Unified Context Describing User-Centric Situation: Who, Where, When, What, How and Why

Seiie Jang and Woontack Woo
GIST U-VR Lab.
Gwangju 500-712, S.Korea

{jangsei,wwoo}@gist.ac.kr

ABSTRACT
With regard to deploying context-aware applications, there has been a steadily increasing interest in context representation for efficient description of complex situations in daily life. However, most ways of describing context are specific to purpose of each service or give undue value to particular information, e.g. location. In this paper, we propose unified context, which describes user-centric situation without dependence on purpose of any service, in terms of 5W1H (Who, What, Where, When, How, and Why). The proposed context can simply represent a user's situation in environments by assorting complicated information into six categories. Also, the unified context can provide several semantic structures by making relationships among elements of 5W1H without any ontological knowledge. The evaluation of unified context has shown that it can describe a user-centric situation in the form of 5W1H. Therefore, unified context will play an important role in developing context-aware applications in ubiquitous computing environments.

Keywords: Context-aware, Context Representation, Unified Context, Ubiquitous Computing.

1. INTRODUCTION
UbiComp-enabling technologies (e.g. embedded sensing, wired/wireless networking, low power consumption, etc.) enable environments to be aware of a variety of situations in daily life. In such environments, there has been a steadily increasing interest in context-aware applications which appropriately react to context of users or environments near them. With regard to deploying context-aware applications, context representation that efficiently describes complex situations, plays an important role in creating, interpreting and exploiting context.

Over the past few years, a great deal of effort has been put into understanding of context and context representation in the world of ubiquitous and pervasive computing. For example, Schilit and Theimer (1994) refer to context as location, identities of nearby people and objects and changes to those objects [1]. Schmidt, et al. (2000) define context as knowledge about the state of user and IT device. This includes situation of surroundings, and, to a lesser extent, location [2]. Dey and Abowd (2000) define context as any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and application themselves [3]. However, most ways of describing context are specific to purpose of each service or give undue value to particular information, e.g., location.

In this paper, we propose unified context, which describes user-centric situation independently of purpose of any service, in terms of 5W1H (Who, What, Where, When, How, and Why). The unified context gives information such as "who is a user in a service environment?"; "where is a user in a service environment?"; "when is a user provided a service?"; "what is a user paying attention to?"; "how is a user making an expression with gestures or action?"; and "why is a user going to trigger a service?". In addition, the unified context is classified into 'preliminary context', 'integrated context', 'final context, and 'conditional context' according to the subject of interpreting context, i.e. a sensor, service or user. From sensor's view point, the preliminary context represents factual information for user's situation in a service environment. From service's view point, the integrated and final contexts provide more accurate information by fusing several preliminary contexts and determine which service is automatically triggered, respectively. From user's viewpoint, the conditional context depicts situational condition specified in services by the users.

With regard to implementing context-aware applications, unified context has the following advantages: unified context can simply represent user's situations in environments by assorting complicated information into six categories. In addition, unified context can provide several semantic structures by making relationships among elements of 5W1H without any ontological knowledge.

This paper is organized as follows: In section 2, we briefly introduce the concept of context and context-awareness. In section 3, we propose unified context and explain how to represent and interpret unified context. Evaluation factors for context representation and analysis are described in section 4. Finally the conclusion and future works are discussed in section 5.

2. BACKGROUNDS
The goal of context in computing environments is to improve interaction between users and applications. This can be achieved by context which enables applications to automatically react to users or surroundings with implicit rather than explicit commands from user [4][5]. In ubiquitous computing domain, many

This work was supported in part by Seondo project of Ministry of Information and Communication in Korea.

definitions for context have been conceived. These definitions generally fall into two categories. The first one enumerates examples of context information and categorization [6][7][8]. The second one is a generic definition of context and takes a more operational approach [3][9]. However, the former can not exploit context information out of definition's range and the latter can not be applied to implement context-aware applications because of definition's ambiguity.

To solve these problems, we redefine the concept of context in context-aware computing as "user-centric information among a variety of situations in service environments that is interpreted, in terms of 5W1H, by applications". The redefined context focuses more on user-centric situations than it does on physical or computing environments. The reason is that user-centric situations can provide fundamental clues to implicit expression of user for exploiting services. This is based on the fact that a goal of ubiquitous computing is to provide user-requiring services anywhere at any time. In addition, we concrete targets of context-awareness by classifying user-centric situations into 5W1H. This provides a way to simply represent a user's situation by assorting complicated information into six categories and to apply this information to practically implement context-aware applications.

