Energy Efficient Routing of WSN Using ProjPSO and V-Leach Protocol

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Abstract- *Wireless sensor networks has been one of the important technologies of communication and so many researchers has shown keen interest towards the same technology in last several years. The Wireless Sensor Network (WSN) is a wireless network consiststhousands small nodes with sensing, computing and capabilities of wireless communication. They have been founded very useful to numerous fields like healthcare area, surveillance system, military- emergency, and so forth. As Energy consumption is the key issue, recent advances in wireless sensor networks have led to many new protocols specifically designed for sensor networks where energy awareness is an essential consideration. Energy efficiency is thus a primary issue in maintaining the network. During our research in this paper we have discussed Energy Efficient Routing Protocols for Wireless Sensor Networks. We have researched on various methodology of energy efficient routing in WSN.We have presented Cluster Head Selection and Vice Cluster Head Selection Process using Optimization Problem and proposed a method to select CH and VCH using Modified PSO by considering distance factor and energy of the nodes. Additionally we also proposed addition of well knownMultiHop mechanism for routing*

Keywords- WSN, Leach, V-Leach, Energy Efficiency, PSO, Optimization,MultiHop, Node Distance

I. INTRODUCTION

WSN is a wireless network that consists of one or more base stations and thousands of nodes (wireless sensors). Clustering of nodes contains Cluster Head that communicates with Base Station. These networks are used to monitor physical or environmental conditions like sound, pressure, temperature and co-operatively pass data through the network to a main location as shown in the figure 1.

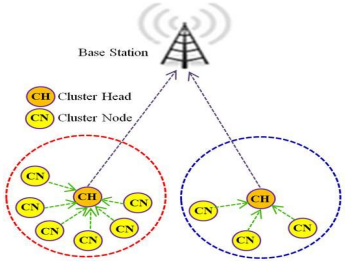


Figure 1 WSN Nodes and CH

A. Structure of WSN

WSN structure can derive any of the topology like Star, Mesh or hybrid. Each type of WSN structure has its own pro and cons. In star topology structure of WSN data is sent to direct base station, nodes can not communicate with each other. In Mesh topology like structure of WSN nodes can also communicate, receive and send data to each other. Multihop type protocols can be used in this type of structure. In hybrid there are two types of sensor nodes high power and low power nodes and it consist both type of features like start and mesh.

B. Protocols in WSN

We can classify the protocols of WSN based on various parameters and their behaviors.

Protocols can be classified as proactive, reactive and hybrid protocols based on their functionality. We can also classify the same protocols by their participation style in communication. Based on communication style we can say two types of protocol Direct Communication, Flat and Cluster based protocols. If we consider network structure then we can classify the protocols as Hierarchical, data centric and Location Based protocols.

C. Applications of WSN

Applications of WSN can be categorized in main two region or purpose.

i) Monitoring
ii) Tracking.

Both purpose are very useful in the fields of Defence Operation, Health Care Areas, Business, Agriculture, Environment, Emergency Servieces etc. Some of the

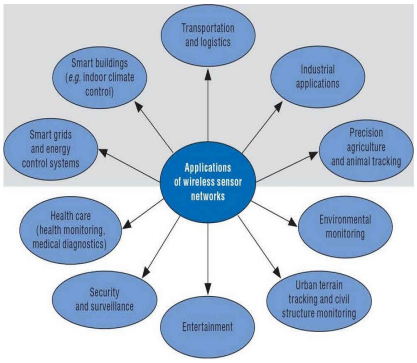


Figure 2 Applications of WSN

D. Leach Protocol

Leach protocol is a TDMA based MAC protocol. The main aim of leach protocol is to improve total lifespan of WSN by lowering the energy consumption of each sensor node.

Working of Leach protocol consists of two phases:

1) Set-up phase
2) Steady phase

Operation of leach protocol consists of several rounds with two phases in each round. Leach protocol is a typically representation of hierarchical routing protocol. It is self-adaptive and self-organized [2]. Leach protocol uses round as unit, each round is made up of cluster set-up stage and steady state storage for the purpose of reducing unnecessary energy costs. Phases of leach protocol are as follows:

A. Set-up phase

In the set-up phase, the main goal is to make cluster and select the cluster head for each of the cluster by choosing the sensor node with maximum energy [3]. Set-up phase has three fundamental steps: 1. Cluster head advertisement 2. Cluster set up 3. Creation of transmission schedule During the first step cluster head sends the advertisement packet to inform the cluster nodes that they have become a cluster head on the basis of the following formula:

$$T(n) = \frac{P}{1 - P\,(r \bmod 1/P)} \quad \text{if } n \in G$$

$$= 0 \quad \text{if } n \notin G$$

T (n) is the threshold. Node becomes cluster head for the current round if the number is less than threshold T (n). Once node is elected as a cluster head then it cannot become cluster head again until all the nodes of the cluster have become cluster head once. This is useful for balancing the energy consumption. In the second step, non-cluster head nodes receive the cluster head advertisement and then send join request to the cluster head informing that they are members of the cluster under that cluster head. All non-cluster head nodes save a lot of energy by turning off their transmitter all the time and turn it on only when they have something to transmit to the cluster head [2]. In third step, each of the chosen cluster head creates a transmission schedule for the member nodes of their cluster. TDMA schedule is created according to the number of nodes in the cluster. Each node then transmits its data in the allocated time schedule [3].

