Leibniz Universität Hannover

Grundlagen der Mensch-Computer-Interaktion

Prototyping

Human-Computer Interaction Group

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Vorlesungen

Termin	Datum	Thema
1	10.10.	Introduction
2	17.10.	History and Paradigms of HCI
3	24.10.	Web Usability
	31.10.	Reformationstag
4	7.11.	Human Information Processing
5	14.11.	Input and Output Technologies
6	21.11.	Models of Interaction
7	28.11.	Interaction Design Process
8	5.12.	Prototyping
9	12.12.	Design Rules and HCI Principles
10	19.12.	Evaluation
11	9.1.	Dialog Design Notation
12	16.1.	Analysis of Experiments
13	23.1.	Information Design

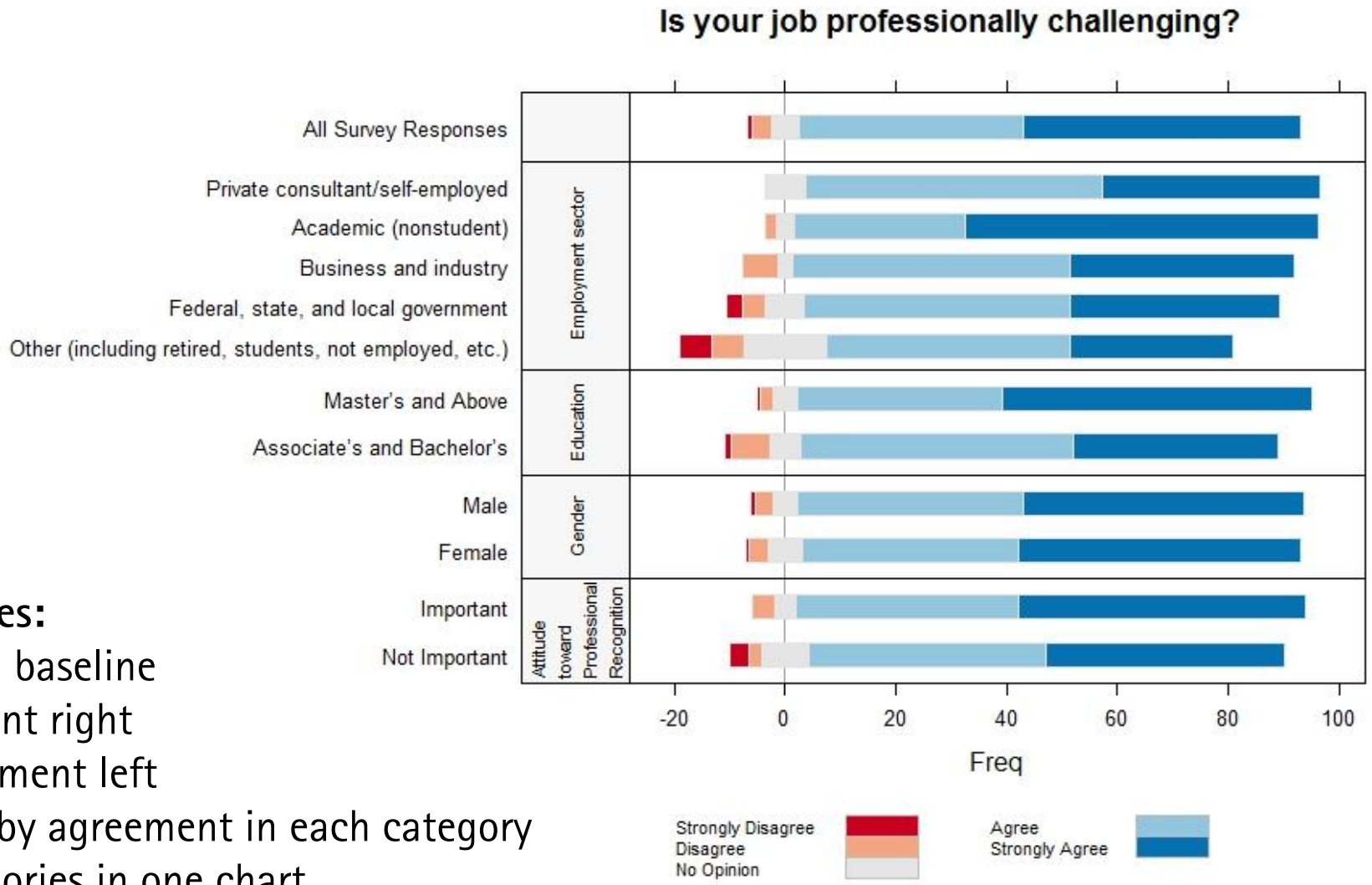
Review

- Interviews
  - Ask a small number of stakeholders
  - Flexible method: unstructured, semi-structured, structured
- Questionnaires
  - Ask a large number of stakeholders
  - Little control over conditions
- Observation
  - Capture context of use
  - Expensive to analyze the results

Review

- When to use interviews, when to use questionnaires?
- How to ask interview questions?
- Which questions to avoid?
- What is a Critical Incident Interview?
- Experiences with online surveys?
- What are Likert scales and what are semantic differential scales?
- How to present questionnaire results?
- Advantages and disadvantages of observation?
- How to guide observation?
- How to analyze observations?

Review: Presenting Results of Rating Scales: Diverging Stacked Bar Chart



Properties:
common baseline
agreement right
disagreement left
ordered by agreement in each category
all categories in one chart

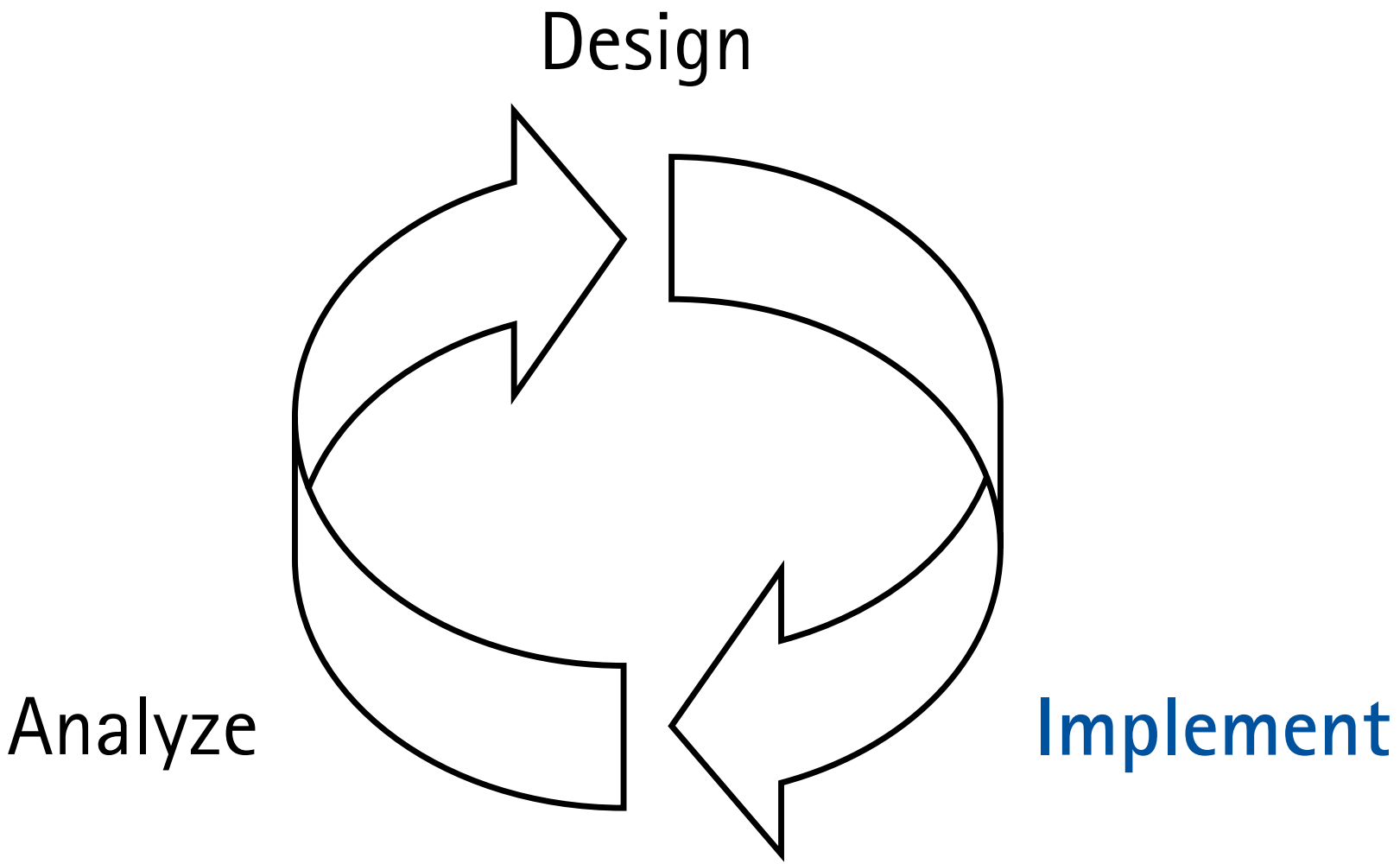
Robbins, Heiberger: Plotting Likert and Other Rating Scales. 2011.

Preview

- Prototyping
- Paper prototyping
- Video prototyping
- “Wizard of Oz” prototyping
- Software prototyping
- User interface builders

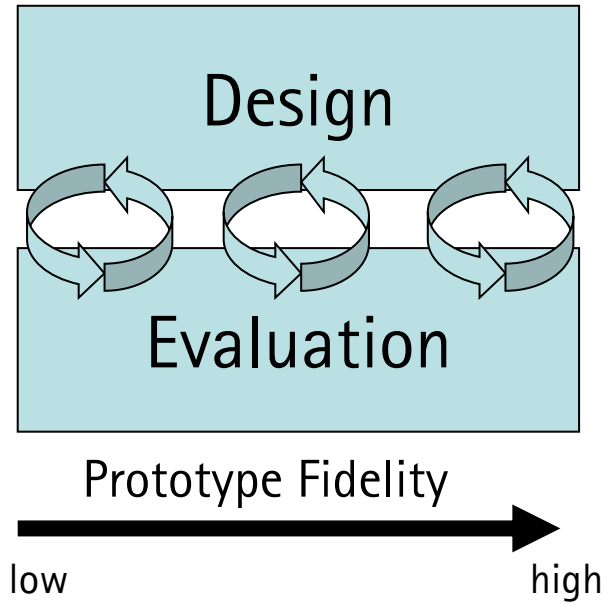
PROTOTYPING

DIA Cycle: How to realize design ideas?



From Ideas to Implementation: Prototyping

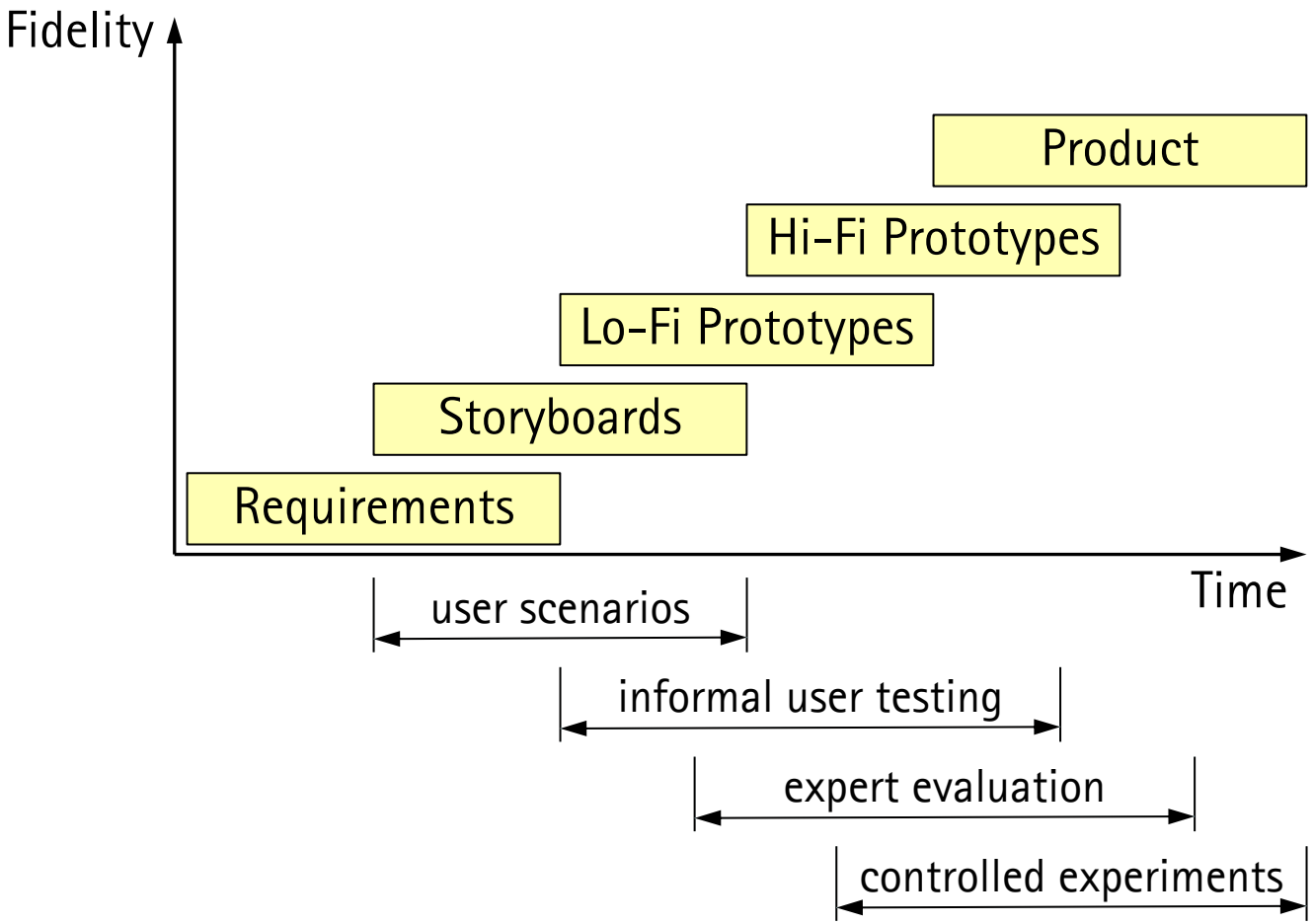
- Building a scaled-down version of an interactive system to collect information to guide its further design
  - Invaluable for iterative design
- Get early feedback on emerging designs
  - After initial requirements analysis, scenarios, storyboards
- Continuous input for design decisions
  - During all design phases
- Make prototype appropriate for
  - Audience
  - Design phase
  - Design question



Why Prototyping?

