Chapter 2.13
Model-Driven Development for Pervasive Information Systems

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ABSTRACT

This chapter focuses on design methodologies for pervasive information systems (PIS). It aims to contribute to the efficiency and effectiveness of software development of ubiquitous services/applications supported on pervasive information systems. Pervasive information systems are comprised of conveniently orchestrated embedded or mobile computing devices that offer innovative ways to support existing and new business models. Those systems are characterized as having a potentially large number of interactive heterogeneous embedded/mobile computing devices that collect, process, and communicate information. Also, they are the target of technological innovations. Therefore, changes in requirements or in technology require frequent modifications of software at device and system levels. Software design and evolution for those require suitable approaches that consider such demands and characteristics of pervasive information systems. Model-driven development approaches (which essentially centre the focus of development on models, and involve concepts such as Platform-Independent Models, Platform-Specific Models, model transformations, and use of established standards) currently in research at academic and industrial arenas in the design of large systems, offer potential benefits that can be applied to the design and evolution of these pervasive information systems. In this chapter, we raise issues and propose strategies related to the software development of PIS using a model-driven development perspective.

INTRODUCTION

Through the years, organizational, technological, and social evolutions brought a shift from a usually

monolithic organization's information systems, with well-defined and limited source inputs, into complex, distributed, and technologically heterogeneous information systems. Nowadays, a digital world emerges with prevalence over the real world; everything has or produces information in an increasingly real-time fashion. This world acquires computational and communication capabilities and is ever more ruled with digital information and processes, and produces more and faster information about everything and everyone. The future points to a world full of embedded or mobile computing devices, with an emerging robotics industry which is "developing in much the same way that the computer business did 30 years ago" (Gates, 2007). This reality and inherent potential has been the subject of study and research in the ubiquitous computing field (the term "pervasive computing" is commonly used with the same meaning).

The emerging innovative technological devices and its widespread availability called for organizations' attention for its potential on collecting, processing, and disseminating information. Organizations see this as an opportunity to improve their business's processes and, therefore, to better compete and respond to market pressures and challenges. Consequently, there is an increasing demand for software development to realize intended applications for these pervasive information systems, taking advantage of those technologies.

This chapter aims to show how model-driven development approaches can be used for software development of pervasive information systems in order to attain full benefits of these systems. It starts by presenting ubiquitous computing and pervasive information systems. Then it introduces MDD fundamental concepts, primary issues and thrusts on MDD research, and current practice on developing systems. It generically presents a project on ubiquitous field and the approach to development, and points out some issues and challenges that arise in the development of software for pervasive information systems. It concludes by presenting guidelines and suggestions to approach MDD development of pervasive information systems.

UBIQUITOUS COMPUTING

Ubiquitous computing is a research field of computing technology that started at the '90s with Mark Weiser's seminal work entitled "The Computer for the 21st Century" (M. Weiser, 1991). In this work, he shared his vision of a new way of thinking about computers.

Ubiquitous computing represents a new direction on the thinking about the integration and use of computers in people's lives. It aims to achieve a new computing paradigm, one in which there is a high degree of pervasiveness and widespread availability of computers or other IT devices in the physical environment. Consequently, the physical world is enriched with the advantages of processing power, storage, and communications capabilities of computers.

This new computing paradigm is not simply restricted to enhancing the physical world with embedded computing devices, sensors, actuators or other elements to provide communications among these. It is also concerned with the way computing is made available for interaction with users in support of their activities. Ubiquitous computing proposes a philosophy that values the nuances of the real world and embodies the assumption that computers should fade into the physical environment in an "virtual or effective" invisible way to people (M. Weiser, 1993a). As stated by Weiser, "Ubiquitous computing takes place primarily in the background. (…) leaves you feeling as though you did by yourself" (M. Weiser, 1993a), ubiquitous computing is gracefully and seamlessly integrated in the environment in a way that people do not notice that it is there. In