

TOWARD THE INTEGRATED CONTEXT-AWARE LIBRARY SERVICES

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ABSTRACT

Wireless technology is already a common element on university campuses. Instead of using the library's computers, students will be able to use laptops or mobile devices to access all library-related resources including catalogue, web sites and other electronic resources. This study presents the integrated context-aware library service to help readers get the right information for them more easily. The integrated context-aware library services' levels included: (1) Traditional Library Service, (2) Campus e-Learning, (3) Libraries Consortium, (4) Libraries without walls. The novel library service should analysis the reader's location and profile, push the right information to them, such as online e-journals, and SDI services. This design based on wireless and mobile computing in educational digital libraries and the informal learning environment. In this study we seek to extend the library service by addressing the gaps in the limitation of space and time. The study presented an idea to compose information-providing services by context-aware library services and the framework of context-aware library services that provide more convenient services to the readers.

Keywords: context-aware, library service, mobile commerce, digital library

INTRODUCTION

A number of large university library provide wireless access [1][2][3][4][5] so students can roam about, laptop in hand, without ever having to plug into anything. Wireless technology is already a common element on university campuses. Mobile computing devices, such as palmtop computers, mobile phones, personal digital assistants (PDA) and digital cameras have gained widespread popularity. [6] Instead of using the library's computers, students will be able to use laptops, PDA, or other mobile devices with wireless LAN capability to access all library-related resources including catalogue, online databases, web sites and other electronic resources. Officials from the Cabinet-level Science and Technology Advisory Group outlined the coming high-tech telecommunications revolution to raise Taiwan's quality of living standards and computer network services to be at par with advanced countries such as Europe and North America by the year 2008. With the M-Taiwan project, the mobile Ubiquitous Network will be created throughout this country. People can have access through wireless LAN and roam the Internet with their mobile phone just about anywhere they go. [7] Future environments will host a vast number of mobile and wireless devices, besides to general-purpose computers. [8] As the mobile everywhere time is coming, people use Internet with Palmtop, Handheld, PDA and Notebook. In this study we seek to extend the library service by addressing the gaps in the limitation of space and time. It's the great time for library can combine those wireless technologies and provide the innovative service to people. The ability to design, develop and deploy reliable context aware services efficiently is becoming of central importance for providers of mobile services, who face increasing competition in the telecommunications market. [9] In this study we propose the new concept of library service, called the integrated context-aware library service. This service can rebuild the relationship between the library and the reader and active traces the reader's information need. Bring the information the reader needs according to the reader's profile and location and greatly improve the service quality. Nowadays, the library just offering traditional library services to a reader is not enough. Services should be aligned to a reader's information need; the reader shouldn't be harassed with selecting the right information for the research work at hand. Anymore, execution details should not be visible to the reader. The study investigates the impact of four levels of context-aware library services can provide more convenient services to the readers.

RELATIVE WORK

Making computers context-aware is an idea that attracts more and more researchers within the computer science communities to the field of context-aware computing. Researchers in the field of Artificial Intelligence are trying to formalize the notion of context and formalize reasoning using context [10][11][12][13][14][15]. Researchers in the

fields of Human Computer Interaction, Mobile Computing, and Ubiquitous Computing are building prototype context-aware systems for use in various settings [16][17][18][19][20][21][22][23][24]. Context-aware mobile services are applications and services that make use of different level of contexts and adapt the way they behave according to the current contexts. [25]

Context aware services

The context is consisting of attributes such as our physical location, our state of mind, our personal history, our present company, and an uncountable number of other features. [26] In the work that first introduces the term 'context-aware,' Schilit and Theimer [27] refer to context as location, identities of nearby people and objects, and changes to those objects. These dynamic environments need an infrastructure that proactively provides the participating entities with a rich set of capabilities and services all the time, everywhere, and in a transparent, integrated and extensible way. [28] These types of definitions that define context by example are difficult to apply. When we want to determine whether a type of information not listed in the definition is context or not, it is not clear how we can use the definition to solve the dilemma. [29] Three important aspects of context are: where a reader is, what a reader is with, and what resources are nearby. Ubiquitous environments facilitate the collection of information pieces from sensors, databases, or mobile devices in order to compose the context of entities like users, places, or things. The context obtained in this way can be used to automatically adapt the behavior of services, which results in the new paradigm of context-aware services (CASs). [30] Context-aware services possess the capability of sensing and receiving feedback from the environment, or context, in which they operate, thus offering to the user potential benefits such as greater responsiveness, flexibility, adaptability, and customizability [31].

