Implementing Node State Information based Clustering for WSN

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Abstract: With the advent of modern technologies like IoT, cloud technologies, RFID etc. the expectations of the people have seen a greater change. We can see a paradigm shift in the way the industry works. Similar shift has taken in the wireless sensor domain. But, still there are many issues like- efficient cluster formation, improving network lifetime are still posing challenges when it comes to practical implementation. The proposed work makes a successful effort to address these issues. The multi—coefficient decision analyzer(MCDA) mechanism and the node state Information based correlation coefficients evaluation(NSICCE) approach are being used to address cluster formation and cluster head selection process. Proposed algorithm results are compared with LEACH protocol where, the energy consumption is reduced by 32%.

Keywords: WSN, Energy efficiency, LEACH, NISC.

1. Introduction:

Lot of active research is happening in the field of wireless sensor networks(WSN). People are finding more and more applications of WSNs to reap benefits. Wireless sensor networks finds its applications in surveillance, disaster management, healthcare domain, manufacturing etc. . Since the nodes are wireless and have become smaller in the size, and are highly scalable in nature and consumes less energy[2]., WSNs have become the obvious choice to collect information from the surrounding environment. The ultimate destination of such sensed information is the Base station[3]. During this data transfer, there should not be any data loss. Hence, for this reason, it is highly desirable to have an efficient wireless sensor network.

In an ideal WSN setup, sensor nodes are arranged into small groups where, each group is a cluster and the head of the group is called as the Cluster Hear(CH). This cluster head is respoNISble for collecting information from all the nodes in that cluster/group[8]. Furthermore, the cluster head sends information to its nearest cluster head, in turn, that cluster head will send it to its nearest cluster head. The same process is repeated until the information reaches the Target node(Base station)[9]. During this course of sending information, different researchers have used various routing and data aggregation strategies which actually helps in consuming less energy and hence, improving the WSNs lifetime. Various researchers have put lot of efforts to improve the network lifetime. But still, LEACH(Low Energy Adaptive Clustering Hierarchy) is considered as the benchmark to compare with any new protocol that is designed for data aggregation and routing in an WSN. LEACH has got few drawbacks like- High energy consumption, routing, node localization etc. We have studid various aggregation and routing algorithms published in recent years. We have discussed some of the routing strategies in the literature survey.

In this research paper, we are proposing a NIS based model to discuss the energy efficiency and data transmission methods using the implementation results.

2. Literature Survey:

From past 2 decades, we have seen significantimprovemrnts in terms of applications of wireless sensor networs and, the trend is gaining more momentum. Te main task of the sensors is to sense information and to transfer it to base station through intermediate nodes, most of the times[14]. The sensor nodes are empowered by finite battery capacity. Thus, they become inactive once the power is fully utilized by the sensor for transceiving information. Hence, the lifetime of a WSN in finite. To improve the lifetime, various mechanisms are suggested by numerous researchers. Major such mechasims contributing to our work are listed below.

A work on Enhanced Clustering Hierarchy(ECH) was presented in [15], that talks about maximizing network lifetime. This methods uses sleep/awake technique. i.e. basically sensors will be kept on sleep mode. But during regular intervals, sensors have to wake up to collect information from its surroundings. Paper[16] also uses the Enhanced Clustering hierarchy with little variation. i.e. few nodes are kept in sleep mode and few in awake/active mode. In this approach, sensors will suffer from range limitations. Hence, may not be able to cover entire network range. Paper[16] uses a fuzzy technique to select the cluster head and helps in expanding network lifetime. Here, just like LEACH, information is sent from sensor node to cluster head, then to the super cluster head(SCH) and finally to the target node.

Paper[17] uses a grid channel technique for environment observation. In an multi-hop network this strategy helps in reducing energy consumption. But the drawback is, it is applicable only to homogeneous nodes. To overcome this, in paper [18], a unique technique called as ARSH-FATI mechanism is used to extend lifetime of an heterogeneous and homogeneous nodes. This technique possess effective mechanism to elect the cluster head(CH). They have used radical energy to trade-off performance. Paper [19] uses effecvtive approach to improve network coverage area and energy efficiency. This network works well if the network size is not too big. Otherwise, it is not possible to optimize energy consumption. Anyhow, this approach minimizes overall energy consumption while increasing network life. Based on SARSA charging, [20] proposes an innovative charging and routing technique for WSNs. Here, a multi objective model is used for wireless charging of sensors. In addition, for information transfer, a self learning machine model is also used. Further, to deal with heterogeneous nodes, [21] proposes a sleep/awake based approach for sensor nodes. This reduces energy usage by nodes and this technique also helps in sending information to intermediate nodes by avoiding network traffic.

