Energy Efficient Clustering Routing Protocol based on LEACH for WSN

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ABSTRACT
Wireless Sensor Networks are made up of restricted energy driven resources. When the installation setup of sensor nodes are over usually they are inaccessible to the user. Hence the replacement of battery source is not feasible. In order to boost the life span of the network, the key design issue is to be enhanced which is energy efficiency. With the restricted energy supply, a number of network layer protocol have been anticipated to increase the operative life span of the network. LEACH(Low Energy Adaptive Clustering Hierarchy) is a Hierarchical Clustering Protocol provides solution for such issues. EEACRA(Energy Efficient Adaptive Cluster Routing Algorithm) a variant of LEACH have been proposed to improve the deficiency of LEACH which is based on the energy decision condition.The proposed EECRL(Energy Efficient Clustering Routing for LEACH)shows several improvement for whole network energy consumption and effectively prolong the network life cycle.

Keywords: EEACRA, EECRL, LEACH, Cluster head

1. INTRODUCTION
The WSN(Wireless Sensor Network) embodies sensor nodes to gather information from the physical environment, process and transmit it to the destination base station. A sensor node can screen set of given natural conditions, such as sound, temperature, light or vibrations. Microcontroller, sensors, radio handset and battery are the segments of a sensor node. Multiple usefulness and simple arrangement are the advantages of sensor node[1].Modern sensor systems allow an extensive number of sensor nodes to be haphazardly sent in blocked off ,unattended zones as a result of their physical dimension. However energy and system lifetime are main consideration in sensor network. In request to exploit highlights of sensor node, certain imperatives connected with them needs to be taken into account. Since the sensor nodes have tiny ,irreplaceable batteries with restricted force ability, it is important to have a system with energy effective and most extreme system lifetime. To allay such issue numerous routing conventions have been proposed. Right now, WSN routing conventions can be principally separated into two classifications, i.e., level directing conventions and various levelled directing conventions. In a moderately ideal various levelled structure, the neighbouring nodes are bunched and after that a bunch head node, which is in charge of overseeing nodes in the group and corresponding with the base station, can be picked. Such a various levelled structure can lessen the correspondence cost, as well as use the group head node with higher energy to gather the information in the bunch's scope in order to spare energy and delay the life of the system.

2. LITERATURE SURVEY
LEACH is a various levelled grouping routing convention which gives most extreme system lifetime and energy efficiency. This convention is proposed by Massachusetts Institute of Technology(MIT) electronic building and Computer Science Institute. Based on multilevel structure this is the first convention applied[2,3,4].This utilizes the method of arbitrarily pivoting the part of a group head among all the nodes in the system. The operation of LEACH is composed in rounds where each round comprises of a setup stage and a transmission stage. Amid the setup stage, the nodes sort out themselves into bunches with one node serving as the bunch head in every group. The choice to turn into a bunch head is made provincially inside of every node, and a foreordained rate of the nodes serve as nearby group heads in each round, overall. Amid the transmission stage, the self chose group heads gather information from nodes inside of their individual bunches and apply information combination before sending them straightforwardly to the base station. Toward the end of a given round,a new arrangement of nodes gets to be group sets out toward the ensuing round. Moreover, the length of time of the transmission stage is situated much bigger than that of the setup stage keeping in mind the end goal to counterbalance the overhead because of bunch arrangement. In this way, LEACH gives a decent model where confined calculations and information collection can be performed inside haphazardly self-chose bunch heads, which help decrease data over-burden and give a dependable arrangement of information to the end user. But still LEACH has a few weaknesses:

1.Additional overhead acquired while transforming groups at every set-up stage.

2..Random choice and uneven dispersion of group heads as arbitrary determination of bunch heads bring about group heads being spread in a brought together range. In this way prompting long transmission separation and wastage of energy.

3.There is no procurement of selecting another group head if there should be an occurrence of sudden disappointment of bunch head.

To defeat the disadvantages, numerous enhanced calculations have been proposed. Whereas ,these calculations principally focus on the advancement issues of the bunch heads rate and appropriation objectivity, and moreover, infrequently consider the information transmission way enhancement. In light of the inside and out investigation of LEACH, we propose a novel enhanced calculation EEACRA.

2.1 Network model

In our exploration, we utilize the single order system model indistinguishable with the one of LEACH with suspicions as take after:

• All nodes are the same, static, and have enough figuring ability to backing diverse MAC conventions and information preparing.

• The radio sign has indistinguishable energy weakening in all headings, and the remote channel is symmetric.