Mobil library services

Oulu University Library and the Information Processing Laboratory and Computer Engineering Laboratory of the Department of Electrical and Information Engineering have developed the SmartLibrary service package in cooperation. There are separate, PDA-optimized versions of the OULA, LINDA and MANDA library catalogues. It is also possible to search the library databases OULA, LINDA and MANDA with a mobile phone, which supports XHTML (For example Nokia 3650, Sony Ericsson P800). [32] Other library, such as the HUT library is also provides services for mobile users [33]. The advancement of wireless networks and mobile computing necessitates more advanced applications and services to be built with context-awareness enabled and adaptability to their changing contexts. [34] Context-aware mobile services are applications and services that make use of different level of contexts and adapt the way they behave according to the current contexts. [35]

Library services with context aware computing

A number of context-aware systems have been developed to demonstrate the usefulness of context-aware computing technology. In the earlier stage of the research, many researchers focused on building application-specific context-aware systems such as the Active Badge [36] project which provided the phone redirection service based on the location of a person in an office; and the Cyberguide [37] project which provided a context-aware tour guide to visitors. One challenge of mobile distributed computing is to exploit the changing environment with a new class of applications that are aware of the context in which they are run. Such context-aware software adapts according to the location of use, the collection of nearby people, hosts, and accessible devices, as well as to changes to such things over time. A system with these capabilities can examine the computing environment and react to changes to the environment. Computational systems are good at gathering and aggregating data; humans are good at recognizing contexts and determining what is appropriate. [38] Traditional library services help people in information seeking and searching, mostly considering as passive services, included reference, circulation, Internet assistance, and document delivery services that are supplemented by mediated and self-service online database searching. To bring up the active library services, the library employed new technologies such as high-speed wireless network, Palmtop, Handheld, PDA and Notebook. A physical location is a particularly valuable attribute in context-aware computing. [39] The Context-aware library service integrated the useful information, such as the reader's profile, physical location, our state of mind, our personal history, our present company, and an uncountable number of other features. With the information, library can serve various active service and better services. Provide the right information at the right time in the right place to the right reader.

LEVELS OF THE CONTEXT-AWARE LIBRARY SERVICE

Wireless Internet service allows college personnel and students to connect a laptop computer to the campus network and Internet from the Library and other locations. Since there are many libraries provide wireless Internet services, people can use Internet in anywhere in the campus. With the Palmtop, Handheld, PDA and Notebook, they use search the book or online databases. Combining the availability of emerging wireless access technologies and nomadic

computing devices with educational digital libraries, opportunities for learning, tutoring. Based on her work with the Electronic Guidebook project at the Exploratorium in San Francisco, Dr Sherry Hsi emphasized in her talk at the workshop that the role of the wireless handheld devices in using an educational digital library should be to support “nomadic inquiry, an inquiry-based approach to learning in which learners are moving both in physical space and across information landscapes.” [40] The awareness service takes charge of pushing information from the physical space to the information space. [41] The awareness service, like the context-aware library service can rebuild the relationship between the library and the reader and active traces the reader’s information need. Bring the information the reader needs according to the reader’s profile and location and greatly improve the service quality. Our research divides context-aware library services into four levels, is illustrated in Figure 1. They are traditional library service, campus e-Learning, libraries consortium, and library without walls.

