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Mobile gateway System for Ubiquitous system and Internet of Things Application

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Abstract

The wireless technology has brought many advantages in the development of u-healthcare system. The most recent interesting technology is the Internet of Things (IoT). IoT aims to provide means to access and control all kinds of ubiquitous and uniquely identifiable devices, facilities and assets. These include equipment that has inherent intelligence such us transducers, sensors, actuators, motes, mobile devices, industrial controllers, HVAC controllers, home gadgets, surveillance cameras, and others, as well as externally enabled things or objects. In this paper we have presented the u-healthcare system in the Internet of Things (IoT) environment with the support of the mobile gateway which makes it possible for integration. We have presented here the mobile gateway architecture in which the main purpose is to receive the sensing data and make a local analysis and generate keywords and then will be sent to remote medical server for analysis. This mobile gateway used Bluetooth technology to send and receive data from the sensor devices.

Keywords: *IoT, u-healthcare, Sensor Mobile Gateway*

1. Introduction

The development of u-healthcare system has been very interesting research topic in recent time. Interconnection with heterogeneous objects, sensing of various phenomena and gathering of large amounts of data are unaware becoming part of our daily routine. The wireless technology has brought many advantages in the development of u-healthcare system and the most recent interesting technology is the Internet of Things (IoT). IoT aims to provide means to access and control all kinds of ubiquitous and uniquely identifiable devices, facilities and assets.

In this paper we have presented the u-healthcare system in the Internet of Things (IoT) environment with the support of the mobile gateway which makes it possible for integration. We have presented here the mobile gateway architecture in which the main purpose is to receive the sensing data and make a local analysis and generate keywords and then will be sent to remote medical server for analysis. This mobile gateway used Bluetooth technology to send and receive data from the sensor devices.

This paper is organized as follows: Section 2 discuss the background of the study, Section 3 discuss about the u-healthcare and the Internet of Things (IoT), Section 4 is the system architecture, Section 5 discuss about the system implementation and lastly, Section 6 is the conclusion.

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2. Background

This section discusses the background of the study, the technology used and the related areaswhich are necessary to this study.

2.1 Internet of Things

In healthcare the possibilities to go beyond usual is so great. Many technologies seen to be a big help in ubiquitous application for healthcare services. These include equipment that has inherent intelligence such us transducers, sensors, actuators, motes, mobile devices, industrial controllers, HVAC controllers, home gadgets, surveillance cameras, and others, as well as externally enabled things or objects, such as all kind of assets aged with RFID, humans, animals, or vehicles, that carry smart gadgets, and so forth [1]. Imagine a wrist or arm band that senses vital signs such as pulse, blood pressure, red blood cell counts, and glucose and cholesterol levels can even monitor activity levels. If walking is a prescribed benefit, the user might be reminded to do so. If medications should be taken at intervals, the user might be alerted to optimal timing. Home, office or mobile ICT devices like smart phones, tablets, laptops and computers might provide the robust connectivity needed for accessing a patient's medical history, uploaded by a medical professional or fitness advisor, where the medical device could synthesize it into health advisories or alerts.

IoT offers promising opportunities to u-healthcare area. The idea is applied to u-healthcare to improve access and interconnection of devices used in u-healthcare. Embedded technologies will take an important role to deliver u-healthcare to people in remote locations and monitoring system that provide a continuous stream of accurate data for better healthcare decisions. As the technology for collecting, analyzing and transmitting data, IoT continue to improve; the IoT-driven healthcare applications and systems emerge. In the Internet of Things (IoT), devices gather and share information directly with each other and the cloud, making it possible to collect record and analyze new data streams faster and more accurately. That suggests all sorts of interesting possibilities across a range of industries: cars that sense wear and tear and self-schedule maintenance or trains that dynamically calculate and report projected arrival times to waiting passengers.

