ABSTRACT

Pervasive environments are characterized by a large number of embedded devices offering their services to the user. Which of the available services are of most interest to the user considerably depends on the user’s current context. Spontaneous service discovery and selection is one of the most important fields of research in pervasive computing. In this paper the authors will present an enhancement of ubiquitous computing discovery mechanisms adding context handling capabilities to Web Services for Devices in Pervasive Computing using UPnP as an infrastructure to address these implicit requests. User preferences, network and location are described by a formal context model ontology that is based on two levels: a generic level and a domain specific level. As compared with previous research, the authors’ method uses location aware, UPnP infrastructure, web service for devices and the notion of proactivity in pervasive computing to continuously present the Spontaneous most relevant services to the user or device in response to changes of context, services or user preferences.

Keywords: Context Awareness, Ontology, OWL, Pervasive Computing, SOA, Spontaneous Service, SWRL, UPnP, Web Services for Devices

1. INTRODUCTION

The ubiquitous computing Mark Weiser (Weiser, 1991) main objective is to incorporate technology into the user’s environment by making it so easy to use that it would become invisible to users. They will be able to focus on their goals instead of thinking on the tools the environment offers. This ubiquitous computing world, as dreamt by Mark Weiser, is now becoming a reality with the increasing on the amount of devices and information available everywhere. People is more and more habituated to receive information according to their location and preferences (Garlan, Siewiorek, Smailagic, & Steenkiste, 2002). Service-Oriented Architecture (SOA) has been widely applied for integrating devices, sensors, actuators and software applications (Web Services for Devices Initiative, n.d.; Timmermann & Golatowski, 2011). State of the art service discovery approaches in pervasive environments...
use techniques from the traditional SOA field, where explicit user requests are the driving factors of service discovery.

In pervasive environments, user context and user preferences become essential aspects when deciding, which of the available services are of most interest to the user in a given situation.

The user context is rich and ever-changing; it covers aspects such as user location, current time and environmental information. These continuously changing aspects pose a significant challenge to state of the art discovery mechanisms (Zhu, Mutka, & Ni, 2005). We argue that most service discovery requests in pervasive environments are implicit. The system should discover and select services in response to changes in the user context (Rasch K. et al. 2011), even if the user did not issue an explicit service discovery request to the system.

Web Services for Devices (Web Services for Devices Initiative, n.d.) specially aim at permitting interoperability, since they do not rely on any specific programming language or hardware architecture (Ferry, Hourdin, Lavriotte, Rey, Riveill, & Tigli, n.d.). Service for Devices also suffers constraints related to devices’ resource dependencies: frequent disconnections, memory limitation, narrow network bandwidth, limited power, processing capacities, etc. Therefore, the description of Service for Device must include these limitations to inform of specific constraints associated to the provided service.

To go further, more specific works on the description of ontological devices and services such as are thus necessary to give a complete Service for Device description. We use SWRL (Semantic Web Rule Language); it can express Horn-Logic Rules, which the OWL cannot express because it is based on DL (Description-Logic). So, we can offer inference service to users, with a wide range of expressions.

Devices being most often connected to the real environment of applications, associated services need to offer mechanisms which take into account applications’ proactivity to environmental variations. Web services for devices thus define communication protocols using events (subscription, notification) in an asynchronous execution context and include concepts of services and event frameworks, as well as decentralized and dynamic discovery.

Besides, the location concept is largely used to determine the availability of services for devices (Strobbe, Van Laere, Dhoedt, De Turck, & Demeester, 2012). In software usage, location is implicitly linked to user’s proximity inside his environment (Niforatosa, Karapanos, & Siouta, 2012). Centralized service directories are difficult to keep up to date, because applications undergo frequent disconnections of devices, which leads to communication overheads while keeping coherence between pieces of information stored in a directory. Adopted solutions in WSFD hold on local and distributed discovery mechanisms between service producers and service consumers. It is the case for UPnP (UPnPForum, 2003) and DPWS (Driscoll & Mensch, 2009), with respectively SSDP protocol and WS-Discovery protocol.

In order to explore such a complementary views, we propose a platform that implements the feature of Spontaneous service discovery using Web Service for Devices in Pervasive Computing and utilize UPnP as an infrastructure. The consumer does not need to specify a desired kind of service to be discovered, but it is the service that is offer to users or devices in the background.

The rest of this paper is organized as follows. Section 2, evolved standard SOA to SOA for device (SOAD). Section 3 introduces the notion of proactivity in pervasive environment. Section 4 reviews existing research on proactive services, ubiquitous computing, and context-aware computing. Section 5, introduce our vision: Proactive Approach for Service Discovery Using Web Service for Devices on Pervasive Computing. Section 6 presents a case study of our Prototype. Section 7 Conclusion and future work are presented in the last section.
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