Performance Comparison of EERP Protocol with Existing Protocol

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Abstract **- In wireless sensor network (WSN) energy efficiency is important aspect due to better powered sensor nodes. The traffic aware energy efficient routing protocol is proposed in this paper. The initial clustering using K-medoid and then, distance, traffic and energy level-based cluster head selection is done in this protocol. The right candidate node as cluster head selection and its effect in terms of energy efficiency is seen in this protocol based experimental analysis. The comparative analysis is performed by comparing the results with LEACH protocol. The performance in terms of lifetime, throughput, packet delivery ratio and energy consumption analysis are evaluated which shows improved results.**

Index Terms **- EERP, LEACH, WSN, K-medoid, Clustering, Routing.**

I.INTRODUCTION

The guaranteed data collection is possible when maximum number of nodes in wireless senor network (WSN) are available. The battery powered nodes information is processed to select some nodes as cluster head which act as a routing node for specific cluster. The data collected from all the sensor nodes within this cluster is transferred towards base station via these cluster heads. Due to collection and delivery operations associated with such cluster heads, the energy draining is more in cluster head nodes. Also, if distance of such cluster heads is more from base station (sink node) (BS), then multiple cluster heads get involved in a route for handing over the data towards BS. The lifetime of the network is the important issue due to such power draining and hence energy efficient mechanism for data collection is necessary.

This paper provides an energy efficient routing protocol which makes use of clustering technique for selecting appropriate cluster heads. Also, the traffic handling load on such cluster heads is the important aspect considered while performing the cluster head selection task. A typical WSN arrangement is shown in figure 1.

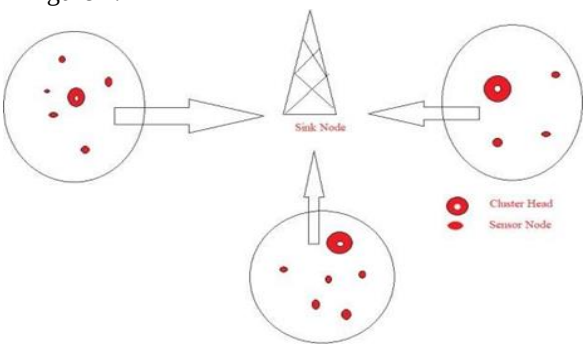

Fig 1. Sink Node in Wireless Sensor Network

II. RELATED WORK

Anika Mansla et al [1] provided a multi-link routing mechanism in which residual energy of the particular sensor node is considered while selecting the cluster heads in each zone. The basic LEACH protocol is modified for this purpose. The results evaluated using energy consumption analysis and packet delivery ratio show improved results over LEACH protocol. Ahmed et al. [2] provided a study of LEACH protocol and its modified versions. The improvement in different aspects is discussed which provide good results for particular parameters. The paper provides good study for understanding the parameter-based significance while modifying the LEACH protocol.

Arslan Rafi et al. [3] developed clustering-based approach by modifying the LEACH protocol. The routing overhead is the main focus of the work provided in which Dijkstra's algorithm is used for shortest route establishment. The protocol LEACH-DA is evaluated using energy consumption and

routing overhead parameters which show improved results over LEACH.

Pack Zhao et al.[4] considered heterogeneous sensor network. The effect of clustering is studied by the authors which shows improved energy efficiency.

Mohammad Z Masoudetal. [5] Considered the location of sink node while deploying the WSN nodes. The study shows that central location is the best possible topology while arranging the WSN sensor node for better energy efficiency and packet delivery ratio. The efficiency is seen to be improved by 30%. M.

Udin Harun Al Rasyid et al. [6] used optimization algorithm for optimizing the energy consumption in each cluster of LEACH based WSN. The LEACH- GA protocol is developed with the use of genetic algorithm for optimization of energy consumption and linear energy draining mechanism.

Pallavi Yarde et al. [7] used cross layer approach for modifying the routing mechanism in LEACH protocol. The information from medium access is used to select the low energy consuming route which improves the energy efficiency in cluster based WSN.

Adnan Yousaf et al [8] studied various protocols useful for WSN which includes basic LEACH and its modified versions. In different protocols, the location of sink node, location of cluster heads and proper strategy for selecting these cluster heads is studied in which distance metric-based selection of cluster heads show more energy efficient network performance.

