PROTOTYPING:
LOW TO HIGH FIDELITY PROTOTYPING

690A- Advanced Methods in HCI

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Slides from Prof. Joanna McGrenere and Dr. Leila Aflatoony
Includes slides from Prof. Karon MacLean and Jessica Dawson

TODAY

- Conceptual design vs. interface design [5 min]
- Prototyping [30 min]
  - Low fidelity
  - Medium fidelity to high fidelity
- In class activity [20 min]
- Discussion of readings [15 min]

LEARNING GOALS

- understand different types of prototyping, purpose and characteristics of each.
- list dimensions of prototyping fidelity and explain how these dimensions may vary;
- explain how these dimensions might differ in low to med to high fidelity prototypes, and give examples of when/why you may use each type
- make strategic choices about prototyping tools given your goals and constraints; be able to justify your choice.

review

CONCEPTUAL MODELS & CONCEPTUAL DESIGN:

- conceptual model = the **foundation** of the interface. different user interfaces could be built upon it.
- ***interface design* translates the CM** into things we can see and interact with. It involves design choices, but must stay faithful to the concepts and terminology of the CM.

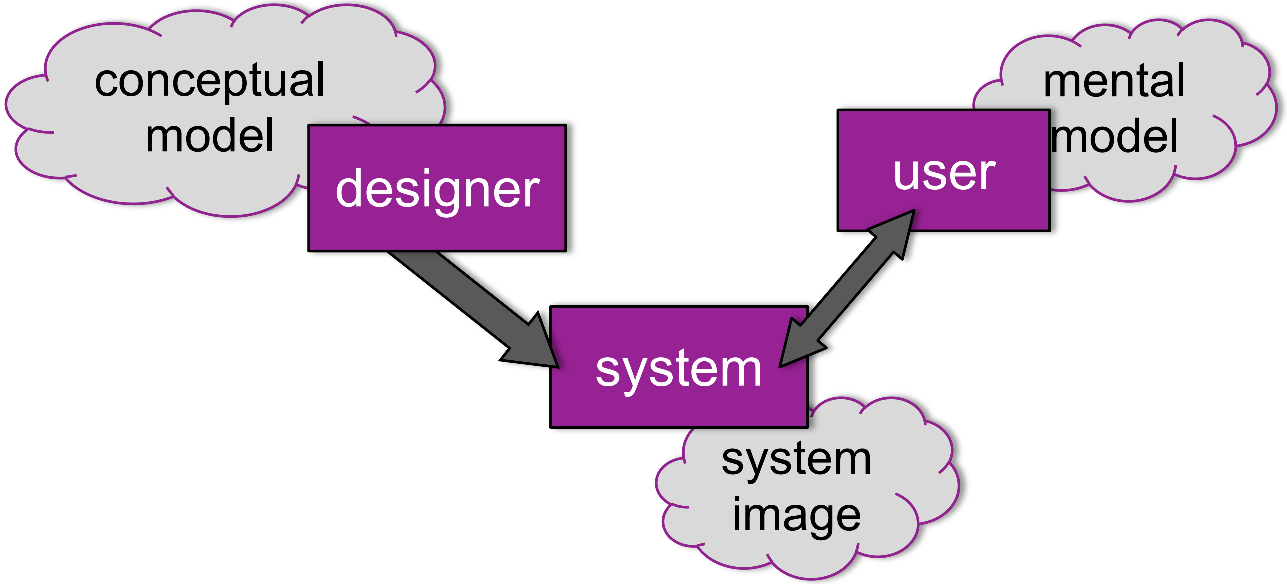
review

CONCEPTUAL DESIGN IS:

- designing systems so users can understand them
- assisting the user to build useful mental models

interface design is:

- representing the CM to the user



review

FROM CONCEPTUAL MODELS TO INTERFACE DESIGN

Interface design goal is to communicate your conceptual model

problem:

- *designer's* conceptual model is communicated via **system image**':

  interface, appearance, instructions, system behavior through interaction

- if system image does not make model clear and consistent:

  → user's mental model will be inconsistent with conceptual model

HOW TO GET STARTED ON INTERFACE DESIGN?

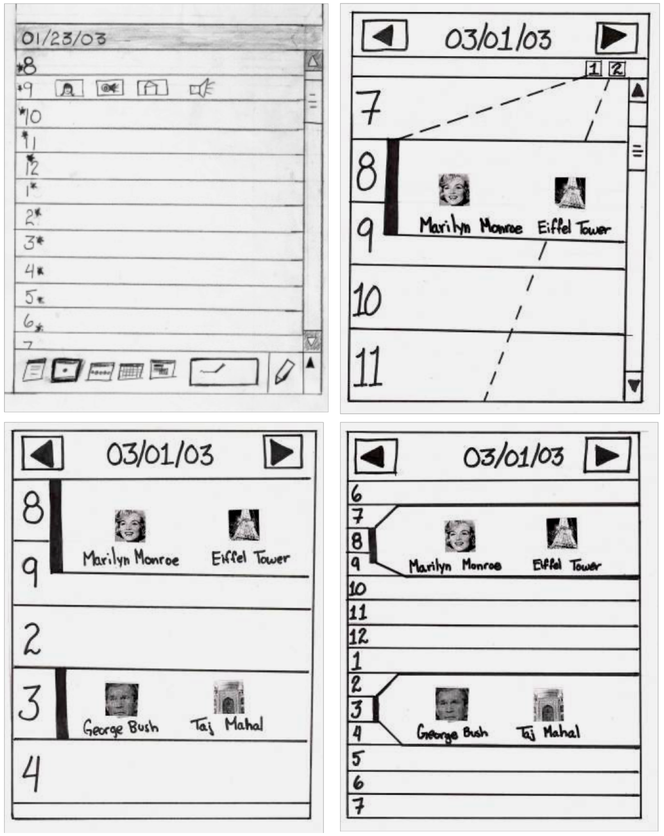
Prototyping!

WHAT IS A PROTOTYPE?

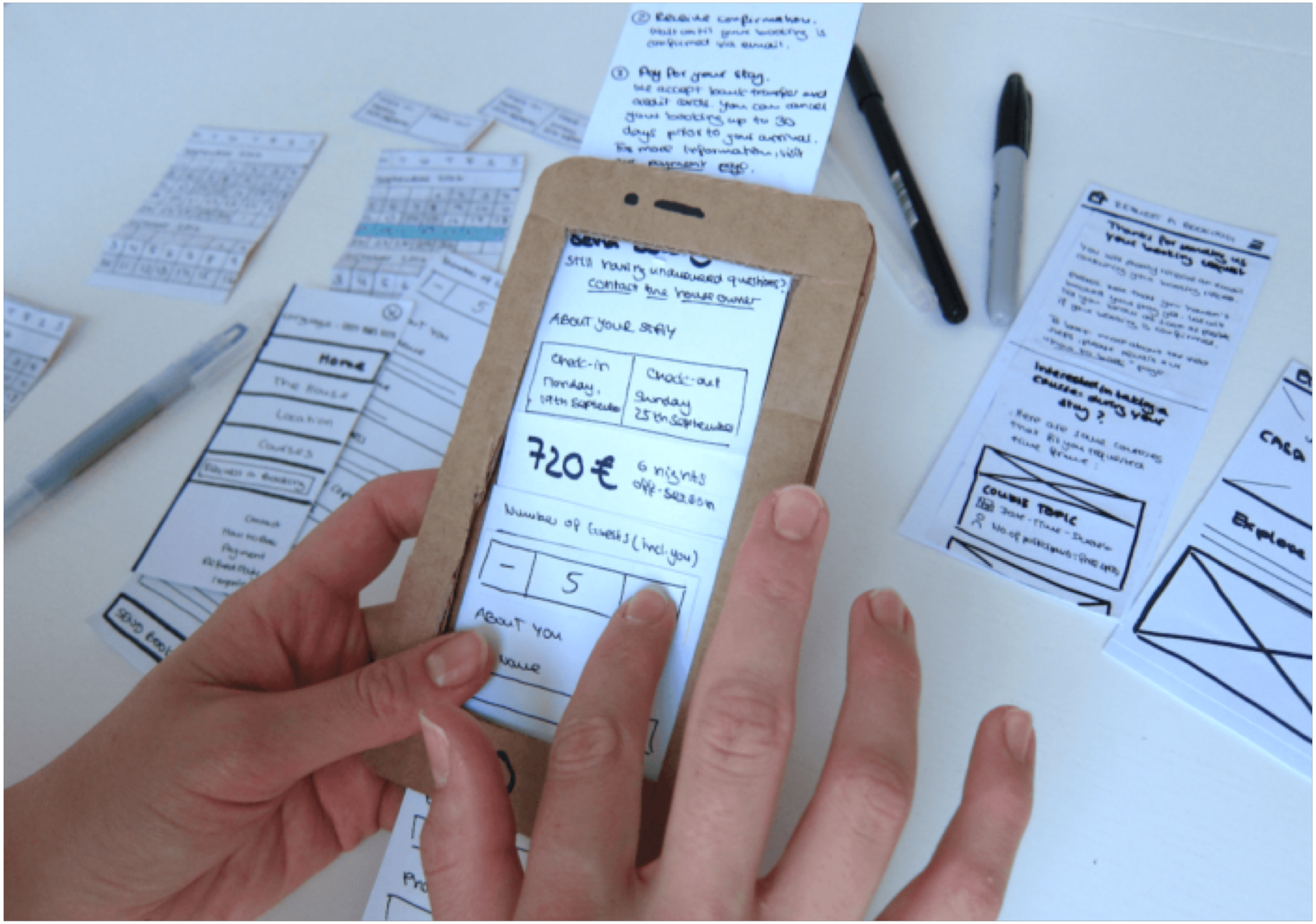
Representation of conceptual design for users (and designers, and other stakeholders) **to interact with**

prototypes take many forms:

