OPTIMIZED CLUSTER ESTABLISHMENT AND CLUSTER-HEAD SELECTION APPROACH IN WSN

Shivshanker. P. Biradar[1] and Dr. T. S. Vishwanath[2]

[1]ECE department, LAEC, Bidar, Karnataka, India
[2]ECE department, BKIT, Bhalki, Karnataka, India

ABSTRACT

In recent years, limited resources of user products and energy-saving are recognized as the major challenges of Wireless Sensor Networks (WSNs). Clustering is a practical technique that can reduce all energy consumption and provide stability of workload that causes a larger difference in energy depletion among other nodes and cluster heads (CHs). In addition, clustering is the solution of energy-efficient for maximizing the network longevity and improvising energy efficiency. In this paper, a novel OCE-CHS (Optimized Cluster Establishment and Cluster-Head Selection) approach for sensor nodes is represented to improvise the packet success ratio and reduce the average energy-dissipation. The main contribution of this paper is categorized into two processes, first, the clustering algorithm is improvised that periodically chooses the optimal set of the CHs according to the speed of the average node and average-node energy. This is considerably distinguished from node-based clustering that utilizes a distributed clustering algorithm to choose CHs based on the speed of the current node and remaining node energy. Second, more than one factor is assumed for the detached node to join the optimal cluster. In the result section, we discuss our clustering protocols implementation of optimal CH-selection to evade the death of SNs, maximizing throughput, and further improvise the network lifetime by minimizing energy consumption.

KEYWORDS

Wireless Sensor Networks (WSNs), Cluster Heads (CHs), Clustering Approach, Energy Efficient (EE), LEACH.

1. INTRODUCTION

The improvement in communication technology and the increase in the demand for smart devices generated novel dimensions for WSNs. WSNs contain different/same types of nodes and BS (Base Station). The BS transmits commands to the nodes in the region of sense. It gathers data from SNs (sensor-nodes), executes very simple processing, and transmits the data through the internet to end-users. WSNs are self-managed network systems that contain several distributed SNs. The main purpose of WSN is to monitor the conditions like environment, temperature, and humidity or to recognize monitoring environment, disaster monitoring, traffic-management, and warfare monitoring [1-2]. Anyways, WSNs have resource constraints. This constraint adds less memory, limited battery power, and limited bandwidth. Among these, the power of a limited battery is one of the main constraints. When the energy efficiency, it is pretty challenging to replace or recharge the battery. There exist many mechanisms like radio optimization, EE (energy-efficient) routing, duty routing, clustering [3-5] in order to minimize energy consumption. The diverse applications and resource constraints of WSNs pose higher challenges. WSNs nodes generally have essential limitations in terms of available energy as well as communication and computing capabilities.

EE is a most eminent feature of the routing protocols for the WSNs, required to prolong the network-lifetime and to improvise the performance of communication and also receives much attention. Different communication nodes and cluster formation of sending data have been the most popular methods. In general, compared to the cluster-based routing-protocols and non-clustering-protocols can proficiently utilize SNs in a network [6]. A CH, called cluster leader, is in removing charge as correlated data that can reduce the volume of final data. Afterward, CH will send aggregated data to BS [7-8]. In the protocols of cluster-based routing, SNs are parted into several clusters to minimize the consumption of energy for longer communication distances. The clustering can reduce all energy consumption and also balance workload that causes a larger difference in energy depletion among other nodes and CHs. Furthermore, clustering is the solution of EE for maximizing the network longevity and improvising energy-efficiency. Anyways, clustering protocols implement optimal CH-selection to evade the death of SNs and further improvise the network lifetime [9-10].

According to [11], SNs consume more energy through communication during the process of computation. Few protocols assume more than one hop communication and nodes nearer to BS that has excessive transmission overhead leading to the energy gaps in the field of the sensor [12]. In order to address the problem of energy and improvise the lifetime of the network, several clustering protocols have been introduced for the WSNs. The LEACH is an eminent hierarchical routing protocol with respect to saving energy with routing protocols [13]. In this, all networks are parted into many clusters and every single cluster chooses the node in a probabilistic manner as the CH, which is in sending the data, receiving a charge, compressing from non-CH-nodes to BS. In order to reduce the WSNs-energy consumption, the protocol of LEACH routing defines only one CH-node in every single cluster and chooses on a rotation basis. Although the efficiency of the LEACH-protocol has been studied, it has some disadvantages that need improvement due to choosing the CH based on round-robin, the number of CHs is not reasonable in every single round, and nodes at the network will be selected as CH. On the other side, there is a consideration of threshold condition, distribution of CHs, and remaining energy of every single node after the end of every single round.

The routing protocol of WSNs is categorized into hierarchical, plane, location-based routing [14]. The routing protocol is utilizing as the LEACH protocol. The LEACH protocol is a representative protocol between the protocols of hierarchical routing [15]. The protocol of LEACH improvised EE of the network with the help of the clustering method but it doesn't assume the movement of situation nodes. Therefore, if the nodes are less as the rate of DT (data-transmission). The protocol of LEACH-mobile is defined as a protocol, which develops the issue of node movements [16]. In the protocol of LEACH-mobile, the given nodes are failed and moved to transmit the data, the issue was resolved by generating a failed node to re-transmitting and re-cluster the data. Anyways, the energy is consumed for the identification of moved nodes and the consumption of energy is higher than the LEACH protocol.

In this paper, a novel OCE-CHS (Optimized Cluster Establishment and Cluster-Head Selection) approach for SNs is represented to improvise the PDR (packet delivery-ratio) and reduce the average energy-dissipation. The main contribution of this paper is 2-fold, first, the CA (clustering algorithm) is improvised that periodically chooses the optimal set of the CHs according to the speed of the average node and average-node energy. This is considerably distinguished from node-based clustering that utilizes a distributed-clustering algorithm to choose CHs based on the speed of the current node and remaining node energy. Second, more than one factor is assumed for the detached node to join the optimal cluster.

The complete paper is organized in such a way that second section demonstrate the complete literature survey of considered topic, 3rd section demonstrates the important equation and their respective explanation of our proposed approach. In addition, result and simulation analysis using proposed model has shown in section 4 and at last we conclude our proposed approach in section 5.

