Novel Energy Aware Hierarchical Round Robin Schedule Cluster-Based (NEAHRC) Routing Protocol

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Abstract- Wireless sensor networks (WSNs) are developing as vital and prevalent ways of providing persistent computing environments for various applications. Unstable energy consumption is an essential problem in WSNs, categorised by multi-hop routing and a many-to-one traffic pattern. In an energy-aware routing approach, the protocols focus on minimizing the total energy consumption and maximizing the network lifetime. In this paper, we propose a novel energy aware hierarchical round robin schedule cluster-based (NEAHRC) routing protocol to improve the energy consumption of wireless sensor network and prolong its system lifetime. We also evaluate the proposed algorithm via simulations.

Keywords—*2-Tier, Leach, Round Robin, Threshold, BS, WSN*

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I. INTRODUCTION

In the field of wireless communications and miniature electronics have allowed the development of low-power, low-cost, multifunctional and tiny sensor nodes. These nodes are composed of equipment's that are responsible for sensing, data-processing and communicating. A collection of such sensor nodes, when scattered in one area, gathers data from their proximate environments and coordinate it to execute a certain task. Thus, this collection of sensor nodes can be referred to as a wireless sensor network (WSN) [1] [2].

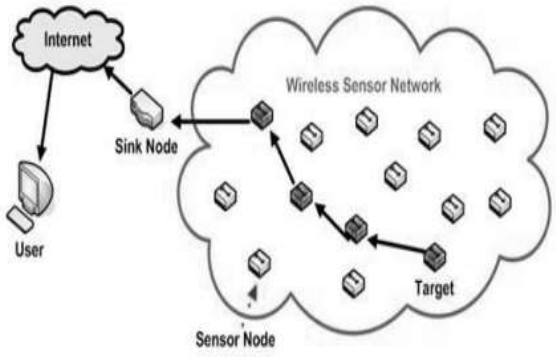

Fig. 1 Architecture of WSN

The basic goals of a WSN are:

- To determine the values of physical variables at a given location like temperature of storage room.
- To detect the occurrence of events like how many time temperature drops below 30 degree.
- To estimate parameters of the detected event or events what's the current temperature
- To classify a detected object
- To track an object.

Sensor nodes are used in a wide variety of applications which requires constant surveillance of particular events. Smart sensor nodes can be built into daily use appliances such as ovens, microwaves, refrigerators which enable them to interact with each and be remote controlled. This type of WSN application proved us a smart environment in which adapt according to the user preferences. Military applications include 24 hours surveillance, guidance system for missiles and provide security assistance from mass destruction. A patient can be monitored remotely by a doctor using WSN. This is more convenient for the patient; it allows the doctor to have better understanding about the patient's current condition. Sensor networks can also be used for detecting foreign chemical agents in the air and the water. They help in identifying the type of object, concentration and location of pollutants. The wireless sensor networks will provide the end user with intelligence and a better understanding of the environment [1].

It is tough to plan WSN that can accomplish price economy and compact size of design. Node energy is the chief concern in scheming pattern because energy is devastated in conduction and by only replacing the battery is nowhere a solution to pact with this problem. With the superior algorithm like clustering, we can conquer better lifespan. Cluster based hierarchical routing protocol is energy efficient. In the system of clustering, sensor nodes are alienated in the nodes into clusters sets with a Head among each set and assemble the data from other nodes in cluster. Cluster heads execute data aggregation and trim down the redundant data and propel it to the BS [6] [10] [12].

The function of clustering protocols is alienated into numeral of rounds and apiece round is accomplished in two phases specifically setup phase and steady-state phase. In Setup Phase, cluster heads election and clusters formation is done using either dispersed or federal clustering algorithm. In Steady State Phase, every node sends its records to its cluster head

within owed TDMA programmed time slot. After getting the figures from their all the cluster members; cluster heads do the data compression, data compression depends upon the degree of correlation among sensed facts. Number of bounds is occupied in the course of clustering. Clustering Algorithms or Protocols are intended by allowing for some of them. The parameters that characterize clustering are given below:

Number of clusters being a graved factor can unswervingly affect the efficiency of the whole routing protocol. Number of clusters can be predetermined or adaptive. For adaptive clusters, proficient methodology or algorithm can be deliberated. Within a cluster, communication between sensor nodes and its cluster head can be solitary hop or multi hop.

