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User Interface Prototyping

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The 7 Quintilian questions

quis | persona
quid | factum
cur | causa
ubi | locus
quando | tempus
quemadmodum | modus
quibus adminiculis | facultas

Who? What? Why? Where? When? How? By what means?

The 7 Quintilian questions

quis	quid	cur	ubi	quando	quemadmodum	quibus adminiculis
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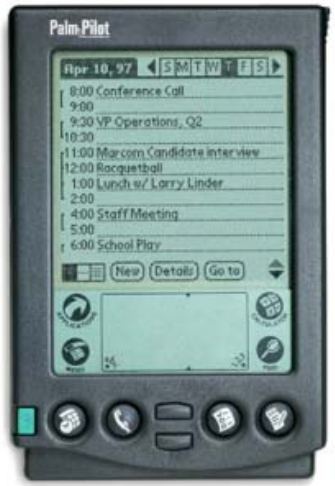
Who? What? Why? Where? When? How? By what means?

What is a UI prototype?

- "A prototype is an early sample or model built to test a concept or process or to act as a thing to be replicated or learned from." – Wikipedia
- A working representation of a final artifact
- A concrete representation of a design at any stage
- Example



What is a UI prototyping?

It consists in an iterative process in which various stakeholders (especially end users for participatory design) are involved for defining the UI of an interactive application for:

- Exploring the UI problem space with end users
- Exploring the UI solution space with designers
- Investigating the future UI based on end users' requirements
- Communicating any relevant UI aspect (e.g., doc.)
- Continuously evolving the system
- …

What is Prototype representation?

Representation = form of UI prototype

- Physical (*off-line*): when paper is the medium of the prototype
  - Contemplative: what you see is all what you get
    - Only sheets of paper pinned on a wall
  - Reactive: how you react is all what you get
    - Often controlled by a protocol like in Wizard of Oz

http://www.paperprototyping.com/

What is Prototype representation?

Contemplative UI prototype

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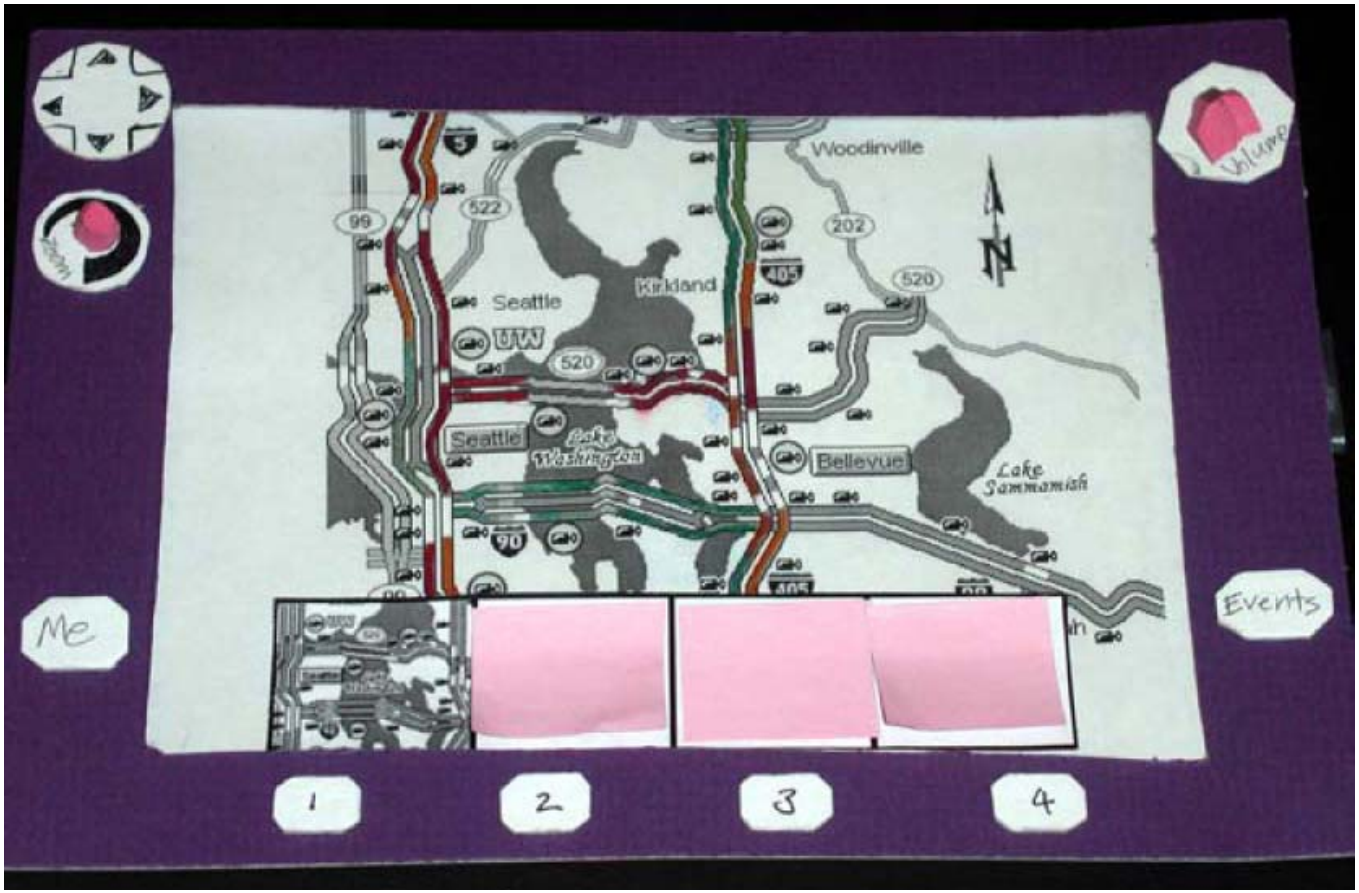
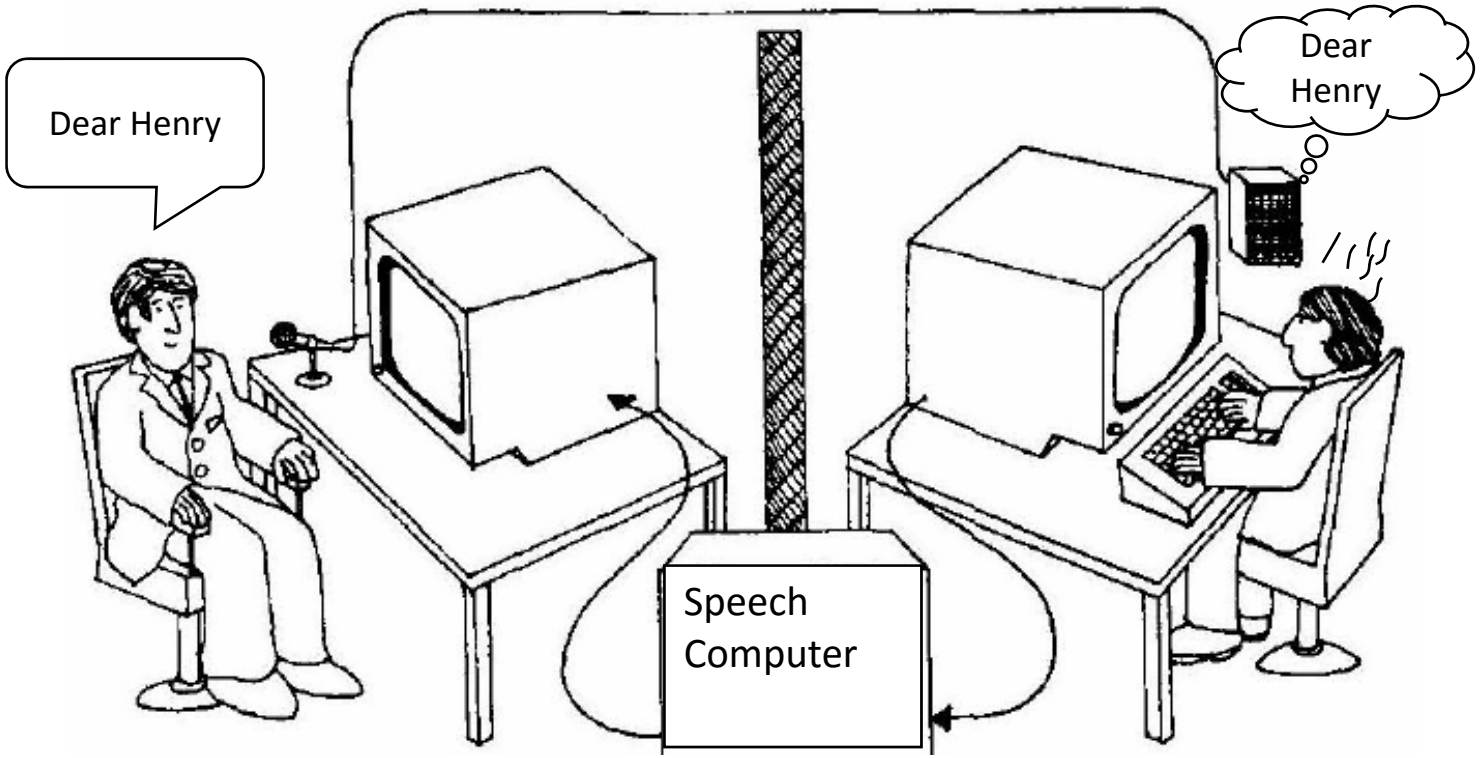
Contemplative UI prototype



What is Prototype representation?

Reactive UI prototyping: Wizard of Oz

- A method of testing a system that does not exist: the listening typewriter, IBM 1984

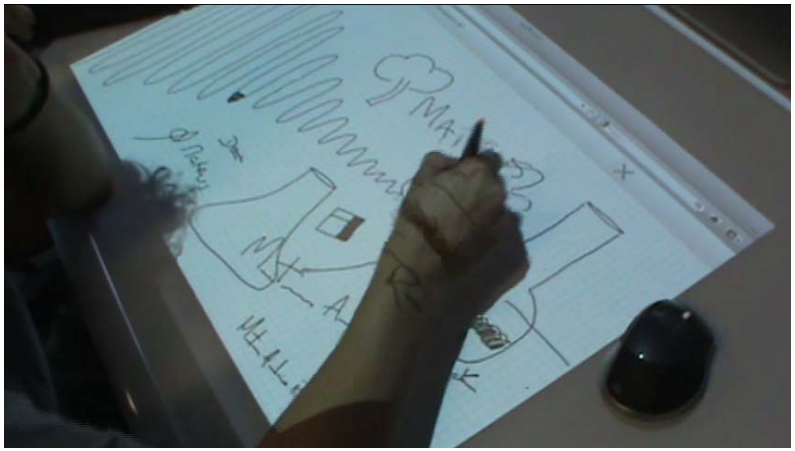


Source: Gould, Conti & Hovanvecz, Comm ACM 26(4) 1983.

What is Prototype representation?

Representation = form of UI prototype

- Digital (*on-line*): when software is the medium
  - Predefined mono-path: only one interaction path possible (video clips)
  - Many paths: many paths possible
  - Reactive: many paths possible with limited behavior (e.g., error handling, function calls, data Create-Read-Update-Delete-Search)



Prototype representation

Representation = form of UI prototype

- Mixed: when the representation combines parts on paper and parts in a software
  - better to incorporate the paper parts in the software
    - Hand drawn material
    - Screen shots
    - Pictures
    - Annoto
    - Beat Signer's PenPaper

Prototype duration

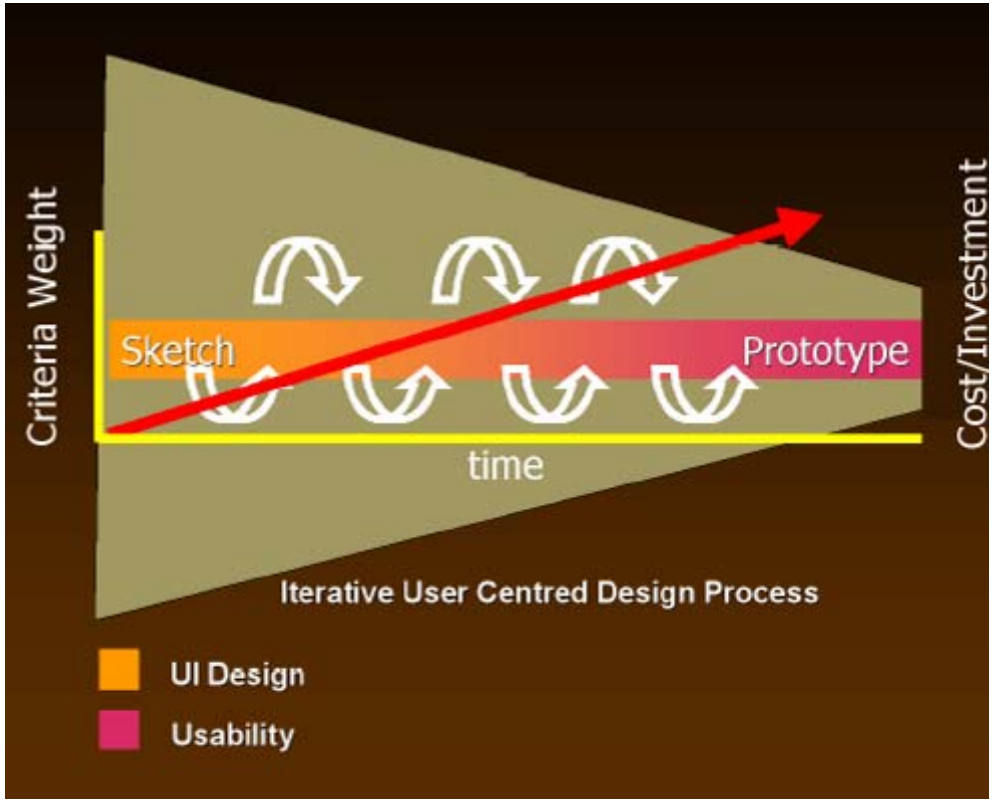
What is the life time of the prototype?

- Ephemeral: iff the prototype is expected to live only a few moments (e.g., some minutes, a hour)
  - E.g., for suggesting a design idea
- Limited lifetime: iff the prototype is expected to stay throughout one complete session
  - E.g., for testing a complete design alternative
- Extended lifetime: iff the prototype is expected to stay across many sessions
  - E.g., for comparing various design alternatives
- Persistent: iff the prototype is expected to stay forever
  - e.g., for design history, project documentation)

Prototype duration

What is the life time of the prototype?

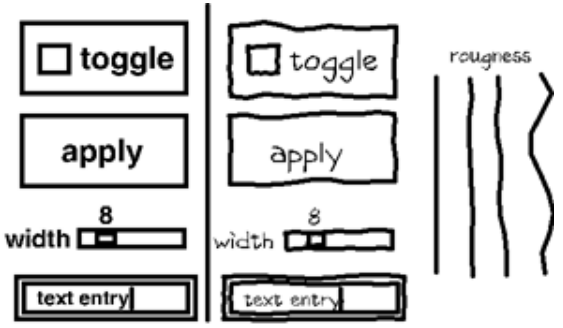
- Will evolve naturally with usability



Source: Bill Buxton, Nicolai Marquardt, Saul Greenberg, and Sheelagh Carpendale, Sketching User ExperiencesMorgan Kaufmann

Level of Fidelity (LoF)

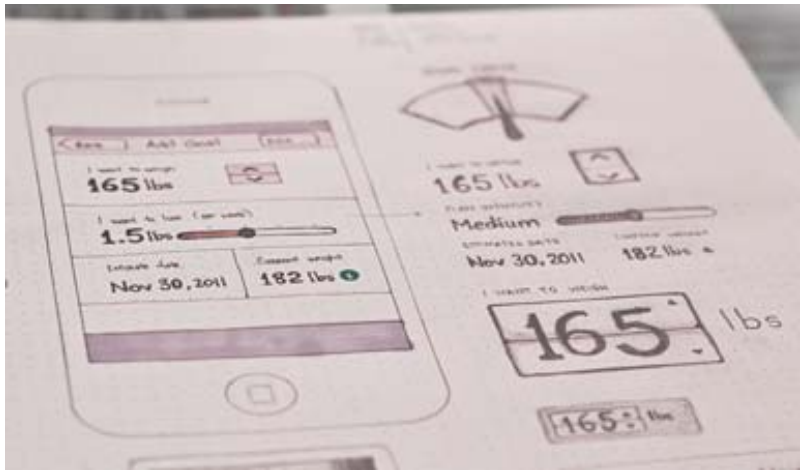
- Expresses similarity between the representation of the prototyped UI and the final UI
  - High (high-fidelity, *hi-fi*): iff the prototype representation is the closest possible to the final one, perhaps the same
  - Low (low-fidelity, *lo-fi*): iff the prototype representation refers to the final UI without making any reference to the technological space (e.g., a particular Look & Feel)
  - Moderate (mid-fidelity, *mi-fi*): iff the prototype representation consists in a simplication of the final UI
- Prototype
  - Mono-fidelity: one LoF at a time
  - Multi-fidelity: many LoF at a time
  - Mixed fidelity: all Lof at once
  - Distributed: all LoF, but one at a time



[Meyer05]

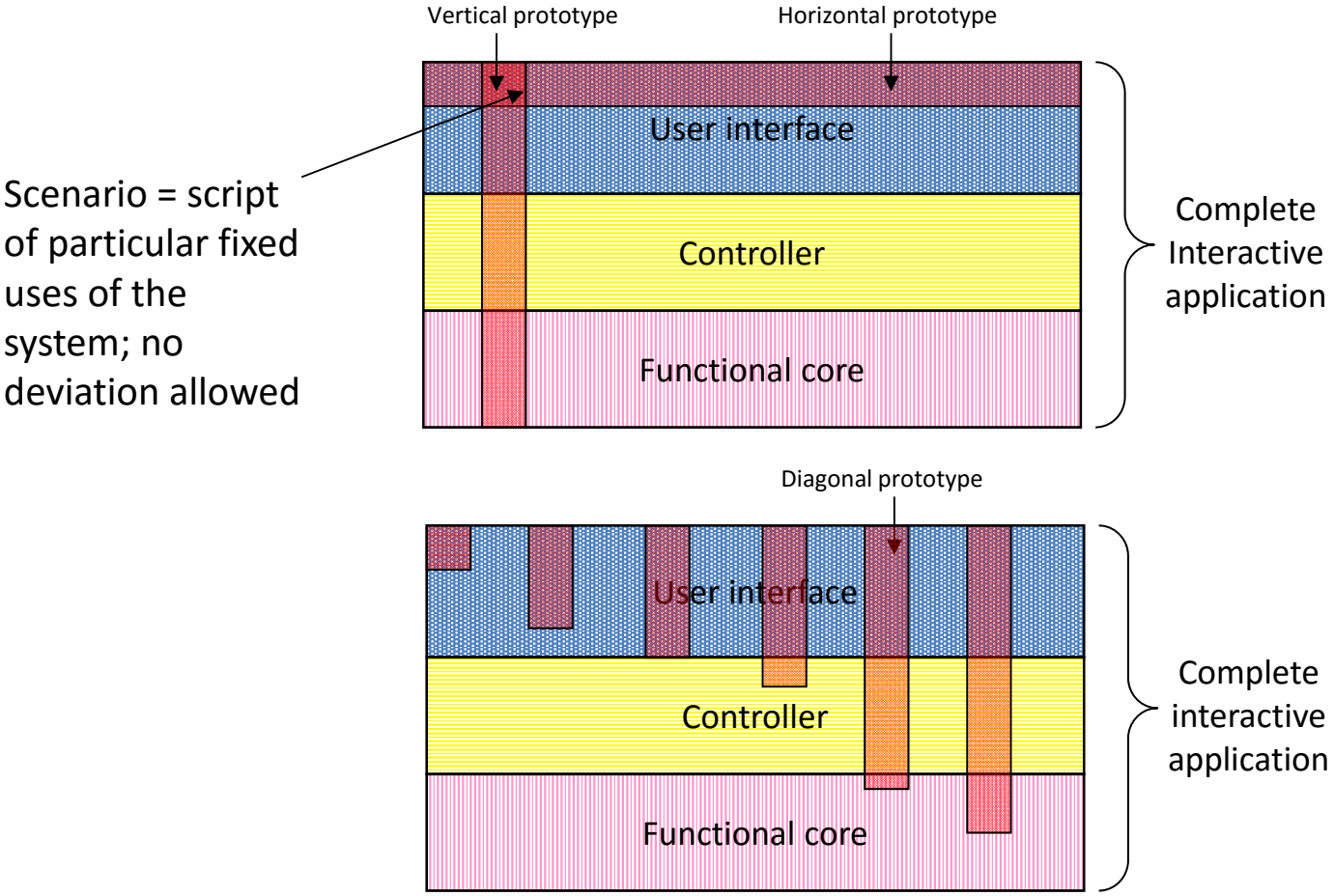
Level of Details (LoD)

- Expresses the precision with which the UI prototype is represented
  - Informal: iff the prototype representation includes only some details of the final UI
  - Polished: iff the prototype representation is expected to contain nearly all details of the final UI
    - All aspects related to presentation, navigation, behavior