2. LITERATURE SURVEY

Since the SNs are powered by batteries, once a few nodes are exhausted, the network may not work properly. Therefore, energy constraint has been the main key to operate an efficient WSN. Few traditional techniques minimize energy consumption and transmission distance of path, thus extending all network lifetime [17,18]. Authors in [17] choose neighbor-node with fewer hops from a source node to SN (sink-node) is utilized as a determinant. In paper [18], introduced ladder-algorithm based ACO (ant-colony-optimization) to solve the issue of the energy consumption in the routing. The algorithm utilized the ACO method to define the transmit paths that can efficiently minimize the consumption of energy. In another way, this algorithm basically based on min-hop count is similar to min-energy routing [19]. Although this type of method can minimize the consumption of energy, it has some drawbacks that undertake the DT (data transmission) in a period of time while the other nodes are idle. They select a forwarding node that doesn't assume residual energy that is very easy to generate few nodes and an outcome is not even energy distribution among the nodes. Thus, the lifetime of a network is at less level.

The routing protocols like GBR (gradient-based-routing) [20], LEACH [21], PEGASIS [22], DD (directed diffusion) [23], SPIN (Sensor-Protocol for Information through Negotiation) [24] were proposed for the efficient routing of multi-hop in the WSNs [25] [26]. SPIN can't ensure a hundred percent packet delivery from the source node to BS. Moreover, the SPIN requires complete topology knowledge. DD is known as the protocol of data-centric and it is required for sink-node to generate, re-route, and transfer intermittent-updates packets. The main object of designing DD was efficiency in the consumption of energy, resulting in maximizing the expectancy of network life. In order to minimize the consumption of energy, DD utilized data processing and compression within the network.

A number of various protocols have been introduced for WSN-node location and localization-based routing protocol. These contain GEDIR [27], GAF [28], SPAN [29], GEAR, GOAFR [30] and MFR. These papers referred to fact that the main benefit of these given protocols is the capability to recognize the correct location of SN within sensor-network. The localization of the node is connected to the efficiency of energy-WSN. It saves the resources of energy-WSN [31]. Anyways, these protocols outcome in the loss of power because of its node-distribution and geographical-topology in WSN. Whereas in paper [32], the author has exploited a novel load-balancing protocol for handling the consumed energy by SNs in WSN in 2019. The simulation was done by utilizing MATLAB, the performance comparison was estimated utilizing 2 protocols like SEP and LEACH.

The authors [33], introduced GWO (grey-wolf-optimization) to solve the problem of CH selection. The function of suitable fitness was used to confirm WSN coverage and it is fed in GWO to discover the optimum. The introduced model outcomes are associated with the routing protocol of LEACH. Four different models such as performance, a lifetime of residual energy, network throughput are analyzed. Lastly, the proposed model outperforms LEACH in entire topologies by various indicators. Whereas in [34], the author introduced an EE-CH-selection algorithm that is based on WOA-C and WOA (whale-optimization-algorithm) was introduced. Therefore, it supports the selection of an energy-aware CH-based fitness function that assumes the remaining energy node and the sum of the adjacent energy nodes. Lastly, an implemented algorithm was estimated based on throughput, overall stability, EE, a lifetime of the network.

Moreover, the WOA-C performance was evaluated against protocols of another standard contemporary routing to represent its superiority over another model.

The cluster-based routing has been proposed with various contributions. They are classified into constraints for CH-selection and algorithms for CH-selection. The constraints for the selection process of CH for routing protocol have been introduced in [35] whereas [36] introduces the algorithm of metaheuristic optimization for the selection process of CH. Since this research aims to improvise the optimization algorithm for the selection process of CH, they assume [35-36] for further analysis and study. Moreover, their paper focused on FA and DA that take the update based on random solutions, distribution, and encircling. It leads an algorithm to coverage prior to traditional algorithms.

This paper [37] introduces an improvised function of heuristic in an ACO and assumes residual energy and distances of nodes to discover an optimal path of DT. In [38], the mechanism for the WSN-routing that can be more effective regarding node energy, criteria of the route length, end-to-end delay is represented. This technique utilized ant-colony based on the routing algorithm and the local inquiries is to discover an optimal route. The above algorithm [37-38] plays much attention to residual path and path-length while ignoring the effects of energy-statistics like minimum energy and average energy that could lead to an imbalance in an energy-dissipation of all networks. Whereas, paper [39] represent ACO based routing-protocol for the WSNs containing the stationary nodes. It gives an effective method of multi-path-DT to obtain reliable communication in node faults while assuming the levels of energy level. Anyways, an algorithm considers the given network, which is static and can't be implemented in more than one sink node.

3. OPTIMIZED CLUSTER ESTABLISHMENT AND CLUSTER-HEAD SELECTION

The cluster-based WSN-SN (sensor-node) with single hop-communication and gateways inside the cluster is represented in below figure-1. The advantages of cluster-based WSN are given as follows: per cluster one representative node requires to be involved in the routing process and DA (data-aggregation), it significantly minimizes the consumption of energy. Additionally, it conserves bandwidth of communication as the SNs requires to interact with CHs and evades redundant messages between them. The cluster can be managed in terms of energy; it improvises the network-scalability. However, it is most crucial if SNs are not-properly allocated to CHs for the formation of the cluster, then a few CHs may have overloaded with a higher number of SNs. Such overloaded may maximize the latency in the communication and degrade the performance of the WSN.

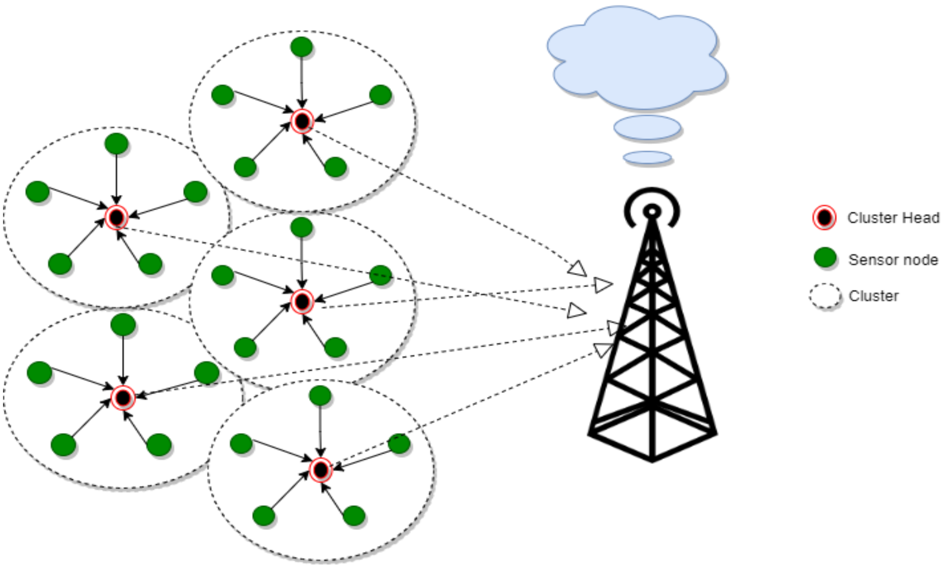

Figure 1. Sensor-node and Cluster-based WSN

The WSN model is examined with the SNs. It is considered as a network model that contains SNs scattered in an area of $c \times c$ meters. An assumption of the network model is represented below:

