Dynamic Energy-Efficient Routing Protocol for Wireless Sensor Networks

بروتوكول التوجيه الديناميكي الموفر للطاقة لشبكات الاستشعار اللاسلكية

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Abstract:

The devices in wireless networks operate on battery, so all routing protocols try to scale back the energy they consume while keeping acceptable performance for the tasks. For that, matching the routes to energy constraints to increase the network lifetime is what we are looking for, i.e, an efficient routing protocol.

Hence balancing the consumed energy among nodes within the networks is that the purpose of energy-efficient routing protocols. These protocols need to maximize the lifetime of the wireless network, and there are many algorithms to try to so like A-star algorithm or using mathematical formulation by changing the permittivity factor to a better value where we›ve high residual energy within the network and set it to a low value for the nodes that don›t have much energy left.

Our newly proposed protocol is trying to balance the vitality utilization to prolong the network lifetime using one between two protocols dynamically, which are DD and LEACH. The simulation results demonstrated that the newly proposed protocol is prolonging the WSNs lifetime.

Keywords: Wireless Sensor Network, Dynamic Energy-Efficient Routing, WSN Application, WSN Routing Protocols.

الملخص:

تعمل الأجهزة في الشبكات اللاسلكية على البطارية، لذا تحاول جميع بروتوكولات التوجيه تقليص الطاقة التي تستهلكها مع الحفاظ على أداء مقبول للمهام. لذلك، فإن مطابقة البروتوكولات مع قيود الطاقة لزيادة عمر الشبكة هو ما نبحث عنه؛ أي بروتوكول توجيه فعال.

ومن ثم فإن موازنة الطاقة المستهلكة بين العقد داخل الشبكات هي أن الغرض من بروتوكولات التوجيه الموفرة للطاقة. تحتاج هذه البروتوكولات إلى زيادة عمر الشبكة اللاسلكية إلى الحد الأقصى. وهناك العديد من الخوارزميات لمحاولة مثل خوارزمية A-star أو استخدام صياغة رياضية عن طريق تغيير عامل السماحية إلى قيمة أفضل حيث لدينا طاقة متبقية عالية داخل الشبكة وضبطها على قيمة منخفضة للعقد التي لا يتبقى لها الكثير من الطاقة.

يحاول بروتوكولنا المقترح حديثًا موازنة الاستخدام المرن لإطالة عمر الشبكة باستخدام واحد من بروتوكولين ديناميكيين، وهما DD و LEACH. أظهرت نتائج المحاكاة أن البروتوكول المقترح حديثًا يطيل عمر الشبكات اللاسلكية.

الكلمات المفتاحية: شبكة الاستشعار اللاسلكية، التوجيه الديناميكي الموفر للطاقة، تطبيق WSN، بروتوكولات التوجيه WSN

Introduction

As a day to day we communicate by transmitting data and sharing services. Network makes information and services obtainable to everyone on the network, notwithstanding the physical location of the resources or users.

Through wireless networks, devices and computers are connected by radio waves or the other wireless media, additionally , various wireless communication standards permit full mobility (Fahmy .(2016).

A Wireless Sensor Network (WSN) may be a group of specialized autonomous sensory and actuators according to Rawat, Singh, chaouchi, Bonnin.(2013).

With the potentiality of sensing, wireless communication and computations Guy (2006).

WSN may be a network of sensing devices connected together to the bottom station by wireless means (Springer) to watch, control physical or environmental conditions at diverse locations, and pass data to regulate the command to the specified actuators through the network(Springer).However, WSNs have their limitations that occur while using like cost, size, and limited power.

The proposed protocols and algorithms for WSNs have numerous problems to cope with. In addition, it is very complex to design routing protocols. The problems start with the energy dissipation, pocket loss rate, coverage and lifetime and they all are essential and need to be improved.

But the energy dissipation has a primary concern to the researchers due to the significance of the transmitted information at the WSN. For that, we need unique performance metrics to be optimized. Such a lot of algorithms had been proposed with trading off a few problems with the others related to the weighted importance to the problem they want to address according to Nabavi, Seyed Reza, Eraghi, Nafiseh Osati, Torkestani, Javad Akbari(2021), Engmann, Felicia, Katsriku, Ferdinand Apietu, Abdulai, Jamal-deen, Adu-manu, Kofi Sarpong (2020). Some of them took into consideration the strength efficient while others have got dead routes and nodes within the early stages of the WSN lifetime.

In our proposed protocol, we will address the energy dissipation by trying to solve the problem of limited power for the nodes.

The limited power problem causes issues within the consumption, which makes the network dies, before the time needed to transfer all the collected data. For this purpose, we try to prolong the network life time. That's why we proposed a replacement protocol that uses two different structures to function with two different protocols so as to save lots of the nodes energy.

