Chapter 7

SYLPH:
A Platform for Integrating Heterogeneous Wireless Sensor Networks in Ambient Intelligence Systems

Ricardo S. Alonso
University of Salamanca, Spain

Dante I. Tapia
University of Salamanca, Spain

Juan M. Corchado
University of Salamanca, Spain

ABSTRACT

The significance that Ambient Intelligence (AmI) has acquired in recent years requires the development of innovative solutions. In this sense, the development of AmI-based systems requires the creation of increasingly complex and flexible applications. The use of context-aware technologies is an essential aspect in these developments in order to perceive stimuli from the context and react upon it autonomously. This paper presents SYLPH, a novel platform that defines a method for integrating dynamic and self-adaptable heterogeneous Wireless Sensor Networks (WSN). This approach facilitates the inclusion of context-aware capabilities when developing intelligent ubiquitous systems, where functionalities can communicate in a distributed way. A WSN infrastructure has been deployed for testing and evaluating this platform. Preliminary results and conclusions are presented in this paper.

INTRODUCTION

People are becoming increasingly accustomed to living with more and more technology in the hopes of increasing their quality of life and facilitating their day-to-day living. However, there are situations where technology is difficult to handle or people lack the knowledge of how to use it. Ambient Intelligence (AmI) tries to adapt technology to people’s needs by incorporating omnipresent computing elements that communicate ubiquitously among themselves (Aarts & Encarnação, 2006; Lytinen & Yoo, 2002). In
addition, the continuous advancement in mobile computing makes it possible to obtain information about the context and to react physically to it in more innovative ways (Jayaputera et al., 2007). Therefore, it is necessary to develop new solutions capable of providing adaptable and compatible frameworks, allowing access to functionalities regardless of time and location restrictions. Ambient Intelligence proposes three essential concepts: ubiquitous computing, ubiquitous communication and intelligent user interfaces (Aarts & Encarnação, 2006). One key aspect in any AmI-based system is the use of context-aware technologies. The context is defined as any information used to characterize the situation of an entity, which can be a person, a place or an object (Dey et al., 2001). Thus, the context includes both the users and the environmental information. This information is important for defining the interaction between users and the technology that surrounds them. The information may consist of many different parameters such as location, the building status (e.g., temperature), vital signs (e.g., heart rhythm), etc. Thus, most of the context information can be collected by distributed sensors throughout the environment and even by the users themselves.

Sensor networks are used for gathering the information needed by intelligent environments, whether in home automation, industrial applications, etc. (Sarangapani, 2007). Sensor networks need to be fast and easy to install and maintain. It is possible to distinguish between two types of sensor networks: wired and wireless. Wireless Sensor Networks (WSN) are more flexible and require less infrastructural support than wired sensor networks. Although there are plenty of technologies for implementing WSNs (e.g., ZigBee, Wi-Fi or Bluetooth), it is not easy to integrate devices from different technologies into a single network (Marin-Perianu et al., 2007; Cho et al., 2007). The lack of a common architecture may lead to additional costs due to the necessity of deploying non-transparent interconnection elements among different networks (Mukherjee et al., 2006). Moreover, the developed elements are dependent on the application to which they belong, thus complicating their reutilization.

This paper describes the Services Layers over Light PHysical devices (SYLPH) platform. This platform is aimed at facilitating the development of AmI-based systems with context-aware capabilities by using dynamic and self-adaptable heterogeneous WSNs. These systems must be dynamic, flexible, robust, adaptable to changes in context, scalable and easy to use and maintain. Although there is currently a wide range of WSN technologies, most of them are not compatible with each other. SYLPH solves this problem by implementing a middleware that consists of additional layers added over the application layer of each WSN’s stack. SYLPH implements an approach based on Service-Oriented Architectures (SOA) (Cerami, 2002). The platform provides a flexible distribution of resources and facilitates the inclusion of new functionalities in highly dynamic environments. Unlike other SOA-WSNs approaches (Marin-Perianu et al., 2007; Malatras et al., 2008), SYLPH allows both services and services directories to be embedded in devices with limited computational resources, regardless of the radio technology they use.

The next section presents the specific problem description that essentially motivated the development of a new platform. Then, it is described the main characteristics of SYLPH and briefly explained some of its components. After that, it is presented the implementation of SYLPH in a real scenario. Finally, it is presented the results and conclusions obtained.

**MOTIVATION AND RELATED APPROACHES**

One of the key aspects for the construction of AmI-based systems is obtaining information about the people and their environment through sensor networks. We have developed several systems...
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