- The BS (Base station) is fixed and it is located in the field of the sensor.
- The BS and FNs are neither energy-constraint while the SNs are energy-constraint.
- Every single node knows its energy level, velocity, and current position.
- Every single node can use the power-setting in order to change transmitted power through RSSI (received signal-strength-location).

We believe that given assumptions are reasonable for real networks. The FNs are powered by energy-harvesting and thus have the continuous power of supply. Every single node identifies its current positions and speed that can be achieved by the algorithms of GPS and location. Additionally, every single node can estimate its energy level based on specific hardware of the energy model. GPS is to estimate the position. Anyways, it is very expensive to train with all nodes and that can't function in the indoor-applications while there is no way to for LOS (line-of-sight) to a satellite.

The consumption of SNs is measured by the same model as energy dissipation of radio-hardware where transmitter dissipates of energy is to run power amplifier and radio electronics, and also receiver disperses the energy to rum radio electronics. Where x is defined as the distance between transmitter and receiver. If distance x is less to the assumed x_0 threshold the open model of channel space is assumed with the loss of energy (e) or else multipath channel model (σ) is assumed. In order to receive and transmit a number of the bit message signal y at the distance x, the cost of receiving and transmitting is given by: $I_T(y,x) = y\, I_{cd} + y z_{kl} e$.

Where distance is x less then x_0

$$I_T(y,x) = yI_{cd} + yz_{mn}\sigma \tag{1}$$

Where distance is higher or similar to x_0

$$I_{\mathcal{R}}(l) = y\, I_{cd} \tag{2}$$

Here, I_{cd} defines the energy bit/dissipation at the receiving and transmitting process, where z_{kl}defines for an amplified energy parameter and also corresponds to the open model of space channel. Furthermore, z_{mn} is defined as the amplified energy parameter and corresponds to the model of the multipath channel.

From the given network, all SNs is given as $C = \{c_1, c_2, c_3, \cdots, c_n\}$, t defines the scale of time polling ($t = 0\ 1, 2, \cdots$). Begin stage, the round t for every single message towards the BS, where range value of i from 1 to n. Anyways, a transferred message consists of node-location, $I(c_a)$ node level of energy and $J(c_a)$ present the node speed. According to the transmitted message, firstly BS calculates the average energy node followed by $\bar{I}_n = \frac{1}{n}\sum_{a=1}^{n} I(c_a)$.

Also, we calculate the average speed of the node as:

$$\bar{J}_n = \frac{1}{n}\sum_{a=1}^{n} J(c_a) \tag{3}$$

Where $c_a \in C$. The BS selects the number of nodes N from C set ($K \subseteq C$) and assumed as:

$$N = \begin{cases} N_1 \cap N_2, & \text{if } |N_1 \cap N_2| \geq D_y \\ N_1 \cup N_2, & \text{if } |N_1 \cap N_2| < D_y \end{cases} \tag{4}$$

The given D_y symbol defines for the optimal CHs number, $N_1$and N_2 represents node sets, and $|N_1 \cap N_2|$ represents $N_1 \cap N_2$ cardinality. Furthermore, the level of energy nodes is given above, then the value of average/threshold energy and calculated current speeds are given below, then the speed of the average value can be given as $N_1 = c_j | I(c_j) \geq \bar{I}_n, \forall c_j \in C$ and $N_2 = c_j | J(c_j) \geq J_n, \forall c_j \in C$.

While assuming a condition, where $|N_1 \cap N_2| \geq D_y$, this implies that the number of set nodes in O have higher energy levels and lower speeds are trained to become the CHs during the particular round. Whereas assuming a condition $|N_1 \cap N_2| < D_y$, this condition implies that the set of nodes in O having higher energy levels and lower speeds that are probable to become the CHs at the time of a particular round.

The number of set nodes is assumed to carry the process of optimization to obtain optimal CHs from K that becomes the CHs at a specific round. Here, we have many processing levels in order to obtain the optimal CHs like completion/final level, initialization level, and neighborhood level.

Firstly, the set of stochastically CHs is created and defined by $D = \{d_1, d_2, d_3, \cdots\}$ from the given O and $m = 0$ to confirm $|D| = D_y$. $m = m + 1$ is assumed to discover out a new set of the nodes N which represents the random perturbation of the L nodes at the finding level of the neighborhood. Furthermore, novel coordinates of $\tilde{A}$ and $\tilde{B}$ nodes in N are calculated via the coordinates of A and B in D.

$$\tilde{A} = A + \text{rand}(-r_{max}, r_{max}) \tag{5}$$

$$\tilde{B} = B + \text{rand}(-r_{max}, r_{max}) \tag{6}$$

Where the function of the rand is assumed to create a random number and r_{max} defines the maximal change at present random perturbation.

Afterward, it found neighborhood-nodes in O that placed around $(\tilde{A}, \tilde{B})$, so node chooses a new CHs set and defined with the help of $\hat{D}$ (this can be written as $D_y = |D| = |N| = |\hat{D}|$). The current state is represented via D CHs set with the help of cost-function $f(D)$ whereas the neighborhood state is represented via $\hat{D}$ CHs set with the cost-function $f(\hat{D})$.

