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Performance Analysis of NEAHC and NEAHRC Routing Protocol in WSN

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ABSTRACT*:* Wireless sensor systems (WSNs) empower new applications and require non-traditional ideal models for convention outline because of a few requirements. Attributable to the prerequisite for low gadget many-sided quality together with low vitality utilization (i.e., long arrange lifetime), a legitimate harmony amongst correspondence and flag/information handling capacities must be found. This rouses a colossal exertion in look into exercises, institutionalization process, and modern speculations on this field since the most recent decade. 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. Results of the proposed technique are also evaluated based on various parameters. Experimental results demonstrate that the proposed technique outperforms the existing technique.

KEYWORDS*:* Wireless Sensor Network, Round-robin scheduling, Cluster head, TDMA.

I. INTRODUCTION

Wireless Sensor Network (WSN) consists of nodes that collectively called as network and utilized for sensing and controlling the environment communication among people or computers. Current advancement in the wireless electronics and networks has led to emergence of WSN. It is the one of most vital technology that may modify the future. Every sensor of a sensor node in a WSN environment contains three sub parts: first part consists of sensor that helps to sense the environment, second is the processing part that helps to perform local calculations on the data obtained after sensing, the third and the last part is the communication part that helps to interact with other sensors by transmitting messages between them [1].

Rapid development occurred in the field of WSN in various domains like health department, industries, environmental applications, military operations, and research and development area and so on [9]. The sensed data by WSN sensors can be accumulated by certain sink nodes that have access to infrastructure systems such as internet. Lastly, a user can fetch this sensed data remotely with the help of these networks.

II. BACKGROUND

Minaie et al. [1] explored the use of current cutting edge of remote sensor systems in medicinal services frameworks and will address how WSN ideas are incorporated in our PC building program. Advances in remote sensor organizing have opened up new open doors in human services frameworks. Sensor-based innovation has attacked restorative gadgets to supplant a huge number of wires associated with these gadgets found in healing facilities. This innovation has the capacity of giving unwavering quality notwithstanding improved portability.

Buratti et al. [2] presented a survey paper on wireless sensor networks technology and evaluation. This study paper points at revealing an outline of WSNs advances, fundamental applications and principles, highlights in WSNs outline, and developments. Specifically, some unconventional applications, for example, those in light of natural observing, are

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examined and plan procedures featured; a case think about in light of a genuine usage is likewise announced. Patterns and conceivable advancements are followed. Accentuation is given to the IEEE 802.15.4 innovation, which empowers numerous applications of WSNs. Some case of execution qualities of 802.15.4-based systems are appeared and talked about as an element of the extent of the WSN and the information write to be traded between hubs.

Ke et al. [3] proposed a novel vitality mindful various leveled bunch based (NEAHC) directing convention with two objectives: limiting the aggregate vitality utilization and guaranteeing decency of vitality utilization between hubs. This paper display the transfer hub picking issue as a nonlinear programming issue and utilize the property of arched capacity to discover the ideal arrangement. Unequal vitality utilization is a natural issue in WSNs, described by multi-bounce directing and a many-to-one movement design. This uneven vitality scattering can altogether decrease organize lifetime. In multi-jump sensor systems, data got by the checking hubs should be steered to the sinks, the vitality utilization rate per unit data transmission relies upon the decision of the following bounce hub. In a vitality mindful steering approach, most proposed calculations go for limiting the aggregate vitality utilization or expanding system lifetime.

Ragiba et al.[4] a novel vitality mindful various leveled round robin plan group based (NEAHRC) directing convention to enhance the vitality utilization of remote sensor arrange and drag out its framework lifetime. Remote sensor systems (WSNs) are creating as indispensable and pervasive methods for giving tireless registering situations to different applications. Flimsy vitality utilization is a basic issue in WSNs, sorted by multi-jump directing and a many-to-one movement design. In a vitality mindful steering approach, the conventions center on limiting the aggregate vitality utilization and amplifying the system lifetime.

