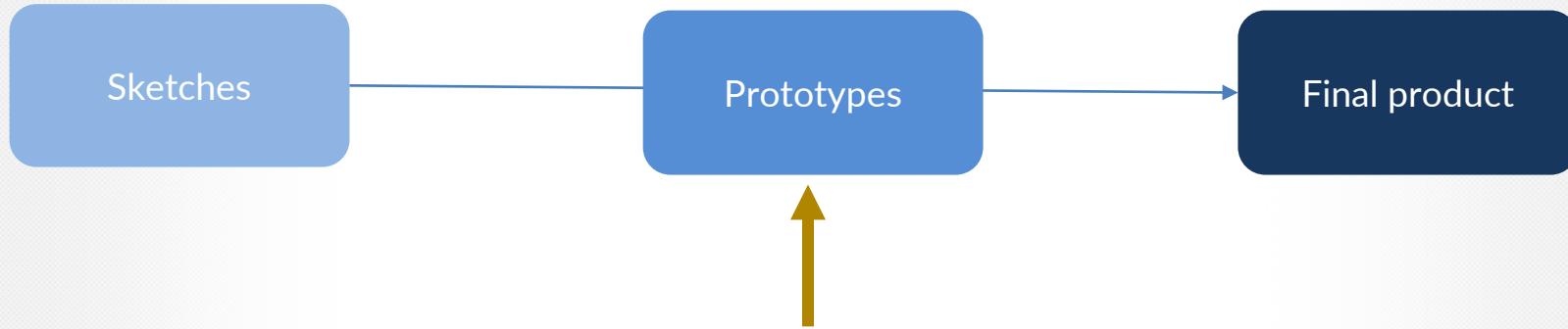
- They imitate the functionality of the final product
- Concrete but more abstract than the final version
- Don't need to actually work just look like they do
- Should respect the constraints of the final platform  
(e.g. web, desktop app, mobile app, physical design, service)



Change is still possible and highly probable with prototypes  
Change is more costly and less probable in final products

# Sketches vs prototypes vs final products

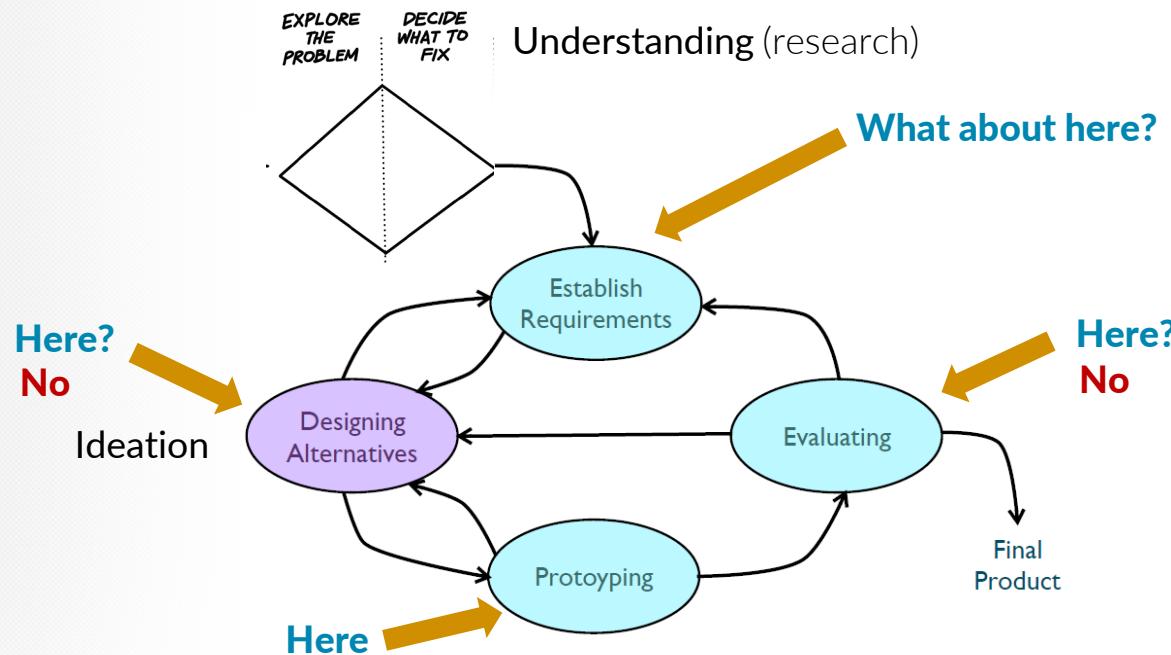
General introduction



Between sketches and the final product

- To test aspects of it before change be too expensive
- To define and refine the idea better
- To create a deliverable that is easy for developers to follow
- To assess engineering or software requirements

# When should we do Prototyping?



# Starting with a prototype?

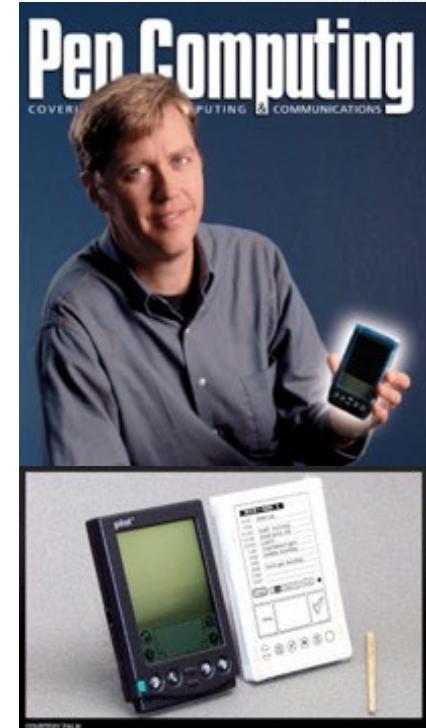
Prototyping

"When asked how small their new device should be Hawkins, the Palm Pilot creator said: "Let's try the shirt pocket."

... he cut a block of wood to fit his shirt pocket. Then he carried it around for months, pretending it was a computer. Was he free for lunch on Wednesday? Hawkins would haul out the block and tap on it as if he were checking his schedule. If he needed a phone number, he would pretend to look it up on the wood.

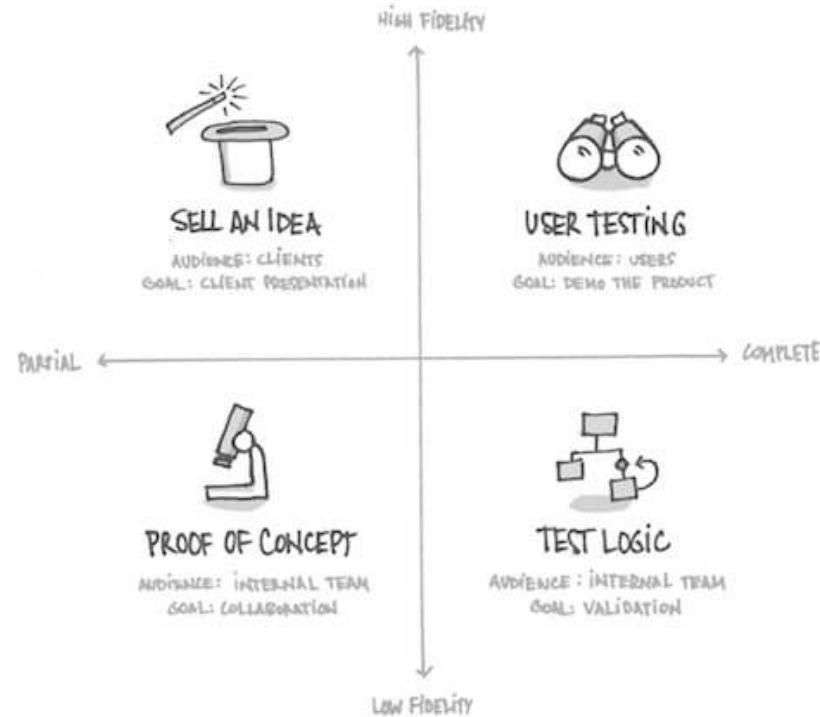
Occasionally he would try out different design faces with various button configurations, using paper printouts glued to the block."

(TIME, 16 March, 1998)



# Prototyping objectives

Prototyping



# Prototyping objectives

Prototyping

## Idea validation:

It can help you, and your team work out exactly what you're trying to achieve.

## Collaboration with others:

It can help collaborate with others in the development team (e.g., explain functionality to developers)

## Convince stakeholders:

Often you need a prototype to prove to investors and stakeholders that this idea is worth taking to the next step.

## Testing:

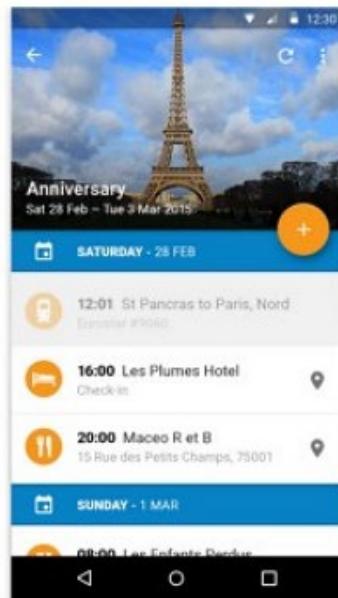
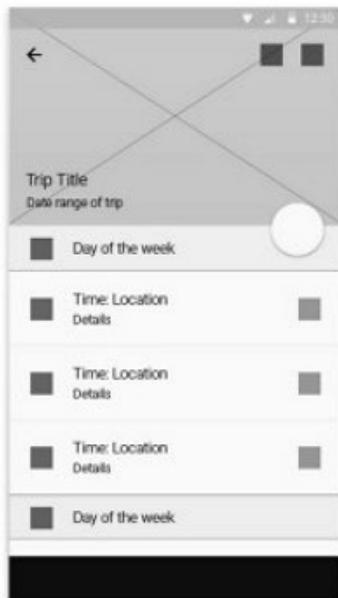
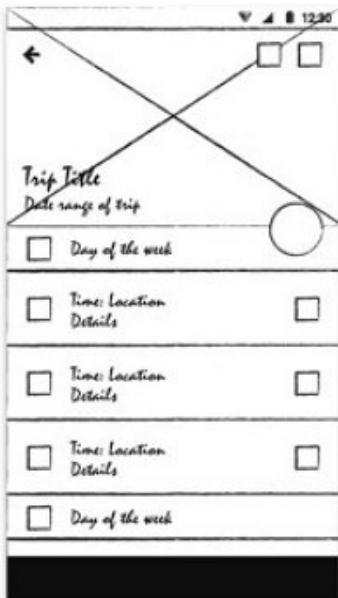
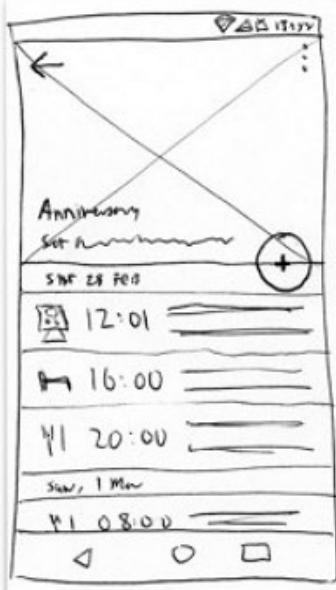
Helps get a version of your design to end users to test it before development starts