Let assume m iteration, the current state will alter to the state of the neighborhood $\hat{L}$ and probability is calculated as follows:

$$N(D \to \hat{D}) = \exp[-f(\hat{D}) - f(D)/ W_m] \tag{7}$$

The given eq. (11) is true when $f(\hat{D}) \geq f(D)$, otherwise the $D \to \hat{D}$ the probability will be only one. Where, Q_m defined as the parameter of the control factor and given by:

$$W_m = \mathcal{R}_{hp} \times \mathcal{E}^{-\frac{m}{20}} \tag{8}$$

Whereas, R_{hp} is defined as the value of hyperparameter that ranges from 100-1000. The calculated W_m value help to decide better clusters and $f(.)$ denotes the function of cost:

$$f(D) = \sum_{a=1}^{n} \min_{\mathcal{E}_a \in C, d_a \in D} e(\mathcal{E}_a, d_a) \tag{9}$$

Where, the distance among channel head d_a and $\mathcal{E}_a$ is specified by the help of $x(.)$. if current state D becomes the state of the neighborhood, then $D = \hat{D}$.

$\mathbb{T}_{itr}$ is assumed as total iterations in the final level, where $\mathbb{T}_{itr}$ is equal and greater to m then the algorithm can be dismissed otherwise it will go to the level of neighborhood find. Once a determination of an optimal CHs is finished, BS is utilized to broadcast the message that contains CH's-ID for every single node which is present in the network. Anyways, the particular ID of a node is similar to CH's ID then it became the CH. Else, the node selects its TDMA-slot for the process of data transfer and the given node falls dead until the time that has come to the forward signal to its CH.

As node e_a and its z_a CH has moved out of the communication range with each other, the transmitted data packet is assumed to be lost from e_a to z_a . We refer e_a a node that is separated from its CH as DN (detached-node). In this case, the DN differs the quantity of the transmitted power and then shows data to all given CHs in a network. On the other side, in order to define an optimal-CH for DN, every single CH sends small messages to BS. This small message contains distance among CH and DN $i.e\ i(e_a, z_a)$, the energy level of CH i.e., $C(e_a)$and the speed of current CH i.e,$\mathcal{R}(e_a)$. Then, BS calculates integrated weights for the CH e_a as follows:

$$g(e_a) = w_1 \times \left(1 - \frac{d(e_a, z_a)}{d_{max}}\right) + w_2 \times \frac{C(e_a)}{C_0} + w_3 \times \left(1 - \frac{\mathcal{R}(e_a)}{\mathcal{R}_{max}}\right) \tag{10}$$

Where, $e_a \in E$, $z_a \in Z$, and C is the CHs set within a present round. Moreover, e_a is defined as a weighted factor and $\sum_{a=1}^{m} w_a = 1, m = 3$. Besides, C_0 simplifies the range of maximum transmission and $\mathcal{R}_{max}$ defines the speed of max MNs. Since BS is in the area center, we describe $i_{max} = \sqrt{2}\ \mathcal{M}/_2$, where $\mathcal{M}$ is defined as the side length of square-area. Thus, an optimal CH $\tilde{z}$ for DN is given by:

$$\tilde{z} = \arg\max_{z_a} g\,(z_a), \qquad z_a \in Z \tag{11}$$

After, BS discovers an optimum CH $\tilde{z}$ for DN, it sends messages that contain an optimal CH-ID to DN, which transmits a joint-request message to the CH $\tilde{z}$. Next, the CH $\tilde{z}$ allots free-timeslot to DN. During its allotted timeslot, DN attached itself and sends sensed data to its CH $\tilde{z}$.

4. Result and Analysis

The SNs are powered by batteries, if some of the nodes are fatigued, the network may not work properly. Therefore, energy constraint has been the main key to operate an efficient WSN. The cluster-based routing has been proposed with various contributions. In this research, our aim is to improvise the algorithm for the selection process of CH, increase the throughput and minimize energy consumption. This section provides the result and analysis at the proposed OCE-CHS approach. The complete simulation has done in MATLAB 2018a with system configuration; Intel i5 processor, 12GB RAM, and Windows operating system.

Here, WSN is analyzed under various sensor nodes such as; 700, 800, 1900 and 2000 which consistently scattered in the 400 x 400-meter squared network coverage area. In addition, real time environment of network is replicated; where energy level, nodes current position and velocity known by node. Before exploring further result analysis, let's have discuss about LEACH, it's a well-known hierarchical routing protocol with respect to saving energy with routing protocols. In order to reduce the WSNs-energy consumption, the protocol of LEACH routing defines only one CH-node in every single cluster and chooses on a rotation basis, which is not efficient to manage energy consumption. The proposed approach utilizes a distributed-clustering algorithm to choose CHs based on the speed of the current node and remaining node energy. For analysis and evolution purpose; packet success rate, error rate, throughput and energy consumption has considered. Finally, state-of-art methods such as; ACO, LEACH and energy balance clustering routing algorithm (EB-CRA) [40] has considered for comparison.

Table 1. Simulation parameters details

Initial Energy	0.1 dB
Optimal Election Probability for CH	0.2
Sensor Nodes	700, 800, 1900 and 2000
Network Size	400 x 400m^2
Hyperparameter value	1
Maximum number of polling	500
Existing Approach	ACO, LEACH and EB-CRA [40]

