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Modeling of User Interfaces . . . *again?!*

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Models of User Interfaces

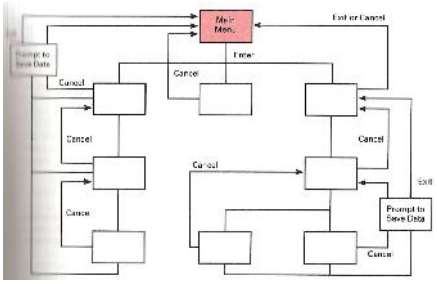
- **It is a very straightforward and natural way to model user interfaces using the concepts and notations of state machines.**
  - Dialogs/Screens correspond to states,
  - Effects leading from one screen to another correspond to state transitions.
- **The idea never quite made it, but has proven die hard.**
  - The very first book on UIs ever (published 1971) already contained that idea.
  - The idea has been re-invented many times over, with different spins to it and for different types of (then modern) UIs: 3270 Dialogs, Web-pages, APPs,...
  - However, the idea also never quite became the dominant way to create UIs.

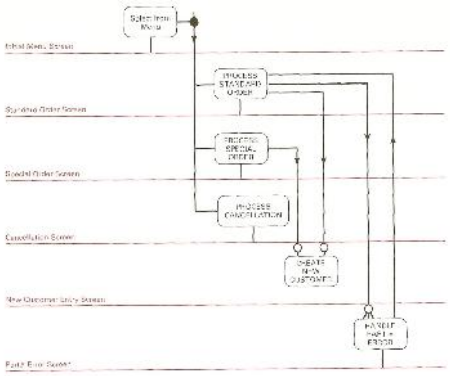
Why has this approach not prevailed?
What are the problems – and can we fix them?

Landmarks of Using SMs for UI-Design

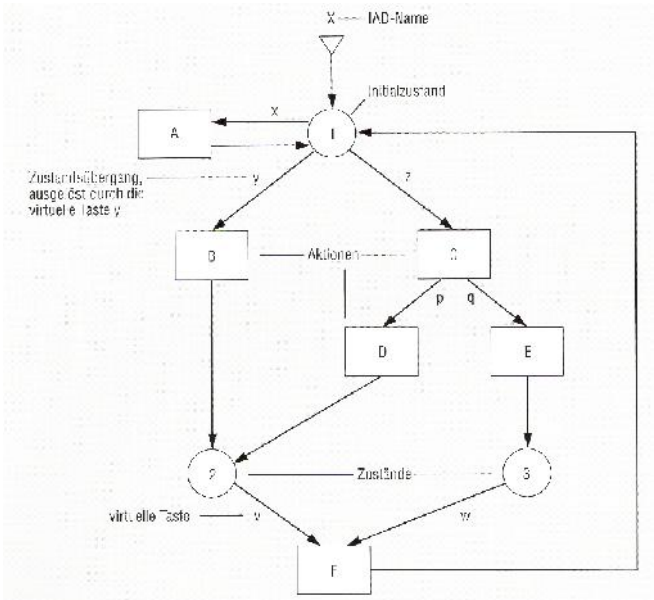
- **Paper Prototypes**
  - **Strengths:** very accessible & fast, cheap, inclusive/participatory
  - **Weaknesses:** not executable, not scalable, limited visual fidelity range
- **Silk/Denim**
  - **Strengths:** sketch input, generates HTML mock-ups
  - **Weaknesses:** not scalable, limited visual fidelity range, niche solution
- **Floella et al.**
  - **Strengths:** simple to use, very accessible & fast,
  - **Weaknesses:** not scalable, limited visual fidelity range, niche solution
- **Web Engineering**
  - **Strengths:** full-fledged code generation,
  - **Weaknesses:** expensive input, not scalable, limited visual fidelity range

