A REVIEW ON WSN BASED PRIVACY & SECURITY OF HEALTH MONITORING SYSTEM

N.Kavitha[1] Dr.V.Selvi[2]
[1]Assistant Professor, E.M.G.Yadava Women's College, Madurai, Tamilnadu, India.
[2]Assistant Professor, Mother Teresa Women's University, Kodaikanal, Tamilnadu, India.

Abstract

Wireless Sensor Network (WSN) invaded medical applications widely. In the past decades the expansion of WSN had enhanced theoverall life aspects, its wide range of capability is utilized in the medical area. It is mainly used for periodical analyzes of human physiological activities like heart rate, blood pressure, sugar and glucose level etc. There are two types of sensors such as wearable and implanted, in which wearable applies on the human body surface or at close contact for action. The implantable medical devices are other kinds that insert into the human body in order to measure for various needs. On the health monitoring system, by means of smart work existing systems achieves examining of patient's activities periodically without the doctor. Wireless Sensor technology is well structured with hundreds or thousands of sensing nodes. These sensing nodes are mainly responsible for capturing or sensing the data. Then the acquired patient physiological details along with other needful information's were passed through the connected nodes. In the modern age, handling of these sensitive data is quite challenge in maintaining its security as well as privacy. To achieve this some security and privacy methods are followed by the research community. In this paper, several monitoring system are analyzed, which are perfect in monitoring various physiological parameters from the patient body. Generally, in healthcare monitoring system the nodes in the patient's body collect the signals from the wireless sensors and pass it to the base station. These sensing behavior updated to the doctor periodically about the patient's heart rate, blood pressure and so on through the application. In the future, it effectively solves the issues of communication delay between the doctor and patient. On overall it will gain good performance and considered to be more beneficial in the medical field.

1. INTRODUCTION

In medical applications there are several wireless technologies are used such as WBAN, WPAN, WWSN etc. Among which most widely used technology is Wireless Body Area Network (WBAN) for measuring the patient physiological signals. WBAN continuously operates the sensors and measures various activities like blood pressure, heart rate, glucose levels, and mobility etc. Generally, in the medical field, wireless sensor networks are two kinds such as wearable and implanted. In this survey, we have presented Wearable Wireless Sensor Networks (WWSN). The wireless sensors networks performance is examined on its aspect in healthcare or hospital environment. On this field, it is applied in a secured manner and analysis are based on the packet loss, access delay, packet segmentation etc. The patient's periodical activities like EEG, ECG, and GSRetc are monitored by implementing Wireless Personal Area Network (WPAN). For research process, all the analysis from the several sensors communicates with the personal server. There are several applications also exists in monitoring sick patients body position measurement in hospitals and at homes. All the information's like health, energy expenditure and fitness about an individual patient's are collected by the Body-area networks. On the aspect of wireless communications, analysis of cross-layer is more important. In the traditional layered approach, there are three major problems such as;

- In the traditional layered approach, sharing of different information within the different layers is not possible. It leads to incomplete sharing of information on each layer.
- Network optimization is not guaranteed in the traditional layered approach.
- The traditional layered approach cannot adapt to environmental change. It is due to the interference among different users, fading, access conflicts and change of environment in the WSN's. The wired networks of traditional layered approach are not suitable for wireless networks.

The remaining section of this paper is as follows. In section 2, discuss the research motivation and its key objectives. Section 3, represents the research challenges in detail. In section 4, analyze several kinds of literature surveys and their research work implementations and results obtained. Section 5, explains a clear view about the architecture of WSN Health monitoring system. In section 6, discuss the security Issues.In section 7, explain the various threats and attacks. In section 8, discuss the conclusion and future works.

2. Research Motivation

The technology advancement and enhancement had a great impact regarding the necessity of healthcare domain, which make use of smart devices rapidly. Now –a – day's more healthcare gadgets are more commonly used by patients at home. Most of the healthcare gadgets are encompass sensors. They are mostly transducers and having the detecting capability of thermal optical, chemical, electrical and other signals [1].The motto of this research is improving the health monitoring systems which are based on the IoT devices. Those devices collect information's from the WSNs and effectively processed the context-sensitive data which are relevant to the patients.

2.1 Key Objectives of Healthcare Systems

Few of the healthcare systemskey objectives as follows;

1) Enhancement in clinical decision making.
2) Minimizing duplication of diagnostic testing, imaging, and history taking.
3) Well-defined medication management.
4) Adoption of screening programs have maximized and health measures are also preventive.