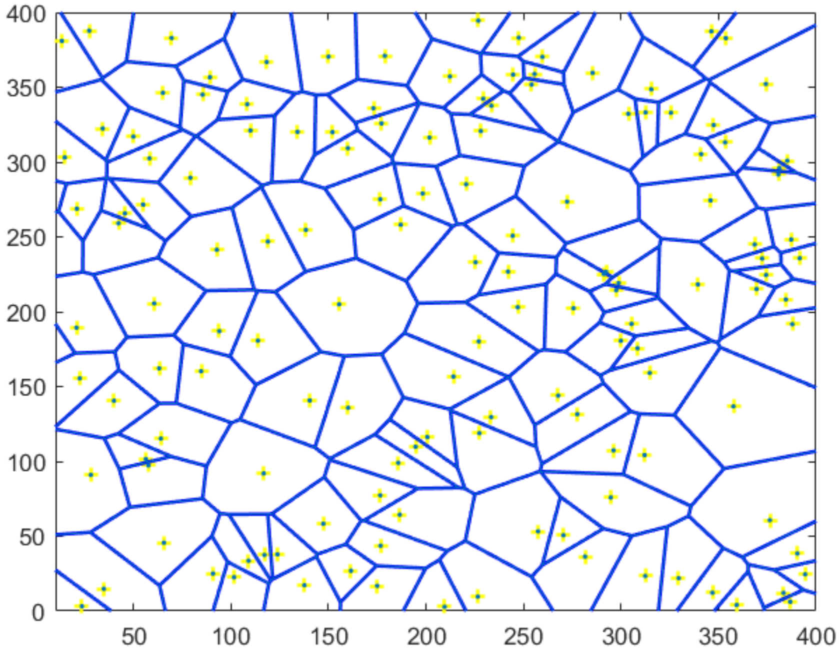

Figure 2. Cluster formation and CHs Localization

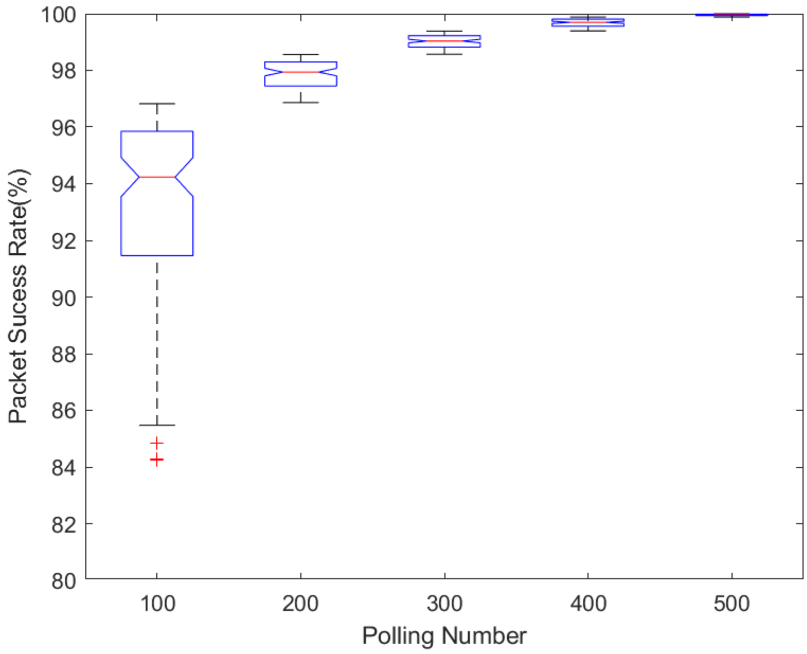

Figure 3. Impact of Polling Number on Packet Success Rate at 700 Nodes

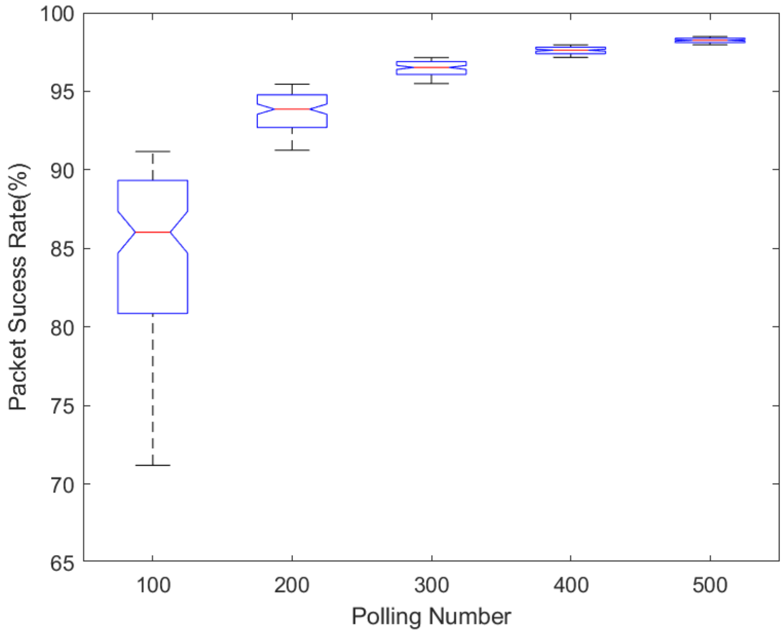

Figure 4. Impact of Polling Number on Packet Success Rate at 2000 Nodes

The representation of cluster formation and CHs localization is shown in figure 2, where blue is dividing the clusters in a 400 x 400-m^2 network and yellow covered dot shows the CH for each cluster.

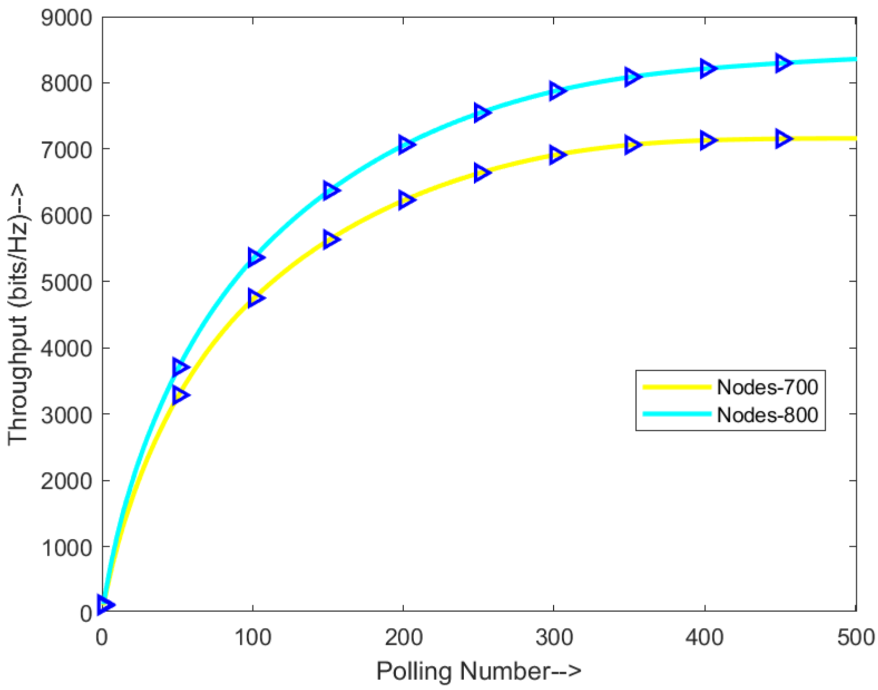

Figure 5. Impact of Polling Number on Throughput at 700 & 800 Nodes

The impact of Polling Number on Packet Success Rate (PSR) at 700 Nodes is shown in figure 3, it's a box plot that represents the standard deviation of 100 poll for PSR values. The x-axis shows in the interval at 100 polling number. Red line inside box represents the mean value of PSR at total 100 polling number. In figure, it clearly seen that mean value of initial 100 poll is 93.2%, whereas at last 400 to 500 poll we achieve 99.95% of PSR.