Previous Approaches 1: Martin

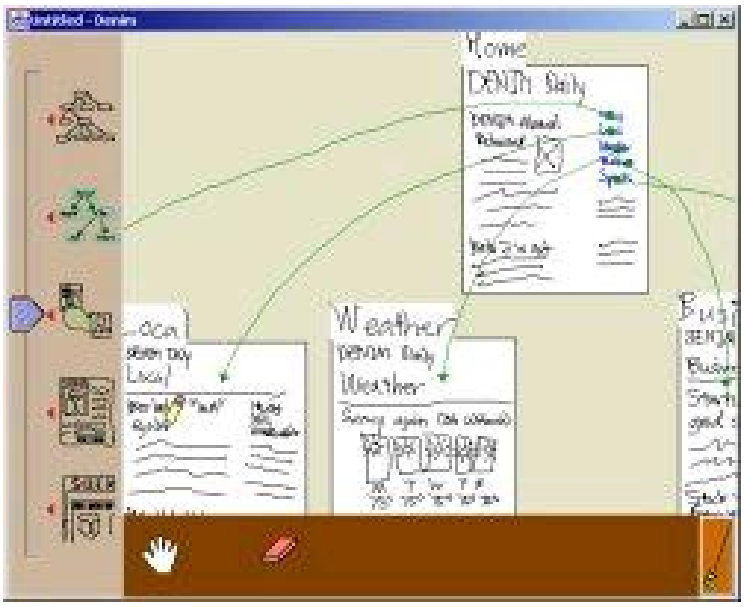




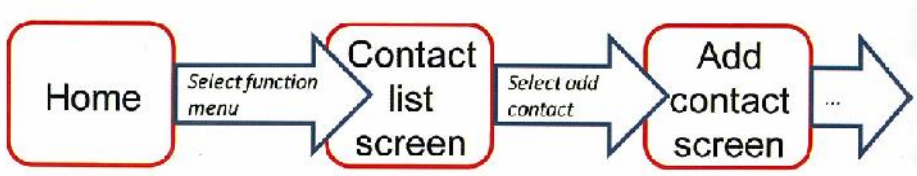
Previous Approaches 2: Denert



Previous Approaches 3: Landay/Myers



Previous Approaches 4: Buxton



WEDs /AIDE

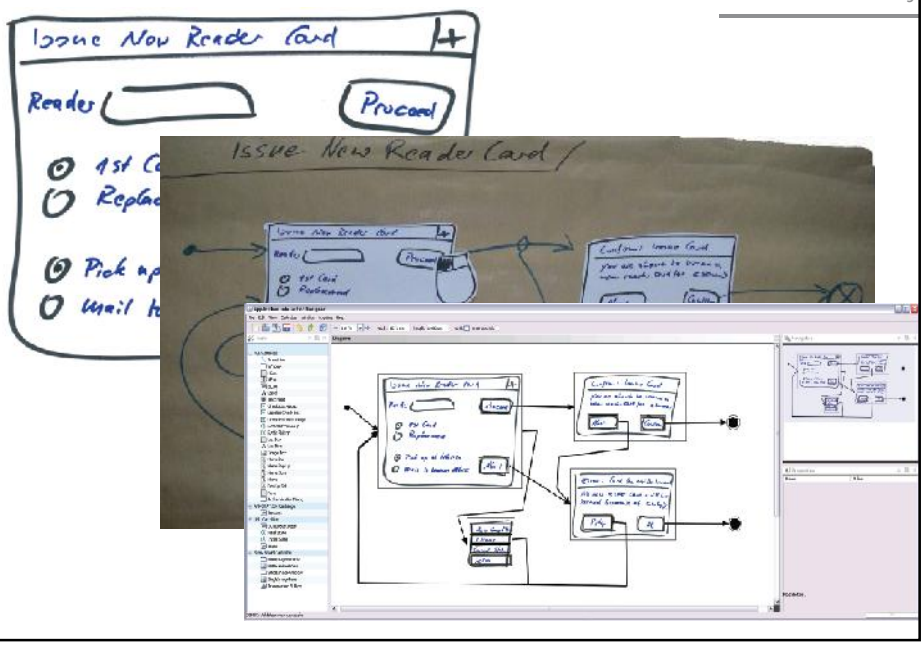
- **Our approach to address previous shortcomings consists of two elements:**
  - Window/Event Diagrams (**WEDs**, since 1999 [1,2])
  - The Advanced Interaction Design Environment (**AIDE**, since 2008 [3,4])

