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# CPT208 Human-centric Computing

User-Centered Design

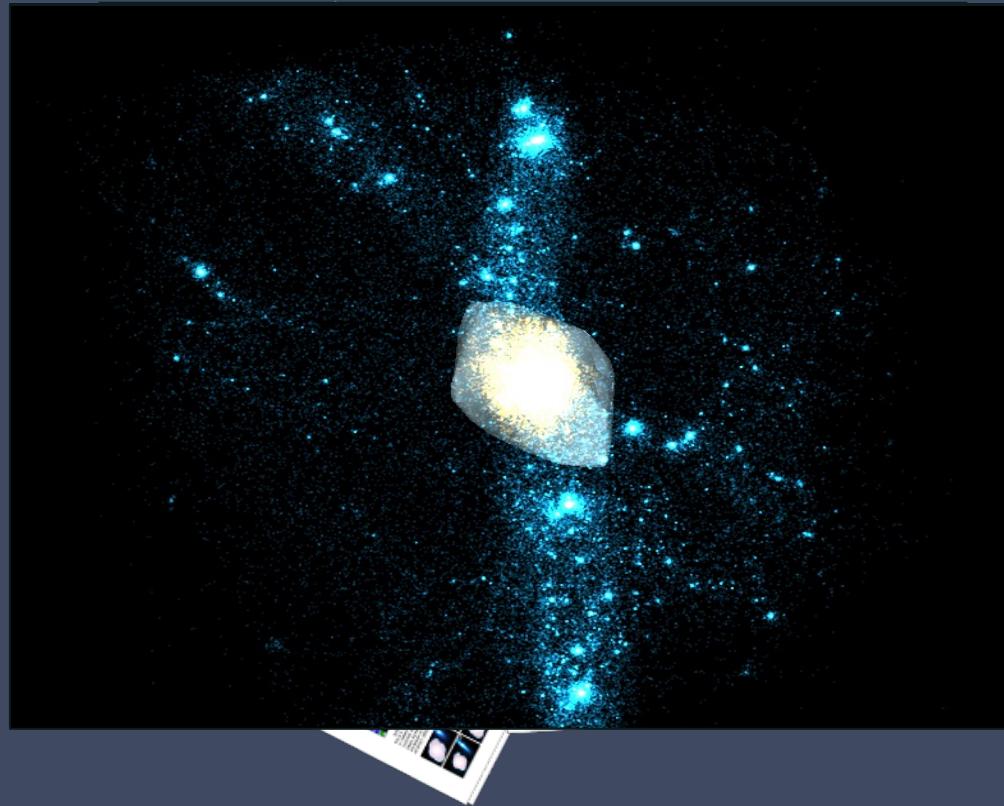
Participatory Design

Prototyping and Evaluation Cycles

Lingyun Yu

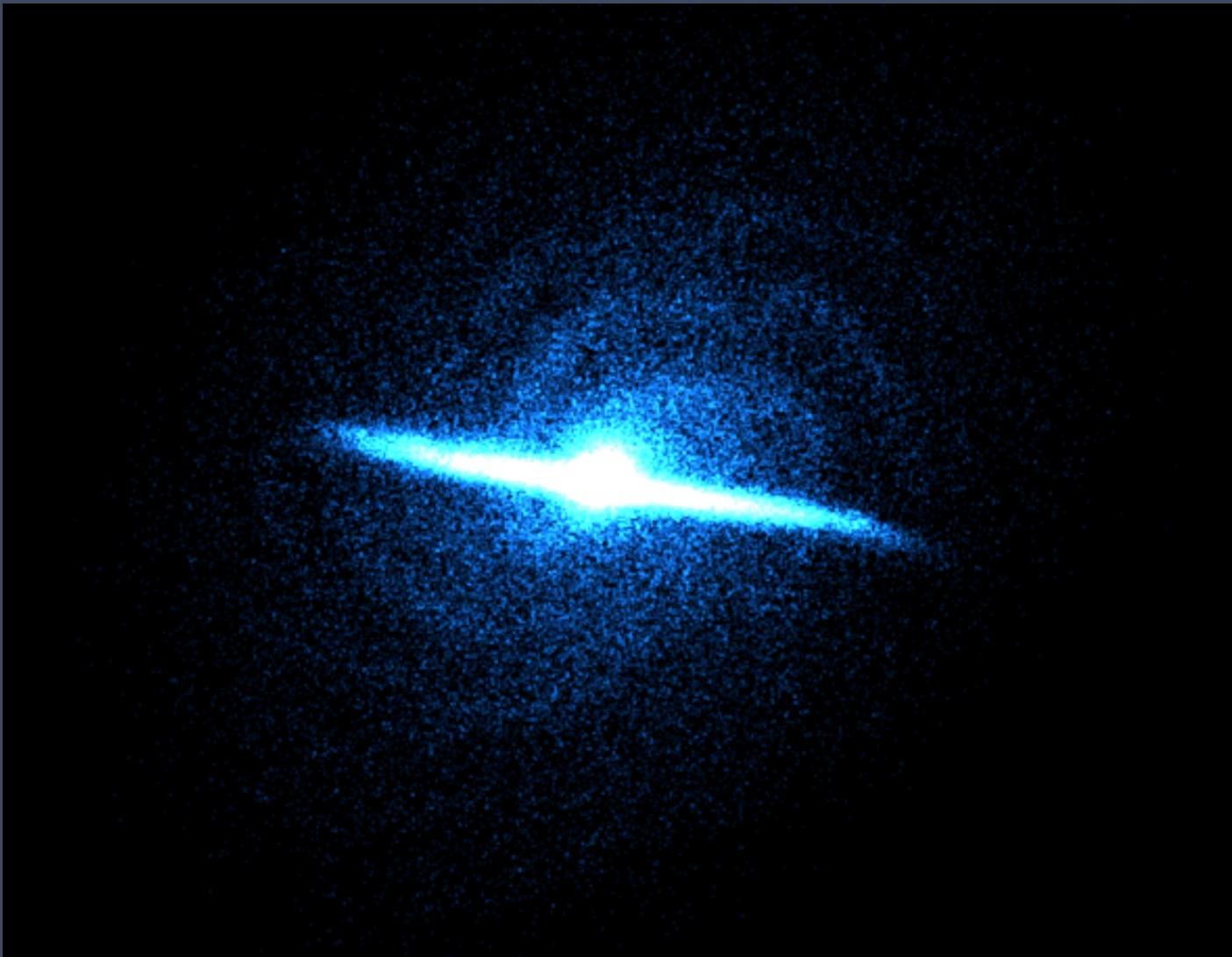
# User-Centered System Design – Example (1)

- Particle selection

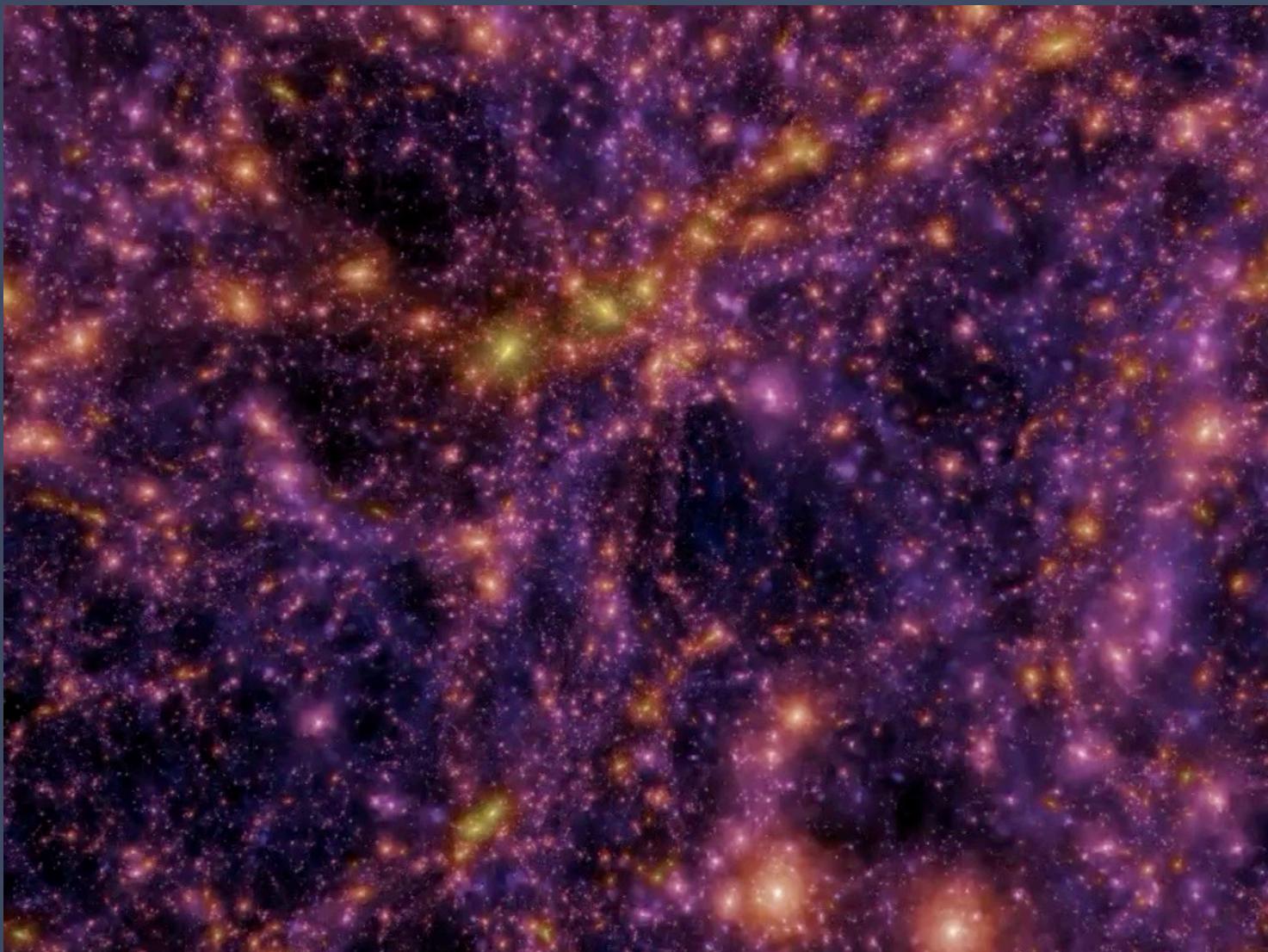


[Particle Selection, 2005]

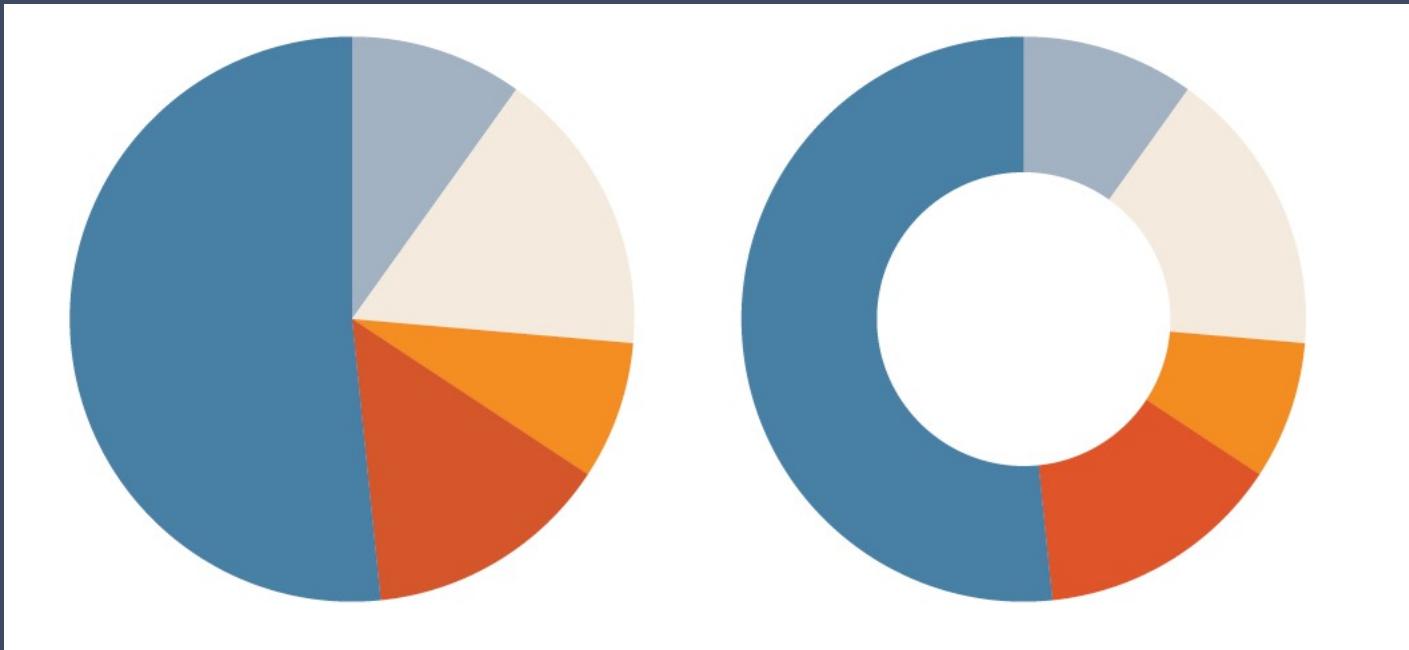
# User-Centered System Design – Example (1)



