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ARTICLE

PERFORMANCE STUDY OF ROUTING AND ENERGY EFFICIENT TECHNIQUES ON WIRELESS BODY AREA NETWORK

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ABSTRACT

Wireless body area network (WBAN) is a network consists of heterogeneous wearable and personal computing radio devices with various functionalities and resources. Every network contains network coordinator or hub which is responsible to establish and synchronize the network. In WBANs, sensor nodes are used to enlarge the human physiological data and addressed to the sink node. The sensor in WBANs has three classifications such as implant nodes, body surface nodes and external nodes based on the position of sensor nodes with respect to human body. Routing plays a major role in WBAN to collect the sensed data and route through relay nodes to reach the destined nodes with minimal usage of energy. During the routing process in WBAN, energy consumption and routing time are major concern in the performance of wireless body area network. The study helps to evaluate the energy efficiency and routing time overheads for effective WBAN communication. The energy efficient approach provides better connectivity between nodes in body area network.

KEY WORDS
Wireless Body Area Network (WBAN); Routing Time; Energy Consumption

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INTRODUCTION

Wireless Body Area Network (WBAN) is employed for increasing as one of most advanced communication networks. The objective of WBANs develops speed, accuracy and reliability of communication of sensors in direct proximity of human body. The challenges of huge capacity is connected with the advantage of WBANs contains several publications. For enhancing the network lifetime, routing models are planned. But the majority of routing models are aimed on coverage distance and residual energy of sensor nodes. WBANs assure unobtrusive ambulatory health monitoring for extensive periods of time and presents real-time restore of patient's status to physician. WBANs are extensively employed for many application such as ubiquitous healthcare, entertainment and military applications.

A body area network (BAN) is termed as wireless body area network (WBAN) or body sensor network (BSN).BANs are used to transform the capture, processing, and communication of significant data for healthcare systems that present new forms of hospitalization and quality health care. BAN method allows the continuous, computerized and remote monitoring of physiological signs to maintain the medical applications. The applications of BANs are mainly in healthcare domain for monitoring and logging parameters in patient knowledge the chronic diseases namely diabetes, asthma and heart attacks. BAN technology maintains the additional personalized applications like sports, gaming, entertainment and military operations.

WBAN is the wireless network from wearable computing devices. BAN devices are inserted and surface-mounted on body in fixed position wearable technology. The growth of WBAN technology with wireless personal area network (WPAN) technologies employs communications inside or outside the human body. BAN denotes the systems where communication is inside the proximity of human body. A WBAN system utilizes WPAN wireless technologies because the gateways are in longer ranges. A medical professionals access the patient data online by internet of patient location.

This paper is organized as follows: Section II discusses wireless body area network. Section III describes the existing wireless body area network method, Section IV identifies the possible comparison between them and Section V concludes the paper, research work is given as to decrease the routing time and power utilization with better efficient.
The main contributions of this existing work including the following methods are,

- To perform adaptive routing protocol for developing lesser energy cost per bit of information
- To present Multi Agent System method monitors the Body temperature, blood pressure, pulse rate and respiratory rate for accumulating and collecting the data in database.
- To design Bayes Node Energy and Polynomial Distribution method minimize routing problem.

The main contribution of this research work evaluates the efficient energy using wireless body area network. The main aim of the proposed work namely,

- To reduce the utilization of power for efficient WBAN technique.
- To decrease the energy drain rate and routing time for avoiding practical issues.
- To improve number of nodes, the network easily shares the data with other network.

Wireless body area network is emerging technology at health service ability due to wide range of services and essential role to increase the human health. The WBANs are applied in healthcare domain, mainly for continuous monitoring and classifying important parameters of patients enduring from chronic diseases

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like diabetes, asthma and attacks. For example, if the patient suffer some health problem. With the help of sensor, the doctor finds the problem in home itself by using wireless body area network. In addition,

- A BAN network is used to monitor the patient in the hospital; previously they contain a heart attack by evaluating the changes in their vital symptoms.
- A BAN network on a diabetic patient preserves auto injects insulin through a pump and immediately their insulin level gets refused.

