International Journal of e-Collaboration
Volume 17 • Issue 4

Energy-Efficient Route Protocols to Minimize Holes in Wireless Sensor Networks Using Probability Enhancement Algorithm

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ABSTRACT

Wireless sensor networks are widely utilized. In the network of wireless sensors, the nodes of sensors normally disseminated arbitrarily are conditional on the method preferred to realize the sensor network. Primarily, the lifespan of a sensor node depends on the active node numbers along with the network connectivity. When a sensor node runs out of power, the sensor node dies too early, affecting network performance. Therefore, an energy hole will be formed with the network. To avoid the problem of energy holes, a number of rules are already proposed. This paper proposed a new method to resolve the problem of energy holes in wireless sensor networks and maximizes the useful life of the network through a different way of cluster head selection using asymmetrical clustering method. This paper proposed PE (probability enhancement) method for choosing the cluster head, which gives improved output compared to LEACH as well as PEGASIS protocol. The result of simulation is performed with MATLAB, and it appears that the projected scheme works better than the previous scheme.

KEYWORDS

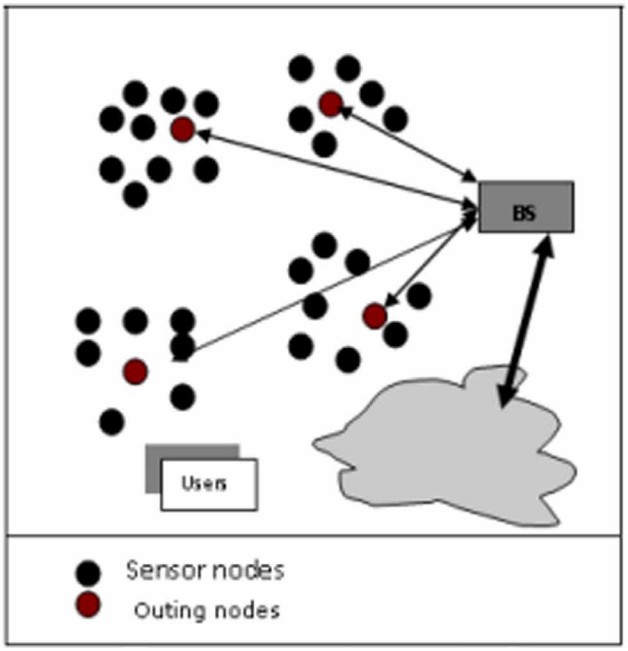
PE, Power Efficiency, Power Optimization, Routing Protocols, WSN

1. INTRODUCTION

Forming an efficient and good wireless sensor network is a challenging task now a day in the matter of power consumption of sensor nodes, since nodes of sensors are with low power. In the Wireless Sensor Networks Sensor nodes send, accept delivery of something, and test information and connect to their neighbors (Shi et al., 2015) Sensor Nodes are basically powered by energy source and have very less power capabilities and less ability to hold the information that decreases energy necessity. A general sensor node is planned with a processor, a memory chip, Sensor, actuators as well as a power supply. WSN is used into several locations wherever a man does not have easy access. The

DOI: 10.4018/IJeC.2021100102

Figure 1. Cluster based structure of a WSN



majority of the function of Wireless Sensor Networks is the forest surveillance, three-dimensional underwater environments in civil work, including health and military activities.

As shown in Figure 1 cluster based structure of a WSN, the nodes of sensors are used with a power source battery which is not replaceable as well as cannot be recharged within the position (Basheer et al., 2019). The power conservation of every sensor node is extremely important, and many researchers use a number of techniques and protocols to reduce root energy consumption. There are many open challenges in building sensor networks node. Simply improve the life of WSN nodes is very necessary, as network access is often unavailable and it is impossible to replace faulty batteries or nodes. So many researchers have adopted diverse solutions to the power competence replica in different conditions. Therefore the key objective of WSN is to keep the accurate information transfer in excess of long distance transmission with suitable methods. Different procedures experimented more than years still the process of work is going on. Developed procedures given as follows:

In LEACH (Low Energy Adaptive Clustering Hierarchy) sensor nodes are configured, along with a specific Cluster score is selected for each group based on the threshold they are prepared for. Here, the sensor settings are organized into groups, and then the arrowhead is selected for each group based on its threshold (Javaid, 2017). The protocol is performed twice in the scheduled and on a regular basis for selecting CHs and data threats, in that TDMA technique is preferred to diminish the interior as well as exterior cluster conflicts. This is utilized in the same search queries as the CH selected at the time. Most communication is limited within the company, thus providing scalability to the business. The load is then transferred to the top of the chip through the data acquisition step. While the protocol has taken on a life-long journey, though it is still a risk that cannot be replicated to a large extent, CHs can be installed in any part of the web, but the integration of they are about the size of the head.