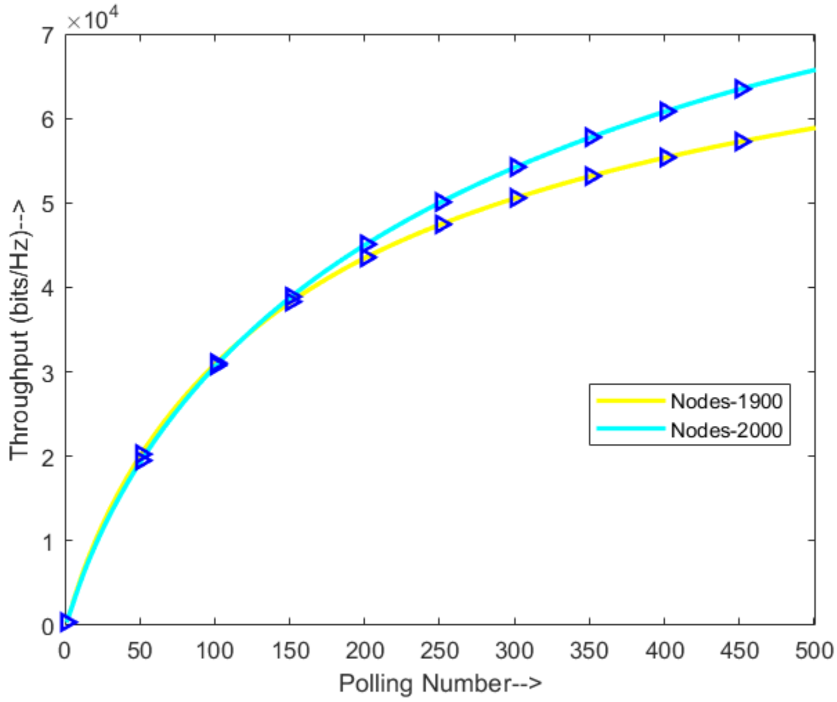

Figure 6. Impact of Polling Number on Throughput at 1900 & 2000 Nodes

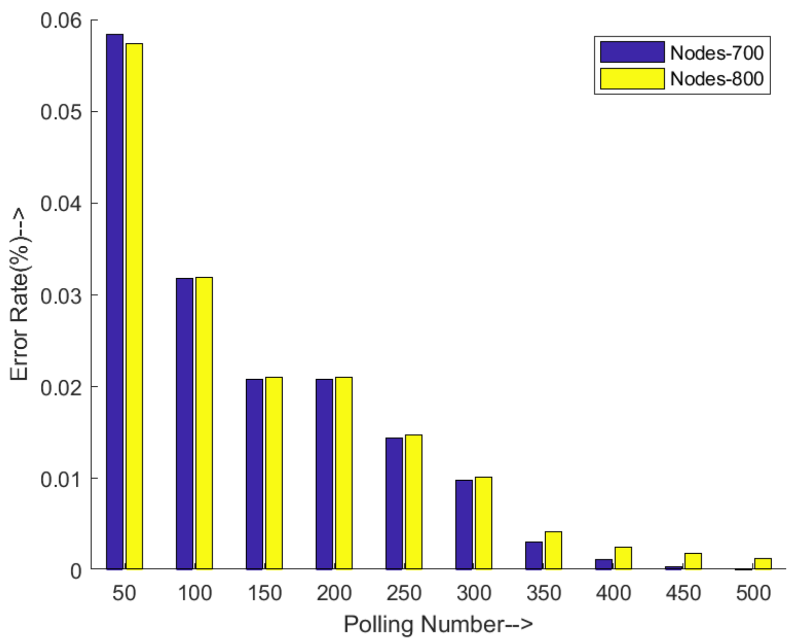

Figure 7. Error Rate w.r.t Polling Number at 700 & 800 Nodes

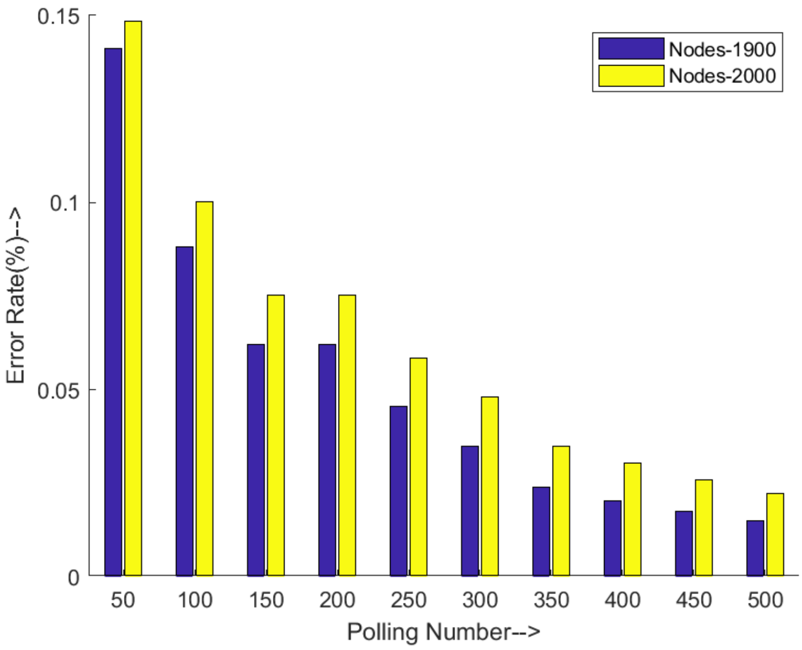

Figure 8. Error Rate w.r.t Polling Number at 1900 & 2000 Nodes

Similarly, when 2000 nodes were considered for analysis of polling number w.r.t PSR as shown in figure 4, at 0 to 100 poll we got PSR mean value as 84.5% and at 400 to 500 poll we achieved 98.24 PSR. Both figure 3 and 4 shows that as per increment in polling number the PSR is also increasing. The Impact of polling number on throughput at 700 & 800 nodes are shown in figure 5, cyan line shows for 700 nodes, while the yellow line represents for 800 nodes. In figure 5, a growth in throughput can be seen from 100 to 300 polls, afterwards it increasing a bit because of its optimal reach of space.

