

Chapter 21

Proactive Context-Aware Middleware

Karen Lee

University of Ulster, Northern Ireland

Tom Lunney

University of Ulster, Northern Ireland

Kevin Curran

University of Ulster, Northern Ireland

Jose Santos

University of Ulster, Northern Ireland

ABSTRACT

Advancements in sensor technology, wireless communications and information technology has enabled the success of new types of dynamic computing systems. However designing systems which are flexible and can adapt to the changing needs of the user remains a major research challenge. Flexibility and adaptability are fundamental requirements for Ambient Intelligent (AmI) systems. The complexity involved in designing applications and devices which change and adapt their behaviour automatically based on their context or situation is well recognised. Providing technology which meets the changing needs of the user is heavily reliant on the appropriate infrastructure design. This work outlines the development of an Ambient Middleware framework for Context-Aware systems. The framework will integrate with sensor technologies, intelligent algorithms and the semantic web.

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-

DOI: 10.4018/978-1-60960-549-0.ch021

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.

AMBIENT INTELLIGENCE AND CONTEXT

The following sections provide a background to the research by reviewing literature relevant to the focus of our research.

Ambient Intelligence

Ambient Intelligence (AmI) refers to a vision of the future information society where intelligent interfaces enable people and devices to interact with each other and the environment. The technology operates in the background while computing capabilities are everywhere connected and always available (Weiser 1991). This intelligent environ-

ment is aware of the specific characteristics of human presence and preferences and can adapt context parameters such as location, proximity, light, temperature and contextual information in accordance with people's wishes and needs. The report published by IST Advisory Group states that Ambient Intelligence is all about 'human-centred computing', user friendliness, user empowerment and the support of human interaction (ISTAG, 2001; Ducatel et al, 2001). Key technological requirements identified for AmI with the year 2010 in the horizon are:

- very unobtrusive hardware
- a seamless mobile/fixed communication infrastructure
- dynamic and massively distributed device networks
- natural feeling human interfaces
- dependability and security

Ambient Intelligence offers many new possibilities in providing convenience for the user and acting as an invisible interface for driving the behaviour of the device or system.

Pervasive Computing

The traditional notion of pervasive computing is a digitally-enhanced habitat where physical and digital devices are seamlessly integrated (Al-Muhtadi et al., 2004). In his seminal paper Weiser (1991) envisaged the concept of pervasive or ubiquitous computing, describing an invisible, embedded technology to serve users in a seamless and unconscious interaction. Pervasive technology can be location and context aware and therefore conscious of the presence of other devices and available resources. The term pervasive also encompasses many mobile technologies which, largely driven by Moore's law lead to the development of dynamic and diminutive devices. Another example is the European success of the Global System for Mobile communications, (GSM). Per-

7 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

www.igi-global.com/chapter/proactive-context-aware-middleware/53341

Related Content

Convergence, Consistence, and Stability Analysis of One-Step Methods for First-Order Intuitionistic Fuzzy Differential Equations

Bouchra Ben Amma, Said Melliani and Lalla Saadia Chadli (2022). *International Journal of Fuzzy System Applications* (pp. 1-23).

www.irma-international.org/article/convergence-consistence-and-stability-analysis-of-one-step-methods-for-first-order-intuitionistic-fuzzy-differential-equations/302123

Innovation and ICT: Key Factors of Successful Business

Ivana S. Domazet, Darko Marjanovi, Deniz Ahmetagi and Jadranka Stanti (2023). *Innovation, Strategy, and Transformation Frameworks for the Modern Enterprise* (pp. 327-345).

www.irma-international.org/chapter/innovation-and-ict/332316

Cloud Service Provider Selection Using Fuzzy Data Envelopment Analysis Based on SMI Attributes

Thasni Thaha, Kalaiarasan C. and Venkatesh K. A. (2022). *International Journal of Fuzzy System Applications* (pp. 1-24).

www.irma-international.org/article/cloud-service-provider-selection-using-fuzzy-data-envelopment-analysis-based-on-smi-attributes/312239

Application of Fuzzy C-Means Clustering and Semantic Ontology in Web Query Session Mining for Intelligent Information Retrieval

Suruchi Chawla (2021). *International Journal of Fuzzy System Applications* (pp. 1-19).

www.irma-international.org/article/application-of-fuzzy-c-means-clustering-and-semantic-ontology-in-web-query-session-mining-for-intelligent-information-retrieval/274883

BTSAMA: A Personalized Music Recommendation Method Combining TextCNN and Attention

Shaomin Lv and Li Pan (2023). *International Journal of Ambient Computing and Intelligence* (pp. 1-23).

www.irma-international.org/article/btsama/327351