A Review on Electronic Health Systems for Remote Monitoring Vital Symptoms of Patients (Case Study: Wireless Body Sensor Networks)

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ABSTRACT:
The advancement of technology along with the feature of sensor networks has increased the benefits of using remote health networks. Sensor networks designed with a sense of human health parameters have created a physical network. Nodes in the body network are directly connected to the human body and this requires a lot of care. Some health care programs require continuous work to collect patient data without user intervention at any time. Such applications require energy conservation of sensors in these networks, which are limited. Wireless sensor networks are usually employed to monitor the status of patients with disabilities in the hospital, and to track and monitor the movement of specific patients. Wireless sensors are also capable of monitoring the performance of operating operators. These networks are used remotely, finding patients and doctors in a therapeutic setting, and managing drugs in a hospital. In this study, our focus will be on reviewing new methods of communication and transmission in the transmission of a WBSN sensor to monitor the vital symptoms of telemedicine patients in the field of electronic health systems. Evaluation and implementation of wireless sensor networks embedded in the body has also been studied in this study due to their importance in the field of human health, especially the control and detection of vital signs and the challenges ahead for their implementation. They will be analyzed.

KEYWORDS: Electronic Health Systems, Remote Patient Monitoring, Wireless Body Sensor Network, WBAN, Vital Signs Diagnosis.

1. INTRODUCTION

The ICT revolution had considerably affected all economic, security and social sectors of the countries. With the advancement of IT in the medical field, a magnificent evolution was occurred in the provision of health care system. Moreover, recent advances in the domain of distributed networks, micro-sensors and energy-efficient microelectronics facilitated the development of body sensor networks. The advent of wireless sensor networks made it possible to control and monitor people around the environment. Also, the continuous monitoring of body sensor networks was effective in early detection. It can be declared that the internet provided modern methods and presented health services to individuals in this regard. Generally, focusing on disease prevention and early detection of high-risk disability as well as controlling and detection of vital signs was one of the main objectives of using body sensor networks. Based on accurate statistics, the number of elderly people over the age of 65 in different societies will reach approximately 70 million by 2025. The elderly people in every society need more health services and facilitate care. Thus, the advancement of body made it simplify to monitor the elderly people and also is used for common people of society. Based on the World Health Organization (WHO) report [14], the cardiovascular diseases formed 30% of mortalities in the world. Most interested thing was the vital signs of health control and detection without considering time and place. Wireless body area network (WBAN) [15] monitors the human physiological signs at home, in the hospital, and even during patient transmission and his critical signs to the medical database. In the data transfer process, most of the energy is spent on communication. So, the improvement of data transfer is of utmost significance [14].

Wireless body sensor networks are composed of a series of heterogeneous biological sensors. The sensors of this network are mounted on different parts of the body and these sensors can be covered or implanted on a person’s body. Each of these sensors needs specific requirements for detecting and recording signs. Generally speaking, a sensor network is able to detect sensors that have fault due to the failure or loss in energy sources with the use of fault tolerant design methods at each level of data processing or data sending by a sensor. For example, in cooperative data collection methods, in which sensors send their environmental assessment results of the importance and necessity of research into soft or hard data to a control center, an energy-efficient sensor may send incomplete data to the center or send no data at different time periods. So, this sensor will make difficult the final decision in the center. These types of networks are able to detect faulty sensors with the use of different methods including allocating the reputation to each sensor or by the method of detecting the outlier data and data mining in the results achieved at the center. Most of the mentioned methods also depend on the issue that the number of sensors in the network is not sufficiently high or the number of environmental measurement is not limited and the delay in the network is not so effective. With regard to the limitation of the WBSN networks that is consisted of few sensors, usually it is somehow difficult to detect faults with the above methods.

Generally, one sensor from the WBSN network uses energy in one of the following three stages of its operation [1]:

- During environmental measurement
- During data processing or information storing
- During making connection with data center or other sensors

Examination of the first two cases requires the observation of hardware issues and electronic and physical design of the related sensor. On the other hand, the highest amount of energy consumption of a WBSN network's sensor is extracted and transmitted when communicating with the environment. To this end, the present research was more focused on a review of modern ways of communicating and transmitting in transmission of one sensor of WBSN network while telemedicine monitoring the vital signs of patients in the field of medical care systems. This research evaluated and analyzed the assessment and implementation of wireless sensor networks that were mounted on the body due to their significance in the field of human health, especially controlling and detecting the subsequent vital signs and the challenges for their implementation.

2. THEORETICAL BACKGROUND

Most patients refer to a doctor when they feel abnormal signs in their body. In fact, after referring to a doctor or hospital, the patient been sick for sometimes and s/he should be treated immediately. Actually, time is passed since disease prevention and the patient has to spend very high cost on treatment. However, using a sensor network not only can detect the status of physical health, but also can even predict the disease and reduce the subsequent costs and risks in treatment. According to the latest news, new researches by electrical engineers at Oregon State University confirmed the matter that an electronic technology called high bandwidth, which can be used in the surveillance sensors network, might be utilized as part of the solution in achieving an ambitious goal in the future associated with health monitoring or monitoring the body health of people [23].