- Communication and coordination tool
  - Discussing concrete designs in interdisciplinary teams
  - Explaining ideas to (non-technical) stakeholders
  - Shared understanding and collective ownership
- Testing tool
  - Testing out ideas for yourself or with users
  - Enabling rapid movement through DIA cycle
- Answering specific design questions
  - Helps choosing between alternatives
  - Helps resolving controversies

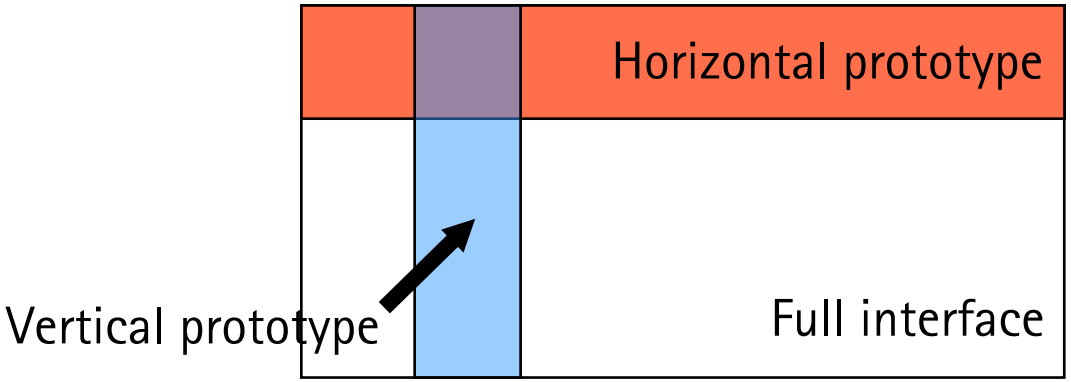
Prototype Evolution



Source: Adapted from Scott Klemmer

Limiting Prototypes

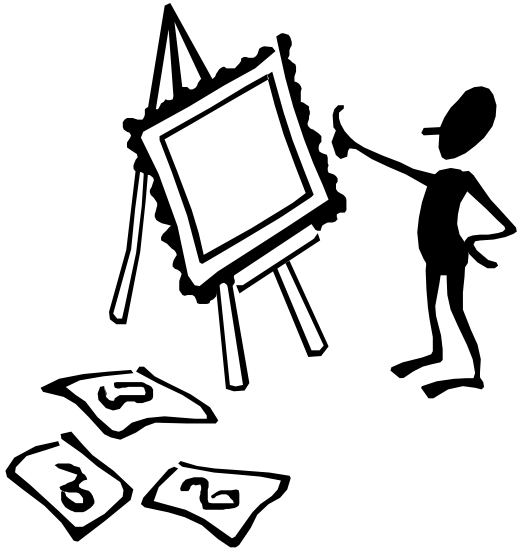
- Horizontal prototypes
  - The entire interface but no underlying functionality
  - A facade, no real work can be performed
- Vertical prototypes
  - Includes in-depth functionality
    for only a few selected features
  - Specific design ideas can be tested in depth

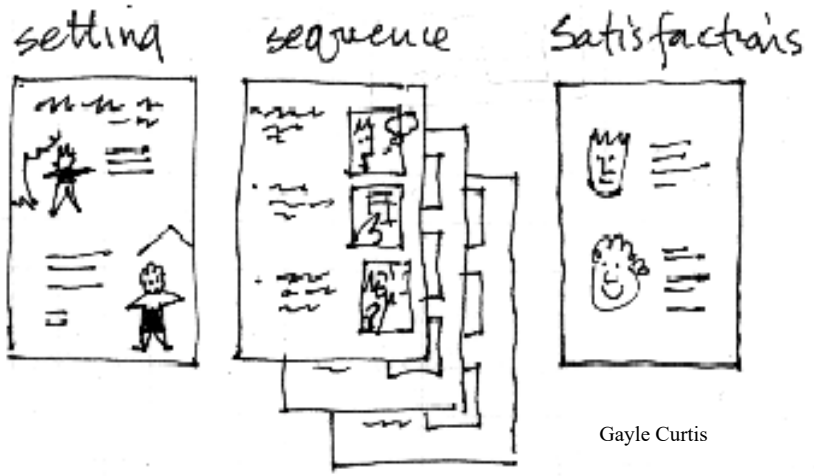


Nielsen, J. (1993) *Usability Engineering*, pp. 93-101, Academic Press.

Low-Fidelity Paper Prototypes

- First prototype, quick and cheap
- Paper and pencil mockup of user interface
  - Sketches of the main screens and dialogs
  - Textual description of interface functions and relationships between screens
- Goals
  - Brainstorming
  - Expert review of interaction flow
  - First user feedback
  - User tests



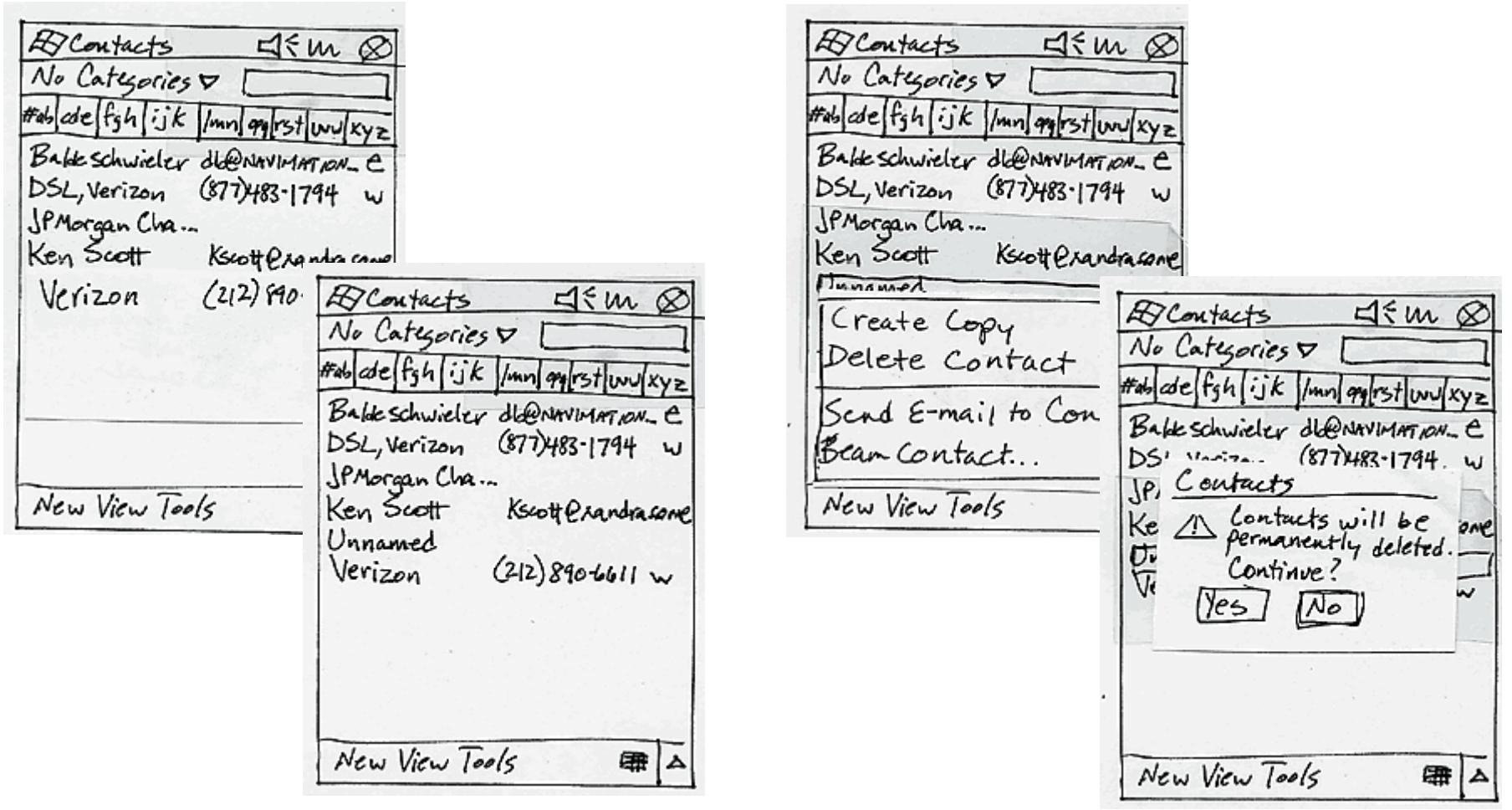


Low-Fidelity Paper Prototypes

- Building prototypes on paper and testing them with real users
  - Construct paper prototype in a few hours
  - Demonstrate behavior of an interface very early
  - Distill lessons from test observations

- Advantages for low-fidelity prototyping
  - Still cheap to make changes
  - Maximizes number of design iterations before committing to code
  - Allows to try more ideas than with high-fidelity prototypes

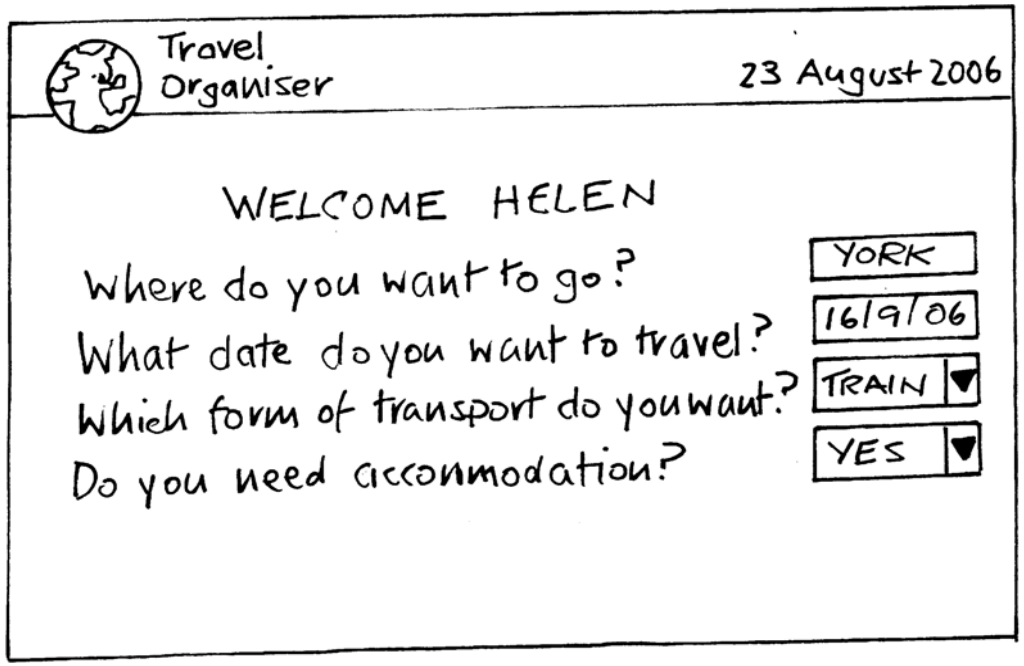
Paper Prototype Example

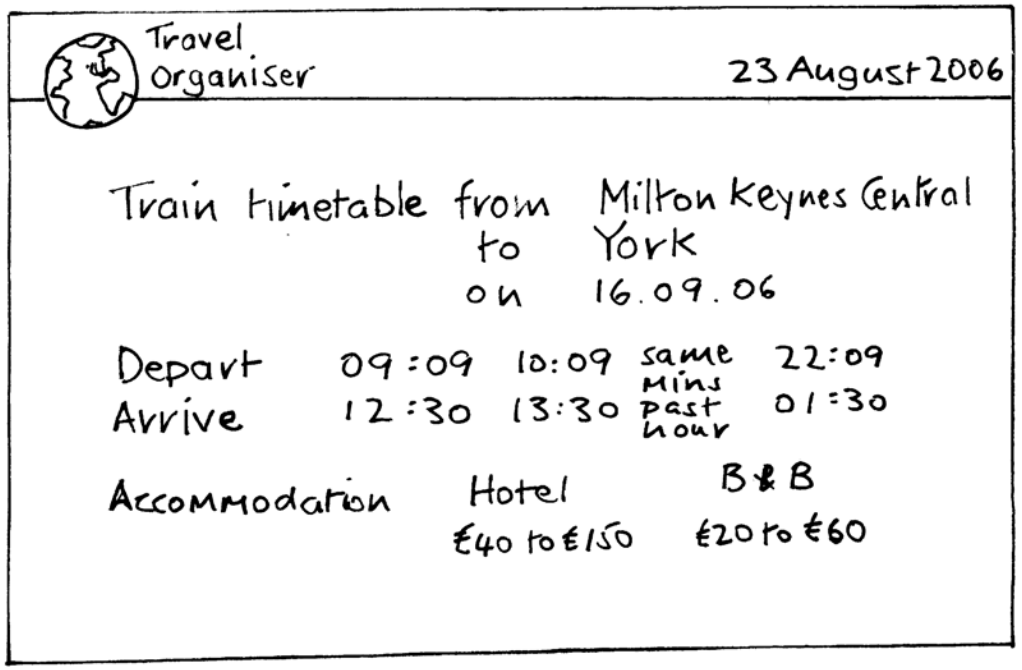


Source: http://www.pocketpcmag.com/_archives/may03/e_prototyping.asp

Card-Based Prototypes

- Index cards
- Each card represents one screen or part of screen
- Often used in website development





Paper / Video Prototype Example: Multi-Touch Table

- Multi-touch table for interacting with media items
  - Selecting
  - Sorting
  - Playing
- Complicated hardware setup
  - IR LEDs
  - Camera
  - Projector

Paper / Video Prototype Example: Multi-Touch Table

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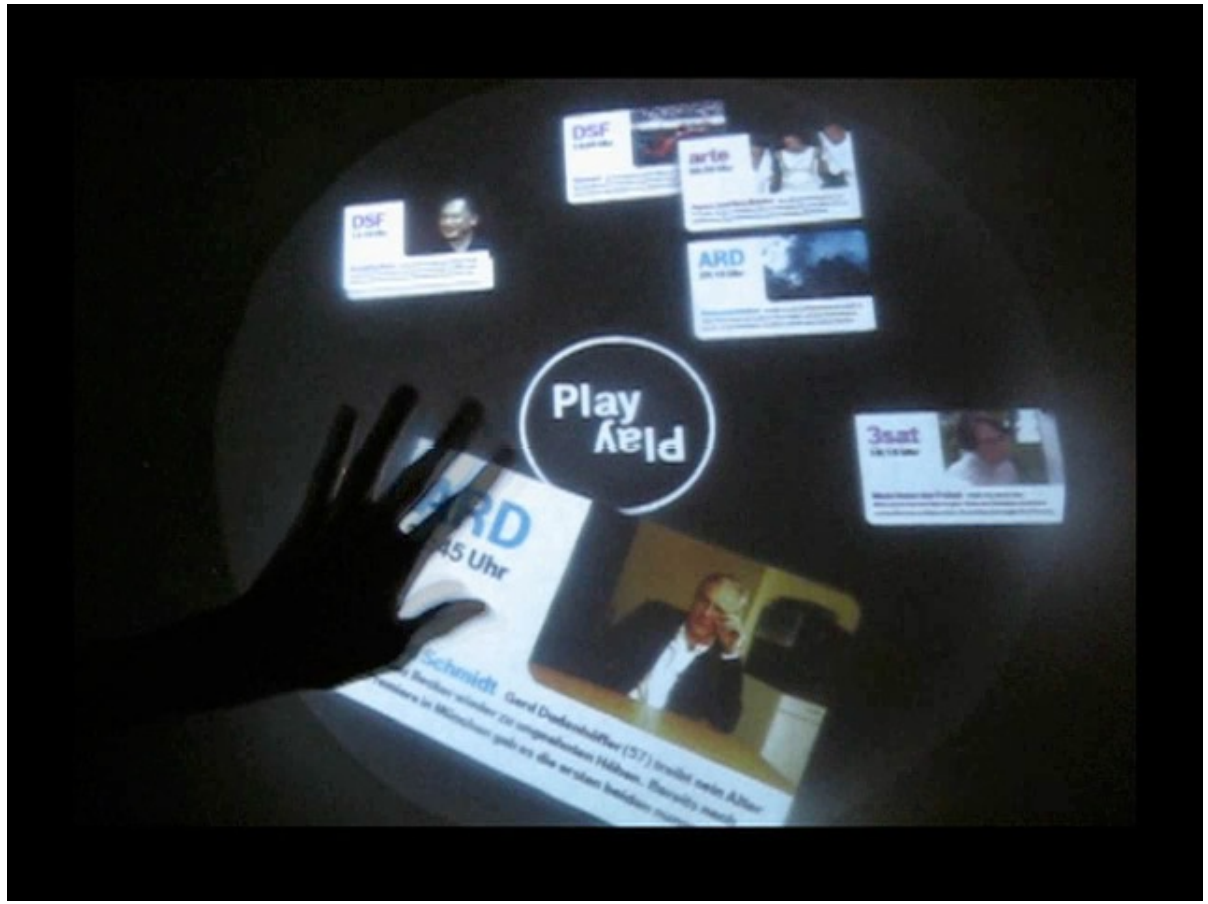


