Ubiquitous Community System for Medical Information

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Abstract With the improvement in information technology and the rapid adoption of automatization at both work and home, people are now enjoying a life that is more comfortable and convenient. In particular, as the automatization is becoming standard in the medical field, especially in the large hospital, the demand for system that can handle various information and data are now more than ever imperative. In the case of medical services, various medical accidents are occurring during offline status and the possibility of much more problems occurring during application of online medical diagnosis is high. This suggests that, there is a need to equip mutual security system structure to reduce conflicts between various medical systems that have been introduced and to maintain integrity of information. Therefore, the researcher will design a class based community system that will categorize systems, as a means to design systematic medical information system in ubiquitous environment. Structure of this research will be as follows. In the Chapter 2, definition of community will be defined and medical information and ubiquitous medical systems will be studied. In the Chapter 3, medical information community system will be designed and evaluated, followed by conclusion in the Chapter 4.

Keyword: **Class, Medical Information, ubiquitous**

1. Introduction

Due to the development in the computing technologies and network technologies, interests for building ubiquitous computing environment are increasing. Existing researches have been centering on how to efficiently and intelligently countermeasure various cases that will be faced within the ubiquitous computing environment by developing computing/networking functions and intellectual decision making functions for individual devices. As a result, technologies involved in the development of sensors, service network technology, etc. have developed continuously.

Generally, when the ubiquitous computing environment is designed using each detailed ubiquitous-technologies, array of these devices or services search cooperative target they require according to the need and provide temporary cooperation services. That is many of devices and services only process given number of situations and consideration for repetition of these phenomenon has been omitted. These phenomenons are problems often seen from all systems using ubiquitous system. In particular, there is an immediate need to solve these problems for medical services where lives of people are depended to these services. In the case of medical services, various medical accidents are occurring during offline status and the possibility of much more problems occurring during application of online medical diagnosis is high. This suggests that, there is a need to equip mutual security system structure to reduce conflicts between various medical systems that have been introduced and to maintain integrity of information. Therefore, the researcher will design a class based community system that will categorize systems, as a means to design systematic medical information system in ubiquitous environment.

2. Definition of Community

"Community" here means interactive relationships with all devices and services in a ubiquitous computing environment that has common goal application. That is, one community is made up of "goal, members, and functions of the members." A community can be a member of other community and one device or service can be included in various communities. In other words, following the particular goal of community, it can form inclusive relationships and shared devices can be used as a service.

With the above definition or metaphor of community as basis, "community-based computing" aims to develop service and devices and unify those developments into creating new services. Additionally, instead of devising new development to meet the service demand arising dynamically, necessary services can be constructed from combining services and devices from already established ubiquitous computing environment [1].

3. Objective of the Community

The objective of engineers designing overall ubiquitous computing environment is for the users within the ubiquitous computing environment to comfortably and safely enjoy their lives. Therefore, objective of community composing of ubiquitous computing environment will correspond to above goal. As an extreme, whole community will desire to achieve an ideal objective and tasks involved in transition to this ideal situation will be carried out by the community. That means, a community having larger extent of objectives than a community with large objective may exist [2]. Specially, in the medical information community, approaching the system as a community might be very practical, as a means to accept various extended technologies and to connect them together.

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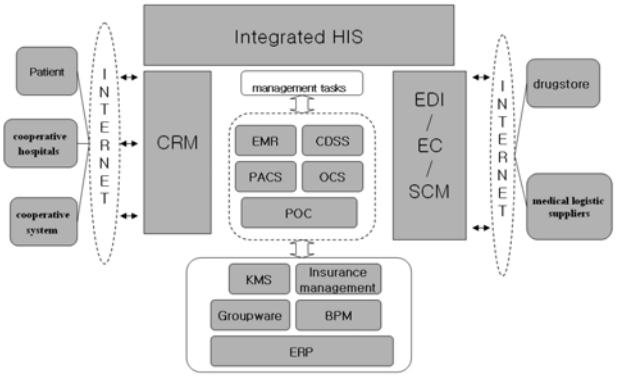
4. Medical Information

The medical information tries to raise efficiency of introducing medical technologies by combining medicine with the information technology. This can be classified in to, medical information that will systematically manage various information required to provide patient diagnosis, medical education, medical research and medical management, the hospital information that introduces hospital information system to design digital hospitals, e-Health where information system is designed to support decisions of doctors efficiently and rationally during patient diagnosis and personal health management by providing medical knowledge and patient information by utilizing information technology, and u-Health which utilizes ubiquitous technologies for the health management system. In particular, services such as slipless, paperless, chartless and filmless digital hospitals, mobile medical environment extending from within the hospital to living space of patient and at home medical services/remote medical technologies are being provided as the ubiquitous health care infrastructure is actualized[3].

In addition, EHR (Electronic Health Records) such as national personal electronic health record, sharing of information among medical facilities through information standardization, etc. and cooperation between organizations are being extended.

