

Do Multi-Fidelity Levels improve Mockup-Driven Development?

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SIEMENS

1. Introduction

2. Problem Identification

- Requirements Elicitation
- Research Gap Identification
- Research Questions

3. Solution Design

- Definition of Term
- Prototyping Process
- Implementation

4. Evaluation

5. Outlook



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Core Idea

Systematic reuse of user interface prototypes for the generation or scaffolding of user interface code.

→ **Non-disposable UI prototypes**

Informal Interviews

Conducted with the head of the department and the head of development (N=2).

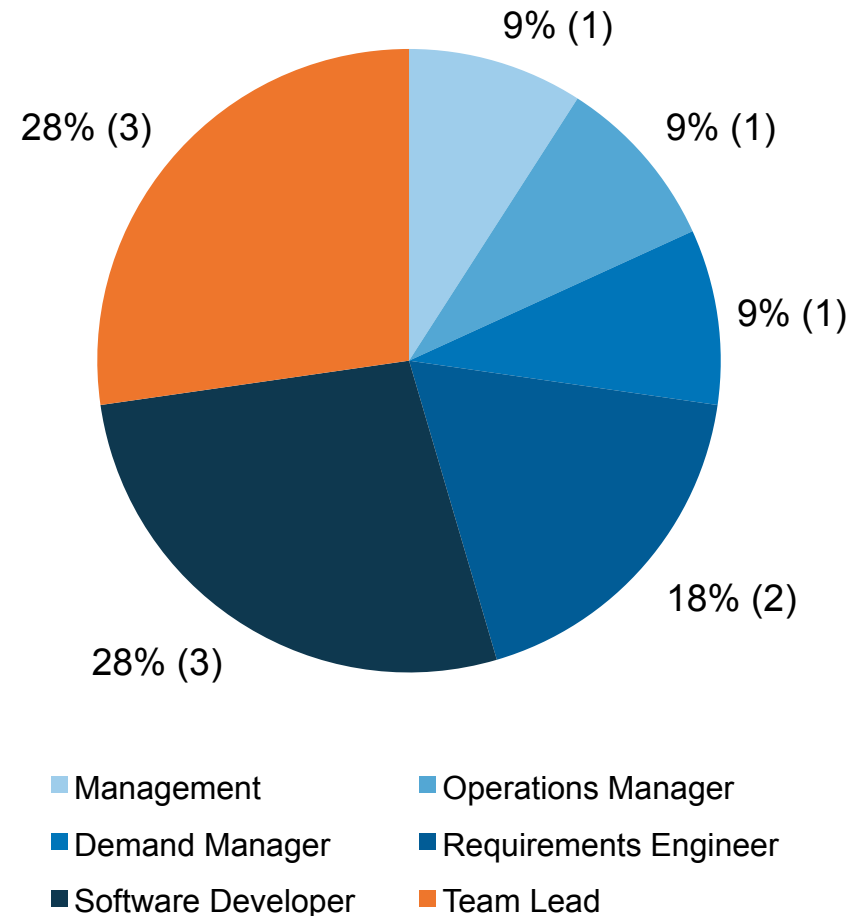
1. Collaboration
2. Custom component catalog
3. Export UI code
4. Integration with ALM solution
5. On-premise solution
6. Test on target platform
7. Platform support of the prototypes

Semi-structured Interviews

Conducted with N=11 experts of different professional and organisational backgrounds.

- Majority of interviewees worked for a large company (72.7%).
- 6 different roles were covered.
- Mean of professional experience in years was 11.82 years ($\sigma = 7.93$).
- 81.8% have used UCD design methods in their professional lives.
- Remaining 18.2% received high-fidelity mockups as a specification document.
- Application focused on the requirements elicitation phase.
- 81.8% (9 persons) worked with high-fidelity mockups exclusively.

