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Performance Evaluation of CEER Protocol for Energy Efficient WSN

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Abstract: Wireless Sensor Network (WSN) is extremely viable for research local area as of late sought after and versatile applications. The hubs of WSN are restricted with their energy which requires the energy to be used in proficient way. The variable of energy consumption would be decreased by gathering the hubs to help steering and information assortment. Various calculations suggested towards the energy the board in various circumstances. This exploration work proposes a Clustering based Energy Efficient Routing (CEER) method to help successful information assortment in WSN. The strategy parts the whole organization district into number of areas and bunches where each group has single Cluster Head (CH). The hubs of WSN are assembled in progressive level which performs steering through the CH distinguished which is pivoted at each timestamp as per energy conditions. CEER approach has been recreated under various situations, and its exhibition is contrasted and existing grouping algorithms. The performance of CEER protocol shows improvement in number alive nodes with respect to iterations and increased packet delivery ratio.

Keywords: WSN, Energy Efficient, Routing, Clustering, packet delivery ratio, dead and alive nodes

I. Introduction

The use of distant sensor networks in both military and popular domestic applications has been steadily increasing over time. WSNs have a superior impact in current correspondence networks as things stand thanks to developing remote correspondence advancements. It has been quickly despatched in various circumstances and can be utilised to carry out various tasks. The sensor middle factors facilitate statistics transmission among various sensor middle factors, such as base stations, and are precise for experience indicators. By using a highly attractive stationary centre that is ahead of the packs and has a sensor next to it that can sense the route inside, statistics are gathered. Any sensor centre gathers nearby information and creating clusters as verified by the primary method. When it comes to guiding sensor centre points to extend their lifetime, batching offers a priceless method thanks to the evolving version of WSN in terms of application and affiliation. While percentages are constantly being produced, the retrying is finished on sporadic justification. The sensor middle factors interchange a variety of data, including information on cost and electricity. Utilizing those data allowed for the collection of mileage and route selection. Each period begins with the selection of the initiator, and supply messages linked to Multilevel Hierarchical Routing are surpassed for group connection. The complexity of using power is kept to a minimum through multi-sway broadcasting. This is a result of the fact that there is a far-reaching component for delivery when considering how electricity tiredness develops in particular neighbours. It describes issues within the community that it has better delayed while deviating from the traditional method of broadcasting. The main considerations for communicating at the route disclosure are what creates the impedance inside the formed groups. However, if rescheduling is problematic, the multi-bounce is typically more advanced than the fast delivery. Additionally, it can be difficult for CH to carry out successful transmission when dealing with social events that include several middle components.

Due to WSNs' initial, resounding success, there is an increased industry need for these networks to offer more difficult functions. Every aspect of WSNs needs to be improved, including the supplier of the sensors, the initial battery capacity, cost-effective sensing, information processing, and energy-efficient reporting to the base station. Routing algorithms are used to choose the most energy-efficient pathways between sensor nodes and the base station (BS) during transmission. Path-planning algorithms used in routing protocols play a key role in the efficient transmission of data to the BS central controller [1–9]. Some unique methodologies are examined in the examination of various clustering protocols in order to comprehend their performance during network operations in WSNs. In this part, certain relevant state-of-the-art protocols are covered. LEACH described a dynamic distributed strategy in [1] that uses a full probabilistic process to nominate CHs and then assigns them the duties of the association phase to finish the cluster's membership. This method avoids BS oversight; in this scenario, nodes are responsible for all computational and communication costs. CHs perform aggregated transmission to BS after collecting data from member nodes during single-hop transmissions. This distributed approach introduces variability in CHs selection, which significantly reduces performance.

