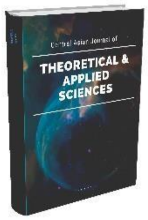

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Remote Cardiac Patients Monitoring System Using Internet of Medical Things (IoMT) Devices

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Abstract: *People nowadays are dealing with a variety of medical, physiological, and psychological issues. They don't have time to go to the specialist on a regular basis. A circumstance may arise when a patient needs immediate care. To address these problems, we need a system that gathers all data on people's illnesses in a variety of settings, from individual to city. Wireless sensor network (WSN) technology is one of the most important topics of study in computer science and the healthcare industry to improve people's lives. The goal of this study is to provide a broad overview of current research on wearable and implantable body area network systems for continuous patient monitoring, as well as future directions.. In this research, medical sensors (MedSnrs) were utilized to gather physiological data from patients and transmit it to an IPDA. The importance of body sensor networks in medicine is discussed in this article, including how they may lessen the need for caretakers and enable chronically unhealthy and elderly individuals to live more independently while still receiving high-quality care. Despite its many merits, the field of wearable and implanted BAN still has significant challenges and open research issues, which are examined and addressed in this article, as well as some prospective solutions.*

Keywords: *Internet of Medical Things (IoMT); Patient Surveillance; Cloud Computing; Medical Instruments, Intelligent Personal Digital Assistant (IPDA)*

I. INTRODUCTION

Because of technology improvements, low-power networked systems and MedSnrs are being incorporated as WSNs in healthcare. These WSNs have the potential to considerably enhance and raise care quality in a variety of situations and for varied populations[1]. As healthcare costs grow and the world's population ages, it's become more important to keep track of a patient's health outside of the hospital and at home. In recent years, a variety of system prototypes and commercial solutions have been created to address this need, with the goal of delivering real-time feedback information about the user's health state, a medical facility, or both. or directly to a supervising Professional physician, as well as the ability to alert the individual in the event of potentially life-threatening conditions. WSN also offers a novel approach to chronic illness management and monitoring for the elderly, post- operative rehabilitation patients, and those with special needs [2]. However, realizing the full potential of WSNs in healthcare necessitates overcoming a slew of technical issues, including the following:

1) Over multichip wireless networks applied in clinical situations, it is feasible to obtain very dependable data transmission [3].

2) Technologies that overcome bandwidth and energy constraints [4].

3) An examination of privacy and security issues in assisted living facilities, as well as possible answers [5].

4) Methods for coping with large-scale data quality issues[6].

The health of humans is increasingly being monitored through embedded sensor networks. A WBAN is created by carefully placing a number of small wireless sensors on/in the body of a patient. A WBAN may monitor vital signs and provide real-time feedback, allowing for a variety of patient diagnostic methods such as chronic disease surveillance and recovery tracking. Recent advancements in WSN have resulted in the creation of a new generation of WSNs that are ideal for on-body and in-body networked instruments[7][8].

II. ARCHITECTURAL DESIGN

The architecture of the remote healthcare surveillance system is described in this section. As indicated in Fig. 1, the system is divided into three stages. The system is made from with:

1) Client Side (Patients) with ECG signals aggregation (such as Holter Machine).
2) WSN for signals transmission between Client/Server continuously.
3) Cloud Server (ECG Signals Storage)as a Processing Side
4) Medical Internet of Things Instruments (IoMT) as a Decision Side.