Role within the company



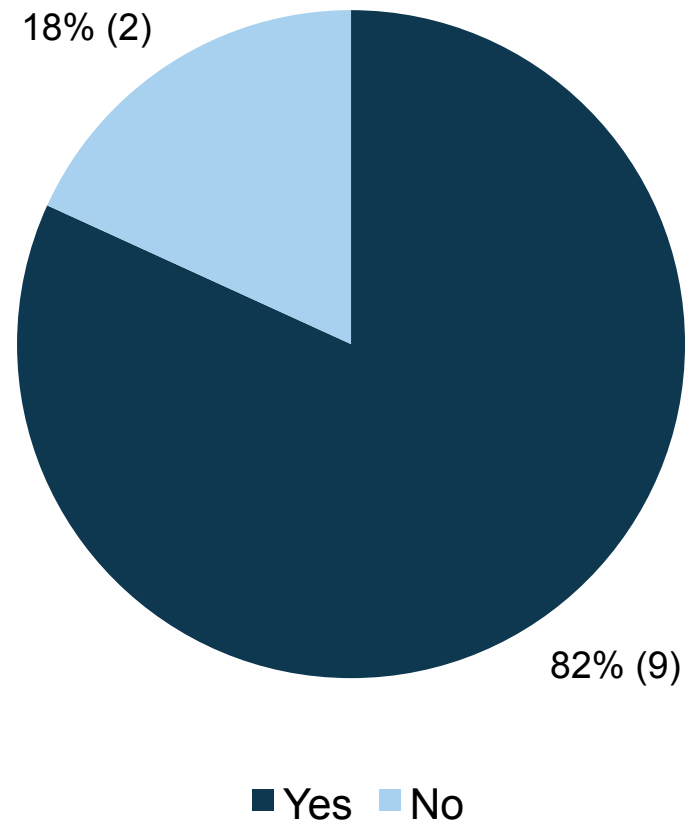
Semi-structured Interviews

- 9 persons (81.8%) did not have an established UCD process.
- 81.8% (9 persons) rated the application predominatly positive.

Negative aspects:

- Create wrong expectation of a production ready user interface
- Disposable character of UCD artefacts
- Collaboration and communication between stakeholders is challenging
- Lack of a standard UI component catalog

Application of UCD methods



Problem Statement

Research Gap Identification

Most mature Enterprise Solutions

	Justinmind	iRise Studio	Balsamiq	Pixate Studio Beta	Visual Paradigm
Collaboration (deliver to endusers, collect feedback)	✓	✓	○	○	○
Custom Component Catalog	✓	✓	✓	✗	?
Export Code	✗	✓	✗	✗	✗
Integration with ALM (Link to requirements, single source for reporting)	○	✓	○	✗	?
On-Premise Solution (Host collaboration platform internally)	✓	✓	✓	✗	✗
Test on the Target Platform	✓	✓	✗	✓	✗
Academic Research Gap	✓	✓	✓	✓	✓
Multi-Fidelity Mockups (support transitions between fidelity levels)	✗	✗	○	✗	✗

✓ = applies, ○ = partially applies, ✗ = does not apply

RQ1

What is the definition of Mockup-Driven Development and the different fidelity levels?

RQ2

What are the requirements for a Multi-Fidelity Mockup-Driven Development system and how could a implementation look like?

RQ3

How to evaluate if a Multi-Fidelity Mockup-Driven Development system improves the software development process?

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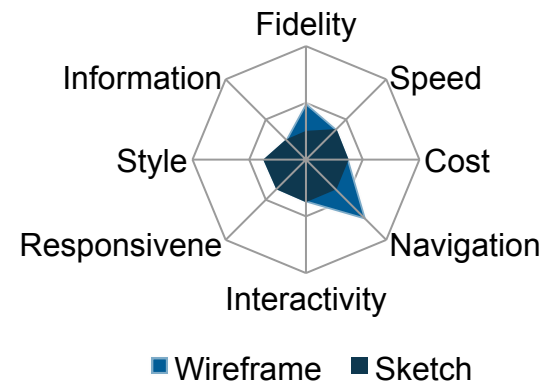
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Definition

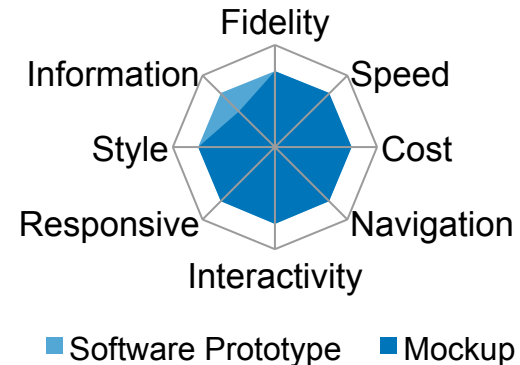
„Degree of exactness with which something is copied or reproduced“, Oxford Dictionary