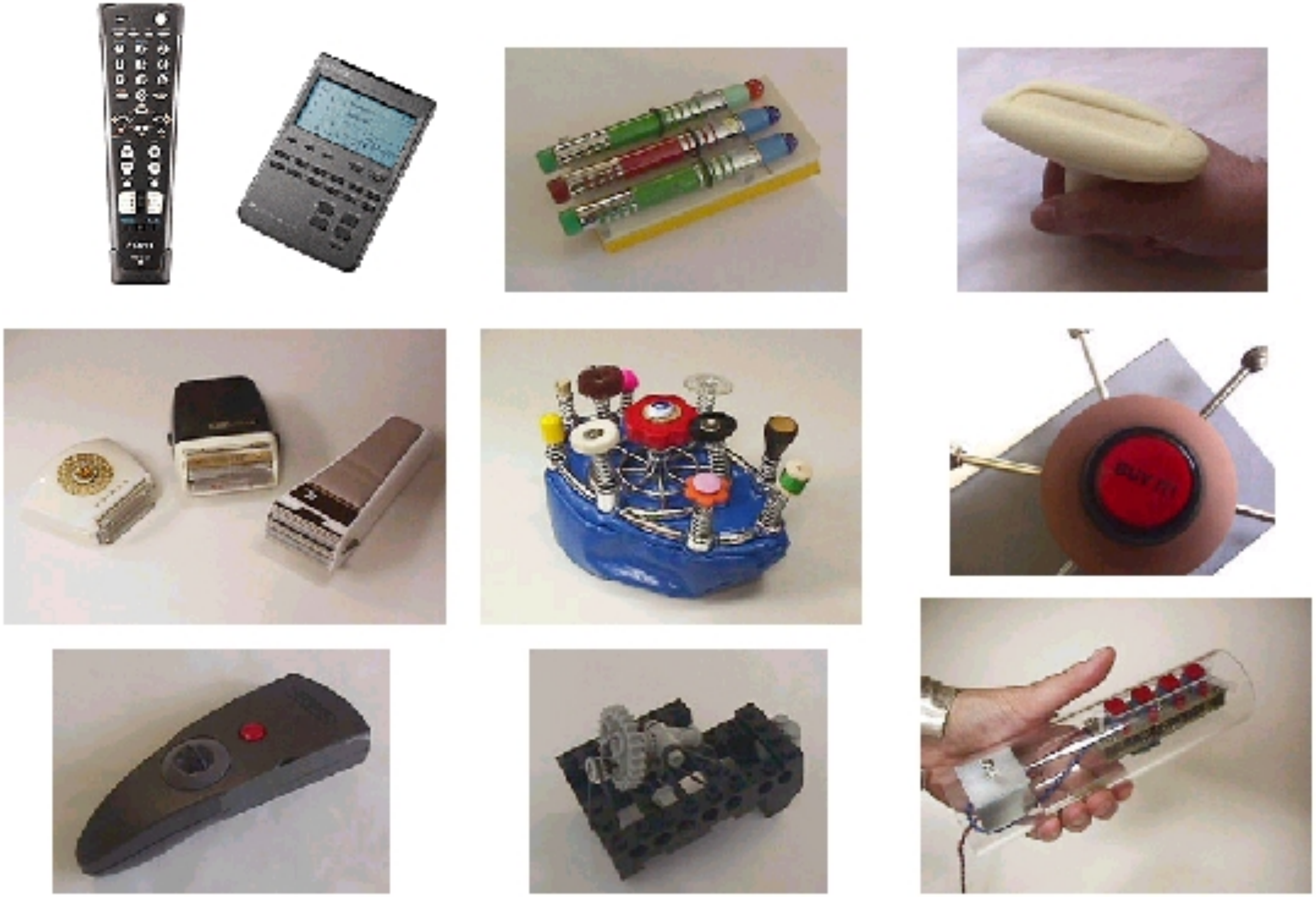
cardboard, foam, software, video, clay, paper, hidden people, website, sketches, scripts, index cards etc.



4 designs: image-enhanced planner


② Receive confirmation.
Wait until your booking is confirmed via email.
③ Pay for your stay.
We accept bank transfer and credit cards. You can cancel your booking up to 30 days prior to your arrival. For more information, visit the payment page.
Still having unanswered questions? Contact the house owner
About your stay
Check-in
Monday, 19th September
Check-out
Sunday 25th September
720 €
6 nights off-season
Number of Guests (incl. you)
–
5
About you
Name
Home
The House
Location
Courses
Thanks for sending us your booking request
Interested in taking a course during your stay?
Course Topic
Explore

HANDHELD "UNIVERSAL REMOTE CONTROL"



WHY PROTOTYPE?

communication: discuss ideas with stakeholders

- “Where’s the ON button?”

develop requirements and/or specifications

- “Uh-oh, here’s something we forgot.”

learning and problem solving

- “Hey, that will work!”

evaluate interface effectiveness for communicating conceptual model

- “Whoops, users didn’t understand that.”

further develop conceptual and physical design

- “That’s way too heavy”

save time and money

- Don’t waste time coding/building the wrong thing

many different kinds of goals and questions possible

QUESTIONS THAT *MIGHT* NEED PROTOTYPING TO ANSWER:

for example:

- screen too crowded? actions clear, or lost in clutter?
- knob versus slider for controlling volume

  much more involved for innovative physical interface

  … imagine the prototyping for the first iPhone!
- navigation: e.g.
  - transparent menu versus solid menu
  - how many files to show in file selection box

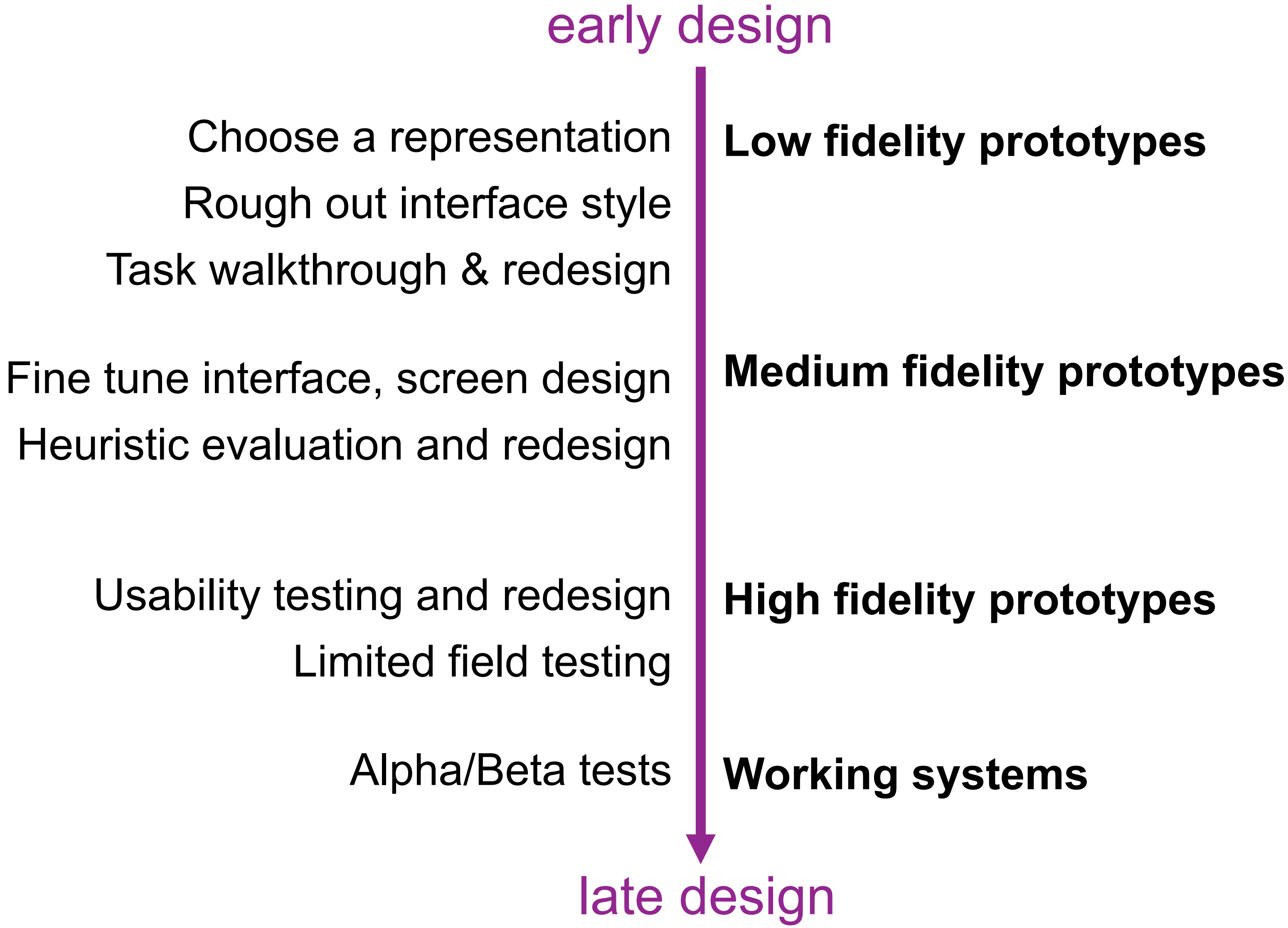
What STAGE of design would you want to establish this sort of question?