LITERATURE REVIEW

Novel medical supervision system architecture [1] is based on distributed wireless body area network. Since several sensors transmit their messages at same time slot for common channel. However, significant problem is not formulate the system more comfortable, simply portable and android application is fixed into Smartphone performs essentially. The topological issues for WBAN [2] are addressed for both cost and energy using effective energy of optimal design and cost effective WBAN. Adaptive Routing for Dynamic On-Body Wireless Sensor Networks (ARDO-WSN) [3]. Adaptive routing protocol is designed for developing and evaluating the reduced energy cost per bit of information. However, the utilization of energy is high. An optimal network control algorithm is planned for distributed network systems of ultrasonic waves in [4]. It is utilized to transmit improved radio-frequency electromagnetic waves in aqueous media like human tissues. However, these results still continue from low-speed of sound in under-utilization of channel and thus throughput gets minimized.

Medium Access Control and Rate Adaptation for Ultrasonic Intrabody Sensor Networks (UsWB) in [5] are based on the idea of transmitting bits of information bits. However, clear channel assessment techniques are not used since it is difficult to detect UWB pulses because of very low power spectral density.WSN technique in [6] is ability to handle the sensor for accumulating and collecting data in database, a Multi Agent System (MAS) is utilized. However, the storage requirement is low with use of data reduction method. Cross Technology Interference (CTI) technique in [7] is analyzed by the utilization of different transmission technologies that distributes identical radio spectrum. However, the computation of CTI method is high. Wireless sensor network is designed for energy sensitive routing in [8] using Bayes Node Energy and Polynomial Distribution (BNEPD) method. In BNEPD method, the node consumes minimum energy rate and provides fairness between different users for decreasing communication overhead. Though, the BNEPD technique is not addressed both energy consumption and routing technique.

The QoS aware energy management in [9] is measured in terms of delay, throughput and packet loss. Though, in such situation, the difficulty of energy shortage is further disturbing due to set of small energy by human motion. The QoS management depend on biometrical WSN in [10] is to enhance the new application and patient monitoring service. However, due to the simplified channel models and protocols, simulations are not actually described. WBANs for medical application in [11]. Though, the bandwidth is not maintaining both the video and voice transmissions. Alternative approach is based on producing the Intrabody opto-ultrasonic communications between nanorobots in [12]. Opto-ultrasonic communications are used to support consequence of opto-acoustic that concedes the acoustic waves of very large frequency. BAN in [13] is based on recent principles and publications. However, the design of body shape and human tissue are more complicated a path loss model for WBANs and low power utilization is not simply modelled. Mobility maintenance through WBAN in [14] is employed to produce better results. While the power in system life time of WBAN communication through power game approach is enhanced, it effectively reduces the interference issue. Mahalanobis -Taguchi System with ECG Arrhythmia Classification during Body Area Network Environment in [15] to categorize different arrhythmic beats by decreasing set of relevant-only ECG features. Though, it is not performed to supply higher robust and optimized by incorporating any dynamic threshold selection mechanism. An efficient next hop selection algorithm in [16] is used in multi-hop BANs. However, the utilization of power and end to end delay is enlarged. High data rate shows the initial time of Ultrasonic OFDM communication method in [17] has large ultrasonic communications of data for Intrabody networks. Though, the more transmission of power is required. The medical application of WBAN is described in [18]. However, these descriptions of prolonged the health monitoring is limited.

