A Review: Wireless Body Area Network Performance Dependency

Ranjeet Singh[1] , Arashpal Singh[2]
Student, Electronics and Communication, GIMET Amritsar, PTU, Punjab, India
Student, Electronics and Communication, GIMET Amritsar, PTU, Punjab, India
Email - itzranjeet@gmail.com, arashpalchahal69@yahoo.com

Abstract: WBAN is a body network which consists of various small sensor nodes. The nodes communicate to each other by creating route or paths. For the purpose of communication nodes needs to have consume an amount of energy. The consumption of energy by nodes is still an issue for the researchers of this field. In order to create an energy efficient network various protocols have been designed but all of them possess some negative points. Such as if the energy consumption is efficient then it lacks in selecting the cluster heads for the communication. If the cluster heads are selected accurately then the problem may arises in the data delivery or loss of data while communication. It also faces the problem of delay in data delivery. In recent years, research has focused on channel modelling, energy conservation. For this many approaches has been introduced in recent years but those approaches generally focus on distance, energy or individual performance. But as per the literature it is seen that the performance of the system depends on the distance as well as the energy not only the distance between node and the other node and the residual energy but also on the distance to the sink. This paper provides a review of work which has been done in the field of WBAN.

Key Words: Wireless Wearable Body Area Network, Clustering, Sensors, Energy.

Introduction:

Wireless network of wearable computing devices is known as Body Area Network (BAN),/ Wireless Body Area Network (WBAN) / Body Sensor Network (BSN).WBAN is a wireless network which is used in wearable computing devices[1]. It can be either embedded inside the body or can be surface mounted on fixed position wearable technology. One can carry theses such devices along with them like in bags, in pockets, By hand etc. A network consists of several miniaturized Body -Sensor Units together with a single Body Central Unit because of the trend in miniaturization of devices.[2] The Smart devices like pad or tabs which are larger in size still plays an important role as data hub, data gateways and provides a GUI to view and manage BAN applications in the appropriate position.
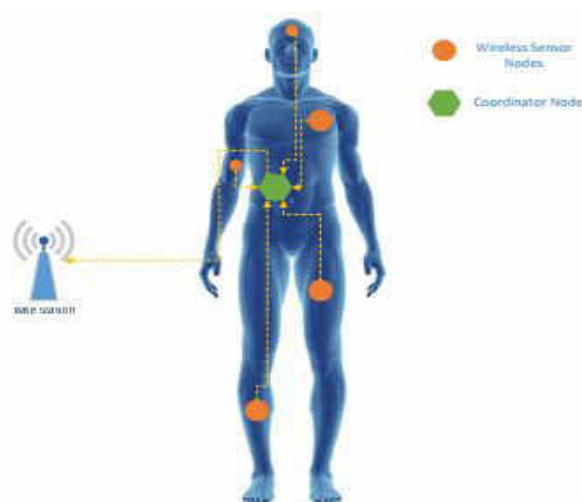

Figure.1 example of WBAN [2]

Components of WBAN:

- Sensing unit
- Processing unit
- Analog-to-digital converter (A/D converter)
- Power unit
- Communication unit (radio transceiver)
- Memory or storage unit

WBAN uses the Actuators because they convert an electrical signal to some action such as a physical phenomenon, e.g., servo motors, insulin pumps, etc. The main task of the sensor node is to sense one or more physical, physiological, chemical or biological signal/signals from human body or its surroundings.[3][4][6] Then these signals are processed like filtration, amplification, digitization, feature extraction etc takes place. The processed data is stored on the temporary basis and then transfer to the gateways by using wireless networks. Te gateways or sink is a device which performs the computations and stores the processed data generated by the WBAN. According to the Application the data may be send as a feedback to the user or may be forwarded to the backbone like ., wireless local area network (WLAN), global system for mobile communication (GSM), general packet radio service (GPRS), universal mobile telecommunication systems (UMTS), worldwide interoperability for microwave access (Wi-MAX), etc to a remote server here, data can be processed further or and displayed in real-time for user's inspection or can be stored for the purpose of analysis.[10][12]

