

Performance Upgradation Against Route Discovery using ABC Optimization in Wireless Body Area Network

Monika Thakur, Manjot Kaur

Abstract: *Wireless body area network (WBAN) is projected as the monitoring environment. The main approach of the wireless nodes is to sense and collection of the data from the certain domain. WBAN is defined as the body area network (BAN) and medical area network that consist of the computing devices may be embedded inside and outside the body. In existing work, the velocity and the location of the patients are change by formation of the unpredictable technology in WBAN. It was problematic approach where their transmission error of the medical data occurs and path losses. For improving existing proposed protocol is used i.e. Balanced Ad-Hoc on-demand distance vector (BAODV) routing protocol with Artificial Bee colony (ABC) optimization. The experimental analysis is done by taking different parameter path loss rate, packet delivery ratio and energy consumption. The simulation result shows the better performance as compare to existing protocol.*

Keywords: *WBAN, Intra body communication, Routing protocol, BAODV, ABC Optimization.*

I. INTRODUCTION

Due to significant development in wireless body area network (WBAN) researcher are getting attracted towards it. Progress in electronics has led to the development of technology for micro-electro-mechanical system (MEMS) [1]. This technology made it possible to develop smart and small sensors. These sensors are able to sense data, transmit and communicate with each other. Recently, it is very popular in field of healthcare. In this different type of sensors are fixed in the human bodies to monitor their health conditions. These sensors have ability to communicate and transmit their data. All the sensors measure different conditions of body such as blood pressure, heart rate, glucose level, body temperature etc. Then process it accordingly. It also transmits the information to hospital through wireless network. These sensors are of three types' implantable sensors, wearable sensors and outside sensors. The implantable sensors are those sensors which are implanted inside the human body by with help of operating the body; for monitoring patient health [2]. Wearable sensors are those sensors which are attached to the human body for monitoring different parameters of body.

And third types of sensors are placed in few distances from the human body.

According to the survey conducted by the Department of Economic and Social Affairs of the United Nation the old aged people was 759 million according to them up to 2025 they will be 1198 million. WBAN will be very helpful for them to monitoring their health condition at home [2]. As we all know that elder peoples (up to 60 old years) require more health checkup; Also, they are not that much capable for stand in rows or waiting for their turn. WBAN will provide such a good facility to them that there will be no need for them to go hospital daily. In this different sensor are attached, implanted and placed in the distance of few centimeters form body and monitor the all body functions. These different sensors collect their body data daily and then send it to hospital server; the doctor checks their daily report and sends some instruction, precautions to them according to their body data that the doctor received. WBAN perform its work mainly in three layers. In first layer there is a human body with different sensors on, in or around it. These sensors communicate with each other by using intra communication model. Intra communication rang for communicate is up to few centimeters. The communication architecture shown in figure.1. In this sensor collect data and BANC (Body area network coordinator) send it to second layer. The Second layer creates an interface between first layer and third layer; processing and transmission of data is also performing here.

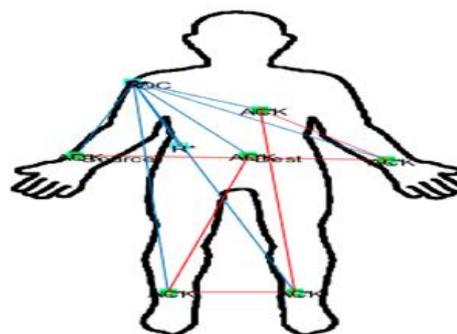


Fig:1 Intra-body Communication model

This layer sends all the data to third layer. In third layer there is a hospital server, doctor check all data of their different patient and revert them back with precaution and also provide authentication to them [9]. In our work we are working on the first layer. In that sensor communicate or transmit their data or information by using intra communication model. For transmission of data there is need of routing protocols. Routing protocol plays very important role for sending data from one source to destination.

Revised Manuscript Received on 30 May 2019.

