I-Care: A realistic lightweight IoT-Based Body Sensor Networks for emergency medical care

SRI SILPA PADMANABHUNI [1]
M.Tech
[1] Assistant Professor, Dept. of CSE, Pottisreeramulu Chalavadi Mallikharjuna Rao College of Engineering & Technology, A.P, India

Abstract: The need arises to get or to provide proper health care services, as the population is increasing worldwide day by day. This need gap may be build up with the help of modern technologies. One of the nucleus technologies of IoT developments in healthcare system is Body Sensor Network (BSN) technology, where a patient can be monitored using a collection of wireless sensor nodes. Sensor is one such technology which can provide the means for Internet of Things based health-care monitoring system. Internet of Things (IoT) method is fitted to healthcare communication for accessing the patient's medical parameters in local and remote area. Without taken into consideration security concern the development of this new technology in healthcare applications makes patient privacy susceptible. Security should be prerequisite while handling the data regarding health. Services are created in an effective manner after fundamental requirements get satisfied, so that social significance can be achieved in various scenarios. We propose a secure IoT-based healthcare system using BSN, which can bring about those requirements adequately. In this Paper we have addressed the use of IoT in Healthcare system, and review on various works carried out on this research area with which a proposed methodology is been discussed.

Keywords:BSN, Data Privacy, Raspberry Pi, Authentication, Encryption, Decryption.

I. INTRODUCTION

In the last decennary the average life expectancy has in-creased substantially while the mortality rate decreased due to the worldwide advancements in society, economy and healthcare. As a result of this, the number of elderly people worldwide has risen constantly. In Today's date, the average percentage of elderly people (a person who is 65 years old or more) worldwide of 8Across the existing chain of frameworks, Internet of Things allows objects to be sensed and controlled remotely. Mainly IoT is cyber-physical systems or a network of networks with the tremendous number of things/objects and sensors/actuators associated to the Internet. By connected things and sensors immense and in some circumstances real-time data flow will be certainly produced. The health condition of a patient can be supervised seamlessly which allows critical illness to be detected at the right time so that suitable actions can be taken as IoT assisted patients can be approached over the internet and by other machines. Also, IoT can support for collecting health documents or records. Generating statistical information correlated to health state, can be done by machines. In IoT-based modern healthcare system, the body sensor network (BSN) technology is one of the most vital technologies used. It is basically a collection of low-power and lightweight wireless sensor nodes that are used to monitor the human body functions and surrounding environment. Since BSN nodes are used to collect sensitive (life-critical) information and may operate in unfavorable environments, accordingly, they require strict security mechanisms to prevent vicious interaction with the system. In this article, at first we address the several security requirements in in BSN based modern healthcare system. Then, we propose a secure IoT based healthcare system using BSN, which can guarantee to efficiently accomplish those requirements.

II. RELATED WORK

The advancement of BSN in healthcare applications have made patient monitoring more feasible. Recently, several wireless healthcare researches and projects have been proposed, which can aim to provide continuous patient monitoring, in-ambulatory, in-clinic, and open environment monitoring (e.g. athlete health monitoring).