The network uses the LEACH to optimize the network energy and use the advantages of the hierarchical characteristic.

The network is conserving the energy by operating the DD protocol on the lookup tables. Therefore, the nodes are on sleep mode till they›re required to work a replacement task of collecting information which is accomplished by LEACH.

The lookup table preserves the situation of the nodes with (X, Y) pairs and variety as a reputation to differentiate it from other nodes. Furthermore, it saves the initial energy (REC) for the network. The energy following every execution. Additionally, the efficient data aggregation (AGG) that utilizes the space and position of nodes to transmit data within the most effective way.

Those two parameters REC and AGG demonstrate the efficient usage of energy for our newly proposed protocol which extends the WSNs lifetime hence the facility source is that the most precious one for the WSNs.

Both the LEACH protocol and DD protocol are dynamically and alternatively utilized in our proposed protocol. The BS has the choice of what to work at a particular moment.

The simulation concludes that our dynamic protocol enhances the WSN lifetime with the share range of 20-25. (Ajit, Sunkara, Kumar (2013)) (Mardini, Khamayseh, AlZou'bi, Baniyassein. (2009).)

Related works

In the recent years, the importance of enhancing WSN has raised, and the researchers place a trial to propose brand-new algorithms to beat the disadvantages of the WSN. Since we have not had a tendency to use internet protocol (IP) address with WSN , this will cause a heavy load within the large areas. Additionally, it's exhausting for the restricted capabilities sensors to deal with the unpredictable topology changes particularly in mobile environments. The previous algorithms focused on prolonging the network lifetime ignoring the importance of quality of service (QoS) and that they have high energy consumption that makes the nodes to die resulting issues with the connectivity, and therefore the algorithms could have transmission errors, energy depletion additionally premature energy exhaustion because of heavy transmission-load. So we tend to think about enhancing the convergence and arrangement of the WSN to cope with the 4G and 5G networks that have a high bandwidth that make it expensive to apply widely (El-Esawy, Shimaa Gamal ,ElShennawy, Nada, Elfishawy, Nawal Ahmed(2018)). (Nabavi, Seyed Reza, Eraghi, Nafiseh Osati, Torkestani, Javad Akbari(2021)).

(Engmann, Felicia, Katsriku, Ferdinand Apietu, Abdulai, Jamal-deen, Adu-manu, Kofi Sarpong(2020)).

(Hassan, Ali Abdul-hussian, Shah, Wahidah MD, Habeb, Abdul-Hussien Hassan, Othman, Mohd Fairuz Iskandar ,AL-Mhiqani, Mohammed Nasser (2020) proposed an improved energy-efficient clustering protocol (IEECP) to prolong the time period of the WSN-based IoT. The planned protocol reduces and balances the energy consumption of nodes

by improving the clustering structure, where ver (IEECP) is appropriate for networks that need an extended lifetime. (Muzakkari, Bashir A, Mohamad, Mohamad A, Kadir, Mohd F. A, Mamat, Mustafa(2020)) presented an Energy Efficient and QoS-aware (EEQ) MAC protocol with a duty cycle scheme that adapts the node's duty cycle to the queue size and priority class of a packet to reduce the delay of high priority packets and support time bounded delivery of priority packets. This approach improves the energy efficiency and extending the lifespan of WSNs.

Bouzid, S.E., Serrestou Y, Raoof K, Omri, M.N. (2020) proposed a brand new routing protocol for WSN supported distributed Reinforcement Learning (RL). That ensures higher energy potency, postpones nodes death and isolation.

WSNs Energy-Efficient Routing Protocols

According to the networks, architecture routing protocols are generally classified as plane routing and level routing. Plane routing protocols like DD, SPIN and therefore the typical level routing protocols are LEACH, PAGASIS, and SPAN.

Therefore, in this thesis, we'll specialize in the LEACH and DD.

Irum, Nawaz, Murad, Saeed (2017), Nandy, Mitra. (2012), Salim. Ahmad, Osamy, Walid, Khedr. Amed M. (2014), Tandel (2016), Yulin, Xianguing. (2007). Pantazis, Nikolaos A. Nikolidakis, Stefanos A. Vergados, Dimitrios D. (2013). Hiremani, Nirmala, Basavaraju, T.G (2017). Elshakankiri, Maher N, Moustafa, Mohamed N, Dakroury, Yasser H.(2008).

Table 1:

Flat Protocols Characteristics.

Protocol	SPIN	DD
classification	flat	flat
mobility	supported	limited
Power management	limited	limited
Network life time	Good	Good
scalability	limited	limited
Resource awareness	Yes	Yes
Query based	Yes	Yes
Data delivery model	Event driven	Demand driven

Table 2:

Average Cluster Protocols Characteristics.