Ragiba et al.[5] different directing conventions and presumed that the round robin timetable can be utilized to enhance the bunching in steering conventions in WSN. Remote sensor frameworks are tried and to an incredible degree control obliged sensor center. In various utilizations of remote sensor composes, a sensor center point distinguishes the condition to get data and passes on them to the sink by methods for a singular skip or multi-bounce way. In remote sensor frameworks, because of compelled battery vitality of sensor center points, one of the key test is to achieve minimum imperativeness use with a particular true objective to extend mastermind lifetime. Low Energy Adaptive Clustering Hierarchy (LEACH) is a remarkable steering convention in WSN. It is a Grouping based tradition which helps in upgrading the lifetime of remote sensor organize.

Zaman et al.[6]proposed a cross layer design methodology was adopted to design an energy efficient routing protocol entitled “Position Responsive Routing Protocol” (PRRP). PRRP is designed to minimize energy consumed in each node by (1) reducing the amount of time in which a sensor node is in an idle listening state and (2) reducing the average communication distance over the network. The result of the projected PRRP was critically assessed in the context of network lifetime, throughput, and energy consumption of the network per individual basis and per data packet basis. The outcomes show a significant improvement in the WSN in terms of energy efficiency and the overall performance of WSN.

Baker et al.[7]investigated the energy efficient routing in cluster based WSN by employing a linear formulation for problem of minimizing energy consumption in such network. This formulation considers energy consumption at different sensor nodes within cluster and jointly optimize at different sensor nodes to transmit data through route with minimum energy. Extensive simulation is conducted to evaluate proposed formulation.

Warrier et al. [8] given a review on vitality productive steering. An examination between Modified LEACH and Mobile Sink enhanced vitality proficient PEGASIS-based steering convention is finished utilizing MATLAB. Paper additionally presents the vitality collecting idea. Since radio transmission and gathering expends vast measure of vitality, control is an imperative factor to be explored on. Vitality protection is consequently a key issue in remote sensor systems. Continuous research includes outlining directing conventions that requires less vitality amid correspondence in this manner broadening the systems lifetime. For a large portion of the applications, a substitution of vitality is excessively costly. Vitality collecting remote sensor systemsmakes utilization of hubs that can reap vitality from condition.

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III. ROUND ROBIN CLUSTER SCHEDULING

In this section, we present the methodology followed for the proposed technique and round robin schedule for cluster heads. Methodology provides understanding of algorithm for implementationbased on hard and soft thresholding.

A. Methodology

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 from 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 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

Round Robin (RR) scheduling is utilized as a part of the working framework to plan the undertaking utilizing a decent amount of CPU. This calculation is represented when quantum which is greatest CPU time assigned to the procedure. After time indicated when quantum slipped by, an undertaking is acquired and next assignment from the prepared line is designated CPU for the term, which is least of CPU time required by the errand to finish its execution and time quantum determined for the RR planning [10]. In the event that there are n forms in the prepared line and the time quantum is q, each procedure gets 1:n of the CPU time in lumps of at most q time units immediately. No procedure holds up more than (n − 1) x q time units.

In this research work, we use round robin scheduling for cluster heads to modify the cluster rotation phase. Cluster Head Election Phase is described as:

Toward the end of neighbor disclosure stage, every hub includes its own particular id, internal virtual matrix id, external virtual lattice id and hold up time in its own particular Round Robin line and after that sorts it as per hold up time. Every hub looks at its own particular Round Robin line to choose whether it should fill in as CH or part hub for the current round. On the off chance that a hub finds that a hub id put away in the Round Robin line restores its own id for a given position, and after that the hub chooses itself as CH, else it fills in as a part. Here, position is given by condition:

$$position = mod(r, length(RRQueue))$$

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wheremod is an arithmetic modulo operation, r is the current round number, RRQueueis used to represent the Round Robin queue managed by the node itself and length is a functionthat returns total elements in the Round Robin queue.

