

# The SAFE Management System Model Based on Context Automatic Awareness

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**Abstract** Aiming at solving the problems associated with existing wireless paging systems, this paper proposed a 4W1H+L+PI concept to context-aware information structure, based on which, a new wireless paging system named 119 system is developed under ubiquitous environment. Because of the adoption of RFID tags in the wireless paging system, hazard and malfunction rates are reduced, thus accuracy is guaranteed. Besides, response time is shortened comparing with existing systems.

In the future, if emergency aid information system can be implemented under the ubiquitous computing environment combined with sensor network, then aid service of good quality will be provided.

**Key Words** : Ubiquitous; Safe119 system; RFID

## 1. Introduction

Important issues in building U-Korea are the social problems appearing with a rapid increase of the old age population. Nowadays, with the rise of the nuclear family, the increase in the number of elderly people living alone, and with the change in status of women, both wives and husbands are employed outside the home, and the relatives who would be responsible for supporting the elderly sometimes are on long or short business trips and it happens that old people can't be looked after. Therefore, we feel deeply that the indispensability of the welfare system for the sick, disabled, old and weak becomes one of the facts of contemporary society.

Accordingly, the government developed a wireless paging system for the sick, disabled, old and weak so that when emergency happens, by just simply dialing 119, an emergency aid center could take prompt action. This system was first put into trial use in Seoul and Pusan in 1997.

Having performed well in the trial, it started spreading through the whole country in 1998 and developed into a federally supported project in 2000, thus increasing the quality of social services offered to the sick, disabled, old and weak. [3]

However, the present wireless paging system composing the underlayer of emergency aid the information system has some problems. A lack of reliability, problems among terminals, mobile transmitters and receiving terminals, the users' unwillingness to admit the need for help and poor operational skills, frequent recalls of suppliers, administrators' perfunctory management and checks because they are over worked, a bad turn of A/S finance plague the system. Therefore the system's efficiency has degraded and a system upgrade is necessary. [1,3]

In this paper, we propose a 4W1H+L+PI formula to determine the context of the objects of the wireless paging system. It is necessary in developing a new wireless paging system for first aid under a ubiquitous environment which corrects the problems of the present wireless paging systems.

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We attempt to evaluate the newly implemented SAFE119 system, a new wireless paging system seeking to correct the problems in the present system. The detailed goals of this paper are as follows:

1. Proposing a 4WIH+L+PI formula to a ubiquitous context-aware information system for developing the SAFE119 system.
2. Giving a scenario of a 4WIH+L+PI based ubiquitous wireless paging system.
3. Evaluating the implemented SAFE119 system, in which new wireless paging systems are included.

The paper is organized as follows. In section 2, we give a correlation study on "Smart Home" and RFID which are the prerequisites of structuring a wireless paging system and then we investigate the responding application case. In section 3, we discuss context-aware computing and a wireless paging system in a theoretical background. Then in section 4, a method which can base the context of the objects of a ubiquitous wireless paging system on information is proposed, a scenario of a ubiquitous wireless paging system is given and the implemented system is evaluated. Finally we conclude the paper in section 5 and also propose our future work in this direction.

## 2. Related research

The correlation study on the "Smart Home" and RFID, which are prerequisites of structuring wireless paging system, included work by AwareHome by Georgia Tech. [7,8], EasyLiving by Microsoft which is for implementing Intelligent Environment [12,13], Adaptive House by Colorado Univ. [11] which aims at home automation, ubiquitous computing and smart home combined Ubihome of U-VR lab in Gwangju Advanced Institute of Science and

Technology [4,5,6,9], Aging People Supporting System and Panasonic Health Toilet in Japan, The Patient Management System integrated with RFID technology.