* Correspondence Author

Er. **Monika Thakur***, Department of computer science and engineering, Chandigarh University, Mohali, India,

Er. **Manjot Kaur**, Department of computer science and engineering, Chandigarh University, Mohali, India,

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an [open access](https://creativecommons.org/licenses/by-nc-nd/4.0/) article under the CC-BY-NC-ND license <http://creativecommons.org/licenses/by-nc-nd/4.0/>

Routing protocols are used in two types of network ad-hoc network and Traditional network. In this the main concern is Ad-Hoc network [3]. Ad-Hoc is structure less network. It is on-demand self organized temporary network. In WBAN heterogeneous sensors are attached on the human body. These sensors are small in size and have limited battery capacity. Because of their limited battery life, during communication and data transmission node failure and route failure or less route maintenance happens. For decreasing this problem in this we proposed an advanced version of Ad-Hoc on-demand distance vector protocol (AODV) i.e. Balanced AODV. And apply ABC optimization on it for increasing battery life, decreasing path loss and increasing packet receiving rate.

II. RELATED WORK

Khan R. A et al, 2018, [1] In this paper author proposed multi-hopping routing protocol for making WBAN system energy efficient and reliable. Multi-hopping technique is used to reduce distance and save energy consumption. In these eight sensors were used among which two are used for critical data and other six are used for computing forward node. Forward node is selected on the basis of two cost function: minimum distance and maximum energy. In this author archived better network stability and life time of the sensor node. **Bhanumathi.V et al, 2017, [2]** Author describes about WBAN its application, brief description about routing protocols by analyzing the different articles from year 2002 to 2016. Categorize all routing protocols and tell about their vital role in the design process of energy efficient, low cost and reliable wireless body area network. Author provides brief description about routing protocols used in healthcare. **Singla.R et al, 2018, [3]** author proposed a Rel-AODV routing protocol for providing more security and privacy in Wireless body area network. By analyzing different study's author analyze that there is an issue or privacy and security of patient data. The proposed work is energy efficient and improves the overall quality of services of the system. **Sonone.S et al, 2014, [4]** In this author proposed an improved new AODV routing protocol for providing a collision free network in wireless body area network. And compare the performance of proposed protocol with AODV, DSR and prove that proposed protocol gives better performance in packet delivery ratio, throughput, and energy saving than existing one. **Elhayatmy.G et al, 2018, [5]** In this author give a review about internet of things (IOT) based wireless body area network in healthcare. In this brief overview of IOT and how it works with WBAN and technologies used in it. It also provides review on WBAN system. Physical layer, routing, MAC layer and challenges in WBAN. **Datey.S.G et al, 2015, [6]** In this author explain about mobile ad-hoc network (MANET) and about communication architectures infrastructure based or infrastructure less also provide overview on its applications. In this author mainly focus on the ad-hoc network and its advantages and disadvantage. **Lokest.S et al, 2018, [7]** In this author describe about WBAN its challenges and propose AODV routing algorithm to increase the network efficiency, data transmission by measuring throughput, delay and improve performance of wireless patient network. In this ID-based aggregate signature scheme is provided for WBAN which can compress signature generated by body sensors into a short range, it can reduce the communication and storage cost. **Kim.B et al, 2017, [8]** In

this paper author discusses about mobility in Wireless body area network. In this author discusses about importance of mobility, its advantages and disadvantages and describe that how mobility model play a vital role in protocol design and performance evaluation. **Tiwari.P et al, 2015, [9]** Author present overview about wireless sensor network and also gives brief overview about its various applications like human health monitoring and player health checking etc. And also describe about the major challenges of WBAN. **Yan.J et al, 2018, [10]** In this paper author defines optimal path of energy consumption (OPEC) in WBAN and design optimal path energy consumption routing with ABC using methods of exchanging path SA, authors implement and design OEABC to solve the problems of the discrete solution space. The result shows that OEABC can effectively solve the NP problems of the optimal energy consumption path in WBAN. **Kumari.R et al, 2016, [11]** In this paper author analyzes the performance of different routing protocols and compare the performance of WSN routing protocols with WBAN routing protocols on the basis of parameters packet delivery ratio, latency and throughput etc. The compared protocols are AODV, DSDV, DSR and AOMDV. After comparison it is found that AOMDV gives better performance. **Yang.X et al, 2018, [12]** In this author proposed a hybrid MAC protocol for energy saving and extending lifetime of the sensor nodes. In this awaiting order state is used for reducing energy consumption of body sensor nodes by using this hybrid CSMA/CA-TDMA technique author achieves energy efficient transmission.

