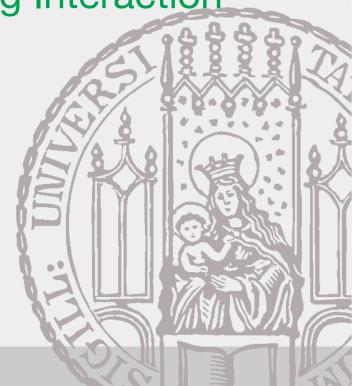# Design and Distribution of Physical and Mobile Interfaces for Multi-Tag Interaction

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Diploma Thesis
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Outline

- **Motivation**

- **Topic of the Thesis**

- **Related Work**

- **Preliminary Classification of Multi-Tag Interaction**

- **1st User Study: Navigation and Selection**

- **Outlook**

- **Interaction between mobile devices and smart objects [Rukzio et al., 2007]**

- **Goals**

  - More intuitive, simpler and direct interaction

  - Overcoming the adversities of mobile devices

- **Physical Mobile Applications**

  - E.g. ticketing, information services, access control, selections

- **Physical Mobile Interaction often as first step in the interaction process with a service**

Sources: www.touchandtravel.de, www.visa-asia.com

Single-Tag Interaction vs. Multi-Tag Interaction

- **Single-Tag Interaction**

  - Interaction with single tag

  - No real physical interface & interaction

  - Suggested classification [Herting et al., 2008]:

    - Presentation of Information

    - Physical Hyperlinks

    - Tagging

    - Broadcasting

    - Tag Emulation

    - 2-Way-Interaction

- **Multi-Tag Interaction**

  - Interaction with more than one tag or object

  - Stronger focus on physical interface & interaction

  - No suggested classification

Source: www.touchandtravel.de

- **Investigation of interface and interaction design distributed between physical objects and mobile devices**

- **Classification of Multi-Tag Interactions and Applications**

- **Comparison and evaluation of different designs for Single-Tag Interaction and Multi-Tag Interaction**

  - Categories of Multi-Tag Interaction

  - Specific example applications

  - Different designs for Single-Tag Interaction and Multi-Tag Interaction

- **Best practices for design of multi-tag applications and interfaces**

- **Enabling Technologies**
    - Numeric Identifiers, Bluetooth, Infrared, Visual Markers, Laser Pointer, RFID, Near Field Communication (NFC)

- **Basic Physical Mobile Interaction Techniques**
    - Touching [Rukzio et al., 2007]
    - Pointing
    - Scanning
    - User Mediated Object Interaction
    - Hovering [Välkkynen, 1997]
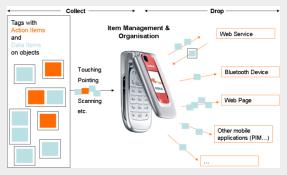
Source: [Rukzio et. Al , 2007]

- **Advanced Physical Mobile Interaction Techniques (Multi-Tag Interaction)**

  - Point & Shoot [Ballagas et al., 2005]

    - Selection with a grid of visual markers

  - Collect & Drop [Broll et al, 2008]

    - Action Items and Data Items

  - Selection Techniques [Reilly et al., 2005]

    - Click-Select, Path-Select, Lasso-Select etc.

  - Touch & Interact [Hardy et al., 2008]

    - Interaction with public display
      (cf. touch screens)

Sources: [Ballagas et al., 2005], [Broll et al., 2008], [Hardy et al., 2008]

- **Navigation**

  - Interaction-specific

  - Navigation within an application accomplished through physical interaction

  - Different tags offer different entry points to an application

- **Selection**

  - Interaction-specific

  - Selection of options/items accomplished through physical interaction

- **Combination of Information**

  - Application-specific

  - Combination of same/different types of information (e.g. actions and objects)

- **Mapping**

  - Application-specific

  - Mapping of specific application-features to specific tags
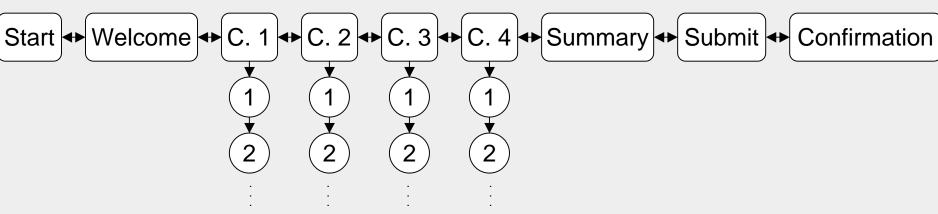
The First User Study

- **Tested pattern**
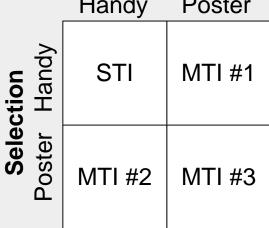 - Selection
  - Navigation

- **Use case**
  - Ordering in a restaurant with the help of an NFC enhanced menu

