Energy Efficient Transmission Approach For WBAN Based on Threshold distance

Anup Kumar[1], Parminder Singh[2]

[1] M.Tech Student, Department of ECE, Doaba Institute of Engineering & Technology, Punjab, India
[2] H.O.D, Department of ECE, Doaba Institute of Engineering & Technology, Punjab, India

---

Abstract - *It is a familiar fact that conservation and preservation of network energy is one of the primary objectives of the sensor nodes in a wireless sensor network. This becomes even more important when we are talking about Wireless Body Area Network (WBAN). In this case, the sensor nodes are working either very close to or inside a human body. Hence performance is a very important task here. In this project we aim to reduce the consumption of energy while a transmission is made. We tend to strategically toggle between working/non-working status of a sensor node while it is being involved or not involved in the transmission process. We are able to increase the network time by a very good amount. Other deceptive parameters are also to be calculated*.

Key Words: Sensor Nodes, Energy Efficiency, Wireless Body Area Network,

1. INTRODUCTION

Wireless body area networks (WBANs) are emerging as one of the newest forms of Wireless Sensor Networks. In WBANs, sensor nodes accumulate human physiological data and transmit it to the sink node **[1].** However, transmission of physiological data to the sink node over a mobile route becomes a very daunting task for sensors due to their limited battery power. Moreover, replacement of critical sensor nodes is a major challenge in such scenarios. In order to increase network lifetime, some routing protocols have been proposed in the literature, but the majority of them are focused on coverage distance and residual energy of sensor nodes. In this work, we will propose an energy efficient routing algorithm for WBANs **[3]**.

Wireless Body Area Network (WBAN) is emerging as one of the most advanced communication networks. WBANs serve a variety of applications including healthcare, personal entertainment, advance sports training, live events, aviation, natural disasters, consumer electronic devices, etc **[6].** Sensors in WBANs measure physiological parameters of human body, such as sugar level, temperature, heartbeat, etc., and forward it to the concerned authorities using an intranet/internet facility **[2]**.

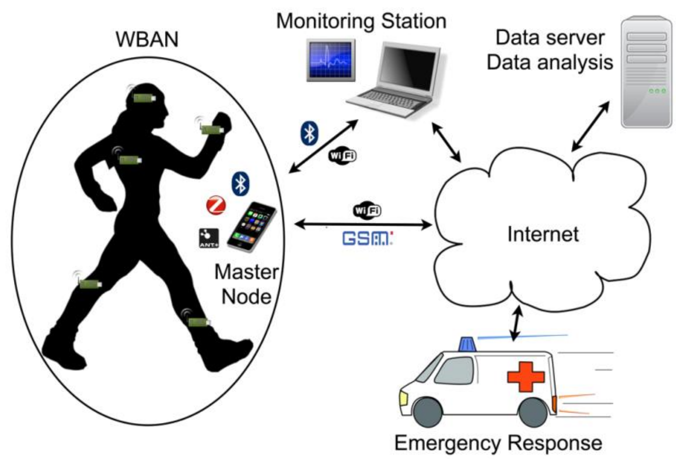


Fig-1: Architecture of WBAN Sensor Network

This kind of continuous monitoring is especially important in critical circumstances such as workers in coal mines and patients with serious medical conditions. The sensors in WBANs can be classified as implant nodes, body surface nodes and external nodes depending according to IEEE 802.15.6 (WBAN) standard, the layered architecture of WBAN consists of Physical and Medium Access Control (MAC) layer which deal with communication. These layers help in establishing energy efficient, highly reliable, cheap and coherent wireless communication in the proximity of the human body **[8]**.

WBAN can be integrated with different wireless technologies like Zig Bee, WSNs, Bluetooth, cellular networks, etc., which will allow expansion of advanced consumer electronics. However, rapid acceleration in the usage of wearable wireless sensor devices expedites the requirement of reliability, security, fault tolerance and quality of service aspect **[10]**. However, there are certain factors like different bandwidth channel topological changes, time-varying wireless channel, and variation in channel bandwidth which make WBANs less lucrative **[9]**. As different types of nodes coexist in WBANs that are scattered in and on the human body, multiple transmission channels are developed between the nodes based on their location. The major goal of a channel model is to evaluate the performance of several physical layer proposals as well as providing a fair comparison amongst them.