Figure 1 is showing schematic of e-Hospital constructed by combining existing cooperative system as the basis. Aside from the fundamental components such as patients, cooperative hospitals, pharmacies and medical logistic suppliers, we can realize various management systems such as ERM that stores all information related to clinical diagnosis of patients and supporting memory of clinical doctors by storing clinical records electronically, PACS which collects various clinical images occurred within the medical environment in digital data, saves these in the storage devices of the computer then transmits these information to various other computers connected to the network for utilization, POC used to process clinical information of patients efficiently right at the scene of diagnosis without limitation of time and space, ERP used to enhance hospital management efficiently by combining the diagnosis system and management tasks, Groupware System Electronic Cooperative Systems(Electronic Mail/ Transaction, Office Management System), DW modeling, construction of Data Mart, etc. are being combined.



(Fig.1) e-Hospital constructed

It can be seen that various systems are connected together according to necessity creating a system that is combined and extended. It is predicted that these union in medical information will be actively progressed even during the ubiquitous environment. However, extensive costs are required for modification of large network systems and for introducing new technologies. Furthermore, there exist difficulties in coping with fast changes in the fundamental technologies.

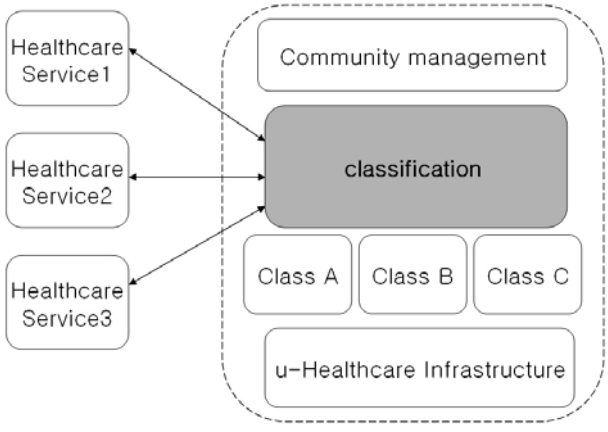
5. Ubiquitous Medical System

Ubiquitous Medical System has already been adopted by hospitals together with the introduction of POC. These technologies will support various types of medical system as the technology involved in basic infrastructure develops. A representing example is the u-Hospital, which utilizes RFID into medical system by using sensors. Massachusetts General Hospital of United States has already adopted RFID and GPS technology to identify location of medical equipments, doctors, nurses and patients. Also, diagnosis can be made remotely within normal households as “at home” medical services utilizing “at home” medical devices and internet develop [4].

The ubiquitous medical system utilizes existing systems that had been developed during the medical information process and has adopted sensors for diagnosing patients effectively [5]. However, countermeasures are being demanded for solving problems arising from compatibilities among equipments and data exchanges.

6. Designing and Evaluating MIC System

In this chapter, the author will design a community required to introduce systems reliably during the procedure of medical information transition. Various types of medical information system is being introduced as the ubiquitous environment develops, causing various compatibility problems. Therefore, class will be constructed between compatible systems and these classes will be combined to provide stability of medical information system. Suggested model has basic design as shown in Figure 2.



(Fig.2) The suggested medical community system

The suggested medical community system will classify healthcare services basing on the classification module. At this time, the classified healthcare service will be registered under the concerning class. Community management module will take role of applying and modifying standards applied by the classification module and will input standards to examine connection between

each class. At this time, the basic infrastructure for supporting ubiquitous environment must have been structured and communication between each class will base on the wireless communication.

6.1 Information Classification

Standard classification of suggested medical community system is defined in the Table 1 to manage healthcare systems.

[Table 1] Classifications for standard classification of the suggested medical community system

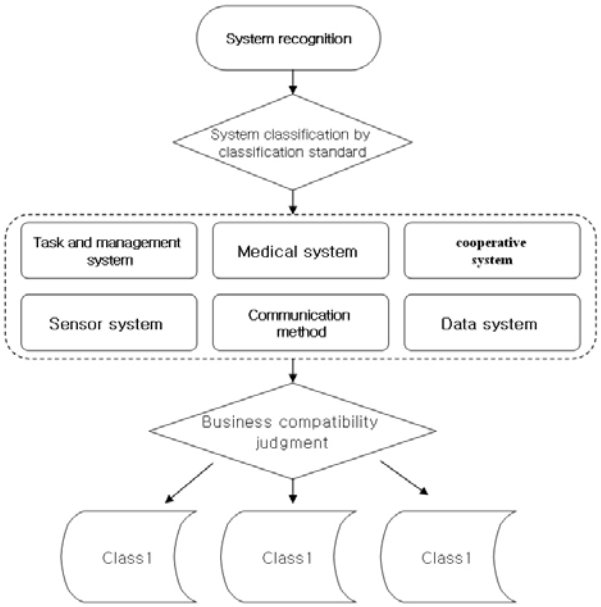
Classification	Define	Example
Task and management	Provide tasks required to execute medical activities	CRM
Diagnosis system	System that is involved with medical activities directly	PACS
Additional system	Systems providing additional support during diagnosis	OCS, POS
Sensor based system	Used sensor system	RFID Mobile
Communication method	Cable or wireless method	POC
Data system	Stores information	ERM

There are 6 classifications for standard classification of the suggested medical community system. System used to provide tasks required to execute medical activities are classified in to task and management system and systems that is involved with medical activities directly is defined as diagnosis system.