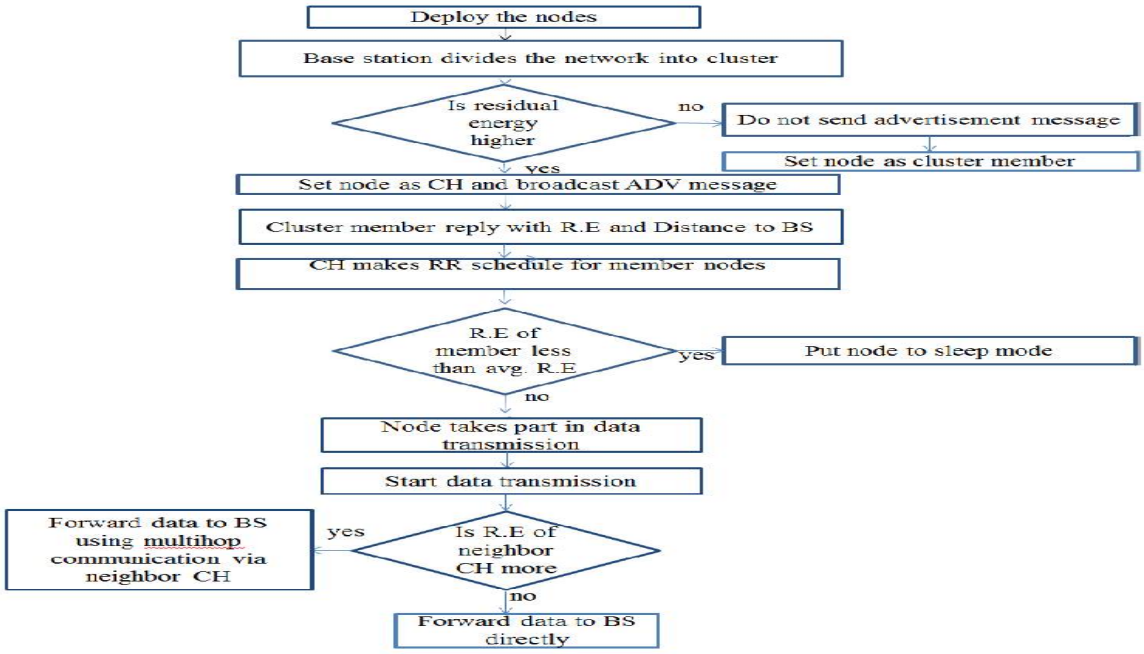

Fig 1. Flow chart of NEAHRC

It might be conceivable that at first RRQueue of all hubs are not same and consequently, at first for a couple of rounds, there are various CHs inside the same external matrix. Be that as it may, this issue can be overcome as takes after: Whenever a hub sends an information parcel, it additionally sends the fundamental data to shape the RRQueue. The beneficiary hubs, i.e., various CHs amid that round, watch that sender hub is a piece of their RRQueue or not. In the event that it is, at that point, nothing is to be done; else it includes sender into the RRQueue and sorts the line as talked about before. This extra data sent by the sender is overhead for the calculation for a couple of rounds as it were. After gathering of information bundles amid the enduring state stage, if CH hub does not discover any hub whose data is absent in the RRQueue, that CH hub sets a banner in its information parcels demonstrating that its RRQueue is synchronized for its external virtual network. These information bundles are sent by the hub when it goes about as a part. Likewise, signal conveys just a single piece data which is an insignificant overhead contrasted with vitality productivity accomplished by this convention. Likewise, there is no compelling reason to send TDMA plan. Every hub sends information as indicated by its situation in its own particular RRQueue. At the point when hub vitality level dips under the predefined edge, a hub sets a pullback banner in its information parcel. This illuminates different hubs to expel its investment in the CH decision process. This limit esteem is application subordinate.

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IV. PERFORMANCE ANALYSIS

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

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

4.1 Comparison in terms of Remaining Energy

This section presents the comparison of the existing technique and proposed technique based on energy remaining in joules.

$$Energy = (E_{elec} * size) + (E_{amp} * size * distnace^2)$$

where, E_{elec}, E_{amp}, size is defined in table 1. Distance^2 is calculated as :

$$d = \sqrt{\sum_{i=1}^{n}(X_i - Y_i)^2}$$ where, X and Y represent the sensors from 1 to n

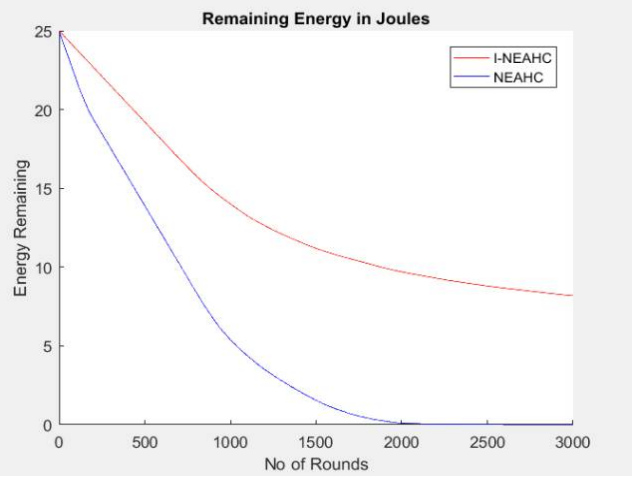

Fig 2: Showing Remaining Energy in Joules

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Above figure shows the comparison of the proposed technique with existing technique on the basis of remaining energy measured in joules. It is clear from the graph that the remaining energy of the proposed technique is much higher than that of the existing technique.