### 2.1 AwareHome by Georgia Tech.

Awarehome means a living environment which can cognize information about home, its surroundings and its residents' behavior. Awarehome develops various services for aging people by introducing the concept called "Human-Like Perception". [7,8]

### 2.2 EasyLiving by Microsoft

The EasyLiving project by Microsoft Research is concerned with the development of architecture and technologies for intelligent environments. You can read the Demo (demonstration) about this Easyliving at Microsoft's web site (S.A.N. Shafer), then you can catch the meaning of ubiquitous computing. EasyLiving is developing a prototype architecture and technologies for building intelligent environments. The goal of intelligent environments is to provide users of mobile terminals with the expected computing resources or enabling non-mobile terminal equipped users access to computing resource by considering the users' environmental condition. [12,13]

### 2.3 Adaptive House by Univ. of Colorado.

Adaptive house has a different meaning compared to home automation, which controls the living environment by displaying the status of the living environment or by touch screen or by cognizing sound orders. Adaptive House places the resident's life pattern into the living environment through sensors and observes data in response to the residents' requirements. The

living environment itself programs an environmental change which matches the results of the observed data. It then executes a learning ability function on the change of the living environment by applying neural network theory. Therefore, the house where a resident's requirements can be predicted beforehand is referred to as Adaptive house. [11]

#### **2.4 The Ubihome of U-VR lab**

U-VR lab in the Gwangju Advanced Institute of Science and Technology calls the living environment which combines Ubicomp and smarthome as Ubihome. The so-called Ubiquitous Home is a kind of living environment which is equipped with various types of sensors to monitor the context of the residents and their living environment in every space of the living environment. It thereby comprehends the intention of the residents and provides a satisfying and convenient service. [5,6,9]

#### **2.5 Aging people supporting system**

For Japan's aging people, eHII(Electronic Home Information Infrastructure) featured a bedside, networked pet robot that, connected to sensors in the bed, monitors the health and condition of its master and informs relatives via the Internet—it can also be contacted by mobile phone—if problems arise.

#### **2.6 Panasonic Health Toilet**

Panasonic developed an electronic health monitoring system connected to a toilet that monitors your weight, calculates body fat and checks for sugar levels in your urine. It also tracks pulse rate, blood pressure and temperature while constantly networking the data to your doctor.

#### **2.7 The Patient Management System integrated with RFID technology.**

An efficient health care application was proposed and embodied by Jang-Mi Baek\*In-Sik Hong (2005) [2], which is one of the application services that the users, who use RFID in ubiquitous environment, are mostly concerned with. The implemented system is based on RFID tags and mobile instruments. They can transmit and manage data about the position of patients and changes in diagnosis or treated prescriptions efficiently. Moreover, they provide a high performance for the whole system by applying a mobile terminal and an application server that are based on system framework and are able to offer an augmentability to physical elements and various services. However, a matter with a hardware related obstacle wasn't considered.

### **3. Theoretical background**

#### **3.1 Context-aware computing**

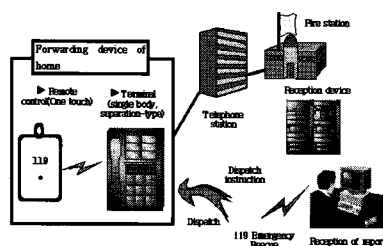
The context-aware computing term was first used by Schilit and Theimer in 1994 to describe applications that "adapt according to its location of use, the collection of nearby people and objects, as well as the changes to those objects over time". After this, some people attempted to define context-aware computing, but the majority of definitions are ambiguous.

Recently, the definition of the improved context-aware computing is the situation which uses context in the process of providing the users with either the appropriate information related to their operations or services. It's possible to define this by a context-aware system. Such a situation gives variety to information groups, generally speaking, information can be classified as follows:

- information about the targets (normality, patients, accident damage, unexpected occurrences)
- information about the environment (indoors, cars, outdoors, the fields)
- information about the computing system (power on/off, internet on/off, log in/off)
- record of user-computer interaction.
- information about IPv6 operation of the building and its inner structure.