Protocol	LEACH	PEGA-SIS	SPAN
classification	clustering	clustering	clustering
mobility	Fixed base station	Fixed base station	Fixed base station
Power man-agement	maximum	maximum	limited
Network life time	Very good	Very good	good
scalability	Good	Good	limited
Resource awareness	Yes	Yes	Yes
Query based	No	No	No
Data delivery model	Cluster head	Chain based	continu-ously

Proposed Protocol

In this section, we discuss how the we created our dynamic protocol for the network, Ajit, Sunkara, Kumar (2013), Ganjali, McKeown(2005), Heidemanm, Estrin, Govindam, Intanagonwiwat (2003), Intanagonwiwat, (2002), Lingxi, Wenjun (2015), Xiao, Khatoon, Keshi (2013), Willig, Kaurl.

WSN Creation

The sensor nodes are positioned during a two-dimensional area of X*X meter, (N) of sensor nodes which are disseminated during a random manner with no mobility. Each node knows its location, the space to the BS, sink node and therefore the neighbor's location.

The network is partitioned into grids and each node belongs to a recognized location. The nodes took their position within the grids, memorized that position, the neighbor's position inside the grid they belong to and their assigned sink node

which will communicate and send the info to the BS as we will see in (Fig.1).

The elected sink nodes gather the collected data from the traditional nodes so as to pass it through the info mining algorithm to create the info pattern to be saved according to Zhn, Zhang, Yang, Wu (2016).

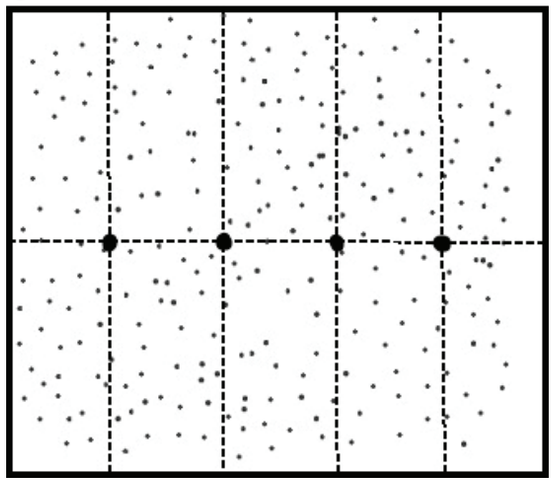


Figure 1: WSN Creation

WSN Route

The nodes choose the shortest path to send the info to the sink node, so it can send the collected data to the BS, which is seen in (Fig.2). The sink nodes communicate and send their locations with one another, and they know which one is that the closest to the BS.

The closer one is elected to speak with the BS on behalf of the entire network.

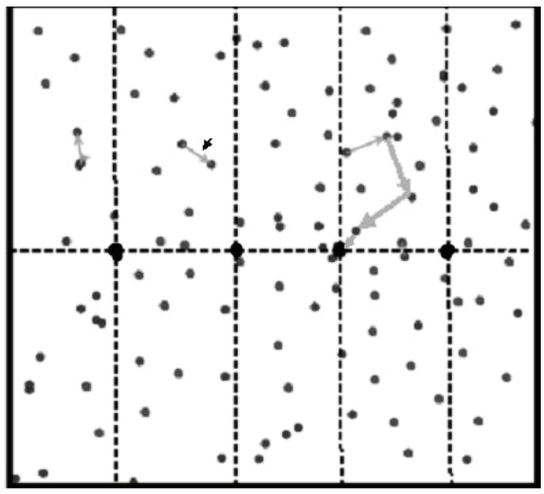


Figure 2: Best Route Finding

WSN Energy Efficient Protocol

The central server requests particular data from the BS then it searches for the data on the search for tables the use of DD protocol with VRS algorithm to look for the constructed patterns and the usage of the information mining algorithm with the decimal normalization. If the information is determined in the search for tables, the data is sent to the BS to the ultimate destination (central server) without looking the total network if not. The BS is sending the request to the sink node to operate LEACH protocol to experience and collect new information needed for the central server. The BS determines which sink node to send the statistics to, primarily based on the region which the BS knows and it has the data in it. In the network we have four sink nodes that send the sensed data (which is remarked with their location) from everyday nodes. Each node takes readings, which are arranged to be positioned in the lookup tables using data mining algorithm with decimal normalization to produce patterns of the data coming from the sink node to be dispatched and saved to the BS. After being divided into levels, we can search the area (X, Y) which has the readings the use of the precise range and location. The main content material in the search for tables are energy and location. The community grid structure has no impact on the constructed patterns. The tables are divided into corporations concurring to the records source location. LEACH protocol is used when we want to comprehend the total state of the network; hence, we want to collect data from all the nodes in a specific area belonging to one grid or many grids. Starting with the clustering, our protocol uses the clustering traits and the distance between nodes via solving the optimization hassle for the network. Thus, our protocol initializes a small world of sensors which are arranged randomly, and the adjacency matrix is developed by means of the usage of the distance formula.