A. **Types and Use of Different devices:**

a) Wireless Sensor node: Wireless Sensor node is a device which reports the information wirelessly. It reports and collect the data physical prompt. It has sensor hardware, a power unit, a processor, memory and a transmitter or transceiver in it.[13]

b) Wireless Actuator node: After sensing device the patient has actuators to perform as a drug delivery system. The medicine can be delivered on predetermined moments, either when the Doctor analyses the data or immediately when sensors notice a problem. The main Component of Actuator is Actuator hardware (which is used to manage the medicine and reservoir to hold the medicine) or it also consists of receiver or transceiver, a power unit, memory.[14]

c) Wireless Personal Device (PD): It is also known as Body Control Unit (BCU), body gateway or a sink. In some implementations, a Personal Digital Assistant (PDA) or smart phone is used it can also be a dedicated unit. This unit gathers all the information collected by the sensors and actuators and transfers it to the user (patient, nurse, etc.) by using an external gateway. A power unit, a large processor, a large memory and a transceiver are the crucial components of thus Unit.[16]

B. **Clustering**

The use of wireless sensor networks is increased in last decades and at the same time the problem of energy constraints in terms of limited battery lifetime is arrived. Since all the operations of the nodes depends upon the energy so it is very difficult to replace or recharge battery once a sensor node is installed. Failure of single node can affect the working of whole system. To save energy caused by communication follow the following steps:[17]

- To schedule the state of the nodes (i.e. transmitting, receiving, idle or sleep).
- · By using suitable clustering algorithm for network formation
- · By using optimal routing methods.

Energy consumption can only be minimized by having minimal activation of sleeping nodes. Every sensing node can be in active, idle and sleep modes for receiving and transmitting activities. [20]

In active mode, energy is consume while receiving and transmitting of data takes place,

In idle mode, energy consumption rate is similar as active mode,

In sleep mode, the radios of the nodes are closed in order to save energy, so this mode is totally energy saving mode.

The small amount of energy in a sensor node restricts the abilities of nodes such as processing, memory, storage, and communication; it may cause to limited lifetime of network. Clustering algorithms are more energy efficient than direct routing algorithm so it is another way of saving energy by using clustering algorithms instead of direct routing algorithms. In clustering algorithms the clusters of nodes are created and each of the clusters is assigned with a cluster head (CH). In this topology, first of all sensor node sends the data to their respective Cluster Head and then these Cluster Heads forwards the data to the server of base station.[21]

C. Event Driven Based Node Selection:

With the recent advancements in the MEMS-based sensor technology, low-power analog and digital electronics, and low-power RF design have makes the development of relatively inexpensive and low-power wireless micro sensors. But these sensors are not reliable or accurate as compare to the expensive macro sensors but still their size and cost enables applications to arrange hundreds or thousands of these micro sensors in order to achieve high quality, fault tolerant sensing networks. Reliable environment monitoring plays an important role in some fields like military. For example, for a security system, acoustic, seismic, and video sensors can be used to form an ad hoc network to detect intrusions. Micro sensors can also used for fault detection and diagnosis. Micro sensors can have hundreds or thousands of sensors located on it.[20][21] It is possible to make these nodes as cheap as energy efficient and reliable output must be generated by it. In the situation of individual node failure network must be able to achieve the fault tolerance with minimizing the energy consumption level. Besides this limited wireless bandwidth is shared between all the sensors within a network, So the routing protocols used for these networks must be able to perform local collaboration to reduce the bandwidth requirements. The data which is gathered by the sensors is transmitted to the base station so that end users can have access to it. Many models are available for the micro controllers.[22]

Related Work:

i.   **Emmanuel Davies, "A Survey on Wireless Body Area Network "[1]** In this paper, the main focus is on the most emerging technology of today is Wireless Body Area Networks and their applications in various fields. WBANs are applicable in various healthcare services and providing medicine to reduce the requirement of caregivers. WBAN's helps the elder and ill people to live their life independently.

ii.   **Ragesh G K, Dr K Baskaran**, **"An Overview of Applications, Standards and Challenges in Futuristic Wireless Body Area**"[2] In this paper, Wireless Body Area Networks comes into realization due to the advancements in low power integrated circuits, ultra low power RF technology, wireless communications and micro sensors. Wireless Body Area Network is becoming the most innovative and emerging technology which gives life to health care management. Various sensors or independent nodes are attached to the surface of the body, implanted into or wear to check the constant values of the patient's health. WBAN offers various applications in the area of real time health monitoring, interactive gaming and consumer electronics. WBAN technology usage is increasing due to its advantage of allowing the patient to move freely anywhere. Thus, it greatly increases the efficiency of a health care system. This paper presents the challenges, problems facing by WBAN including sensors used, applications, power efficiency, communication protocols, and security requirements.

