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Energy Enhancement and Performance Evaluation of LAEEBA Routing Protocol in WBAN using NS-2

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Abstract: - **A WBAN consists of several sensors and possibly actuators equipped with a radio interface. Each WBAN has a sink or personal server such as a PDA. Sink node (Base Station) is kept at the center of the human body. WBAN generally used as a heterogeneous network .there are total seven nodes deployed in the network. Sensors node are used to detect the different types functions. Among these seven nodes 1 node is used for detecting the ECG and other one is used for Glucose. These two nodes is connecting directly to the sink node. And remaining is act like the relay for transmission of the data. In the LAEEBA protocol all the nodes are active at every time, but the total usage period of few nodes is very less depending upon the disease covered. This leads to the wastage of the energy. This energy consumption can be reduced. The sensor node can be at sleep state or active state. The sleep state energy consumption is very less as compared to the active state. The sink node will remain active all the times and the other node are in the sleep state. The simulation results show that the proposed technique is better than the existing technique. The comparison is done by using the Total Generated Packets, Total Received Packets, Total Dropped Packets, PDR, and Average E2E Delay, throughput, remaining energy, consumed energy and network lifetime. The delay gets decreased and the throughput gets increased. The PDR in the proposed algorithm is greater than the existing algorithm. Remaining energy after the computation time will be increased up to 20 percent with respect to the consumed energy. the network lifetime is increased of WBAN network so the proposed algorithm is better than the existing algorithm.**

Keywords: **WBAN, ModLAEEBA, PDR, Avg Throughput, Generated Packets, E-2E Delay, Received Packets, Packets Drop, Consumed Energy, Remaining Energy, Network Lifetime.**

I. INTRODUCTION

WBANs is a advanced technology can be used for the verity application, like health care monitoring system, fitness for the sports man, and emergency response and device control. recent technology for the hardware components like sensors and radio model breakthroughs in solid-state electronics afford for the creation of lower energy, and profile devices these all components can be modularly interconnected in order to create sensors nodes comprised of one or more sensors nodes o devices, a microcontroller unit (MCU), and the radio transceiver that is make it like wireless device to communicate and then transmits the collected data through the wireless network. The nodes functions like to propagate the collected data to the to an external electronic healthcare (eHealth) care system or the data will be stored in the same network to monitoring system or as a self-contained hub for local monitoring and control. In fact, some companies have recently introduced wireless MCUs to the open market [6].

A WBAN is a collection of miniaturized, multi-functional, and energy efficient wireless sensor nodes which monitor human body functions and its surroundings [6]. Figure 1 depicts a WBAN with a few wireless sensor nodes which are monitoring different parameters relating to human body and are reporting to a central node called as a coordinator node or a sink node. Coordinator node itself can be a sensor node or it can simply be an aggregating and relaying device. Coordinator node in turn transmits monitored data for further processing to the backbone network through wireless access point (AP). In some applications coordinator node serves as an AP as well [7].

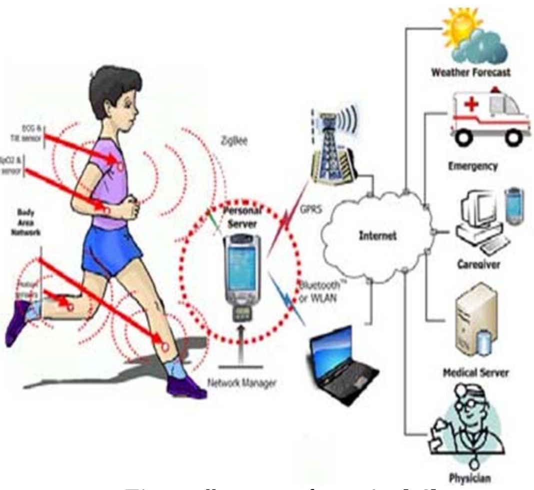


Fig. 1: Illustration of a WBAN [16].

Wireless sensor nodes can be either wearable or implanted into a human body. Nodes communicate with each other using certain short range wireless technology, e.g., Bluetooth, ZigBee, or ultra wide band (UWB) [7]. A WBAN sensor node consists of fundamentally six components, namely.