The above said approaches uses various approaches but still fail to meet the goals when implemented practically. Hence, a Node State Information(NIS) based technique is used for effective selection of Cluster Head(CH) by using local information collected by sensors.

3. Evaluation of Node State Information(NIS):

This section discusses about the effective mathematical modelling of proposed NIS-based Clustering (NISC) model for a Wireless Sensor Networks (WSNs) to enhance lifetime of sensor network by using efficient Cluster Head selection mechanism and energy efficient algorithms. Various models like sensor node energy enhancement model, energy consumption model and sensor network model are adopted in this article to achieve objectives of energy-efficient Wireless Sensor Networks.

3.1 Node State Information (NIS) Evaluation:

Assume that $\mathbb{A}$ is a disjoined arbitrary variable and disjoined deNISty function can be expressed as $\beta(y) = \rho\{\mathbb{A} = y\}$ where $y \in \mathbb{A}$. The Node State Information (NIS) for a disjoined arbitrary variable $\mathbb{A}$ can be determined by the following equation:

$$\mathbb{L}(\mathbb{A}) = -\sum_{y\in\mathbb{A}} \beta(y) \log_2 \beta(y) \qquad (1)$$

Where, the maximum value of Node State Information (NIS)($\mathbb{L}_{max} = \log_2(\mathbb{x})$) is achieved when each disjoined deNISty function has the similar values of $\frac{1}{\mathbb{x}}$. Here, $\mathbb{x}$ represents the total quantity of sensor nodes. Whereas Node State Information (NIS) becomes minimum i.e. zero, whenever any of the disjoined deNISty function becomes zero.

A. Sensor Node Energy Enhancement Model:

A Wireless Sensor Network (WSN) is made up of various different features in nature, including computational, diversified node connectivity, and diverse energy. Furthermore, the suggested NISC model covers all of the above-mentioned WSN properties in depth. Basic stage nodes, middle stage nodes, and final stage nodes are the three types of sensor nodes used in the proposed NISC paradigm. The preliminary energy of intermediary nodes is equal to the midpoint between the preliminary energies of basic and final stage nodes. Furthermore, the preliminary energy of basic sensor nodes may be expressed as, whereas the preliminary energies of intermediate and final stage nodes can be expressed as.

$$N_I = (1+\varphi)N_P \text{ and } N_F = (1+\lambda)N_P \quad (2)$$

Where, φ and λ are the energy correction coefficients for intermediary and final stage sensor nodes respectively. Thus, the combined preliminary energy of all the nodes can expressed as,

$$N_C = aN_P(1 + n\varphi + u\lambda) \quad (3)$$

Where, u is described as the ratio of final stage nodes. Similarly, n is described as the ratio of intermediary stage nodes whereas a represents total quantity of sensors present in a Wireless Sensor Network (WSN).

B. Energy Consumption Model:

The energy consumption in sensor nodes take place in a Wireless Sensor Network (WSN) due to transfer of information either transmitting or receiving. Moreover, energy consumption is high while transmitting information rather than receiving signal due to the extra energy needed to amplify signal between interval and destination. Here, constraints which are utilized for the modelling of proposed NISC model are node energy, information aggregation and energy variables. Therefore, the node energy consumption to transfer information of $m-bits$ to an interval i can expressed as,

$$N_{G_y}(m,i) = \begin{cases} mN_e + m\chi_{li}i^2 \\ mN_e + m\chi_{gi}i^4 \end{cases} \quad (4)$$

Where, $N_{G_y}(m,i)$ represents node signal transmission energy and electronic energy consumption while transmitting signal is N_e. Moreover, energy consumption for transmitting signal for an interval greater than i is represented as χ_{gi}whereas for an interval less than $i$for transmitting signal is represented as χ_{li}**Sensor**

C. Sensor Network Model:

CoNISder that Z number of sensor nodes with dimeNISon$K \times K$ are arbitrarily placed in an area A. Moreover, let all these sensor nodes are steady in nature and every sensor node coNISsts of a distinctive ID. Let that every sensor node is linked with its adjacent nodes and have an information of their IDs and exact location. This information can collected by sensor nodes between each other statically or occasionally if continuous modifications take place in sensor network.

