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Abstract

Wireless Sensor Networks (WSN) consists of nodes with limited power deployed in the area of interest. Nodes tend to collect, transmit and forward data to a base station. In WSN, clustering and scheduling techniques ensures that the data should be collected in an energy efficient manner. In this work, we have reviewed many papers relating to clustering and scheduling of sensor network. After reviewing many papers we believe that the work done in it is the latest one, modifications in the work is needed. This proposal give the basic description of wireless sensor network and their importance in energy efficiency and give a brief about most famous protocol is describes leach and their improved version In this work we have proposed a novel self-organizing clustering scheme which considers the real time parameters for setting up the clusters for data collection. Unlike several proposed algorithm, this scheme reclusters the network only when CH fall below a threshold level. Repeated unnecessary clustering in every round depletes the energy of the network more quickly. We have introduced heterogeneity in the proposed work. By mean of heterogeneity in terms of energy, lifetime of the network can be extended. An algorithm is functional if the area of interest is covered by active nodes. The period for which the network is functional is termed as persistent period in our work. Simulation results show that the proposed scheme is comparatively more energy efficient, scalable & robust and has longer persistent period. And later part of the proposal gives the advantage and disadvantage of these protocols.

Keywords: WSN, Sensor Nodes, LEACH Protocols, Clustering

I. INTRODUCTION

Today, time is the technology i.e. a huge number of techniques are introduced in a short span time and start research is on. Many techniques are used to communicate and transmit the information between networks. Wireless sensor network (WSN) made up of hundreds and even thousands of small tiny devices called sensor nodes to monitor environmental or physical conditions, such as sound, vibration, temperature, pressure. Many protocols are used to reduce the energy tuberculosis. Energy plays effective role in wireless sensor network.

A. Architecture of WSN

In wireless sensor networks, as no. of sensor nodes are used for communication which mainly forms a sensing field and sink (Base station). Many tiny, smart and inexpensive sensor nodes are scattered in the target sensor field to collect data and send the useful information back to the end user.

![Fig. 1: WSN Architecture](image)

All sensor nodes are cooperating with each other with help of wireless connection to form a network, collect and analyze data coming from the environment. Suppose the data collected by node A is routed within the sensor field by other nodes. Edges of node E received all data and then forwarded to target. The destination works like a gateway with higher processing capacity and...
communicate with the task manager node. The connection between destination and task manager node is the public networks in the form of satellite. The end users receive the data from the task manager node and perform processing on received data.

**B. WSN’s Applications**

1) **Environmental Applications**
   - Air pollution monitoring
   - Flood and oceans detection
   - Forest fire detection
   - Precision agriculture

2) **Military applications**
   - Monitoring, tracking and surveillance of borders
   - Nuclear, biological and chemical attack detection
   - Battle damage assessment

3) **Health applications**
   - Drug administration
   - Remote monitoring of physiological data
   - Tracking and monitoring doctors and patients inside a hospital

4) **Home applications**
   - Automated meter reading
   - Home automation
   - Instrumented environment

5) **Commercial applications**
   - Monitoring vibration that could damage the buildings structures
   - Monitoring traffic flow and road condition
   - Vehicle tracking and detection

**C. Data Aggregation**

The aim of data aggregation protocols is to combine and then summarize data packets of several sensor nodes so that amount of data transmission is reduced.

![Data Aggregation Algorithm](image)

**Fig. 2: Data Aggregation Algorithm**

**D. Cluster Routing**

Cluster routing protocol is used to make the network useful and efficient. A cluster based routing protocol collection of sensor nodes where each group of nodes has a channel head. Data is sent to the CH rather than send it to the BS. A number of routing protocols have been intended for WSN. LEACH, PAMAS and PEGASIS are most well-known hierarchical protocols.

![Clustering in WSNs](image)

**Fig. 3: Clustering in WSNs**
Both of these show significant minimization in the comprehensive network energy over other non-clustering protocol. Hierarchical routing protocols have mental plan to reduce energy consumption by localizing communication within the cluster and add data to reduce transmissions to the BS.