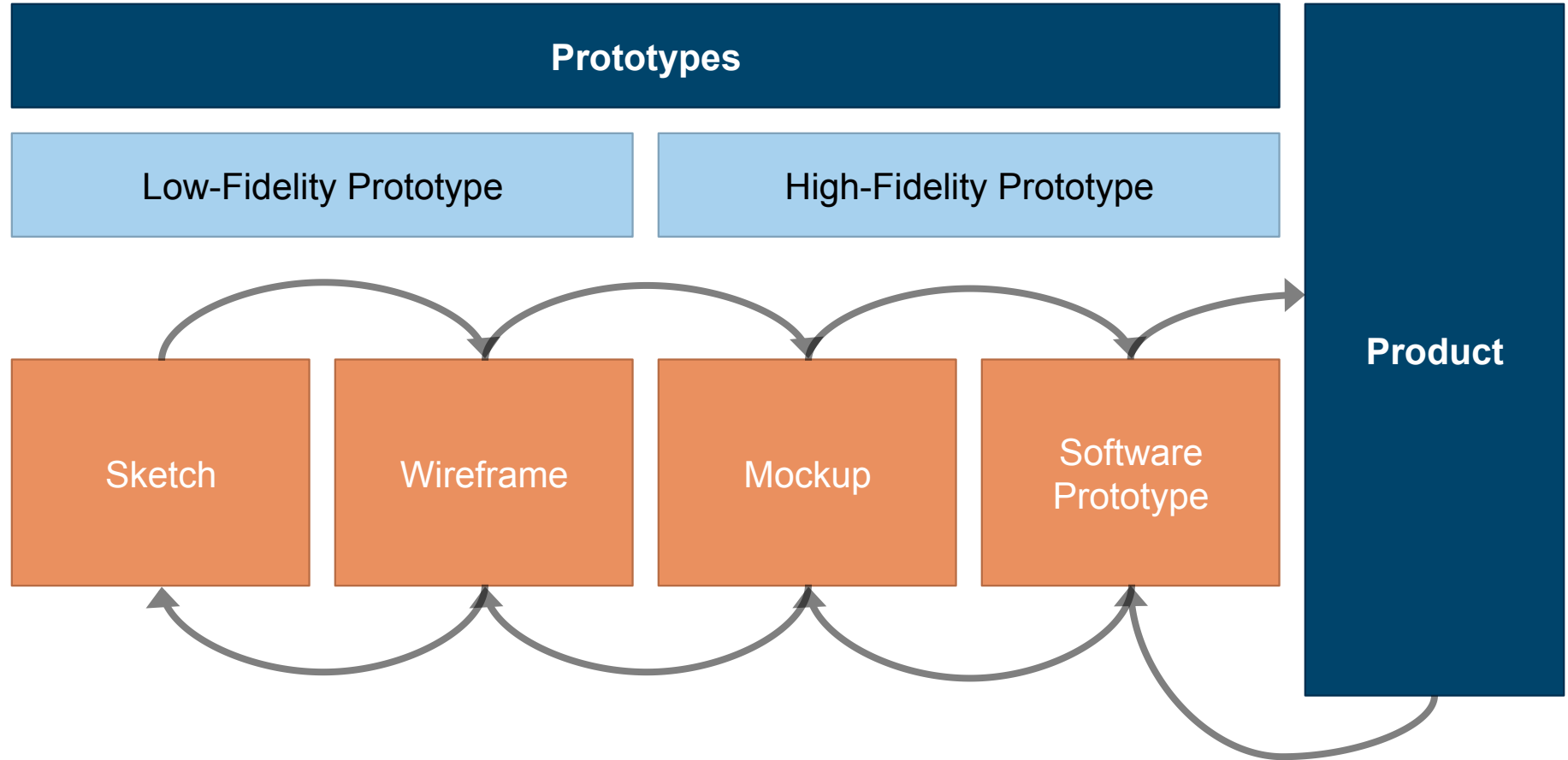
- Performed literature review to identify fidelity-levels and their artefacts
 - Low-Fidelity Prototypes (Sketch & Wireframe)
 - High-Fidelity Prototypes (Mockup & Software Prototype)
- Analysed the number of style properties of a button across different fidelity levels (Sketch: 7 → Mockup: 37 → Product: 71)