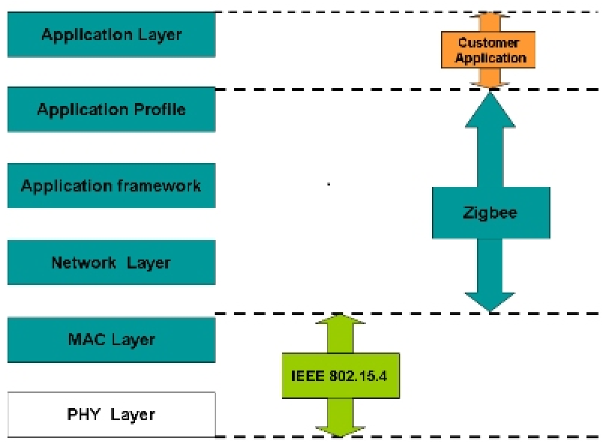


Fig-2: Layered Architecture for WBAN

2. RELATED WORK

S.Kannan [7] has Summarized individual quality of life can be improved by using collection of sensors which can be embedded into the fabric of wearer is called as wearable physiological monitoring system. This system can continuously monitor vital signals and transmit wirelessly to be mote monitoring system. Wireless sensor network can be used in wearable physiological system which has limited availability of energy on network nodes. Clustering can be used to increase lifetime for wireless sensor networks. Energy efficient is possible in wireless sensor network by reselecting cluster heads according to the ratio of residual energy of each node to their distance from base station.

Guangxia Xu, Manman Wang [8] have says an important branch of Wireless Sensor Network (WSN), Wireless Body Area Network (WBAN) has received extensive attention of various fields as it is portable and removable. However, energy consumption is highlighting increasingly as nodes are hard to be recharged or replaced. Up to now, many energy efficient routing algorithms or protocols have been proposed with techniques like clustering, data aggregation and location tracking etc. However, many of them aim to minimize parameters like total energy consumption, latency etc. In order to optimize network routing and prolong the life of network, this paper proposes an energy-efficient routing algorithm in WBAN which is based on Genetic Ant Colony Algorithm (GACA).GACA makes full use of Genetic Algorithm (GA) and Ant Colony Algorithm (CA).

Chenfu Yi, Lili Wang, and Ye Li[11] have summarized Energy efficiency is a key concern for wireless sensor nodes, especially for wireless body area network (WBAN) in which sensors operate in close vicinity to, on or even inside a human body. In this paper, we first present a system-level energy consumption model associated with transmission distance d and transmission data rate over on-body wireless communication link. Then, based on the analysis of tradeoff between circuit energy and transmission energy on distance, a threshold distanced which is responsible for the proportion of transmission energy and circuit energy is derived for energy saving in WBAN. With the case of d = d, since circuit energy is comparable with transmission energy consumption, the total energy consumption can be saved by optimizing the transmission data rate R. Simulation results show that a 59.77% or even more energy saving is achievable using the optimized scheme, compared with baseline scheme. With d>dth, since the total energy consumption is monotonically decreasing with respect to time t, an offline algorithm is applied to energy saving by prolonging transmission time within the deadline time. In addition, on the basis of the offline algorithm, a battery-aware transmission approach is presented for WBAN using battery electrochemical property. Experimental results show that, using the presented battery-aware approach, 71.05% and 60.81% energy saving can be obtained, in comparison with the baseline and offline schemes, respectively.

Sidrah Yousaf, Nadeem Javaid, Umar Qasim, Nabil Alrajeh, Zahoor Ali Khan, and Mansoor Ahmed [4] have analyzed incremental cooperative communication for wireless body area networks (WBANs) with different numbers of relays. Energy efficiency (EE) and the packet error rate (PER) are investigated for different schemes. We propose a new cooperative communication scheme with three-stage relaying and compare it to existing schemes. Our proposed scheme provides reliable communication with less PER at the cost of surplus energy consumption. Analytical expressions for the EE of the proposed three-stage cooperative communication scheme are also derived, taking into account the effect of PER. Later on, the proposed three-stage incremental cooperation is implemented in a network layer protocol; enhanced incremental cooperative critical data transmission in emergencies for static WBANs (EInCo-CEStat). Extensive simulations are conducted to validate the proposed scheme. Results of incremental relay-based cooperative communication protocols are compared to two existing cooperative routing protocols: cooperative critical data transmission in emergencies for static WBANs (Co-CEStat) and InCo-CEStat. It is observed from the simulation results that incremental relay-based cooperation is more energy efficient than the existing conventional cooperation protocol, Co-CEStat. The results also reveal that EInCo-CEStat proves to be more reliable with less PER and higher throughput than both of the counterpart protocols. However, InCo-CEStathas less throughput with a greater stability period and network lifetime. Due to the availability of more redundant links, EInCo-CEStat achieves a reduced packet drop rate at the cost of increased energy consumption.