### 3.2 Wireless paging system

119 automatic pagers were spread(created) for protecting elderly people living alone and the disabled people, so that by simply pressing the button on the remote control or fixing device(terminal), they can send an alarm to the District Fire Department through Korea Telecom(telephone network) as soon as an emergency happens or they need help. When the device is triggered, the voice repeats from the fixing device in the home to the District Fire Department. After the receiving end obtains the information about the caller, such as a contact address and a medical history, from the computer in the District Fire Department, they can either talk with the caller on the phone or go to the scene. Therefore, a prompt 119 emergency aid action can be taken to send the caller to the hospital in case of an emergency. Figure 1 shows the structure of the wireless paging system.



<Figure 1> Structure of the wireless paging system

## 4. Wireless paging system model for u-computing

### 4.1 The objects of the ubiquitous wireless paging system.

The objects of the ubiquitous wireless paging system, just like the meaning of the word ubiquitous, mean the objects which can be connected at any time, at any place to the system. For this goal, they should also include the elements, which are not usually found in a given place where traditional objects included, but can base objects on information.

### 4.2 The context information of the objects of a ubiquitous wireless paging system.

#### 4.2.1 The definitions about context 5W1H theory

The frequency of using a single context is low, because there is no consistent, approximate method which can accommodate and manage the context. Owing to this, the concepts about 5W1H are proposed to express context information according to the studies in advance which concerned on operating context information in computer area [10]. 5W means Who, What, Where, When, Why. 1H means How. Among 5W1H, Who means target-aware; What means object-aware; Where is location of buildings and objects; When is time of occurrence; How means how it happened; Why is movements and intention acted by targets. We can cognize why which means why it happened by use of 4W1H(Who, What, Where, When, How). Such why can be considered as a final context because it provides the reason of living environment variety.

#### 4.2.2 The definitions of 4W1H+L+PI.

If just using above mentioned 5W1H, there would exist different understandings between these following two occasions: the context which integrates a sensor and a target in the building controlled by wireless paging system and the context which integrates a target out and a sensor or something. Reactions of sensors in ubiquitous wireless paging system appear different if the location of a target who use space varies. Hence information about people's location should be also contained in context structure elements. So we introduced PI which means present information.

In this paper, we decide to propose 4W1H+L+PI in order to express context information.

For example, a target h1 is lying on the bed at 7:10分. To express this information, we use What to represent bed; Who to represent h1; When to represent 7:10; Location to represent the position of h1, that is on the bed; PI to represent the present state information of h1, that is lying.

Substance of information structure elements is defined as follows:

① who(targets-aware): When a target walks in and out of home, cognizing the target by using personal information which is deposited in memory and RFID or weight perception sensors which was set on the ground so that master the identity of the target.

② what(objects-aware) : Cognizing the building and objects by using a signal(RF/Ultrasonic or Ultrasound) of a sensor which is attached on objects.

③ where(location of buildings and objects) : Using and analyzing the signal of a sensor which is attached on the objects took by a target so that master the location information about objects.

④ when(time of occurrence) : Cognizing the

time of the target event occurrence and depositing information about the target.

⑤ how(state-aware): Controlling or making devices move with sensors' movement.

⑥ Location: Giving real-time position coordinates or position information of a target whose position keeps changing. The Where of 5W1H shows a coordinate which doesn't follow time to move. As far as a building and position information about a matter concerned, we should distinguish Where and Location which is used to express the position of a target who keeps moving. The reason of distinguishing Where and Location is that Location can react the real-time information to system as time passed by.

⑦ I(Present Information): Compared with Why which is to cognize why it happened by using 4W1H(Who, What, Where, When, How), PI is to show the situation which now is happening.

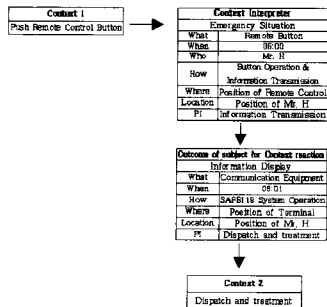
#### 4.3 Reaction scenario of ubiquitous wireless paging system.

