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The Design of mBodyCloud System for Sensor Information Monitoring in the Mobile Cloud Environment

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Abstract

Recently, introduced a cloud computing technology to the IT industry, smart phones, it has become possible connection between mobility terminal such as a tablet PC. For dissemination and popularization of movable wireless terminal, the same operation have focused on a viable mobile cloud in various terminal. Also, it evolved Wireless Sensor Network(WSN) technology, utilizing a Body Sensor Network(BSN), which research is underway to build large Ubiquitous Sensor Network(USN). BSN is based on large-scale sensor networks, it integrates the state information of the patient's body, it has been the need to build a managed system. Also, by transferring the acquired sensor information to HIS(Hospital Information System), there is a need to frequently monitor the condition of the patient. Therefore, In this paper, possible sensor information exchange between terminals in a mobile cloud environment, by integrating the data obtained by the body sensor HIS and interoperable data DBaaS (DataBase as a Service) it will provide a base of mBodyCloud System. Therefore, to provide an integrated protocol to include the sensor data to a standard HL7(Health Level7) medical information data.

Keywords: Mobile Cloud, Body Sensor Network(BSN), Hospital Information System(HIS), DBaaS (DataBase as a Service), HL7(Health Level 7), HealthCare, Mobile HealthCare

1. Introduction

Recently, through the introduction of cloud computing technology, stationary terminals and smartphones, such as the desktop, it became possible connection between mobility terminal such as a tablet PC. By utilizing this, we are focused on mobile cloud which can perform the same operation in wireless terminal capable moved. Mobile cloud is an extension by applying a concept of existing cloud to the wireless terminal. This is for users, data storage and sharing, various services such as streaming services are appeared[1][2]. In addition, regardless of where in the development of WSN technology, anytime, anywhere study of USN

technology that can be connected to a computing environment has been actively promoted[3]. Among them, BSN is to adhere to the human body, a WSN one of which is introduced to monitor the status of the body.

BSN is, health help human life management, emergency management, offers a variety of platforms, such as fitness. Patients measures their health conditions in personal communications wearable, can be real-time monitoring on a personal desktop and smartphones, physicians and parents are capable of analyzing offline the acquired sensor data remotely[4]. Studies on current m-healthcare utilizing BSN and the mobile device is actively conducted, the service of a new concept of the medical field are presented. However, in most studies, cellular phones, has remained only the role of a gateway for transmitting data measured by the BSN smartphones simply Hospital Information System(HIS)[5]. Therefore, In this paper, it is to provide a HIS and data interoperable DBaaS(DataBase as a Service) based mBodyCloud System by integrating the sensor information acquired by BSN. However, it is difficult to interoperability of data between the BSN and HIS for the heterogeneity of the problem of sensor data and medical information data of the body. Therefore, mBodyCloud System provides a standard HL7(Health Level7) environment capable of integrating the protocols and body sensor data of medical information. The System design uses a dynamic reconfiguration of the cloud group, a based mobile cloud environment that allows data exchange between the smart phone. This paper is organized as follows. In Chapter 2, related works Body Sensor Networks in research, Mobile Cloud Computing, Mobile Healthcare, DBaaS. In Chapter 3, configuration and conceptual diagram of the system proposed in this paper, we describe the operation process. In Chapter 4, we describe the application of the system. Finally, In Chapter 5, we describe the conclusions and future research.