3. STANDARDS FOR WBAN COMMUNICATIONS

A large number of communication standards are used for WBAN. Wearable devices which are based on micro chips also rely on these standards. Most widely used standards are Bluetooth, ZigBee, MICS, and Ultra Wide Band (UWB) IEEE 802.15.6.

IEEE 802.15.1 (Bluetooth)

IEEE 802.15.1 is a communication standard which is used for short range communication typically within 10m range. The data rate of Bluetooth standard is 3Mbps. The bandwidth of Bluetooth standard is high while latency rate is low. High bandwidth encourages use of Bluetooth standard in UHC. However, this standard consumes high energy, so this standard is normally avoided in UHC. This standard is not well fit for network of sensitive bandwidth and latency.

ZigBee

It is another frequently used communication standard. ZigBee is used in communication devices which utilize less energy like sensor nodes. This standard is employed with a collision avoidance technique. ZigBee got the power to control complex operations related to communication. It utilizes very less energy in communication nearly about 60mW. The data rate of this standard is low nearly 250kbps. ZigBee has the capability of encryption to give considerable protected communication.

MICS

MICS standard is particularly designed for communication in medical applications. This standard is specifically used for on body or in body communication in WBAN. This standard is used at distance of short range that is a range of human body. It collects data from different sensors placed on the body or implanted inside the body and transfer data to sink in multihop manner. MICS utilizes low power as compared Ultra Wide Band (UWB) so it radiates less energy that is good for human body tissues.

IEEE 802.15.6 Ultra Wide Band (Uwb)

UWB is a high bandwidth communication standard and it is used in high data rate applications. UWB is best choice whenever a application requires a high bandwidth. In emergency applications, UWB is considered best choice to use for communication. UWB are implemented with Global Positioning System (GPS). This feature provide short routing path to medical coordinator. GPS facility provide routes which has less traffic and that makes communication faster and emergency data can be easily forward to medical server in critical situation. The receiver of UWB band is very complex that makes it not good for use in wearable application.

4. PROBLEM FORMULATION

Wireless body area sensors are used to monitor human health with energy constraints. Different energy efficient routing schemes are used to forward data from body sensors to medical server. It is important that sensed data of patient reliably forward to medical specialist or server for further analysis. Proposed scheme facilitate mobility at cost of low throughput and high energy conservation. We plan to achieve a longer stability time and high throughput.

The Authors in[15] have says Energy efficiency is a key concern for wireless sensor nodes, especially for wireless body area network (WBAN) in which sensors operate in close vicinity to, on or even inside a human body. In this paper, we first present a system-level energy consumption model associated with transmission distance d and transmission data rate over on-body wireless communication link. Then, based on the analysis of tradeoff between circuit energy and transmission energy on distance, a threshold distanced which is responsible for the proportion of transmission energy and circuit energy is derived for energy saving in WBAN. With the case of d = d, since circuit energy is comparable with transmission energy consumption, the total energy consumption can be saved by optimizing the transmission data rate R.

5. WIRELESS BAN APPLICATIONS

This section covers the applications areas WBAN including E-Health care, lifestyle and sports, military applications, WBAN for animals, Preventing of Cable and Conductor (C & C) Theft and finally its applications in networks and communications.

E-Health Care

BANs can make available interface for diagnostics, for remote monitor of human physiological data, for administration of drugs in hospitals and as an aid to treatment. In the future it will be possible to monitor patients constantly and give the necessary medication whether they are at home, in a sanatorium or elsewhere. Patients will no longer require to be connected to large technology in order to be monitored.