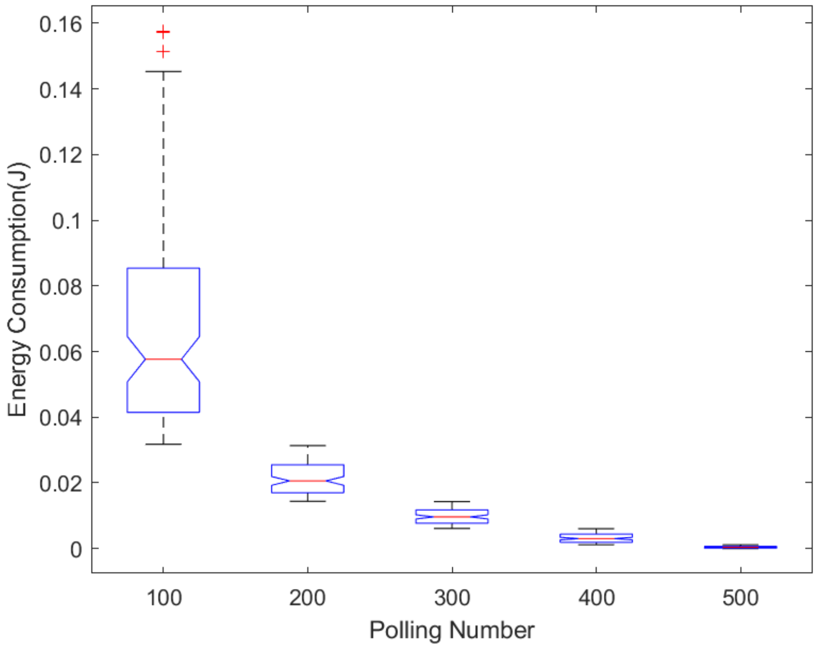

Figure 9: Impact of Polling Number on Energy Consumption at 700 Nodes

Similarly, the Impact of polling number on throughput at 1900 & 2000 nodes can be seen in figure 6, at shown 1900 nodes, we have got 58 Kbits/Hz at 500 polling number while at 2000 nodes got 65 Kbits/Hz. Figure 7 shows an error rate w.r.t polling number at 700 & 800 nodes, where blue bar shows for 700 nodes and yellow bar shows for 800 nodes.

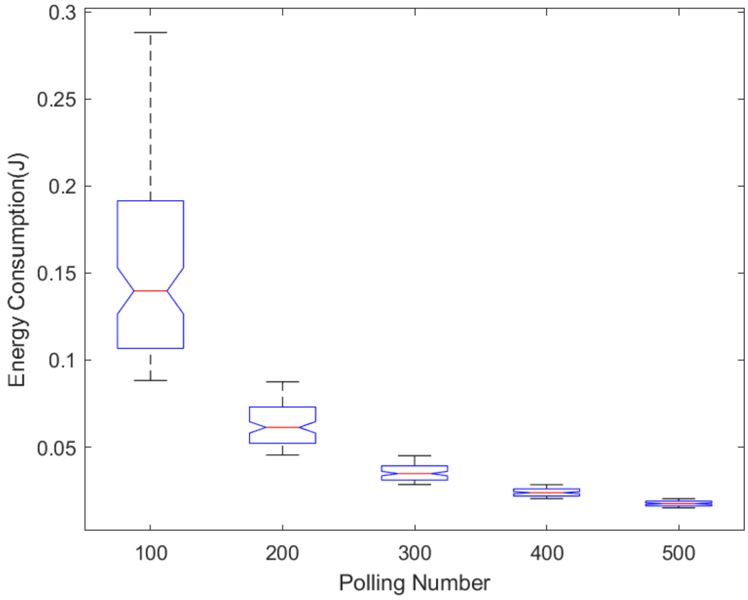

Figure 10. Impact of Polling Number on Energy Consumption at 2000 Nodes

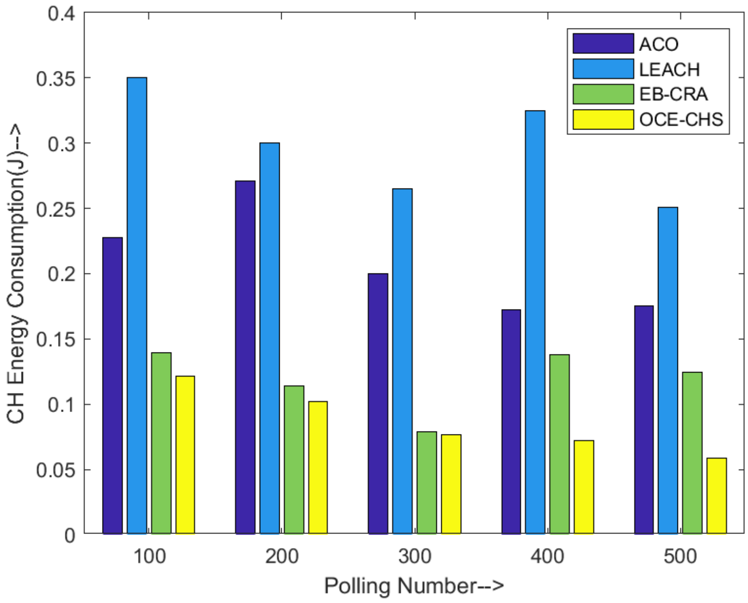

Figure 11. Presentation of energy comparison at different polling number

In figure 7 polling number 1, the error rate is 0.0583 for 700 nodes and 0.0573 error rate for 800 nodes. But increasing in polling number, the error rate is more in high number of nodes. When we further increase the number of nodes to 1900 and 2000, the error rate w.r.t polling number can be seen in figure 8. Where at 1 polling number, 0.141 error rate at 1900 nodes and 0.148 error rate at 2000 nodes.

