

Grundlagen der Mensch-Computer-Interaktion

Prototyping



Human-Computer
Interaction Group

Prof. Dr. Michael Rohs
michael.rohs@hci.uni-hannover.de

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

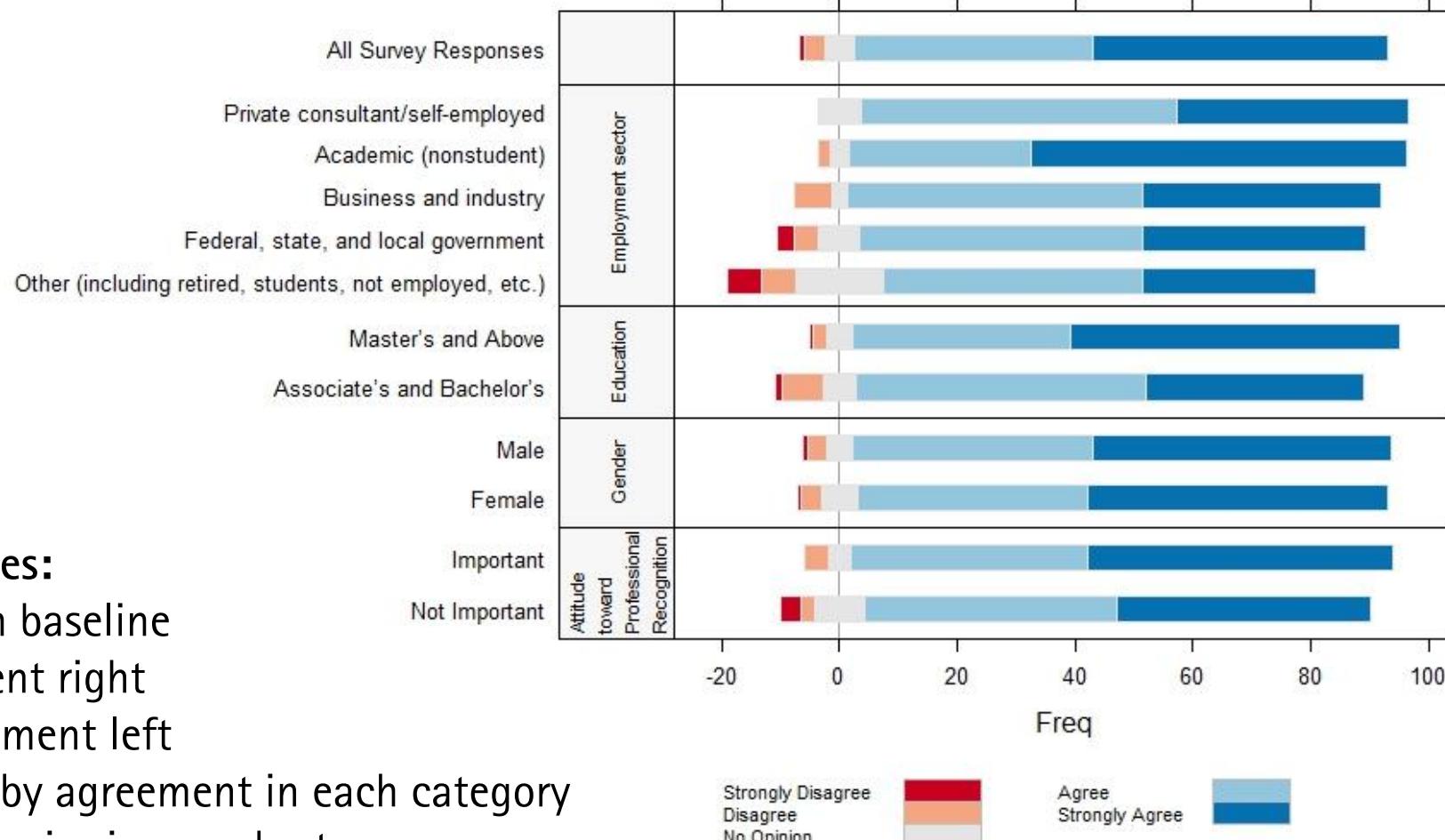
- Interviews
 - Ask a small number of stakeholders
 - Flexible method: unstructured, semi-structured, structured
- Questionnaires
 - Ask a large number of stakeholders
 - Little control over conditions
- Observation
 - Capture context of use
 - Expensive to analyze the results

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

Is your job professionally challenging?



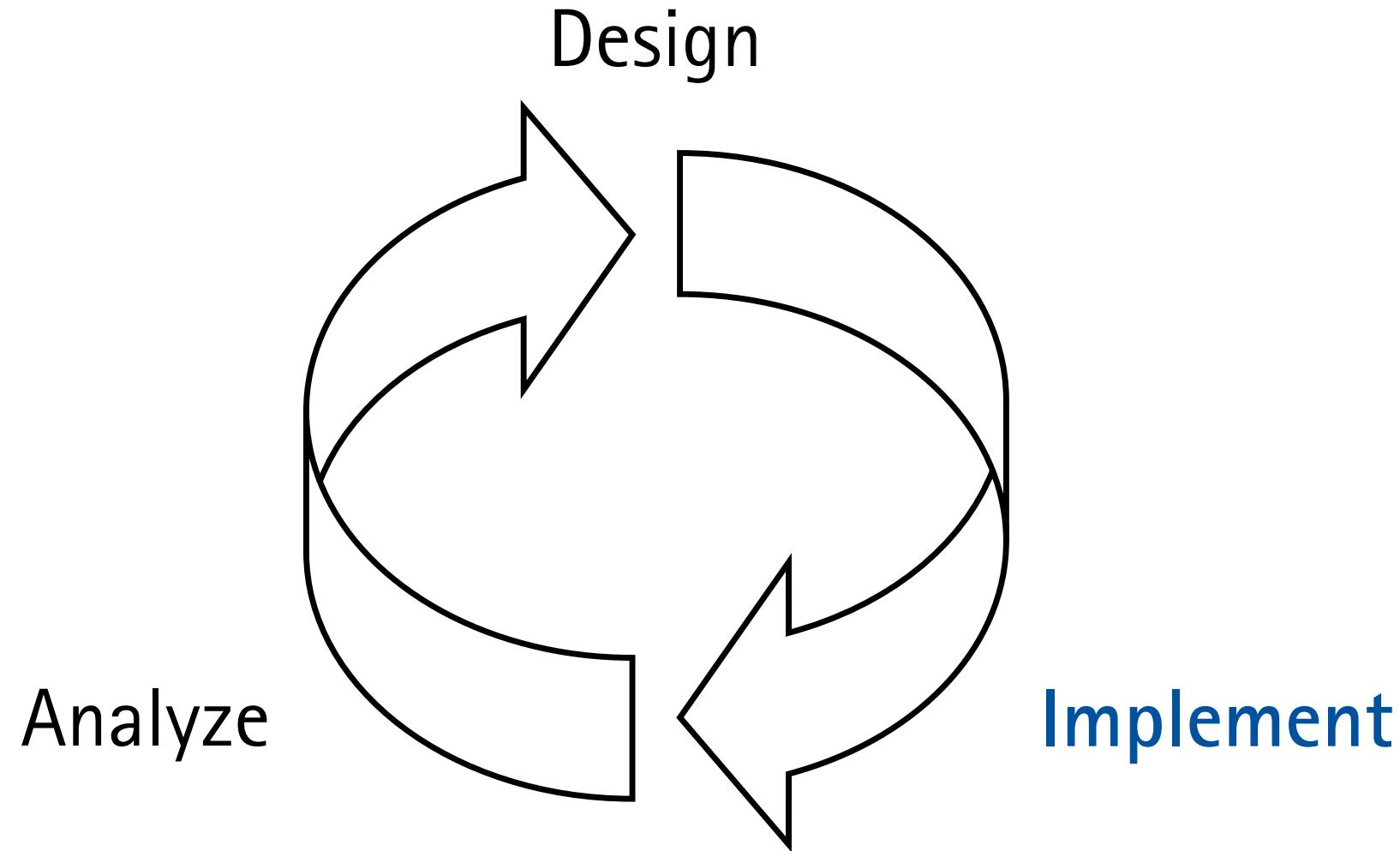
Robbins, Heiberger: Plotting Likert and Other Rating Scales. 2011.

Preview

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

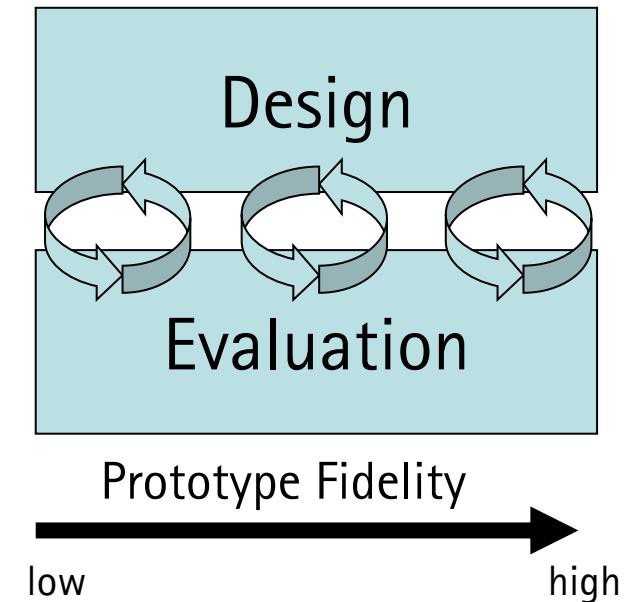
PROTOTYPING

DIA Cycle: How to realize design ideas?



From Ideas to Implementation: Prototyping

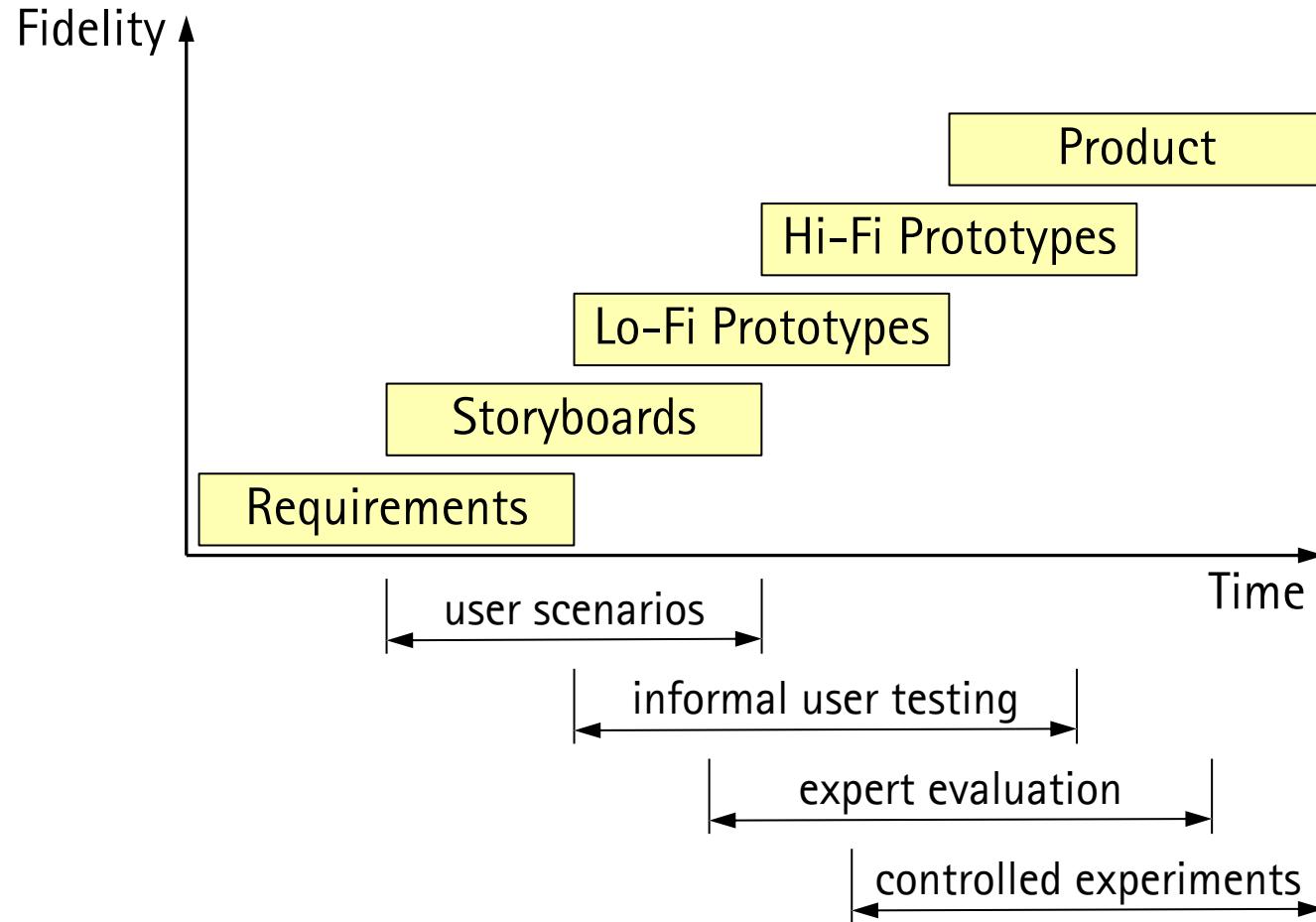
- Building a scaled-down version of an interactive system to collect information to guide its further design
 - Invaluable for iterative design
- Get early feedback on emerging designs
 - After initial requirements analysis, scenarios, storyboards
- Continuous input for design decisions
 - During all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

