

# Design Thinking & Prototyping

SWE 432, Fall 2016

Design and Implementation of Software for the Web



# Today

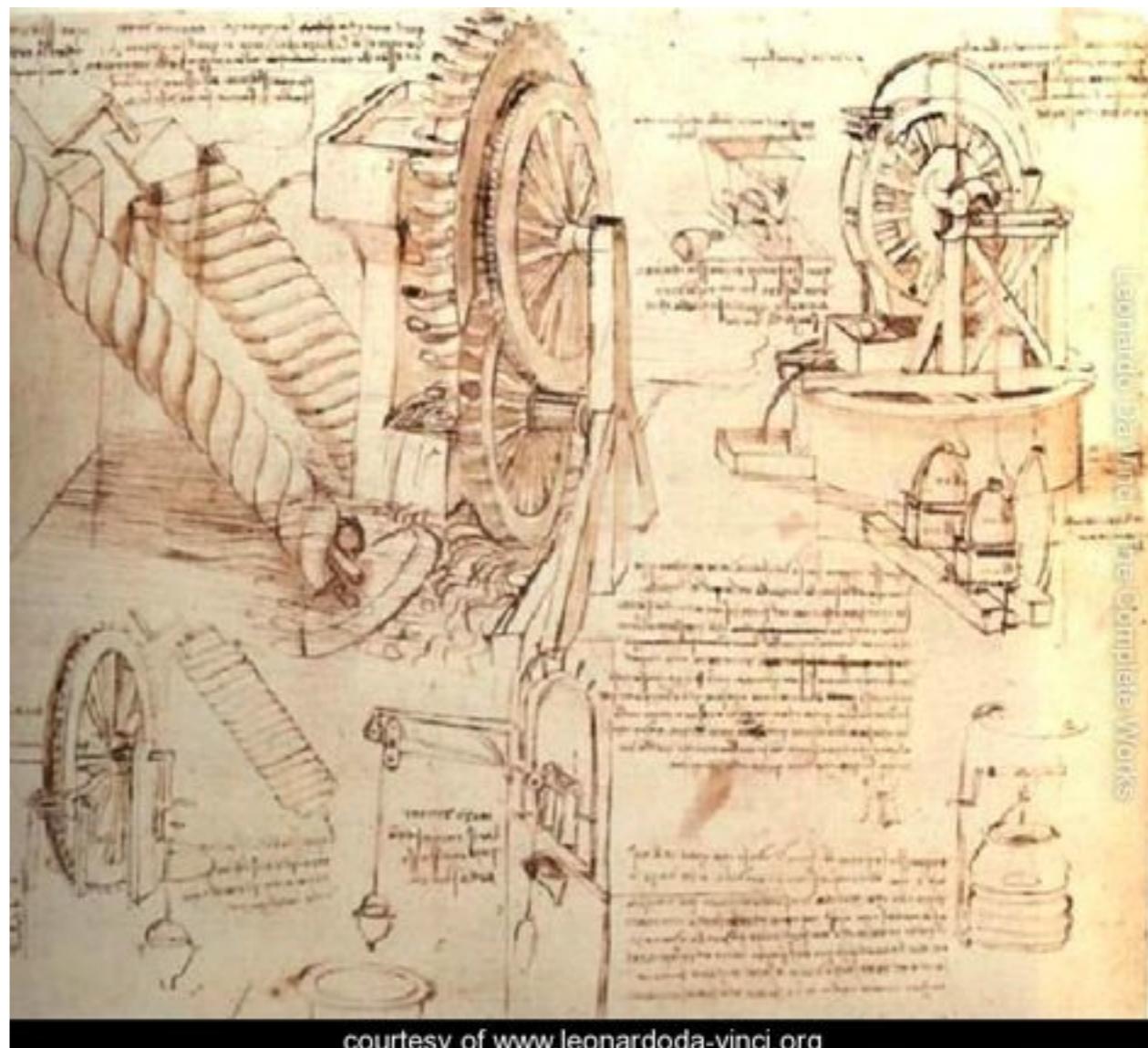
- How do we set ourselves up to build good interfaces from the start?
- What is the iterative process by which we start out with a lot of ideas, and end up with some good, end result interface?

For further reading:

<http://interchangeproject.org/2013/11/02/paper-prototyping/>

# Why sketch?

- Design is process of creation & **exploration**
- Sketching offers **visual** medium for exploration, offering cognitive scaffolding to externalize cognition
- Sketches let us explore many alternative designs

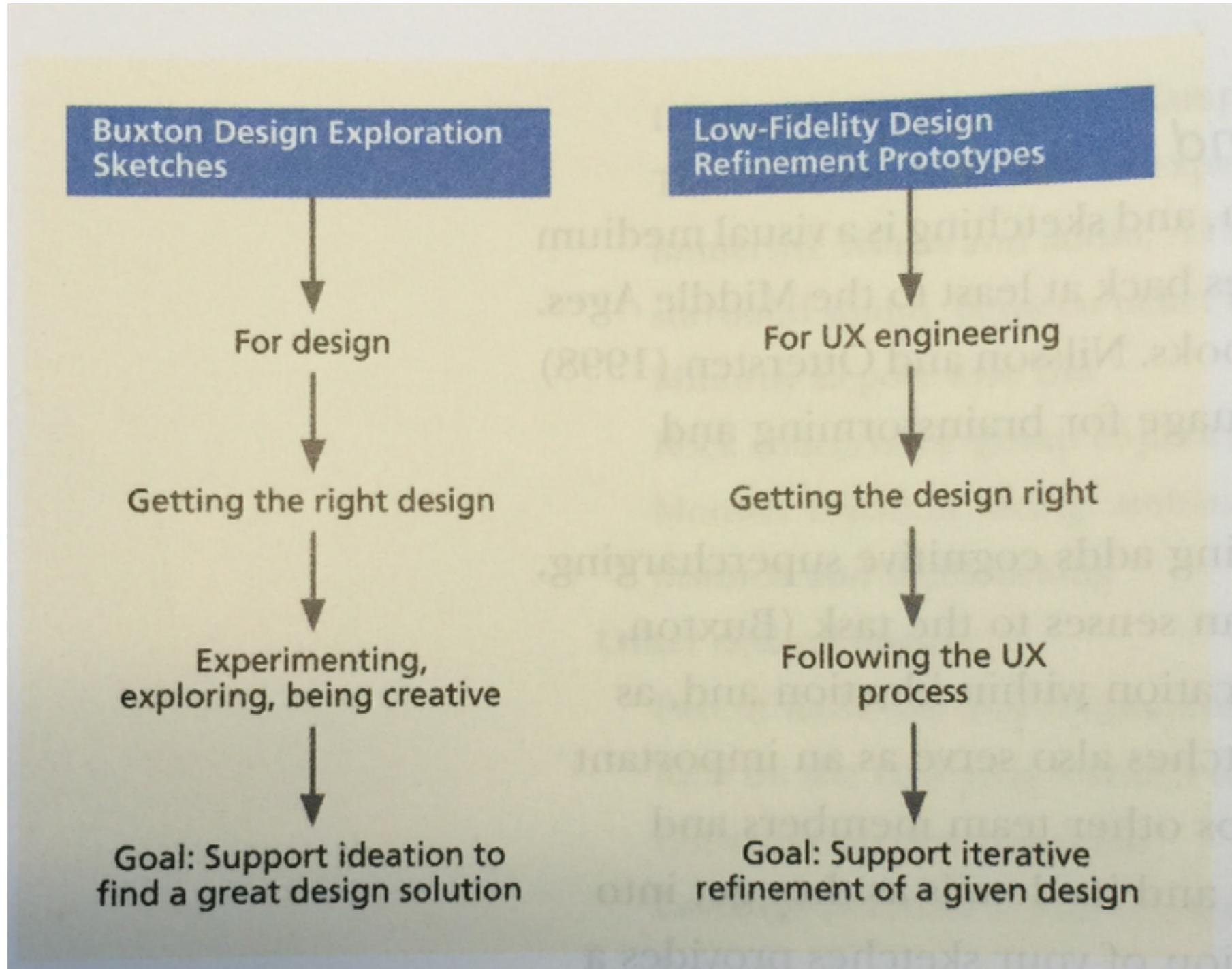


courtesy of [www.leonardoda-vinci.org](http://www.leonardoda-vinci.org)

# Why alternatives?

- Important to think broadly about a wide range of possible designs
  - What are the different ways in which user might do  $x$ ?
- Rather than reimplement the status quo, alternatives offer options for doing things differently, enabling analysis of which is best
  - Important to challenge preconceptions and think deeper
- Rather than develop a single idea, sketching enables exploration and consideration of multiple designs, allowing examination of pros and cons
- Expert designers often create **many** alternatives
  - 10, 50, 100 alternative designs

# Sketching vs. Prototyping

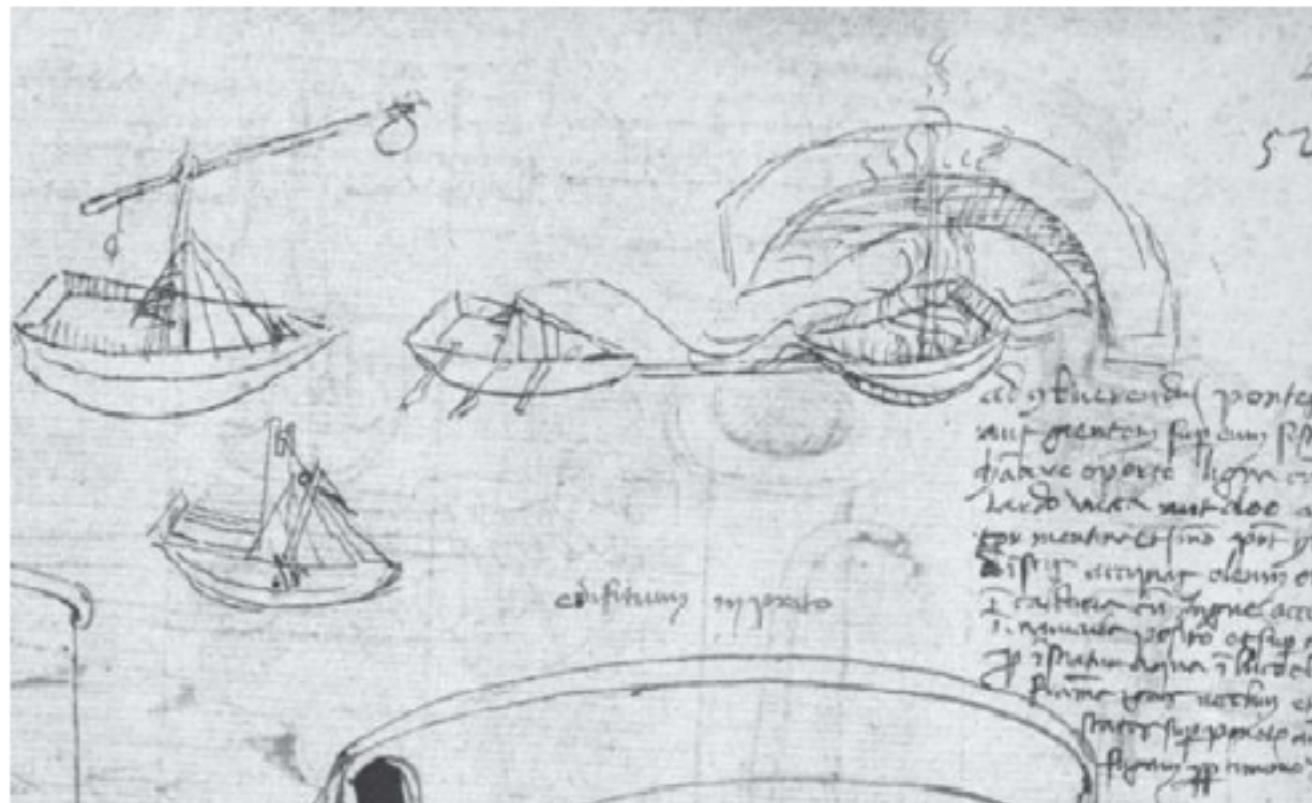


# Physical sketches

- Production tools for sketching:
  - whiteboards, blackboards, cork boards, flip chart easels
  - post it notes
  - duct tape, scotch tape, push pins, staples
  - marking pens, crayons, spray paint
  - scissors, hobby knives, foam core board
  - duct tape
  - bits of cloth, rubber