Part 3

## 3 Types of prototypes

# Prototype Fidelity

General introduction



# Prototype Fidelity

General introduction

## What are high and low fidelity prototypes ?

Common misunderstanding :

Low fidelity = wireframes , High fidelity = refined visual design comps

Fidelity can vary on multiple aspects of your design

- **Visual design** (e.g. color, typography, layout)
- **Interactivity** (how our UI elements react to input)
  - Low fidelity prototypes = static wireframes
  - high fidelity prototypes = simulates how the application reacts to user interaction
- **content** (e.g. Text, videos, images)
  - Low fidelity = placeholder text, images
  - high = actual content
- **Context of use -Physicality**

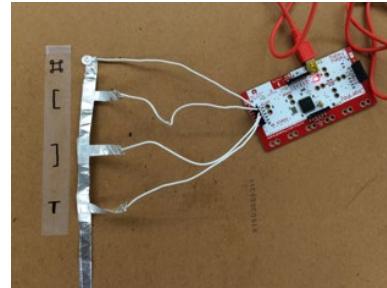
# Prototype Fidelity

General introduction

- match the fidelity to the stage of design
- can be used to emphasise parts of the design?
- If used for testing it should allow some form of interaction

examples :

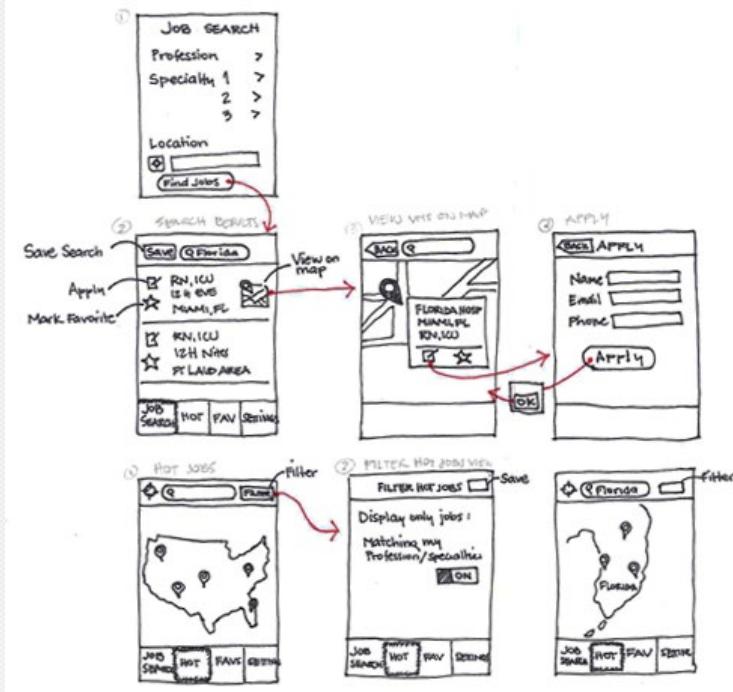
- paper-based drawing
- cardboard mock-up
- wire-frame
- 3D printed model
- video simulation
- software program
- hardware mockup



# Terminology

# Sketches

General introduction



- Help explore your ideas quickly
- Good at communicating ideas to the group
- Disposable, cheap

Are they prototypes?

No, but they can be (paper prototypes)

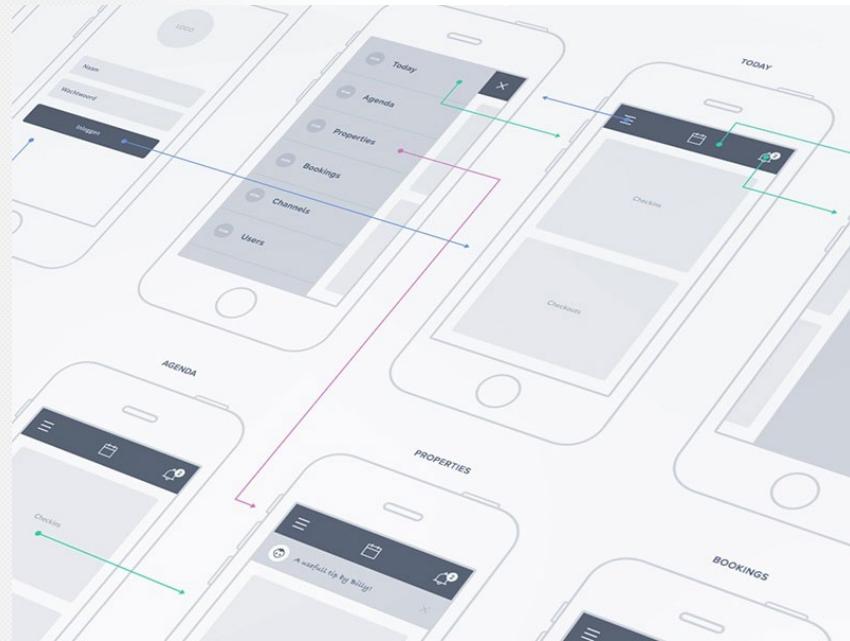
Should you show them to:

Users    Maybe

Clients    Probably not

# Wireframes

General introduction



- Spatial representation of elements on a screen
- A map of the project.
- A visual guide to its internal structure
- More refined than sketches
- Usually, no aesthetic elements

Are they prototypes?

No, but they can be

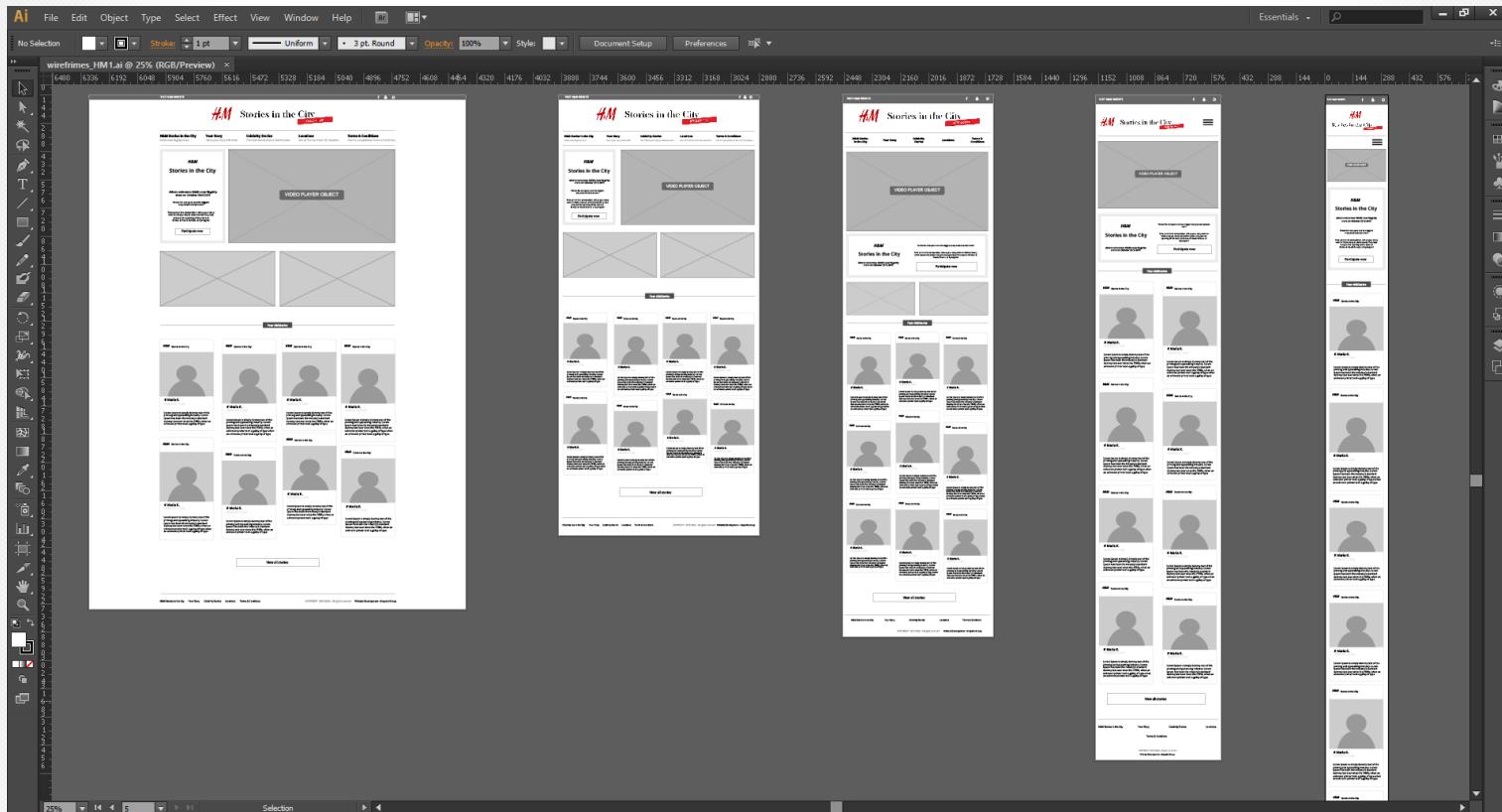
Should you show them to:

Users    Maybe

Clients    Maybe

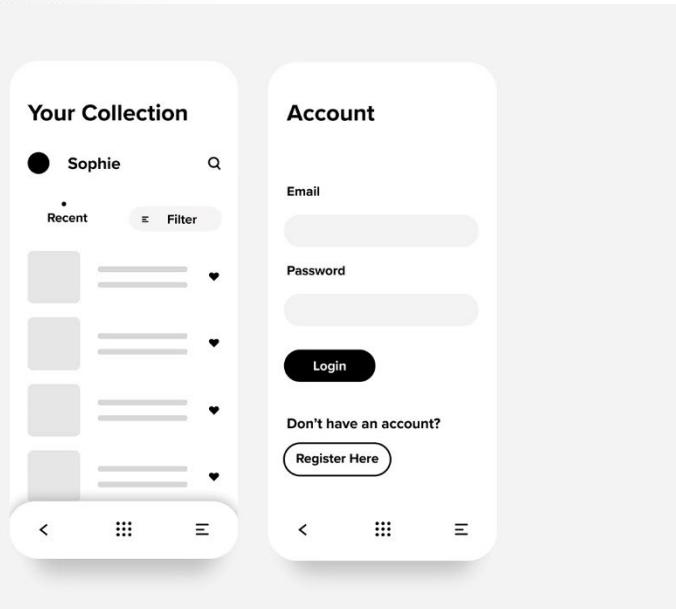
# Wireframes

General introduction



# Low fidelity prototype

General introduction



- Low fidelity representation (on some aspects) of the final product
- Usually, low fidelity on aesthetic elements because the purpose is to examine content functional elements and interaction

Are they prototypes?