3. Research challenges

In the real-time world, theevolution of WSN is rapid by its wide variety of applications in various fields. Its enhanced potentiality has modified our economy and life in a quiet manner. Still, there is a need for advanced protocols and algorithms to overcome the real-time challenges in this field. Before designing a better protocol it is important to analyze its working as well as a deep understanding of the challenges. Major challenges in implementing a Health Monitoring System are listed below;

1) Ensuring privacy and security
2) Technical issues
3) Organizational obstacles
4) Financial costs
5) Different policies
6) Effective training programs for practitioners and healthcare providers

4. Literature survey

In this survey section, we have discussed different technologies which are to be utilized in the proposed research. Other works based on this research will also be reviewed in the upcoming subsections

Data distribution to several nodes is considered as one of the major problems in wireless sensor network [3-7]. The major task which is considered in WSN processing is task scheduling, allocating and data sensing. In WSN's, OS and middleware architectures were also plays important role in data distribution. In recent years, the implementation of Wireless Sensor Networks (WSNs) in health care monitoring system was increased tremendously. In many kinds of research, the remote server carried out the process of the sensor, emergency messages sending and health state decisions making entirely. Managing and transmission of huge data volume consume more communication resource. This makes the remote server lack in performance as well as the delay in decision time and notification time.

Ahmed Harbouche et al proposed the implementation of WBSN in his work. The WBSN is a wireless network that is specially structured which enables communication flow between the sensor nodes. These are sensor nodes are attached to a human body which is responsible for monitoring vital signals, parameters, and environment. The WBSN systems design and implementation on health monitoring field grab lot of attention among the researchers. The costly health care's encouraged this design and pave a way for the development of miniature health monitoring devices.

D Mahesh Kumar designed a special prototype for WSN health care systems at a home environment. It is a concept of smart gateway integration based on interconnection and services management platform. This design built an association between WS and public communication networks. The combined structure of lightweight database, smart gateway system and onboard data decision system enables effective patients' health state decisions even in low-power and low-cost embedded systems. It also establishes the communication protocols among the WSN, gateway and remote servers. For achieving of exact report and information notifications to caregivers, Ethernet, WI-FI and GSM/GPRS communication modules were also additionally integrated.

To bridge communication between the residents and their caregivers, in-home pervasive networks provides a continuous report on medical monitoring, medical data access, memory enhancement and emergency communication [8, 9]. By means of the constant monitoring it possible to detect the emergency conditions and diseases of the patients. Additionally based on the environment it also allows offers a wide range of healthcare services in the aspect of cognitive and physical disabilities [10]. It is more benefits for the parents in delivering high-quality care services for their babies and little children. To innovate a broad vision of smart healthcare, a combined dedication is carried out among the computer, networking, and medical field researchers globally.

5. Healthcare Monitoring System Working Principle

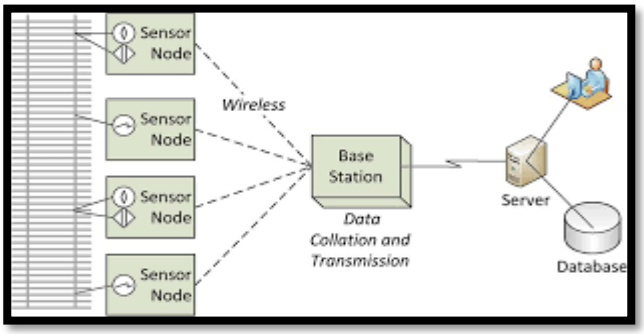

Fig-1 General architecture Health monitoring system in WSN

In the architecture of WSN Health monitoring system, the base station consists one or more components like computational, energy and communication resources. Those are responsible for the communication of data between the sensor nodes and the end user as well as forwarding data WSN to a server.

A WSN is a wireless network with spatially distributed autonomous devices mainly utilized for monitoring the physical or environmental conditions [11-21]. This WSN system act as a gateway by providing a link to the wired world and distributed nodes. The selection of wireless protocol is based on your requirements. The available wireless protocol is 2.4 GHz radios which are based on either IEEE 802.15.4 or IEEE 802.11 standards or proprietary radios of generally 900 MHz.

Sensor Nodes	Base station	End-user

Fig-2 Structure diagram in Healthcare monitoring system

In a typical sensor network, the major components are;

Sensor nodes: Sensor nodes are considered as the heart of the network. The main responsibility of these sensor nodes is collecting and routing the gathered information's.

Sensor field: It is an area where the nodes to get placed.

Base Station: In the network, the base station is the central point of controls. The extract the data and distributes those data into the network. For the other network, it is a gateway, storage place, powerful data processing component and access point where a human can interface. A base station can be a laptop or a workstation, on which the data are streamed by means of various communication modes like the Internet, wireless channels, satellite etc.