# Sketches are Sketchy

- Not mechanically correct and perfectly straight lines
- **Freehand**, open gestures
- Strokes may miss connections
- Resolution & detail **low** enough to suggest is concept
- Deliberately **ambiguous** & abstract, leaving “holes” for imagination



# Benefits of Sketching

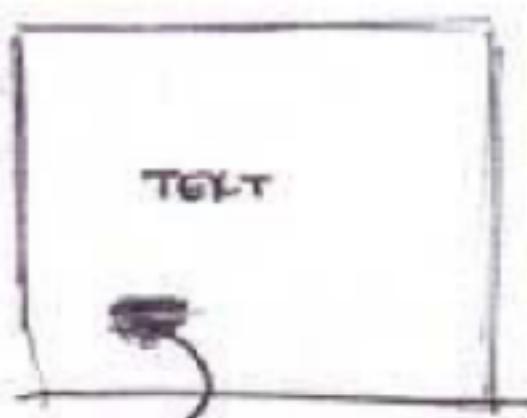
- No “programming” needed! Fast turnaround
  - Costs less
  - Allows more iterations
- Human computer
  - Can be (re)programmed quickly
  - Cannot crash
  - Changes can be made on the fly
- Developers feel less affection for status quo because changes are easy
- Rough “sketchy” appearance
  - Emphasizes content instead of appearance
  - Avoids low-level critiques of visual detail
  - Users are more willing to criticize high-level problems and less willing to blame themselves if something doesn’t work

# Rules for sketching

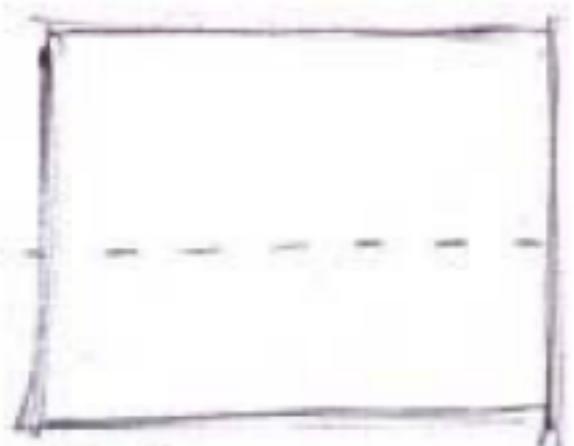
- Everyone can sketch; you do not have to be artistic
- Most ideas conveyed more effectively with sketch than words.
- Sketches are quick and inexpensive to create; do not inhibit early exploration
- Sketches are disposable; no investment in sketch itself
- Sketches are timely; made in-the-moment, just-in-time
- Sketches are plentiful; entertain large # of ideas w/ multiple sketches of each

# Sketches include annotations

Revisiting the helium project



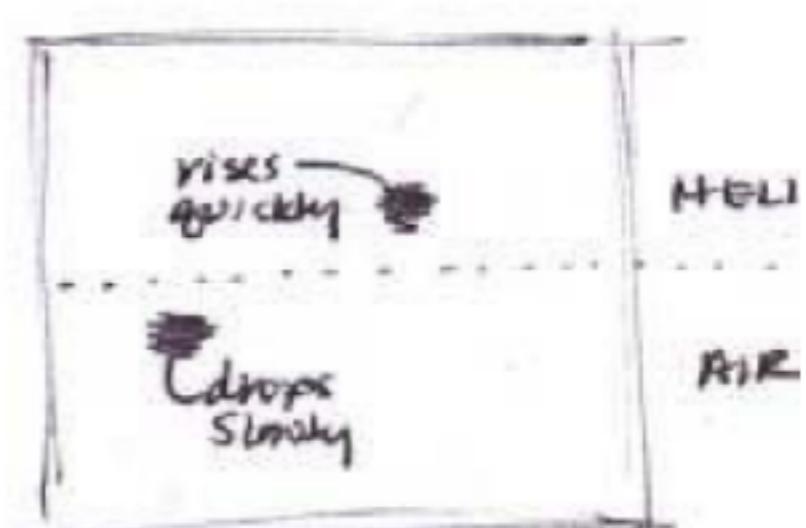
CURSOR AREA  
FADING IN



CAN THE  
SPLIT BE  
TOP AND  
BOTTOM?

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.

OK



HELI

AIR

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 support design exploration

**Top Left Sketch:** A horizontal timeline from "Novice" to "Expert". Below it, a note says "May stop anywhere on this line, which is fine!"

**Middle Left Sketch:** A diagram showing "Physical interactions" (Mouse, keyboard, touch) and "Physical Software interactions" (what things are on screen, where things are, states). A central circle contains "LEARNING THE BASICS".

**Bottom Left Sketch:** A "Navigation" section with "Right/left click", "Backwards, forwards", "scrolling", "closing", "swiping, undoing". It also shows "REGIONS" (Toolbar, toolbar, Taskbar) and a UI snippet with a checkbox labeled "THIS IS A TOOLBAR" and another labeled "I'm not a novice!".

**Bottom Left Sketch (Continued):** A "WANTS TO TEACH THEM STUFF." section with "LEARN AS YOU GO", "LEARN BY EXAMPLE", and "HOW DO USERS GET CONFIDENT". It includes a "Confidence meter" icon and a speech bubble: "If you need to know one thing it's this... PSST... EXPLAIN BASIC STUFF".

**Bottom Left Sketch (Continued):** A note "(Shades of the office cubicle)" and a "SHOW ME" button.

**Top Right Sketch:** A question "Is there any way of establishing a user experience?". It branches into "[Ask them]", "[Try and guess]", "[Annoying]", and "[unpredictable]".

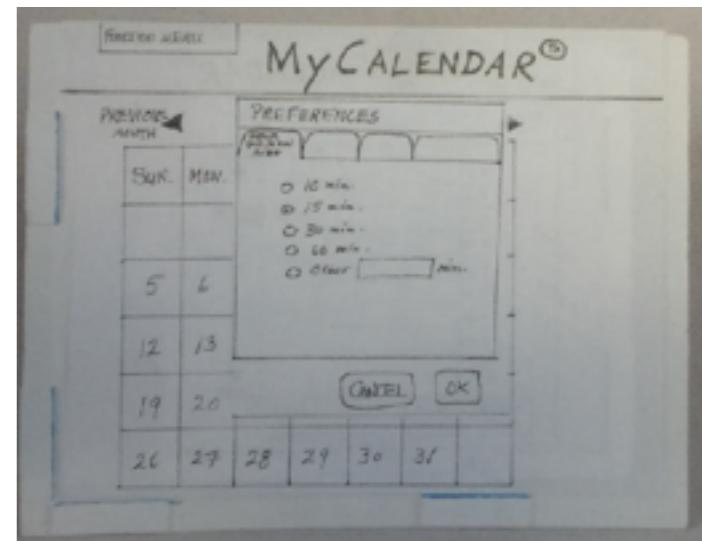
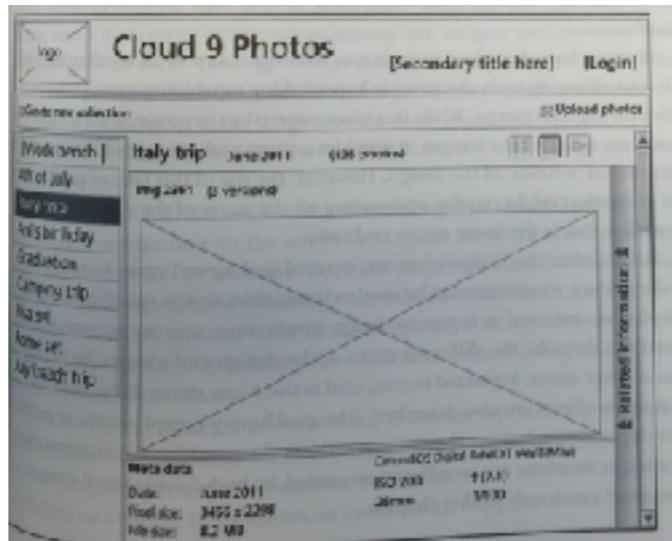
**Middle Right Sketch:** A list: "- Do you need help with a concept?", "- Do you need help from a friend? → Network of friends.", "New User support group".

**Bottom Right Sketch:** A list: "Not knowing the basics", "Not knowing how to set something up", "Ignoring warning".

**Bottom Right Sketch (Continued):** Notes about "Problem 1: figuring out the expertise of someone", "Problem 2: knowing what they need help with", "Problem 3: Building a UI that goes as they go".

**Bottom Right Sketch (Continued):** Two UI sketches: one with a toolbar banner and one with a "Faster sharing screen".

# Fidelity of sketches & mockups



storyboard

wireframe

prototype

low



(many details  
left  
unspecified)