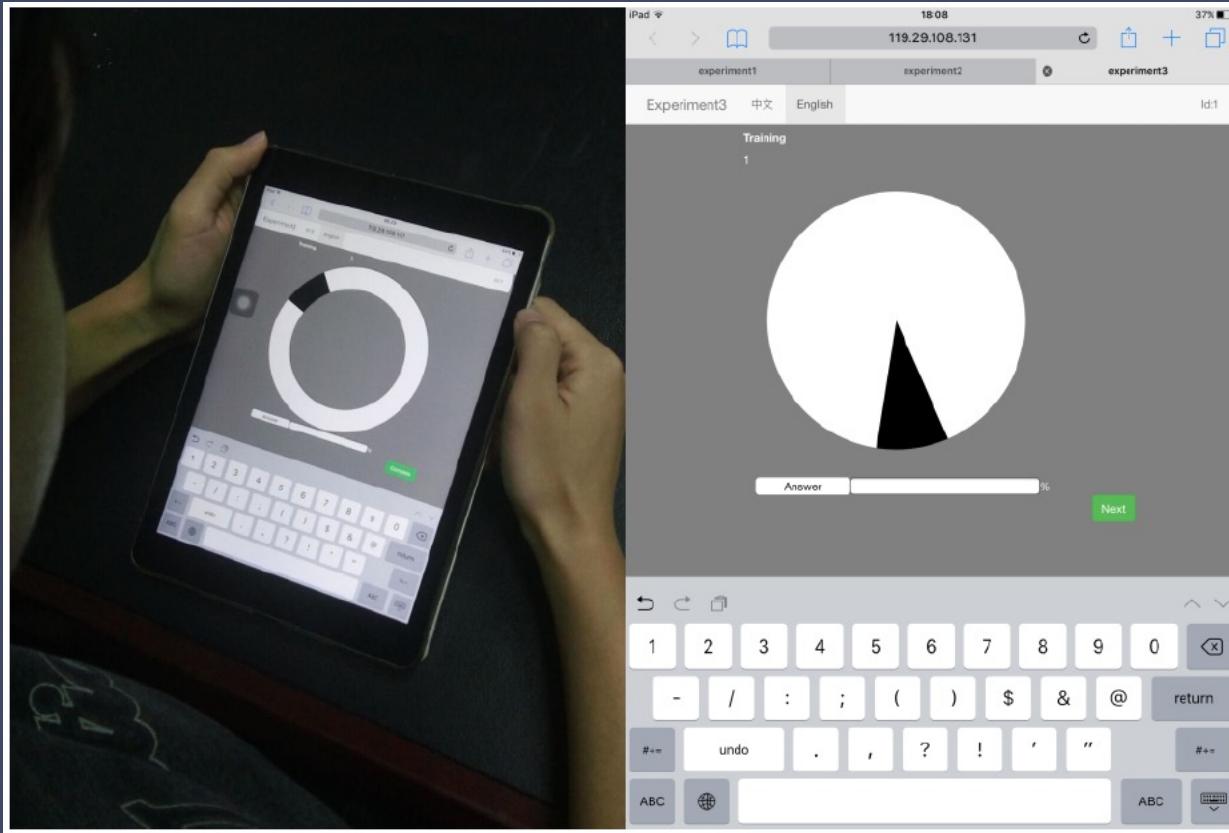
# User-Centered System Design – Example (1)



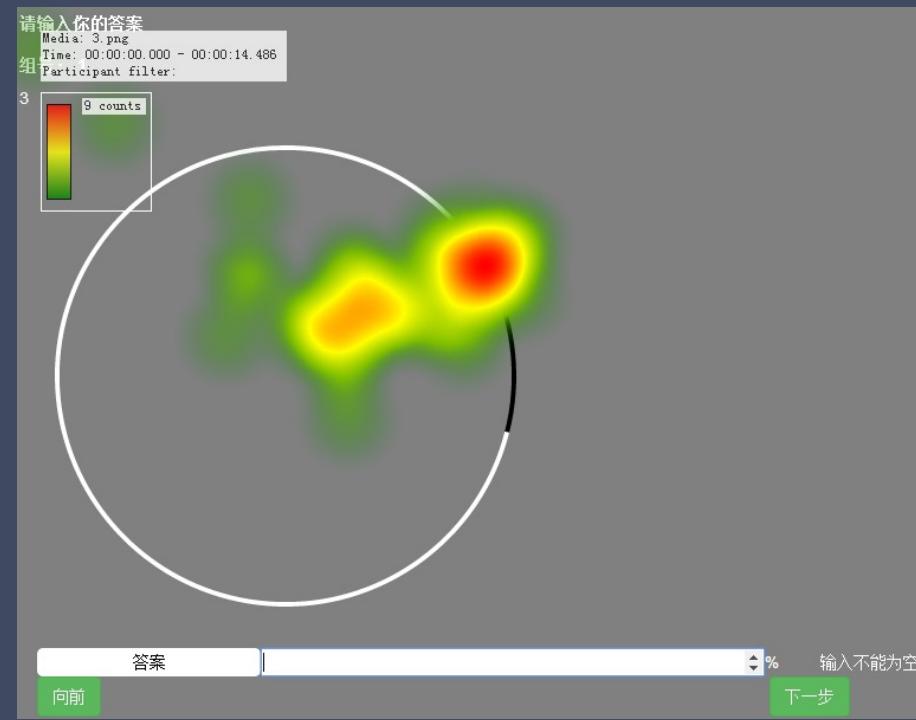
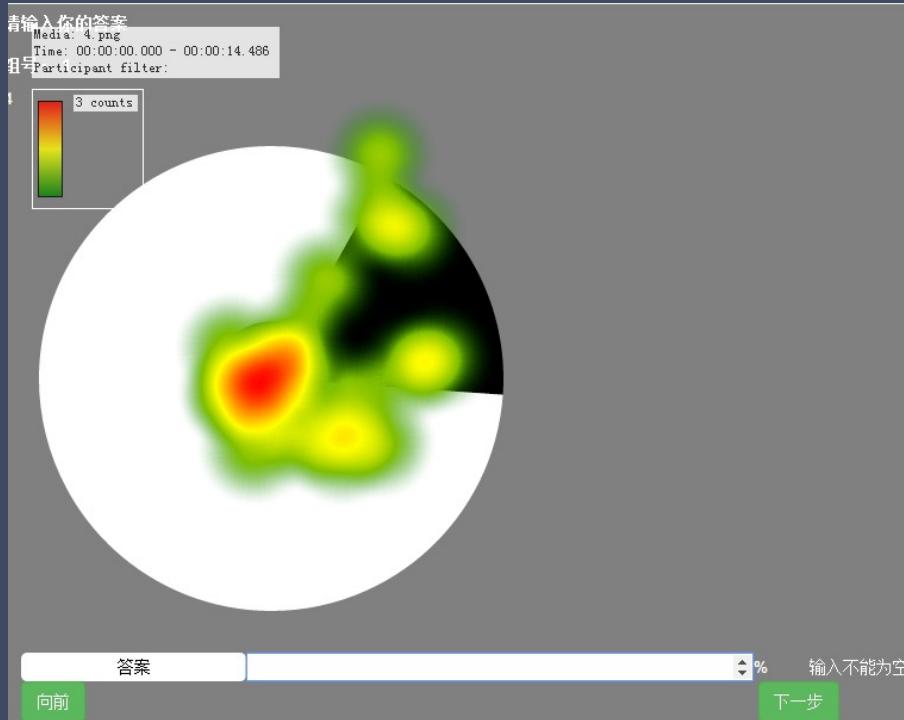
# User-Centered System Design – Example (2)



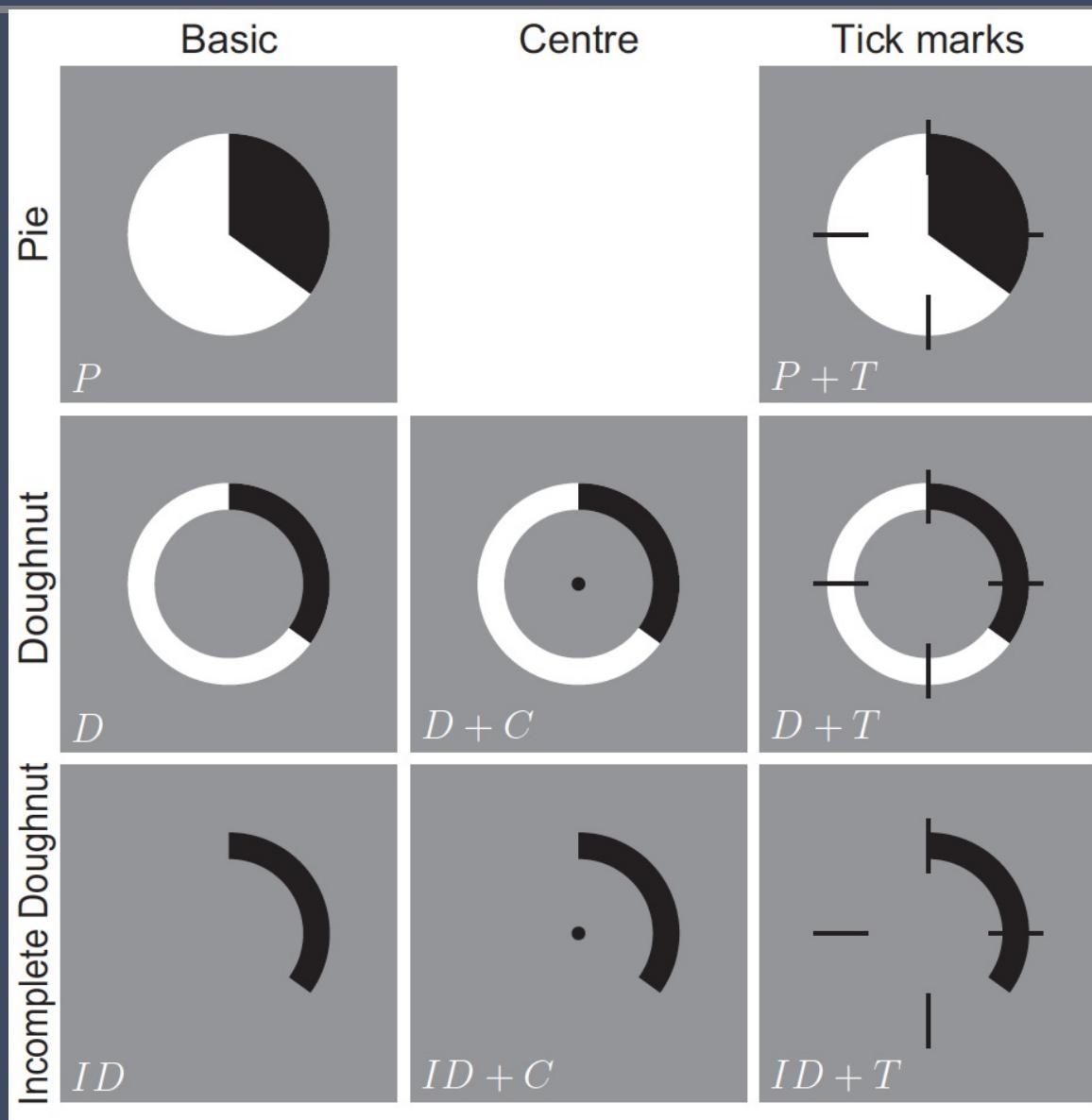
# User-Centered System Design – Example (2)



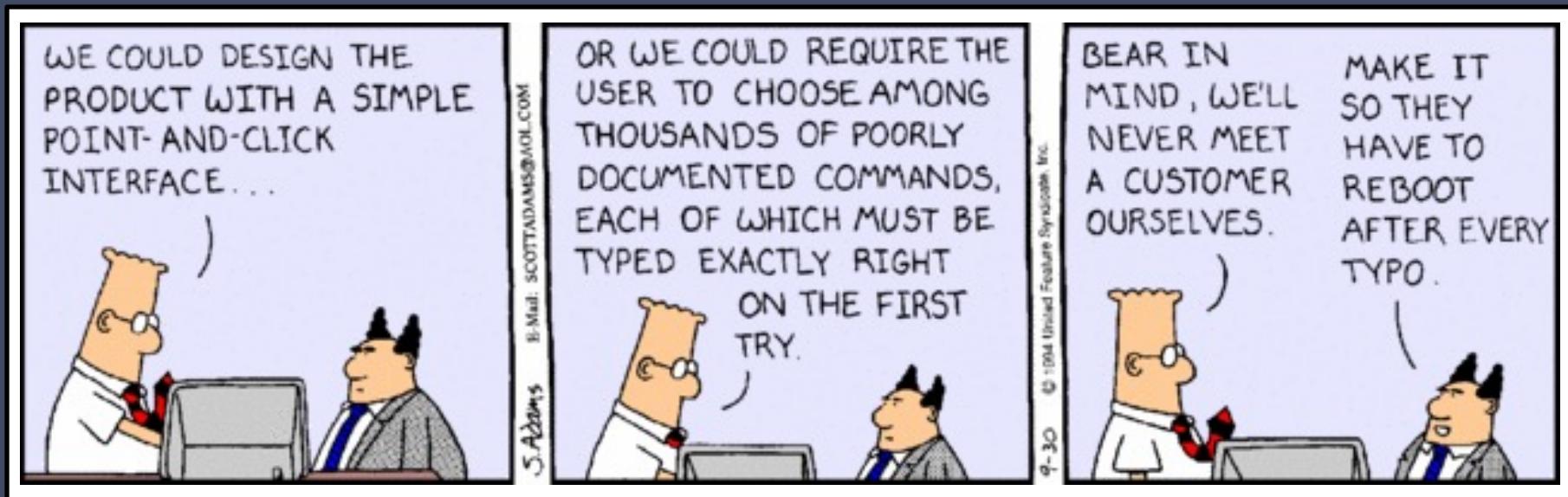
# User-Centered System Design – Example (2)



# User-Centered System Design – Example (2)



# System-Centered Design



# System-Centered Design

- what can I easily build on this platform?
- what can I create from the available tools?
- what do I as a programmer find interesting?