The QoS aware energy management contains the problem of energy shortage is more disturbing due to small set of energy by human motion. The bandwidth of WBANs for medical application is not preserving both the video and voice transmissions. In body area network, the shape of body and human tissue structure are more difficult. Ultrasonic OFDM communication method is to demonstrate the primary time of high data rate requires more transmission power.ECG features is not performed for high robust and optimized by integrating some method of dynamic threshold selection. Due to the simplified channel models and protocols in the management of QoS, simulations are not described essentially based on biometrical WSN. An optimal network control algorithm is still continuing from the low-speed of sound in under-utilization of channel and reduced throughput. UsWB method is complicated to identify UWB pulses because of its very small power spectral density. Efficient next hop selection algorithm has maximum

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utilization of energy and end to end delay. In order to overcome the above mentioned problem, the wireless body area network provides very less energy efficiency and routing time in an efficient manner.

WIRELESS BODY AREA NETWORK

Wireless Body Area Networks (WBANs) in has received wide attention for continuous monitoring of patients. The fast development in low power circuits and wireless communication allowed the new generation of wireless sensor networks termed as body area networks (BANs). WBANs provide wide range of applications such as healthcare, personal entertainment, advance sports training, live events, aviation, natural disasters and user electronic devices. The WBANs sensor is employed for defining physiological parameters of human body including sugar level, temperature and heartbeat and forwards the disturbed authorities by internet facility. These varieties of continuous monitoring are essential in critical circumstances like workers in coal mines and patients with serious medical conditions. The performance of WBAN is compared against with three existing methods namely Multi Agent System (MAS), Adaptive Routing for Dynamic On-Body Wireless Sensor Networks (ARDO-WSN) and Bayes Node Energy Polynomial Distribution (BNEPD) methods.

Agent based health monitoring of elderly people in indoor environments using wireless sensor networks

Wireless sensor networks (WSN) is employed for designing the health care monitoring system in which the ability of collecting, retrieving, storing and analyzing the essential signs of patient. Body temperature, blood pressure, pulse rate and respiratory rate are the important symbols are monitored. Due to handle these sensors and for accumulating and collecting the data in database a Multi Agent System (MAS) is utilized. In WSN, the cause of dynamic nature and mobility of agents are suitable for preserving these sensors.

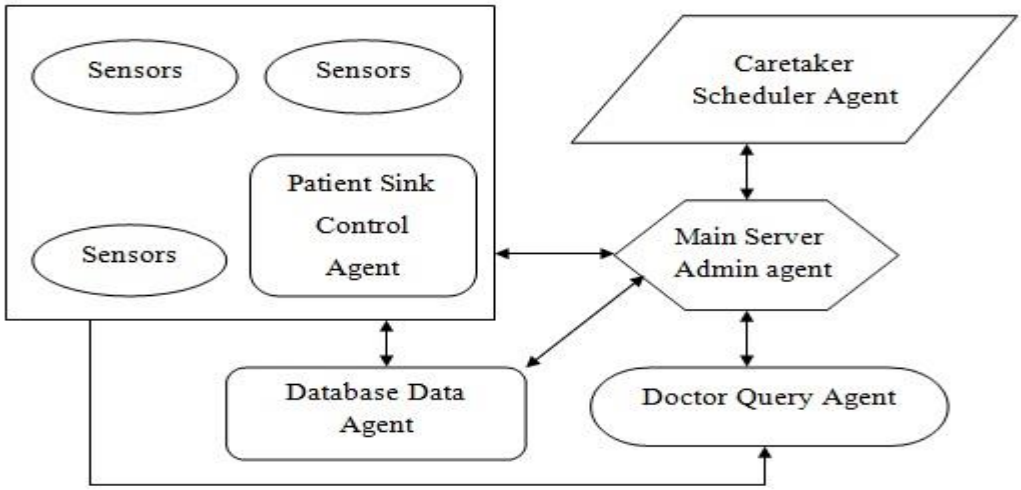

Fig. 1: Block diagram of Agent Architecture

[Fig.1] represents the block diagram of agent architecture. The MAS method contains four agents such as Admin agent, Control agent, Query agent and Data agent. Admin agent plays major role of terminating the other agents. Control agent is subjected to accumulate the data sensed by sensors into the database. Data agent is used for executing the reduction of data which is accomplished by Epsilon approximation. The objectives of data agent scheme are to decrease the data traffic and requirement of secondary storage space. Query agent is addressed for producing GUI for doctors to analyze the patient's essential sign details. The agent system is known as multi agent system. Each agent has an exact purpose and controlled by admin agent. By assigning specific function to each agent, it becomes easy to modify the system and control the changes. Even if there is an error with one of the agents, it does not affect the whole system because each agent is not depends on other. Finally, the performance of agent system demonstrates the reduced set of values near the original set and minimum amount of data is used to store.