PEGASIS (the official compiler of the data management system) is based on LEACH as well as close to best possible series procedure. Expand live nodes near only talk about connected nodes (Adebisi et al., 2012). The second round starts when the nodes are rounded up and communicates

with the BS terminator (Krishna et al., 2016). In the flow of full power on the internet this means the need for reduced power requirements. While there is a coordination between bandwidth of nodes that will lead to better life. The entire process is based on the content of the chain due to reduced clustering efficiency. The procedure requires active corrections chosen made with network structure.

Therefore, in this document a new cluster head choosing method is projected by means of PE method together with asymmetrical clustering. The proposed PE method of cluster head selection overcomes the problems of existing methods. Rest part of the article is structured as given here: Segment II describes related works of clustering protocols with the advantages of the protocols as well as different techniques involved; Segment III describes proposed PE algorithm; Segment IV describes the experiment outcomes with analysis of projected PE method with the existing methods and finally Segment V involves conclusion.

2. RELATED WORKS

As we know Wireless sensor networks are come in dissimilar infrastructure as well as their implementation method differs for application and requirements.

The model of wireless sensor networks varies according to needs; in some cases, the position dealing with nodes in WSNs is absolutely dissimilar. Different techniques are available to solve the power utilization problem of random sensors and sensors in a network system.

Given the dimension of a sensor networks while sensor nodes are located in slighter areas, data can be efficiently transmitted due to less workload and energy savings. The compactness of the nodes accountable for power utilization, including the sensor nodes in the vicinity of the basin, utilize extra power in a big environment, as each curve sensor node transmits information to neighboring nodes and nodes close to the basins are transmitting data that is not free to operate, so that the power utilization with the environment is maximum so, varieties load balancing procedures are used to prevent such problems.

The authors of Basheer et al., (2019) described a well-organized research routing protocol using a variety of outlines:

1. Centralized Routing procedure
2. Stratified Routing procedure
3. Region Situated Routing procedure

In centralized routing, the node on the sink transmitted packet to specific areas and stay for receiving message from the nodes in chosen locations. Because queries request information, feature-based names are required to determine the data properties. In this case, the information must be accurate and avoiding more data being saved from energy saving, so the security of the nodes is as well a demanding platform for power competent scheme (Basheer et al., 2019).

The purpose of stratified routing procedure is to effectively continue the power utilization of sensor nodes, and then to introduce multi-hop traffic surrounded by an exacting group and to perform information gathering and combination to reduce the amount of forward message to the sink (Tyagi & Mathur, 2016). Most sensor network routing protocols need position data for sensor nodes. Mostly, position data is required to estimate the remoteness among two specific nodes so that the power utilization can be predictable (Basheer et al., 2019). Due to the different problems of wireless sensor networks, here is no resolution to every problem with mechanism of the wireless sensor network exclusive of models and dissimilar methods.

Direction finding set of rules (Karthikeyan et al., 2019), investigator has developed a procedure deploy scheduled a package transmission system. The method is used homogeneously. Here is the sink in use with GPS. The most important features here are neighborhood management, time evaluation, data transfer. The sensor node recognizes the occurrence or information envelope entering to node.

It focuses on a recital evaluation among the random network and sensor implementation. Performing the protocol can be compared to some of the associated protocols. It is observed that the primary properties of the procedure are virtually the same in both deployment scenarios. However, certain random deployment irregularities were observed during the evaluation of measuring parameters such as termination delay, parcel transmission proportion and time constraint proportion. It has also be found with the aim of random implementation in some cases provides better results over network implementation. The performance delay protocol is based mainly on the following factors. In the other scenarios listed above, the other two scenarios are only suitable meant for network implementation as well as it is not appropriate for haphazard node exploitation.