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

Sometimes a WBAN sensor node is also equipped with an actuator. Actuator is a device to convert an electrical signal to some action such as a physical phenomenon, e.g., servo motors, insulin pumps, etc. Fundamental task of a sensor node in a WBAN is to sense (monitor) one or more physical, physiological, chemical or biological signal/signals from human body or its surroundings. After sensing, they are responsible for processing the sensed data (signals), i.e., filtration, amplification, digitization, feature extraction etc. This processed data is then stored momentarily and forwarded to the gateway (sink node or coordinator node) through the wireless link. [6,7,8]

II. SENDSORS OF WBAN

The sensors of a Body Area Network as we can see in figure 2 are extremely compact and complex in design. The fact that the sensors are so minute means that the patients will be able to lead a normal life, as the sensor devices are very unobtrusive. All sensors produced will contain the same basic elements such as a power supply and wireless transceiver as well as a control mechanism, a sensor and the casing that will hold all of the components together. The sensors will be designed in a way that allows them to be self-governing for the entire lifetime. BAN's work through a process of data being transmitted from an implanted device to an external device. The sensor which is implanted inside a patient's body interacts with other sensors and actuators wirelessly. The mechanism by which an agent acts upon an environment is known as an actuator. Artificial intelligent agent or any other autonomous being (human being or an animal) can be an agent. The Body Area Network functions by passing data from each sensor to a main station. The main station then fuses the data passed from each of the sensors and it is then sent to a recipient via the internet [9].

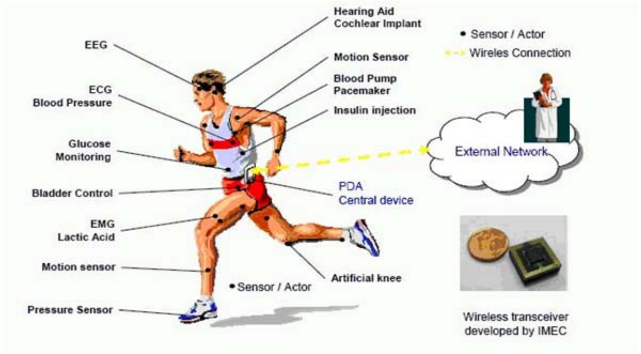


Fig. 2: A BAN on an Athlete [9].

III. PROBLEM STATEMENT

In the existing work all the nodes are active at every time, but the total usage period of few nodes is very less depending upon the disease covered. This leads to the wastage of the Energy.

IV. MOTIVATION OF WORK

Increasing number of patients population and people who wants to take care all the time also continuous with health monitoring system where the rising the cost of health care system in the hospitals. Hence, hospitals are becoming the largest crude places and doctors and nurses are over becomes over loaded. Applying medical information and communication technology (MICT) to solve this problem of healthcare services and improve the above situation in medical to provide a high quality medical support [2].Main roles of MICT include the following aspects:[2].

1. Network formation with high security and reliability for data delivery
2. Collection and transmission of various medical and healthcare from vital sensors.
3. Ranging and positioning of sensors to find location of objectives wireless technology.

WBANs network specially used to monitor the human body condition and his/her health but the energy is limited of the WABN resources. There are different route or path aware and energy efficient routing protocol have been introduced with limited energy resources. When the data or information detected by the sensors is sense from the human body by the nodes is reliably received to the medical specialist for the further process. In [3] authors have presented an opportunistic protocol which facilitates mobility at cost of low throughput and additional hardware cost of relay node. They have deployed sink at wrist. In this scheme, the function of the sink node is to relay the information from the neighboring nodes. It takes the support for transmission range also to collect the data from other nodes whenever the patient's activity like hand moving up and down can disconnect the link simultaneously. It's called link failure it may consume more energy repeatedly to connect again and again; also more packets will drop causing the critical data to loss. In [1], the authors in SIMPLE protocol have tried to devise an energy efficient protocol but no attention was paid to the path-loss taking place in the link connecting the sensors among themselves as well as the sink. To enhance this protocol performance to improve its feature, we have proposed a new scheme, which not only minimizes the path loss of the sink but also contributes to high throughput to increase the lifetime of a network. Our proposed model is described in detail in the following section.

V. SCOPE OF WORK

In the existing work all the nodes are active at every time, but the total usage period of few nodes is very less depending upon the disease covered. This leads to the wastage of the energy. This energy consumption can be reduced. The sensor node can be at sleep state or active state. The sleep state energy consumption is very less as compared to the active state. The sink node will remain active all the times and the other node are in the sleep state. The node which get selected for the transmission i.e. the parent node and the forwarder node will change its state to the active state, other nodes will remain in the sleep state.

To develop modified LAEEBA, our primary objectives of this project work are summarized as follows:

1. Develop a simulated environment of WBAN having configurable parameters.
2. To study previous routing protocols and their features.
3. Investigation in Energy efficient routing algorithm with an application of optimizing WBAN.
4. To create modified LAEEBA (ModLAEEBA) from Leach on NS-2 for optimizing its various parameters.
5. To conduct a comparative performance evaluation is done by using the PDR, E2E Delay, throughput, drop ratio, remaining energy, consumed energy and network lifetime.

