

Ubiquitous Healthcare System Management based on Agent Platform with Application of PLD

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Abstract

This paper outlines the ubiquitous healthcare technology and trends for patient location data (PLD) application. The field of healthcare became more sophisticated, and purpose of u-healthcare technologies is to provide convenient healthcare service to both caregivers and patients, and to make it easy to analyze user's health condition by a caregiver. Along with that the interest of the remote-treatment has also been increasing. Systems are being developed that can check the health status of a patient and treat them in a distance in a real time. A system is proposed to improve the effectiveness of u-healthcare by process and manage data at the hospital or emergency room in a distance by transferring bio-data such as ECG data, pulse data, and which can detect the location of patients through the portable-equipment based on wireless communication network.

Keywords: *U-Healthcare, Ubiquitous Healthcare, Location Based System*

1. Introduction

The modern society is facing a major change in the aging society and requires convenient approach to the medical environment. As wireless communications are being developed and ubiquitous environment is emerging, the interest for ubiquitous healthcare also gradually increases. However, u-healthcare infrastructure that reflects the condition of a patients' health is insufficient. Similarly, the approach to precise processing of the context information is also insufficient. As a result, various systems are being developed to check patient conditions and give them proper treatment from a remote place in real-time. In addition to this, services to find patients' location and the closest caregivers are needed. In U-Healthcare environment, there are large numbers of environmental and patient sensors and actuators that are used to monitor and improve patients' physical and mental condition at the comfort of their homes [1]. The move towards U-Healthcare systems is also influenced by the growth in healthcare spending fuelled by an ageing population and the increase in the rate of chronic diseases such as obesity, diabetes, cancer and chronic heart and lung diseases [2].

Healthcare professionals rely on the collected patient information to provide care. For the patient suffering from diabetes, for example, U-Healthcare system may be used to monitor blood glucose of the patient as the patient maintains his or her normal daily activities as well monitoring his or her lifetime medication. These systems may be used

to warn patients as well as healthcare professionals of the vital signs that a problem may occur and therefore help healthcare professionals to provide early diagnosis [3]. Additionally, these systems may be used to collect data for trend analysis and medical research and hence increasing efficiency, accuracy and availability [4]. The patient information collected is considered to be highly private and sensitive which requires protection.

Healthcare organizations have undergone an increasing pressure to improve healthcare services for patients through effective prevention and post-operative care. The application and use of these systems is expected to enable healthcare professionals to remotely perform real-time monitoring, early diagnosis and treatment for potential risky diseases and hence prevent terminal situation as well as assessing post-operative care and body reaction to complex therapeutic drug regimes. To achieve the aforementioned benefits, sensitive patients' information is collected using U-Healthcare systems without patients' obligation.

Ubiquitous healthcare is an area of technology that uses a large number of environmental and patient sensors and actuators to monitor and improve patients' physical and mental conditions in a networked system. U-Healthcare system is a system with ubiquitous access to e-health. Service of U-Healthcare system is not only restricted to clinic, hospitals but is available at every place. U-healthcare system is about management of EMR (Electronic Medical Record), PACS (Picture Archiving Communication System), HIS (Hospital Information System), OCS (Order Communication System) and enhancing the healthcare by increasing the availability of patient monitoring devices, and various health data of the patients to physicians. The advantages of the Ubiquitous Health care systems are that they have the convenience of mobility, due to the continuous monitoring it is easy to detect during the early stages itself, can alert during the times of emergency. This can be handy for mobility-impaired people [5]. Consequently, this approach increases the availability of protected healthcare information (PHI) to medical practitioners and provides security to the information. In a ubiquitous healthcare system, databases pertaining to different healthcare devices, pharmaceutical centers and patients PHI are connected to an array of physicians' records over secure wired and wireless networks. A U-Healthcare system must ensure data integrity, confidentiality and availability of health information.

2. Related Works

2.1 Technology Used

In the conventional circumstance, a patient attaches a sensor on his/her arm. PDA like collects the information. Then, the information is transmitted to a local place through wireless LAN, CDMA and cellular modems. Existing platform consists of a pulse checking sensor, the non-contact temperature sensor (ZTP- 1 15 from GE) for checking body temperature, the CC2420 chip from Chipcon Co., for supporting IEEE 802.15.4 and ATMege128L chip of AMTEL for controlling nodes. In addition, PDA used is iPAQ5450 which use PocketPC2003 as operating system. Although this conventional system may identify users' condition, patient may not have proper treatment on time because it cannot provide information regarding the patient location in emergency. Therefore, a system which allows rescuing patient more quickly is needed.

2.2 Jade

JADE is a middleware that facilitates the development of multi-agent systems. Each running instance of the JADE runtime environment is called a Container as it can contain several agents. The set of active containers is called a Platform. Main Container is called special container in the Platform. It includes AMS (Agent Management System) and DF. While AMS provides the naming service among the agents, DF provides the yellow page service.

2.3 Location Based System (LBS)

In TS 22.071 of 3GPP, LBS is a standard network service which can supply location based applications. Also, in OGC (Open GIS Consortium, 2001) LBS is defined as every application software service which connect, supply and adopt location information. FCC (Federal Communications Commission) defines LBS as a service which allows user being able to receive their physical location and position and existence.

LBS is defined as application services and systems for providing and using additional information combined users' location information in moving and much different information in real-time with consideration of two important sides which are location movement and accessibility to information in the movement. LBS can be divided into Location Determination Technology, LBS server technology for management of location data and LBS application technology for providing service. Among these, the Location Determination Technology ensuring location accuracy and reliability must be prepared for LBS activation. Location Determination Technology for detecting terminals is inevitable in the LBS realization. Determination Technology can be divided into the Determination Technology based on satellite communication and Determination Technology based on mobile communication. Types of Determination Technology which receives a signal from certain mobile phone by defining signal reaching area of base station as a cell. Especially, if the area the base station covers is wider such as rural, the accuracy is significantly low. However, it can be applied to existing mobile phones without attaching additional device or upgrading software.