Adaptive Routing For Dynamic On-Body Wireless Sensor Networks

In wireless body area network, the energy is limited during mobile computing devices including wearable and implantable devices. An adaptive routing protocol is designed for developing and evaluating lesser energy cost per bit of information by using channel information to choose the best route data approach. The source node is employed to determine the switch between the direct and relayed communication

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based on quality of link. Using single relay, channel quality is smaller than the threshold. An adaptive cross layer protocol is initiated to increase the channel information at transmitter side to choose the routing strategy. The transmitter achieves the channel information through feedback and decides whether to utilize an alternate relay channel to generate redundancy.

An analytical model is improved for transmitting energy cost per bit of information. While supporting the Markov chain of process and the model is validated through simulations. ARP model provides more power efficient and performance of protocol in terms of energy efficiency and evaluates the outage. Moreover, the standard in system level through mathematical analysis and simulations is calculated. The arithmetic model for received energy in dynamic body area network is produced during real-time and time domain measurements.

The cost of energy is addressed for transmitting a bit of information during dynamic human body location. The fundamental idea of ARDO-WSN is adaptively used for modifying the routing approach occupies the quality of channel. The adaptive protocol is arithmetically estimated based on intermediate access measures of IEEE 802.15.6 standard and the analytical model is validated. Channel measurements is a dynamic human body, the advantages of adaptive routing strategy in conserving on-body sensors energy is verified.

Bayes Node Energy Polynomial Distribution to improve Routing in wireless Sensor Network

Wireless Sensor Network monitors and manages the physical world through large number of low-priced sensor nodes. Wireless Sensor Network (WSN) is obtainable for sensing the data through continuous selection of data resulting in higher delay and energy utilization. In order to overcome the routing issue and minimize energy drain rate, Bayes Node Energy and Polynomial Distribution (BNEPD) technique is designed for energy aware routing in the WSN. The BNEPD technique assigns the sensor nodes that identify an object similar to particular regions with application of Bayes rule.