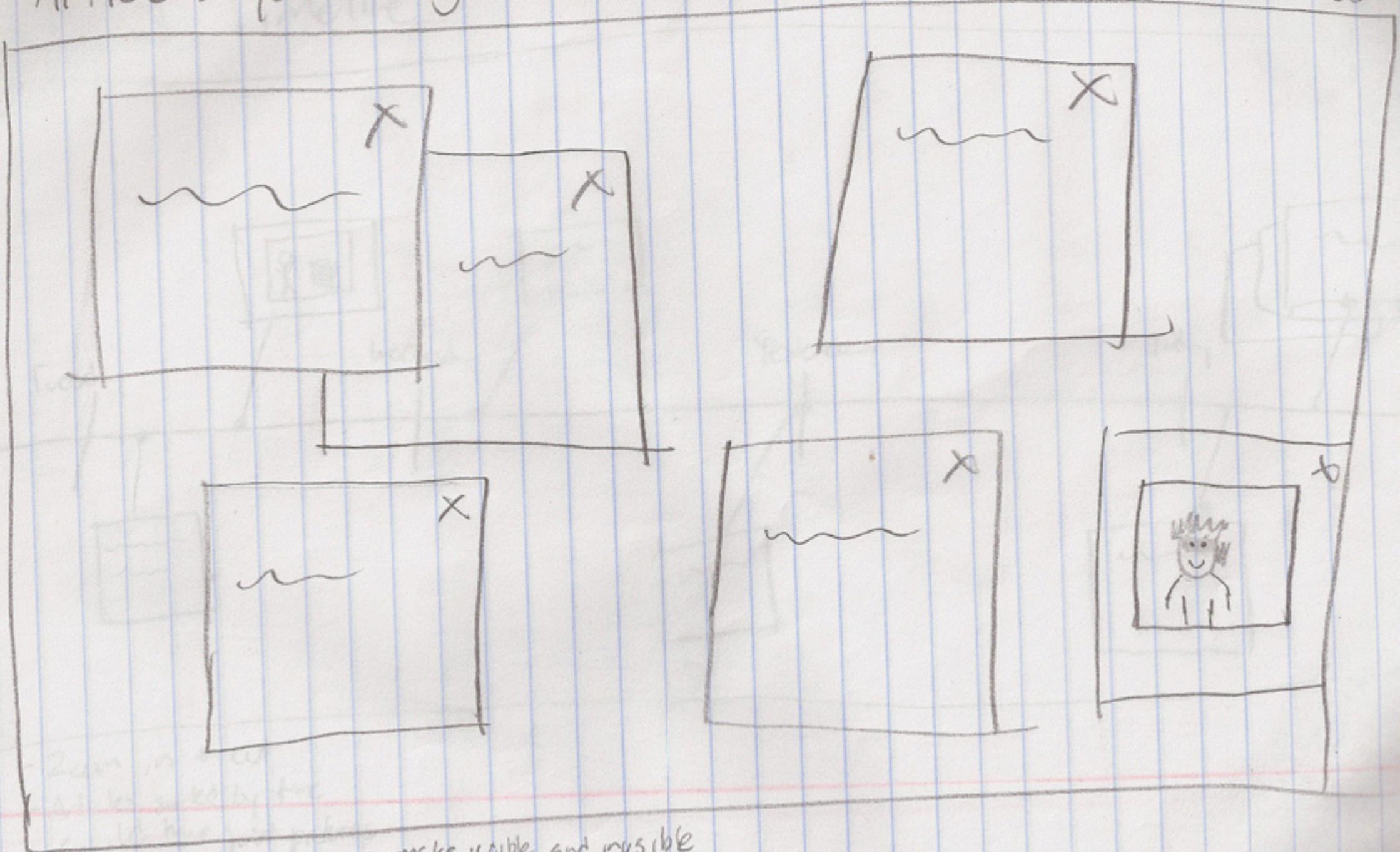
fideli

high

(more polished  
& detailed)

# Sketching Example: News Viewer

~~Article Layout through moveable windows (DADA) - drag and drop articles~~



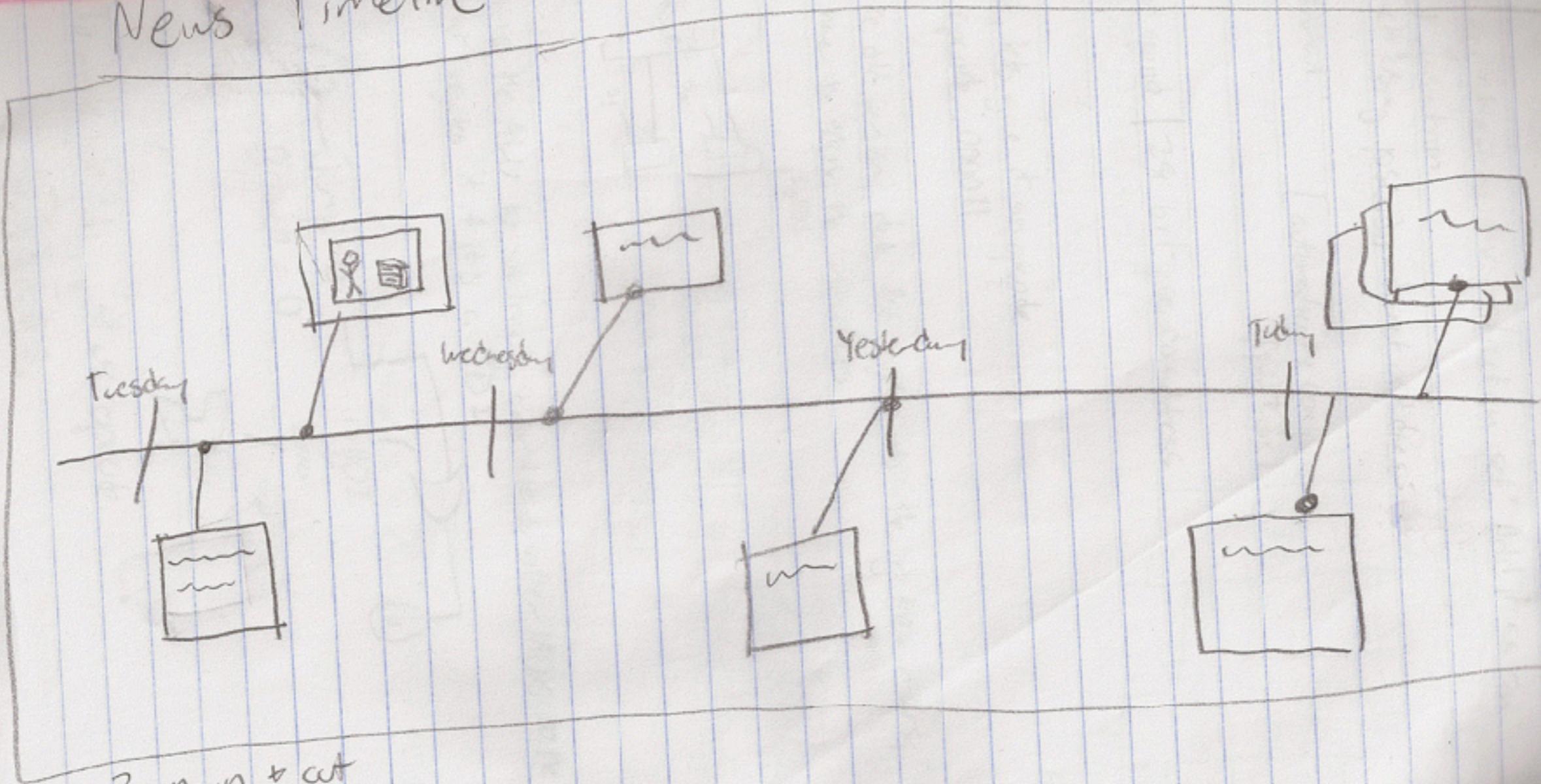
- Moveable windows

- Closeable

- Layered by importance

- make visible and invisible

## News Timeline

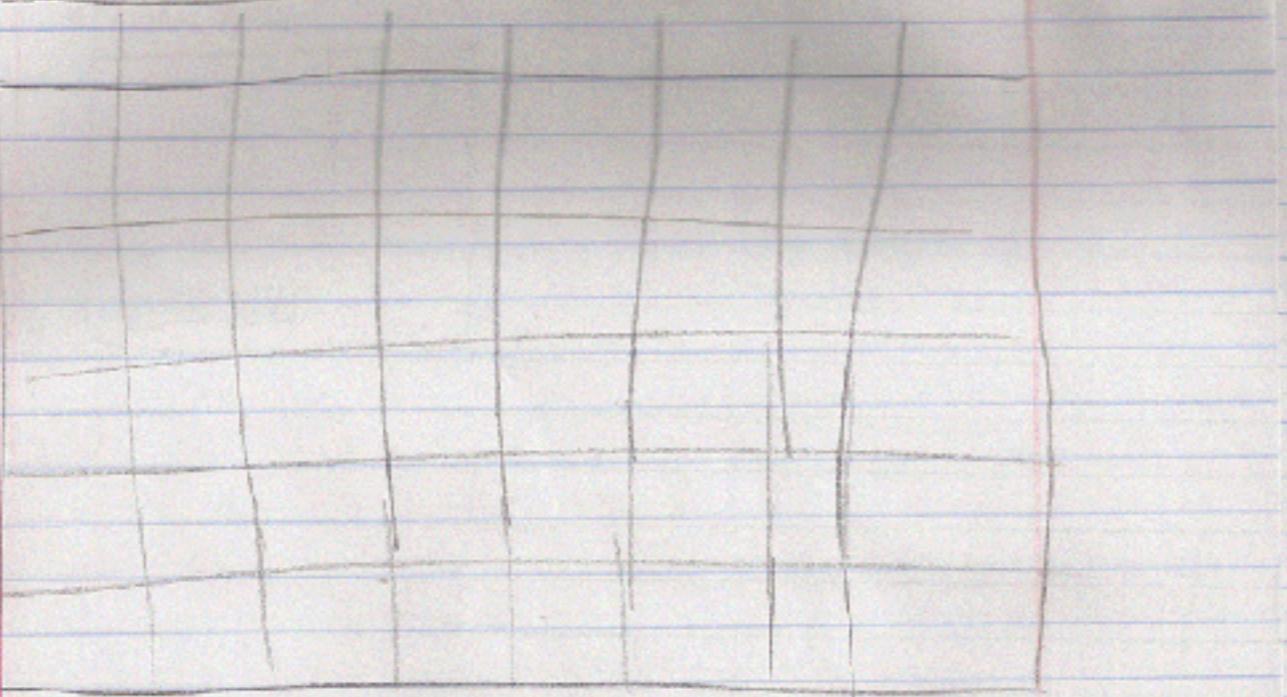


- Zoom in + cut
- Articles sorted by time
- (w/ 1C have just pictures)

## UID Wireframe

FLEXible News

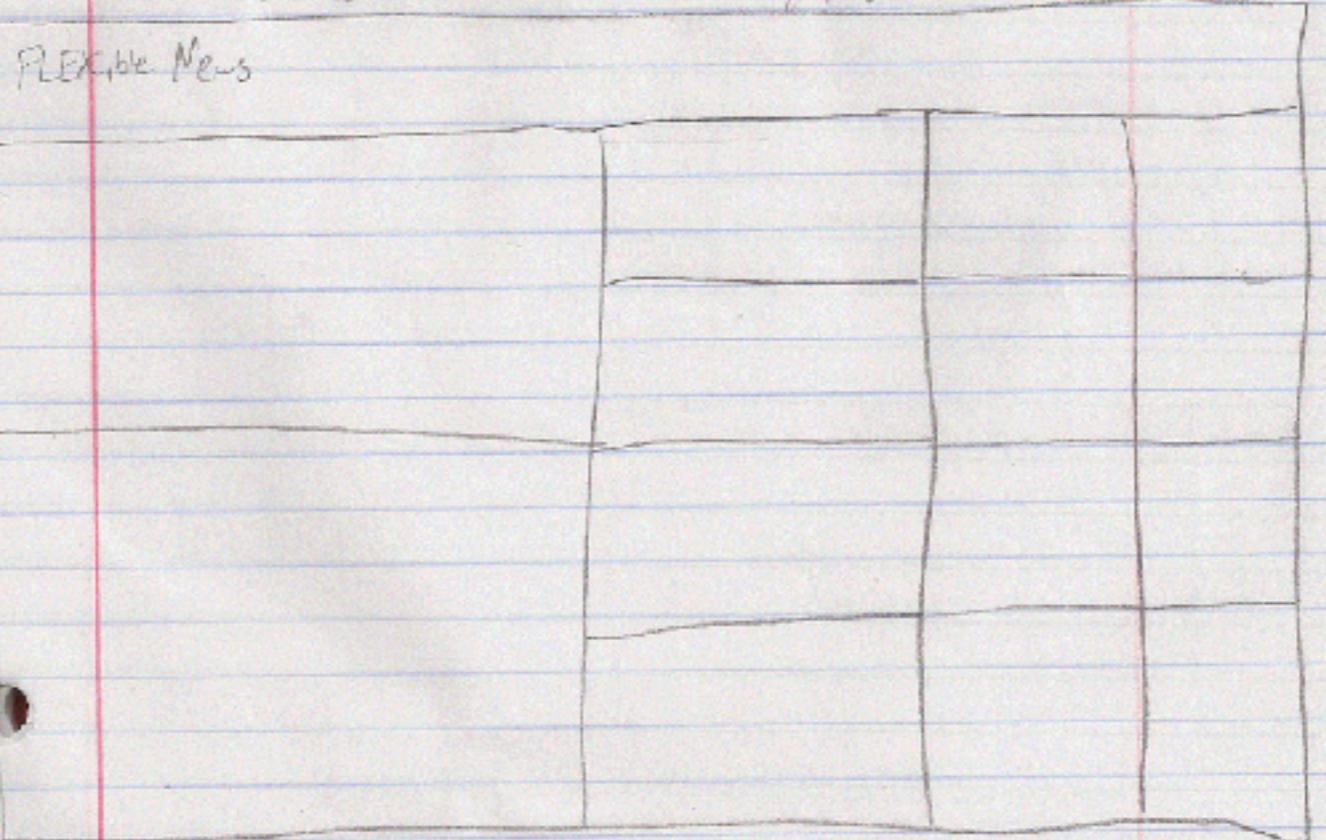
Paper      sports      Tech      Entertain



- Even boxes?

