Comparing Techniques for Mobile Interaction with Objects from the Real World

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Motivation: Mobile Interaction with the Real World

- Everyday objects can be augmented and associated with additional information and services
- Technologies: visual marker recognition, RFID, NFC, laser pointer, IrDA, Bluetooth, GPS, …
- Objects become electronically recognizable and get digital identities
- Powerful mobile devices for capturing, processing and using this information from the real world
- Both trends build the foundation for Physical Mobile Interaction
Physical Mobile Interaction

- Extends mobile interaction to the interaction with real world objects
- More intuitive and more familiar access to information through interaction with associated objects
- Techniques:
  - Touching (e.g. NFC)
  - Pointing (e.g. visual marker)
  - Scanning (e.g. Bluetooth)
  - Location Based Selection (e.g. GPS)
  - ...
- Often only simple usage => gateway for traditional interaction
Motivation and Approach

- Approach of PERCI (PERvasive ServiCe Interaction): Collaboration between NTT Docomo Eurolabs and LMU
- Taking advantage of Physical Mobile Interaction for better mobile interaction with (Semantic) Web Services
- Physical Mobile Interaction to make mobile interaction with people, places, things easier and more intuitive
- Touching or Pointing instead of complex menus
- Outbalancing constraints of traditional mobile interaction
- Shift focus of interaction from mobile devices onto physical objects => ubiquitous interfaces
- Explore the potential of more complex techniques for Physical Mobile Interaction
The Perci Framework - Overview

- Framework bridging the gap between the Web Service Domain and the Physical Mobile Interaction Domain
- A Universal Client running on a mobile device is interacting with Physical Objects, providing a technical connection to services
- Interaction Proxy (IAProxy) mediates between the two domains
• Automated generation of adaptable interfaces from extended Semantic Web Service descriptions to support Physical Mobile Interaction
• Different service descriptions and interface extensions as basis for interface generation, customization and rendering
• XSLT transformation of different description sources to composed Abstract UI Description => basis for further transformations and UI rendering
Use Cases for Mobile Ticketing

**Permi Movie Tickets**

1. **Select a Cinema**
   - Maxx
   - Hochstaedter
   - Leinster
   - Mariner
   - Gloria

2. **Select a Movie**
   - The Da Vinci Code
   - Geisha
   - Pirates of the Caribbean

3. **Select an Action**
   - Order Movie Ticket

4. **Select the Number of Persons**
   - 1
   - 2
   - 3
   - 4
   - 5

5. **Select a Time Slot**
   - 13:00
   - 15:00
   - 17:00
   - 19:00
   - 21:00
   - 23:00

**Permi Transportation Tickets**

1. **Select the Duration of your Journey**
   - 1 Hour
   - 3 Hours
   - 4 Hours
   - 1 Day
   - 1 Week
   - 1 Month

2. **Select the Number of Passengers**
   - Adult
   - Child
   - Bicycle

3. Define Origin and Destination of your Journey by selecting the Areas, in which the appropriate Stations are located.
Prototype-Implementation of Physical Mobile Interaction

• Prototype implemented with J2ME, the Nokia RFID & NFC SDK 1.0 and kXML
• Posters were augmented with NFC-tags and visual markers
• Development and testing with Nokia 3220 (plus NFC shell) and 6630 mobile phones
• Typing of tags: actions and parameters
• **Touching**: reading object descriptions from NFC-tags
• **Pointing**: recognition of visual codes through phone cameras
• **Direct Input**: typing of number identifiers (e.g. in a HTML-browser)
User Study and Evaluation

- 17 participants, aged from 23 to 46, 4 female, 13 male
- Process
  - Preliminary interview
  - Carrying out a task (buying a movie ticket) with all 3 interaction techniques
  - Touching and Pointing tested with Java ME clients
  - Direct Input was tested with a mobile HTML-browser (Opera)
  - Order of the techniques was changed with every user
- General Results and Issues:
  - Subjects often did not know how to start the interaction; expected workflow
  - Lack of predefined interaction sequence confused them
  - Most subjects ignored instructions on the poster or did not appreciate them
  - Concept of action/parameter tags was often not understood at first
  - Subjects learned how to use them after the initial problems
Comparison between Touching, Pointing and Direct Input

- Direct input suffered from problems with the HTML-browser
- Pointing suffered from the delay when taking a picture of a visual marker
- Touching was by far considered to be the fastest (13/12 subjects before/after the study) and most favourite (13/13 subjects before/after the study) interaction technique

- **Touching**: 
  - best overall results
  - most reliable, enjoyable, innovative and easiest to handle

- **Pointing**: 
  - overall bad results
  - more innovative and reliable than Direct Input

- **Direct Input**: 
  - reliable and easy to handle
  - neither innovative nor enjoyable
Conclusion and Future Work

- Generic framework for the combination of Physical Mobile Interactions and Semantic Web Services
- J2ME client prototype supporting the interaction techniques Touching, Pointing and Direct Input
- Evaluation showed overall acceptance and potential of more complex techniques for Physical Mobile Interaction
- Still constraints and limitations => need for usability design guidelines
Questions?

Thank You!

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www.hcilab.org/projects/perci
Related Work

Physical Mobile Interaction

- Visual markers
- Touching
- Scanning
- Pointing
- Touching
- Scanning
- Pointing

Interface Generation

- SUPPLE
- D Khushraj, O. Lassila, 05
- SUPPLE
- D Khushraj, O. Lassila, 05

Interface Description

- XAML
- XUL
- WML
- UsiXML
- XAML
- XUL
- WML
- UsiXML

(Semantic) Web Services

- UIML
- UsiXML
- WML
- XHTML
- UIML
- UsiXML
- WML
- XHTML

PERCI Framework

- OWL-S
- Jena API
- WSDL
- OWL-S
- Jena API
- WSDL

E. Rukzio
M. Rohs
T. Ballagas
J. Riekki
NFC
RFID
IrDA
Bluetooth
GPS