Akkaya & Younis, (2005) suggests a method base on cluster and cluster leader configuration that includes the Permanent Contest Based Cluster (PCBM) algorithms. This procedure is for permanent WSNs. The output is compared to the well-liked technique LEACH, which is superior for harmonized disseminated cluster. The biggest problem with all suggested structural design is to expand the lifespan of Wireless Sensor Networks. CH is an important issue in the grouping algorithm.

Praveen Sundar et al., (2020) notes that Spatial Modulation is a new method that enhances phantom competence cluster-based technique. In this technique, a single active receiver is used for the duration of communication to keep away from conduit intervention. With this procedure WSNs can accomplish excellent power competence. Realistic information transfer procedures are extremely vital. The key issues in this technique are only limited or clustered construction.

Vinoth Kumar et al., (2020) presented a cross-cover proposal method. By analyzing LEACH and LARP, CH is chosen in a new approach. Node is distributed over a network with the intention of forest flames control model and catastrophe management systems. The environment is a fortified group and the zinc in between. Power utilization is in a straight line proportional to remoteness. In this technique every sensor node communicates information to the nearest node has a shortest transmission distance. This procedure is superior for an information transfer cycle. The standard power consumption in the first phase is with the intention of the three primary stages are during installation and information transfer. To intensify the lifespan of the wireless sensor network, the factor indicates impressive performance. Node is disseminated haphazardly. every node in this procedure sends its information to the nearest national. every processing cycle consists of four steps: i) Tree Building (TB), (ii) Scheduling (SB), iii) Gateway Selection (GS), iv) Sending Information.

Vinoth Kumar et al., (2020) says that The LARP is analogous to the LEACH, where every sensor node is able to converse through the sink and the information acquisition otherwise relocate mechanism is an instance plan. Intended for every iteration, together with 1, 5 and 10 iteration. The experiment outcomes show so as to LARP sensor nodes able to wait longer and use as much energy as possible for longer. Such as, after a 10-cycle experiment, the pattern indicates that the final node in the LEACH procedure die following 275 seconds when the LARP nodes die after 350 seconds.

Shokrzadeh & Moghadaszadeh, (2016) shows that power minimization is performed by means of fusion procedure. Minimization of transmission low, real node minimization. It is a powerful, competent collection of wireless sensor data systems. Use a DSR procedure that is better suited for low energy density. The main objective is to select and identify the nodes which lifespan completed and find next available route for transmission as a result communication is more even and fewer power utilization. Two routes are applicable i) practical (PEGASIS) in addition to ii) Router technology immediate (DSR) to provide a fast and intact road slower transmission delay. Verifying trust for each broadcasting round. Hybridization optimization like GA and BFO is used to detect power efficient roads. The main issues are high errors; The network suffers from the overheads of the packages.

G.Morbita et al.(2006) projected TL-LEACH procedure. It is the enhanced version of LEACH. It uses prime CHs as well as secondary CHs in a two stage hierarchy in the sensor network. In this method the base station is lies far from the network and the nodes are structured into three types such as simple, primary and secondary.

KH Phung et al. (2012) projected a hierarchical method of routing. The main objective of this method is to balanced power as well as load that eliminate all the drawbacks of LEACH. It also priorities the residual energy of the nodes for the selection of cluster head. This protocol also overcomes the disadvantages of LEACH by reducing the chance of choosing of two cluster heads that are very close to each other.

Saraswat et al. (2014) projected an enhanced PEGASIS procedure wherever in support of information the degree of sensor nodes as well as their remaining power two parameters accumulated. It creates multi-level graphics that improve the chain configuration procedure. The power costs of the sensor network are enhanced by having the same node reviewed. It also reduces the search space for the algorithm. For the selection of leaders and data transmission, a factor that is inversely proportional to degree and distance is used. The amended protocol cuts the distribution of energy in half and improves the lifespan by 40% compared to PEGASIS.