- Different size boxes with same format every time?

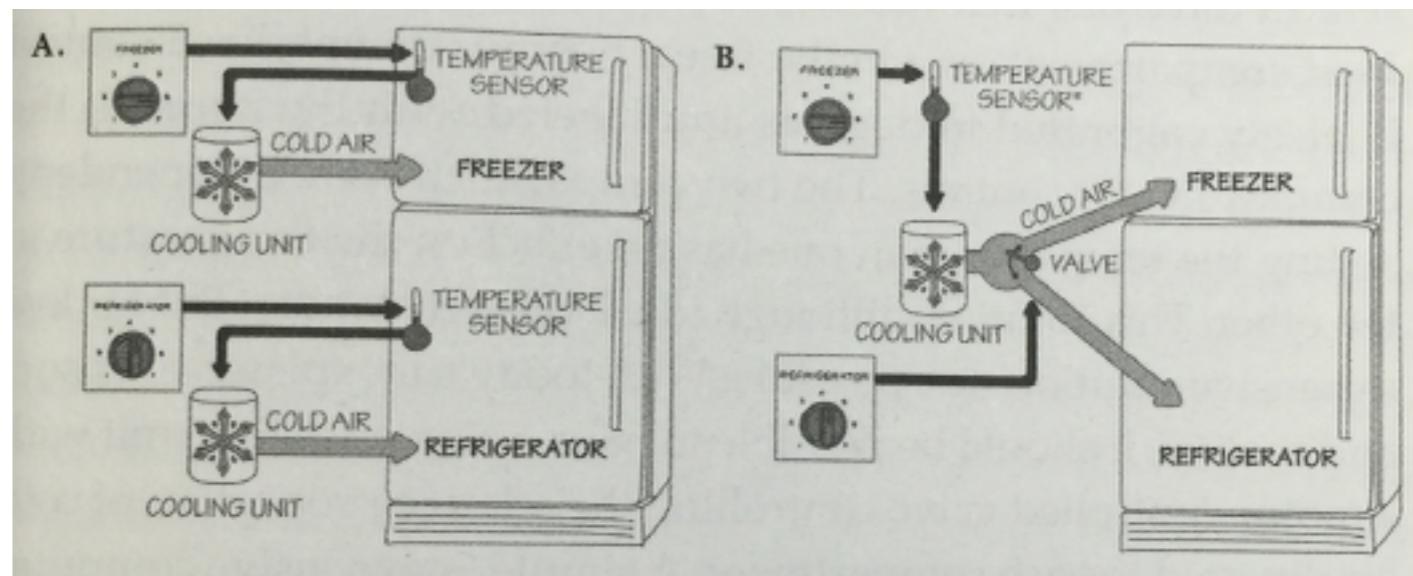
FLEXible News



# Conceptual design

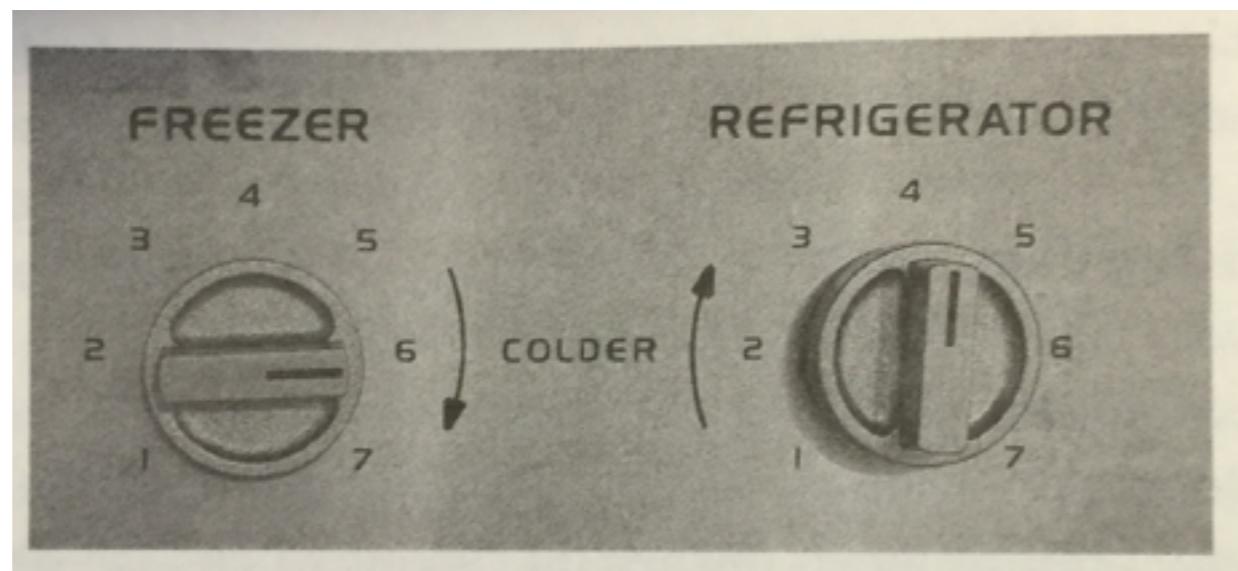
# Designer's mental model

- Conceptualization of the envisioned system
  - what it is
  - how it is organized
  - what it does
  - how it works



# User's mental model

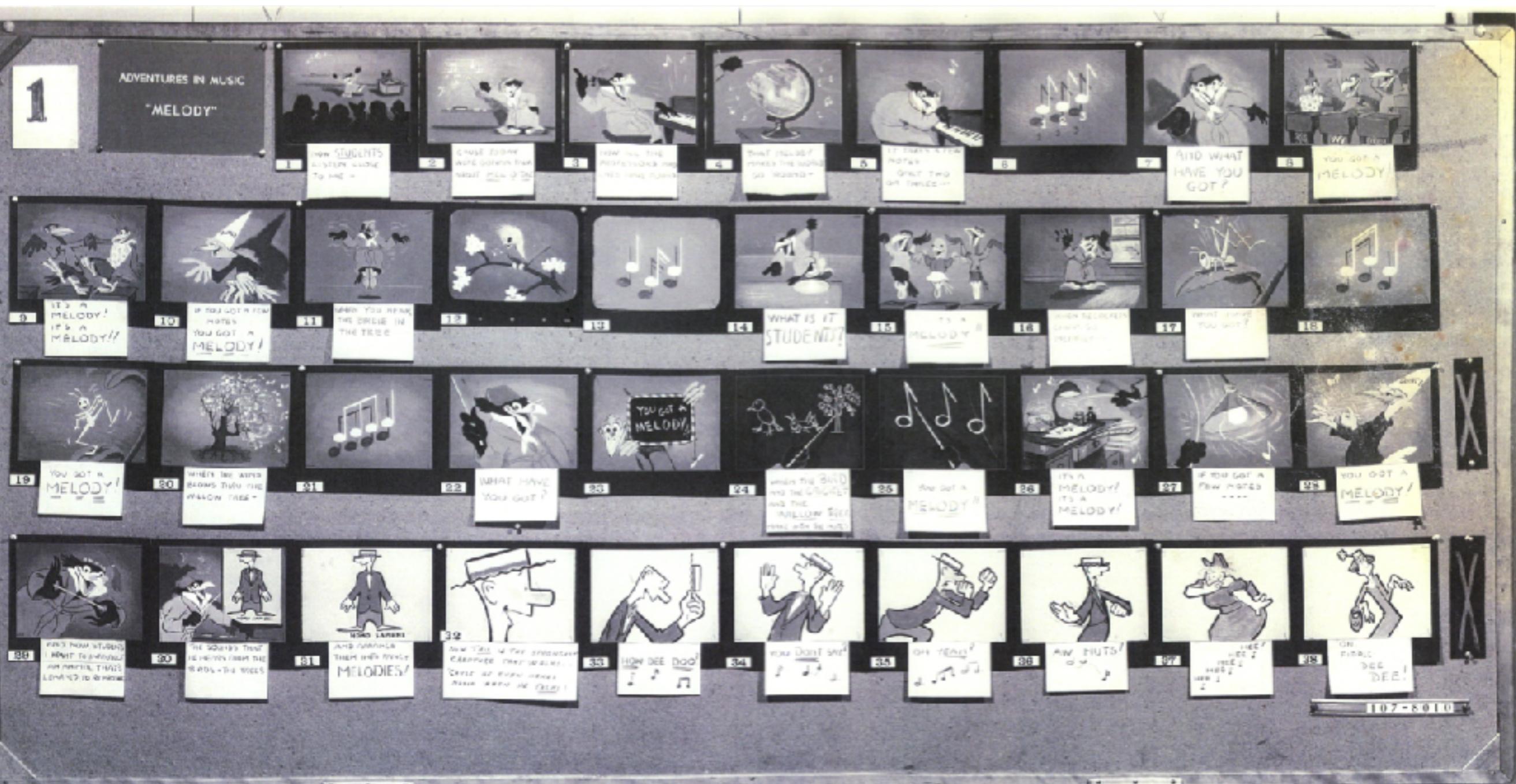
- Comes up from existing interactions with systems
- Users form cause & effect relationships to form theories that guide actions



# Conceptual design

- Goal: match users' **mental model**
- Tool: Metaphor - analogies from existing system
  - Offers expectations about what system does & what can be done
- Examples
  - Email <—> physical mail
  - Backup software <—> time machine
  - OS desktop <—> top of a desk

# Storyboards



Storyboard for Disney's Melody: Adventures in Music (1953)

Source: Michael Sporn Animation



# Storyboards for UI design

- Sequence of visual “frames” illustrating **interplay** between user & envisioned system
- Explains how app fits into a larger **context** through a single scenario / story
- Bring design to **life** in graphical clips - freeze frame sketches of user interactions
- “Comic-book” style **illustration** of a scenario, with actors, screens, interaction, & dialog