Continuous monitoring of body sensor networks enhances the early detection of emergency situations in patients with high health risk and provides a wide range of health services to people with different degrees of cognitive and sensory and motor disability. These networks consist of a number of sensors on the body surface or inside body tissues or on clothing that these sensors together make it possible to receive and process and communicate. There is one base station in these networks that receives the information from sensor nodes and sends it to remote centers. This technology is considered as one of the latest technologies in the field of detection and management of health care to measure vital signs of the patient. The existed sensors in this network are portable and very small [1]. Each sensor node is usually able to receive one or more vital signs and process these signs and store the processed information and transmit the data to other sensor nodes or a wireless body sensor network. The body sensor network has a smaller number of nodes than the wireless sensor network. Smaller nodes have smaller batteries, and this issue has dramatic effect on energy consumption reduction, processing and storing, communication resources, accuracy and permittivity and transmission delay [23].

In the body sensor networks, some sensors such as motion sensors and electrocardiogram sensors are mounted on the patients' body in order to monitor vital signs of patients and detect the motion. Indeed, body sensor network is consisted of several biosensors. In addition to monitoring the vital sins of the patients, a wireless body sensor network also provides a real-time feedback to the user and the user can monitor the progress of their disease and take the required prevention. Wireless body sensor network is a subsystem mounted as a case sensor network on the patients' body. The components of body sensor network can be considered as RFID tags and electrocardiogram sensors. Body sensor networks are alike with wireless sensor networks in terms of many challenges and existed opportunities. Body sensor networks provide the possibility of long-term monitoring of patients' health under normal physiological conditions without limiting their routine and normal activities. There is large number of inexpensive and very small nodes in all body sensor networks with communication and computing capabilities and uses the obtained information for detecting disease and prescribing medicine. The cause of the significance of using the body sensor networks in the medical environments is the unique opportunity that causes these networks in order to transmit the medical care from the hospital environment to the patients' own home environment [23].

This issue leads to more optimum use of hospital resources and an earlier detection of medical signs and ultimately medical costs reduction. The application of body sensor networks has a noticeable effect on health and results in improved quality of life and comfort for patients. This technology is progressing every day and is aimed at conducting the patients, physicians and the treatment team. These systems can contribute significantly to people by providing services such as medical monitoring and providing medical information and people's memory enhancement and controlling home appliance and making connection in emergency conditions. The increase in the number of patients with chronic disease and deaths from this disease and increase in the population of people over the age of 60 results in the increase of the need for the health care industry. Among the reasons of the significance of these networks are factors such as: early detection, signs of deterioration and warning health care providers to be present in the critical conditions and figuring out a relation between health and life style and providing health care for remote places and developing counties and changing health care by providing real-time physiological information to physicians. These systems improve health care and reduce health costs and improve the quality of care services [23]. Sensor networks in the future will be widely applied in health care fields. Nowadays, some of these elementary sensors are used in the in some advanced hospitals in order to monitor physiology data of patient, observe the medicine consumption periods, monitor physicians and patients in the hospital.

With the advancement of technology in the hardware and software sectors, the expansion of the wireless network penetration becomes naturally more, easier and cheaper. But this matter increases the battery use and reduces the useful life of operating sensors inside these networks.

3. MONITORING HUMAN HEALTH WITH THE USE OF WIRELESS SENSOR NETWORKS

The advancement of technology along with the feature of sensor networks causes the benefits of applying remote health networks. Sensor networks designed with a sense of human health parameters have emerged a body network. The nodes in the body network are directly connected to the human body and this requires great care. Some health care programs need ongoing work to gather patient data without user involvement at any given time. Such application programs require being cared from the sensors energy in these networks that have limitations.

Wireless body sensor networks are used to monitor the status of disable patients in the hospital, and to track and monitor the motions of special patients. Wireless sensors are also able to monitor the performance of working operators. These networks are applied in cases such as remote collection of physiological information from the human body, finding patients and physicians in a therapeutic milieu as well as managing drugs in a hospital. With respect to the widespread development of wireless sensor network technology in the medical sector and the use of information outside the hospital, it will enable the medical team to review the incidents and take timely action [3], [4].

The attention to wireless systems for medical applications is rapidly growing. With numerous benefits more than 12 options, such as ease of use, reduced risk of infection, reduced risk of disability, reduced suffer and discomfort, increased motion and low cost of health care provision, the applicable wireless cases will fertilize the available possibilities for new applications in the medical market. Portable devices such as heartbeat controller, pulse oximeter, blood pressure controller and respirometer are known as essential tools in intensive care. Traditionally, sensors for these tools are linked to patients by wire. The patient is constantly confined to the bed. Moreover, at any time that the patient needs to move, all monitoring devices must be disconnected and then again reconnected. Today, all of these time-consuming works will be finished through wireless technology, and the patients can be extricated from these tools. These wireless devices assembled wireless technology.