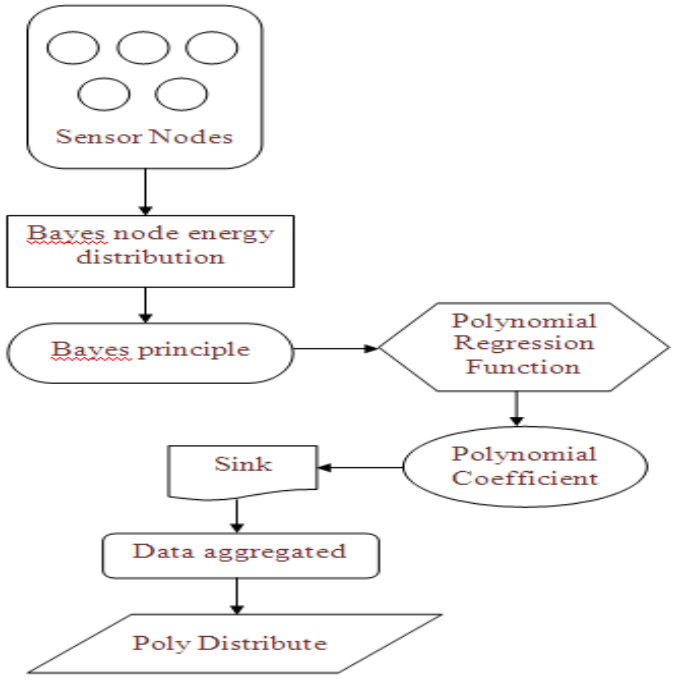

Fig. 2: Bayes Node Energy Polynomial Distribution Framework

[Fig. 2] describes the framework of bayes node energy polynomial distribution for WSN.The structure of BNEPD technique is separated for implementing the Polynomial Regression Function for data aggregation and function of Poly Distribute algorithm. The framework starts with construction of BNEPD that applies Bayes rule during sensor nodes detect the target object is parallel to its frequency to decrease the energy utilization. The Polynomial Regression Function is employed to target object of identical events for connecting various sensors. There are mainly depends upon the measure of smallest and highest object and sent to the sink node. Poly Distribute algorithm distributes the sensor nodes in an efficient manner. The aggregation of data is produced with sensor nodes aroused for generating a polynomial regression function that minimizes the rate of drained power. As an ultimate result demonstrates the limitation of distribution algorithm decreases the node energy drain rate and provides fairness between various users for reducing communication overhead. The experimental evaluation using Wireless Body Area Network (WBAN) technique is conducted on various factors namely security, energy consumption and routing time.

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COMPARISON OF WIRELESS BODY AREA NETWORK USING DIFFERENT TECHNIQUES AND SUGGESTIONS

In order to compare the wireless body area network method using different techniques, number of nodes is taken to perform this experiment. Various parameters are used for wireless body area network techniques.

Security

Security measures the number of nodes that are secured. The security is defined as the rate at which the packet sent to receiving end without any inclusion. Security is measured in terms of percentage (%).When the security level is higher, the method is said to be more efficient.

Table 1: Tabulation of Security

Number of Nodes	Security (%)		
	MAS	ARDO-WSN	BNEPD
10	56	70	62
20	58	73	64
30	59	76	65
40	63	78	69
50	66	80	73
60	69	82	75
70	72	85	77

[Table 1] describes the security versus different number of nodes in the range of 10 to 70.The security comparison takes place on existing Multi Agent System (MAS), Adaptive Routing for Dynamic On-Body Wireless Sensor Networks (ARDO-WSN) and Bayes Node Energy Polynomial Distribution (BNEPD) methods.

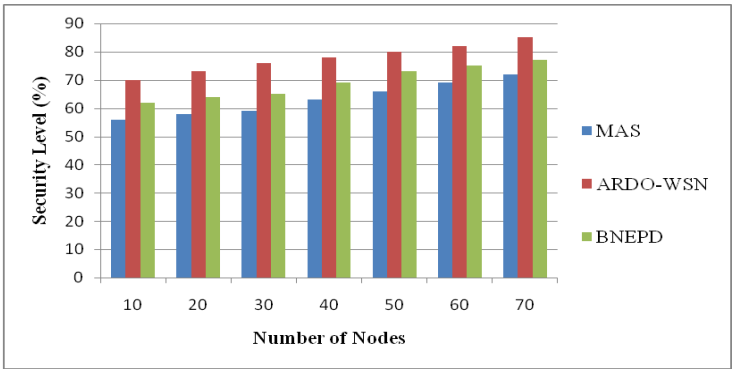

Fig. 3: Measurement of Security Level

[Fig. 3] measures the security of existing techniques. Security of Adaptive Routing for Dynamic On-Body Wireless Sensor Networks (ARDO-WSN) technique [3] is comparatively higher than that of Multi Agent System (MAS) [6] and Bayes Node Energy Polynomial Distribution (BNEPD) [8] methods. Research in Adaptive Routing for Dynamic On-Body Wireless Sensor Networks (ARDO-WSN) method has 11% higher security than Bayes Node Energy Polynomial Distribution (BNEPD) method and 19% higher security than Multi Agent System (MAS) method.