# Crafting a storyboard

- Set the stage:
  - Who? What Where? Why? When?
  - Show key interactions with application
  - Show consequences of taking actions
  - May also think about errors

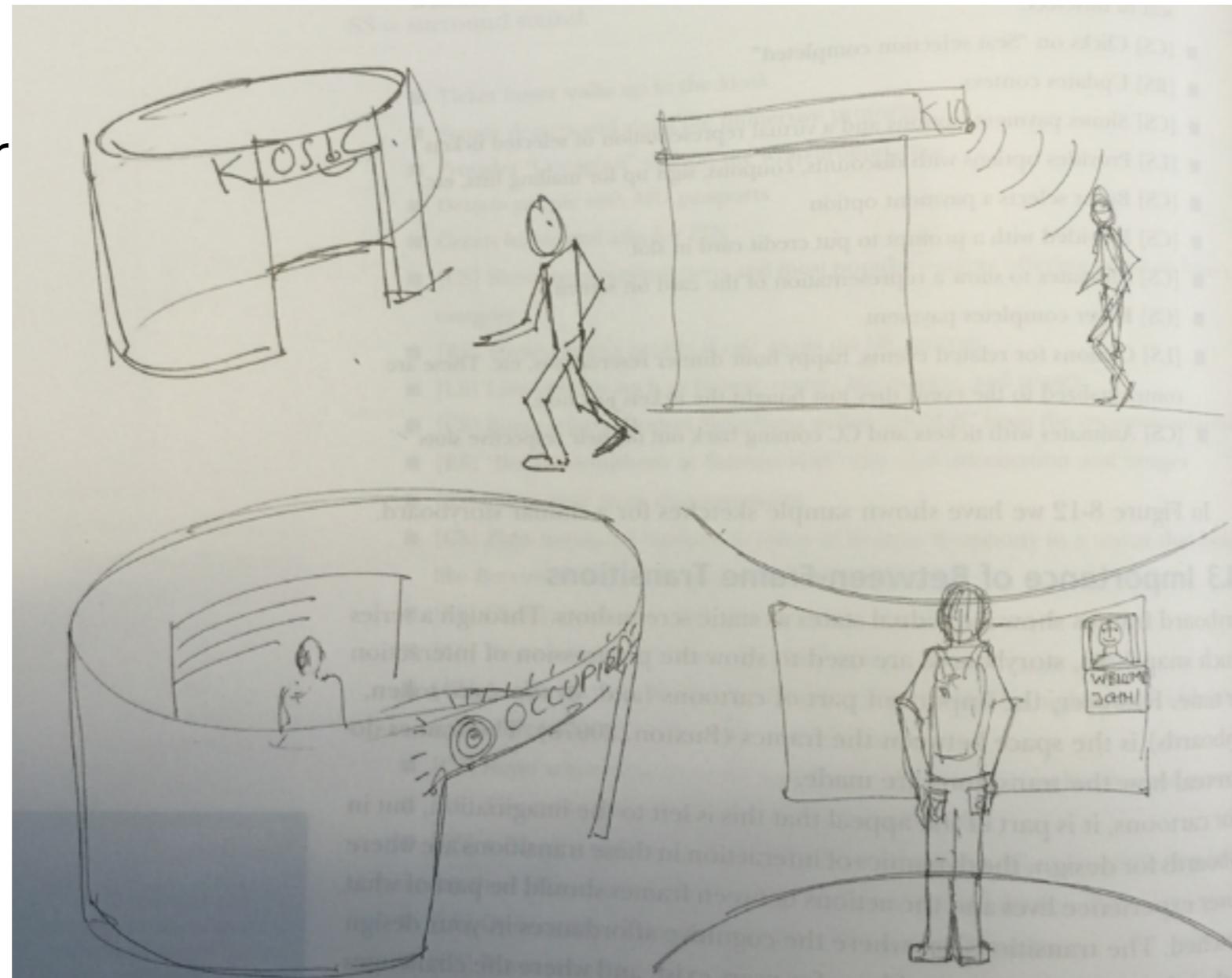
# Example elements of a UI storyboard

- Hand-sketched pictures annotated with a few words
- Sketch of user activity before or after interacting w/ system
- Sketches of devices & screens
- Connections with system (e.g., database connection)
- Physical user actions
- Cognitive user action in “thought balloons”

# Example: ticket kiosk

Ticket buyer walks up to the kiosk

Displays “Occupied” sign on wraparound case



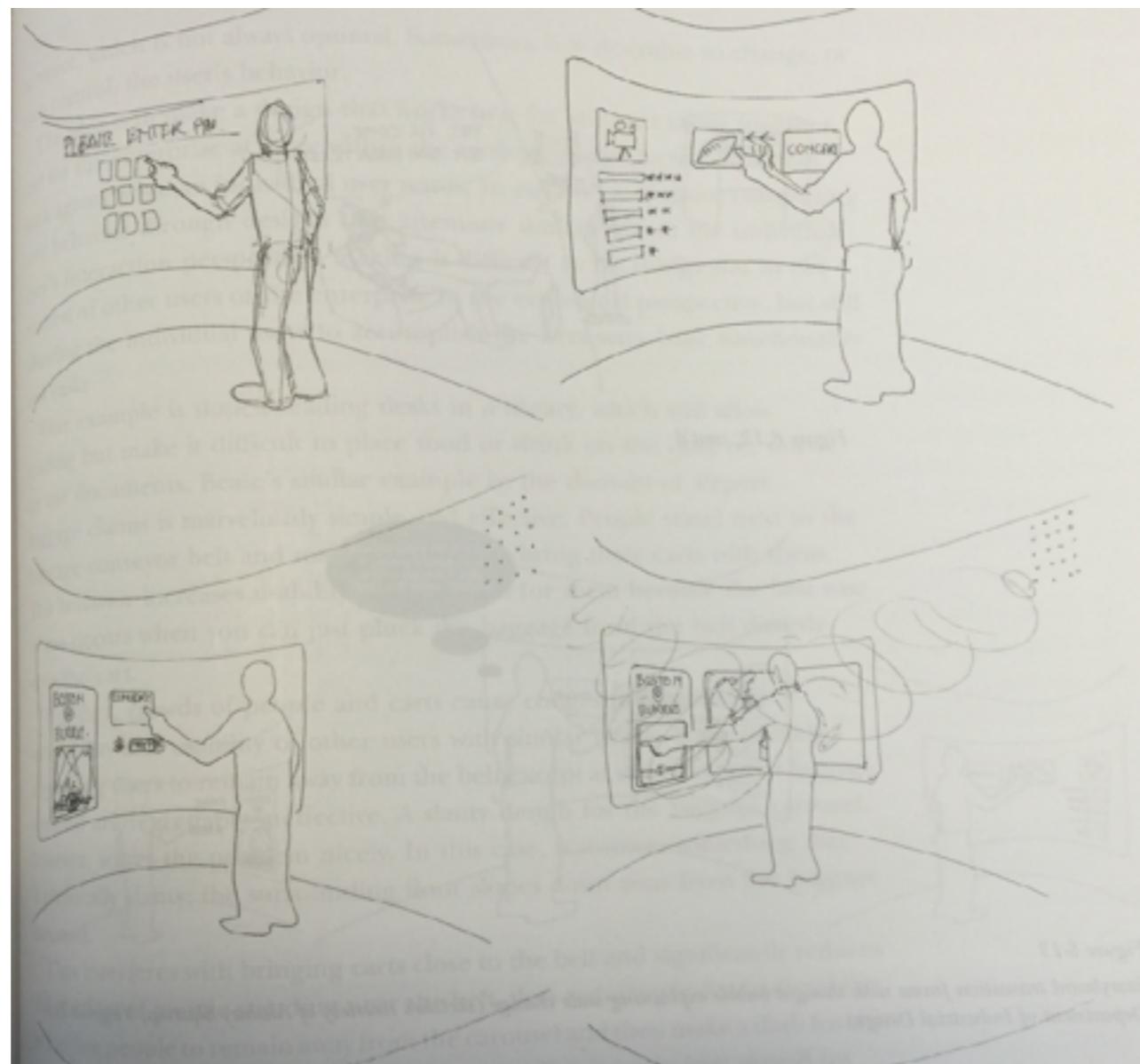
Sensor detects user & starts immersive process

Detects people with ID card

# Example: ticket kiosk

Greets buyer  
and asks for  
PIN

Buyer selects  
“Boston  
symphony at  
Burruss Hall”



Shows  
recommendations  
& most popular  
categories

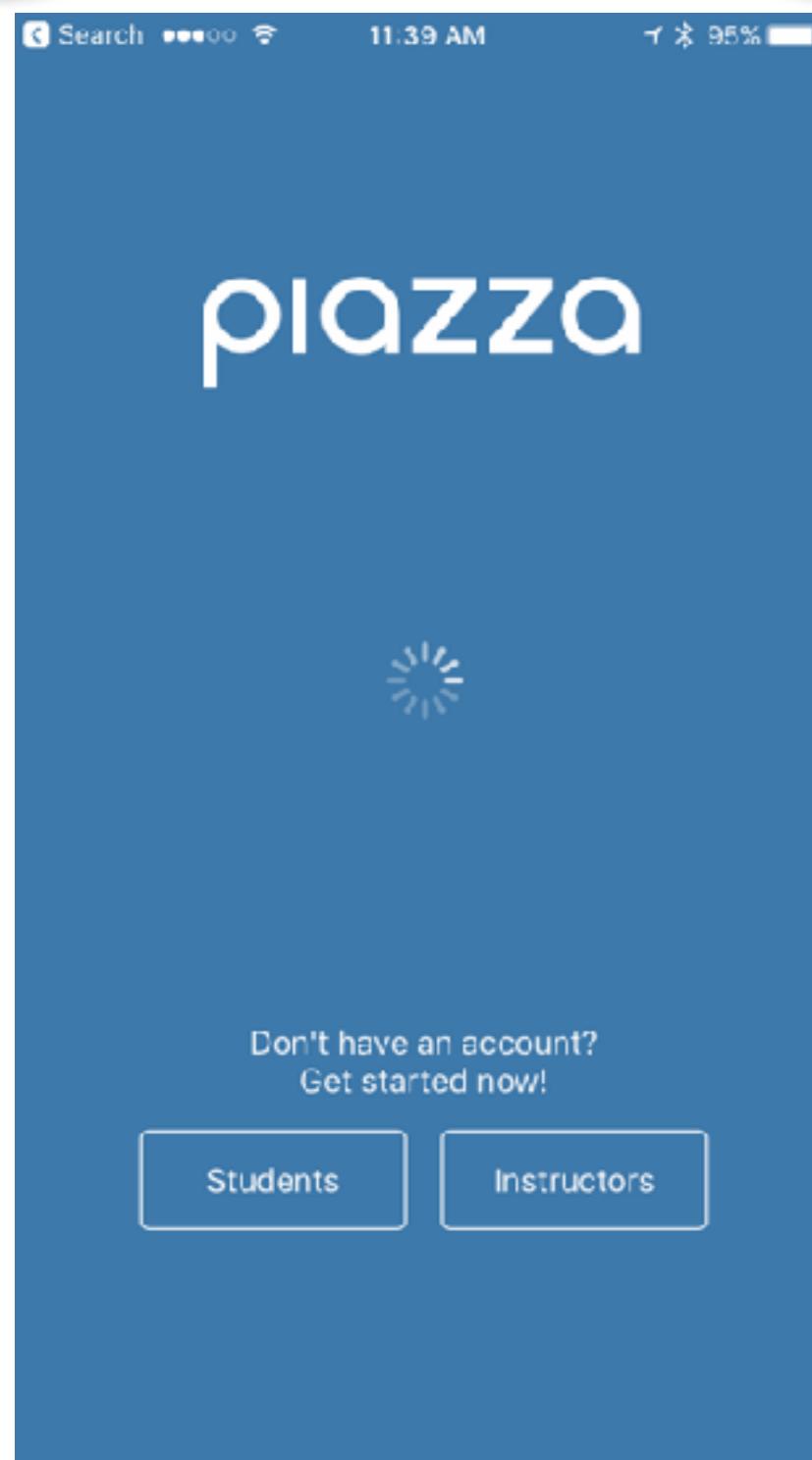
Plays music  
from symphony,  
shows date &  
time picker

