An Energy-Efficient New Approach for Cluster Head Selection Algorithm in Wireless Sensor Network

P. Thiruvannamalai Sivasankar, B. Maheswara Rao

Abstract— ***Wireless Sensor Networks (WSNs) forced in its exclusive typesets such seeing that it can be accomplished to endure the callous natural situation, improved scalability, etc. Wireless Sensor Network (WSNs) consists of sensors and a Sink. The sensor nodes received energy resources from the battery only. So, network lifetime is most important while overworking for information transmission. Clustering is one of the great efficient of energy method. The principal node in a Cluster group (Cluster-Head) is a significant role and duty to the transformation of information in between Cluster-members and the Sinks. For this proposed method, the nodes are participating individually at the time of Cluster-head (CH) election process. In this proposed method, the sensor node among its distance as well as energy score analysis of the sensor node to motivate the sensor nodes to involved honestly on the process of election its Cluster groups. The energy score analysis and distance are calculated on every round of the process and is updated. In this proposed method, each and every sensor node can participate directly without individuality and also the proposed scheme to calculate for the distance in between nodes in a cluster group and Sinks(BS) at time of election processes, So, it requires performing tasks like data control, data-aggregation exposure to the Sinks. The proposed method is gauged by using Quality of Service metrics through simulation results.***

Keywords: WSN, Cluster, Sinks, energy

I. INTRODUCTION

A group of tiny sensor nodes to form the Wireless sensor networks (WSNs) and the nodes connected with the Sink node (Base-station). The size of the sensor is tiny and it has a minimum quantity of battery power for its operation The deploying sensor nodes in their sensing field is difficult for the user to change the source of energy because of the sensor nodes very small battery-powered device and the sensor node with limited energy in the WSN. The energy efficiency of WSN is an important [1][2] WSN is used widely in different types of applications. The energy conservation of sensor node in WSN should be optimized. The survey of the literature shows the Various necessity and application of WSN like monitoring of health and advanced power systems and environmental monitoring and military applications [3][4][5]. provided

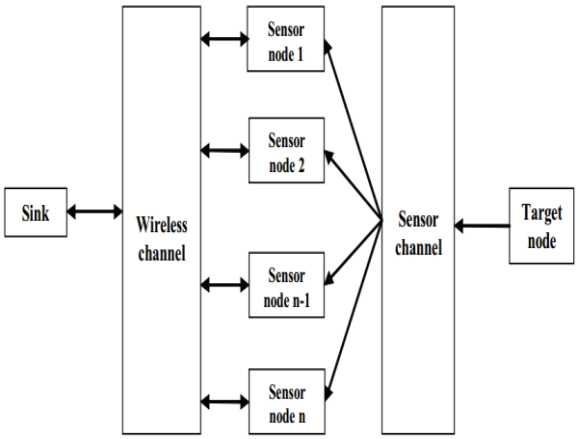

Figure 1 Wireless Sensor Network

The lifetime of energy is a highly defined parameter in a WSN because of all sensor nodes are located far away from Sinks(BS), its energy of the node is not restricted. The sensor nodes are spatially distributed in WSN and nodes collect the information within the range. The collected information transmits to Sinks (BS) in Figure 1.

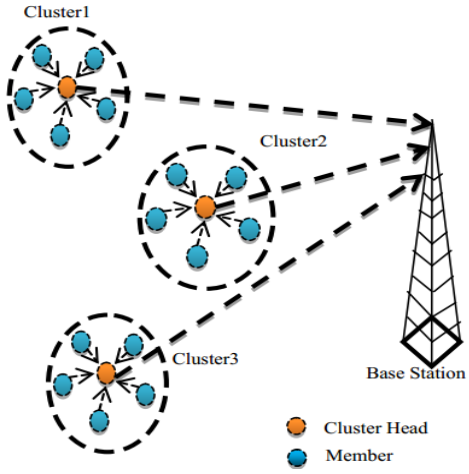

Figure 2 Cluster Group Formation

The Sinks receives the information either locally or through the Network gateway [6].

The storage capacity and capability of the computational, ability of communication of the sensor nodes are very less amount. So, a clustering method to improve the entire network lifetime. Every cluster member its data forwards to its Head of Cluster. The Head of Cluster (CH) is taking responsibility at a time of sensed information transmit to the Sinks. Hence, the selection of Head of Cluster (CH) should be careful.

Revised Manuscript Received on March 25, 2019.

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The selected cluster head based on the proposed scheme collects information from a member in a Cluster and convey to the Sinks. At the time of transmission, energy is directly proportional to distance and network. So, improved the lives of the Sensor nodes.