• All nodes can speak with one another and the sink in single bounce mode.

• All nodes can be mindful they could call their own remaining energy and adjust transmission force as per correspondence separations.

• Sinks are static, and with enough power supply.

• Each node transmits information at given time opening. The information detected by adjoining nodes are correlative, so the bunch head can meld the aggregate .

2.2 Energy model

We utilize the first request radio model here. To transmit a k-bit information to a separation d, the radio equipment energy utilization is:

$E_{TX}(k,d)=E_{TX\text{-}elec}(k)+E_{TX\text{-}amp}(k,d)$

$$\begin{cases} Eelec * k + \varepsilon fs * k * d\text{^}2 & d < do \\ Eelec * k + \varepsilon mp * k * d\text{^}4 & d \geq do \end{cases} \quad (1)$$

where Eelec is the factor of electronics energy consumption, ε_{fs} and ε_{mp} are identical to the ones in (2), do is the reference distance between transmitter and receiver, which is given by square root of $\varepsilon_{fs}/\varepsilon_{mp}$.

To receive a k-bit data, the radio expends:

$$E_{RX}(k)=E_{elec}\times k \quad (2)$$

It is expected that the detected data is associated, consequently group head can simply total the information accumulated from its individuals into a solitary length-altered bundle. Bunch head totals k-bit information from n individuals to consume:

$$E(k,n)=n\times E_{DA}\times k \quad (3)$$

where E_{DA} is the factor of data aggregation .

3. THE EXISTING EEACRA OF LEACH

In the setup stage, every node chooses whether or not to turn into a bunch head for current round. The determination relies on upon choice made by the node by picking an arbitrary number somewhere around 0 and 1. On the off chance that the number is not exactly the limit T(n)[5] ,the node turns into a group head for the present round. The limit is situated as:

$$T(n) = \begin{cases} \frac{p}{1-p\left(r \bmod \left(\frac{1}{p}\right)\right)}, & if\ n \in G \\ 0, & otherwise \end{cases} \quad (4)$$

Where p is the likelihood of the node being chosen as a group head node, r is the quantity of rounds passed, and G is the situated of nodes that have not been bunch heads in the last 1/p rounds, mod signifies modulo administrator. Nodes that are group heads in round r should not be chosen in the following 1/p rounds. Accept that the starting node number N_0, and the ideal bunch head rate or likelihood is Kep/N_0. As indicated by comparison, K_{opt} is in extent to square base of the living node number N, and backwards extent to N . Consequently the enhanced bunch head likelihood is:

$$Pep = \frac{kep}{\sqrt{No}\sqrt{N}} \quad (5)$$

where N_0 is the introductory node number, N is the living node number. N is equivalent to N_0 if no node fails.Based on Pep, we present energy weighted variable and energy choice limit. So the enhanced group head race edge can be communicated as:

$$Tep(n) = \begin{cases} pep \times En\_cur \times \frac{\sigma}{Ech\_av\ (r-1)}, & \beta \geq 0.5 \\ 0, & \beta < 0.5 \end{cases}$$

$$Tep(n) = \begin{cases} kep \times En\_cur \times \frac{\sigma}{Ech\_av*(r-1)\sqrt{No}\sqrt{N}}, & \beta \geq 0.5 \\ 0, & \beta < 0.5 \end{cases}$$

Where $\beta = \frac{En\_cur}{Ech\_av(r-1)}$ (6)

where Pep is the bunch head decision likelihood of node n in current round, β is energy weighted element, En-mutt is the lingering energy of node n, Ech_av(r-1) is normal leftover energy of all nodes in last round; r is the present round number[6];σ is amendment variable.The routing calculation is in light of Selecting the ideal hand-off bunch heads by figuring introductory way cost,updating the way cost lastly keeping up the ideal way.

4. PROPOSED EECRL FUNCTIONING

The EEACRA uses the threshold which is same as the LEACH.In LEACH the selection is in random fashion,so the lower residual nodes could be elected as the cluster head in the next round.To avoid lower energy nodes to be selected as the cluster head the residual energy is used to find the cluster head for the next round.The threshod is changed as

$$\boldsymbol{T(n)} = \begin{cases} \frac{\boldsymbol{p}}{\boldsymbol{1-p\left(r\ mod\left(\frac{1}{p}\right)\right)}} * \boldsymbol{p}\left(\frac{\boldsymbol{Eavg}}{\boldsymbol{Ecur}}\right), & \boldsymbol{if\ n \in G} \\ \boldsymbol{0}, & \boldsymbol{otherwise} \end{cases} \quad (7)$$