VI. System Overview

Recent improvements in signal processing and very-low-power wireless communications have motivated great interest in the development and application of wireless technology in healthcare and biomedical research, as figure including Wireless Body Area Sensor Networks (WBASNs). Figure 3 shows a Weans Signal Processing and Communications (WSPC) framework. WSPC framework consists of three major components for real-time applications, namely Sensing and Preprocessing (SAP), Application-specific WBASN Communication (AWC) and Data Analysis and Feedback (DAF) to the patient. SAP contains a number of sensors for capturing a raw data related to medical phenomena including blood pressure, respiratory rate, ECG and EEG. AWC utilizes application-specific wireless protocols such as ZigBee (Cao *et al*., 2009) or Bluetooth (Kristina,) to transfer data from body sensors to the gateway, less commonly, in case of high data rates without compression, Wi-Fi protocol may be utilized for intensive data transmission. Analysis of raw data including, possibly, detection and classification of medical anomalies will occur at the DAF component, providing strict and accurate criteria for the physician to make recommendations that maybe sometimes fed back to the patient to provide proactive treatment [5].

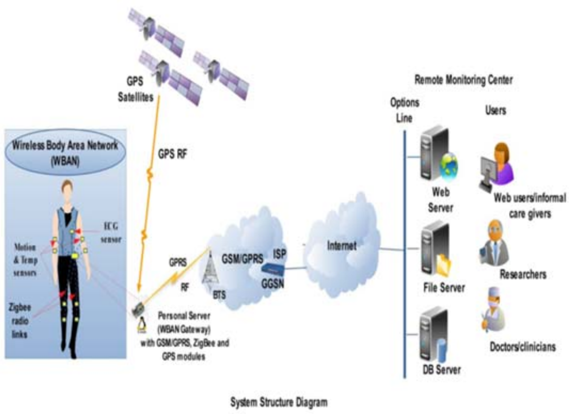


Fig. 3: System Structure Diagram [5].

VII. Laeeba: Existing Work

The limited number of nodes in a WBAN environment gives us an opportunity to relax constraints in routing protocols. Consider following figure 4 which shows the five phases of LAEEBA, existing have tried to improve the network life-time of the network; energy of the network as well as the path loss of the link being established between the nodes. The path selection is done in such a way that a path with minimum number of hops for data transmission, direct communication for emergency data and multi hop for normal data delivery. Thus, relay nodes can easily forward the received data to sink due to higher energy levels. Additionally, it analyzes their protocol for cross layer application in terms of path loss and network life-time. For checking improvement of the protocol we have compared LAEEBA protocol with the existing routing protocols SIMPLE and M-ATTEMPT for BAN technology. Next subsections give detail of the system model and detail of LAEEBA protocol [11].

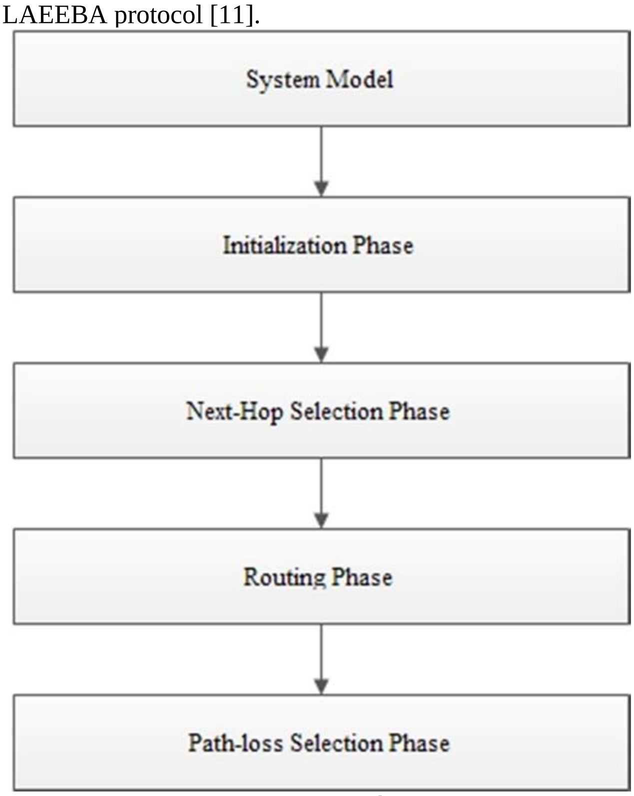


Fig. 4: LAEEBA phases

VIII. Proposed Work Of Modified Laeeba

In the existing work all the nodes are active at every time, but the total usage period of few nodes is very less depending upon the disease covered. This leads to the wastage of the energy. This energy consumption can be reduced. The sensor node can be at sleep state or active state. The sleep state energy consumption is very less as compared to the active state. The sink node will remain active all the times and the other node are in the sleep state. The node which get selected for the transmission i.e. the parent node and the forwarder node will change its state to the active state , other nodes will remain in the sleep state. This procedure can be explained by the following flow diagram:

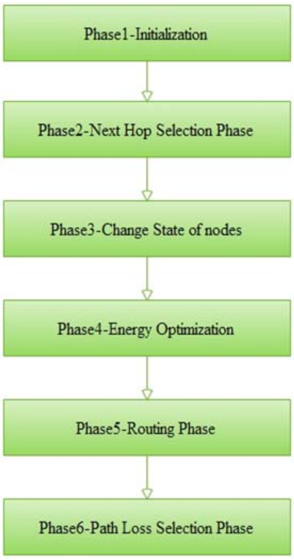


Fig. 5: ModLAEEBA Phases

In the initialization phase, the sink node gets the location and energy status of each node. The sink node sends a signal to change the state of sensor node i.e. either from sleep to active or active to sleep state. Initially the sink node sends a signal to change the state of all nodes to sleep state. The next hop selection phase selects the parent and the forwarder node. The sink node sends a signal to selected nodes that changes their state to the active state. Then the routing and the path loss phase occur similar to the existing work.

A. Proposed Algorithm (ModLAEEBA)

Algorithm: ModLAEEBA
INPUT: Enhanced LAEEBA
OUTPUT: ModLAEEBA
Begin

1. Initiate
2. Transmit signal from BS
3. Activate the nodes receiving signal
4. Calculate distance of BS from active nodes Dist (actv_node) = sqrt((x(actv_node) - x(bs))^2 +(y(actv_node)-y(bs))^2))
5. Emergency
6. If Yes then Direct Transmit to BS in One hop
7. Exit Go to Step-15
8. Calculate number of hops
9. Sort route by number of hops
10. Transmit data to next hop
11. Base Station
12. If Yes then Exit Go to Step -15
13. Or Change state of node and receive data
14. Go to step—9
15. Stop

End

B. Flow chart of the proposed algorithm (ModLAEEBA)

Flow chart presented following figure 6 shows the process of the suggested algorithm. This proposed algorithm will be implemented in the next phase. To find efficient pattern is main idea of this algorithm.

The Modified LAEEBA Routing protocol is performs the operational role of the whole of our proposed work and is used to improve the performance of the WBAN with change in state if the node in down to the sleeping state (or *Sleep Mode)* in current area of WBAN. We have already shown that the LAEEBA Protocol during initialization will receive all the status information from the sink node and then selects the next hope to the nearest rout of signal transmission from the sink node. And in case of ideal conditions the node will change its state to sleep node until the sink node does not send the signal ("HELLO" Message) to the node which forwards the data to the sink node.

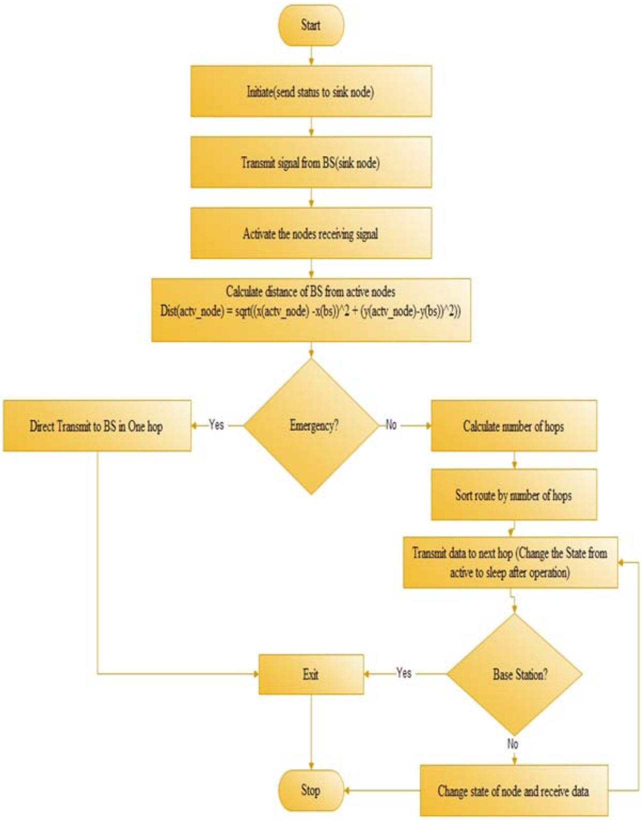


Fig. 6: Mod LAEEBA Protocol

Now, the sink node broadcasts the signal to activate the nodes and then receives the signals after activation of the node, as in the earlier phase we found the shortest path from the source node to the sink node, the data route calculates distance of base station to the active node by this function.