4. A REVIEW OF MEDICAL APPLIED ELECTRONIC SYSTEMS

The rapid growth of the technologies expanded the potential of the use of market for wireless medical applications. Nowadays, with the help of moveable solution and large-scale wireless networks, such as 3G mobile phone, WiFi and WiMAX mesh, the health care providers can access the vital information at anywhere and anytime in health care network. The display of extensive calculations including RFID Bluetooth, ZigBee ،and wireless sensor network presented new environment in data transfer for medical applications.

4.1. Wimax

Based on the standards of IEEE 802.16 known as wireless MAN standards, WiMAX was created by forum WiMAX and had high-security remote data wireless transfer about 50 km, and about 70 Mbps data rate and about 150 km per hour high mobility. This standard was a combination of several advanced technology of radio transmission such as adaptive modulation and programming (AMC), adaptive error correction at FEC destination, well-defined qualify of service framework (QoS), connector circuit of one signal to orthogonal several systems (ODFM).

4.2. Wlan

WLAN standard on arrival was in 1997 (3) from 12, i.e. IEEE 802.11. The capabilities of IEEE and IEEE 802.11a in 54Mbps in the first version to 1-2Mbps were evolved from IEEE802.11 802.11b standards. IEEE802.11 had 100 and 800 fir boards. 802.11b had 350 fit coverage in outdoors and 150 fit in indoors. After the arrival of 802.11a and 802.11b, Wi-Fi connection was appeared and operated with certificating the wire-based devices. Since then, 802.11 became more developed. Many suffices of 802.11 were created, such as the added 802.11g in 2003 with 54Mbps transmission capabilities effective on 2.4GHz band in 350 fit outdoor and 150 fit indoor, 802.11n with higher power about 200Mbps added in 2004 with advanced security, 802.11s added for mesh network [3, 4].

4.3. Wban

Recent technological developments propagated the wireless communications, physiological sensor and the development of small, lightweight, low power monitoring devices in low-power integrated circuits. An integrative body network, considered as a WBAN, can be created by integrating these devices. WBAN with low power consumption sensors were used to monitor the patients in clinical conditions in hospitals. Outside the hospital, this network can transmit vital signs of the patient to their physicians via the internet in real-time. Normally, WBAN used ZigBee or UWB standard.

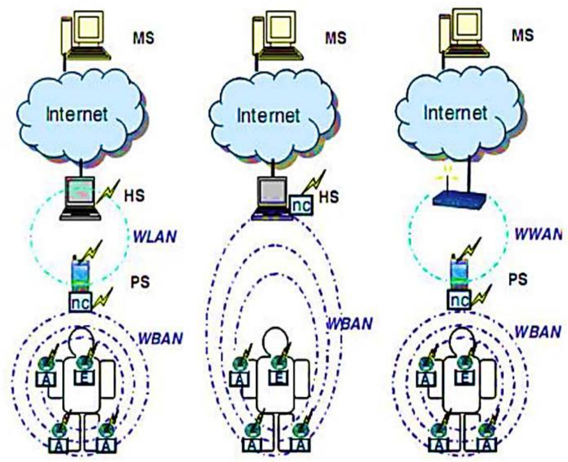

Fig. 1. Widespread scenarios of WBAN.

5. WIRELESS TECHNOLOGY POTENTIALS IN ELECTRONIC CARE SYSTEMS

Wireless monitoring in body is an important application of wireless network in monitoring patients. Through WBAN technologies for transferring data from surveillance devices, such as endoscopic capsules, to the outside of the body, these applications are applied with the purpose of monitoring gastrointestinal organs such as the small intestine through video and sequential image data. The system used 802.15.6 IEEE and coverable WBAN to ensure system quality. More information about endoscopic capsules will be discussed in the next section. Operation help is a very modern application of wireless network. In surgery, physicians should monitor the patient's vital signs for timely actions. These signs can be obtained with the use of electrodes attached to the patient, so that the signs can be transmitted through the wires to the monitor screens. The large number of wires used around the operating table inhibited the medical team from approaching to the patient. Moreover, this adhesive was able to be separated from the patient. In order to contribute the medical teams and surgeons to work more freely, Smart Pad (4) is provided. This device displayed the patient's signals without adhesive or wire. Although the issue of monitoring real-time patients is not a new subject in the wireless medical applications, researchers and industries are spent a lot of attempt and huge capitals for it. These applications mainly used biomedical sensors in order to monitor patients' physiological signals such as heartbeat recording by power (ECG), blood pressure, blood oxygen level, blood glucose, coagulation, body weight, heartbeat, EMG, ECG, oxygen saturation and so on.