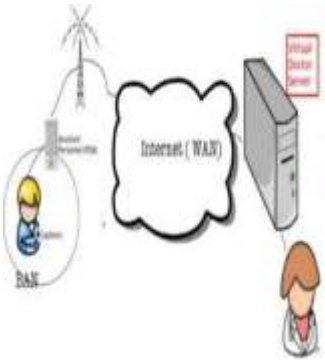
This section describes few popular research projects about healthcare system using body sensor networks.CodeBlue is a popular healthcare research project based on BSN developed at Harvard Sensor Network Lab. In this architecture, several bio-sensors are placed on patient's body. These sensors sense the patient body and transmit it wirelessly to the end-user device (PDAs, laptops, and personal computer) for further analysis. The basic idea of the CodeBlue is straightforward, a doctor or medical professional issues a query for patient health data using their personal digital assistant (PDA), which is based on a published and subscribed architecture. Besides, CodeBlue's authors acknowledge the need of security in medical applications, but until now security is still pending or they intentionally left the security aspects for future work. Subsequently, a heterogeneous network architecture named Alarm-net was designed at the university of Virginia . The research is specifically designed for patient health monitoring in the assisted-living and home environment. Alarm-net consist of body sensor networks and environmental sensor networks. Besides, the authors have developed a circadian activity rhythms program to aid context aware power management and privacy policies. Furthermore, Alarm-net facilitates network and data security for physiological, environment, behavioral parameters about the residents. However, Wood et al. have pointed out some confidentiality infringement scenarios on Alarm-net, such as the fact it is susceptible to adversarial confidentiality attacks, which can leak resident's location; Meanwhile, Ng et al. another BSN based healthcare system UbiMon was proposed in the department of computing, Imperial College, London. The aim of this project was to address the issues related to usage of wearable and implantable sensors for distributed mobile monitoring. Although Ng et al. proposed and demonstrated the ubiquitous healthcare monitoring architecture, it is widely accepted that without considering the security for wireless healthcare monitoring, which is a paramount requirement of healthcare applications, according to government laws. In 2006, Chakravorty designed a mobile healthcare project called MobiCare . MobiCare provides a wide-area mobile patient monitoring system that facilitates continuous and timely monitoring of the patients physiological status.Although, Chakravorty acknowledged the security issues in MobiCare, but only addressing security issues are not sufficient for real-time healthcare applications. Thus, security and privacy is still not implemented in MobiCare healthcare monitoring or may have been left out for future work.
Nevertheless, there are many security issues such as secure localization, anonymity, etc, have not even mentioned in MobiCare system. Recently, a new system designed at Johns Hopkins University named Median, especially designed for patient's monitoring in hospital and during disaster events was reported.
It comprises multiple physiological monitors (called PMs), which is battery powered motes and equipped with medical sensors for collecting patients' physiological health information's (e.g. blood oxygenation, pulse rate, etc.). In their description of Median its author acknowledged the need for encryption for PMs, however they did not mention which crypto-system has been used for data privacy and how they have checked the integrity of the received data. Thus, although the authors included some of the security properties to Median, their study did not reveal much information about their security implementation. Sometimes an image may contain text embedded on to it. Detecting and recognizing these characters can be very important, and removing these is important in the context of removing indirect advertisements, and for aesthetic reasons.

III SECURE IOT-BASED HEALTHCARE SYSTEM USING BSN (BSN-CARE)

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. It has great potential to revolutionize the future of healthcare technology and attained a number of researchers both from the academia and industry in the past few years. 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. Now, our BSN-Care
is a BSN architecture composed of wearable and implantable sensors. Each sensor node is integrated with biosensors such as Electrocardiogram (ECG), Electromyography (EMG), Electroencephalography (EEG), Blood Pressure (BP), etc. These sensors collect the physiological parameters and forward them to a coordinator called Local Processing Unit (LPU), which can be a portable device such as PDA, smart-phone etc. The LPU works as a router between the BSN nodes and the central server called BSN-Care server, using the wireless communication mediums such as mobile networks 3G/CDMA/GPRS.

Besides, when the LPU detects any abnormalities then it provides immediate alert to the person that wearing the bio-sensors. For example, in general BP less than or equal to 120 is normal, when the BP of the person reaches say 125,

the LPU will provide a buzzer sound.When BSN-Care server receives data of a person (who wearing several bio sensors) from LPU, then it feeds the BSN data into its database and analyzes those data. We can continuously monitor the patient when go out of hospital through mobile. We divide the all security requirements (mentioned above) into two parts: network security, and data security. Network security comprises authentication, anonymity, and secure localization. On the other hand, data security includes data privacy, data integrity. Now, to the best of the knowledge there is no two-party authentication protocol which can achieve all the aforesaid properties of the network security. Hence, in order to achieve all the network security requirements here we propose a lightweight anonymous authentication protocol. Subsequently, to accomplish all the data security requirements we adopt OCB authenticated encryption mode.