[1] Models of Software Architecture, Book on Demand, 2001
[2] Group Exercises for the Design and Validation of Graphical User Interfaces, Proc. Modellierung, GI, 2002
[3] Model driven development of user interface prototypes: an integrated approach, Proc. NWMODE, ACM 2010
[4] Improving Modeling with Layered UML Diagrams, Proc. MODELSWARD, ICSEA 2013

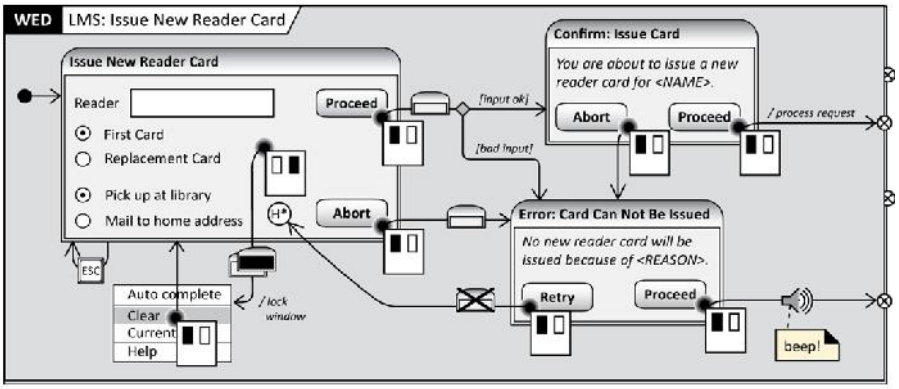
- **Together, they bundle contributions to achieve synergies.**

1 Input by Pen & Paper	2 UML State Machines	3 Navigation Support	4 Executable Prototypes
▪ Best usability ▪ great cost/ benefit ratio ▪ include diverse audiences	▪ concurrent states ▪ history states ▪ Rich events ▪ extensions	▪ Locator,Toolbox , Zoom/Pan, … ▪ Accelerators ▪ Diagram layers	▪ Simple HTML-mockups ▪ executable XUL code

1 Input by Pen & Paper



2 UML State Machines

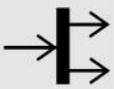
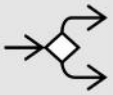


2 UML State Machines

Demo

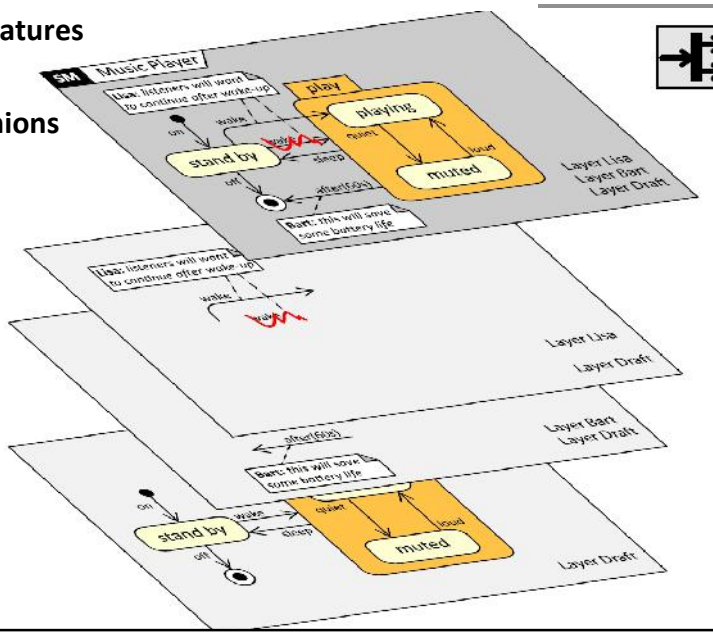
3 Navigation Support

- **UI-Models become very large (and impossible to handle), quickly.**
- **We provide a multitude of tools for moving in large diagrams („every known technique“):**
  - Fully interactive locator view, Zoom/pan with multiple ways of interaction
  - Movable toolbox, keyboard accelerators, short-hands (“quick button“, …)
  - Jump-marks, color clouds, looking glass
- **Syntactic Diagram Layers**