The system was rapidly growing in terms of quantity and quality form 12 in-house monitoring systems for chronic patients and the elderly. Application of these systems can reduce the confined to bed and increase the mobility and safety of patient.

6. THE CHALLENGES OF WIRELESS TECHNOLOGIES IN MEDICAL APPLICATIONS

The utilization of wireless technologies in medical environments has created main benefits for existing health care services. However, they enjoy numerous significant research challenges such as different types of network communication infrastructures, fault tolerance, data integrity, low power consumption, transmission delay, node failure, and more. Reliability is known as one of the most important factors in a successful health care system.

To make sure the reliability of this factor, system designers should take care in node adaptation when switching position, connection and link quality. Different kinds of network communication infrastructures should be used in the appropriate situation. Although the above mentioned challenges are associated with technical implementation, there are many other challenges linked to the development of modern technology. Specifically, the new system is expected to be low cost and they are supposed not to interfere with existing infrastructure. Thus, the management of the interference between the old and the new system and using the spectrum correctly are the technological challenges used for medical applications. In the patient's aspect, one of the most considerable subjects is the feeling of patient while using these modern application cases. Therefore, applications should be useful and non-prominent, especially small, lightweight, and so on. Finally, the information about patients should be private and secure and accessible to those responsible people, respectively.

7. APPLICATION OF WIRELESS BODY NETWORK IN HEALTH CARE SYSTEMS

WBAN is a cost-effective and health and treatment economic technique that is available anywhere and is used for monitoring the health in terms of speed, temperature, data scrolling, heartbeat, breathing, and more. No specific standard can be observed for WBAN, but it usually works on ZigBee when lower bit rates are needed, and works on IEEE 802.15.3a or IEEE 802.11 a/b/g when higher data rates are required. There are various kinds of possible devices that can connect over a single WBAN network through one network, relying on the amount of port. But something should not go beyond is the load of whole system that should be less than 500 kbps. The WBAN system has many medical applications. It can be used due to having vital data of patient when connecting to a clinical monitor. Many patients can be monitored by one advanced monitor screen of single health care. Usually, it can control 5 networks similar to WBAN network (total/traffic 10), but kbps of this system has low power devices. The purpose was to present communication technology which consumed only 10% of power compared to total device. Body sensor networks support a number of interesting and innovative application programs.

These application programs include several fields such as intelligent health care, assisted life for elderly, emergency reactions and interactive games. As mentioned earlier, many researches on WBAN application programs are classified as medical and non-medical types [1, 2]. In reference [1], the authors detected two categories of application programs inside and on the body for medical application programs. A number of treatment and health application cases are activated by wireless sensor network technology such as physiological monitoring, measuring and reporting of vital signs, motion and activity monitoring. There is some application cases for continuous monitoring of activity at different levels and are able to measure organ movements, muscle activity and are also applied for intensive analysis. In this section, an overview of the major categories of medical application programs is provided.

7.1. Monitoring the Event of Mass Losses

The events of mass losses enjoy three different types. It can be extremely hot or strongly cold weather or it may be flood, earthquake, fire, which are known as natural disasters. There are some technical hazards, such as building collapses and major industrial accidents. This point addresses the provision of emergency medical services to monitor multiple accident events, in which the provision of medical supplies for a large number of patients is required to improve the evaluation of the first responsible health during such a situation. Here, the technology is effective in terms of increasing portability, scalability and automatic reporting to the relevant team. It also contributes the incident to be tracked and enables the effective control in collaboration with existing resources. It can present the continuous information to relevant the authorities or departments.

7.2. Reliability

Wireless sensor networks have traditionally suffered due to their energy and bandwidth limitations. Furthermore, unreliable wireless devices, and the reliability of important data received from a sensor network are considered a serious problem ahead. This matter is now a problem in health care applications that imposes difficult conditions on end-to-end reliability and data delivery. For instance, measurements of a pulse oximeter application should up to at most 4% of the actual oxygen concentration in the blood. Another factor that is an obstacle to acceptance of reasonable quality of WSN services is medical facilities, some of which are developed systems, very harsh environments for radio frequency (RF) communications. The reason of this harshness is that these facilities have structural factors, such as metal doors, as well as deliberate attempt to provide devices with the purpose of preventing unwanted radiation. Moreover, other devices are used for 4, 15, 802 radios.

These devises are susceptible to interference from Wi-Fi networks Bluetooth devices, and wireless phones. The effect of obstacles and interference is heightened by the fact that the majority of wireless sensor network systems are limited to low power radios to increase system life. Another reason is the reduction of throughput of the system. Since the maximum theoretical throughput of IEEE 802/15/4‹Kb/s radios is 250, which is much lower in practice due to MAC protocols and multi-hop Comm as a standard, attention to real-time applications such as activity monitoring is only able to support a small number of devices, or it can only perform a subset of measurements at a specific time. The quality of data collected from AWSN in some cases can be exposed at risk not by the faults and failures of sensors, but by user actions. Therefore, WSNs in health care and treatment should provide metadata to inform the consumer of the quality of the delivered data.