Determination Technology based on mobile communication can be divided into the network based type which uses reception signals from a base station of network and handset based type which uses a GPS receiver on handsets.

2.4 Personal Health Record (PHR)

Most people have their health information in lots of different places - at home, in their doctor's or therapist's offices, and anywhere they've been hospitalized - and want to have a healthcare service anytime and anywhere called u-Healthcare service. PHR can help keep all of this information in one place, making it easier to find and share with others such as specialists or family members.

A personal health record (PHR) is usually an electronic document recording one's health information and recent services, such as one's medical conditions, allergies, medications, and physician or hospital visits that can be stored in one place, and then shared with others, as one see fit. In PHR, one's health information must be protected from being viewed without one's consent or authorization. Therefore the security technology must be used by the system who offers PHRs. Security of health records primarily encompasses privacy and confidentiality [6, 7]. In the most systems, with

one's own unique user ID and password, one can control who can see the information in one's PHR, but it isn't sufficient [8].

3. Enhanced U-Health Architecture

The proposed architecture consists of 3 main Agents: Patient, Broker Agent, and Caregiver.

3.1 Patient

Patients' tasks include only the retrieval of information through sensors and sending them via internet or CMDA to the broker agent. Patient has also the option to send an appointment request in case if wished for an appointment. The appointment will be stored in the appointment database of the caregiver.

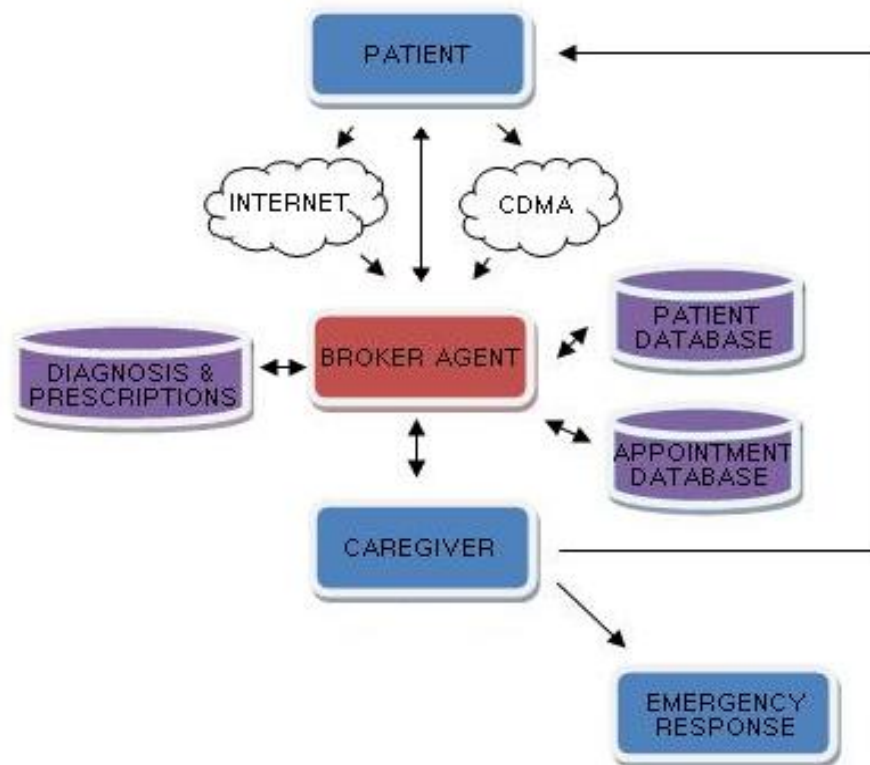


Figure 1. Wireless Networks

3.2 Broker Agent

Broker Agent is the bridge agent for making connections between remote Patient and the Caregiver. First, Broker Agent receives user's context information from the Patient. It updates the data in the patient database, and sends the information to the Caregiver (the hospital and the doctor to which the patient is attached). In the case of critical conditions or state of the patient, the Caregiver can dispatch the emergency response (e.g. a doctor, an ambulance). In this case, the broker agent will retrieve the location of the patient via LBS and send it to the Caregiver to provide to the emergency response.

The Broker agent also stores the diagnosis and prescriptions that the Caregiver provides to the Patient, for future reference and scientific data.

3.3 Caregiver

Caregiver in the architecture is the hospitals and the doctors working in the hospitals. Once the Patient data is received, the doctor reviews the data and the conditions, and can give the required diagnosis and prescriptions and send to the Patient. In case of critical conditions or state, the Caregiver can dispatch the emergency response. If an appointment is required, the Caregiver requests for an appointment, in which case the broker agent will send an appointment notification to the Patient.

3.4 Caregiver

Free movement is allowed to the patient with mobile sensor attached. The measured data are transmitted to the remote server through the CDMA and WLAN network by the mobile unit such as PDA. To obtain the position data, position information is periodically transmitted with the biometric data by adding the GPS module, though the GPS positioning has a limitation in the indoor positioning.



Figure 2. Healthcare Communication Environment of the System

4. Conclusions

A system was proposed to improve the effectiveness of u-healthcare by process and manage data at the hospital or emergency room in a distance by transferring bio-data such as ECG data, pulse data, and which can detect the location of patients through the portable-equipment based on wireless communication network, future works of which include the addition of a security mechanism, improved and more precise location mechanism, and perform simulations and evaluate the performance between the current and existing architectures.

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