# Frame transitions

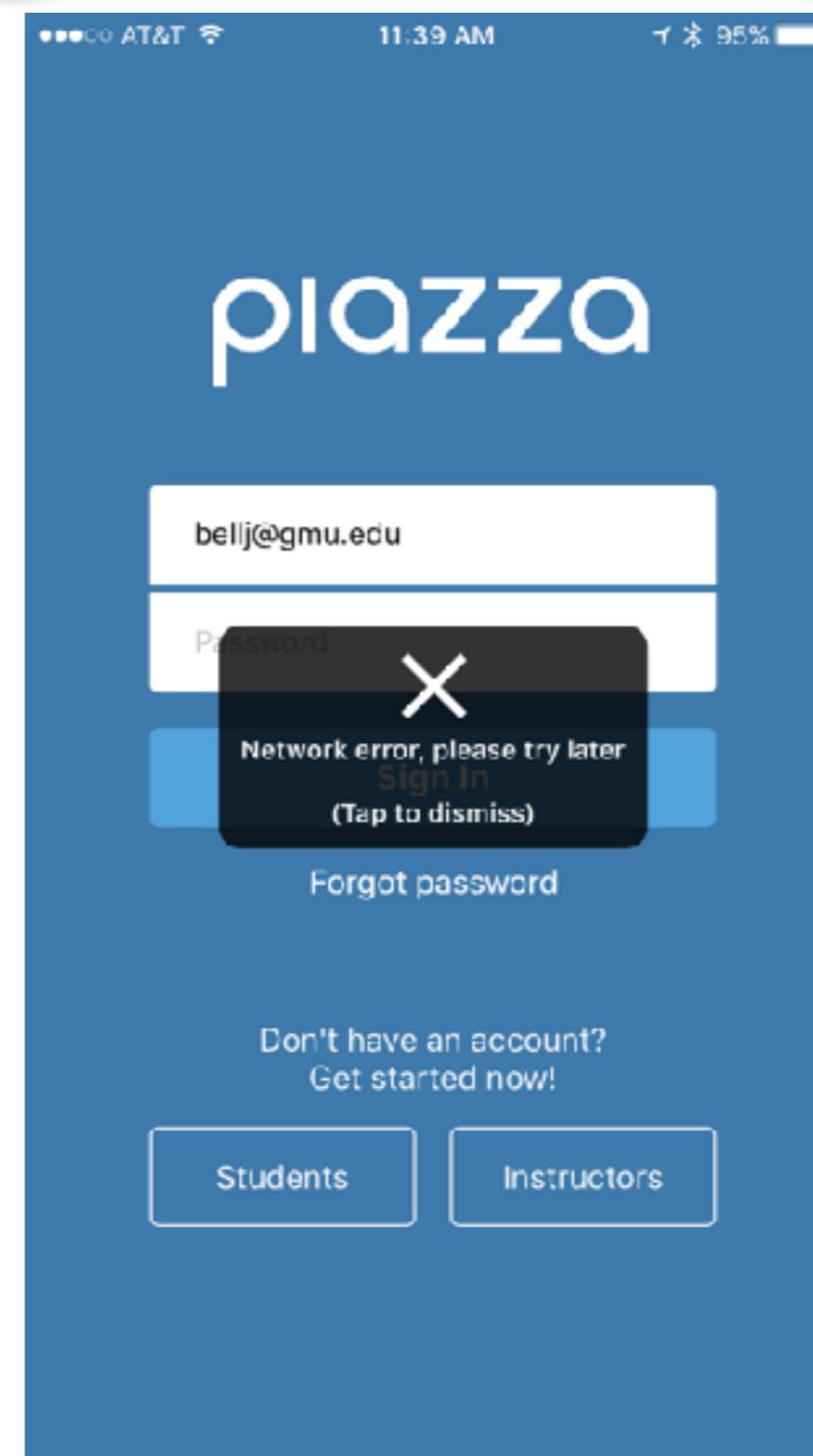
- Transitions between frames particularly important
- What users think, how users choose actions
- Many problems can occur here (e.g., gulfs of execution & evaluation)
- Useful to think about how these work, can add thought bubbles to describe