According to change in the concept of context, it is necessary to redefine "context-awareness". In general, the definitions of context-awareness fall into two categories: using context [7][8][10][11][12] and adapting to context [13][14][15][16][17]. However, these definitions are incorrect because "using context or adapting to context" implies that some operations are done after context-aware process. That is, context-awareness is a procedure before some actions are triggered such as generating contextual information or interpreting context. In this regard, we redefine context-awareness as "a process that generates context in terms of 5W1H and interprets user-centric situation by establishing relationships among elements of 5W1H. The redefined concept clarifies the difference between situational information and context. The previous definitions require a context-aware system to detect, interpret and respond to the context without explaining when and how to generate context. This blurs the border between context and information generated by sensors. In our definition, situational information is translated into context after a context-aware process. As a result, the concept of context-aware computing practically distinguishes context-aware from context-exploiting process.

3. REPRESENTATION AND INTERPRETATION FOR UNIFIED CONTEXT DESCRIBING USER-CENTRIC SITUATION

3.1 Unified Context Describing User-Centric Situation

"User-centric situation" refers to information that decides which services and what kind of actions will be automatically given to a user. According to the subject of exploiting the user-centric situation, it can be folded into three kinds of information; sensor, user, and service. A situation of sensor's view describes the physical state of users in service environments. A situation of user's view is a set of conditions to appropriately trigger services that a user requires. A situation of service's view represents description that a service is automatically given by observation of physical states satisfying user's requirements. Context-aware applications transform such situational information into context by means of context-aware process. Then, context-aware applications exploits context to trigger a service appropriately.

To easily translate user-centric situation to context, it is necessary to uniformly represent, in terms of 5W1H, context that provides information about users in service environments without depending on specific purpose of sensors or services. 5W1H is a popular way to describe a fact with "Who, What, Where, When, How and Why". 5W1H that is applied to user-centric situation can depict "a certain user (Who) is", "in a certain location (Where)", "in a certain time (When)", "paying attention to a certain object/service (What)", "representing a certain expression with physical signs (How)", or "because of a certain intention or emotion (Why)". This unified context can be classified by the view point of sensor, user, and service. A unified context of sensor's view means "someone$_{Who}$ is paying attention to something$_{What}$ or representing a certain expressions with some signs$_{How}$ in some location$_{Where}$ on some time$_{When}$". A unified context of user's view point means "I want to get a certain service$_{What}$ if I$_{Who}$ is in a certain location$_{Where}$, on a certain time$_{When}$, with some expression$_{How}$ or in a certain mood$_{Why}$". A unified context of service's view point means "a certain service$_{What}$ is automatically triggered if a user$_{Who}$ is in a certain location$_{Where}$, on a certain time$_{When}$, with some signs$_{How}$ or in a certain mood$_{Why}$". Because all unified contexts share basic elements (5W1H) describing user-centric situation, they can be easily converted to each other. Therefore, unified context, in terms of 5W1H, enables applications to be aware of and exploit context conveniently.

Unified context consists of 5W1H elements and attributes describing the features of each element. Elements represent user's situations in service environments. Attributes provides the meta-data related to an element or relationship with other elements. Examples of the attribute include generator, confidence and uncertainty. The generator provides identification of a sensor or service that makes elements of 5W1H. The confidence means the physical or logical quality of being certain of abilities or capacities of the generator. The uncertainty describes the range within which correct values of the element have a specified probability of being found. It is necessary to refer to attributes during context-aware process in order to interpret user-centric situation more accurately. This is because even same element has different confidence and uncertainty according to the context-aware subject.

3.2 Representation of Unified Context

As shown in Figure 1, unified context is identified as 'preliminary', 'integrated', 'final', and 'conditional' context. All contexts are comprised of 5W1H elements with attributes. Preliminary context is a user-centric situation of sensor's view point and has a set of 5W1H. Integrated context is a user-centric situation of service' view point and generates a 5W1H by merging several preliminary contexts according to each element. Final context is also a user-centric situation of service' view point and decides what a service is automatically triggered through analyzing integrated context. Conditional context is a user-centric situation of user's view point and depicts situational conditions that users specify in services corresponding to their desire. It may contain several 5W1Hs because a user sets many conditions in order to automatically trigger several operations of services. In addition, all contexts have "working area" as an attribute that refers to the available range of the context in service environment.