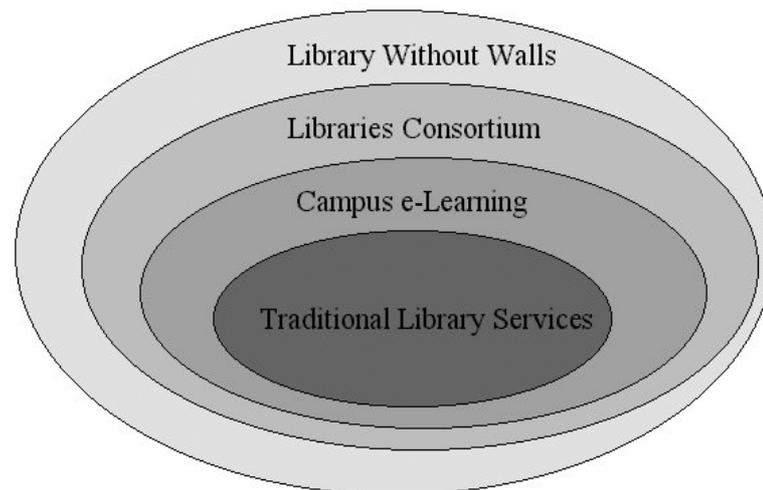


Figure 1. Levels of the context-aware library service

Traditional Library Services

Traditional library services include reference, circulation, Internet assistance, and document delivery services which are supplemented by mediated and self-service online database searching. Public workstations for searching databases and the online card catalog are available in the reference area and other areas of the library. Detailed information on services and resources may be found in the information guides available at the library.

Traditional library service combine mobile devices can provide various services to readers, includes:

- (1) General direction question: simple reference services, such as ask the location of resources, where is the library, how to loan the books, library opening time, and other questions about newspapers.
- (2) Online resources service: use PDA or other mobile devices to download e-books, e-journals, and VOD services.
- (3) Collection location service: help reader to know which the subjects found on each floor of the library.
- (4) Collection Inventory: help the librarian to manage the collection with the PDA.

Campus e-Learning

The second service level can integrate the learning resources. Composing the information providing services manually is painful for users. According to the location of professor or student and the reader’s profile, context-aware service can automatically push the right materials to them. Those information services include new book arrival, SDI (Selective Dissemination of Information), library news, and peer learning service.

- (1) SDI is a service that enables reader to keep informed about new publications via e-mail. Reader can receive a list of titles via e-mail or only want to be informed that new titles have been added to the database with the PDA. In both cases a hyperlink is included in the message with which reader can link the new titles directly through the wireless LAN.
- (2) Support collaborate learning: Since everyone has their own mobile device, they can easily find the reader with the same learning interest and discuss with each other. The students can also search the online database and ask the question to the librarian.

Libraries Consortium

Consortium of libraries is well known for sharing of resources all over the world. Several libraries in the world have

formed consortia to share their human and electronic resources. However, Consortium now being overheard everywhere is because of digital form of information. It refers to co-operation, co-ordination and collaboration between and amongst libraries for the purpose of sharing information resources. Enhanced mobile library services are provided with an emphasis on access to new electronic resources including databases and services offered through the Internet and World Wide Web with PDA.

Libraries without Walls

Library without walls is often described as existing in a space free from the spatial and temporal constraints of bricks and mortar, a space in which patrons (through the wireless LAN) can search catalogs and access electronic files without having physically to walk through a library's doors. Because nearly 85% of students' time is spent outside a formal classroom [42], transforming coincidental, daily events into meaningful learning opportunities can significantly impact the level of learning. With the mobile library services, the learners can easily retrieval the information they need.

SYSTEM ARCHITECTURE

Context is not simply a collection of features of the surrounding environment, but a partial and approximate representation used by an agent to interact with the environment and with other agents. [43] Context-aware computing is generally associated with elements of the ubiquitous computing program, and the opportunity to distribute computation and interaction through the environment rather than concentrating it at the desktop computer. [44] In order to implement this service, we explore a novel methodology and the architecture for the investigation of context-aware library service. The architecture of context-aware library system is dividing into nine components, is illustrated in Figure 2. (1) Reader Model: This model manage the reader's profile, such as name, age, gender, school, interests, and etc. (2) Environmental model: This model has the data of objects, classrooms, departments, buildings, and schools in the map, and the link between objects and expressions. (3) Library Services Model: This module manages various library services and online resources. (4) Communication support: This model provides interactive library reference services and online Q&A. This server also manages an online chat tool, and stores their logs into a database. (5) Location manager: This module allocates each reader's location and stores into the database. (6) Adaptation engine: This module recommends to the reader the suitable library services and electronic resources. (7) Communication client: This is an online communication tool. (8) Location sensor: This module sends the reader's location from GPS to the server automatically. (9) Content Reader: This module converts various documents into PDF files and shows to the reader.