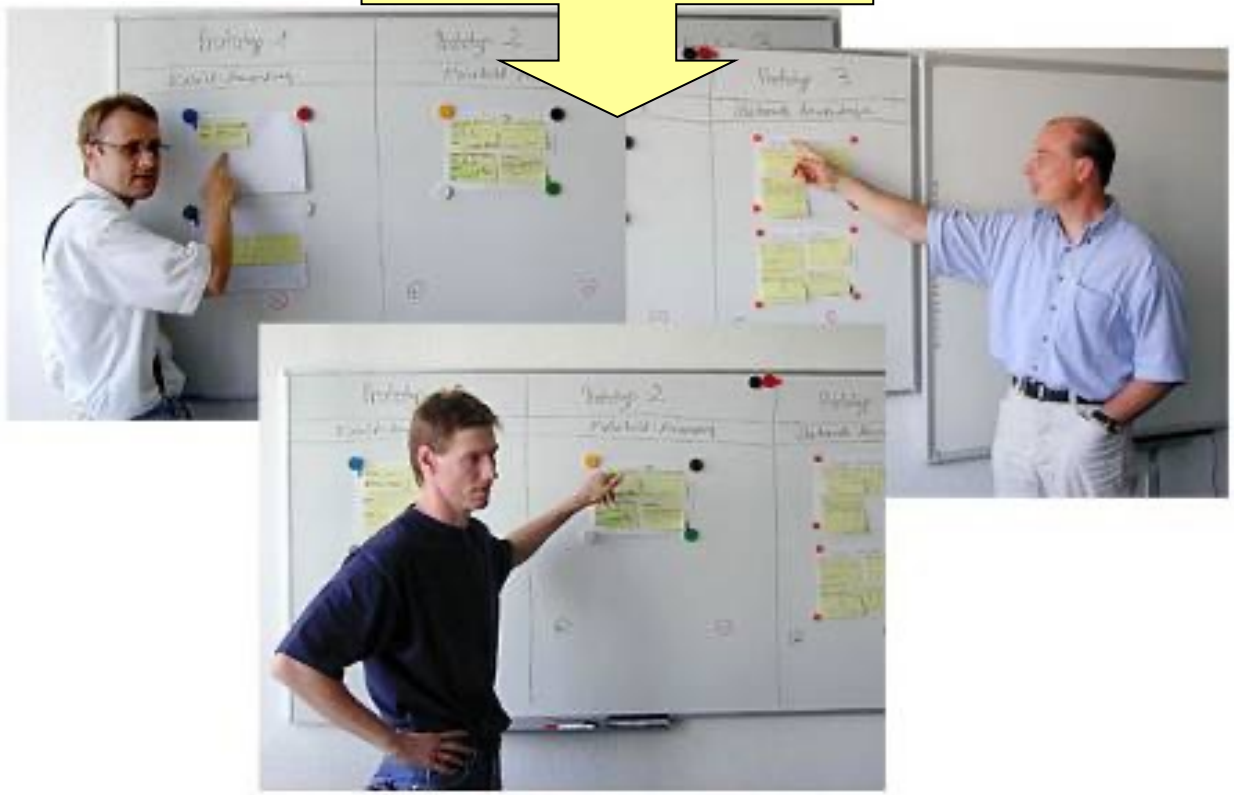
Paper Prototyping Video: Social Phonebook for iPhone

http://www.youtube.com/watch?v=UZjNEWQbZiU

Collaborative Paper Prototyping

Collaboratively creating the prototypes

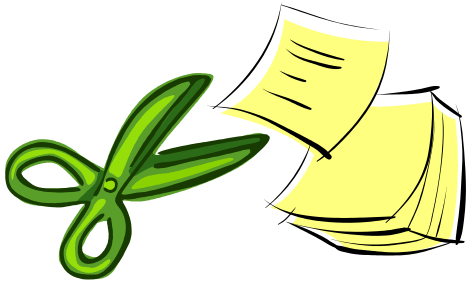
Reviewing the prototypes

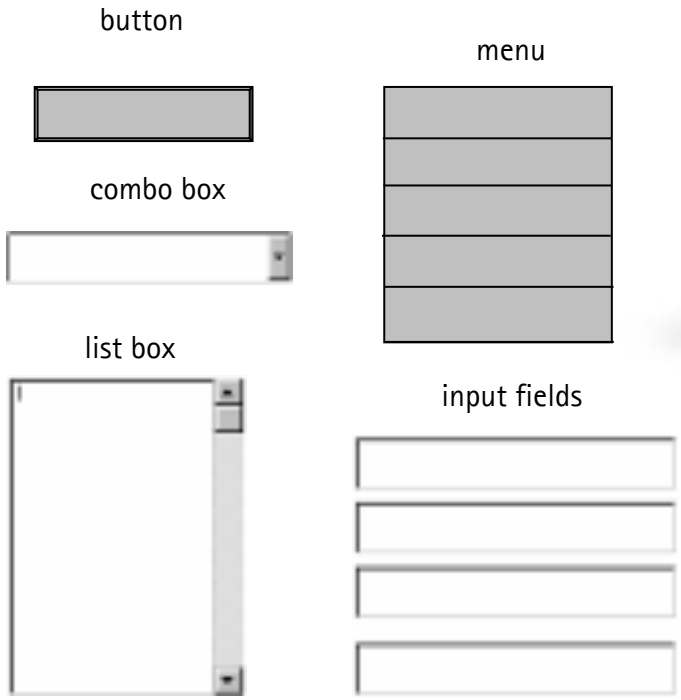


Source: http://www.pocketpcmag.com/_archives/may03/e_prototyping.asp

Building a Low-Fidelity Prototype

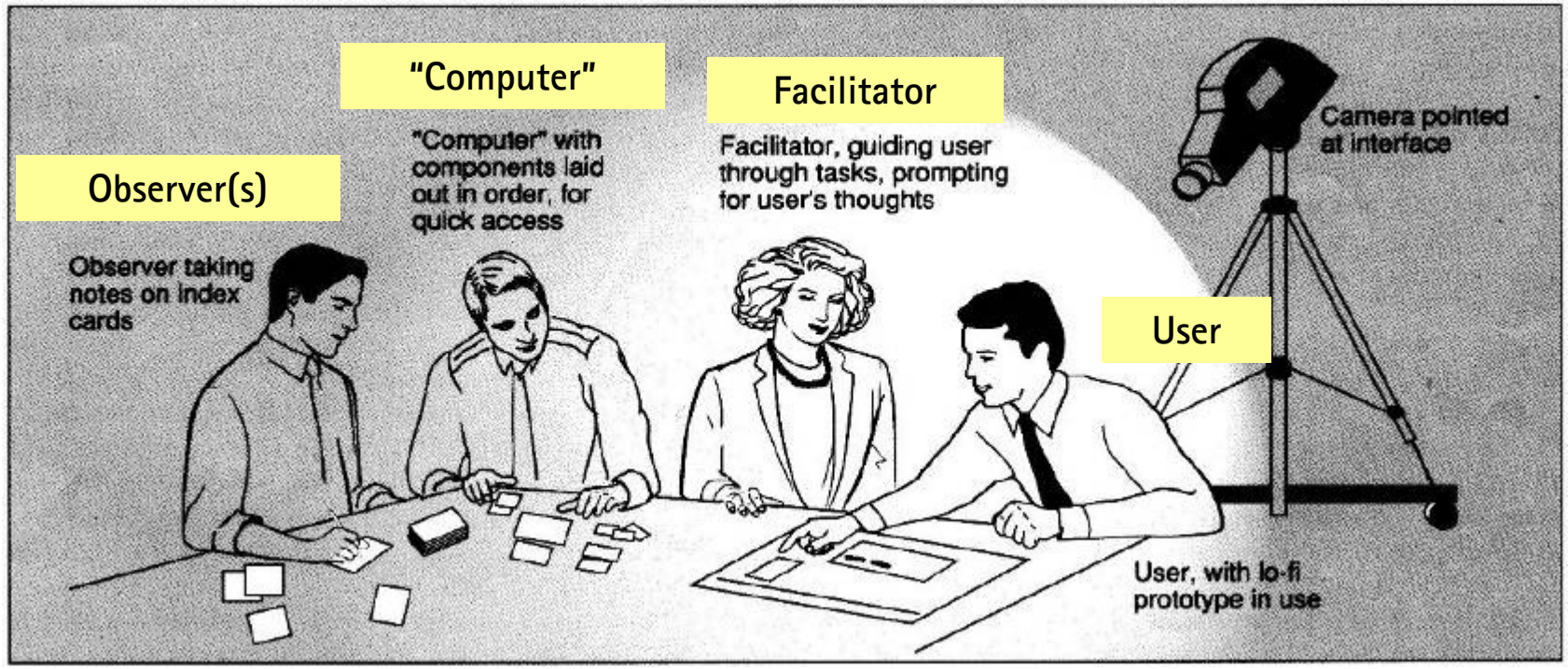
- Assemble material
  - Paper: large heavy paper for designs
  - Adhesives: tape, glue sticks, correction tape
  - Markers: colored pens and pencils, highlighters
  - Post-it notes: dialog boxes, tooltips, notifications
  - Transparent sheets for user input
- Create components
  - Anything that moves, comes and goes, changes appearance, on its own piece of paper
  - Easy to play computer
- Print a library of empty standard widget images





Low-Fidelity User Testing

- Select users
  - Representative for target users group
- Prepare test scenarios, drawn from task analysis
  - Familiar data
  - Realistic tasks
- Practice
  - Team members know their roles
    - Observer takes notes
    - Computer changes UI state
    - Facilitator guides through tasks, asks user to think aloud
  - Camera records user activity

