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An Enhanced Energy Efficient Low Energy Adaptive Clustering Hierarchy (LEACH) Protocol for WSNs

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Abstract— In this analysis work, an intelligent based energy-efficient routing protocol for Wireless sensing Networks (WSNs) is advised. The sensing element nodes are divided into four logical regions on the premise of their location within the sensing field. Base Station (BS) is installed out of the sensing space and a intelligent node at another sensing space. If the space of a sensing element node from base station or intelligent node is less than predefined distance threshold, the node uses direct communication. The remaining nodes are divided into 2 equal regions whose distance is more than the threshold distance. Cluster heads (CHs) are selected in every region that is independent of each other region. These CHs are selected on the premise of probability. The performance of our protocol is compared with LEACH (Low Energy Adaptive Clustering Hierarchy)[1]. Performance is analyzed and compared results show that our projected protocol perform well in terms of energy consumption, network period and leads to less global cost.

Keywords: Wireless Sensor Networks; Clustering; Intelligent node; Cluster heads; Base station;

I. INTRODUCTION

A key concern in WSN technology is to boost the network lifespan and to scale back the energy consumption of the sensor network. Wireless device nodes are spread usually in sensing space to watch earthquake, battle field, industrial environment, habitant observation, agriculture field, physical atmosphere conditions and sensible homes. Sensor nodes sense the surroundings, gather data and transmit to Bachelor of Science through wireless link[2] [3].

Due to escalating in Micro-Electro-Mechanical System technology, currently it's doable to line up thousands or millions of device nodes. The extreme preparation of WSN makes it quite troublesome to recharge sensor node. Therefore, a key subject for WSNs is to curtail power expenditure of device nodes to prolong network period of time. several bunch based mostly algorithms[4] [5] area unit planned. Cluster could be a technique in which network energy is well managed by minimizing the transmission of the sensors. In this modus operandi, CH manages the cluster communication with the BS. Device nodes not transmit knowledge on to the BS instead CHs receive the entire cluster messages, aggregates and forwards to the base station.

All nodes in cluster transmit their information to corresponding CH. The CH problems a Time Division Multiple Access (TDMA)[6] schedule for its member nodes to avoid collision. TDMA programming helps in saving energy of nodes and these nodes are kept alive for extended amount of time. As a rule, every member node transmits its information to near CH therefore; device nodes need minimum energy for information transmission. CHs perform computation on collected information and filter out the redundant bits, it reduces the number of information that has to forward to the BS. During this analysis work, we design an intelligent based energy-aware multi-hop routing protocol.

The impulse behind this work is to trim back the energy consumed by the sensor nodes when we divide the network logically into four regions. We use different communication hierarchies in different regions of the network. Nodes in one region communicate on to BS whereas nodes in region two communicate on to intelligent node. Nodes in different 2 regions use cluster hierarchy and sensor nodes transmit their data to intelligent node through their CHs. Intelligent node assists in processing clusters and issues a TDMA schedule for CHs. Every CH issues its own TDMA schedule for its member nodes.

II. LITERATURE REVIEW

This chapter presents the tutorial literature pertinent to the analysis, and places it in context of the analysis. The aim of this chapter is to produce the background knowledge of the analysis topic and to denote the gaps inside the analysis literature, so on establish the areas this analysis will specialize is to see a solid foundation of this literature, and to analyze previous research:

B. Manzoor et al. had projected associate increased version of LEACH named as Q-LEACH [7]. In this paper author implement Quadrature-LEACH (Q-LEACH) for homogeneous networks that enhance stability amount, network life-time and turnout quiet significantly. during this paper author enhances the prevailing protocol specified a lot of strong and optimized results may be achieved. Q-LEACH, significantly improved network parameters and appears to be an attractive selection for WSNs which extends and enhances the overall network quality parameters.

Q. Nadeem et al.[8] presents Gateway-Based Energy-Aware Multi-Hop Routing Protocol for WSNs. during this paper, author divides the network into logical regions. Every region use totally different communication hierarchy. 2 regions use

direct communication topology and 2 regions square measure more sub-divided into clusters and use multi-hop communication hierarchy. Every node in an exceedingly region elects itself as a CH independent of alternative region. This system encourages higher distribution of CHs within the network and the simulation results show that the proposed protocol performs well as compared to LEACH in terms of Network lifespan, Residual energy and turnout.

Fan Xiangning et al. presents Improvement on LEACH Protocol[9] .Changed LEACH protocols: energy-LEACH protocol and Multihop-LEACH protocol are measured during this paper. Energy-LEACH protocol considers residual energy within the part of cluster head choice. Multihop-LEACH protocol adopts multi-hop communication between the cluster and the sink. Simulation results show that energy-LEACH and Multihop LEACH protocols have higher performance than LEACH protocol.