II. RELATED WORKS

The method was proposed the clustering fuzzy C-means to decide cluster based on its an optimal number. The fuzzy C clustering technique is effective for reducing energy consumption because of it selected the cluster based it's an optimal number [7].

The method has proposed an algorithm for selection Cluster-Heads(CHs) based on a process of Analytical hierarchy process in Wireless sensor networks [8].

The Head in Cluster (CH) selected on Fuzzy logic is existing is reducing the level of energy at the time of the transmission to the Sinks. So, Network lifetime is improved. Fuzzy logic descriptors in [7] include energy level, centrality, and concentration. The Head of Clusters(CH) is selected on its location.

The rest of the article follows as section I introduces the overall concept of proposed works. In the second section, we discuss the methodology and implement the works. In section III describes implemented works. In Section IV produces result and feature of proposed

Private Head of Clusters election is proposed in Head of Clusters (CH) to protect from different types of attacks [9]. Private Head of Clusters (CH) election method skins the individuality of Head of Clusters (CH) from attackers can check the implementation of Head of Cluster (CH) model of an election.

An Efficient Head of Clusters (CH) selection method has proposed in [8] then the main focus is an eliminating the re-clustering and reducing energy consumption for the program purpose by involving and ignoring overload in Head of Clusters (CH)

In [10] the lifetime of the network is improved because of Head of Clusters (CH) is selected using a method of hit sets.

In this clustering mechanism used based on location is proposed [11]. In this method, the sensor-node which is very close to Sinks is elected as the Head of Clusters (CH)[11][13][14].

In [12] the election of Cluster-head model in this proposed novel to eliminate individually to involve in the election method. In this proposed election method, the sensor node involved individually based an energy score analysis value. The energy score analysis value is calculated on the level of energy in a node.

III. PROPOSED WORK

A. *To avoid acting as a cluster head selfishly*

- The WSN is the limited resource-network. The sensor nodes many times act individually in this network. In this proposed clustering method, the Cluster-head play is an important role.
- A sensor node may not be involved at the time of election process because of that node selfishness. The node acts sometimes individually elected as a Head of Clusters (CH). To solving this situation a proposed method Head of Cluster election is introduced.
- In this proposed method, the sensor node among its distance cum energy score analysis of sensor node is motivating to sensor nodes as per honestly involving in process of election its Cluster groups. The distance and the energy score analysis value are calculated for all and each round, the distance and the energy score analysis value of the sensor nodes are calculated.
- The Esteem value (ESVi) estimated through a number of expected slots of time that a sensor node wants to stay alive (nTi) in a Cluster group and Energy level (E) of each sensor node.
- The Esteem-value(ESV) is estimated given eqn 1..

$$ES_{Vi} = E_{i\,/\,n} T_i \quad (1)$$

$$PC(Si) = \frac{ES_{Vi}}{\sum_{i=1}^{N} ES_{Vi}} \quad (2)$$

$$R_i = \begin{cases} \infty & if\ (E_i < E_{dgi}) \\ PC(Si)_{\,i} \,/\, Em; & otherwise \end{cases} \quad (3)$$

The notations of the above equations are given below:

- nTi →Number of Time slots Node to alive
- E_i → Sensor Node Energy Level i
- $Pc_i\ (S_i)$ →Sampling Value
- Em_{ch} → Minimal energy in Cluster-Heads(CHs)
- R_i → Value of Energy score analysis N→ Number of Packets
- ES_{Vi}→ EsteemValue

When the node value of energy score analysis is infinity (∞) at the time node energy level is lowerthan the required energy to gathering data activity. This represents that the node level of energy is too low to become a Head of Clusters(CHs)

Algorithm:

Notations

- nT_i → Number of Time slots Node to alive
- E_i → Energy Level- i
- $PC_i(S_i)$ → Sampling Value of Per- Centum
- Em_{ch} → Minimal energy in Cluster-Heads(CHs)
- R_i → Value of Energy score -analysis
- N → Number of Packets
- ES_{Vi} → EsteemValue

Data Input

- N→ Number of Packets
- E_i → energy level of the node i

Published By:
Blue Eyes Intelligence Engineering
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Result:

Energy score analysis (R_i)

Step 1:

Begin

$$ES_{Vi} \leftarrow \frac{E_i}{nT_i}$$

$$E_i \leftarrow \sum_{i=1}^{n} Em_i;$$

Step 2:

$$PC_i(S_i) = \frac{Em_i}{E_i}$$

Step 3:

$$If\ (E_i < Em_{ch})\ //\ cluster\ head\ selection$$

Begin

$R_iR_iR_i \leftarrow \infty$ // energy score analysis

// not selected

Else

Begin

$R_i \leftarrow PC_i(S_i)$ /Emi ;

End if

End

End.