7.3. Privacy and Security

WSN is used in health care to determine the daily activity of life. Hence, WSNs create opportunities to violate the privacy. In addition to policy and query privacy violation in databases, WSNs are affected by privacy attacks that achieve information by investigating the sensors' radio transmissions to infer private activity, even when the transmissions are encrypted. The network privacy can be at risk by FATS spy attack based on timing and fingerprinting, in which an eavesdropper listens to radio sensors to collect time and fingerprint tags of all radio transmissions. The eavesdropper then uses multiple inference phases to detect the location and kind of each sensor. Hence, different private user activities and health care conditions can be derived.

One major related issue is dealing with security attacks. The security problem in WSNs is exacerbated by the sudden permanent and temporary failures that are common to WSNs, which can be exploited and utilized by attackers. The solution to this security issue lies in the large amount of the redundancy in the WSNs. This redundancy creates a large potential for designing WSN systems that permanently deliver their target services unlike failures or attacks.

7.4. Supplies Shortage

WSNs are limited with low power components that operate with limited supplies to enhance their battery life. These limitations created many challenges for system design. Software must be exactly designed with these resource limitations in mind. Insufficient memory prefers to use event-oriented and unique models. So, traditional design of OS is removed. The relatively small amount of on-screen processing should be carried out in order to reduce the required data forwarding.

7.5. Patient Monitoring and Telemedicine

The increase in the health care costs and the aging growth of the world's population were dramatically effective in telemedicine networks advancements to provide different health care services. Telemedicine enables remote patient care with the use of information systems and communications technologies, allowing scientists, physicians and other medical professionals around the world to serve more patients. Indeed, with the help of signals provided by body sensors, the information collected can be effectively processed to obtain accurate physiological estimates and reliable, and allow the remote physician to make real-time comments for medical diagnosis and prescription. Some healthcare intelligent systems can prepare application programs for monitored detection, maintenance of chronic conditions, and post-operative recovery phase. Generally, patient monitoring application programs control vital signals and provide real-time biological feedback and information for improving the patient [3]. In such a situation, we can hold the patient under the supervision of a doctor in natural physiological situations without limiting ordinary activities and imposing high cost on them. Daily life activity monitoring application programs actually monitor patient activity during their day-to-day lives, which suffer from some specific diseases. While, in-hospital monitoring application programs concentrate on some cases in which the patients are usually monitored for long periods in the hospital's intensive care unit. Meanwhile, various medical parameters are recorded continuously. In-house monitoring application programs for post-operative recovery deal with those patients who were spending recovery period after a surgery/medical operation and who passed a recovery period in the hospital. A wireless body network is able to prepare ongoing measurements of physiological parameters and make it possible for better diagnosis of organ disability and faster detection of emergency conditions. Such a remote monitoring system will be faster, easier and cheaper. Many researches were proposed this regard. Some of them attempted to design a general framework in order to support most cases, while other studies investigated specific diseases. Cardiovascular Disease [23], Diabetes [14], Cancer Diagnosis, Parkinson's [13], Asthma, Alzheimer's and Retina prosthesis are a few instances of specific patient monitoring application programs [21].

7.6. Rehabilitation and Therapy

The aim of rehabilitation is to allow patients to normalize their functionality through appropriate rehabilitation treatments after leaving the hospital. Indeed, rehabilitation is considered as a dynamic process that uses existing facilities to correct any unwanted movement behavior with the purpose of reaching the desired level. In order to make someone, who has experience a stroke, able in reaching the highest possible level of self-independence and being a constructive person, patients' movement during the rehabilitation period must be continuously monitored and amended to maintain a proper movement pattern. Consequently, detection/tracking of human movements is appeared as a vital request in the home-based attendance method. Sensor diversity, multi-sensor data integration, real-time feedback for patients and its integration with virtual reality are examples of features that shifted the rehabilitation into a specific area of research with specific limitations and needs [6].

7.7. Biofeedback

At the present time, self-remote monitoring is also probable for the human body by accessing data collected by sensors. Sensors are implanted in the human body with the purpose of monitoring pathologies or behaviors and to assist patients to keep their health through biological feedback phenomena such as temperature analysis, blood pressure detection, electrocardiography (EEG) and electromyography (EEG) among others. In this context, biofeedback addresses to measure physiological activity in addition to other potentially useful parameters and give back the parameters to the user to empower him to learn how to change and control the physiological activity with the aim of improving his health and performance [18, 19 and 20]. Biofeedback was used from 1960 and was revealed that could be useful in controlling emotional states and involuntary body functions such as migraines and hypertension. Biofeedback devices can include capabilities such as breathing monitoring, heart function, muscle activity and brain waves [18].