*d(i):*Dist(actv_node) = sqrt((x(actv_node) -x(bs))^2 + (y(actv_node)-y(bs))^2)) (1)

The next step pertains to the Emergency data ,if the data is emergency then the data will be sent directly to the BS (Base Station) otherwise the distance of next hope is calculated by cost function *c(i)* .It also calculates the number of hopes between active node and BS.

The data will routed by the shortest path from the active node to the BS (Base Station).After receiving the data the next hope becomes a forwarder, after transmission is complete the node will change its mode to sleep mode.

In this way the hope will become active to receive the data and till transmission process is completed it remains in active state. After completion of the transmission process the node will revert to sleep mode until no signal is encountered by the node from the BS (Base Station). As soon as the BS sends the signal state of the node changes into a receiver to receive the data.

IX. IMPLIMENTATION

The dissertation implements the proposed protocol by using NS2.35 which is installed over fedora 21. The simulation is analyzed over different scenarios having different nodes. The snapshot of the results obtained after running the AWK script over the TR (trace) file to get the results are shown below:

Type Command to Simulate each file (.Tcl) one by one in order to get the results of performance Evolution Parameters and Comparing Xgraph as figure 7 shows the nodes are arranged.

Command: ns filename.tcl

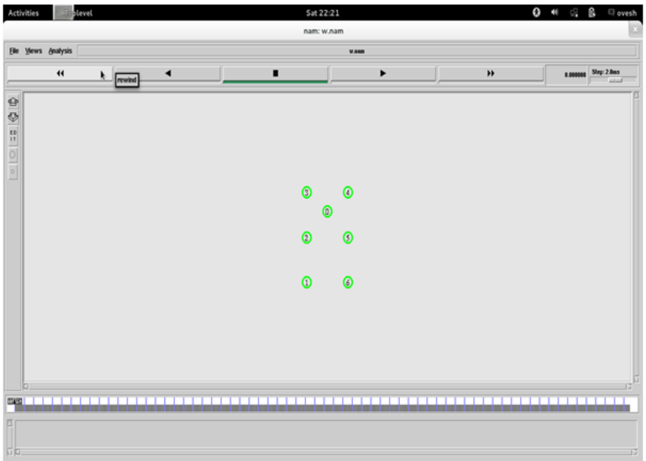


Fig. 7: NAM Shows the Position of nodes

In figure 8 shows that phases of protocol will be proceeded to send and receive the data in between “nodes” and “Base Node”.

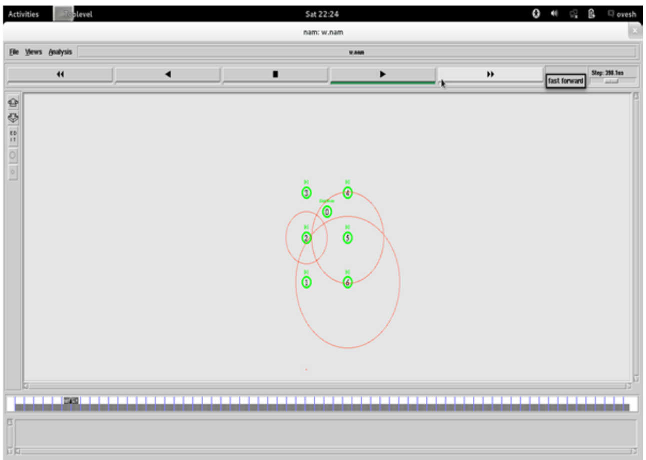


Fig. 8: At the NAM shows data broadcasting

The Node which has no any energy to remain it active will change the color to “red” we can see in the figure 9 the sink node has become “red” color and that’s mean it battery energy had discharged.