# User-Centered System Design

- design is based upon a user's
  - abilities and real needs
  - context
  - work
  - tasks
  - need for a usable and useful product
- golden rule of interface design:

## Know The User



# User-Centered System Design

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- ... is an iterative process that focuses on an understanding of the users and their context in all stages of design and development.
- ... is based on understanding the domain of work or play in which people are engaged and in which they interact with computers.

# User-Centered System Design

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- assumptions:
  - the result of a good design is a *satisfied customer*
  - the process of design is a *collaboration between designers and customers*
  - the *design evolves and adapts* to the user's changing concerns, and the process produces a specification as an important byproduct
  - the customer and designer are in *constant communication* during the entire process

# Participatory Design

- problems:
  - intuitions (about the users, their tasks, ...) may be wrong
  - interviews etc. may not be precise
  - designer cannot know the user sufficiently well to answer all issues that come up during the design
- solution:
  - designers should have access to representative users
  - these should be *END users*, not their managers etc.



# Participatory Design

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- users are 1<sup>st</sup> class members in the design process  
→ active collaborators vs. passive participants
- users are considered subject matter experts  
→ know all about the work context  
→ but: users should not be required to design
- iterative process  
→ all design stages are subject to revision

# Participatory Design

- up side
  - users excellent at reacting to suggested system designs
    - designs must be concrete and visible
  - users bring in important “folk” knowledge of work context
    - knowledge may otherwise be inaccessible to design team
  - greater buy-in for the system often results
- down side
  - hard to get a good pool of end users
    - expensive, reluctance, etc.
  - users are not expert designers
    - don’t expect them to come up with design ideas from scratch
  - the user is not always right
    - don’t expect them to know what they want

# Methods for Involving the User

- at the very least, talk to users  
it is surprising how many designers don't ...
- contextual interviews & on-site visits
  - interview users in their workplace,  
as they are doing their job
  - discover the user's culture,  
requirements, expectations, ...



# Methods for Involving the User

- explain your designs
  - describe what you are going to do
  - get input at all design stages
  - all designs are subject to revision by users
- have visuals and/or demos
  - people react far differently compared to verbal explanations
  - thus, prototypes are critical
  - type of prototype matters:  
sketchy for early design phases  
later more pronounced/developed/precise



# Sketching and Prototyping

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## 1. sketches

- initial ideas, very fast, very low cost, no interactivity, many different variants can be explored

## 2. low fidelity prototypes

- fewer variants explored further, still fast and low cost, some interactivity can be simulated

## 3. medium fidelity prototypes

- more functionality is simulated to test refined concepts

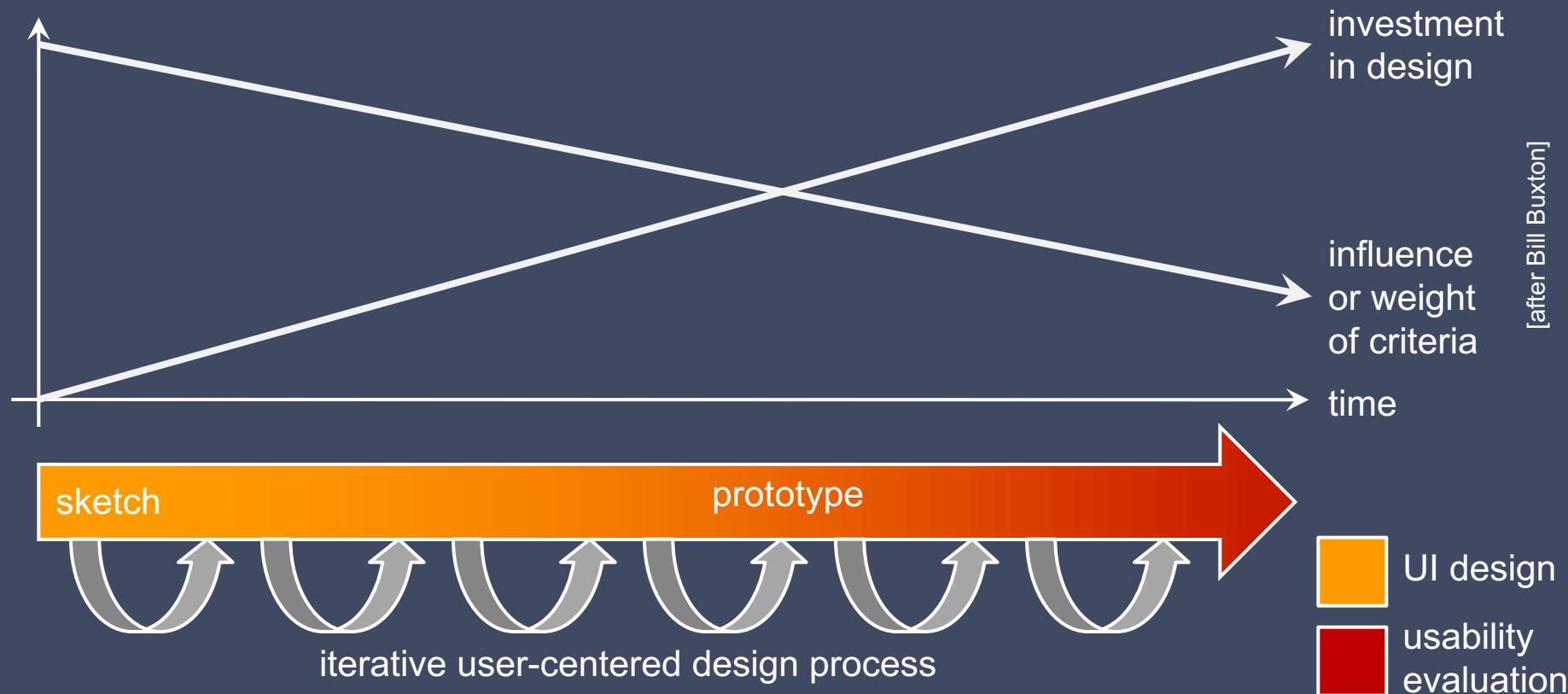
## 4. high fidelity prototypes

- field testing of the refined designs, more expensive

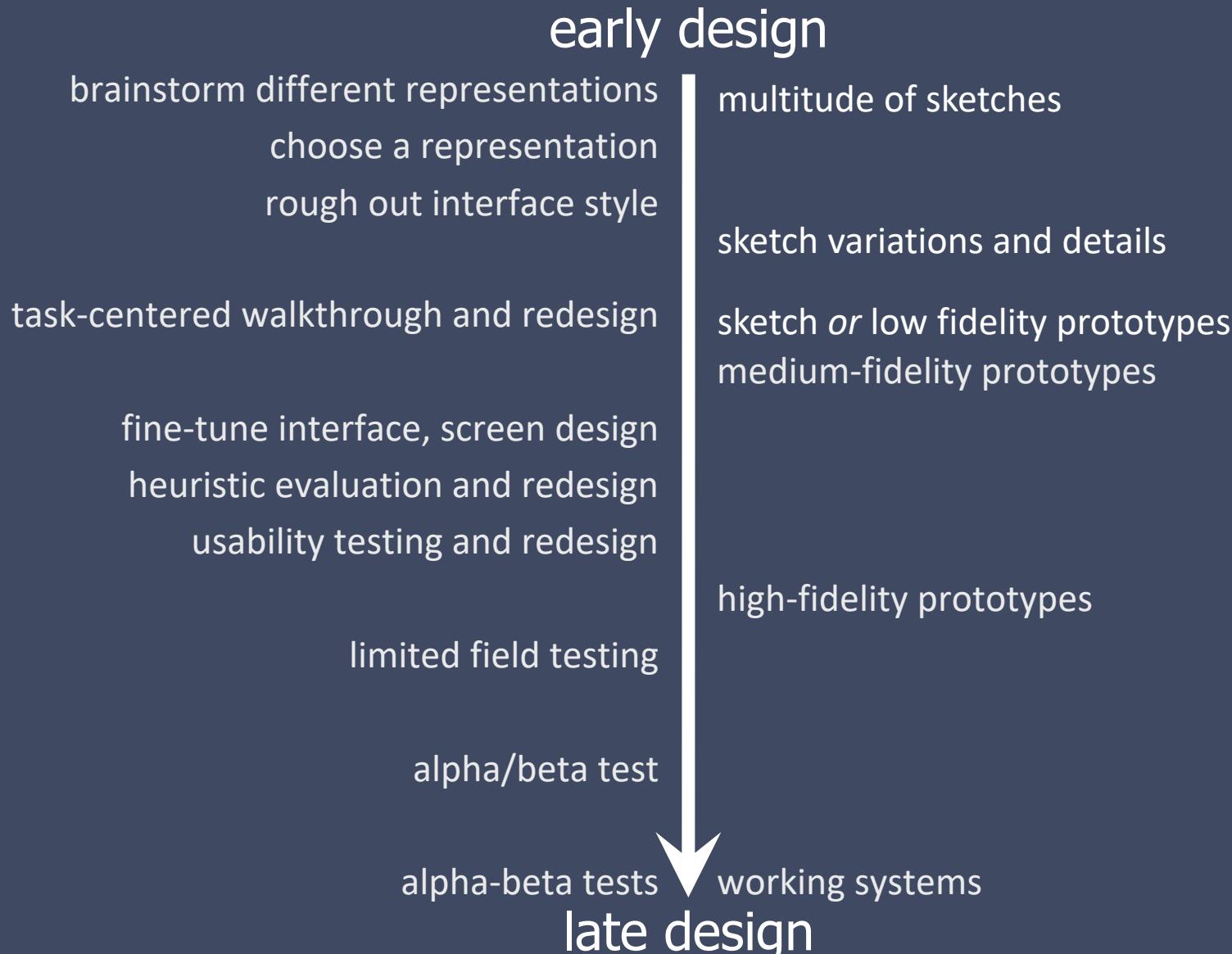
## 5. final design

# Sketching and Prototyping

- from design to evaluation
  - interface design (idea generation) progresses to usability testing (idea debugging and refinement)