7.8. Life with the Help of Environment

Increasing the age of population, increasing health care cost and the matter of independent living all presented the motivation for the development of creative life accommodated for safe and independent aging. Application programs in this regard enhance the quality of life in order to maintain a more independent lifestyle with the use of home automation [15]. Indeed, the facilities of accommodated life are emerged as a replacement home tool for individuals with physical disabilities and the elderly. This category of individuals is not considered independent, but on the other hand there is no need 24-hour medical care for them, such as nursing or nursing homes. With the help of continuous physical and perceptive monitoring, an environmental sensor network can sense and control living environment parameters and then transfer body data to a central station. Their health conditions of these individuals can be estimated from heartbeat rate, blood pressure and accelerometer data. In cases in which extreme changes occur in observed parameters or deviations from the natural range, the system may be connected to a health care center for observation and emergency assistance [26].

8. BACKGROUND OF CONDUCTED RESEARCHES

Body space is a set of sensor nodes connected to the human body. BANS is one hopeful technology that can amend extremely the variety of medical applications. One comprehensive study of BANS was confirmed in [7], in which the researchers provided an overview of body space systems through better description of art technologies situation. A comprehensive description of sensor devices was exhibited in the physical layer, data link layer and radio technology for BANS in this script. There were numerous challenging issues in BANS that limited its expansive implementation. Lack of high-level software was one of the existing challenges in the BANS, leading to the complexity of system programing. In [8], the programing framework was presented in the form of open source, called signal process, in node environment of spine, designed to support fast, flexible prototyping and to manage sensor applications and to point the need for a body-space framework with the appropriate layer abstraction. Two software node structure of spine and synchronizer of spine can provide one application program interface (API) to manage body-space network programs. Spine maximized the efficiency of application programs in BANS and was able to use that to improve rapidly the body-space network programs.

Performance analyses were carried out for the most prevalent sensor or software tools to tackle the needs identified within the body space network framework. Designing an effective protocol (MAC) is required in order to attain high throughput in an energy efficient method. Time synchronized channel hopping (TSCH) is now the most effective way to prevent confronting with it. To preserve the time-frequency mechanism, one centralized synchronizer is required. In [9], one networking with non-centralized time was presented for ad hoc wireless networks. MAC proposed protocol performed the paired-pulse oscillators that synchronized simultaneously on multiple channels, in which the nodes randomly linked to a channel and automatically extended to the existing channels. The delay caused by channel switch mechanism was considered as one challenge for its implementation in WBAN with a group of nodes.

Using machine learning for improving the performance of MAC was presented in [10]. A reinforcement learning algorithm is used to manage a radio programing. MAC protocol, one suggestion based on ql, allowed any node to determine better timing policy and adaptation with changes in local traffic conditions. MAC performance was compared with conventional protocols of MAC. The results indicated that the behavior of MAC guaranteed the performance of better networks with respect to package delivery and moderate energy consumption. Similarly, some MAC protocols were extensively studied and received worldwide attention as a WBAN technology based on 802, 15, 4 IEEE. Considerable research efforts were performed to suggest new MAC protocols based on 802, 15, 5, in order to fulfill strict requirements.

In [11], the researchers presented one guaranteed MAC protocol, in which data and control channels were segregated to support high data rate communications without collision. Application specific control channels are used to provide priority guarantees for critical medical applications during consumer traffic. Improving energy efficiency was obtained from the MAC protocol. Kim et al. [12] proposed one mechanism for 802, 15, 4 IEEE, in order to present one separation scheme based on competition window (CW) and power cut off (be). In this scheme, higher priority nodes had less CW and more values than others. CW had more effect on the saturation output, while affecting medium delay of each device. So, the data regulation can be carried out by deformation and better throughput and can be achieved by regulating the size of CW.

Wak and Olah [13] proposed one MAC for tracking the emergency traffic and demand, in which a table was held to maintain the traffic patterns of the nodes. The authors amended the MAC structure for 400 times to consider the configurable access period (cCAP). However, the other frame parts were greatly similar to traditional standard 802, 15, 4 IEEE of MAC. This frame contributed to solve the stagnant ears and eavesdropping problems by using the traffic information of the nodes.

Kim et al. [14] focused on the emergency transportation schemes for WBANS. They suggested the extraordinary frame structure with combined period of mp and extended period of ep. In MAC, access time interval (CAP) and competition time was entered to transfer emergency data promptly. While, ep had one extension request period (ERP), one period without reallocation discussion (CFT) and one CAP. It ensured the propagation of unsuccessful split in representative on reallocation (CFT). The authors of this paper declared that (mp) and ep can control the emergency data with Lee and Tancy et al. [15]. They suggested one advanced 802, 15, 4 IEEE Mac protocol for health monitoring programs with one reinforced extraordinary frame structure containing one polling period (pp) and one emergency work (es) for tracking the emergency conditions. Es is a completely short period, in which the data transfer is described with success or failure. This protocol is consisted of one long CFT after one inactive period.