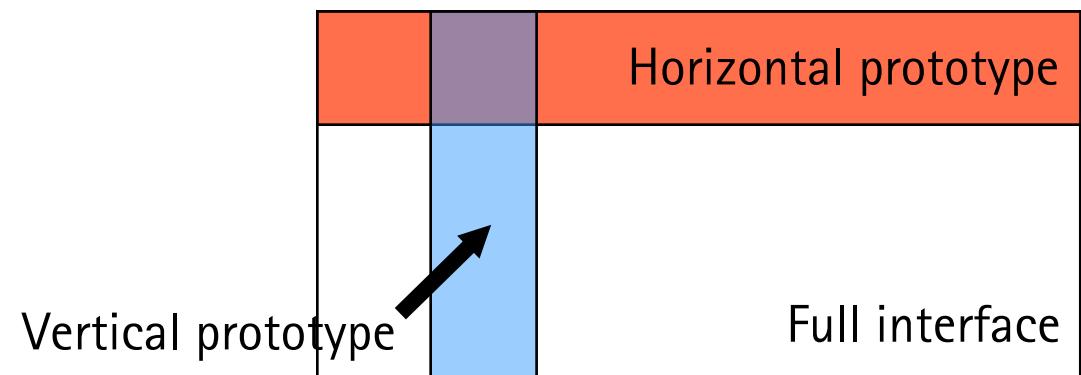
Prototype Evolution



Source: Adapted from Scott Klemmer

Limiting Prototypes

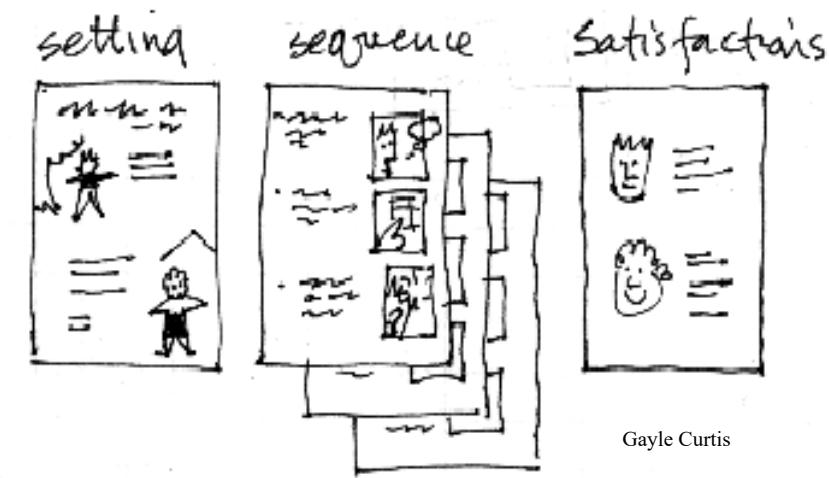
- Horizontal prototypes
 - The entire interface but no underlying functionality
 - A facade, no real work can be performed
- Vertical prototypes
 - Includes in-depth functionality for only a few selected features
 - Specific design ideas can be tested in depth



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

Low-Fidelity Paper Prototypes

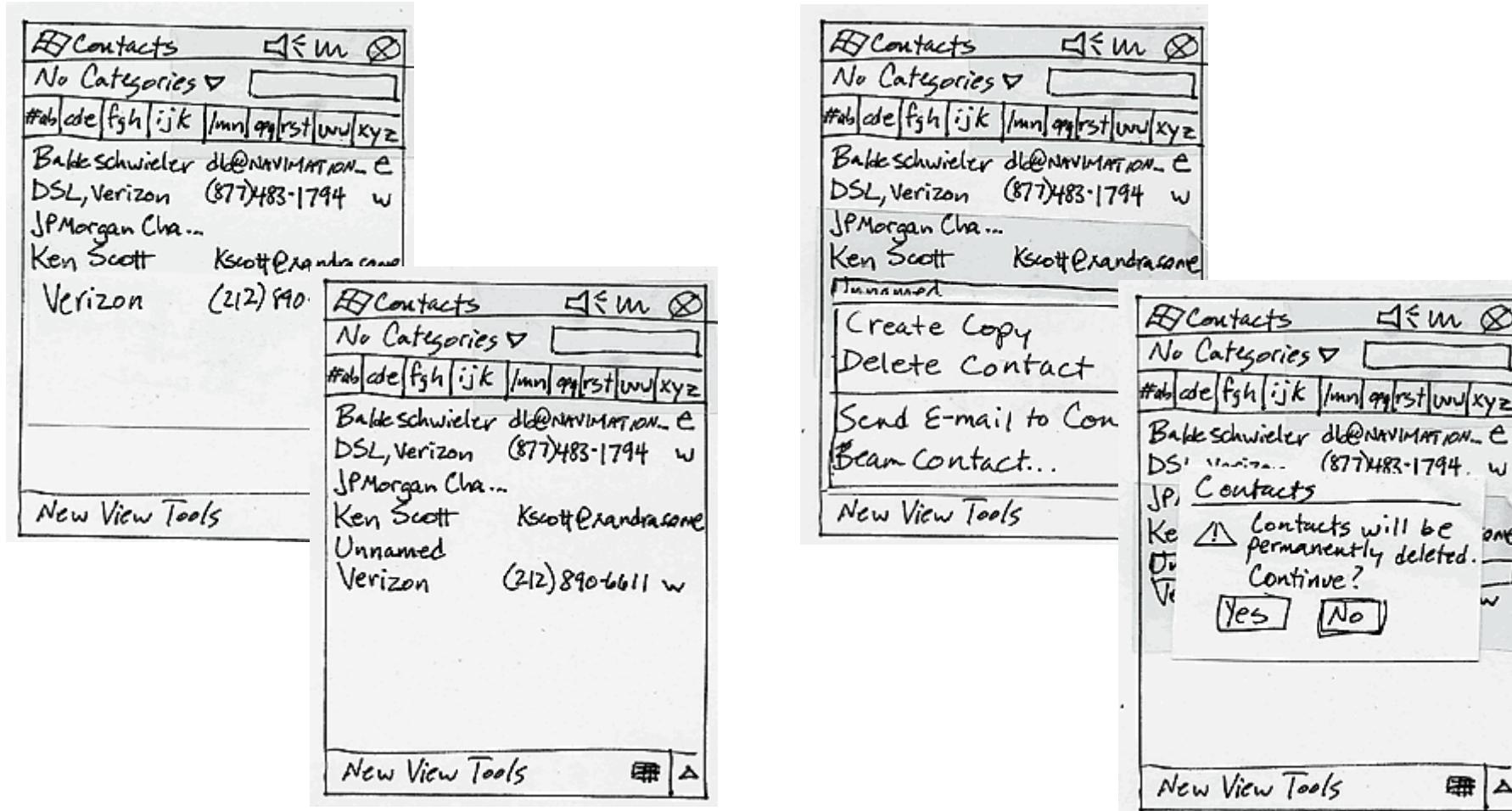
- First prototype, quick and cheap
- Paper and pencil mockup of user interface
 - Sketches of the main screens and dialogs
 - Textual description of interface functions and relationships between screens
- Goals
 - Brainstorming
 - Expert review of interaction flow
 - First user feedback
 - User tests



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

Travel Organiser 23 August 2006

WELCOME HELEN

Where do you want to go?

What date do you want to travel?

Which form of transport do you want? TRAIN

Do you need accommodation? YES

Travel Organiser 23 August 2006

Train timetable from Milton Keynes Central
to York
on 16.09.06

| | | | | |
|--------|-------|-------|-------------------------------|-------|
| Depart | 09:09 | 10:09 | same | 22:09 |
| Arrive | 12:30 | 13:30 | <small>mins past hour</small> | 01:30 |

Accommodation Hotel B&B
£40 to £150 £20 to £60

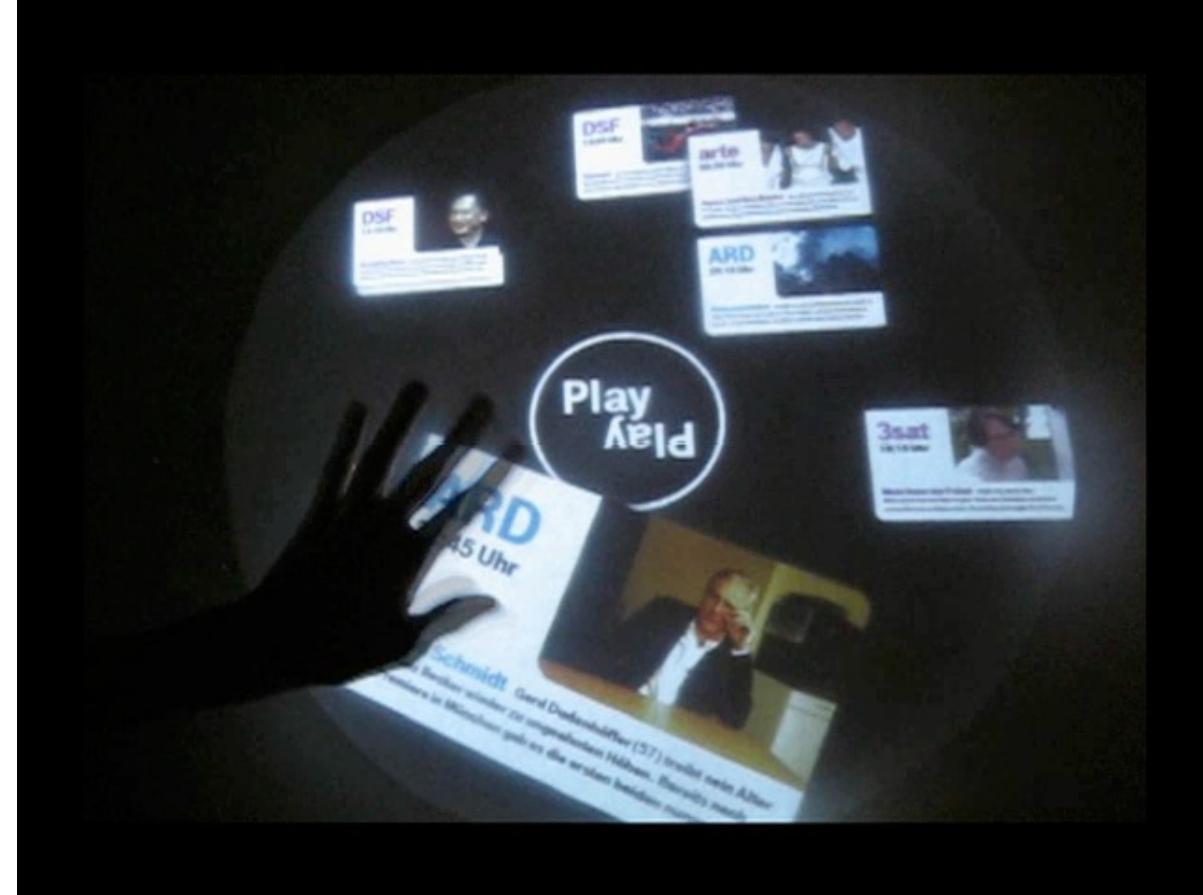
Paper / Video Prototype Example: Multi-Touch Table

