Context-Aware Computing

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When you boil down the many visions of pervasive and ubiquitous computing, its main appeal lies in the potential to make our lives easier. A critical element of this utopian plan is automating the collection of context—information that can help direct a computational service's behavior. In the same way that humans use any situation's context to appropriately gauge behavior, we hope to augment virtual services to react in ways suitable to the environment in which they are invoked.

Plenty of debate goes on about what context means to those who claim to do context-aware computing. Philosophical complaints aside, most would agree context refers to information that attempts to describe something about the conditions in which an application executes. No clear boundary divides what is and is not context, but the most interesting kinds of context are those that humans do not explicitly provide. With advances in sensing and automated means of perceiving the physical environment, we can automatically collect much more implicit context. This has inspired a growing community of researchers because of the technological and social challenges.

Interest in context-aware computing is high, which provided some motivation for arranging this special issue. Despite Mark Weiser's grand visions of pervasive and ubiquitous computing (see *IEEE Pervasive Computing*'s Jan.–Mar. 2002 issue), the field remains somewhat poorly defined and diverse. Emergent themes such as context-aware computing provide focus to the research community. *IEEE Pervasive Computing* brings together various disciplines, including hardware technologies, software infrastructure, sensing and influencing the physical world, graceful integration with users, and issues of deploying real systems. Context-aware computing is relevant to all these categories.

When we originally proposed this special issue topic to the IEEE, it was targeted for the *Personal Communications* magazine. Since that original proposal, *IEEE Pervasive Computing* came into existence and *Personal Communications* was renamed *IEEE Wireless Communications*. The editorial boards decided to spread the special issue across both magazines. We received a total of 24 submissions, and 12 were accepted (seven in *IEEE Pervasive Computing* and five in the Oct. 2002 *IEEE Wireless Communications*). In *IEEE Pervasive Computing*, the following articles appear:

"Activity and Location Recognition Using Wearable Sensors," by Seon-Woo Lee and Kenji Mase, describes how you can use inexpensive wearable sensors to distinguish basic activities such as sitting, standing, and different forms of walking as well as to determine transitions between important locations. This article presents many of the reasoning methods used to gather implicit context information about an individual in an indoor environment.

"Reconfigurable Context-Sensitive Middleware for Pervasive Computing," by Stephen S. Yau, Fariaz Karim, Yu Wang, Bin Wang, and Sandeep K.S. Gupta, provides a high-level overview of an object-based middleware for pervasive computing. The targeted environment consists of several small, mobile devices that engage in short-lived communications with each another.

"A Context-Aware Decision Engine for Content Adaptation," by Wai Yip Lum and Francis C.M. Lau, deals with content adaptation for mobile devices. The authors use specific context—such as intended target device capabilities, network conditions, and user pref-

erences—in a negotiation algorithm based on decision trees.

"ConChat: A Context-Aware Chat Program," by Anand Ranganathan, Roy H. Campbell, Arathi Ravi, and Anupama Mahajan, describes an application of context to improve textual chat. ConChat communicates the context of one chat partner—such as location and mood—to another chat partner. This context also helps provide rules that automatically translate phrases that the two partners type to each other. ConChat not only is an interesting application of context, it also demonstrates the use of Gaia, the smart space software infrastructure developed at the University of Illinois at Urbana-Champaign.

"Modeling Privacy Control in Context-Aware Systems," by Xiaodong Jiang and James A. Landay, addresses the unique opportunity in context-aware infrastructure to provide technological support for some privacy concerns. Many privacy concerns stem from the unintentional flow of information between parties after a change in their environment. This article discusses a model in which explicit tagging of information can restrict information flow in moving devices and people.

"Data Management in Location-Dependent Information Services," by Dik Lun Lee, Jianliang Xu, Wang-Chien Lee, and Baihua Zheng, discusses some data management issues and solutions in location-dependent information services. The authors discuss the impact of the requirements of location-dependent information systems on traditional data management issues such as query scheduling, data indexing, data replication, and caching and identify interesting research issues.

"Integrating Virtual and Physical Context to Support Knowledge Workers," by Stephen Voida, Elizabeth D. Mynatt, Blair MacIntyre, and Gregory M. Corso, provides an application-centric view of how you can use context to support individual office workers' everyday informal activities. A combination of virtual and physical context drives the creation of activity representations on a wall-sized peripheral display, letting a user monitor each of his or her work activities.

In *IEEE Wireless Communications*, the following articles, emphasizing wireless technologies or communications applications, appear:

"Location Sensing in a Context Aware Computing Environment," by Asim Smailagic and David Kogan, provides an account of new and better methods for calculating location based on wireless LAN infrastructure. These new methods are more power- and security-aware.

"HotTown, Enabling Context-Aware and Extensible Mobile Interactive Spaces," by Theo G. Kanter, introduces an architecture for context-aware personal communication that places the point of integration for user services on the mobile devices. The author proposes the HotTown solution, in which peers negotiate services on the basis of their context, and provides two application examples.

"Intelligent Service Mediation for Supporting Advanced Location and Mobility Aware Service Provisioning in Reconfigurable Mobile Networks," by Spyridon Panagiotakis and Athanassia Alonistioti, describes the software extension of an information system for mobile phones to include support for location-dependent information services.

"Collaborative Context Determination to Support Mobile Terminal Applications," by Jani Mantyjarvi, Pertti Huuskonen, and Johan Himberg, proposes a new way to collect context in situations with many devices, such as mobile phones. Rather than relying on independent environment sensing and interpretation, this approach attempts to gather predetermined context from neighboring devices. The authors present a few examples of potential applications of such collaborative behavior along with some discussion of context recognition, context communication, and network requirements.

"Context-Aware Communication," by Bill N. Schilit, David M. Hilbert, and Jonathan Trevor, focuses on context-aware communication. Through a review of past work, the authors suggest two distinguishing dimensions: the extent of autonomy in context sensing and the extent of autonomy in communication action. ▣

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