BEFORE YOU CAN PROTOTYPE

before you build, identify:

- users and tasks to build your prototype around
- requirements
- goals: questions your prototype(s) need to answer

WHEN TO USE DIFFERENT TYPES OF PROTOTYPES?



early design

Choose a representation
Rough out interface style
Task walkthrough & redesign

Low fidelity prototypes

Fine tune interface, screen design
Heuristic evaluation and redesign

Medium fidelity prototypes

Usability testing and redesign
Limited field testing

High fidelity prototypes

Alpha/Beta tests

Working systems

late design

LOW FIDELITY PROTOTYPES

meant to be rough, quick to build, easy to throw away

purposes

- proof of concept(s)
- rough (**but flexible**) interface design
- facilitate communication with users early on
    - can be useful for generating and narrowing requirements

BENEFITS OF LOW FIDELITY PROTOTYPES

cheap/easy to make

- try out and explore multiple conceptual models

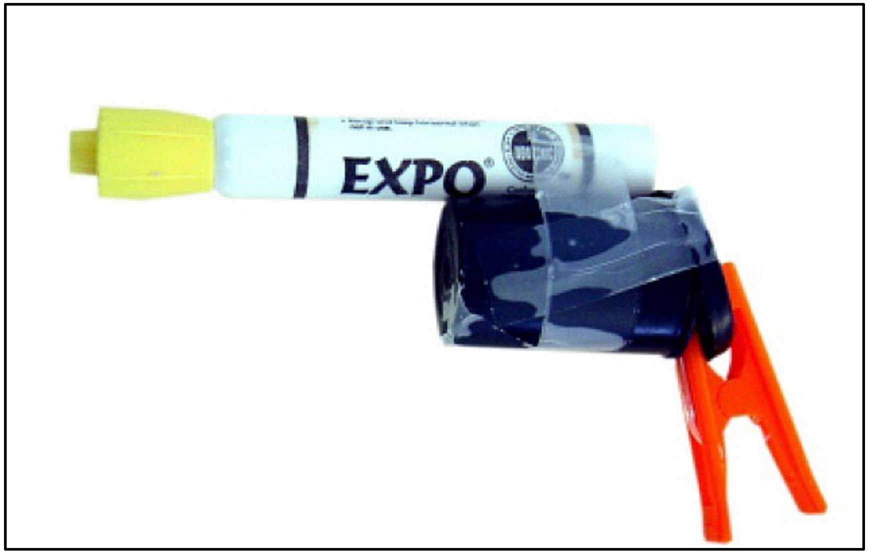
lack of polish less intimidating to users
this is surprisingly important

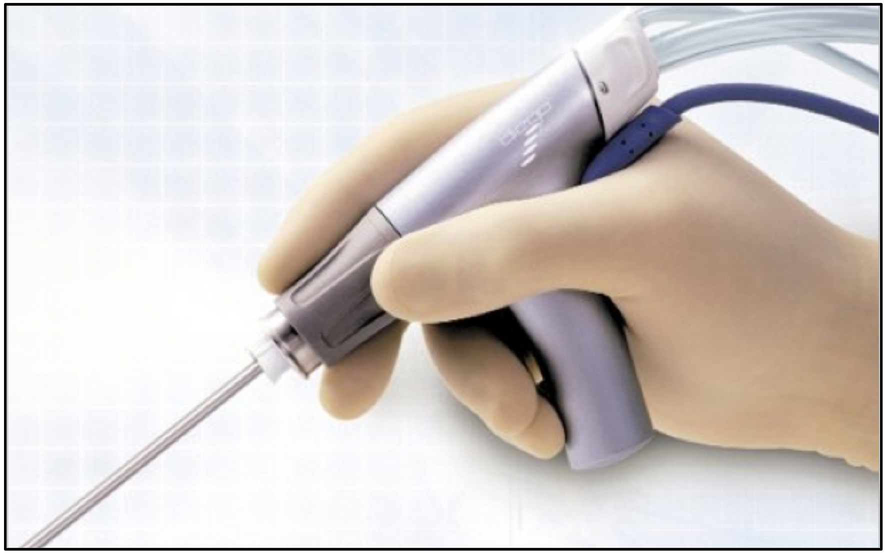
- more willingness to criticize
- inspires more creative feedback
- avoids nitpicky feedback

reduces effort invested by design team

- so easier to make changes, start over

IDEO SURGICAL TOOL PROTOTYPE





APPROACHES TO PROTOTYPE/PRODUCT INTEGRATION

throw-away

- prototype only serves to elicit user reaction
- creating prototype must be **rapid**, otherwise 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
- eventually becomes the final product

APPROACHES TO ‘SCOPING’ PROTOTYPE FUNCTIONALITY

most relevant for low- and med-fi prototypes (when scope is limited)

vertical prototype

- includes in-depth functionality for only a few selected features
- key design ideas can be tested in depth

horizontal prototype

- surface layers only: includes the entire user interface with no underlying functionality
- a simulation; no real work can be performed

prototype scenario

- scripts of particular fixed uses of the system; no deviation supported
- *see* whole thing (fake)
- *use* implemented
  small part of it.

PAPER PROTOTYPING

common low fidelity technique

popular in industry . . .

despite prevalence
of ‘mockup’ software
tools

because: easy to

- *build*
- *alter on the fly*
- *show*
- *stick on wall & compare*
- *discuss*

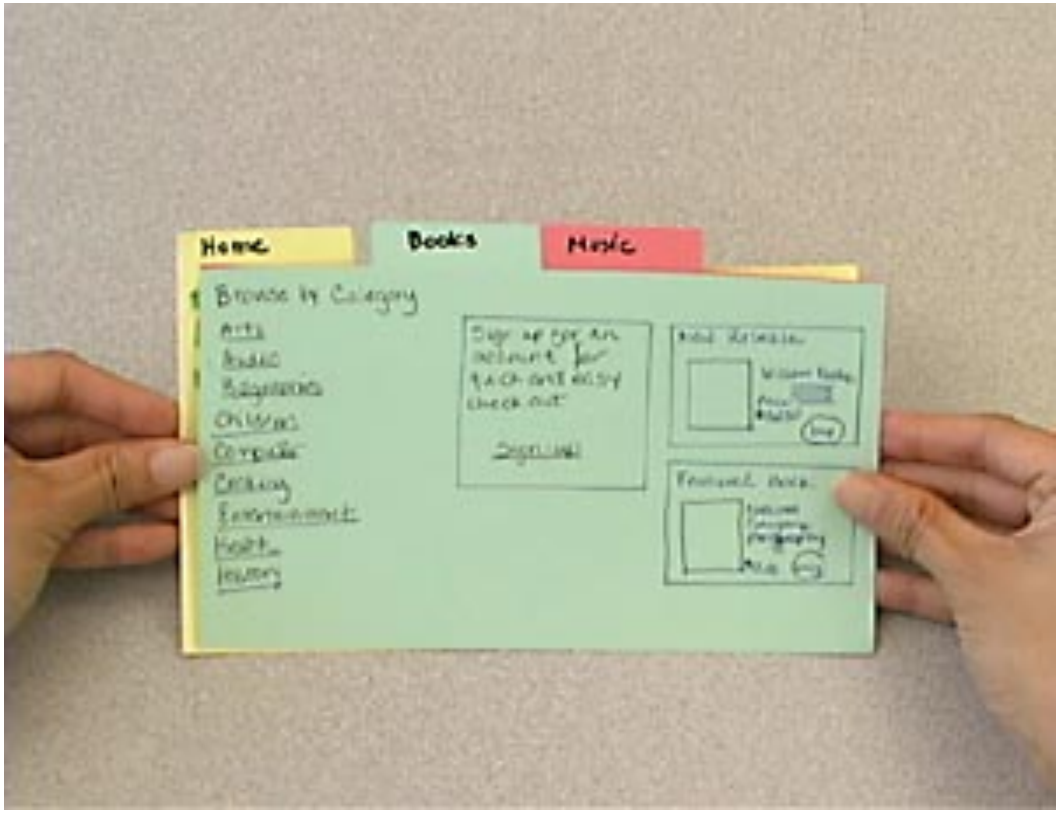


photo: http://hci.stanford.edu/courses/cs247/2009/handouts/paper-2009-exercise.html