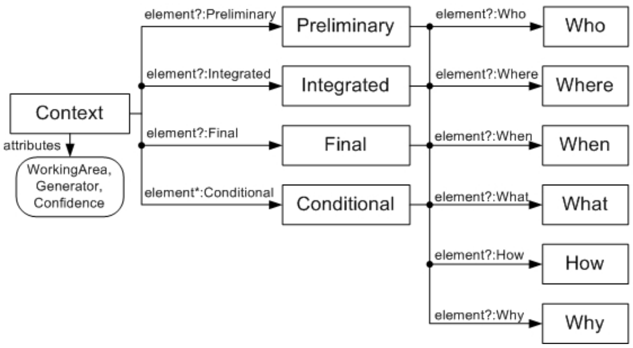

Figure 1: Structure of Unified Context

• Who

'Who' element of 5W1H provides identification of a user in service environments and is a basis for interpreting a set of 5W1H. As shown in Figure 2, 'Who' consists of 'Name' and 'Profile' as sub-elements. 'Name' has user name as a value and 'UID' and 'PWD' as attributes. 'UID' and 'PWD' refer to extra-data for accessing services in home or office environments, e.g. social security number. 'Profile' is personal information that is open to environments by users. Personal information, such as favorite service lists or relationships with other persons, plays an essential role in triggering services harmoniously. However, it is difficult for applications to be aware of personal information and to exploit it without user's permission. Therefore, 'Profile' enables users to make such personal information open to service environments. 'Profile' consists of 'FavoriteService' and 'Relationship'. 'FavoriteService' has service list as a value and 'At' and 'Type' as attributes. 'At' refers to service environments such as home and office. 'Type' alludes to a sort of service, e.g. movie, music, light, etc. 'Relationship' has social relationship with persons as a value and 'Person' and 'Priority' as attributes. 'Person' refers to the object of the relationship and 'Priority' shows the priority over the person.

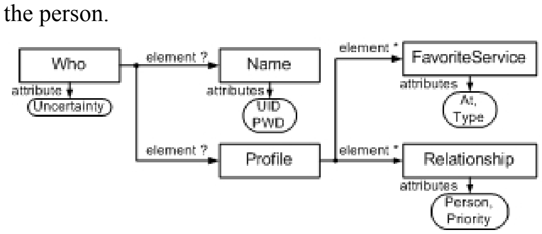

Figure 2: Structure of 'Who'

• Where

'Where' element of 5W1H gives a user's location in service environments. The location plays an import role in accessing available services surrounding a user because all applications work in active range. As shown in Figure 3, 'Where' contains 'Location'. Among various ways to represent location, coordinates-based and symbolic methods are popular in context-aware applications. 'Location' consists of 'Coordinates' and 'Symbol'. In addition, it has 'Type' as an attribute which refers to whether a location is for indoor or outdoor places. 'Coordinates' has 'X', 'Y', and 'Z' sub-elements representing a 2D or 3D position. This also has 'Granularity' and 'Origin' as attributes. 'Granularity' specifies a unit of coordinates, e.g., centimeter (cm) or meter (m). 'Origin' refers to the origin of coordinates such as the door. 'Symbol' has abstract-level location corresponding to coordinates as a value and 'Reference' as an attribute. 'Reference' specifies a translator which converts a coordinates into symbol.

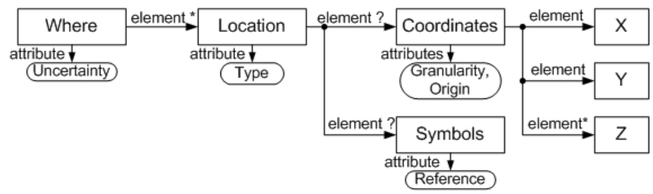

Figure 3: Structure of 'Where'

• When

'When' element of 5W1H represents time when a context is available, i.e., a given context is valid only at a given time or interval. As shown in Figure 4, 'Where' consists of 'TimeStamp' and 'Interval' as sub-elements. 'TimeStamp' has time point as a value. 'Interval' consists of 'From' and 'To' that represents a time duration. All contexts can be indexed by time information and then they are usefully exploited in context-aware process such as analyzing context pattern of triggering services. There are various ways to represent time like location. Among them, absolute and symbolic methods are popular. Both 'TimeStamp' and 'Interval' have 'Type' and 'Reference' as attributes. 'Type' refers to whether time is absolute or symbolic. If time is symbolic, 'Reference' indicates a translator which converts absolute into symbolic time.