	**Orthogonal Models** - orthogonal angles or viewpoints - independent contributions (e.g., comments) - optional aspects, features, or qualities	**Benefits** - n layers replace 2^n separate views - merge n contributions while keeping traces - easy combination of subsets
	**Alternative Models** - competing variants - diverging versions - overlapping branches	**Benefits** - avoid redundancy in overlapping submodel - easy switching between alternatives - combine n branches in a single diagram
	**Sequential Models** - consecutive steps or stages - temporal evolution of model - increasing/decreasing levels of detail (zoom)	**Benefits** - provide connected layouts - avoid cascading changes - allow also for branching evolution

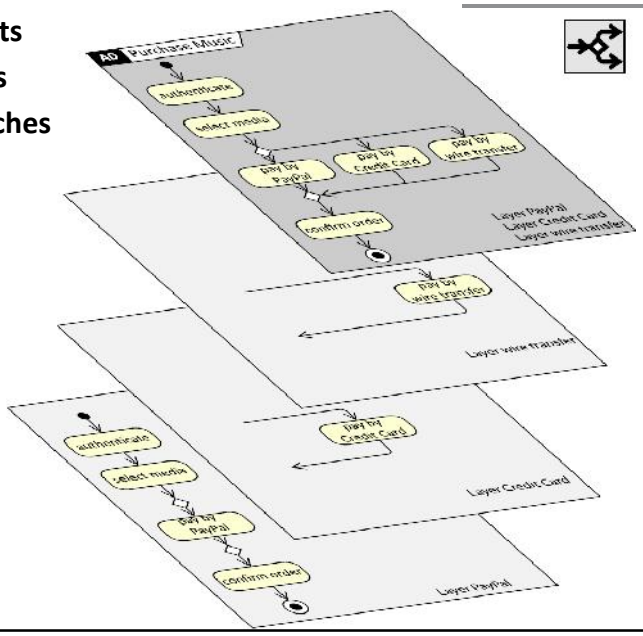
Orthogonal Layers

- Options / Features
- Viewpoints
- Review Opinions



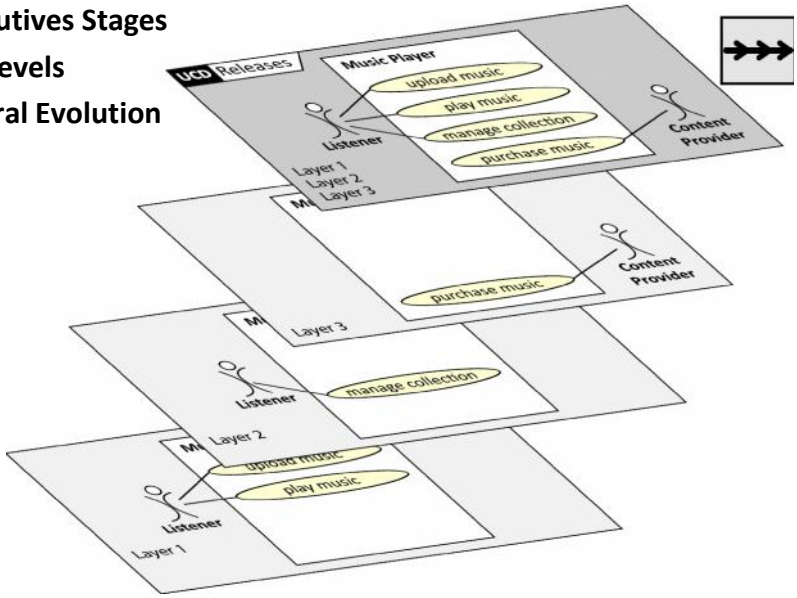
Alternative Layers

- Competing Variants
- Diverging Versions
- Overlapping Branches



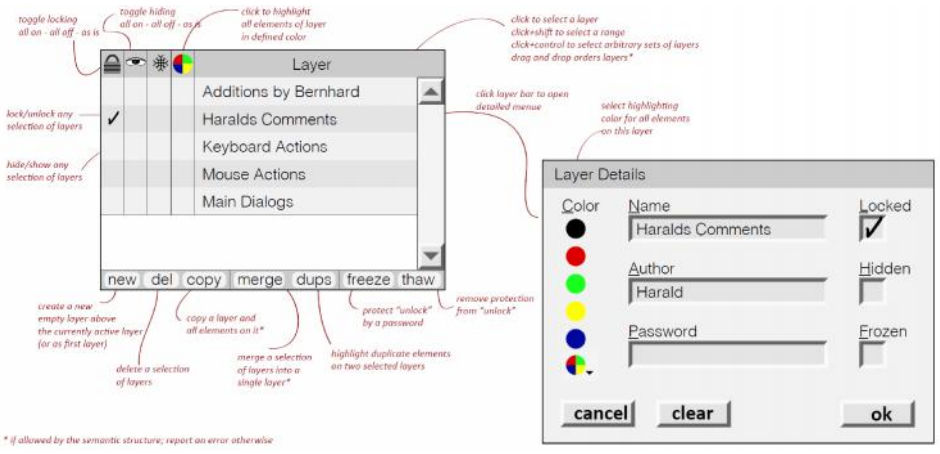
Sequential Layers

- Consecutives Stages
- Zoom Levels
- Temporal Evolution

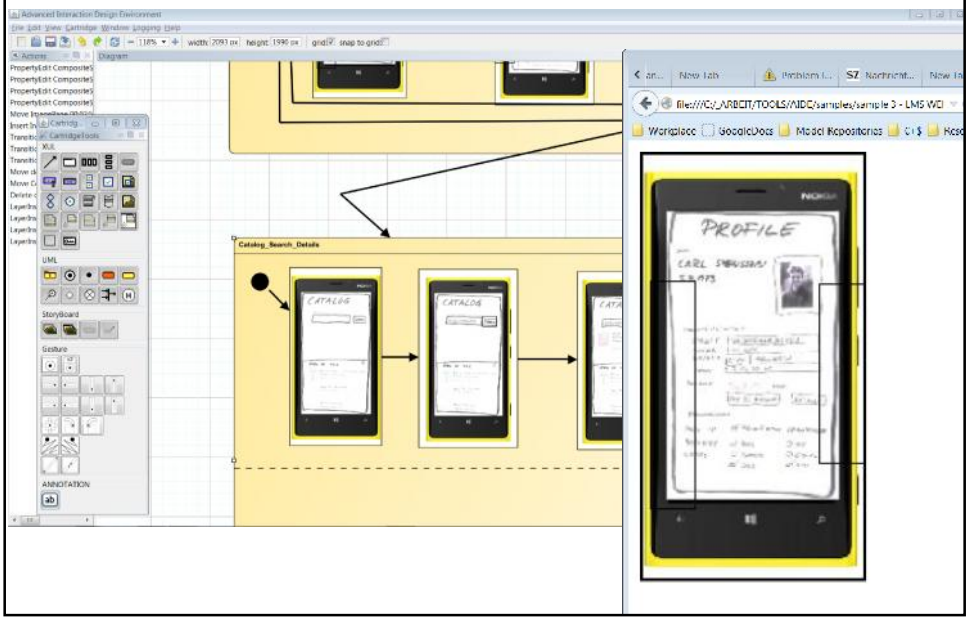


3 Navigation Support

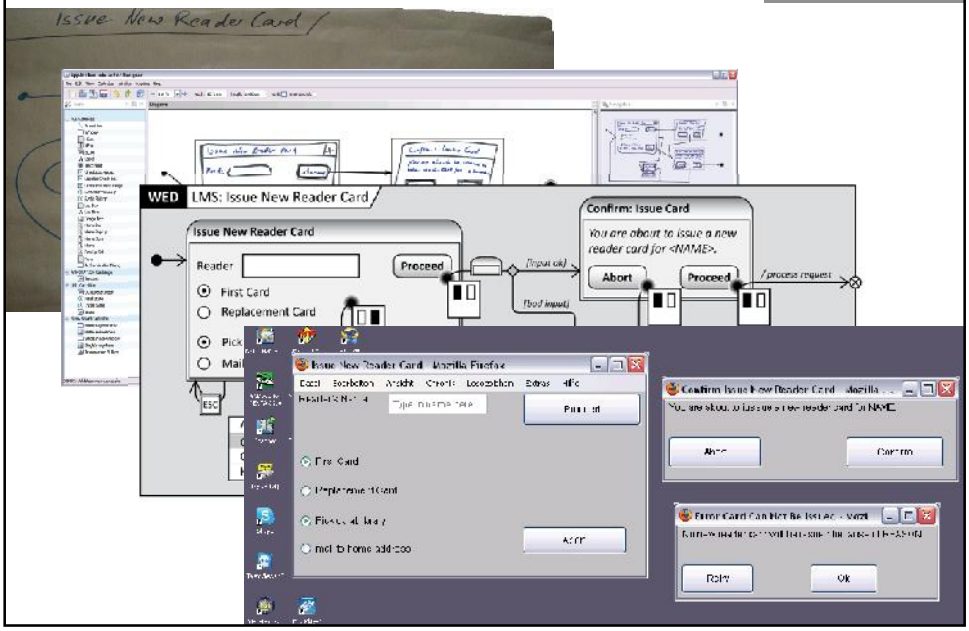
Original Design of the implementation



4 Executable Prototypes



Results (1/3)