Communications are via sorts of long-and short-range wired or wireless devices in different kinds of networking environments such as Intranet, extranet, and Internet that are supported by technologies such as cloud computing, SaaS, and SOA based on regulated data formats and transmission standards. The immediate goal is to achieved pervasive M2M connectivity and grand integration and to provide secure, fast, real-time and personalized functionalities, services such as monitoring, sensing, tracking, locating, alerting, scheduling, controlling, protecting, logging, auditing, planning, maintenance, upgrading, data mining, trending, reporting, decision support, dashboard, back office application, and others. The ultimate goal is to build a universally connected world that is highly productive, energy efficient, secure, and environment friendly

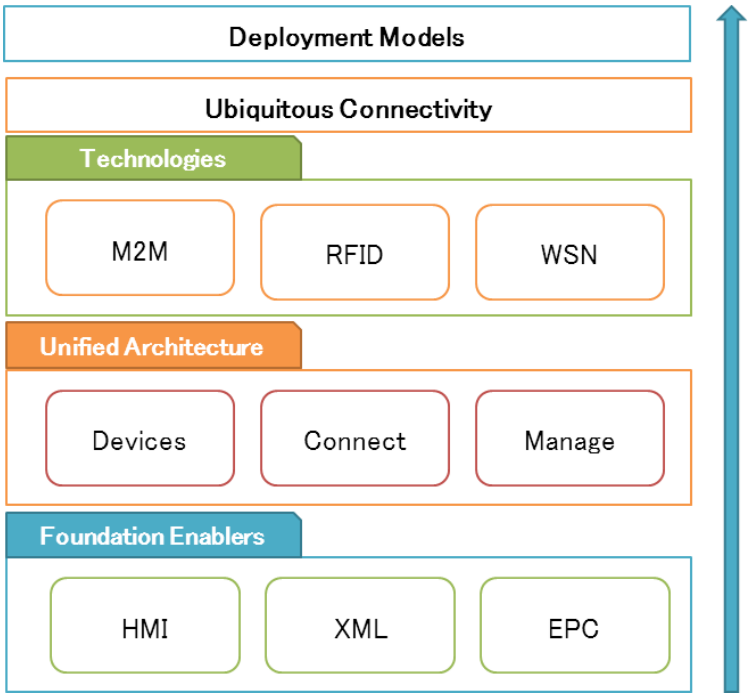

Figure 1. Internet of Things (IoT) architecture overview

2.2 WSN Typical Architecture

WSN is more for sensing and information-collecting purposes. Wireless Sensor Networks (WSNs) consisting of low power, low data-rate communicating sensor nodes can collect valuable information of various processes under observation over an area of interest. Sensor nodes must be able to communicate with some distant location or be accessible from it. This is typically done via other nodes and through an appropriate gateway(s) to other networks. In such case only these need to support multiple communication interfaces. In addition to data from sensors it is increasingly important for advanced applications to have an access also to the metadata providing spatial, temporal and thematic information required for discovering, analyzing and managing sensor data. As an example of basic metadata we use in this paper sensor nodes identification numbers and their geo-locations. These includes, Body sensor network (BSN), visual or video sensor network (VSN), vehicular sensor network and other sensor networks application. BSN is term used to describe the application of wearable computing devices to enable wireless communication between several miniaturized body-sensor units and a single body central unit worn on the human body to transmit vital signs and motion readings to medical practitioners or caregivers. Application of BSN are expected to appear primarily in the healthcare domain, especially for continuous monitoring and logging of vital parameters for patients suffering from chronic maladies such as diabetes, asthma, and heart attacks.

The architecture of a typical sensor network is shown in figure above. The topology of the WSNs can vary from a simple star network to an advanced multi-hop mesh network with a gateway sensor node connected with a remote central server. Sensor node sense target events, gather sensor readings, manipulate information, and send them to gateway via radio link. The base station communicates with sensor nodes and user. The operator sends query and do the managerial tasks.