Yousef Jaradat et al. [9] shown the packet size-based effect on energy efficiency in LEACH protocol. The modification is proposed which makes use of adaptive packet sizing method for improving the energy efficiency by controlling the loss of data during packet dropping and queue full conditions.

Li Tan et al. [10] provided modified version of LEACH protocol called as LEACH-M. The energy efficient route selection shows significant impact on energy efficiency whereas data speed is seemed low compared to LEACH protocol.

Kulsoom Manzoor et al. [11] focused on handover mechanism in which minimum hop count in a route is the fundamental strategy used. The protocol shows improved performance in terms of lifetime enhancement and energy efficiency.

Korhan Cengiz et al. [12] developed energy aware multi hop routing protocol in which each cluster head stores the information of other cluster heads with decreasing order of their energy levels. The information forwarding is done by selecting other cluster heads in a route with highest priority with highest residual energy.

Madari et al. [13] used dynamic distance recognition method with less energy consuming route for improving the energy efficiency of the WSN.

Alid et al [14] suggested modification in LEACH protocol with adaptive energy-based cluster head selection strategy. This strategy improves the energy efficiency over basic LEACH protocol.

Junling Li et al. [15] studied the basic LEACH protocol for modification in terms of energy efficient route selection and highest energy levels-based cluster head selection.

III.PROPOSED WORK

The LEACH convention is seen as a hub for selecting an energy-efficient and long-lasting course of action when conveying correspondence and information.

1. Distance of the hub from base station (BS) and different hubs
2. Residual Energy
3. Previous burden
4. Minimum degree of Energy.

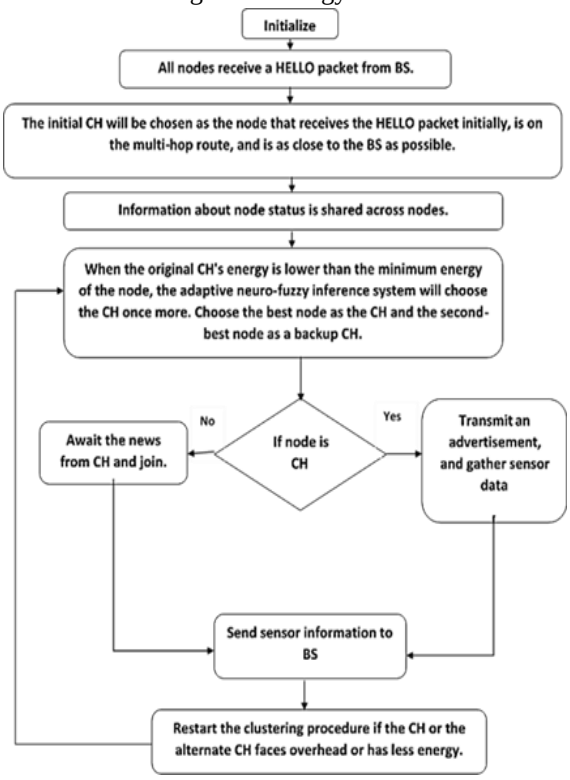

Fig 2. Work Flow

Assumptions:

The WSN with modified LEACH protocol for energy efficiency is the main objective of the development and the assumptions are:

1. Execute initial random clustering method during start of the network.
2. Provide autonomous CH selection method for each zone.
3. Traffic handling requirement for CH of specific zone should be taken into account during CH selection

1. Setup phase:

Applying K-Medoids:

1. First random hubs are selected as CH in K-medoid based bunching.
2. The decided Hubs simply within their local inclusion zone are spoken to by CH.
3. Regular hub's separation-based relationships are limited to connecting with CHs that are farther away from a given hub.
4. Therefore, the requirement to become a group part associated with a certain CH is only less separation.

2. Test Assumptions:

For the test inquiry, an absolute number of 1000 hub's is taken into account in order to generate 50 clusters utilizing K-medoid calculations. The cluster head replacement operation won't be complete until the current CH's leftover energy exceeds the limit.

IV.RESULTS AND ANALYSIS

MATLAB is used to experiment with the proposed protocol, which is a modified version of the LEACH technique.