III. LITERATURE REVIEW

The following are some of the works that are linked to the manuscript's goal: Abdulbaqi A.S., Saif Al-din M. Najim, and Ismail Yusuf Panessai are the authors of [9]. Introduced a comprehensive real-time patient surveillance approach that surveillance patients in a variety of settings. This system comprises of a WEMOS-UNO that is connected to a WSN through numerous electrodes on the patient's body and then connected to a PC to provide a comprehensive link to the expert online. Fatusi et al. looked at symptom uncertainty and causal correlations between many illnesses and symptoms in order to come up with a thorough estimate that could be trusted. For patient safety, a processor that gathers sensor signals is being implemented. Shihab A. Hameed et al. (2008) established a framework model for centralized medical records that utilize open source software and can be viewed and changed by professionals utilizing any internet browser. A.I. Heernande et al. provided a whole real-time framework for non-clinical electrocardiogram (ECG) processing, transmission, storage, and display in [12]. Raised, M.F.A., and Woodware, B., concentrated on creating the processor that collects patient signals from sensors in [13]. It then utilize the "General Packet Radio Service" to send digital data to a mobile phone through a Bluetooth connection (GPRS). The following are the primary contributions of this work: (I) Utilizing a new generation of microcontroller known as the Arduino UNO Type (model WEMOS D1-ESP 8266), (ii) Investigating more study by the research community.

IV. SYSTEM METHODOLOGY

The patient is the major character in this approach. Wearable sensors create a wireless body area network (WBAN), which monitors changes in a patient's vital signs and delivers real-time feedback to assist maintain optimum health. MedSnrs are usually made up of five major components:

1. **Sensors:** It's a chip that detects physiological data from a patient's body.
2. **Microcontrollers:** It controls the functioning of the sensor node's other components and conducts local data processing such as data compression.
3. **Memories:** It is utilized to temporarily store sensory data.
4. **Radio Transceivers:** It is in charge of wireless communication between nodes as well as sending and receiving detected physiological data.
5. **Power_Supply:** The nodes of the sensor are powered by batteries that have a long life span [14].

One or more physiological signals may be sensed, sampled, and processed by sensor nodes. EKG sensor, for example, can be utilized to surveillance the activity of the heart, sensor for blood pressure can be utilized to surveillance the pressure of the blood, a breathing sensor can be utilized to surveillance respiration, EMG sensor can be utilized to surveillance muscle activity, and EEG sensor can be utilized to surveillance brain electrical activity[10][15]. A powerful sensor called MSS is included into the WBAN in our design MSS. Other sensor nodes lack the memory, processing, and the capabilities of the communication of this sensor. MSS communicates with additional body sensors through radio frequency, whereas ZigBee is utilized as a communication mechanism with the Personal Server (PerSer)[16].

MSS gathers, filters, and stores essential patient data from body sensors invisibly, decreasing the vast amount of data supplied by BSNs. IEEE 802.15.4 / ZigBee implementation [12][17].

Due to each node no longer has to transmit sensed data to the IPDA but instead to the cool-lector, which is MSS and is closer to the BSs than the IPDA, total bandwidth utilize is improved while BSs power consumption is reduced and sensor node battery life is extended [18][19].