LEACH-C introduced a centralised approach in which BS is primarily in charge of nominating CHs in an effort to reduce uncertain oscillations in CH creations. Nodes with more energy are referred to as advanced nodes and have a higher likelihood of selection than CHs in the two-level clustering for heterogeneous WSNs SEP [2]. The DEEC approach [3] illustrates effective clustering in a multi heterogeneous network environment where each node's probability index is determined by residual energy. However, nodes have fewer opportunities to communicate the collective knowledge across the entire network in fully distributed cluster formation. A hybrid model called HADCC has been put forth; its main contribution to the establishment of this protocol is the intelligent handling of region-wise homogeneity and heterogeneity. This approach also establishes an algorithm [4] that can be distributed and centralised at the same time, both of which are advantageous in various network regions. Due to single-hop route designs, the majority of existing routing protocols struggle with network scalability and load balancing problems, even though these simpler routing methods are useful for speedy path discovery with minimal resource usage and computational complexity, when having to perform link rediscovery in long complex network. These algorithms are also ineffective in increasing network capacity. Multi-hopping algorithms are suggested as a solution to these problems in order to meet the high performance requirements and continue establishing network pathways in all circumstances. The goal of multi hop routing systems is to create and renew effective multiple paths with a minimal amount of packet loss and minimal energy consumption. To accomplish the stated objectives, more complex algorithms are required for existing protocols [5–12].

II. Proposed Work

WSNs can help specialised records applications by using the cluster-based Energy Efficient Routing (CEER) approach. In this manner, the CH immediately communicates with the bottom station, and the BS (Base station) continuously sends "welcome" messages to all facilities. As a result, based on the signal quality that is provided, each middle component can manage its unclear department to the BS. It exhorts middle players to converse with the BS while also selecting the great strength stage. Three levels—Cluster head affirmation stage, Cluster basis stage, and Data correspondence stage—are present in the proposed CEER technique. Many streamed package deal heads are allocated with a little bit of control up throughout the selection of collecting head stages. The chosen bunch head creates a social gathering during the % plan stage. As shown in Fig. 1, CH gathers the information from the data collection personnel and delivers it to the bottom station during the facts transmission stage.

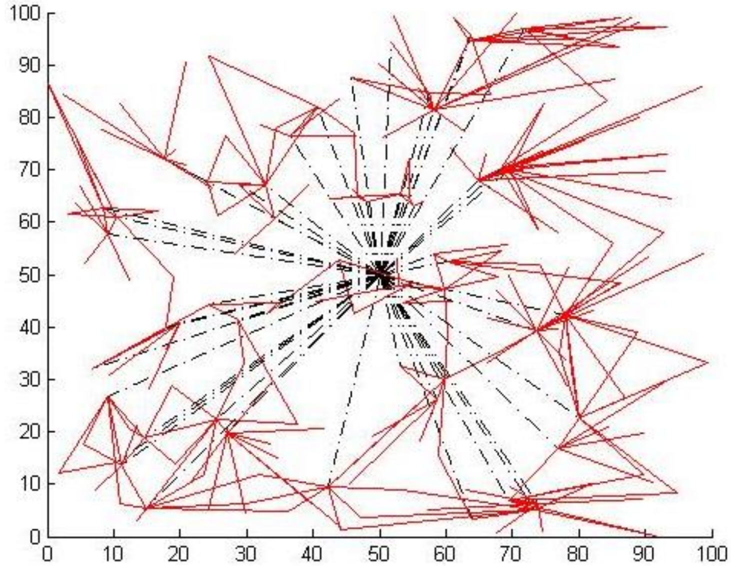

Figure 1: Clustered WSN

CH Selection

The collection head is chosen at the CH confirmation level, and a get-collectively is then formed. The distinguishing percent head power may gradually diminish over time and desire to demonstrate the collection head affirmation process. According to Fig. 1, the affiliation is divided into a group of Cluster Regions (CR) at the CH confirmation level. Each CR includes contributions from the facilities in determining the CH nominee (CHN), which is decided using a probability scale specific to each sensor. Each sensor has the option of becoming a CHN, as is demonstrated in this regard. The likelihood of selecting a CH middle is correlated with energy level. The following probability ensures that Estimation of Pi is finished just once after bob neighbour middle display for a middle factor I in region R. In the beginning, each middle factor selects an erratic all out within the range of [0 1]. The approach recognises the CH in the event that the overall isn't for the largest component to a volume like Pi. With the use of this tool, T% or more of all facilities are selected as CHNs.