Table 2. Comparison analysis at energy consumption with state-of-art model

Poll No.	ACO	LEACH	EB-CRA	OCE-CHS
100	0.228	0.3501	0.1394	0.1215
200	0.2709	0.3	0.1141	0.1022
300	0.2	0.2649	0.0791	0.0763
400	0.1723	0.3248	0.1376	0.0723
500	0.175	0.2511	0.1243	0.059

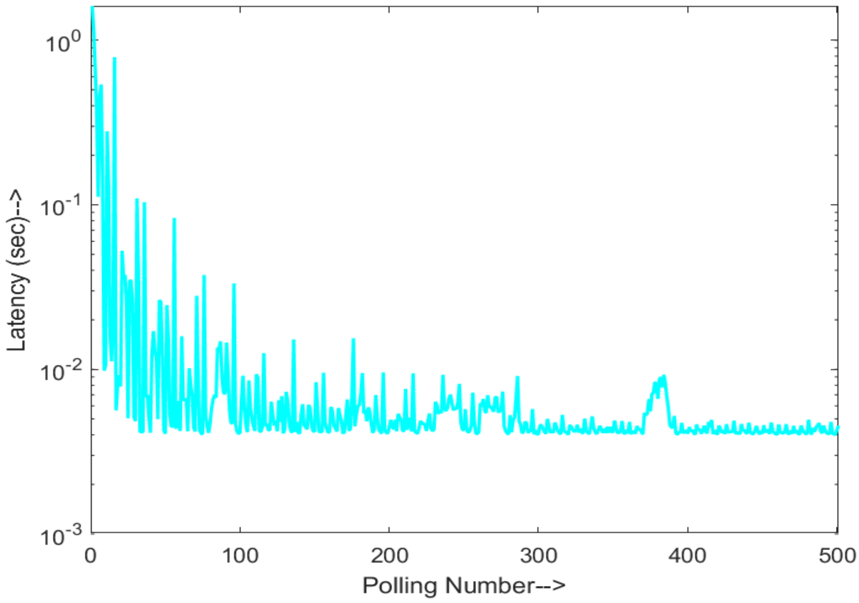

Figure 12. Latency impact as per polling number at 700 nodes

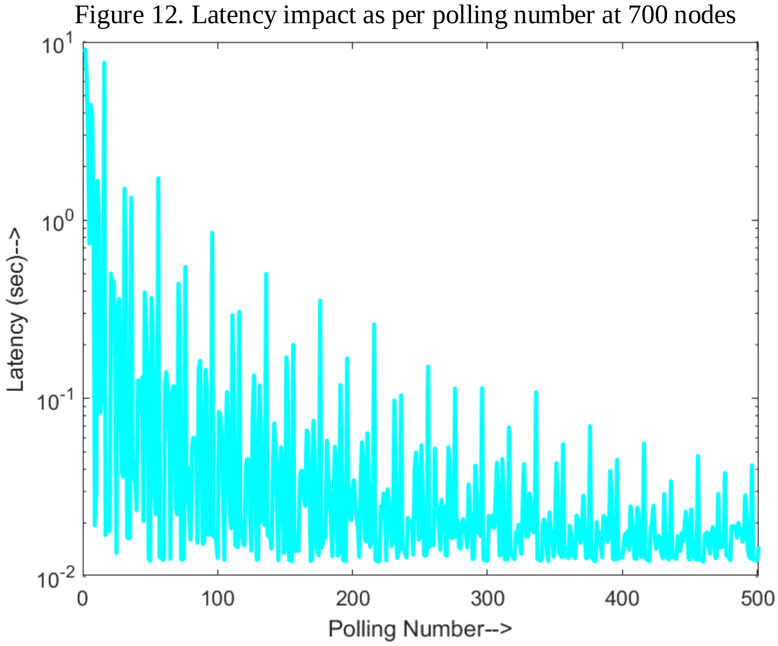

Figure 13. Latency impact as per polling number at 2000 nodes

Figure 9 represents the impact of polling number on energy consumption at 700 nodes. In 0 to 100 polling number, average power consumption is 0.067 J as seen in fig 9, whereas from 400 to 500 polling number average power consumption is 0.0004 J that is very less compared to previous polling range. Similarly, the impact of polling number on energy consumption at 2000 nodes is shown in figure 10, where average power consumption is 0.15 J at 0 to 100 polling number and 0.0175 J at 400 to 500 polling numbers. Figure 11 presents energy comparison at different polling number and the detailed numerical analysis is shown in table 1. For this particular energy comparison, a WSN model with the SNs is observed and our network model consists of 200 number of SNs that uniformly distributed in monitoring area of 100 x 100 meter. At 100 polling number, our proposed OCE-CHS approach has got 0.1215 J, which is 46%, 65% and 12% less energy consumption compared to ACO, LEACH and EB-CRA techniques. At 400 poll number, our proposed OCE-CHS approach has got 58%, 77% and 47% less energy consumption compared to ACO, LEACH and EB-CRA techniques. Transmission of data from source node to destination node is considered in order to achieve the delay requirements. Therefore, the less latency is required to improve used experience and higher reliability. Network transmission latency impact as per polling number at 700 nodes is shown in figure 12 and for 2000 nodes is shown in figure 13. While analyzing both the figs 12 and 13, its clearly seen that normalize the value of time has achieved as per increasing in polling number.

5. CONCLUSIONS

In WSN, the deployment of large and autonomous SNs is a very difficult task to perform. There are various other challenges as well; EE protocol to minimalize power consumption, high throughput, and packet transmission. The major advantage of cluster-based WSN are: per cluster one representative node requires to be involved in the routing method and DA, which significantly reduces the energy consumption. In addition, it conserves bandwidth of communication as the SNs requires to interact with CHs and avoids redundant messages in transmission. In this study, the OCE-CHS approach for SNs is represented to improvise the throughput, PDR and reduce the average energy-dissipation and error rate. The entire analysis has done under a large network scenario, where simulation has set up in MATLAB tool with user's alteration. The routing protocol such as LEACH protocol, ACO, and EB-CRA has considered for energy comparison is considered real-time network environment. The analysis of our result has shown in the above section clearly state that our proposed approach is much more efficient and stable for data transmission in WSN. Here, our optimized cluster-based approach managed in terms of energy and it improvises the network scalability. However, this approach is not tested under a complete 5G environment, so this can be considered as future scope of work.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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AUTHORS

SHIVSHANKER. P. BIRADAR Completed B.E (Electronics & Communication Engineering), M. Tech (Communication System) and perusing Ph.D. from VTU, Belagavi, India. Research work at congestion control in sensor network using routing techniques. The area of interest in wireless communication, digital processing, etc.

Dr.T.S.Vishwanath Ph.D. in Control System, Institution: Dr. MGR Educational and Research Institute University Chennai India, M. E. in Control System, Institution: WCE Sangli, BE in Electrical Engineering, Institution: PDA College of Engineering Gulbarga. Research work at "Robust H∞ control and analysis" application to electrical drives. Member of MIE, ISTE, IETE and IJEET.