Yes

Should you show them to:

Users Yes

Clients Maybe

# High fidelity prototype

General introduction



- May look and behave exactly like the final product but usually is developed with prototyping tools (no code)
- Jumping directly into hifi prototypes may not be the best idea
- People may feel its final so be reluctant to suggest changes or may fixate on aesthetic aspects

Are they prototypes?

Yes

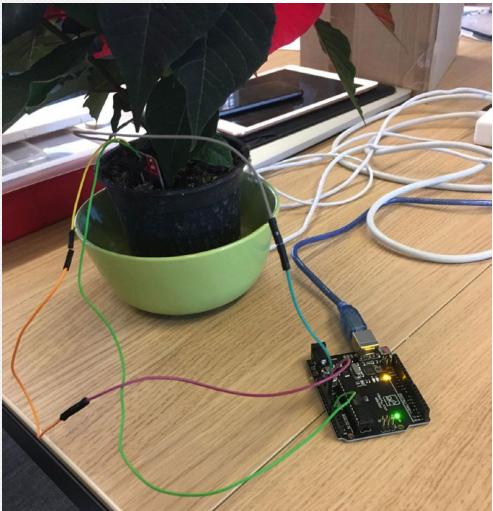
Should you show them to:

Users Yes

Clients Yes

# Physical prototypes

General introduction



- Beyond screens physical objects
- Can contain electronic devices (Arduinos, raspberry pies to emulate functionality)
- Emphasis on physical attributes

Are they prototypes?

Yes

Should you show them to:

Users Yes

Clients Yes

# Functional vs nonfunctional

General introduction

- **Functional prototypes allow for some level of interaction**  
They may only emulate functionality, but they provide insights into how users may use it
- **Most examples of prototypes we have seen are functional**  
In those examples non-functional would be just sketches or wireframes
- Non-functional prototypes may be used to communicate how complex systems may be used

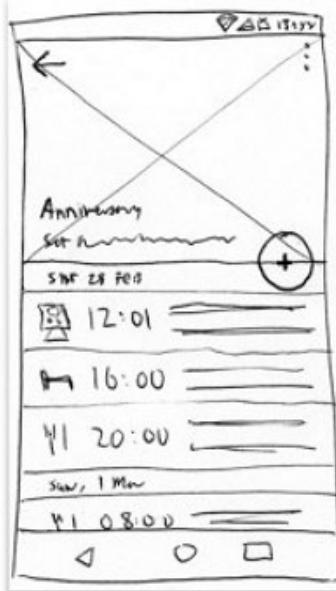
for example

Using mock-ups to create video-prototypes

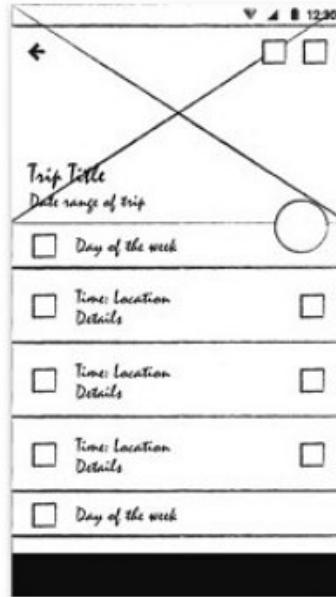
# Terminology

General introduction

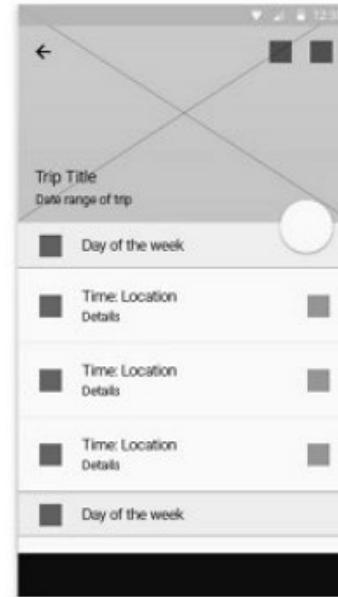
Sketch



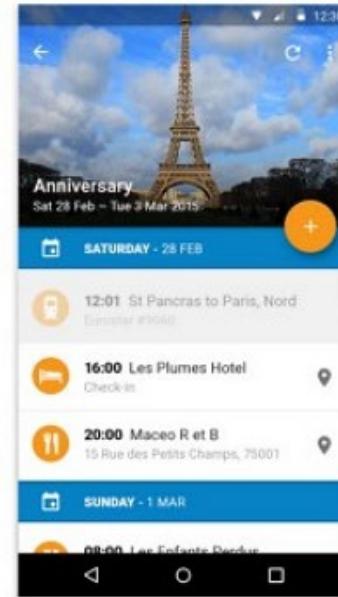
wireframe



LoFi Prototype



HiFi Prototype



# Terminology

General introduction

## Common misunderstanding

### Low Fidelity

- Non-interactive
- Wireframe or other simple representation

### High Fidelity

- Some functionality or micro-interactions implemented
- Graphically similar to the final product



This is wrong  
But  
very common representation

Be aware of the terminology problem, but it is not so important what prototypes are called rather than why and when they are used

# Paper prototypes

# Paper prototypes

General introduction



## Disposable

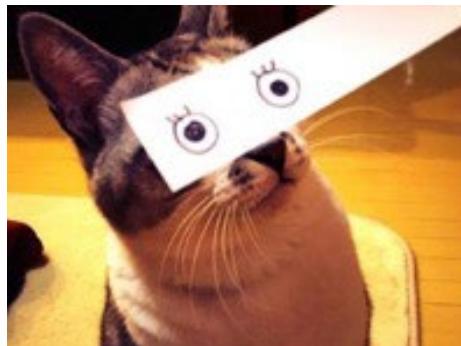
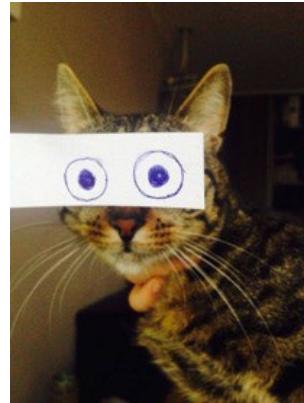
- Low threshold to make,
- low risk to experimentation.
- low budget -> Sketches, post its, tape, photocopies
- High number and high variability between them.

## Exploratory

- Design elements, labelling and layout
- Make decisions based on hard data by involving the user

# Paper prototype

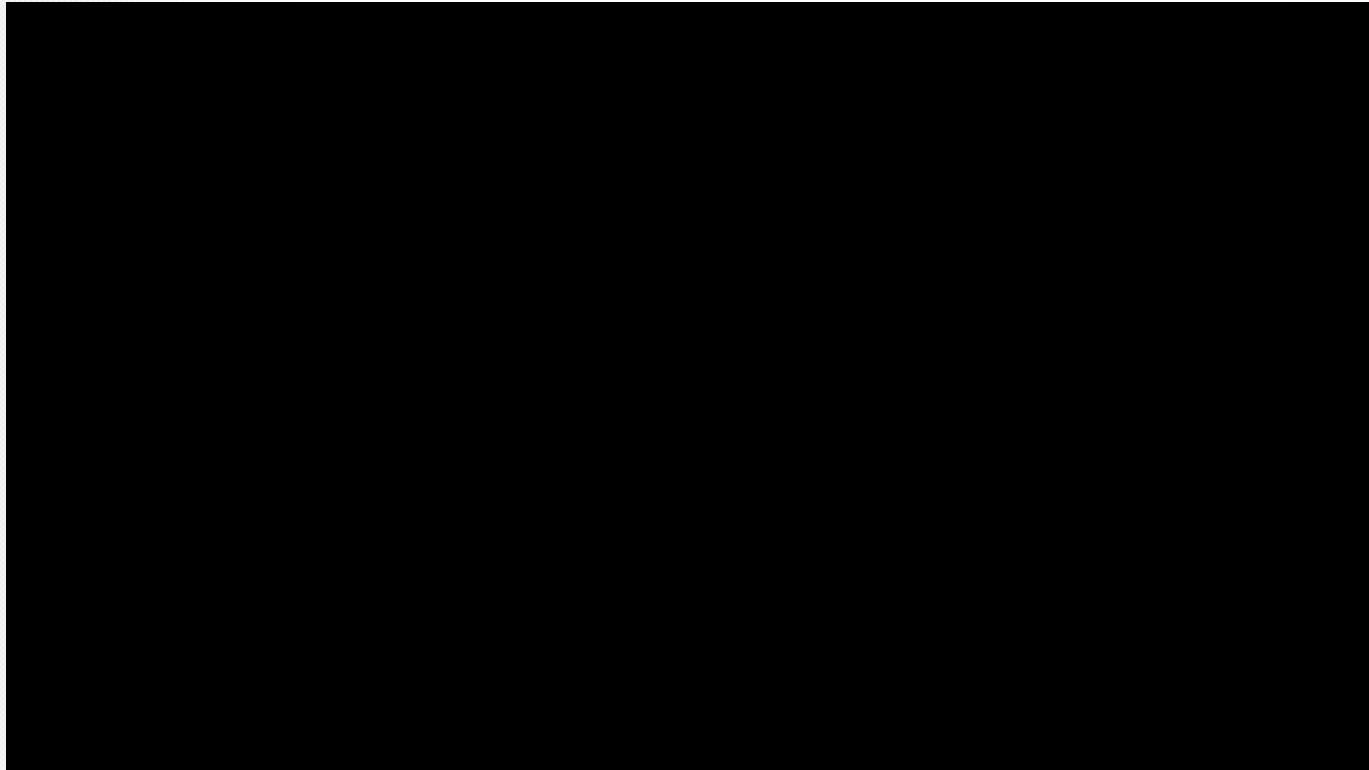
General introduction



“cat montage”  
(neko montaaju)