Establishing CH

Each CH notifies certain sensors of its transparency as a CH by sending a "CH declaration" percent inside a location of transmission clean Ri once the CHs have been chosen. The sole purpose of choosing this CH-confirmation run is to ensure that each Cluster Member (CM). receives about one disclosure package and might collaborate with a CH. A trigger device sends location broad communicates to provide get-collectively of verbalization bunches via means of unique middle points. In order to avoid such situations, a sensor without a CH affiliation constantly gathers its by-pass range and seeks out the nearest CH source of assistance. By selecting a steady span clock as demonstrated by the development restrictions and remote channel quality, synchronisation between each level must be established so that each centre has a reasonable chance of finishing the process for the crucial time-body. Every percentage head in the longer time body carries a schedule inside its group.

When the hub's separation from the edge is greater than the edge value, the normal hub attempts to acquire energy and the lingering energy level is updated in each datum transmission.

$$E = E- (E_{TX} \text{ x } (Bt) + E_{mp} \text{ x } Bt \text{ x } (D_0 \text{ x } D_0 \text{ x } D_0 \text{ x } D_0)) \quad \ldots(1)$$

Where,

E_{mp} = transmit amplifier energy

E_{TX} = Energy required to transmit each bit

D_0 = minimum distance for transmission, that is range of communication in normal amplification of signal.

E = initial energy of a node

Bt = number of bits

Algorithm:

Setup Phase:

1. *Network Initialization*
2. *Choose primary CH randomly.*
3. *Use distance metric to perform clustering and CH assignement*

Re-CH selection Phase:

4. *Estimate Energy and distance.*
5. *Estimate the Candidate for CH*
6. *Set CH if old CH has Energy less than threshold*
7. *Else continue With Current CH*

The energy expended is determined and remaining energy level is refreshed for each datum transmission and gathering endeavor made by typical hub when separation of the hub is not exactly the edge esteem, can be given by,

$$E = E - (E_{TX} \times (Bt) + E_{fs} \times Bt \times (D_0 \times D_0)) \quad \ldots(2)$$

Where,

E_{fs} = friss loss energy of amplifier

D_0 is distance of coverage area and estimated with current CH taken for calculation. The maximum value of β is more on attraction to get selected. The distance from base station is calculated using Cartesian distance formula.

$$D_0 = \sqrt{(x_1 - x_2)^2 + (y_3 - y_4)^2} \quad \ldots(3)$$

The energy consumed by cluster-head while receiving the data is given by,

$$E_{ch} = E_{ch} - ((E_{RX} + E_{DA}) \times Bt) \quad \ldots(4)$$

Where,

E_{ch} = Initial energy of the cluster head

E_{RX} = Energy consumed for reception

E_{DA} = Energy consumed for data aggregation

Where, the parameter Bt is usually positive.

III. Results and Analysis

The simulation is performed for 50, 100, 150 and 200 nodes for evaluation of performance of proposed protocol. The protocol configuration is shown in table 1.

Table1: Configuration of Simulation Parameters

Parameter	**Value**
Number of nodes	50,100,150,200
Sensor deployment area (field)	100 x 100 m^2
Initial Energy of each node	200 J
Location of sink node	Center of the field
Reception energy	50 nJ
Transmission energy	50 nJ
Number of data bits	4000
Data aggregation energy	5 nJ
Protocols	Basic LEACH, CEER

Analysis of Dead Nodes:

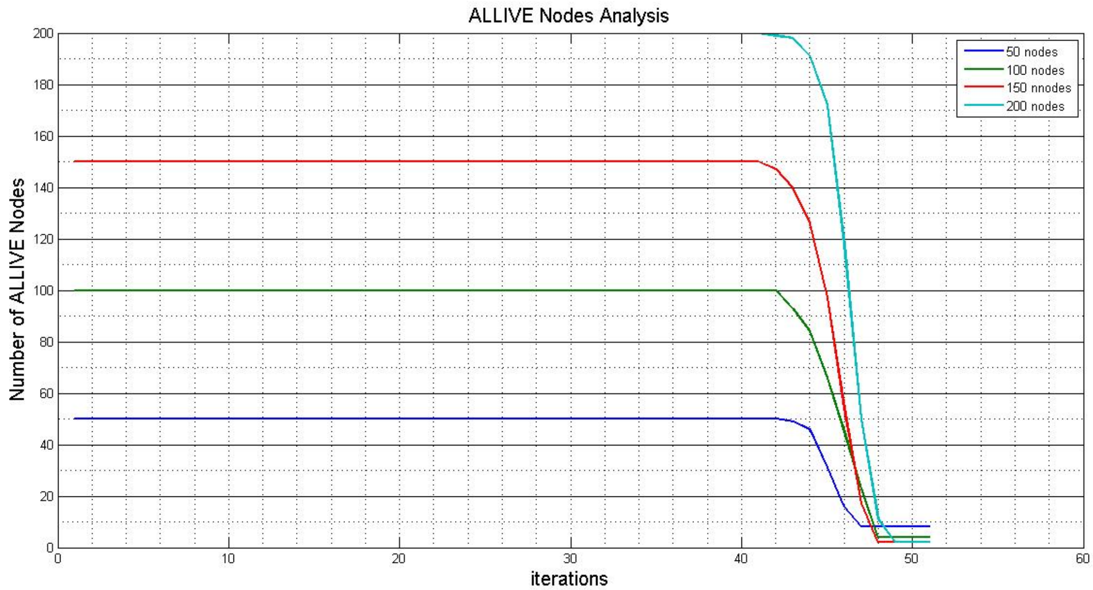

Figure 2: Analysis of ALIVE node for different number of nodes in network

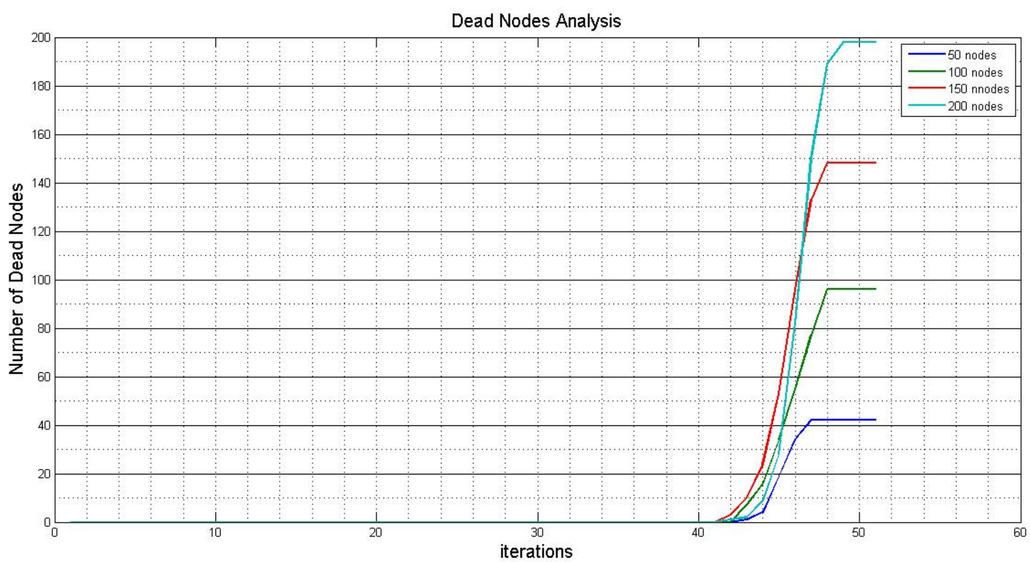

Figure 3: Analysis of DEAD node for different number of nodes in network