Research Gap:

After the comprehensive review off literature, the following gaps have been identified:

- The performance of WBAN depends intensely on energy consumption, delay and throughput of the network. The routing protocol play very important role in increasing the performance of the system.
- The Bio medical sensors (BMS) used to monitor different sign of human body such as heart beat rate, respiratory rate, EEG, ECG, glucose, temperature, and blood pressure etc. These sensors have different data rate and frequencies that consume high processing power and energy to transmit the patient's data to the body coordinator. Literature survey reveals that requirement of an energy efficient routing protocol that supports heterogenous data rates of different sensors.
- WBAN works in 3- tier architecture model. For communication between these tier routing protocol play vital role. For sending data from source to destination securely.
- Due to sensors node heterogenous nature, when they all send data at a same time than collision occur in the network.
- It has been identified in the literature that due to high energy consumption of sensors some time they stop working and path loss occur in the network.
- Delay in data sending and data loss by sensor nodes degrades the performance of the system. Moreover, nodes consume more energy in waiting and retransmission.

- Due to traffic in the network packet receiving rate also decrease to overcome these issues of WBAN routing protocol play vital role,

III. PROPOSED WORK

In proposed work we deploy eight sensors on the human body. In first phase different sensors are attached in the human body at different parts, these sensors are in on and around the body. A body area network coordinator (BANC) is created with design of coverage set for distance and range calculation. Routes are generated using AODV protocol with the generation of balance index. Any node can send route request in the network, if the route is free the reply message is sending otherwise no reply is sent. Artificial Bee Colony Optimization (ABC) is applied if route failure take place and best path is selected from balance index. ABC optimization is applied if on further request the route is not free otherwise packet is sent along the route.

Detailed Description in proposed work:

Initialize the deployment of the wireless body area network (WBAN) and calculate the network area 1000*1000 meters. Calculate the network area with twice parameter metrics required that is network length and network width. In this network assign the base station to manage the packets in the network. Evaluate the coverage set based on active node and sleep node in the wireless body area network.

In this coverage we calculate the distance based on

$$= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \quad (1)$$

The purpose of the coverage set range and distance calculation to found the data transmission in the WBANs. Signal broadcasting continues to the start node and send the request to the nearest neighbor nodes in the network. Whenever free the node is free then replies back to the network. All nodes are communicating one node to another node. We are developing the balanced ad-hoc network to route discovery in the wireless body area network. In route discovery, individual route has a life-time after which the path expires if it is not utilized. A path is maintained only, when it is used and hence previous paths are neither used. In this phase, create the various routes and calculate the balanced route in the network. Balance index creating to consume less energy, distance and time. In this proposed work, we implement an artificial colony optimization algorithm in the wireless body area network (WBANs). In this network that to communicate the packet one node to another sensor node in the network. In this algorithm are uses three phases like employee bees, onlooker and scouts.