2. Related works

2.1 Body Sensor Networks

Body Sensor Network so as not to interfere with human normal activities, by attaching a small biosensor to the human body, which is one of the Wireless Sensor Network technology has been introduced to monitor the health condition. Body sensor refers a technology that can detect a number of stimuli that are detected temperature and blood pressure, from the outside[6]. This is regardless of location by sending external processing equipment the sensor information to the external processing device in real time, streaming all the information to the physician in charge of the patient[7][8]. Services that take advantage of the BSN is typically state monitoring, fitness monitoring, motion sensor based games, there is such as information sharing[9][10]. Figure 1 is a software architecture of a BSN[4][11].
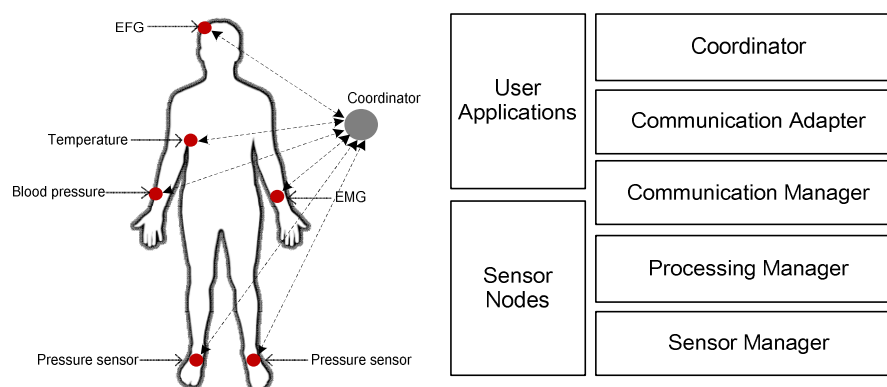

Figure 1. A BSN architecture.

2.2 Mobile Cloud Computing

Mobile cloud computing is a technique that has been developed to provide an environment which can perform the same operation in wireless terminal movement is possible, such as smart phones and tablet PC. That is the mobile cloud is the cloud was extended to apply existing concepts to the wireless terminal[12]. And actively take advantage of the characteristics of the terminal, for users, data storage and sharing, streaming services, a variety of services, such as the use of working environment software have appeared. Compared to existing cloud computing, mobile cloud computing, mobile terminals, high stability, easy accessibility, the service scalability is demanded. Moreover, in order to provide movement of data between the terminal and requires the platform it can be transmitted by integrating heterogeneous data. Currently, the standard perspective of mobile cloud has been the field of media, Ubiquitous field, research to define a standard for each domain, such as medical /video sector[13].

2.3 Mobile Healthcare

The development of IT technology, the current medical service utilizes a Ubiquitous network environment, anytime, anywhere evaluate health individuals in real time diagnostics, and ubiquitous health care services that can provide treatment are possible. Ubiquitous Health Care, the spread of mobile terminals, in conjunction with a mobile network, can be monitored daily smartphone, and define it as the mobile healthcare (m-Healthcare). m-Healthcare acquires the data from the sensors, there is the advantage that it can be connected to a Hospital Information System[14]. However, most of the m-Healthcare, because merely remain in the role of a gateway for transmitting sensor information to smart phones, it does not take advantage of the role of the powerful computing tool smartphone[5]. In this paper, through a Bluetooth smart phones, to collect data generated by a plurality of body sensors, and provides for a processing m-Healthcare.

2.4 DBaaS(DataBase as a Service)

While requiring collaboration between recent enterprises, various studies to solve the data heterogeneity problems is underway. Each company, since the building their own system, there is a problem that it is difficult to collaboration data format is different. However, it will be necessary to consume a lot of costs and time when it comes to rebuilding the system for collaboration among companies. The DBaaS to have a forte that can solve these problems. DBaaS as one cloud technology, can be in accordance with the state of the application, using the effective database. DBaaS is in the cloud, there is a consolidation type in the schema level of integration with the RAC(Real Application Clusters). Integrating the schema level, when implemented by defining a standard schema, difficulties are often, but the implementation is, it is possible to most efficiently use. Also, by it maintains a local database, for basic database functions are provided, it is possible to use the SQL. This access to the data of large, division, and are dispersible treatment[15][16]. In this paper, after transferring the sensor data acquired in the smartphone to DBaaS based mBodyCloud system, it is possible to transfer to the HIS by HL7 integration is an international standard of medical information.