If the nodes are immobile in the sensor field, stable clusters can be planned. While if nodes are energetic or portable, cluster heads should sustain an appropriate membership with the energetic nodes and should be coordinated with their mobility.

Cluster configuration methodology is a vital where time proficiency or latency is a chief devise measure. Clusters can be shaped either in disseminated manner or using federal approach. In distributed manner, sensor nodes outline clusters using local verdict while in centralized approach, base station elects appropriate cluster heads to form clusters.

Cluster head selection can be probabilistic or deterministic. In probabilistic loom, cluster heads are chosen randomly as in LEACH protocol. Whereas, in deterministic approaches like HEED, etc. cluster heads are elected in view of metrics like residual energy, sensor node density, node centrality, node concentration, local and global distance etc.

Routing techniques in WSNs have to deal with different challenges and design issues. Despite advancement in field of information technology, limited battery power, bandwidth limitation, inadequate processing power and limited memory are some restrictions faced by networks having wireless sensors. Due to these reasons, routing protocols should be highly adaptive and more aware about resources. This paper aims to provide effective protocol to minimize the energy consumption in the network and increase the network stability. It proposes a novel algorithm using round robin schedule-based cluster head formation using energy aware hierarchical routing protocol.

II. RELATED WORK

Wireless Sensor networks have arisen as an effective solution for a wide range of applications. Wireless sensor network consists of large number of nodes positioned randomly or deterministically in the area of interest to sense the event. Various clustering algorithm have been proposed in the literature to increase the lifetime of the WSN. Some of them have been examined and presented here:

Beibei Wang et al. [2] proposes an progressed LEACH protocol to clear up the above problem. In progressed LEACH protocol, after clusters are mounted, each cluster head makes a decision whether or not to choose a new cluster head, based on their energy consumption. The new cluster head may be the node having extra residual electricity. Thus, the ones clusters with much less load can avoid the energy intake ended in selecting cluster head regularly. At the equal time, it can also save you the overloading of the cluster head node to fail. Simulation consequences display that the progressed LEACH protocol efficaciously prolong the community lifetime and successfully enhance node's energy efficiency.

Yong-Zhen Li et al. [3] proposes a cluster-head reappointment routing algorithm (i.e., LEACH-R), it solves the disadvantage that cluster-head regularly constructed cluster and consumes plenty of energy. The test results show that the LEACH-R, in phrases of system lifetime/first-rate of the community lifetime and power intake in massive-scale networks, is higher than LEACH-M and LEACH-C [3].

A. Ahmad et al. [4] delivered a brand new energy efficient cluster based routing technique. In this approach they attempted to conquer the trouble of insurance hole and energy hollow. This approach managed those problems via introducing density controlled uniform distribution of nodes and fixing most excellent range of Cluster Heads (CHs) in every round. Finally we proven our technique by experimental consequences of MATLAB simulations.

Degan Zhang et al. [5] proposed strength-balanced routing approach primarily based on ahead-conscious aspect (FAF-EBRM). In FAF-EBRM, the following-hop node is selected in keeping with the awareness of link weight and forward power density. Furthermore, a spontaneous reconstruction mechanism for local topology is designed moreover. In the experiments, FAFEBRM is as compared with LEACH and EEUC, experimental results show that FAF-EBRM outperforms LEACH and EEUC, which balances the power consumption, prolongs the feature lifetime and guarantees excessive QoS of WSN [5].

Madhumathy, P. et. al. [6] In this paper authors proposed an efficient routing protocol for single mobile sink and multiple mobile sinks for gathering of the data in WSNs. In this scheme, the next position of the sink is determined by using biased random walk method. After this the optimal data transmission path is found using rendezvous point selection with splitting tree technique. The proposed model effectively supports sink mobility with low overhead and delay when compared with Intelligent Agent-based Routing protocol (IAR) and also increases the reliability and delivery ratio when the number of sources increases.

