

Wireless Body Area Networks in Health Management: Trends and Technologies

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Abstract: Wireless Body Area Network is becoming reliable remote health management system to provide wireless health improvement services to patients as well as defense persons, players, senior citizens with a aim of health improvements as an alternative of health services provides personal and environmental hygiene. As the technology grows body sensors are increasing in use because now at least one person of every family has any gadget that is useful in health status detection remotely. For the body detection factors body area network need many factors are considered like power, security, storage device etc. For a better detection and health managements these challenges should be handled better. Body sensors are classified into various categories according to their data detection. This paper provides a brief introduction to wireless body area network and various body sensors that are used in Wireless Body Area Network and its Architecture, advantages and disadvantages in various fields.

Keywords: Body area network, body sensors, E-health care.

Introduction

Wireless Body Area Network is a network that connects body sensors to human body through a wireless communication. Various body sensors are connected on body or under the body. These sensors detects pulse rate, temperature, heart beat rate, blood sugar level, blood pressure ,breath rate etc. patient have not to move hospital for these checkups. It saves patient's hospital visit cost and time. Besides the patients WBAN is also helpful to body maintainer, Sportsmen to improve the functionality of body. It provides home health care to senior citizens, and children. Data that is collected by the body sensors are also useful for the future health maintenance. Body sensors provide early detection of body conditions if any emergency then transmit the signal to patients and the related real time medical server. WBAN becomes an emerging network for e-health, telemedicine, home healthcare.[1]

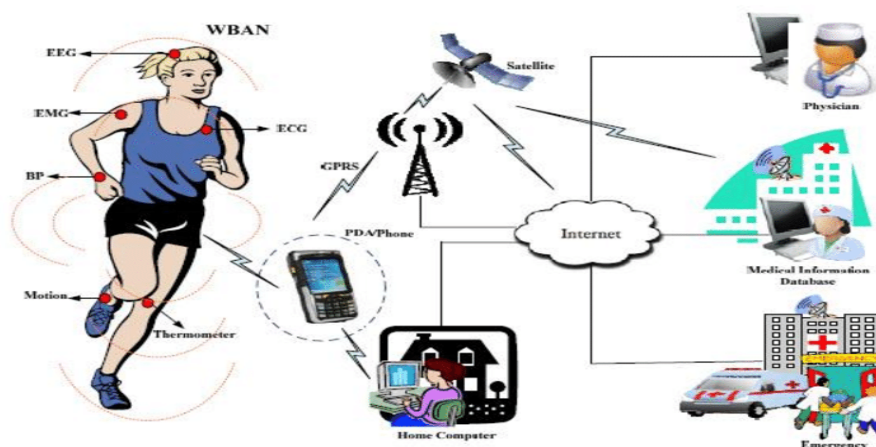


Figure.1 Body area network

WBAN make easy to provide home health care even at work places. Body sensors may connect to medical server by mobile phones, GPRS, telephone networks, Wifi. Through these wireless networks patient's health status is send to the medical server for future health maintenance. WBAN also attract the attention in sports training centers where body sensors are used to monitor the performance of players and collected information is used for improvement in their skills. WBAN become flexible, because hardware design of sensors that is easy to carry in/on body or with clothes, pockets.[2]

Most populated and developing country like India ,where aging population is increasing day to day and medical resources are limited ,so it is impossible to provide proper health care. Because people cannot afford hospital

stays. so WBAN become a bless for health care at home . Because it provides flexible home health care that is cost effective.[3] Some fatal diseases like cancer , asthma are inspected too late. so it increase death rate. With the help of body sensors these diseases are detected at early stage. The problem of patients and senior citizens is that they cannot visit to hospitals at the early spot ,so this problem is solved by WBAN.[4]

1. LITRATURE SURVEY

Reza Khalilian et al.[2016] introduces a strategy that improve WBANs security issues. The aim of this study is to reduce the requisite memory control parcels versatile nature, controlling current harm and cradle over stream used by high speed of data transmission among nodes [5].

Ilkyu Ha [2015] represents that wireless body area network has ecological features is not similar as that of presented WSNs. The innovation that associated to existing sensor networks is not associated to wireless body area network on grounds that wireless sensors in body area network is connected to different human body parts. [6]

Bonato et. al. [2003] illustrates a data mining scheme which use to cluster electromyography information recorded over a daily activity [7]. These collected data are use to establish neuromuscular methods related with particular biomechanical behaviors.