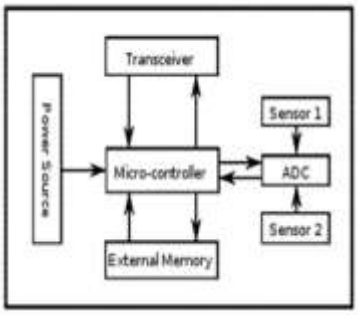


Fig1.Overall view of BSN Care system using IoT Fig2.Structure of BSN Network

IV. PROPOSED SYSTEM

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. On the other hand, an on-body sensor network allows communication between non-invasive/wearable devices and a coordinator. These sensors collect the physiological parameters and forward them to a coordinator called Local Processing Unit (LPU), which can be a portable device such as PDA, smart-phone etc. The LPU works as a router between the BSN nodes and the central server called BSN-Care server, using the wireless communication mediums such as mobile networks 3G/CDMA/GPRS. When the BSN-Care server receives data of a person (who wearing several bio sensors) from LPU, then it feeds the BSN data into its database and analyzes those data.

In our BSN system we enforcement of security in BSN-care system we divide the all security requirements (mentioned above) into two parts: network security, and data security. Network Security comprises authentication, anonymity, and secure localization. On the other hand, data security includes data privacy, data integrity, and data freshness. Now, to the best of the knowledge there is no two-party authentication protocol which can achieve all the afore said properties of the network security. Hence, in order to achieve all the network security requirements here we propose a lightweight anonymous authentication protocol. Subsequently, to accomplish all the data security requirements we adopt authenticated encryption mode.

IMPLEMENTATION

Raspberry Pi Board

Raspberry Pi is a credit-card-sized single board computer developed in the UK by Raspberry Pi foundation with the intention of stimulating the teaching of basic computer science in schools. It has two models; Model A has 25 6Mb RAM, one USB port and no network connection. Model B has 5 12Mb RAM, 2 USB ports and an Ethernet port. It has a Broadcom BCM2835 system on a chip which includes an ARMl176JZF -S 700 MHz processor, Video Core IV GPU, and an SD card. The GPU is capable of Blu-ray quality playback, using H.264 at 40MBits/s. It has a fast 3D core accessed using the supplied OpenGL ES2.0 and Open VG libraries. The chip specifically provides HDMI and

there is no VGA support. The foundation provides Debian and Arch Linux ARM distributions and also Python as the main programming language, with the support for BBC BASIC, C and Perl. Python was chosen as the main programming language, as it is generally accepted to be both easy to learn and a fully edged , programming language suitable for real world applications. Due to the unique advantages of the Raspberry Pi system, this technology holds great promise for providing solutions within the developing world. The most distinctive feature of the Raspberry Pi when used for educational purposes is the GPIO module.

A. Python Features

Python's features include: Easy-to-learn Python has few keywords, simple structure, and a clearly defined syntax. This allows the student to pick up the language quickly. Python's bulk of the library is very portable and cross-platform compatible on UNIX, Windows, and Macintosh. Interactive Mode: Python has support for an interactive mode which allows interactive testing and debugging of snippets of code. Portable Python can run on a wide variety of hardware platforms and has the same interface on all platforms.

B. ADXL Sensors

ADXL345 ultra-low-power digital accelerometer has an output data range that scales from 0.1Hz to 3.2 kHz, unlike competing devices, which have fixed 100Hz, 400Hz, or 1kHz data rates. This allows portable system designers to better manage energy consumption by precisely allocating power for a given system function and reserving unused power for other uses. The ADXL345 measures dynamic acceleration resulting from motion or shock and with a 10,000-g shock rating is well suited for applications such as hard-disk drive protection in personal computers.