Abdulgader et al. (2016) explained how to make clustering using LEACH protocol and the procedures to select a cluster head that introduces drawbacks in situation of remote sensor nodes. One more method PEGASIS that overcomes the problems of LEACH, however dynamic behavior of LEACH is not included in PEGASIS. Since there is only one node head, it may be the bottle neck of the network causing delay. It is the major drawbacks in PEGASIS.

3. PROPOSED PE CLUSTERING ALGORITHM

The projected job mainly identified two different techniques proposed for enhancement of energy efficiency and network lifespan of wireless sensor networks. The ideas used are PE procedure for the selection of cluster head by means of irregular clustering.

3.1. Probability Enhancement (PE)

It is a technique to discover optimum approximate a limit or boundary which defines the scope of the process in geometric replica. Every round of the PE algorithm includes two important levels as shown in Figure 2 identified as probability(P-level) as well as Enhancement(E-level).This Probability level generate a function intended for probability resulted by means of existing approximation factors in addition to an Enhancement (E) level, that determine factors enhancing the probable originate from the P level. Then the factors approximates utilize to find out suppressed wavering in the succeeding P level. The main purpose relating to PE method will enhance the probability P (x |θ) x is given which is extracted from unidentified allocation model parameterized given by θ. The probability of a factor assessment, θ, known the results x, equivalent the implicit probability for those experiential results specified individuals parameter standards, as follows:

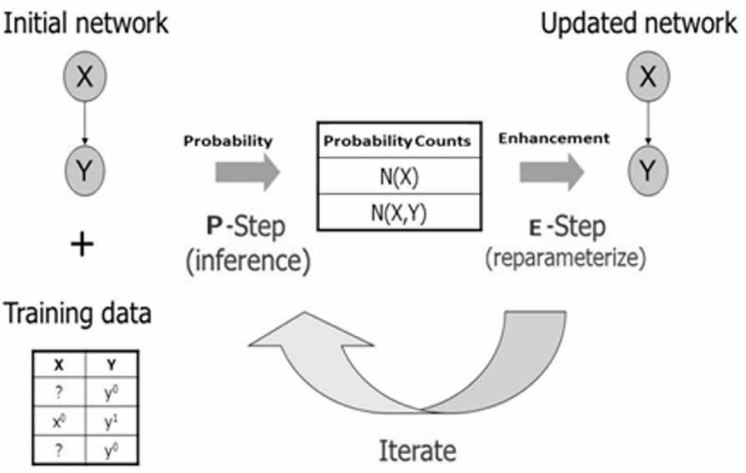
$$£\left(\theta \mid x\right) = P\left(x \mid \theta\right)$$

In support of density estimation and also for clustering the most suitable method is used called Gaussian Mixture Model (GMM).The variables of GMM are predictable as of instruction facts by means of the iterative probability enhancement procedure. The GMM for the data is given as:

$$P\left(x\right) = \sum_{k=1}^{k} \pi_{k} \, N\left(x \mid \mu_{k}, \sum k\right)$$

There is no popular closed appearance result for the utmost probability.

Figure 2. Two steps method of PE



3.2. PE Based Clustering

The projected algorithm is built with PE clustering technique as well as focus on power efficiency and longer lifespan of WSN. The procedure is mainly separated into two phases' setup phase and steady state phase as represented in Figure 2. The main objective of setup phase is to prepare clustering using PE algorithm (Figure 3). This proposed model focus on PE algorithm to construct cluster of sensor nodes as determined for Gaussian Mixture Model as parameters of the clusters obtained utmost probability.

The second step is the steady state phase where every CH (Cluster Head) generates TDMA scheme as well as transmits to the cluster nodes. Every sensor nodes in the cluster sends the information to the corresponding head within the time slot provided. Then the CH transmits the information to the base station as shown in Figure 4 and over all framework for proposed method in Figure 5.