B. Steady phase

In steady phase, cluster nodes send their data to the cluster head. The member sensors in each cluster can communicate only with the cluster head via a single hop transmission. Cluster head aggregates all the collected data and forwards data to the base station either directly or via other cluster head along with the static route defined in the source code. After predefined time, the network again goes back to the set-up phase.

As We have discussed Introduction related to our research work in Section I, now we will discuss our related research done from so many existing research work in Sector II. We will discuss the Proposed methodology and Steps and Flow of our proposed system in Section III.

II. RELATED WORKS

We have researched over so many papers regarding energy efficient routing protocol in WSN.

In paper Energy Efficient Routing of WSN using Particle Swarm Optimization and V-Leach Protocol authors Alka Singh, ShubhangiRathkanthiwar and SandeepKakde[1] , presented cluster head (Ch) and vice

cluster head (VCh) selection method using PSO and V-Leach protocol. They considered their method energy efficient compared to leach protocol by comparing their result to the original leach protocol results. They also included that they have got better performance to minimize energy dissipation in the transmission and increases the life time of the wireless sensor networks, also other comparative performance metrics like End to End delay, data transmitted and total energy consumed shows V-Leach PSO protocol provides better performance in comparison to existing leach protocol. Table 1. We have shown the energy comparison shown in paper.

Table 1 Energy Consumption Comparison

No Of Rounds	Total consumed Energy(nJ) x107using Vleach protocol with PSO	Total consumed Energy(nJ) x107using leach protocol
50	2	81
100	9	258
150	20	579
200	44	1034
250	67	1767
300	98	2681
350	107	3709
400	140	560
450	221	5657
500	317	7640

In Paper, Improving Lifetime of Wireless Sensor Networks by Mitigating Correlated Data using LEACH Protocol authors RajatKandpaland Rajesh Singh[2] proposed IL-LEACH (Improved Lifetime Low Energy Adaptive Clustering Hierarchy) method. This method aims to mitigating the correlated data transmissions by forming groups of nodes into virtual correlated cluster (VCC) and allowing only one node to send data. By using their method they increased lifetime of sensor network by about 30.006% in comparison to the existing LEACH protocol.

In Paper An Enhanced PSO-Based Clustering Energy Optimization Algorithm for Wireless Sensor Network by authors C.Vimalarani, R.Subramanian, and S.N.Sivanandam[3] proposed an Enhanced PSO Based Clustering Energy Optimization (EPSO-CEO) algorithm for Wireless Sensor Network in which clustering and clustering head selection are done by using Particle Swarm Optimization (PSO) algorithm. They also founded reductioninenergyconsumption.

In Paper, Impact of the energy-based and location-based LEACH secondary cluster aggregation on WSN lifetime authors Oluwatosin Ahmed Amodu and Raja Azlina Raja Mahmood[4] presented 2 Level Cluster Head Mechanism to overcome the problem of Ch overload. They also founded an improved performance over existing state-of-the-art homogeneous routing protocols

In Paper An energy efficient routing protocol for correlated data using CL-LEACH in WSN researchers PreethaMarappan and Paul Rodrigues [5] proposed proposes a Cross Layer-Low Energy Adaptive Clustering Hierarchy model (CL-LEACH) which considers residual energy and for cluster head selection and provides an energy efficient transmission schemes. They got better results in terms of number of live nodes, energy dissipation, message cost when compared to the traditional LEACH protocol.

III. PROPOSED WORK

We are going to propose an Modified PSO Based V-Leach Protocol for energy efficiency. As we reviewed the current work[1] which consists V-Leach protocol and PSO algorithm for optimized solution of Cluster Head and Vice Cluster Head Selection. During the current work they have not considered distance of the nodes at the time considering the Ch and VCh. In our proposed system we are considering Energy Level and Distance of the Node both parameter at the time of Ch and Vch Selection. We are also including MultiHop routing technique to reduce the overload of Ch to communicate between Bs.

Hereby We present the steps of our proposed system.