Different UI prototype types

- From one level of fidelity to another



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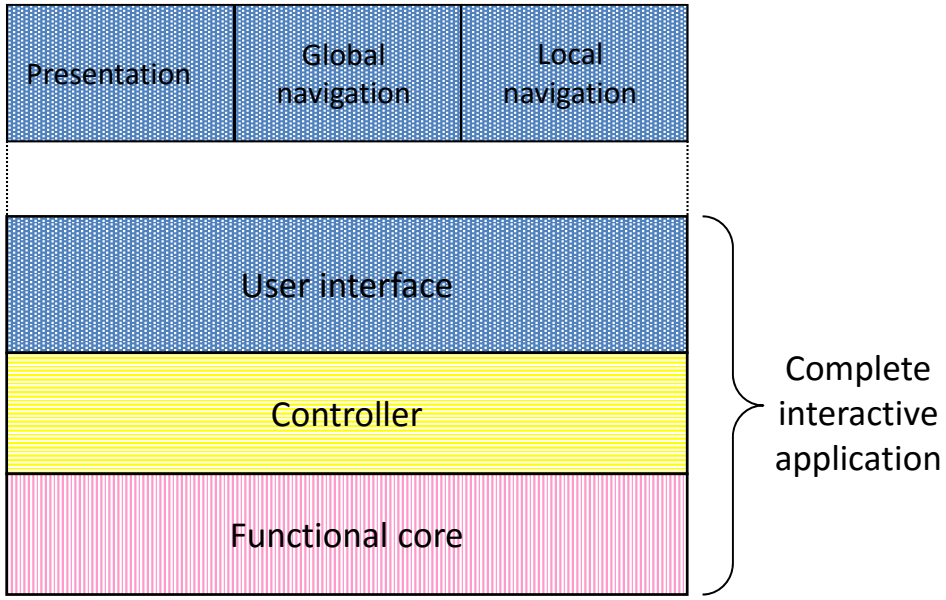
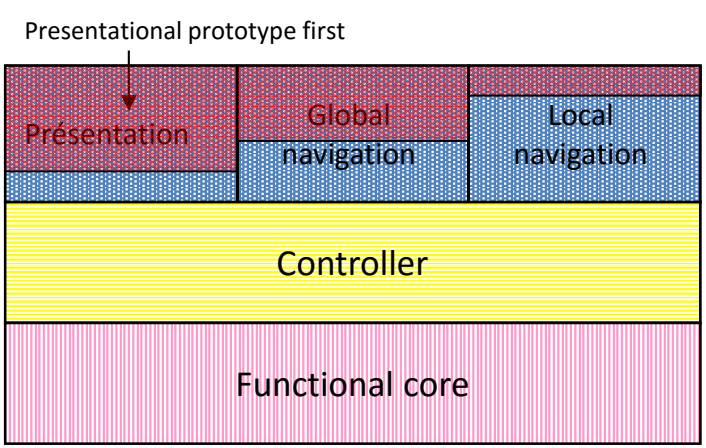
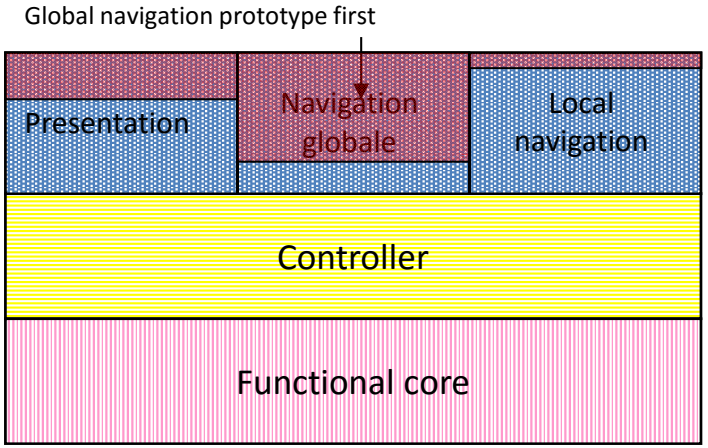
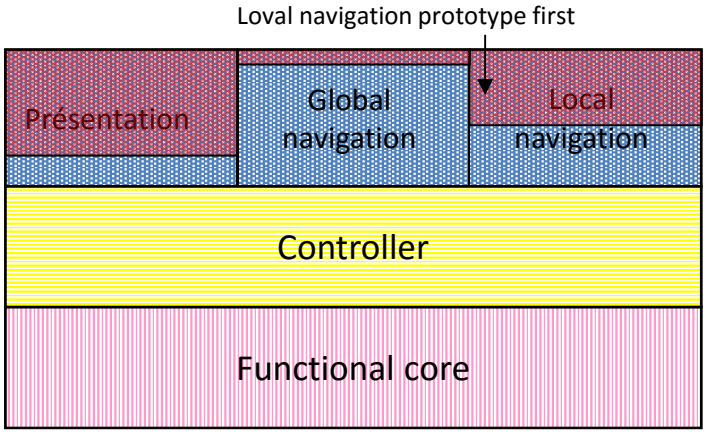


Different UI prototype types

- From one level of fidelity to another







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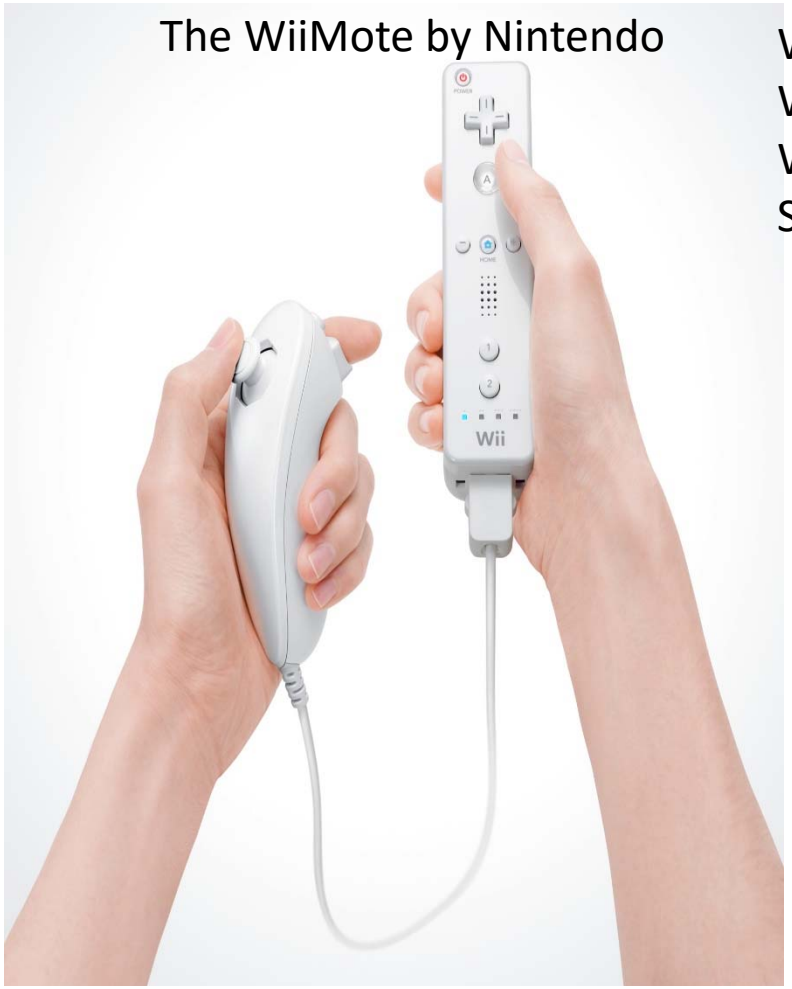
Why UI Prototyping?

- To obtain as quick as possible a UI that satisfies end users' requirements
  - Stay compatible with User-Centered Design
  - Avoid late validation
- To early discover usability problems
  - You can solve the problem now with an eraser or later on with a hammer (Frank Lloyd Wright)
- To reduce costs
  - Reduce production time
  - Minimize involved resources (end users, human factors experts, usability engineers, designers, developers,…)
- To check feasibility
  - Desirable from usability standpoint, but not from developer standpoint
  - Desirable from developer standpoint but not from usability

Why UI Prototyping?

- To discover unanticipated usability problems

The WiiMote by Nintendo



Which problems?
Was thrown at TV screens
Was slippery
Separated joystick

Why UI Prototyping?

- To foster creativity and put it ahead of LoD
- LoD is more important than LoF
  - LoF subsumes level of readiness
  - LoF increases design time
  - LoF decreases creativity
  - LoF reduces stakeholder participation
    - No war on colors, fonts, backgrounds, foregrounds, aesthetics (although important)
    - No guerilla on style guides
    - Performance is more important than preference

Why Lo-Fi Prototyping?

- Advantages
  - Requires minimal resources (people, time, hardware, software)
  - Covers multiple design alternatives
  - Addresses the wicked problem
    - No complete initial prototype
    - No definitive final prototype
    - Open, iterative
  - Allmost all interaction could be prototyped
- Shortcomings
  - Slow to operate
  - Hard to implement some interaction (e.g., feedback, visualization, animation)
  - Not close enough to the final UI
  - Computer-based may be buggy
  - End user are not autonomous

Why Me-Fi Prototyping?

- Advantages
  - Still requires affordable resources (people, time, hardware, software)
  - Simulate some but not all features of the interface
  - More engaging for end users
  - Provides sophisticated but limited scenario for the end user to try
- Shortcomings
  - End user's reactions often limited, depending on LoF
  - End users do not dare challenge designer
  - End users are reluctant to touch the design
  - Management may think its real!

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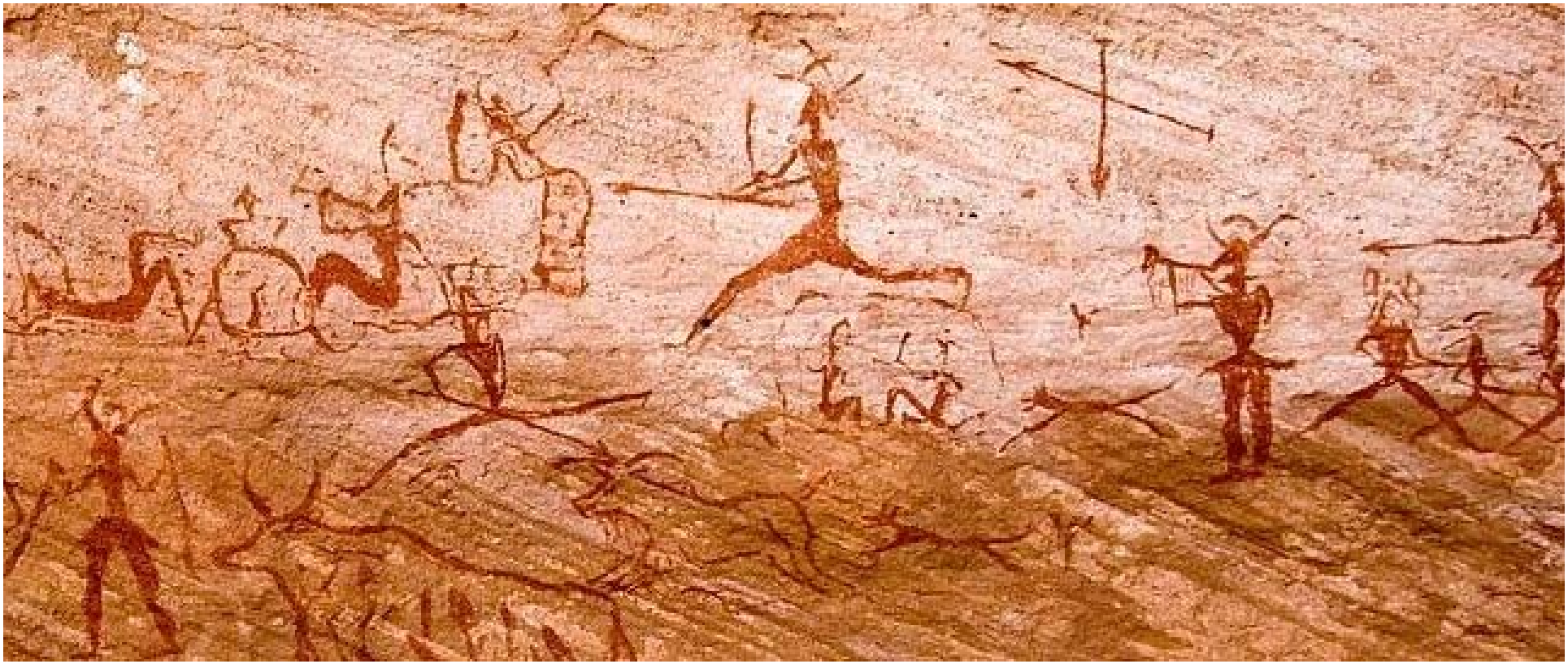
How to prototype?

- **Drawing** versus Sketching



Source: Luca Galuzzi [CC-BY-SA-2.5] via Wikimedia Commons

How to prototype?

- Drawing versus **Sketching**

How to Prototype?

- **Sketches**
  - Invite
  - Suggest
  - Explore
  - Question
  - Propose
  - Provoke

Prototype

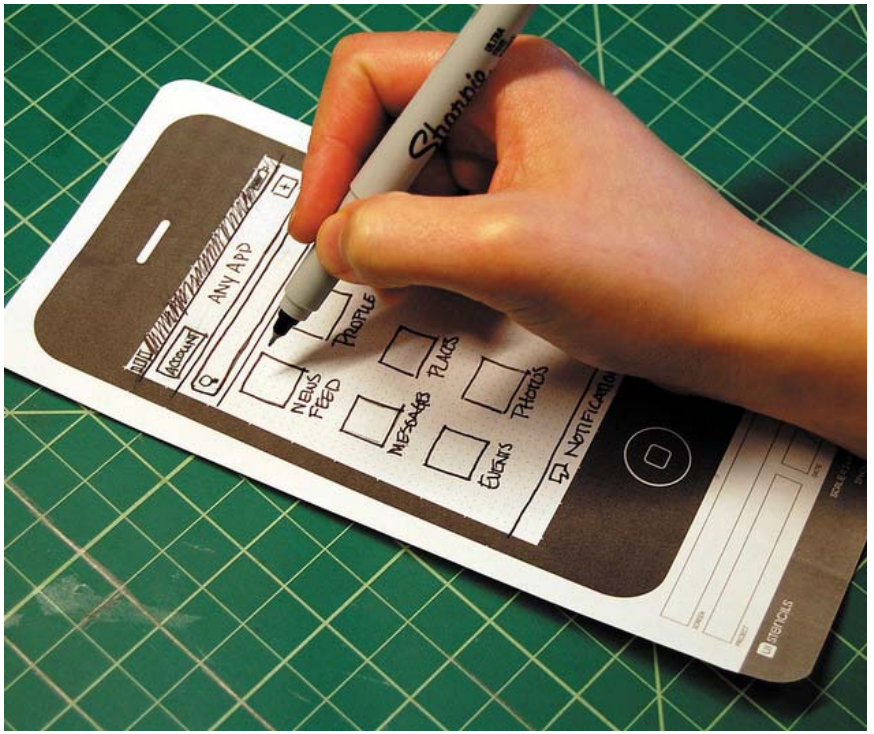
- Attend
- Describe
- Refine
- Answer
- Test
- Resolve

Source: Bill Buxton, Nicolai Marquardt, Saul Greenberg, and Sheelagh Carpendale, Sketching User ExperiencesMorgan Kaufmann

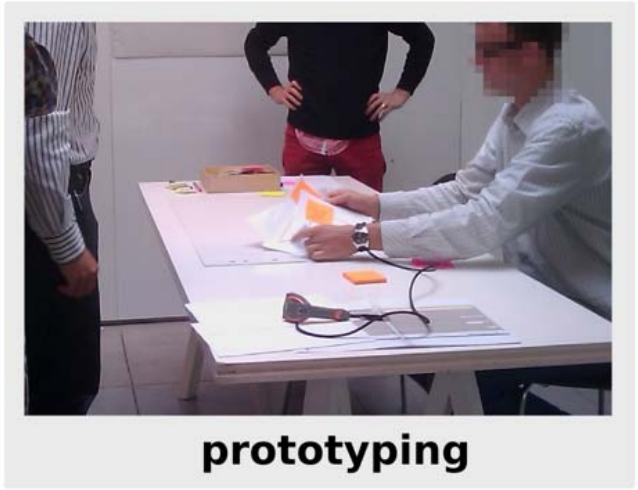
How to Prototype?

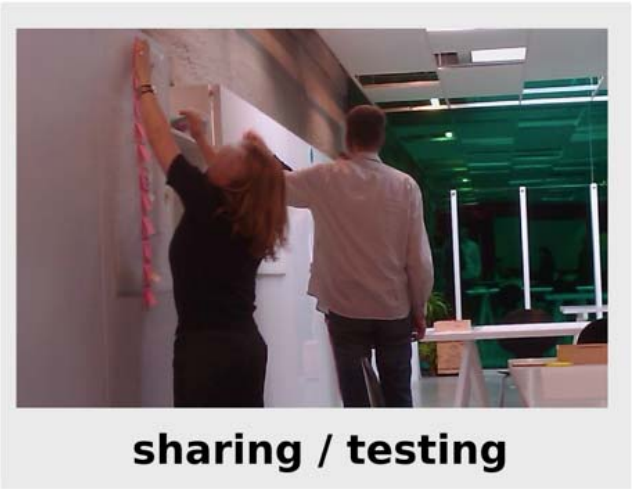
3 Functions of Sketching

1. Externalize ideas
2. Interpret each other's ideas
3. Stimulate use of early ideas



UI Prototyping life cycle





Prototyping life cycle

- Tips for drawing
  - Set a firm deadline
  - Just draw it! Everybody can draw
  - Draw a window/web page/screen frame on large paper
  - Put different screen regions on cards
    - anything that moves, changes, appears/disappears
  - Ready response for any user action
    - e.g., have those pull-down menus already made
  - Use photocopier to make many versions

Prototyping life cycle

- Tips for prototyping
  - Explore design alternatives
  - Keep 2-3 versions in the end
  - Highlight important regions
  - Emphasize alternate paths

Prototyping life cycle

- Tips for sharing/testing
  - Select your end users carefully
    - Understand their background
    - Use a questionnaire to get the people you need
    - Don’t use friends or family or colleagues since they are not neutral (they will please you)
  - Prepare scenarios that are
    - Typical
    - Representative

Prototyping life cycle

- Four roles
  - Greeter: puts users at ease & gets data
  - Facilitator: only team member who speaks
    - gives instructions & encourages thoughts, opinions
  - Computer: knows application logic & controls it
    - always simulates the response, w/o explanation
  - Observer: take notes & recommendations and does not make ANY intervention (even if solicited)
- Typical session <= 1 hour
  - Preparation, familiarization
  - Test
  - Debriefing

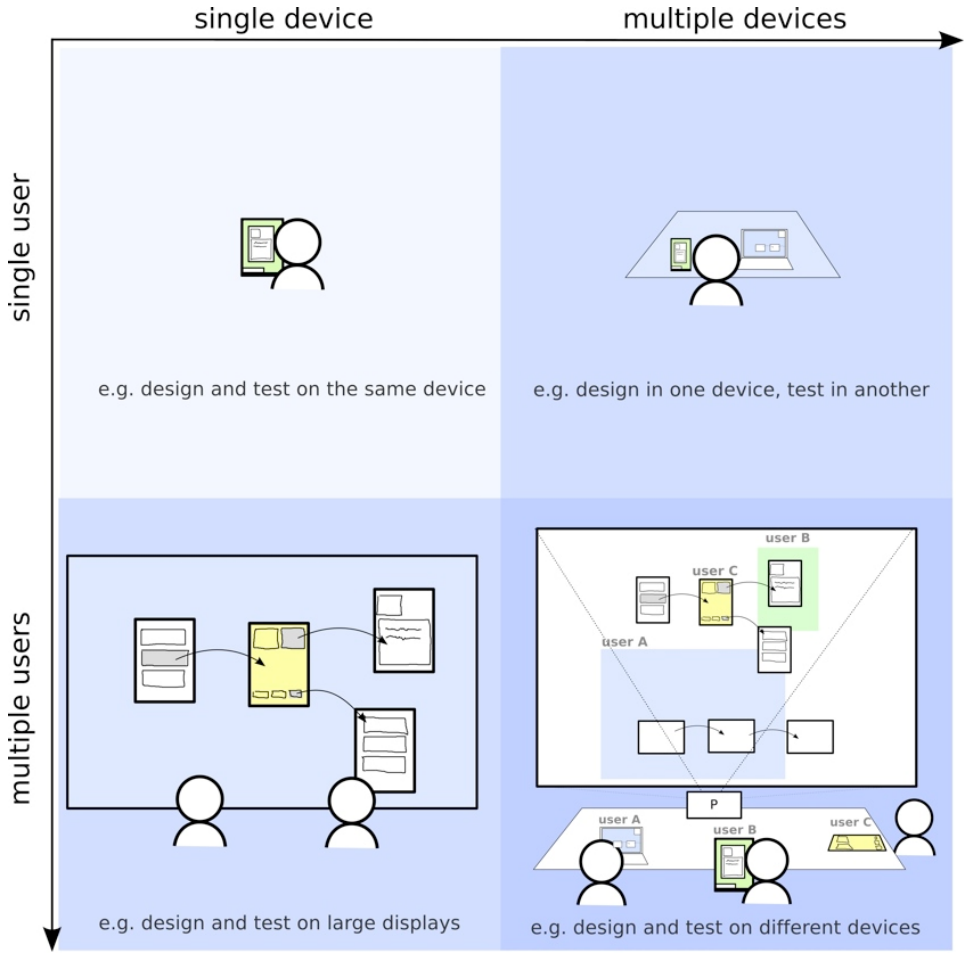
Source: Bill Buxton, Nicolai Marquardt, Saul Greenberg, and Sheelagh Carpendale, Sketching User ExperiencesMorgan Kaufmann

Prototyping life cycle

- Tips for discussing/reflecting
  - Sort comments by
    - Frequency
    - Importance
    - Criticity
    - Inter-dependence
  - Report them
  - Apply Pareto rule: 80-20