PAPER PROTOTYPING MATERIALS

interface elements/screens created on paper

- or other ‘easy to throw away or modify’ materials, e.g.,
  - whiteboard, magnetic taps, transparencies

can incorporate other things that people interact with in completing their task, e.g:

- other people
- hardware

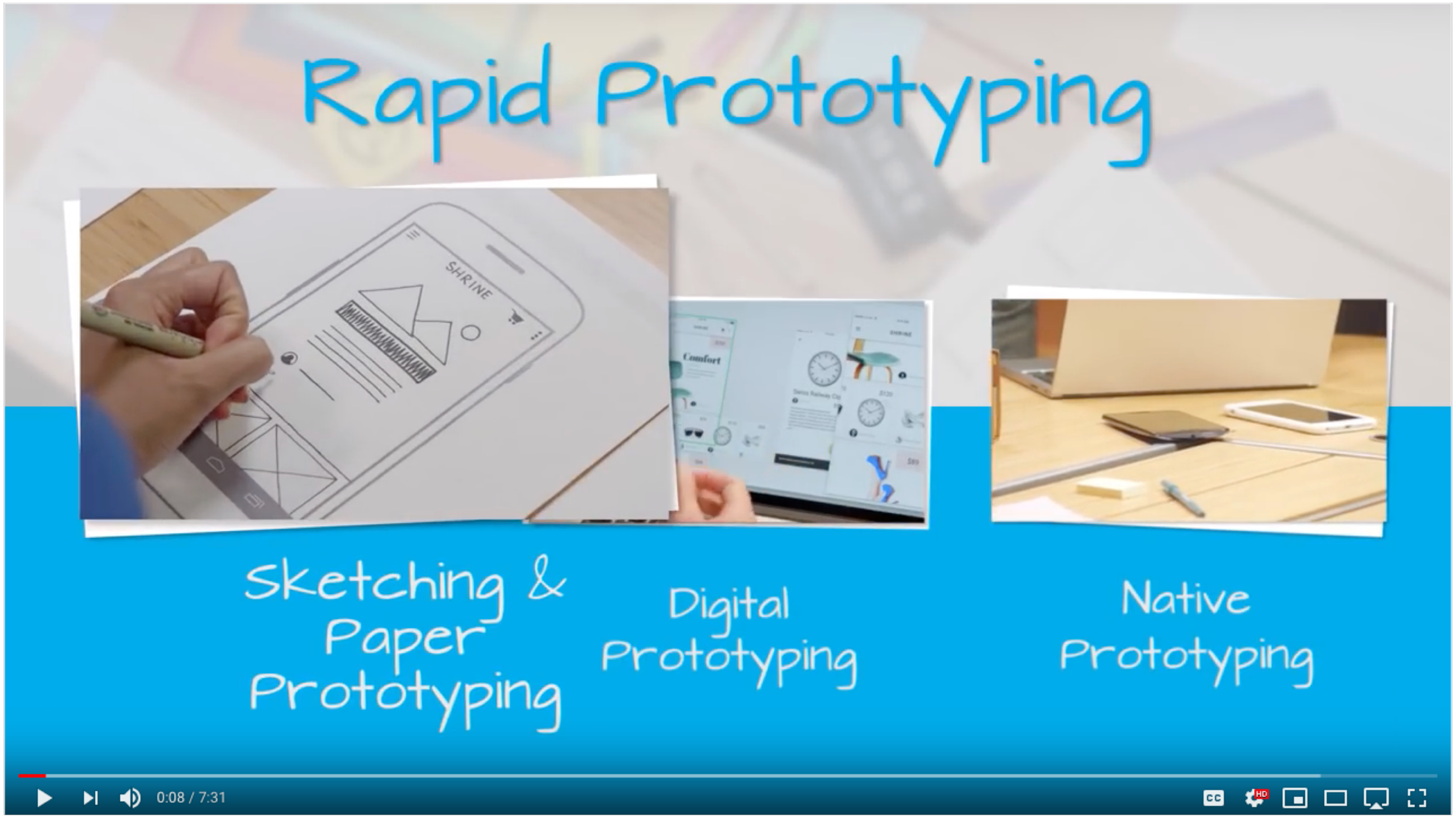
SIMULATING INTERACTIONS IN PAPER PROTOTYPING

can simulate relatively sophisticated interactions

- complex/subtle interactions won’t be perfect
- requires some imagination on users part
- *forces you to stay in “early design” mode*

with some creativity, can mockup almost any kind of widget or interaction

RAPID PROTOTYPING 1 OF 3: SKETCHING & PAPER PROTOTYPING

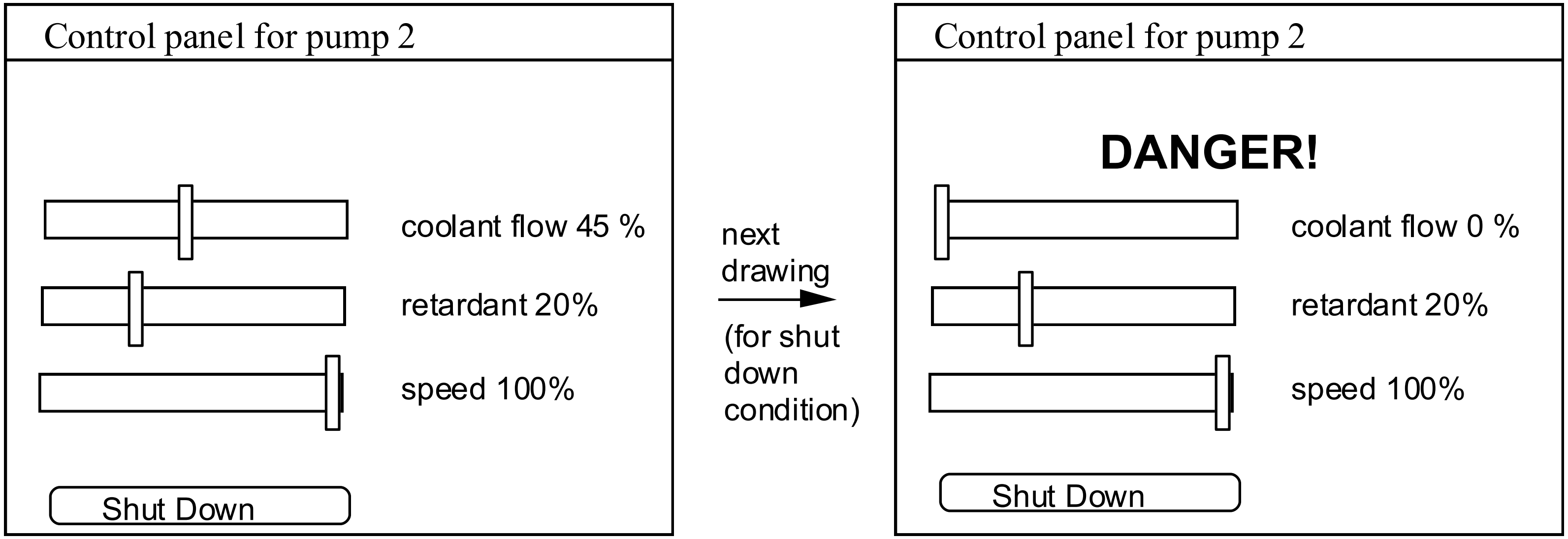


https://www.youtube.com/watch?v=JMjozqJS44M

TECHNIQUE: DIGITAL STORYBOARDS

elements aren’t active: like paper prototype, but on screen

- draw each storyboard scene on computer
  - use wire framing/mockup software (e.g., balsamiq)
  - or painting/drawing packages (e.g., photoshop)
- a very thin horizontal prototype
- does not capture the interaction “feel”



next drawing

(for shut down condition)

moving towards med-fi elements can be active – but still only narrow functionality

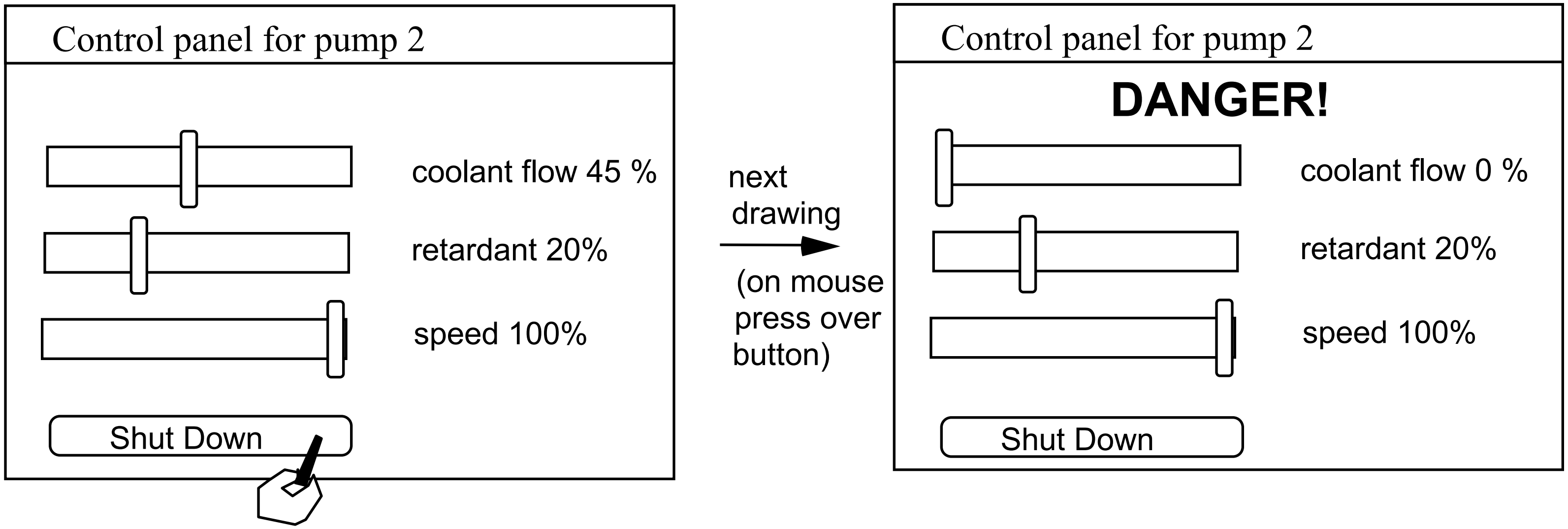
TECHNIQUE: SCRIPTED SIMULATIONS & SLIDE SHOWS