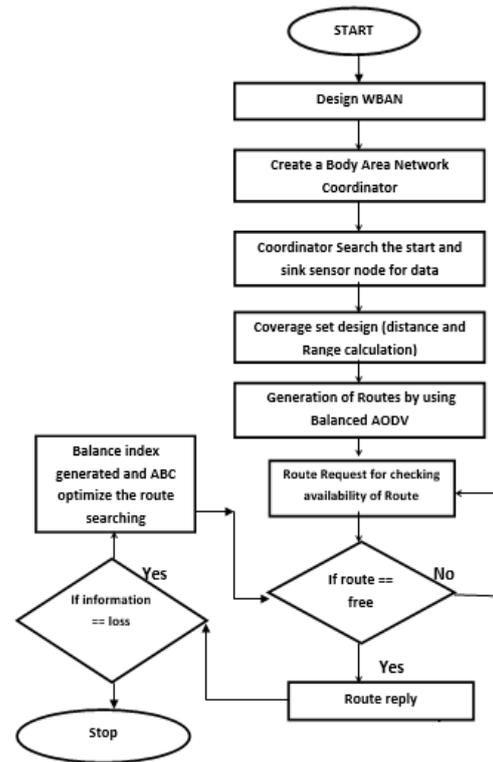


Fig.2 Research Methodology

In this algorithm evaluation fitness function using evaluate the fit value in the network. To evaluate the performance metrics like as a Throughput, packet receiving in the sink and path losses and compared with the existing work. The mathematical formulas for the calculation for these different parameters are as follow:

Packet delivery ratio: The packet delivery ratio is the ratio of transmission of packet or data from source to destination at a time interval. Packet delivery ratio is the number of the received packet to the number of the packet transmitted packet. The mathematical Packet loss comparison of three methods is given in Fig 5. PL of the proposed method is minimizing than that of Hybrid (ABC+BAODV) algorithm formula for the calculation or packet delivery ratio is as follow:

$$\text{PacketDeliveryRatio} = \frac{\text{no of the packets recieved}}{\text{Total number of the packets transmittted}} \quad (2)$$

Energy consumption: The consumption of the energy during the routing and the transmission of data may loss of power in the network. The mathematical formula for the calculation of the energy consumption in the network is as follow:

$$\text{Energy-Consumption} = E_S + E_C + E_D + E_M \quad (3)$$

Energy consumption is the sum of the energy in signal transmission (E_S), energy consumption during aggregation (E_C), energy during depletion of energy (E_D) and energy consumed during mobile process (E_M).

Path loss: Path loss is the reduction of the power density of an electromagnetic density which propagte through the space. Path loss can be calculated as follow:

$$P_{loss} = 10 \log_{10} \frac{P_T}{P_R}$$

(4)

In wireless body area network P_T is the transmitted power and P_R is the received signal power during the communication of the network.

IV. RESULT DISCUSSION AND ANALYSIS

The proposed BAODV protocol and ABC optimization algorithms have been designed using MATLAB 2009. Simulation tool is used for data communication the real dataset and its performance parameters compare with existing WBANs algorithms such as Multi-hop protocol. In these eight sensors are deployed in the human body fig.1. In which two sensors represent source and destination and one another sensor represent a data center. In this concept of balanced indexed is used with ABC optimization to choose best path and to save energy of sensor nodes. In this body area network used these methods that the performance improvement with respect to energy, path loss and packet receiving in the sink node.

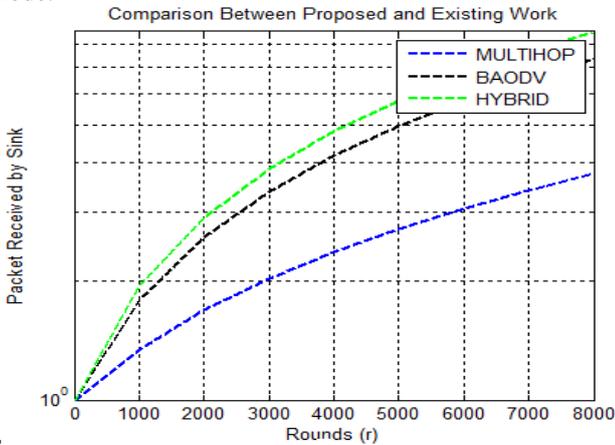


Fig 3 Comparison Packet Received by Sink

The data send from source to destination is very sensitive, because it is related to human health. So, it is important that data reach destination. Above fig.3 the comparison between proposed and existing algorithm, in term of packet received by sink and their rounds. It can be observed that the packet receiving rate of hybrid (BAODV+ABC) is high as compare to BAODV and existing protocol. Successful number of data packers received is called packet delivery rate and BAODV+ABC (hybrid) algorithm. So, it can be concluded that the proposed protocol increases the packet receiving rate.