# Storyboarding Fail

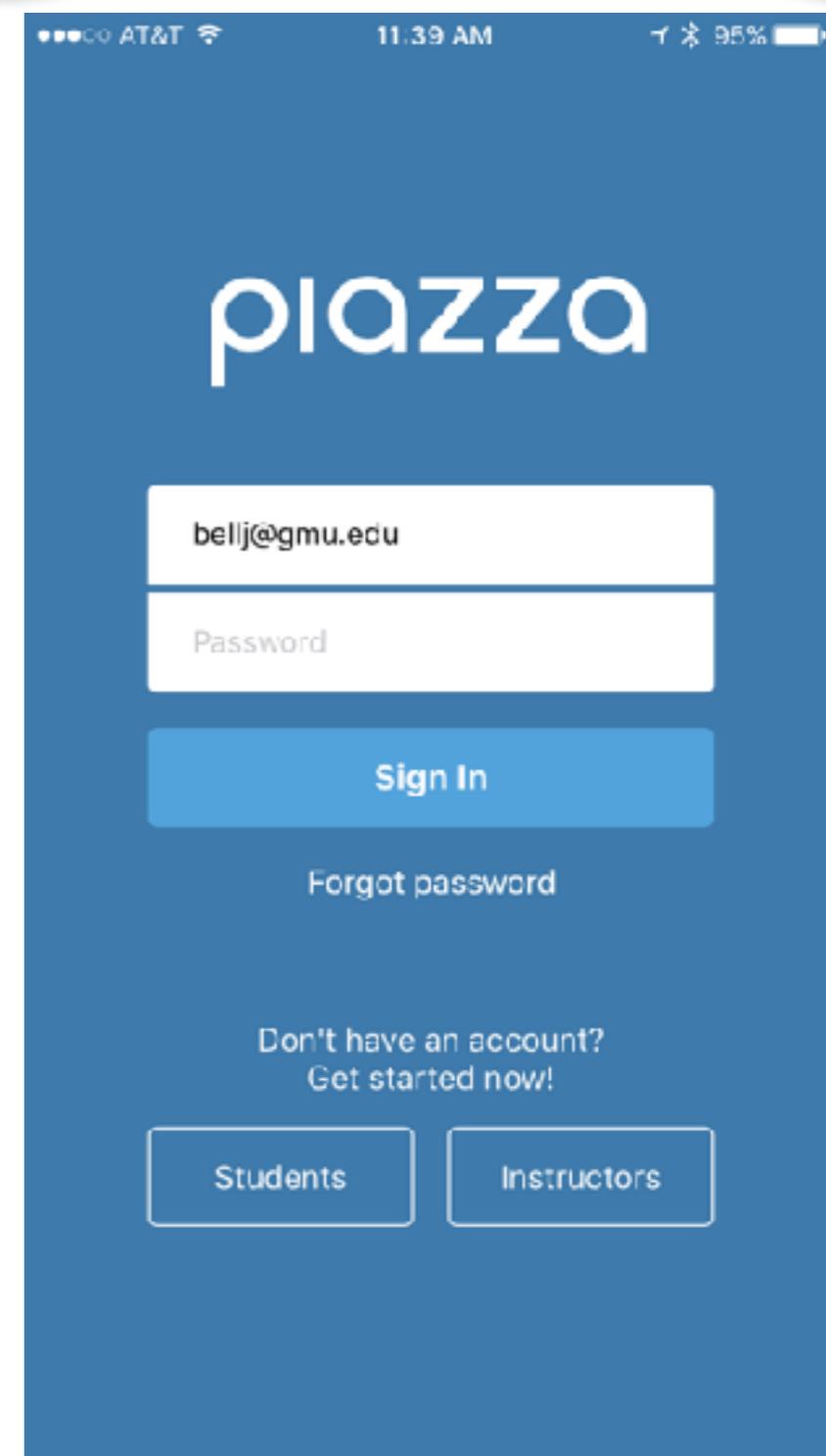
1: Auto-login to Piazza app



2: Network error



3: Asked for password

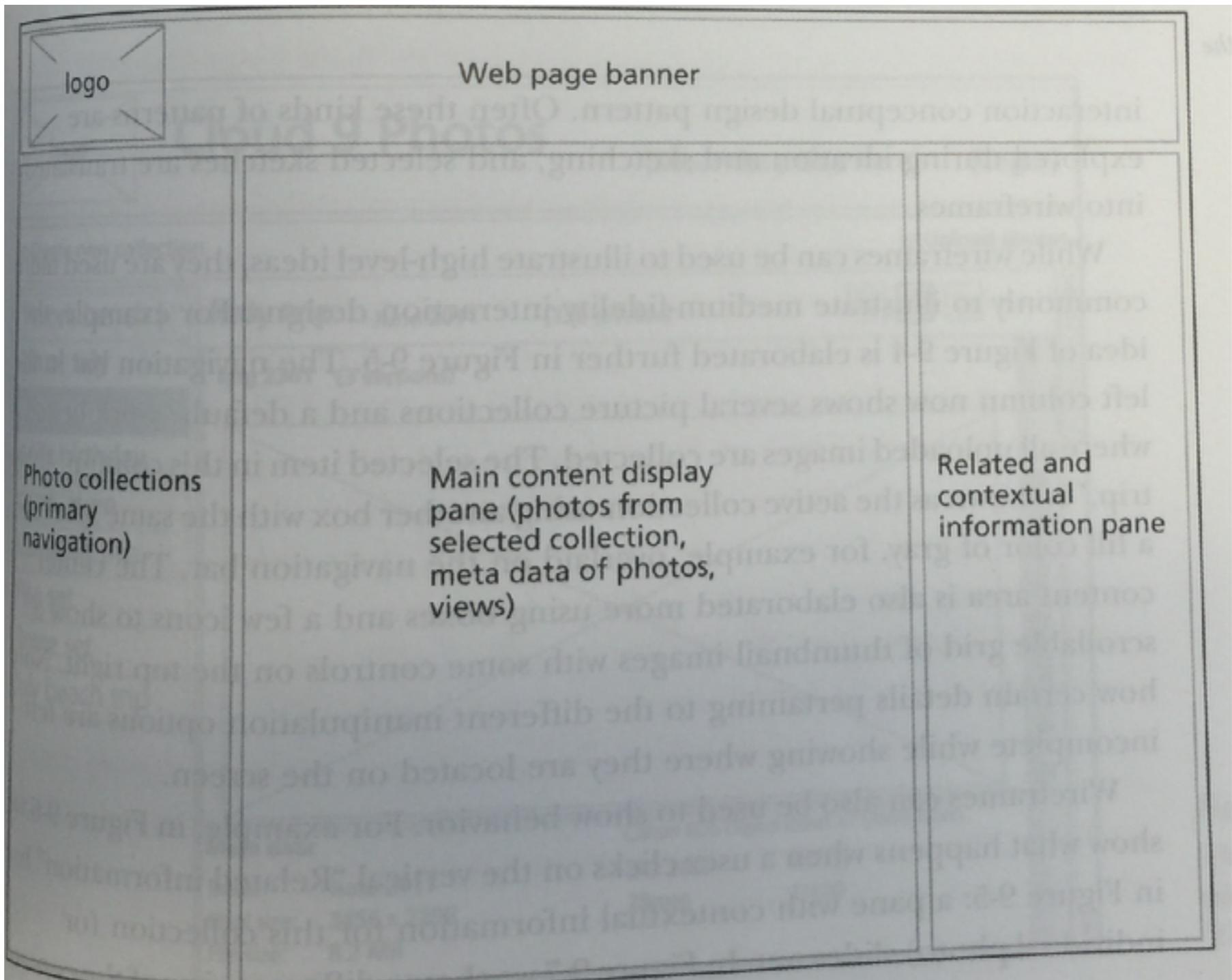


# Wireframes

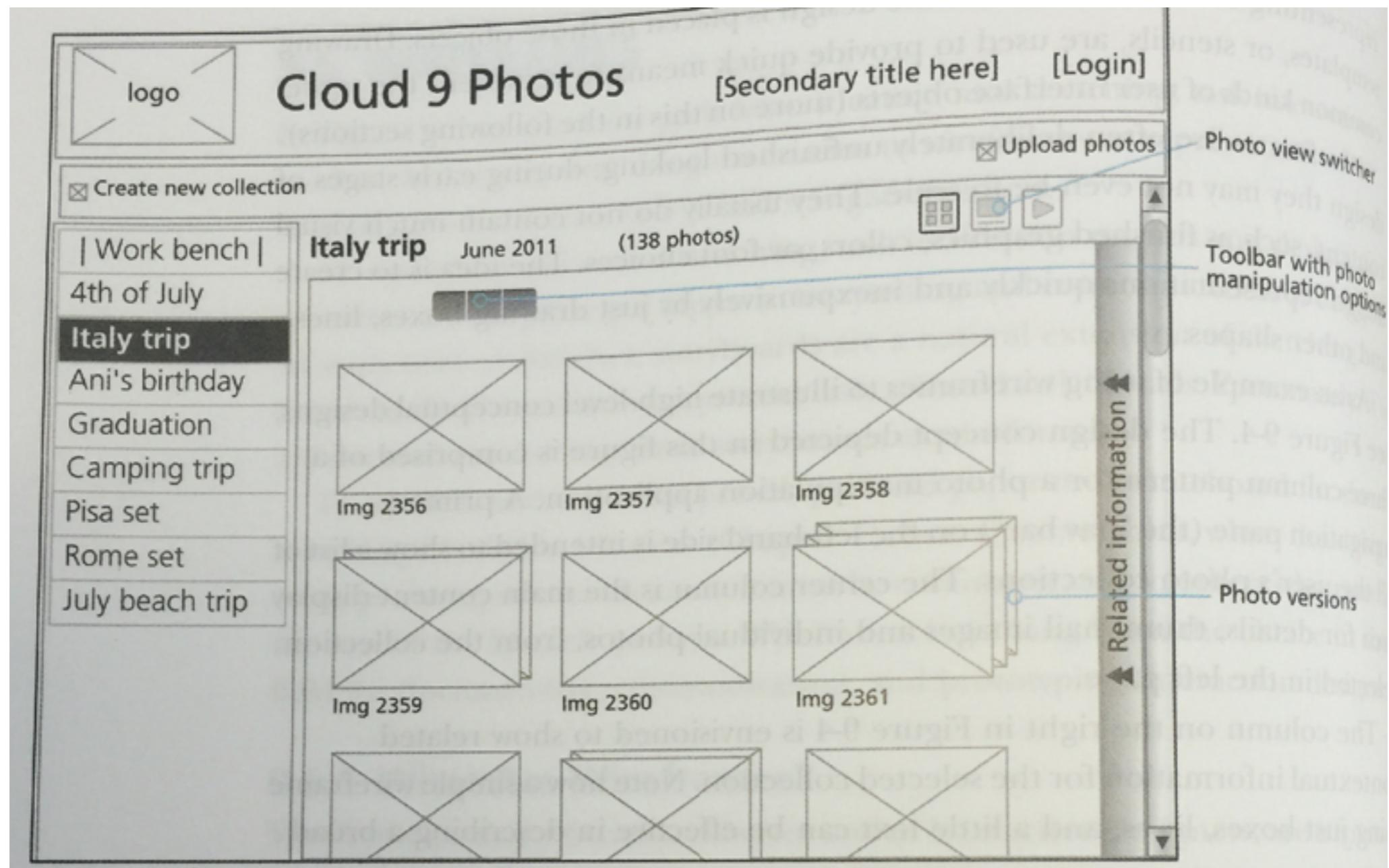
# Wireframes

- Lines & outlines (“wireframes”) of boxes & other shapes
- Capturing emerging interaction designs
- Schematic designs to define screen content & visual flow
- Illustrate approximate visual layout, behavior, transitions emerging from task flows
- Deliberate unfinished: do not contain finished graphics, colors, or fonts

# Example



# Example



# Wireframes

- Can be used to step through a particular scenario
- Focus on key screens rather than every screen
- Tools can help
  - Can be made clickable
  - Can use stencils & templates; copy & edit similar screens

# Example tool - Balsamiq

The screenshot shows the Balsamiq Mockups application interface. At the top is a menu bar with options like Project, Edit, View, Help, and a Quick Add button. Below the menu is a toolbar with various icons. The main area is divided into sections: UI Library, Canvas, and Project Browser.

**UI Library:** This section contains a grid of UI components. Labels include: Breadcrumbs, ComboBox / Pull..., Data Grid / Table, Icon and Text La..., Label / String of ..., Link, Link Bar, Navigat..., List, and Menu. A large icon labeled "UI Library" is centered above the grid.

**Canvas Examples:**

- Top Canvas:** Shows a horizontal button bar with four buttons labeled "Button One", "Button Two", "Button Three", and "Button Four". A callout bracket groups this with the "List" component in the UI Library. Below the button bar is a rounded rectangle labeled "Canvas".
- Bottom Canvas:** Shows a horizontal table with four columns, each containing a "Label". A callout bracket groups this with the "Data Grid / Table" component in the UI Library.

**Project Browser:** On the right side, there is a sidebar titled "Project Browser" containing a list of UI design concepts, each with a small preview icon:

- Buttonbar and Container
- iPhone Customizable Background
- Overlay to add fill to form elem...
- Using Dingbats in Text Compon...
- Datagrid Widths
- Pivot Table
- PDF Export Options
- Color macro
- Icon Placeholder
- Dingbats with color macros
- Dialog with Fill Using Overlaid Re...
- iPhone Picker with Dates
- Indicating continuation of elem...
- Using Nested by cont...
- Table with Headers in First Column
- Creating...
- X and Check Icons
- Multiple selection in tree pane
- Check List
- Custom iPhone-style Dialog
- Rounded corner table border
- Big Vertical Scroll Bar
- Rectangle fill on iPhone Menu
- Button states and fills
- Winforms Datagrid Example
- Grid Grouping
- Table Cell and Row Styling Techn...
- Smartphone Bootstrap Header
- Multi-row tabs
- Splitter Color Overlay
- Dashed Rulers
- touch interactions
- checkbox shape

# Prototyping

# Prototyping

- How do you know your system design is right before you invest the time to build it?
- Answer: prototyping!
  - Evaluation performed **before** investing resources in building finished product
  - Early version of system constructed much **faster** & with less expense used to evaluate & **refine** design ideas

# Fidelity of prototypes

Kind of Iteration	Purpose	Types of Prototypes
Ideation and sketching	To support exploring ideas, brainstorming, and discussion (so design details are inappropriate)	Sketches, fast and disposable mockups, ultralow fidelity
Conceptual design	To support exploration and creation of conceptual design, the high-level system structure, and the overall interaction metaphor	Evolution from hand-drawn paper, computer-printed paper, low-fidelity wireframes, high-fidelity wireframes, to pixel-perfect interactive mockups (to communicate with customer)
Intermediate design	To support interaction design for tasks and task threads	Evolution from paper to wireframes
Detailed design	Support for deciding navigation details, screen design and layout, including pixel-perfect visual comps complete specification for look and feel of the "skin"	Detailed wireframes and/or pixel-perfect interactive mockups
Design refinement	To support evaluation to refine a chosen design by finding and removing as many UX problems as possible	Medium to high fidelity, lots of design detail, possibly a programmed prototype

# Interactivity of prototypes

- Scripted, click through prototypes
  - Prototype w/ **clickable** links to move between screens
  - Live action storyboard of screens
  - Simulates real **task flow**, but w/ static content
- Fully-implemented prototypes
  - Usually **expensive** to implement actual system
  - But can build key piece of system first to evaluate

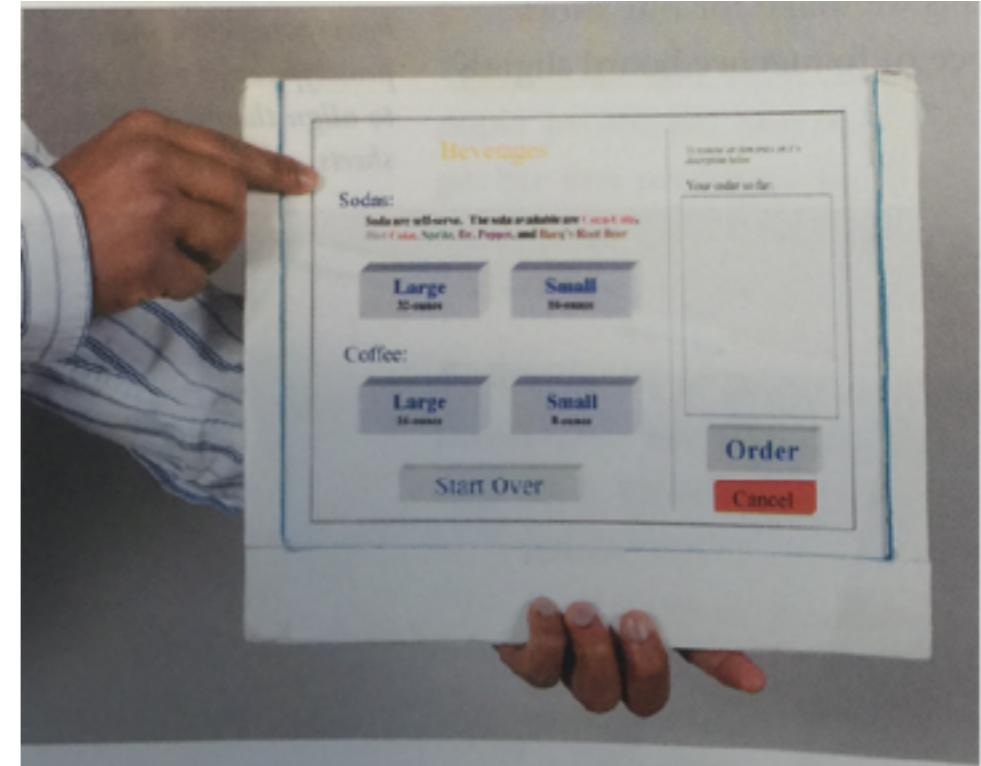
# Wizard of Oz

- Goal: **simulate** actual system w/ out building it
  - Want user to interact **as if** they were interacting w/ real system
  - Helps explore how users would interact w/ novel interaction if it were to exist
- Example: natural command line (Good et al 1984)
  - Users typed in commands to interact w/ computer
  - Commands intercepted by hidden human who interpreted commands & executed them