Systems providing additional support during diagnosis, such as stock management and diagnosis delivery system, are defined as additional system and sensor driven systems such as RFID is defined as sensor based system. Communication method will be defined following cable or wireless method and lastly, system like ERM that stores information is defined as data system. Classified systems within the community system classification may alter depending on the situation. Specially, systems having high relativity in information processing will be treated as being the same Class, allowing easy construction of community.

6.2 Suggested Medical Information Community System

Medical information community should be designed basing on virtual scenario. This is a countermeasure of the research trying to support various problems that may arise during the medical information processing through situational class bases. The scenario of this research will be creation of mobile device community between the medical information system within the hospital and the mobile devices of the patient when the patient visits the hospital. Following the scenario, the classification will under go procedures as shown in the Figure 3.



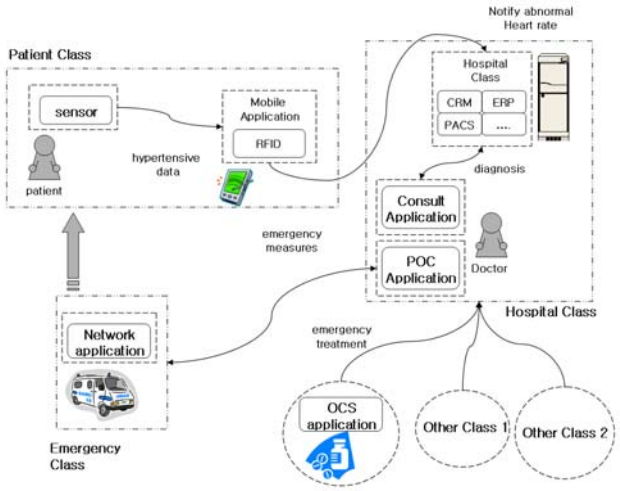
(Fig.3) Classification procedures

At this time, there is high tendency for the definition of work compatibility section to alter depending on the situational recognition. Therefore there is a need for the Com-munity management to assign a standard by recognizing the situation. Specially, con-sideration for compatibility and data migration is necessary when a new system is introduced to the existing system.

In the classification of each class following scenario introduction, classes are classified in to Patient class, Hospital Class and Outer Task Class. With the consideration of portability and convenience, the Patient Class will consist of sensor based system and wireless communication method system based on the RFID mobile. The Hospital Class will be comprised of Electronic Medical Diagnosis Record (ERM), Medical Image Storing Information System (PACS) and the Enterprise Resource Management System (ERP), furthermore, the Outer Task Class will be comprised of Diagnosis Delivery System (OCS) and Stock Management System (POS).Cable and wireless communication between each class has been assumed to be possible following the result of medical information system class structures. Also, sensor information of Patient Class was assumed to provide required patient information to necessary systems within the Hospital Class.

6.3 Medical Information Community System

By applying suggested medical information system to actual emergency medical situations, following structures as shown in Figure 4 had been designed. Abnormal heart beat of patients with heart problems among Patient Class will be detected through sensor recognition and this information will be transmitted to the Hospital Class through mobile devices.



(Fig.4) Medical information community system

At this time, sensor information will be analyzed, classified and transmitted to doctors then will trigger occurrence of emergency situation. After this, patient transfer will be ordered by communicating with ambulance while the emergency treatments will be executed through remote diagnosis system. Mutual interlock among systems plays an important role in complex situations like this. As a result of applying medical information community system suggested in this research, to a specific example, we were able to design class classification and structure where addition of class can be done easily. Furthermore, community classified in to class based can be simply expanded, provide environment that can cope with limited services while providing much effective services to users utilizing medical information as user unit gets recognized as a class.

6.4 System Evaluation

Various kinds of community method are being researched to design effective systems within the ubiquitous environment. The research aimed to provide smooth mutual interlock among systems by grouping classified class based systems and focused on easy scalability and modification. The basic model of the research was; each class contains its own applications and these services mutually interlock in complex platforms. The community considered in this research is a basis for providing combined management of medical equipments and applications within environment where compatibility is causing problems during migration, and is suitable for designing medical information system within the ubiquitous environment.

7. Conclusion

The class based community system suggested to design medical information system, allows expansion of possible service targets by designing class units for the complex structured medical information, reduces unnecessary waste of resources such as repeated by interlocking systems and will provide convenient managements by classifying individual users into objects.

Lastly, further researches on community management module and security protection scheme for classes are required, to clearly define changes in classes following situational changes.

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