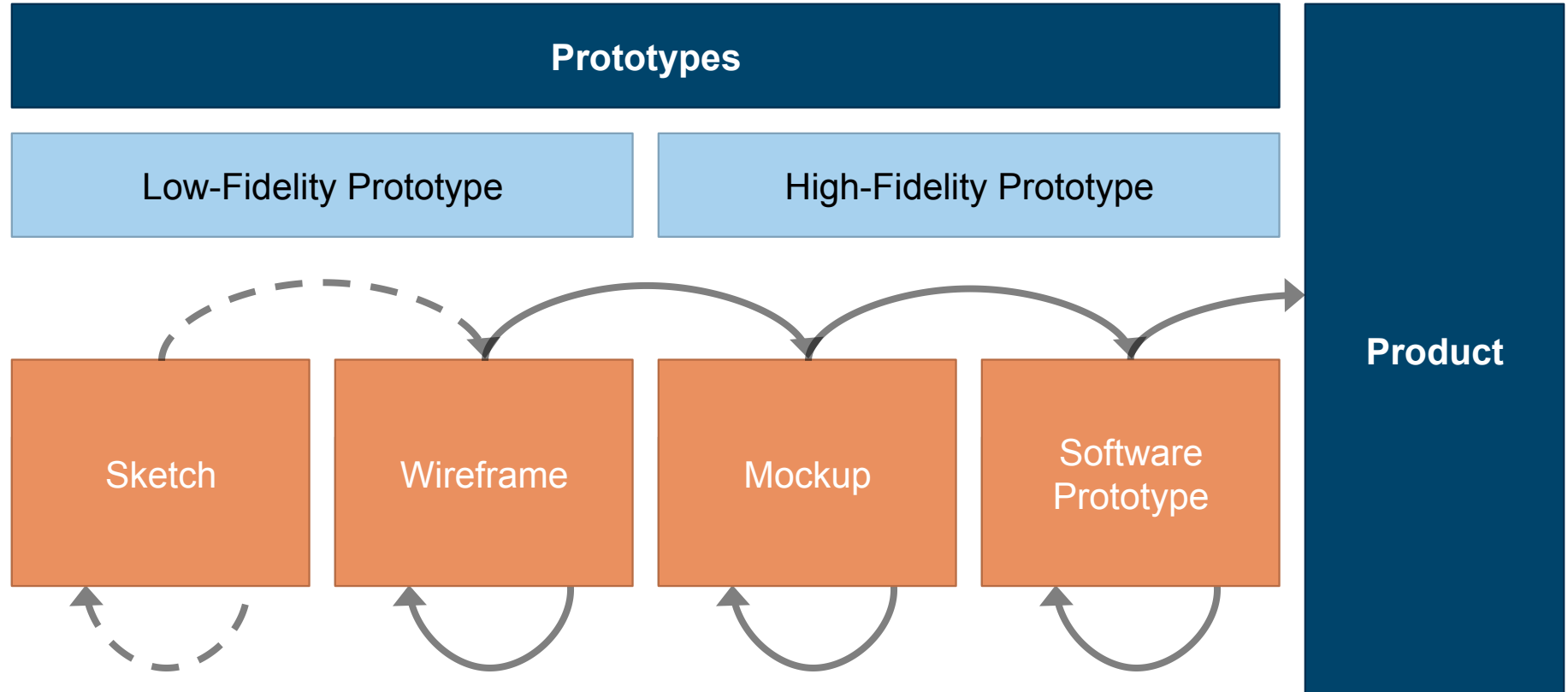
Low-Fidelity Prototypes



High-Fidelity Prototypes



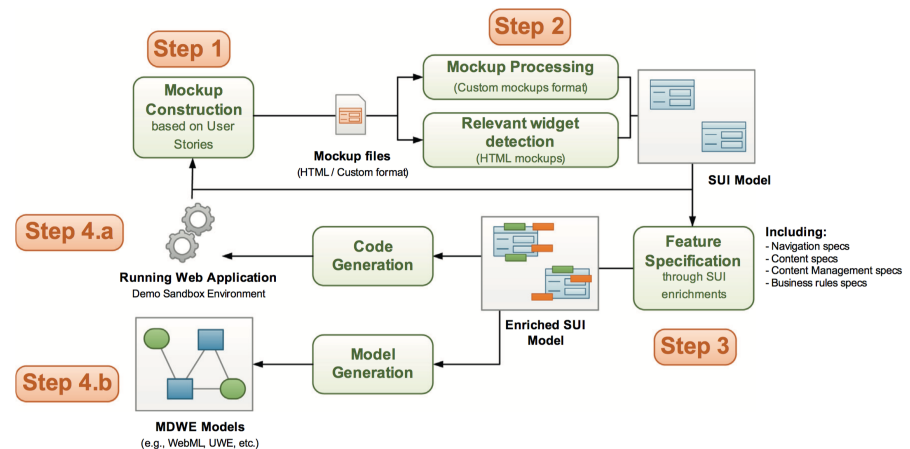




Related Work

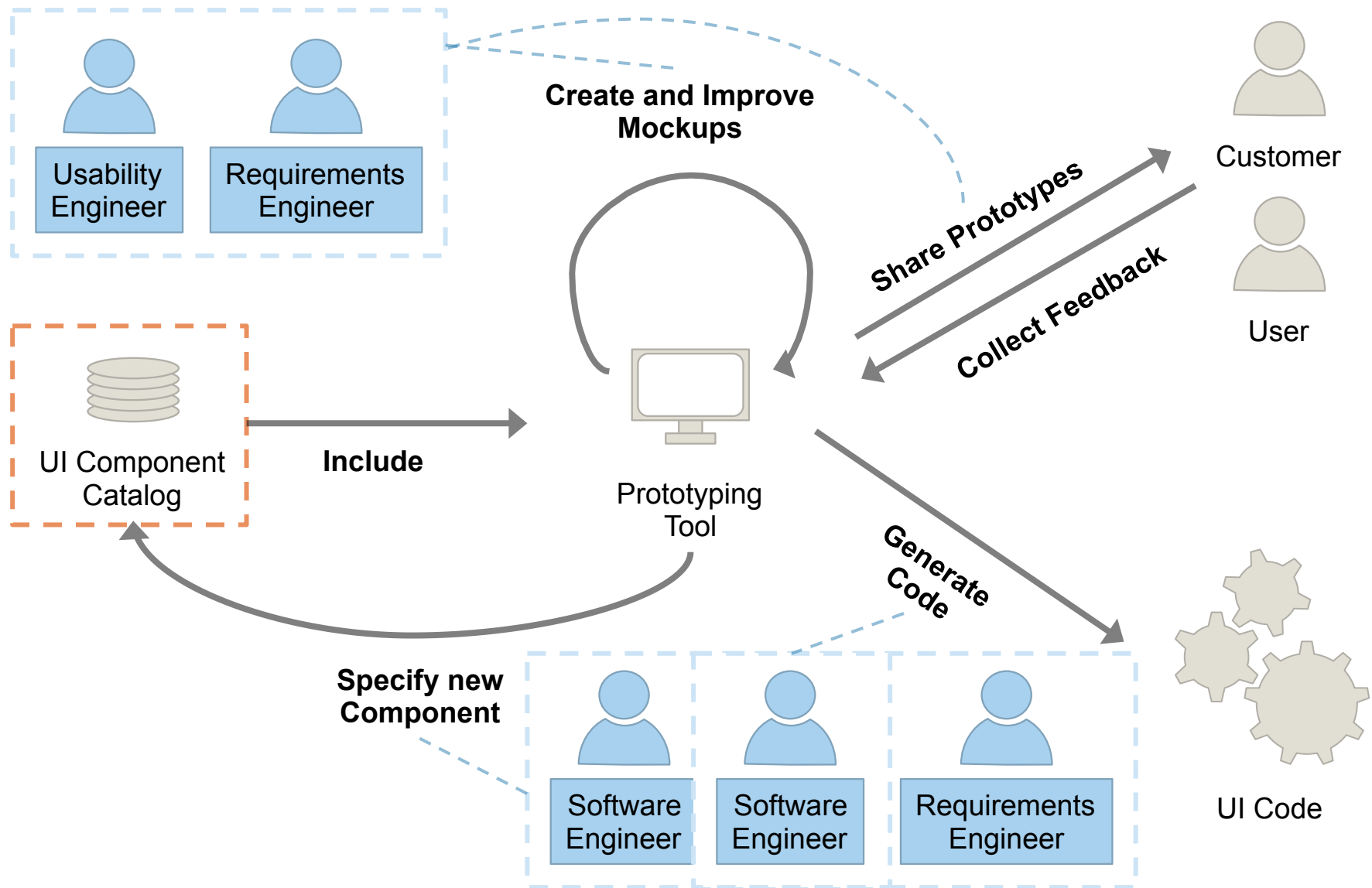
Mockup-Driven Development: Providing agile support for Model-Driven Web Engineering, Rivero 2014

- Coined the term: MockupDD (Mockup-Driven Development)
 - Create User Stories and Mockups
→ Mapping through a SUI (Structural User Interface) Model
 - Use the SUI Model to generate Code and MDWE Models
