Chapter 2.1
Ubiquitous and Pervasive Application Design

M. Bakhouya
The George Washington University, Washington DC, USA

J. Gaber
Université de Technologie de Belfort-Montbéliard, France

INTRODUCTION

The recent evolution of network connectivity from wired connection to wireless to mobile access together with their crossing has engendered their widespread use with new network-computing challenges. More precisely, network infrastructures are not only continuously growing, but their usage is also changing and they are now considered to be the foundation of other new technologies. A related research area concerns ubiquitous and pervasive computing systems and their applications. The design and development of ubiquitous and pervasive applications require new operational models that will permit an efficient use of resources and services, and a reduction of the need for the administration effort typical in client-server networks (Gaber, 2000, 2006). More precisely, in ubiquitous and pervasive computing, to be able to develop and implement applications, new ways and techniques for resource and service discovery and composition need to be developed.

Service discovery is the process of locating which services are available to take part in a service composition. The service composition process so far concentrates on combining different available existing services as a result of the service discovery process. Most research to date in service discovery and composition is based on the traditional client/server interaction paradigm (CSP). This paradigm is impracticable in ubiquitous and pervasive environments and does not meet their related needs and requirements. Gaber (2000, 2006) has proposed two alternative paradigms to the traditional client/server interaction paradigm to design and implement ubiquitous and pervasive computing applications: the adaptive services/client paradigm (SCP) and the spontaneous service emergence paradigm (SEP).

Bio-inspired approaches are adequate to carry out these new paradigms for designing and implementing ubiquitous and pervasive applications (Gaber, 2000). Indeed, the adaptive servers/client paradigm, considered as the opposite of CSP, could be implemented via a self-adaptive and reactive middleware inspired by a biological system like the natural immune system. The service emergence paradigm could also be implemented by a natural system that involves self-organizing and emergence behaviors (Gaber, 2000).

Recently, agent-based approaches, with self-adapting and self-organizing capabilities, have been proposed in Bakhouya (2005) and Bakhouya and Gaber (2001, 2006a, 2006b) to implement SCP and SEP respectively. More precisely, these approaches, inspired by the human immune system, provide scalable and adaptive service discovery and composition systems for ubiquitous and pervasive environments.

UBIQUITOUS COMPUTING

In ubiquitous computing (UC), the objective is to provide users the ability to access services and resources all the time and irrespective to their locations (Weiser, 1993). Service discovery and access systems can be classified into three categories as depicted in Figure 1: structured systems, unstructured systems, and self-organized systems. Structured systems can be classified also in indexation-based architectures and hashing-based architectures. In indexation-based architectures, there are two categories: centralized and decentralized systems. In centralized indexation-based systems, typical resource discovery architectures (Bettstetter & Renner, 2000), such as Jini (2001), consist of three entities: service providers that create and publish services, a broker that maintains a repository of published services to support their discovery, and services requesters that search the service broker's repository. Centralized approaches scale poorly and have a single point of failure. To overcome the scalability problem, decentralized approaches, such as m-SLP (Zhao, Schulzrinne, & Guttman, 2000) or Secure Service Discovery Service (Xu, Nahrstedt, & Wichadakul, 2001), traditionally have a hierarchical architecture consisting of multiple repositories that synchronize periodically. In hashing-based architectures (Wang & Li, 2003), proposed primary to file-sharing, distributed hash tables (DHTs) are used to assign files to specific nodes. This technique allows the implementation of direct search algorithm to efficiently locate files. However, hashing-based architectures require overlay networks between nodes that are generally hard to maintain.

In unstructured systems, the most typical localization mechanisms are flooding and random walk. There are two main flooding techniques: the push and the pull technique. In the first technique, the server advertises periodically its services across the network. The clients receive the service advertisement and cache the information. This information must have a time period associated with it, and must be flushed out from the cache when this time period expires. Hence,

7 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/chapter/ubiquitous-pervasive-application-design/37787

Related Content

On the Use of Optimal Stopping Theory for Secret Sharing Scheme Update
Constantinos Delakouridisand Leonidas Kazatzopoulos (2013). *Intelligent Technologies and Techniques for Pervasive Computing (pp. 276-295).*
www.irma-international.org/chapter/use-optimal-stopping-theory-secret/76793

Social Media and Autonomous Learning at a Latin America University: The Social Neuroscience Role of the Developing Metacognitive Capacities
Eduardo Adrián Tolozaand Wolfram Lothar Laaser (2018). *International Journal of Advanced Pervasive and Ubiquitous Computing (pp. 38-57).*
www.irma-international.org/article/social-media-and-autonomous-learning-at-a-latin-america-university/209371

Kernel Parameter Selection for SVM Classification: Adaboost Approach
Manju Balaand R. K. Agrawal (2010). *Strategic Pervasive Computing Applications: Emerging Trends (pp. 44-55).*
www.irma-international.org/chapter/kernel-parameter-selection-svm-classification/41579

Heart Disease Prediction Model Using Varied Classifiers with Score-Level Fusion
Mohammad Haider Syed (2022). *International Journal of Security and Privacy in Pervasive Computing (pp. 1-39).*
www.irma-international.org/article/heart-disease-prediction-model-using-varied-classifiers-with-score-level-fusion/313587

Method of Measuring the Switching Time of Dual Redundant NIC
Zhengrong Taoand Zhenxing Yin (2011). *International Journal of Advanced Pervasive and Ubiquitous Computing (pp. 24-29).*
www.irma-international.org/article/method-measuring-switching-time-dual/66063