# Paper prototypes

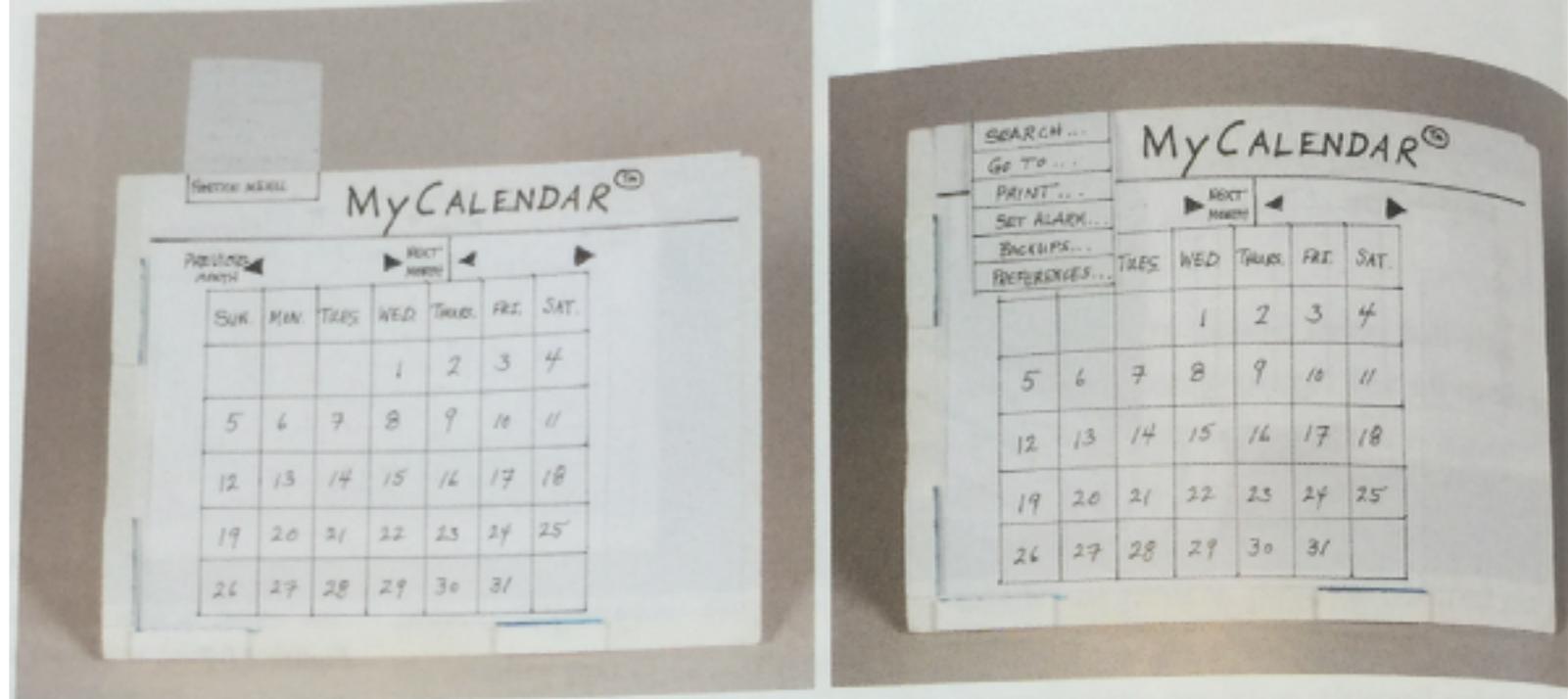
- **Low fidelity** prototype w/ paper mockups
- Goal: get feedback from users early w/ very low cost interactive prototype of envisioned interaction design

# Paper prototyping (1)



- Set a realistic deadline
- Gather set of paper prototyping materials
- Work **fast** & do not color within the lines
- Reuse existing sketches & mockups
- Make underlying paper mockups of key screens

# Paper prototyping (2)



- Use paper cutouts & tape onto full-size transparencies as “interaction sheets” for moving parts, making modular by including only a small amount
- Do not write or mark on interaction sheets
- Be creative
- Reuse at every level
- Cut corners wherever possible (trade accuracy against efficiency)
- Make a “this feature not implemented” message

# Paper prototyping (3)

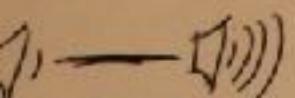


- Include “**decoy**” user interface objects not needed for expected tasks
- Accommodate data value entry by users w/ blank transparencies
- **Organize** materials to manage complex task threads
- **Pilot** test thoroughly

? Help

video Stage

Currently listening to



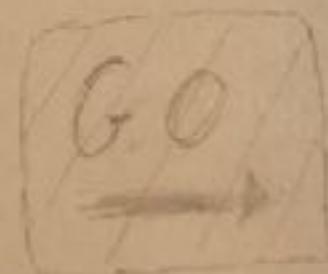
MASTER CONTROL

Enter a search...

Welcome to videoStage!

- ① Enter a search term above.
- ② Click on a video to select it.
- ③ Click **GO** to send selected videos to the stage.

FAVORITES



SEARCH

Help

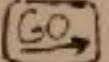
Currently listening to

video Stage

MASTER CONTROL

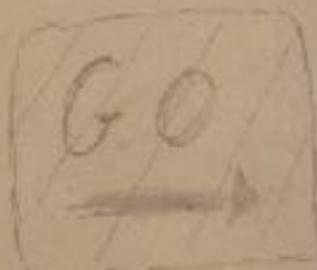
Enter a search...

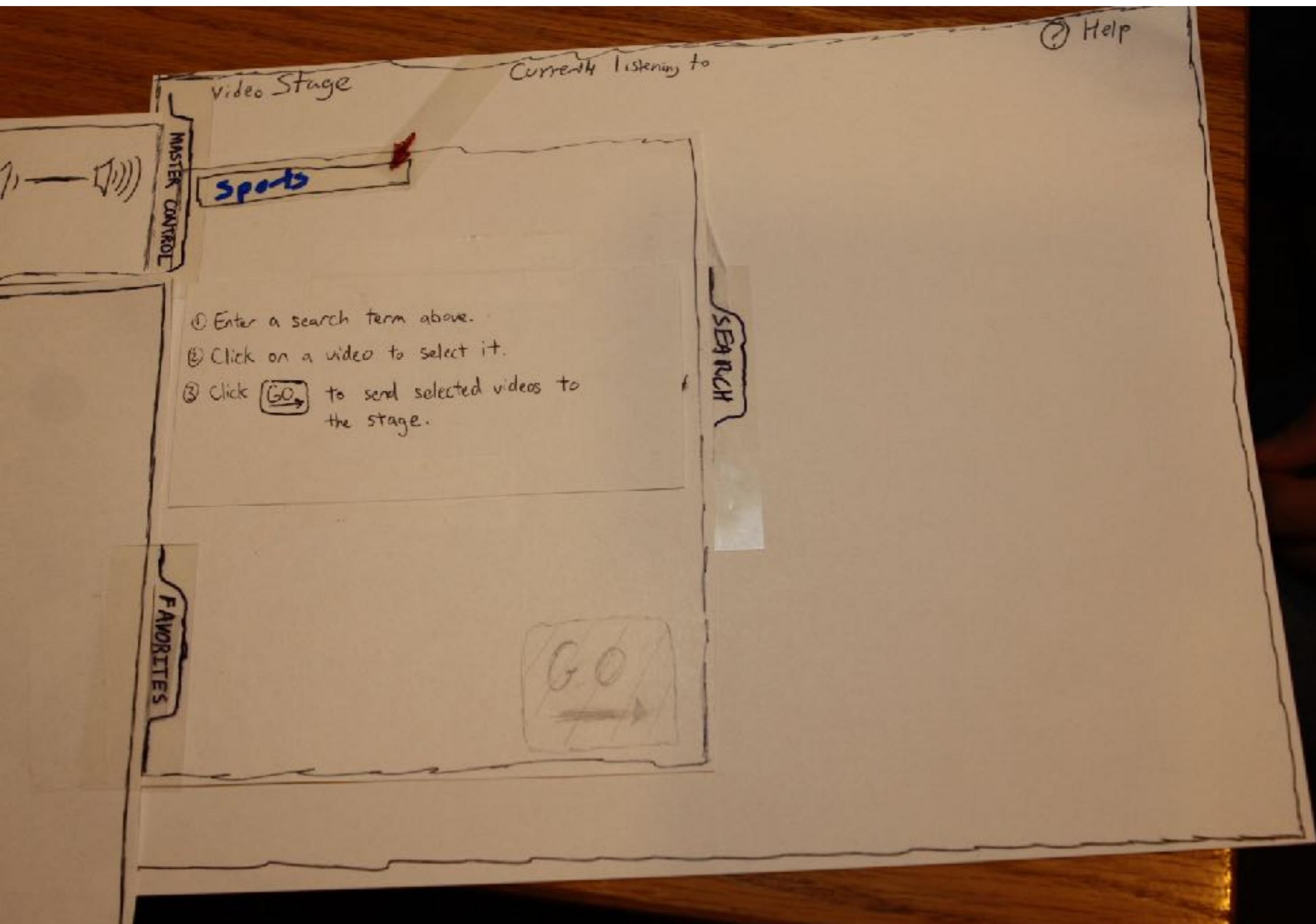
Welcome to videoStage!

- ① Enter a search term above.
- ② Click on a video to select it.
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FAVORITES

SEARCH





Help

Currently listening to

Video Stage

MASTER CONTROL

sports



at

se

selected videos to

e.



NBATV



Father LFTV



weather

FAVORITES



SPY SAFARI



SEARCH

Help

Currently listening to

video Stage

MASTER CONTROL

Sports



NBATV

Added videos to



[Football 4x4]

(weather)

FAVORITES



[Spy Satellite]



SEARCH







# Advantages of prototyping

- Offers concrete baseline for communication between users & designers
- Provides conversation “prop” to communicate concepts
- Allows user to “take design for a spin”
- Give project visibility & buy-in with customers
- Encourage early user participation and involvement
- Give impression that design is easy to change
- Afford designers immediate observation of user performance & consequences of design decisions

# Conceptual Design of Transit Card Vending

- Design an interface for a machine that vends transit cards
- The machine accepts cash, coins, and credit cards
- The machine sells and reloads transit cards
- Transit cards can be loaded with:
  - Passes - valid for unlimited travel in the given period (1,7,30 days)
  - Value - Direct proxy for cash, used to pay fares
- Things to think about:
  - How does user decide to reload vs buy new card?
  - Can a card have both value and a pass on it? How does that work?