- **Focusing on the transition between high-fidelity mockup and the product**
- **No benefits from a multi-fidelity approach**



Solution Design

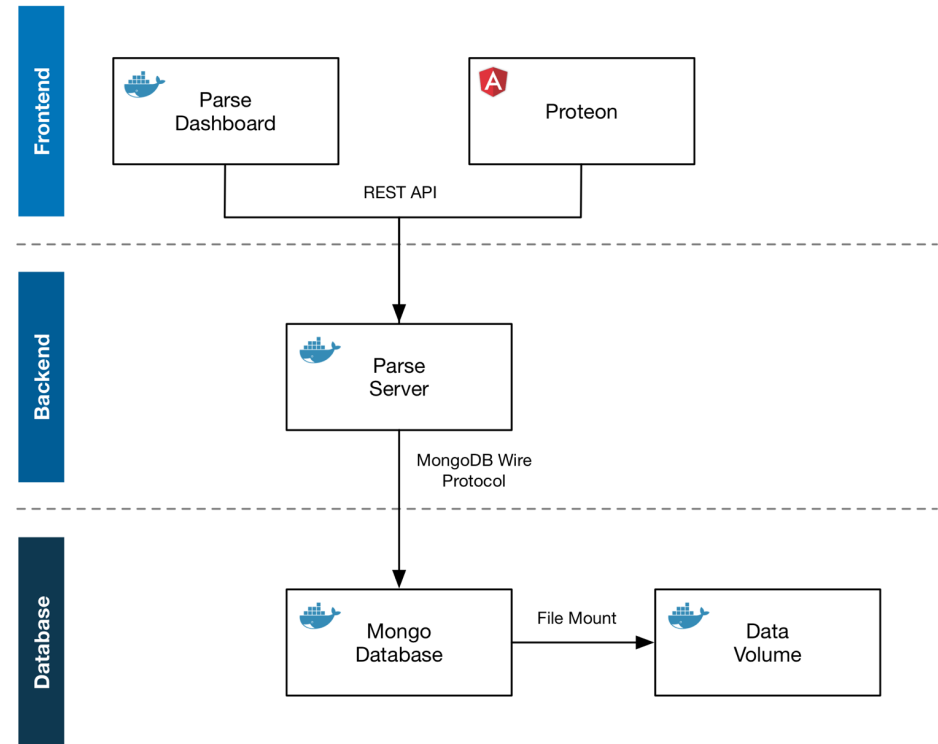
Prototype-Driven Development Process



Component Catalog

Prototype for the creation and maintenance of UI components

- Utilizing the „backend-as-a-service“ Parse in a Docker Compose setup
- Definition of custom view model based on UIML
- Development of an AngularJS web application



