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Performance Evaluation of Sensor Node Scalability on Reactive Modified I-Leach Protocol

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***Abstract*—**Sensor nodes in Wireless Sensor Networks having restricted power, weak computing capacity and reduced storage capacity. Therefore an proficient energy saving method is required to extend the duration of a network. LEACH is one of the popular algorithm, but it's some negatives such as for example each node may possibly not be established often in clusters, even though nodes have different power, CH is selected unreasonably and many other. These limitations are over come in I-LEACH algorithm by which sensor node with higher remaining power, more neighbors and lesser range from Base station is selected as a Cluster Head. I-LEACH algorithm more could be revised and thereby we could reduce the energy consumption of the network. Thus it's be great for prolonging the network lifetime. This research paper has dedicated to increasing the network lifetime by using the reactive I-LEACH protocol. The comparison among LEACH, I-LEACH and proposed method has also been performed based on power usage and network life time. Even in case of node scalability analysis the proposed technique shows rather effective results.

***Keywords*—**Leach, I-Leach, Cluster Head, Energy Efficiency, Reactivity

1.INTRODUCTION

Wireless Sensor Network (WSN) is a network that contains abundance of sensor nodes. WSN technology has been many widely used for transport safety, environmental monitoring, armed makes safety etc. With the help of networking little sensor nodes, it becomes simple to acquire the info about physical phenomena which was very difficult with mainstream methods. The duty of sensor arrangement in WSN is sensing and advertising right back the info of the monitored region. These node process knowledge and send it to the base station named as sink. For interaction of knowledge between nodes and sink, several redirecting systems are used originally, such as straight communication and multi-hop data transmission. But these techniques weren't so efficient and were unsuccessful to reach in the network suitability periods. As WSNs has some personal characteristics compared to mainstream networks such as the issue of the available methods, like energy. Sensor nodes are battery operated, so life duration of battery becomes the lifetime of sensor node. Additionally, because of perilous functioning environments, resources specially the battery of sensor nodes, would not be put back or re-energized. LEACH stands for Low Power Adaptive Clustering Hierarchy. This process has planned dynamically strategy to make cluster and selection of cluster head node. Cluster-heads dispatch aggregated knowledge to Base Section by single hop transmission. In this process a probability P is taken which was the percentage of node to be decided as cluster head. The complete operation could be divided into two phases: set-up phase and steady state phase[10]. The earlier is for clustering and the final is for information broadcast. The system repeats the clustering and transmission in every round. LEACH have planned the very efficient model to save power, it had been more enhanced by getting different parameters. The focus is generally enhanced the network life time which is essential because of restricted battery in sensor nodes. Therefore to boost the network life time, Network stability time and minimize the power use, large amount of research work has been moved out. To attain these objectives lowering of power use is essential issue; various techniques have been placed on address power use factor.

2. LITERATURE SURVEY

Beiranavand, et al. (2013) [1] have proposed a enhancement in LEACH namedI-LEACH, An Improvement has been done by considering basically three factors; Residual Energy in nodes, Distance from base station and number of neighboring nodes. Elbhiri, et al. (2013) [2] have explained the spectral

clustering methods. Spectral Classification for Robust Clustering in Wireless Sensor Networks (SCRC-WSN) named algorithm has been proposed. The aim is to separate the network in a fixed optimal number of clusters for which this protocol uses spectral partitioning method using Graph theory techniques.A centralized approach has been used to calculate the nodes residual energy. Renold, et al. (2012) [3] have explained the security of information during operation of leach protocol. An improvement has been done by implementation of gray hole attack. The performance is being evaluated in terms of packet radio data, average end to end delay and throughput. Gray hole attack is special type of black hole attack in which the malicious node selectivity drops some of packet it receives.