A step by step procedure to implement PE method is given as follows:

1. The primary steps involve distribution of nodes in the sensor region.

Figure 3. Clustering using PE Method

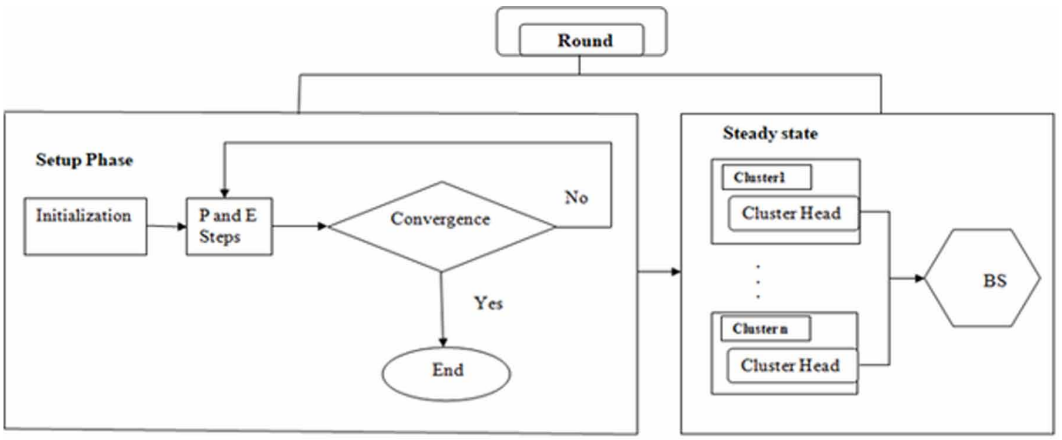
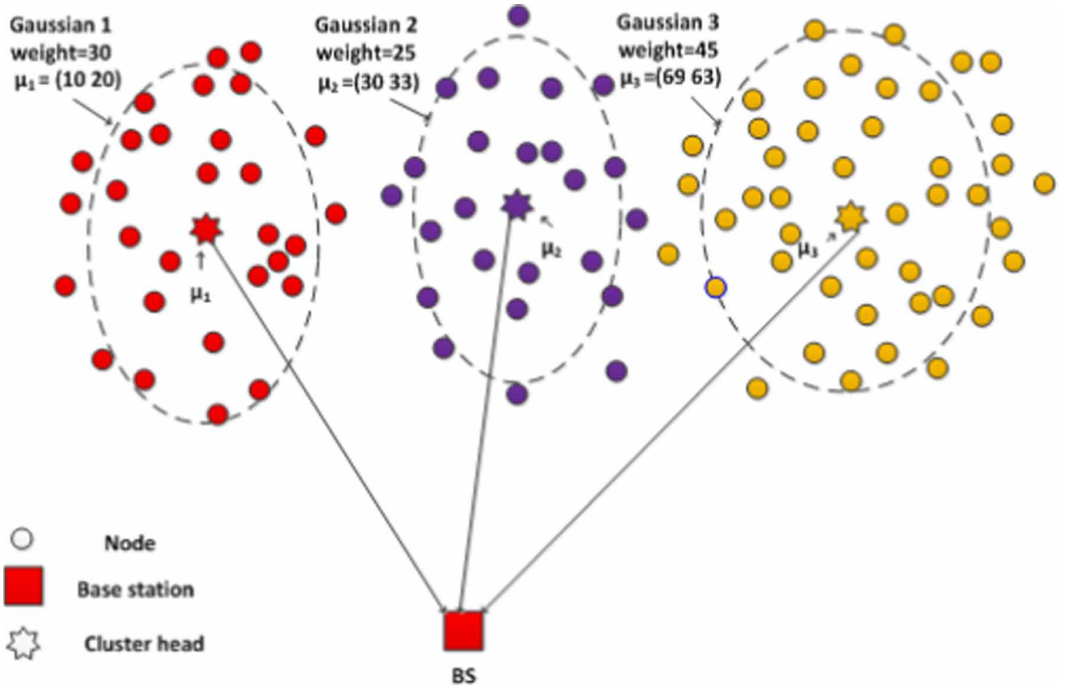