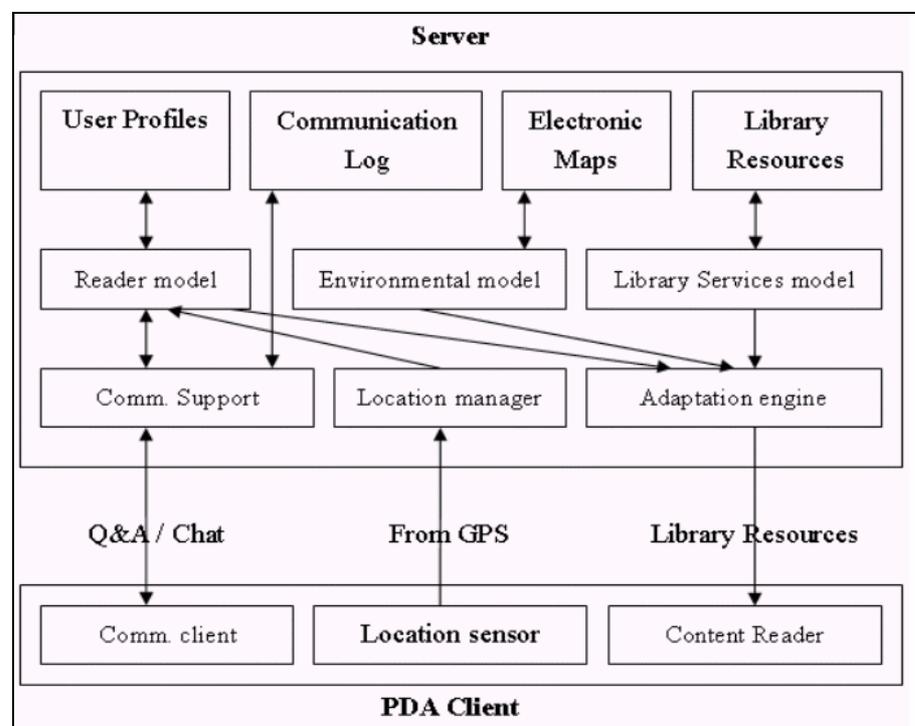


Figure 2. System Architecture

IMPLEMENT

In this section, we introduce the implementation for context-aware library system. First, context-aware library service need to show the information through the mobile devices, such as the Palmtop, Handheld, PDA and Notebook. We must consider the necessary information for the reader in the limited screenshot. Second, automatically reduce the data sizes and translate the HTML into WML. Third, according to the reader's location and profile, push the right information to them, such as online e-journals, and SDI services. Furthermore, we assume that there is at least exit one libraries consortium, as the reader travel around the universities they can even gain more the electronic resources form the collaborative library.

Hardware Configuration

The standard hardware for mobile library system as follows: wireless LAN, mobile communication devices, and the novel integrated library services. User's client is including mobile phone, PDA, Notebook, Smart Phone, etc. Network systems are 1.GSM 2.GPRS 3.PHS 4.CDMA 5.other wireless network (such as WLAN, Bluetooth). The characteristics of small wireless devices, such as browser-equipped cellular phones and handheld devices, which typically have very small displays, slow CPUs, limited memory capacity, low bandwidth and restricted user-input capabilities. Currently library services for wireless devices are limited. Obviously the multimedia rich contents that reside at the corporate knowledge bases will need to be modified according to the wireless client capabilities, available bandwidth and user preferences. As the capability of wireless devices become powerful, the novel mobile library service will become more important and necessary to readers.