Sen, et al. (2012) [4] proposed a new hierarchical routing protocol named as Layer Based Low-Energy Adaptive Clustering Hierarchy (LB-LEACH). Layer factor is considered as a cluster head selection parameter. This prolongs the lifetime of WSN. Kim, et al. (2012) [5] studied a problem of Far – Zone LEACH (FZ-LEACH) protocol. In proposed work they use quadrant method and average coordinate to choose the Far – Zone Header. Quynh, et al. (2012) [6] enhanced the LEACH protocol. They propose a new hierarchical routing protocol (called EL-LEACH: Energy and Load Balance LEACH). This achieves energy efficiency and balance the load. In proposed protocol cluster head selection also depends upon the remaining energy of the node and the distance to Base Station of the node. Xu, et al. (2012) [7] have proposed an enhancement in LEACH protocol called E-LEACH. An improvement has been done in E-LEACH protocol by considering the remaining power of the sensor nodes in order to balance network loads. In LEACH protocol the round time for selection of cluster head is fixed whereas using proposed protocol round time changes depends on the optimal cluster size. Sikander, et al. (2013) [8] have deduce the performance of LEACH, LEACH-C and PEGASIS by varying different parameters. LEACH-C performs better than LEACH in terms of throughput, energy usage and network lifetime, while PEGASIS outperforms both LEACH and LEACH-C. Tripathi, et al. (2013) [9] have proposed an Energy Efficient Clustered routing protocol based on LEACH-C called LEACH-CE. LEACH-CE use Novel cluster based routing, in which, base station finds the highest residual energy node among the cluster and mark it as a cluster head for current time.

Heinzelman, et al. (2000) [10] proposed Low- Energy Adaptive Clustering Hierarchy (LEACH), a clustering based protocol that utilizes randomized rotation of local cluster base stations to evenly distribute the energy load among the sensors in the network. LEACH use small area coordination to enable scalability and integrates data fusion into the routing protocol to reduce the amount of information. LEACH out perform in terms of energy dissipation, ease of configuration and system lifetime has been observed. Kodali, et al. (2013) [11] has further extended the basic LEACH based data aggregation approach for improvement in energy efficiency. Work deals with two different second level hierarchical protocols, called, Two-level LEACH (TL-LEACH) and direct Diffusion LEACH (DD-LEACH). Ahlawat, et al. (2013) [12] has proposed an enhancement in LEACH protocol called V-LEACH. For improvement, vice cluster head technique is used. Vice cluster head is that alternate head which works only when cluster head will die. HOANG, et al. (2014) [13] has presents a novel cluster-head selection approach. In this cluster structure, four types of sensor nodes are considered i.e. (i) Normal nodes: which confine and transfer data directly to the gateway, (ii) Cluster head candidate nodes: which are similar to normal nodes and are much closer to the sink. (iii) Temporary cluster head which perform whenever gateway is abruptly down due to energy exhaustion. (iv) Gateway or cluster head of cluster which is responsible for data collection, aggregation and transmission to the sink. This technique allows to select the most suitable sensor nodes to become cluster head. Ruperee, et al. (2014) [14] proposed a method to reduce the length of packet from node to Cluster Head by processing the data at node itself during cluster head algorithm approach. The processing of data at node is done by using Delta Modulation. Yadav, et al. (2014) [15] has focused on analytical categorizations of different proposed Cluster Head selection schemes. For that algorithms are analyzed based on descriptor parameters they had considered and which WSN characteristics have been improved. It has been observed that algorithms those are reviewed are different from each other as some uses fuzzy clustering, where some are using verity of different parameters like remaining energy, distance from base station, node location etc. Wang, et al. (2014) [16] proposed a fuzzy-based simulation system for wireless system networks, in order to calculate the lifetime of a sensor by considering sleep time rate, remaining battery lifetime and transmission time rate. Sharma, et al. (2014) [17] proposed a novel routing approach based on Ant Colony Optimization (ACO) algorithm in wireless sensor networks on which LEACH protocol is applied, to route the data packets in sensor network to exploit energy efficiency and to enhance the network life. According to ACO routing, there is

successfully applied routing to find the shortest path between food sources and their nest by means of a pheromone trail laid by other ants. Kumar, et al. (2014) [18] has proposed and evaluate two new clustering based protocols for heterogeneous WSNs, and named these proposed protocols as single-hop energy- efficient clustering protocol (S-EECP) and multi-hop energy-efficient clustering protocol (M-EECP). In S-EECP, we adopt transmission in intra-cluster and inter-cluster communication. Whereas in M-EECP, after election of cluster heads, member nodes communicate with their respective cluster heads by using single-hop communication. Election process of cluster heads is more stable in S-EECP than energy-efficient clustering technique (EECT) and energy-efficient heterogeneous clustered (EEHC).