Figure 4. Information transmission to the BS



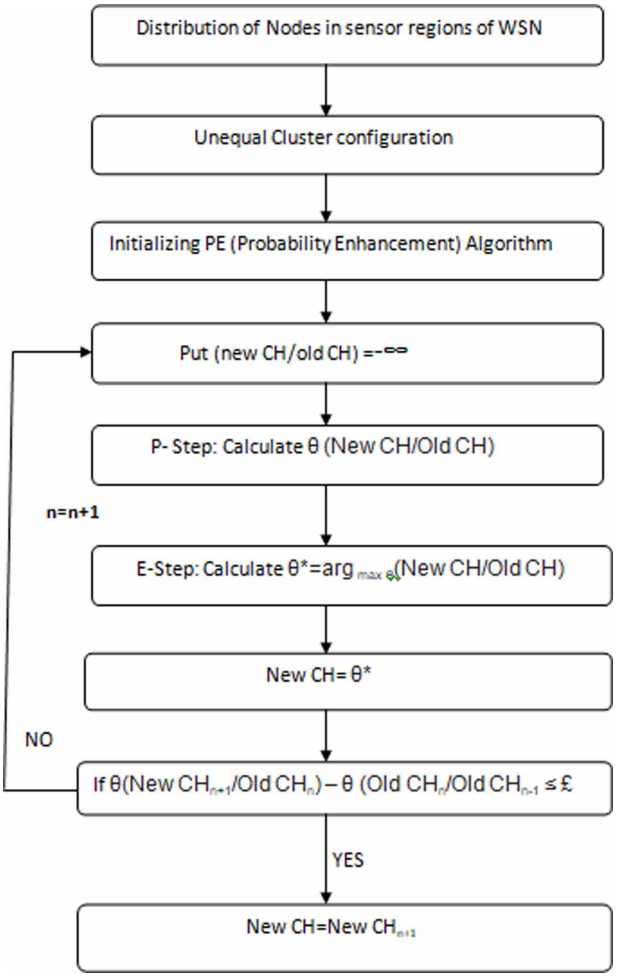
2. The Second step nodes are organized into clusters, each of which has a cluster head. This step follows the rules of irregular clustering.
3. Factors of Probability Enhancement (PE) methods assign an initial value to make computation.
4. Probability of a fresh cluster head is designed based on previous cluster head assessment.
5. Enhancement technique is used to Enhancing the result of earlier to achieve improved cluster head assortment.
6. The Enhancement result is allocated seeing that fresh cluster head.
7. When the propositional variation of the results chosen for contiguous rounds is a lesser amount in comparison to the situate threshold at that time fresh cluster head is situate for upcoming round if not the procedure is repetitive from iv.

In the P-Step probability the allocation of the unknown variables specified the information as well as the recent assessment of the variables. E-step adjusts the value of the variables to make the most of sharing of information as well as the unknown parameters. The probability of all Gaussian point is measured by means of P-step.

The second step is the E-step which changes the value of the variables on the report of subsequent allocation of the unknown parameters to maximize the probability of data. At this time optimization parameters are integrating the means, coefficients and covariance. Method of analysis is given as follows:

1. Initialize the m_k(means), $\sum_k$(covariances) and $\prod_k$ (mixing coefficients).
2. P-Step evaluates the posteriors using the current parameter values.
3. E-Step re-estimate the parameters using the current posterior probabilities.

Figure 5. Overall framework of Proposed Method



$$\mu_k^{new} = \sum_{n=1}^{N} \gamma\left(Z_{nk}\right) x_n$$

$$\sum_k^{new} = \frac{1}{N} \sum_{n=1}^{N} \gamma\left(Z_{nk}\right)\left(x_n - \mu_k^{new}\right)\left(x_n - \mu_k^{new}\right)$$

$$\mu_k^{new} = N_k \,/\, N$$

The class posterior probabilities are denoted as $\gamma\ (z_{nk})$.
This algorithm monotonically improved the likelihood.

4. SIMULATION RESULTS

Proposed algorithm is simulated using MATLAB. We considered initially100 numbers of sensor nodes and are distributed arbitrarily in the region of WSN. The network area chosen as 100 * 100 square unit. Power of each sensor nodes in the network is primarily use as 50 Joule. As sensor nodes

utilize power with every round the power of sensor nodes gets used up. The node is considered as a dead or lifeless node whose power become absolutely void. The purpose of this proposed method is to decrease the number of dead nodes with the aim of reducing energy holes in the WSN as well as reduce the power utilization in every round which is shown in Figure 8 and Figure 9. As the experiment outcome shown the energy utilization in the proposed PE algorithm is very less in comparison to other existing procedures like LEACH and PEGASIS.