D = [(X2 − X1)2 + (Y two − Y 1)2] (1/2) (1)

The distance formulation has been used to determine the superior number of chosen sink nodes with the aid of the usage of the clustering evaluation to share the resemblance of the centric communication function. Hence, to enforce it, the hierarchical clustering analysis is used to construct

a collection of sensor nodes from the lowest level to the absolute best with the consideration of the node's communication distance.

The cluster evaluation desires an appropriate quantity of sink nodes to be identified, which is scaled through the lifetime of the network. Sink node price and the premier power for the network. To attain that, we want a median node called key nodes linked without delay to the sink, which will supply the data from the sensor to sink. The data has to skip from (N-K)/K sensors. Where (N) is the whole network nodes number, while (K) demonstrating the range of key nodes that are linked with the BS. To restrict the increasing quantity of sink nodes we outline the community price as C=N.Cn+n.Cs and the fantastic variety of sinks will be computed by sink.

Table 3:

Nodes Communication Model.

Nodes	Nodes Task
Normal Node	Collect and sense data and send it to the sink
Sink Node	Communication between normal nodes and BS
BS	Request data and communicate with central server

Where (Cn) is the sensor node cost, whilst (Cs) is the BS cost, (Et) is the transmitted strength for communication per node pairs, (Er) is the obtained strength for communication per node pairs, (E0) power consumption while there is no verbal exchange between nodes. According to that, if we had two grids having the wished information the nearest one to the BS will do the verbal exchange process. In DD, The VRS has been used to ship the statistics to the region that wanted it, not the nodes that requested it. To achieve this, we will take care of the flooding problem that reasons overlapping and messages duplication. The computation for which protocol to be chosen, and the grid division is finished by way of the BS. In addition, BS will shop a look-up desk for the community conduct, so it doesn't have to do the computation all over again every time when the facts are needed from the nodes.

The BS of the network is the node with full energy, which is dividing the community into ten equal grids each and every sensor in these grids is gathering records in it till it is needed. Every node is aware of its area and distance to the BS, in LEACH protocol we have sink nodes that connect the regular nodes with the BS. Sink nodes speak at once with the BS. The packet is sent from the node to the sink node closer to the BS in the equal direction back and forth. The direction with the LEACH protocol is decided by using the optimization algorithm. The BS requires the wished data, By sending the request to the particular region that is aware of it can find the information required in it, and now not for the whole network which saves the energy for the unrelated nodes from recollecting and computation.

The VRS algorithm is operated and has a high-quality advantage. Those are not having a confined route discovery segment and an excessive tolerance for the rapid changes. If one node dies, the neighbors of this node are going to deal with the records request and communicate concurring to the time slots. The benefit of no longer having a restricted route path for the VRS is assisting with running the optimization algorithm used in LEACH to take care of the DD as well.

Table 4:

Transmitted Packets Contents.

Data Packet	Request Packet	Reply Packet	Error Packet
Packet Number	Packet Number	Packet Number	Packet Number
Source Location	Source Location	Source Location	Source Location
Destination Location			
Destination Location		Destination Location	
Destination Location			
Residual Energy	—	—	—
Protocol	Route Path	Route Path	Route Path
Data	Request	Reply	Error

When the network energy is suitable, the quantity of information is big (harvested from every sensor), and has a recognized location. We can use the LEACH protocol and use the optimization algorithm.

If the amount of statistics is small (in the look-up tables) we can use DD. The nodes gather the data and keep it until it is needed, the BS is going to ship a request according to the distance and place to a unique node and that is going to be the reply direction for the information to go returned to BS.

The optimization algorithm is used to measure the distance and the place for each node and VRS collects the information from nodes and shop them till needed. That's how the data is changed between the nodes and BS for the DD and LEACH. BS will take the statistics from the region for each node into consideration to supply the packet to the unique location, which wishes the information, which will give us so many advantages about power conservation due to the fact the nodes don't have to store the data tables for the routes.

The information packet arrival is primarily based on the nodes vicinity and the distance the usage of LEACH. Data series from all the cluster heads will be executed by way of CH, and it will check the redundancy of the information to recognize the passed off pattern, which is really useful for the sensor readings according to Dr. Arockiasamy, V.S.Anita (2011) and greve, gehlot, Sha (2012). This is focusing on energy conservation on WSN and with this way we make simply the cluster head communicates with the BS

S=U 1, U 2, ..Un

Computes the distance dj from Ui If (N (ui)) and distance dj from Ui Ci=Ui0, Ui1, ..Uin Do

Compute E(OiI) where I = zero to n

CHi is the cluster head of Ci if E(OiI) is excessive uni senses the records and passes the messages to CHi while(E(uiI)) >> (E(uij))

CHi passes the facts and aggregates it to the BS

The previous algorithm shows to the distance computation system for the sensor nodes S and that helps the nodes to follow the nearest CH then it computes the energy to determine which sensor is chosen to be the CH to communicate with the BS and aggregate the data.