3. PROPOSED ALGORITHM

Flowchart of the proposed algorithm contains nine steps, these are described below:-

Begin: Reactive I-LEACH

Step1: First of all initialization of the network is done by setting up various constants and variables of the network. Like diameters of sensor network, distance of base station from the network, no of nodes, probability of a node to become cluster head, energy supplied to each node, transmitter energy per node, receiver energy per mode, amplification energy, distance between cluster head and base station etc.

Step 2: : Select a node as cluster head based upon residual energy.

$$T(n) = \begin{cases} \dfrac{p_{opt}}{1-p_{opt}\left(r.mod\left(\frac{1}{p_{opt}}\right)\right)} & if s \epsilon G \\ 0 & otherwise \end{cases}$$

for every node (1)

If $E_i(r) > E_{ALL}(r)$ and MDCR (minimum distance cluster range hold)

Here r represent the current round in WSNs network lifetime, $E_i(r)$ is the current energy of each node. $T(n)$ is the Threshold function for cluster head selection.

$E_{ALL}(r)$Average remaining energy will be evaluated using eqn. (2).

$E_{ALL}(r) = \frac{\sum E_i(r)}{n}$for every node i (2)

Step 3: The CV on that first broadcasting happens, is stored in an interior variable in the sensor node called SV. It decreases the amount of broadcasts. Now the sensor nodes will again communicate the packets in identical cluster time. When the difference of the CV and SV is more than the ST i.e. if the CVvaries from SVby a quantity equivalent to or more than ST, then it supplementary decrease the number of communications.

Step 4: Evaluate the energy dissipated using eqn. 3 and 4.

$E_{Tx}(l,d) = l E_{elec} + l\varepsilon_{fs} d^2, d < d_0$ (3)

$E_{Tx}(l,d) = l E_{elec} + l\varepsilon_{mp} d^4, d \geq d_0$ (4)

Step 5: Update remaining energy of each node (i) and move to step 2 again.

Return: Performance metrics

4. PERFORMANCE ANLYSIS

4.1 Performance Evaluation for nodes =100

Figure 2 has shown the histogram of the first node dead time. It is clearly shown that the first node dead has been prolonged than the LEACH and I-LEACH. Therefore proposed algorithm has significant improvement over the LEACH and I-LEACH.

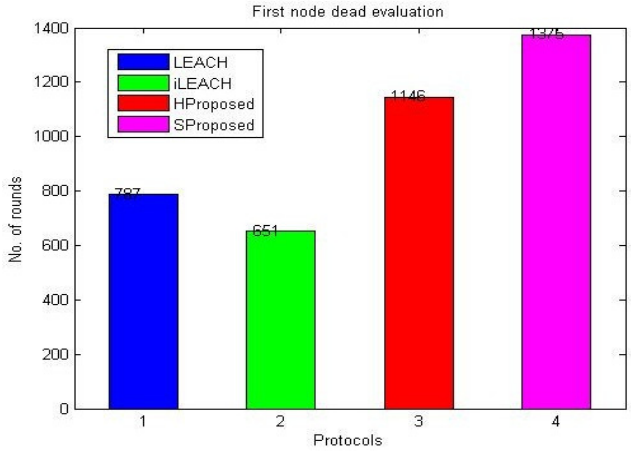

Fig 2: WSNs with first node dead time evaluation

Figure 3 has shown the histogram of the last node dead time. Last node dead time is also called the network lifetime. It is evidently publicized that the last node dead time has been increased than the LEACH and I-LEACH. Therefore projected algorithm has significant enhancement over the LEACH and I-LEACH.