# Sketching and Prototyping

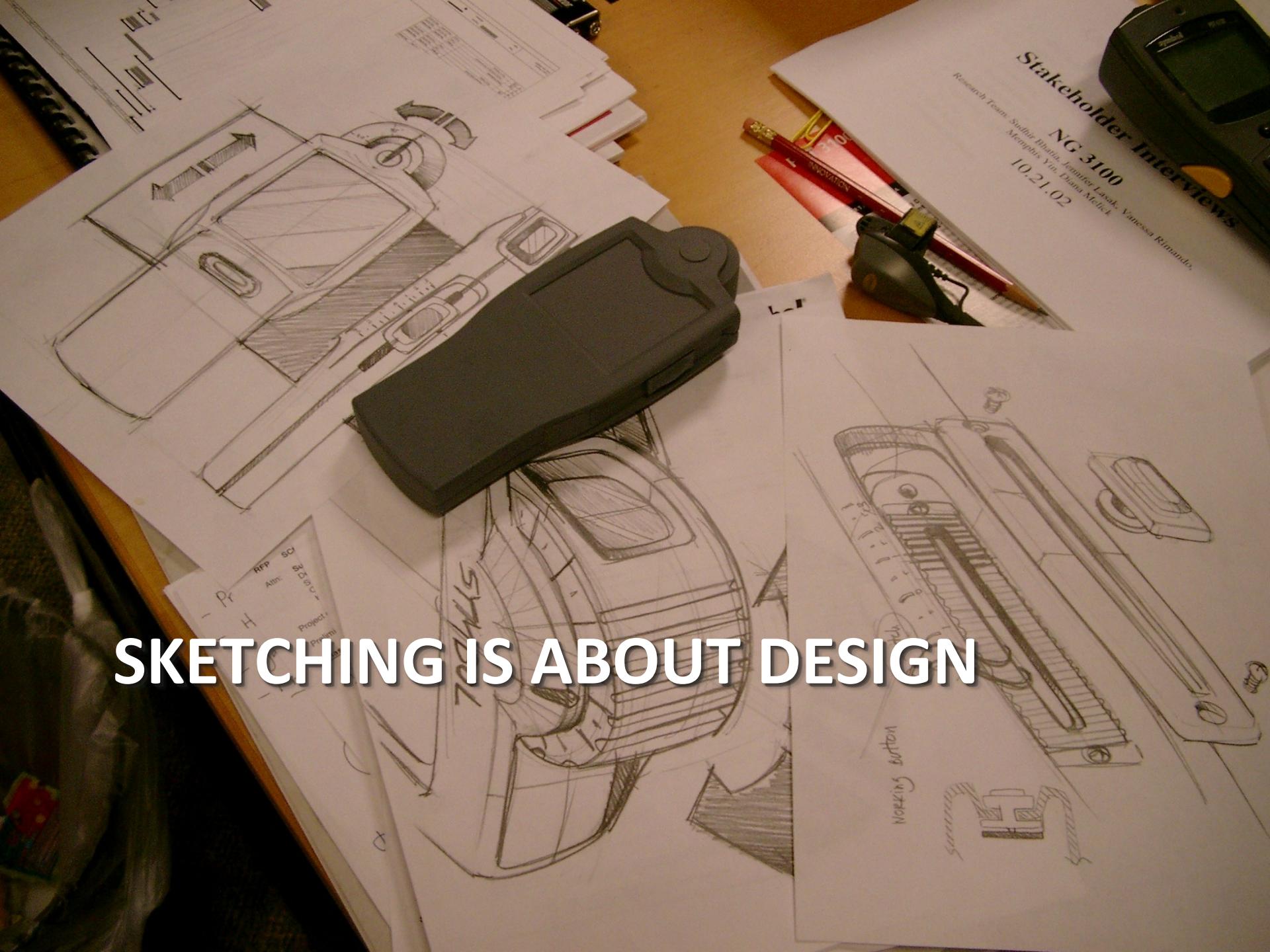


# Sketches & Low-Fidelity Prototypes

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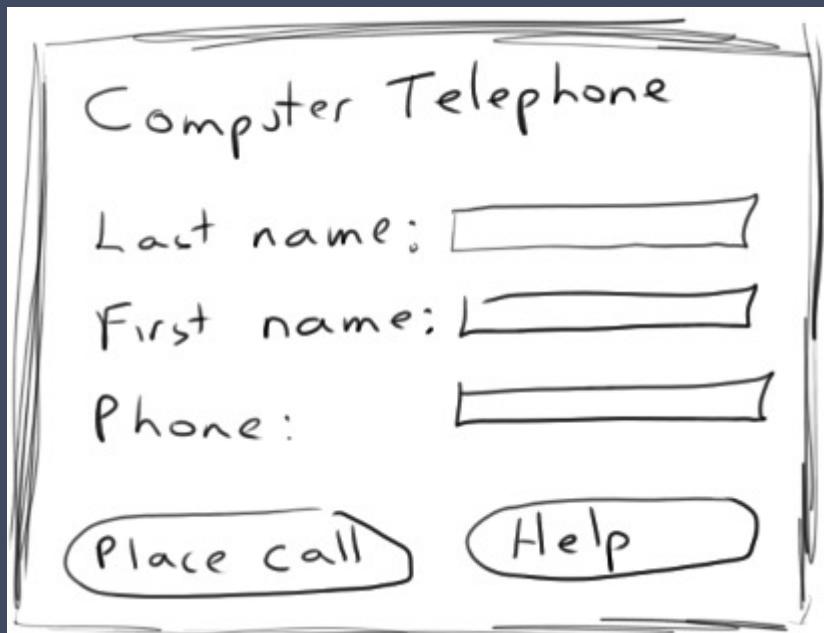
- paper mock-up of the interface's functionality, look, and feel → quick & cheap to prepare and modify
  - drawing of the outward appearance of intended system
  - crudity means people concentrate on high-level concepts
  - harder to envision a dialog's progression
- purpose
  - brainstorm competing representations
  - elicit user reactions
  - elicit user modifications/suggestions

# SKETCHING IS ABOUT DESIGN



# Sketches

- drawing of the outward appearance of the intended system
- crudity means people concentrate on high level concepts
- Deliberately **ambiguous** & abstract, leaving “holes” for imagination
- but hard to envision a dialog’s progression



## What to Do    What you selected

Touch a different  
Color or scan  
another item



JPA Stroll

Green

Red

Blue

All done?

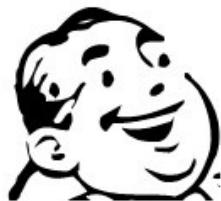
order

print

Discard

## What to do

Touch a different color,  
or scan another item.



## What you selected



### JPG Stroller

For children between  
1-3 years old ...\$98.

Green

Blue

Red (out of stock)

### Item

### Style

### Cost

JPG Stroller

Green

98.00

[Delete](#)

tax: 6.98

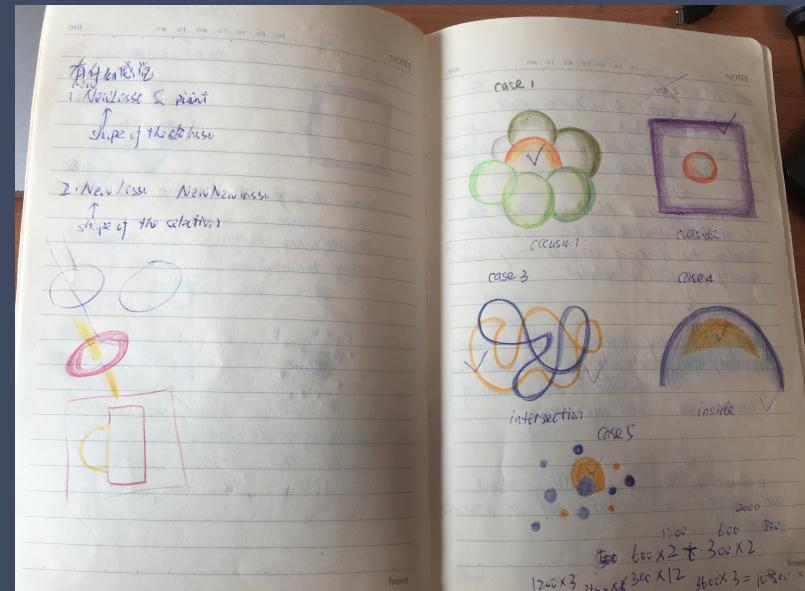
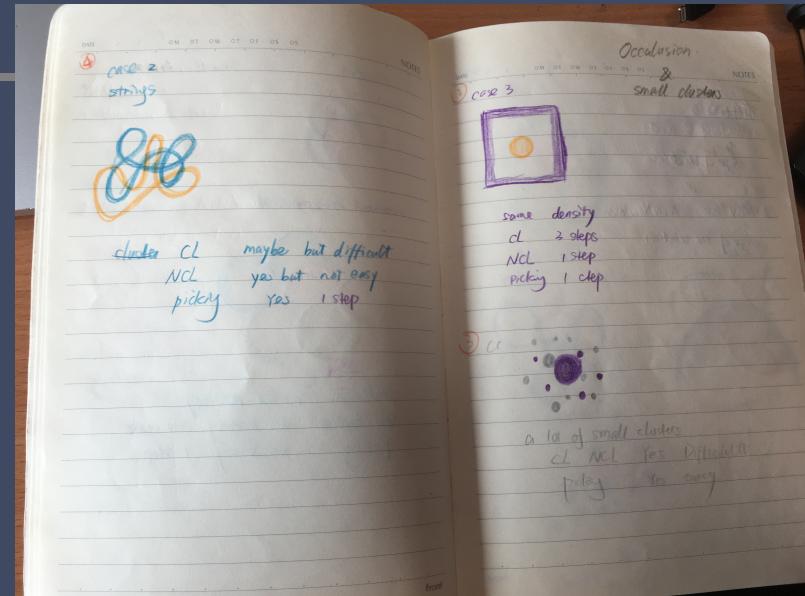
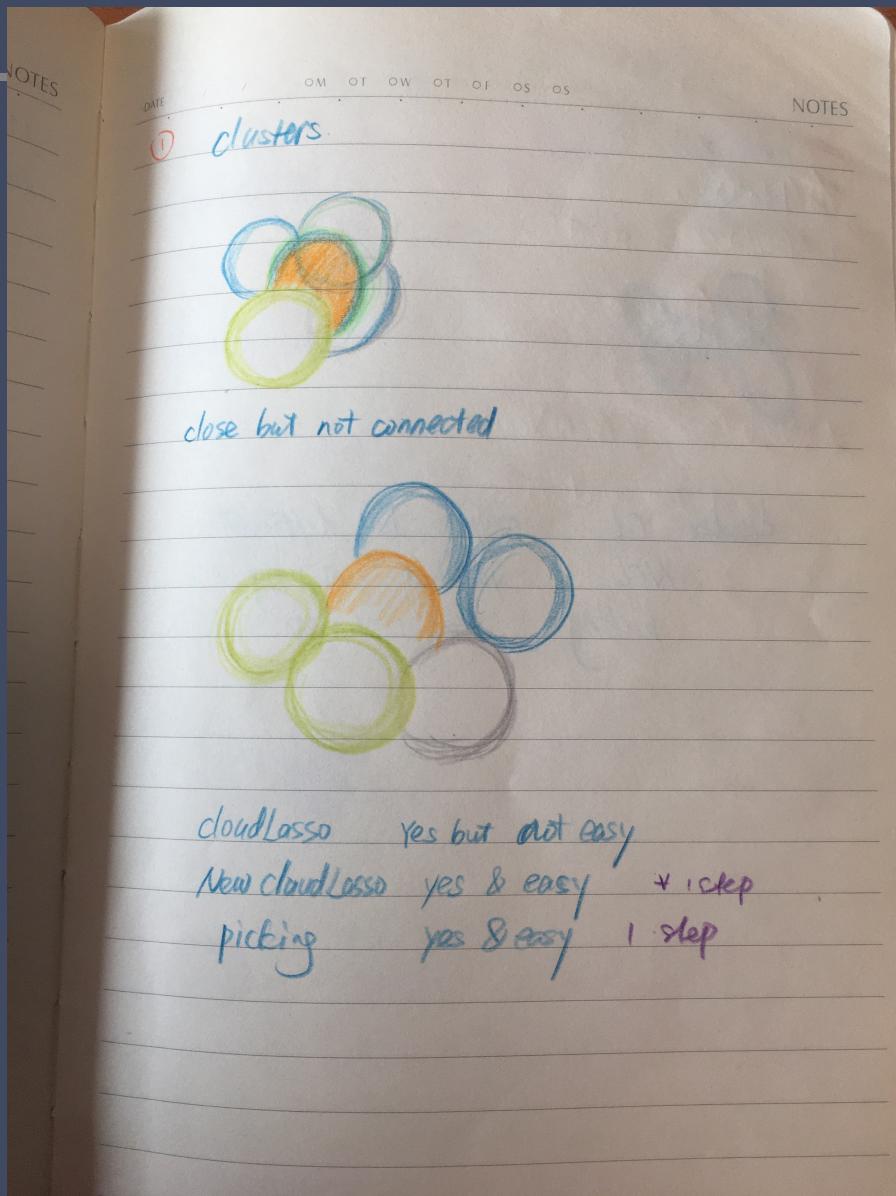
**Total:** \$104.98

## All done?

[Place your order](#)

[Print this list](#)

[Throw this list away](#)