The packets content material is the node location, distance between the node and the BS, the residual electricity and the direction is going to take it.

For the maintenance, if the BS sent a request whilst that node is useless and has no strength the network sends an error message and the closest neighbor node that has almost the equal location is going to deal with the request after sending the error message and for the new request or accepting the reply that is sent from the neighbor.

A network with (100) sensors are built, and those sensors are attending to collect data from their environment according to their location during a distributed way. However, this step is distributing the workload during a resilient way which will prolong the network lifetime.

Hence, the distributed way will control the quantity of communication between nodes and forbid heavy traffic from happening within the limited bandwidth of the wireless channels, which may be a source preserving. Because by this way, we control the power utilized in computation and communication process and to avoid any effects or unusual values in our information some normalization goes to be done on the data and decimal scaling is that the used technique by moving the decimal points.

To do so, distributed data algorithm is employed to cope with the nodes limitations

(power, computation, memory). The distributed algorithm goes to process the data locally then the results are aggregated. During this way, the energy for the communication process is reduced and at an equivalent time, the amount of messages during the process of data transfer to the central data is reduced.

The option of distributed data mining algorithm helps the WSNs to live longer and controls the massive data flow which will cause bottleneck and wastage of communication bandwidth because it‘s collecting an enormous data to analyze.

Initialize network

Stand by until receive request from server

IF {If data in BS}

search using DD in look up tables

else

Nodes take their positions

Compute cluster heads number

Compute the distance between nodes

Find the best route based on distance

Transmit data between nodes and the BS

Make patterns using data mining algorithm

Save in B using look up tables

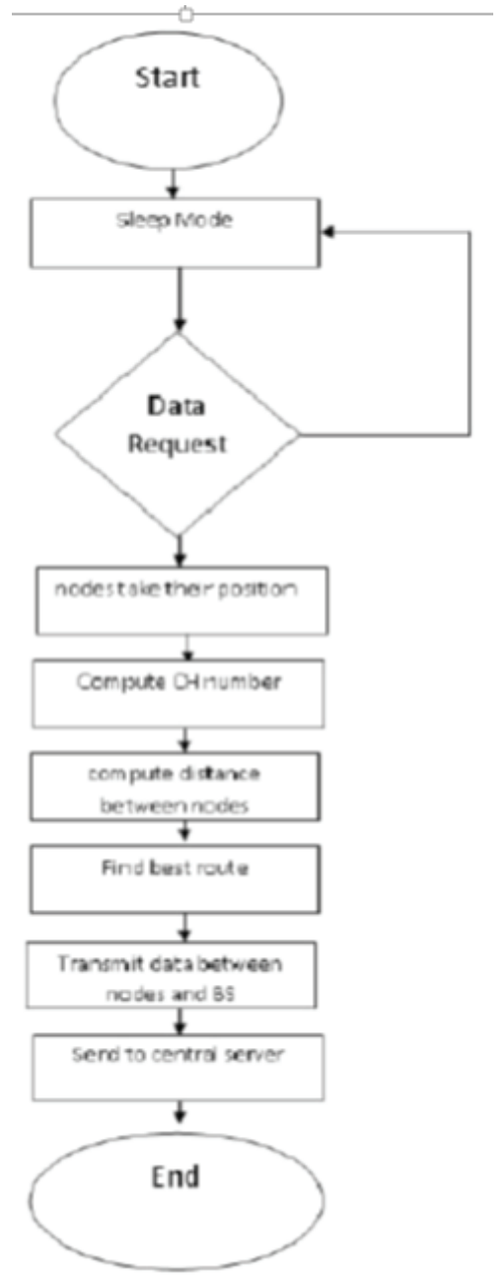
End if

Sending required data to server

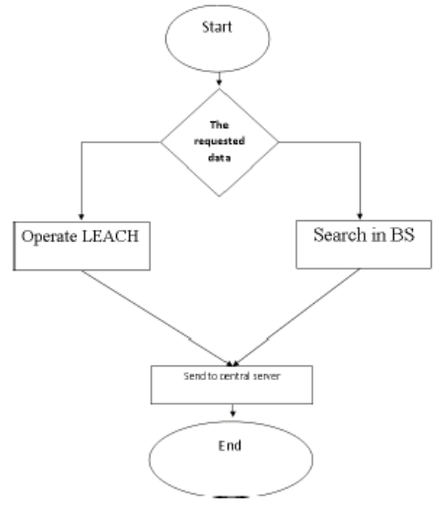
Go to step2

ENDIF

ENDIF



network initialization using LEACH



network flowchart

Assumptions

For this model, we made some assumptions as follows:

1. The BS is located at point (100,100) far from the sensors and it›s fixed.

2. The nodes are homogeneous and energy constrained.

3. There›s no mobility for sensor nodes.

4. The nodes can use power control to vary the quantity of power transmitted to reach the BS.

Our main concern is measuring the performance of WSN in terms of energy sufficiency. We are using metrics that have an influence on energy consumption. In WSN, the matrices are used to evaluate the performance of a WSN as an entire. These metrics are: [Tang, Tong. (2010), Verma, Sharma.(2013), Sunitha, Yadav(2014), Mardini, Khamayseh, A-lZou'bi, Baniyassein (2009).