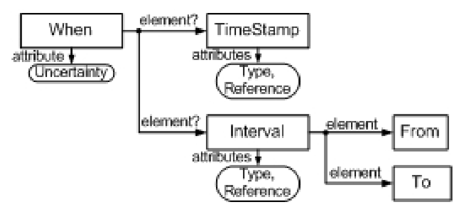

Figure 4: Structure of 'When'

• What

'What' element of 5W1H is information of an object which a user is paying attention to. As shown in Figure 5, 'What' consists of 'Destination' and 'Manipulation' as sub-elements. 'Destination' is comprised of 'DName' and 'Conflict'. 'DName' has the identification of the object as a value and 'Type' as an attribute. 'Type' refers to a sort of service which the object provides. 'Conflict' has other objects that the object collides with if they are triggered simultaneously, e.g., TV and Audio. In addition, it contains 'Priority' as an attribute that refers to the priority over the conflicted object. 'Manipulation' provides operational information of the object which a user is interested in. So it consists of 'Function' and 'Parameter'. 'Function' has operations of the service as a value and 'Parameter' contains parameters that a function uses as input.

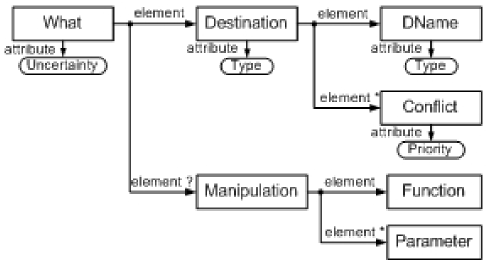

Figure 5: Structure of 'What'

• How

'How' element of 5W1H depicts a user's expression with signs such as behaviors or bio-signals. As shown in Figure 6, 'What' consists of 'Behavior' and 'BioCondition' as sub-elements. 'Behavior' is comprised of 'Gesture', 'Action' and 'Activity'. 'Gesture' has movements of the hands, legs, and body as values. 'Action' contains high-level information that is translated from successive gestures. 'Activity' shows abstract information that is interpreted from some actions. Behaviors, user's explicit expression, can be used to manipulate a service. 'BioCondition' provides indirect information of user's expression through the changes of bio-signals such as pulses, temperature, and galvanic skin response. So 'BioCondition' consists of 'PPG (photoplethysmogram)', 'GSR(galvanic skin response)' and 'SKT(skin temperature)'. All sub-elements of 'BioCondition' have 'Type' as an attribute because each bio-signal is differently represented according to measurements.

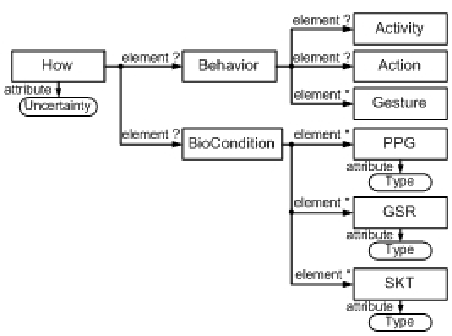

Figure 6: Structure of 'How'

• Why

'Why' element of 5W1H represents a mental state of the user such as intention or emotion. Because intention or emotion cannot be detected by sensors, they are generated by interpreting 'Who', 'Where', 'When', 'What' and 'How' together. Therefore, it is difficult to represent a state of user's mind correctly. The goal of using 'Why' is not to be aware of full mentality but to provide a clue to trigger a service or to get user's feedback on given services. As shown in Figure 7, 'Why' consists of 'Intention' and 'Emotion' as sub-elements. 'Intention' has mental states related to service operation as a value, e.g., turn on, tune off, etc. 'Emotion' has psychological values corresponding to given services such as good, bad, happy, and unhappy. Both 'Intention' and 'Emotion' contain 'Type' as an attribute because they are represented with various values and in categories.