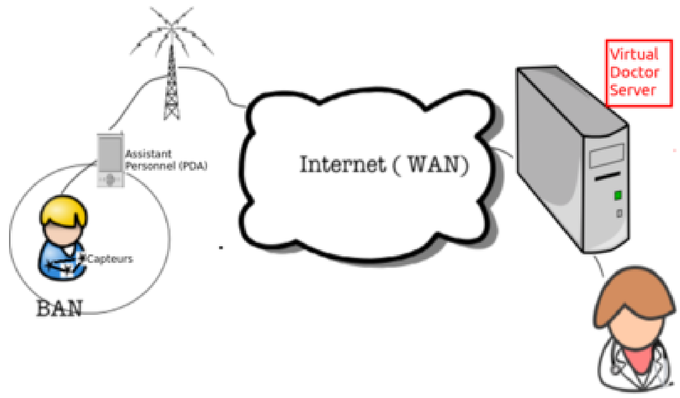


Fig 3. E-Health Care System

Military Applications

The Army Research Laboratory (ARL) has accomplish experiments using auditory sensor arrays hanging below tethered aerostats to sense and confine fleeting signals from mortars, weaponry and arms fire. This unrelenting inspection can have an influential consequence on the survivability and lethality of our soldiers. Inspiring the array gives an appreciably longer range of detections under flattering MET circumstances. The opportunities for using BANs in the forces are numerous. Some of the military application for BANs includes monitoring health, location, and high temperature and hydration levels. A battle dress uniform included with a BAN may become a wearable electronic network that connects devices such as life support sensors, cameras, RF and personal PDAs, health monitoring, and transports data to and from the soldier's wearable computer. The network could perform functions such as chemical recognition, detection to prevent victims from friendly fire and monitoring of a soldier's physiological condition. Calling for support, his radio sends and receives signals with an antenna blended into his uniform. As a result, BANs present new opportunities for battlefield lethality and survivability.

WBAN for Animals

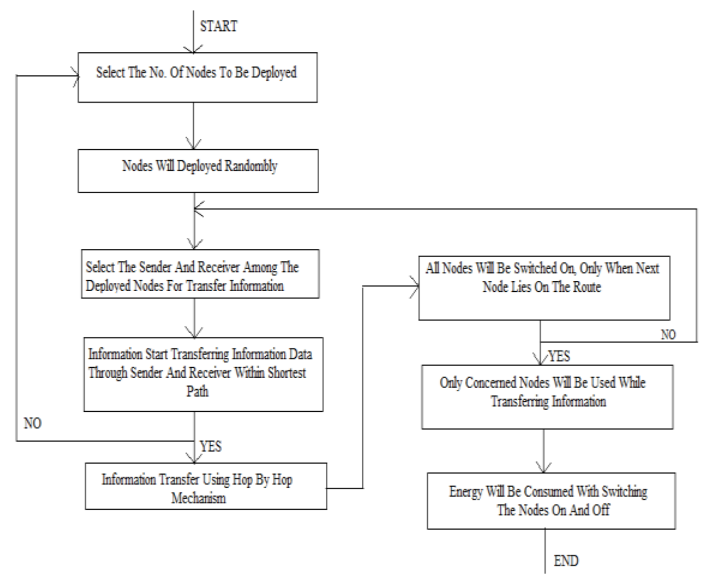
Wireless BANs is very beneficial device. It may be used for improving health and diagnosis of different infectious diseases in human being as well as animals. It is very important matter, if want to improve human health and control diseases first we have to improve animals health and control diseases that provide food to the human being e.g. milk, meet, eggs etc One important thing is behind this motive is that human and animals are inter depending each another. There is symbiotic relationship.

Networking and communications

These help the integration with Internet and other networks, low operation and maintenance cost, highly secure wireless communication system to decrease the costs other resources needed to operate a WSN. Cognitive radio play important role in communications in the harsh environment. Some factors are harsh environmental condition that are, interference, highly caustic environments, high humidity levels, vibrations, dirt and dust, or other conditions that challenge its performance.

6. METHODOLOGY

In The Methodology Flow Chart, We showed how we work on our Proposed Papers for Energy Consumed in Wireless Body Area Network. Firstly, we select the nodes to be deployed randomly among the huge no. of nodes. After the nodes deployment, we select the sender and receiver for transferring the information within the shortest path. All nodes will used switching method, when the next node lies on the route the then only concerned nodes will goes too switched ON mode. This way only the concerned nodes will be used while transferring the data. Hence, the energy could be consumed strategically switching the nodes ON and OFF.



Flow chart. Methodology

7. RESULTS AND STEPS OF DESIGN

Step1: In the first step we will deploy the nodes randomly. Here some nodes may be faulty and some nodes are good for transferring the information. When we will run the code then they will ask for "Enter the no. of sensor nodes to be deployed". After entering some numeric no. the first fig shows the placement of nodes.