1. ***End-to-End Delay***: it represents the time needed for a packet to be transmitted from source to destination.

2. ***Packet Delivery*** Rate: helps us to grasp the ratio of the delivered packets to their destination with the packets sent from the source.

3. ***Efficiency (Residual Energy):*** the energy of an isolated node is constant and independent of any changes occur within the system.

4. ***Network Throughput***: the quantity of data computed in any given period of time.

5. ***Packet Routing Load***: it represents the entire number of routing packets transmitted within the process of successful data transmission.

Simulation Environment

The proposed protocol has been tested to measure the metrics influence on the energy, to save lots of the energy and prolong the lifetime of the network. Within the following experiments, the nodes density has been fixed to 100 sensors and assumed there is no mobility within the network.

NS3

Our model simulation is completed by using NS3 simulator because of its advanced benefits over doing the real physical experiment within the world. Using simulation to visualize the connection between the parameters and seeing the interactions inside the network and therefore the way it deals with the obstacles and the normal operation within the communication process between the channels.

In the simulation, we had a dynamic environment to regulate our experiment and to create the network using mathematical equations and algorithm, which we›ve to adjust them if there›s a necessity to do so. Using dynamic environment like simulators helping to construct efficient implementation to the network model. Handling that is getting to help us understand the experiment and analysis easily. With the advantage of the low-cost experiment.

The used platforms within the simulators give us the graphs and therefore the results needed to deduce the new fact and helping to prove our model. The simulator helps you to verify and validate your model using its techniques.

In WSN, we›d like to use simulation to reinforce the model. Therefore, the simulator is constructing our model with accurate results. Network simulator version 3, is the tool that we are using to implement, which is an open source, discrete event network simulator. This has helped to model the actions of the dynamic compound system to offer a series of defined proceedings.

Results analysis and discussion

This section is related to discuss the results of the proposed protocol simulation compared to the opposite protocols.

Using five matrixes to get the energy consumption and therefore the QoS while not commerce off the two qualities

The obtained results show that the projected protocol has variations within the performance like considering message. Therefore the distance between nodes by emerging the benefits of the two protocols compared with.

This shows a significant enhancements over

the LEACH and VRS on their own and it provides us a sensible importance of the protocol.

The End-to-End Delay versus the Node Number

End-to-End delay means the packet time of arrival to their destination. This include the route discovery operation delay and therefore the packets transmission queue. The packets that are counted only have successfully reached the destination. We run the simulation to calculate the average delay for 100 (samples) nodes. Therefore, when the packet arrives to the destination we record the time of arrival to calculate the current delay. An equivalent operation is completed with every packet and that we increment the samples one by one then we will get the entire delay for the entire network.

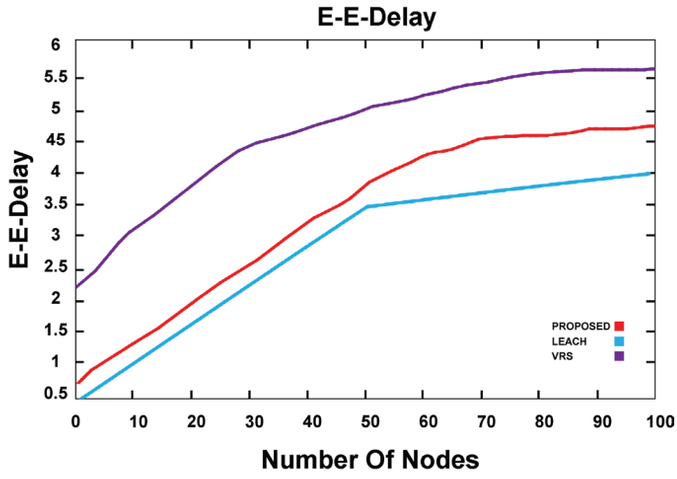


Figure 3:

End-to-End Delay.

Fig (3) presents the rate of the data arriving at their destination, it increases by the number of nodes participating in sending the required information. However, the rise is due to the new route discovery, which is completed by the nodes trying to compete to reach the wireless channel and to not be dropped or lost. Fig (3) represents the end-to-end delay for the proposed protocol gradually starts from 0.6 second for the transmission process for one node, which suggests that the network always has routes to the destination and is obtainable all the time. Then the proposed protocol starts stabilizing at node no. 70 tell the last node participating within the network.