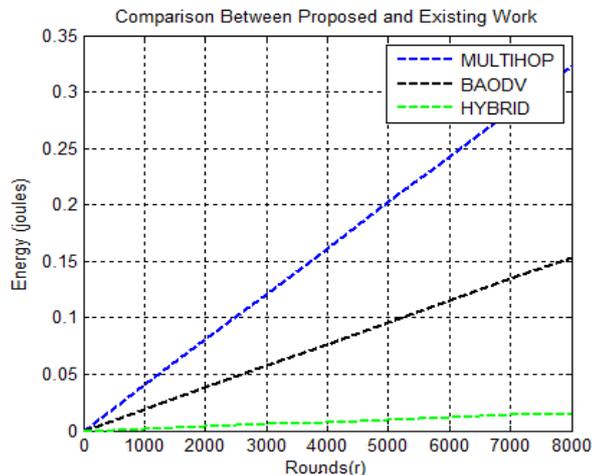


Fig. 4 Comparison Energy (Joules)

Fig.4 defined the comparison between proposed and existing work in terms of energy in joules and number of rounds. As it is observed as that energy consumed by proposed scheme is less than 0.05 joules and energy consumed by existing is more than 0.25 joules. It is observed that proposed scheme consumes less energy as compare to existing protocol.

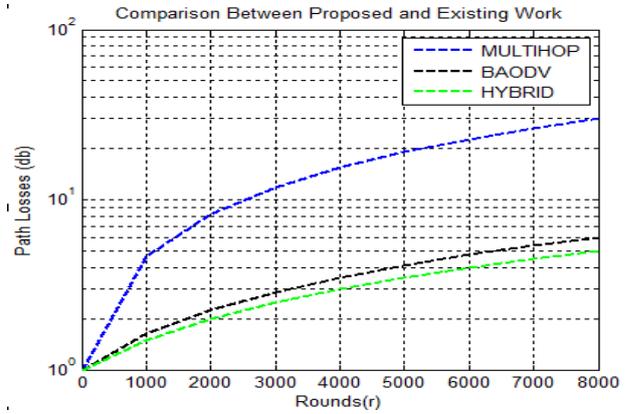


Fig.5 Comparison Path Loss

In fig.5 path loss is less in proposed scheme as compared to existing protocol. In proposed path loss is less than 10^1 and in existing path loss is greater than 10^1 hence it is observed that in proposed scheme path loss also decrease. The analysis of the Multi-hop existing algorithms is denoted by blue color line, BAODV is denoted as black color line and proposed algorithm denoted by green color line. The energy consumption of proposed method is stable as compared to existing one in which energy consumption isn't stable making the sensor node. In proposed work was attained by the method with the help of fitness cost value in every round making the sensor distance minimum due to the artificial algorithm through forward to the destination. In hybrid algorithm balance route index generating to transfer the data secure route but some cases data not stable in balance route cause of minimum energy, minimum time and minimum overload occur and recovery of the network.

Table 1. Comparison proposed and existing work in Packer receiving in sink nodes, Energy and Path losses:

Parameters	Hybrid (ABC+B-AODV)	B-AODV	Multi-hop
Packet receiving in sinks nodes (%)	95.27	79.39	35.0
Path Losses (db)	50.1	62.69	78.2
Energy (joules)	0.197	1.9	2.4

By comparing proposed and existing parameters like packet receiving in sinks nodes, path losses and energy (joules). Packet delivery increases with proposed scheme and path losses and energy minimize in the wireless body area network (WBAN).