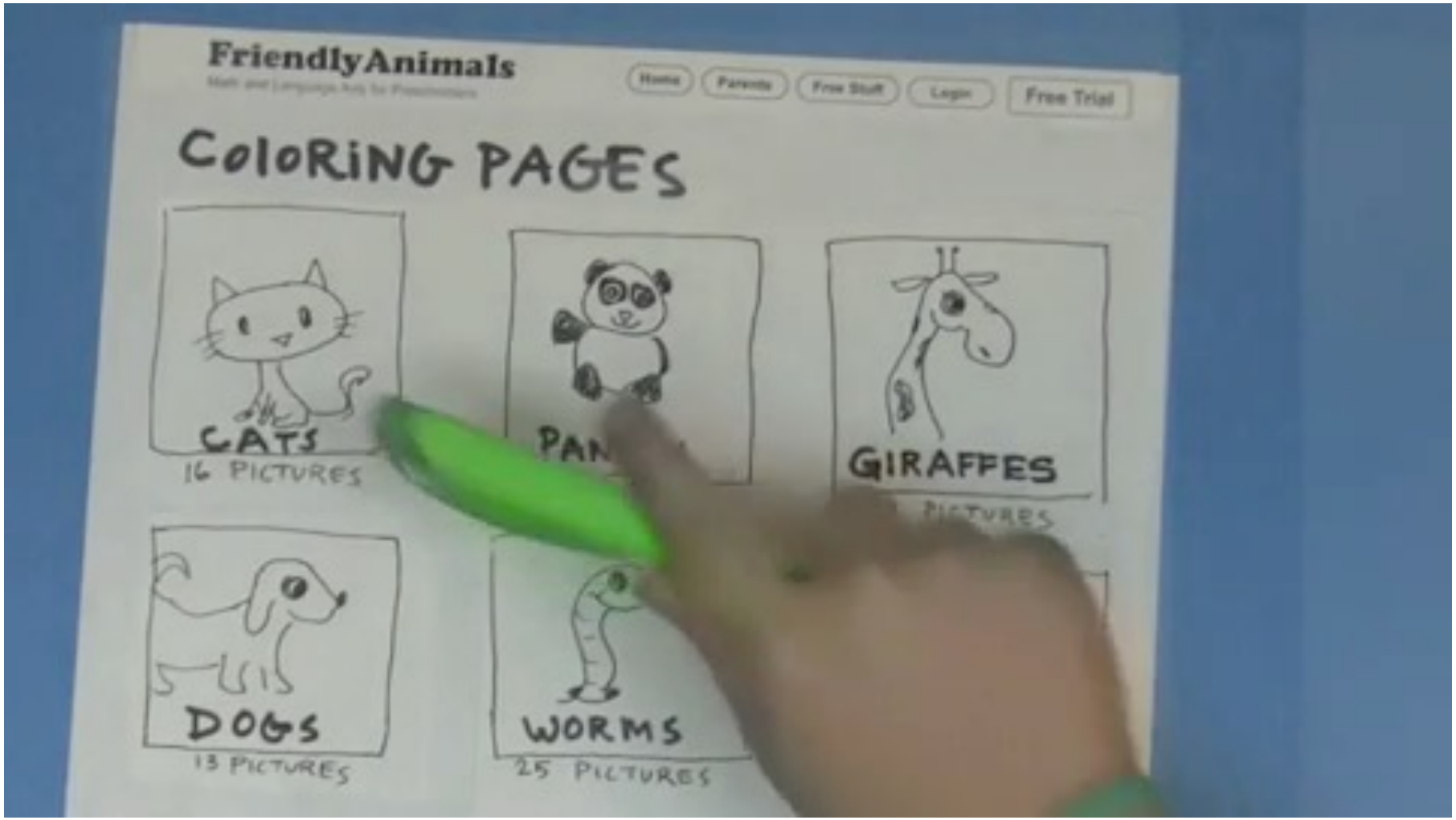


Marc Rettig: Prototyping for Tiny Fingers

Paper Prototyping Test: Blood Test Kiosk

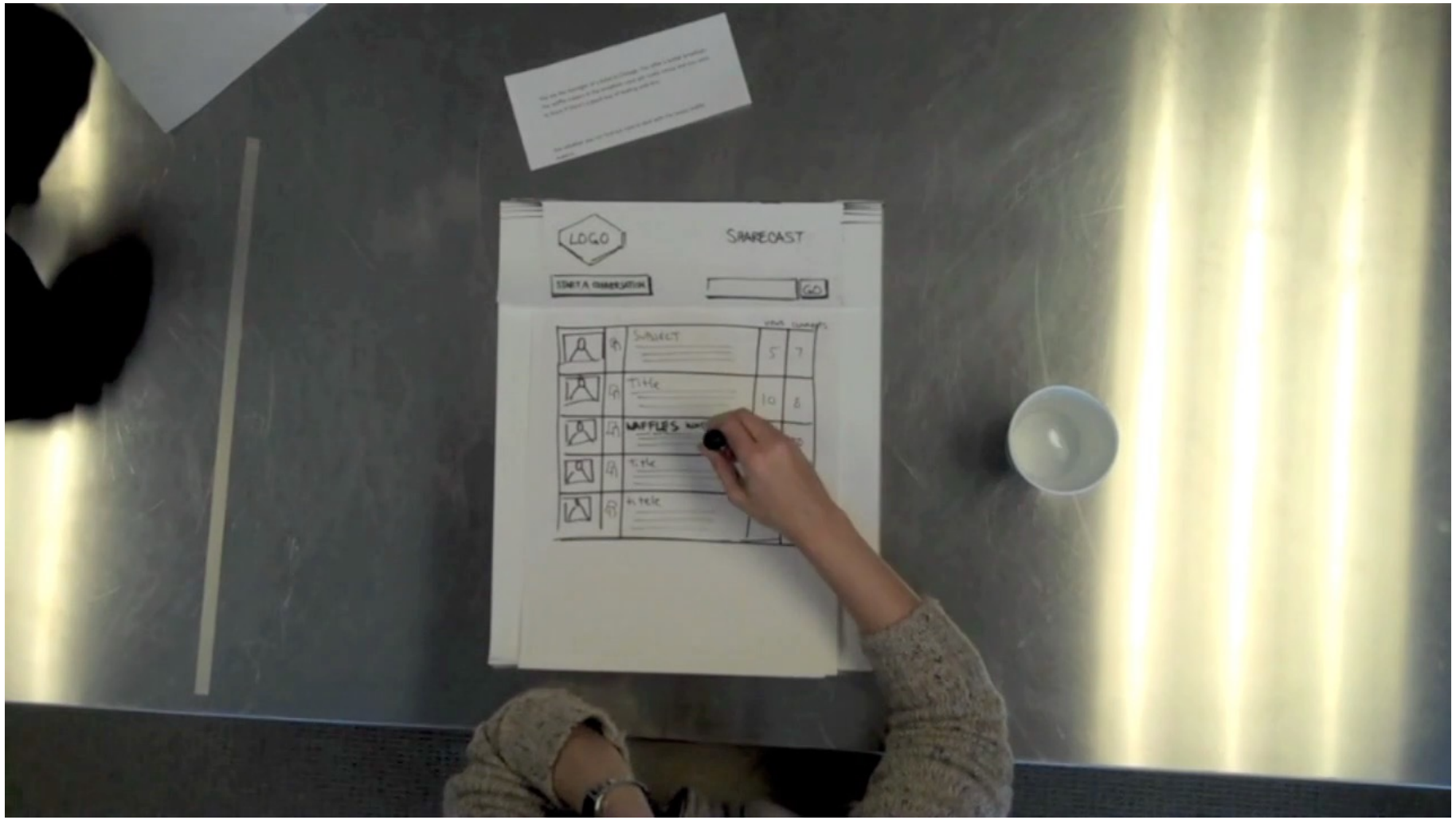
http://www.youtube.com/watch?v=_g4GGtJ8NCY

Paper Prototyping Test: Web Page Kids



http://www.youtube.com/watch?v=9wQkLthhHKA

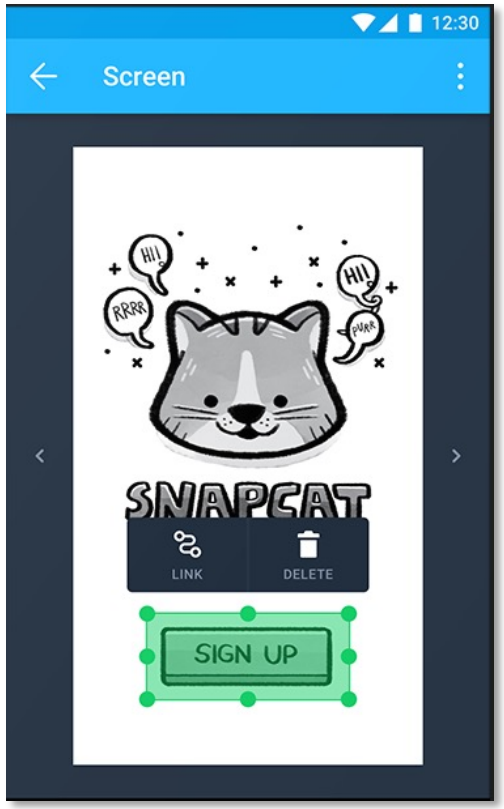
Paper Prototyping Test: Hotel Manager Web App



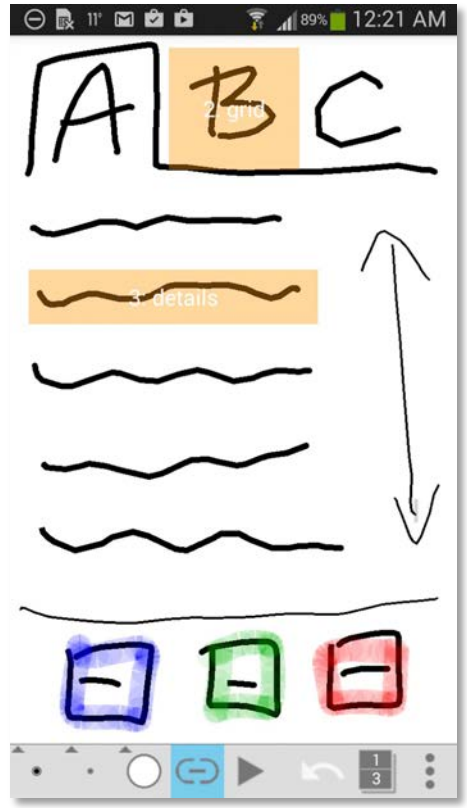
http://vimeo.com/48675078

Web-Based Prototyping Tools

- Create individual screens
  - Draw on paper and take photo
  - Draw on tablet or in Web browser
  - Add annotations
  - Collaborate remotely as a team
- Link screens
  - Define hot areas and links between screens
- Share design
  - With your group
  - With your test users
  - Via Web browser
  - Collect test data



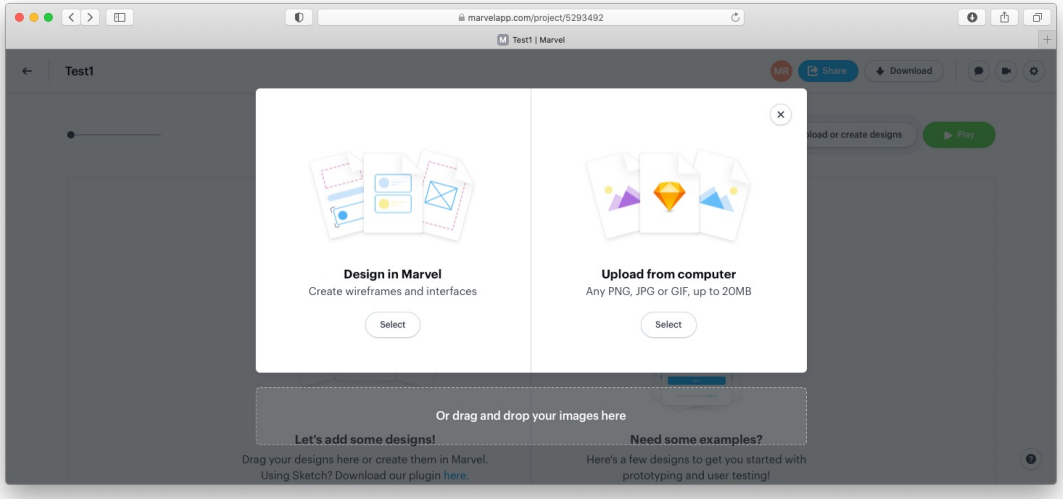
Marvel



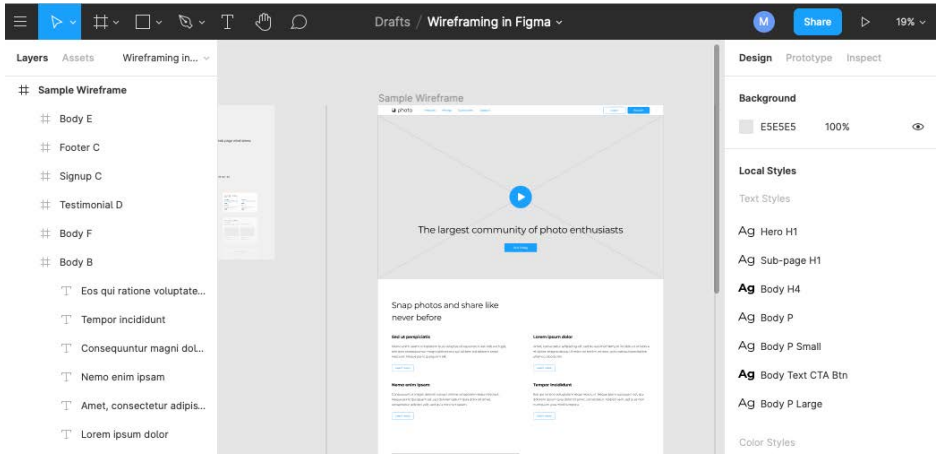
Quick Proto

Web-Based Prototyping Tools

- Marvel: https://marvelapp.com
- Figma: https://www.figma.com
- Balsamiq: https://balsamiq.com/wireframes/
- Proto.io: https://proto.io