3.2 Node State Information based Clustering (NISC) Model:

This section covers everything you need to know about clustering based on node state information. The major goal of a suggested NIS-based Clustering Model (NISC) is to provide a dynamic and self-arranging clustering mechanism that reduces the energy consumption of a WSN, resulting in a significant increase in network lifetime. For the efficient selection of Cluster Head in a Wireless Sensor Network, the proposed model requires coordination of two key techniques. The first approach is the Multi-Coefficient Decision Analyzer (MCDA), and the second is the Node State Information based Correlation Coefficients Evaluation (NSICCE). Some of the factors described above have a direct impact on the above-mentioned techniques, such as enduring energy, total number of assisted sensor nodes, total distance to source station, and the sum of distances from one node to all of its adjacent nodes. The following is a full discussion of the aforementioned factors:

A. Enduring Energy $N(j_b)$:

The most significant characteristic for every sensor node of a Wireless Sensor Network is an Enduring Energy and the lifetime of a sensor network is majorly dependent on this Enduring Energy amid sensor nodes.

B. Total Distance to Source Station $C(j_b)$:

The factor total distance to a source station is also an essential parameter to enhance lifetime of a sensor network as energy consumption between sensor nodes will be more if the distance of sensor nodes and source station is quite long while transmission of information packets.

C. Summation of Distance from One Node to All of their Adjacent Nodes (CZ):

CoNISder that Cluster Head (CH) is connected with all the nodes presented in that cluster then for the transmission of information packets between a CH and its associated members requires high energy and hence the lifetime of battery-driven sensor nodes reduces continuously.

3.3 Cluster Head Selection Process:

The selection of a Cluster Head (CH) for a Wireless Sensor Network (WSN) is described in this section. The sensor node's local data includes information about the node's current energy, the distance between nodes and the source station, and the distance between a sensor node and its neighbouring nodes. The local data of a sensor node is a critical coNISderation for choosing an effective Cluster Head (CH). Setting up a Multi-Coefficient Decision Analyser (MCDA) to pick exact Cluster Heads with lower energy consumption and greater data packet transmission rate with no data redundancy relies heavily on the local data of sensor nodes. The suggested Multi-Coefficient Decision Analyser (MCDA) method is designed to eliminate the decision-making issues that frequently arise during CH selection.

A. Multi-Coefficient Decision Analyser (MCDA) Mechanism:

In this Multi-Coefficient Decision Analyser (MCDA) Mechanism, a ratio is multiplied with $(R_1, R_2, R_3 \dots)$ and compared with each other for every benchmark$(\mathbb{D}_s)$. Every ratio is increased to the power similar to the relative weight of the respective benchmark. The two sensor nodes R_X and R_Y can compared using Multi-Coefficient Decision Analyser (MCDA) Mechanism by following equation,

$$Q.(R_X.\ (R_Y)^{-1}) = \prod_{b=1}^{u} \left(v_{X_b}.\ \left(v_{Y_b}\right)^{-1}\right)^{\mathbb{t}_b} \quad (5)$$

Here, $X\ and\ Y$ can be defined as $X, Y = 1,2 \dots \dots \dots, \mathbb{x}$ and the potential measure of sensor nodeR_s can be denoted asv_{sb}. It is concluded that the sensor nodeR_X is more efficient than in comparison with R_Y when the ratio $Q.(R_X.\ (R_Y)^{-1}) \geq 1$ and vice versa. The most effective sensor node is the one which is greater than or at least same as all other sensor nodes. Moreover, the another way for setting up Multi-Coefficient Decision Analyser (MCDA) Mechanism is the utilization of only product term instead of a ratio which can determined by following equation,

$$Q\ .(R_X) = \prod_{b=1}^{u} \left(v_{X_b}\right)^{\mathbb{t}_b} \quad (6)$$

Where, the product term $Q.(R_X)$ shows the potential measure of sensor nodeR_X presented in equation (10) when all the benchmarks are assessed using Multi-Coefficient Decision Analyser (MCDA) Mechanism. The

Correlation Coefficients$\mathbb{t}_b$ of separate standard can determined using Node State Information based Correlation Coefficients Evaluation (NSICCE) approach which is discussed in following section.

B. Node State Information based Correlation Coefficients Evaluation (NSICCE) Approach:

Node State Information Evaluation approach is discussed to find out the correlation coefficients for a particular standard. The key stages to evaluate correlation coefficients of u standard and $\mathbb{x}$number of sensor nodes can determined in following manner,

- Firstly, evaluate the Node State Information for every benchmark $s = 1, \dots \dots, u$ which can determined using equation (1).

$$\mathbb{L}_s = -(\log_2 \mathbb{x})^{-1} \sum_b^{\mathbb{x}} \beta_{sb} \log_2 \beta_{sb} \quad (7)$$

Where, b can be defined as $b = 1, \dots \dots \dots, \mathbb{x}$ and$\beta_{sb} = \frac{\mathbb{D}_s(j_b)}{\sum_b^u \mathbb{D}_s(j_b)}$. Here, $\mathbb{D}_s(j_b)$ is the potential measure of sensor nodej_b. Moreover, the value of $\beta_{sb} \log_2 \beta_{sb}$ becomes zero whenever$\beta_{sb} = 0$.