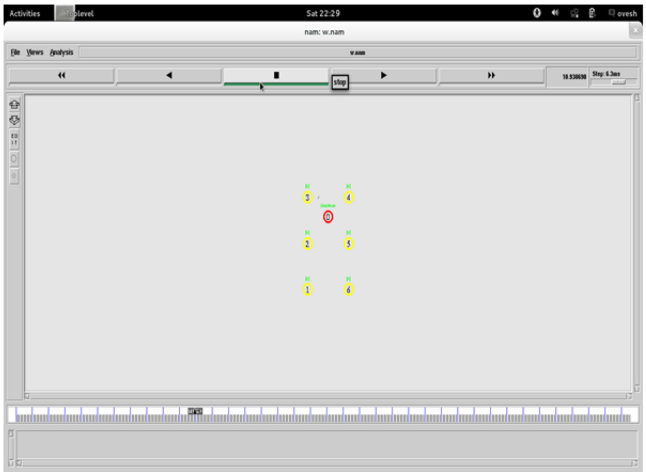


Fig.9: NAM shows the sink node is discharged and gets red

To plot the energy graph of two Scenario of LAEEBA and ModLAEEBA Protocol with the help of generated of both the protocol green line is for proposed protocol and red line is indicating the existing protocol. Its clear shows that the network life time is increased of ModLAEEBA. i.e.,filename.xgr as in figure 10 is shows.

Command : Xgraph filenamee1.xgr filenamep1.xgr

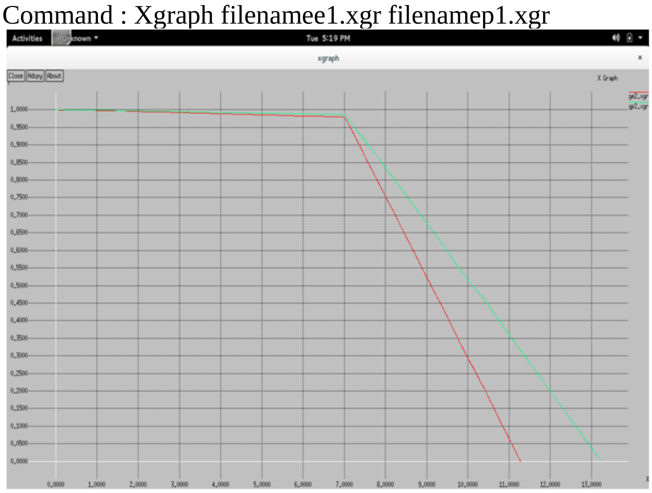
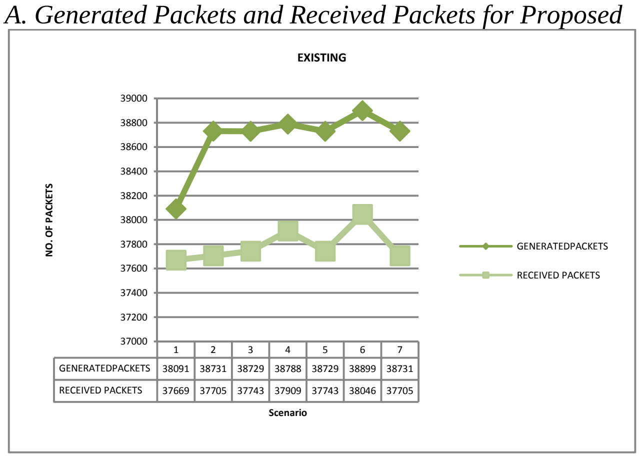


Fig. 10: Compression between exiting and proposed energy Xgraph

X. SIMMULATION RESULTS DISCUSSION

Various parameters used for analysis are described below.

A. Generated Packets and Received Packets for Proposed



	1	2	3	4	5	6	7
GENERATEDPACKETS	38091	38731	38729	38788	38729	38899	38731
RECEIVED PACKETS	37669	37705	37743	37909	37743	38046	37705