System Procedure

Context-aware library services are composed by the active library services and the passive library services. Active library services inform users some information (short message is required) e.g., the due day of borrowed books, the available of reserved book, the arrival of new journals, etc. Passive library services response the query command from users. This kind of service should integrate with the existing system. Creating interactive environments on a wireless device such as a cellular phone or a cellular-connected PDA is infrastructural difficult since the bandwidth to the device is typically low resulting in a challenge to the client-server model, and the device does not have significant computing capability resulting in the need for thin-client applications. We are investigating fundamentally system procedure is illustrated in Figure 3. Suitable active services are launched after analysis the user's location, wireless devices' specification, user's profile, and library accessibility right by profiling service. The Profiling Service will be capable of determining a number of characteristics of the mobile device such as screen size, network speed, and screen size, as well as the profile of the end-user, such as interested journals list and SDI services. Combined with information about the content requested via the Content Analysis module, including location information (e.g. GPS), the content will be filtered and modified (recoding) accordingly before being delivered to the reader. The content includes Current Awareness Services such as Table of Contents (TOC) or Selected Dissemination of Information (SDI), e-journal paper query and download, e-books, and other promote activities. Reader's request is response by passive services, analysis the reader's location and provides the suitable service, so the reader can get the library service anytime and anywhere.

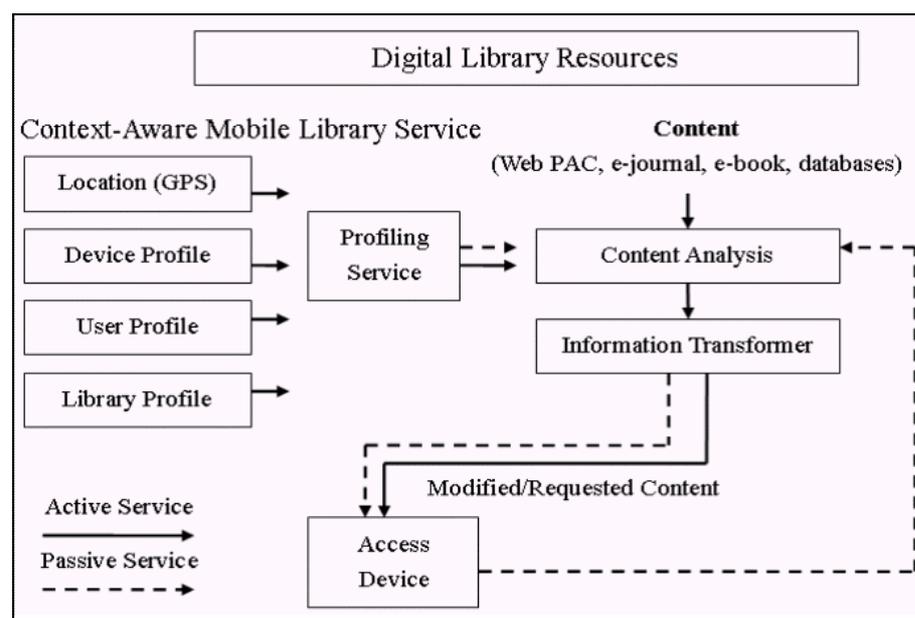


Figure 3. System Flow Chart

CONCLUSION

In this study we presented an idea to compose information-providing services by context-aware library services and the framework of context-aware library services. Construct the context-aware library service is a huge challenge to the librarian. Librarians must have more creativity, and think about how to install novel mobile library services. There are many libraries provide wireless network services, but mobile library services is few. This research proposal the context-aware library services and hopes the mobile library service is not only transfer HTML into WML format. The novel library service should analysis the reader's location and profile, push the right information to them, such as online e-journals, and SDI services. The potential benefit is getting the right information at the right time and the right place is the key in all these services.