V. CONCLUSION AND FUTURE SCOPE

In this research work, an energy efficient routing protocol for wireless body area network is proposed in which collaboration of the information and sensing of the wireless nodes along with a certain domain and various operations are applied for various medical sensor and applications that is positioned inside and outside the body. In this proposed protocol BAODV is used for the finding a balanced route and after that it applies artificial bee colony algorithm on the balanced route for making generation of the optimized path. The fitness function is evaluated for the generation of the optimized path. The experimental analysis is done using BOADV and ABC algorithm. The various performance parameters are throughput and path discovery. In the proposed approach, performance is enhanced by increasing the throughput, packet delivery ratio and decreasing path loss problem. Future scope, a wide research will be done in sensing the body area network and real time implementation is attained and a testing approach could be suggested which would help in improving the proposed algorithm.

AUTHORS PROFILE



Monika Thakur ME Research Scholar, Department of computer science and engineering, Chandigarh University. I have done B.Tech from HPTU, Hamirpur, H.P. I have done diploma in CSE from JUIT Wagnaghat, Solan, H.P, India.



Manjot Kaur, Associate Professor Department of computer science and engineering, Chandigarh University, Mohali, India.

REFERENCES

1. Khan, R. A., Mohammadani, K. H., Soomro, A. A., Hussain, J., Khan, S., Arain, T. H., & Zafar, H. (2018). An energy efficient routing protocol for wireless body area sensor networks. *Wireless Personal Communications*, 99(4), 1443-1454
2. Bhanumathi, V., & Sangeetha, C. P. (2017). A guide for the selection of routing protocols in WBAN for healthcare applications. *Human-centric Computing and Information Sciences*, 7(1), 24.
3. Singla, R., & Kaur, N. (2018). Compressed and secure efficient routing protocol for WBAN. *International journal of computer Sciences and engineering*, 6(7), 2347-2693.
4. Sonone, S. (2014). Improved New AODV (INAODV) Routing Protocol for Collision Free Wireless Sensor Body Area Network for Health Monitoring. 5(1), 165-170.
5. Elhayatmy, G., Dey, N., & Ashour, A. S. (2018). Internet of Things based wireless body area network in healthcare. In *Internet of things and big data analytics toward next-generation intelligence* (pp. 3-20). Springer, Cham.
6. Datey, S. G., & Ansari, T. (2015). Mobile Ad-hoc networks its advantages and challenges. *International Journal of Electrical and Electronics Research*, 3(2), 491-496.
7. Lokesh, S., & Rao, J.B., (2018), Performance analysis of an improved AODV routing protocol in wireless body networks. *International journal of engineering research and application*. 8(11), 2248-9622.
8. Kim, B. S., Kim, K., & Kim, K. I. (2017). A survey on mobility support in wireless body area networks. *Sensors*, 17(4), 797.
9. Tiwari, P., Saxena, V. P., Mishra, R. G., & Bhavsar, D. (2015). Wireless sensor networks: introduction, advantages, applications and research challenges. *HCTL Open International Journal of Technology Innovations and Research (IJTIR)*, 14, 1-11.
10. Yan, J., Peng, Y., Shen, D., Yan, X., & Deng, Q. (2018). An Artificial Bee Colony-Based Green Routing Mechanism in WBANs for Sensor-Based E-Healthcare Systems. *Sensors*, 18(10), 3268.
11. Kumari, R., & Nand, P. (2016, April). Performance Comparison of various Routing Protocols in WSN and WBAN. In *2016 International Conference on Computing, Communication and Automation (ICCCA)* (pp. 427-431). IEEE.
12. Yang, X., Wang, L., & Zhang, Z. (2018). Wireless body area networks MAC protocol for energy efficiency and extending lifetime. *IEEE sensors letters*, 2(1), 1-4.