Fig. 11: Comparison between Generated Packets and Received Packets for Existing

B. Generated Packets and Received Packets for Proposed

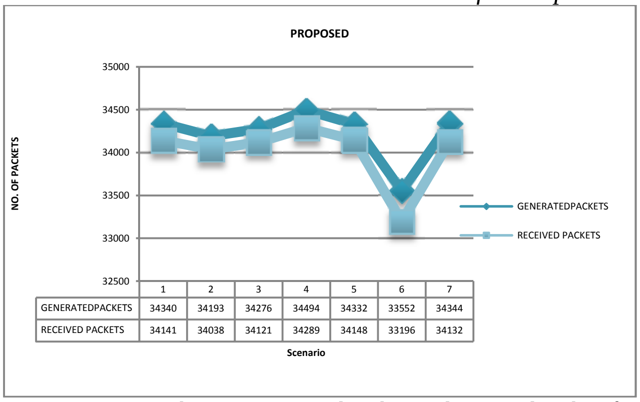


Fig.12: Comparison between Generated Packets and Received Packets for Proposed

C. Dropped Packets

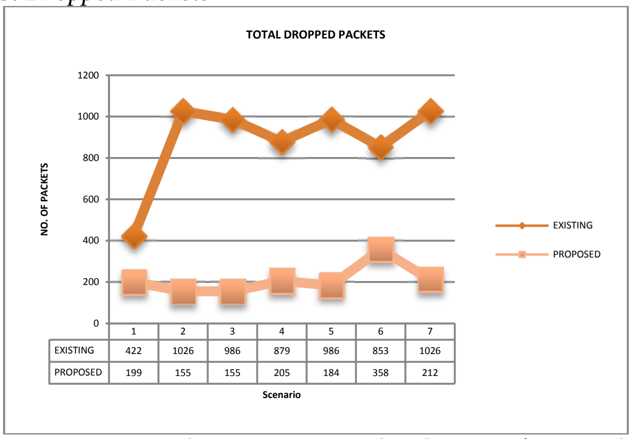


Fig. 13: Comparison between LAEEBA and ModLAEEBA for Dropped Packets

D. Packet Delivery Ratio

The ratio of the number of delivered data packet to the destination. This illustrates the level of delivered data to the destination as in figure 14 shows.

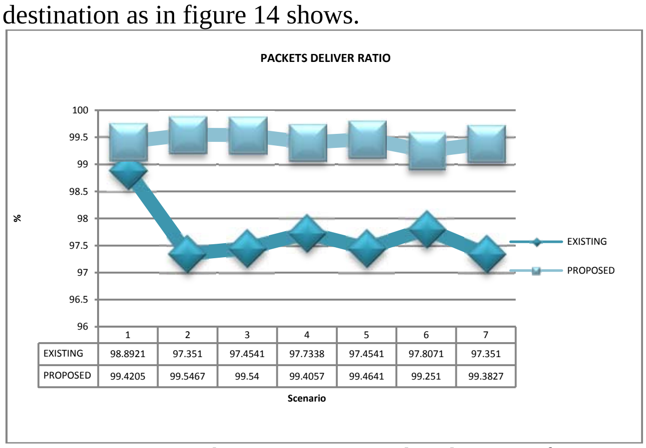


Fig. 14: Comparison between LAEEBA and ModLAEEBA for PDR

The greater value of packet delivery ratio means the better performance of the protocol.

E. End-to-End Delay

The average time taken by data packets to arrive in the destination. It also includes the delay caused by route discovery process and the queue in data packet transmission. which shows in figure 15 as follows. Only the data packets that successfully delivered to destinations that counted.

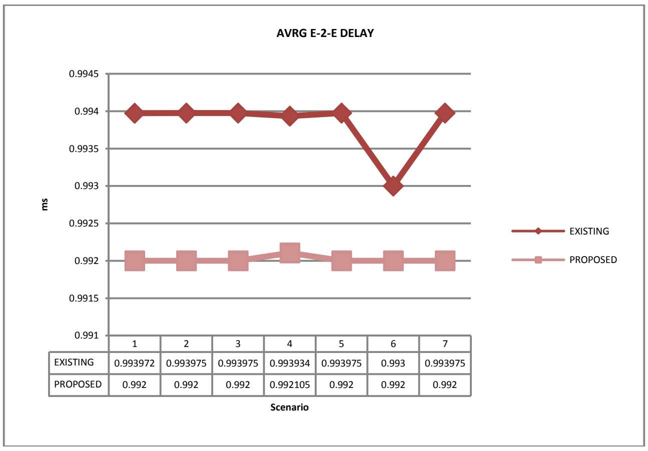


Fig. 15: Comparison between LAEEBA and ModLAEEBA for Average E2E Delay

F. Throughput

Throughput or network throughput is the average rate of successful message delivery over a communication channel. Figure 16 is shows as follows.

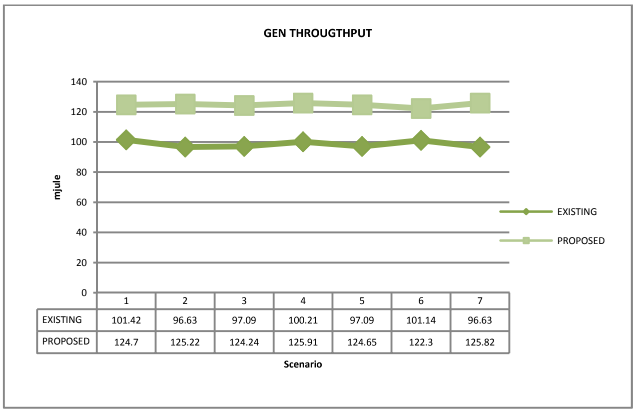


Fig. 16: Comparison between LAEEBA and ModLAEEBA for throughput

G. Total energy consumption

The plot for total energy consumption vs. load of three routing protocols is shown in Figure 17. The total energy consumption includes energy consumption in transmission, reception, idle and sleep modes of operation.