Toolchain from Sketches to Prototypes



Results (2/3)
Observational studies on WEDs

Physical Interaction

Embodied Cognition

Maintain focus across zoom levels

Integrate Overview and Details

Allow concurrent work

Results (2/3)
Observational studies on WEDs

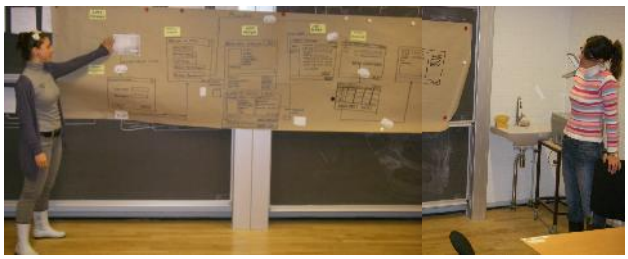
Support Communi-cation

Deictic Interaction

Division of labor

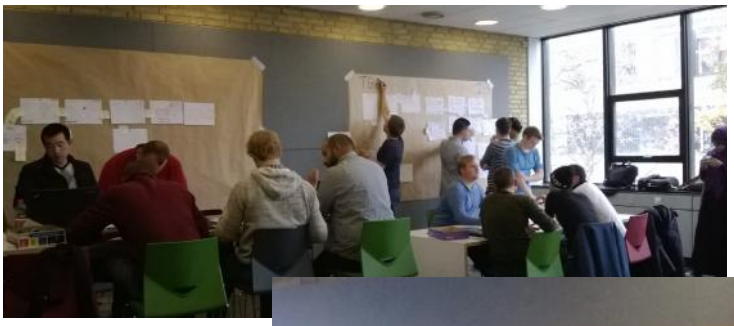
Facilitates Presentation

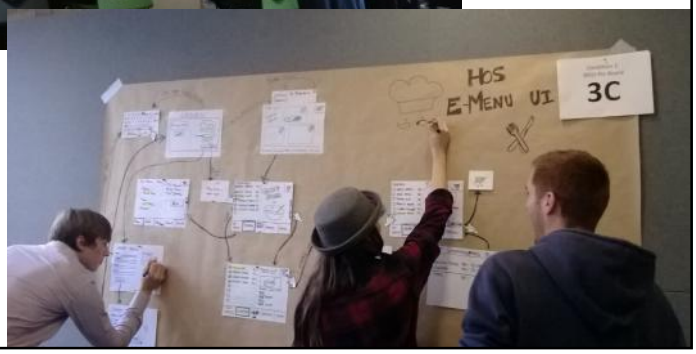
Provides Overview



Sense of Ownership

Results (3/3)
Large Scale Experiment





Summary / Future Work

Approach
- Concepts and Notation for WEDs
- Incremental and Participatory UI Design