Where $p\left(\frac{Eavg}{Ecur}\right) = \begin{cases} \frac{(Ecur-Eavg)}{Ecur}, & if\ Eavg < Ecur \\ 0, & otherwise \end{cases}$ (8)

Here E_{avg} is the average residulal node enrgy for a round.The selection of cluster head based on the energy decision threshold is modified using logarithm function on energy weighed factor as

$$Tep(n) = \begin{cases} log(\beta) + Pep * \sigma, & \beta \geq 0.5 \\ 0, & \beta < 0.5 \end{cases} \quad (9)$$

The routing calculation utilized as a part of EEACRA is in view of expense methodology which is tedious and postures extra upkeep of directing talble. But to dodge it in EECRL we utilize energy qualities got by the bunch head .The group head finds the greatest energy values by keeping up a list. So the

present group head sends Task Handover message to next bunch head with most extreme energy. Nodes send information at their particular times till the following change time.

5. SIMULATION RESULTS

In this area, we fundamentally utilize reproductions to dissect and assess the execution of the calculation. Here Matlab is

utilized as apparatus to recreate all the strategy. To confirm the enhanced calculation proposed, we will come close the outcomes with EEACRA. The fundamental recreation parameters for our model are specified in Table I. The analysis is done by utilizing the same energy source whose starting energy is 0.5J[7,8]. The combination coefficient is 0.5. Each node transmits a k bits information parcel every round to its bunch head. A hundred sensor nodes are orchestrated arbitrarily in the field of 100m×100m square meters. The sink node position is changed likewise[9,10].

Table 1. Transmission Parameters value

Description	Symbol	Value
Number of nodes	N_o	100
The initial node energy	$E_{initial}$	0.5J
Energy consumed by the amplifier to transmit at a short distance	E_{fs}	10pJ/bit/m^2
Energy consumed by the amplifier to transmit at a longer distance	E_{mp}	0.0013pJ/bit/m^4
Energy consumed in the electronics circuit to transmit or receive the signal	E_{elec}	50pJ/bit
Data packet	k	4000 bits
Control packet	L_{ctrl}	100 bits
Data aggregation energy	E_{DA}	5pJ/bit
The cluster probability of LEACH	p	0.05
The Sensing area	M×M	100m×100m

We have considered following parameters for EEACRA and EECRL variants:

- Rounds v/s No of data signals received at BS
- Rounds v/s Total energy dissipation
- Rounds v/s Number of nodes alive
- Number of nodes v/s Network Lifetime
- Network Lifetime v/s Base-Station Location