Solution Design

Implementation - Demo

The screenshot displays the Proteon web application interface. The browser address bar shows `localhost:8080/webpack-dev-server/`. The application header includes the Proteon logo, navigation tabs (DASHBOARD, COMPONENT MODELER, PROTOTYPE MODELER), and a user profile for MAX MUSTERMANN, ADMINISTRATOR. The COMPONENT MODELER tab is active, showing a 'TABLE' component. The left sidebar contains a 'General Information' panel with details about the 'Table' component, including its name, tag, category, description, and creation/modification dates. The main area is titled 'Structure' and shows a hierarchical tree of the component's structure. The tree includes a 'Table' root, which contains two 'Table Row' components, each with two 'Table Cell' components, and a 'Pagination' component. A dropdown menu is open for the 'Table' component, showing a list of sub-components: 'Search results', 'Table Header Cell', 'Table Header Content', 'Table Body Content', and 'Table Footer Content'. The 'Table' component is also shown with its XML tag `<sebis-table>` and a close button. The 'Table Row' components are shown with their XML tags `<tr>` and `<td>`. The 'Pagination' component is shown with its XML tag `<sebis-pagination>`. The 'Table' component is also shown with its XML tag `<table>` and a close button. The 'Table Row' components are also shown with their XML tags `<tr>` and `<td>`. The 'Table Cell' components are also shown with their XML tags `<td>`. The 'Table Header Cell' component is also shown with its XML tag `<th>`. The 'Table Header Content' component is also shown with its XML tag `<thead>`. The 'Table Body Content' component is also shown with its XML tag `<tbody>`. The 'Table Footer Content' component is also shown with its XML tag `<tfoot>`.

Proteon

DASHBOARD COMPONENT MODELER PROTOTYPE MODELER

TABLE

Structure

EXPAND ALL COLLAPSE ALL

General Information

Name Table

Tag sebis-table

Category Tables

Description Customised table with optional pagination.

Created By Unspecified

Created At 11/15/2016 10:22

Last Change By Unspecified

Last Change At 11/24/2016 00:39

Table

Table Row

Table Cell

Table Row

Table Cell

Table Cell

Pagination

table

Search results

Table Header Cell

Table Header Content

Table Body Content

Table Footer Content

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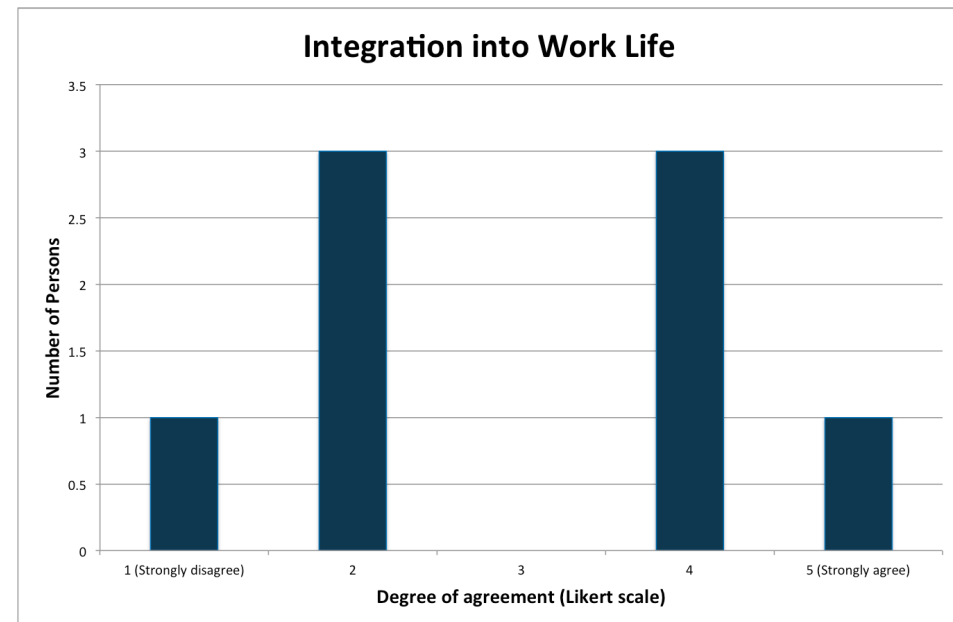
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Usability Walkthrough

- Custom and System Usability Scale (SUS) questionnaire conducted (N=8)
 - 5 point Likert-scale
 - 75% (6 persons, $\sigma = 1.07$) strongly agreed that the collaboration and reuse of existing components is improved
 - 4 persons (50%, $\sigma = 0.76$) agreed that the process could accelerate the software development
 - SUS score of 67.19 (average of 68 in literature)
- **No clear benefits from a multi-fidelity approach**
- **Process enhances collaboration and enables systematic reuse**