# Sketching is about design

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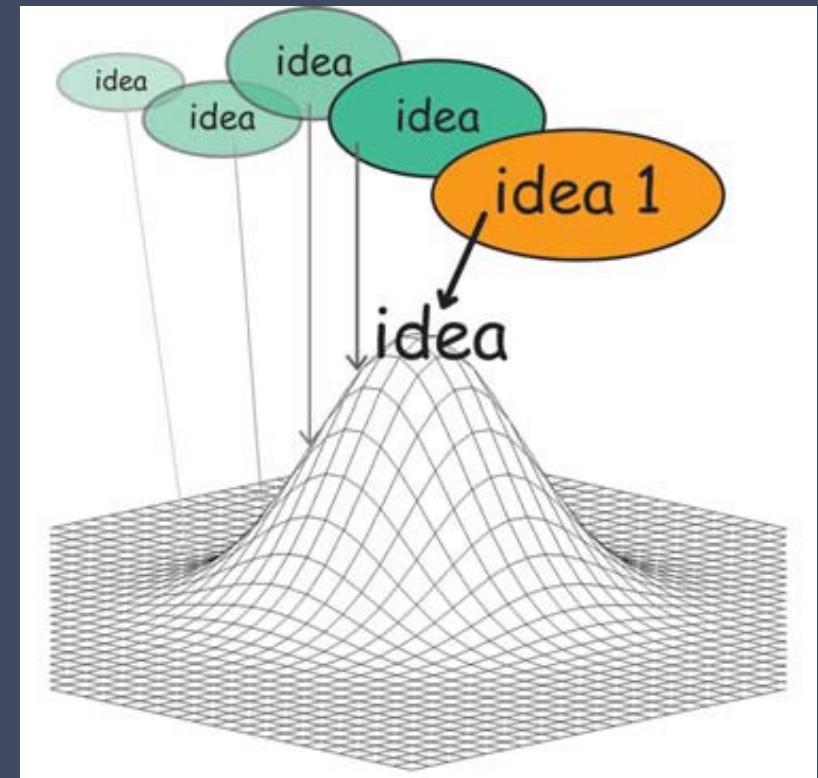
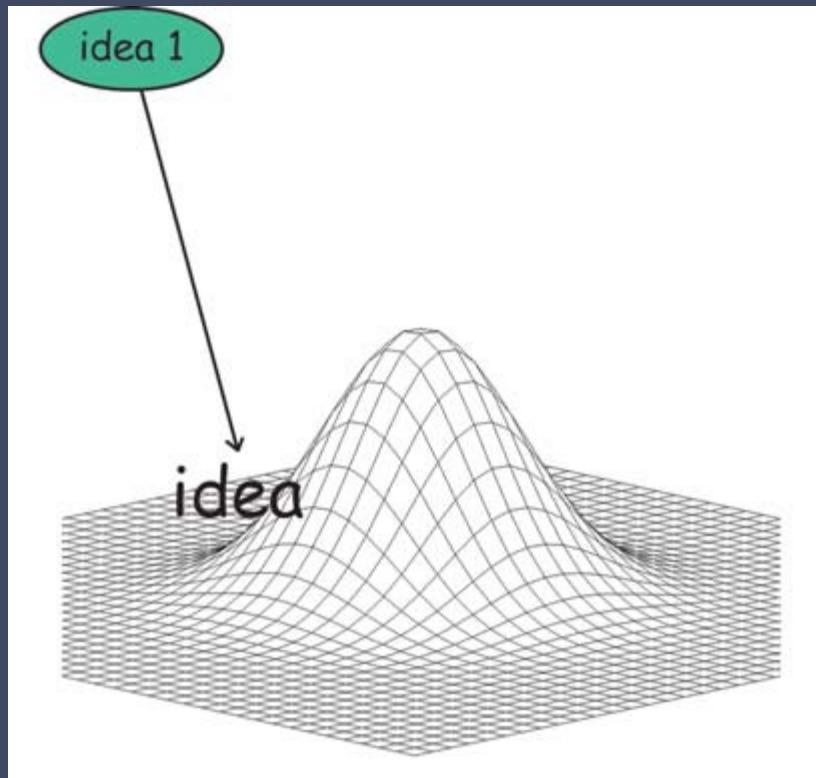
- Sketching is not about drawing; it is about design.
- Sketching is a tool to help you:
  - express
  - develop, and
  - communicate design ideas
- Sketching is part of a process:
  - idea generation
  - design elaboration
  - design choices
  - engineering

# Why Sketch?

- **Create**
  - early ideation
  - think openly about ideas
  - think through ideas
  - force you to visualize how things come together
  - brainstorming: generate abundant ideas without worrying about quality
  - invent and explore concepts
- **Record**
  - ideas you develop
  - ideas that you come across
  - archive ideas for later reflection
- **Reflect, share, critique, decide**
  - communicate ideas to others
  - invite responses, criticisms, and alternatives;
  - choose ideas worth pursuing

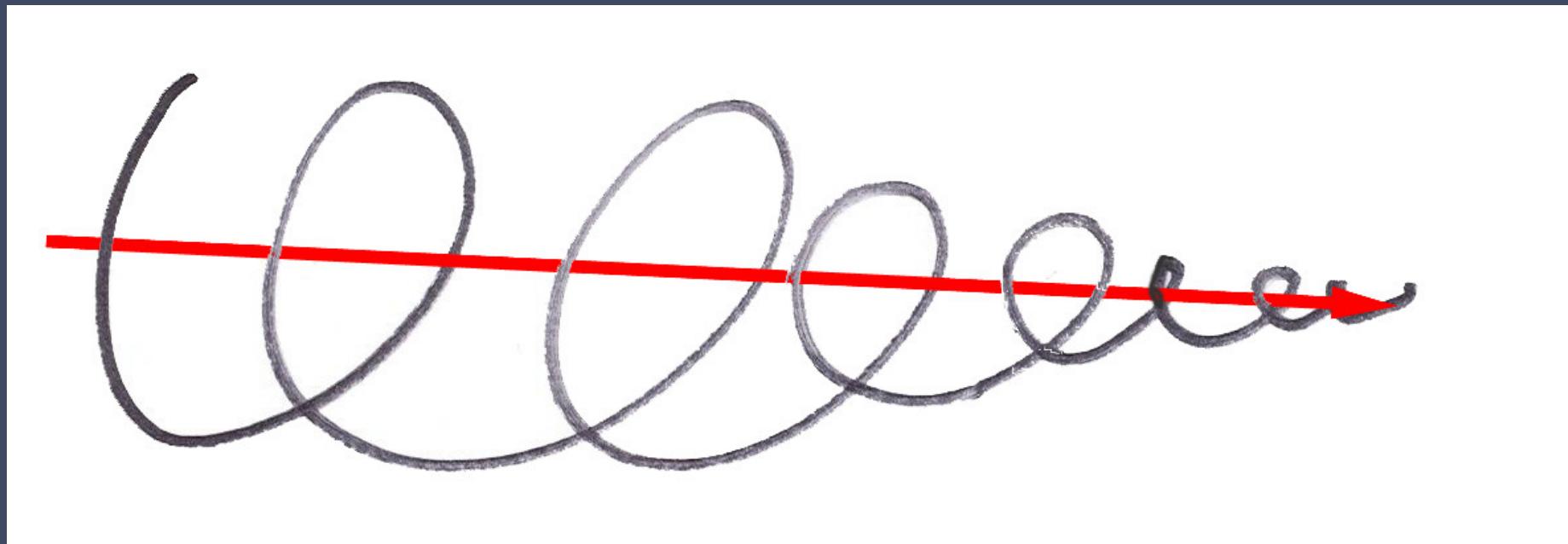
# Getting the Design Right

- Generate an idea
- Iterate and develop it



***But is it the best idea?***

# Getting the Design Right



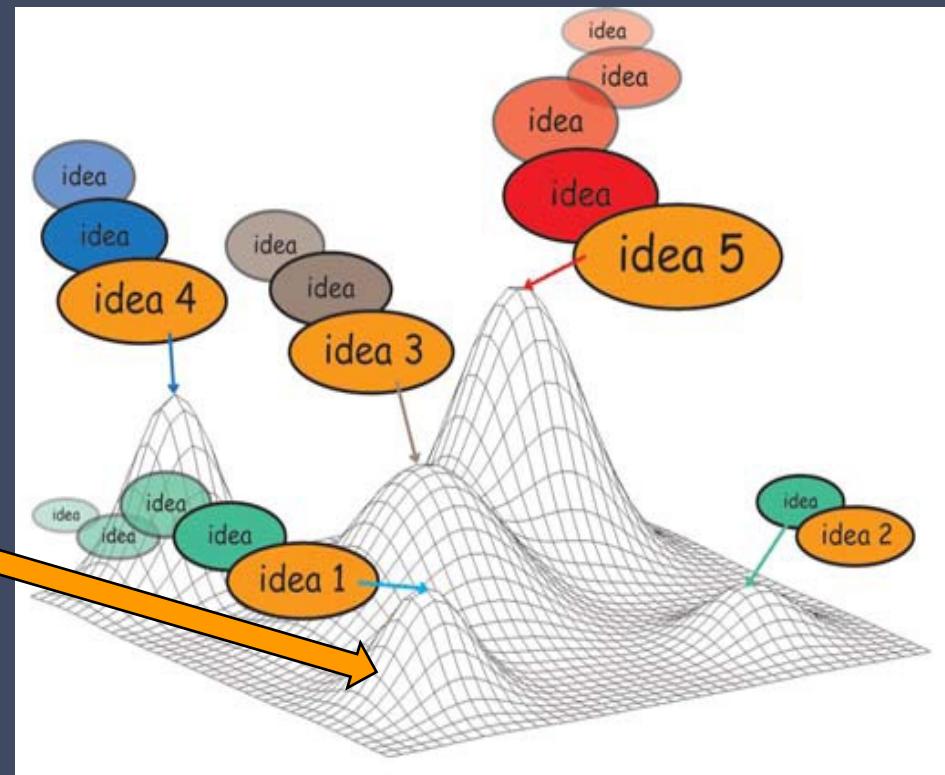
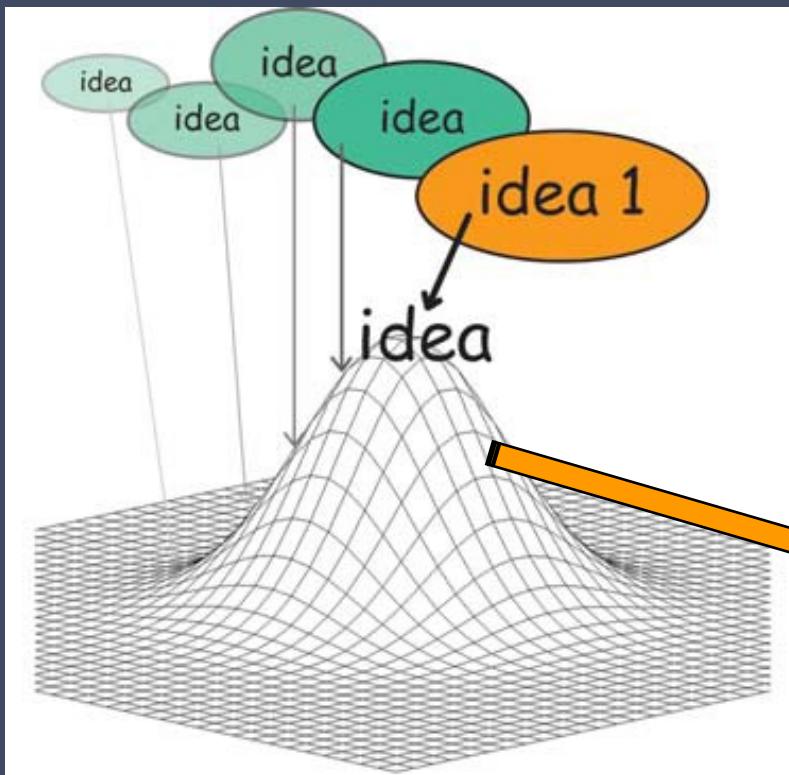
# Getting the Design Right

## The Problem

fixates on first idea

local hill climbing issue

- did you reach local vs. global maxima?



# Sketch Attributes

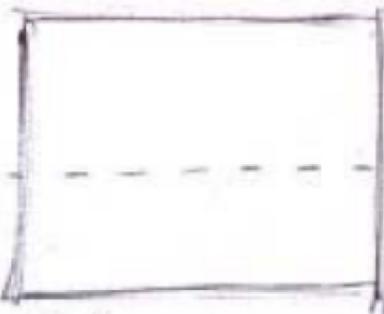
- quick
  - to make
- timely
  - provided when needed
- disposable
  - investment in concept, not in execution
- plentiful
  - allow to create a series or collection of ideas
- clear vocabulary
  - rendering and style indicate that it's a sketch, and not an implementation
- constrained resolution
  - doesn't inhibit concept exploration
- consistency with state
  - refinement of rendering matches the actual state of development of the concept
- suggest & explore rather than confirm
  - value lies in suggesting & provoking what could be; i.e., they are the catalyst to conversation and interaction

# Sketches include annotations

Revisiting the helium project



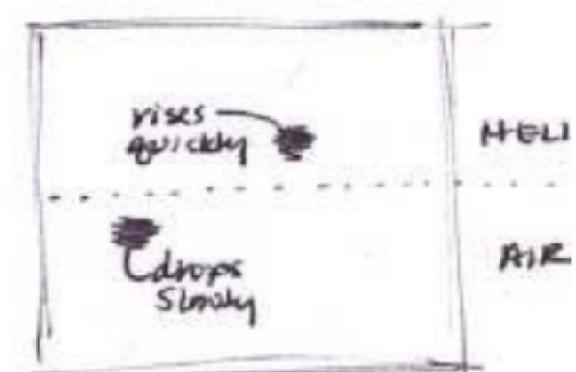
CURSOR AREA  
FADES IN



CAN THE  
SPLIT BE  
TOP AND  
BOTTOM?

OK

If the cursor moves  
above the line or  
"up" it (the cursor)  
changes to helium.  
If it moves down  
it changes to air.  
Speed is matched.



Single image used.  
Black rectangle appears  
when entering the  
opposite area? or  
blurred cursor circle  
just behaves differently  
in one versus the other.

Myers et al. (2008). How Designers Design and Program Interactive Behaviors. VL/HCC 2008.