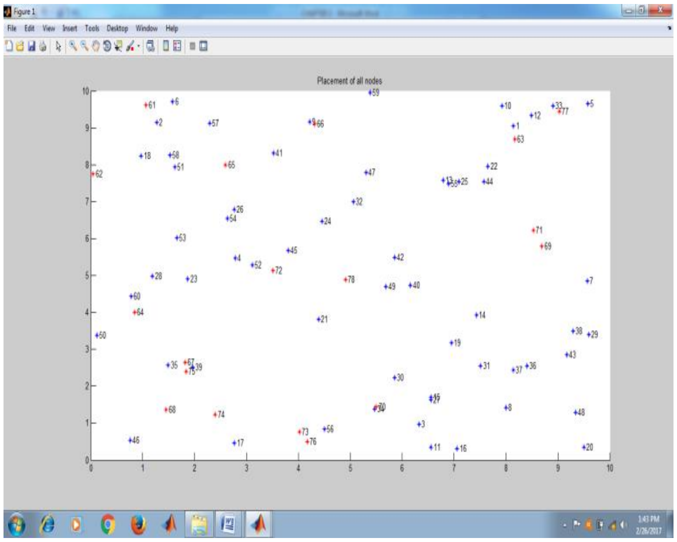
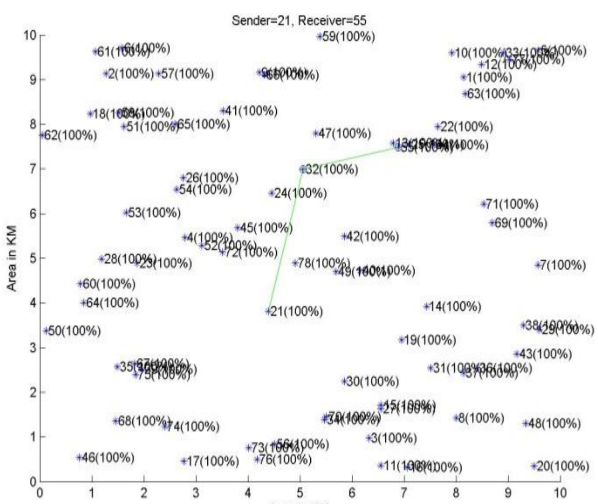


Fig 4. Placement of nodes

Step2: In the second step we show the shortest path from sender to receiver randomly. In this, the whole process shown in two steps of information transfer. The first step had shown the energy consumption for the nodes. In this all nodes consume energy either they are in active mode or sleep mode. This process shown in first information transfer, Run count 1 to 10 respectively. And all nodes consume energy at the interval of 10% or what we defined in coding, the level of energy consumption. By this process we can imagine how the energy is wasted when the nodes are not in used. This process shown by bar graph also in the same process that how energy will consumed for all Run count in information transfer one.



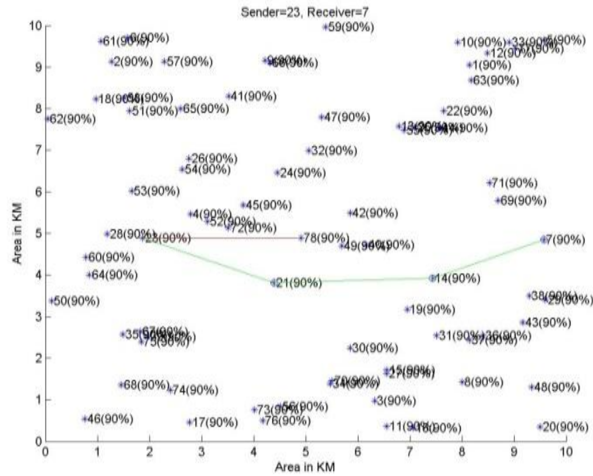


Fig 5. Energy Consumption in IT1

This consumption of energy also defined by the bar graph, How the energy will consumed by each and every nodes when they are in active or sleep mode in information transfer 1 (IT1).