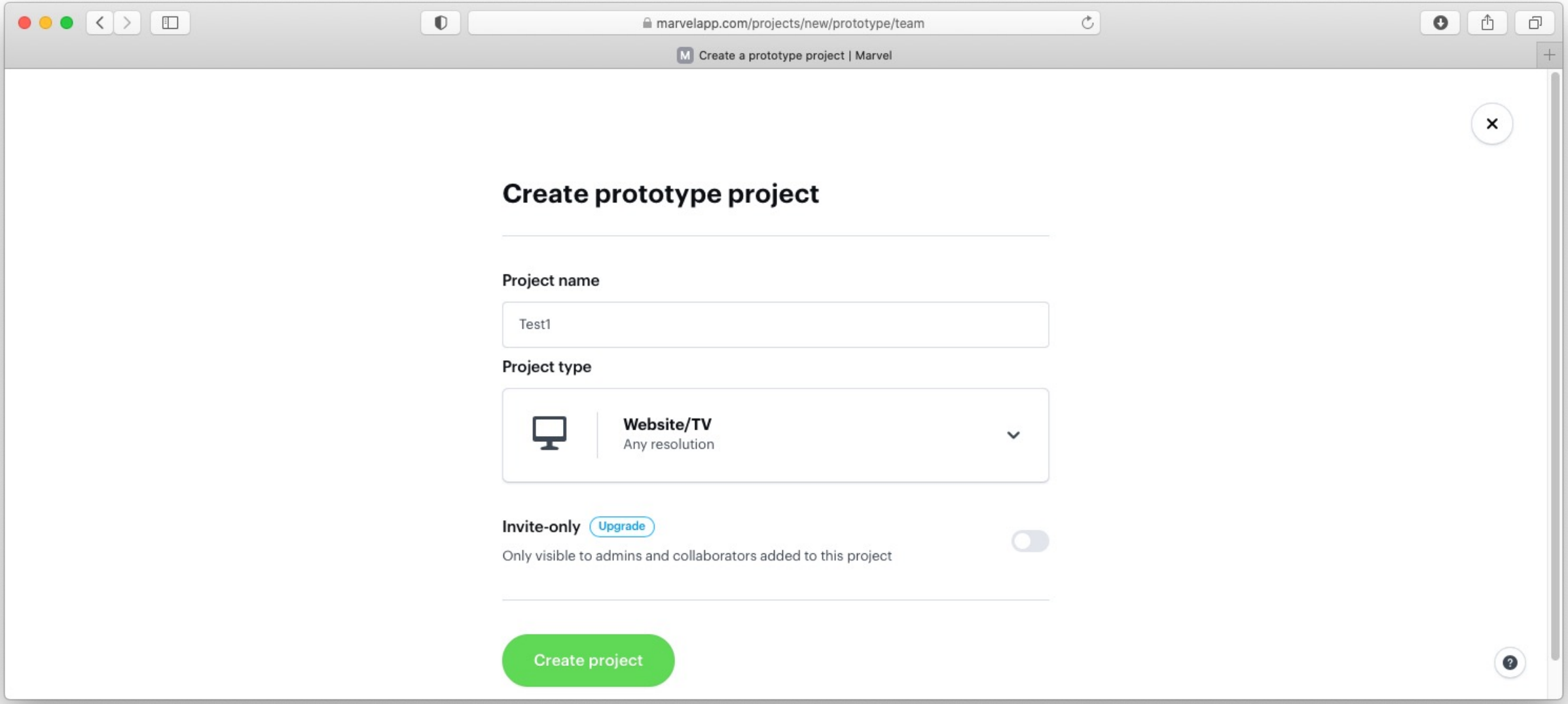


Marvel

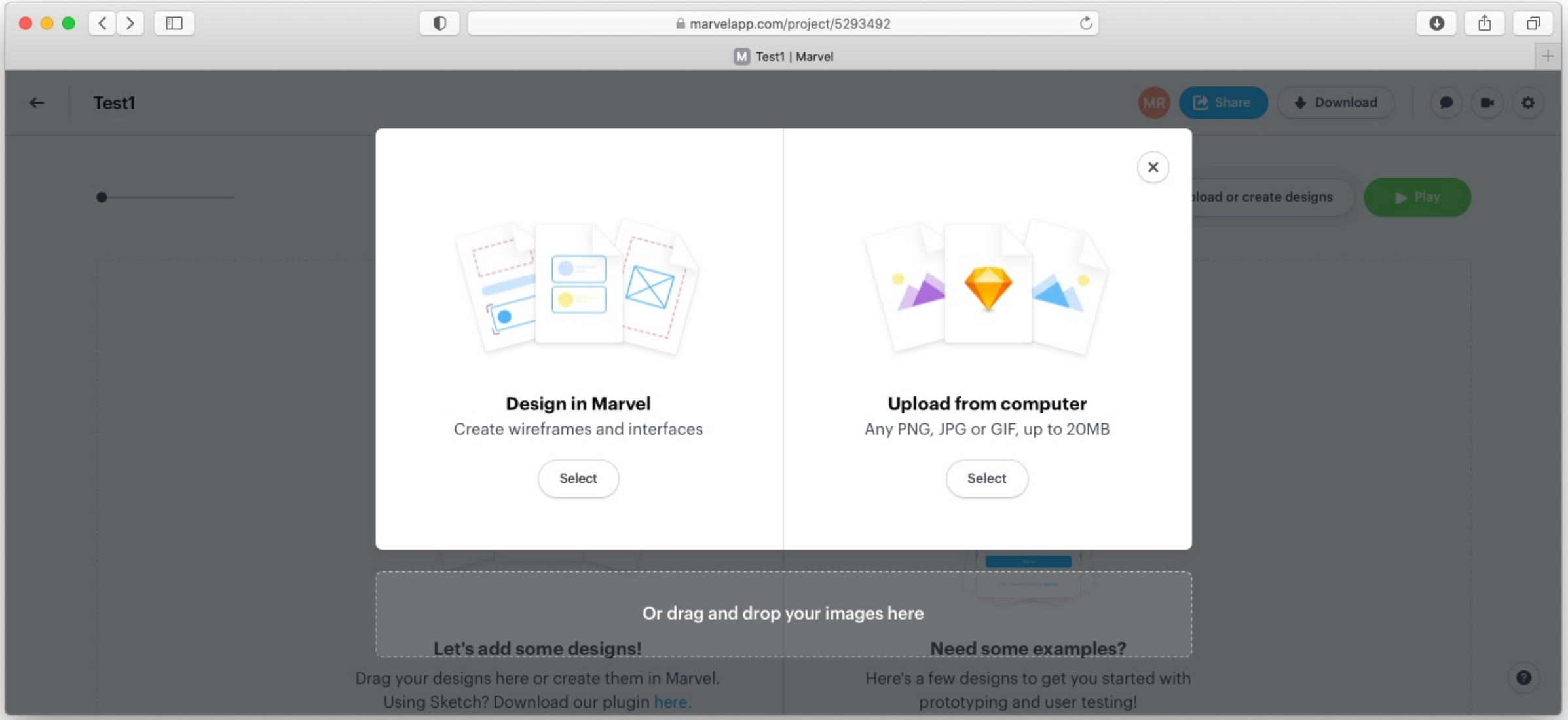


Figma

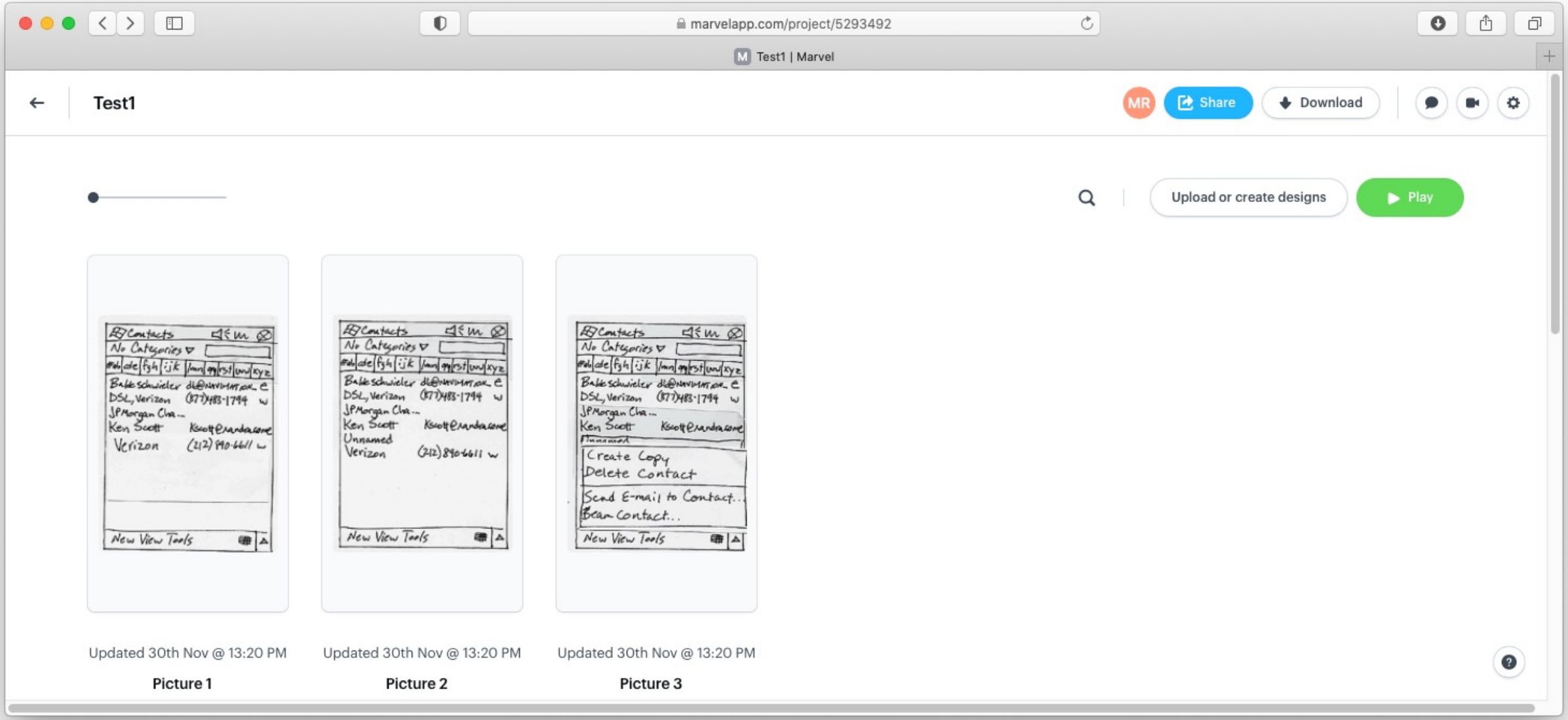
Marvel: Create Project



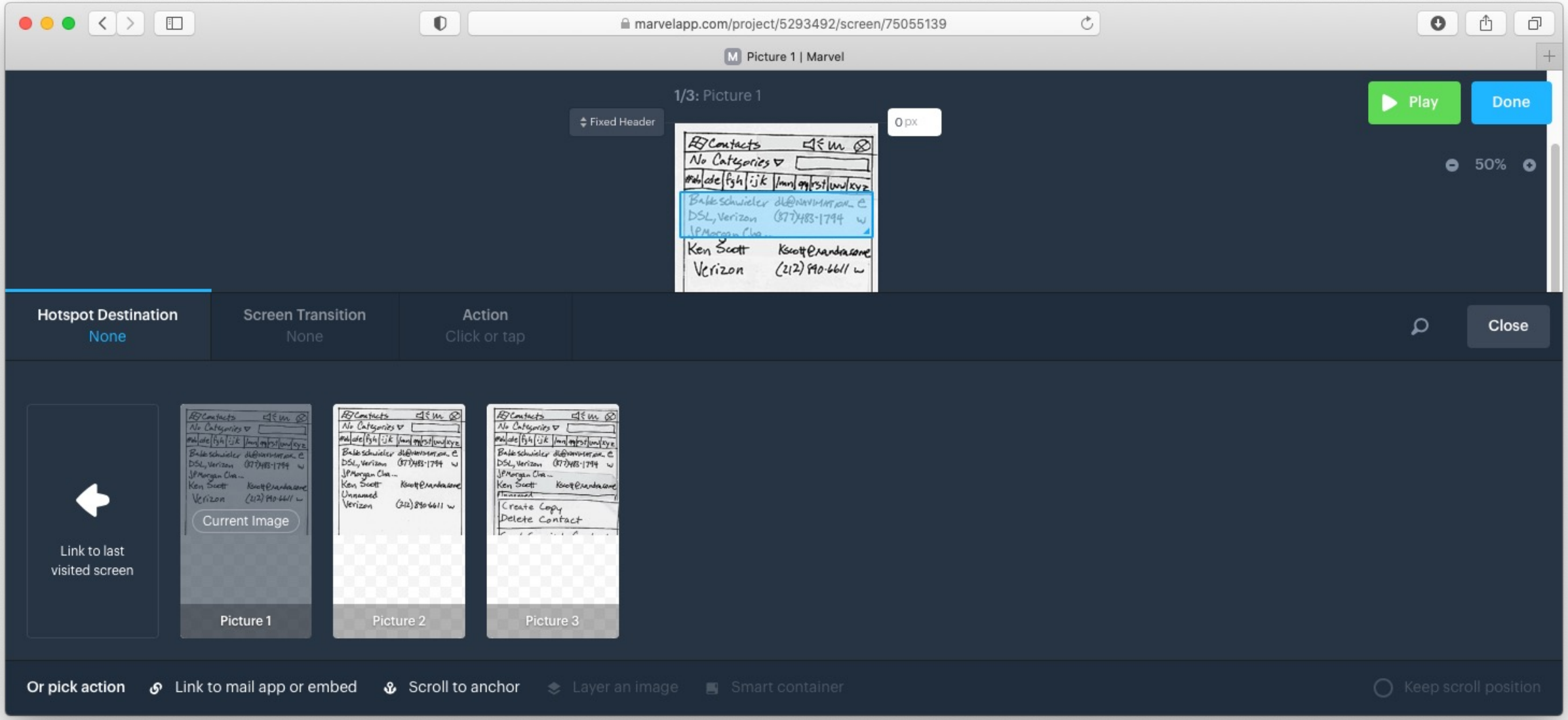
Marvel: Upload Images



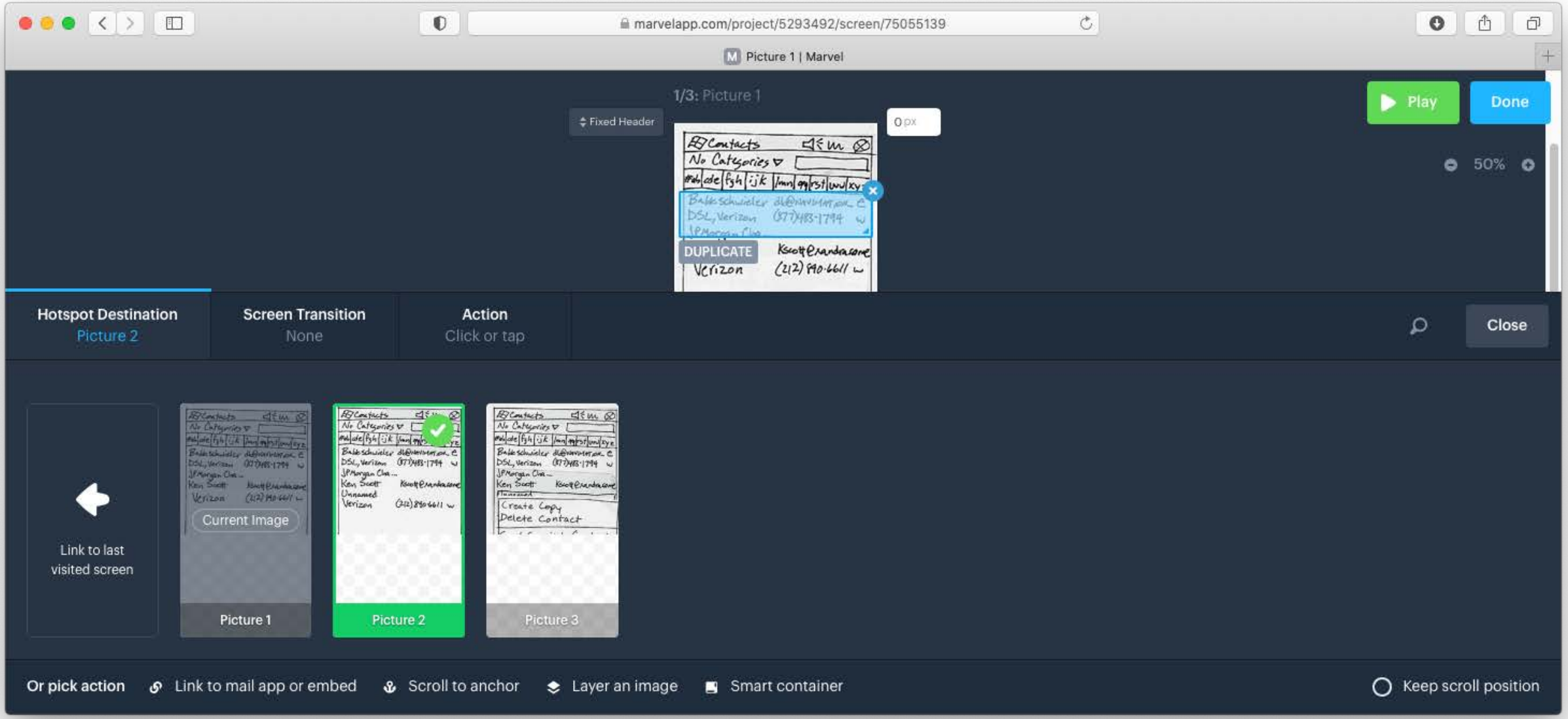
Marvel: Upload Images



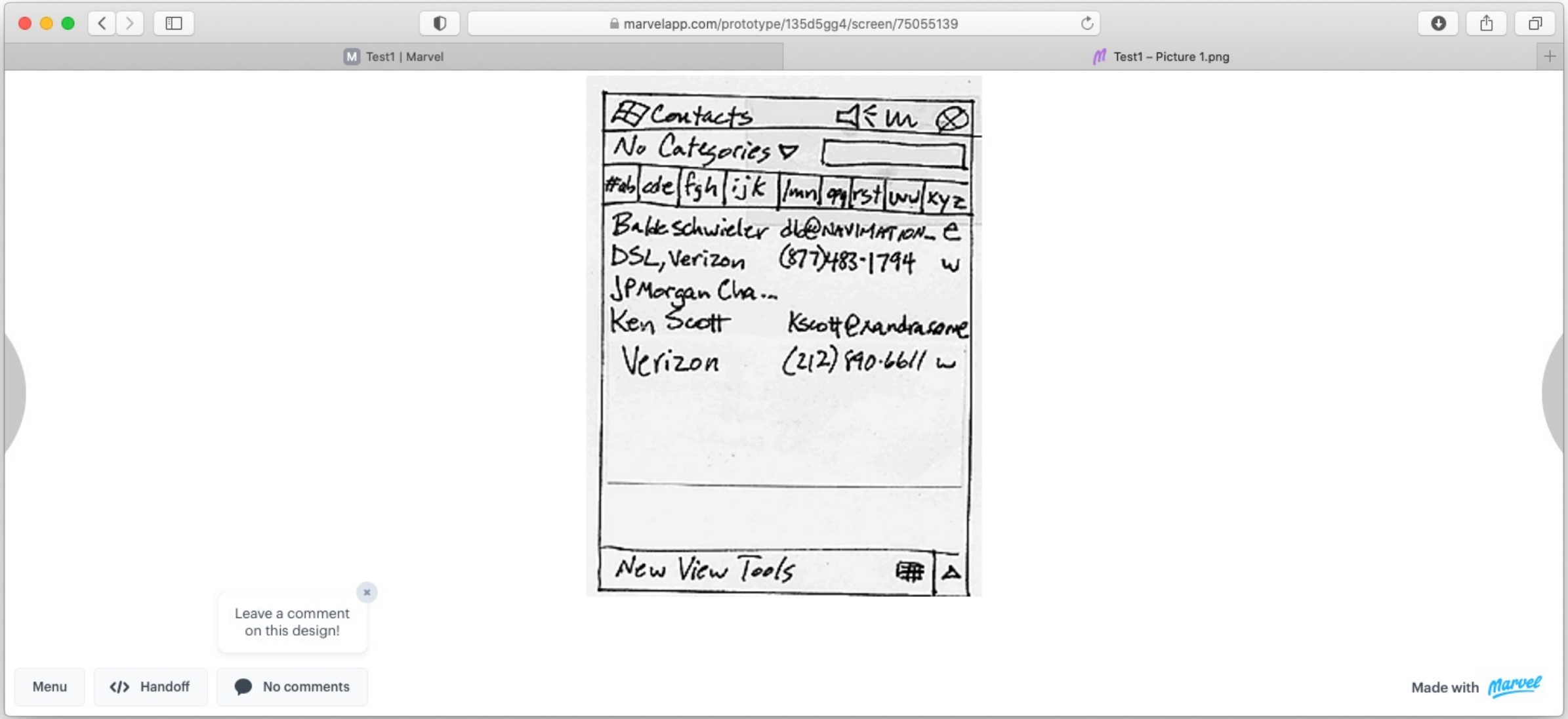
Marvel: Draw Hot Areas