As shown in the Figure 6 the chart shows that the lifetime of a WSN is increased in proposed algorithm, In Figure 7 it is observed that after a particular time period the number of live sensor nodes is more in comparison to other existing methods. Figure 8 indicate the average residual energy of proposed protocols also increased and Figure 9 shows that the energy utilization of the projected

Figure 6. The network lifetime in each protocol

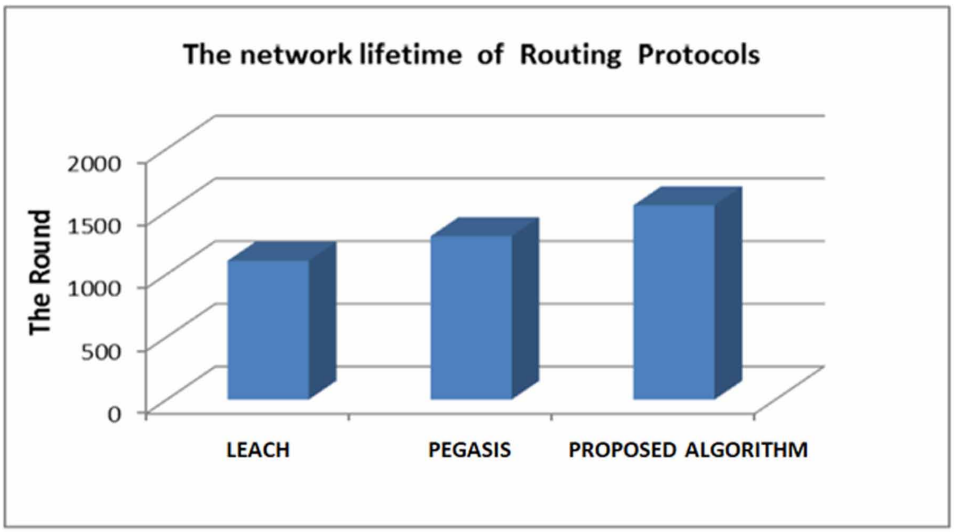


Figure 7. Number of live nodes

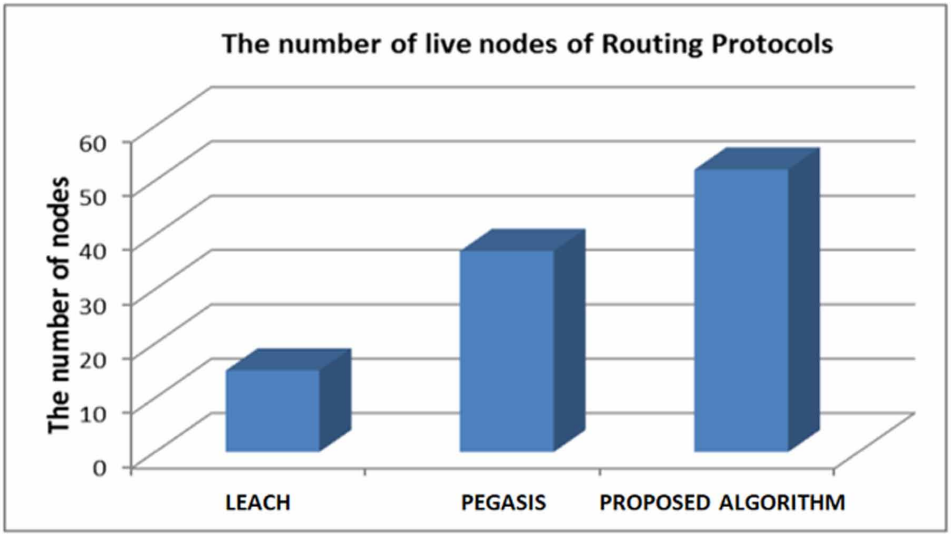


Figure 8. Average residual Energy in protocols

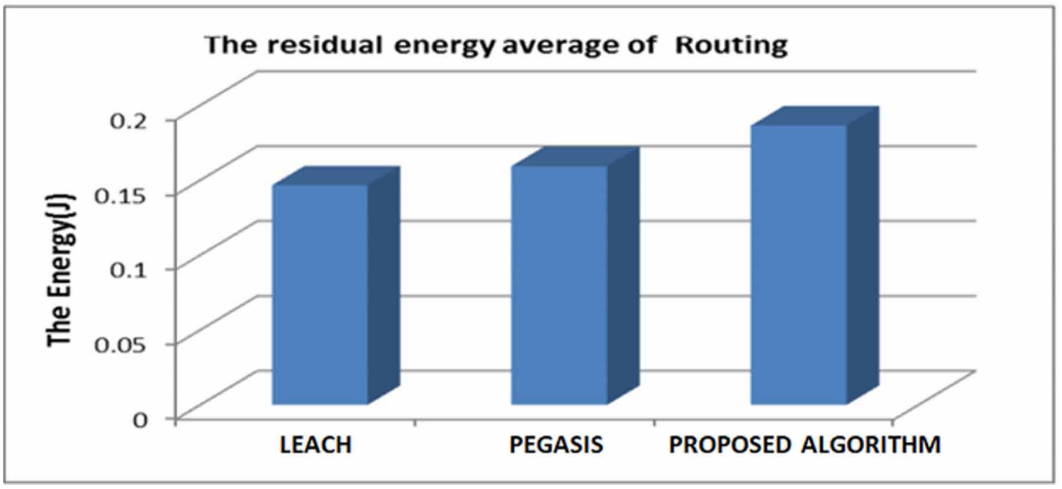
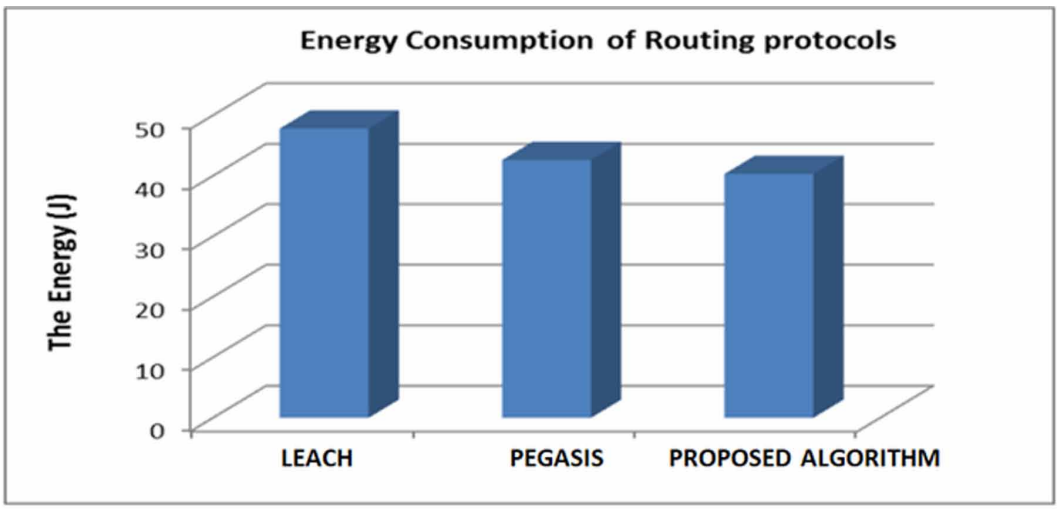


Figure 9. Utilization of Energy in protocols



protocol is very less in compared to the existing protocols such as LEACH and PEGASIS. Because power utilization is one vital issue in the devise of wireless sensor networks; thus, the projected method gives improved result in compared to other existing methods.

5. CONCLUSION

This paper is based on PE (Probability Enhancement) distributed technique with adjacent neighbor random probability distribution estimations. In this paper hierarchical clustering techniques added for dropping practical power utilization. This Clustering also be able to decrease the overhead of transmission. The PE performs better than the LEACH and PEGASIS in compared to the issues like

accuracy, data set size, convergence speed etc. Therefore, we proposed PE (Probability Enhancement) clustering procedure which gives improved outcome in compared to other existing algorithm. This PE be capable of lower power utilization along with enhance the factors like lifespan of WSN, residual energy of the nodes...etc.

In future this algorithm can be continued with particle swarm optimization (PSO-PE) method by decreasing power utilization as well as increasing lifespan of wireless sensor network.

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