Due to the new route discovery operated by LEACH, the delayed packets are increased to 1.3 second for node no.1 comparing with an equivalent node within the proposed model and starts stabilizing at node no. 50.

For the VRS it starts from 2.3 second for node no. 1 and increases steadily then stabilize at node no 80.

The proposed protocol gives us low rate of delay which means connected data without gaps or lost pieces of information which will make a deference in enhancing the performance. Stabilizing at 50 for the LEACH means gaps in the sent data and lost packets, on 80 for the VRS means overloading the transition bandwidth of data that may not be beneficial, hitting 70 with our proposed one means the needed data have been delivered before the nodes vanish.

Energy Consumption Versus the number

Energy consumption means what proportion energy the WSN consumes while operating. The main concern is that the efficiency of the WSN. Hence, presenting the energy consumption with the number of nodes, so as to the high energy consumption of the cluster head formation.

The energy consumption during a sensor is that the sum of the transmission energy consumption and therefore the received energy consumption multiplied with the time. Ec=(Et+Er)*t .

Where Ec is that the consumed energy, Et transmission energy consumption, Er received energy consumption, t is that the time.\

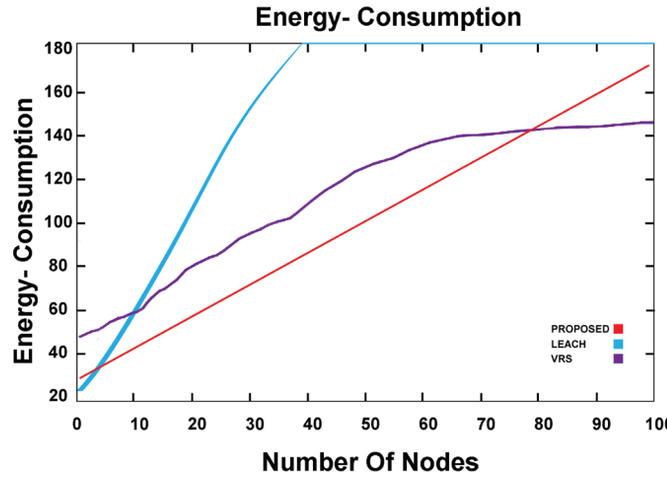


Figure 4:

Energy Consumption.

Fig (4) presents energy consumed by the activated nodes through the network while harvesting data to seek out the specified information which increases with the rise of the nodes number participating within the process.

Fig (4) shows that the energy consumption for the proposed protocol gradually starts with 20 for 10 nodes and reaches the maximum energy consumption 180 when using every node within the WSN. However, the LEACH reaches the maximum when using 40 nodes only which clearly shows that the proposed protocol is energy efficient more than LEACH. The proposed protocol is consuming the energy economically and does not reach the maximum until all the sensors are participating within the process.

For the VRS starts gradually from 30 for one node and the stabilized starting from node no.60.

The proposed protocol gives us high energy efficiency compared with the LEACH and VRS which means no lost data due to nodes vanish. This makes a deference in enhancing the performance by sending all the needed data before the power depletion.

The Packet Delivery Rate Versus Time

Packet delivery rate means the ratio of sent packets to the amount of received packets at the destination. We will compute it by dividing the successfully received packets to the entire sent packets. Packet delivery equals successfully received packets/ total packets.

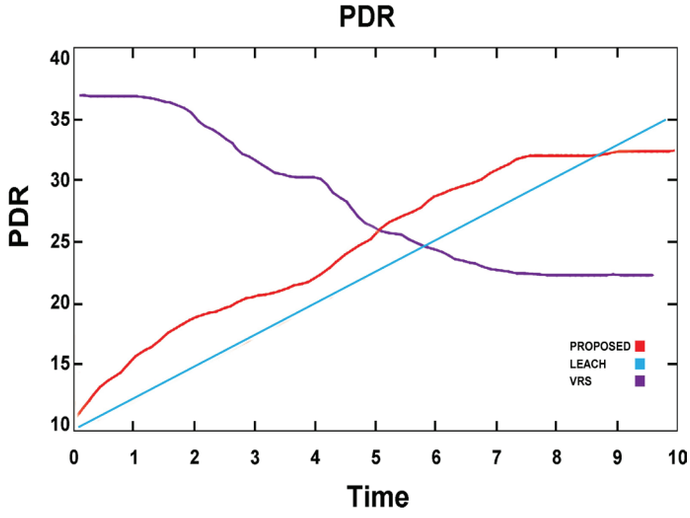


Figure 5:

Packet Delivery Rate.