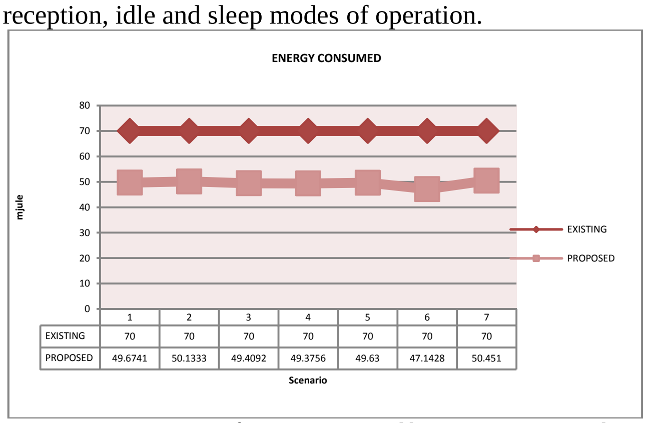


Fig. 17: Comparison of Energy Consumed between LAEEBA and ModLAEEBA

H. Remaining Energy (Residual Energy)

The remaining node energy of all sensors (7 nodes scenario) at the end of simulation has been plotted in figure 18 The graph shows LAEEBA decreases very early than the ModLAEEBA.

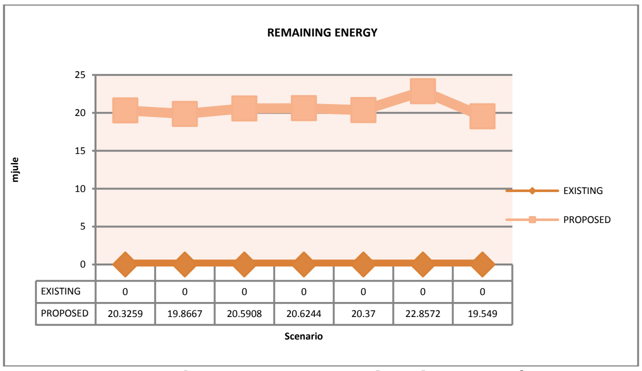


Fig. 18: Comparison between LAEEBA and ModLAEEBA for Remaining Energy

I. Network Lifetime

The Figure 19 describes performance of the network lifetime verses the traffic loads. The network lifetime calculation in our simulation based on residual battery

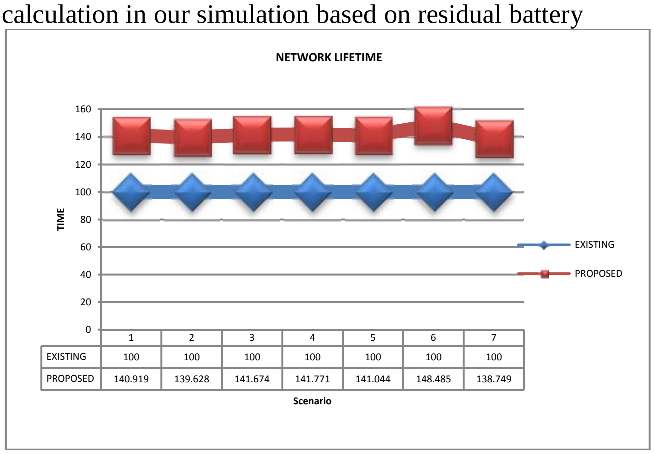


Fig. 19: Comparison between LAEEBA and ModLAEEBA for Network Lifetime

XI. Cunclusion And Future Scope

The limited number of nodes in a WBAN environment gives us an opportunity to relax constraints in routing protocols. Considering these constrains in mind, existing have tried to improve the network life-time of the network; energy of the network as well as the path loss of the link being established between the nodes. This protocol is named as the LAEEBA protocol. In the LAEEBA protocol all the nodes are active at every time, but in ModLAEEBA the total usage period of few nodes is very less depending upon the disease covered. This leads to the wastage of the energy. The node which get selected for the transmission i.e. the parent node and the forwarder node will change its state to the active state, other nodes will remain in the sleep state. The simulation is done using the NS2. The simulation results show that the proposed technique is better than the existing technique. The comparison is done by using the PDR, E2E Delay and throughput. The delay gets decreased and the throughput gets increased. The PDR in the proposed algorithm is greater than the existing algorithm so the proposed algorithm is better than the existing algorithm. In future following work can be done:

1. This work can be extended in terms of security.
2. This work is not capable to handle the faulty node; this procedure can be added to extended the work.
3. The work can be implemented for the WPAN devices.

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