UI Prototyping configurations

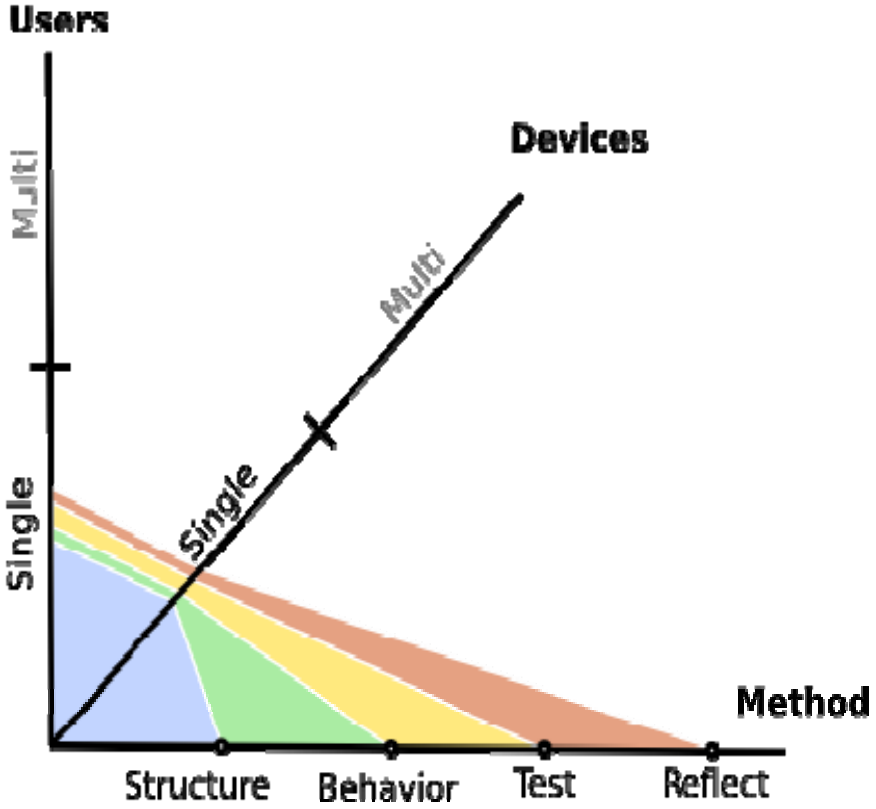
The whole space



UI Prototyping configurations

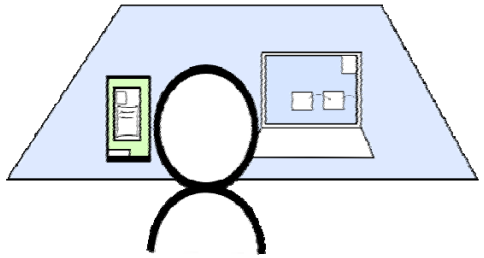
- Single user, Single device

e.g. design and test on the same device

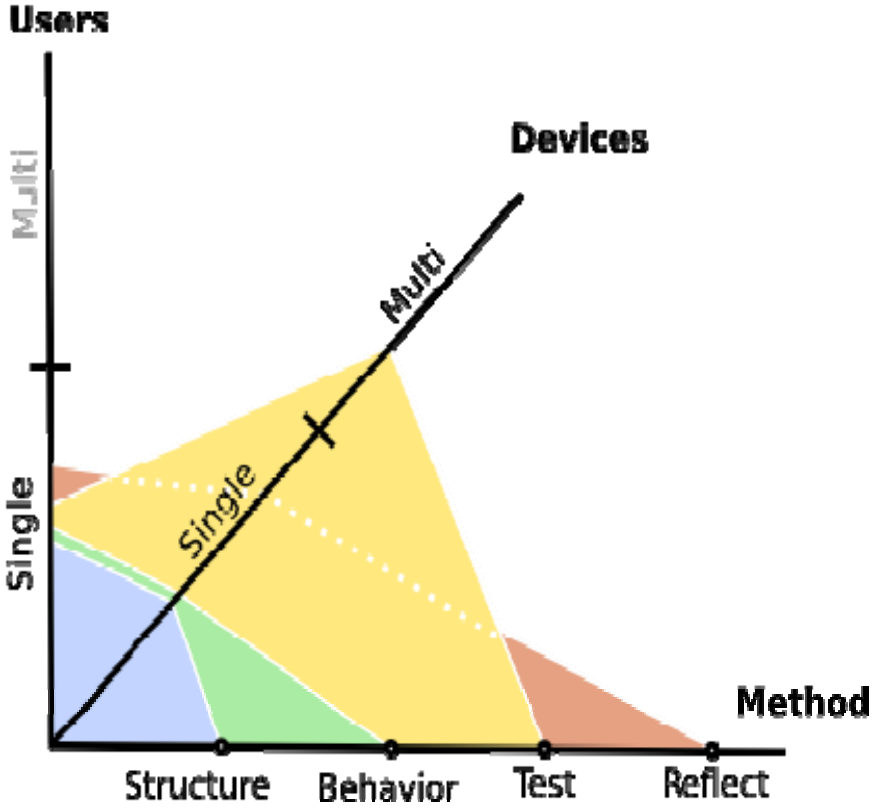


UI Prototyping configurations

- Single user, multiple devices

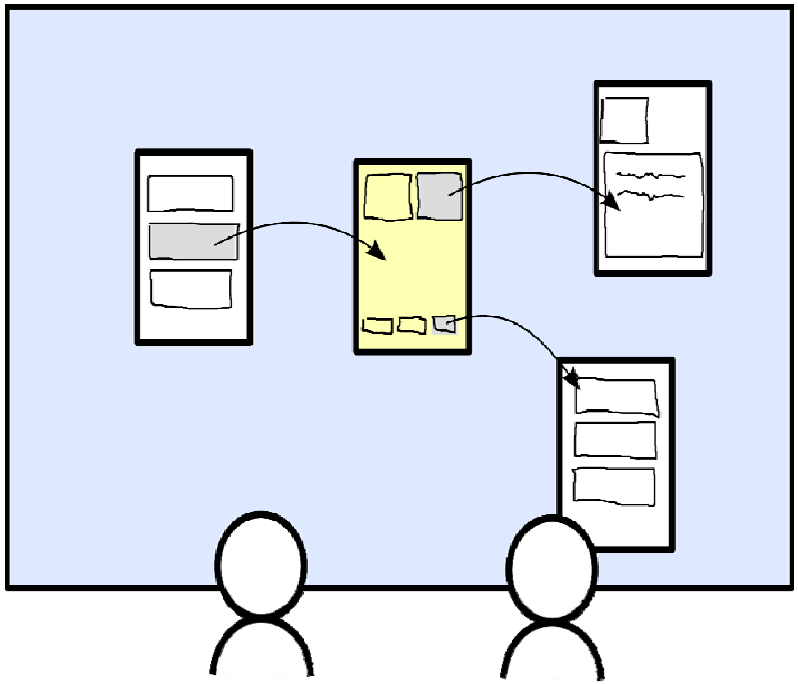


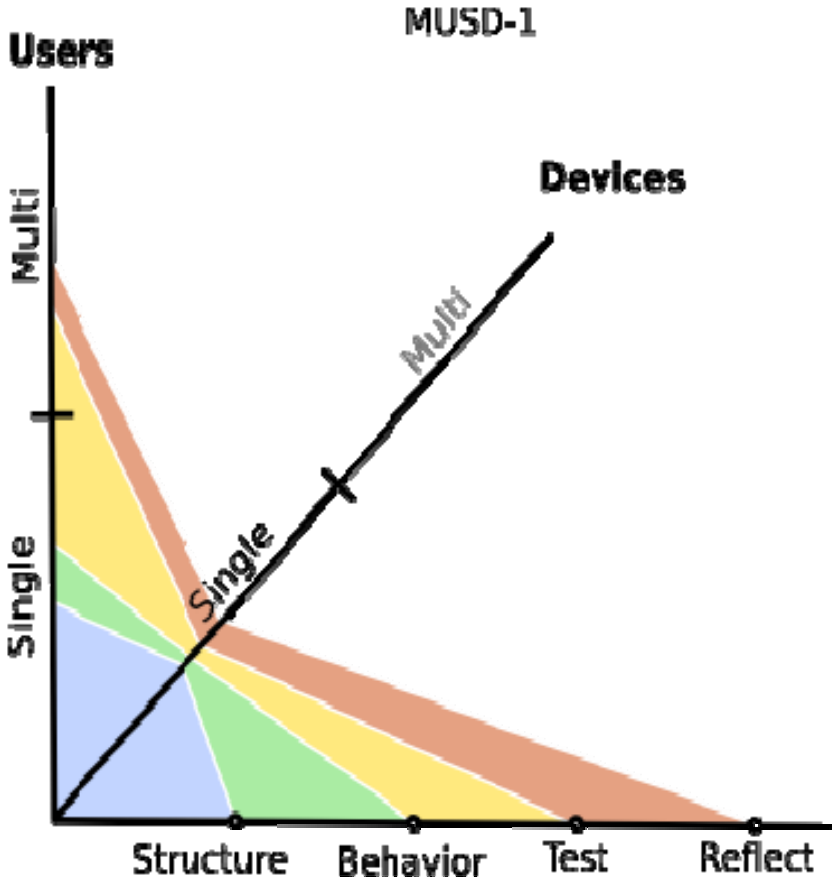
e.g. design in one device, test in another



UI Prototyping configurations

- Multiple users, single device

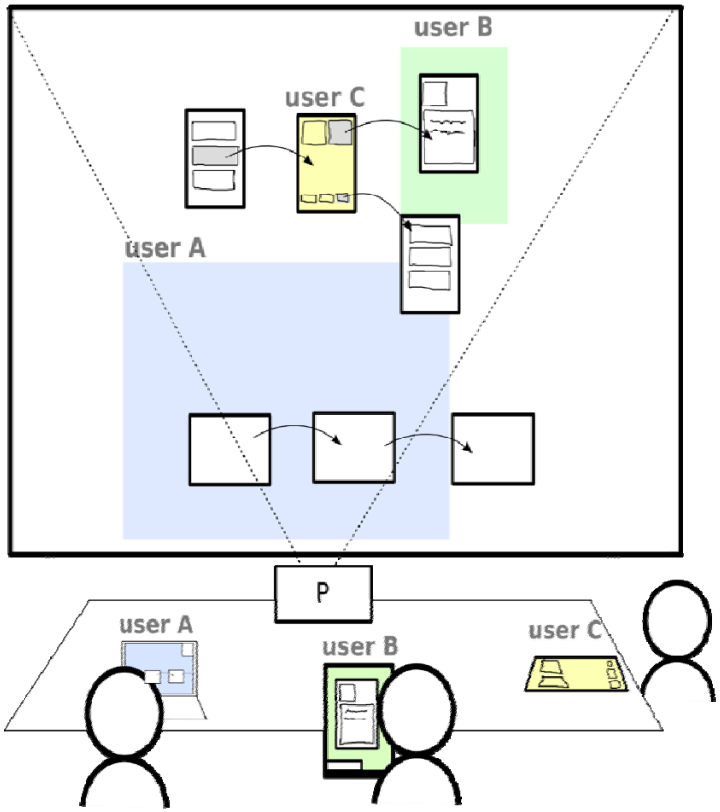




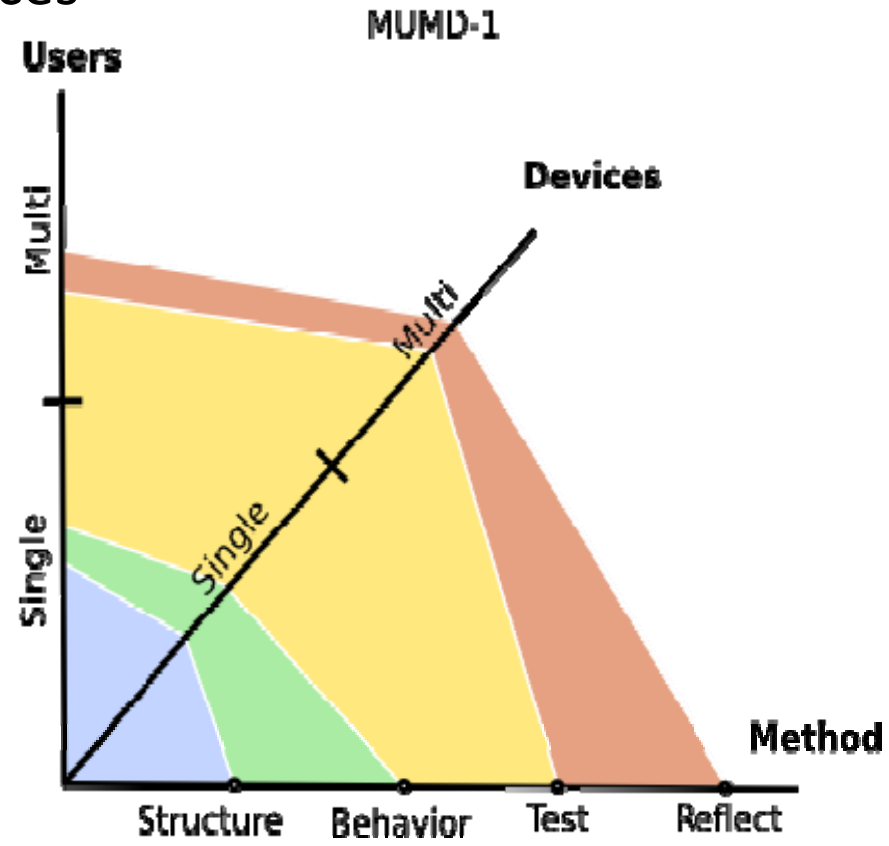
e.g. design and test on large displays

UI Prototyping configurations

- Multiple users, multiple devices



e.g. design and test on different devices



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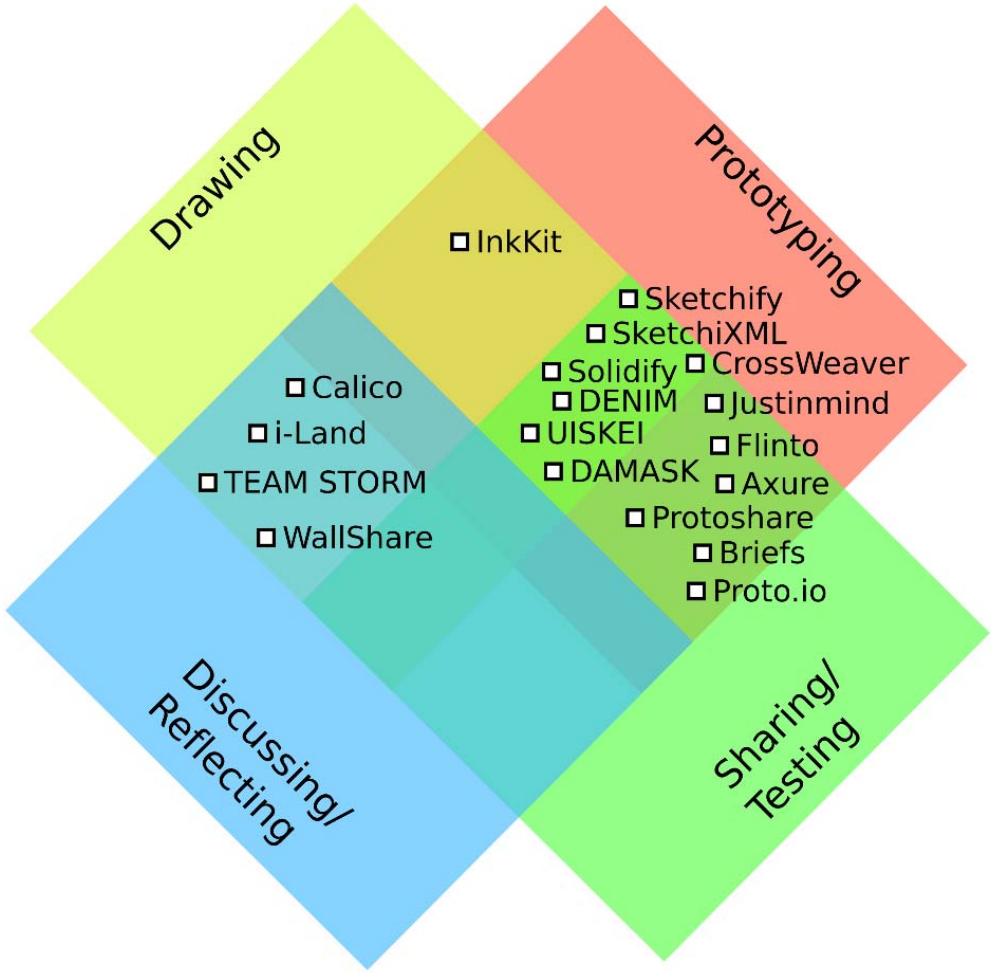
Who? What? Why? Where? When? How? By what means?

What are the means to prototyping UIs?

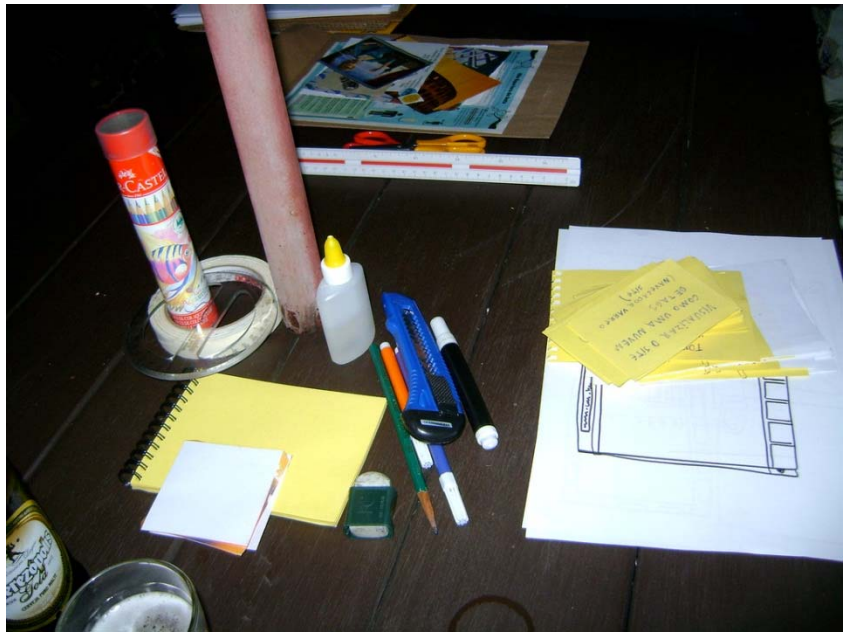
Coverage of the four steps by software



What are the means to prototyping UIs?

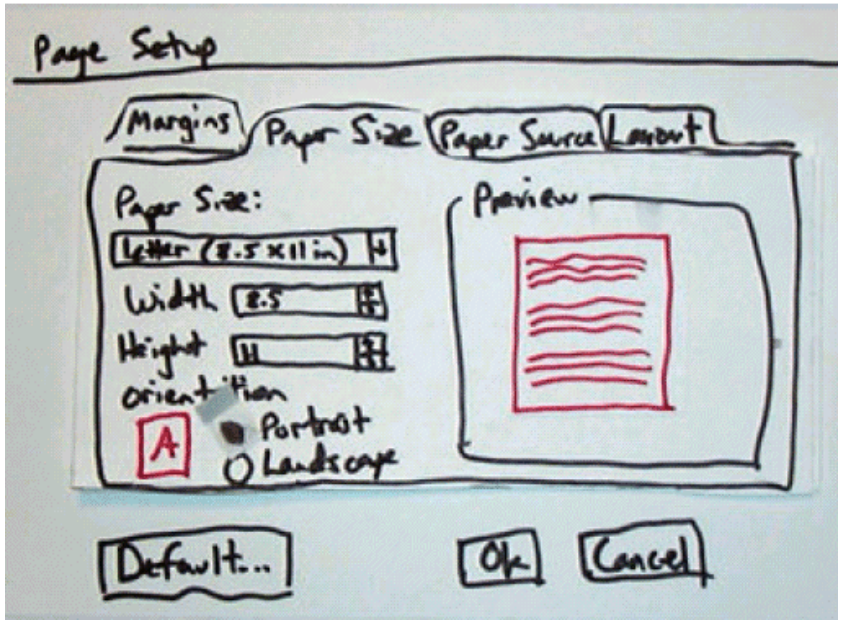
Physical means

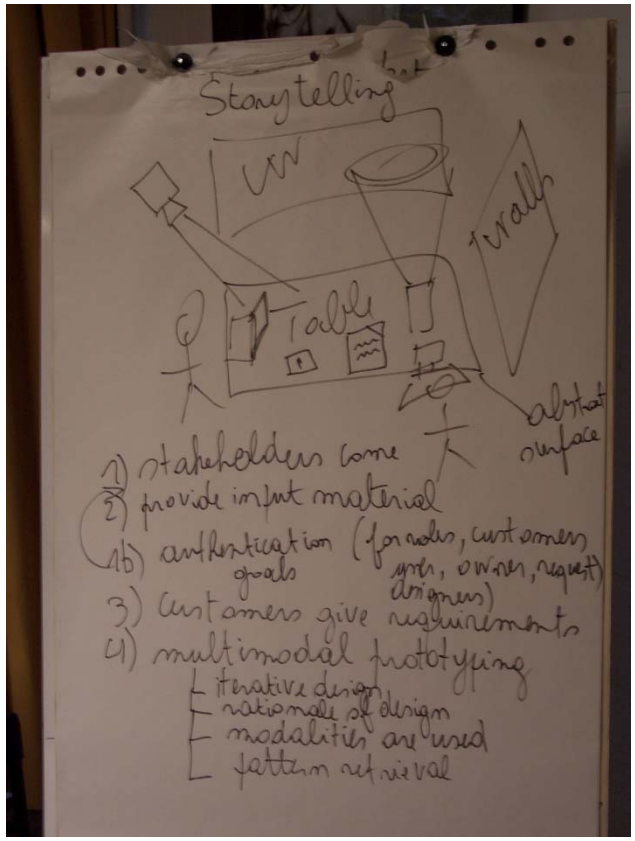
- Large, heavy, white paper (A3 or 11x17)
- 5x8 in./A5/A6 index cards
- Tape, stick glue, correction tape
- Pens & markers (many colors & sizes)
- Color Post-its
- Highlighters
- Eraser, typex®
- Overhead transparencies
- Scissors
- X-acto knives, etc.



What are the means to prototyping UIs?

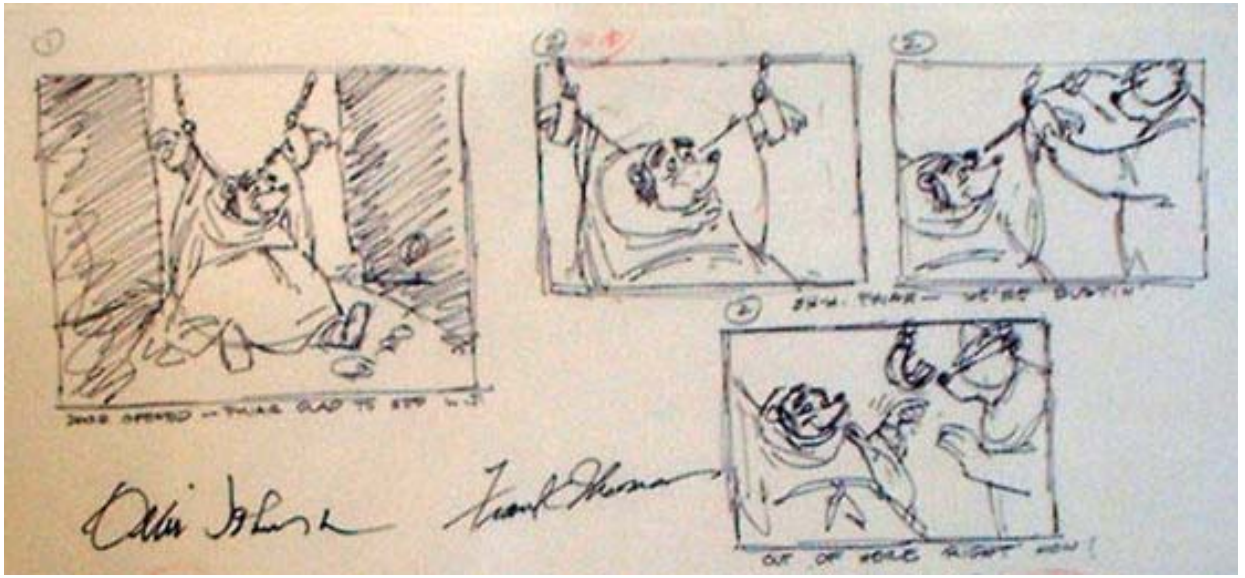
Physical means: whiteboard (paper or physical),…





What are the means to prototyping UIs?

- Storyboard = a series of key frames as sketches
  - originally from film; used to get the idea of a scene
  - snapshots of the interface at particular points in the interaction
- users can evaluate quickly the direction the interface is heading

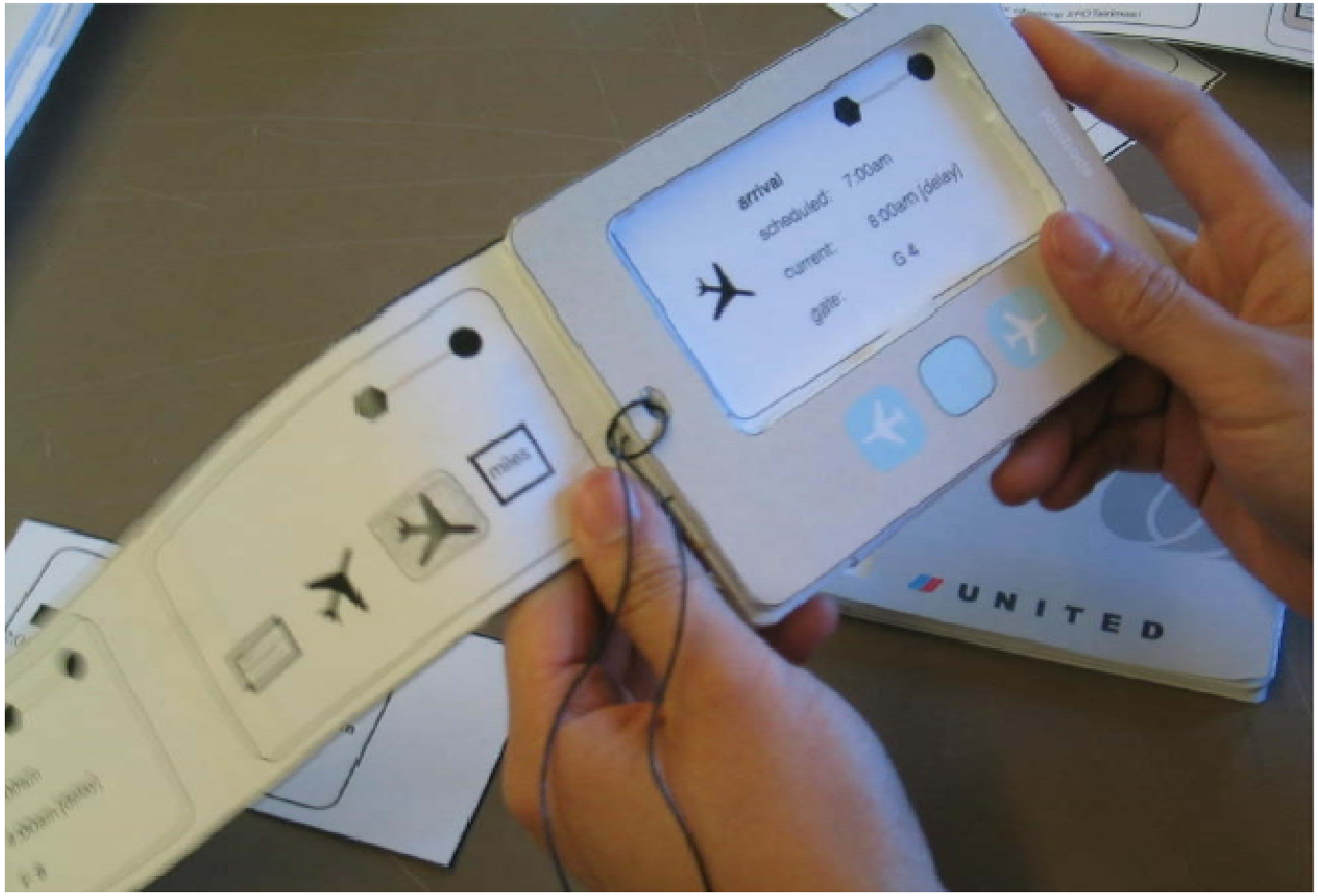


Excerpts from Disney's Robin Hood storyboard, www.animaart.com/Cellar/disneyart/90robin%20storyboard.jpg.html

What are the means to prototyping UIs?