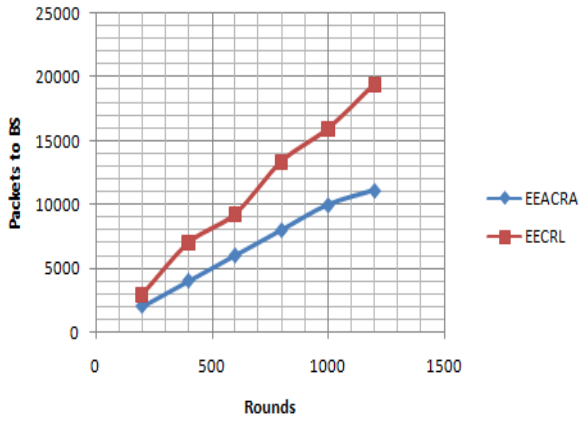

Fig.1 Rounds v/s No of data signals received at BS

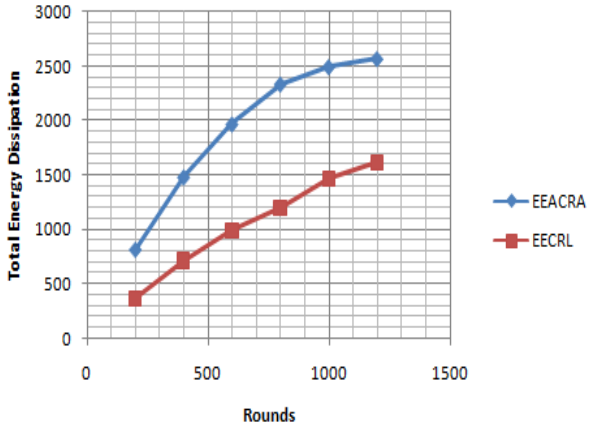

Fig.2 Rounds v/s Total energy dissipation

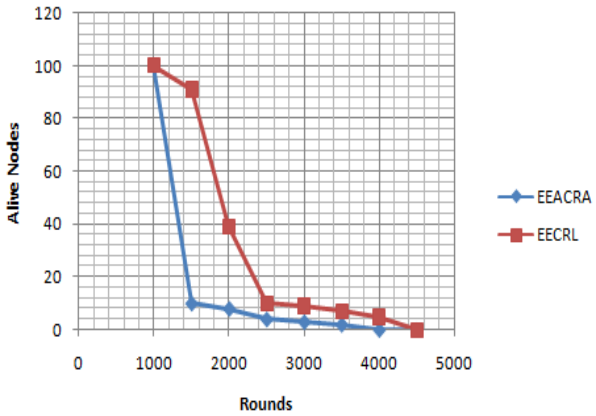

Fig 3 Rounds v/s Number of nodes alive

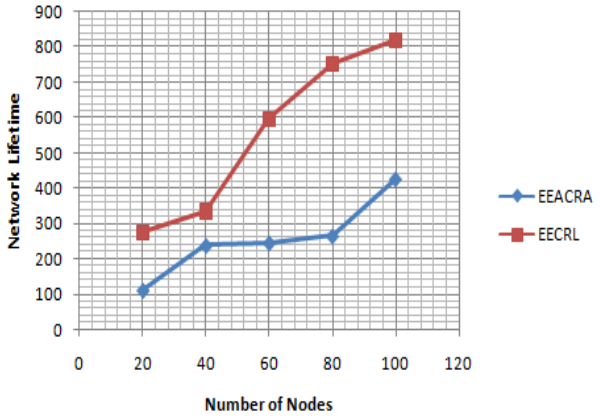

Fig. 4 Number of nodes v/s Network Lifetime

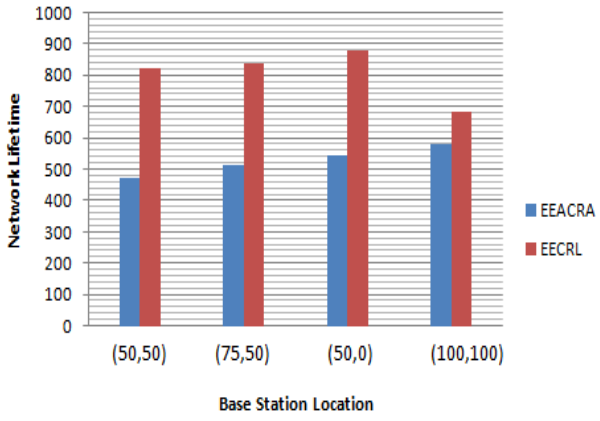

Fig. 5 Network Lifetime v/s Base-Station Location

6. ANALYSIS OF RESULTS

The outcome in figure1 demonstrates that packets conveyed to the base station is more in EECRL because of the enhanced edge having proficient cluster-head pivot by lingering energy of the nodes. It is seen from the figure 2 that aggregate energy dispersal is less if there should arise an occurrence of EECRL. The reason is adjusted energy choice limit by presenting energy measuring factor. Figure 3 passes on that the quantity of living nodes are less in EEACRA, since EECRL utilizes ideal group head appropriation all through the node relying upon sink location. Figure 4 briefs that system shakiness of EECRL is shorter, and when the system is near to its lifetime, the nodes come up short speedier, so EECRL can successfully adjust energy consumption. The 53.7% of nodes kick the bucket quicker in EEACRA than EECRL as a result of the routing of parcels in view of the energy got in the bunch head. According to figure 5 Network lifetime is more in base station location (50,0) but in case of EEACRA it is moderately good.

7. CONCLUSION

In view of the exploration of LEACH, a novel convention EEACRA for WSNs was proposed. EEACRA acquires the benefits of LEACH including the grouping, bunch head pivot, information combination component, and makes enhancements by presenting of energy weighted figure group head decision threshold.But despite everything it utilizes the cocept of LEACH which does not takes care of the issue that the lower energy nodes getting to be Cluster head for next round.In expansion it utilizes the expense based way to deal with course parcels which is prolonged and postures issues in keeping up directing table.Where as the proposed calculation EECRL utilizes leftover energy of nodes to effectively choose the group head.The adjusted energy choice edge and routing in light of most extreme energy got by group head gives great reenactment result. The reproduction results demonstrate that, contrasted and EEACRA, EECRL can further adjust the entire system energy utilization, and draw out the soundness and lifetime of the system. EECRL has more prominent energy effectiveness and ecological flexibility. The future scope is that there is still possibility of modification in the mathematical model related to selection of cluster head threshold.

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