Step 1 : Initialize Parameter
[nodes, energy, bs location, distances, network distance]
Step 2: V-Leach Setup Phase
Create Cluster using PSO
Create Ch and VCh using Fitness function
Assign nodes to Ch (Membership)
Step 3: Steady and Data Pass Phase
Apply Multi-Hop
If(ch has energy)
Ch collects the data from nodes
Else
Ch=Vch
Pass Data from Ch to other Ch
(Ch for data receiver is selected based on distance from Base Station)
Step 4 : Send Data to Base Station
Step 5 : Calculate Energy Consumption/Speed/Throughput

Distance Calculation

There are so many types of distance functions that can be used to form clusters. In our research we implement

Euclidean base distance function for clustering and analyze its accuracy in predicting the accurate data.

Euclidean Distance Function

Euclidean distance function It is the ordinary distance between entire points in the data set. It is given by [8]

$$E(x_i, x_j) = \sqrt{\sum_{j=1}^{m} (x_i - x_j)^2}$$

where xi , xj € X and m is the total number of data points available in the data set.

By following the steps of the prosed methodology we can show the same in Flow/Block like

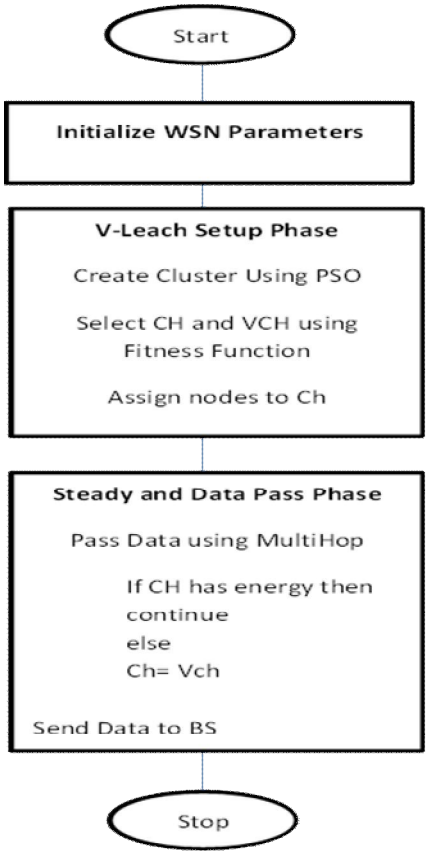


Figure 3 Flow of Proposed System

IV. SIMULATION

Still we have presented the mathematical model of our proposed system. We are going to implement the same model using Matlab simulation and we will prove the improvement in our next research paper. We will compare and analyze the results of Simulation with various input parameters to find the better solution of the problem.

V. RESULT

By Applying our method ProjPSO with V-Leach Protocol we have got significant improvement. We have applied following parameter settings for our execution.

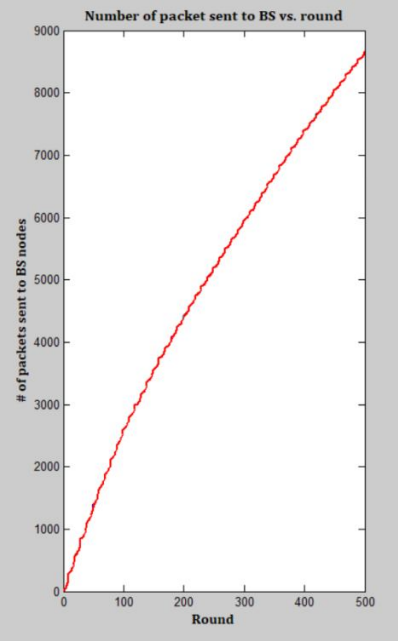
Table 1.0 Parameter Settings

Parameter	Value
Time	3600 (Seconds)
Total Nodes	100
Total Ch	10
Area	300m x 300m
Initial Energy	100mJ
Protocol	Modified V-Leach(ProjPSO)
Observation Parameter	Throughput Energy Delay Time
Max Rounds	500
Max Packets	12000

Simulation Result

Table 2.0 Simulation Result

Method	Packets	Sum of Energy Remaining	Dead Noes
V-Leach with PSO	9000	07	61
V-Leach Proj PSO	9000	12	54



Graph 1.0 Comparison of Packets Sent with round

VI. CONCLUSION

Wireless Sensor Networks (WSN), which may be spread over vast geographical area in the world ,are finding so many applications in various areas. So that In this context, there is need of approaches which can manage these WSNs in better way. During our research work in this paper, we presented need for better clustering to overcome several limitations of WSNs. Detailed discussion about current existing work is provided. Brief working of chosen clustering protocols, namely LEACH & V-LEACH, is presented. We also proposed batter clustering scheme for WSN V-Leach and Multi Hop routing. As a conclusion of observation from our mathematical model, we can say we can find better result compare to basic V-Leach by our modifications. In future we will implement the same in Matlab Simulator and prove our mathematical model in Simulation environment for getting significant improvement in overall performance of the WSN.

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