Anurag Tiwari et al.[2016] are to a large degree key for persons that are experience disease like rationally furious patients , heart related maladies, pregnant lady, etc., they need ceaseless perception. Because of web associated with each of these exercises, so need more security. They present a protection and security related issues [8].

Jovanov et. al. were proposed using their WISE for EEG signal acquisition applications [9]. This is a sensor microcontroller based system able of data acquisition, wireless communication, low-level real-time signal processing, and analog signal conditioning.

AdwanAlanazi et al. [2016] several qualities of service routing techniques focus on change of throughput and end-to-end interruption in Wireless Sensor systems. This paper introduces ONSP technique for hearty multipath quality of service direct for WMSNs. This technique depends on deciding improved node that helps flexible course exposé for enhancing QoS attributes [10].

Farshchi et. al. have also presents a wireless neural edge, by Mica2dot and Mica2 and [11] systems as wireless sensor platform, that is accomplished of acquire two channels of EEG data [12].

Muhammad Moid Sahndhu et al. [2015] Wireless Body Area Networks are receiving increasing interest on account of their suitability for extensive diversity of medicinal and non therapeutic applications. These applications request WBAN to stay useful for a further drawn out time that needs vitality proficient operation [13].

2. ARCHITECTURE OF BODY AREA NETWORK

Simple WBAN architecture is divided into several levels: Lave11 is the part which is consists of sensor nodes. These sensors are the body detection devices that detect the human body. Body sensors are used to monitoring various body activities like heart beat, brain activities, blood pressure, motion activities etc.

Next level is that all body sensors are connected to Central Control Unit .CCU collect information from all sensor nodes.Level1 is connected to level2 by wireless networks using systems like WLAN, WiFi, Bluetooth, ZigBee . Third level is transfer the information to destination server.[14] Above figure describes the three tier architecture of WBAN ,in which tier1 has various sensor nodes, including Electrocardiogram(ECG), oxygen saturation sensor(spo2)used to check the oxygen level in body and other body temperature sensor ,motion checking sensors, to check motion activities, other more for checking glucose , lactic acid etc. Tier2 is related to personal server that is running on convenient devices like telephone, PDA ,Ipod and exchange the collected data from various sensor nodes into accessible form by using CCU.Tier3 has store of information that is in accessible form to take appropriate decision for treatment. This information is stored in database or on medical server for further diagnosis.[15] Wireless sensor nodes are attached to each user's body that is interconnected to medical servers. These sensor nodes monitor the vital signs from human body and transmit the signal to the personal server using some communication media like Bluetooth, WiFi, Personal Digital Assistant(PDA)etc.

The medical server keeps the medical records and provide them medical services according to their reports. Medical server analyze the data records that is transmit by users and take appropriate action to improve their health status. Medical server recognize the health status in order to give care in emergency case. The data that is collected in database is useful for future knowledge for the research purpose diagnosis. To communicate with medical servers it uses GPRS, WLANs, and Internet Access Point. Personal Server manages the data that is coming from various sensor nodes and process data retrieval and processing and data fusion. It is also uses for providing feedback to user [16].

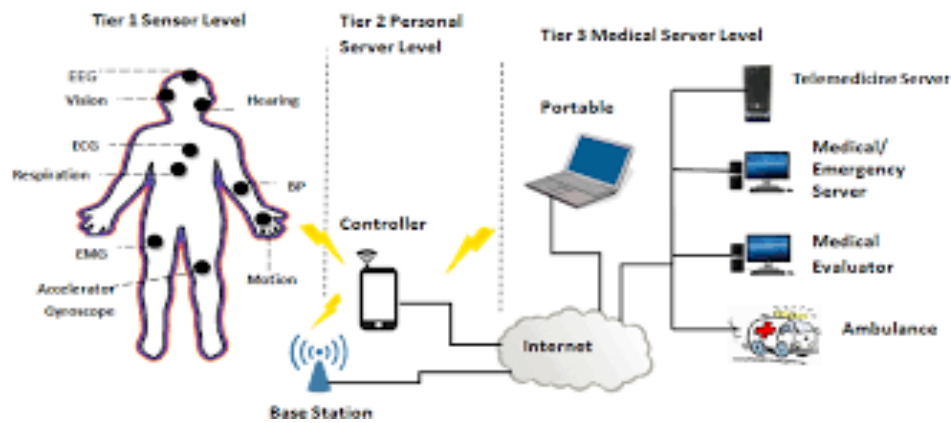


Figure.2 Architecture of Body Area Network

3. BODY SENSORS

Body sensors are the biomedical devices that are used to monitor body and gather information. These devices monitor movements of body parts like heartbeat, muscles activities, brain activities etc.