E. Energy Efficiency in WSN

In WSN energy efficiency is a process to reduce the amount of energy which is required to provide sensors and products. Many algorithms have been proposed for the routing issue in WSNs. The minimum energy routing problem has been addressed in. The minimum total energy routing approaches in these papers are to minimize the total consumed energy. If all traffic is routed through the minimum energy path to destination the nodes along that path will run out of batteries quickly rendering other nodes useless due to network partition even if they do have available energy. Instead of trying to minimize the total consumed energy on the path, the objective is to maintain the connected network as long as possible. If sensor nodes consume energy more equitably, they continue to provide connectivity for longer, and the network lifetime increases. In WSN many routing protocols that are used to minimize the energy extending and maximize the lifetime. Proposed work is Improvement in LEACH based on lifetime of alive nodes in Wireless Sensor Network

F. Leach Protocol

LEACH is first proposed by W.B.Heinzelman. This protocol provides a conception of round. LEACH protocol runs with many rounds. Each round contains two states: cluster setup state and steady state. In the set-up phase, each node decides whether or not become a cluster-head for current round. This decision is made by the node n choosing a random number between 0 and 1. If the number is less than a threshold T(n), the node becomes a cluster-head for the current round. The threshold is set as:

\[
T(n) = \begin{cases} 
\frac{P}{1 - \lfloor r/n \rfloor}, & n \notin G \\
0, & \text{otherwise}
\end{cases}
\]

- T(n) is the threshold value.
- P describes desired percentage of Cluster Heads (e.g. P=0.05) or in simpler words, it is the probability of the other nodes to become cluster head in the current round.
- G is the set of nodes that have not been CHs in the last 1/P rounds.
- r is the current round number.
- n is the node number.

Then, operation moves to the steady phase, the steady phase is divided into frame, where nodes send their data to the cluster head at most once per frame during their allocated transmission slot. After a period, the entire networks are renewed, preparing for the new round. The flow chart of LEACH algorithm is shown in figure 4.

![Flow chart of LEACH Algorithm](image)

G. Problems of LEACH Protocol

Problems of LEACH Protocol Cluster head selection algorithm, adopted by LEACH protocol, avoid fast energy loss of cluster heads and its data aggregation effectively reduces the amount of communication. Therefore, LEACH protocol prolongs the network life time in contrast to plane multi-hop routing and static routing. However, there are still some improvements to be
done in the LEACH protocol. Firstly, the probability in selecting cluster heads is equivalent, without considering the remaining energy of nodes. Therefore, those nodes with less remaining energy may be chosen as the cluster heads which will lead to fast energy loss of these nodes, hence making them invalid. Secondly, the number of cluster heads is fluctuating heavily. The stochastic cluster-head selection of LEACH is prone to result in the unbalanced clusters partition in the network and thus increase the total energy dissipated in system.

![LEACH Aggregation algorithm](image)

**Fig. 5: LEACH Aggregation algorithm**

II. VARIOUS APPROACHES

Pawan Singh Mehra et al. 2015 [1] presents that clustering is one of the efficient techniques which not only help in protraction of lifetime of wireless sensor network but also make it scalable and robust. Subdivision of network into group of sensor nodes with a coordinator is called a cluster. Cluster members collect the physical data by sensing the environment and forward it to the coordinator which is generally termed as Cluster Head (CH). This cluster head aggregates the data and transmit it to the Base Station for further processing of data to meet the requirement of the application. In this paper we have proposed a novel self organising clustering scheme which considers the real time parameters for setting up the clusters for data collection. Unlike several proposed algorithm, this scheme reclusters the network only when CH fall below a threshold level. Repeated unnecessary clustering in every round depletes the energy of the network more quickly. We have introduced heterogeneity in the proposed work. By virtue of heterogeneity in terms of energy, lifetime of the network can be extended. An algorithm is functional if the area of interest is covered by active nodes. The period for which the network is functional is termed as persistent period in our paper. Simulation results show that the proposed scheme is comparatively more energy efficient, scalable & robust and has longer persistent period.

Hongqin Liu et al. 2012 [2] proved that, in recent years, with the developments of wireless sensor networks technology, how to prolong the lifetime of WSN and reduce energy consumption by the sensor nodes becomes a hot topic. This article analyzes the mechanism of clustering in LEACH protocol and presents improved approaches based on energy of sensor node and the distance between the node and the base station, then compares their performances. Results of simulation indicate that the improved protocols can balance the network load and prolong the network lifetime.

El khediri et al 2011 [3] proposed “Synchronization issues in Wireless Sensor Network”, talked about LEACH (Low-Energy Adaptive Clustering Hierarchy) in which they utilized random based rotations of local cluster. It is used to distribute the energy for balancing the load. LEACH was used to enable scalability and robustness for non static networks and add data fusion into the routing protocol for reducing the amount of data. It was able to transmit to base station and performs experiments with larger number of nodes (thousands), and also to conduct test other node.