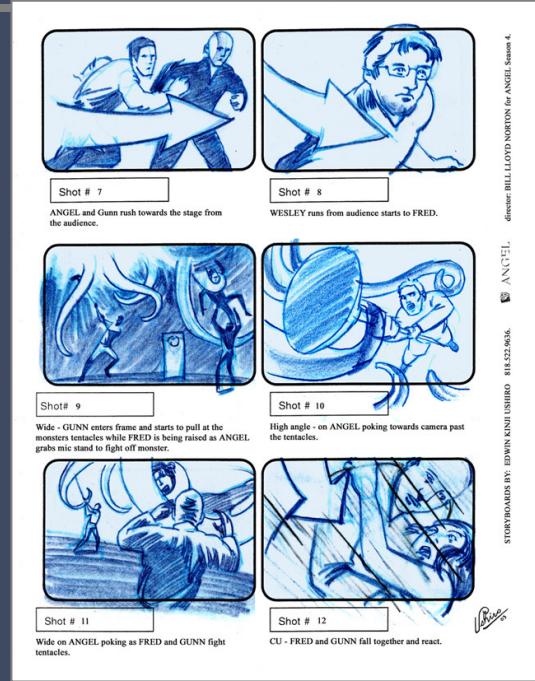
- Annotations explain what is going on in each part of sketch & how



- Sketches suggest
  - If you want to get the most out of a sketch...
  - ...you need to leave big enough holes for the imagination to fit in

# Storyboarding

- series of key frames as sketches
  - originally from film; used to get the idea of a scene
  - would be talked through
- in interaction (HCI) design:
  - a series of (usually) hand-drawn sketches of the interface
  - snapshots of the interface at particular points in the interaction
  - (can/should) contain annotations of what happens



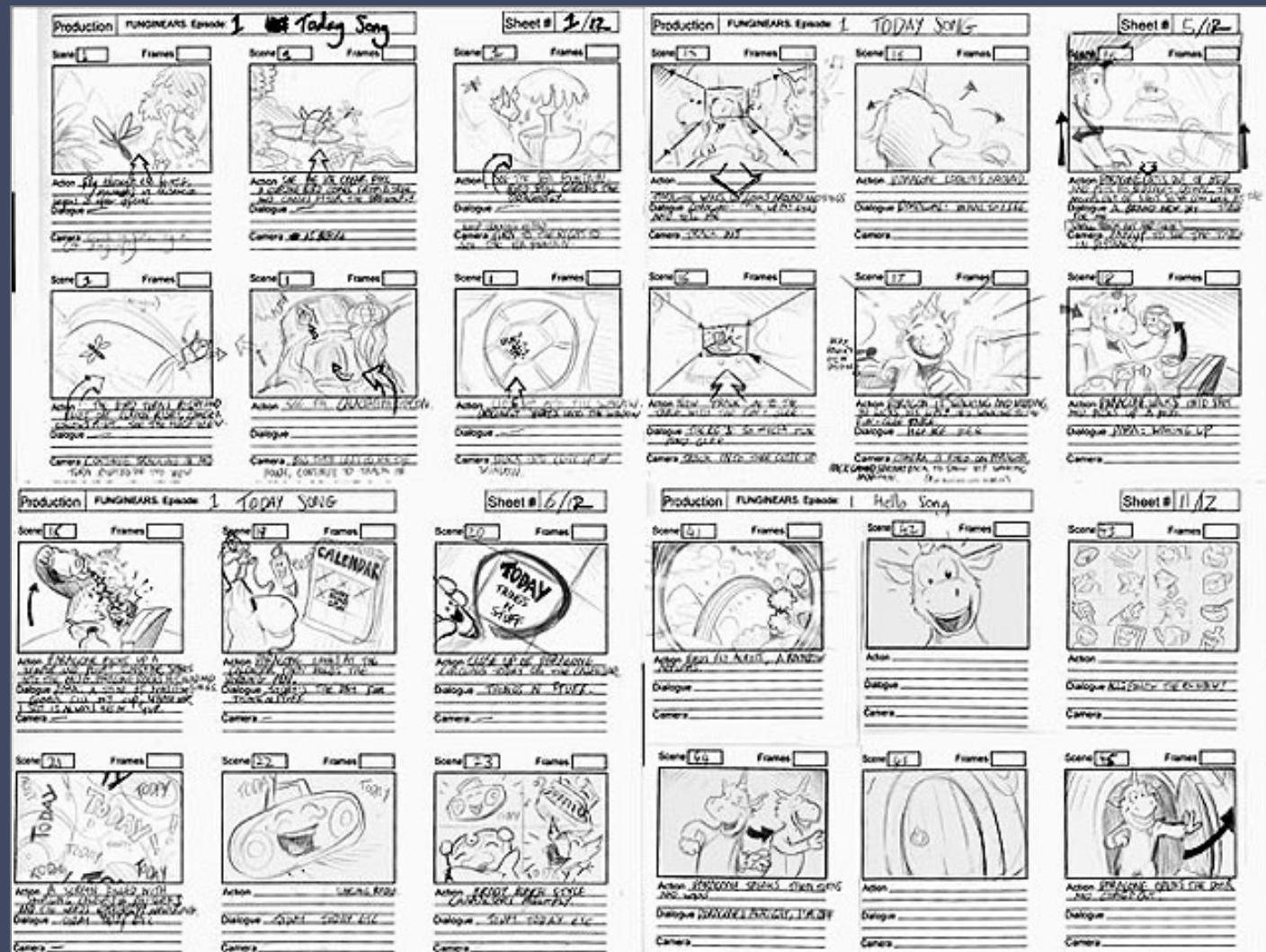
© Warner Brothers Television

# Storyboarding

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- Purpose of storyboards in HCI
  - to pitch ideas for a user interface to developers or possible users
  - users can evaluate quickly the direction in which the interface is heading
  - they can serve as a reference for the development

# Storyboarding



© Sun and Moon Studios 2008

note how each scene in this storyboard is heavily annotated

# Interface Storyboards: Stroller Example

initial screen

**What to do**  
Find the item you want in the catalog and scan the bar code next to it.

**What you selected**



**Item**      **Style**      **Cost**

tax:  
**Total:** \$ 0.00

**All done?**

Place your order    Print this list    Throw this list away

**What to do**  
Touch a different color, or scan another item.

**What you selected**



**JPG Stroller**  
For children between 1-3 years old ...**\$98.**

Green  
 Blue  
 Red (out of stock)

**Item**      **Style**      **Cost**

JPG Stroller    Blue    98.00 **Delete**

tax: 6.98  
**Total:** \$104.98

**All done?**

Place your order    Print this list    Throw this list away

change the color

scan the barcode of the stroller

**What to do**  
Touch a different color, or scan another item.

**What you selected**



**JPG Stroller**  
For children between 1-3 years old ...**\$98.**

Green  
 Blue  
 Red (out of stock)

**Item**      **Style**      **Cost**

JPG Stroller    Green    98.00 **Delete**

tax: 6.98  
**Total:** \$104.98

**All done?**

Place your order    Print this list    Throw this list away

**What to do**  
To get your items, bring your printout to the front counter.

**What you selected**



**JPG Stroller**  
For children between 1-3 years old ...**\$98.**

**Item**      **Style**      **Cost**

JPG Stroller    Blue    98.00

tax: 6.98  
**Total:** \$104.98

**All done?**

Place your order    Print this list    Throw this list away

place the order

# Interface Storyboards: Stroller Example

alternate path

**What to do**  
Touch a different color, or scan another item.



**What you selected**  
**JPG Stroller**  
For children between 1-3 years old ...\$98.  
 Green  
 Blue  
 Red (out of stock)

Item	Style	Cost
JPG Stroller	Blue	98.00 <span style="border: 1px solid black; padding: 2px;">Delete</span>

tax: 6.98  
**Total:** \$104.98

**All done?**  
Place your order Print this list Throw this list away

scan the shirt

**What to do**  
Touch a different size, or scan another item.



**What you selected**  
**JPG Stroller**  
For children between 1-3 years old ...\$98  
 Green  
 Blue  
 Red (out of stock)

Item	Style	Cost
JPG Stroller	Blue	98.00
Rad Shirt	Large	45.99 <span style="border: 1px solid black; padding: 2px;">Delete</span>

tax: 10.08  
**Total:** \$154.07

**All done?**  
Place your order Print this list Throw this list away

touch previous item

**What to do**  
Touch a different size, or scan another item.



**What you selected**  
**JPG Stroller**  
For children between 1-3 years old ...\$98  
 Green  
 Blue  
 Red (out of stock)

Item	Style	Cost
JPG Stroller	Blue	98.00 <span style="border: 1px solid black; padding: 2px;">Delete</span>
Rad Shirt	Large	45.99

tax: 10.08  
**Total:** \$154.07

**All done?**  
Place your order Print this list Throw this list away

delete that item

**What to do**  
Touch a different size, or scan another item.



**What you selected**  
**Rad Shirt**  
Casual adult wear \$45.99  
 Large  
 Medium  
 Small

Item	Style	Cost
Rad Shirt	Large	45.99 <span style="border: 1px solid black; padding: 2px;">Delete</span>

tax: 3.22  
**Total:** \$49.21

**All done?**  
Place your order Print this list Throw this list away

# Interface Sketch-Storyboard Videos

Bill Buxton, 2006

# **LOW / MEDIUM / HIGH FIDELITY PROTOTYPES**

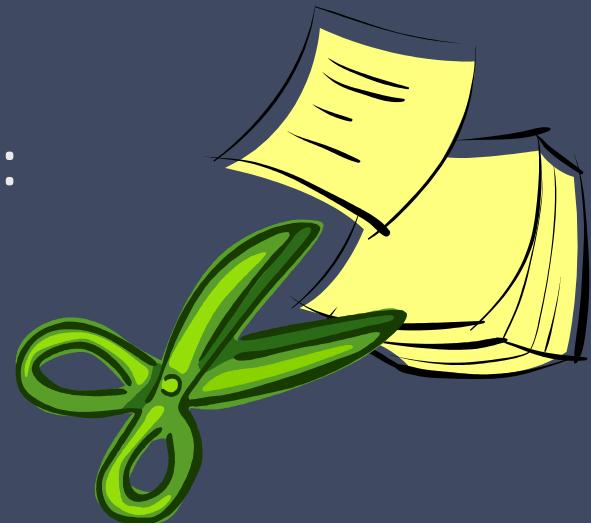
# Low fidelity prototype

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- **Low fidelity** prototype w/ paper mockups
- Goal: **get feedback** from users early w/ very low cost interactive prototype of envisioned interaction design

# Low fidelity prototype: Paper Prototypes

- make storyboard sketches interactive
- use office supplies
  - layers of background sketch, sticky notes, plastic overlays
  - make elements to represent icons, menus, windows, etc.
- interaction demonstrated by manipulating notes: new interfaces built on-the-fly
- sessions videotaped for later analysis:  
usually end up with mess of paper and plastic

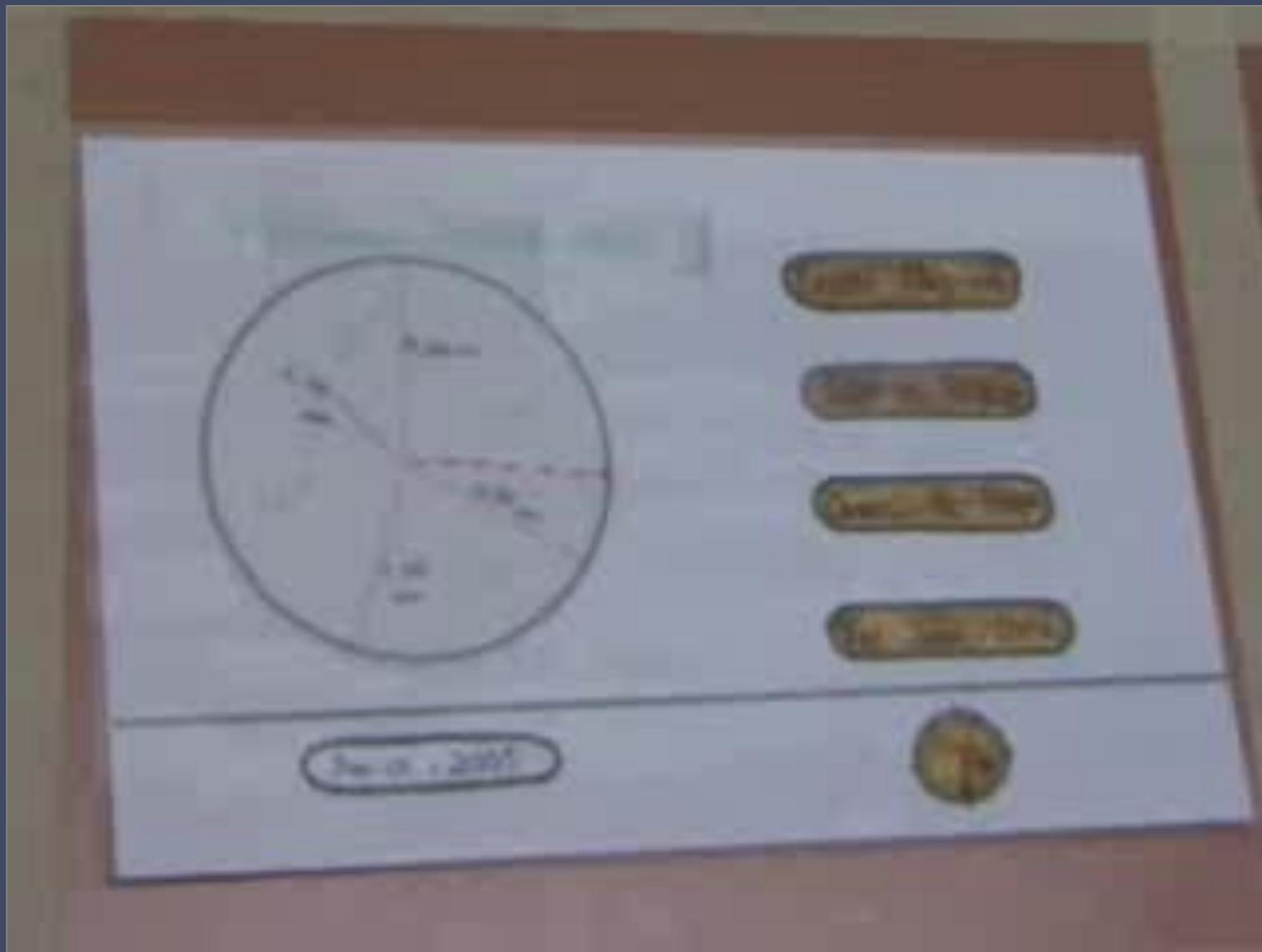


# Paper prototyping

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- Set a realistic deadline
- Gather set of paper prototyping materials
- Work **fast**
- Reuse existing sketches & mockups
- Make underlying paper mockups of key screens