Tool
- Input by scanned sketches
- Extensive support for zooming and navigation
- Code Generation for HTML5 and XUL

Improvement
- Ongoing incremental usability improvements
- Android app for input/update, Automatic deployment
- XAML code generation, mixed code, frames/resolutions

Evaluation
- Analyse observations from case study (grounded theory)
- Define and conduct follow-up experiments
- Run and evaluate realistic field trial

Dissemination

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Appendix:
A Simple Smartphone Library Client

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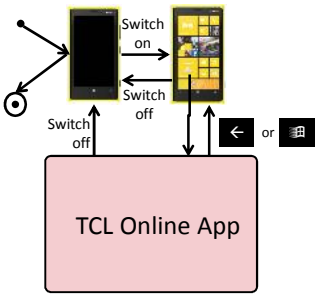
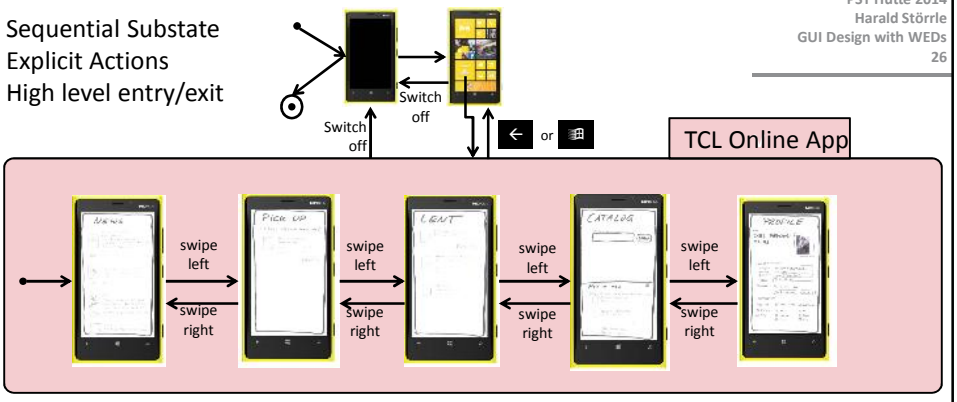
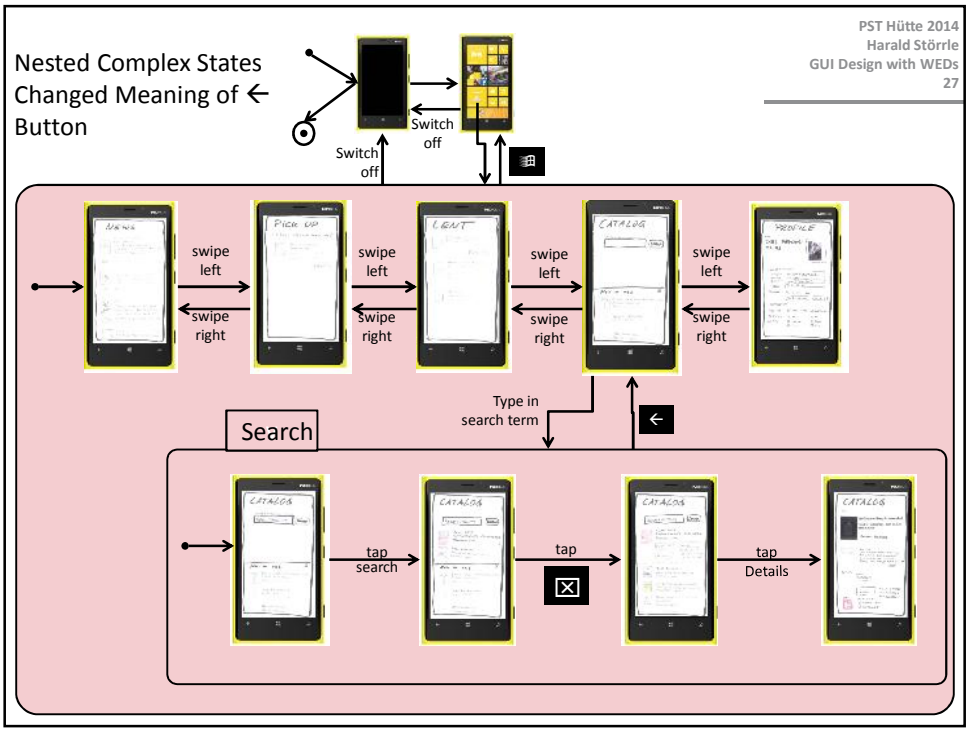
States
Initial/Final States
Transitions