3. Mobile BodyCloud System(mBodyCloud System) Architecture

In this study, proposed the mBodyCloud System, it is possible to provide the doctor to earn the sensor data generated by the body sensor in the mobile device. Conventionally, but medical personnel real-time sensor information that occurs in daily life of the patient was not able to get, Is the sensor data and the international standard by integrating HL7, it is possible to transfer to the medical information system. Services schematic diagram of the mBodyCloud System in Figure 2 is defined as a system that can be processed by obtaining the real-time sensor information generated in daily life of patients accumulate HIS

the PHR. The System proposed in this paper consists of a patient area, mBodyCloud System, HIS Cloud. For a description of each component follows. Area of the patient, it is possible to acquire the real-time sensor data of the patient to the smartphone via Bluetooth. mBodyCloud System is the sensor data acquired for the patient's smart phone, integrates the data, and transmits the HIS Cloud. HIS Cloud monitors the sensor information of the patient, in charge of the treatment, it is possible to PLHR sharing between hospitals. In this study, by using the smart phone wireless communication network, unlike the existing studies that the role of the data transmission, and that the leverage powerful computing capabilities of smart phones, to transmit a more accurate sensor information. Also, medical personnel, receives the sensor information stored in the HIS Cloud mobile cloud environment, it is possible to share between the terminals.
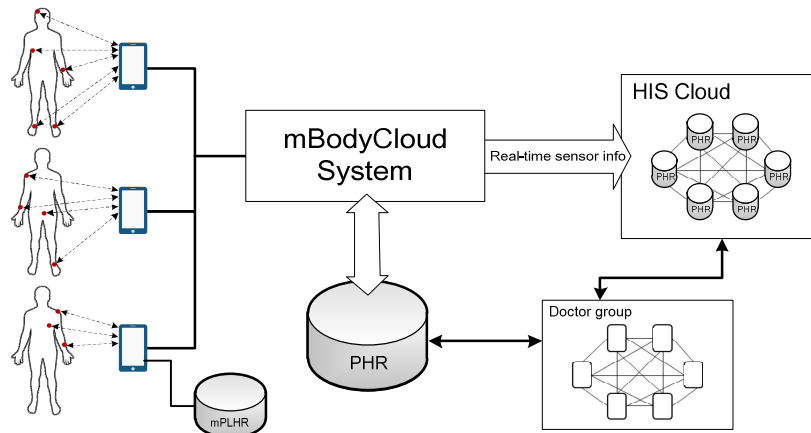
Figure 2. The Service Conceptual diagram of mBodyCloud System

3.1 The Architecture design of Mobile BodyCloud System

In this paper, to obtain a body sensor data in a mobile cloud environment to create a record of the body in the HIS, to be able to accumulate a standard HL7 and sensors standard for the transfer of the medical information field to provide DBaaS based mBodyCloud System that provides an environment that can be integrated IEEE11073. Patient Group acquires the sensor information to the smartphone via Bluetooth. Acquired data are integrated by sending the mBodyCloud System, it is possible to transmit the HIS Cloud.
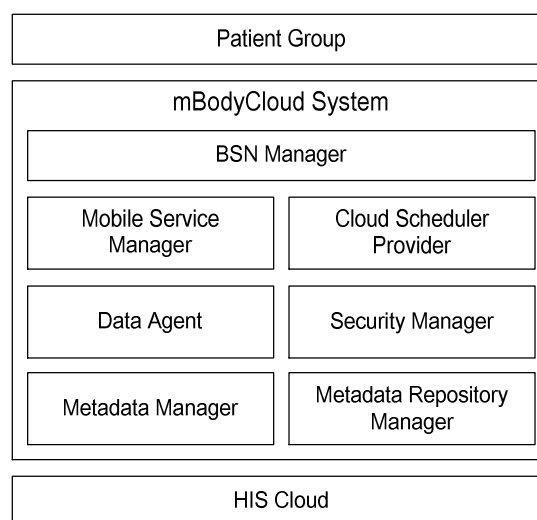
Figure 3. The DBaaS based mBodyCloud System in mobile cloud environment

Figure 3 is BSN manager, Mobile Services Manager, Cloud Scheduler Provider, Data Agent, Security Manager, Metadata Management, Metadata Repository Manager consist. The following is a description of the components of each module.