With the growing technology new innovations like mobile phones and other electronic devices become a revolutioning the involvement of doctors and patients in the modern healthcare system. Information Technology provide such great services like telemedicine, mobile health care. Body sensors are integrated with body to collect essential information for health care. The concept of remote monitoring is new but attract lot of attention because of small sized wearable and attachable body monitoring devices. These tiny sized wearable devices are more reliable and flexible to carry. These body sensors which is used to monitor body conditions and transmit data to personal device or to medical server. Body sensors sense the vital signs ,daily body movements and body organic substances. These devices are easily manageable and provide accurate and reliable information .some sensors are placed at any body part like wrist, ankle, waist, chest, arm, legs etc. Some wearable that are placed within clothes include gloves, pins, earrings, brooches even belt buckles.[17]

Sensor nodes act as gateway between the patient and devices from which we capture required information about patient's health status and provide early detection with the help of these nodes. Somebody sensors are given below:

- ECG (Electro Cardio Gram) sensor which is used to monitor heart activities.
- EMG (Electro MyoGraphy) sensor which is used to monitor the muscle activities.
- EEG (Electro Encephlo Gram) sensor which is used to monitor to brain activities.
- A Blood Pressure sensor, which measures the pressure of blood circulation.
- A Tilt sensor monitoring the position of trunk.
- A Breathing sensor for monitoring the respiration system.
- Motion sensor measure motion activities like accelerometer.
- Pulse Oximeter measure blood oxygen.
- Body Temperature sensor.[18]

4. APPLICATIONS OF BODY AREA NETWORK

Body Area Network is becoming an emerging network in various fields especially in medical fields. Some advantages of Body Area Network are given like this:

A. Telemedicine

Telemedicine provides cost effective health care to patients. It also provides remote monitoring, that make it a bless for aging patients, children. Telemedicine enables the remote delivery of medicines, doctor's attention etc. Telemedicine gives the ideas to maintain health by providing maintenance in emergency situations. Telemedicine measures continuously patient's health and take a suitable action to improve the functionality of body.

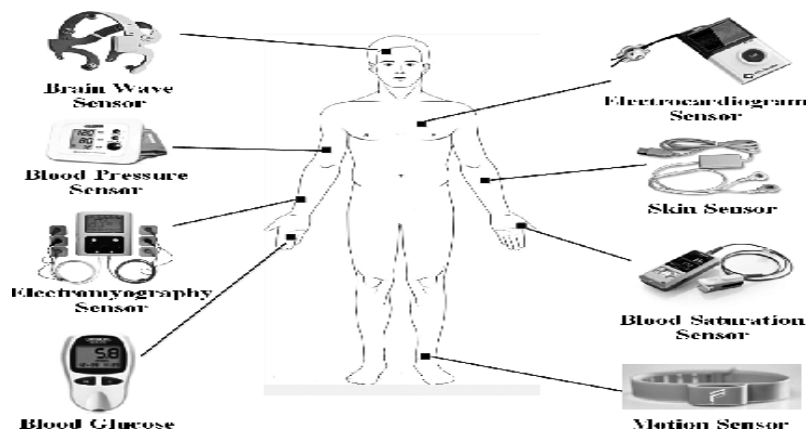


Figure.3 Applications of Body Area Network

B. Rehabilitation

Rehabilitation saves the patient from undesired situations after the diagnosis. Body sensors continuously sense patient's body if any problem occur then transmit the signal to related medical personal to take suitable action.

C. Bio feedback

The information that is transmitted by sensors are stored at medical server in database. This collection of information is useful for feedback to measure present health to previous [19].

D. E-health care

E-health care is a way to monitoring the health with the digital technologies like GPRS, WLAN, WBAN, Mobile phones, Wifi etc. E-health care is cost effective because not any paper work needed and need not to visit hospital.

E. Life style and Sports

Body sensors are providing an improved life style. With the early detection of fatal diseases appropriate treatment is given to patient at early stage. In sports body sensors are used by sports training centers to monitor the performance of players and collect information that is used to improve the skills of players.

F. Emergency

Body sensors are attached to the patients. So their health status is detected from home. If any emergency occurs sensors give signal to doctors, is provide early medical facilities and save the patients from any disease.

