A SECURED MOBILE HEALTH CARE SYSTEM USING WIRELESS BODY SENSOR NETWORK

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Abstract

In the modern health care environment, IoT technologies are used for convenience of physicians and patients. Health care monitoring for patients and physically disabled persons has become a focus of recent researches and developments. Identification and solving the health issues of patients have become difficult, because of poor mobility and weak interaction in existing healthcare systems. This paper proposes A Secured Mobile Health care System using Wireless Body Sensor Network (WBSN). The nodes of WBSNs include ECG sensors, EEG sensors, EMG sensors, BP sensors, Motion sensors, Thermometer sensors etc. This proposed people-centric sensing system is efficient in solving the problems faced by patients and physician by monitoring human activities and interacting with the living environment.

Index Terms: Wireless Body Sensor Network, Internet of Things, Health care, Security.

I. INTRODUCTION

Internet of things is an integrated part of Future Internet and could be defined as a dynamic global network infrastructure with self configuring capabilities based on standard and interoperable communication protocols where physical and virtual things have identities physical attributes and virtual personalities and use intelligent interfaces and are seamlessly integrated into the information network. In the IoT 'things' are expected to become active participants in business, information and social processes where there are enabled to interact and communicate among themselves and with the environment, while reacting autonomously to the 'real/ physical world' events and influencing it by running processes that trigger actions and create services with or without direct human intervention.

Internet of things is having different features which mainly include univocally identifiable and addressable objects, artificial intelligence, size consideration, and Geo-localization. IoT can be implemented through Wi-Fi, Barcode, ZigBee, radio frequency identification technology (RFID), sensors and smart phones.

IoT can be used in different applications such as traffic monitoring, security, transport and logistics, daily and domestics and health care etc. Healthcare monitoring system of the patients can be effectively implemented using IoT. IoT is mainly to solve issue of interconnection such as Things to Things, Human to Things and Human to Human. All objects in the physical world can take the initiative to exchange information via the Internet, to achieve interconnection each other in any time and place, ubiquitous networking and ubiquitous computing. Wireless body sensor network (BSN) and smart phones are important part of IoT in health care monitoring for communication. A Secured Mobile Health care System using Wireless Body Sensor Network is proposed in this paper.

II. RELATED WORK

Lin Yang et.al. propsed a paper "A Home Mobile Healthcare System for Wheelchair Users" which explains the system architecture and design of Wireless Body Sensor Networks. The system is monitoring the status of wheelchair and living environment to realize the dangerous state of wheelchair users. [6]

Prosanta Gope et.al. explained in the paper "BSN-Care: A Secure IoT-based Modern Healthcare System Using Body Sensor Network" about the Body Sensor Network technologies as one of the core technologies of IoT developments in healthcare system. In this system a patient can be monitored using a collection of tiny-powered and lightweight wireless sensor nodes [1].

Tzonelih Hwang et.al. discussed about distributed IoT system architecture and anonymous authentication scheme in the paper "Untraceable Sensor Movement in Distributed IoT Infrastructure". The proposed system works in three phases: Registration phase, inter-cluster movement phase and inter-network movement phase. It provides more security features with the assurance of less computational overhead [2].

Tianhe Gong et.al. analyzed the problems in current smart health care system in the paper "A medical Health care system for privacy protection based on IoT". A lightweight private homomorphism algorithms and an encryption algorithm improved from DES are designed for privacy protection [5].

Tae-Yoon Kim et.al proposed a multi-hop WBAN construction scheme that is consists of 4 operations, the clustered topology setup, mobility support, and transmission efficiency enhancement. As an auxiliary benefit, the proposed scheme achieves an energy efficient feature by reducing the number of total control messages [3].

Charalampos Doukas et.al. presented platform based on Cloud Computing for management of mobile and wearable healthcare sensors, demonstrating this way the IoT paradigm applied on pervasive healthcare [4].

Geng Yang et.al.proposed an intelligent home-based platform, the iHome Health-IoT. The platform involves an open-platform-based intelligent medicine box (iMedBox) with enhanced connectivity and inter- changeability for the integration of devices and services; intelligent pharmaceutical packaging (iMedPack) with communication capability enabled by passive radio-frequency identification (RFID) and actuation capability enabled by functional materials; and a flexible and wearable bio-medical sensor device (Bio-Patch) enabled by the state-of-the-art inkjet printing technology and system-on-chip. The proposed platform seamlessly fuses IoT devices (e.g., wearable sensors and intelligent medicine packages) with in-home healthcare services (e.g., telemedicine) for an improved user experience and service efficiency. The feasibility of the implemented iHome Health-IoT platform has been proven in field trials [7].

III. PROPOSED SYSTEM

In today's modern world, wireless sensor networks and embedded computing technologies, miniaturized pervasive health monitoring devices have become practically feasible. The recently proposed Body Sensor Networks (BSN) incorporates context aware sensing for increased sensitivity and specificity also, it provides continuous monitoring and analysis of physiological parameters. With its low power, flexible and compact design, the BSN nodes provide a versatile environment for wireless sensing research and development [1].

The architecture of Health Monitoring system is shown in

Fig. 1. WBSNs and smart objects are described in first part. Interaction of smart phone with WBSNs and smart objects are discussed in second part and data center layer in the cloud is the third part.

A. WBSNs and Smart Objects

Body Sensor Network (BSN) allows the integration of intelligent, miniaturized low-power sensor nodes in, on or around human body to monitor body functions and the surrounding environment. Generally, BSN consists of in-body and on-body sensor networks. An in-body sensor network allows communication between invasive/implanted devices and base station. On the other hand, an on-body sensor network allows communication between non-invasive/wearable devices and a coordinator [1].