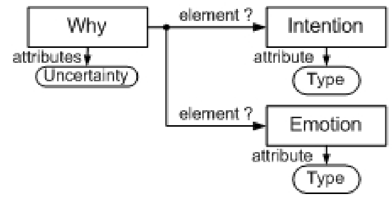

Figure 7: Structure of 'Why'

3.3 Interpretation of Unified Context

A process of interpreting unified context falls into two categories: translating unified context of sensor's view point to service's one, and transforming unified context of user's view point to service's one. The former requires merging preliminary contexts into an integrated context and then interpreting user-centric situations by means of establishing relationships among elements of 5W1H, as shown in Figure 8. To set relationship, elements having uncertainty over a threshold should be selected among 5W1H. This is because each element as a result of fusing contexts has different uncertainty according to the logical quality of being certain of abilities of integrator. By controlling threshold value, several sets of 5W1H may be generated. Then, selected sets are applied to such a template "a certain service$_{What}$ is automatically triggered if a user$_{Who}$ is in a certain location$_{Where}$, on a certain time$_{When}$, with some signs$_{How}$ or in a certain mood$_{Why}$". As a result, several candidates of final context are generated and then compared with conditional context.

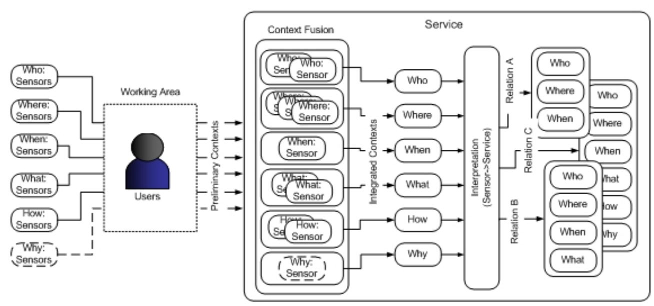

Figure 8: Interpreting process to translate unified context of sensor's view point to service's one.

Interpreting unified context of user's view point to service's one is to transform the user-specifying description into conditional context. In general, users would like to describe conditional context in natural language. However, we assume that user would specify conditional context through 5W1H-based interface such as "I want to get a certain service$_{What}$ if I$_{Who}$ is in a certain location$_{Where}$, on a certain time$_{When}$, with some expression$_{How}$ or in a certain mood$_{Why}$". A set of conditional context is transformed to this form "a certain service$_{What}$ is automatically triggered if a user$_{Who}$ is in a certain location$_{Where}$, on a certain time$_{When}$, with some signs$_{How}$ or in a certain mood$_{Why}$", in order to compare with final context. After transform process, each conditional context has uncertainty according to the logical quality of being certain of abilities of translator. If the value of uncertainty is under a threshold, service removes the conditional context or provides a feedback to a user who specifies conditional context again.

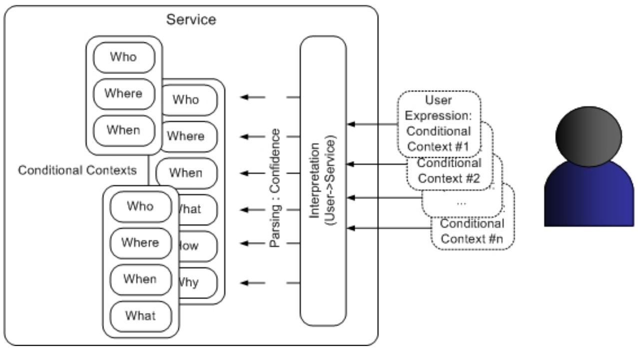

Figure 9: Interpreting process to translate unified context of user's view point to service's one.

4. Evaluation

According to researches conducted on context-aware computing, the evaluation for context representation has been reported. For example, Held (2002) noticed the requirement of context representation for gathering, transferring, storing, and interpreting context information [18]. Strang, et al. (2004) introduced evaluation factor for modeling context with respect to appropriateness for ubiquitous computing [19]. Unfortunately, due to these researches are still in the early stage, they have not covered to efficiently evaluate context representation. To solve the problem, we make seven evaluation factors for context representation as a result of surveying previous researches.

•Structure: Context should be structured to present a huge number of user's situational information. A structured representation provides a way to filter relevant information effectively and to reduce ambiguity of context by separating meta-data from contextual information.

