ABSTRACT

Ubiquity in Information Systems (ISs) is a new requirement widely expressed by customers and users due to emerging and evolving communication and mobile technologies. Each IS should support a set of mobile applications used either to interact smartly with the changing environment, to provide adaptive services to customers or both. Designing ISs with highly technological risks requires a precise and appropriate development process. However, such processes fail to consider ubiquitous requirements throughout the development process. This paper tries to solve this issue by proposing a process for identifying and modeling ubiquitous requirements that can be integrated into an existing IS engineering process. This process, called E-CARe, focuses on adapting to the surrounding context; this requires detailed specification and analysis work by a context designer. E-CARe uses an event-driven logic, as dynamicity and reactivity are the major properties required from ubiquitous applications. A Model-Driven Engineering (MDE) approach is used to automate specification work. In order to test the process, a case study from the intelligent transport domain is applied as an illustration.

Keywords: Context-Awareness, Context-Reactivity, Engineering Process, Event Flow, Ubiquitous Requirement

1. INTRODUCTION

The concept of ubiquity or pervasiveness provides attractive prospects and innovative applications for system computing. Today, several disciplines are exploiting ubiquity integration in their products. However, novel characteristics are linked to ubiquity and constitute challenges to be overcome by research. These characteristics are summarized in the following points: context-awareness, mobility and its consequences (portability, dynamicity, reactivity), distribution and its consequences (heterogeneity, connectivity, scalability) and

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security. The development of a ubiquitous IS should support the ubiquitous properties required by the user and other properties added by system developers. These properties are called ubiquitous requirements and they include adaptation and context-awareness, associated with system functions.

Adapting to context is the focus of every ubiquitous application, and it is often the case when the context consists of highly dynamic information. This temporal dimension of context is controlled by events occurring either internally or externally with regard to the system. Reporting events is an essential step for mobile applications to be aware of their context. Event-based systems are called “sense-and-respond” systems (Schiefer et al., 2007). They are able to interact efficiently and in real time to changes occurring in their environment. Haeckel carried out a study on companies that were successful in the past and continue to be (Haeckel, 1999). According to him, companies that continue to be successful today are flexible organizations that adapt rapidly to changing situations. These companies therefore use sense-and-respond systems. Consequently, it is crucial for an enterprise to have an event-based IS to support dynamicity and reactivity (rapid response to occurring events). This constitutes a challenge to be addressed by ubiquitous IS development processes that should be different from conventional engineering processes. It is clear that most ubiquitous applications today suffer from a lack of usability. This can be explained by a general dissatisfaction expressed by users who find services mundane with no smart exploitation of personal data. This is partly explained by a lack of ubiquitous IS development processes.

This paper presents a process for the development of ubiquitous information systems called E-CARe (Engineering Context-Aware and Reactive systems). It should be noted that this particular run-through of our methodology corresponds to a development cycle with high technological risks. Our process is particularly suitable for this type of project, for which it is advisable to document the development iterations accurately, especially if the development team is not familiar with the business context and/or the technologies.

The E-CARe process (Ben Cheikh et al., 2012) separates functional, ubiquitous and technical specifications. It then merges these specifications for system design. In this process, context-awareness refers to adaptation to context. Adaptation concerns four main levels. The first level concerns business adaptation, where system processes should adapt to certain conditions. It may affect process activities, roles or interactions. The second level is presentation adaptation, where interfaces should adapt to the context including the platform used. The third level concerns information adaptation, where requested information is adapted to the context either by content adaptation or information filtering. The final level is communication adaptation, where access to the different components of the system depends on certain access adaptation rules with context conditions. The adaptation specification work and the design of ubiquitous models are carried out by a context designer. This new role is created to satisfy a special need for expertise in context specification and modeling work.

E-CARe is based on a set of generic metamodels used to specify ubiquitous models. Metamodel genericity guarantees process adaptability to different application domains and interoperability between the systems produced. The E-CARe process extends an existing engineering process called Symphony. Symphony is a method for engineering IS that is equivalent to the 2 Tracks Unified Process (2TUP) (Rocques & Vallée, 2002), but it uses component-based technologies since earlier life-cycle phases (Hassine et al., 2002). Symphony was developed after collaboration between our research team SIGMA and the UMANIS society (Umanis). Symphony presents some advantages presented in (Godet-Bar et al., 2010). The E-CARe process reuses the functional and technical aspects of Symphony to derive functional and technical specifications and then merges them with ubiquitous models. Model Driven
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