Nabajyoti Mazumdar et. al [7] In the energy- constrained wireless sensor networks (WSNs), clustering is an efficient technique to minimize the energy consumption of the sensor nodes. But, the clustering algorithms for WSNs with a static sink frequently suffers from uneven energy consumption problems, where cluster heads (CHs) further away from sink consume more energy in a single hop communication, with the CHs sending its data directly to the sink. In order to solve such problem, the authors have proposed a Distributed.The experimental results demonstrate the efficiency of our proposed algorithm over the existing state-of-the-art algorithms in terms of different metrics like, network lifetime, energy consumption, etc.

Amjad and Abu-Baker [8] This paper investigates the energy efficient routing in cluster based totally WSN by using a linear components for trouble of minimizing strength intake in such network. This method considers electricity intake at one-of-a-kind sensor nodes within cluster and jointly optimize at extraordinary sensor nodes to transmit facts via direction with minimal strength. Extensive simulation is performed to evaluate proposed system.

RATHNA. R et. al., [9] proposed paper concerning the wi-fi sensor community for the ecological observations. A Wireless Network involves numerous sensor nodes besides a base station. The amount and type of sensors further to the proposed policies for any kind of wi-fi sensor community is decided via its use. The sensor information of the community is probably light depth, hotness, pressure, moistness. Clustering plus transmitting of statistics are the two elements which are given extra attention in this paper.

Seifemichael B. Amsalu et. al. [10] In this paper, a routing procedure named Grid Clustering Hierarchy (GCH) that delivers a proficient energy management for WSNs has been projected. This procedure splits the network into a flexible amount of virtual grids grounded on the present average energy of the network to generate finest clusters in relationship to energy depletion. By means of a typical radio energy dissipation prototype model that is frequently used for replication of WSNs, GCH is replicated in addition, its outcome is paralleled with an eminent routing procedure for WSNs termed LEACH.

III. CONTRIBUTIONS AND PROPOSED WORK

A. Contributions

This paper contributes in the designing and developing a WSN routing protocol that can be implemented on available WSN infrastructures to improve the network and lessen the amount of energy consumed by the network. The existing work [11] aims at improving the lifetime of the wireless sensor network by using the clustering scheme. The scheme is a modification to the LEACH clustering protocol. Likewise, LEACH this is also divided into set up phase and steady phase. However, the authors have the sleep awake approach. In each round the cluster heads decide which of the cluster members have lesser energies, and upon finding them those nodes must be put to sleep mode. So they won't consume much of the energies and thus can work for duration of time. The formula for the threshold value that decides whether the node would be elected as cluster head or not, is also modified by considering the residual energy of the nodes into the account.

Nonetheless, the network does not make any changes in the clustering phase or set up phase. This phase involves a lot of messages that are required to be broadcasted to form the clusters. For instance, first the cluster heads send the advertisement messages to all the nodes asking them to join their cluster. Then, each non-cluster head sends join message to the cluster head and again a third time cluster heads sends the message to the members informing which nodes must be out to the sleep node. So every time, the round changes this process gets repeated leading to so many messages being broadcasted thus leading to higher energy consumption. This method can be replaced by the round robin schedule where the cluster heads for the subsequent rounds are decided in the initial phase itself.

than average residual energy of the cluster will be put to the sleep mode. This information will be conveyed by the cluster head to all the members along with their TDMA schedule to send the data.

8. During the data transmission phase, the same multi hop approach will be followed as described in the existing scheme.

B. Round Robin scheduling approach for the selection of Cluster Head

Round Robin (RR) scheduling approach is proposed for cluster head election in WSNs, as RR is a fair scheduling scheme. In order to achieve load balancing between the WSN nodes, role of CH should be rotated and each node should get equal chance to become cluster head from the set of nodes belonging to the same cluster.