encode the storyboard on the computer

- *scene transition activated by simple user inputs (i.e. clickable regions)*
- a **simple** horizontal and/or vertical prototype
- supports 'limited' branching

user given a very tight script/task to follow

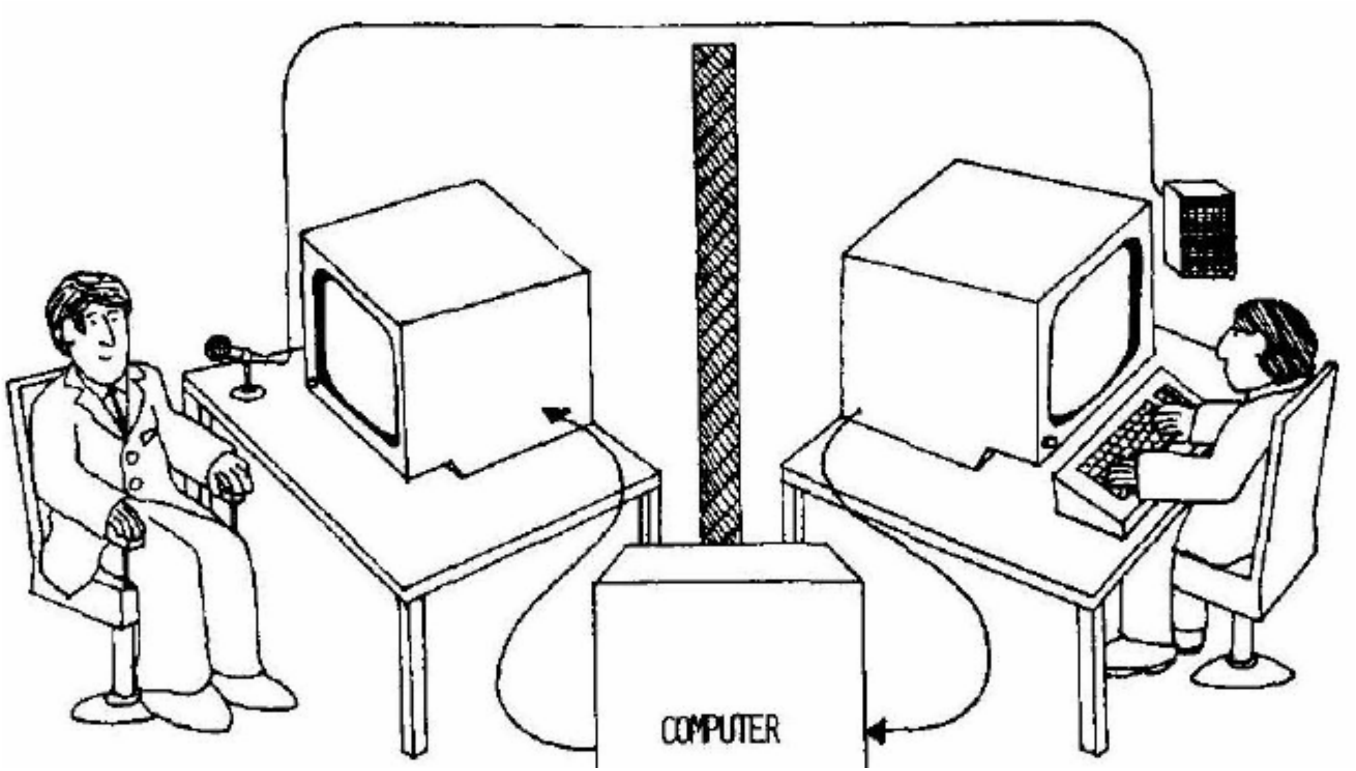
- appears to behave as a real system
- but script deviations blow the simulation



WIZARD OF OZ

A method of testing a system that does not exist

- the voice editor, by IBM (1984)



What the user sees

The wizard

From Gould, Conti & Hovanvecz, Comm ACM 26(4) 1983.

WIZARD OF OZ (“WOZ”)

human simulates system’s intelligence & interacts with user

- “pay no attention to the man behind the curtain!”

user uses computer as expected

“wizard” (sometimes hidden):

- interprets subject’s input according to a **preset algorithm**
- makes computer/screen behave in appropriate manner

good for:

- adding simulated and complex vertical functionality
- testing futuristic ideas

WIZARD OF OZ EXAMPLES

IBM: an imperfect listening typewriter using continuous speech recognition

- secretary (i.e., Wizard) trained to:
  - understand key words as “commands”
  - type responses on screen as the system would
  - manipulate graphic images through gesture and speech

intelligent agents / programming by demonstration

- person trained to mimic “learning agent”
  - user provides examples of task they are trying to do
  - computer learns from them
- shows how people specify their tasks

ON YOUR OWN

SUMMARY OF LO-FI

prototyping

- speeds up design and lowers overall cost
- allows users to react to the design and suggest changes
- prototypes and scenarios are used throughout design
- low-fi best for brainstorming and choosing a conceptual model
- med/hi-fi prototypes best for fine-tuning and detailed design

low-fi prototyping methods

- scope: vertical, horizontal prototyping
- paper
- sketching
- storyboarding
- scripted simulations
- Wizard of Oz

MEDIUM-FIDELITY PROTOTYPES

- prototyping with a computer
- engaging for end users
- **simulate some but not all features of the interface** (interactive)
- can test more subtle design issues

pitfalls

- blinds people to major representational flaws because of a tendency to focus on more minor details
- users reluctant to change/challenge designer
- management may think its real!

WHAT'S THE DIFFERENCE BETWEEN "LOW" AND "MEDIUM" ?

used to be obvious! paper vs. nearly anything else.

in last ~10 years: many powerful tools that:

1. make it very easy *(a low-fi trait)* to generate mockups
2. look real and are at least somewhat interactive *(usually a "medium fidelity" trait)*

e.g.: balsamiq, axure – low or medium; usually not high

MANY DIMENSIONS OF “FIDELITY”

what are ways a prototype can be ‘true to life”?

- **visual realism:** how real it *looks*. polish, graphic imagery
- **physical realism:** shape and form for 3D objects; feel
- **scope:** how many functions included; horizontal vs vertical
- **functionality:** what actually works? e.g. web app: links live?
- **data:** operates on real vs faked data
- **autonomy:** operates alone vs requires “supervision”
- **platform:** interim vs final implementation

IMPORTANT LESSONS:

1) **it is COMPLICATED (slow, expensive) to prototype multiple dimensions at once.**

→ so don't. Instead: *modularity of prototyping*.

2) **each prototyping tool has strengths and weaknesses**

- may be *better* (more efficient and capable) for some of these prototyping dimensions than others.

→ you may need multiple tools throughout your design's life cycle.

MATCHING GAME:
WHAT MEDIUM MAKES MOST SENSE FOR EACH DIMENSION?