Fuzhe Zhao et al. had projected Improved LEACH Routing Communication for WSNs[10]. During this paper, an outline of the initial LEACH and LEACH-C protocols are provided and a new protocol is proposed in this work. The projected protocol obtains energy efficiency by the modification to picking of cluster heads formula and also the steady-state part Through the modification and simulation, author complete that our projected protocol performs higher than LEACH and LEACH-C protocols.

Sumedha Sirsikar et al. had compared varied bunch Algorithms to style New bunch Approach[11]. This paper includes survey of assorted bunch algorithms. So, the comparative study is helpful to seek out out parameters required in cluster head choice, overhead in CH choice and shows whether or not the algorithms is energy economical or not.

III. PERFORMANCE EVALUATION

The performance of a proposed protocol is accessed and compared with existing protocol in WSN, known as LEACH.

A. Simulation setting

In order to enhance the performance of our proposed protocol, we have simulated our protocol using MATLAB. We have considered a wireless sensor network with 100 nodes distributed randomly in 100m X 100m field. An intelligent node is deployed in another region of the sensing field. The BS is located away from the sensing field. Both intelligent node and BS are made stationary after deployment. We have considered a packet size of 4000 bits. We have compared our protocol with LEACH protocol.

B. Performance Parameters

In this subsection, we present performance metrics. In this work, we evaluated four performance parameters given below:

1) Network lifetime: The time interval from the start of the network operations till the last node die defines the network lifetime.

2) Throughput: To evaluate the performance of throughput, the numbers of packets received by Base Station are compared with the number of packets sent by nodes in each round.

3) Residual Energy: The residual energy of network is calculated in order to get detailed knowledge of the energy consumption of nodes in each given round. Residual energy ensures the graceful degradation of the network life.

4) Dead Nodes: It is the alive nodes subtracted from total number of nodes that results in dead nodes.

C. Simulation Results and Analysis

In this section, we have shown simulation results by running extensive simulators and comparing our results with LEACH protocol. Following gives detail of each metric used :

1. *Network Lifetime:* In fig 1, we have shown the results of the network lifetime. Nodes are considered dead when they consume 0.5 joule of energy. Enhanced protocol obtains the longest network lifetime because the energy consumption is well distributed among nodes. Sensor network is divided into four logical regions , where two of them are further sub divided into clusters head regions. Enhanced topology balances energy consumption among sensor nodes. On the other hand, in LEACH protocol, nodes die quickly as the stability period of network ends at an early stage. It is not evident that predestined CHs in LEACH protocol are distributed uniformly in the network field. So, there is a possibility that the selected CHs will get concentrated in one region of the network. In Fig 1 we note that, the results of Enhanced protocol are statically different and perform well.

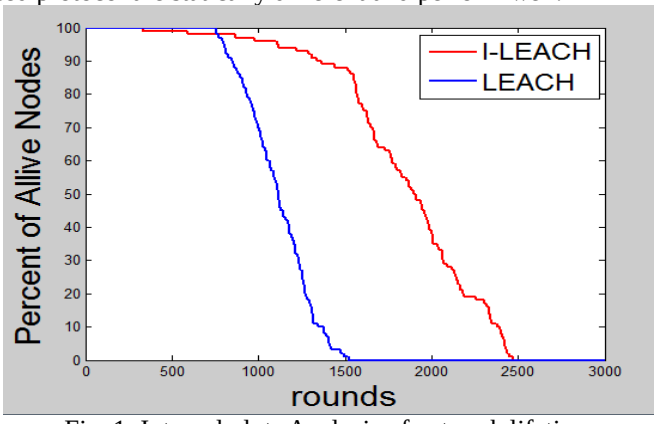

Fig. 1: Interval plot- Analysis of network lifetime

2. *Throughput:* Average packets sent to the BS are detected through extensive simulations used in this work. Simulation results of Enhanced protocol illustrates an increased throughput. Interval plots of Enhanced and LEACH in fig 2 clearly depicts performance of both protocols. To calculate throughput, we have assumed that CHs can communicate directly with the intelligent node. Simulation results show an increased throughput of 5 times then LEACH. Sensor nodes near intelligent node send their data directly to intelligent node; similarly nodes near the BS send data directly to the BS. Sensor nodes in both the regions consume less transmission energy therefore, nodes stay alive for longer period of time. More alive nodes contribute to transmit more packets to the BS.