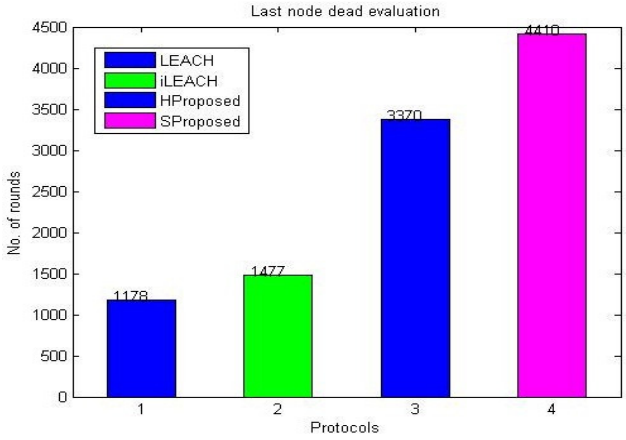

Fig 3: WSNs with Last node dead time evaluation.

Figure 4 has shown the comparison among LEACH, I-LEACH and planned with respect to average consumed power. It has been clearly shown that the average consumed power with respect to rounds in case of the planned is quite less than the LEACH and I-LEACH. It has evidently proved that the planned algorithm is quite improved than the available techniques.

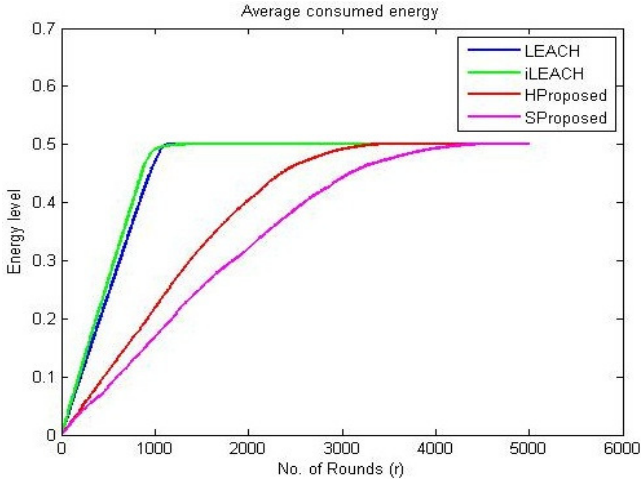

Fig 4: Average consumed energy in rounds evolution

Figure 5 has shown the comparison among LEACH, I-LEACH and proposed with respect to number of Alive nodes in each round. It has been clearly shown that the Alive nodes with respect to rounds in case of the proposed are quite more than the LEACH and I-LEACH. It has obviously demonstrated that the proposed algorithm is relatively better than the available techniques.

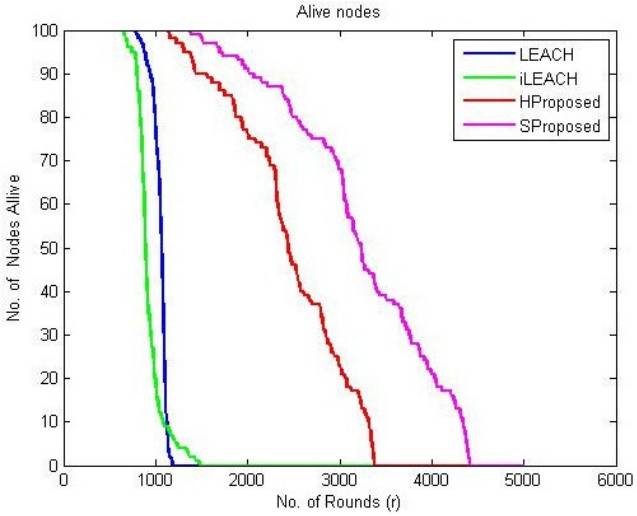

Fig 5: Alive nodes comparisons

Figure 6 has shown the comparison among LEACH, I-LEACH and proposed with respect to number of packets transferred between the base stations to cluster head as well as between cluster head to member nodes in each round. It has been clearly shown that the packets with respect to rounds in case of the proposed are quite more than the LEACH and I-LEACH. It has obviously demonstrated that the proposed algorithm is relatively better than the available techniques.