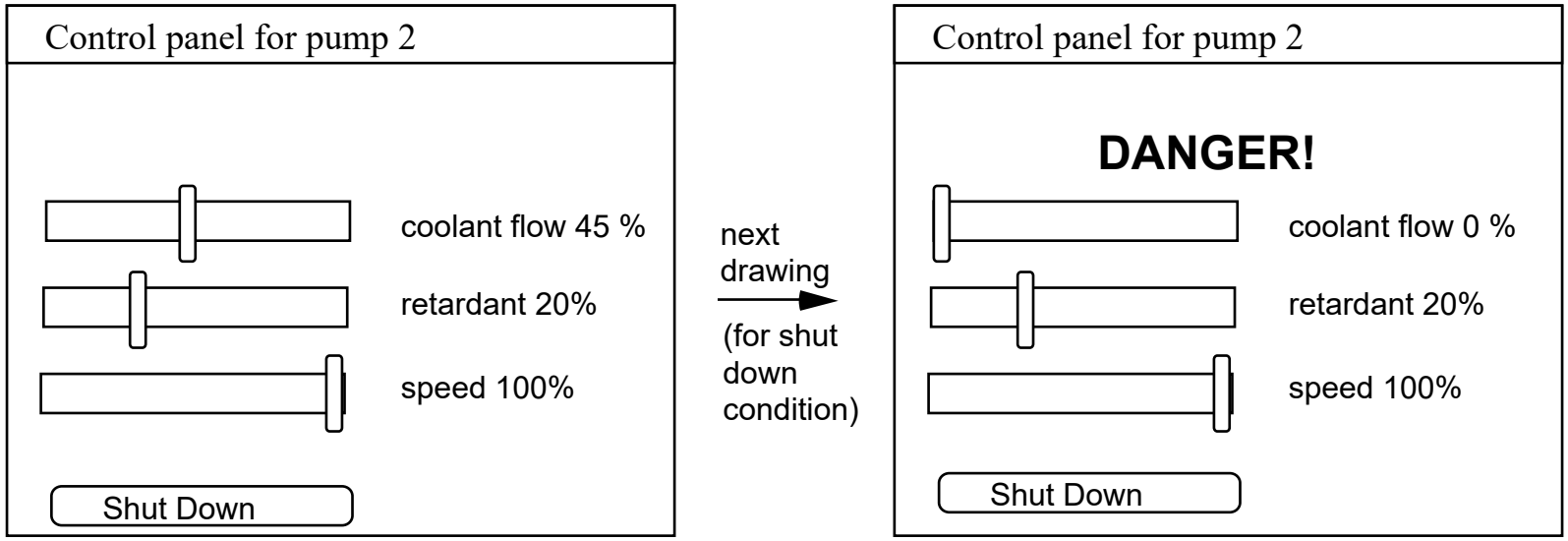
- Spotlight: an interactive foam core and paper sketch/storyboard Credit: Sue-Tze Tan, Dept Industrial Design, University of Washington

From Design for the Wild,
Bill Buxton



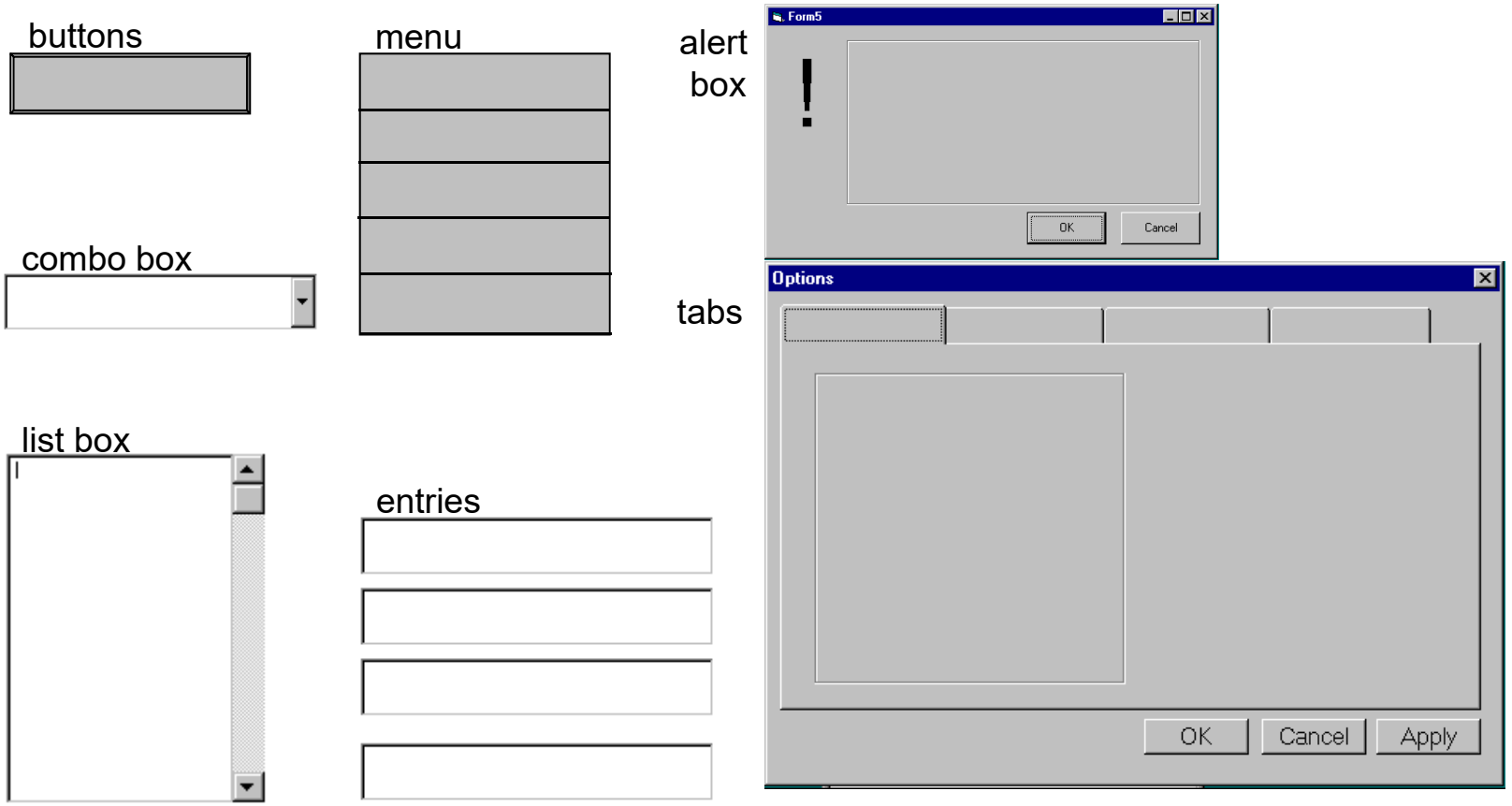
What are the means to prototyping UIs?

- Drawing/painting packages
  - Draw each storyboard scene on computer
  - Very thin horizontal prototype
  - Does not capture the interaction “feel”



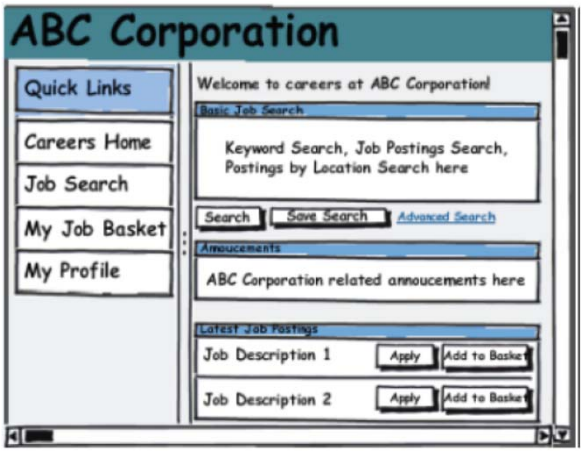
What are the means to prototyping UIs?

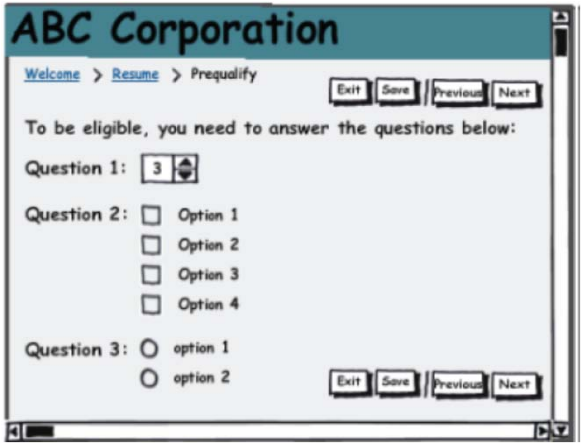
- Can pre-make paper interface components

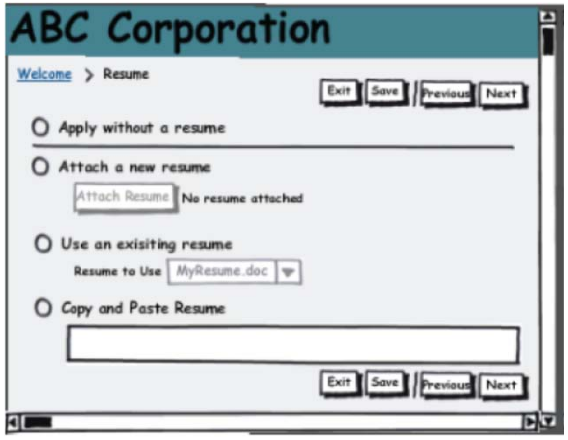


What are the means to prototyping UIs?

- www.balsamiq.com

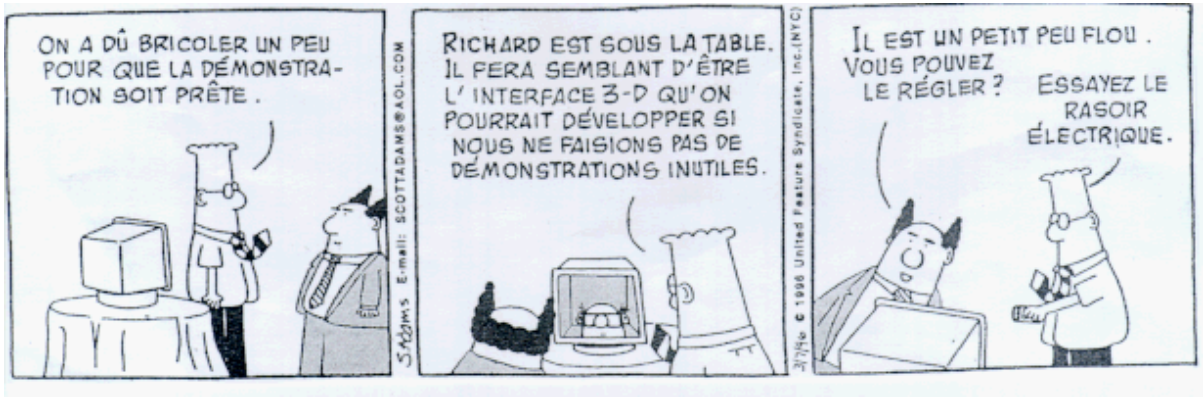






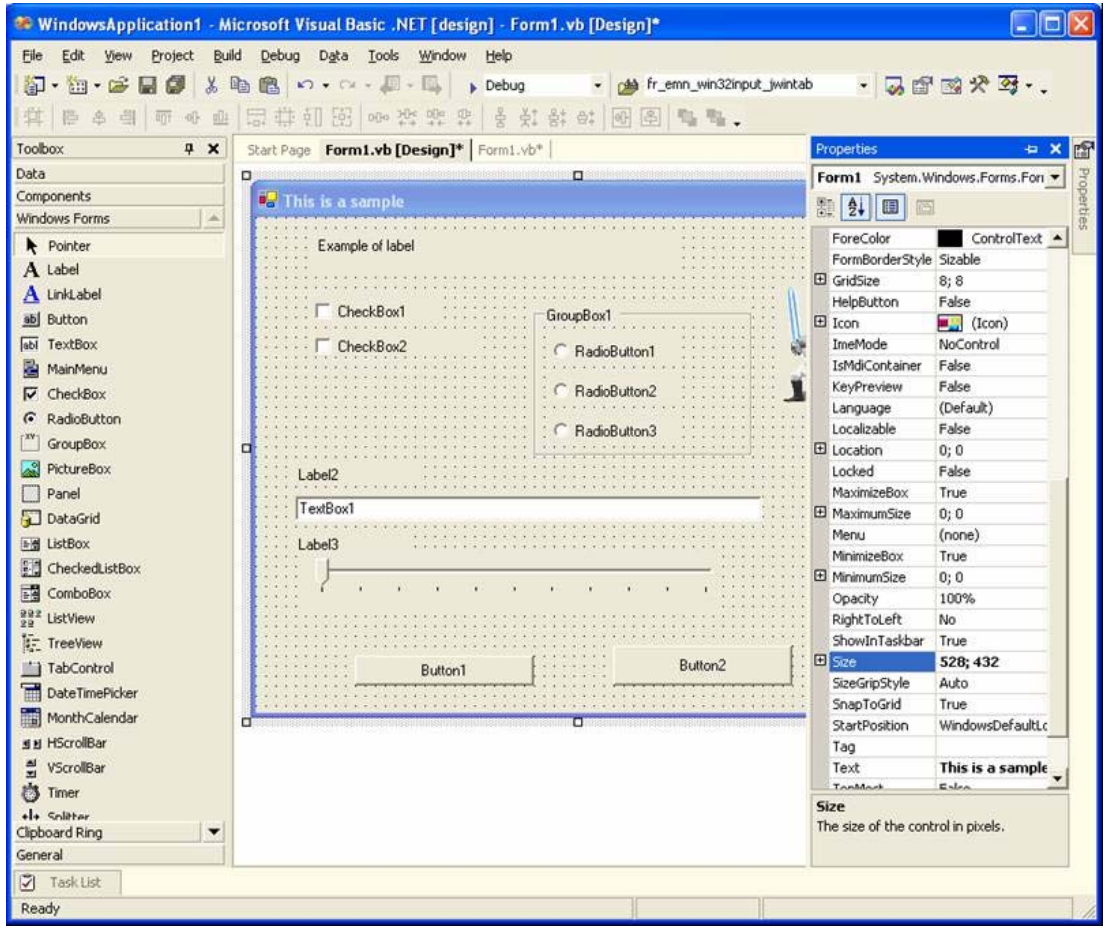
What are the means to prototyping UIs?

- Shortcomings of physical means
  - Hard to prototype dynamic, advanced aspects
    - Withing a screen, window, web page
    - Across screens, windows, and web pages
  - Hard to save the prototyping history
  - Hard to reproduce the final version for development
  - No transition towards development
  - Multiple interpretations possible



What are the means to prototyping UIs?

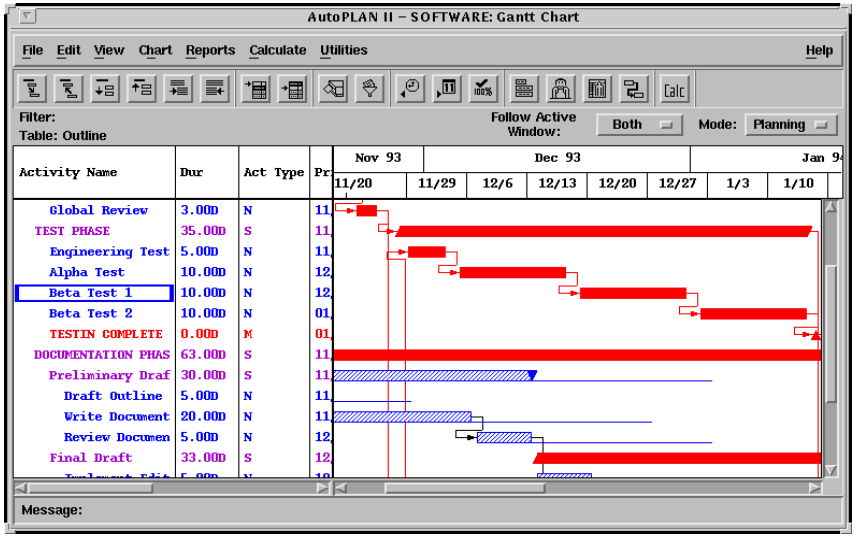
- User Interface builders



What are the means to prototyping UIs?

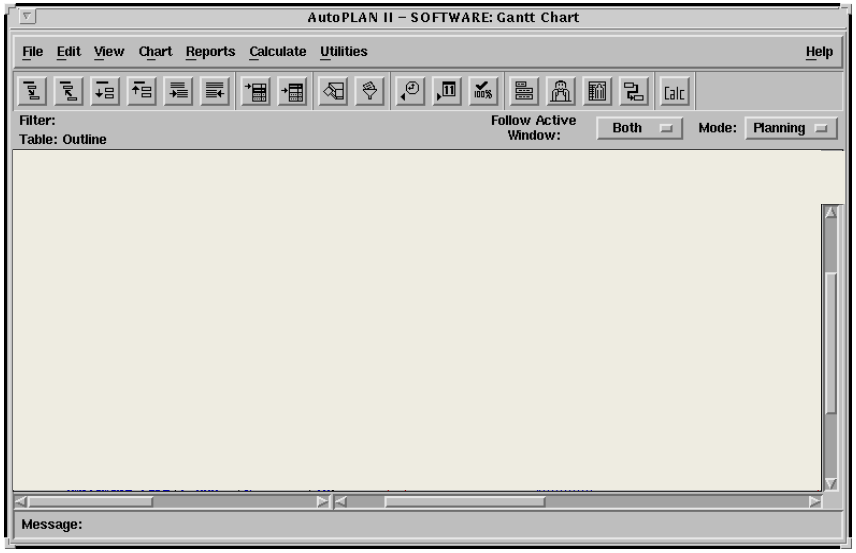
- Shortcoming of UI builders

Desired UI



- Tables with dynamic data
- Gantt chart
- Direct manipulation of tasks

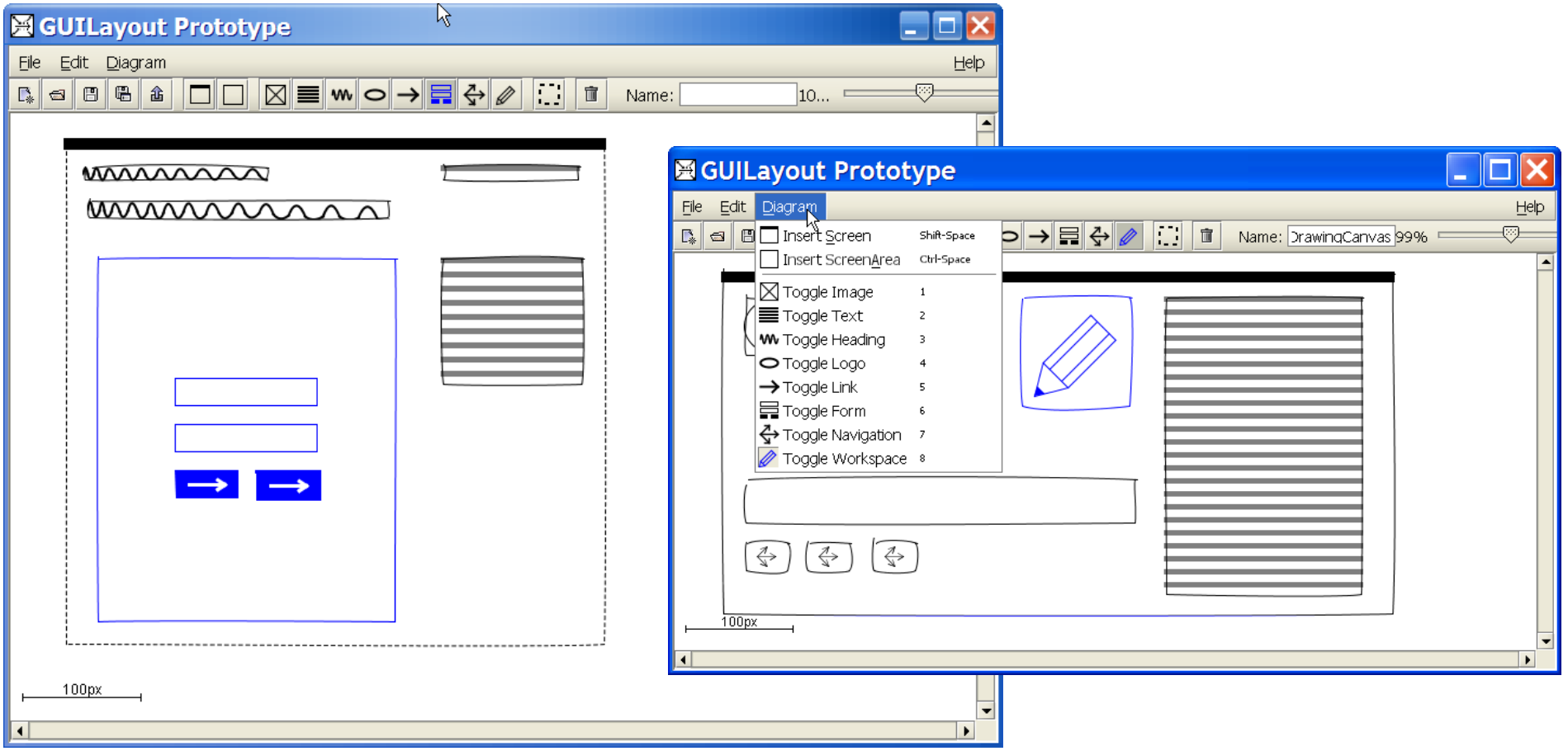
Obtained UI



- Window with menu bar
- Toolboar with icons
- Static controls: list boxes, push buttons,
- No navigation

