Chapter XLII
Enhancing User Experience with Context-Dependent Tasks in Smart Home

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ABSTRACT

The vision of pervasive computing is floating into the domain of the household and aims to assist inhabitants (users) to live more conveniently and harmoniously. Due to the dynamic and heterogeneous nature of pervasive computing environments, it is difficult for an average user to obtain right service and information in the right place at the right time. This chapter proposes a context-dependent task approach to address the challenge. The most important component is its task model, which provides an adequate high-level description of user-oriented tasks and their related contexts. Leveraging the model, multiple entities can easily exchange, share, and reuse their knowledge. The conversion of OWL task ontology specifications to the First-Order Logic (FOL) representations is presented. The performance of FOL rule-based deducing in terms of task number, context size, and time is evaluated. Finally, we present a task supporting system (TSS) to aid an inhabitant's tasks in light of his or her lifestyle and environment conditions in smart home.

INTRODUCTION

Beginning with Weiser's (1993) vision of ubiquitous computing, much progress has been achieved in resource discovery mechanisms, programming environments, middleware, and user interfaces that simplify the creation of user-centered applications that adapt to the various resources available in various computing environments. However, despite these advances, little research has addressed how a pervasive computing application should use all the sensors, actuators, and other computing devices available in order to actually help a user carry out a task without disturbance and notice. Consequently, many pervasive computing applications operate in a myopic mode and lack the ability to proactively assist the user in his or her task, inform the user when he or she is unfamiliar with the task, and gracefully fail-over (and explain the rationale for this behavior) when resources become unavailable.

From our point of view, there are two critical challenges in building pervasive computing systems. One is how to stay user-focused by understanding a user's goal, and the other is how to achieve these goals and activities adaptively with the available services and resources. Obviously, pervasive computing systems should shift paradigm from technology-oriented to user-centered; that is, they should recognize a user's intentions and then autonomously fill in any details that the user left out and assist the user in a particular set of tasks. Recently, the task computing (TC) paradigm has gained increasing acceptance as the choice computing model for pervasive computing environments (Masuoka et al., 2003; Wang & Garlan, 2000). The key idea behind TC is that the system should take over many low-level management activities so that users can interact in a pervasive computing environment in terms of high-level, user-centric tasks that they wish to accomplish (i.e., WHAT) rather than the actual mechanisms to perform those tasks (i.e., HOW). Another attraction of TC is its ability to manage the tasks in runtime by having the capability to suspend from one environment and resume the same task later in another environment. This is made possible by the way a task is often specified independent of both the actual underlying services and resources and the surrounding environment itself. The underlying TC software infrastructure achieves this by providing the necessary support to maintain and manage task-associated context information in the form of task states (e.g., user preferences) from one environment to another. Despite its promises, however, there exists a number of challenges in TC that are still to be addressed fully; that is, how to model the tasks and context information and how a task can be associated with the underlying service (see Related Work).

Smart home has always been considered as an important part of pervasive computing. The home system will effectively integrate communication and computing networks among the previously separated equipments in homes and incorporate core tenets of pervasive computing. If the home system intends to dynamically adapt its behaviors according to the user's activities and environments, awareness of the user's activities and environment is required.

Given the need for smart home applications to be smarter in assisting their users, we propose a context-dependent task model established in the fact that man is a creature of habit, and he will perform a certain activity at a particular situation as a routine. The context-dependent task modeling approach uses the abstraction of tasks in order to separate logical relations of relevant items from the services realizing and fulfilling the intended goals. This approach is able to support human requirements and preferences better for the following reasons:

1. Task definition models human preferences and requirements better than service-orientation models adopted in earlier works;
2. Separation of tasks and services would allow for greater flexibility of changing the