Fig (5) shows that it increases with time. This indicates an honest performance for the WSN. Due to the effectively delivered packets to their destination without errors or being lost.

Fig (5) indicates that the packet delivery ratio for the proposed protocol is better than the packet delivery for the LEACH on its own. The packet delivery ratio for the proposed protocol gradually starts from 15 at the 1 second of the transmission process then stabilize at second 7. However, the LEACH start from 11 at the 1 second, which indicates that the proposed protocol is delivering the packet to the destination effectively.

For the VRS, it starts from 36 at the 1 second the decreases gradually then stabilize at second 6.

The proposed protocol gives us an efficient packet delivery and then stabilize after the 7 second that means no overhead and less lost packets compared to the LEACH which gradually increasing which may cause an overhead and the VRS which cause a lost packets because it gradually decreases.

The Throughput Versus the number of Nodes

Throughput is that the maximum infallible packets delivered to the destination during the communication process, and the way fast sending the packet through the communication channel is without having congestion.

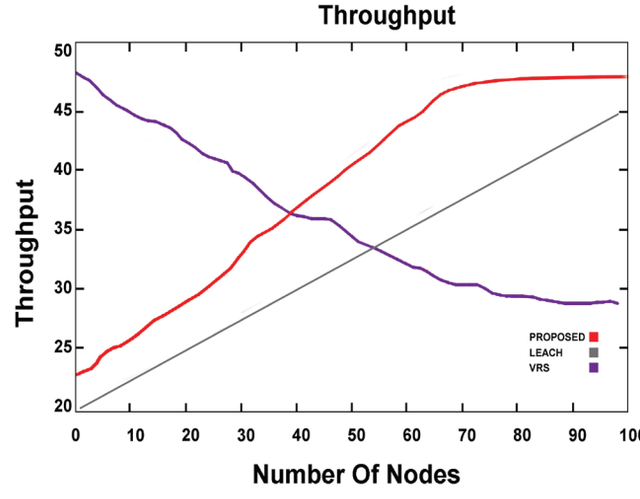


Figure 6:

Throughput.

Fig (6) presents that more nodes are delivering more packets. Which indicates an honest performance for the WSN.

Throughput for the proposed protocol starts gradually from 23 Mbps for the primary node then starts stabilizing when node no.60 is activated.

LEACH throughput depicts that it›d have some energy lost handling the congestion problem. Furthermore, the packets are delivered effectively to their destination through the communication process.

For VRS it decreases from 48 Mbps the stabilizes at the node no. 70.

The proposed protocol gives us less congestion which means more energy retention compared with the LEACH that will consume more energy to handle the congestion problem.

The VRS decreases because it is not competent to utilize the proposed protocol advantages.

The Packet Routing Load vs Simulation Time

The packet routing load expresses the entire number of transmitted packets over the successful transmission. During which the router chooses the simplest low-cost route to the destination, and during this case with low energy consumption.

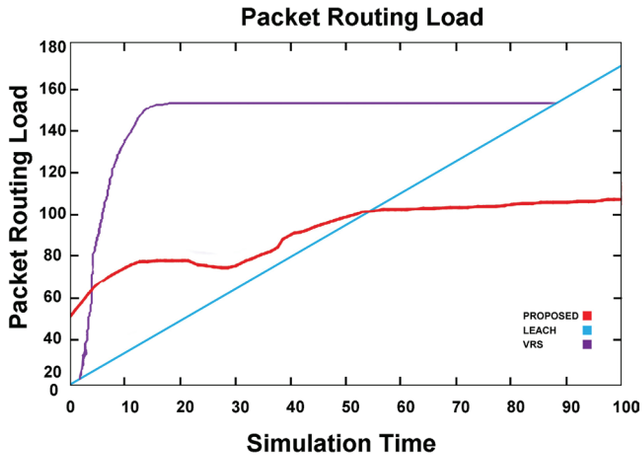


Figure 7:

Packet Routing Load.

Fig (7) shows that more packets are sent to their destinations at the primary few minutes and then, it stabilizes. This suggests that the proposed protocol saves the energy for the nodes that transmit data. Because it delivers 160 packets in less than 15 seconds then stabilize at this range of packet delivery Fig (7) represents LEACH routing load gradually increases which depicts that the increasing packet routing load with time consumes more energy from the nodes which reduce the network performance.

However, VRS starts from 50 packets then stabilizes at node no. 50 with 90 packets delivered.

Conclusion

In this paper, we discussed the dynamic proposed WSN routing protocol from the energy efficiency point of view to prolong the network lifetime and to scale back the amount of energy they consume while finding the route path from the source to destination. We used the hierarchical based (LEACH) is that the common protocol to reserve the energy and therefore the DD can find a solution for the routing problems like flooding using VRS algorithm. We will use this information to enhance the newly proposed protocol and have prolonged life for the network since the networks.

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