5. LIMITATIONS OF BODY SENSORS

There are few limitations of body sensors which are:

A. High consumption of energy

For processing of sensors energy is needed, for energy batteries are used. Batteries has limited power so it is requires recharging which consumes a lot of energy. So to use sensors nodes we should have good resources of energy.

B. Costly

Sensors are costly devices that most of population cannot afford to buy. Besides the sensors, hardware also required to process the detected data into information like mobiles, PCs, GPRS, PDA for exchange of information from sensor nodes to medical server [20].

C. Hardware failure

If the sensor nodes get damaged and cannot work properly, it causes any emergency. Because of not sending proper information and it may be stop the working, by this patients cannot get proper healthcare at right

time.[21]

D. Security threats

The information that is in plain text has threats of unauthorized access. So there is a lot of chances of misuse of confidential information by attackers [22].

E. Bad effects on body:

Sometimes sensors give false impacts on human body like biochemical sensors produce unnecessary chemicals in body that affects genetics and hormonal system of body.

6. OPEN RESEARCH AREAS AND FUTURE TRENDS

In present days various WBAN users and researcher interests open new application areas that may be used with WBAN devices. With increasing need or affordability of WBAN devices needs instant attendance for further improvement in performance. In this paper, we proposed, some of future research trends as follows.

WBAN spectrum management

Now a day's wireless body area network is more commercialization so number of users contributes to massive data traffic in transmission media and enlarged network resource competition. But network resources are limited, current use of available spectrum will not be fulfill the future demand to give a better quality of service. Various methods used to improve the performance of network by using low frequency techniques in minimizing; interference, collisions, power requirement and delay have not given satisfactory results for dynamics in WBAN emergency situations with incredible information heterogeneity. Therefore, further studies are required for WBAN applications that will give alternative solution for future WBAN challenges.

Body to body network connectivity

Efficiency and speed of internet services are day by day increased that will change future wireless body area network as per user requirements, and will getting new challenges. The large recent researches focus only on increasing network performance using efficient security, routing policies, enhanced data delivery success, power conservation, and security. Furthermore, future hassles for packet routing, power efficiency, and QoS call for robust resolution to address disputes correlated to mobility, inter BAN interference, in this view, data frame variation related problems, data flow rate, incomplete data, faults, packet collisions, resource utilization for distributed BAN and malicious attacks, must be revisited at intersection of large data for B2B connection.

Network security

With increasing use of WBAN, security is primary necessities to maintain patients' legal rights and privacy to personal health data. Introducing a data security scheme may involve use of validation messages and decode keys. About WBAN environment, complex validation systems are undesirable. So, use of unique biometrics, e.g., EKG/ ECG sketch for safe end to end link is a needful research area for future. Machine learning based algorithm on artificial neural networks will give best security characteristics during the mitigation and detection of various activities before happening. It is essential to increase WBAN computational capacities and memory, or desire substitute security procedures considering such tradeoffs without changing regular network work in body to body and PAN.

Network delay

BANs transmit data at the same time in a densely populated area with high mobility. Multihop systems usually face an end to end delay since the routing of the data packets takes several network devices to reach the destination. A delay constrained network faces increased difficulties in channel accessibility. Excessive competition in accessing the transmission channel may cause congestion, especially for CSMA-CA mechanisms. Alternative methods such as TDMA, DSME and TSCH may be applied for congestion reduction. Further findings on the use of SDN-WBAN may contribute in solving future network challenges.

Radio frequency radiation safety

Due to the supporting data rates, the commercialization of 5G systems will inevitably expand services provided by the internet of things. Radiation exposure among consumers will rise with growing use of radio frequency (RF) equipment. To guarantee that there will be no or minimal radiation effect on human health, more research must be done. The EMI shield cannot likely be implemented since WBAN devices operate in an open system. Plans like the AA scheme for WBAN have been shown to be sufficiently secure while meeting security standards. The development of more adaptable, attribute-based, and cryptographically enforced access control methods is the way forward.

7. CONCLUSION

Body area networks providing health care at homes, even at workspaces, improving life style and collect health status in database for future uses. Sensors in this network easily carry within body, clothes, and pockets and help in early detection of fatal diseases like asthma, cancer. Wireless body area networks are is cost effective and save patients from extra overheads of visiting hospitals. It becomes a big need of today's sportsman and players to measure their daily performance, because body sensors are easy to carry, so it is a big boon for players. Besides the sports body sensors are also useful for heavy duty persons like military man air force army etc.

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