REFERENCES

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- [1] Bill Drew. Libraries with Wireless Networks. 03/11/2005 [cited May 2 2005]. Available from http://people.morrisville.edu/~drewwe/wireless/archived_wirelesslibraries.htm.
 - [2] Markus Aittola, Tapio Ryhänen, and Timo Ojala. 2003. SmartLibrary - Location-Aware Mobile Library Service. Edited by Luca Chittaro. Udine, Italy ed.Springer.
 - [3] HUT Library. Library Services for Mobile Users. in Helsinki University of Technology [database online] . 17.5.2005 [cited May 20 2005] . Available from <http://lib.hut.fi/Information/mobileservices.html>.
 - [4] Bill Drew. Wireless Librarian: Libraries with Wireless Networks. 03/15/2005 [cited May 20 2005] . Available from <http://people.morrisville.edu/~drewwe/wireless/wirelesslibraries.htm>.
 - [5] Ajou University Library, Mobile Library Service. [cited March 3 2005] . Available from <http://library.ajou.ac.kr/eng/>.
 - [6] Capra, Licia, Wolfgang Emmerich, and Cecilia Mascolo. 2003. CARISMA: Context-Aware Reflective Middleware System for Mobile Applications. *IEEE Transactions on Software Engineering* 29, no. 10:929-945.
 - [7] Jason Pan. 2004. Officials target completion of 'Mobile Taiwan' project by 2008. Taiwan News.
 - [8] F. Michahelles. 2001. Designing an Architecture for Context-Aware Service Selection and Execution.. Ph.D. diss., University of Munich.
 - [9] Jens Wohltorf, Richard Cisse, Andreas Rieger. 2005. BerlinTainment: An Agent-Based Context-Aware Entertainment Planning System - Entertainment. *IEEE Communications Magazine* 43, no. 6.
 - [10] John McCarthy and Sa-sa Buva-c. 1998. Formalizing Context (Expanded Notes). *Computing Natural Language* 81, 13-50.
 - [11] Sasa Buvac. 1996. Quantificational logic of context. *AAAI/IAAI* 1, 600-606.
 - [12] Varol Akman and Mehmet Surav. 1996. Steps toward formalizing context. *AI Magazine* 17, no. 3:55-72.
 - [13] F. Giunchiglia, C. Ghidini, and M. Semantics. 1998. Local models semantics, or contextual reasoning = locality + compatibility. *Proceedings of the Sixth International Conference on Principles of Knowledge Representation and Reasoning* 282-289.
 - [14] Paolo Bouquet and Luciano Sera-ni. 2001. Two formalizations of context: A comparison. *CONTEXT* 87-101.
 - [15] Sasa Buvac. 1993. Propositional logic of context. *Proceedings of the Eleventh National Conference on Artificial Intelligence* 412-419.
 - [16] R. Want et al. December. An overview of the PARCTab ubiquitous computing environment. *IEEE Personal Communications* 2, no. 6:28-33.
 - [17] Roy Want, Andy Hopper, Veronica Falcao, and Jonathan Gibbons. 1992. The active badge location system. *ACM Transactions on Information Systems* 10, no. 1:91-102.
 - [18] Frazer Bennett, Tristan Richardson, and Andy Harter. 1994. Teleporting - making applications mobile. *IEEE Workshop on Mobile Computing Systems and Applications* 82-84.
 - [19] G. Abowd, C. Atkeson, J. Hong, S. Long, R. Kooper, and M. Pinkerton. 1997. Cyberguide: A mobile context-aware tour guide. *ACM Wireless Networks* 3, 421-433.
 - [20] Nigel Davies, Keith Cheverst, Keith Mitchell, and Adrian Friday. 1999. Caches in the air: Disseminating tourist information in the guide system. *Proceedings of the 3rd International Symposium on Wearable Computers* 21-28.
 - [21] K. Cheverst, N. Davies, K. Mitchell, A. Friday, and C. Efstratiou. A. Friday, and C. Efstratiou. 2000. *Experiences of developing and deploying a context-aware tourist guide: The GUIDE project*. ACM Press.
 - [22] Abhaya Asthana, Mark Cravatts, and Paul Krzyzanoski. 1994. An indoor wireless system for personalized shopping assistance. *Proceedings of IEEE Workshop on Mobile Computing Systems and Applications* 84.
 - [23] N. Marmasse and C. Schmandt. 2000. Location-aware information delivery with comMotion. *Proceedings of the* 157-171.
 - [24] N. Ryan, J. Pascoe, and D. Morse. 1999. Fieldnote: A handheld information system for the field. *First International Workshop on TeloGeoProcessing*.
 - [25] T. Gu, H. K. Pung, D. Q. Zhang. 2004. A Middleware for Building Context-Aware Mobile Services. *Proceedings of IEEE Vehicular Technology Conference*.