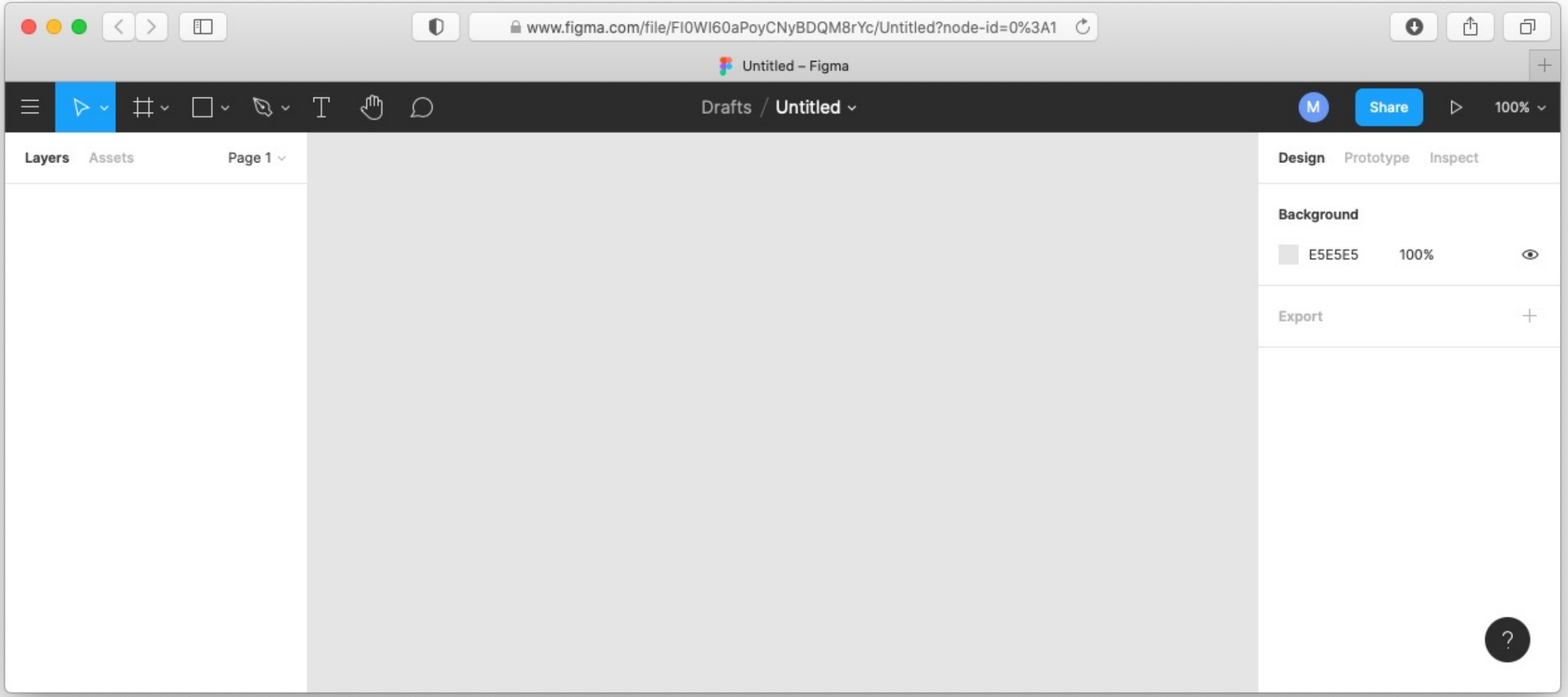
Marvel: Define Links



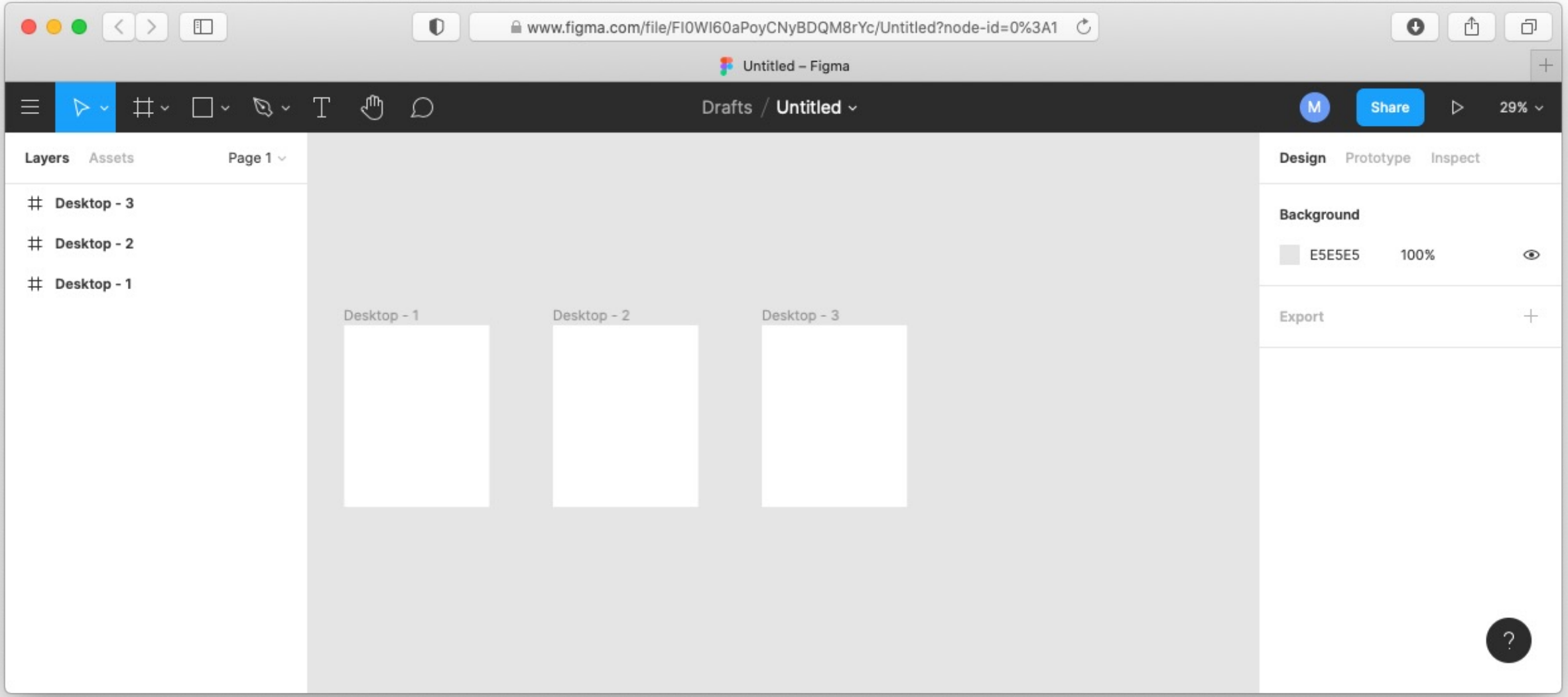
Marvel: Play Prototype



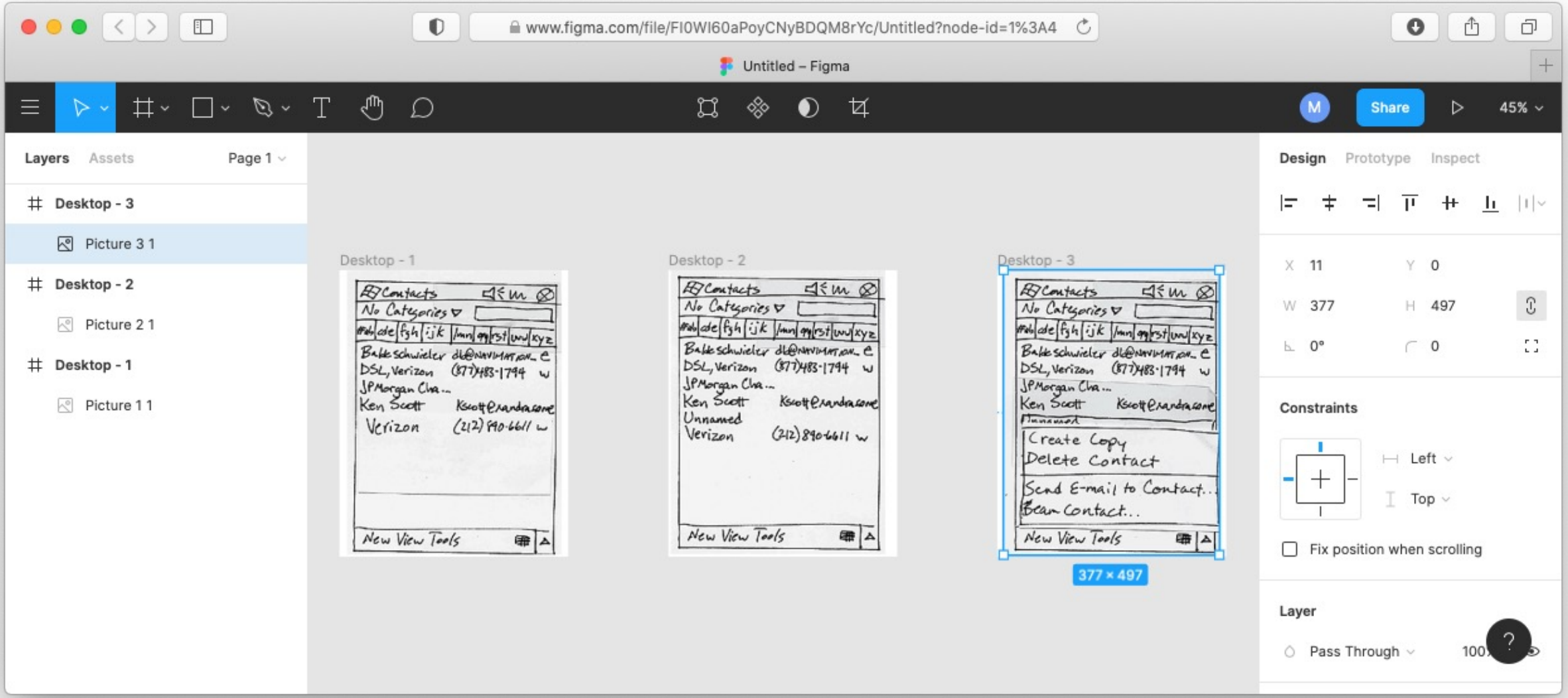
Figma: File New



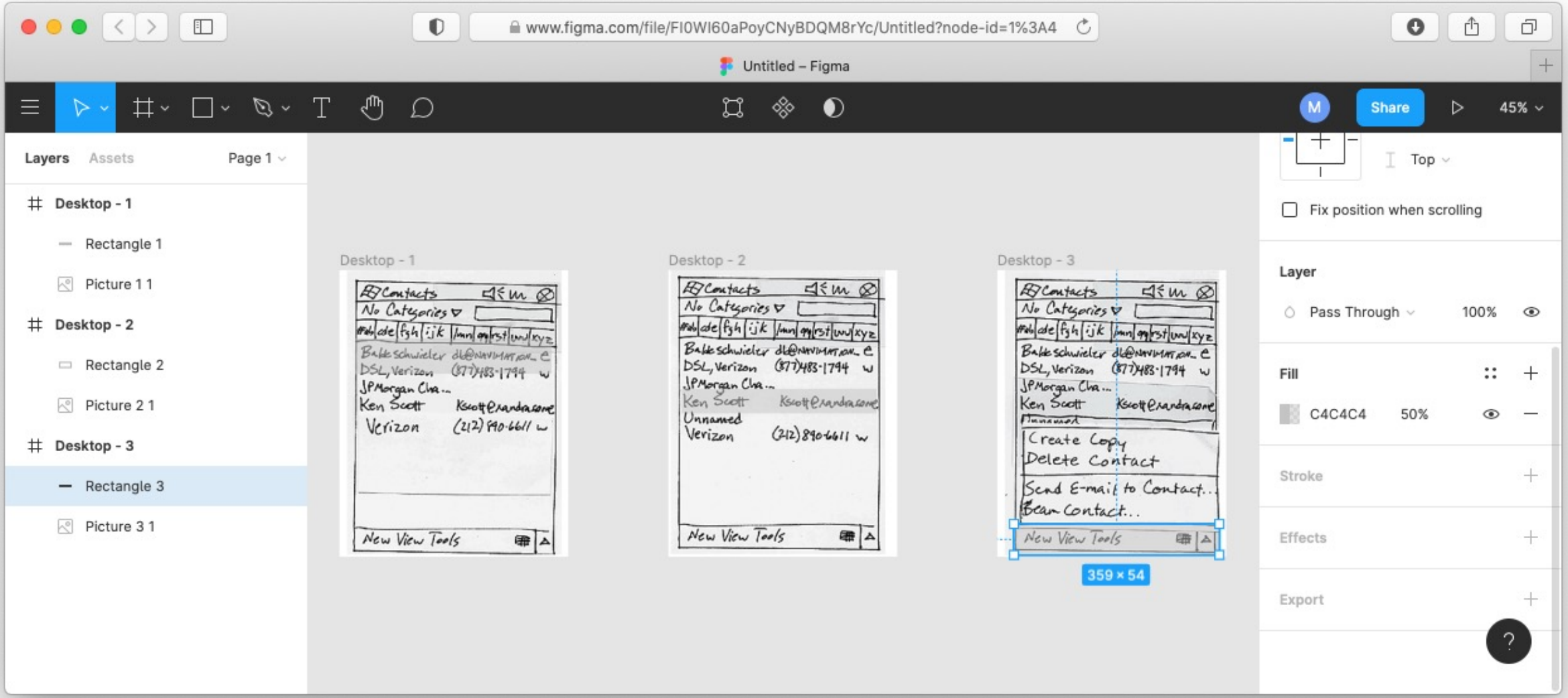
Figma: Create Frame (F), WxH = 400x500



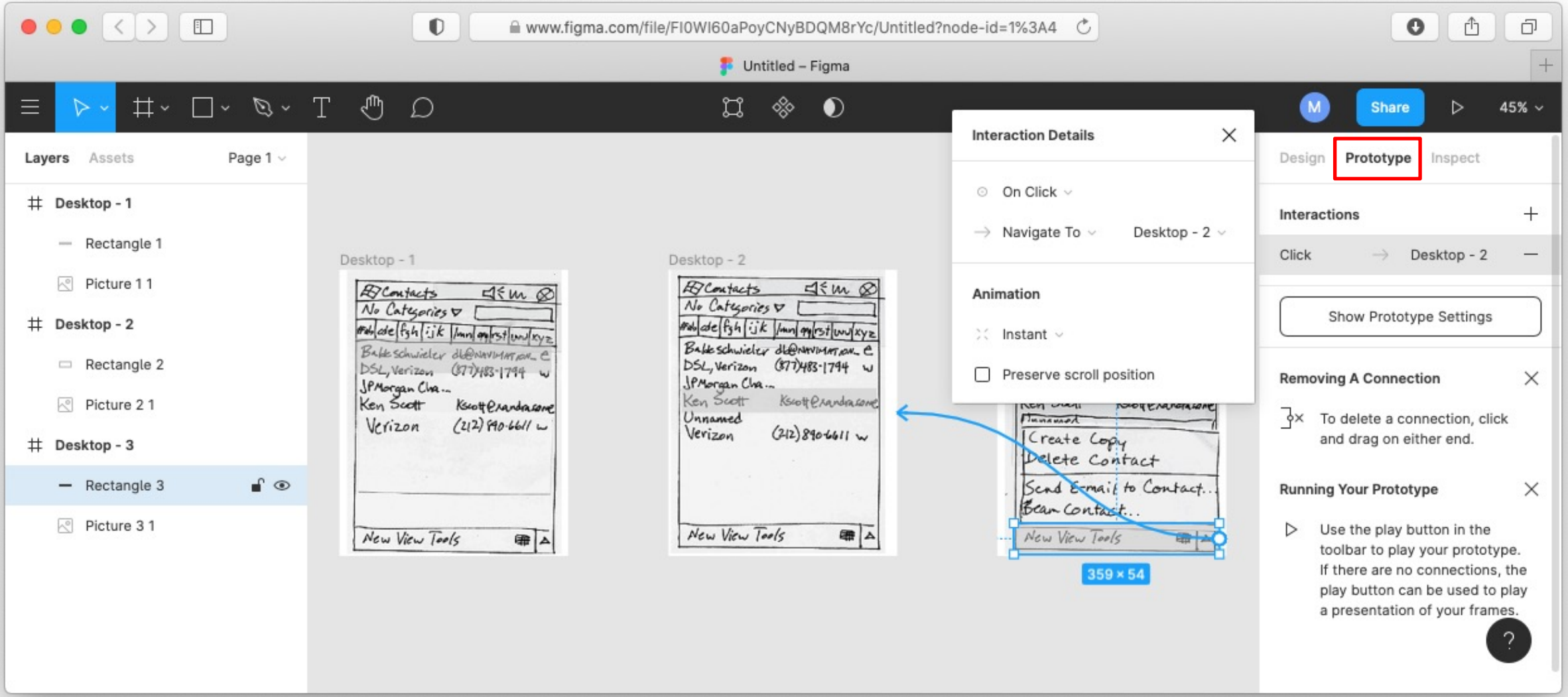
Figma: Import Image (Ctrl+Shift+K)