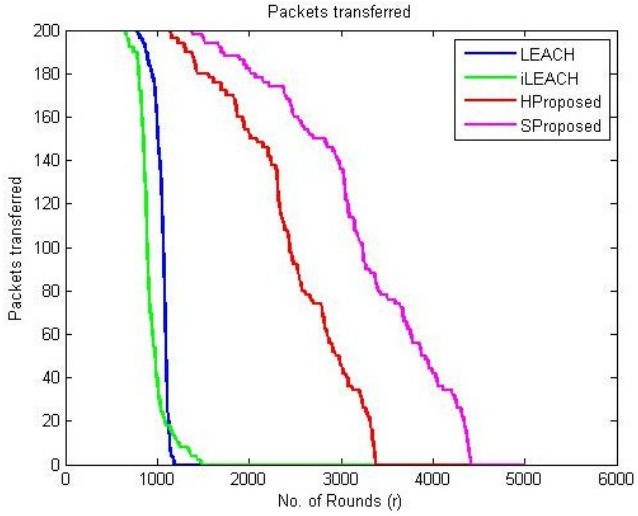

Fig 6: Packets communicated comparisons

4.1 Performance Evaluation for nodes =200

Figure 7 has shown the histogram of the first node dead time. It is clearly shown that the first node dead has been prolonged than the LEACH and I-LEACH. Therefore proposed algorithm has significant improvement over the LEACH and I-LEACH.

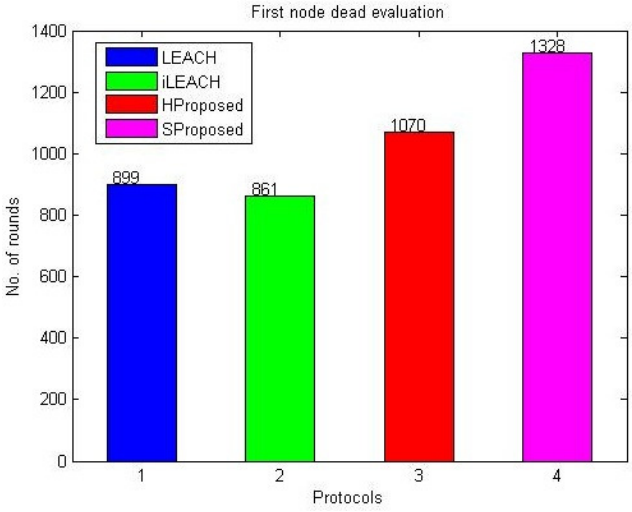

Fig 7: WSNs with first node dead time evaluation

Figure 8 has shown the histogram of the last node dead time. Last node dead time is also called the network lifetime. It is evidently publicized that the last node dead time has been increased than the LEACH and I-LEACH. Therefore

projected algorithm has significant enhancement over the LEACH and I-LEACH.

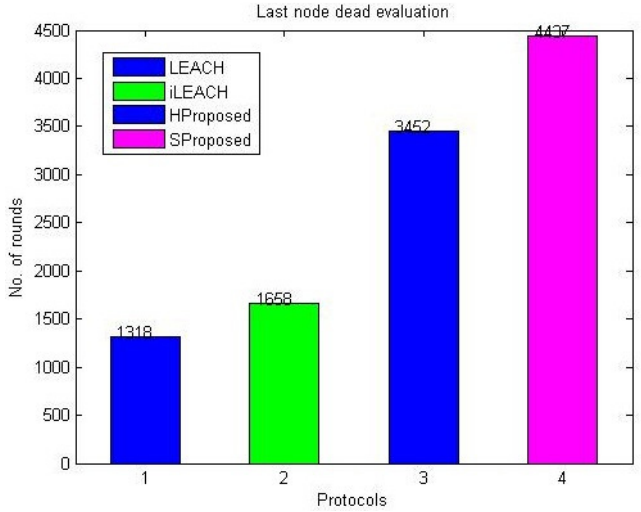

Figure 8: WSNs with Last node dead time evaluation.

Figure 9 has shown the comparison among LEACH, I-LEACH and planned with respect to average consumed power. It has been clearly shown that the average consumed power with respect to rounds in case of the planned is quite less than the LEACH and I-LEACH. It has evidently proved that the planned algorithm is quite improved than the available techniques.