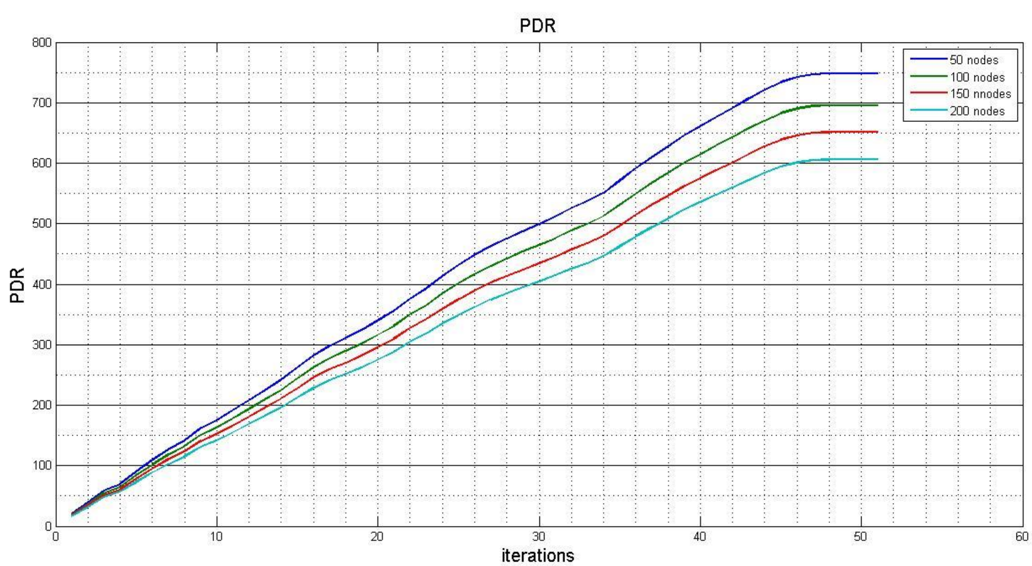

Figure 4: Packet Delivery Ratio Analysis

Comparative analysis:

A comparative analysis is done by comparing results of 200 nodes network using proposed protocol and LEACH protocol.