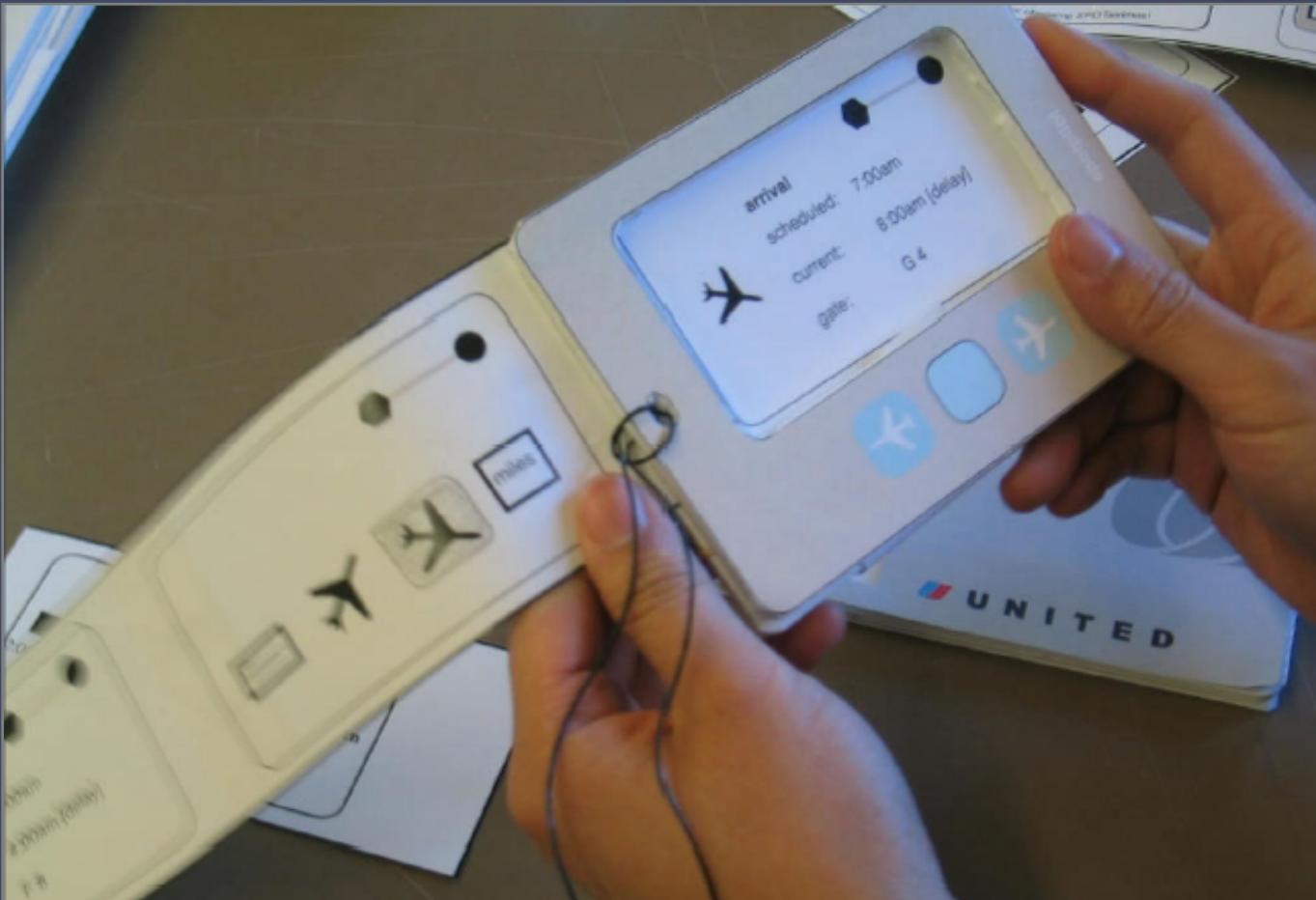
# Paper Prototype Example: Climate Control



Bill Buxton, 2006

# Paper Prototypes

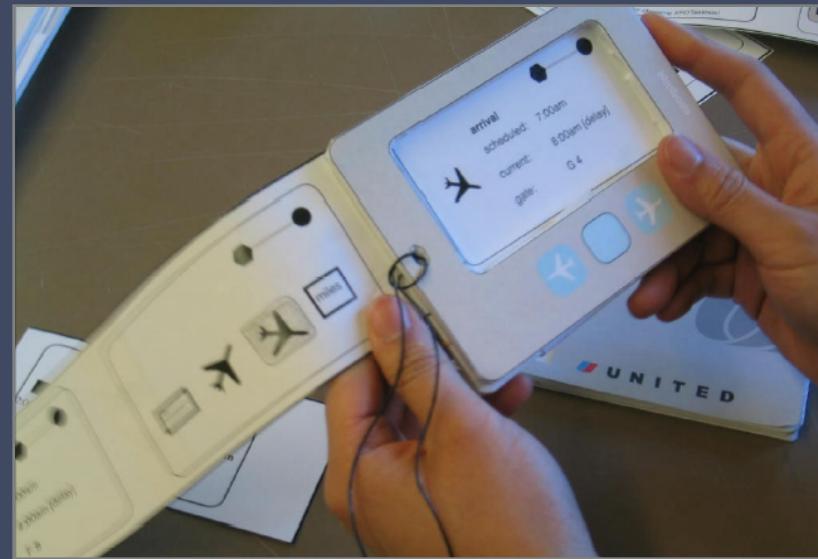
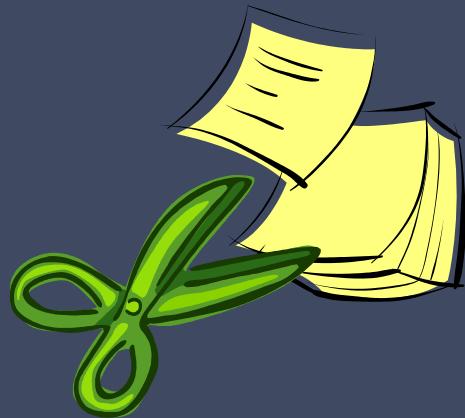
- other example: spotlight – an interactive foam core and paper sketch/storyboard



Sue-Tze Tan,  
Dept. Industrial Design,  
University of Washington

# Low-Fidelity Prototypes: Advantages

- takes between only minutes to just a few hours
- does not require “real implementation”
- no expensive equipment needed
- can test multiple alternatives, fast iterations
- almost all interaction can be faked



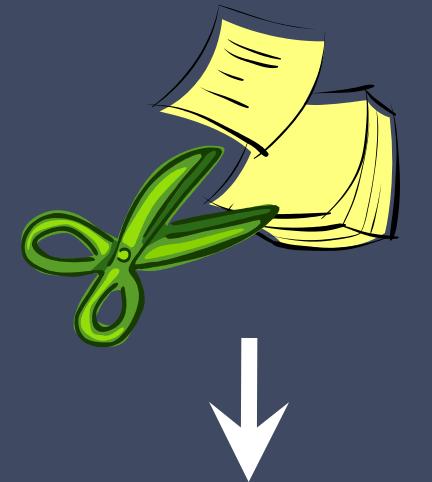
# Low-Fidelity Prototypes: Problems

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- human-simulated “computer” inherently buggy
- slow interaction compared to real application; timings not accurate
- difficult to implement some interaction (e.g., pull-downs, feedback, dragging, visualization, etc.)
- looks different from final product; elements sometimes difficult to recognize
- end-users cannot use it by themselves: not in the context of the user’s work environment

# Medium-Fidelity Prototypes

- prototyping with a computer
  - simulate some but not all features of the interface
  - engaging for end users
- purpose
  - provides sophisticated but limited scenario for the end user to try
  - can test more subtle design issues
- dangers
  - users' reactions often “in the small”
  - users reluctant to challenge designers
  - users reluctant to touch the design
  - management may think it is real!



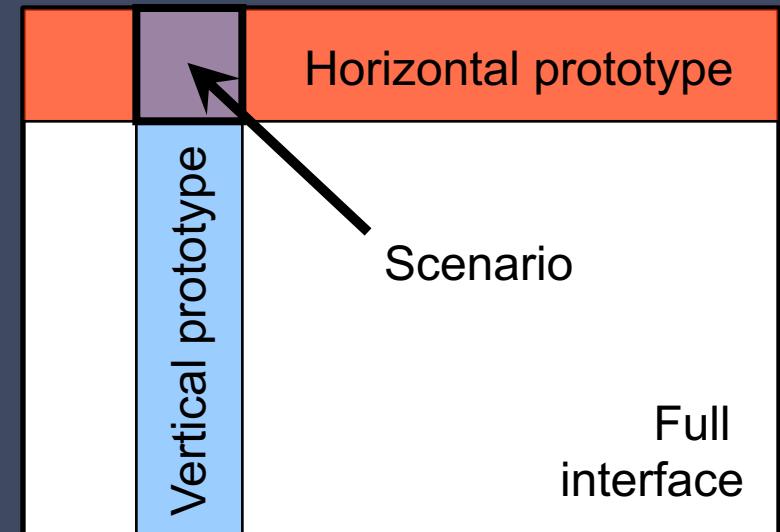
# High-Fidelity Prototypes

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- prototyping with (still simple) computer programs, (complex) scripted simulations, interface builders, physical interface builders
- Advantages:
  - more the final look-and-feel
  - more functionality
  - can test things in detail, engaging for end users
- Disadvantages
  - more effort
  - less likely to get major changes
  - constrained to selected (programming) tools

# Limiting Prototype Functionality

- vertical prototypes
  - include in-depth functionality for a few selected features
  - common design ideas can be tested in-depth
- horizontal prototypes
  - the entire surface interface w/o underlying functionality
  - a simulation; no real work can be performed
- scenario
  - scripts of particular fixed uses of the system



# Integrating Prototypes and Final Products

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- throw-away
  - prototype only serves to elicit user reaction
  - prototype creation must be rapid, otherwise will be too expensive
- incremental
  - product built as separate components (modules)
  - each component prototyped and tested, then added to the final system
- evolutionary
  - prototype altered to incorporate design changes
  - prototype eventually becomes the final product

# Approaches: Scripted Simulations



## What to do

Find the item you want in the catalog and scan the bar code next to it.