Ranjeet et al. [16] also proposed emergency lamps and one emergency control protocol (MAC) for health monitoring programs with the use of one period of ERP. This wonderful frame controls the emergency traffic with minimizing the delay with a fast channel allocation for emergency users. (MAC) PNP-protocol [17] is based on the 802, 15, 4 IEEE structure of wonderful frame. This method can have different applications with different requirements through fast reallocation, split reallocation, transmission, etc. This MAC inherits the advantages of using competition-based media access techniques and thus supports various types of traffic including continuous streaming, periodic data, and critical emergency alert and non-periodic data. It supports (qos) according to traffic priority.

The researchers in [18] supposed one opportunistic decision making protocol (ODMP), and MAC protocol again for medical and engineering applications based on competition. MAC protocol is one suggestion for supporting data emergency medical data, one method of temporary switching between inactive period and opportunity period through (ODCP) and provides a four med opportunity period.

In [19], the authors proposed one (med MAC) (MAC) protocol for WBANS, in order to improve the channel access mechanisms and reduce the energy scattering. This protocol was consisted of channel access without connecting to some variables from the (TDMA) channels, and was considered as adjustable energy efficiency and time dynamics, optimized energy efficiency by dynamically adjusting qos requirements with the use of continuous traffic analysis and optional connection duration used for low-level data, emergency operations and network startup procedures. Most previous studies were successful enough to limit the rapid delivery of vital data related to emergency conditions associated with human life to one synchronizer. The main cause for the long delay is the lack of interaction between the nodes and a synchronizer in the active period as well as in the inactive time period designed to economize energy. Therefore, this paper suggested a new framework structure and operations for rapid channel allocation with the purpose of transmitting all vital cases related to emergencies.

The development of wireless networks now has many applications in the medical field and for human services. For example, detecting the imbalance of the elderly and their falling in the paper [1], detecting the place on elderly Alzheimer's in the paper [2] by one cellular wireless network and with the help of one auxiliary node in [1]. In one WBSN network, consisted of small sensors with low thermometer power consumption, EKG accelerometers and gyroscopes, which may be embedded in the patient’s body like clothing, this capability should be to sample and process the data network caused by environmental condition measurement and to send patient’s vital signals to an assessment center. But since most wireless electronics were powered by a limited battery, it was very important to adopt effective methods of energy consumption. This issue was evaluated and explored in many articles and researches. For example, papers related to simultaneous and asynchronous media access were introduced and their main purpose was to reduce energy consumption and prevent accidental data transfer or to prevent duplicate data transfer. In [6-8] papers, TDMA time allocation methods were introduced for non-competitive channel access and decreased the power consumption properly with respect to reducing the expected time for transmission. In most of these methods, it was hypothesized that sensors exploited one synchronizer properly. However, it should be focused that this synchronization protocol was one factor for energy consumption in these methods. In [9-11] papers, some methods were proposed for optimizing the length of sent package. In [9] paper, the effective package length was estimated in high-noise channels, which was assumed to be channels over a long distance.

To cope with the effect of the channel noise in this paper, the length of the package has been used longer.

With this interpretation, it is evident that the channel noise is high energy consumption. In the article [10] appropriate package length is calculated with the statistical conditions of channel and constraints of energy sensors. The interesting point of this paper is the comparison of the optimal length of the package for re-sending signals. In a channel with inappropriate statistical conditions, it is possible to re-send less energy from the system. Until we have to get rid of the problem, we continuously make the length of the sent package. In the article [11] because the channel specification is different when you are sending the physical and out of the body, it has been shown that allocation of a specific packet length will result in a problem. In this article, using reapply when ARQ error occurred and the use of the FEC codes, the error caused by the channel is compensated. All three of the above articles, with good results, but still use a homogeneous network, the distance between some of the sensors with the center will be significant, so the energy consumption of these networks is still high.

In the article [12], Internet-based structure has been used for the design of WBSN network. In this paper, to take advantage of the network's maximum of each of the network sensors, a smart sensor is connected to the Internet network and therefore, in this network, the IP-based protocol is implemented. . However, in this paper, energy consumption has not been considered, but the use of internet infrastructure network for data transmission in WBSN network is considered a new work. In the article [13] various methods of data collection in WBSN and delay of these methods have been discussed. In this paper, the relationship between delays for a body sensor network has been calculated with traffic silent pattern and shown that depending on the time allocated network data collection can be improved by various methods.

In article [14] a heterogeneous network is considered in the vicinity of the WBSN network to be the task of transferring data from WBSN center. In this structure, the sensor can reduce the length of the packet by using the compressed data, and then send the data by one or two other links depending on your energy budget. It should be noted that high data processing in the sensor itself causes more energy, but the amount of energy consumption in the delivery phase is always more than it.