Zhiyong PENG et al. 2010 [4] states that in wireless sensor networks, the power resource of each sensor node is limited. Minimizing energy dissipation and maximizing network lifetime are important issues in the design of routing protocols for sensor networks. In this paper, Cluster routing protocol LEACH (Low-Energy Adaptive Clustering Hierarchy) is research and improved. We extend LEACH stochastic cluster-head selection algorithm via changing the round time According to the situation of sensor network. It is named Variable-round LEACH. The result simulated in NS2 shows that the energy is significantly reduced and the lifetime of the whole network is increased compared with the previous routing algorithm for the sensor networks.

M.BaniYassein et al 2009 [5] paper, “Improvement on LEACH Protocol of Wireless Sensor Network” studied a new version of LEACH protocol called VLEACH which aims to reduce energy consumption within the wireless network. In this, LEACH and V-LEACH was evaluated through extensive simulations using OMNET++ simulator. It shows that VLEACH performs better than LEACH protocol.

Fan Xiangning et al 2007 [6] explained “Improvement on LEACH Protocol of Wireless Sensor Network”, study that energy proficiency was a vital design issue that needs to be boosted in order to increase the lifetime of the network. LEACH was a hierarchical routing protocol which efficiently maintains the energy storage of nodes in Wireless Sensor Network (WSN). The nodes using LEACH were divided into clusters. The advantage of LEACH for each node was the equal probability to be a cluster head, which makes the energy wastage of each node, be relatively balanced. In LEACH protocol focuses on how to decide the next hop nodes more reasonable when the data are transmitted at the steady state. Energy-LEACH protocol improves the CH
selection procedure. It makes reusable energy of node as the main metric which decides which nodes turn into CH or not after the first rounds. Like LEACH protocol, E-LEACH was divided into rounds, in first round, all node has the same probability to turn into CH, this mean nodes are randomly selected for making CHs, in the next rounds, the residual energy of each node was different after one round communication and taken into account for the selection of the CHs. That mean nodes have more energy to become a CHs rather than nodes with less energy and it shows that the algorithm after improved was more energy-efficient than LEACH protocol.

Wedi Heinzelman et al 2000 [7] paper, “Energy-Efficiency communication Protocol for Wireless Micro-sensor Network”, study O-LEACH (optimization Low Energy Adaptive Clustering Hierarchy) to improve previous LEACH and LEACH-C by selecting cluster according to the residual energy of nodes dynamically. The simulation results provides longer stability rather than original LEACH and LEACH-C.A clustering-based routing protocol that minimizes global energy usage by distributing the load to all the nodes at different points in time. LEACH reduces communication energy and minimum-transmission-energy routing. The first node was death in LEACH occurs over eight times later than the first node death and last node dead occur three times later than other protocols.

III. PROBLEM DEFINITION

The nodes in Wireless Sensor Network collects the information from their environment and send it to the selected cluster head which further transmit information to the base station. In this process energy consumption of nodes should be less, so that energy efficiency of nodes would increase. There are uncertainties in selection of cluster head which needs to be minimize so that the selected cluster head must have enough energy to take part in its role. In the existing work the researchers have improved the performance of leach protocol with the a dynamic way selecting cluster head on the basis of sorting algorithm i.e. the node containing the highest energy will be selected as cluster head and remaining neighbourhood nodes will be the part of that cluster.

But will not be able to increase the performance of existing leach protocol in a very significant manner so in the proposed work our aim is design a protocol over which the cluster head will selected on basis of optimization technique so that we will be able to improve the performance of existing leach protocol to significant level in terms of energy efficiency.

IV. OBJECTIVES

The Objective of the study which will direct towards achieving our aim to:

1) To study the existing energy efficient protocols. To design a mathematical model for optimization technique.
2) To implement the improved leach protocol with the designed optimized modal to improve the residual energy levels of the network with respect to the no. of rounds.
3) To compare and improve the performance of proposed energy efficient leach optimized protocol to the existing protocols.