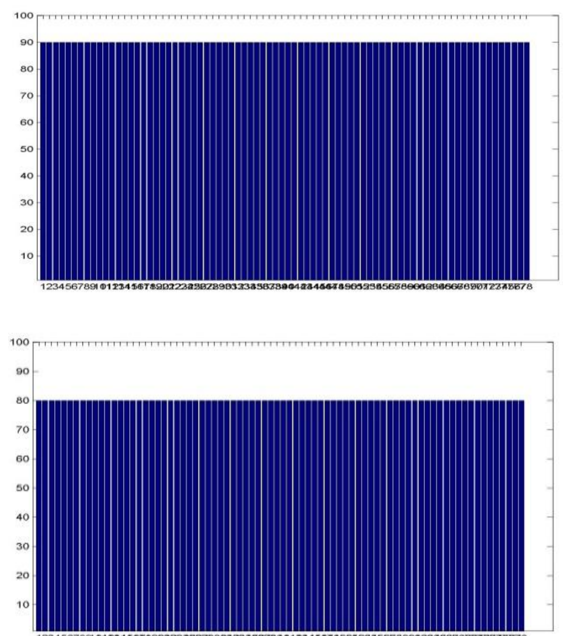


Fig 6. Energy Consumption In IT1 Shown By bar Graph

In the second process or in the information transfer 2 the energy consumed by only those nodes which will be in used. The difference between first information transfer and second information transfer is that, in first transfer all nodes consumes energy in every Run count but in second transfer only active mode nodes will consumes energy in every Run count. Here if nodes once used in any count then the energy will stable for that nodes till further Run count. This process showed by the fig 7 and 8 respectively. And like first step they also define about consumption of energy level by the bar-graph. They mainly focused on to show which nodes will be used while transferring the information. If once energy will consumed by any nodes in any count then that consumption of energy for that particular nodes will be shown in the next Run count either they will be in used for next count or not. Through the fig 7 we can see this experiment, how they take place for proposed method of energy consumption.

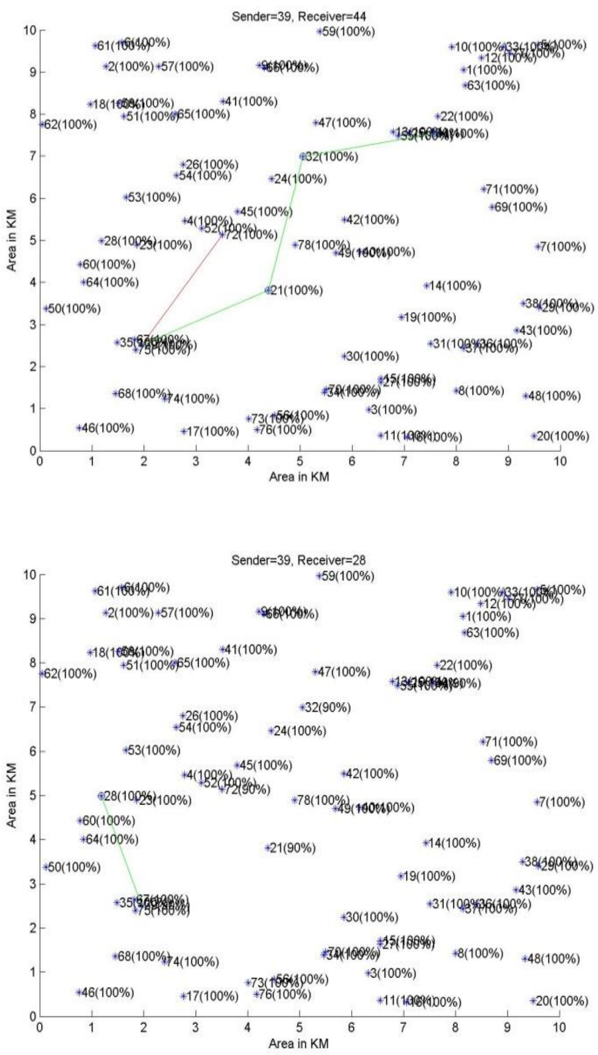


Fig 7. Energy Consumption In IT2

Now this outcome observation we can also define by the bar graph for better understanding about the nodes used, while the transferring information two for different no. of Run count. Here only those nodes will consuming energy they are in use or in active mode.