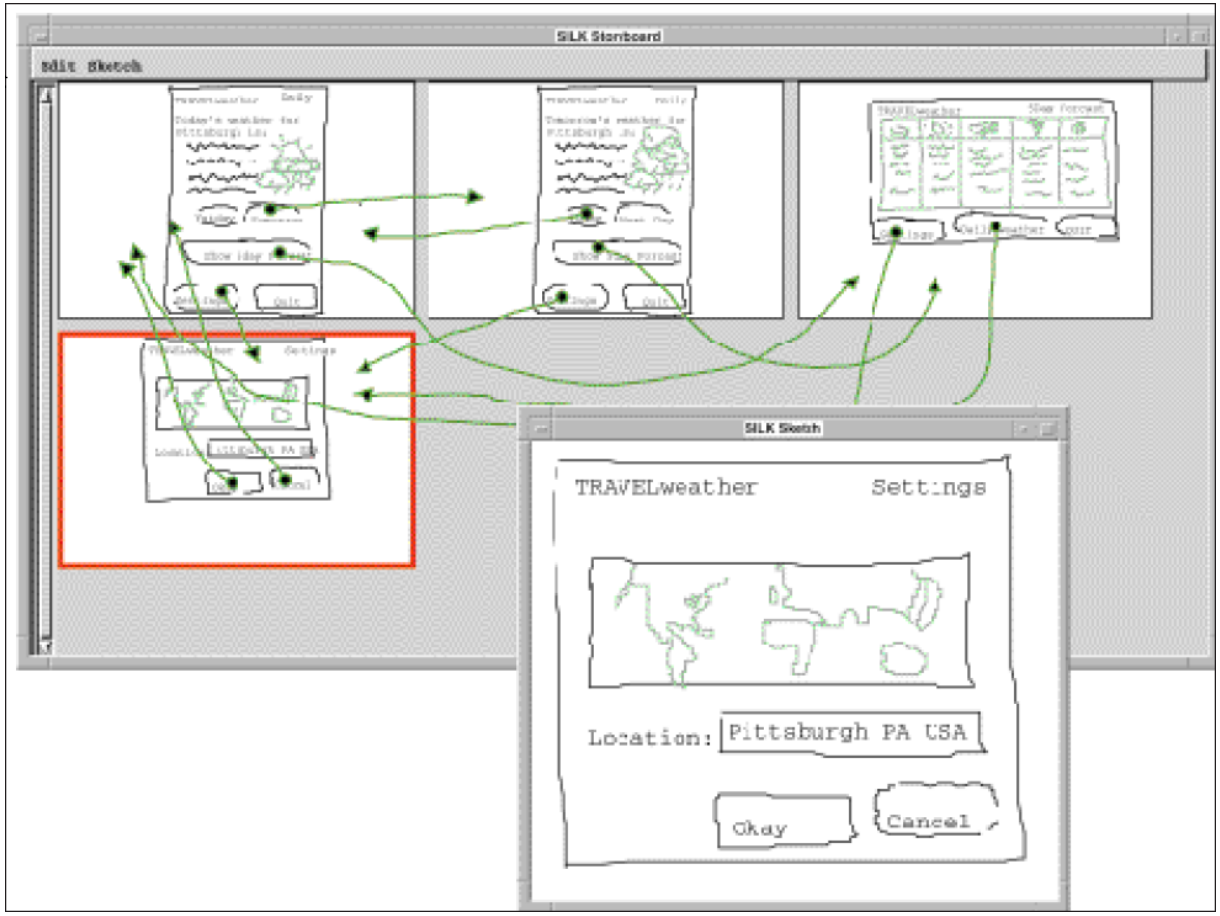
What are the means to prototyping UIs?

- GUILayout++



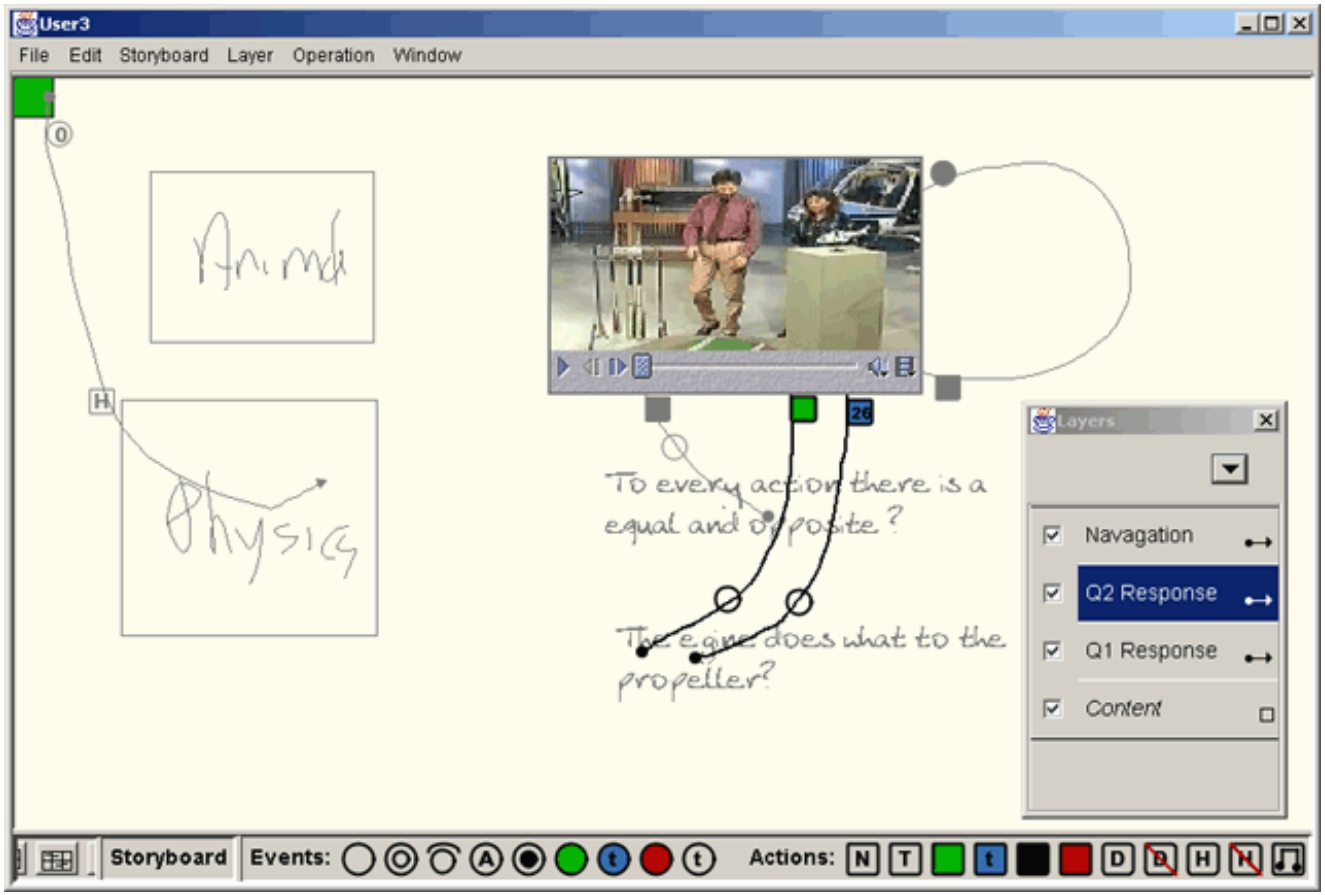
What are the means to prototyping UIs?

- SILK



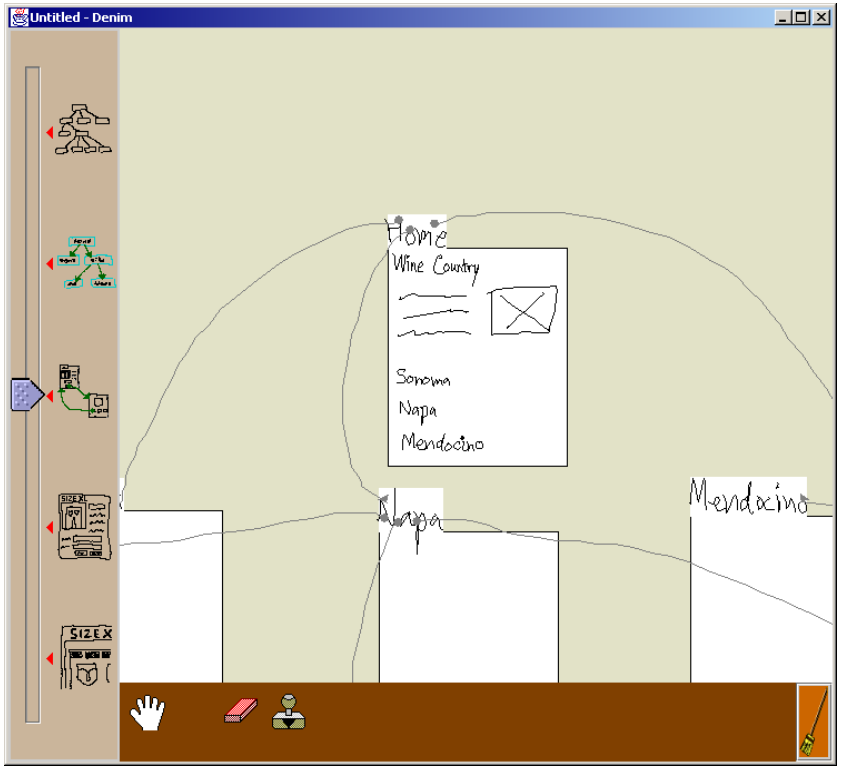
What are the means to prototyping UIs?

- DEMAIS: for multimedia UIs



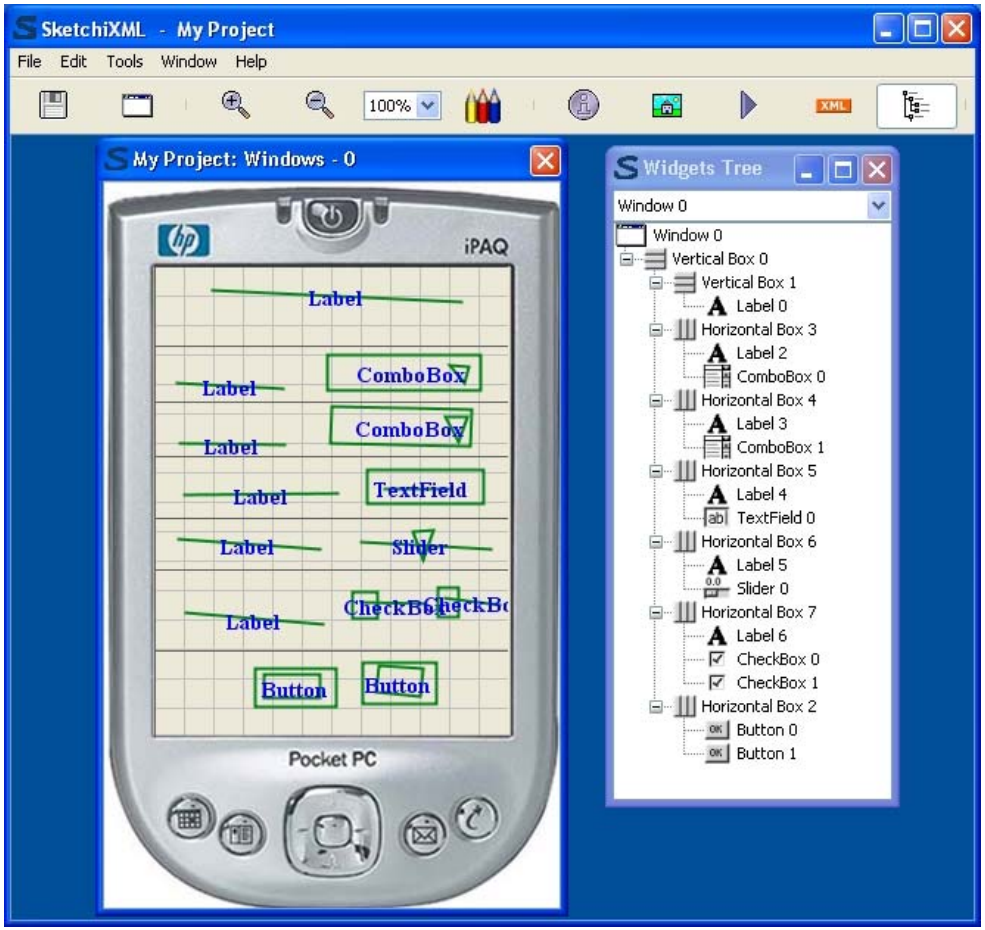
What are the means to prototyping UIs?

- DENIM: for web pages, no recognition



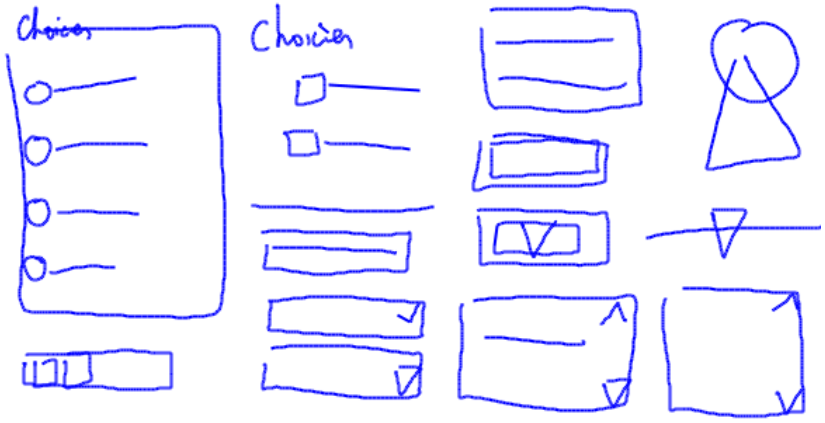
What are the means to prototyping UIs?

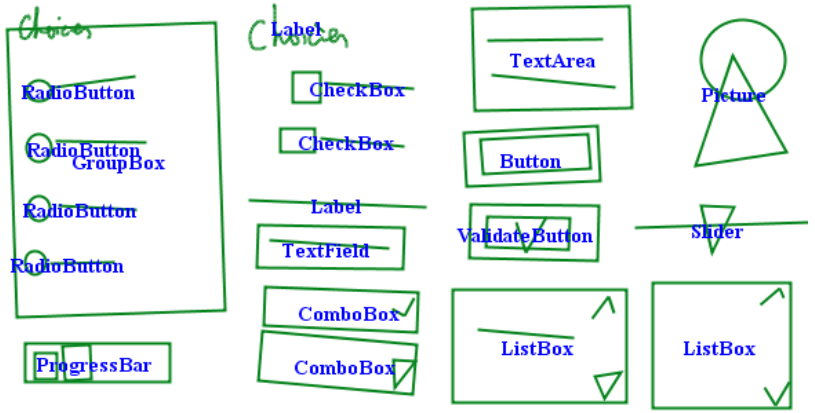
- SketchiXML: for any UI, with sketch recognition, code generation

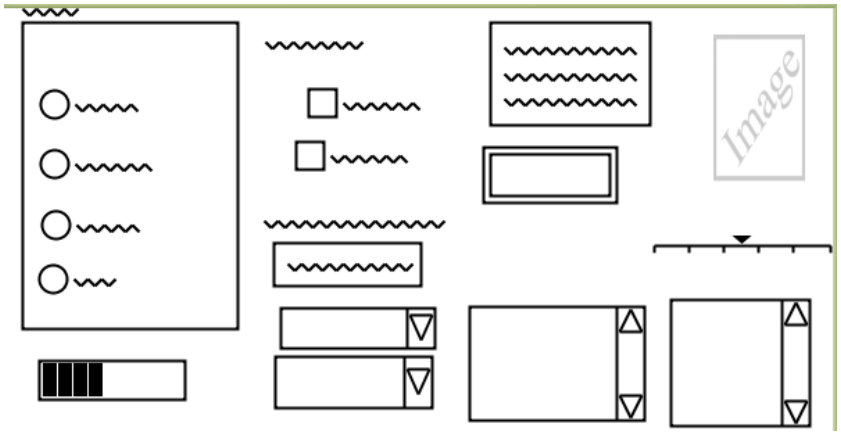


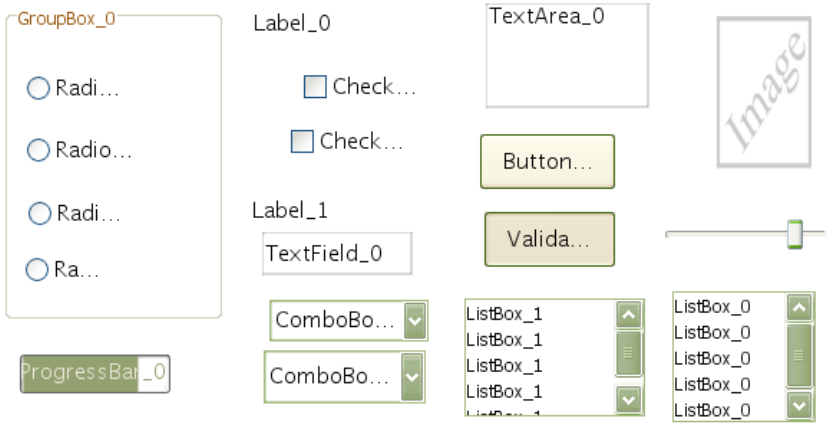
What are the means to prototyping UIs?

- SketchiXML: for any UI, multi-fidelity



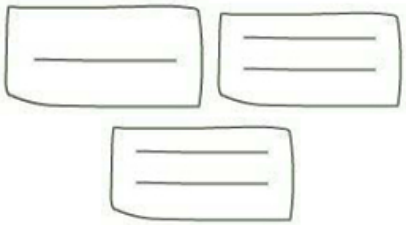






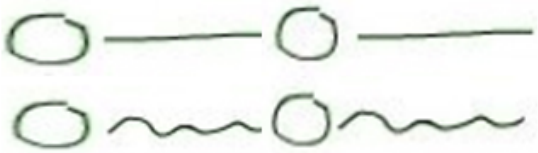
What are the means to prototyping UIs?

- SketchiXML: gestures for sketching widgets

Widget Type	Graphical Representation	Sketching propositions	Supported by SketchiXML
Text	This is text		✓
TextField			✓
TextArea			✓
Button	Button		✓
Search Field	submit		✓

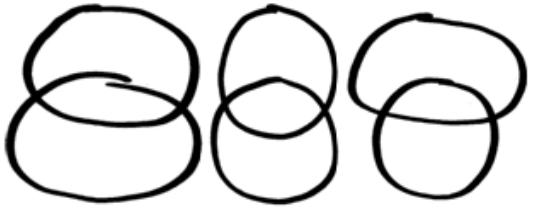
What are the means to prototyping UIs?

- SketchiXML: gestures for sketching widgets

Login	User name Password Log in		✓
Log out	Log out		✓
Reset Form	Reset		✗
Validate	Validate		✓
RadioButton	Radio Button		✓

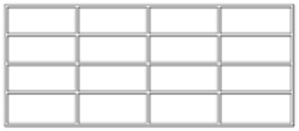
What are the means to prototyping UIs?

- SketchiXML: gestures for sketching widgets

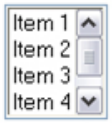
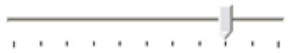
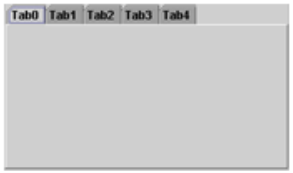
CheckBox	Check Box		✓
Combobox			✓
Image	Image		✓
Multi Media Area	Multi-media		✓
Layer			✗

What are the means to prototyping UIs?

- SketchiXML: gestures for sketching widgets

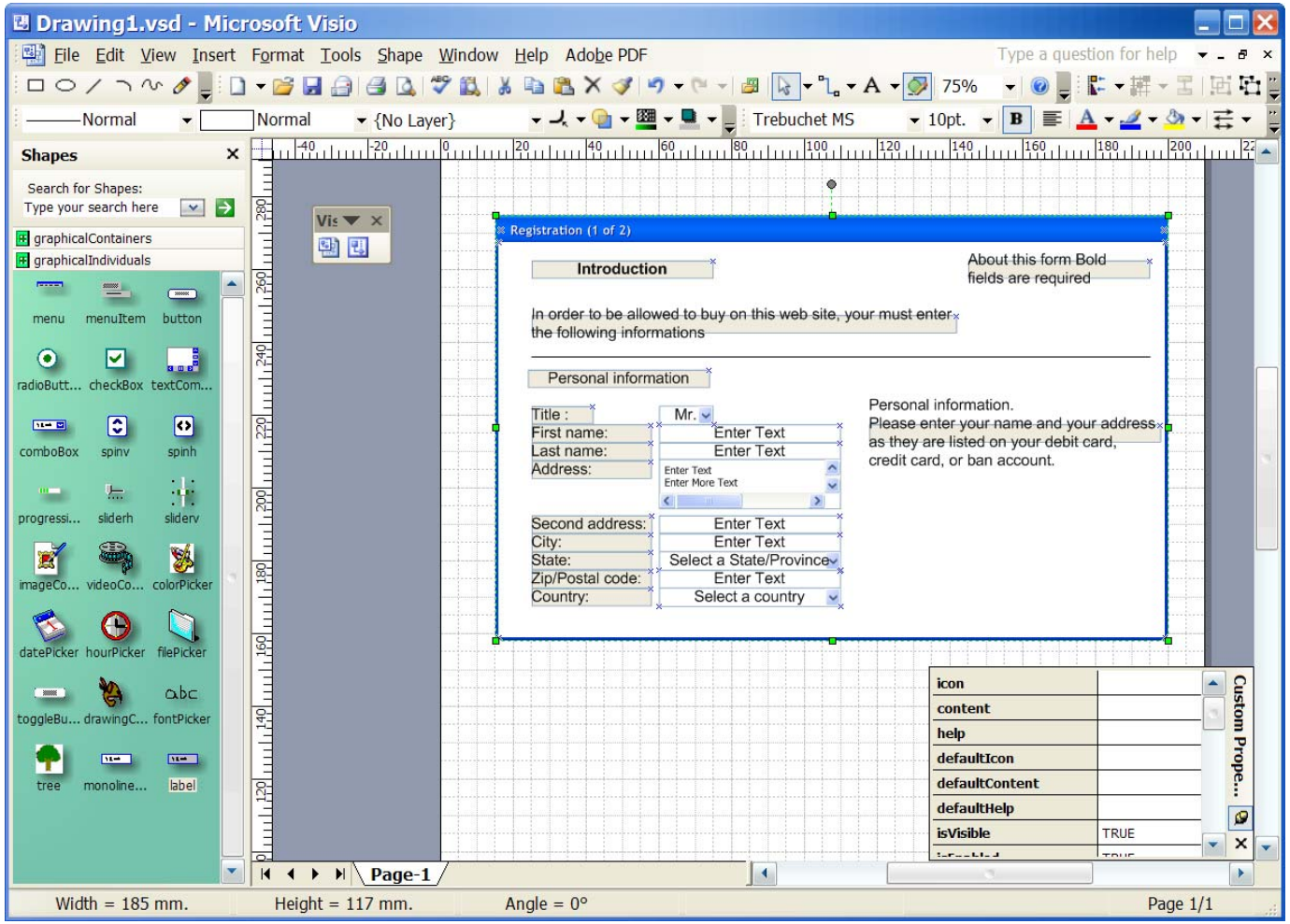
Group Box			✓
Table			✗
Separator			✗
Frames (Box)			✓
Hyperlink	Hyperlink		✓
Anchor			✗

What are the means to prototyping UIs?