At the tip of neighbour discovery part, every node adds its own id, inner virtual grid id, outer virtual grid id and wait time in its own spherical Robin queue so types it in keeping with wait time. every node examines its own spherical Robin queue to determine whether or not it ought to work as CH or member node for this spherical. If a node finds that a node id keep within the spherical Robin queue returns its own id for a given position, then the node elects itself as CH, else it works as a member.

C. Proposed Technique

The methodology provides an understanding of implementation of novel algorithm on the basis of hard and soft thresholding. The methodology includes the following steps:

1. The base station will initially divide the network into required number of areas. The number of areas will be equivalent to the number of cluster heads or number of clusters required in the network. This step will make sure that every cluster is dimensionally of equal size thus each cluster head will be sharing the approximately same load.

2. The base station will inform every node in the network regarding their respective areas in which the nodes will start the clustering process. This will allow each node to compute its distance from the base station.

3. From each cluster, one node will be elected as cluster head according to the residual energy in the initial starting round.

4. The cluster head node will send advertisement message to all the nodes in the respective cluster asking them to join the cluster. Since the cluster heads will be sending the message in their respective cluster, so none of the node will receive the message form more than one cluster head.

5. When the nodes receive the message, they will reply back to the cluster head with the join request. In the join request packet, the nodes will forward their residual energy and distance to the base station.

6. The cluster head node upon receiving the request will create a table in which the cluster members will be arrange in order of highest residual energies and lowest distance from the base station. This table will be the round robin schedule for the nodes. The node at the top of the list will be the cluster head for the second round and so on.

a. This step will ensure that when the new round begins the nodes do not have advertise themselves to form the clusters, instead each node will know of the next cluster head.

7. The next step is to check on which of the nodes will be put to the sleep mode. The nodes whose residual energy is less

IV. SIMULATION RESULTS

This section presents the simulation results of the proposed technique implemented in MATLAB.

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Table 1. Simulation Parameters

Parameter	Value
WSN area/m^2	100x100
Number of Nodes	100
Base Station Location	(50m,50m)
Initial energy/J	0.1
E_{elec}/(nJ.bit^{-1})	50 x 10^ -9
E_{fs}/(pJ.(bit.m^2)$^{-1}$)	10 x 10^ -12
E_{mp}/(pJ.(bit.m^4)$^{-1}$)	0.0013 x 10^ -12
r_0/m	5
Sleeping % of CMs/(%)	10
E_{agg}(nJ.(bit.message)$^{-1}$)	5 x 10^ -12
Desired % of CHs/(%)	5
Data packet size/B	512

