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Ambient Middleware for Context-Awareness (AMiCA)

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ABSTRACT

Recent advances in wireless networking technologies and the growing success of mobile computing devices are enabling new classes of applications. Distributed applications running in a mobile environment are often subject to varying qualities of service from the underlying infrastructure. The objective of the work outlined in this research is the development of an Ambient Middleware framework for Context-awareness which will offer new opportunities for application developers. Context-awareness has been a central issue in Ambient Intelligent research for the last decade. Ambient Intelligent systems and applications represent extremely complex and heterogeneous distributed systems, composed of hardware and software, and the need for middleware for seamless integration is well recognised. Research shows that existing middleware solutions need to evolve, thus permitting the dissemination of omnipresent attributes within the Ubiquitous and Pervasive computing environments of today. To determine the effectiveness of this middleware framework, a cloud computing based application will be developed.
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Keywords: Ambient Intelligence; Bayesian Networks; Context-Awareness; Middleware; Semantic Web Technology; Swarm Intelligence; Ubiquitous Computing

INTRODUCTION

Recent advances in wireless networking technologies and the growing success of mobile computing devices are enabling new classes of applications which present challenging problems for designers. Devices face temporary

and unannounced loss of network connectivity when they move from one cell to another and are frequently required to react to changes in the environment, such as a change in context or a new location. The concept of context and context-awareness has been central issues in Ambient Intelligent research for the last decade (Oh et al., 2007).

Context-awareness has emerged as an important idea for achieving automatic behaviours' in pervasive and predictive systems. For example, a system that senses a user's condition, location or physical actions and adapts to maximise user convenience is utilising context awareness. Initial research began by looking at context-aware systems more generally and independently of specific applications, including context middleware and toolkits from Dey et al., (1999). Building upon this work, ontology's describing context for building different context-aware applications were researched by Chen et al., (2004). The need for middleware to seamlessly bind the required hardware and software components together is well recognised; middleware improves maintainability and also promotes reuse (Henricksen et al., 2005). Middleware for ubiquitous and context-aware computing entails several challenges, including the need for balance between heterogeneity, transparency and awareness, while maintaining the requirement for a certain degree of autonomy (Soldatos, 2007). Mobile devices need to be aware and adapt themselves to highly dynamic environments therefore adding momentum to research into context and location aware middleware.

The focus of our research is to design a context-aware Ambient Intelligent middleware framework. To test and evaluate the context-aware functionality, a social networking or other appropriate applications will be developed. This proposed design will incorporate supporting intelligence to facilitate reasoning relating to the target applications. The objectives of the work are to design a context-aware Ambient Intelligent middleware framework and investigate the application of intelligent algorithms to reason over contextual data.

From observing the general research objectives outlined above, further research into several key areas related to context awareness will need to be first addressed. These are:

- Defining and representing context, e.g. semantic web technologies
- Context sensitive networks, e.g. real time association of context
- Spontaneous processing to determine context communication between multiple contexts, e.g. two-way context

This article provides an outline of preliminary work into an ambient intelligent framework which integrates context awareness and is built on a cloud computing platform.