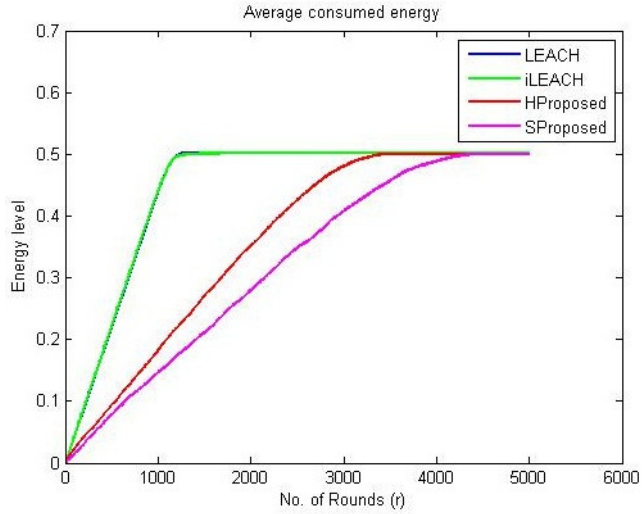

Fig 9: Average consumed energy in rounds evaluation

Figure 10 has shown the comparison among LEACH, I-LEACH and proposed with respect to number of Alive nodes in each round. It has been clearly shown that the Alive nodes with respect to rounds in case of the proposed are quite more than the LEACH and I-LEACH. It has obviously demonstrated that the proposed algorithm is relatively better than the available techniques.

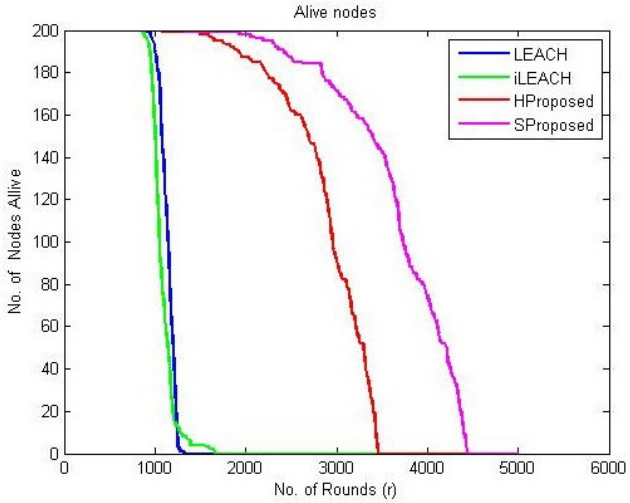

Fig 10: Alive nodes comparisons

Figure 11 has shown the comparison among LEACH, I-LEACH and proposed with respect to number of packets transferred between the base stations to cluster head as well as between cluster head to member nodes in each round. It has been clearly shown that the packets with respect to rounds in case of the proposed are quite more than the LEACH and I-LEACH. It has obviously demonstrated that the proposed algorithm is relatively better than the available techniques.

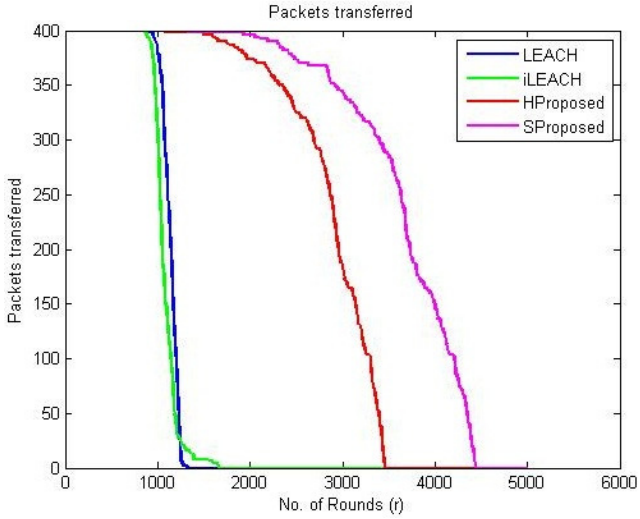

Fig 11: Packets communicated comparisons

4.1 Performance Evaluation for nodes =300

Figure 12 has shown the histogram of the first node dead time. It is clearly shown that the first node dead has been prolonged than the LEACH and I-LEACH. Therefore proposed algorithm has significant improvement over the LEACH and I-LEACH.