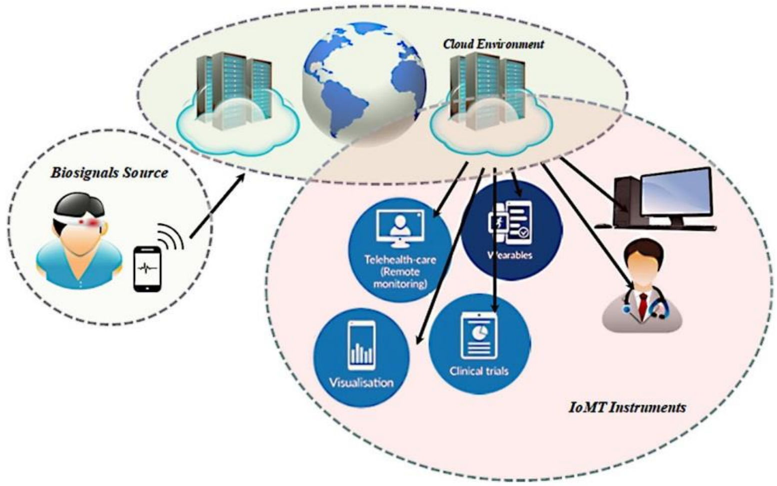

Fig.1. Overall system structure

The Server Side

The ZigBee protocol is used by WBAN nodes to connect with PerSer. The IPDA is used to implement it. It keeps track of patient records and connects to Medical Services (MedSer) through its IP address. When there is a sudden clinical change in the patient's current condition and data content, such as changes in cardiovascular signals, temperature, or oxygen saturation, it collects and processes physiological biosignals from the WBAN and prioritizes the transmission of critical data to the MedSer [15] [20]. IPDA may also analyse physiological data, use local heuristics to estimate a person's health state based on MSS data, and deliver feedback via an intuitive interactive visual user interface. Although PerSer and Layer 3 are interconnected through 3G connections, alternative long-distance communication protocols such as GPRS and WWAN may be utilized [21]. IPDA offers a premium service that uses two approaches to increase data transmission quality in terms of latency, bandwidth, and power consumption. Priority scheduling and data compression are the two. This approach utilizes less power during transmission since only the most necessary vital signals are provided instantaneously, while the less crucial ones are stored and transmitted later [22].

V. SURVEILLANCE MEDICAL SERVER (MMS)

The third tier, MedSers for Healthcare surveillance (MMS), is the backbone of the whole system, receiving data from the PerSer. It is located at medical facilities that offer MedSers. It is clever because it can learn patient-specific thresholds and from a patient's past treatment data [23]. MMS maintains electronic medical records (EMRs) for enrolled patients, which are accessible through the internet by a variety of medical workers from their hospital offices, including general practitioners, specialists, and specialists. The present status of the patient may be observed by medical staff. MMS is in responsible of user authentication, data extraction from a PerSer, data preparation and entry into the necessary EMRs, and data trend analysis [24].
The patient's physician may utilize the intranet/internet to acquire data and trends from his or her office and review them to verify the patient is within anticipated health metrics. Medical staff in the emergency unit may be notified if the collected data is out of range (i.e., a departure from the threshold) or if major health

abnormalities are identified. A professional will analyze the patient's physiological data, diagnose the disease, and prescribe the required treatment and medications if the patient is in a distant location. The specialist at the faraway hospital will get this information over the internet. The MMS also provides patient input, such as exercises recommended by the specialist [25].

Patient ID with Age	Temperature	ECG	Heart Rate	Sp O2	State of the Patatient
P1 (57)	90°F	80/ 135	110	92	Normal
P2(27)	95°F	80/135	90	96	Normal
P3(54)	102°F	80/123	110	85	Abnormal
P4(60)	105°F	80/116	120	78	Abnormal
P5(43)	90°F	80/125	100	96	Normal

This article assesses the current state of wearable low-cost unobtrusive health- surveillance research and development by summarizing and contrasting the attributes of the most promising current achievements of various worldwide initiatives and commercial products. Section II covers the most important and widely utilized biosensor technologies, as well as the associated measured biosignals.

CONCLUTION

Wireless networks are increasingly being utilized in medical applications. In this in-depth study article, we focused on the benefits of utilizing wireless networks for medical applications. We addressed how these new Wireless technologies may be utilized to help human health in the future. As a result, these technologies aid in the development of less obtrusive Wireless sensor instruments, which aid in the preservation of human life. We gained a strong understanding of wireless networks after doing research. We want to put the insights we gleaned from this extensive research into medical applications that will benefit the whole human race.

REFERENCES

1. Edward, H. et al., (2005)," A Wireless Health Monitoring System". International Conference on Information Acquisition (pp. 247-252). Hong Kong: Stony Brook Publisher.
2. Maghawry, N. E., & Ghoniemy, S. (2019). A Proposed Internet of Everything Framework for Disease Prediction. International Journal of Online & Biomedical Engineering, 15(4). https://doi.org/10.3991/ijoe.v15i04.9834
3. Thangarasu, G., & Subramanian, K. (2019). Big data analytics for improved care delivery in the healthcare industry.
4. Miskovic, V., & Babic, D. (2016). Pervasive Personal Healthcare Service Designed as Mobile Social Network. InternationalJournal of Interactive Mobile Technologies, 10(4). https:// doi.org/10.3991/ijim.v10i4.5913
5. Fatusi, et al., (2013), "Health Sector Reforms and Poverty". Ife: University of Ife Press.
6. Shihab A. Hameed, V. M. (2008)," An Efficient Emergency Healthcare and Medical Information System", International Journal of Biometrics and Bioinformatics, 1-9.
7. A. I. Heernandez et al.,"Real-time ECG transmission via Internet for nonclinical applications", IEEE Transaction on information technology in biomedicine, vol. 5, no. 3, pp. 253- 257, Sept. 2001.