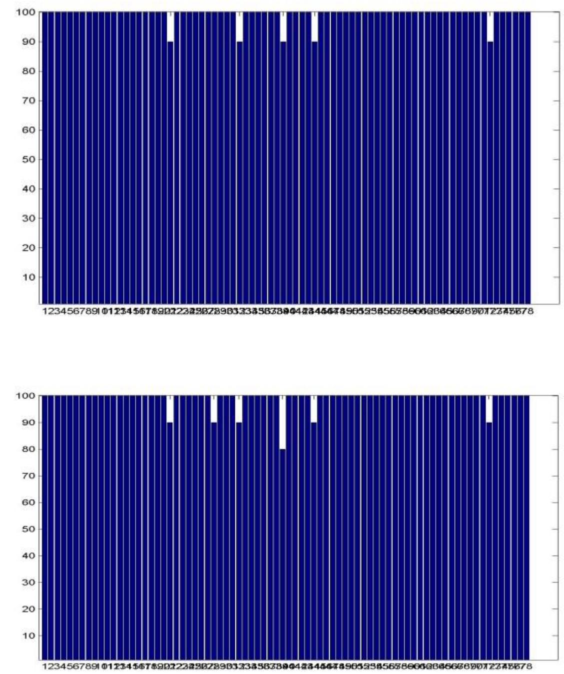


Fig 8. Energy Consumption In IT2 Shown By Bar Graph

Form here now we will move for other steps After entering the different no. of nodes we can see how the performance of energy consumption will increase or decrease randombly. These all process will be defined by duty cycle and rate of performance of energy consumption at the different nodes.

Firstly we will shows the result at different number of nodes like 70 & 100, from these nodes we will get get some result. And from these graph we can see the rate of performance of energy at different level.