Energy Consumption

Energy consumption (EC) technique measures the energy required in every node for evaluating the different number of nodes. Energy consumption is measured in terms of Joules (J) and mathematically formulated as below,

$$EC = \frac{\text{Average energy consumes for every node}}{\text{Total number of energy consumed}}$$

When energy consumption gets decreased, the method is said to be more efficient.

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Table 2: Tabulation of Energy Consumption

Number of Nodes	Energy Consumption (J)		
	MAS	ARDO-WSN	BNEPD
10	68	56	61
20	74	59	64
30	77	63	67
40	80	65	69
50	82	68	71
60	84	71	74
70	86	75	77

[Table 2] explains the energy consumption versus different number of nodes in the range of 10 to 70.The energy consumption comparison takes place on existing Multi Agent System (MAS), Adaptive Routing for Dynamic On-Body Wireless Sensor Networks (ARDO-WSN) and Bayes Node Energy Polynomial Distribution (BNEPD) methods.

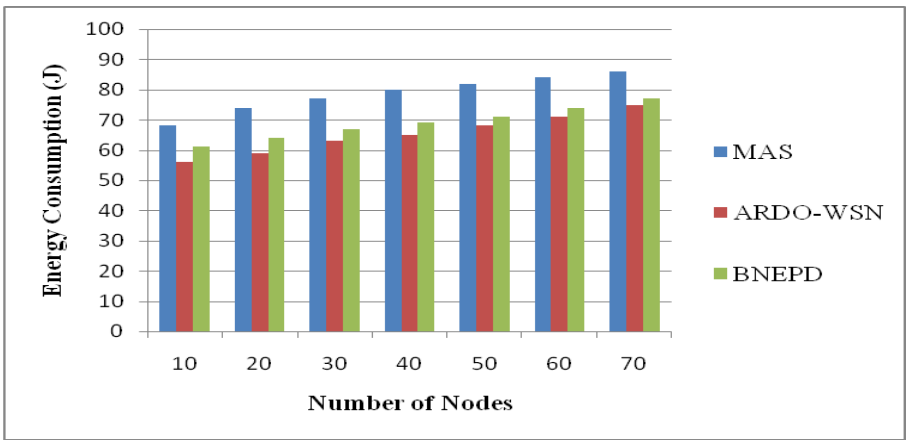

Fig. 4: Measurement of Energy Consumption

[Fig. 4] measures the energy consumption of existing techniques. Energy consumption of Multi Agent System (MAS) technique [6] is comparatively higher than that of Bayes Node Energy Polynomial Distribution (BNEPD) [8] and Adaptive Routing for Dynamic On-Body Wireless Sensor Networks (ARDO-WSN) [3] methods. Research in Multi Agent System (MAS) technique consumes 17%lesser energy than Adaptive Routing for Dynamic On-Body Wireless Sensor Networks (ARDO-WSN) method and 12% lesser energy consumption than Bayes Node Energy Polynomial Distribution (BNEPD) method.

Response Time

Response time defines the difference between the starting time and ending time for responding the number of nodes taken. Response time is measured in terms of milliseconds (ms) and mathematically formulated as below,

Response time (ms) = Ending time – Starting time for routing the information

When the response time is lower, the method is said to be more efficient.

Table 3: Tabulation of Response Time

Number of Nodes	Response Time (ms)		
	MAS	ARDO-WSN	BNEPD
10	36	45	29
20	38	47	32
30	41	50	34
40	42	53	37
50	44	56	39
60	47	58	40
70	50	60	43

[Table 4.3] describes the response time versus different number of nodes in the range of 10 to 70.The response time comparison takes place on existing Multi Agent System (MAS), Adaptive Routing for Dynamic On-Body Wireless Sensor Networks (ARDO-WSN) and Bayes Node Energy Polynomial Distribution (BNEPD) method.