# Paper prototype (for testing)

General introduction



# Paper prototypes (How)

General introduction

## Have a goal for each prototype

- Set a clear goal that you want to achieve with a prototype. Think of a problem you try to solve and create a prototype that will help you solve it.
- Think of the context of use and technology platform (e.g. mobile, web)
- Focus on navigation, information architecture and content before you go into aesthetics

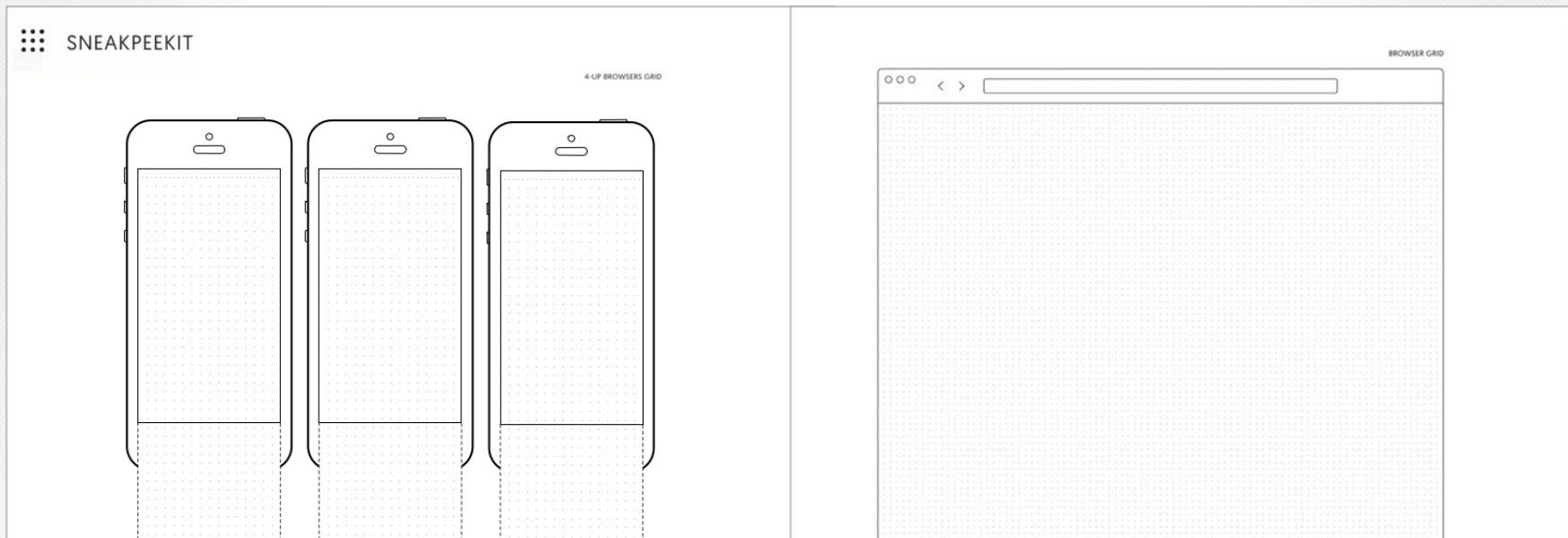
# Paper prototypes (How)

General introduction

## Use templates

Find a template or make one, preferably one screen per page.

Can be 2x or 4x the real size. You can scale it down with photocopies or prints.

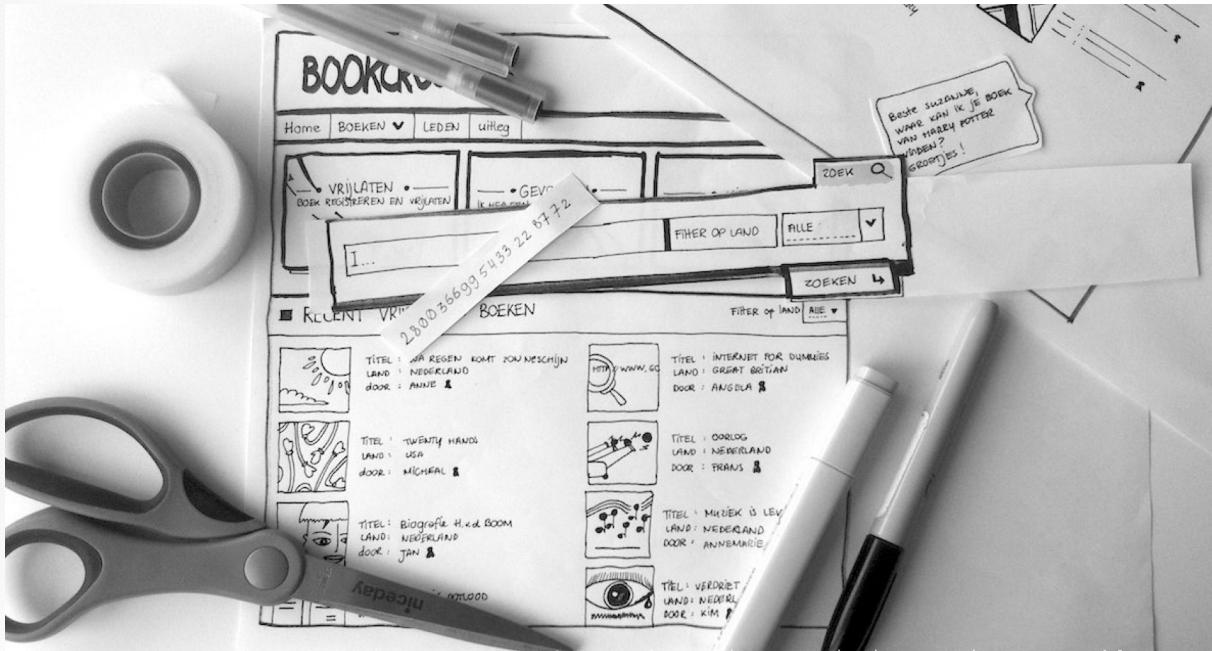


# Paper prototypes (How)

General introduction

## Make reusable design elements

Make modular design: buttons, navigation can be repeated and printed



# Paper prototypes (How)

General introduction

## Make it physical

If you are prototyping for a non standard device, it is very helpful to hold it.



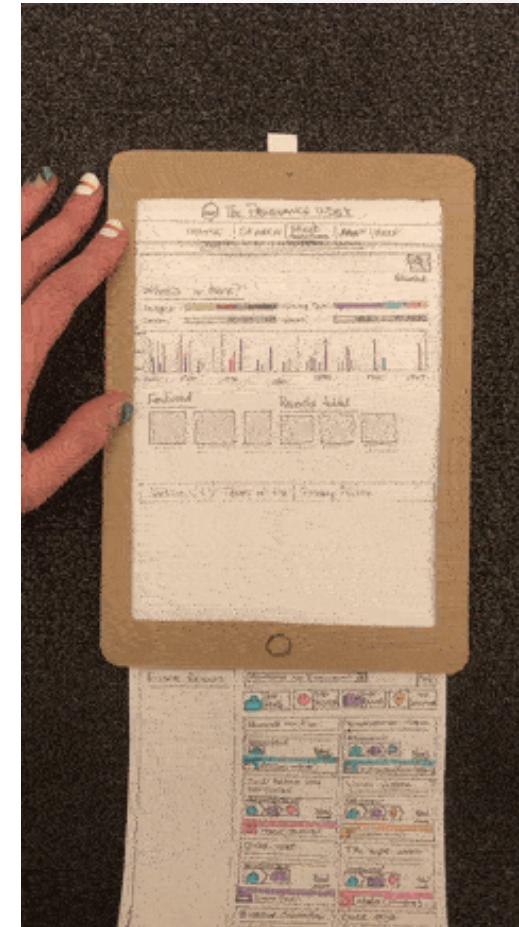
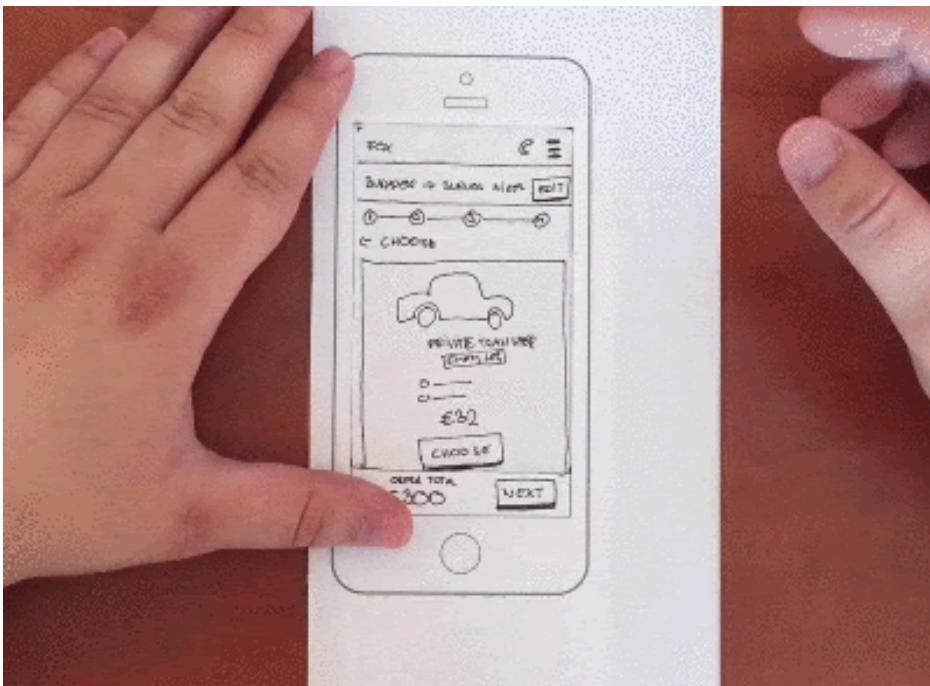
# Paper prototypes (How)

General introduction

## Advanced

You can make advanced animation if you think it is useful

.