V. METHODOLOGY

The improved version LEACH protocol is proposed in which the number of rounds as well as stability of network is increased as compared to original LEACH protocol. The ideas behind proposed LEACH protocol are given below:

- Multilevel Clustering: In proposed LEACH the multilevel clustering is employed in which five levels of nodes is defined which is better suited for defining heterogeneous environment as compared to four levels of nodes defined in the multilevel clustering model of original LEACH protocol. It must be noted that the total energy of network is kept same as that of original LEACH protocol. This new clustering model helps in increasing the network stability in heterogeneous network.
- Distance based routing: The distance between member nodes and nearby cluster heads is calculated, after calculation distance a comparison is made that ensures the minimum distance between the member node and the cluster head and then the join request message is only send to that cluster head which fulfil the condition of minimum routing distance. In this way the energy consumption via transmission of data from member node to CH is reduced to possible extent which results in improve network lifetime. So, the no. of rounds gets increased to possible extent without affecting the network stability.
- Cluster head selection at each round: The proposed LEACH ensures that selected cluster head is different at different round. After completion of first round the previously selected cluster head is released from the role of cluster head without checking its residual energy. Instead of checking residual energy of previously selected cluster head the proposed LEACH checks for the node which has maximum residual energy in whole cluster so that it becomes new cluster head for next round. This cycle repeat itself for the defined number of rounds. This method guarantees the uniform energy consumption of the network by selecting different cluster heads at different rounds thus the stability gets increased to possible extent without affecting the number of rounds.

VI. IMPLEMENTATION

Based on our simulation studies, the following are observed, which make the improved LEACH protocol desirable. The flowchart of improved LEACH algorithm is shown in the figure 6.
The implementation steps are as follows:
The above explained is the procedure of proposed work of improved LEACH algorithm.

**VII. RESULTS**

The results obtained from proposed LEACH protocol shows improvement in number of rounds, stability of network as well as throughput of the network.

**Fig. 6: Flowchart of improved LEACH Algorithm.**

*Fig. 7: Nodes dead during rounds in proposed leach protocol.*

*Fig. 8: Nodes alive during rounds in proposed leach protocol.*

*Fig. 9: Packets to base station v/s no. of rounds plot comparison.*
The FND (First Node Dead) also known as stability period is at 3007th round means that the network is stable up to 3000 rounds. The LND (Last Node Dead) also known as instability period is at 7546th round also it shows that network lifetime is about 7500 rounds by using proposed LEACH protocol.

Table 1 shows the simulation results proposed LEACH in comparison with existing protocols i.e.

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Round (Stable period)</th>
<th>Round (Persistent period)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEACH</td>
<td>2023</td>
<td>2233</td>
</tr>
<tr>
<td>PAWAN et al.</td>
<td>2728</td>
<td>3208</td>
</tr>
<tr>
<td>PROPOSED</td>
<td>3007</td>
<td>5012</td>
</tr>
</tbody>
</table>

The results are obtained by several hundred simulations which are carried out to achieve normalized values. The proposed work has 35% longer stable period than LEACH and 44% better persistence period than LEACH.

Total throughput or packets sent to base station during several rounds are 68250.

The total energy efficiency is increased by 56% in proposed approach as compared to several other approaches.

The stable period of proposed algorithm is 48% better than LEACH and 10% better than Pawan et al. as shown in table 1. The proposed algorithm has 124% and 56% better persistent period than LEACH and Pawan et al. approaches respectively.

**VIII. CONCLUSION**

In this research a purely LEACH that better utilizes the most valuable network resource (energy) in WSN is introduced. Improved LEACH outperforms the probabilistic-based models we have considered, by guaranteeing that a fixed number of cluster-heads are elected per round. At different rounds cluster-heads are elected using the local information of their residual energies within each clusters to choose the appropriate cluster-heads. As discussed earlier, IMPROVED LEACH has been able to distribute the energy consumption in the WSN evenly among the nodes, hence the nodes die out almost at the same time. The characteristics of Improved LEACH is very desirable as it is close to an ideal solution. Even when we change the number of cluster heads per round, IMPROVED LEACH proves to be more robust and more stable than the probabilistic-based models.

Overall, IMPROVED LEACH improves the lifetime of wireless sensor networks by an order of magnitude which is significant when compared with LEACH, SEP and SEP-E. IMPROVED LEACH takes advantage of the local information i.e the residual energy of each node to optimize the energy consumption in both homogeneous and heterogeneous scenarios we have considered, regardless of the level of energy hierarchies in the network. Longer persistent period in proposed work justifies the load balancing in the network.

**IX. FUTURE SCOPE**

In our future work, we intend to adapt IMPROVED LEACH protocol to a real world application setting such as
- In agricultural farmland for fertilizer spraying operations.
- Intrusion detection system (IDS).
- Detection of poisonous gas.

It is our hope that this method can provide more insight into optimizing WSN energy consumption in real-world scenarios.

**REFERENCES**