•Composition/Decomposition: Any ubiquitous computing system is a derivative of a distributed computing system which lacks a central instance being responsible for creating, interpreting, and exploiting context. Therefore, context representation requires composition of distributed contexts in order to interpret or exploit context accurately. In addition, it guarantees decomposition to precisely get or to easily manage context in distributed system.

•Interchange: Context should be interchangeable among the different components of the system, i.e., from sensor to service, between service and service. To achieve the exchange, context requires a serializable representation.

•Unification: It is highly desirable that each participating party in context-aware computing shares the same interpretation of context exchanged and the meaning "behind" it. This requires a unified representation of context.

•Extensibility: No set of elements and attributes that can be identified today will be sufficient for all future applications. Therefore, a context representation format should provide for future extensions.

•Uncertainty: The set of context describing situations of users in service environment is usually incomplete and/or ambiguous. Processing different-uncertainty contexts together causes an interpretation of context to be vague. To protect from increasing uncertainty, context representation provides a way to indicate incompleteness of the contextual information.

•Applicability: From the implementation perspective, it is important that a context must be applicable within the existing infrastructure of ubiquitous computing environments.

Table 1: Unified Context Evaluation

Factor	Rating	Comment
Structure	High	Element/attribute pairs, Unambiguous element/attribute naming
Composition /Decomposition	High	Preliminary Context, Integrated Context, Final Context, Conditional Context
Interchange	High	By XML Serialization
Unification	High	By 5W1H
Extensibility	Middle	Structural Restrictions Apply
Uncertainty	Middle	Attributes for Ambiguity
Applicability	Low	Not yet.

We evaluate the representation of 5W1H-based Unified Context with above seven factors. Table 1 shows the result of the evaluation.

Structure of Unified Context: Unified context consists of elements and attributes. An element represents user's situations and an attribute describes features of the element. Unified context enables an element to include sub-elements representing user-centric situations in details. In addition, all elements and attributes are labeled to reduce the ambiguity that may occur during interpreting context.

Composition/Decomposition of Unified Context: Unified context is classified into preliminary, integrated, final, and conditional context. This is adaptable to create, interpret, and exploit context in distributed computing environment. Pervasive sensors in daily life generate contextual information as preliminary context and deliver it to services in same active area. Each service composes preliminary contexts and interprets integrated context to trigger actions. To support such a process, unified context guarantees the composition of context. Also, user-specifying conditional contexts are distributed to services that locate in same active area with the user. This requires unified context to support decomposition of context representation.

Interchange of Unified Context: Unified context guarantees the serialization of context representation because it is based on XML. Unified context enables any service to use context from any sensor in same active area. In addition, it guarantees harmonized services that share the state of operation with others by means of final context.

Unification of Unified Context: Unified context represents user-centric situation in terms of 5W1H and is interpreted according to the view point of sensor, user, and service. 5W1H-based unified context has ability to simply represent user's complicated situations. However, it requires formalizing sub-elements of each element of 5W1H in order to describe user's situation in details.

Extensibility of Unified Context: Unified context guarantees extensibility of context by means of structural representation that enables an element to contain sub-elements. However, there is a restriction that all contextual information should fall into six categories. In addition, unified context should be extended to describe user-centric situation for physical and computing environments.

Uncertainty of Unified Context: Unified context represents the ambiguity of user-centric situation because each element has special attributes such as confidence and uncertainty. However, it lacks quantitative measurement of confidence and uncertainty. To solve the problem, we need to standardize the level of context-awareness and requirement per context level.

Applicability of Unified Context: To be applicable within existing infrastructure, unified context should observe the standard of context-representing activities such as W3C[20] and SOUPA[21]. Unfortunately, unified context does not guarantee applicability because it does not concern with such activities. However, unified context should apply the standard of the activities to itself.

5. Conclusion

In this paper we proposed unified context, describing user-centric situation independently of purpose of any service, in terms of 5W1H. In addition, we suggested seven evaluation factors for context representation: structure, composition/decomposition, interchange, unification, extensibility, uncertainty, and applicability. With the evaluation of unified context, it is proven that unified context has the following advantages. The unified context can simply represent user's situations in environments by assorting complicated information into six categories. Furthermore, the unified context can provide several semantic structures by making relationships among elements of 5W1H without any ontological knowledge. Therefore, unified context can play an important role in developing context-aware applications in ubiquitous computing environments.