Prototyping dimension:

- how real it *looks* (polish)
- scope how many functions included; horizontal vs vertical
- real vs faked functionality
  how *much* of it is faked?
- operates on real vs faked data
- operates alone vs requires "supervision"
- for 3D products: physical aspects, or just images?
- interim vs final platform

Useful Links:

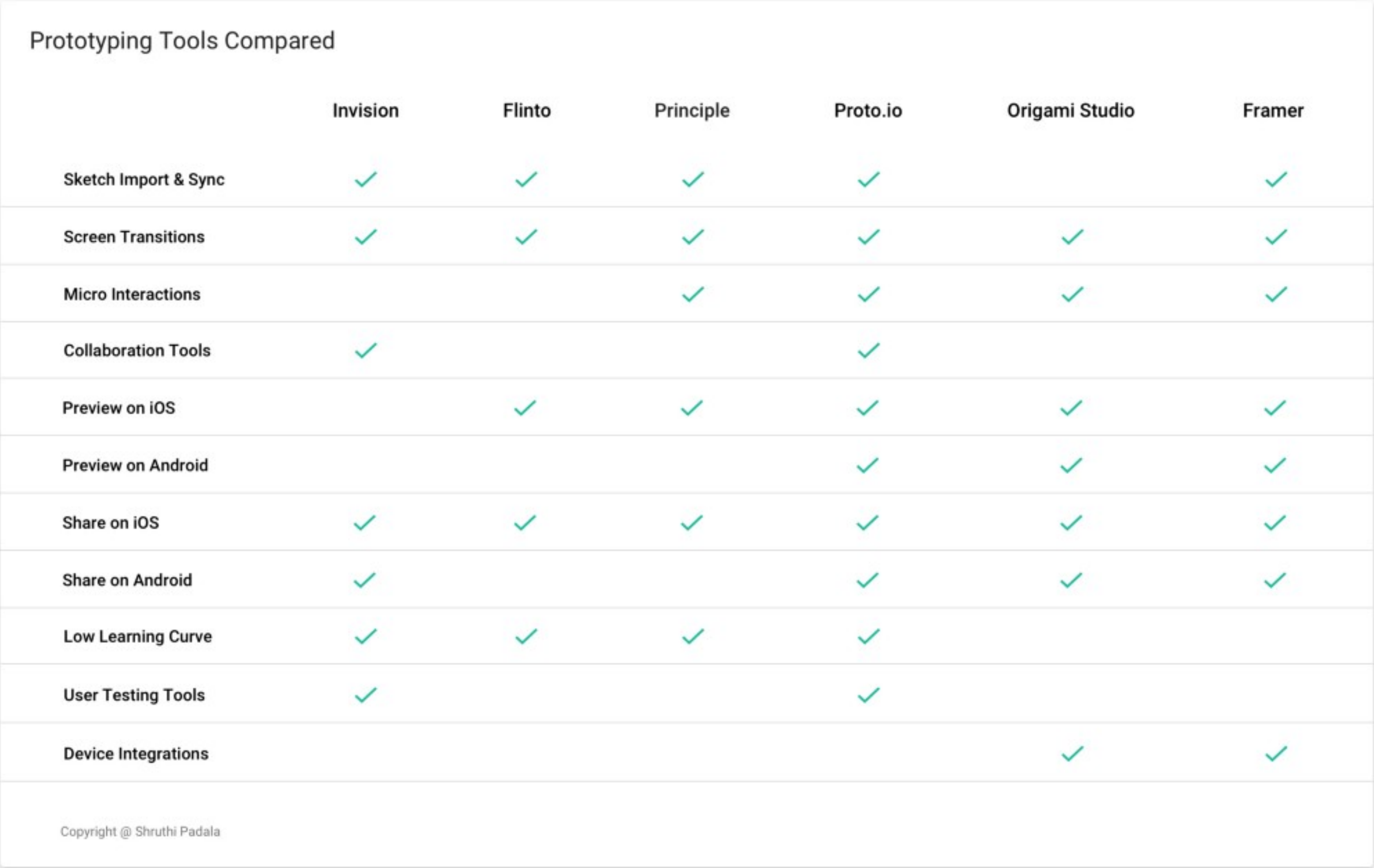
https://www.creativebloq.com/advice/the-8-best-prototyping-tools-for-2018
https://kfginternational.com/blog/top-prototype-ux-ui-tools/
http://www.nexgendesign.com/top-7-prototyping-mockup-tools

prototyping medium:

paper
Balsamiq
Axure
InVision
Proto.io
Flinto
Powerpoint
html (or Dreamweaver)
Java/Swing
Processing
modeling foam & hot-melt glue
Flash
Visual Basic
Photoshop
Arduino
found objects
tcl/tk
Python
POP

A COMPETITIVE ANALYSIS OF PROTOTYPING TOOLS

ON YOUR OWN

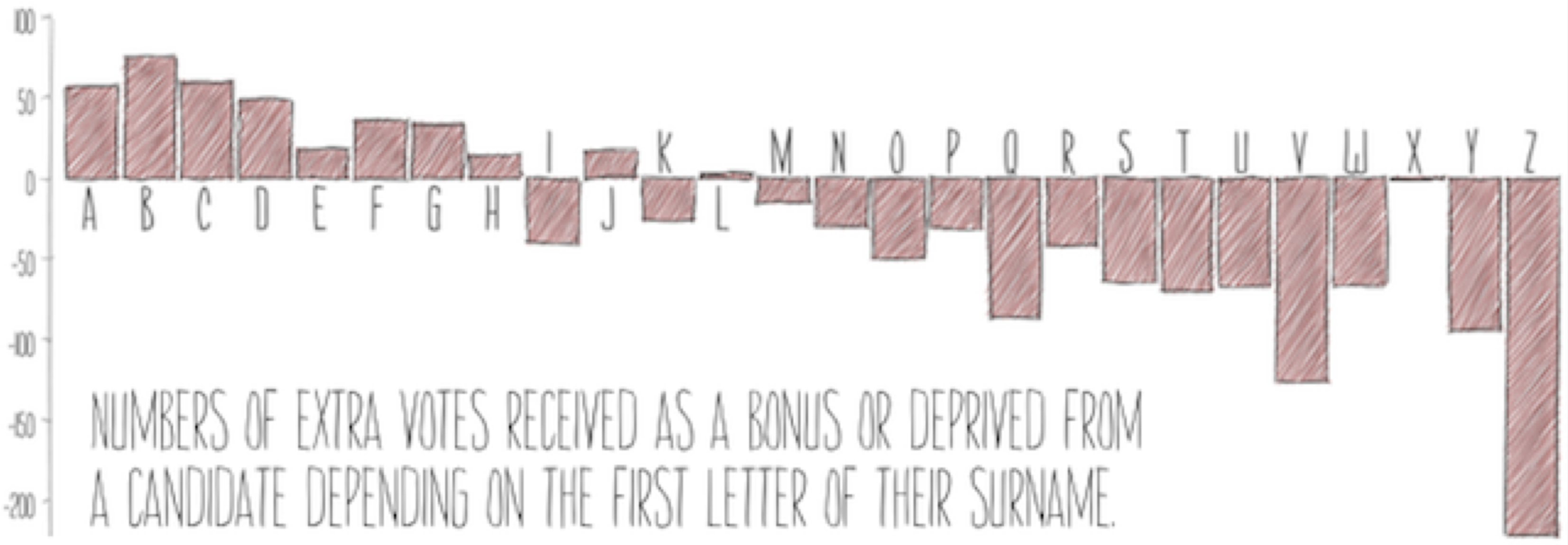


Prototyping Tools Compared

	Invision	Flinto	Principle	Proto.io	Origami Studio	Framer
Sketch Import & Sync	✓	✓	✓	✓		✓
Screen Transitions	✓	✓	✓	✓	✓	✓
Micro Interactions			✓	✓	✓	✓
Collaboration Tools	✓			✓		
Preview on iOS		✓	✓	✓	✓	✓
Preview on Android				✓	✓	✓
Share on iOS	✓	✓	✓	✓	✓	✓
Share on Android	✓			✓	✓	✓
Low Learning Curve	✓	✓	✓	✓		
User Testing Tools	✓			✓		
Device Integrations					✓	✓

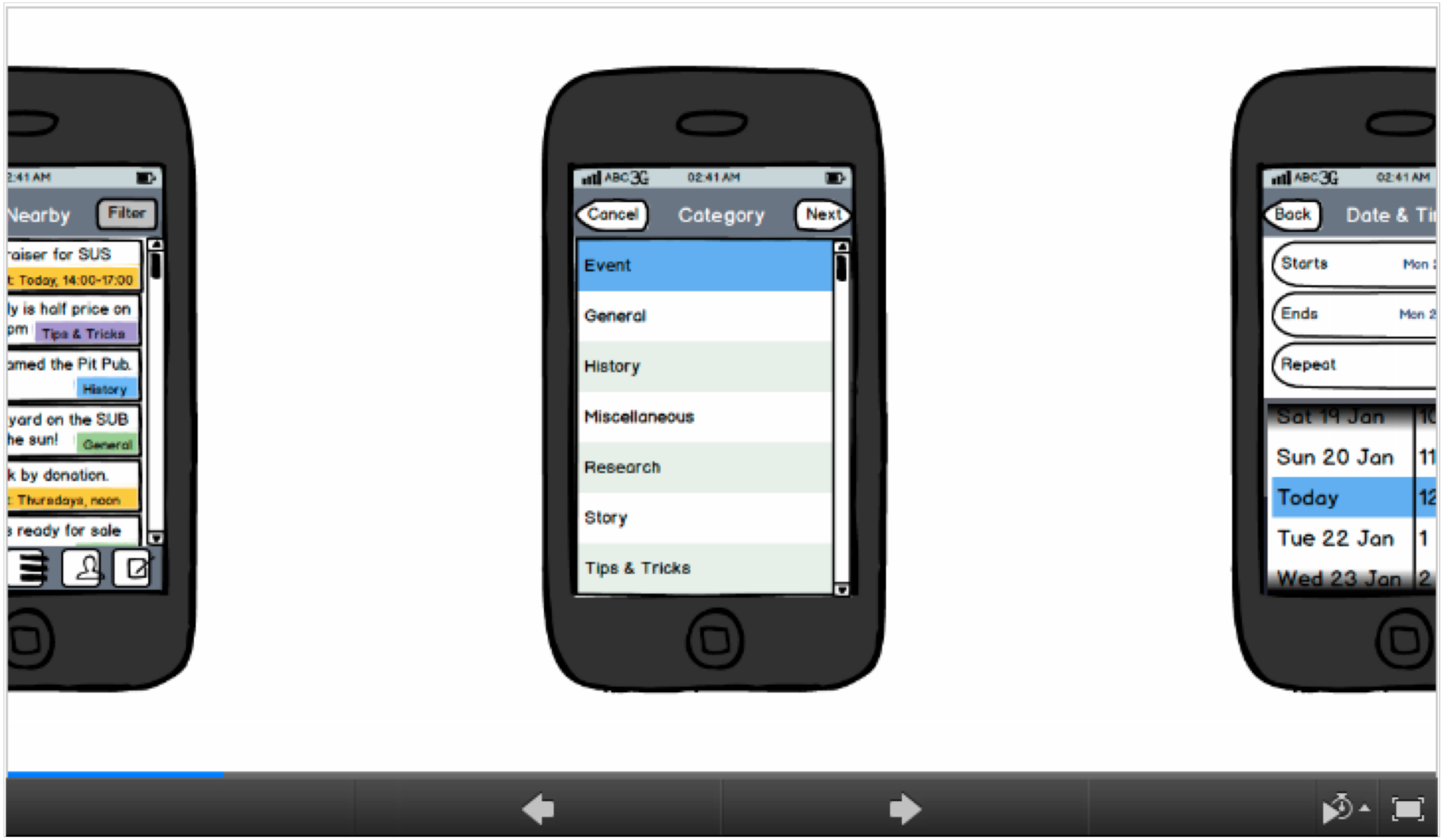
https://uiux.blog/quest-for-the-perfect-prototyping-tool-ef35f89bfb31