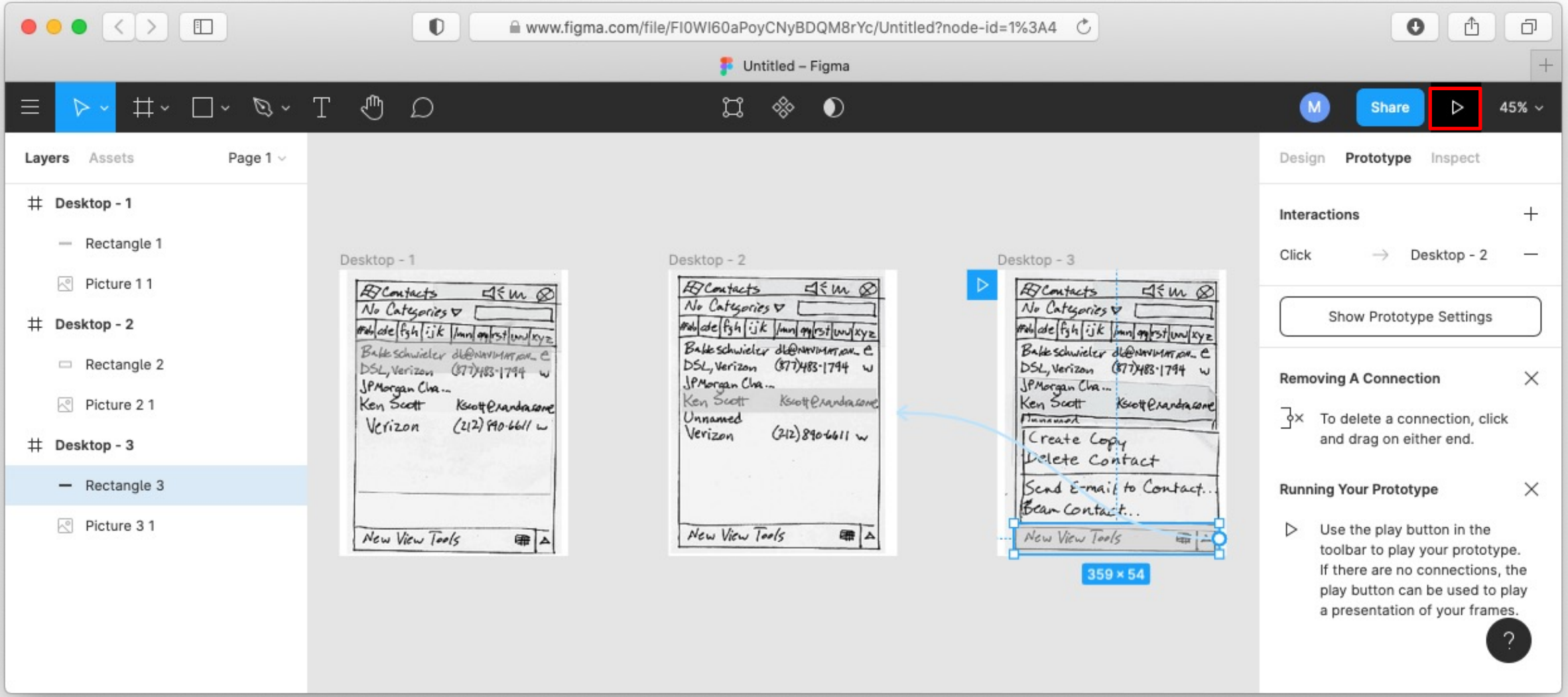
Figma: Draw Hot Aras (Rectangles, R)



Figma: Prototype (Define Transitions)

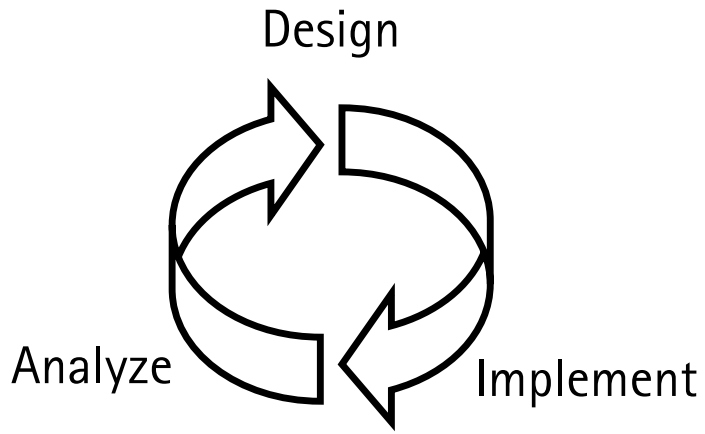


Figma: Present (Play Prototype)



Revision of Low-Fidelity Prototype

- Analysis of test results
  - Arrange paper prototype on table
  - Pile note cards next to component
- Summarize and prioritize problems
  - Written report on findings
  - Bullet points often suffice
- Prototype refinement
  - Agenda for meeting to discuss design changes
  - Attach post-it notes with changes to each component



Paper Prototype Pros & Cons

- Pros
  - Not too detailed
  - Designers and users concentrate on concepts
  - Easy to use
  - Fast turn-around
  - Encourages team design
- Cons
  - Difficult to capture interface behavior
  - Not executable (automatic screen transitions for Web-based tools)

Video Prototypes

- Cheap and fast
  - Use a mobile phone camera
  - Focus on illustrating the interaction flow
  - Do not invest a lot of time in video editing
- Communication tool
  - Helps achieve common ground
  - Portable and self-explanatory
  - Can serve as an animated specification for developers
- Ties interface design to tasks (and situation)
  - Watch users perform a task given an interface (in a specific situation)
  - Puts interface elements into task perspective

Source: Adapted from Scott Klemmer

Video Prototypes

- Can use audio or a silent movie with title cards
- Interface can be paper prototype, software prototype, or invisible (show just the task)
- Video prototypes can be any fidelity
  - Brainstorm result: 5 minutes creation time
  - Paper prototype demonstration: 1 hour creation time
  - Professional video: days, outsourced, expensive

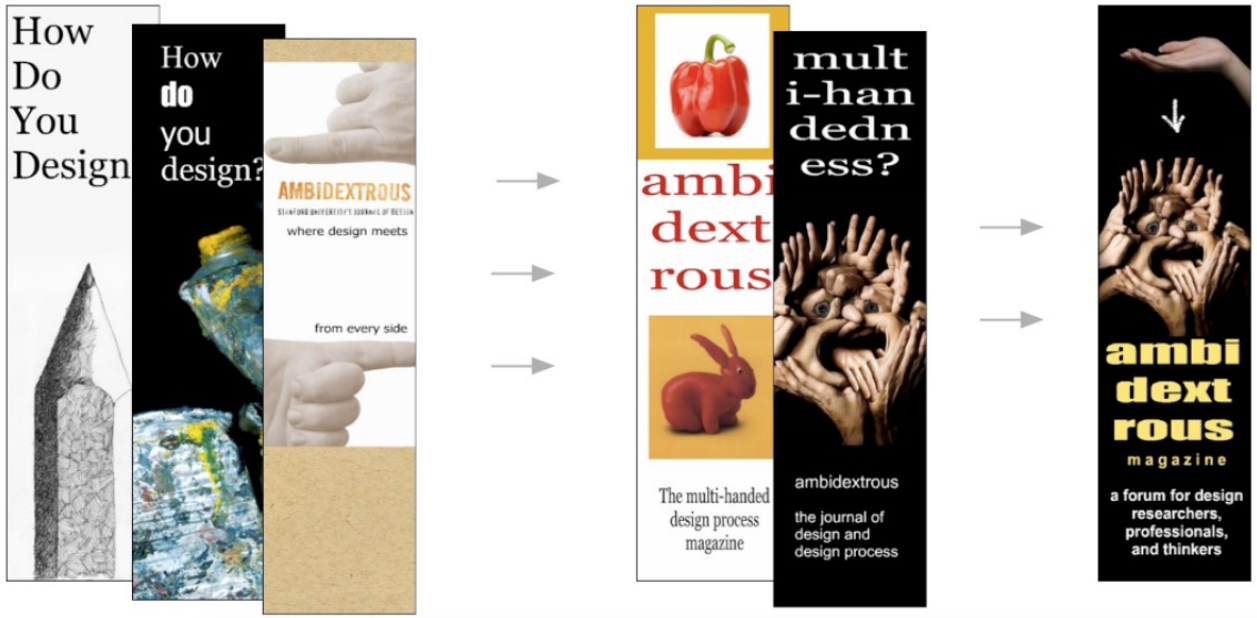
Source: Adapted from Scott Klemmer

Serial vs. Parallel Prototyping

Serial prototyping

Parallel prototyping

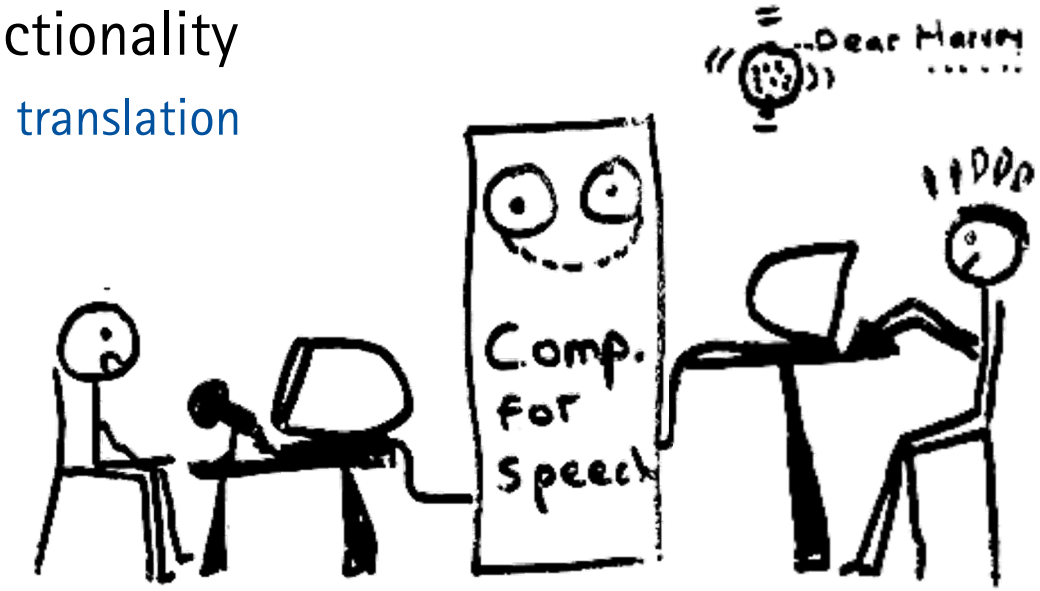
When to give feedback?



Dow, Glassco, Kass, Schwarz, Klemmer: The Effect of Parallel Prototyping on Design Performance, Learning, and Self-Efficacy. 2009.

Wizard of Oz Prototyping

- Method for testing a non-existing system
- Human "wizard" simulates system responses
  - Interacts with user via a simulated user interface
- Useful for adding complex vertical functionality
  - Speech and gesture recognition, language translation



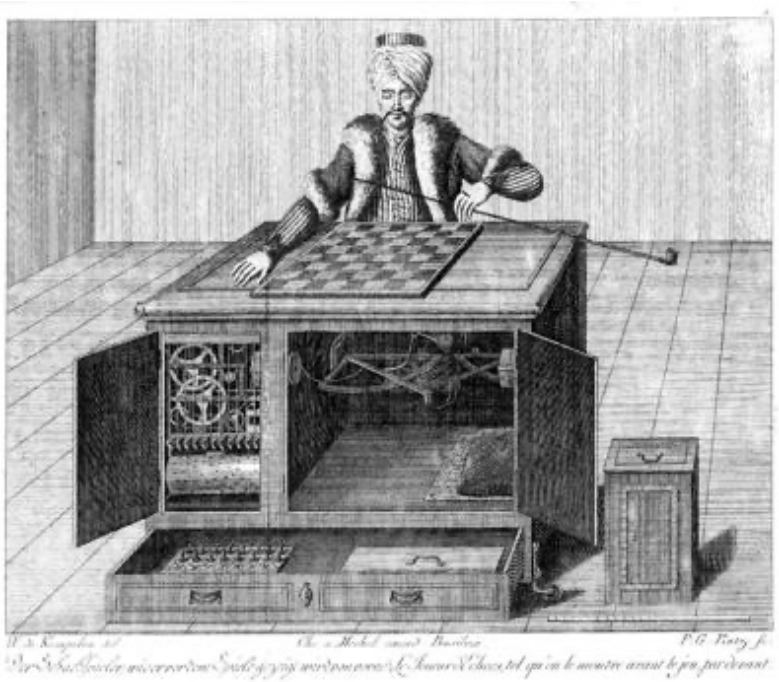
What the user sees

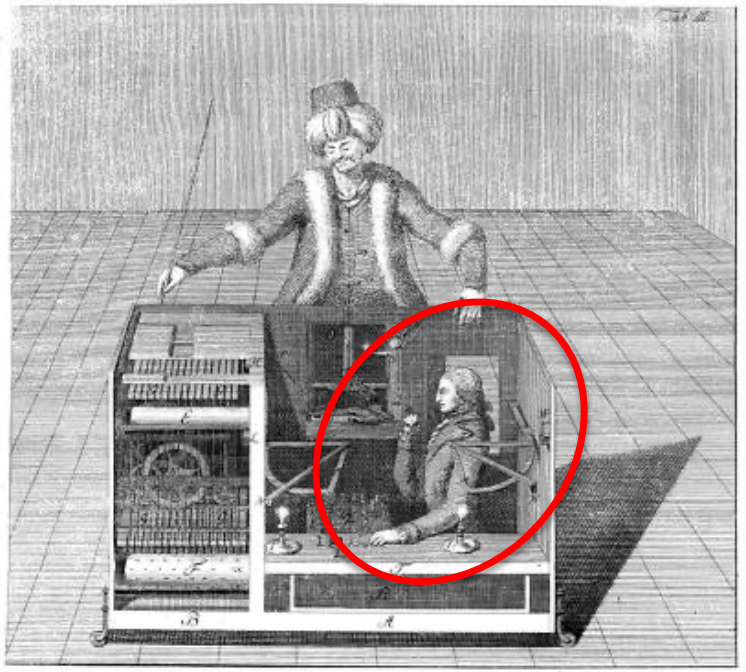
The Wizard

Wizard of Oz Prototyping

The first "Chess Computer"

"In 1769, Hungarian nobleman Wolfgang von Kempelen astonished Europe by building a mechanical chess-playing automaton that defeated nearly every opponent it faced."