User: User is who using the data or information of the wireless sensor network. The user can perform some desired task or take a decision by means of this informations.

This survey represents Wearable Wireless Sensor Networks and the performance of WSN in the healthcare system. Fig 3 describes the Body sensor network (BSN) systems architecture in providing healthcare services. It performs major functions like medical data access, medical monitoring and providing communication between the healthcare provider and the doctor. In emergency situations, these communications were sent to the doctor via SMS or GPRS. The wearable or implantable body sensor networks in the human executes continuous health monitoring and maximize the emergency condition detections among the patients. In addition, this system enables several suitable methods for acquiring and monitoring the physiological signals . These systems improve the patient's life quality without interrupting their normal life.

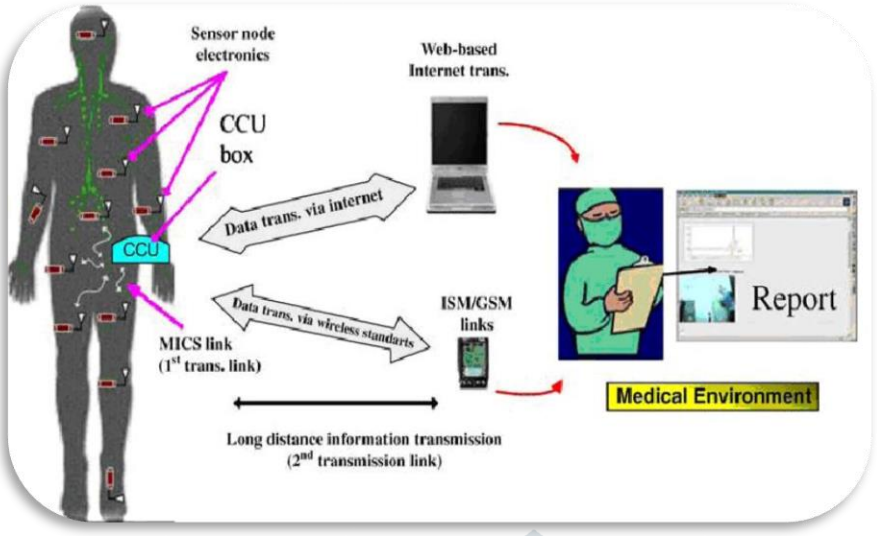

Fig-3 Functional diagram health care monitoring system in WSN

The present system achieves continuous monitoring of patient vital signs. This system needs the sensors to be connected with the PC's and make the patient be free from the bed. The wireless devices and wireless networks design do not required any relationship between equipment and sensors. It enables the patient to move around, but within the specific range for monitoring. Because on out of range it is not possible to collect the data. Take an example, an application for monitoring and controlling a pregnant woman. In general, the blood pressure of a pregnant woman is as same as the other normal person. But in pregnancy period it is must to monitor the blood pressure mainly for preeclampsia. A frequent BP check is to be carried, at the case on too high the women need to be hospitalized. In the existing system, the sensors attached to the patient's body detects the physiological signals and send to base-station along with the PC for the purpose of storing and analyzing. In the emergency cases, an alert by means of short message service (SMS) is also provided for immediate responses and rescues.

6. Security issues

Security is one in all the fore most concern in WSN, once it involves the medical system additional care ought to be taken to retain its privacy. On the side of security, many peoples outlined in numerous terms however the fact is maintaining the privacy of a system all told manner. consistent with the America Department of commerce web site security may be a condition with numerous institution and maintenance of protecting measures that guarantee during a state of inviolability from hostile acts or influences.

The need for advancement in the healthcare system and WSN advantages make the healthcare system in a wireless nature. In this advancement, the major issue is security threats. These security threats were leads to severe problems of an individual who uses the wireless sensor devices. Especially in some cases tracking the patient location may lead to unexpected serious losses. Some people maliciously track those private data and harm those patients. These drawbacks have widely grabbed the research community attention and always be in the active topic. In recent time's research on wireless sensor networks security issues are the major research areas. Various authors demonstrate their works on WSN security issues and some latest work specifically addressed security issues in healthcare applications. In the following section, we highlighted and discuss some major real-time threats and attacks along with its countermeasures.

7. Threats and attacks

Security issues in the healthcare applications of sensor networks are considered as the security issue of a WSN application environment. These security issues are of two levels such as system security and information security. A detail discussed in the following subsections. The author states there are two types of threats and attacks such as passive and active. The passive attack occurs during the routing of data packets in the systems. In which by means of the malicious activities the attacker divert the packet's destination or make routing inconsistent. There is a huge possibility of stealing health data by interfering in the wireless communication media. Next active attacks, it is deeply in concern as it leads to a life-threatening situation. Because it paves a way for cruel minded peoples in getting the location of the user by means of eavesdropping.