The network configuration utilized in the experiment has a variable number of nodes. The performance evaluation is done with throughput and packet delivery ratio parameters.

Throughput is calculated as,

$$Throughput\ (kbps) = \frac{Number\ of\ bits\ successfully\ received}{Total\ number\ of\ bits\ sent} \times \frac{1}{1000} \quad (1)$$

The packet delivery ratio is calculated as,

$$PDR = \frac{Number\ of\ bits\ received}{Total\ number\ of\ bits\ sent} \times \frac{1}{number\ of\ killobits\ per\ packet} \times \frac{1}{1000} \quad (2)$$

The Throughput and PDR analysis is performed and results are shown in table I and II

Table I: Throughput Analysis

Number of nodes	LEACH Throughput (Kbps)	EERP Throughput (Kbps)
10	411	515
20	441	529
30	466	539
40	390	480
50	373	411

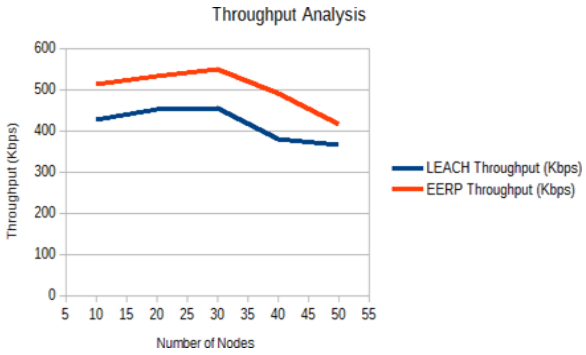

Fig 3: Throughput Analysis

Table II: PDR Analysis

Number of nodes	LEACH PDR	EERP PDR
10	51.15	65
20	54.15	65.4
30	56.89	69.4
40	48.1	62.21
50	46.11	52.12

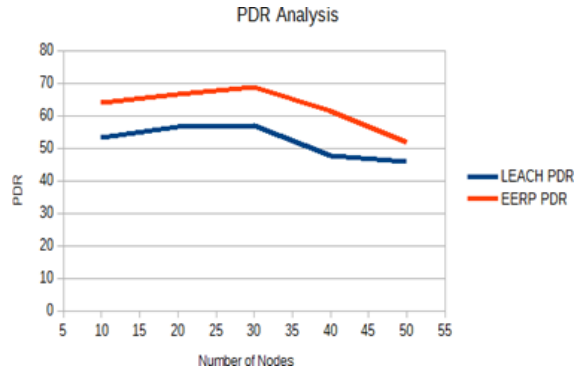

Fig 4: PDR Analysis

The delay analysis is performed which is given as,

$$End\ to\ end\ delay = \frac{sum\ of\ delay\ of\ each\ packet\ delivery}{Total\ number\ of\ packets} \quad (3)$$

Table III shows the delay analysis and fig 5 shows the graph of delay analysis.

Table III: Delay Analysis

Number of nodes	LEACH PDR	EERP PDR
10	38.14	49.81
20	41.11	50.12
30	43.12	52.41
40	36.22	46.41
50	33.16	37.98

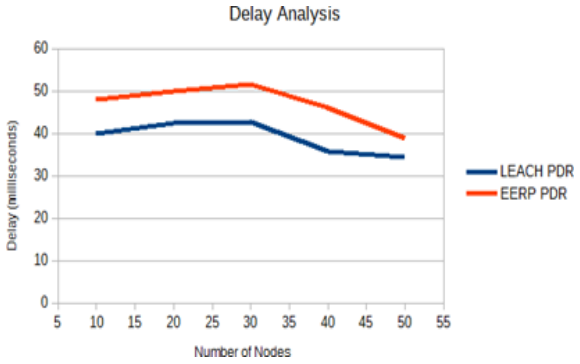

Fig 5: Delay analysis

Number of alive and dead nodes are analyzed and their results are shown in table IV and V. The graph for alive and dead nodes are shown in fig 6 and 7.