## What you selected

### Item

### Style

### Cost

tax:

Total: \$ 0.00

## All done?

Place your order

Print this list

Throw this list away

# Approaches: Scripted Simulations



**What to do**  
Touch a different color,  
or scan another item.



**What you selected**

**JPG Stroller**  
For children between  
1-3 years old ...\$98.

Green  
 Blue  
 Red (out of stock)

<b>Item</b>	<b>Style</b>	<b>Cost</b>
JPG Stroller	Green	98.00

tax: 6.98

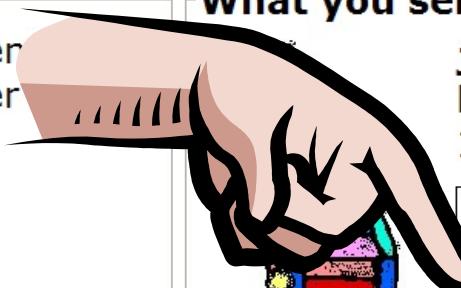
**Total:** \$104.98

**All done?**

Place your order      Print this list      Throw this list away

# Approaches: Scripted Simulations

**What to do**  
Touch a differer or scan another



**What you selected**

**JPG Stroller**  
For children between 1-3 years old ...\$98.

Green  
 Blue  
 Red (out of stock)

<b>Item</b>	<b>Style</b>	<b>Cost</b>
JPG Stroller	Blue	98.00

tax: 6.98

**Total:** \$104.98

**All done?**

# Approaches: Scripted Simulations

**What to do**  
To get your items,  
bring your printout to  
the front counter.



**What you selected**

<u>Item</u>	<u>Style</u>	<u>Cost</u>
JPG Stroller	Green	98.00

tax: 6.98

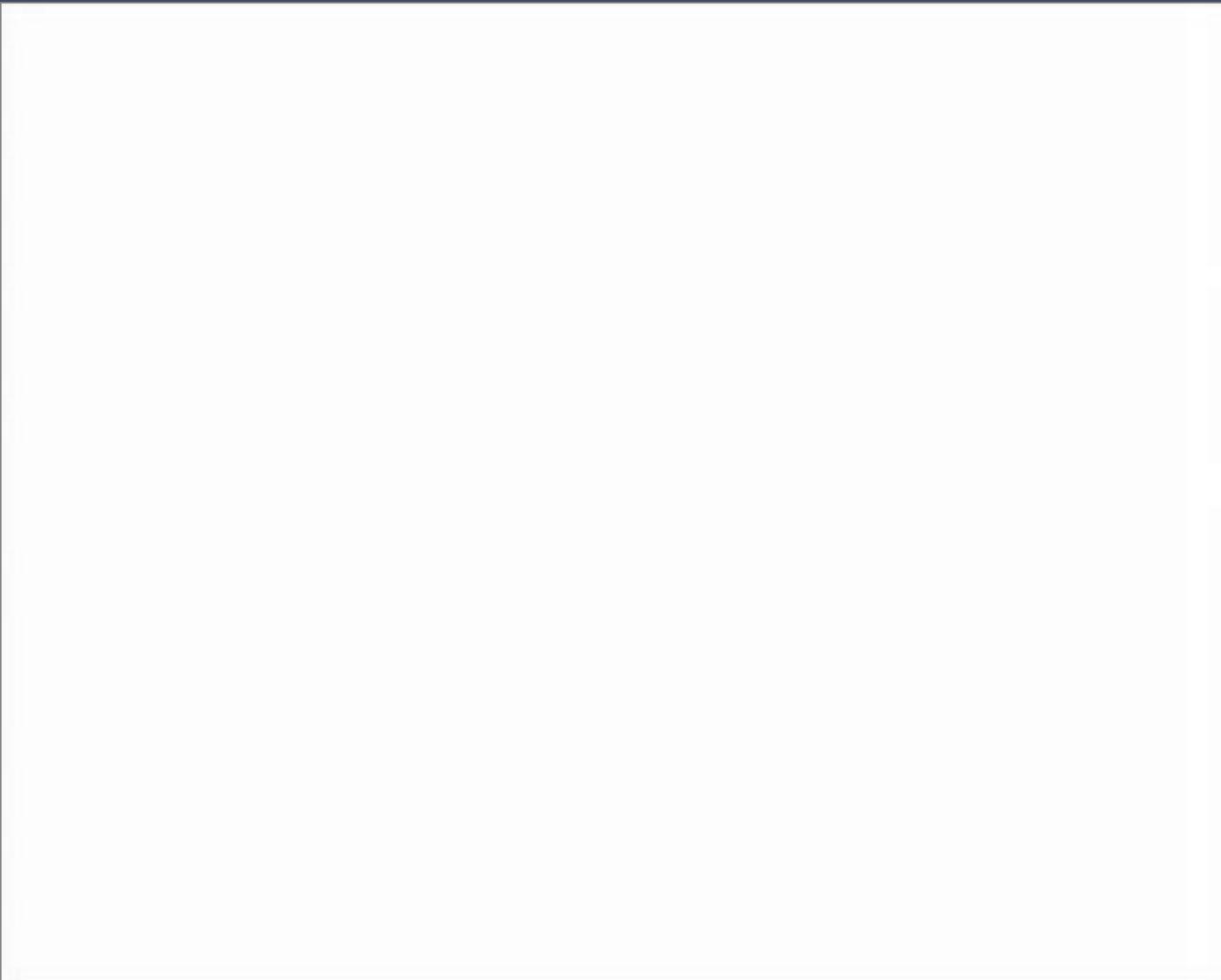
**Total:** \$104.98

Done?

[Place your order](#)   [Print this list](#)   [Throw this list away](#)



# Physical Interface Builders: VoodoolO



Villar et al., 2006

# Physical Interface Builders: VoodooSketch



Block et al., 2008

# Medium- vs. High-Fidelity Prototypes



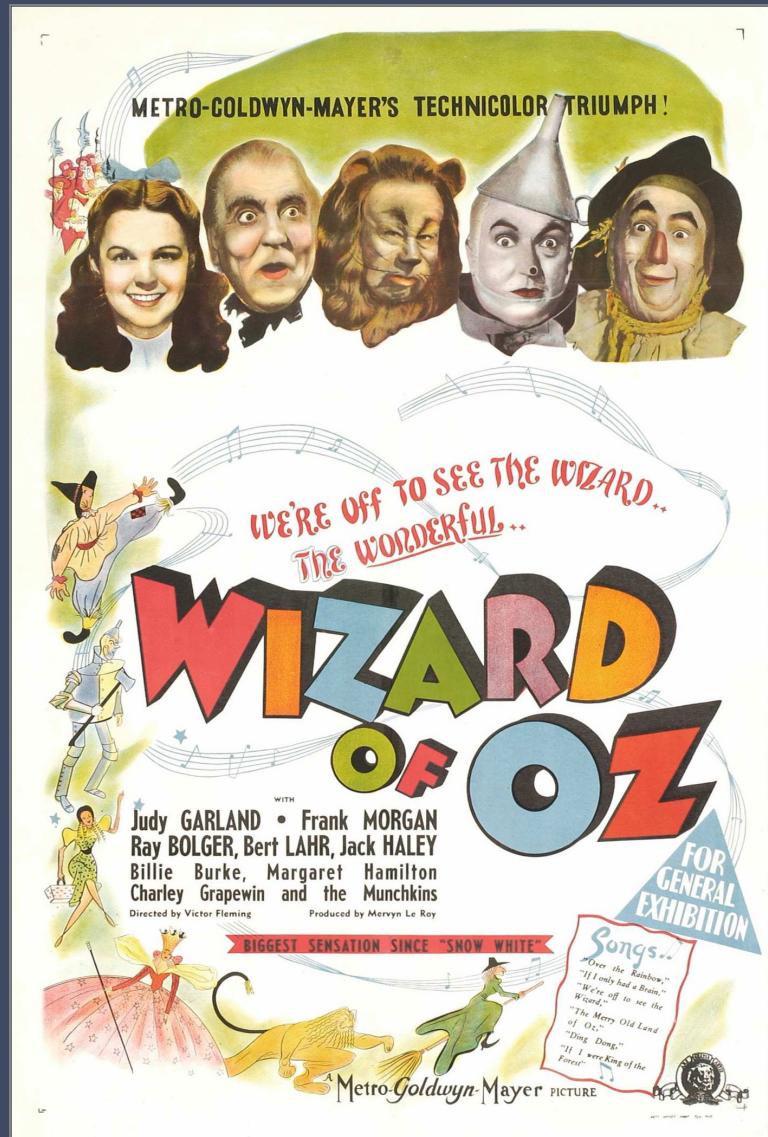
## The Mug Metaphor Interface

Lucia Terrenghi



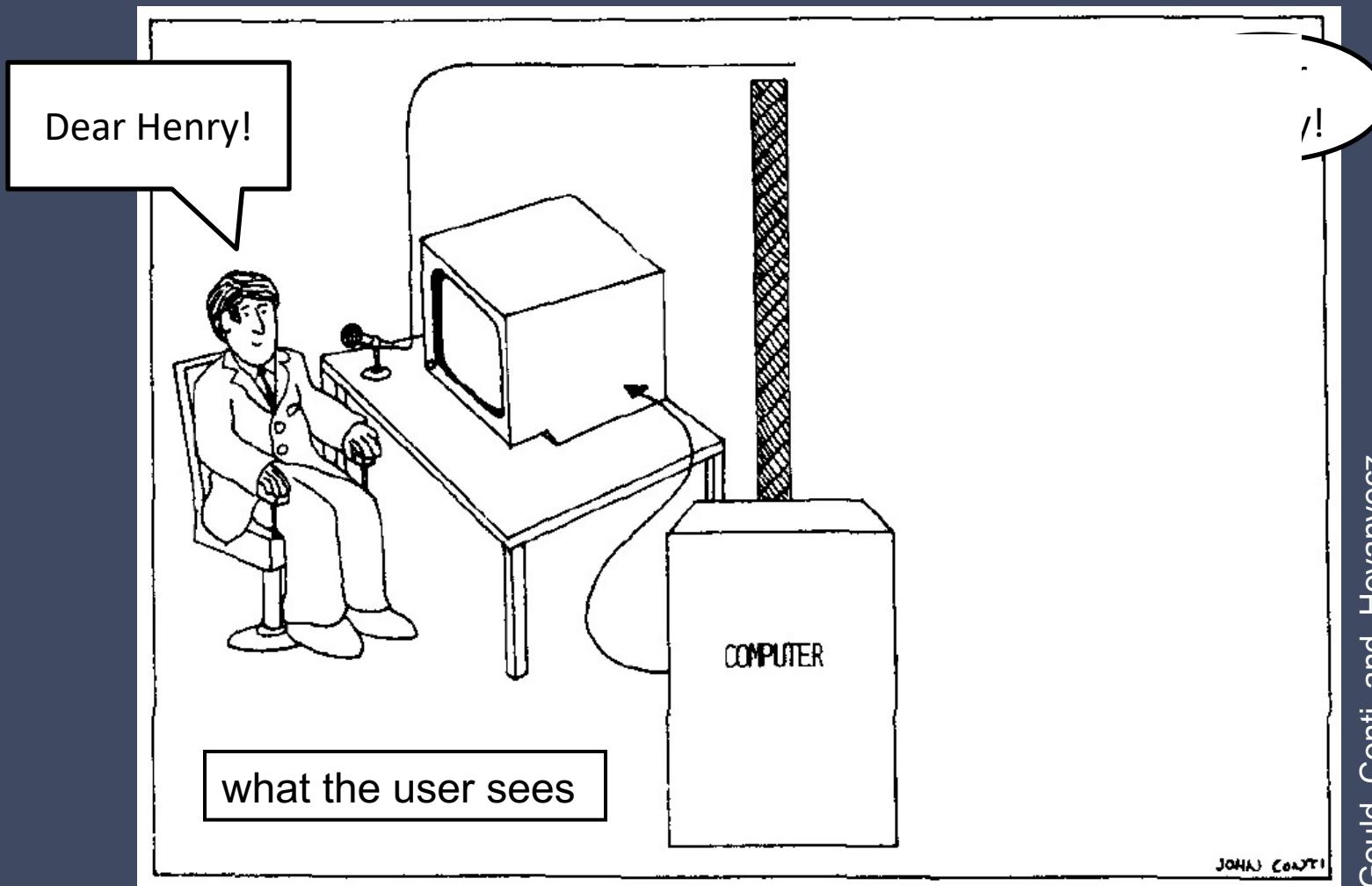
# Wizard of Oz Technique

- reference to the story/movie about a fake wizard who pretends to be able to do magic



# Wizard of Oz Technique

- method of testing a system that does not exist



Gould, Conti, and Hovanyecz.  
Composing letters with a simulated listening typewriter.  
Communications of the ACM, 26(4). April 1983.

# Wizard of Oz Technique

- human “wizard” simulates the system’s response
  - interprets user input according to an algorithm
  - controls computer to simulate appropriate output
  - uses real or mock interface
  - wizard sometimes visible, sometimes hidden (“pay no attention to the man behind the curtain”)

- good for:
  - adding simulated and complex vertical functionality
  - testing futuristic ideas



# **IN CLASS ACTIVITY**

# Group activity

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- work with your group
- continue the work from last time
- develop low fidelity prototypes
- do a walk-through evaluation and discuss the prototypes with end users (students from other groups)
- The end users and class identify problems, and we redesign the system on the fly

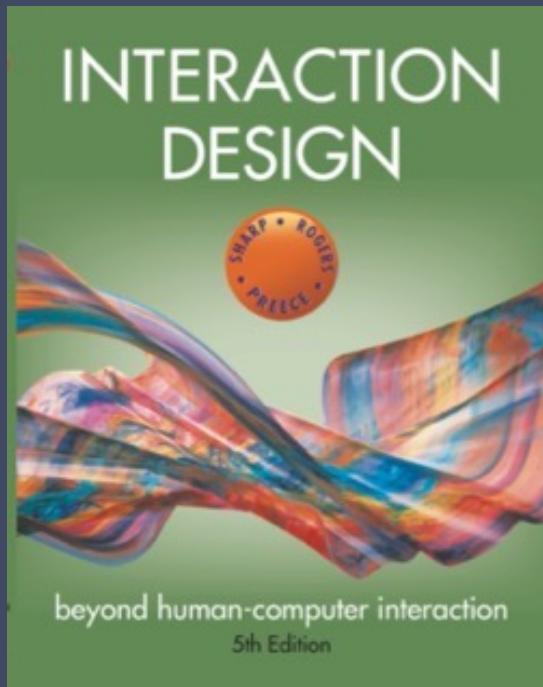
# Summary

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- user-centered and participatory design
  - based upon a user's real needs, tasks, and work context
  - bring end-user as a first-class citizen into the design process
- prototyping
  - allows users to react to the design and suggest changes
  - sketching/low-fidelity vs. medium-fidelity prototypes
- prototyping methods
  - vertical, horizontal, and scenario prototyping
  - sketches, storyboarding, paper prototypes
  - scripted simulations, Wizard of Oz

# References

- Chapter 11, 12



# An Interface Design Process