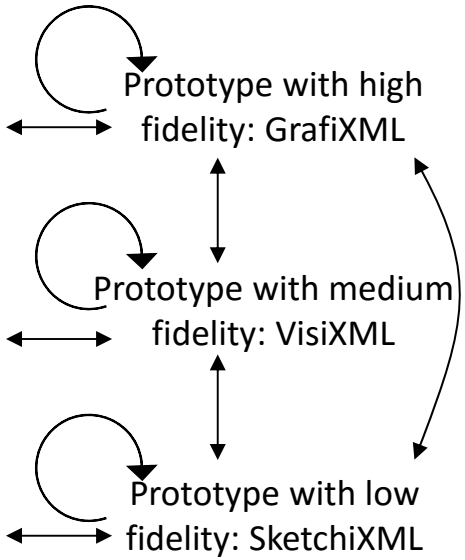
Menu			✓
ListBox			✓
Hour Picker			✓
Toggle Button			✓
Slider			✓
Progress Bar			✓
TabDialog Box			✗

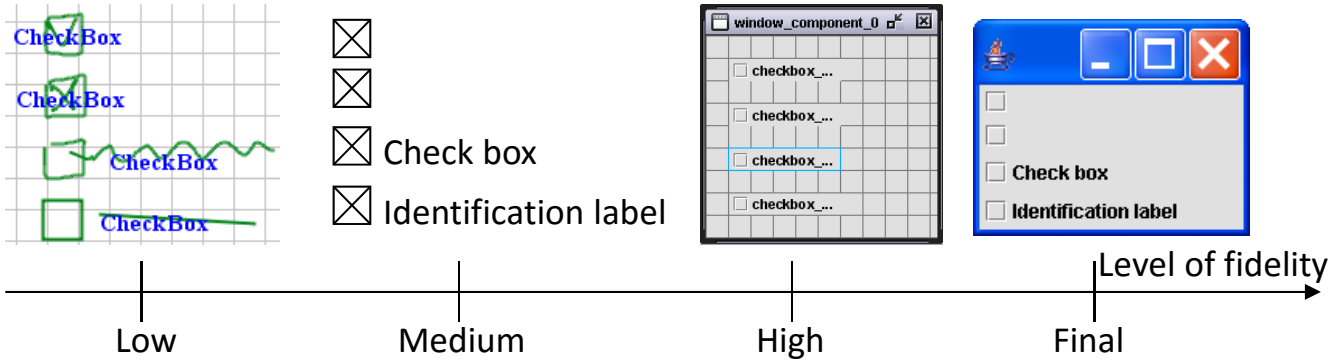
What are the means to prototyping UIs?

- Microsoft Visio: stencils for various Windows UI versions



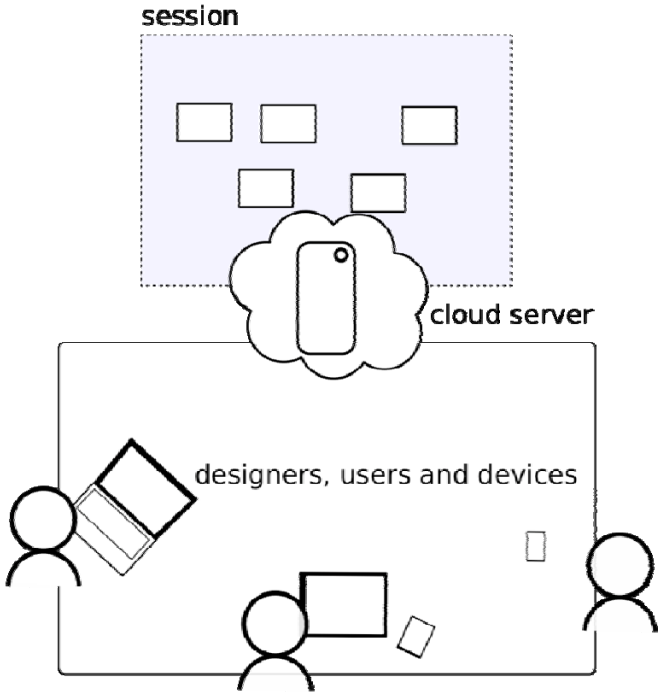
What are the means to prototyping UIs?

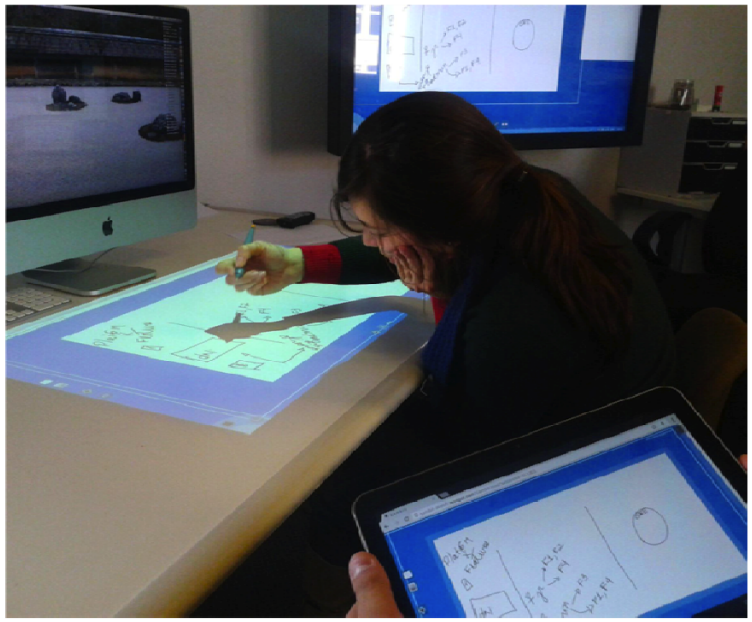




What are the means to prototyping UIs?

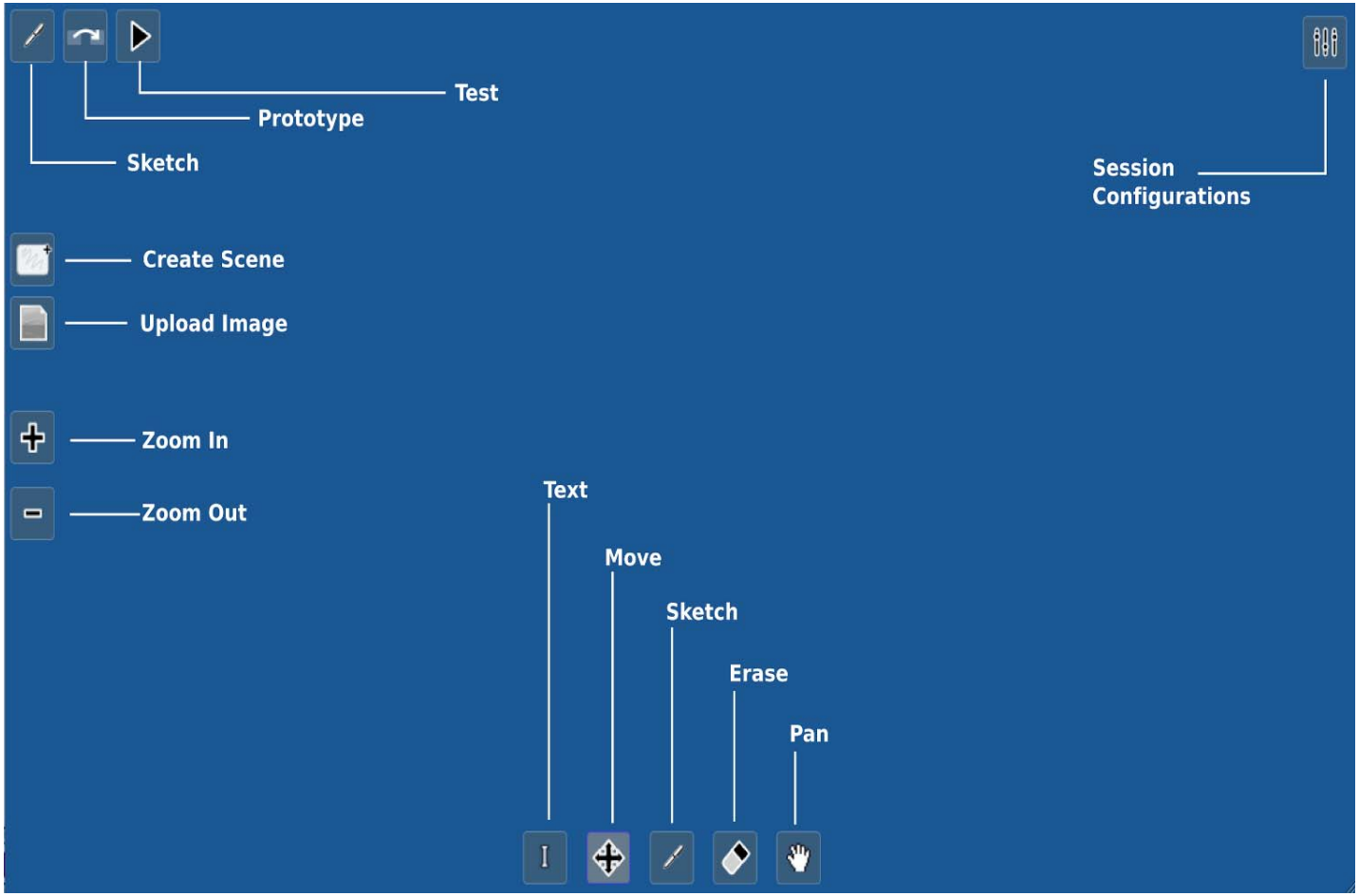
GAMBIT:
http://gambitexperience.appspot.com/





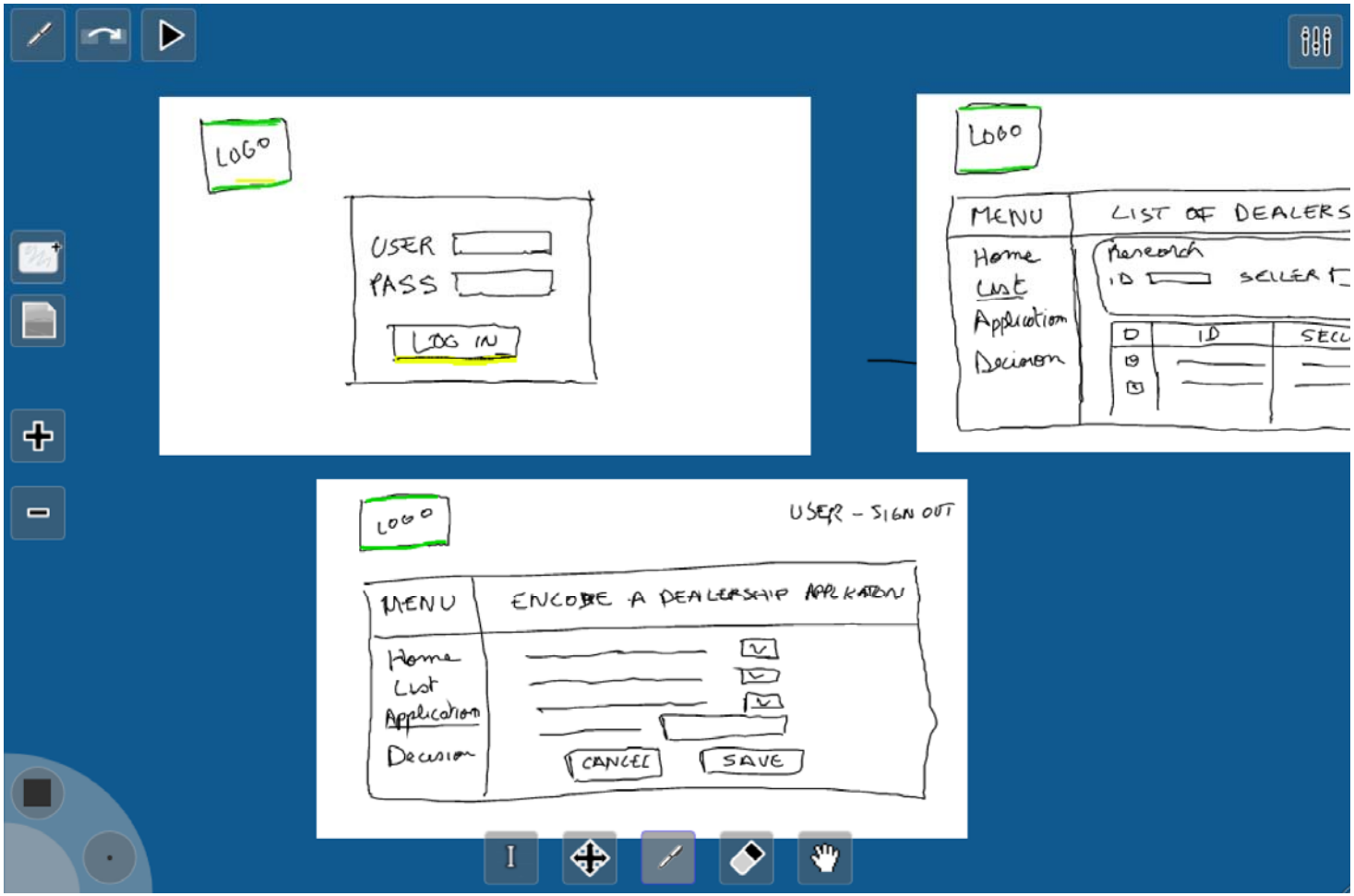
What are the means to prototyping UIs?

GAMBIT



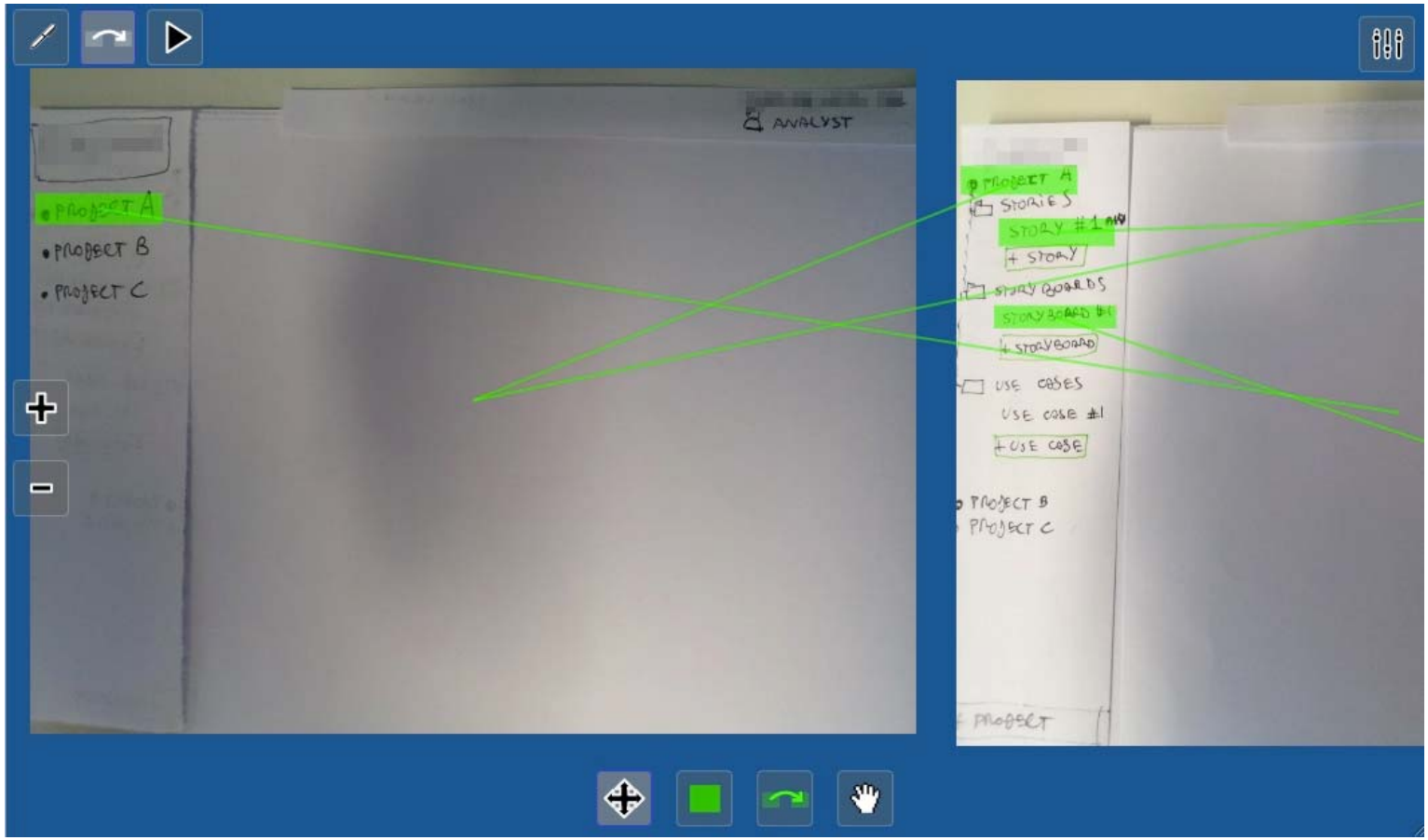
What are the means to prototyping UIs?

1- Define Structure



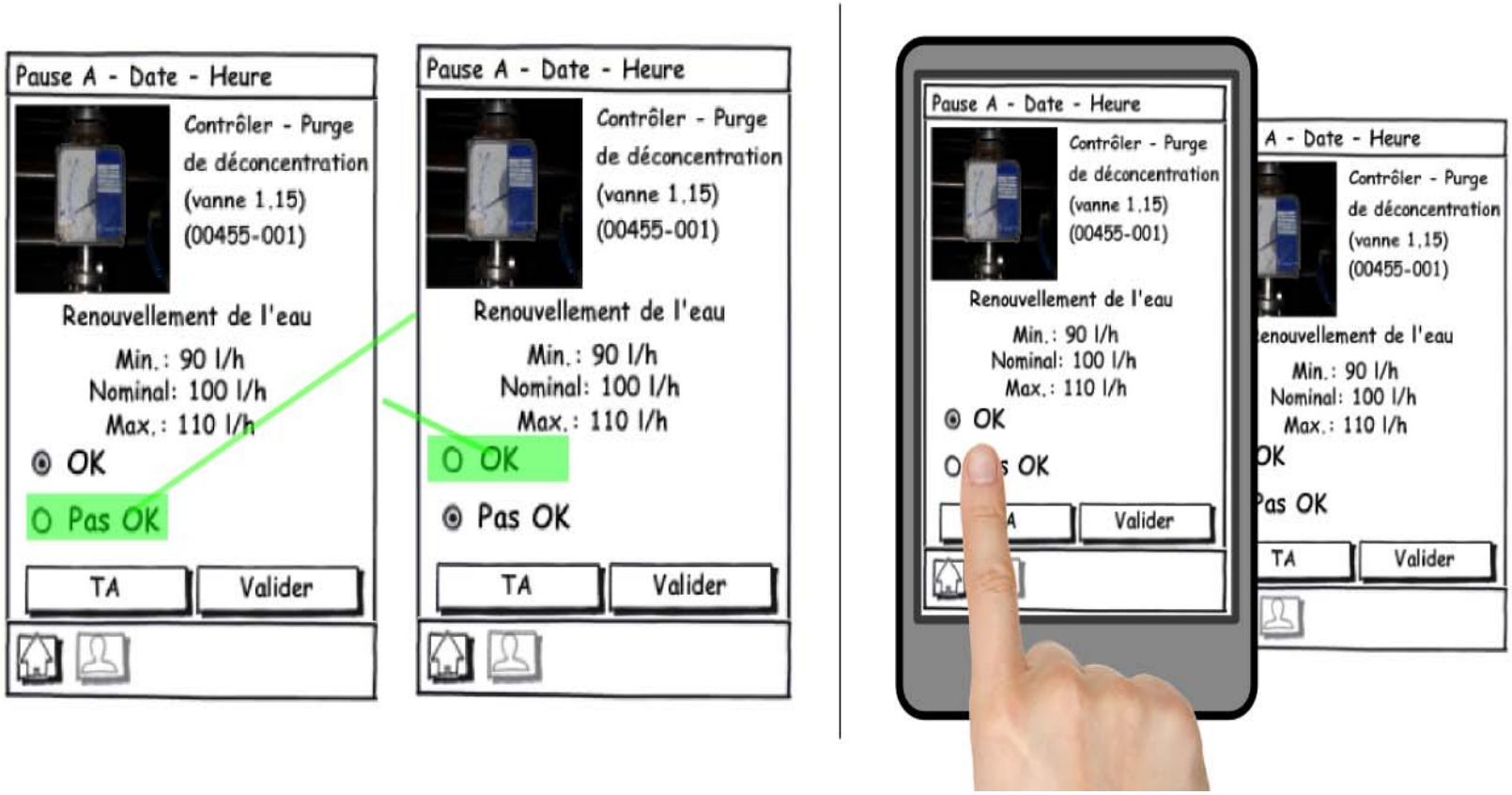
What are the means to prototyping UIs?

2- Define Behavior



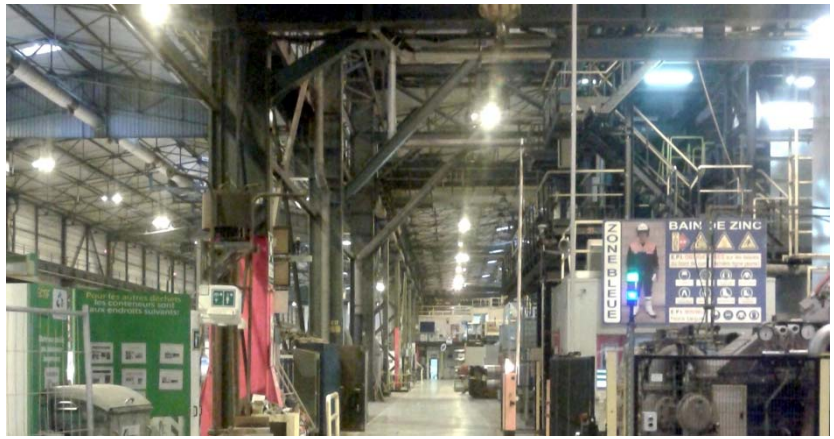
What are the means to prototyping UIs?

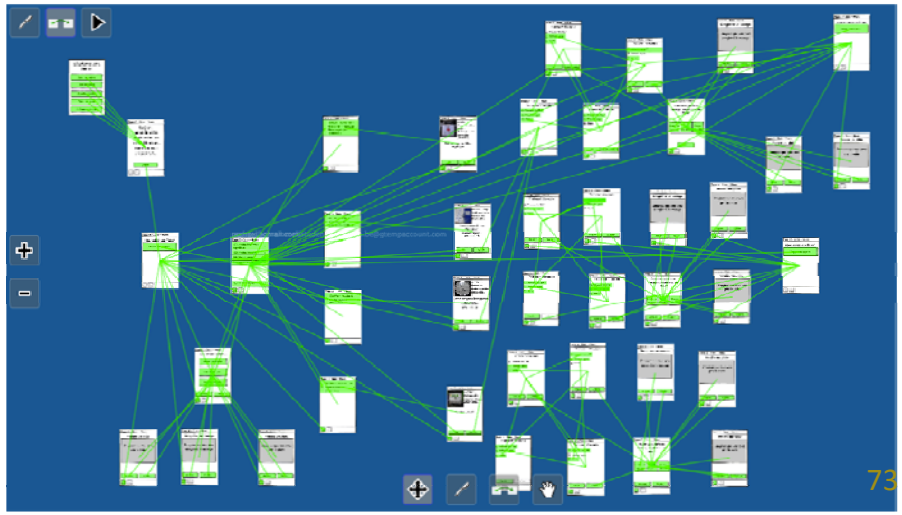
3- Test



What are the means to prototyping UIs?