iii.   **Ramli, S.N., "Surveying the Wireless Body Area Network in the realm of wireless communication"[3]** This paper describes that the wireless communication technologies and sensors are developing gradually and empowering development of Wireless Body Area Network (WBAN). The reason behind using wireless technologies are because of the new, practical and inventive ideas offers by variety of sensors that helps to improve health monitoring and other health care applications system. Few years back, the main focus of researchers was to devlope system architecture of health monitoring so that the technical requirements that are specifically designed or

needed should be improve for WBAN. Though, it has many pros but due to the part of communication medium WBAN has many cons regarding security like loss of data, authentication and access control. There are less number of research have been found in terms of strong security system of WBAN. The whole study concludes that WBAN technology is providing various medical and non-medical applications. In this paper, we put emphasis on the body area network as well as their issues regarding security problem. We also define the differences between Wireless Body Area Network and Wireless Sensor network (WSN). Somehow, WBAN and WSN are facing same type of problems. At the end, we have to focus on some security challenges to make WBAN available everywhere.

iv.   **Sana ULLAH, Pervez Khan, niamat ullah, Shahnaaz Saleem, Henry Higgins, Kuyun Sup Kwak "A Review of Wireless Body Area Networks for Medical Applications"[4]** Wireless Body Area Network has been realized through the advances in Micro-Electro-Mechanical Systems (MEMS) technology, integrated circuits, and wireless communication. WBAN ensures the quality in health monitoring and available the patient's status to the physician. WBAN has various applications as healthcare, entertainment, and military area. We also include the architecture for WBAN that provides solutions to on-demand, emergency, and normal traffic. In-body antenna design and low-power MAC protocol discuss in this paper. The basic discussion held on the realization for new power efficient solutions regarding in and on body sensor networks.

v.   **Chris A. Otto, Emil Jovanov, aleksandar, Milenkovic"A WBAN-based system for health monitoring at home"[5],** this paper focuses on the WBAN technology that allows the patient to move anywhere. Thus, a prototype system describes continual health monitoring at home through WBAN and home health server. Sensors implanted on the body and theses sensors sends data (e.g. Heart rate and locomotive activity) to the home server. Further, this data sends to other medical server or stores in the database for user's inspection. This data is used by physician or the caregivers so that right action should be taken.

Conclusion:

This paper provides brief introduction to the concept of WBAN. WBAN is a wireless network which is used in wearable computing devices. It can be either embedded inside the body or can be surface mounted on fixed position wearable technology. Traditionally various approaches have been proposed for the WBAN for the selection of the cluster head. But the performance of the system not only relies on the parameter such as distance between the nodes or energy consumed by the clusters or various nodes for data transmission distance from source to sink node etc. There are some other factors which also affect the performance and lifetime of the network. So there is a need to develop such a system which can cover the other parameters also.

References:

1. Emmanuel Davies, "A Survey on Wireless Body Area Network " International Journal of Scientific and Research Publications, Vol4, Issue 3,Pp 1-7, 2014
2. Ragesh G K, Dr K Baskaran, "An Overview of Applications, Standards and Challenges in Futuristic Wireless Body Area" IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 1, Pp 180-186, 2012
3. Ramli, S.N, "Surveying the Wireless Body Area Network in the realm of wireless communication" IEEE, Pp 58 – 61, 2011
4. Sana ullah, Pervez Khan, niamat ullah, Shahnaaz Saleem, Henry Higgins, Kuyun Sup Kwak, " A Review of Wireless Body Area Networks for Medical Applications",IJCNS, Vol 2, Pp 797-803, 2009
5. Chris A. Otto, emil Jovanov, aleksandar, Milenkovic, "A WBAN-based System for Health monitoring at Home" , IEEE, Pp 20 – 23, 2006
6. Karthiga I, Sharmila Sankar, Dhivahar P "A study on routing protocols in wireless body area networks and its suitability for m-Health applications", IEEE, Pp1064 – 1069, 2015
7. Aftab Ali, Farukh Aslam Khan, " Energy-efficient cluster-based security mechanism for intra-WBAN and inter-WBAN communications for healthcare applications",SPRINGER, Pp 1-19, 2013

8. Karma Wangchu, Minseok kim, Jun ichi Takada "Cooperative relaying and outage performance in narrowband wireless body area network, IEEE, vol 16(23,)Pp 554-565, 2014

9. Norman A. Benjamin, Suresh Sanakarnarayanan, "Failure Performance Study of Hierarchical Agent Based Patient Health Monitoring in Wireless Body Sensor Mesh Network, Advances in Computing, Control, & Telecommunication Technologies, Pp 85 – 87, 2009