- Secondly, Node State Information based Correlation Coefficient ($\mathbb{t}_s$) of every benchmark s,

$$\mathbb{t}_s = (1 - \mathbb{L}_s).\left(u - \sum_s^u \mathbb{L}_s\right)^{-1} \quad (8)$$

Where, $\sum_{s=1}^{u} \mathbb{t}_s = 1$ and the value of $\mathbb{t}_s$ lies between 0 and 1

C. Cluster Head Selection Process:

An efficient Cluster Head (CH) is selected by following the steps shown in the algorithm 1. The primary steps are:

i. Evaluate the correlation coefficients for every benchmark using Node State Information Evaluation approach.

ii. Evaluate the product term Q for every sensor node j_b with respect to u standard using Multi-Coefficient Decision Analyser (MCDA) Mechanism by following equation:

$$j_b.Q = (j_b.\mathbb{D}_1)^{\mathbb{t}_1} \times (j_b.\mathbb{D}_2)^{\mathbb{t}_2} \times \dots \dots \dots \dots \times (j_b.\mathbb{D}_s)^{\mathbb{t}_s} \quad (9)$$

iii. Where, for every benchmark $\mathbb{D}_1, \mathbb{D}_2, \dots \dots \dots \mathbb{D}_s$ the correlation coefficients can be represented as $\mathbb{t}_1, \mathbb{t}_2, \dots \dots . \mathbb{t}_s$ respectively.

iv. The sensor nodes which coNISsts of greatest values of Q is selected as a CH for a WSN.

3.4 Node State Information based Clustering (NISC) Model Stages:

This section discusses about the formation of cluster and selection of its Cluster Head stage and information broadcast stage using Node State Information based Clustering (NISC) Model.

3.4.1 Formation of Cluster and Cluster Head Selection Stage:

In first stage using NISC model in a WSN, source station finds out the most favourable number q for CH in the primary round i.e. $\mathbb{g} = 1$. Source station take part in election of CHs only in the primary round. Based on algorithm 1, CHs is selected for a cluster in a WSN by taking in coNISderation, the factors like benchmark, N,Z_{assist} and C etc.

i. **Cluster Head Selection Stage:**

Energy consumption in CH take place due to energy consumption in receiving information from all other sensor nodes, information aggregation and transmitting information to SS. CoNISder that Z number of sensor nodes are placed in a WSN evenly and q number of clusters are present in that WSN.

Then, the number of sensor nodes present in a WSN per cluster can be determined by $\frac{Z}{q}$ in which cluster value is 1 and remaining sensor nodes are determined using $\frac{Z}{q}-1$. Then, total energy consumption for round by CH is determined suing following equation:

$$\mathbb{E}_{CH} = \left(\frac{Z}{q}-1\right) N_{H_y}.(m) + \frac{Z}{q}.m.N_d + N_{G_y}(m, i_{SS}) \quad (10)$$

The energy consumption by sensor nodes in transmitting information to CH can be determined by the following equation,

$$\mathbb{E}_{osn} = N_{G_y}(m, i_{CH}) \quad (11)$$

Where, i_{CH} is the information broadcasting distance between sensor nodes and CH and i_{SS} is the information broadcasting distance between CH and SS. Then, i_{CH} and i_{SS} can determined using following equation for a field $K \times K$,

$$i_{CH} = 0.765.K.(2)^{-1}, i_{SS} = K.\left((2\pi q)^{1/2}\right)^{-1} \quad (12)$$

Assume that a sensor node j works for a $\mathbb{d}_{osn}$ duration and CH works for a $\mathbb{d}_{CH}$ duration then the total expense of energy for a sensor node j in a primary round $\mathbb{g}$ can determined as,

$$N_{expense}(j, \mathbb{g}) = \mathbb{E}_{CH}\mathbb{d}_{CH} + \mathbb{d}_{osn}\mathbb{E}_{osn} \quad (13)$$

From equation (14), the remaining energy present for a sensor node j in the next iteration $\mathbb{g}+1$ can utilized to evaluate where primary round $\mathbb{g}$ has ended.