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

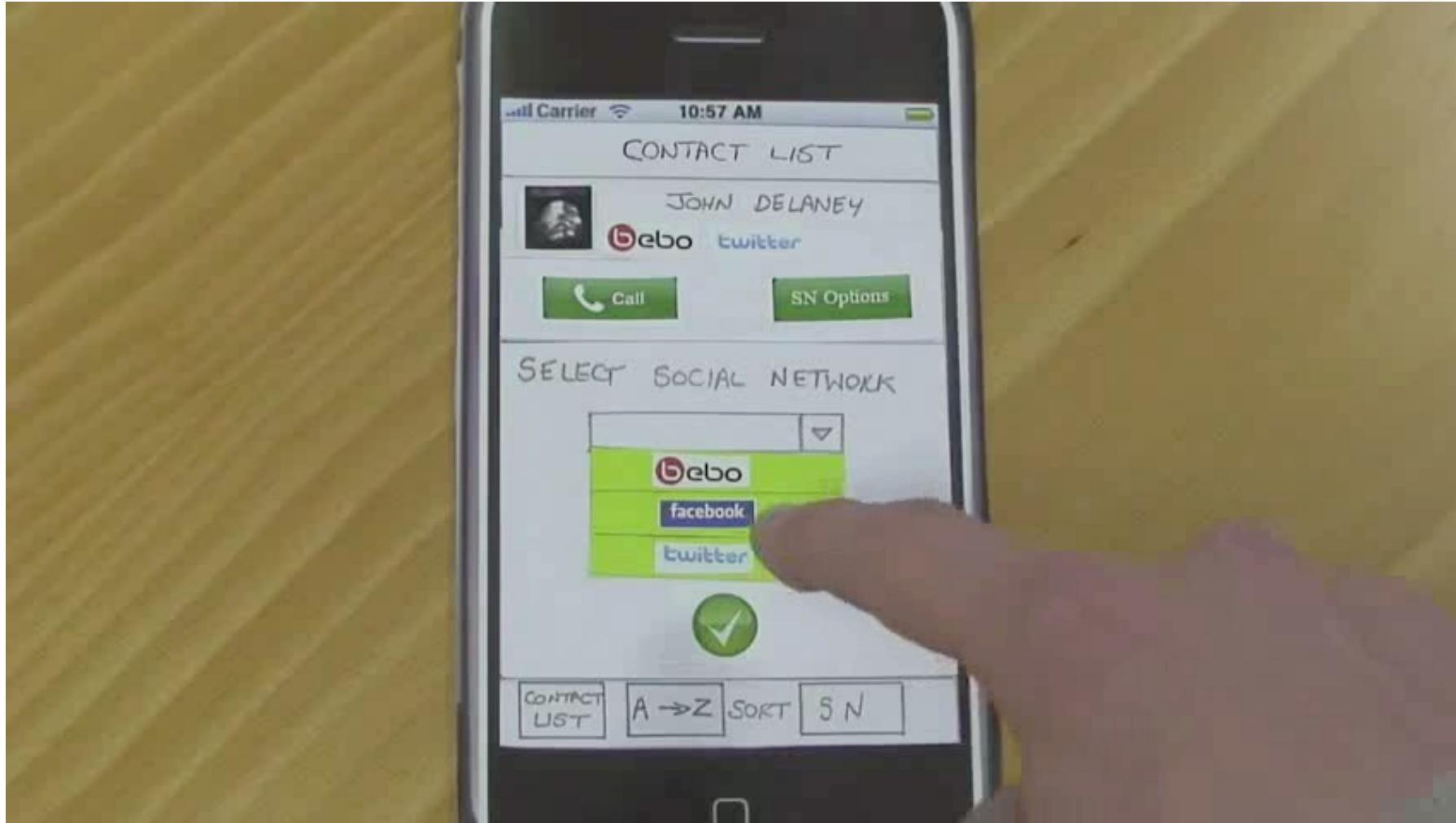


Paper / Video Prototype Example: Multi-Touch Table

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



Paper Prototyping Video: Social Phonebook for iPhone



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

Collaborative Paper Prototyping



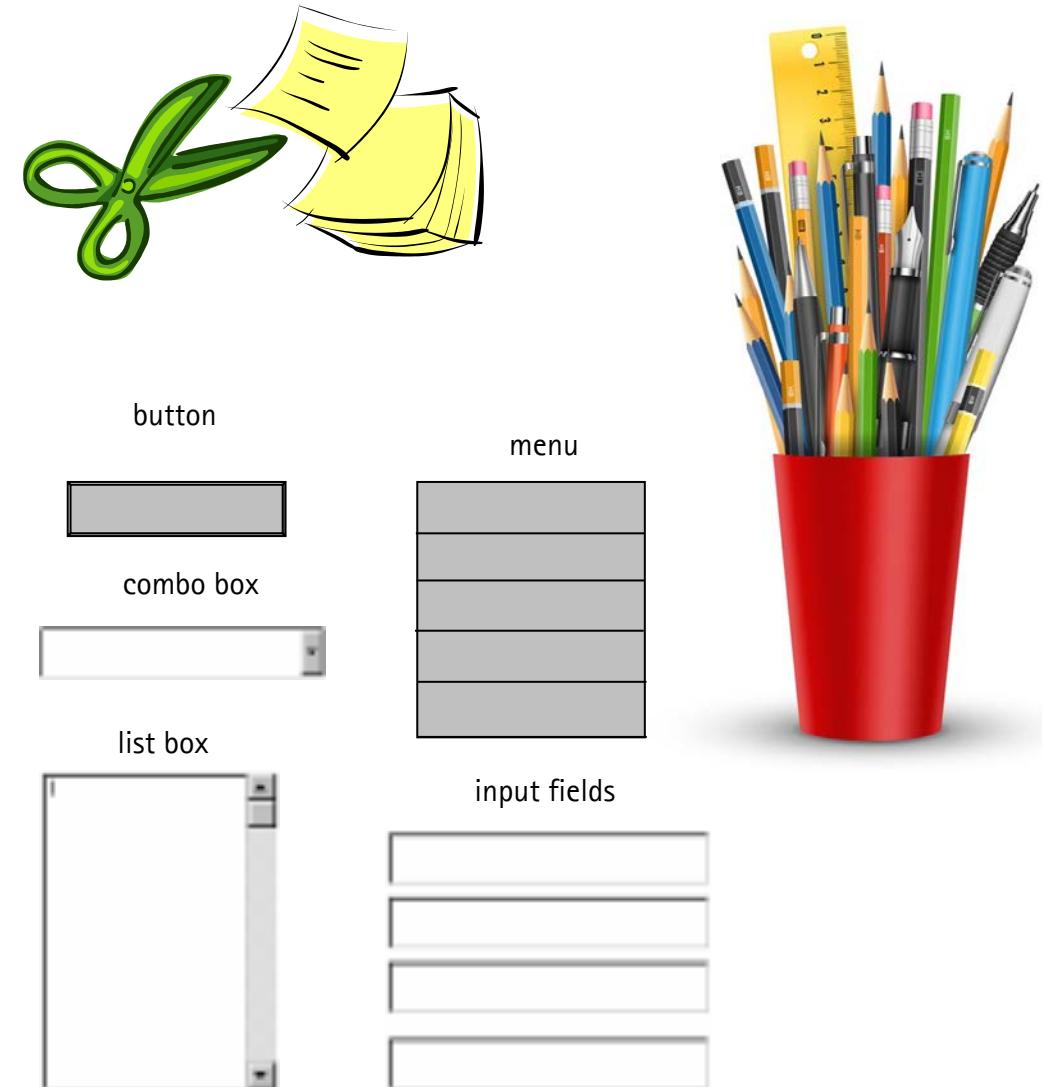
Reviewing the prototypes



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

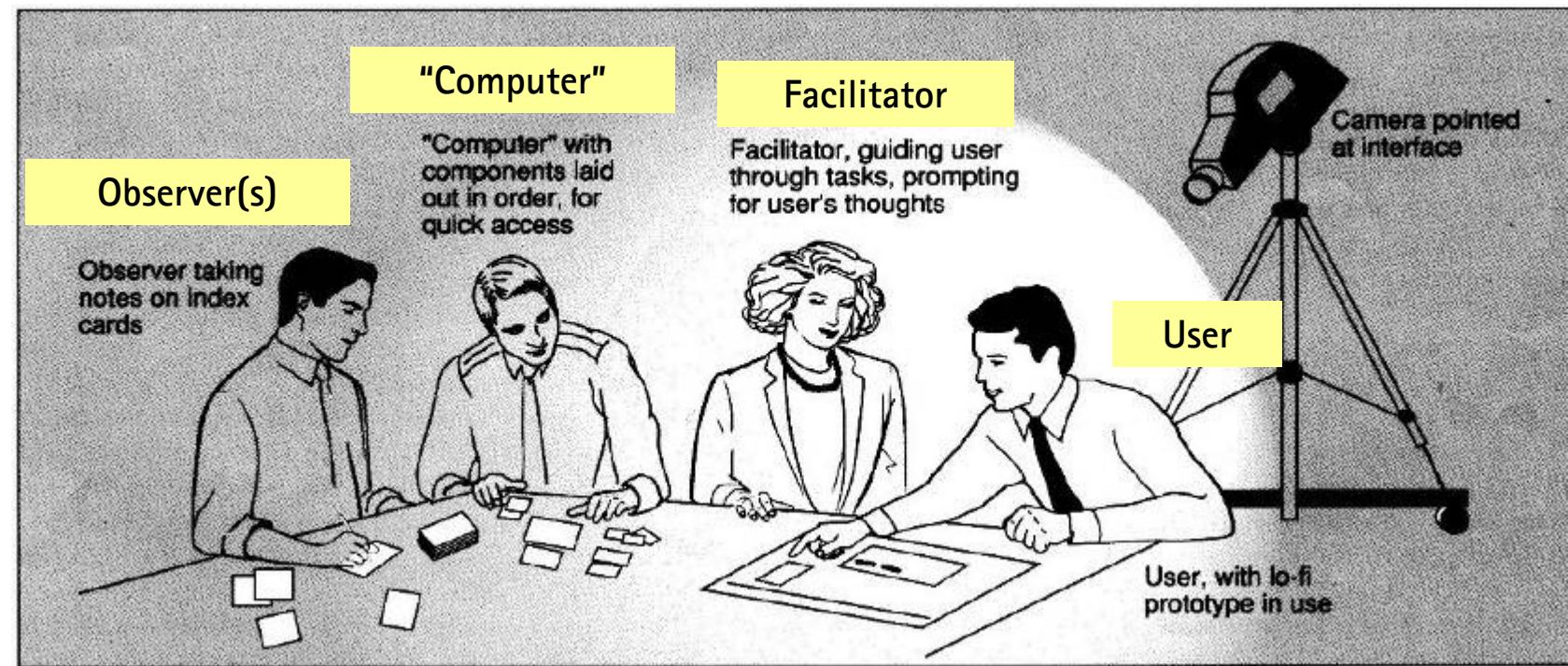
Building a Low-Fidelity Prototype

- 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



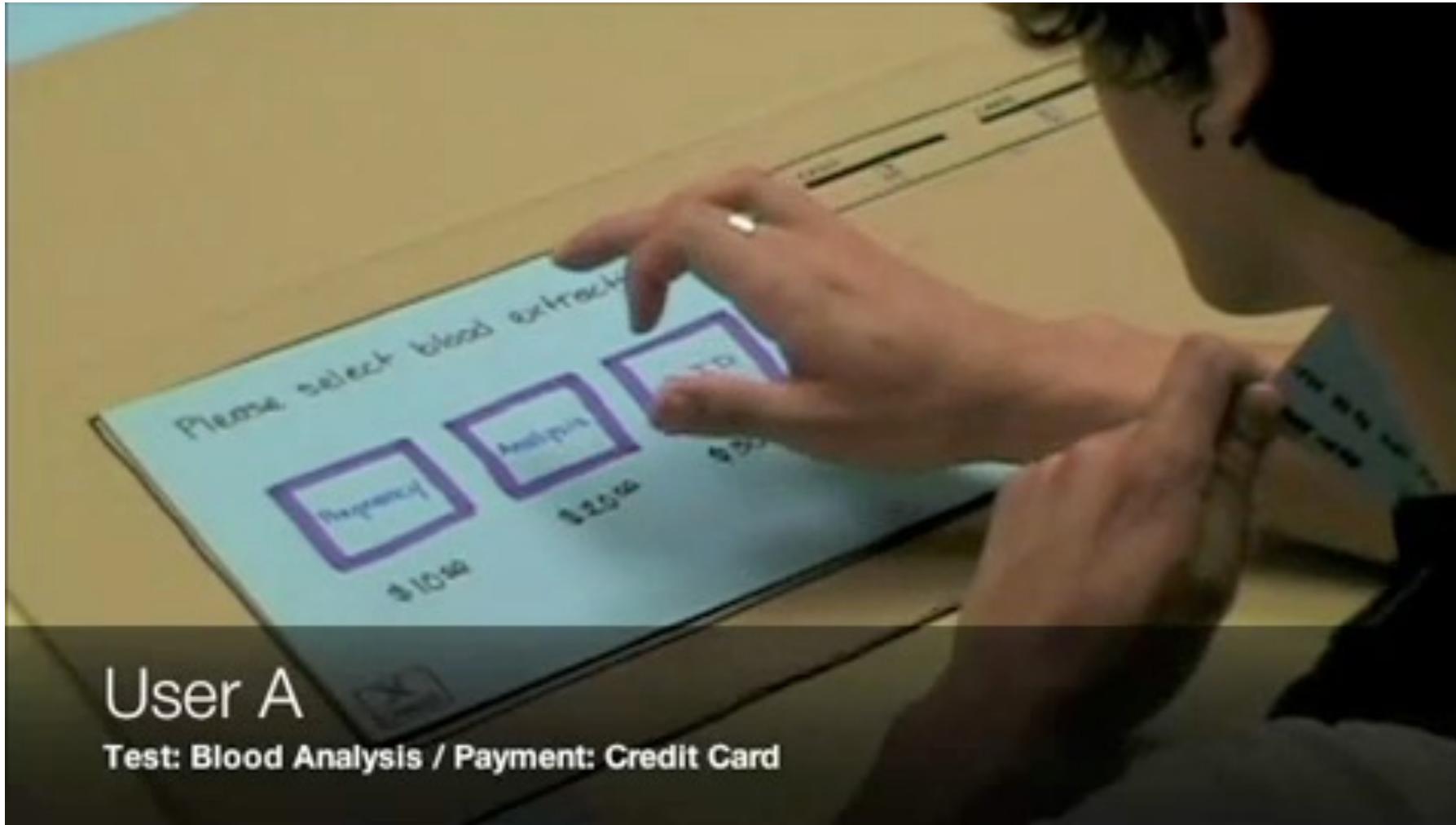
Low-Fidelity User Testing

- 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



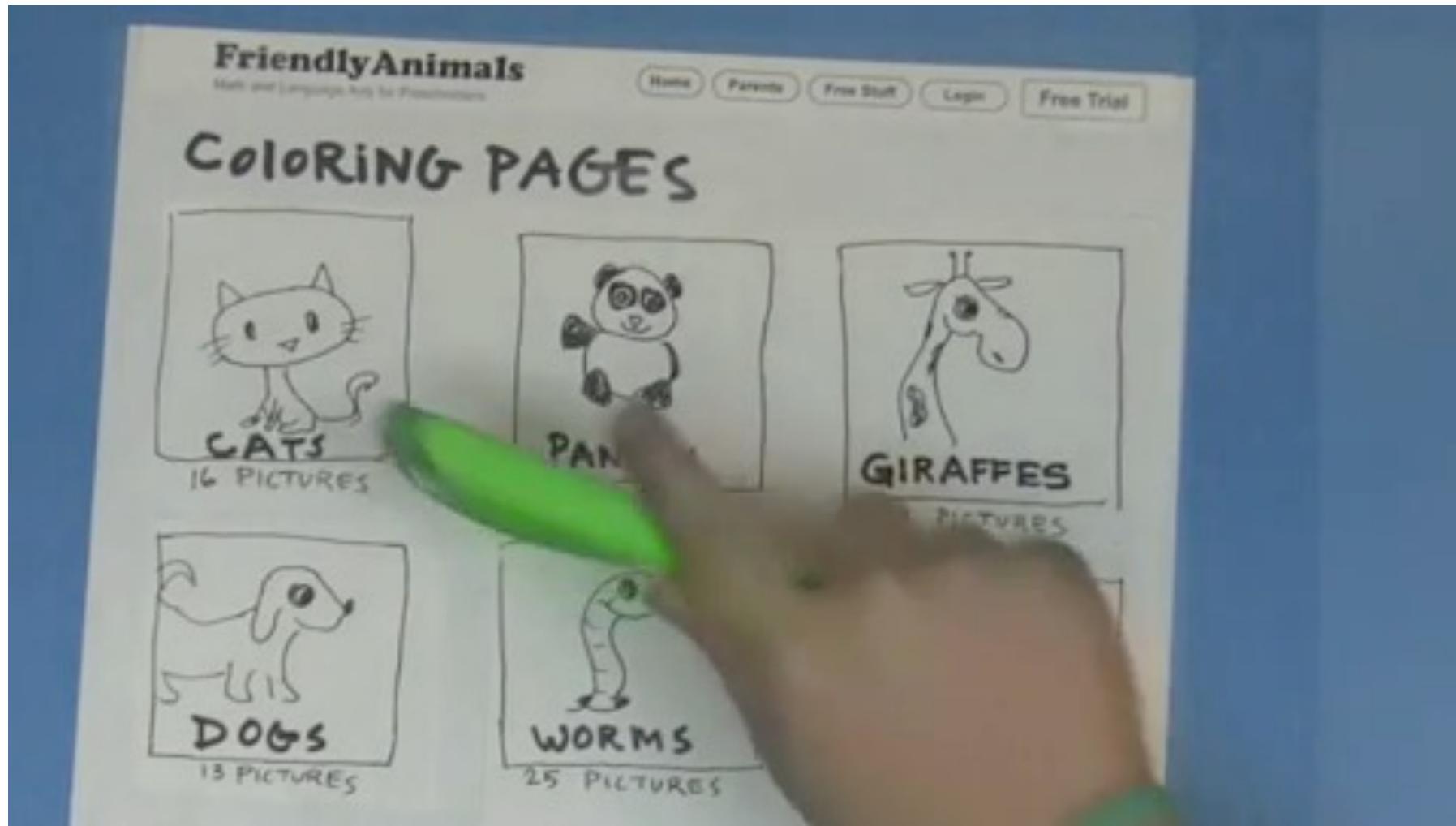
Marc Rettig: Prototyping for Tiny Fingers