3.2 The mBodyCloud System operation process

Figure 4 is a process for performing a process for transferring the sensor information that has been integrated with mBodyCloud System for HIS[17]. Description of the execution of each process are as follows. Patient Group acquires sensor data generated by the body sensor via Bluetooth to your smartphone. Acquired data is transferred in real time mBodyCloud System. When transferring the sensor information of each patient to the Hospital Information System, for interoperability of data, and to integrate a standard HL7 and IEEE11073 of medical information. Integrated data, after performing encryption on the Security Manager for security, to be transferred to the HIS. Doctor Group saves the health information of patients who have been sent from the HIS to the smartphone. The stored data in the mobile cloud environment, it is possible to exchange data between the doctor.
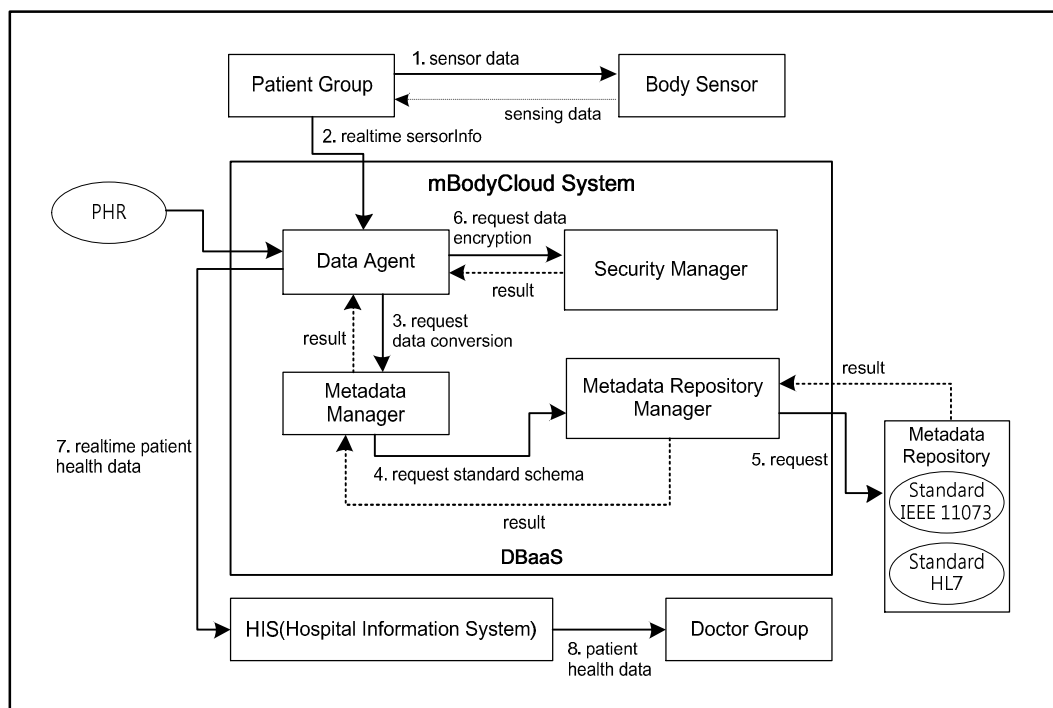

Figure 4. mBodyCloud System operation

4. Implementation of Mobile BodyCloud System(mBodyCloud System)

Mobile Healthcare, corresponds to the continuous changes in the technology and exclusive method is performed. This ubiquity in order to allow users to easily install and operate the system, affordability, ease of use is required. mBodyCloud System proposed in this paper, to get the body sensor information via mobile, the Bluetooth network of smartphone. Acquired data provides a service to be transmitted to mBodyCloud System via an LTE or WiFi network smartphone. mBodyCloud System, the sensor information collected at the patient's smart phone integrates with HL7, plays a role of transmitting to the HIS. Study on the most mobile health care, it has been granted the role of a data transmission that uses the smartphone of wireless