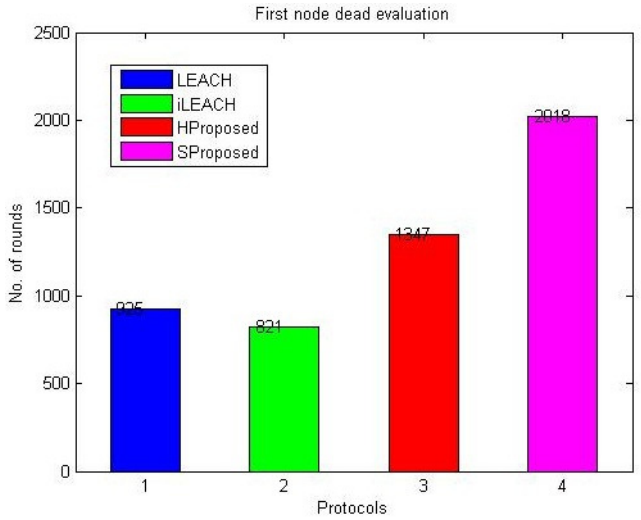

Fig 12: WSNs with first node dead time evaluation

Figure 13 has shown the histogram of the last node dead time. Last node dead time is also called the network lifetime. It is evidently publicized that the last node dead time has been increased than the LEACH and I-LEACH. Therefore projected algorithm has significant enhancement over the LEACH and I-LEACH.

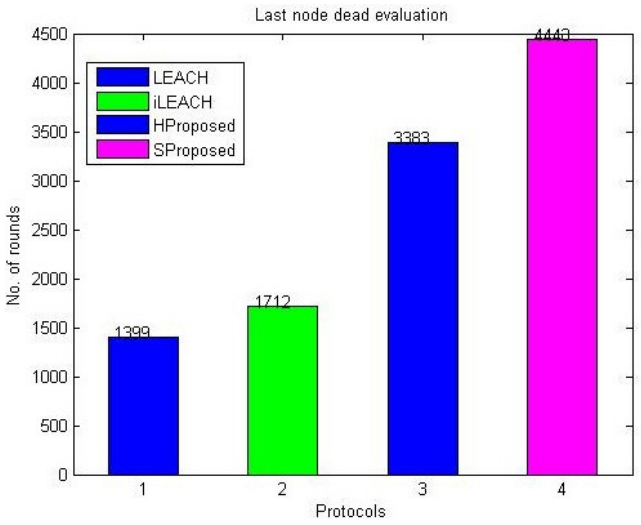

Figure 13: WSNs with Last node dead time evaluation.

Figure 14 has shown the comparison among LEACH, I-LEACH and planned with respect to average consumed power. It has been clearly shown that the average consumed power with respect to rounds in case of the planned is quite less than the LEACH and I-LEACH. It has evidently proved that the planned algorithm is quite improved than the available techniques.

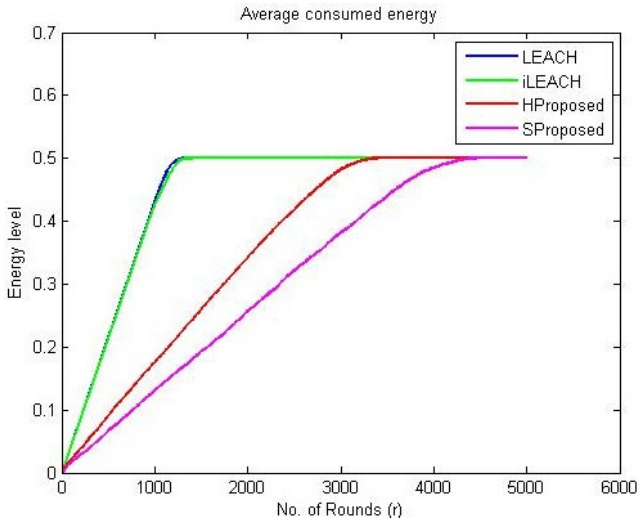

Fig 14: Average consumed energy in rounds evolution

Figure 15 has shown the comparison among LEACH, I-LEACH and proposed with respect to number of Alive nodes in each round. It has been clearly shown that the Alive nodes with respect to rounds in case of the proposed are quite more than the LEACH and I-LEACH. It has obviously demonstrated that the proposed algorithm is relatively better than the available techniques.