B. *Area of yhe Cluster Group:*

The number of Cluster group to be formed with a group of nodes with look upon to its Base station (BS). The distributed sensor node in a circular region is equally splited by given formula

$$Degree_{partition} = \frac{360}{N_{cluster}}$$

Area of Circle $= \pi r\text{^}2$

Let the Cluster Areas are A1, A2, A3, A4 // divided in to four portions

$\frac{\pi r^2}{4}$ is the Cluster Area of CA1,CA2,CA3,CA4

Cluster Area 1 having some of the sensor nodes

CA1 = $\int_{S_{11}}^{S_{1n}} \frac{\pi}{4} ds$ where S is the sensor node

S11 - is the cluster Area1 starting node

S1n - is the cluster Area1 ending node

$$CA_1 + CA_2 + CA_3 + CA_4 =$$

$$\int_{S_{11}}^{S_{1n}} \frac{\pi r^2}{4} ds + \int_{S_{21}}^{S_{2n}} \frac{\pi r^2}{4} ds + \int_{S_{31}}^{S_{3n}} \frac{\pi r^2}{4} ds + \int_{S_{41}}^{S_{4n}} \frac{\pi r^2}{4} ds$$

C. *Distance Estimation of the Cluster Group:*

$$for(i = 1; i <= n; i++)$$

$$for(j = 2; j <= n; j++)$$

$$D_{i,j+1} = \sqrt{S_{i,j} - S_I}$$

$$DS_{i,j} = \sqrt{(x_{i,j+1} - x_i) + (y_{i,j+1} - y_i)}$$

$$DS_{i,j+1} = \sqrt{(x_{i,j+2} - x_i) + (y_{i,j+2} - y_i)}$$

$$X = \min(DS_{i,j}, DS_{i,j+1})\ //\ Nearest - selection$$

$$if\ (X == Ds_{i,j})$$

Node $S_{i,j}$ *is linked to* $S_{i,j+1}$ *link to node distance* $Ds_{i,j}$

Else

Node $S_{i,j}$ *is linked to* $S_{i,j+1}$ *link to node distance* $Ds_{i,j}$

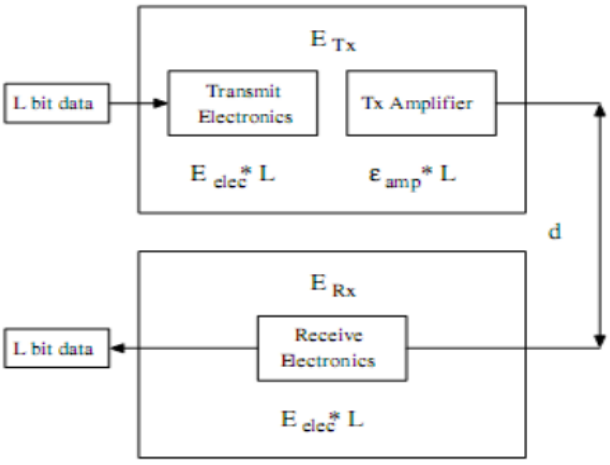

Figure 3.Model of Energy Consumption [15, 16]

The following parts are in Model of Energy consumption [15][16] in WSN.:

1. The energy requires for the message size l-bit at d distance.

$$E_{Tx}(1,d) = \begin{cases} l * E_{ele} + l * \varepsilon_{fs} * d^2, d \le d_0 \\ l * E_{ele} + l * \varepsilon_{mp} * d^4, d \le d_0 \end{cases}$$

Where

E_{ele} - Circuit fatigue of sender cum receiver

d_0 - Critical Distance multipath-free space and fading form.

ε_{fs} - Free Space form.

ε_{mp} - Fading form of multipath.

2. Required Energy of Receiving message size l-bit at d distance is

$$E_{RX}(l) = l * E_{ele}$$

3. The Energy of Data Aggregation is

$$E_{DA}(l) = l * E_{da}$$

IV. PERFORMANCE EVALUATION

The Network Performance is evaluated by NS2 simulator. In NS2 using the object-oriented language C++ and Object Oriented Tool Command Language (OTCL). The C++ and OTCL are acted as both backend and front end.

The EECHS method to evaluate the list of parameters such as

i) Ratio of Packet delivery

ii) Ratio of Packet loss,

iii) Energy consumption.