C. Pulse Sensors

Pulse Sensor is a well-designed plug-and-play heart-rate sensor for microcontroller. It can be used by students, artists, athletes, makers, and game mobile developers who want to easily incorporate live heart rate data into their projects. The sensor clips onto a fingertip or earlobe and plugs right into microcontroller. It also includes an open-source monitoring app that graphs your pulse in real time.

VI. CONCLUSION AND FUTURE WORK

In this article, at first we have described the security and the privacy issues in healthcare applications using body sensor network (BSN). Subsequently, we found that even though most of the popular BSN based research projects acknowledge the issue of the security, but they fail to embed strong security services that could be preserve patient privacy. Finally, we proposed a secure IoT based healthcare system using BSN, called BSN-Care, which can efficiently accomplish various security requirements of the BSN based healthcare system.

References

[1] Ajmal Sawand, Soufiene Djahel, Zonghua Zhang, Farid Naït-Abdesselam, "Toward Energy-Efficient and Trustworthy eHealth Monitoring System", IEEE/CIC ICCC 2014.

[2] Boyi Xu, Li Da Xu, Hongming Cai, Cheng Xie,Jingyuan Hu, and Fenglin Bu, "Ubiquitous Data Accessing Method in IoT-Based Information System forEmergencyMedicalServices",IEEETRANSACTIONS ON INDUSTRIAL INFORMATICS

[3] Geng Yang, Li Xie, Matti Mäntysalo, Xiaolin Zhou, Zhibo Pang, Li Da Xu, Sharon, Kao Walter, Qiang Chen, Lirong Zheng, "A Health- IoT Platform Based on the Integration of Intelligent Packaging, Unobtrusive Bio-Sensor and Intelligent Medicine Box", IEEETransactions on Industrial Informatics, 2014.

[4] Jun Zhou, Xiaodong Lin, Xiaolei Dong, Zhenfu Cao, "PSMPA: Patient Self-controllable and Multi-level Privacy-preserving Cooperative Authentication in Distributed m-Healthcare Cloud Computing System",IEEE TRANSACTIONS ON PARALLEL AND DISTRIBUTED SYSTEMS, 2013.

[5] KUO-HUI YEH, K-H. Yeh, "A Secure IoT-Based Healthcare System With Body Sensor Networks", IEEE Access, 2017.

[6] Loreto Pescosolido, Riccardo Berta, Lorenzo Scalise, Gian Marco Revel, Alessandro De Gloria, Gianni Orlandi, "An IoT-inspired Cloud- based Web Service Architecture for e-Health Applications", IEEE, 2016.

[7] Ngo Manh Khoi, Saguna Saguna, Karan Mitra and Christer Ahlund, "IReHMo: An Efficient IoT-Based Remote Health Monitoring System for Smart Regions", International Conference on E- health Networking, Application & Services (HealthCom), 2015.

[8] Pardeep Kumar and Hoon-Jae Lee, "Security Issues in Healthcare Applications Using Wireless Medical Sensor Networks: A Survey", Sensors (Open Access), 2012.

[9] Ravi Kishore Kodali, Govinda Swamy, Boppana Lakshmi, "An Implementation of IoT for Healthcare", IEEE Recent Advances in Intelligent Computational Systems (RAICS), 2015.

[10] Sara Amendola, Rossella Lodato, Sabina Manzari, Cecilia Occhiuzzi, and Gaetano Marrocco, "RFID Technology for IoT-Based Personal Healthcare inSmart Spaces", IEEE INTERNET OF THINGS JOURNAL, VOL. 1, NO. 2, APRIL 2014.

[11] Sourav Kumar Dhar, Suman Sankar Bhunia, Nandini Mukherjee, "Interference Aware Scheduling of Sensors in IoT Enabled Health- care Monitoring System",Fourth International Conference of Emerging Applications of Information Technology, 2014.