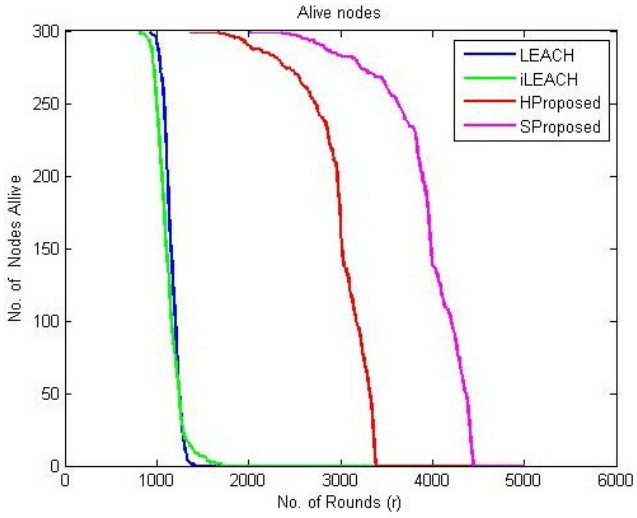

Fig 15: Alive nodes comparisons

Figure 16 has shown the comparison among LEACH, I-LEACH and proposed with respect to number of packets transferred between the base stations to cluster head as well as between cluster head to member nodes in each round. It has been clearly shown that the packets with respect to rounds in case of the proposed are quite more than the LEACH and I-LEACH. It has obviously demonstrated that the proposed algorithm is relatively better than the available techniques.

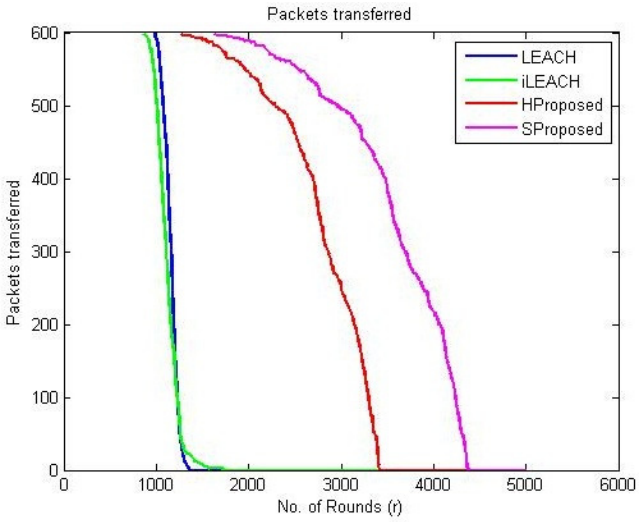

Fig 16: Packets communicated comparisons

5. CONCLUSION

LEACH is one of the widely used algorithm, but it has some drawbacks such as each node may not be arranged regularly in clusters, although nodes have different energy, CH is selected unreasonably. These limitations are overcome in I-LEACH algorithm in which sensor node with higher remaining energy, more neighbors and lesser distance from Base Station is selected as a Cluster Head. The research has increased the network lifetime by using the integrated LEACH protocol which will increase the network life time by using HS and if then rules based algorithm and optimum size cluster formation mechanisms. The comparison among LEACH, I-LEACH and proposed protocol has also done based upon energy consumption and network life time. The performance analysis has shown that the reactive I-LEACH outperforms over I-LEACH and LEACH even when the number of nodes increases from 100 to 200 and 300. Thus proposed technique has shown quite efficient improvement.

This work has considered only homogeneous nodes so in near future the effectiveness of the proposed technique will be evaluated in heterogeneous environment. Also no effort has been done for inter cluster data aggregation in this paper, so intercluster data aggregation will be used in near future.

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