In the articles [14-16] which survey the structure of mobile cellular networks and although the desired network is not WBSN but a subject in these networks, it seems that its implementation in our optimal network pose important results. In these networks, to reduce the traffic of a cellular network in an asymmetric and heterogeneous network, using the load transfer optimized parameter, the most optimum means of the mobile user to use as link forwarding and connection to the internet network is selected. What is important in these articles is the reduction of traffic load and reducing the queue of the requested users, but what appears is that it can be defined by defining an energy budget parameter and near realm a network sensor of WBSN an Internet infrastructure network such as the WiFi the most Optimal means of data transfer to the center.

Table 1. Electronic health records.

Type	Example	Status
Observational studies	Health Deployment Drug use Epidemiology (prevalence/degree of prevalence) Natural History	These are widely accepted and used
Safety monitoring	Traditional safety monitoring after marketing	These are widely accepted and used
	Active monitoring (e.g. soldier protector)	In emerging
Clinical Research	Hypothesis Production	This has been accepted
	Feasibility Assessment	This has been accepted
	Performance improvements, follow-up instructions	This has been accepted
	Employing patient	In emerging
	Comparative effectiveness, health technology assessment	In emerging
	Practical trials (e.g. PROBE design)	In emerging
	Randomized Care Tips	In emerging
	Registration of random tests in order to test new interventions	In emerging
	ECRF data collection source (removal or minimizing the need to (extract data/data inputs	In emerging/hidden
	Proof or endpoint SAE	In emerging/hidden
supervisory	Safety monitoring, pharmacy	This has been accepted
	New marks or marketing permissions	hidden

Table 2. challenges of using the health-related files

Problem	Example	Potential Solutions
Quality and validity of information	Selection of the desired measurement for a clinical trial if there are multiple measurements (e.g. laboratory data)	Specific parameters (for example, using date or time valves) that are expressed in the protocol or process for extracting data from EHR to eCRF
	False information in Ehrs Programming errors	Using reimbursement related codes that have a higher reliability
Complete registration of data	Clinical Endpoint	Development of standards in order to share data and privacy
	SAEs	Discovery of Ehrs transplant with national death record
	death	
Heterogeneity between systems	Different sellers in a specific country or region	Resource commitment in order to coordinate efforts
	Unregulated systems	The working Group formed all stakeholders to insert a consensus agreement on a common set of data variables created in the systems
Knowledge system	Improper understanding of the database and its structure	clarity
	Researchers may not understand database restrictions	Development and maintenance of data standards and manual manuals performance
		Report of strengths, limitations and subtle differences of databases in the initial versions
		Training informatics for researchers

In table 1 we have Electronic health records [30-33] and in table 2 the challenges of using the health-related files of the world [34-36] with the study of previous articles.

9. GENERAL CONCLUSION

In this paper, we review the main applications of the monitoring network of patients in the framework of electronic health systems and we have determined the quality of service requirements. The aim is to provide suitable and tailored wireless technology for such networks. For this purpose, a list of communication technologies has been provided. Choosing a suitable radio technology for body sensor networks can be decided based on the specific needs of a WBAN and a surface of the architecture where it is deployed. We can consider three types of connections in a general WBAN Architecture: 1-the internal communication of the body, which takes place between body sensors and a senior node, and consideration of energy, delay and operational throughput may also be considered. 2-Communication between the body networks, which is performed between the senior node and one or several access points (APs), which in this connection in a common channel can easily deal and interfere. Wireless technology for the communication between the body network are: WLAN, Bluetooth, ZigBee, cellular, and 3G, etc. 3-Communication beyond the body network is required for health care workers to be able to remotely access the medical information by using a cellular or Internet network.

According to the World Health Organization (WHO), cardiovascular disease is 30% of all deaths in the world. The wireless network of the Body (WBAN) monitors the human being and measures the physiological symptoms at home, in the hospital and even during the movement and transfers the vital signs of the patient. In the process of transmitting more energy in communication is spent. Therefore, the improvement of the data transfer method is very important. Therefore, finding new methods in communication and transmission can be a valuable step in speeding up data transmission. In this research, we are looking for a method that improves the performance of the receiver and transmitter to better identify the defective bits caused by defective sensors and reduce the overall power consumption of the sensor by improving the bandwidth of consumption.

As stated in the article, sensors are vital signs to form analog signals that are later converted to digital. It then processes the data processor, and the compression and encryption are performed on the signals. This is to reduce bandwidth consumption and increase the security of data for data transmission. The data is sent by digital encryption to the receiver.

The main levels of the Wireless Body Sensor Network (WBAN) are as follows:

First level: Contains a set of smart sensors and actuator or node.

Second level: Personal Server (personal digital device, mobile phone or PC). Here is the vital information the patient collects from the knot.

Third level: Includes remote servers that manage patient medical information.

The biological signal to measure and control the vital signs of the living organisms are a short signal type that can be continuously measured by the biological symptom information. In fact, the sensors contained in each organ of the body to measure the electrical current and the electrical resistance of changes and reports obtained values that have any incompatibility of values with the standard values, meaning the impairment in the extremities that warns of the person's impairment is occurring.

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