The first part of proposed health monitoring system architecture composed of wearable and implantable sensors. Each sensor node is integrated with bio-sensors such as Electrocardiogram (ECG), Electromyography (EMG), Electroencephalography (EEG), Blood Pressure (BP), etc. These sensors collect the physiological parameters for e.g. The ECG allows you to assess the electrical and muscular functions of the heart, EMG evaluates and records the electrical activity produced by skeletal muscles, EEG records electrical activity of the brain and so on. After collecting these physiological parameters, they are forwarded to a coordinator called Local Processing Unit

(LPU), which can be a portable device such as PDA, smart-phone etc [6].

Fig. 1 The architecture of health monitoring system

B. Local Processing Unit (LPU)

The second part of this system explains the interaction between BSN, smart objects and LPU. The LPU works as a router between the BSN nodes and the central server, using the wireless communication mediums such as mobile networks 3G/CDMA/GPRS. Whenever the LPU detects any abnormalities then it immediately provides alert to the person who is wearing the bio-sensors. For example, in general BP More than 120 over 80 and less than 140 over 90 is normal, when the BP of the person reaches above/below the normal range, the LPU will provide a gentle alert to the person through the LPU devices (e.g. beep tone in a mobile phone) and also send the details to concerned family member. If required this data can also be forwarded to the physician and preventive actions can be taken as per the table 1.

The smart phone works as a gateway of local sensor networks and also the server of managing the smart objects. As a gateway, the smart phone bridges the short range wireless networks to the internet. And as a server, the smart phone process, store and visualize the data from the sink node. The smart phone can also work as the interface to interact with intelligent device, and it changes the statue of the equipment via operating the screen. While the patient move outdoors, the smart phone also perceives the surroundings via the sensors build-in the phone, such as GPS, camera, accelerometer, compass Etc [1][6].

TABLE I
EXAMPLE OF ACTION TABLE USING BP DATA

BSN BP Data	**Action**	**Response**
BP ≤ 120	No Action	Null
BP > 130	Inform Family Members	FR:T/F
BP > 160 and FR:F	Inform Local Physician	PR:T/F
BP >160, FR:F and PR:F	Inform Emergency	ER:T/F
FR:Family Response; **PR**:Physician Response; **ER**:Emergency Response		

C. Data Center Layer

The data center is a software platform to contain data from gateway via internet communication infrastructure, such as 3G, GPRS Etc. to manage and share the data of smart objects. The aim of data center is to visualize the real-time data of the human and living environment that analyzes the historical data of physiological parameter for giving healthcare advices, and accordingly sends alarm message of emergency to family and physicians. After manually confirming the abnormal data it is stored to sample trainings library for automation warning.

In this proposed system, when a LPU wants to send the periodical updates to data center, then it needs to confirm the identity of LPU.

D. Security for Data Center Layer

We can divide all security requirements into two parts: network security, and data security. Network security comprises anonymity,

authentication, and secure localization. On the other hand, data security includes data privacy, data integrity, and data freshness. In order to achieve all the network security requirements we will use a lightweight anonymous authentication protocol. It consists of two phases: In Phase 1, the data center issues security credentials to a LPU using secure channel, this phase is known as registration phase. The next phase of authentication protocol is the anonymous authentication phase, where before data transmission from the LPU to data center, both the LPU and the data center will authenticate each other.

IV. CONCLUSION

Aiming at the current problems in Health monitoring system, a secured health care system using wireless body sensor network has been proposed in this paper. First we have described the health care applications using body sensor network (BSN) and the security and the privacy issues in it. The system provides continuous monitoring and analysis of physiological parameters of patient and corrective action will be taken accordingly.

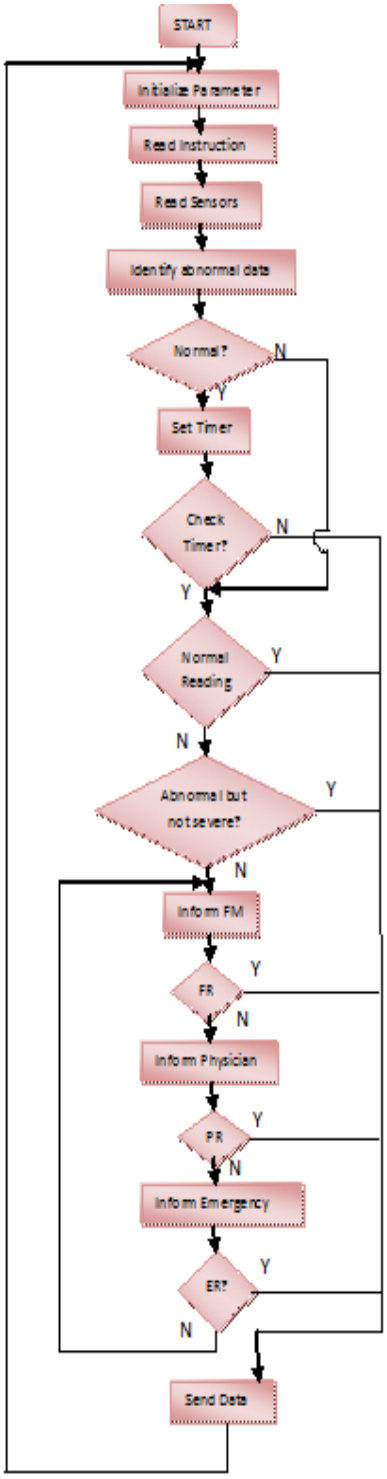

Fig. 2 Flowchart of radio module

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