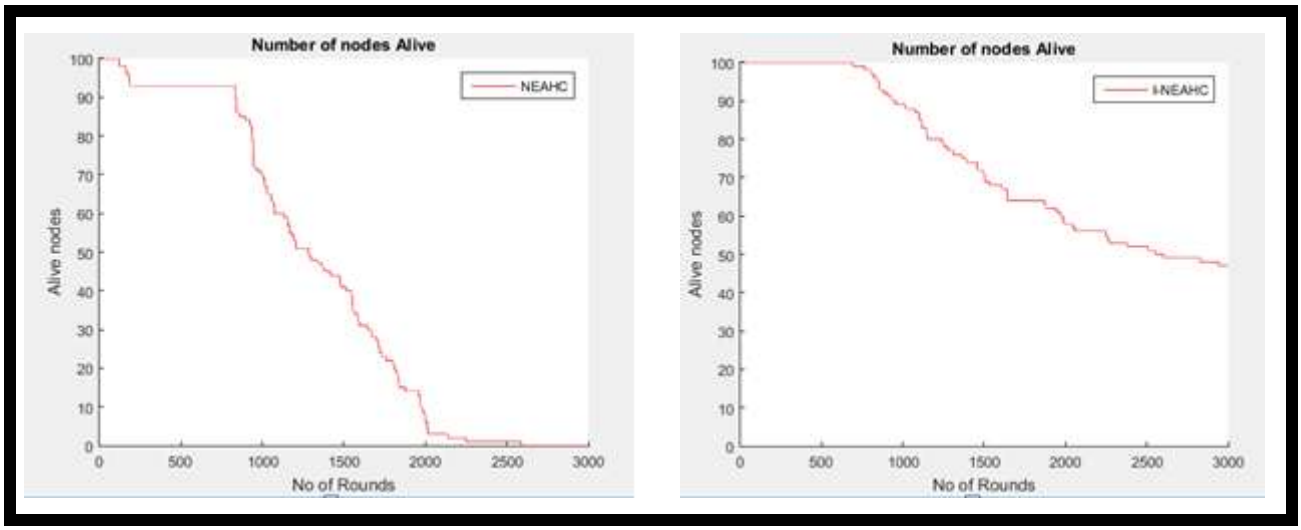

Fig. 2 Alive Nodes

The figure above clearly shows the proposed scheme is resulting into more no of alive nodes as it shows more no. of rounds as compared to existing base paper approach.

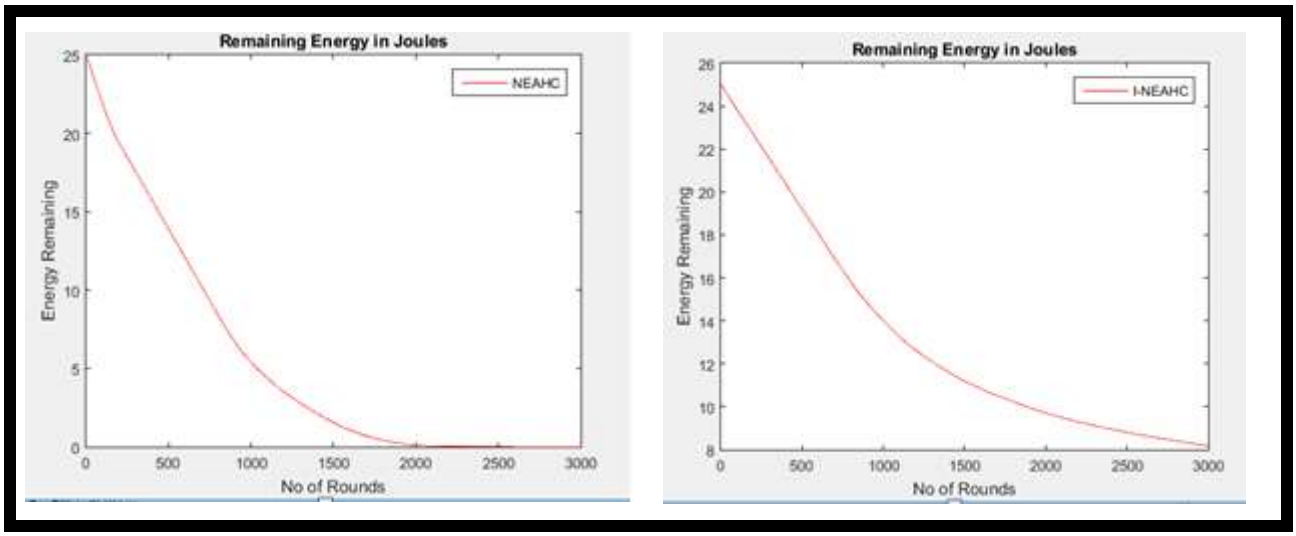

Fig. 3 Remaining Energy

Table 2 Comparing Alive Nodes of Existing and Proposed Technique

Parameter	Existing Technique	Proposed Technique
No. of Rounds	2500	3000
Alive Nodes	90	100

Table 3 Comparing Remaining Energy of Existing and Proposed Technique

Parameter	Existing Technique	Proposed Technique
No. of Rounds	2000	3000
Remaining Energy	25	26

The graph clearly shows the proposed scheme is resulting into more residual energy as it shows more no. of rounds as compared to existing approach.

V. CONCLUSION

The key objective of this paper is to build a set of rules that can provide a better and reliable wireless sensor network services using stable network having nodes with prolonged lifetime. Here reliable means a platform that is durable and having better throughput. In this paper, the round robin schedule has been used for the cluster heads selection for subsequent rounds in the initial phase. The simulated results of the protocol shows that the proposed technique performs better in case of no of rounds and residual energy.

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