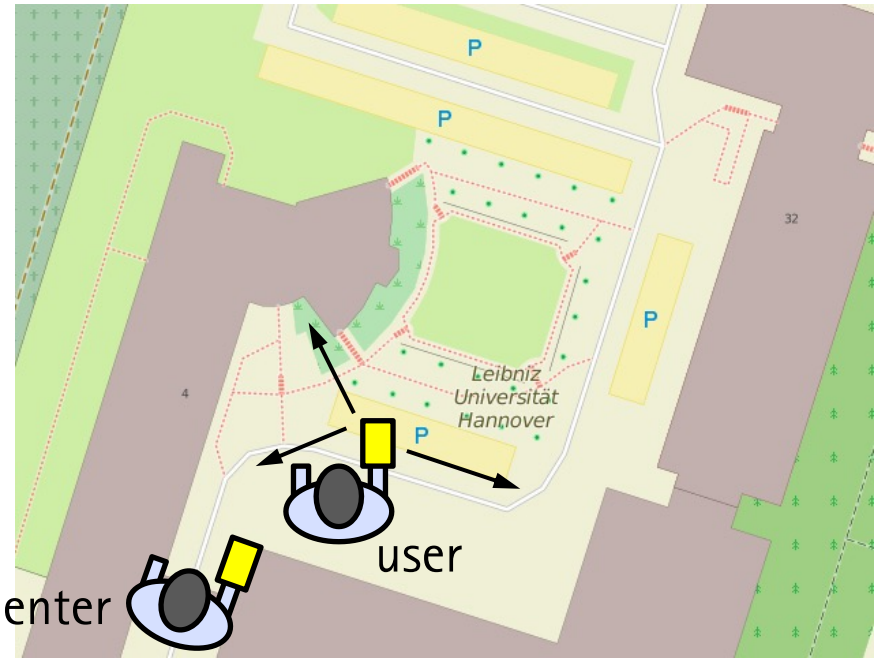




Source: http://collabor.f4.fhtw-berlin.de:8888/mmgestalt07s/topics/Beispiel/

Wizard of Oz Prototyping

- Example: New pedestrian navigation system
- Problem
  - Requires very precise positioning outdoors
  - Much better than GPS
- Solution
  - Experimenter follows participant and triggers "navigation events"



Prototyping Tools

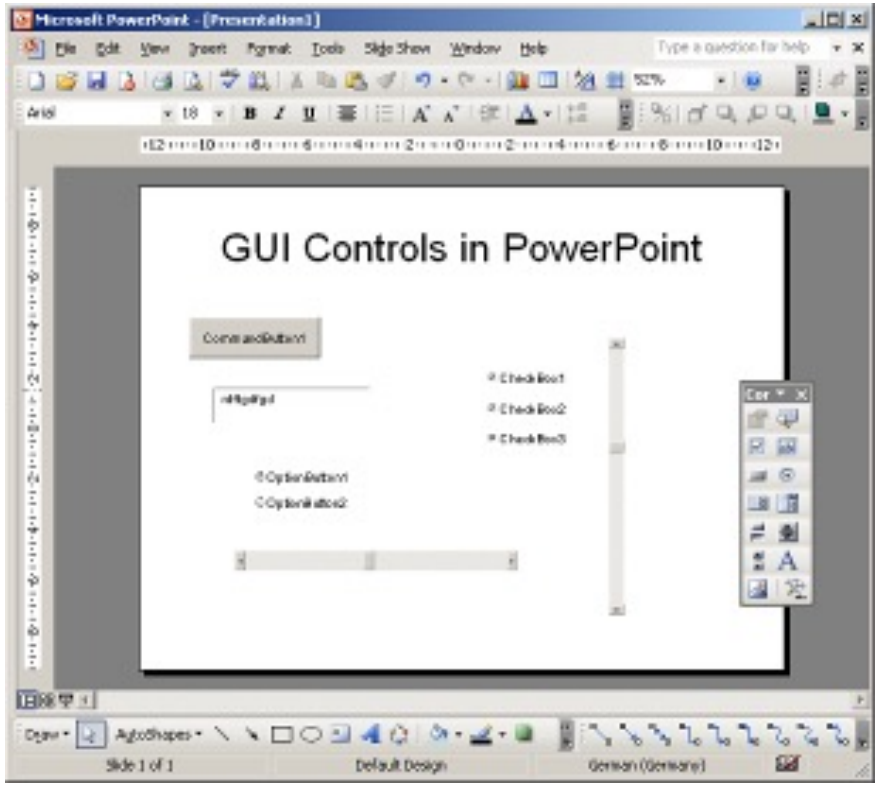
- Make prototyping process effective and cheap

- Ease of use
- Fast turn-around
- Flexibility
- Data collection capabilities
- Executable prototypes
- Collaborative design

Facade Prototypes

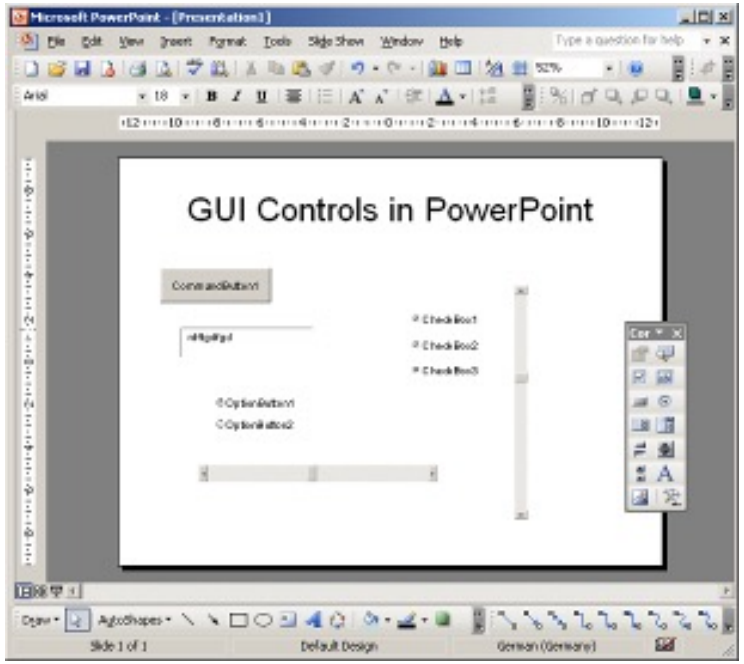
- Drawing editors with ability to specify input behavior
  - Looks like real application,
    but no application logic behind
  - Click-through prototypes
  - Switch between screens
  - On-screen storyboards
- Presentation programs like PowerPoint
  - Animation features
  - Buttons for navigation to specific slides

Button



Facade Prototypes Pros & Cons

- Pros
  - Easy to use
  - Fast turn-around
  - Reliable feedback
  - Executable (with limitations)



- Cons
  - Do not produce reusable code
  - Facade prototype and application might be built by different teams
    - Lessons learned from prototype may not carry over to implementation

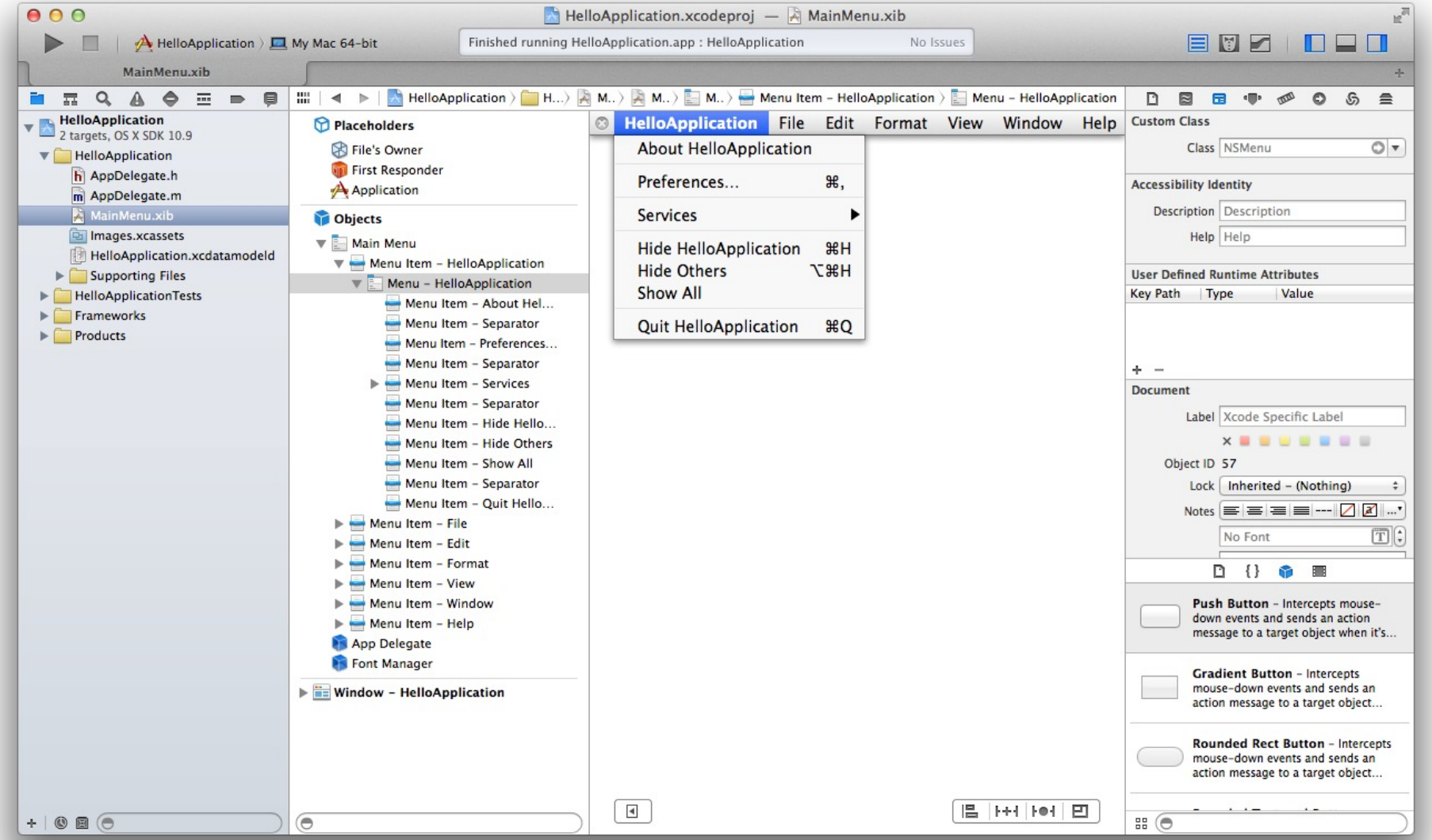
User Interface Builders

- Graphical tools to define the UI of the actual application
- Usually part of integrated development environment (IDE)
  - Visual Studio, Eclipse, NetBeans
- Pro
  - Real look & feel
  - Vertical functionality can be added easily
  - Finished design can be used in final implementation
- Con
  - Limited to specific system and its toolkit (windows, buttons,...)
  - Needs considerable expertise
  - Needs attention to technical details
  - False expectations, because looks finished

Example: Xcode Interface Builder (macOS)

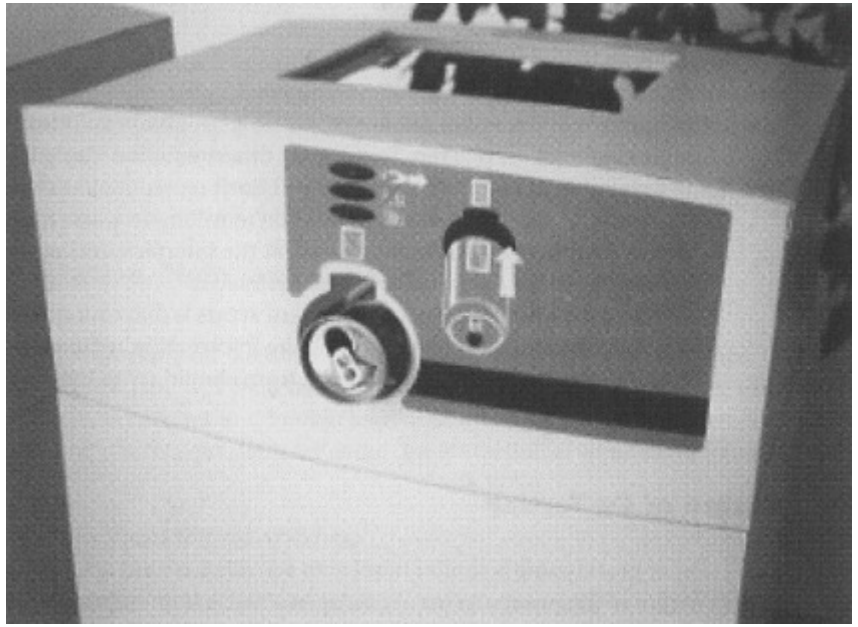
- Graphical tool to create UIs for macOS applications
  - Part of Apple's standard Xcode IDE for macOS
- Visually place widgets (buttons, menus,...) in a UI
  - Static layout
- Define connections between widgets and application code
  - Dynamic behavior
- Implementation process
  - Start with the user interface, not the application functionality
  - Xcode generates source code skeleton that can then be filled in

Example: Xcode Interface Builder (macOS)



Hardware Prototypes

- For systems that are hard to imagine by software alone
  - Example: Recycling machine
- Physical interaction is important
  - Example: Inserting cans
- Design in wood, plastics, styrofoam, cardboard, etc.
- Problem: considerable effort to build and change



Hardware prototype of a can recycling machine

High-Fidelity vs. Low-Fidelity Prototypes

- Too long to build and change (weeks vs. hours)
- Elicits feedback on “fit and finish” issues but feedback on “big things” is needed
  - Clarity of basic metaphor
  - Flow of interaction
  - Terminology
- Developers resist change
- High-fidelity prototype may set expectations that are hard to meet

Overview Tools: Pros/Cons

	Paper	Facade Tools	Interface Builders	Actual Implementation
Ease of Use	++	+	0	-
Fast Turn-around	++	+	+	-
Flexibility and Control	++	+	0	0
Executable Prototypes	--	+	0	++
Team Design	++	+	0	--

Summary

- Developing interactive systems is a creative process
- Designers have good methods to foster creativity
- Adapt methods pragmatically

- Prototyping enables rapid feedback on design ideas
- Different kinds for different purposes and design stages
- Low-fidelity vs. medium-fidelity vs. high-fidelity
- Many approaches, methods, and tools

Sources

- Preece, Rogers, Sharp: Interaction Design – Beyond Human-Computer Interaction, John Wiley & Sons, 2002.
  - Chapters 7 (data gathering), 8 (data analysis), 11 (prototyping)
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- John M. Carrol: Scenario-Based Design. In: Helander, Landauer, Prabhu: Handbook of Human-Computer Interaction, 2nd edition, 1997.