- **Workflow**

	Navigation	
	Handy	Poster
Selection Handy	STI	MTI #1
Poster	MTI #2	MTI #3

- **Tag-Enhanced Poster & Mobile Application**

Multi-Tag Interaction #1

- **Tag-Enhanced Poster & Mobile Application**

- **Tag-Enhanced Poster & Mobile Application**

- **Tag-Enhanced Poster & Mobile Application**

- **Interface Complexity**

  - Single-Tag Interaction

  - Multi-Tag Interaction #1 (Navigation)

  - Multi-Tag Interaction #2 (Wizard, Selection)

  - Multi-Tag Interaction #3 (Free Selection)

- **Interaction Complexity**

  - Short List (7 items)

  - Long List (14 items)

- **Task Complexity**

  - Without corrections

  - With two corrections

- **Implementation**

  - J2ME, Nokia 6131 NFC SDK, J4ME

- **User Study Design**

  - 16 Participants (Latin Square Design)

  - Demographic Questionnaire, Standardized IBM "Computer System Usability Questionnaire", Comparing Questionnaire

  - Video Analysis

  - Dependent Variables: Attention Shifts, Errors and Execution Time

  - Beforehand analysis with the Keystroke-Level-Model
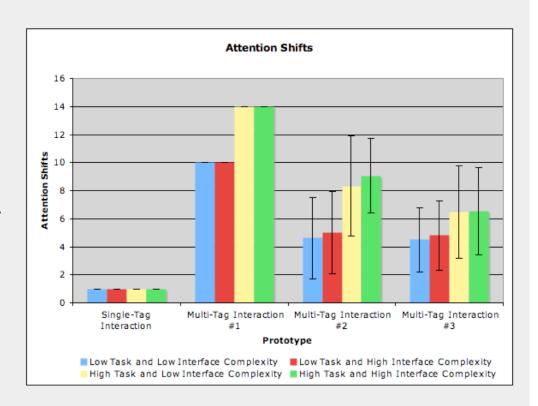
  - Evaluation with SPSS

- **Attention Shifts**

  - Between mobile device and poster

  - Constant using Single-Tag Interaction and Multi-Tag Interaction #1 due to the design of the prototypes

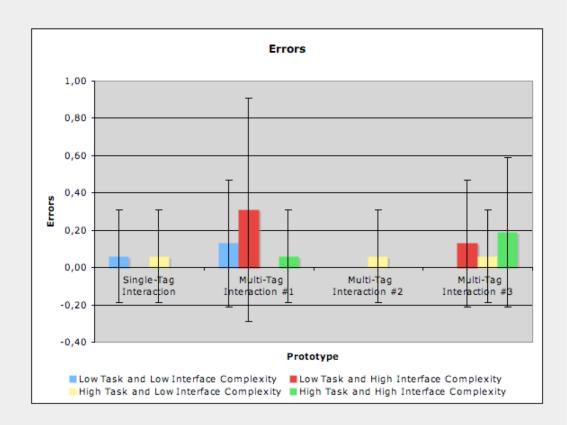 - Task complexity has a stronger influence than interface complexity

- **Errors**
  - Hardly any errors
    - Explaination and practice beforehand
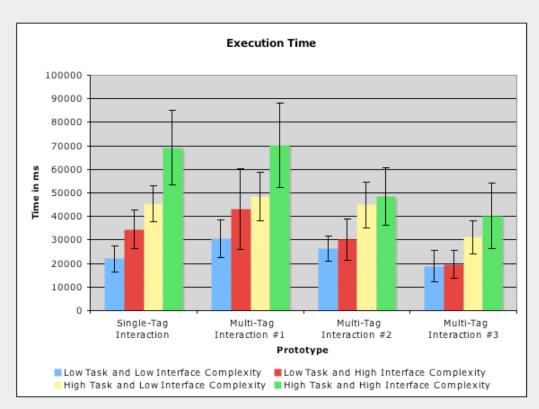 - Problems:
    - Usage of radiobuttons
    - Handling of NFC

- **Execution Time**
  - Time from "Start" to "Submit"
  - MTI #2 additionally was timed with help of the video
  - The more tags, the faster execution
  - STI and MTI #1 task- and interface complexity affect equally
  - MTI #2 und MTI #3 task complexity affects more
  - Comparison with Keystroke-Level Model: nearly the same times

- **Multi-Tag Interaction #3**

  - Preferred by all participants

  - Got the highest rating in all (applicable) questions of the IBM questionnaire

  - Reasons: No given order, easy correction, no permanent switching between mobile device and poster

- **Suggestions of Improvements**

  - Additional information when touching a tag e.g. ingredients, price

  - More graphical design e.g. pictures of the meals

  - Search or filter function for the long lists using STI and MTI #1

  - "Submit" not only as NFC-tag but as button on the mobile device, gives feeling of being in control

- **Two further user studies**

  - Action and Objects: Combination of Information

    - Objects: 7 Sights; Actions: Information, Route, Photos

  - GUI Widgets: Selection

    - Selection via GUI Widgets (Dropdown, Textfield, Radiobuttons, Checkboxes)

Questions?

Thank You!

Navigation

	Handy	Poster
Selection Handy	STI	MTI #1
Selection Poster	MTI #2	MTI #3