# Paper prototype examples

General introduction

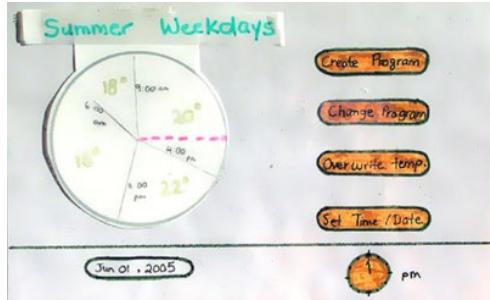


Figure 2: The “Circular” paper prototype

Program	<input type="text" value="Summer on Vacation"/>		
Morning	From: 7:00	To: 9:00	Temperature: 15
Day	7:00	5:00	15
Evening	5:00	12:00	15
Night	12:00	7:00	15
Date	12/01/2005	12:00 PM	23

Figure 3: The “Tabular” paper prototype

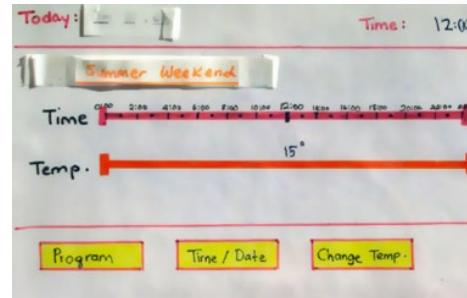


Figure 4: The “Linear” paper prototype

# Horizontal & Vertical Views

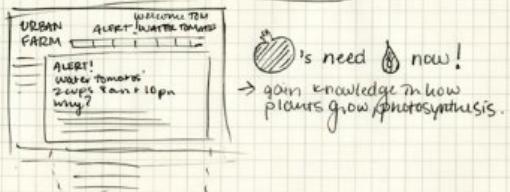
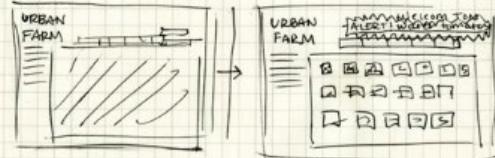
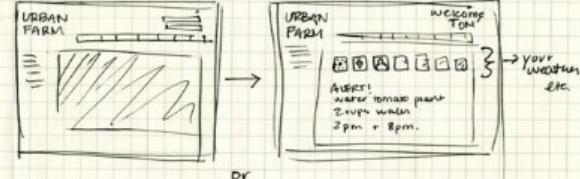
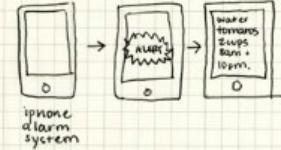
General introduction



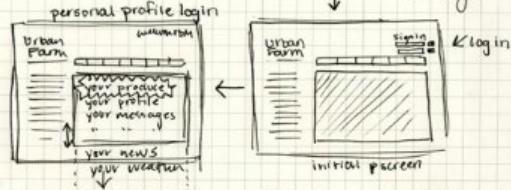
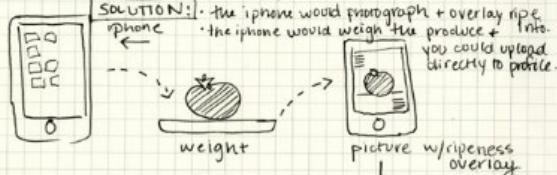
# Is that a paper prototype?

General introduction

NEED: the user needs to know when to water/feed their produce.  
SOLUTION: An alert system for your iphone, an daily updates online.



NEED: to know if a piece of produce is ripe/how much it weighs.



# Challenge

# Challenge

instructions

In pairs, design and draw screen designs for the following case:



a smartphone app used to find a friend  
at a festival

Create a paper prototype showing how  
one would use this app to find someone

You have 10 minutes

# Challenge

instructions

## Examples



# Challenge

instructions

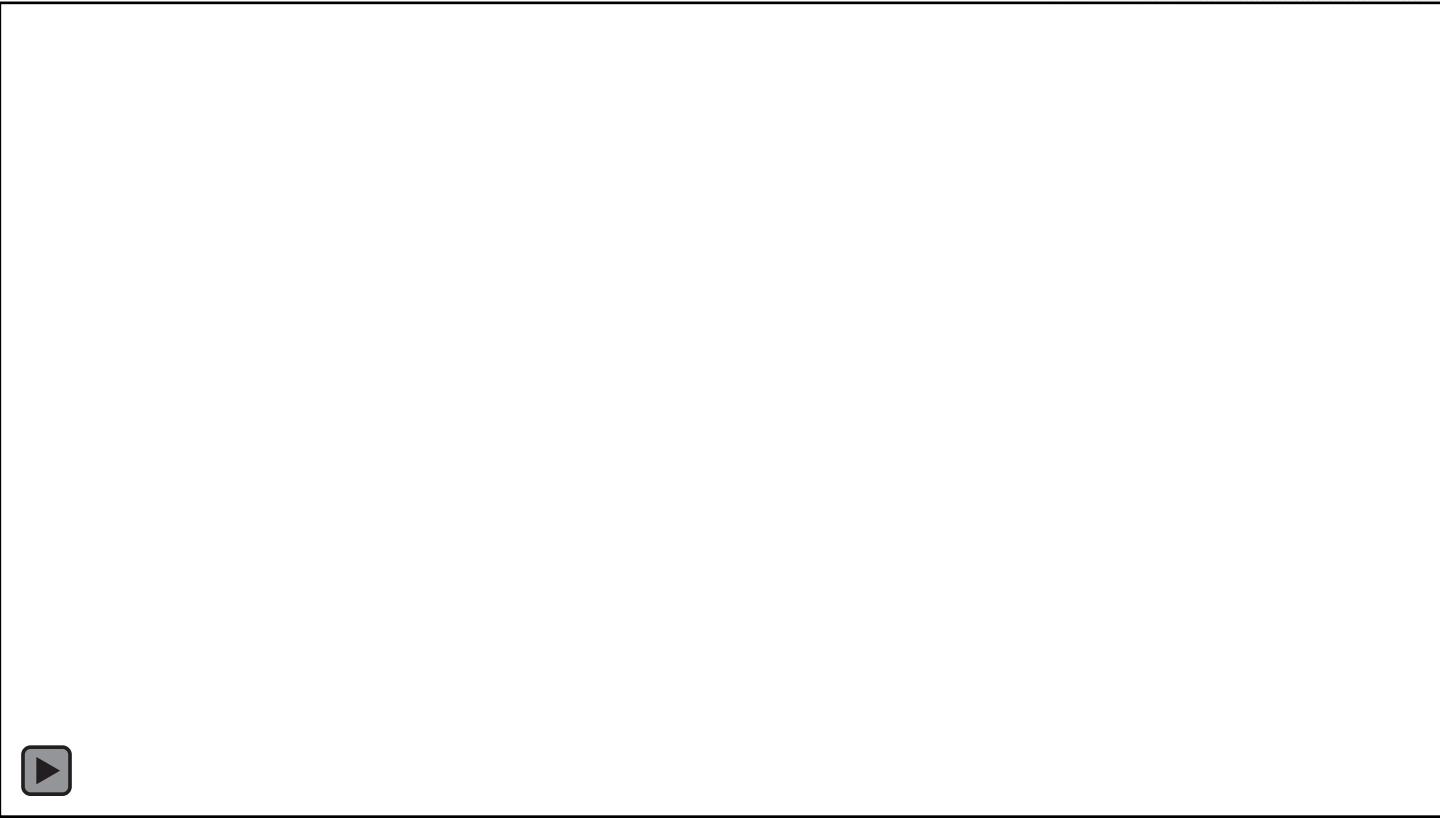
## Examples



# Challenge

instructions

## Examples



# Physical Design

# Physical prototypes

General introduction

Use of material that will allow us to create a physical representation of our design

Cardboard, glass, plastic electronics (e.g. Arduinos, sensors, servo motors), laser cut wood, 3D printed parts, lego, anything we have available



# Prototyping for production

General introduction



what stage of design?  
features being explored?



who are these aimed at?

looks more like final product  
can evolve into final product

# Cardboard Mockups

What are cardboard mockups



who are these aimed at?

what stage of design?

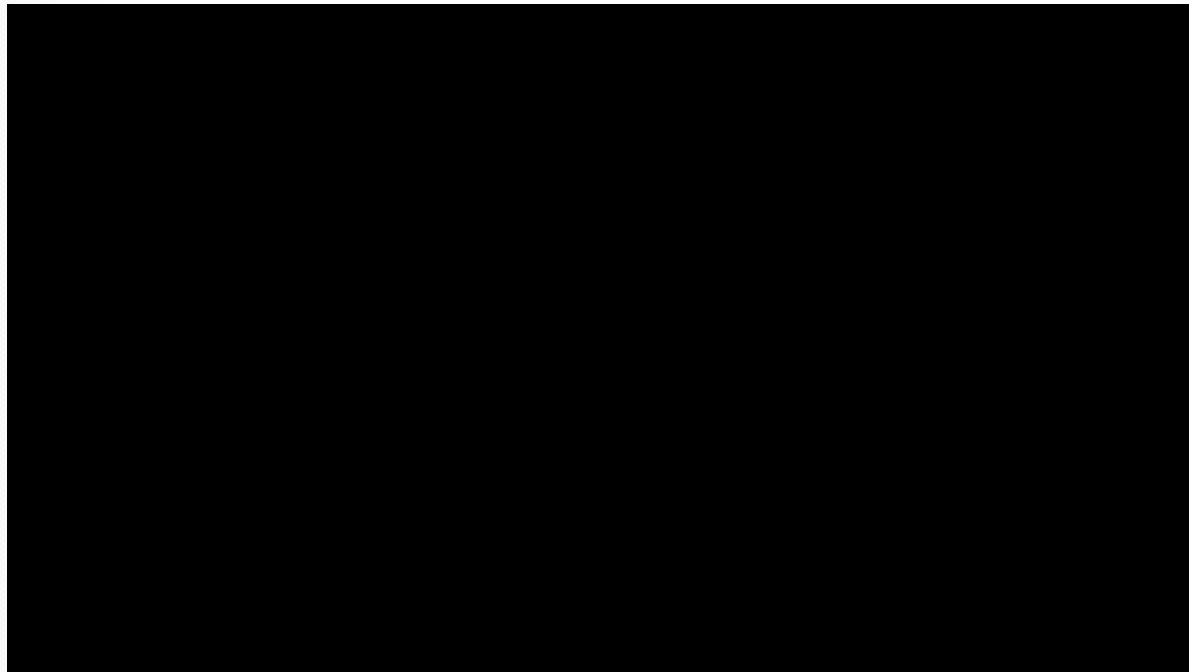
features being explored?