Paper Prototyping Test: Blood Test Kiosk



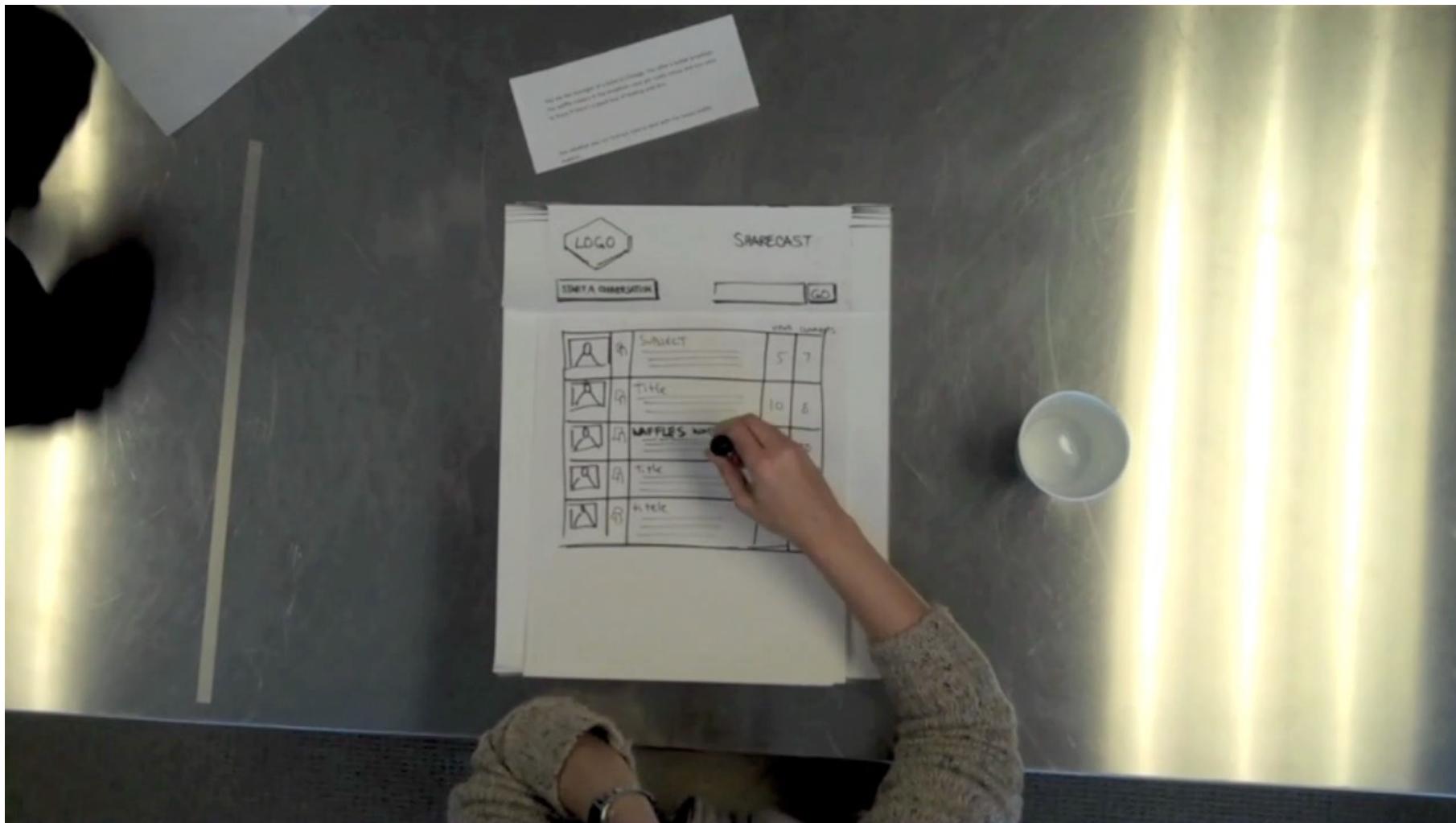
http://www.youtube.com/watch?v=_q4GGtJ8NCY

Paper Prototyping Test: Web Page Kids



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

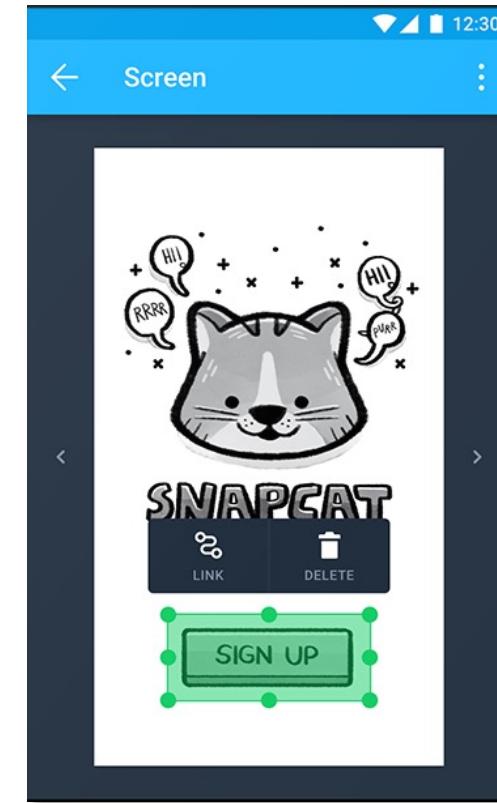
Paper Prototyping Test: Hotel Manager Web App