Sequential Substate
Explicit Actions
High level entry/exit




Nested Complex States
Changed Meaning of ← Button
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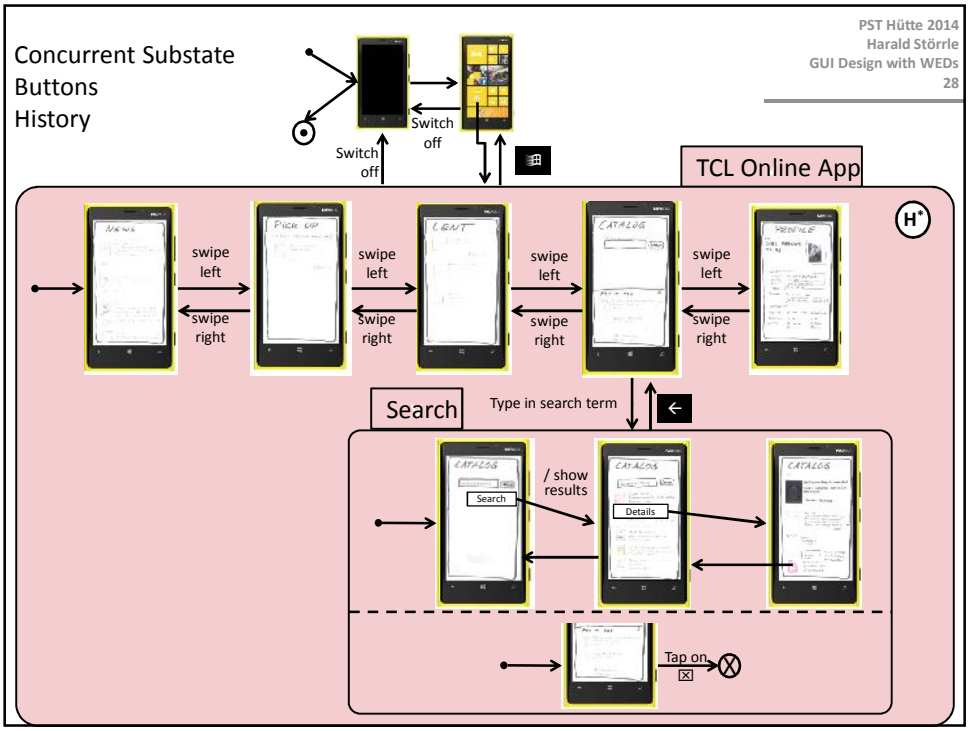
GUI Design with WEDs
27
Switch off
Switch off
swipe left
swipe right
swipe left
swipe right
swipe left
swipe right
swipe left
swipe right
Type in search term
Search
tap search
tap
tap Details


Concurrent Substate Buttons History
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GUI Design with WEDs
28
Switch off
Switch off
TCL Online App
H*
swipe left
swipe right
swipe left
swipe right
swipe left
swipe right
swipe left
swipe right
Search
Type in search term
Search
/ show results
Details
Tap on