YOU CAN EVEN MAKE MEDIUM-FIDELITY MOCKUPS LOOK LOW-FI



this graphic is generated from code (*processing*).
http://www.gicentre.org/handy/ [more examples]

BALSAMIQ: LOW TO MEDIUM



- Quickly mock up images and hyperlinked interactivity.
- But - real functionality difficult.

DIFFERENCE BETWEEN MED TO HIGH-FIDELITY PROTOTYPES

increasing in **completeness** and **detail**:

- more aspects being prototyped at same time
- higher degree of functionality
- higher degree of polish
- etc. . .

fidelity is a **spectrum**

- not always a firm line between low/med or med/hi

MEDIUM AND HIGH-FIDELITY PROTOTYPING
WHAT CAN YOU USE?

many things:

drag-and-drop GUI toolkits for standard UI mockups

- e.g. Axure, Visual Basic

scripting languages & interface libraries for add'l flexibility

- e.g. python, tcl/tk, java script libraries (e.g., jquery)

graphical languages for visualization & novel interface creation

- VB, Java, Flash; Processing; D3

special purpose tools and environments

- e.g. toolkits for integrating speech, haptics, I/O devices

→ **a prototyping platform can be medium- OR hi-fi; depends on how you use it.**

ON YOUR OWN

THE SITUATION TODAY FOR PROTOTYPING TOOLS (VS. DEVELOPING ON FINAL PLATFORM)

for simple prototyping.

- balsamiq, axure, html, powerpoint

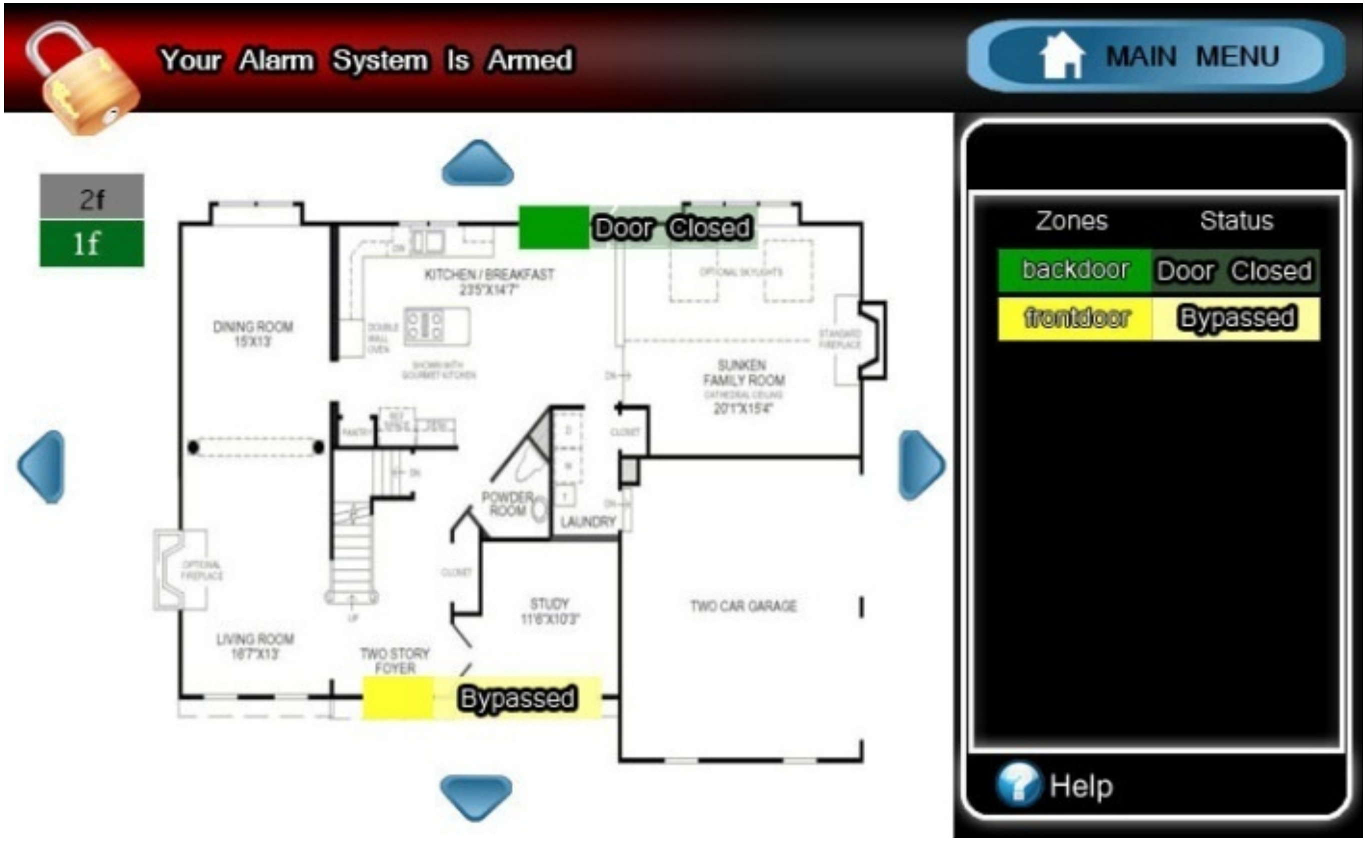
more advanced features in e.g. Supercard, Director:

- text-to-speech, speech recognition, QuickTime, filmstrips, graphic import and export, MP3 playback etc.

advanced UIs still require (scripting) language + libraries

- HTML + javascript
- Tool Command Language/Tool Kit (TCL/TK)
- Python
- Processing (Java based, but way more accessible; good for sketching, no good for larger code projects)
- still a need for C++, C#, Objective C, Java

HOME ALARM SYSTEM

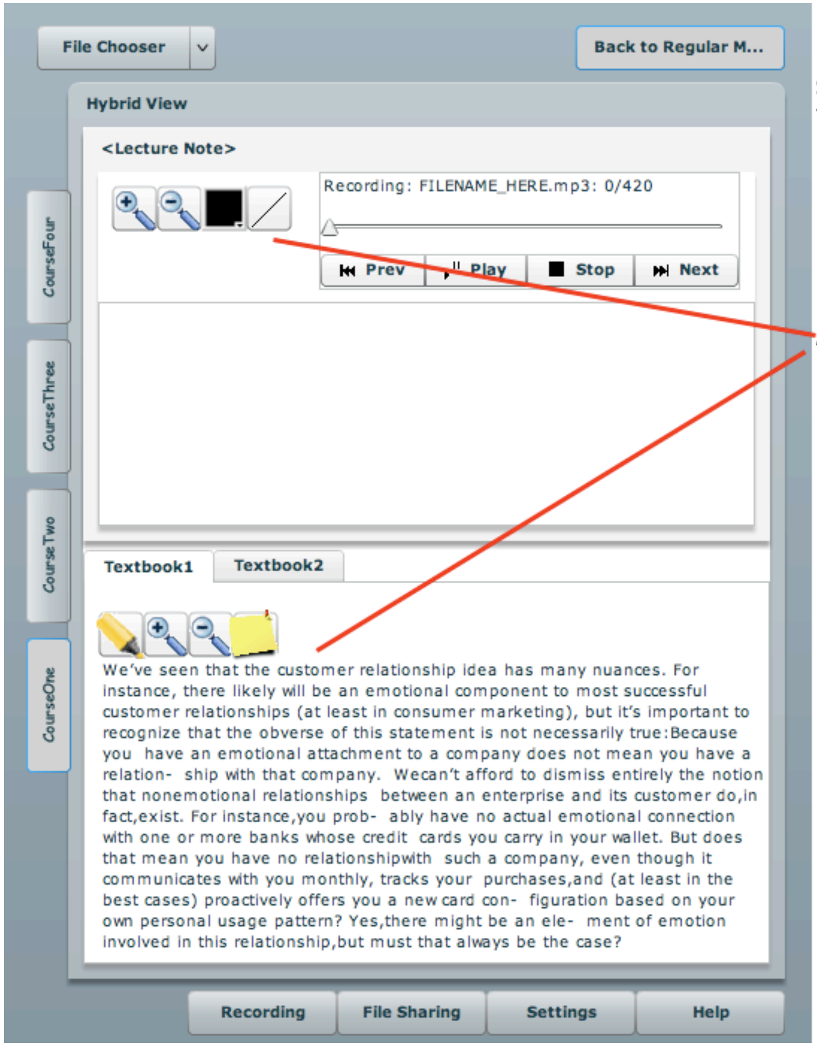


Zones	Status
backdoor	Door Closed
frontdoor	Bypassed

Flash:

- product for the home
- needed to gauge reactions to having it in ones house
- imagery + graphic resolution critical

E-READER & NOTE-TAKING TOOL



Recording: FILENAME_HERE.mp3: 0/420

We've seen that the customer relationship idea has many nuances. For instance, there likely will be an emotional component to most successful customer relationships (at least in consumer marketing), but it's important to recognize that the obverse of this statement is not necessarily true:Because you have an emotional attachment to a company does not mean you have a relation- ship with that company. Wecan't afford to dismiss entirely the notion that nonemotional relationships between an enterprise and its customer do,in fact,exist. For instance,you prob- ably have no actual emotional connection with one or more banks whose credit cards you carry in your wallet. But does that mean you have no relationshipwith such a company, even though it communicates with you monthly, tracks your purchases,and (at least in the best cases) proactively offers you a new card con- figuration based on your own personal usage pattern? Yes,there might be an ele- ment of emotion involved in this relationship,but must that always be the case?

Hybrid View:

Split views for displaying two files simultaneously.

References: Can make hyperlink references between content

All controls are preserved

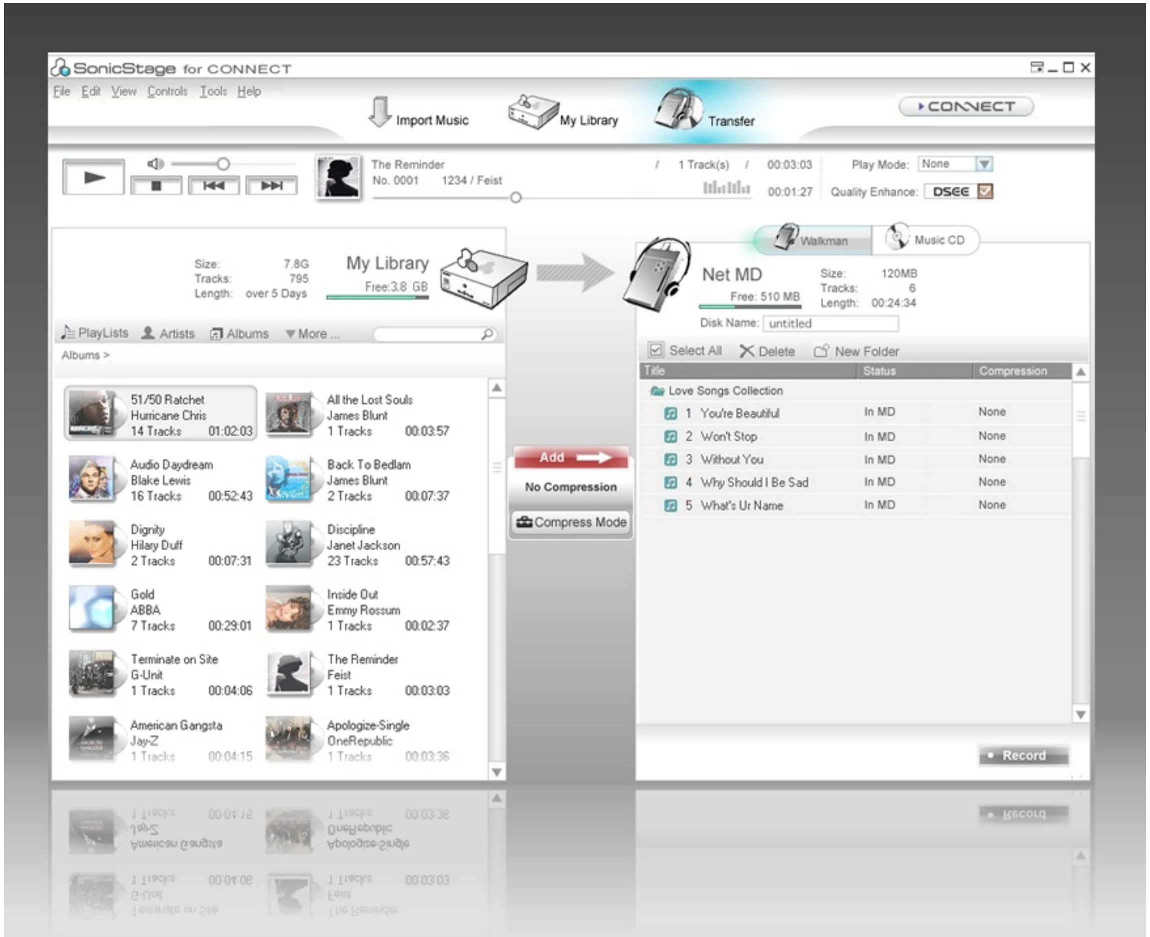
Flex:

needed to test how well the concept worked for **actually taking notes in lecture**

highly functional

detailed vertical

SONIC STAGE MUSIC SYNCHRONIZATION TOOL



The Reminder
No. 0001 1234 / Feist
/ 1 Track(s) / 00:03:03
00:01:27
Play Mode: None
Quality Enhance: DSEE

My Library
Size: 7.8G
Tracks: 795
Length: over 5 Days
Free:3.8 GB

Net MD
Free: 510 MB
Size: 120MB
Tracks: 6
Length: 00:24:34
Disk Name: untitled

51/50 Ratchet
Hurricane Chris
14 Tracks 01:02:03

All the Lost Souls
James Blunt
1 Tracks 00:03:57

Audio Daydream
Blake Lewis
16 Tracks 00:52:43

Back To Bedlam
James Blunt
2 Tracks 00:07:37

Dignity
Hilary Duff
2 Tracks 00:07:31

Discipline
Janet Jackson
23 Tracks 00:57:43

Gold
ABBA
7 Tracks 00:29:01

Inside Out
Emmy Rossum
1 Tracks 00:02:37

Terminate on Site
G-Unit
1 Tracks 00:04:06

The Reminder
Feist
1 Tracks 00:03:03

American Gangsta
Jay-Z
1 Tracks 00:04:15

Apologize-Single
OneRepublic
1 Tracks 00:03:36

Title	Status	Compression
Love Songs Collection		
1 You're Beautiful	In MD	None
2 Won't Stop	In MD	None
3 Without You	In MD	None
4 Why Should I Be Sad	In MD	None
5 What's Ur Name	In MD	None

Flash w/ imported photoshop

observe scanned, hand-drawn sketches

HOW DO YOU KNOW WHEN YOU HAVE – OR NEED – A HIGH-FI PROTOTYPE?

- scope is complete (horizontal *and* vertical)
- prototype can be tested in just about every way performance as well as subjective and cognitive analysis; more realistic scenarios; in field
- feels like time to switch to final development platform
- design is becoming rigid and finalized

ACTIVITY

get into groups of 2-3

discuss the following questions for your own projects:

- what are the main challenges that your prototype means to solve?
- what fidelity seems right for your prototype?
- what dimensions you need to consider?
- what are some possible tools for your project? what are the tradeoffs?

DISCUSSION ON REQUIREMENT READINGS [20 MIN]

- What surprised you? or
- What you disagreed with?
- Others?

ON DECK…

Next class (TUESDAY) …

- Cognitive Walkthroughs
- Heuristic Evaluation

Readings (as posted)

EXTRA SLIDES

SUMMARY
LOW FIDELITY VS. HIGH FIDELITY

cheap

easy to build lots

facilitate communication

gross design (layout)

market requirements

proof-of-concept

limited error checking

hard to get to code

facilitator driven

limited functionality

complete functionality

interactive

user-driven

exploration and testing

look and feel of final product

provides specification

marketing and sales tool

expensive

time consuming

inefficient proof-of-concept

poor for requirements gathering

can be hard to throw away

TOOLS AVAILABLE TO YOU

Balsamiq hands out course licenses – let me know if you want me to ask for one.

Axure is installed on the X360 (HCI Studio) computers with a license that is a few years old, but still operable.

The Adobe Suite, Photoshop, InDesign, Illustrator, Premiere, and Dreamweaver

Microsoft Office suite (PPT can be useful).

Note that many tools have 30-day free trials