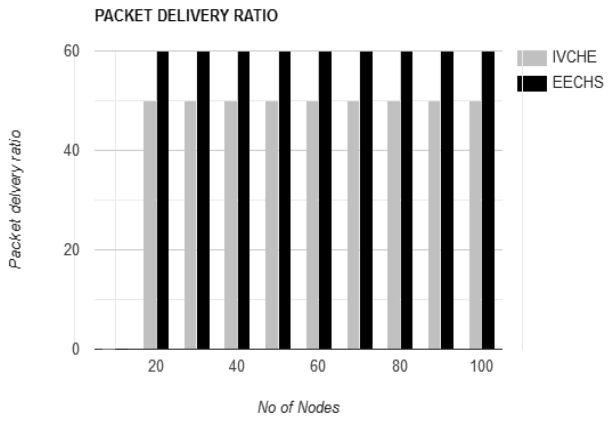

Figure 4 Proportion of Frame delivery

Figure 4 Shows Proportion of Frame Delivery methods of Energy Efficient Head of Cluster Selection (EECHS) and In-vulnerable Cluster-Head Election (IVCHE)

a. The Proportion of Frame Delivery (PFD)

Frame delivered effectively at one end is Proportion of Frame Delivery

Network quality is evaluated by the limitation of Frame delivery Proportion. A Proportion of Frame delivery is calculated as follow

DNF = Delivered number of Frames.

PDR = DNF / Timeslots (4)

The new EECHS Scheme is high performance compared to existing IVCHE Scheme.

b. The Proportion of Frame Loss(PFL)

A Proportion of Frame Loss (PFL) is

PFL = NFD / Timeslots (5)

Where NFD is Number of Frames Dropped

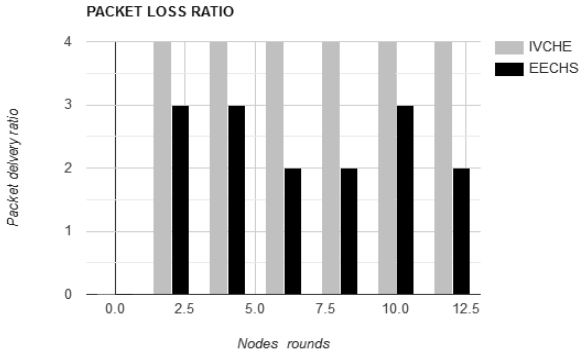

Figure 5 Proportion of Frame Loss

Figure 5 Shows Proportion of Frame loss methods of new a scheme of EECHS and existing scheme of IVCHE

The network quality provided by the routing scheme is used to evaluate the proportion of frame loss. The graph of the Packet loss ratio (PLR) of the new proposed scheme (EECHS) as shown in Figure 5.The high performance of the network based on the Lower the Packet loss ratio.

Energy Consumption

The node energy produces its lifetime

Balanced energy of a node is defined by

Balanced Energy = TE - (n*PT) (6)

Where,

TE →Total Energy

n → Number of Transmission

PT → Transmission Power

Figure 6 shows the consumption of energy in the sensor node while using the proposed EECHA scheme compared with the In Vulnerable Cluster Head Election (IVCHE) method.

Figure 6 show that the new proposed scheme (EECHS) consumes energy is less because of its efficient. The proposed EECHS scheme provides a higher battery lifetime.

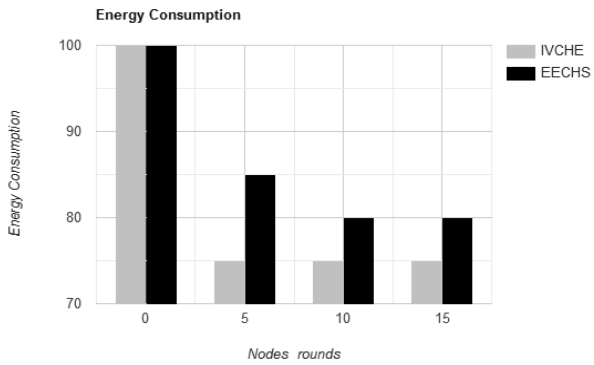

Figure 6 Energy Consumption

V. CONCLUSION

In Wireless sensor nodes have the minimum amount of power from a small battery and the battery power utilize to sense critical data like a different level of environmental and medical, military etc.. So, the nodes of sensors are not ready to freely accept heavy transmission with data to the base station. So, we have to select the energy efficient Cluster-head using the clustering technique. At the time of Head of Cluster election, the sensor nodes may act individually and some of the sensor nodes do not involve because of its individuality. In this new present article Head of cluster election scheme (EECHS) to avoid individuality involve in Head of Cluster (CH) election and also consider the distance of its sensor nodes in the Cluster head (CH) selection. In this proposed scheme is calculated the value of energy score analysis and also calculated the distance between for each sensor node. The proposed method is evaluated on the node energy through energy score analysis. The proposed method utilized chooses whether the node having the potential to broadcast the required quantity of information. This novel provides a key to reserve consumption of Head of Cluster (CH) among its member of Cluster to avoid participate individually. This method can be utilized for communication very easily.

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