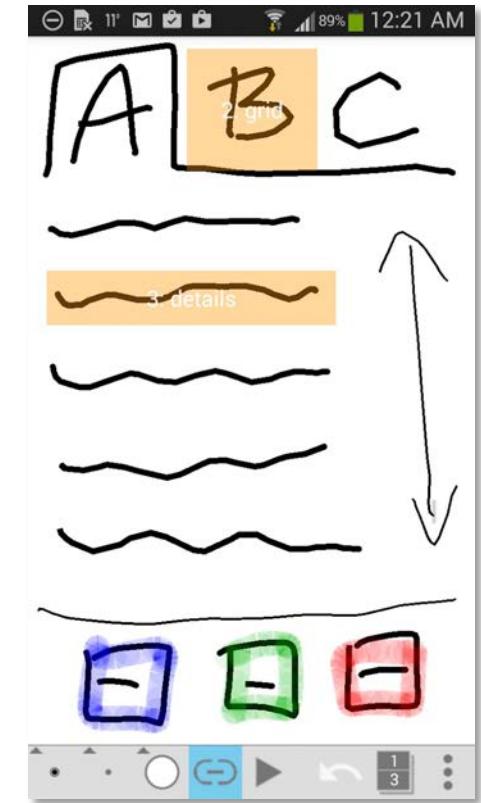
<http://vimeo.com/48675078>

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



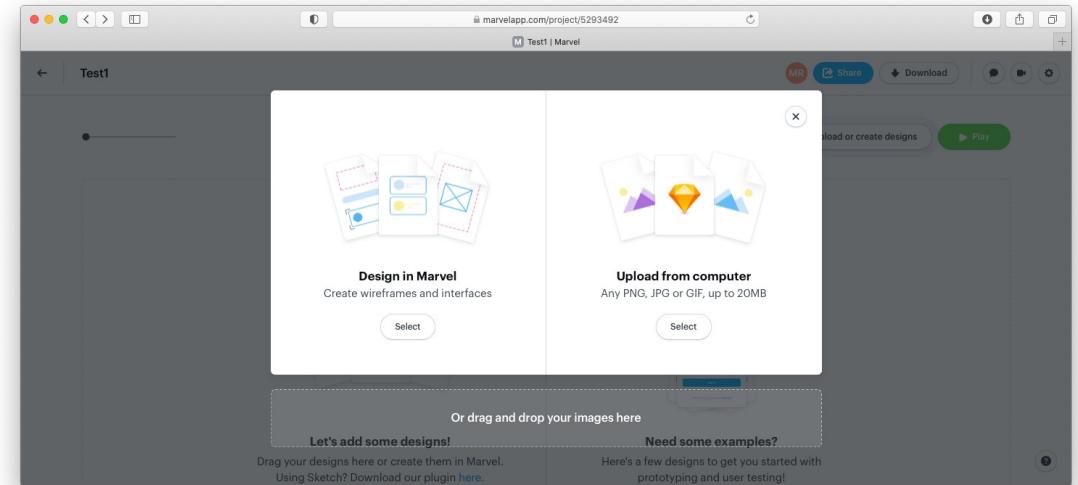
Marvel



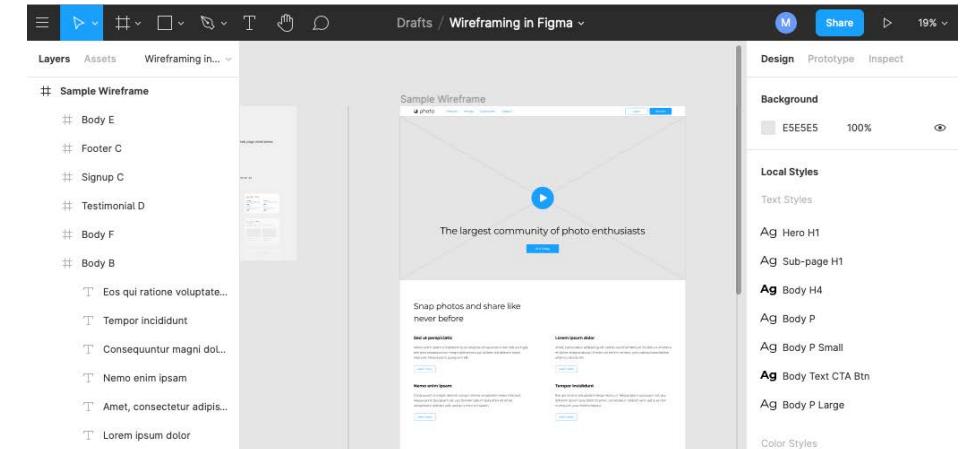
Quick Proto

Web-Based Prototyping Tools

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

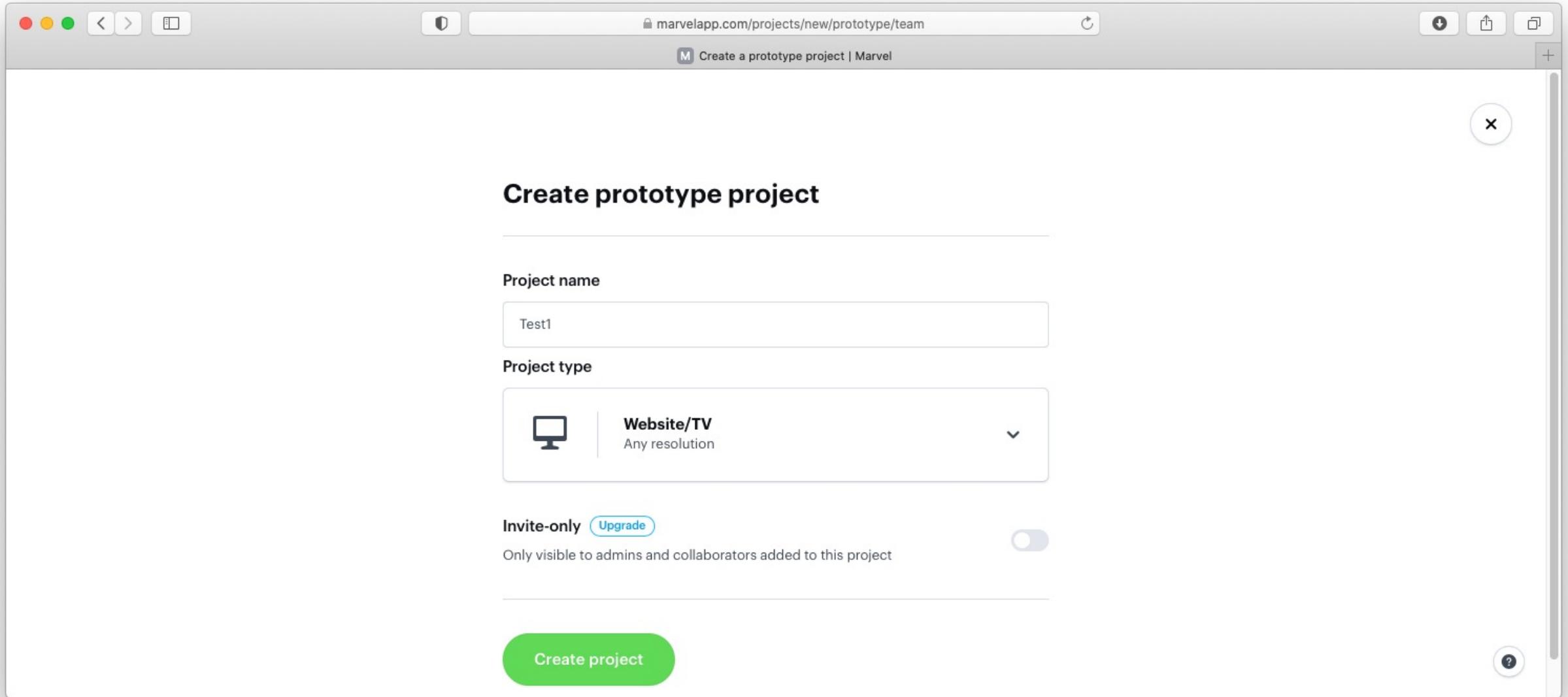


Marvel



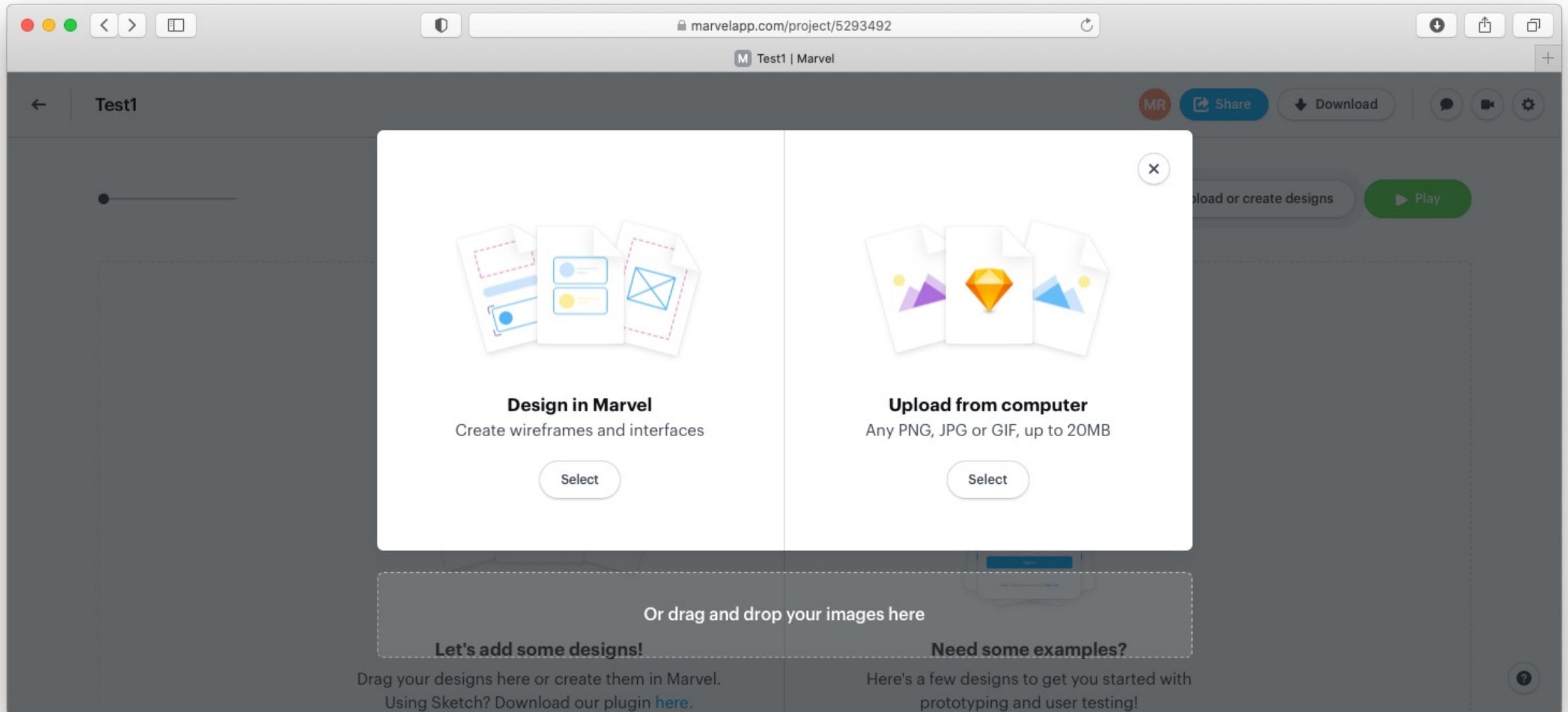
Figma

Marvel: Create Project



The screenshot shows the 'Create prototype project' page of the Marvel app. At the top, there's a navigation bar with standard window controls (red, yellow, green buttons) and a title bar showing the URL marvelapp.com/projects/new/prototype/team. Below the title bar, the main heading 'Create prototype project' is displayed. The first input field is labeled 'Project name' with the value 'Test1'. The second input field is labeled 'Project type' and contains a dropdown menu with an icon of a computer monitor, the text 'Website/TV', and the subtext 'Any resolution'. There's also a small downward arrow icon next to the dropdown. Below these fields is an 'Invite-only' toggle switch, which is currently off, indicated by a grey switch and the text 'Only visible to admins and collaborators added to this project'. At the bottom of the form is a large green button labeled 'Create project'.

Marvel: Upload Images



The screenshot shows the Marvel application interface for uploading designs. At the top, there's a navigation bar with a back arrow, a title 'Test1' in a dark grey header, and various project management and sharing buttons. Below the header, there are two main sections: 'Design in Marvel' and 'Upload from computer'. Each section features a small icon of three cards with dashed outlines, followed by descriptive text and a 'Select' button. A large central area contains a dashed box with the placeholder text 'Or drag and drop your images here'. Below this box, there are two additional sections: 'Let's add some designs!' with instructions to drag designs or create them in Marvel, and 'Need some examples?' with a note about a few designs available for prototyping and user testing. A 'Sketch' plugin download link is also present in the 'Let's add some designs!' section.

Design in Marvel
Create wireframes and interfaces
Select

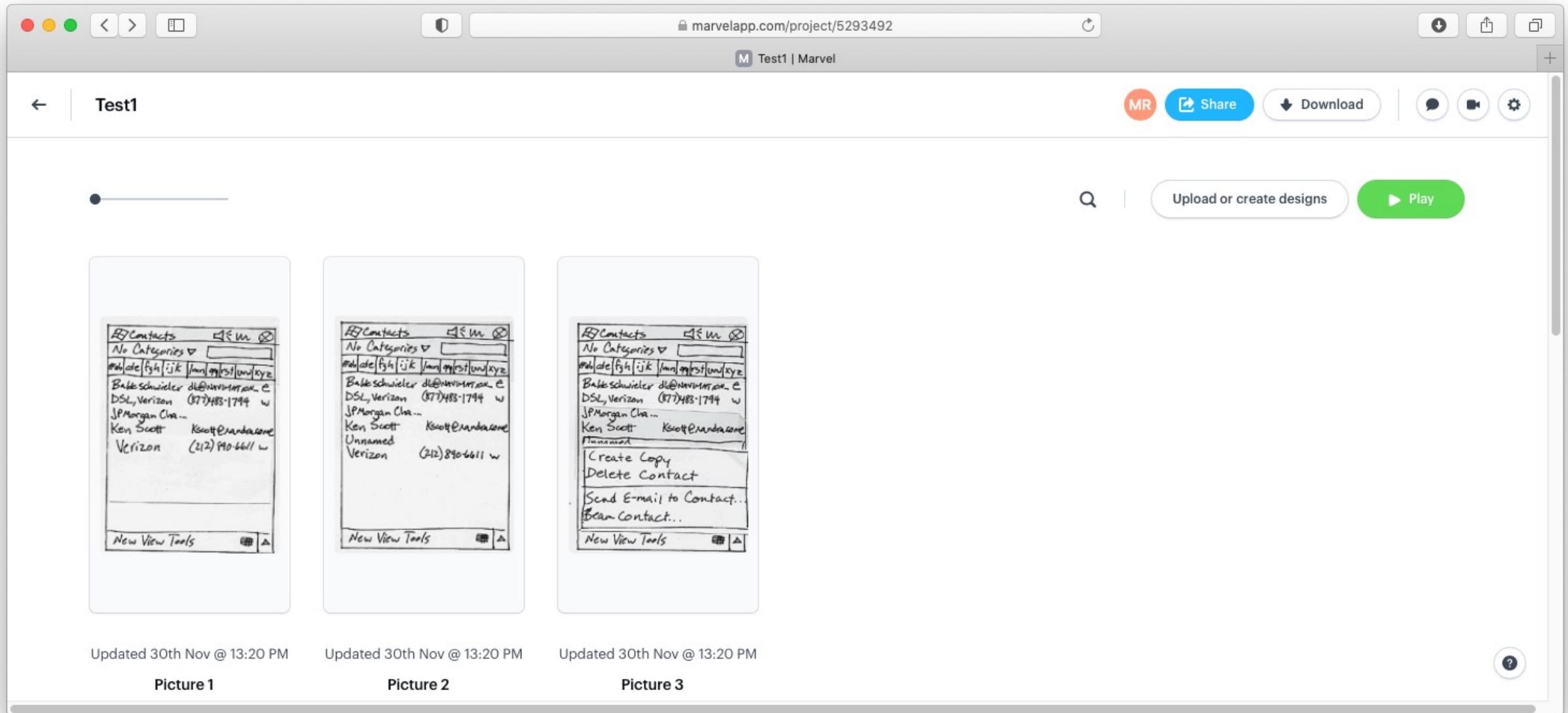
Upload from computer
Any PNG, JPG or GIF, up to 20MB
Select

Or drag and drop your images here

Let's add some designs!
Drag your designs here or create them in Marvel.
Using Sketch? Download our plugin [here](#).

Need some examples?
Here's a few designs to get you started with prototyping and user testing!

Marvel: Upload Images



The screenshot shows the Marvel app interface with three contact cards displayed side-by-side. Each card has a header with a 'Contacts' icon, a 'New View Tools' button at the bottom, and a 'No Categories' dropdown menu. The first two cards show standard contact information, while the third card includes a context menu with options like 'Create Copy', 'Delete Contact', 'Send E-mail to Contact...', and 'Scan Contact...'. The central toolbar at the top includes a search bar, a 'Upload or create designs' button, and a 'Play' button.

Picture 1

Picture 2

Picture 3

Marvel: Draw Hot Areas

marvelapp.com/project/5293492/screen/75055139

M Picture 1 | Marvel

1/3: Picture 1

Fixed Header 0 px

Play Done

50%

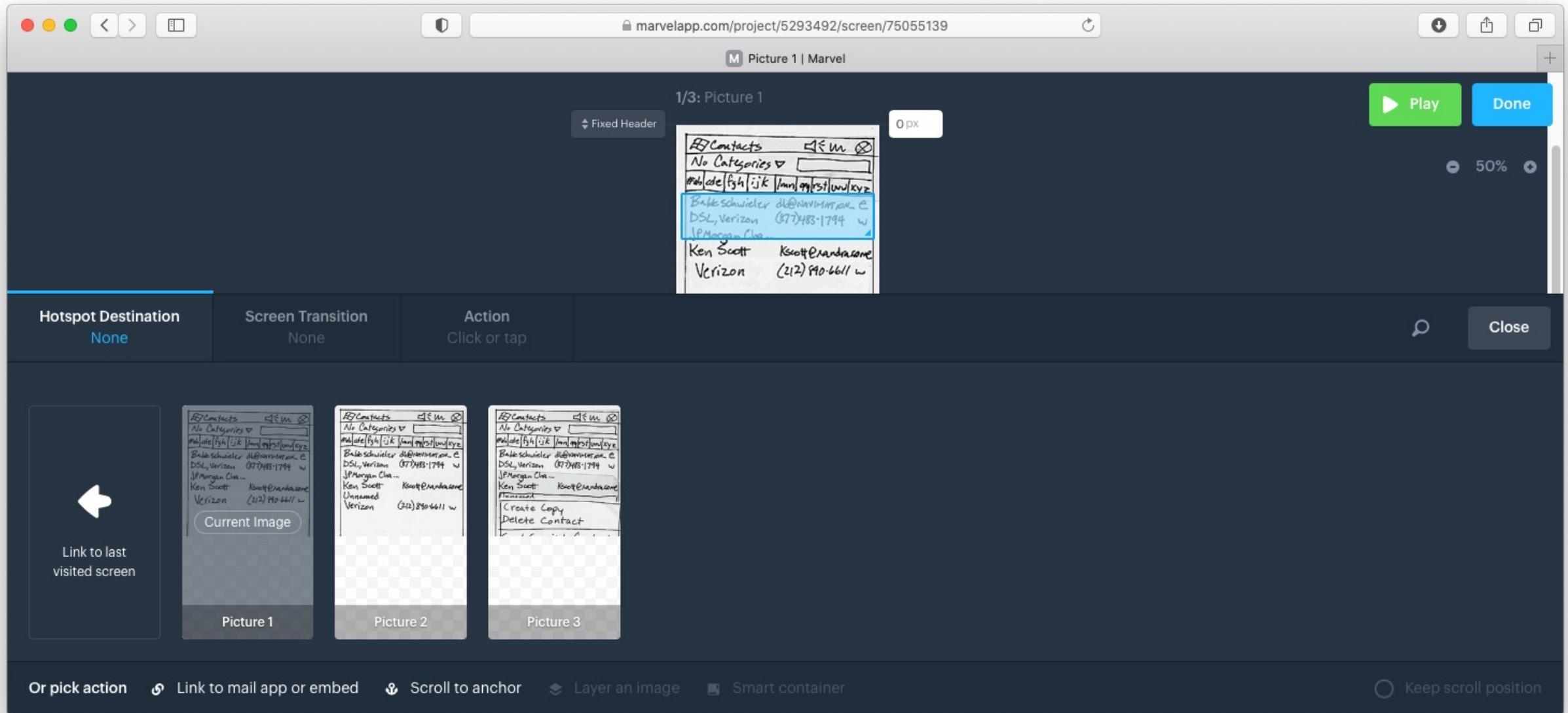
Hotspot Destination: None Screen Transition: None Action: Click or tap

Link to last visited screen

Current Image

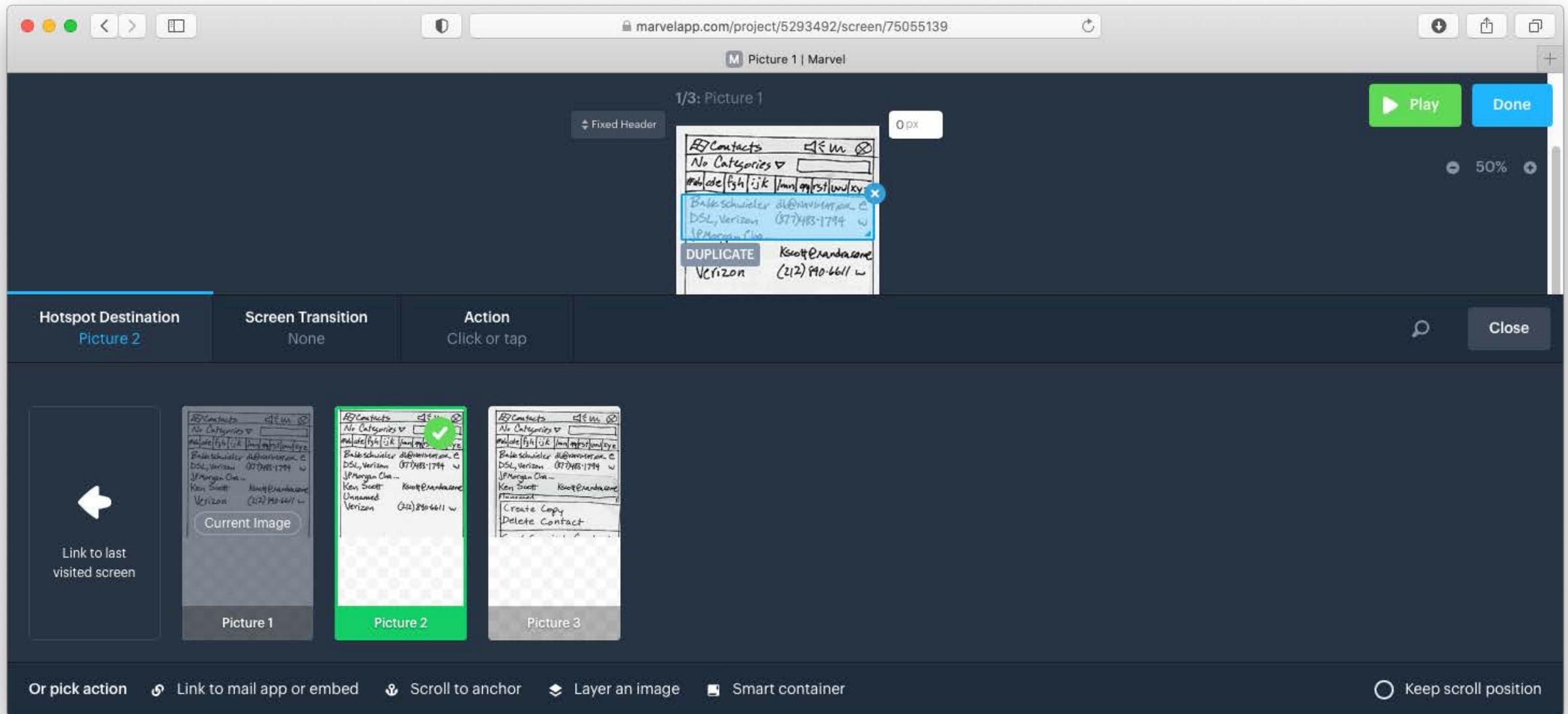
Picture 1 Picture 2 Picture 3

Or pick action: Link to mail app or embed, Scroll to anchor, Layer an image, Smart container, Keep scroll position



The screenshot shows the Marvel app interface for a project. At the top, there's a header with a navigation bar and a URL. Below it is a main canvas area titled "1/3: Picture 1" showing a contact list from an iPhone Contacts app. A blue rectangular selection box highlights a specific contact entry. To the right of the canvas are "Play" and "Done" buttons. Below the canvas is a control panel with "Hotspot Destination" set to "None", "Screen Transition" set to "None", and an "Action" button labeled "Click or tap". At the bottom, there are three preview cards labeled "Picture 1", "Picture 2", and "Picture 3", each showing a different view of the contact list. A "Link to last visited screen" button is also present.