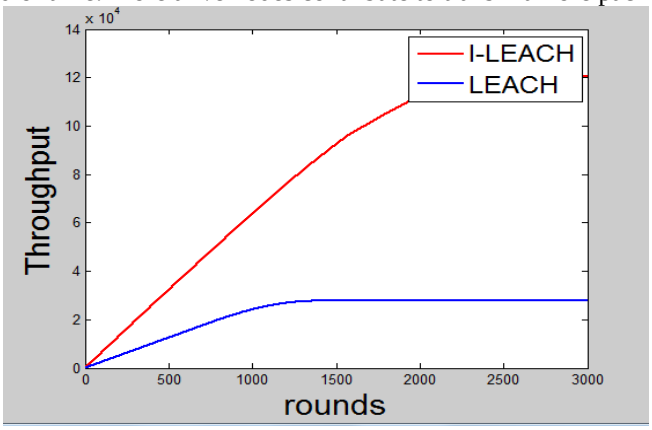

Fig. 2: Interval plot- Analysis of Throughput

3. *Residual Energy:* Fig 3 shows average residual energy of a network in each round. We assume that each node taken in this work has 0.5 joule of energy. The total energy of 100 node network is given as 50 joule. Enhanced protocol yields minimum energy consumption as compared to LEACH. Fig 3 clearly depicts that our protocol performs better than LEACH routing protocol in terms of energy consumption per round. Deployment of intelligent node and high probability of CHs in logical regions leads to minimum energy consumption.

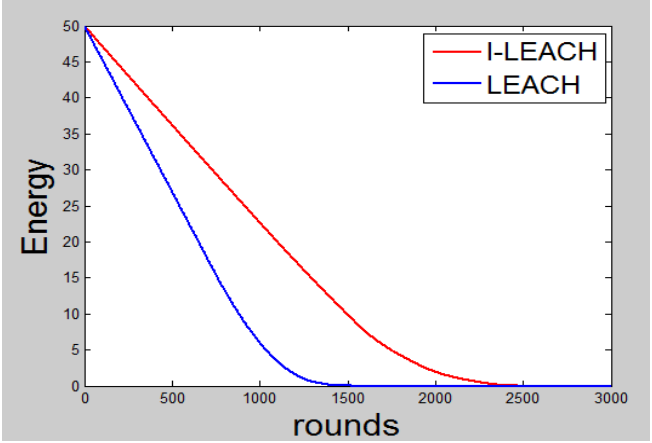

Fig. 3: Interval plot- Analysis of remaining energy

4. *Dead Nodes:* Fig 4 shows decline in number of dead nodes in a wireless sensor network. Enhanced protocol results in higher percentage of alive nodes as compared to LEACH which in turn increases the energy of the nodes and the nodes will not die early as the nodes in Enhanced protocol consumes less energy as compared to LEACH . So, Enhanced protocol performs better than LEACH.

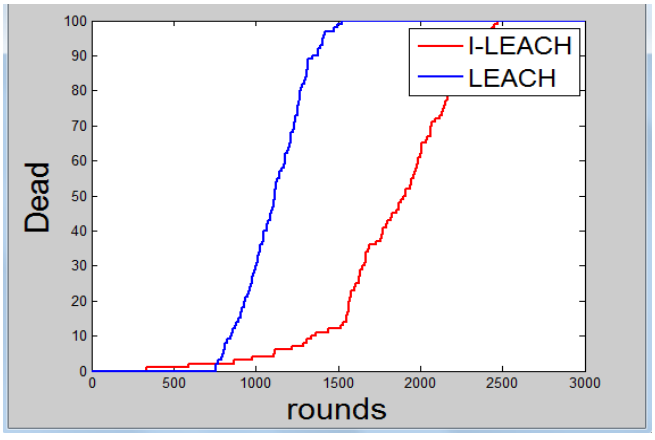

Fig. 4: Interval plot- Analysis of dead nodes

IV. CONCLUSION

An energy-efficient low adaptive clustering hierarchy routing protocol is described using intelligent node in order to reduce the energy consumed by the sensor nodes of the network. In this work, the network has been divided into four logical regions. Each logical region uses different communication hierarchy in order to transmit data to the sink. Two regions are using direct communication topology and remaining two regions are further divided into clusters that use cluster head hierarchy and transmit data to the intelligent node which further transmits the entire filtered data to the base station. Each node in a region elects itself as a CH independent of the other region. This technique encourages better distribution of CHs in the network. As the survival rate of nodes is higher more efficient is the network which in turn reduces the global cost of the network. Simulation results show that our proposed protocol performs well as compared to LEACH. In this work, we study the four performance metrics: Network lifetime, Residual energy, Throughput and Dead nodes.

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