REFERENCES

[1] B.N.Schilit, I.A.Norman and R.Want, "Context-aware computing applications," *In the Proceedings of the 1st International Workshop on Mobile Computing Systems and Applications,* pp. 85-90, Santa Cruz, CA, IEEE. (1994)

[2] A. Schmidt, KA Aidoo, A. Takaluoma, U. Tuomela, K. Van Laerhoven, and W. Van de Velde, "Advanced Interaction in Context," *In the Proceedings of 1th International Symposium on Handheld. and Ubiquitous Computing (HUC99),. & Lecture notes. in computer science*; vol. 1707, ISBN 3-540-. 66550-1; Springer. (1999)

[3] A.K.Dey and G.D.Abowd, "Towards a better understanding of context and contextawareness," *In the Workshop on the What, Who, Where, When and How of Context-Awareness, affiliated with the 2000 ACM Conference on Human Factors in Computer Systems*. (2000)

[4] H. Leibernman and T. Selker, "Out of Context: Systems That Adapt to, and Learn from, Context," *IBM System Journal* 39, 3&4, pp 617-632. (2000)

[5] A.Schmidt, "Implicit human-computer interaction through context," *2nd Workshop on Human Computer. Interaction with Mobile Devices*. (1999)

[6] B.N. Schilit, and M.M. Theimer, "Disseminating active map information to mobile hosts," IEEE Network 8(5), pp.22-32, (1994)

[7] N.Ryan, J.Pascoe, and D.Morse, "Enhanced Reality Fieldwork: the Context-Aware Archaeological. Assistant," Computer Applications in Archaeology Gaffney,V., van Leusen, M., Exxon, Editors. Oxford.

[8] A.K.Dey, "Context-Aware Computing: The CyberDesk Project," *In Proceeding of AAAI '98 Spring Symposium*, Technical Report SS-98-02, pp.51-54. (1998)

[9] G.Chen and D.Kotz, "A Survey of Context-Aware Mobile Computing Research," Technical. Report. TR2000-381. Department of Computer Science, Dartmouth College.(2000)

[10] R.Hull, P.Neaves, and J.Bedford-Roberts, "Towards Situated Computing,"*In Proceedings of the. IEEE 1st International Symposium on WearableComputing* (ISWC'97), pp.146-153. (1997)

[11] D.Salber, A.K.Day, R.J.Orr and G.D.Abowd, "Designing for ubiquitous computing: A case study in context sensing," Technical Report GIT-GVU-99-29. Georgia Institute of Technology, GVU Center. Atlanta, GA.

[12] A.K.Dey, "Providing Architectural Support for Building Context-Aware Applications," Ph.D. thesis, December 2000, College of Computing, Georgia Institute of Technology.

[13] B.N. Schilit, and M.M. Theimer, "Disseminating active map information to mobile hosts," *IEEE Network 8(5)*, pp.22-32.(1994)

[14] British House of Commons, "Committee on Privacy and Related Matters, *Report of the Committee on Privacy and Related Matters*", Cm.1102, London, (1990)

[15] A.Ward, A.Jones, and A.Hopper, "A new location technique for the active office," *IEEE Personal Communications* 4(5): pp. 42-47.(1997)

[16] N.Davies, K.Mitchell, K. Cheverst, and G.Blair, "Developing a context-sensitive tour guide," In the 1st Workshop on Human Computer Interaction for Mobile Devices, Glasgow. (1998)

[17] G.Kortuem, Z.Segall, and M.Bauer, "Context-aware, adaptive wearable computers as remote interfaces to 'intelligent' environments," *In the Proceedings of the 2nd International Symposium on Wearable Computers (ISWC '98)*, pp.58-65. (1998)

[18] A. Held, S. Buchholz, and A. Schill, "Modeling of Context Information for Pervasive Computing Applications," *In Procceding of the World Multiconference on Systemics*, Cybernetics and Informatics. (2002)

[19] T. Strang, C. Linnhoff–Popien, "A Context Modeling Survey," In *Workshop on Advanced Context Modelling, Reasoning and Management associated with the Sixth International Conference on Ubiquitous Computing (UbiComp 2004)*, Nottingham/England, September. (2004)