https://doi.org/10.1109/4233.945297
8. Raised et al., (2005), "Bluetooth telemedicine processor for multichannel bio-medical signal transmission via mobile cellular networks". Information Technology in Biomedicine, IEEE Transactions on 9(1), 35. https://doi.org/10.1109/titb.2004.840070
9. Abdulbaqi, A.S. and Ismail Yusuf Panessai, "Efficient EEG Data Compression and Transmission Algorithm for Telemedicine",Journal of Theoretical and Applied Information Technology (JATIT), Feb. (2019), Vol.97. No 4.
10. Virone, et al., (2006, April),"An Advanced WSN for Health Monitoring ", In Trans disciplinary conference on distributed diagnosis and home healthcare (D2H2) (pp. 2-4).
11. Hasiang Lin and I.C.J. (2004)," A Wireless PDA based Physiological Monitoring System for Patient Transport". IEEE Transactions on Information Technology in Biomedicine, 439- 447.
12. M.F.A, R., & .B, A.W. (2014)," A Wireless Emergency Telemedicine System for Patients Monitoring and Diagnosis". International Journal of Telemedicine and and Applications, 371-380.
13. Purnima et al. (2014)," Zigbee and GSM based Health Monitoring System". International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, 6664-6669.
14. U. A. et al., (2005)," A Wearable Multi parameter Medical Monitoring Alert System". Information Technology in Biomedicine, 415-427.
15. A, S. et al., (2012)," Automatic Patient Monitoring System Utilizing Scatternet for Critical Healthcare". Journal of Theoretical and Applied Information Technology, 62-66.
16. A.I, et al., (2001)," Real time ECG Transmission via Internet for Non Clinical Applications". Transactions on Biomedical Engineering, 253-257.
17. Al-Rousan, A.-A. a. (2004)," Java based home automation system". IEEE Transactions on Consumer Electronics, 57-68. https://doi.org/10.1109/tce.2004.1309414
18. Abdulbaqi, A.S., Recruitment internet of things for medical condition assessment: Electrocardiogram signal surveillance, AUS Journal, Institute of Architecture and Urbanism, University of Austral de Chile, Special Issue (2019) 434-440.
19. Abdulbaqi, A.S. and I. Y. Panessai, Designing and implementation of a biomedical module for vital signals measurements based on embedded system, Int. J. Adv. Sci. Tech. 29(3) (2020) 3866–3877.
20. Abdulbaqi, A.S., S. A. M. Najim and R. H. Mahdi, Robust multichannel EEG signals compression model based on hybridization technique, Int. J. Engin. Tech. 7(4) (2018) 3402–3405.
21. Z. Arbabi et al, Application of neural networks in evaluation of key factors of knowledge management system, case study: Iranian companies based in Alborz province, J. Phys. Conf. Ser. 1530 (2020) 012111.
22. M. K. Adimulam, M. B. Srinivas, A 1.0 V, 9.84 fJ/c-s FOM reconfigurable hybrid SAR-sigma delta ADC for signal processing applications, Analog Integ. Circ. Sig. Proc. 99(2) (2019) 261-–276.
23. N. Alajlan, Y. Bazi, F. Melgani, S. Malek, M. A. Bencherif, Detection of premature ventricular contraction arrhythmias in electrocardiogram signals with kernel methods, Signal Image Video Proc. 8(5) (2014) 931—942.
24. A. Burguera, Fast QRS detection and ECG compression based on signal structural analysis, IEEE J. Biomed. Health Inf. 23(1) (2019) 123-–131.
25. S. L. Chen, M. C. Tuan, H. Y. Lee and T. L. Lin, VLSI implementation of a cost-efficient micro control unit with an asymmetric encryption for wireless body sensor networks, IEEE Access 5 (2017) 4077-–4086.