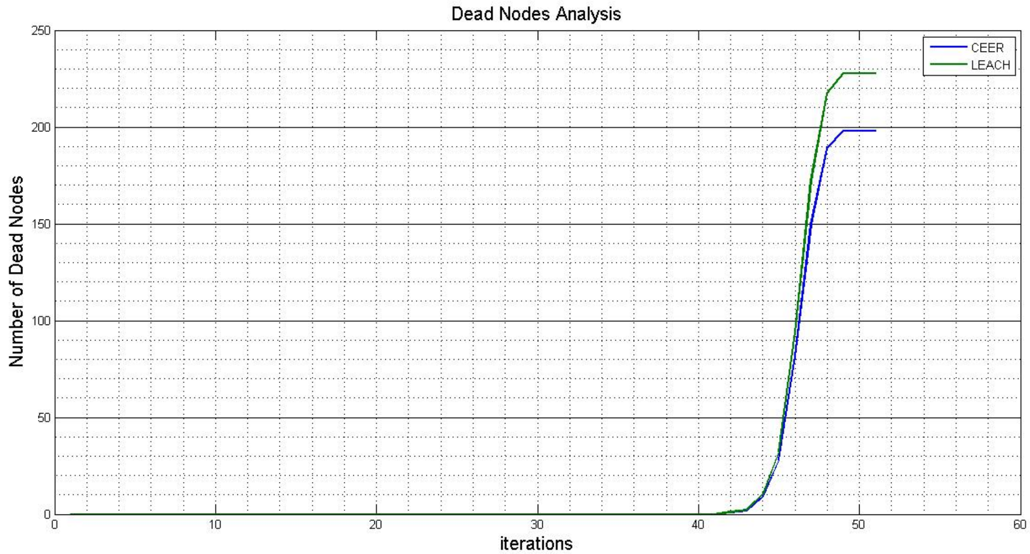

Figure 5: Comparative of Dead nodes with respect to iterations

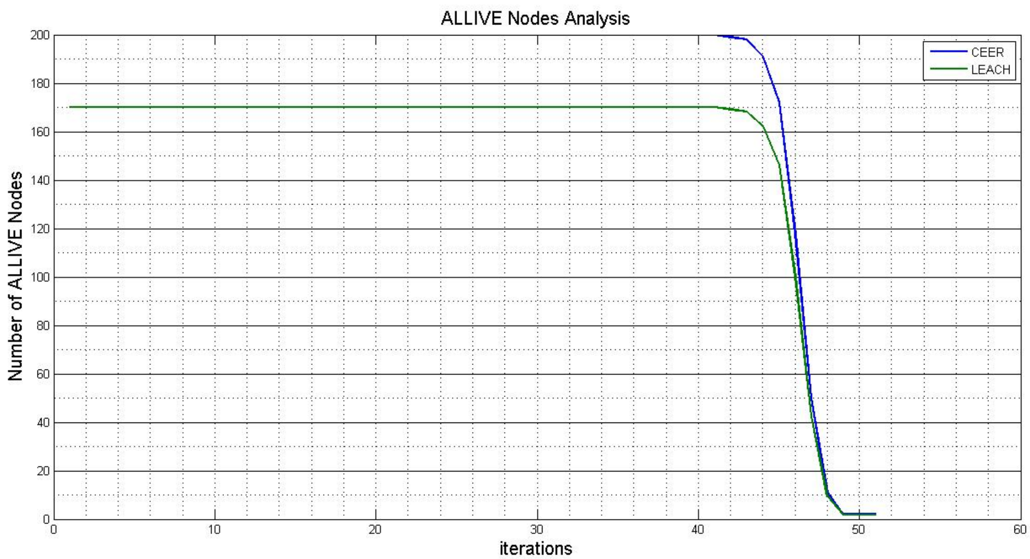

Figure 6: Comparative of ALIVE nodes with respect to iterations

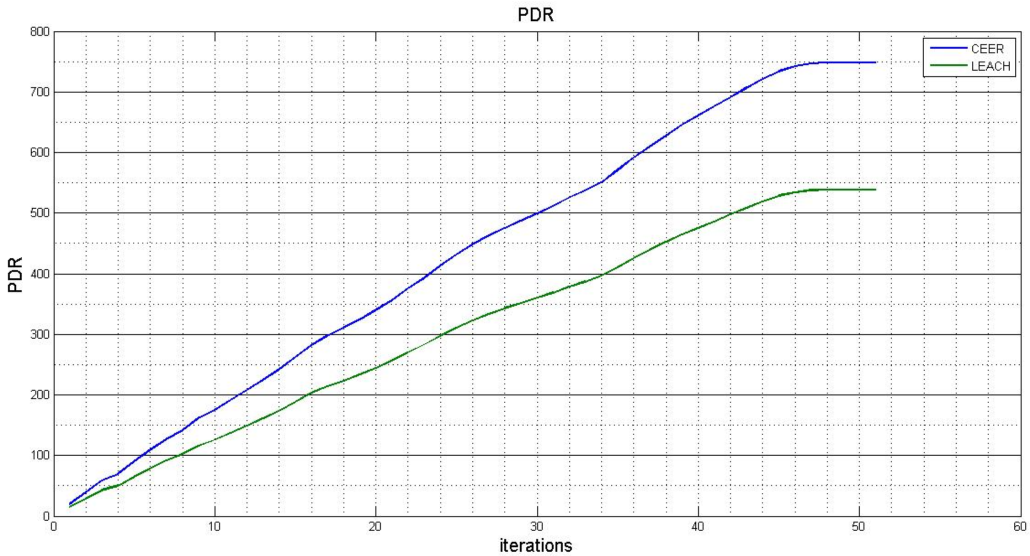

Figure 7: Comparative of packet delivery ratio

IV. Conclusion

This study makes a contribution to the cluster-based, energy-efficient WSN protocol. Comparing the protocol to the LEACH protocol, the performance is better. Compared to LEACH, the number of dead nodes every iteration is lower. Additionally, compared to LEACH, the retention of more ALIVE nodes for longer iterations is improved. Due to the proper candidate being chosen as the CH, this protocol performs better in terms of packet delivery ratio and demonstrates a nearly 60% reduction in dead nodes.

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