Mobile sensor networks are WSNs in which nodes can move under their own control or

under the control of the environment. Mobile network systems combined the most advanced concepts in perception, communication, and control to create computational systems capable of interacting in meaningful ways with the physical environment, thus extending the capabilities of each network component and network user encompass a much wider area and range of data. A key difference between a mobile WSN and static WSN is how information is distributed over the network. Under the static nodes, a new task or data can be flooded across the network in a very predictable way. Under mobility, this kind of flooding is more complex, depending on the mobility model of the nodes in the system. The proliferation of commodity smartphones that can provide location estimates using variety of sensors, GPS, Wifi real-time location systems, or cellular triangulation [3, 4].

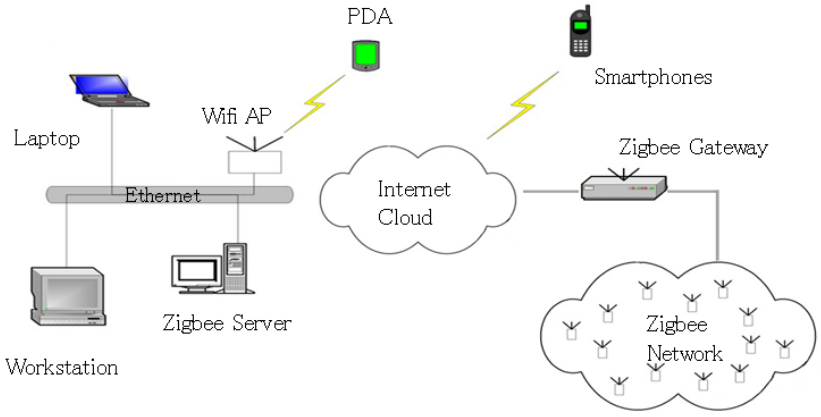

Figure 2. WSN Typical Architecture in Zigbee environment

3. U-healthcare and the Internet of Things (IoT)

The internet of things provides the means to access and control two categories of ubiquitous and uniquely identifiable devices- those that have inherent intelligence and those that are externally enabled via all sorts of wired and/or wireless communications in all kinds of networking environments, supported by cloud computing technologies with adequate security measures, to achieve pervasive connectivity and grand integration and to provide services such as monitoring, locating, controlling, reporting, decision support and so on.

A revolution in healthcare is quietly brewing. The “Internet of Things” a global system that could eventually comprise billions of devices and applications including sensors, actuators, microcontrollers, mobile-communication devices, nano-pumps and more will make health monitoring, diagnostics and treatment more personalized, timely and convenient, while also lowering costs.

BAN devices may be embedded inside the body, implants, may be surface-mounted on the body in a fixed position Wearable technology or may be accompanied devices which humans can carry in different positions, in clothes pockets, by hand or in various bags. Figure 3 shows the BSN Typical Architecture in the cloud. This is one of the practical applications of Internet of Things in u-healthcare system.

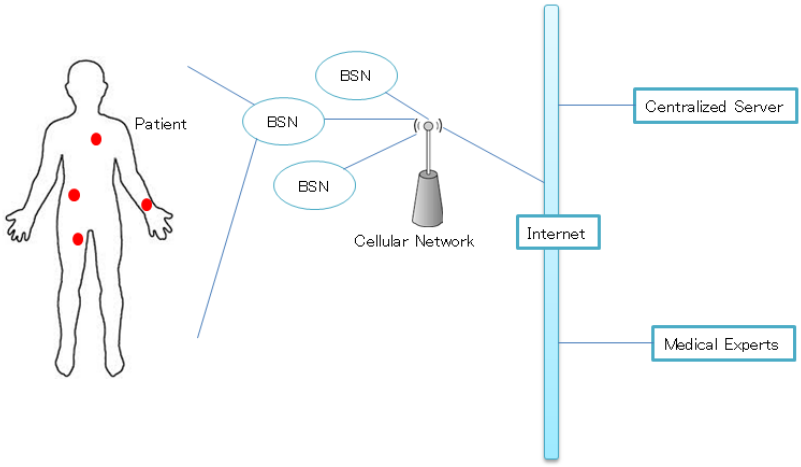

Figure 3. BSN Typical Architecture in the cloud

4. System Architecture

Mobile healthcare applications include applications related to health/medicine, social network and human-to-human services. These mobile applications maybe applied to all aspects of our lives.