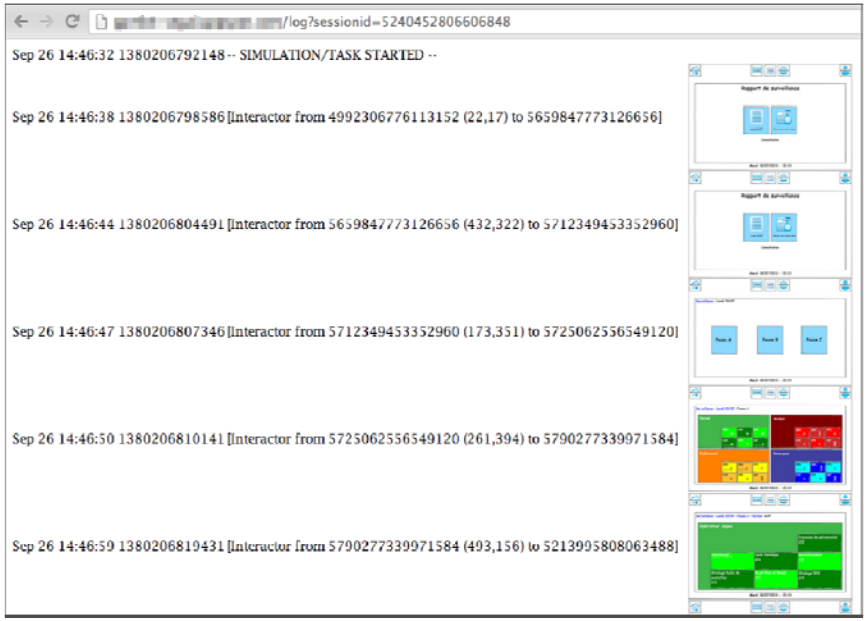
3- Test



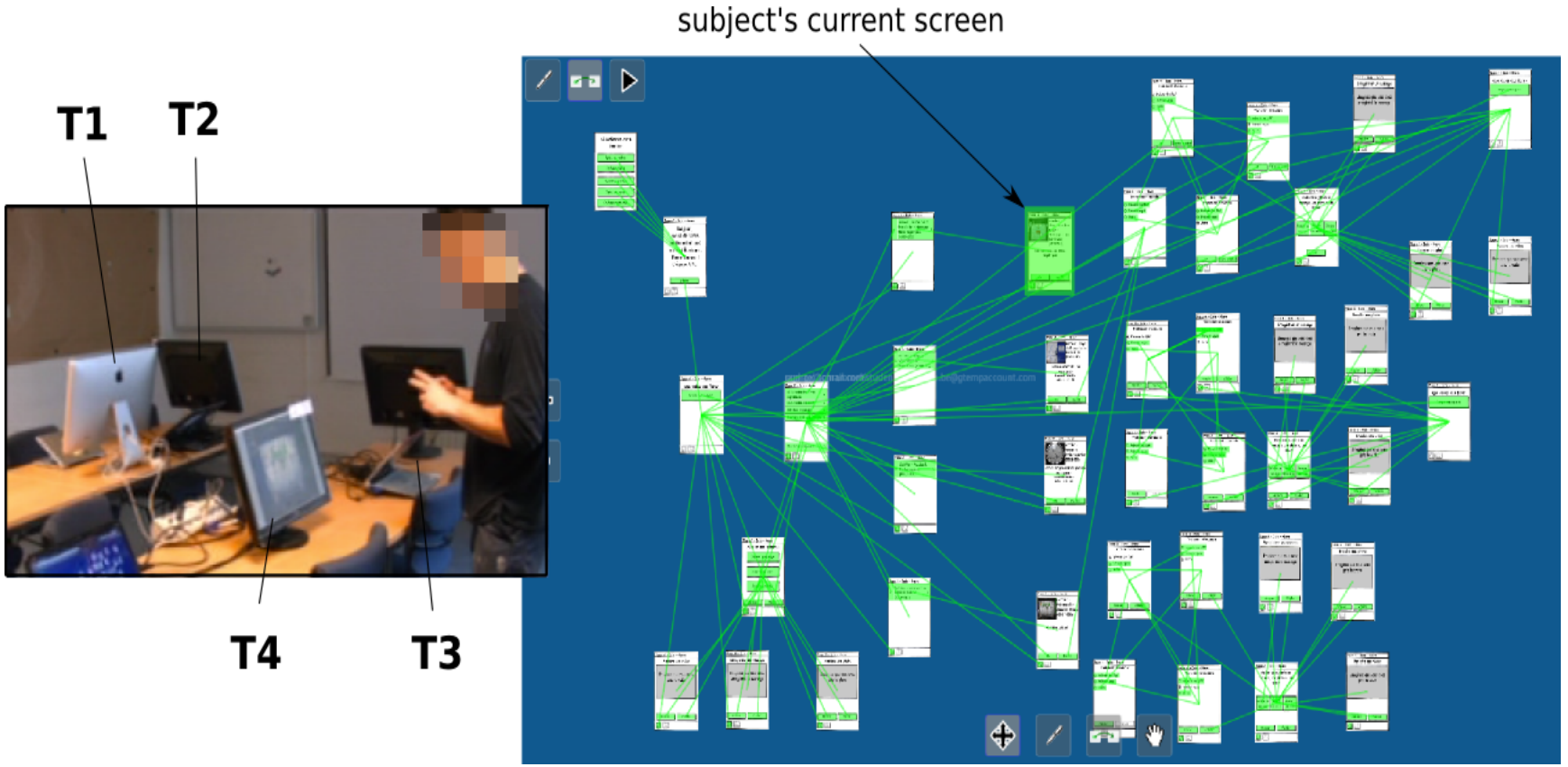


What are the means to prototyping UIs?

4- Reflect

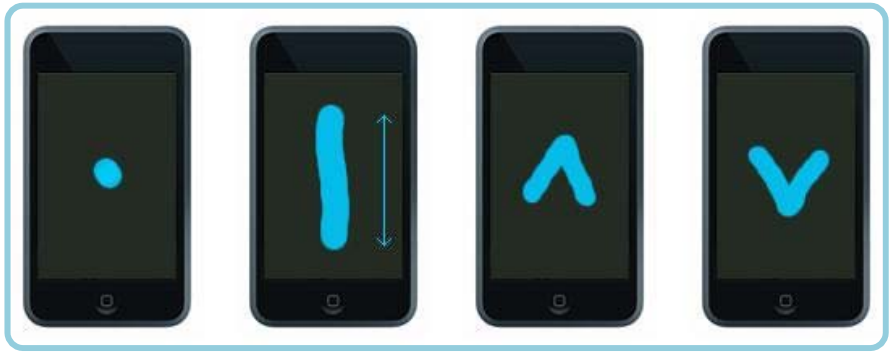


What are the means to prototyping UIs?



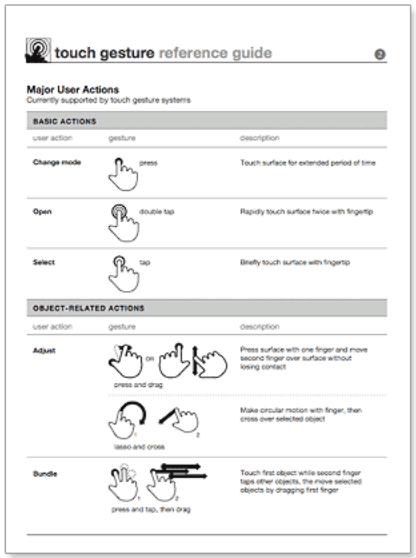
Gestural UI prototyping

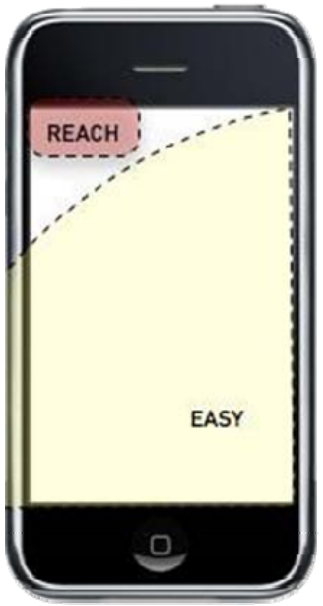
- Gesture = physical movement that can be detected by digital device, without additional hardware, such as mouse or pen
- Usability guidelines
  - Avoid Repetition
  - Refrain from using hard-to-do gestures
  - Use standard gestures:
    - Tap to activate
    - Tap to select
    - Drag to move
    - Slide for scrolling
    - Pitch/Shrink to zoom in/zoom out
  - Hit zones should be large enough (1-2 cm)
  - Enough room between hit zones



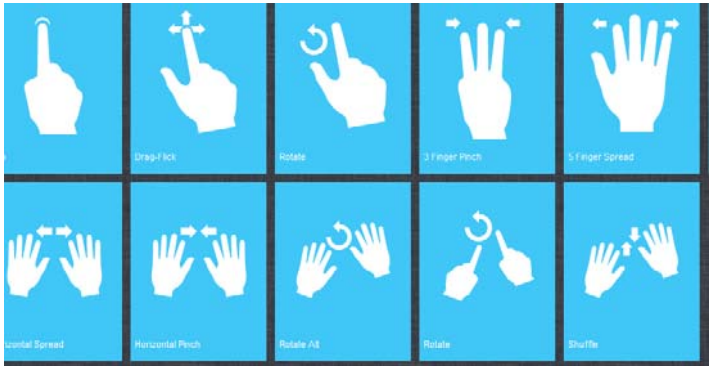
Gestural UI prototyping

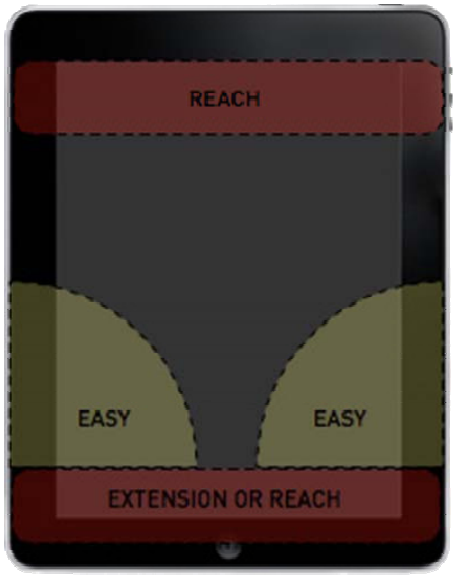
- Usability guidelines
  - Consider activity and comfort zones
  - Order by importance
  - Order by frequency
  - Escape/home always top left
  - Keep OS-possible gestures





http://gesturecons.com/

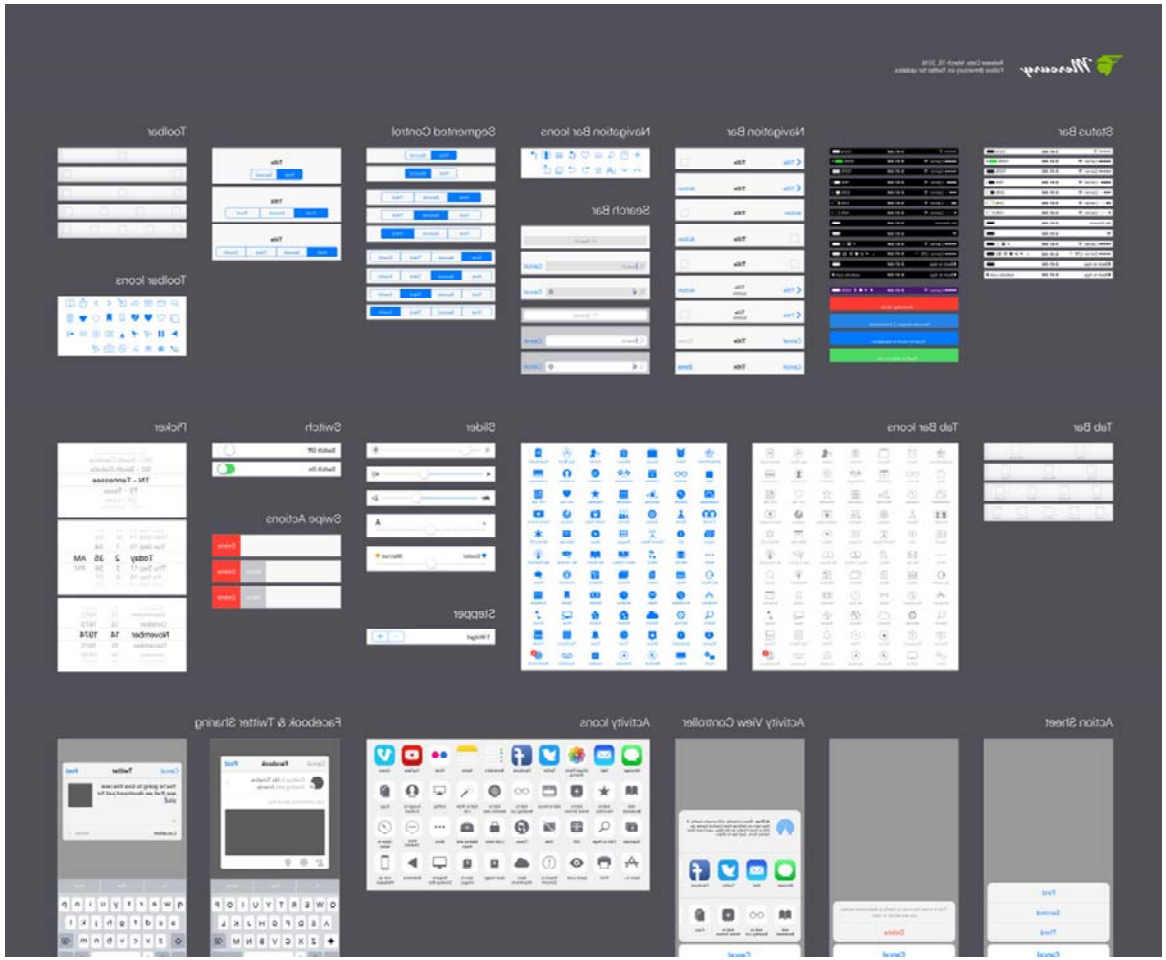




Touch Gesture icons Sketch Resource: http://www.sketchappsources.com/free-source/476-touch-gesture-icons.html

OS-oriented prototyping

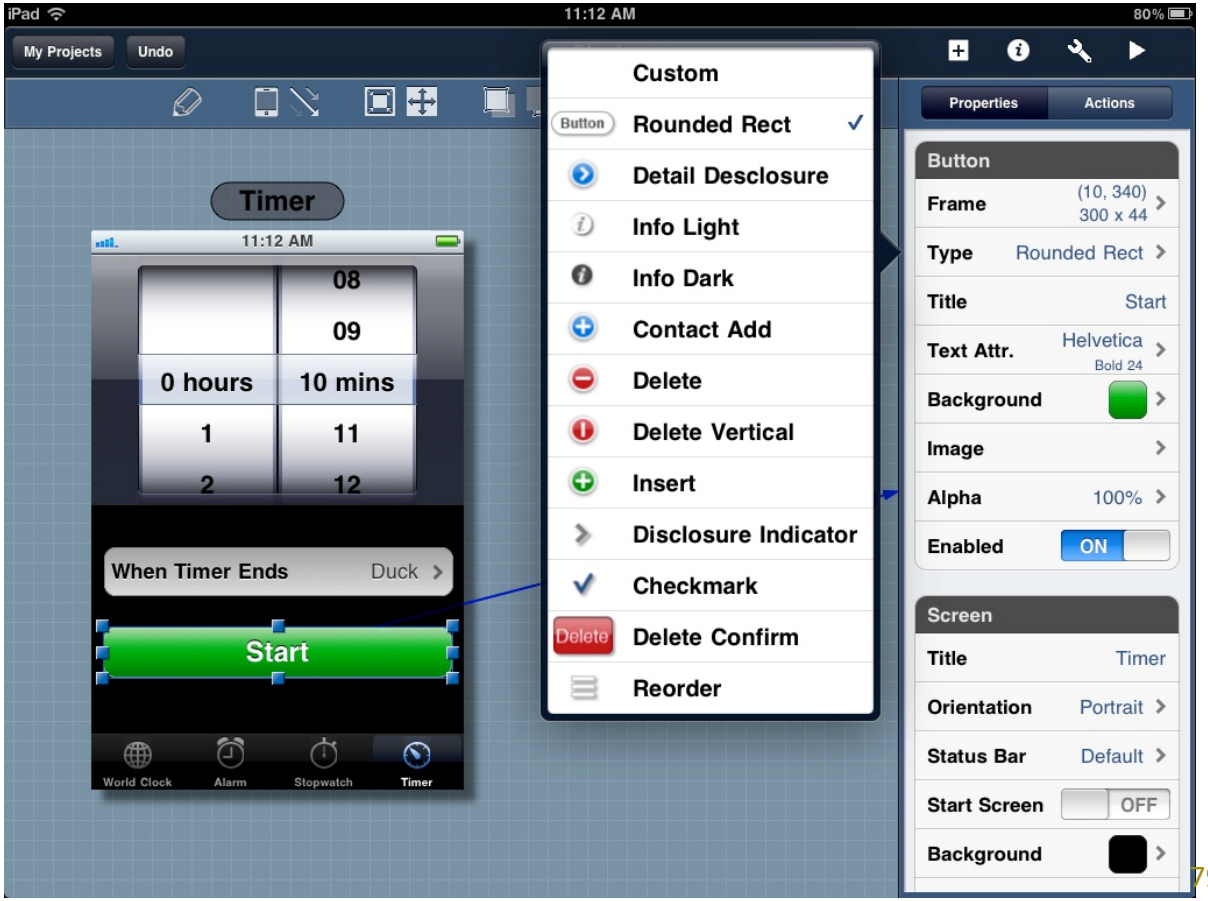
- iOS 9.3 UI Kit Sketch Resource



http://www.sketchappsources.com/free-source/1889-ios-9-iphone-gui-kit-sketch-freebie-resource.html

OS-oriented prototyping

- iOS iPhone, iPad, iTouch BluePrint Prototyping Software: it's a native iOS app!



http://www.groosoft.com/blueprint/

What are the means to prototyping UIs?

- Graphical User Interfaces (GUIs)
- Vocal User Interfaces (VUIs)
  - Suede: http://www.eecs.berkeley.edu/XRG/Summary/Old.summaries/01abstracts/srk.2.html
  - https://www.youtube.com/watch?v=ULfAwZAUUbs
- Multimodal User Interfaces
  - CrossWeaver: http://dl.acm.org/citation.cfm?id=958457
- Different modalities
  - Tactile, haptics, tangible
- Different means
  - Video-based prototyping

What are the means to prototyping UIs?

- Professional, other software
  - Axure: www.axure.com/Free_Trial
  - InVision: www.invisionapp.com
  - FluidUI: https://www.fluidui.com/
  - Android Asset Studio: https://github.com/romannurik/AndroidAssetStudio

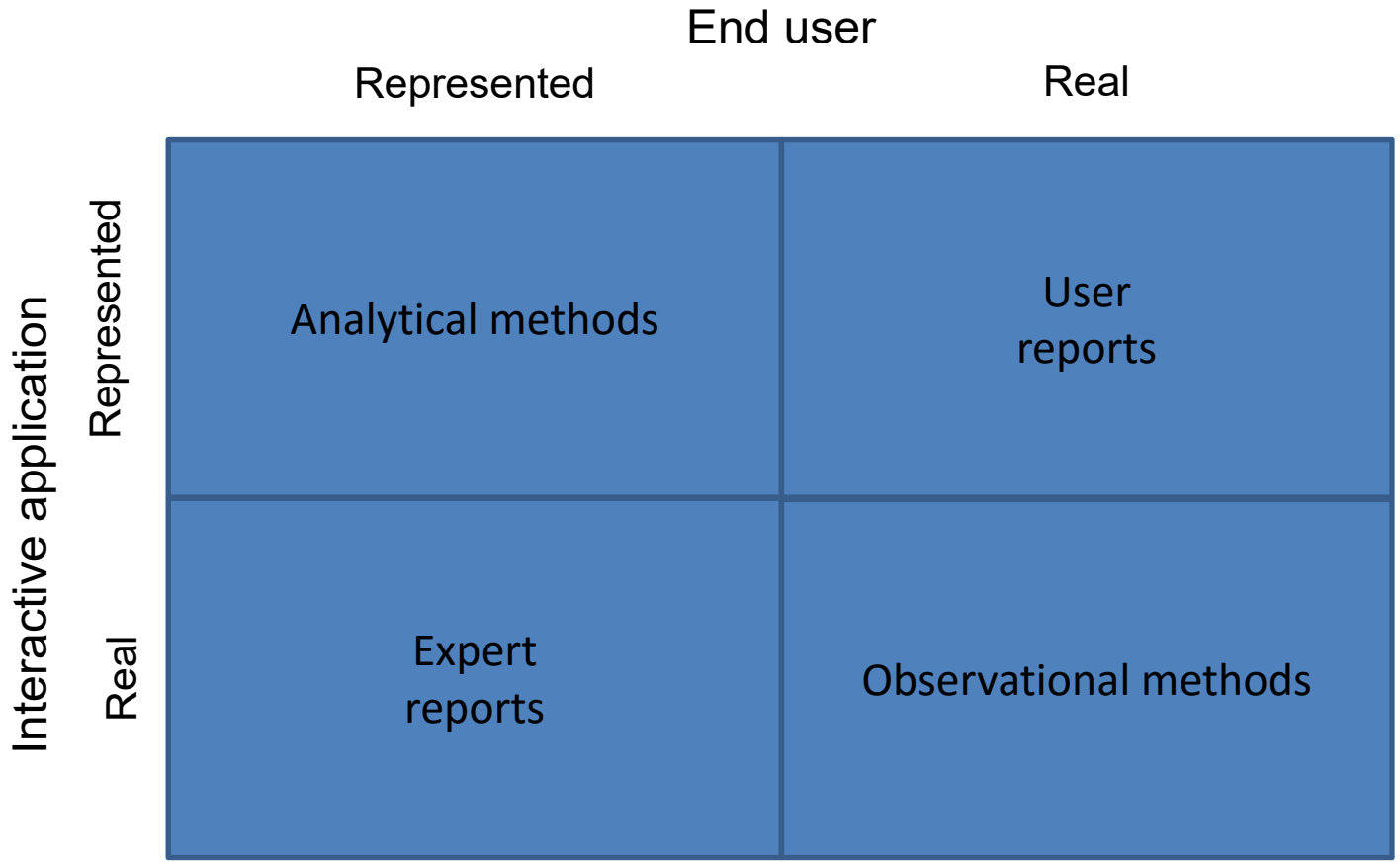
The 7 Quintilian questions

quis	quid	cur	ubi	quando	quemadmodum	quibus adminiculis
persona	factum	causa	locus	tempus	modus	facultas

Who? What? Why? Where? When? How? By what means?

Who is involved in a UI prototype?