Marvel: Define Links



The screenshot shows the Marvel app interface for defining user interactions on a mobile screen. The main view displays a wireframe of a contact list screen titled "Picture 1 | Marvel". The screen shows a list of contacts with fields for name, email, and phone number. A specific contact entry for "Balteschneider" is highlighted with a blue border. Below the wireframe, a navigation bar allows switching between "Picture 1", "Picture 2", and "Picture 3". The current image is "Picture 2". The navigation bar also includes a back arrow icon and a "Close" button.

| Hotspot Destination | Screen Transition | Action |
|---------------------|-------------------|--------------|
| Picture 2 | None | Click or tap |

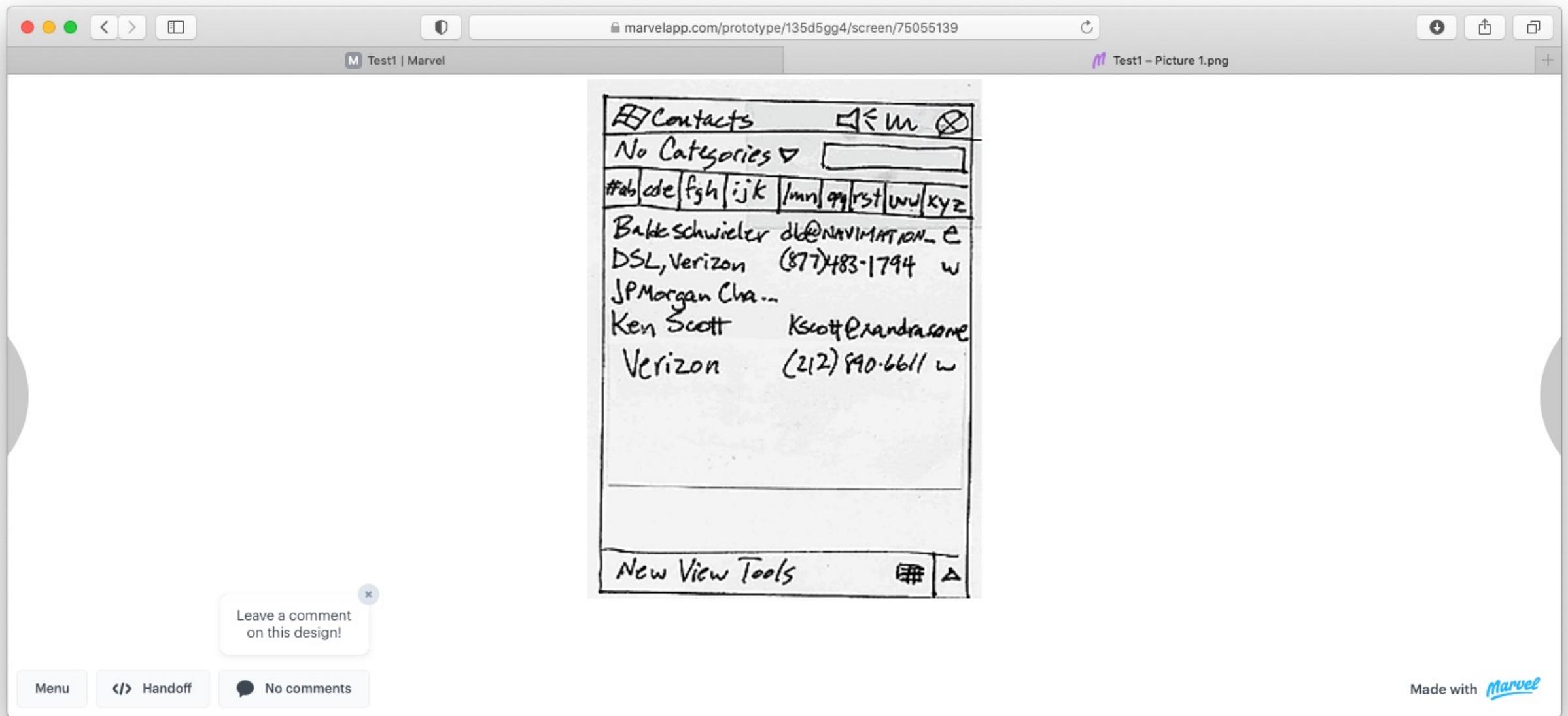
Below the navigation bar, there are several action buttons:

- Link to last visited screen**: An arrow pointing left.
- Picture 1**: The current selected screen.
- Picture 2**: The screen with the highlighted contact.
- Picture 3**: The third screen in the sequence.

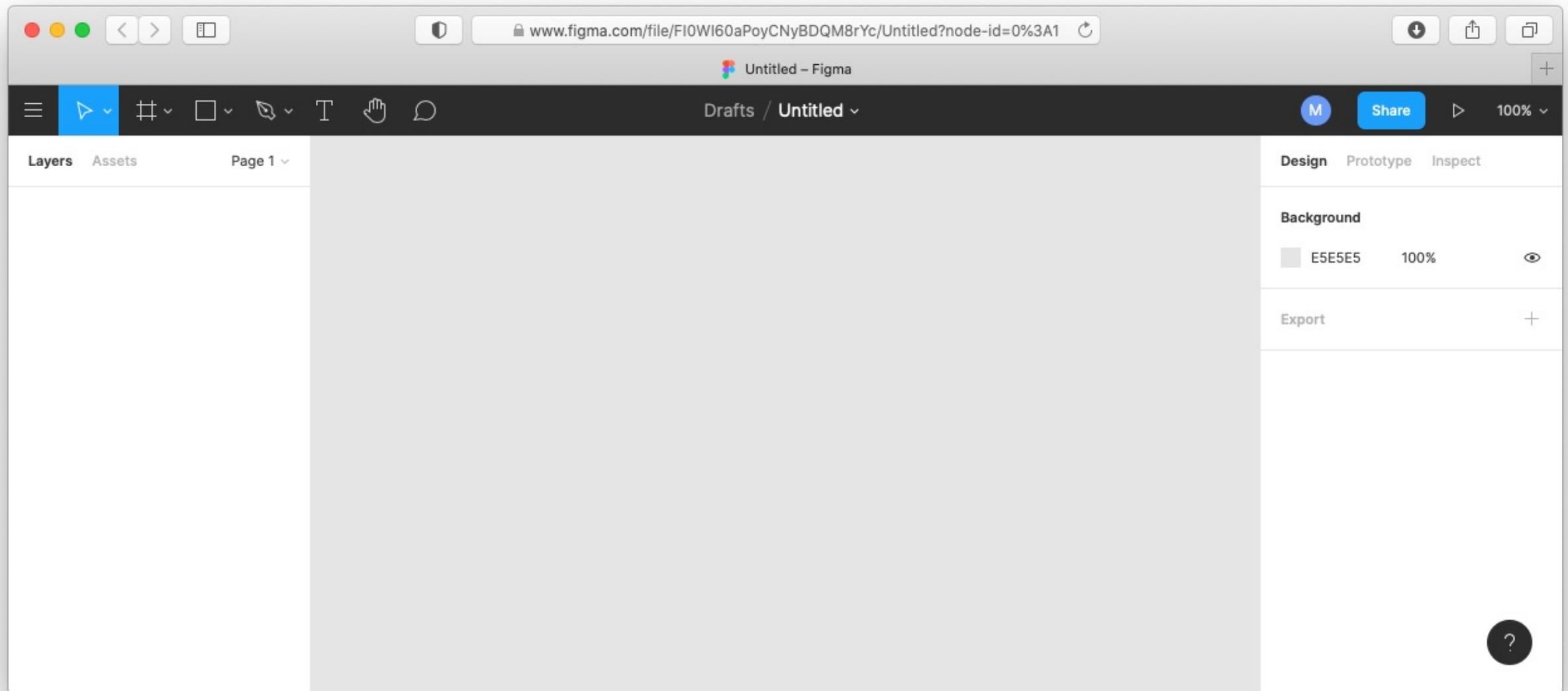
At the bottom of the interface, there are additional options and settings:

- Or pick action**
- Link to mail app or embed**
- Scroll to anchor**
- Layer an image**
- Smart container**
- Keep scroll position**