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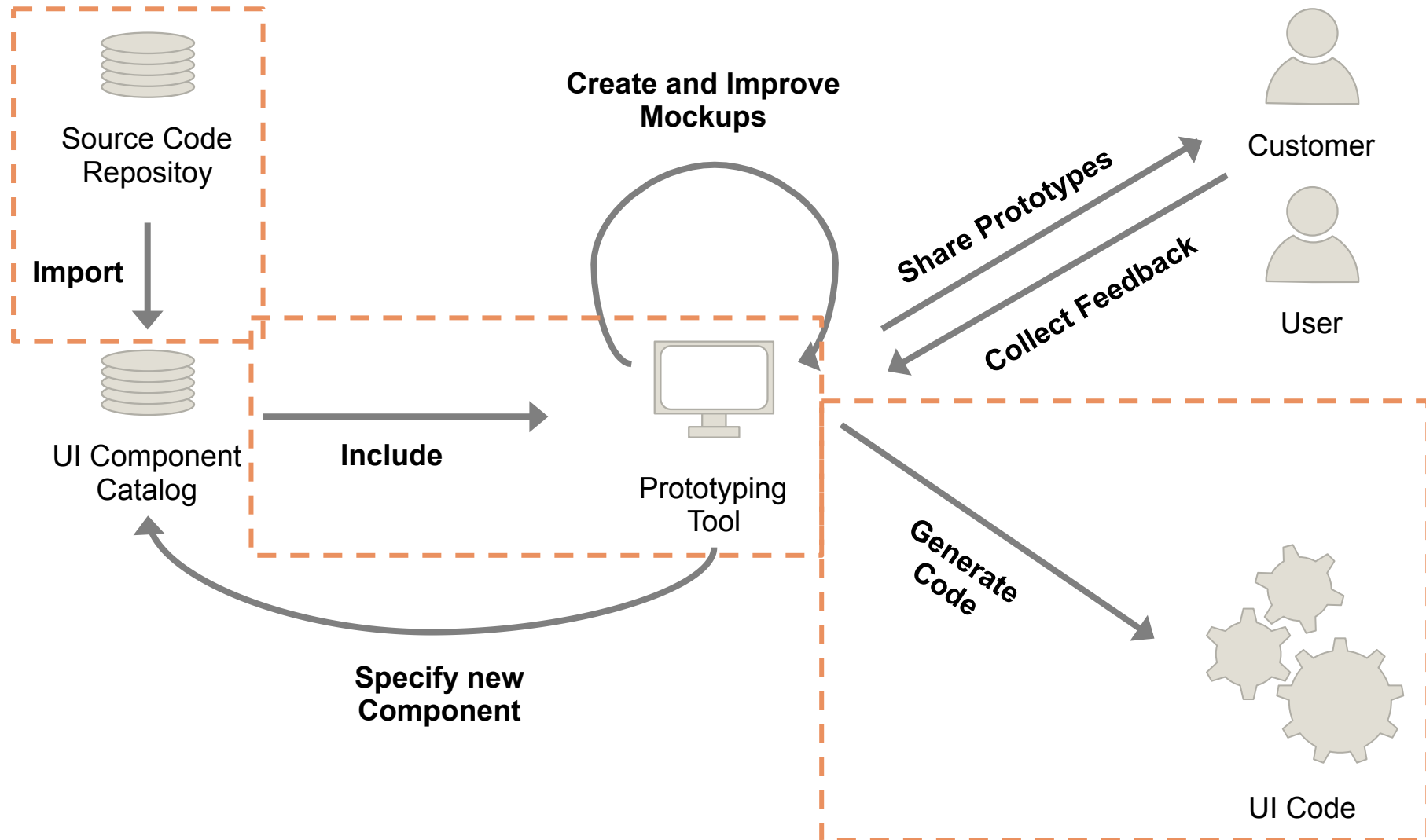
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Thank you! Questions?



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Backup

Category	Criterion	Prototype				Product
		Sketch	Wireframe	Mockup	Software Prototype	
General	Technique	paper-based	computer-based	computer-based	software-based	software-based
	Speed	fast	fast	slow	slow	slowest
	Cost	cheap	cheap	expensive	expensive	most expensive
Fidelity	Low-Fidelity	✓	✓	✗	✗	✗
	Medium-Fidelity	✗	✓	✓	✗	✗
	High-Fidelity	✗	✗	✓	✓	✓
Behaviour	Navigation	✗	✓	✓	✓	✓
	Interactive Elements	✗	✗	✓	✓	✓
Structure	Responsive Design	multiple static screens	multiple static screens	single interactive screen	CSS / Other Technology	CSS / Other Technology
	Placeholders	✓	✓	○	○	✗

✓ = applies, ○ = optionally applies, ✗ = not applied

Category	Criterion	Prototype				Product
		Sketch	Wireframe	Mockup	Software Prototype	
Information	Label	✓	✓	✓	✓	✓
	Text	✗	✗	○	✓	✓
	Images	✗	✗	✓	✓	✓
Style	Colors	black & white	black & white	colored	colored	colored
	Icons	✗	✗	✓	✓	✓
	Typography	✗	✗	✓	✓	✓

✓ = applies, ○ = optionally applies, ✗ = not applied

Solution Design

Definition of Terms – Multi-Fidelity

Mockup	Sketch Low Fidelity	„Paper and Pencil“ or „Whiteboard and Post-It“ approach. Focus: Basic functionality & UI interaction
	Wireframe Medium Fidelity	Skeletal illustration of the UI, which usually has no styling, colors or graphics. Focus: Content of the UI
	Prototype High Fidelity	Almost undistinguishable from the final UI, could often be executed on the final platform. Focus: Design, Fully executable UI prototype
Code		Code of the final UI, which often relies on frontend frameworks (e.g. Bootstrap, Foundation) ➔ Automatically generate!