10. Changhong Wang, Qing wang, shunzhung shi "A distributed wireless body area network for medical supervision" IEEE, Pp 2612–2616, 2012

11. Ademola Philip Abidoye, Nureni Ayofe azzeez, Admola Olusola Adesina, Kehinde K. Agbele, Henry O. Nyongesa" Using Wearable Sensors for Remote Healthcare Monitoring System", IEEE, Vol 1, Pp 22-28, 2011

12. Hadda Ben Elhadi, Lamioa Chari, Lotfi Kamoun "A Survey of Routing Protocols in Wireless Body Area Networks for Healthcare Applications", International Journal of E-Health and Medical Communications (IJEHMC), vol 3(2), 2012,

13. Jamil Y. Khan,Mehmet R.Yuce, Farboof karami, "Performance evaluation of a Wireless Body Area sensor network for remote patient monitoring", IEEE Engineering in Medicine and Biology Society, Pp 1266 – 1269, 2008

D. Li, Huan Bang li, Ryuji Kohno, "Performance Evaluation of IEEE 802.15.4 for Wireless Body Area Network (WBAN)", IEEE , Pp 1 – 5, 2009

14. Kenichi Takizawal, Watanabbe K, Kumazawa K, Hamada Y, Lkegami T, Hamaguchi K," Performance evaluation of wearable wireless body area networks during walking motions in 444.5 MHz and 2450 MHz",   IEEE, Pp 370 – 373, 2010

15. S. Cui, A. J. Goldsmith, and A. Bahai, "Energy-constrained modulation

16. optimization," IEEE Trans. Wireless Commun., vol. 4, no. 5,pp. 2349–   2360, 2005

17. Xiyu Lu, Xinlei Chen, Guang Sun, Depeng Jin, Ninge GE, Lieguang Zeng"UWB-based Wireless Body Area Networks channel modeling and performance evaluation", IEEE, Pp 1929–1934, 2011

18. Venki Balasubramanian, Andrew Straineiri "Performance evaluation of the dependable properties of a Body Area Wireless Sensor Network", Optimization, Reliabilty, and Information Technology (ICROIT), Vol 6(8), Pp 229 – 234, 2014

19. Chao Chen, C Pomalaza Raez, "Design and Evaluation of a Wireless Body Sensor System for Smart Home Health Monitoring",. IEEE, Pp 1–6, 2009

20. Aung Aung Phyo Wai, Wei Nei, Robert Hseih, Yu Ge, "Development of visualization and performance evaluation testbed for Wireless Body Area Network, IEEE, Pp 205 – 208, 2011

21. Obaid ur Rehman, Nadeem Javaid, Ayesha bibi, Zahoor Ali khan, "Performance Study of Localization Techniques in Wireless Body Area Sensor Networks", International Conference on Trust, Security and Privacy in Computing and Communications, 1968 – 1975, 25-27 June 2012

22. Venki Balasubramanian, "Critical time parameters for evaluation of body area Wireless Sensor Networks in a Healthcare Monitoring Application", Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP),Pp 1–7, 2014

23. Punyawi Jamjareegulgarn, "Performance evaluation for cooperative diversity-based wireless body area network, IEEE International Conference on Networks (ICON), Dec. 2013Page(s):1 – 6

24. Jae Myeong Choi, Heau-jo kang, yong seonk choi, "A Study on the Wireless Body Area Network Applications and Channel Models" IEEE, vol 2, Pp 263 – 266, 2008

25. Nhat-Quang Nhan, Mathew Gautier, Olivier Berder "Asynchronous MAC protocol for spectrum agility in Wireless Body Area Sensor Networks",International Conference on Cognitive Radio Oriented Wireless Networks and Communications (CROWNCOM), Pp 203 – 208, 2008

26. Lamia Chaari Fourati , "Wireless Body Area Network and Healthcare Monitoring System"Healthcare Informatics (ICHI), Pp 362, 2014

27. B. Manzoorl N javaid, A bibi, Z A khan, M Thair, "Noise Filtering, Channel Modeling and Energy Utilization in Wireless Body Area Networks", IEEE, Pp 1754 –1761, 2012,

28. Marina Sukorl, Norsheila fisal, Sharifah Hafizah Syed Arif, Adel A Ahmed Abdullah,"Performance Study of Wireless Body Area Network in Medical Environment", IEEE, Pp 202 – 206, 2008

29. Khaled A. Ali, Jahangir sarkar, Hussein T Mouftah "Urgency-Based MAC Protocol for Wireless Sensor Body Area Networks", IEEE, Pp 1 – 6, 2010.