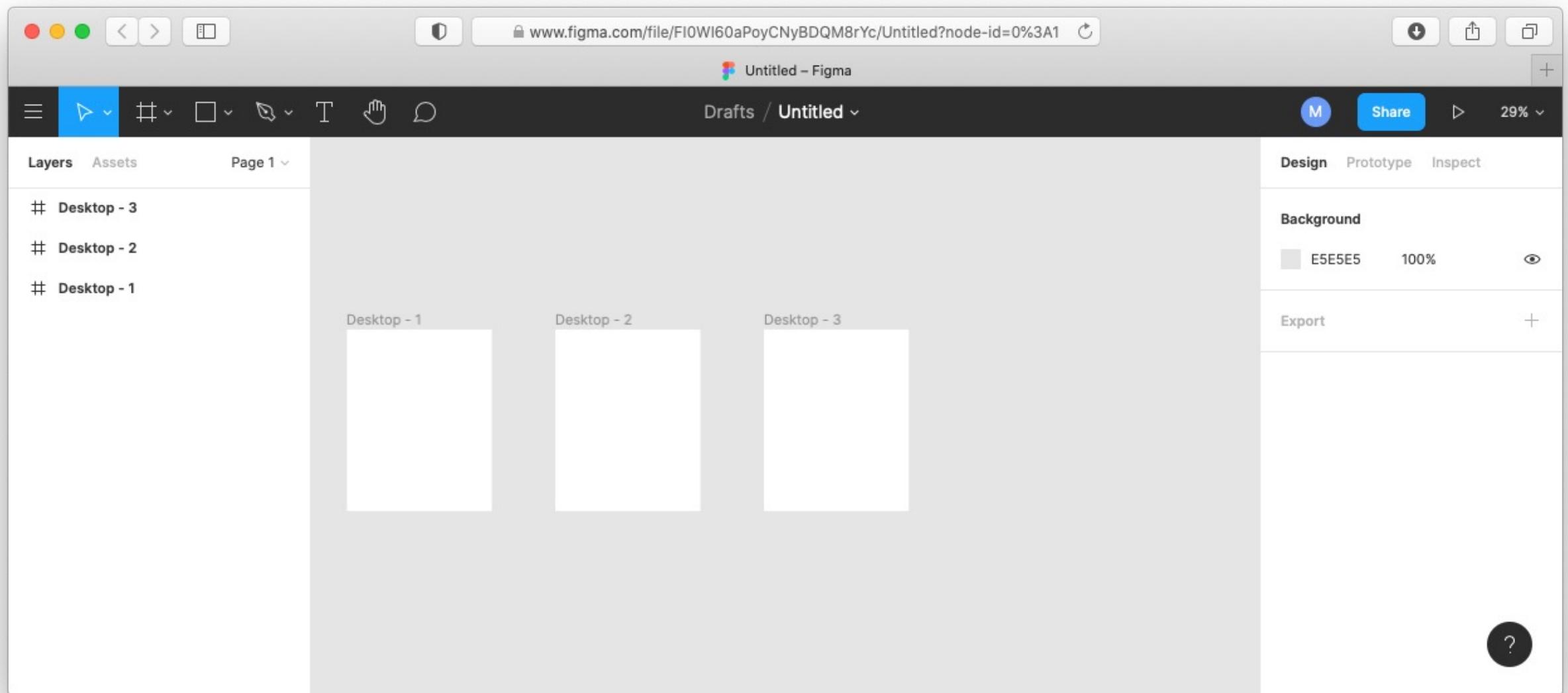
Marvel: Play Prototype



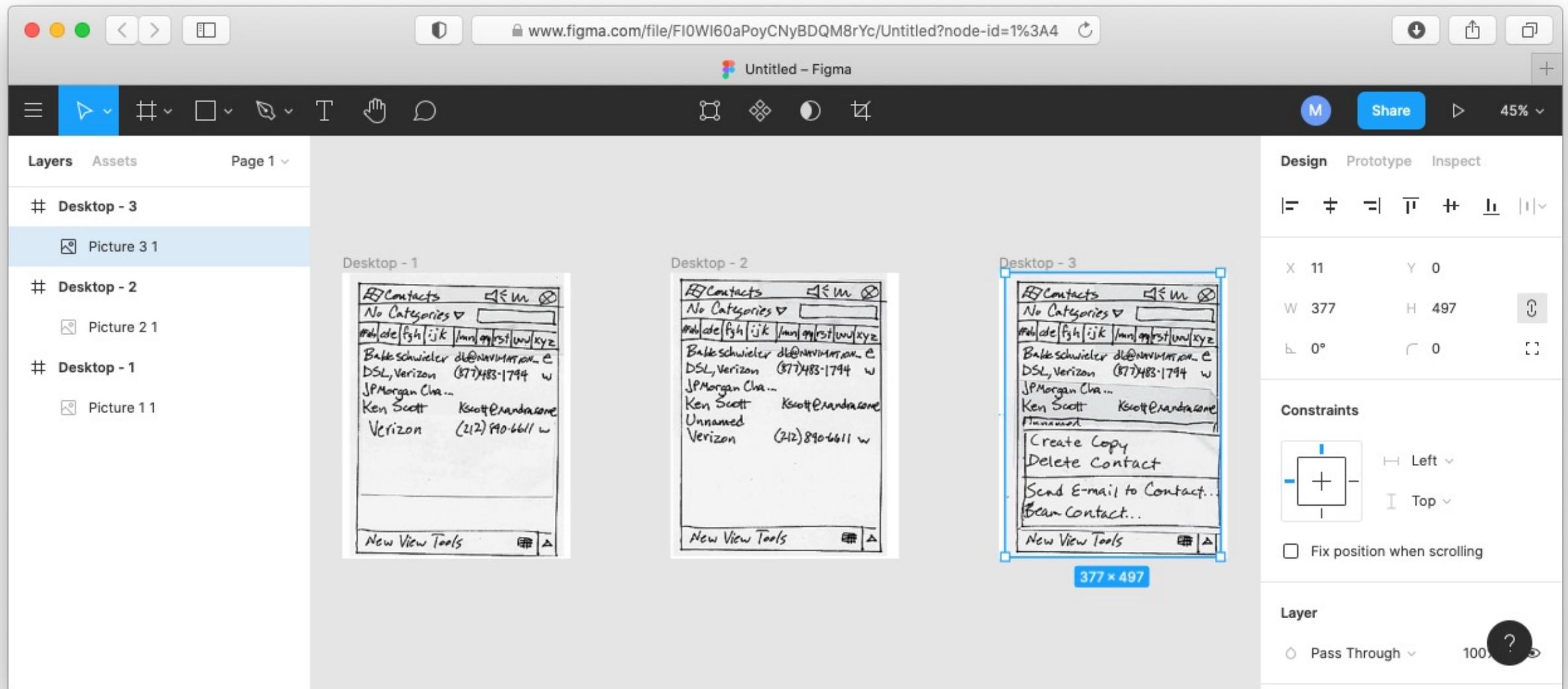
Figma: File New



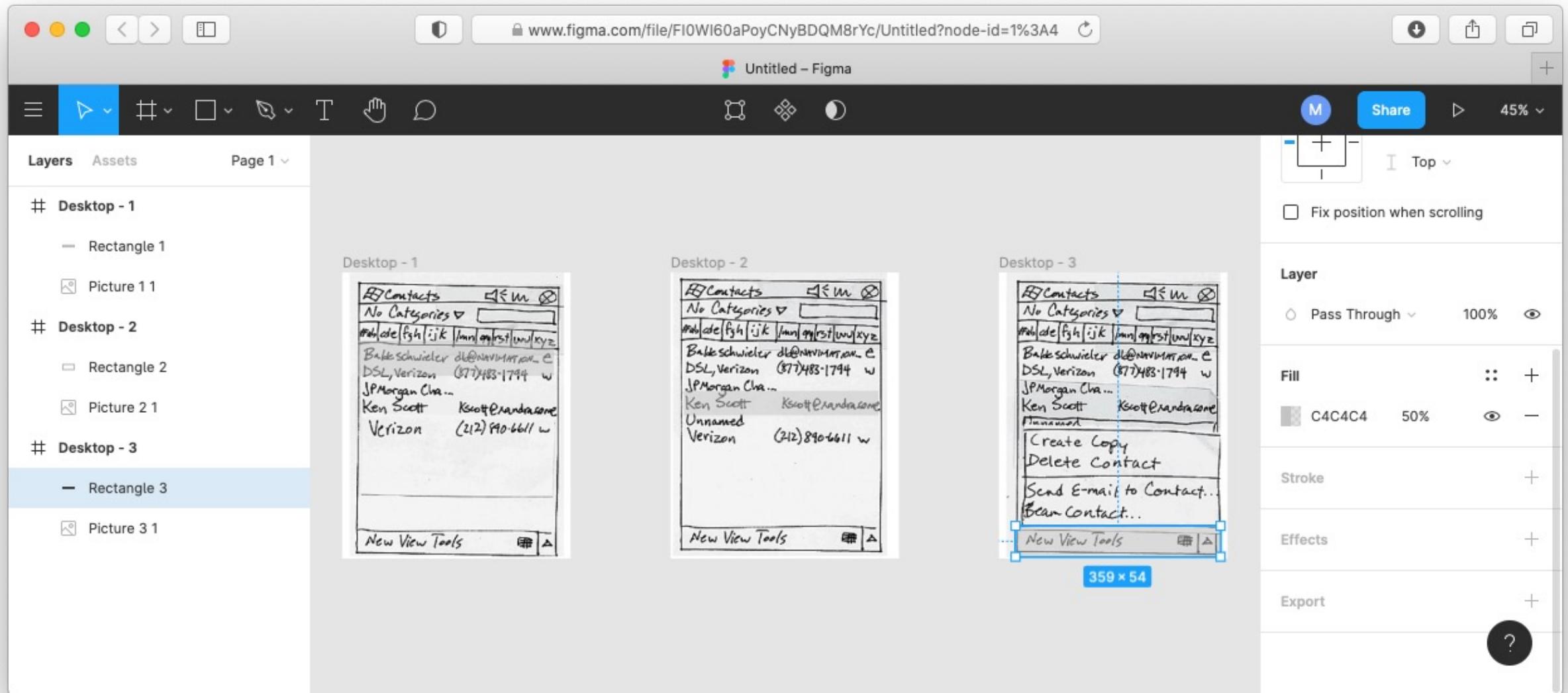
Figma: Create Frame (F), WxH = 400x500



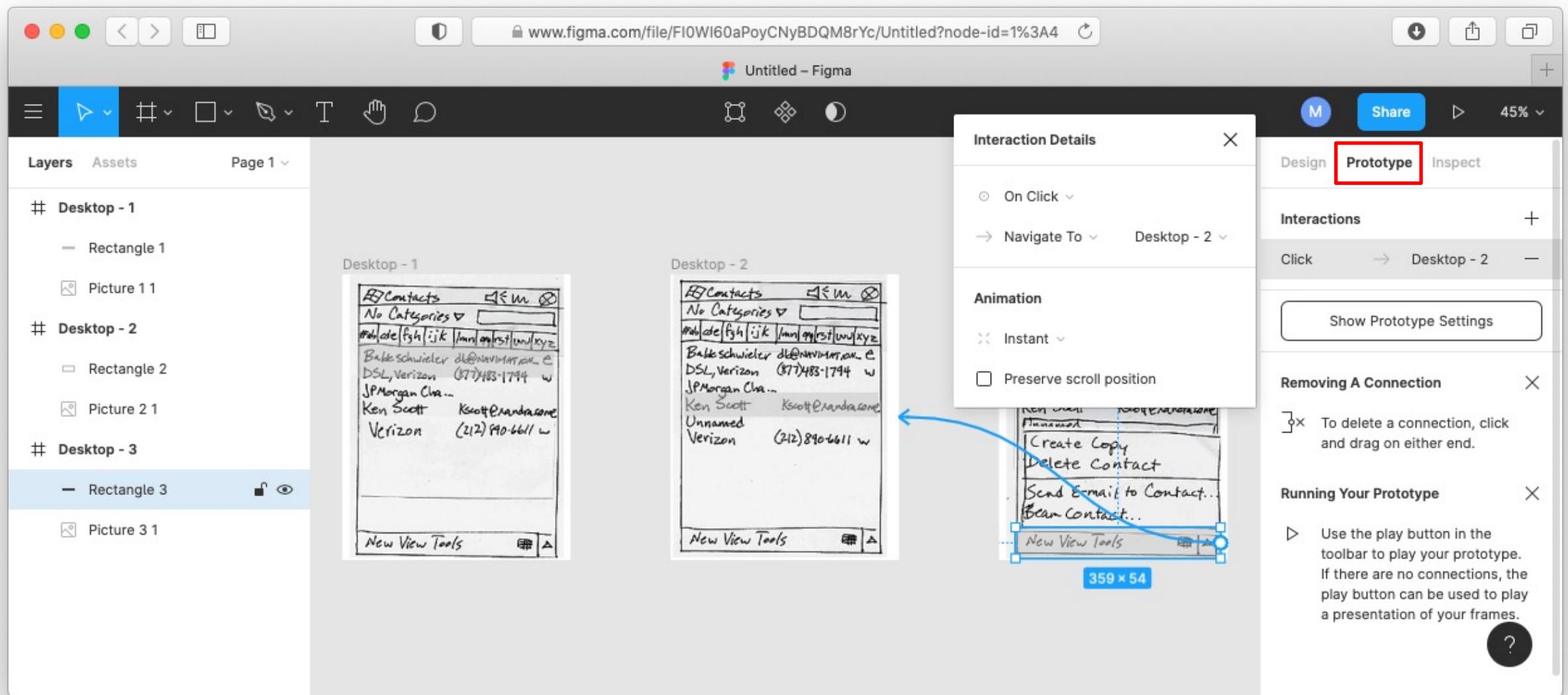
Figma: Import Image (Ctrl+Shift+K)



Figma: Draw Hot Aras (Rectangles, R)



Figma: Prototype (Define Transitions)



Figma: Present (Play Prototype)

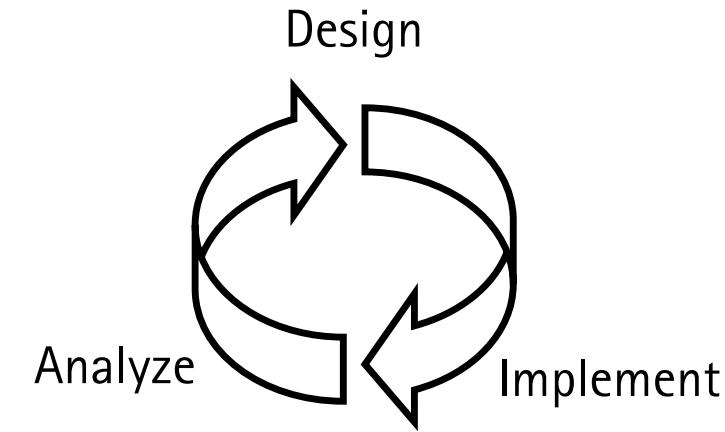
The screenshot shows the Figma interface with three desktop prototypes connected in a sequence.

- Desktop - 1:** Contains a "Contacts" list with entries like "Babke Schwieder", "DSL, Verizon", and "JPMorgan Ch...". It also has a "New View Tools" bar at the bottom.
- Desktop - 2:** Contains a similar "Contacts" list with the same entries. It also has a "New View Tools" bar at the bottom.
- Desktop - 3:** Contains a "Contacts" list with the same entries. It also has a "New View Tools" bar at the bottom. A blue arrow points from Desktop - 2 to Desktop - 3, indicating a connection.

The Figma toolbar at the top includes icons for file operations, navigation, and selection. The status bar shows the URL www.figma.com/file/FIOWI60aPoyCNyBDQM8rYc/Untitled?node-id=1%3A4. The right sidebar shows "Design", "Prototype", and "Inspect" tabs, with "Prototype" selected. A "Show Prototype Settings" button is visible. A "Removing A Connection" tooltip explains how to delete connections, and a "Running Your Prototype" tooltip explains how to use the play button.

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

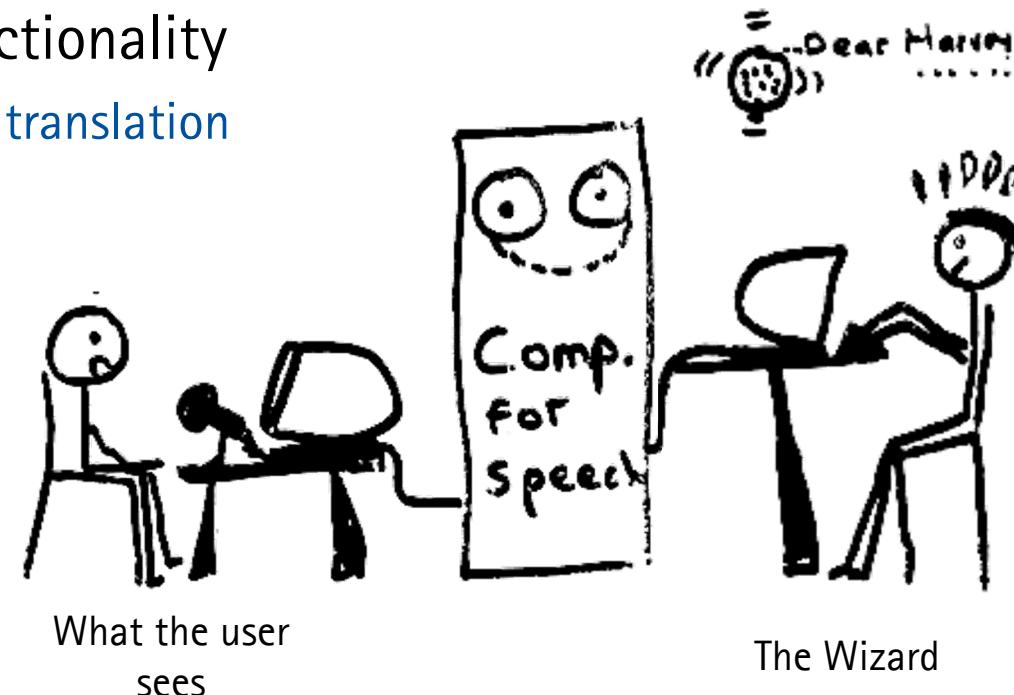
When to give feedback?