communication network. However, mBodyCloud System of this study is that of being able to exchange the sensor information of the patient collected by the mobile cloud environment, it can be a differentiation for existing research. Development environment, the operating system, using the Android, the hardware platform is based on the Samsung Galaxy Note 3 LTE model. Via Bluetooth technology is interlocked with IEEE11073 PHD terminals, development language used the like Java, HTML5, Ajax. Database management system uses a unique SQLite in Android operating system. Sensor networks, since the continuous data is generated, in order to manage seamlessly sensor data from the server, which requires a highly scalable and data processing capabilities. Interface is automatically reflected in a mobile environment, it is designed with bootstrapping simple and flexible grid system, sensor data generated was designed Google Charts is an API provided by Google base.
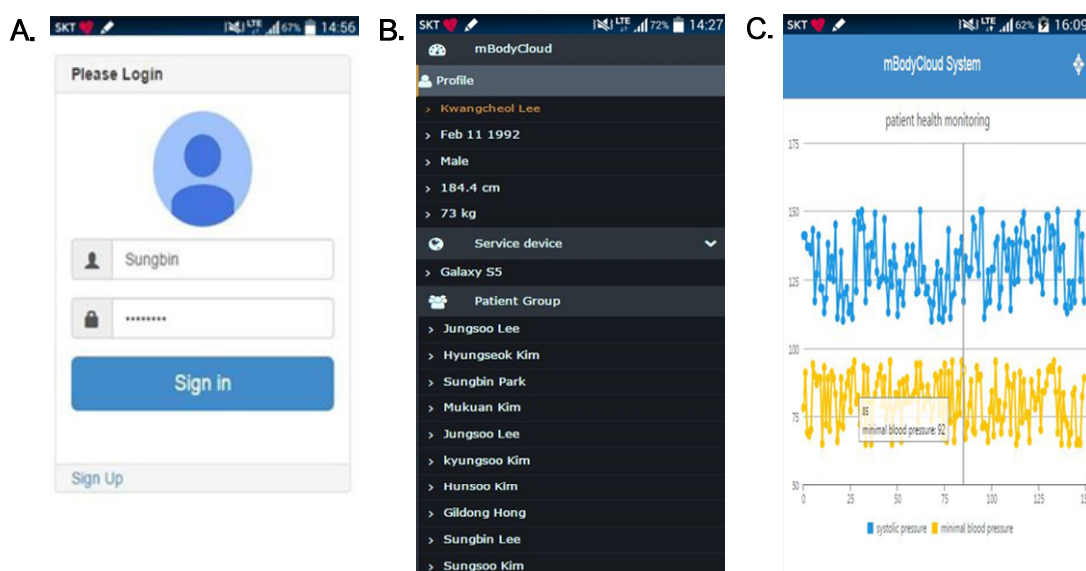
Figure 5. The System for patient health data monitoring in mobile cloud environment

5. Conclusion

Recently, studies met the mobile era is about to use the ubiquity in the mobile health care are inherent in the smart phone has been actively carried out. However, most of the mobile health care, between the role of the smartphone is the body sensor and the HIS, the functions of the only smartphone application to just the role of the meson to transfer by obtaining the sensor information been able to take full advantage no. Therefore, in this paper, by utilizing the powerful computing capabilities of smartphones, It provides the mBodyCloud System interoperable data between body sensor networks and HIS. mBodyCloud System, capable of sensor information exchange between the terminal in the mobile cloud environment, By integrating the sensor information obtained through the smart phone, it is transmitted to the HIS. In addition, because of the interoperability of data between the BSN and the HIS, I have integrated the standard IEEE11073 the HL7 protocol of sensor information. In addition, based on Patient Group and Doctor Group smartphone between mobile cloud environment that allows data exchange through the dynamic reconfiguration of the cloud group. In the future, so as to support the early determination of the disease through research to enhance the region of   the patient to the system mBodyCloud System.

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