Towards Effects-Based Service Description And Integration In Pervasive Environments

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1-Introduction
2-Semantic Services in Pervasive Environments
3-Effects in Pervasive Computing
4-Ontological Model for Service Representation
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6-Conclusions and Future Work
7-Questions, comments and suggestions
We are surrounded by many devices (PC, PDA, embedded devices, etc.) We have the necessary infrastructure to achieve Weiser's vision.

but ...

The reality is that we are a long way from the vision.

why?

The majority of the devices are isolated. The features they offer are described in a very simple manner. Functionalities offered by services cannot be adequately consumed. Services are not integrated with the environment (context-aware). Necessary full integration between services and context.

Semantic service representation languages

Effect- and condition-based approach

Ontology based context models
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Service Oriented Architectures (SOA) paradigm meets perfectly the requirements of a pervasive computing environment due to the provided network services and applications are abstracted and loosely-coupled services that can be integrated in bigger systems.
A Web Service is an interface that describes a collection of operations that are accessible over the network by using XML standard messages. A Web Service carries out a specific task or group of tasks. This standard XML, namely WSDL, provides required details to interact with services.
Integrating ontologies in the service domain to Web Services leads to Semantic Web Services (SWS). These allow describing both functional and non-functional service attributes in a more expressive way than today’s, enabling less human intervention (enabling automation).
**Context-awareness**

**Context:** group of characteristics and ambient states that determines application behavior

**Context-awareness:** Coined by Schilit and Theimer in 1994 to describe applications that adapt as a function of: the location of users and objects in the environment as well as their changes over time.

Semantic Services in Pervasive Environments
Our Vision

- Service Oriented Architecture
- Semantic Web Services
- Context-awareness

Pervasive Services

Semantic Services in Pervasive Environments
I want to increase the illuminance of this room

Which services do I have to invoke for that?

Lamp switchON()

User think in effects!!!

Effects in Pervasive Computing
User Interaction

Relation between: User-Service-Context

User   Invokes   Service  Changes  Context

isPerceivedBy

User think in effects, but…. is the same for services and context

What is done currently to represent effects in this relation?

Effects in Pervasive Computing
In order to consume services it is essential to know their descriptions. Service description types can be divided in two aspects (IOPEs):

- **Signature-based description**
  - Information transformation
  - Inputs and Outputs
    - “how to invoke it”
  - Syntactic (UPnP, WS, etc.)
  - Semantic (SWS)

- **Specification-based description**
  - World state change
  - Effects and Preconditions
    - “environmental changes”
  - User Oriented and Context-Aware
  - Service Discovery and Integration
All these languages support effects and preconditions but **they neither detail how to do it nor do they provide an ontological model for their representation**.

**Effect- and condition-based approach**

- **Semantic service representation languages**
  - OWL-S
  - WSMO
  - SWO
  - WSDL-S
  - SAWSDL
  - AmIGOS

- **Ontology based context models**

**Context modelling ontologies**

- SOUPA-CoBrA
- CONON
- CoDaMos
- CoOL
- GAIA
- Task-Computing

- **No support for effects and preconditions**
- **Support but not used, only IOs**
- **Used, but very simple manner**

**No ontological model for services and context integration**
Outline

1-Introduction

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4-Ontological Model for Service Representation

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Proposed Model

Ontological Model for Service Representation
Entity and Attribute Model

Ontological Model for Service Representation
Service Model

Ontological Model for Service Representation
Ontological Model for Service Representation
Effect Model

Ontological Model for Service Representation
Operation Model

Ontological Model for Service Representation
Ontological Model for Service Representation

Scenario representation

Condition Model
- Precondition
  - DayLuminance = Sunny
- Precondition2
  - DayLuminance = Dark

Effect Model
- Effect1
  - hasEffect
  - hasEffect

Effect Model
- Effect2
  - hasEffect
  - hasEffect

Effect Model
- Effect3
  - hasEffect
  - hasEffect

Effect Model
- Effect4
  - hasEffect
  - hasEffect

Effect Model
- Effect5
  - hasEffect
  - hasEffect

Effect Model
- Effect6
  - hasEffect
  - hasEffect

Operation Model
- Operation1
  - BlindHeight = BlindHeight + 46 cm.

Operation Model
- Operation2
  - RoomLuminance = RoomLuminance + 30 lx.

Operation Model
- Operation3
  - RoomLuminance = RoomLuminance + 20 lx.

Operation Model
- Operation4
  - PowerConsumption = PowerConsumption + 20 W

Operation Model
- Operation5
  - LampState = ON

Entity Model
- Lamp
  - hasAttribute

Entity Model
- Room
  - hasAttribute

Entity Model
- Blind
  - hasAttribute

Attribute Model
- RoomLuminance
- BlindHeight
- LampState
- PowerConsumption
# Service Discovery

<table>
<thead>
<tr>
<th></th>
<th>Blind</th>
<th>Lamp</th>
<th>Knowledge of what services can do</th>
<th>Reasoning about service effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Signature-based syntactic service descriptions (WSDL)</strong></td>
<td>Describe how to invoke the Blind Service</td>
<td>Describe how to invoke the Lamp Service</td>
<td>user</td>
<td>user</td>
</tr>
<tr>
<td><strong>Signature-based semantic service descriptions (OWL-S)</strong></td>
<td>Describe how to invoke the Blind Service with annotated semantic concepts</td>
<td>Describe how to invoke the Lamp Service with annotated semantic concepts</td>
<td>machine</td>
<td>user</td>
</tr>
<tr>
<td><strong>Specification-based semantic service descriptions</strong></td>
<td>Describe contextual changes: Raise the blind Increases illuminance</td>
<td>Describe contextual changes: Increases electric consumption Increases illuminance Changes lamp state</td>
<td>machine</td>
<td>machine</td>
</tr>
</tbody>
</table>
Conclusions and Future Work

1. Extend current model with effect uncertainty and temporal information
2. Integrate our model with existing domain ontologies
3. Service Matchmaking mechanism
4. Service Integration mechanism
5. Integrate the model in a real scenario (DomoLab at Ikerlan)
Questions, comments and suggestions

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