In the normal sensor device design, the external security features are limited and hence the possibility for physical tempering. These maximize the chance of device vulnerability and creates some severe security challenges. Correspondingly during the transmission between WBAN networks through GPRS, valid data can be stolen by eavesdropping.

.***Data modification***— For some illegal purposes, malicious attacker delete, replace the partial or entire information's and send the modified data to the original receiver. In the case of health-related data modifying those results in severe cases like system failure and even disaster for a person.

a. ***Impersonation attack***—An attacker interrupts in the wireless sensor node's identity information and those are more comfortable to cheat the other nodes in the network.
b. ***Eavesdropping***—The major problem of wireless channel used by sensor networks is the possibility of an opponent interruption in radio communications between the wireless nodes freely and easily. The stolen data were utilized for malicious purposes that results in severe causes.
c. ***Replaying***— The attacker can get a piece of valid information by means of interruption and resend to the original user to do some kind of violability in a different case.

These attacks and security threats are of both internal and external. It is hard to track the external attackers as they are not in part of the system. The main objective of these attackers is stealing valid personal data. Consider to wired media, wireless media is more vulnerable and easy for the attackers. The increasing value of personal health data maximizes the possibility of stealing in using both internal and external attacks.

8. Conclusion and Future Work

This paper demonstrates various existing WSN technology applied in health care monitoring system. This survey is generally based on the art of technologies in meeting the requirements which are stated by the dictatorial authorities. In existing works, the scholar first outstretched the different real-time issues like privacy, security, energy consumption of sensor nodes. Then they examine its cause and effects of these issues. In this survey not the entire list of challenges provided, but the represented challenges are considered as the major issues facing in wireless sensor networks. These challenges are mainly seen in WSN implementation on other application domains like energy, agriculture, and transportations. Our survey explains the wireless technology implementation in the medical field as well as their enormous energy consumption and security threats. By means of the disadvantages observed from the existing systems, this paper planned to fulfill the drawbacks in energy consumption, privacy and security issues in the future work.

Reference

[1]. V. Stantchev, A. Barnawi, S. Ghulam, J. Schubert, and G. Tamm, "Smart items, fog, and cloud computing as enablers of servitization in healthcare," Sensors & Transducers, vol. 185, no. 2, pp. 121–128, 2015. View at Google Scholar

[2] Institute of Medicine (US) Committee on Data Standards for Patient Safety, Key Capabilities of an Electronic Health Record System: Letter Report, National Academies Press, 2003.

[3] Amudhavel, J., Sruthy, G., Padmashree, D., Pazhani Raja, N., SaleemBasha, M.S., Bhuvaneswari, B., "A comprehensive analysis on multi-agent decision-making systems", (2016) Indian Journal of Science and Technology, 9 (11)

[4] Amudhavel, J., Vigneshwaran, R., Janakiram, A., Jarina, S., Prem Kumar, K., Anantharaj, B., Sathian, D., "An empirical analysis on Quality of Service(QoS) in cloud computing", (2016) Indian Journal of Science and Technology, 9 (22)

[5] Amudhavel, J., Dhavachelvan, P., Baskaran, R., "Leaf Cutter communication strategy, skills and attributes - a novel Bio-inspired intelligent communication for computing research", (2016) Indian Journal of Science and Technology, 9 (11)

[6] Karthikeyan, P., Sathian, D., Amudhavel, J., Raghav, R.S., Abraham, A., Dhavachelvan, P., "A comprehensive survey on variants and its extensions of BIG DATA in a cloud environment", (2015) ACM International Conference Proceeding Series, 06-07-March-2015

[7] Thilagavathi, N., Saravanan, D., Kumarakrishnan, S., Punniakodi, S., Amudhavel, J., Prabu, U., "A survey of reversible watermarking techniques, application, and attacks", (2015) ACM International Conference Proceeding Series, 06-07-March-2015 International Journal of Pure and Applied Mathematics Special Issue 491

[8] H.S. Ng, M.L. Sim, C.M. Tan, C.C. Wong, Wireless technologies for telemedicine, BT Technology Journal, Vol. 24, No.2,pp.130–137, 2006.

[9] S. Meyer, A. Rakotonirainy, A survey of research on context-aware homes, in Australasian Information Security Workshop Conference on ACSW Frontiers, Darlinghurst, pp. 159–168, 2003.