Multi-fidelity Prototyping of User Interfaces

- Identified the same research gap of missing support for fidelity transitions
- Focus on the transition from “no-fi” (hand drawn) to “lo-fi”
→ Gesture recognizer
- Low shape detection speed
→ Problematic when used for complex UIs
- Static templating: “custom element could be drawn in lo-fi and a predefined widget could be added in me-fi or hi-fi”

Source: Coyette, A., Kieffer, S., & Vanderdonckt, J. (2007). Multi-fidelity prototyping of user interfaces. *Human-Computer Interaction – INTERACT*, 4662, 150–164. doi:10.1007/978-3-540-74796-3_16

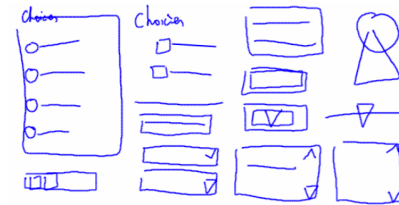


Fig. 1. No-fi mode without labels

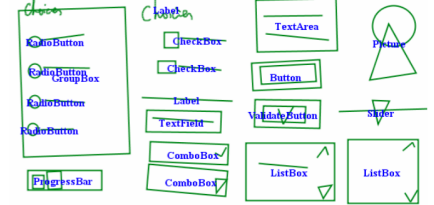


Fig. 2. Lo-fi mode for sketching UI elements (with labels)

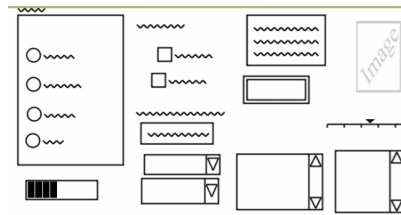


Fig. 3. Me-fi mode without labels

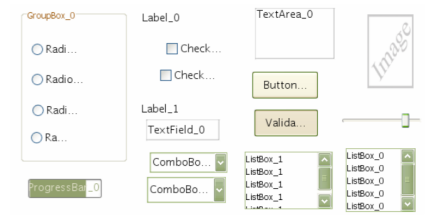
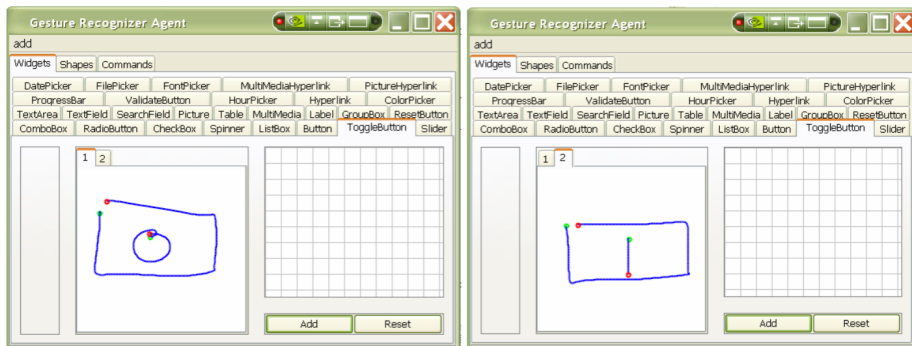
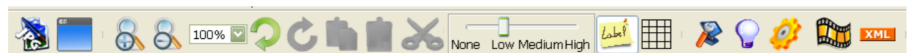


Fig. 4. Hi-fi mode without labels



Mockup Driven Web Development

- Definition of Cascading Tree Sheets (CTS)
→ Describe relationship between content and structure
- CTS as input for the generation of a web application

Benson, E. (2013). Mockup Driven Web Development. *Proceedings of the 22nd International Conference on World Wide Web Companion*, 337–341.

Mockup-Driven Development: Providing agile support for Model-Driven Web Engineering

- Coined the term: MockupDD (Mockup-Driven Development)
- Mockup as “requirement elicitation helper”
- Create User Stories and Mockups
→ Mapping through a SUI (Structural User Interface) Model
- Use the SUI Model to generate Code and MDWE Models

Source: Rivero, J. M., Grigera, J., Rossi, G., Robles Luna, E., Montero, F., & Gaedke, M. (2014). Mockup-Driven Development: Providing agile support for Model-Driven Web Engineering. *Information and Software Technology*, 56(6), 670–687. doi:10.1016/j.infsof.2014.01.011