4.2 Comparison in terms of Alive Nodes

This section presents the comparison of the existing technique and proposed technique based on number of alive nodes. Alive nodes can be calculated as:

$$Alive\ nodes = total\ number\ of\ sensor\ nodes - number\ of\ dead\ nodes$$

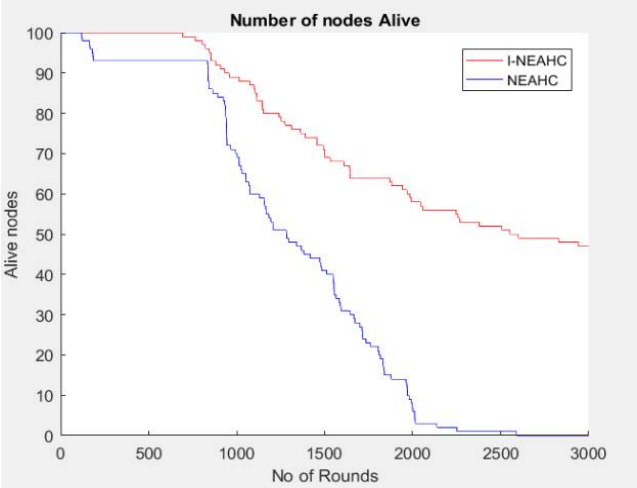

Fig 3: Showing Number of Alive Nodes

Above figure shows the comparison of the proposed technique with existing technique on the basis of number of alive nodes. It is clear from the graph that there are more number of alive nodes in case of proposed technique as compared to the existing technique.

4.3 Comparison in terms of Data Packet Delivery

This section presents the comparison of the existing technique and proposed technique based on the delivery of data packets.

$$Data\ packet\ Delivery = \frac{energy\ consumed}{data\ packet\ size * E_{elec}}$$

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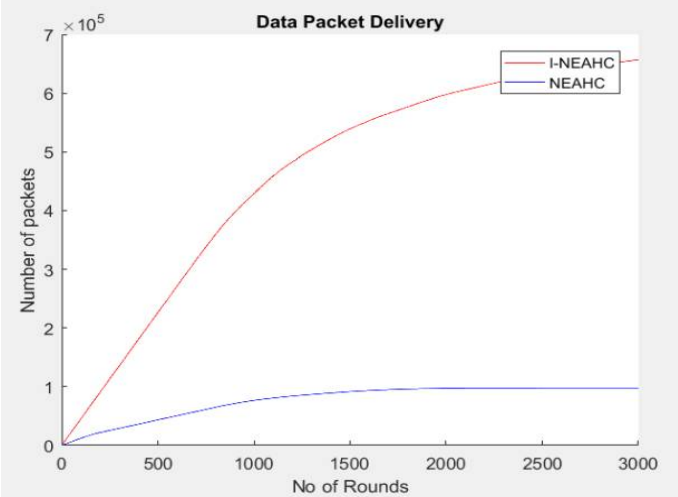

Figure 3: Showing Delivery of Data Packets

Above figure shows the comparison of the proposed technique with existing technique based on the delivery of data packets. It is clear from the graph that more number of data packets are delivered in case of the proposed technique as compared to the existing technique.

V. CONCLUSION

This research work aim to enhance the network lifetime. This work proposed round robin schedule based algorithm for cluster heads to modify the cluster rotation phase. By using round robin scheduling, cluster heads for the subsequent rounds are decided in the initial phase itself. MATLAB tool is used to implement the proposed work. Results of the proposed technique is compared with the existing technique on the basis of three parameters: remaining energy, number of alive nodes, and delivery of data packets. Experimental results demonstrate that the proposed technique gives more remaining energy, more number of alive nodes, and more number of data packets are delivered as compared to the existing technique.

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