It provides the sensed information to a home medical station or doctor. It analyzes the details of the patient's healthcare information and it also delivers the doctor's instructions. It can provide selective medical knowledge using the healthcare expert system, which accumulates the know-how of physicians and healthcare professionals. It can deliver the healthcare information and treatment methods.

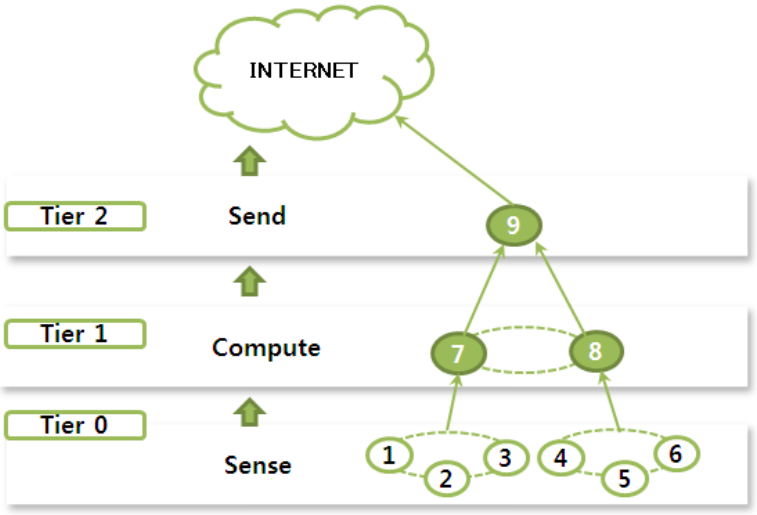

Figure 4. Tiers of u-healthcare System

The Figure 4 shows the tiers of u-healthcare System. First, in the Tier 1, the body sensor senses the data and transmits to the mobile phone. Mobile phone is capable of processing the data received through multi-purpose gateways and compute the received information in Tier 2.

The mobile phone will transmit the data to be analyzed in monitoring center (MC) in Tier 3.

The mobile phone will compute the received sensing information and generate keywords and transmit to the monitoring system through mobile phone. Then the monitoring center received the keywords and give diagnosis as a result.With the Internet of Things (IoT) this u-healthcare system is possible.

The data is filtered by using the semantic meanings. Local analysis is performed by program installed in mobile phone. Internet provides interesting u-healthcare information as feedback to the mobile healthcare client layer.