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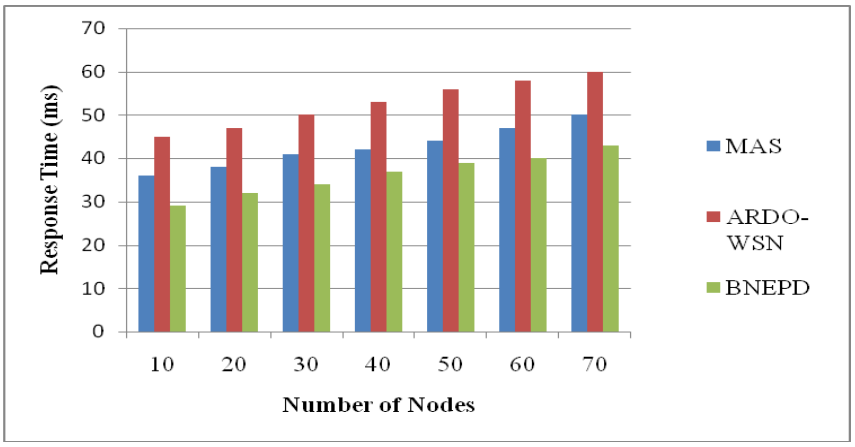

Fig. 5: Measurement of Response Time

[Fig.5] measures the response time of existing techniques. Response time of Bayes Node Energy Polynomial Distribution (BNEPD) technique [8] is comparatively lesser than that of Adaptive Routing for Dynamic On-Body Wireless Sensor Networks (ARDO-WSN) [3] and Multi Agent System (MAS) [6] methods. Research in Bayes Node Energy Polynomial Distribution (BNEPD) technique consumes 46%lesserresponse time than Adaptive Routing for Dynamic On-Body Wireless Sensor Networks (ARDO-WSN) method and 18% lesser response time than Multi Agent System (MAS) method.

DISCUSSION AND LIMITATION OF WIRELESS BODY AREA NETWORK USING DIFFERENT TECHNIQUES

An Adaptive Routing for Dynamic On-Body Wireless Sensor Networks (ARDO-WSN) [3] protocol is intended for developing and determining the reduced power cost per bit of information. While using the channel information to choose most excellent route data approaches. The large number of nodes is not deal with effect of network. Hence the network does not share the medium with other user BAN, because the number of nodes is small. But, the utilization of power is increased.
In Multi Agent System (MAS) [6], the WSN is the ability to handle the sensor for accumulating and collecting the data in database. The requirement of storage is low with the use of data reduction method. The amount of data stored is high. The power consumption is high while transmitting the huge stored data. Hence, the method in which they are transmitted is designed for concerning the low power consumption. There is a problem in storing large amount of data since the monitoring is continued.

Bayes Node Energy and Polynomial Distribution (BNEPD) technique [8] is capability of increasing the routing issue and energy drain rate. The stability between communication overhead and routing are not efficiently attained. The evaluation of distributed energy control in wireless sensor networks is not required to increase the large range of network with more sensor nodes. BNEPD technique is not accepting the data to developed and stored by each device with more resources.

Future Direction

The future direction of wireless body area network can be used to decrease the energy consumption and routing time is decreased. In addition, the transmission of data storage is developed where the utilization of energy is minimized.

CONCLUSION

The comparison of different techniques for wireless body area network technique is carried out. BNEPD model [8] evaluates the distributed energy control in WSN is not essential to improve the huge range of network with more sensor nodes. Thus, the rate of drained energy is decreased for enhancing the total network performance. In the MAS method [6], it is employed to achieve very high complexity. The MSA

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method consists of reduction of data and therefore the amount of data is used to accumulate small value. In ARDO-WSN protocol [3], the consequence of large number of nodes is not recognizing the attractive future. Network distributes the medium with users of other BANs and entire number of nodes is minimized. In addition, the utilization of power is enlarged. Finally, from the result, the research work can decrease the consumption of energy and routing time. Thus the storage of data communication can be increased with better energy efficient

CONFLICT OF INTEREST

There is no conflict of interest

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