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- [26] J. Small, A. Smailagic, and D. P. Siewiorek. Determining user location for context aware computing through the use of a wireless LAN infrastructure. in Carnegie Mellon University [database online] . Dec. 2000 [cited March 20 2005] . Available from <http://www-2.cs.cmu.edu/~aura/docdir/small00.pdf>.
- [27] Dey, A.K. Abowd, G.D. 2000. Towards a Better Understanding of Context and Context-Awareness. Lecture Notes In Computer Science 1707, 304-307.
- [28] Khedr, M., and A. Karmouch. 2005. ACAI: agent-based context-aware infrastructure for spontaneous applications. Journal of Network & Computer Applications 28, no. 1:19-44.
- [29] Anind K. Dey. 2001. Understanding and Using Context. Personal and Ubiquitous Computing 5, no. 1:4-7
- [30] H. G. Hegering, A. Küpper, C. Linnhoff-Popien, and H. Reiser. 2003. Management Challenges of Context-Aware Services in Ubiquitous Environments. Heidelberg, Germany ed. DSOM.
- [31] D. Mandato et al. 2002. CAMP: A Context-Aware Mobile Portal. *IEEE Communications Magazine* 90-97.
- [32] Oulu University. Oulun yliopiston kirjasto - SmartLibrary -mobile services in the library. in Oulu University [database online] . OULUN YLIOPISTO, 31.3.2005 [cited May 20 2005] . Available from <http://www.kirjasto.oulu.fi/english/palvelut/mobileservices/>.
- [33] Helsinki University of Technology, Library Services for Mobile Users. [cited March 3 2005] . Available from <http://lib.hut.fi/Information/mobileservices.html>
- [34] Gu, Tao, Hung K. Pung, and Da Q. Zhang. 2005. A service-oriented middleware for building context-aware services. Journal of Network & Computer Applications 28, no. 1:1-18.
- [35] T. Gu, H. K. Pung, D. Q. Zhang. 2004. A Middleware for Building Context-Aware Mobile Services. *Proceedings of IEEE Vehicular Technology Conference*.
- [36] Roy Want, Andy Hopper, Veronica Falcao, and Jonathan Gibbons. 1992. The active badge location system. *ACM Transactions on Information Systems* 10, no. 1:91-102.
- [37] Sue Long, Rob Kooper, Gregory D. Abowd, and Christopher G. Atkeson, "Rapid Prototyping of Mobile Context-Aware Applications: The Cyberguide Case Study", Proceedings of the 2nd ACM International Conference on Mobile Computing and Networking (MobiCom'96), November 1996.
- [38] Erickson, Thomas. 2002. Some Problems with the Notion of Context-Aware Computing. Communications of the ACM 45, no. 2:102-104.
- [39] J. Small, A. Smailagic, and D. P. Siewiorek. Determining user location for context aware computing through the use of a wireless LAN infrastructure. in Carnegie Mellon University [database online] . Dec. 2000 [cited March 20 2005] . Available from <http://www-2.cs.cmu.edu/~aura/docdir/small00.pdf>.
- [40] Hsi, S. 2002. The Electronic Guidebook: A study of user experiences using mobile web content in a museum setting. Växjö University, Sweden ed.
- [41] Lluís Arcos, Josep, and Enric Plaza. 2002. Context Aware Personal Information Agents. International Journal of Cooperative Information Systems 11, no. 3/4:245.
- [42] Medrich, E.A., Roizen, J.A., Rubin, V., and Buckley, S. 1982. The serious business of growing up: A study of children's lives outside school. Berkeley: University of California Press.
- [43] Benerecetti, Massimo, Paolo Bouquet, and Matteo Bonifacio. 2001. Distributed Context-Aware Systems. Human-Computer Interaction 16, no. 2-4:213-228.
- [44] Dourish, Paul. 2001. Seeking a Foundation for Context-Aware Computing. Human-Computer Interaction 16, no. 2-4:229-241.

This article reviews some approaches to architecting context-aware services, including context delivery and enrichment, dynamic context-driven service discovery, and invocation. Mobile computing has ignited the idea that the physical and logical context of users can influence the behavior of services they call for. This article reviews some approaches to architecting context-aware services, including context delivery and enrichment, dynamic context-driven service discovery, and invocation. This content is no longer being updated or maintained. The full article is provided "as is" in a PDF file. Given the rapid evolution of technology, some content, steps, or illustrations may have changed. View PDF file. [static.content.url=http://www.ibm.com/developerworks/j](http://www.ibm.com/developerworks/j)