

Theme issue on context-aware middleware and applications

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Context-aware computing is a central theme of ubiquitous computing. In order to facilitate the development and proliferation of context-aware applications in ubiquitous environment, a context-aware middleware is indispensable. Although many middleware systems have been presented in recent years, context-aware applications are still not very widely deployed in our real-life settings. Several key issues are not properly addressed, such as low cost (light-weight), QoS, spontaneous access, prototype verification and testing, balancing autonomy and user control, safety and privacy, scalability, etc. Context-aware middleware and applications require further scientific research for extending the current capabilities to be more effective and applicable in the real world.

Submissions to this special issue come from an open call for papers as well as from selected papers presented at the 6th International Conference on Ubiquitous Intelligence

and Computing (UIC-09) held at Brisbane, Australia, 7–9 July 2009. We received a total of 22 submissions of which six papers were accepted after three rounds of rigorous reviews. A large number of reviewers assisted us in the review process. In order to ensure high reviewing standards, three to four reviewers evaluated each paper. The six selected papers just fall into the two main topics equally, three are about context-aware middleware, and the other three are about context-aware applications.

In the opening paper of this special issue, “Towards a cooperative programming framework for context-aware applications”, Bin Guo, Daqing Zhang, and Michita Imai propose an ontology-based programming framework for rapid prototyping, sharing, and personalization of context-aware applications, called OPEN. The framework provides different programming support for users with diverse technical skills. According to the programming requirements of different users, several cooperation patterns are identified, and the mechanisms to facilitate resource sharing and reuse are built into the framework. Three corresponding programming modes are elaborated by showing how a context-aware game is developed step-by-step with the support of the OPEN framework.

The second paper, “Mobility management in ubiquitous environments”, authored by Chiung-Ying Wang, Hsiao-Yun Huang, and Ren-Hung Hwang, addresses the problem of managing mobility in context-aware services. It first introduces an open framework, namely Ubiquitous Gate (U-gate) that includes a distributed context management architecture and a communication model based on standard protocols. A context-aware path planning mechanism (UbiPaPaGo), and a context-aware handoff mechanism (UbiHandoff), is proposed to achieve complete mobility management. Based on the path planning results of UbiPaPaGo, UbiHandoff derives a minimum Access Point

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(AP) handoff plan that satisfies multiple QoS requirements for individual users and services.

The third paper, “Supporting rapid design and evaluation of pervasive applications: challenges and solutions”, by Lei Tang, Zhiwen Yu, Xingshe Zhou, Hanbo Wang, and Christian Becker, presents a survey of the current research in designing and evaluating pervasive context-aware applications. It first identifies the design challenges with special concerns on the characteristics of pervasive applications during the design cycle. Afterwards, an overview of the underlying prototyping techniques and existing toolkits was well given. It also discusses various open issues (e.g., simulating pervasive environment, description of context-awareness, demonstrating application semantics, robust debugging environment, logging test data, integrating the design process, field deployment, and evaluation criteria) as possible ways to extend the capabilities of current prototyping toolkits. It is believed to be the first review of the state-of-the-art of the design and evaluation concepts, systems, techniques, trends, and challenges of pervasive context-aware applications.

In “COSAR: hybrid reasoning for context-aware activity recognition”, Daniele Riboni and Claudio Bettini report their work on human activity recognition for context-aware systems and applications. Unlike previous supervised learning approaches, COSAR combines ontological reasoning with statistical inferencing. Structured symbolic knowledge about the environment surrounding the user allows the recognition system to infer which activities among the candidates identified by statistical methods are more likely to be the actual activity that the user is performing. Ontological reasoning is also integrated with statistical methods to recognize complex activities that cannot be derived by statistical methods alone. The effectiveness of the proposed technique is supported by experiments with a complete implementation of the system using

commercially available sensors and an Android-based handheld device as the host for the main activity recognition module.

The fifth paper, “Context-aware pervasive service composition and its implementation”, written by Jiehan Zhou, Ekaterina Gilman, Juha Palola, Jukka Riekk, Mika Ylianttila, Junzhao Sun, examines the issue of service composition in ubiquitous computing. The concept of Context-Aware Pervasive Service Composition (CAPSC) is introduced, which aims to enable a pervasive system to provide user service compositions that are relevant to the situation at hand. Following the identified requirements, the CAPSC system is designed and implemented that supports context-aware peer coordination, context-aware process service adaptation, and context-aware utility service adaptation.

The last paper, “On context-aware distributed event dissemination”, by Chen Lin, Beihong Jin, Zhenyue Long, and Haibiao Chen, investigates the problem of information sharing and event dissemination in pervasive environments. It first analyses different context in Pub/Sub systems that has remarkable impacts upon user satisfaction to event dissemination. A context-aware-distributed event dissemination strategy is proposed by exploiting time context and event preference context to provide personalized event dissemination. Specifically, the system provides the extended matching against long-standing events by leveraging time context and presents the event recommendation algorithm based on hidden Markov process using event preference context.

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