H who is sleeping in the bed feels a sudden pain in the chest at about 6 o'clock. So he pressed the remote control button of the wireless paging system. After receiving end in District Fire Department obtained the information about H, they gave an instruction to the emergency rescue party. Pursuant to the instruction, the emergency rescue party set off, carry on an urgent processing and escorted H to hospital to receive treatment.

The reaction context of the ubiquitous wireless paging system to the scenario presented in Figure 2 began when H pressed button.

First of all, the RFID information about H(Who) who pressed the remote control button(What) at 6 o'clock(When) was read and transmitted by antenna, the position (Where) of the wireless paging system's terminal was located by operating the wireless paging system and then

the Location of H was found. According to this object-context-reaction result, setting off and an urgent processing (PI) were carried on.



<Figure 2> Reaction scenario

#### 4.4 Implementation and evaluation of SAFE System

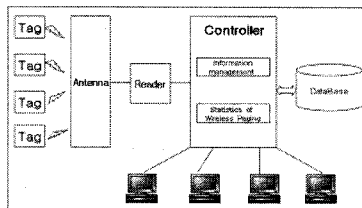
##### 4.4.1 Structure of the system

Figure 3 shows the structure of the SAFE119 system, The hardware environment of such a system is as follows :

- ALR-9780 RFID Reader
- Pentium-IV controller
- 1GB memory
- 160GB HDD
- Windows 2003 server.

As for development tools, we use Visual Studio.NET 2003 and MS-SQL 2000 Server DBMS.

The Controller manages the information about wireless paging targets, terminals' information and wireless statistical data based on the information read by a reader.



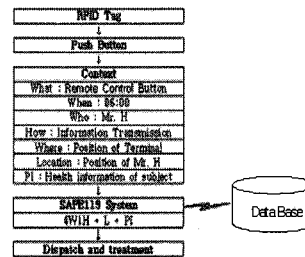
<Figure 3> Structure diagram of system

#### 4.4.2 The function of System.

The goal of SAFE119 system is that as soon as a wireless paging target presses the remote control button, telephone Number stored in RFID tags can be read by a reader and then the information about the caller, such as name, telephone number, relatives who are responsible for the caller, address, can be displayed on the receiving terminal which is connected with a database via the controller in District Fire Department. On confirming the information, District Fire Department gives an instruction to the police station nearest the caller to carry on an urgent processing.

The main functions of SAFE119 system are: wireless paging targets' information management, wireless paging terminals' information management, wireless paging terminals management, relatives' information management, who are responsible for the targets, wireless paging statistical data management and so on.

Figure 4 shows the process of carrying out the scenario in Figure 2 by SAFE119 system.



<Figure 4> The execution process of the scenario

In this paper, we attempt to propose the structural element 4WIH+L+PI and give the execution process by system. The object-reaction-context began when the target H pressed the remote control button. First of all, if H(Who) presses the remote control button(What), information (telephone Number) stored in RFID tags which are set up in the remote control is read by a

reader and transmitted(How) by antenna to the controller in District Fire Department. According to this, the information about the caller, such as name, telephone number, relatives who are responsible for the caller, address, health condition which were stored in a database, is displayed on the receiving terminal in District Fire Department. Here, context information is: the remote button is "What"; the caller is "Who"; the time of giving a call is "When"; information transmission(How) is processed inside the system; the position(Where) of SAFE119 system terminals (Remote control) is obtained automatically, the address information of the caller is represented by the position (Location)of H.

Context-reaction objects gain the position of SAFE119 system terminals and H automatically so that setting off and an urgent processing (PI) are carried on.

#### **4.4.3 Evaluation of the implemented system**

Advantages of the implemented SAFE119 system in this paper are as follows:

##### **(1) Prevention management**

Because the integration of the existing system isn't so good that it can't prevent the occurrence of accidents efficiently, while SAFE119 system bases on database so that the integration of system can be enhanced, according to which, SAFE119 system can manage the wireless paging targets then prevent the occurrence of accidents.