# 3D printing

Prototyping

"“to evaluate the design of an interactive product effectively, designers must prototype their ideas”  
(Preece, et al., 2015, p. 386)



(Hudson, CHI 2014, “Printing Teddy Bears”)

# Cardboard prototypes

Prototyping



[https://www.youtube.com/watch?v=k\\_9Q-KDSb9o](https://www.youtube.com/watch?v=k_9Q-KDSb9o)

# Mockups

Example of a mockup

Example: external HMI for autonomous cars



Figure 1. Text-based eHM



Figure 2. Icon-based eHM

# Mockups (testing)

Example of a mockup

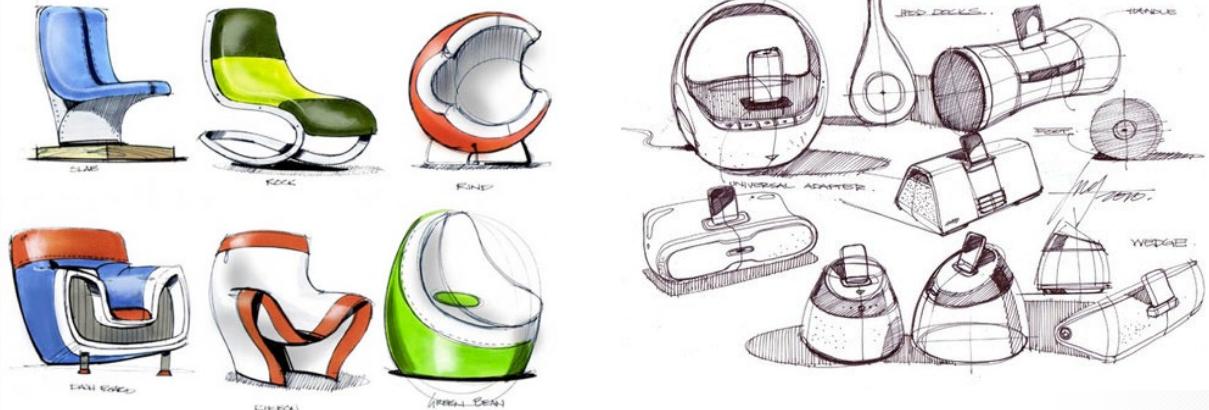
Example: external HMI for autonomous cars



# Prototyping for Envisioning

General introduction

concrete/external representation of design:  
communicate, reflect, refine, explore

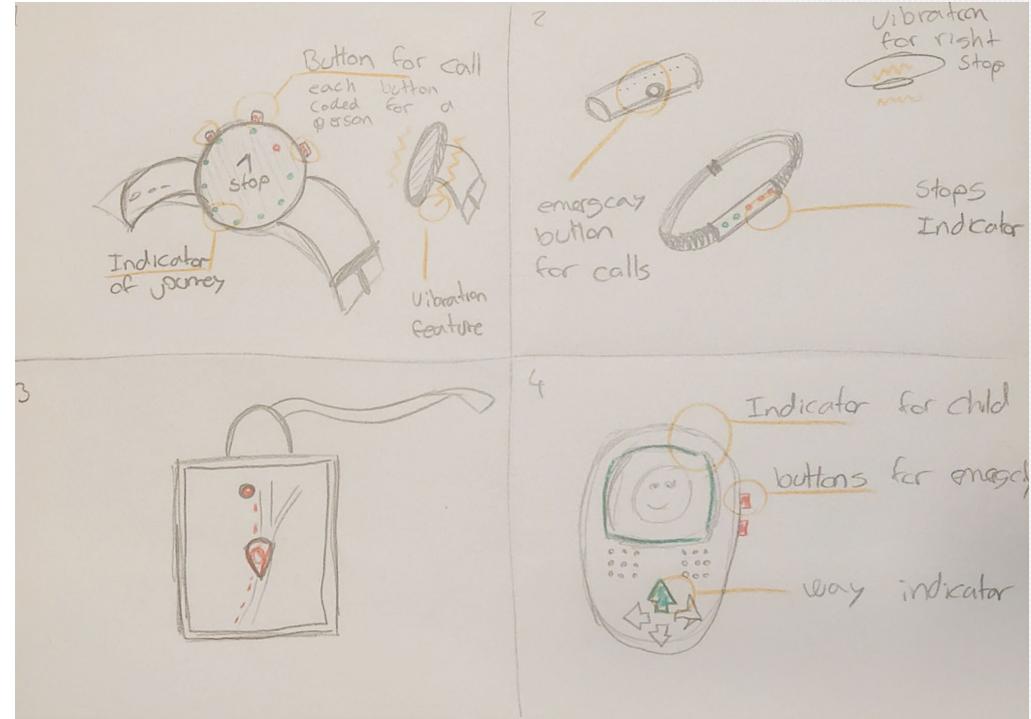
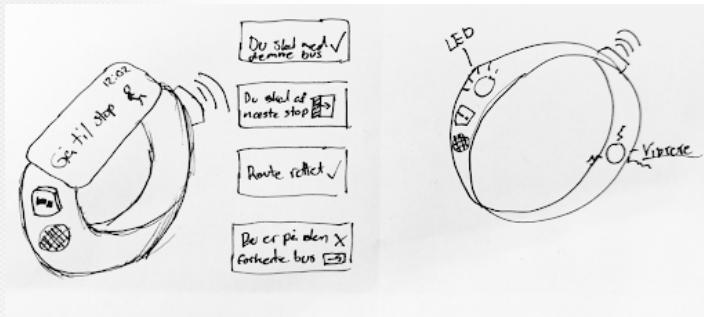


# Example

General introduction

## Travel assistance for children

### Sketches



# Example

General introduction

## Travel assistance for children

Paper prototype

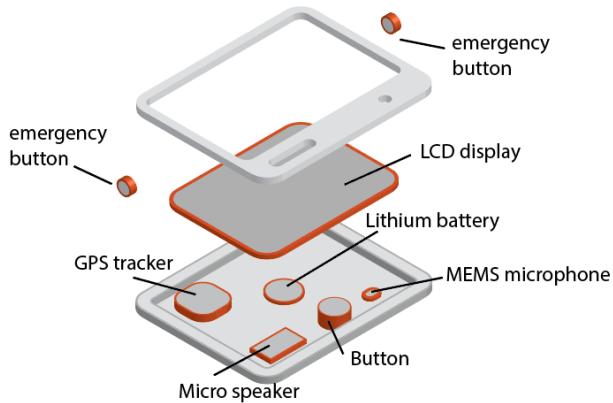


# Example

General introduction

## Travel assistance for children

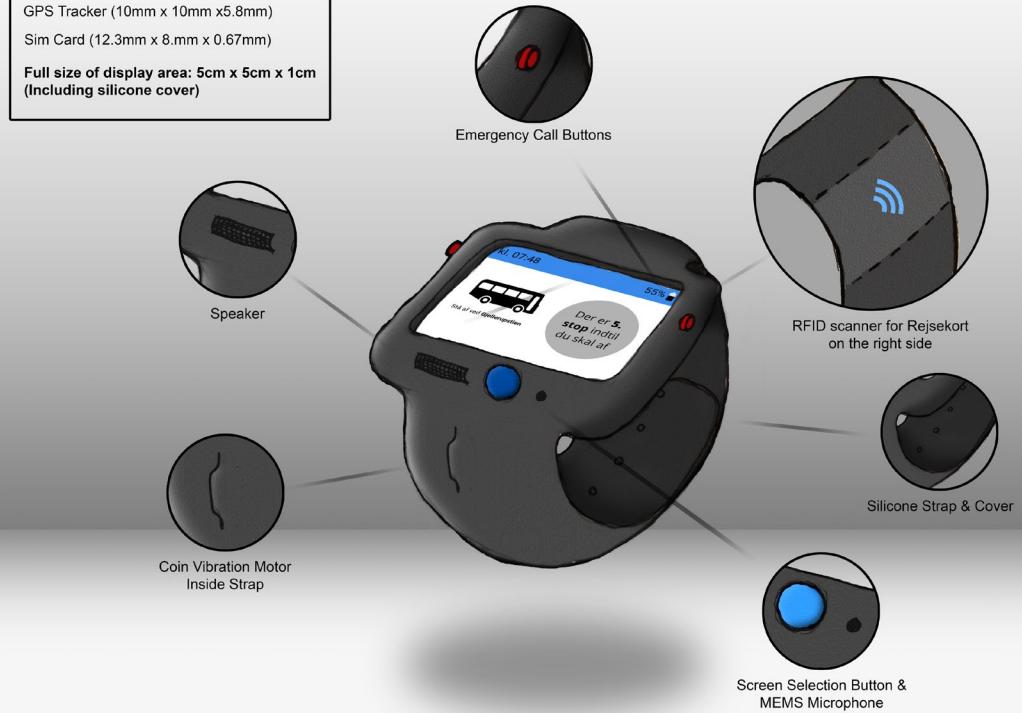
### Envisionment



**Size & Other Components**

- 2 inch LCD display (4cm x 3cm)
- GPS Tracker (10mm x 10mm x5.8mm)
- Sim Card (12.3mm x 8.mm x 0.67mm)

**Full size of display area: 5cm x 5cm x 1cm (Including silicone cover)**



# Example

General introduction

## Travel assistance for children

### Functional prototypes

The image displays three functional prototypes of a mobile application interface:

- Screenshot 1 (Left): Route Planning Screen**

Start position: [Placeholder]

Destination: [Placeholder]

Afgangstid: 08 : 30

Tilføj Rute

Accepter

This screen shows a map with two locations: "Peter" and "Johan".
- Screenshot 2 (Middle): Information Pop-up for Peter**

Næste stop: Stå af bus ved Elisevej

Stadig på den korrekte bus: 07:47

Ankom til busstopstedet: 07:48

**Information**

Peter stod ikke af ved Elisevej.