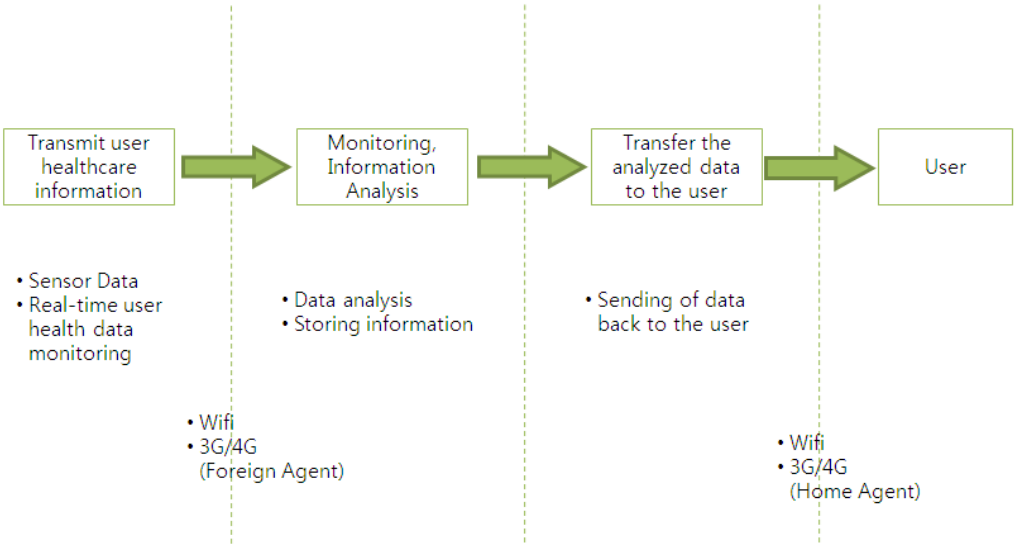

Figure 5. Message transmission flow

In forward information flow, the mobile gathers digital bio-signal data, user locations and environment information. Then it is periodically or non-periodically transmitted to the medical expert system via internet. Figure shows the message flow of the data from the sensor devices to the mobile phone and the keyword analysis to the transferring of the analyze data to the user.

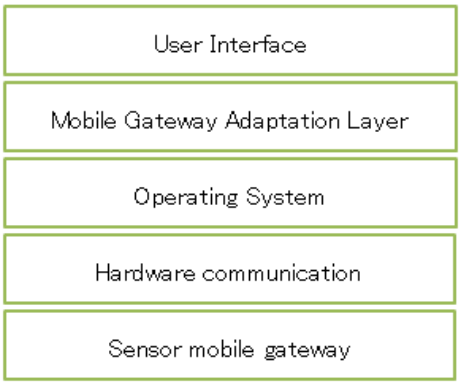

Figure 6. Sensor Mobile gateway

For the satisfactory information transmission of the mobile healthcare, seamless data transfer must be supported. To construct a seamless data flow, the heterogeneous network integration, the disconnected operations and the communication link redundancy are important issues.

Sensor mobile gateway should ideally be hosted on a small and portable device, suitable for daily use, such as a smartphone or PDA. The majority of smartphones and PDAs currently do not support typical WSN or Near Field Communication interfaces, but there already are some exceptions which are announcing their comprehensive implementation.

A general mobile gateway structure that suits various sensor networks with homogeneous or heterogeneous nodes from the hardware and software point of view is depicted in Fig.6. Such mobile gateway should integrate interfaces to sensor network technologies such as ZigBee, WirelessHART, 6LoWPAN and ANT on one hand and interfaces to other well established data communication technologiesincluding Bluetooth, Wi-Fi and GSM/UMTS on the other.

5. System Implementation

To configure heterogeneous cloud system as single information transmission flow, a compatible interface for information security and information transmission of bio-signal must be supported. Also in order to configure by integrating the mobile healthcare cloud system, the components for minimum basic standard configuration and open interface specification must be proposed.

Server side HTTP connection via GPRS, EDGE, 3G, or 4G enabled mobile internet access. The first and second layer performs the translation between HTTP and Bluetooth communication which run in smartphone in J2ME application and between Bluetooth and Zigbee communication. The last is the graphical user interface running on smartphone. Adaptation layer monitors communication on all attachedand relevant communication interfaces and reacts only on data received interrupts. It interprets all received frames, removes old and adds new headers,and forwards new frames to the appropriate destination interface or data to GUI. The relevant keywords are then generated and send to remote medical expert system for diagnosis.

6. Conclusion

This paper studies the u-healthcare system with respect to the Internet of Things (IoT) perspective. In our study, we come up to the proposed mobile gateway interface to support the mobile devices to be a device to receive sensing information from the sensor devices. This study aims to make mobile device gateway an integrated gateway which supports heterogeneous devices. In the propose u-healthcare system, the received sensing information will be analyze using smartphone devices which will generate keywords. The keywords will then be sent to the medical expert system for analysis. The finding will then be sent to the user as final diagnosis of the health condition.

Acknowledgements

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