At the number of nodes 70, we get

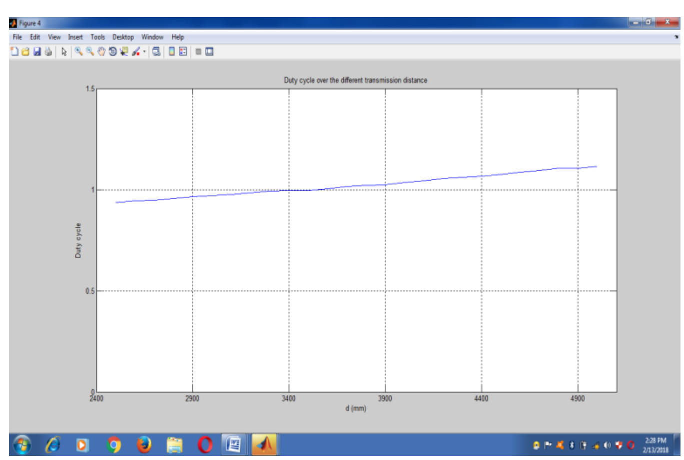


Fig 9(a). Duty Cycle

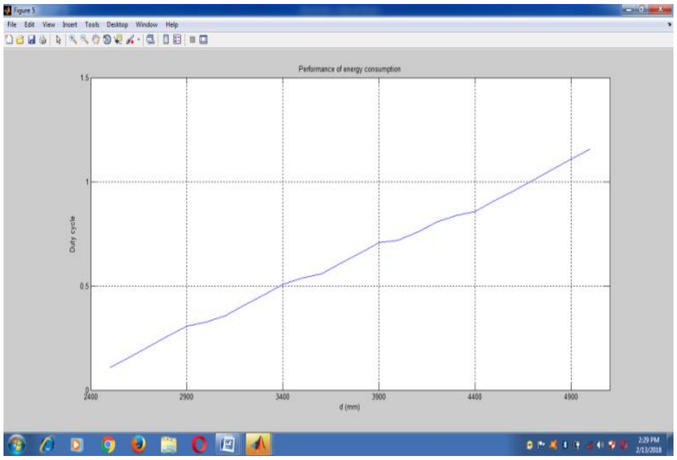


Fig 9(b). Rate of permonace of Energy Consumption

Now we will take the number nodes as 100, we get

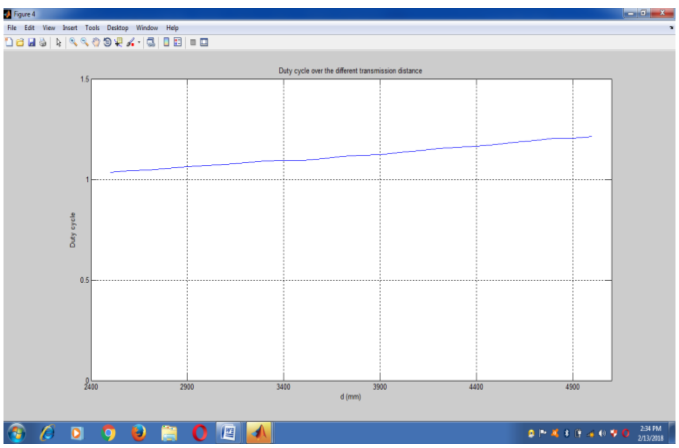


Fig 10(a). Duty Cycle

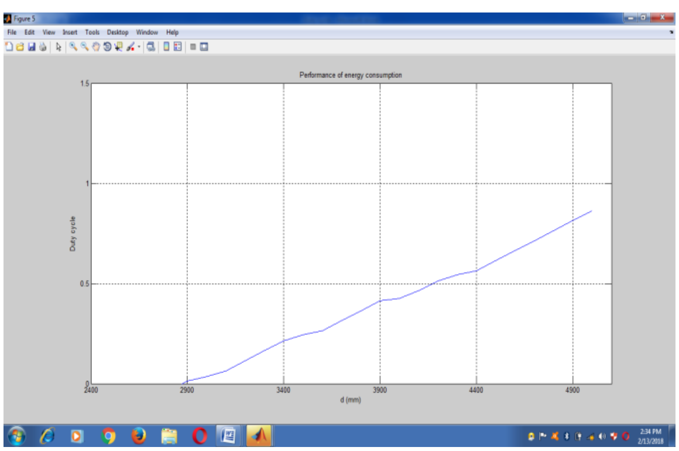


Fig 10(b). Rate of performance of energy Consumption

From These experiments we get some graph for showing that how the energy consumption will increase or decrease after using different number of nodes. And we can also differentiate the performance of energy consumption at different number of nodes with performing these tasks.

5. CONCLUSION

In this paper we discussed about various Authors and their thought. For Energy Efficient Transmission Approach For WBAN we can consider a network where 1 or multiple nodes are mobile. In that case, due to continuous routing, energy conservation could be difficult. So we can try to work around this problem where either the sink, source or multiple nodes are continuously moving.

6. ACKNOWLEDGEMENT

The authors are thankful to Mrs. Maninder Kaur, M.tech coordinator, DIET and her staff for providing the necessary facilities for the preparation of the paper. Without their proper guidance it is not possible to learn latest technologies and research works.

REFERENCES

[1] H. C. Keong, K. M. S. Thotahewa, and M. R. Yuce, “Transmit-only ultra wide band body sensors and collision analysis,” IEEE Sensors J., vol. 13, no. 5, May 2013, Pages: 1949–1958,

[2] C. C. Y. Poon, Y.-T. Zhang, and S.-D. Bao, “A novel biometrics method to secure wireless body area sensor networks for telemedicine and m-health,”IEEE Commun. Mag., vol. 44, no. 4, Apr. 2006, Pages: 73–81

[3] J.Zhu and S. Papavassiliou, “On the energy-efficient organization and the lifetime of multi- hop sensor networks,” IEEE Commun. Lett. , vol. 7, no. 11, Nov. 2003, Pages: 537–539.

[4] Sidrah Yousaf, Nadeem Javaid, Umar Qasim , Nabil Alrajeh , Zahoor Ali Khan, and Mansoor Ahmed,” Towards Reliable and Energy-Efficient Incremental Cooperative Communication for Wireless Body Area Networks,” mpdi sensor, Dec 2015, Pages:1-22.

[5] M. Patel and J. Wang, “Applications, challenges, and prospective in emerging body area networking technologies,” IEEE Wireless Commun., vol. 17, no. 1, Feb. 2010, Pages: 80–88.

[6] Channel Model for Body Area Network (BAN), IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs), IEEE Standard P802.15-08-0780-09-0006, Apr. 2009.

[7]S.Kannan," A Novel Approach Towards Achieving Energy Efficient and Load Balancing for Wireless Sensor Network used in Wearable Physiological Monitoring," Australian Journal of Basic and Applied Sciences, 9(5) March 2015, Pages: 63-71

[8]Guangxia Xu, Manman Wang," An Energy-Efficient Routing Mechanism Based On Genetic Ant Colony Algorithm for Wireless Body Area Networks," Journal of Networks, vol. 9, no. 12, DEC 2014, Pages: 3366-3372

[9] F. M. Costa and H. Ochiai, "Energy-efficient physical layer design for wireless sensor network links," in Proc. IEEE Int. Conf. Commun. (ICC), Jun. 2011, pages: 1–5.

[10] J. Abouei, J. D. Brown, K. N. Plataniotis, and S. Pasupathy, "Energy efficiency and reliability in wireless biomedical implant systems," IEEE Trans. Inf. Technol. Biomed., vol.15, no. 3, May 2011, Pages: 456–466,

[11] Chenfu Yi, Lili Wang, and Ye Li, Member, "Energy Efficient Transmission Approach for WBAN Based on Threshold Distance," IEEE Sensor journal, vol. 15, no. 9, SEP 2015, Pages: 5133-5141.