Hans rute er blevet justeret til at få ham tilbage på rette spor. Hvis nødvendigt kan du ringe til Johan og snakke om den nye rute og andre eventuelle bekymringer.

  - 1 Stå af ved busstopstedet X
  - 2 Gå til busstopstedet på modsatte side
  - 3 Stå på bus #B mod X
  - 4 Stå af ved busstopstedet X
  - 5 Stå på bus 2E

Ring
- Screenshot 3 (Right): Travel Timeline**

kl. 07:48 55%

kl. 08:00 55%

Stå af ved **Gjellerupstien**

Der er **5. stop** indtil du skal af

The timeline shows the user's journey from home to a bus stop, then walking to another stop, and finally getting on a bus.

# Example

General introduction

NutriBuddy

Functional prototypes

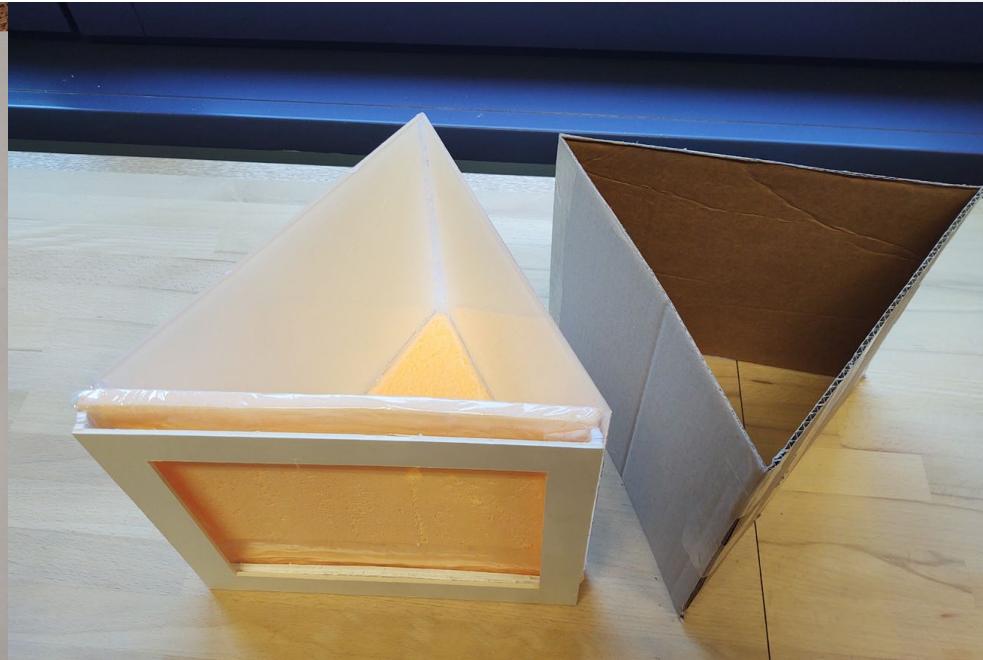
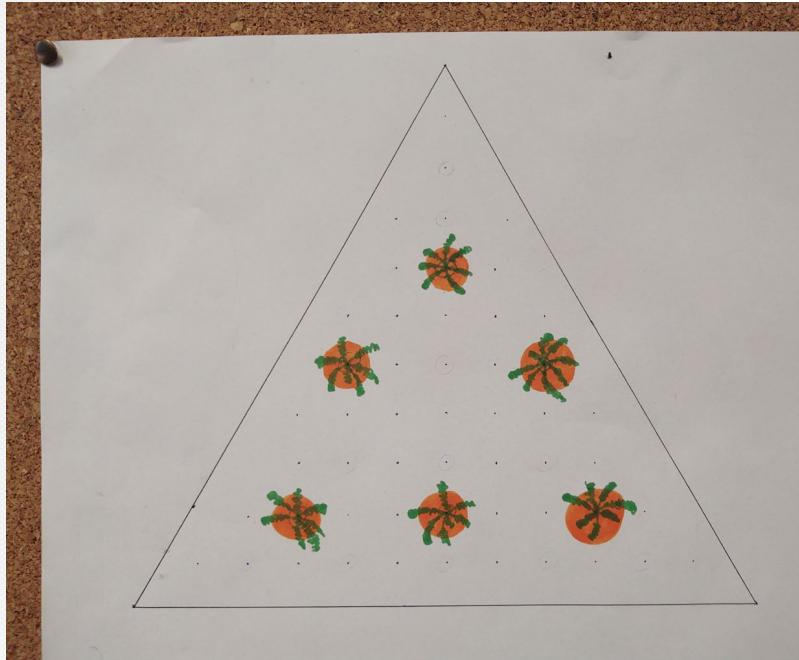


# Example

General introduction

## NutriBuddy

Sketches and cardboard mockups



# Example

General introduction

## NutriBuddy

Physical prototype

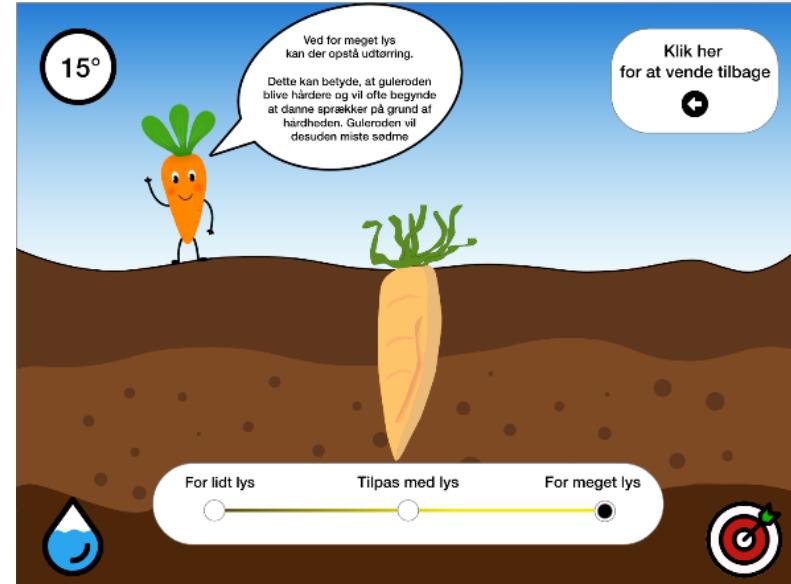
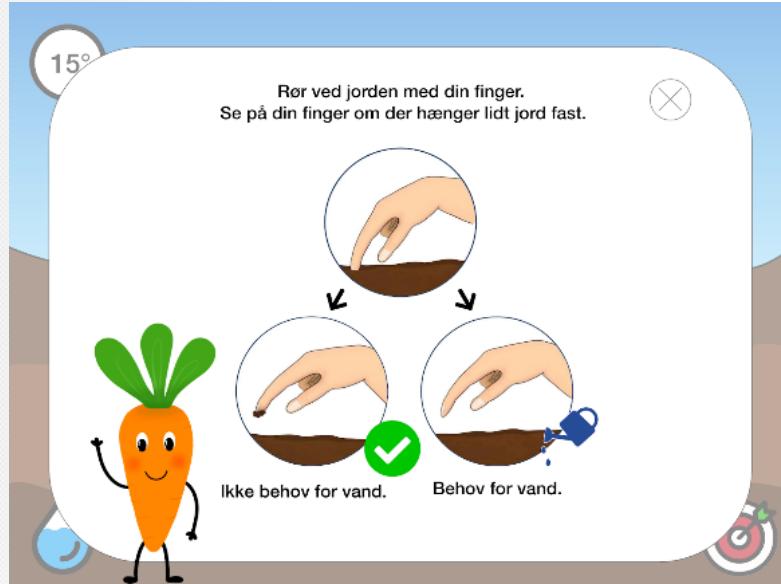


# Example

General introduction

## NutriBuddy

Interface high fidelity prototype

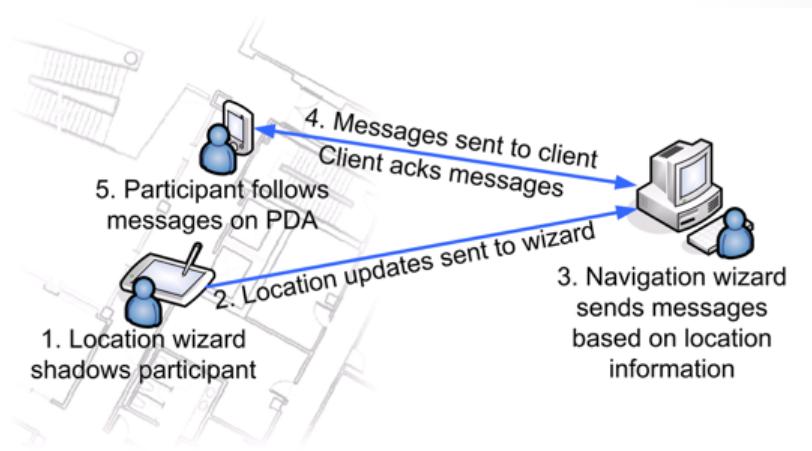


# Wizard of Oz Prototyping

General introduction



user thinks they are interacting with a finished system – but developer is actually “faking” responses

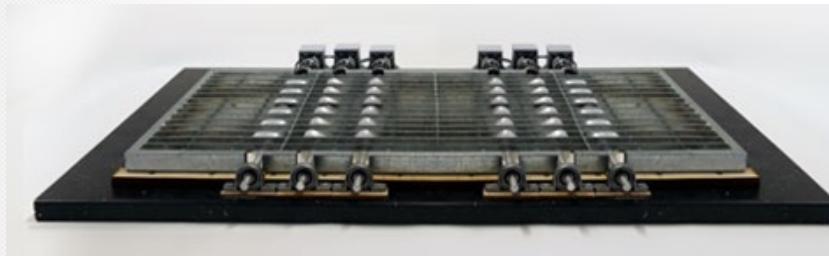


# Example

General introduction

Feetback (directional cues through the feed in public transportation)