[20] W3C, http://www.w3.org/Mobile/CCPP/

[21] H.Chen, F.Perich, T.Finin, and A.Joshi, "SOUPA: Standard Ontology for Ubiquitous and Pervasive Applications," *In International Conference on Mobile and Ubiquitous Systems(MobiQuitous04)*, pp.258-267. (2004)

UbiCNS 2005

Korea · Japan Joint Workshop on Ubiquitous Computing & Networking Systems 2005

Date ▸ June 9 -10

Location ▸ Cheju National University International Center, Jeju, Korea

Organizer
Korean Institute of Communication Science(KICS)
Jeju City
Information Processing Society of Japan(IPSJ)

[PAPER SESSION]

Paper Session 1 (Community Computing Technology 1)

Session Chair : Minkoo Kim (Ajou University)

1) NAMA-US : A Multi-Agent Community Computing Approach to Ad hoc Need Identification and Group Formation of Nomadic Community
   Ohbyung Kwon, Keunho Choi (Kyunghee University)

2) Device Collaboration for Ubiquitous Computing : Scenarios and Challenges
   C Narayanaswami, MT Raghunath, MC Rosu (IBM T.J. Watson Research Center)
   HK Jang, SE Jin, SY Kim, MC Lee, S Lee, YS Paik (IBM Ubiquitous Computing Lab)

3) Autonomous Configuration of Smart Nodes in Ubiquitous Environment
   Kil Jeon, Seong-Ju Chang and Min-Soo Hahn (Information and Communication University)

4) Backup and Restore Method for Ubiquitous Devices
   Masahiro Motobayashi (Hitachi, Ltd.)

Paper Session 2 (uT Networks 1)

Session Chair : Younghan Kim (Soongsil University)

1) A Synchronization Technique for OFDM Systems with Smart Antenna
   Kyu In Lee, Dong Han Kim (Chung-Ang University), Jae Young Ahn (ETRI), and Yong Soo Cho (Chung-Ang University)

2) Adaptive Transmission Techniques for Ubiquitous Personal Area Networks with Multiple Antennas
   Myung-Sun Baek, So-Young Yeo, Mi-Jeong Kim, Young-Hwan You, and Hyoung-Kyu Song (Sejong University)

3) Efficient Packet Forwarding Strategies Via Pricing In Wireless Ad Hoc Network
   Mingmei Li (The Graduate University For Advanced Studies), Eiji Kamioka, and Shigeki Yamada (National Institute of Informatics)

4) An unbalanced and distributed clustering algorithm Đ UBDC
   EunHyoung Chu, Tsunenori Mine, Makoto Anamiya (Kyushu University)

Paper Session 3 (Community Computing Application 1)

Session Chair : Woontack Woo (GIST)

1) A Rule-based System for Sense-and-Respond Telematics Applications
   SangWoo Lee (IBM Ubiquitous Computing Laboratory), Jonathan Munson (IBM T.J. Watson Research Center), DaeRyung Lee (IBM Ubiquitous Computing Laboratory), Gerry Thompson (IBM T.J. Watson Research Center), JungSun Park (IBM Ubiquitous Computing Laboratory)

2) COCOLAB : Supporting Human Life in Ubiquitous Environment by Community Computing
   Sounghun You, Jaedong Choi, Gil Heo, Dongsoon Choi, Heejung Park, Hyeonsook Kim, Weduke Cho (Center of Excellence for Ubiquitous Computing & Networking)

3) Experiences on Building Applications, Services, and System Infrastructures for Ubiquitous Computing
   Eiji Tokunaga, Kaori Fujinami, Tatsuo Nakajima (Waseda University)

4) A Study on the Energy Consumption of Cluster-based Multi-Hop Wireless Network
   Yuki Miyagoshi, Shigeru Teruhi, Shuichi Yoshino, Masashi Shimizu (NTT Inc.)

Paper Session 4 (Context Awareness)

Session Chair : Jaeyoung Choi (Soongsil University)

1) Unified Context Describing User-Centric Situation : Who, Where, When, What, How and Why
   Seiie Jang and Woontack Woo (GIST.)

2) Context aware service control based on personal history
   Eiji Kobayashi (NTT Corporation), Masanori Ogawara (NTT Comware Corporation), Ikuo Yoda (NTT Corporation)