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

Wizard of Oz Prototyping

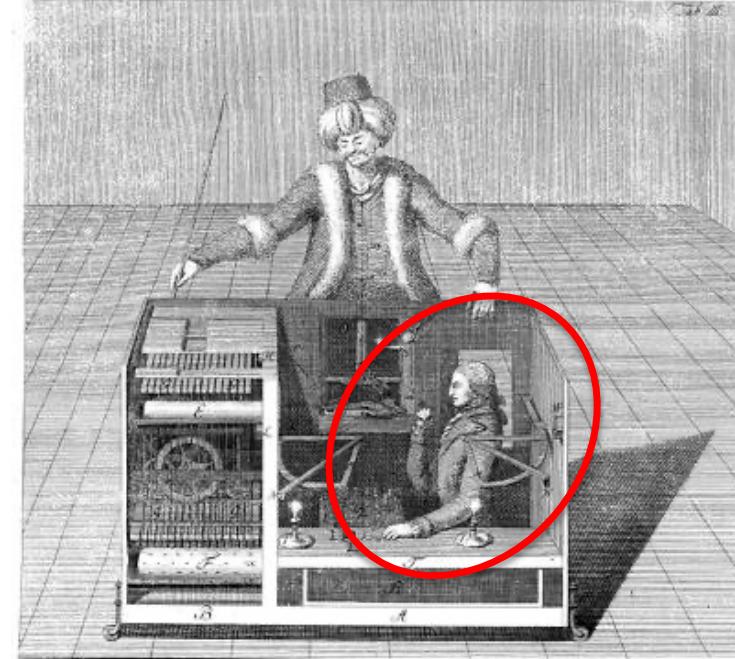
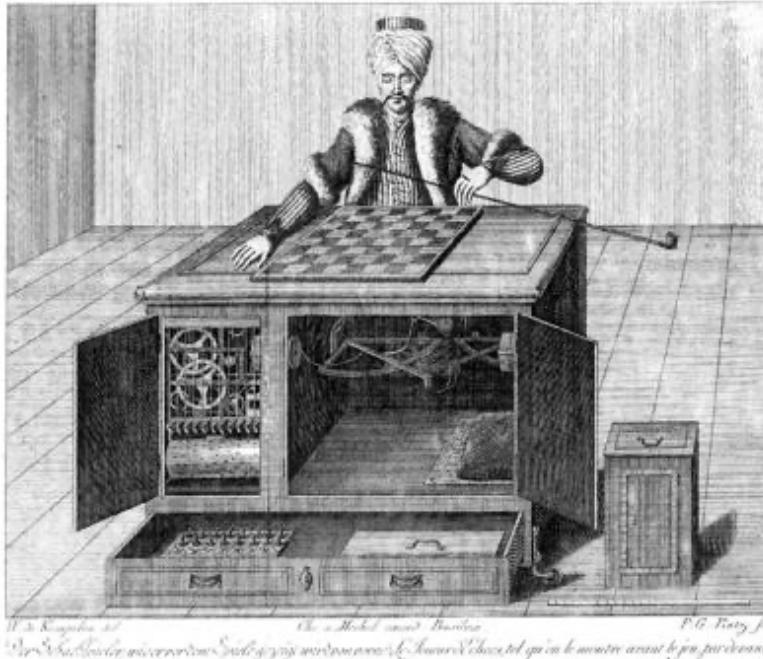
- Method for testing a non-existing system
- Human “wizard” simulates system responses
 - *Interacts with user via a simulated user interface*
- Useful for adding complex vertical functionality
 - Speech and gesture recognition, language translation



Wizard of Oz Prototyping

The first "Chess Computer"

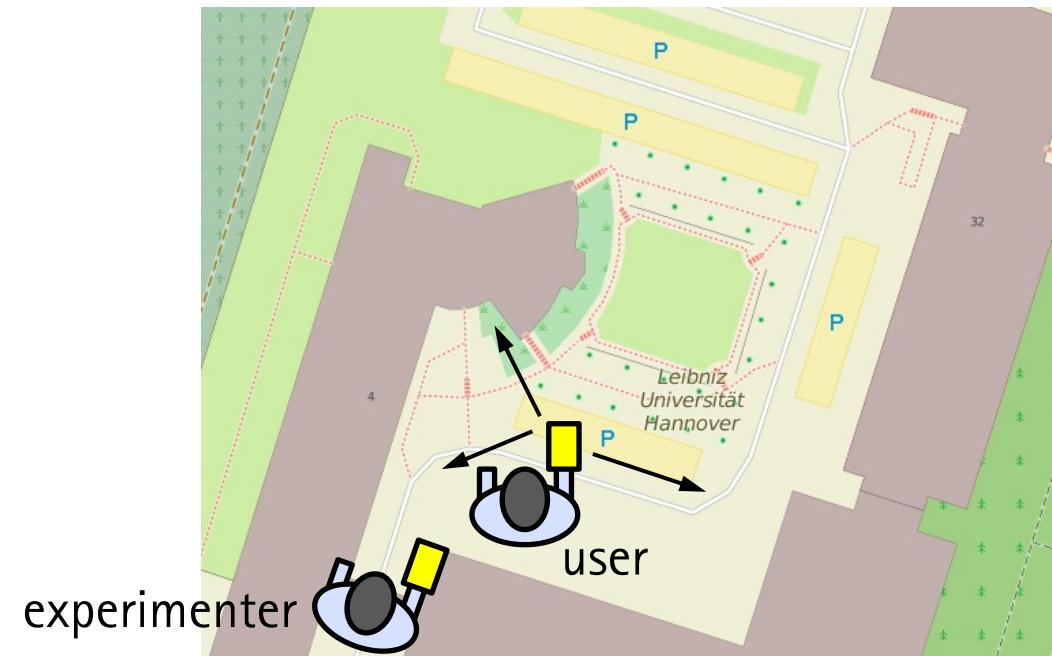
"In 1769, Hungarian nobleman Wolfgang von Kempelen astonished Europe by building a mechanical chess-playing automaton that defeated nearly every opponent it faced."



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"



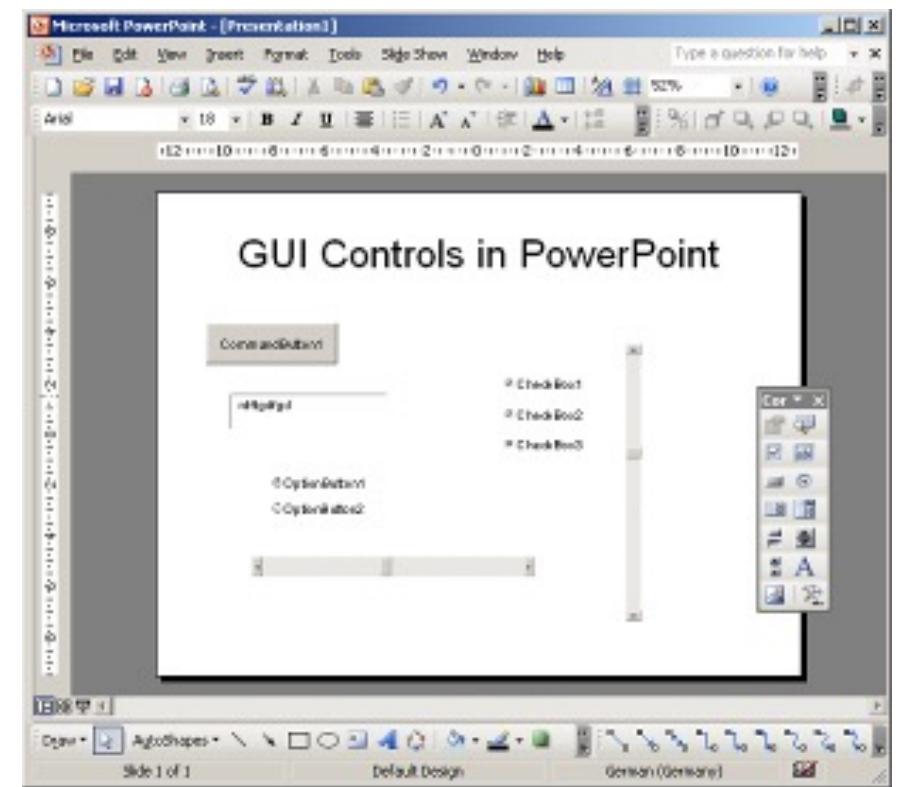
Prototyping Tools

- 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



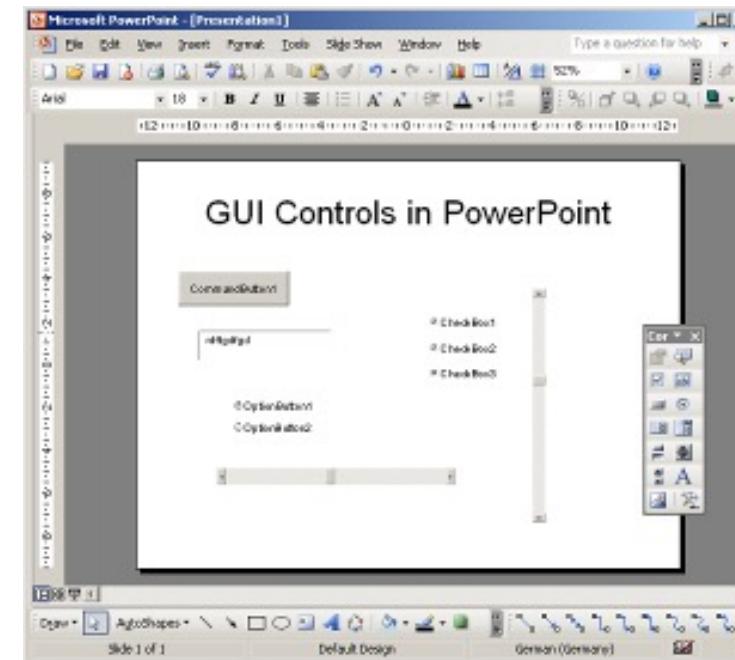
Facade Prototypes Pros & Cons

■ 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

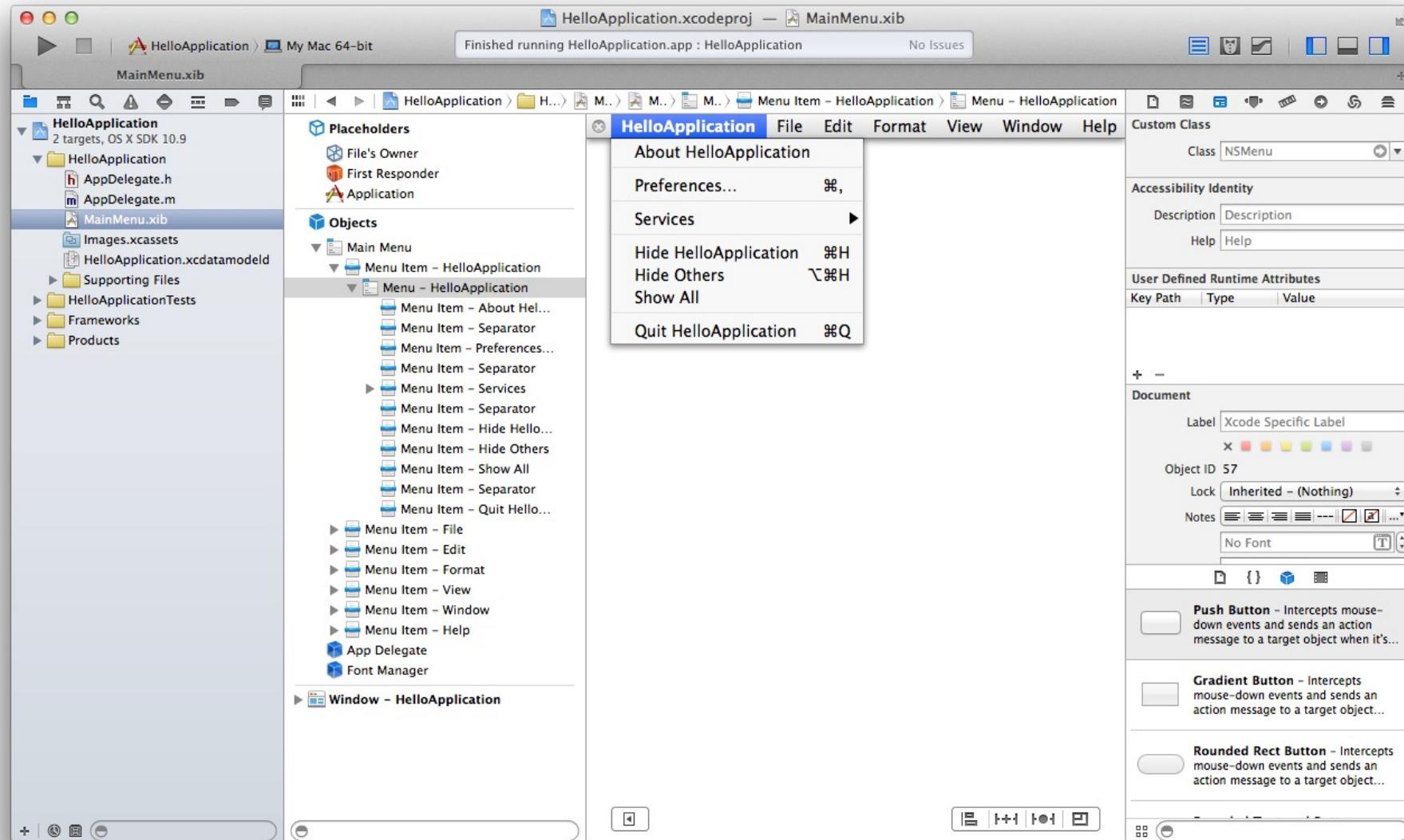
- Graphical tools to define the UI of the actual application
- Usually part of integrated development environment (IDE)
 - [Visual Studio](#), [Eclipse](#), [NetBeans](#)
- Pro
 - Real look & feel
 - Vertical functionality can be added easily
 - Finished design can be used in final implementation
- Con
 - 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)

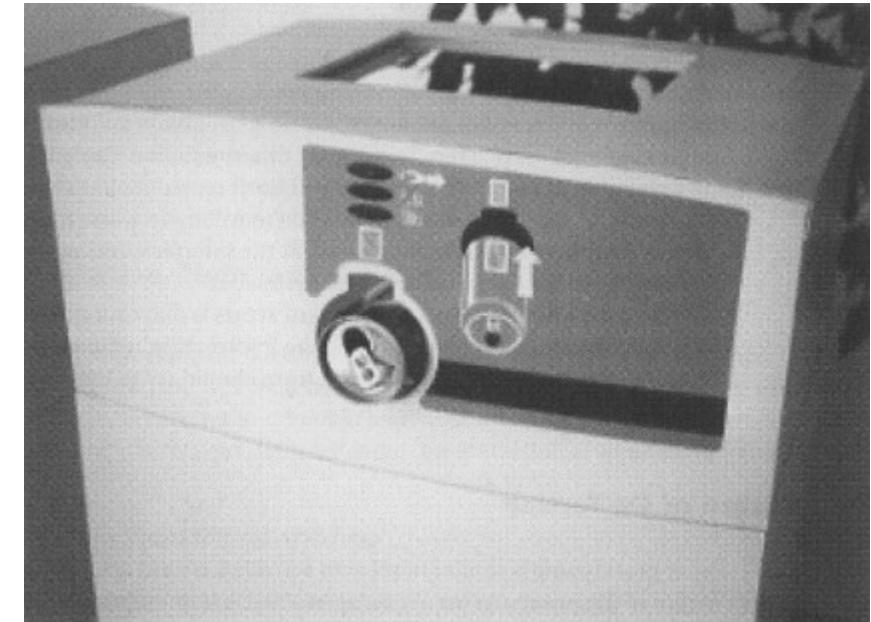
- Graphical tool to create UIs for macOS applications
 - Part of Apple's standard Xcode IDE for macOS
- Visually place widgets (buttons, menus,...) in a UI
 - Static layout
- Define connections between widgets and application code
 - Dynamic behavior
- Implementation process
 - Start with the user interface, 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. Carroll: Scenario-Based Design. In: Helander, Landauer, Prabhu: Handbook of Human-Computer Interaction, 2nd edition, 1997.