[10] C. Orwat, A. Graefe, T. Faulwasser, Towards pervasive computing in health care – a literature review, BMC Medical Informatics, and Decision Making, vol.8, no.1,pp.1-26. 2008.

[11] Padmapriya, V., Amudhavel, J., Gowri, V., Lakshmipriya, K., Vinothini, S., PremKumar, K., "Demystifying challenges, opportunities and issues of Big data frameworks", (2015) ACM International Conference Proceeding Series, 06-07- March-2015

[12] Amudhavel, J., Kodeeswari, C., Jarina, S., Jaiganesh, S., Bhuvaneswari, B., "Mathematical modeling on avoidance-to-acceptance transition in leaf-cutting ant colonies", (2016) Indian Journal of Science and Technology, 9 (11)

[13] Karthikeyan, P., Deepika, P., Amudhavel, J., Saranya, M., Infanta, E., Nandhini, C., "Impact on self-organization in Mobile AdHoc Networks: An comprehensive review", (2015) ACM International Conference Proceeding Series, 06-07-March-2015

[14] Jaiganesh, S., Jarina, S., Amudhavel, J., Premkumar, K., Sampathkumar, S., Vengattaraman, T., "Performance analysis of collision avoidance frame works in VANETS", (2016) Indian Journal of Science and Technology, 9 (11)

[15] Amudhavel, J., Prabhu, U., Inbavalli, P.,Moganarangan, N., Ravishankar, V., Baskaran, R., Dhavachelvan, P., "Survey and Analysis of Web Service Composition Strategies: A State of Art Performance Study", (2016) Indian Journal of Science and Technology, 9 (11)

[16] Amudhavel, J., Kumar, K.P., Jayachandrameena, C., Abinaya, Shanmugapriya, Jaiganesh, S., Kumar, S.S., Vengattaraman, T., "An robust recursive ant colony optimization strategy in VANET for accident avoidance (RACOVANET)", (2015) IEEE International Conference on Circuit, Power and Computing Technologies, ICCPCT 2015

[17] Amudhavel, J., Sathian, D., Raghav, R.S., Pasupathi, L., Baskaran, R., Dhavachelvan, P., "A fault tolerant distributed self organization in Peer to Peer (P2P) using Krill Herd optimization", (2015) ACM International Conference Proceeding Series, 06-07-March-2015

[18] Padmapriya, V., Bakkiya, K., Amudhavel, J., Sujitha, B., Thamizhselvi, M., Premkumar, K., "A scalable service oriented consistency model for cloud environment (SSOCM)", (2015) ACM International Conference Proceeding Series, 06-07- March-2015

[19] Amudhavel, J., Padmapriya, V., Gowri, V., Lakshmipriya, K., PremKumar, K., Thiyagarajan, B., "Perspectives, motivations, and implications of big data analytics", (2015) ACM International Conference Proceeding Series, 06-07-March-2015

[20] Amudhavel, J., Prabu, U., Dhavachelvan, P., Moganarangan, N., Ravishankar, V., Baskaran, R., "Non-homogeneous hidden Markov model approach for load balancing in web server farms (NH2M2-WSF)", (2015) Global Conference on Communication Technologies, GCCT 2015

[21] Ganesan, M., PremKumar, A., KumaraKrishnan, S., Lalitha, E., Manjula, B., Amudhavel, J., "A novel based algorithm for the prediction of abnormal heart rate using Bayesian algorithm in the wireless sensor network", (2015) ACM International Conference Proceeding Series, 06-07- March-2015

[22]A. Grady, S. Yoong, R. Sutherland, H. Lee, N. Nathan, and L. Wolfenden, "Improving the public health impact of eHealth and mHealth interventions," Australian and New Zealand Journal of Public Health, vol. 42, no. 2, 2018.

[23]I. Masood, Patient Data Privacy and Security in Sensor-Cloud Infrastructure: Past Present Future, vol. 35, ACM Computing Surveys, 4 edition, 2018.

[24] F. Firouzi, A. M. Rahmani, K. Mankodiya et al., "Internet-of-Things and big data for smarter healthcare: From device to architecture, applications and analytics," Future Generation Computer Systems, vol. 78, pp. 583–586, 2018

[25]S. Sharma, K. Chen, and A. Sheth, "Towards practical privacy-preserving analytics for IoT and cloud based healthcare systems," IEEE Internet Computing, vol. 22, pp. 42–51, 2018.

[26]I. Masood, Y. Wang, A. Daud, N. R. Aljohani, and H. Dawood, "Privacy management of patient physiological parameters," Telematics and Informatics, vol. 35, no. 4, pp. 677–701, 2018.