## Physical prototype

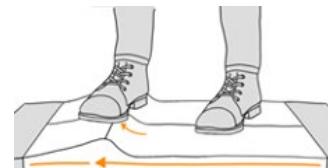
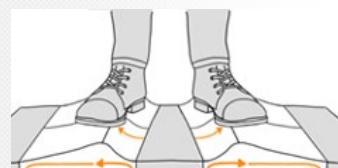
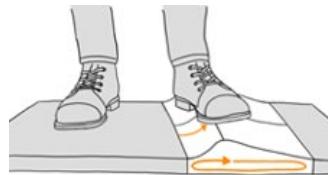


# Example

General introduction

## Feetback

### Iterations



# Example

General introduction

## Feedback

high fidelity prototype

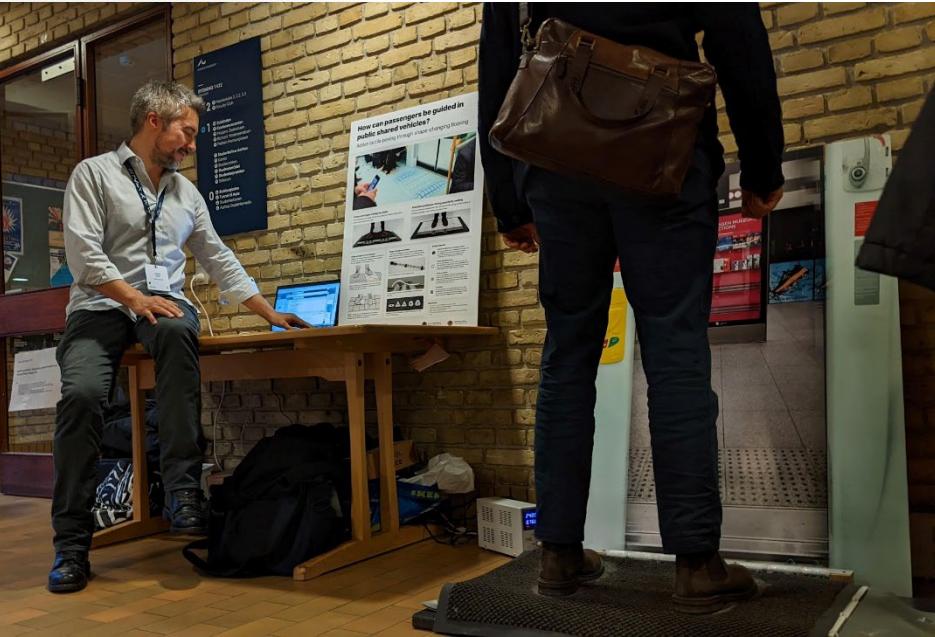


# Example

General introduction

## Feedback

### Wizard of Oz

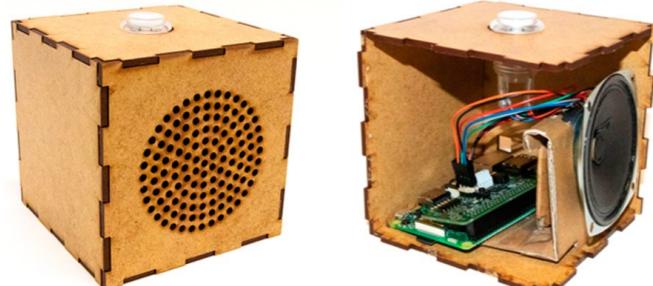
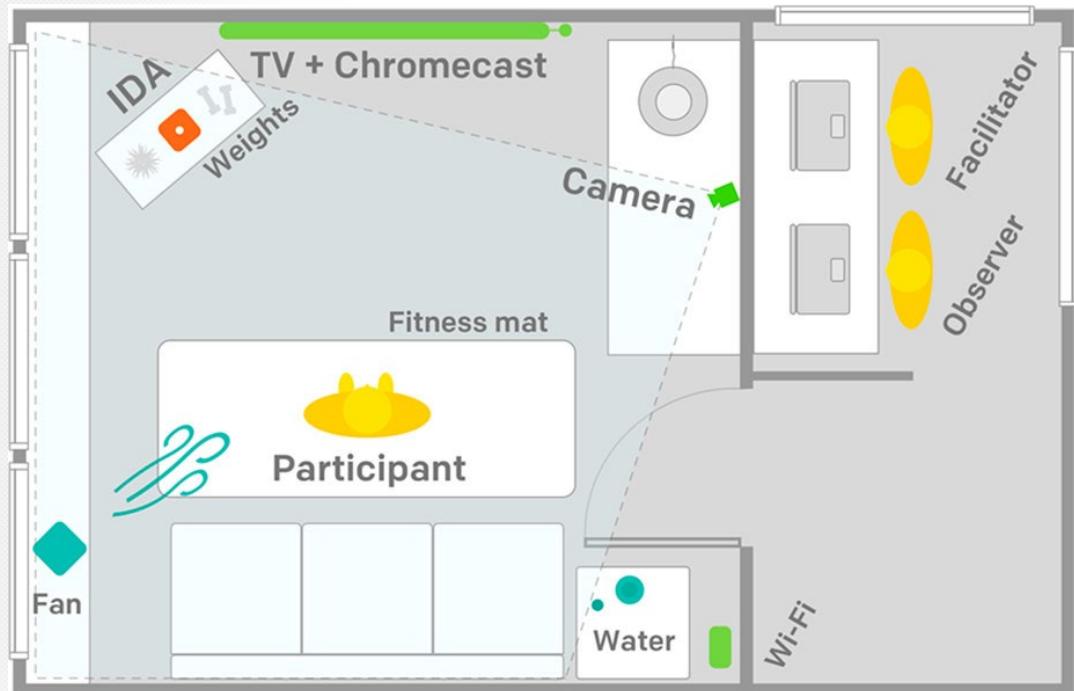


# Example

General introduction

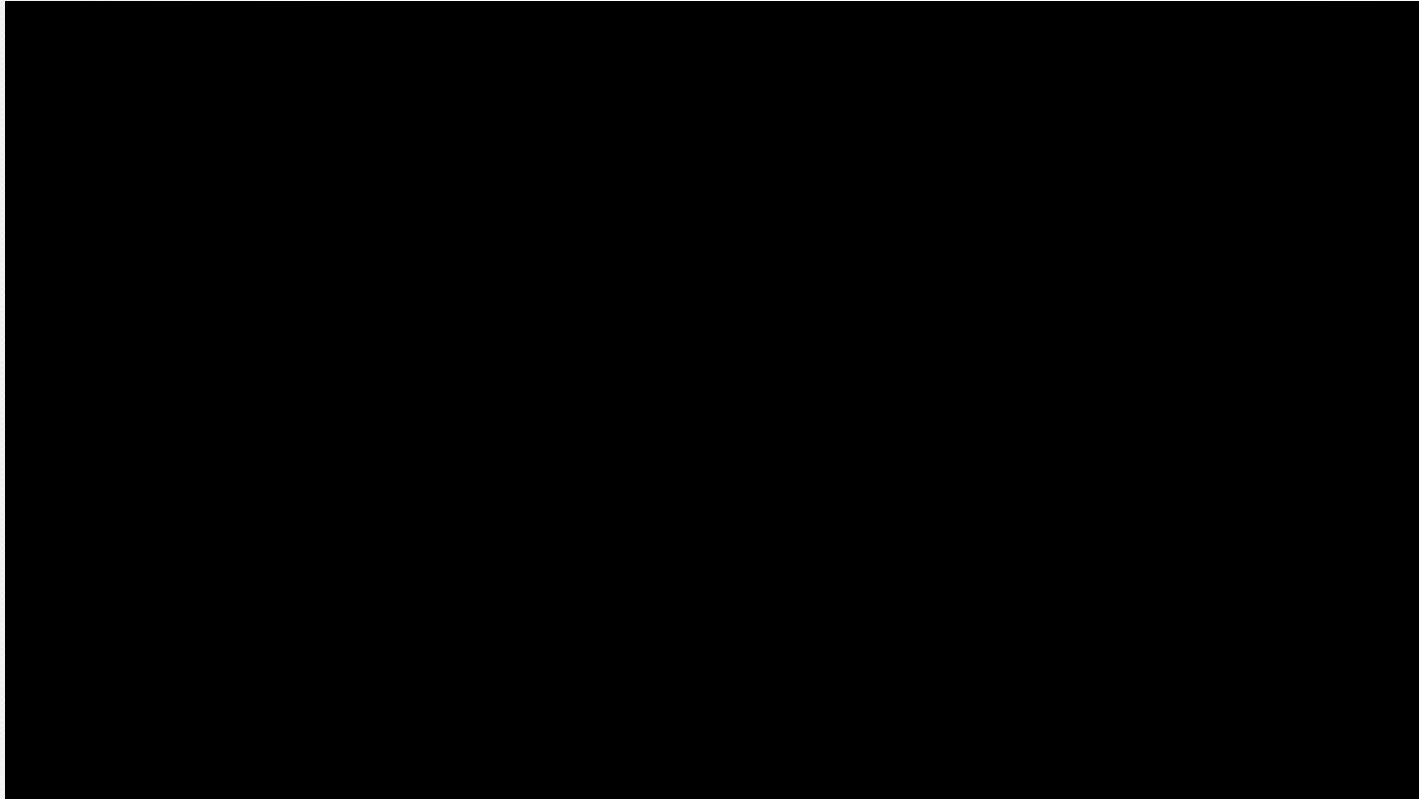
Can digital personal assistants persuade people to exercise?

Wizard of Oz



# Video prototyping

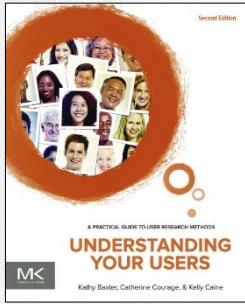
General introduction



# Reading material for this Lecture

exercise

## Reading



I will provide additional external resources in the lecture slides

I will provide an overview of software tools for prototyping

# For the Lab session

project

Meet up in the Lab rooms to develop a paper prototype for the design problem you have

- Start by sketching the various interfaces
- Create a user path and make a video (or gif) showing transitions from on-screen to another that would explain your solution
- If you have a physical design with no screens try to make a cardboard (or use paper) prototype and make a video (you can use still photos) showing how it would be used



# Thank you

Lefteris Papachristos  
Associate Professor, NTNU