##### **(2) Preparation management**

It's impossible to take a prompt action using a public network, so SAFE119 system uses dedicated network so that a prompt and efficient action can be taken, according to which, SAFE119 system can prepare a condition for carrying on an urgent processing after accidents happen.

##### **(3) Accurate information**

The existing system keeps breaking down and therefore making the position of the caller not clear, but as for SAFE119 system, when it receives the alarm, it can obtain the accurate position through the address information and the rough sketch of the system.

##### **(4) Recover information**

The existing system can't carry on various information managements and statistical managements, so the SAFE119 system makes various statistical managements possible by using the information of the wireless paging targets, thus can effectively manage information about wireless paging targets.

##### **(5) Response time**

It costs the terminals of the existing system around 15 seconds to connect with receiving end in District Fire Department. SAFE119 system makes use of an dedicated network to replace a public network, shortening time as 10 seconds, thus establishing a quick system.

##### **(6) Accuracy**

Because of the terminals' malfunction and transmission itself problems, the satisfying functions of the existing wireless paging system can't be brought into play, compared with which, SAFE119 systems adopt RFID tags in the wireless paging system so that reduce the malfunction rate, thus guaranteed the accuracy.

##### **(7) Expenses for the installment**

Compared with the existing system, although expenses for the first installment of SAFE119 system are high, if RFID tag is standardized and with mass production, a moderate price can be attained.

##### **(8) Maintenance costs**

A great quantity of bad terminal products and a high malfunction rate causes high maintenance costs. SAFE119 system reduces the malfunction rate and moderate maintenance costs.

<Table 1> Comparison between the existing system and SAFE119 system.

classification stage	The existing system	SAFE119 system
Prevention management	The integration of the existing system isn't good	Enhancing the integration of system
Preparation management	Impossible to take a prompt action using a public net	A prompt and efficient action can be taken by using dedicated network
Accurate information	Keeps breaking down and therefore making the position of the caller not clear	Can obtain the accurate position
Recover information	Can't carry on various information managements and statistical managements	Can effectively manage information about wireless paging targets
Response time	15seconds	10seconds
Accuracy	Low	High
Expenses for the installment	Moderate	High
Maintenance costs	High	Moderate

## 5. Conclusion

This research made objects of the wireless paging system ubiquitous. For connecting and controlling objects and targets whenever and wherever, we proposed a method which figures the objects' context of the ubiquitous wireless paging system and gave a corresponding scenario. Based on this scenario, after we described the object-reaction-process of the wireless paging system, we implemented SAFE119 system that can deal with our given scenario.

The following is the detailed conclusion of our paper:

1. Proposing 4WIH+L+PI to ubiquitous context-aware information system for developing SAFE119 system.
2. Giving a scenario of 4WIH+L+PI based ubiquitous wireless paging system.
3. We gave the result of evaluation after implementing SAFE119 wireless paging system. Compared with the existing system, accuracy

was improved and response time was shortened. The integration of system was enhanced in prevention management respect and a prompt and efficient action can be taken because of using dedicated network in preparation management respect. Besides, the accurate position can be obtained and various kinds of statistical management about wireless paging targets can be effectively carried on in accurate information and recover information respects.

In this paper, we proposed a method which figures the objects' context of the ubiquitous wireless paging system, displayed the reaction process, but only implementing the system by using RFID tags. Therefore in the future, if we can implement a system which combines with various sensors such as biosensor etc, that would be perfect. If the system can be combined with construction of sensor network, services of good quality will be expanded by using the structure of emergency aid information system under a ubiquitous environment.

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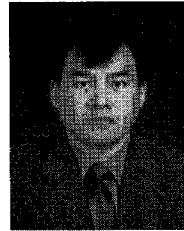
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