Table IV: Number of Alive Nodes

Iterations	LEACH	EERP
10	693	824
20	520	730
30	431	641
40	391	520
50	361	491

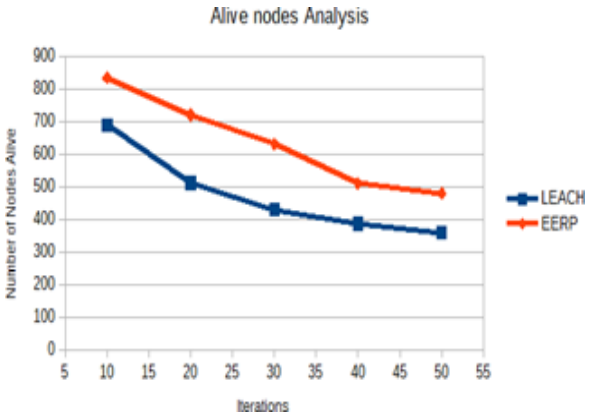

Fig 6: Number of Alive Node Analysis

Table V: Number of Dead Nodes

Iterations	LEACH	EERP
10	311	0
20	489	6
30	571	60
40	614	106
50	641	167

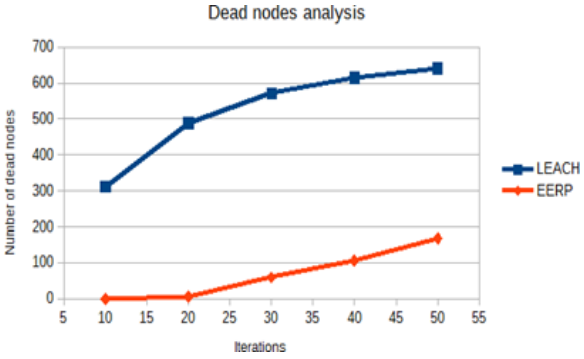

Fig 7: Number of Dead Nodes Analysis

Table VI: Energy Consumption Analysis

Iterations	LEACH	EERP
10	122859.5	23149.57
20	150602.9	44893.62
30	163340.3	64243.02
40	171162.8	79801.2
50	176755	93240.76

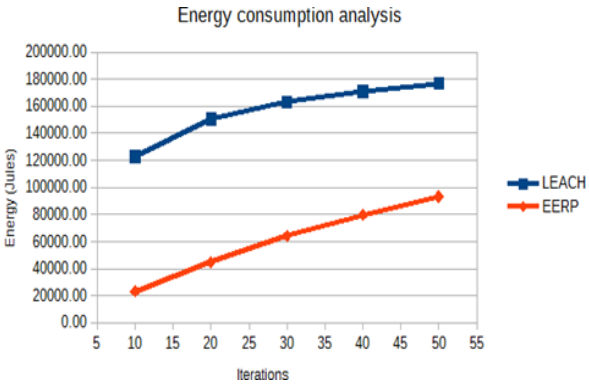

Fig 8: Energy Consumption Analysis

Table VII: Residual Energy Analysis

Iterations	LEACH	EERP
10	97340.48	197050.4
20	69597.12	175306.4
30	56859.71	155957
40	49037.25	140398.8
50	43444.95	126959.2

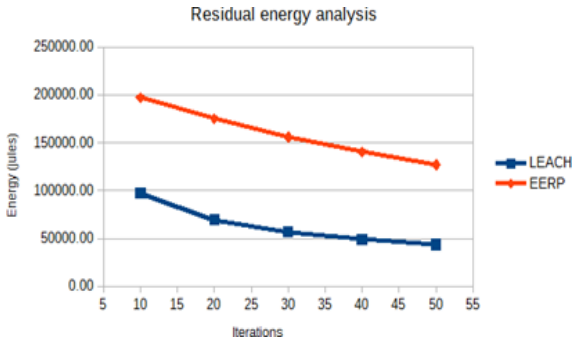

Fig 9: Residual Energy Analysis

V.CONCLUSION

The Energy Efficient Routing Protocol is the main contribution of this paper. The protocol shows improved, energy efficiency, improved lifetime, and optimum level of throughput and packet delivery ratio when compared to LEACH protocol. The protocol is developed by modifying the LEACH protocol and hence improved results over LEACH are sufficient to understand the improvement while using the protocol for wireless sensor network. The further improvement is feasible with the use of neural network-based approach for selecting the cluster head faster in each zone in an autonomous manner which may improve the performance by keeping latency minimum.

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