Supporting Mobile Service Usage through Physical Mobile Interaction

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Motivation: Using Mobile Services

- Using Web Services in the mobile domain not as widespread and established as in desktop computing
- Mobile applications and services restricted by constraints of mobile devices:
  - Interaction (e.g. tiny keys, fiddly joysticks)
  - Presentation (e.g. small screens)
  - Usability (e.g. nested and glutted menus)
- Adds to general problem of adapting mobile applications and interfaces to different platforms
- Development of and interaction with mobile applications/services thus often tedious, intricate and inflexible
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
Physical Mobile Interaction - Examples
Approach and Agenda

- How to facilitate mobile interaction with Web Services through the interaction with physical objects?
- How to make complementary usage of Web Services and Physical Mobile Interaction?
- Focus of the PERCI project (PERvasive ServiCe Interaction): collaboration between LMU and DoCoMo Eurolabs
- Taking advantage of Physical Mobile Interaction for easier access to and usage of mobile services
- Taking advantage of Semantic Web Services to support more complex Physical Mobile Interactions
- Shift focus of interaction from mobile devices onto physical objects => ubiquitous interfaces
Related Work

**Physical Mobile Interaction**
- J. Riekkii
- M. Rohs
- E. Rukzio
- NFC
- RFID
- Bluetooth
- GPS
- IrDA
- Touching
- R. Ballagas
- Pointing
- Scanning
- Visual markers

**Interface Description**
- XAML
- XHTML
- UIML
- WML
- XUL
- UsiXML

**Interface Generation**
- SUPPLE
- D Khushraj, O. Lassila, 05
- PEBBLES/PUC

**PERCI Framework**
- OWL-S
- Jena API
- WSDL

**(Semantic) Web Services**
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* (IAPproxy) 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
Service Description Extensions

- **Service User Interface Annotation:**
  - Extensions of OWL-S service descriptions
  - Describe additional interface elements
  - E.g. labels, predefined value sets, image, ...

- **Abstract Widget Type Model:**
  - Represents most common widget concepts in user interfaces
  - Suggests application-specific rendering of abstract widgets
  - E.g. Single select input => radio buttons

- **Abstract Parameter Types:**
  - Abstract information typing system
  - Associates service parameters and information captured through Physical Mobile Interaction
• XSLT transformation of different description sources to composed *Abstract UI Description* => basis for further transformations and UI rendering

• Two target platforms depending on the *device profile*:
  - Direct interpretation by J2ME runtime
  - Additional transformation to create HTML-interfaces for mobile web browsers
- <abstractUI>
  - <group title="Cinema Ticketing Service">
    - <widget type="http://perci.medien.ifl.lmu.de:8080/axis/ui/ParameterTypeModel.owl#singleSelectInputParameterType">
      <abstractType>http://perci.medien.ifl.lmu.de:8080/axis/domain/cinema/cinema.owl#Time</abstractType>
      <label>Timeslot</label>
      <desc>Please select the time slot in this form or on the physical poster if available.</desc>
      <image>http://perci.medien.ifl.lmu.de:8080/axis/serviceDescription/extendedCinema/image4.jpg</image>
      <parameterValueType>http://www.w3.org/2001/XMLSchema#string</parameterValueType>
    - <ParameterValueSet>
      - <option>
        <value>14:00</value>
        <label>14:00</label>
        <desc>N/A</desc>
      </option>
      + <option></option>
    </ParameterValueSet>
  </widget>
</group>
</abstractUI>
Linking Objects and Services through Abstract Parameter Types

<tag type="parameter">
  <abstractType>http://peri.medien.ifi.lmu.de:8080/axis/domain/cinema/cinema.owl#MovieTitle</abstractType>
  <value>XMen 3</value>
  <label>XMen 3</label>
  <desc>The X-Men make a last stand in the war between humans and mutants.</desc>
</tag>

Matching Abstract Parameter Types
Use Cases for Mobile Ticketing

**PERCI Movie Tickets**

Please follow the steps below in order to use this poster. To select an action or an option, take a picture of its visual marker, type its number identifier or touch its NFC-Symbol with your NFC-enabled mobile phone.

1. Open the PERCI client on your mobile phone.
2. On the poster, select the action or option you want to accomplish.
3. Follow the instructions on your mobile phone.
4. Select the options on the poster that are appropriate for your action.

**PERCI Transportation Tickets**

Please follow the steps below in order to use this poster. To select an action or an option, take a picture of its visual marker, type its number identifier or touch its NFC-Symbol with your NFC-enabled mobile phone.

1. Open the PERCI client on your mobile phone.
2. On the poster, select the action or option you want to accomplish.
3. Follow the instructions on your mobile phone.
4. Select the options on the poster that are appropriate for your action.

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

Select the Number of Passengers
- 1
- 2-5
- Child
- Bicycle

Define Origin and Destination of your Journey by selecting the Areas, in which the appropriate Stations are located.

Select the Type of your Ticket
- Single Ticket
- Day Ticket
- Partner Ticket
- School Ticket
- Exhibition Ticket
- User Card Ticket
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

- **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)
10 participants, aged from 23 to 46 (average 30.7), 8 participants with technical background

Process
- User-Experiment: Accomplish to buy cinema tickets for given properties. Use all interaction techniques (Touching, Pointing, Direct Input).
- Post-Survey: Quantitative rating of interaction techniques

Results:
- Good acceptance of the prototype in general, but strongly depending on the used interaction technique
- Initial problems with the workflow of the interaction
- Uncertainty about interaction order on the poster
- Many participants wanted to use the interface directly for inputs although having been advised to use Touching or Pointing
Conclusion and Future Work

- Generic framework for the combination of Physical Mobile Interactions and Semantic Web Services
  - Automatic user interface generation from service descriptions and annotations
  - Support for the complete Physical Mobile Interaction workflow
  - UI adaptation to J2ME runtime and XHTML browser
- J2ME client prototype supporting the interaction techniques Touching, Pointing and Direct Input
- Making Physical Mobile Interaction more usable and intuitive
- Extending the different service models
- Evolving Ubiquitous Interfaces
- Authoring support for creating physical mobile service applications
Questions?

Thank You!

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www.hcilab.org/projects/perci