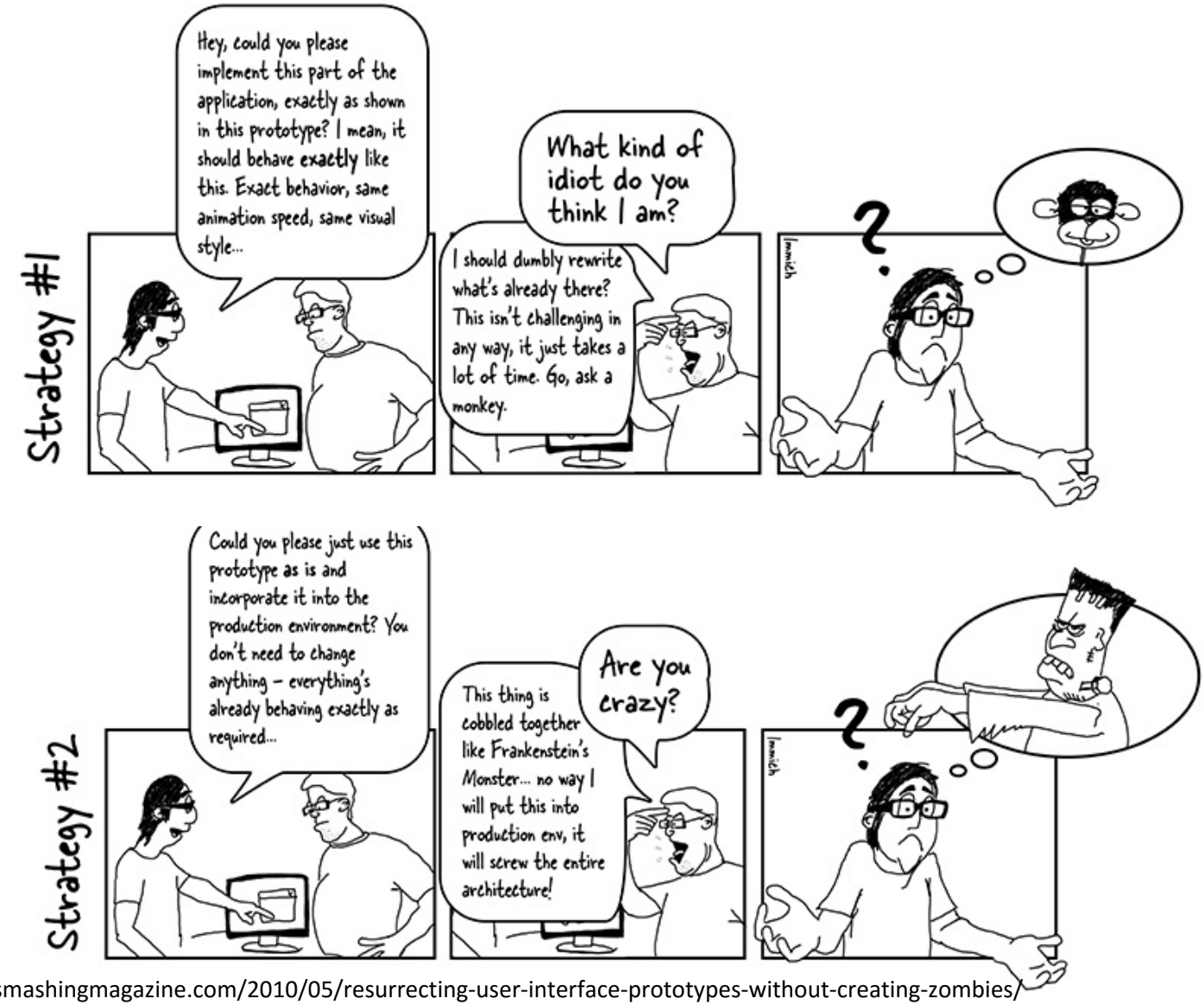
- Participatory design, User-Centered Design



Who is involved in a UI prototype?

- All stakeholders
  - End user
  - Usability engineer
  - Human Factors expert
  - Graphic expert (e.g., style guide compliance)
  - Designer
  - Developer
  - Marketing people
  - Management people (project leader)

Whos is involved in a UI prototype?



Source: https://www.smashingmagazine.com/2010/05/resurrecting-user-interface-prototypes-without-creating-zombies/

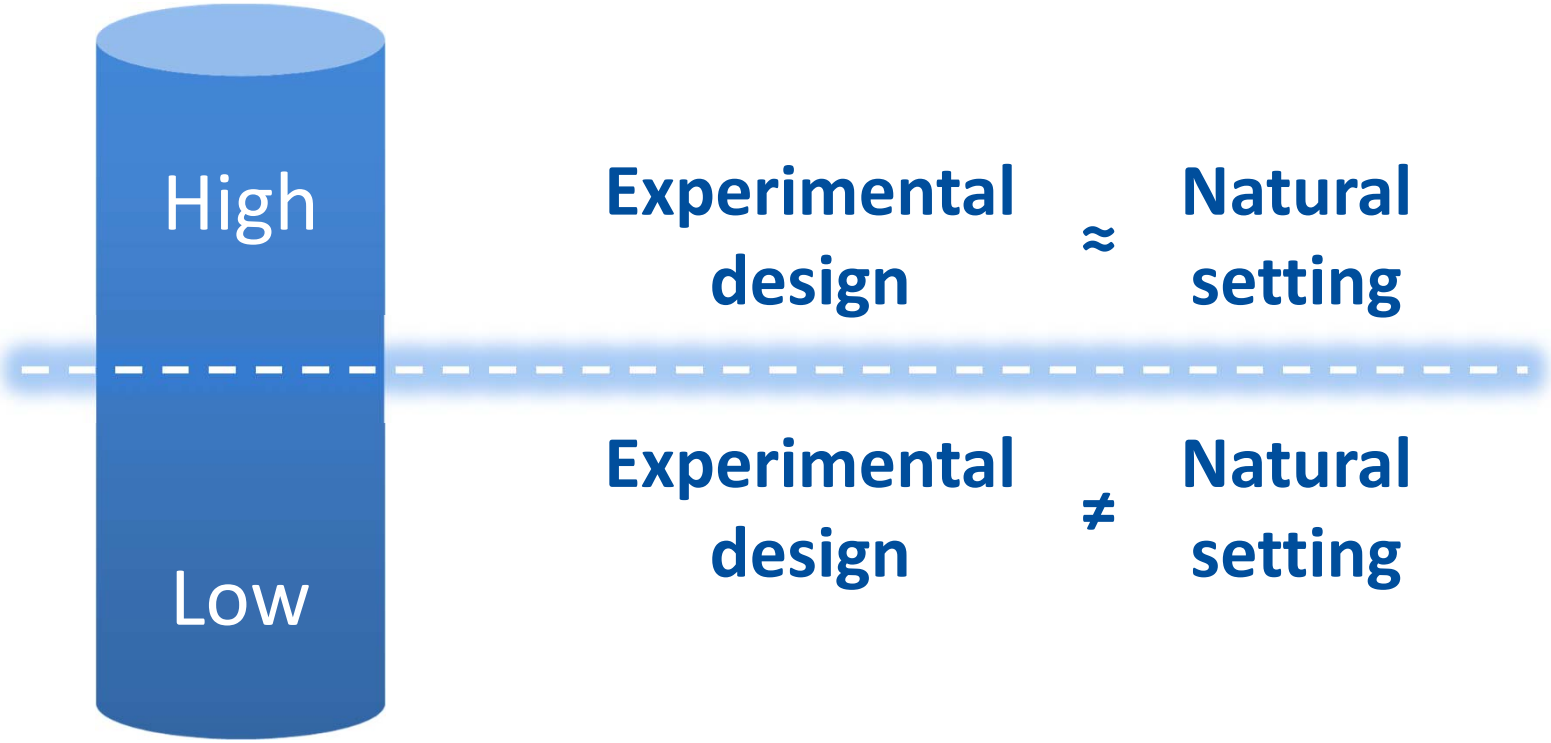
The 7 Quintilian questions

quis	quid	cur	ubi	quando	quemadmodum	quibus adminiculis
persona	factum	causa	locus	tempus	modus	facultas

Who? What? Why? Where? When? How? By what means?

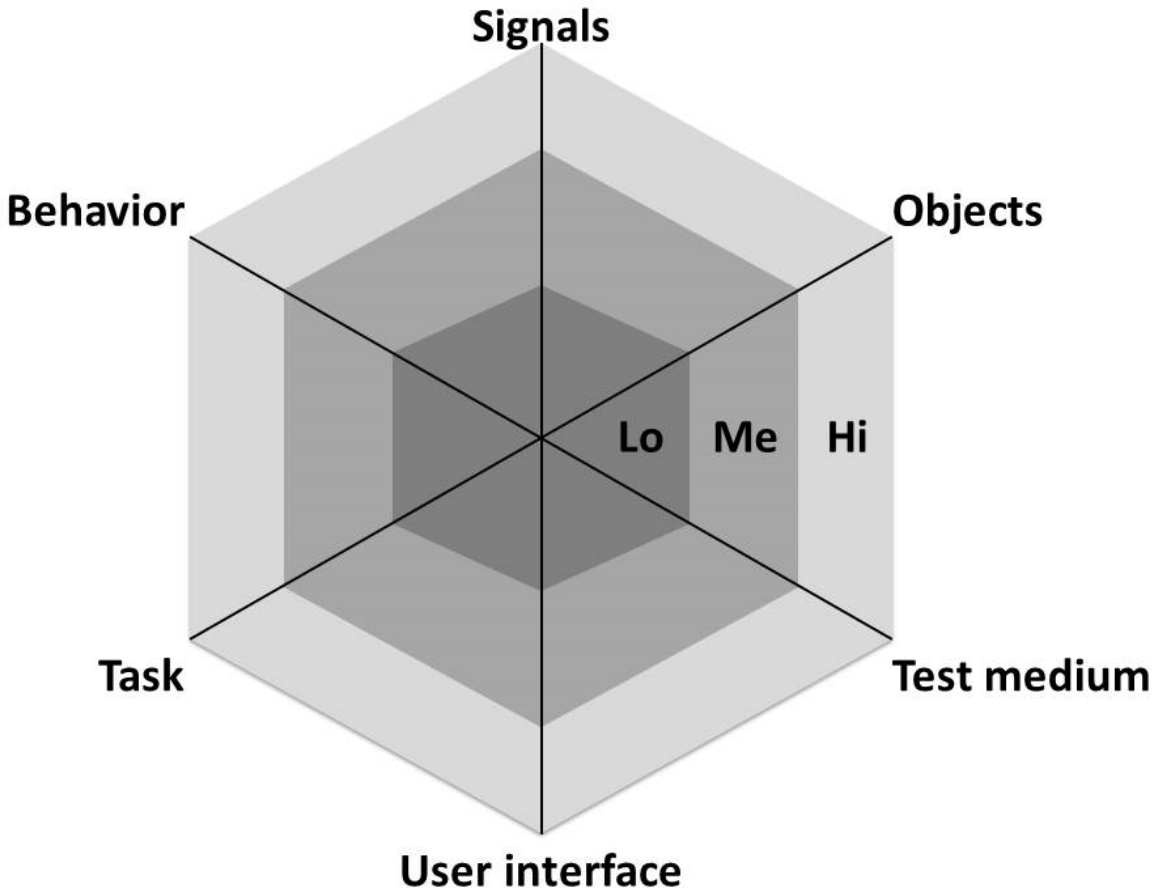
Where to prototype?

- Ecological validity: ECOVAL framework [Kieffer et al., 2015]



Where to prototype?

- ECOVAL framework [Kieffer et al., 2015]



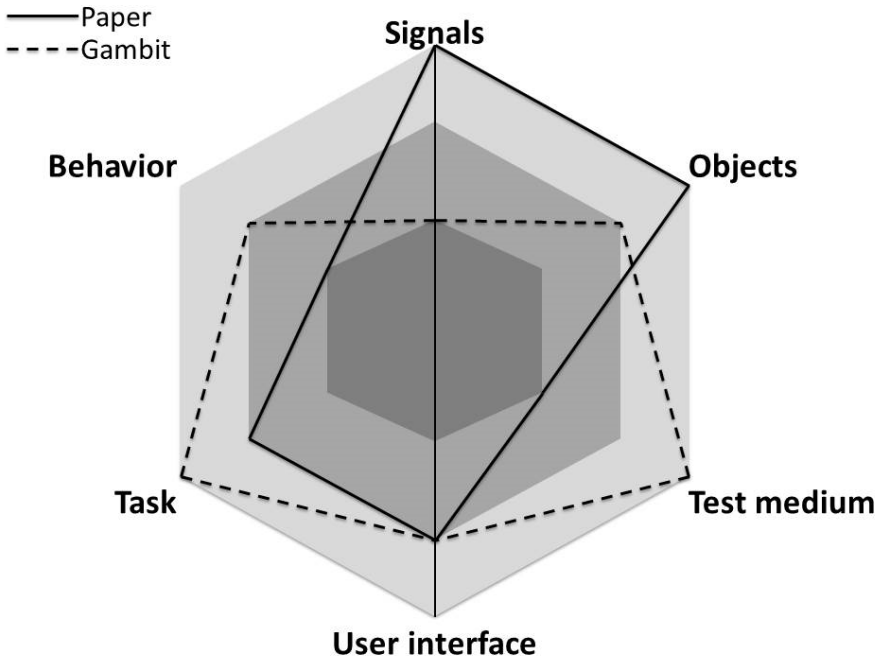
Where to prototype?

- ECOVAL framework [Kieffer et al., 2015]

	Low	Medium	High
Signals	No signals	Synthetized signals	Real signals (dust, noise, heat, pain, etc.)
Objects	No objects	Mock objects	Real objects
Test medium	Paper	Mock device Different device	Intended device
User interface	Video Storyboard	Prototype Mockup	Final interface
Task	Only verbalized	Mimicked and possibly verbalized	Real usage Real manipulation
Behavior	Only verbalized	Mimicked and possibly verbalized	Real actions (moving, talking, inspecting, etc.)

Where to prototype?

- ECOVAL framework: example

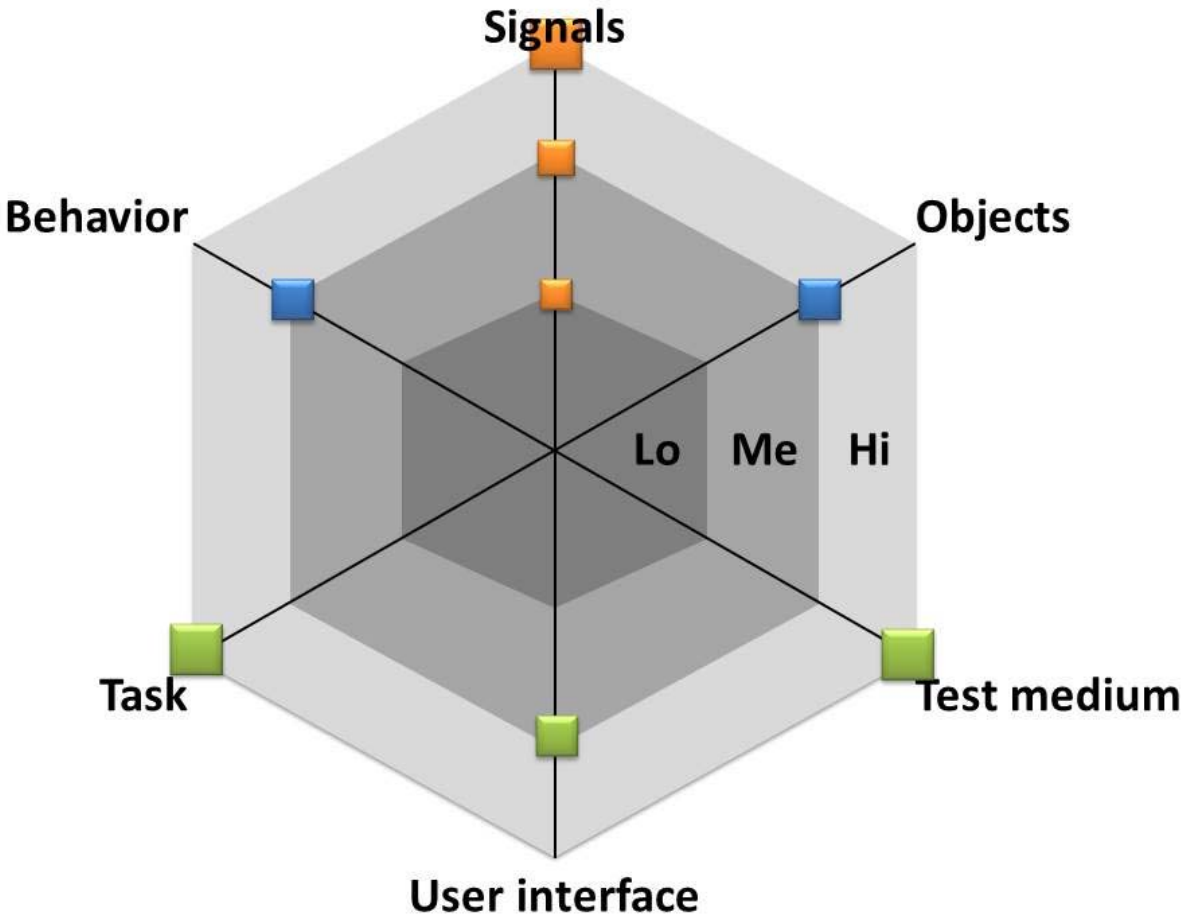


	Paper *First evaluation*	**Gambit** *Second evaluation*
Signals	Real (GA line) → High	Artificial (meeting room) → Low
Objects	Real (GA line) → High	Mock objects → Medium
Test medium	Paper → Low	Intended device → High
User interface	Balsamiq mockups → Medium	Balsamiq mockups → Medium
Task	Mimicked gestures → Medium	Real manipulation → High
Behavior	Only verbalized → Low	Mimicked actions → Medium

Ratio Paper-to-Gambit for ecological validity of 1:1.17

Where to prototype?

- ECOVAL framework: guidelines

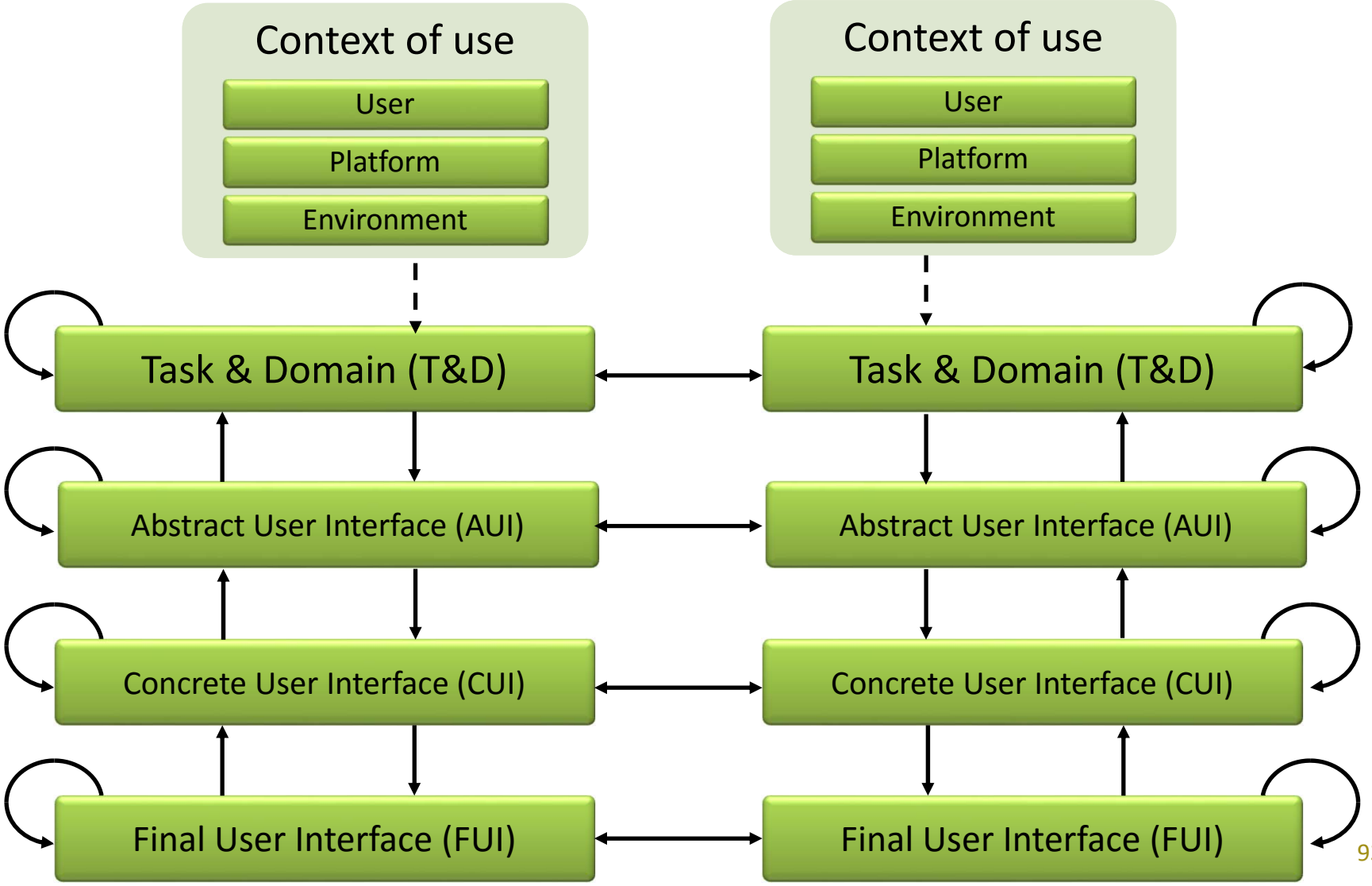


The 7 Quintilian questions

quis	quid	cur	ubi	quando	quemadmodum	quibus adminiculis
persona	factum	causa	locus	tempus	modus	facultas

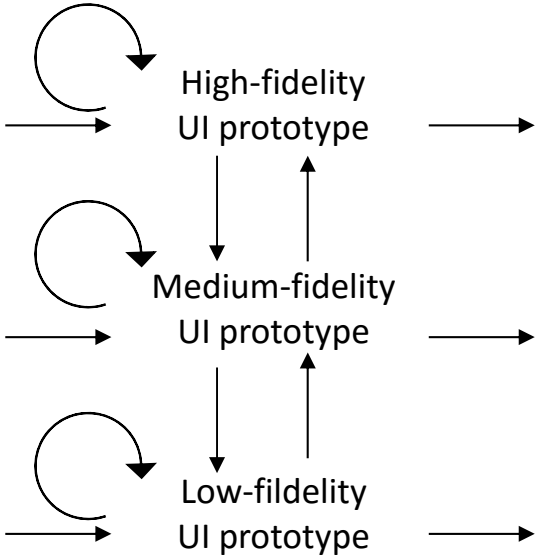
Who? What? Why? Where? When? How? By what means?

When?
Cameleon Reference Framework (CRF)



When?
Prototyping paths

- From one level of fidelity to another



Conclusion

Main steps for your future project

- Decide your ECOVAL setup and justify it!
- Select LoF and LoD you want to achieve
- Select target population and justify it
- Select which prototyping mean to use
  - Paper and pencil
  - Software
- Report on findings (e.g., by importance, priority)
- Iterate, perhaps by increasing LoF

Thank you very much for your attention

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