$$N_{evaluate}(j, \mathbb{g}+1) = N_{remaining}(j, \mathbb{g}) - N_{expense}(j, \mathbb{g}) \quad (14)$$

The present remaining energy is how close to the evaluated energy is calculated by the following equation for a sensor node j,

$$\delta = \left|1 - \left(N_{evaluate}(j, \mathbb{g})\right).\left(N_{remaining}(j, \mathbb{g})\right)^{-1}\right. \quad (15)$$

The evaluation error can be determined when a constant coefficient χ is greater than δ. The decision of next round after completion of primary round is taken based on sensor node data such as their ID, $N_{evaluate}$, $N_{remaining}$ and Z_{assist} by executing Algorithm 1.

ii. **Cluster Formation Stage:**

For transmitting incisive information to SS, the sensor nodes jointly transmit their information to the CH which requires least broadcasting cost to transmit information to SS due to received signal strength. CH decides the duration in which information need to transmit by the sensor nodes to CH. This approach will reduce collision between information transmissions as well as reduce traffic.

iii. Information Broadcasting Stage:

All the sensor nodes transmit their sensed information in the given time duration by CH in proposed NISC model. However, collected information contains information about their ID, $N_{evaluate}$, $N_{remaining}$ and Z_{assist}. Therefore, this information can be utilized for changing CH in the following rounds. After collecting information from all the sensor nodes, CH processes this information and then processed information is transmitted to SS.

Algorithm 1: Cluster Head (CH) Selection Process

Step 1: **Input:**Group of Sensor Nodes$J$,q is total quantity of CHs and sensor node j
Step 2: **Output:**q Sensor nodes with greatest product term$Q$
Step 3:the benchmark value for a sensor node$j$considering a standard s is $j_b.\mathbb{D}_s$
Step 4: total quantity of standards is u
Step 5: Quantity of sensor nodes in Group of Sensor Nodes J is $\mathbb{x}$
Step 6: while$s = 1$ to u do
Step 7: while $b = 1$ to $\mathbb{x}$ do
Step 8: $\beta_{sb} = \frac{\mathbb{D}_s(J_b)}{\sum_{\Gamma=1}^{\mathbb{x}} \mathbb{D}_s J(\Gamma)}$
Step 9: end while
Step10: $\mathbb{L}_s = -(\log_2 \mathbb{x})^{-1} \sum_b^{\mathbb{x}} \beta_{sb} \log_2 \beta_{sb}$
Step 11: end while
Step 12: while $s = 1$ to u do
Step13: $\mathbb{t}_s = (1 - \mathbb{L}_s).(u - \sum_s^u \mathbb{L}_s)^{-1}$
Step 14: end while
Step 15: while $b = 1$ to $\mathbb{x}$ do
Step 16: $J(b).Q = \prod_{s=1}^{u}(J(b).\ \mathbb{D}_s)^{\mathbb{t}_s}$
Step 17: end while
Step 18: Start again q Sensor nodes from Group of Sensor Nodes$J$with greatest product term Q

4. Result and Discussion:

To address these concerns of High energy consumption, node failure etc. , a Node State Information based Clustering (NISC) technique is presented in this paper for the effective selection and construction of Cluster Heads (CH) in Wireless Sensor Networks (WSNs). The proposed NIS-based Clustering Model (NISC) is a self-organizing clustering method that is dynamic. Local information acquired (Node ID,, and) from sensor nodes installed in the field of WSN is used to build clusters and elect cluster heads for those clusters. In the following part, the simulation findings are discussed.

In comparison to Low Energy Adaptive Clustering Hierarchy (LEACH), this section discusses the performance evaluation of the proposed NIS-based Clustering (NISC) Model based on performance metrics such as energy consumption of sensor nodes in a WSN, overall lifetime of the network, routing length, and communication overhead occurred. Furthermore, the time interval between the start of a simulation and the death of the first sensor node may be calculated to determine the network's stability lifetime. Table 1 shows many factors coNISdered in evaluating the performance of the proposed NISC model. The purpose of this paper is to provide an effective clustering approach in a WSN and to improve the network's lifetime while transferring quality information to the CH and from the CH to the SS. Furthermore, after each round, a graphical depiction of the simulation results is shown in terms of energy consumption as the number of rounds, number of failing nodes, communication delay, routing length, and number of active nodes increases. It is clear from the performance findings of the proposed NIS-based Clustering Model that the suggested NISC model outperforms LEACH in terms of the performance criteria provided.

Table 1 Simulation Parameters

Parameter	Value
Sensor Network Field Size	$(25 \times 25)\ m$
Number of Sensor Nodes	500,750,1000
Transmission Range	5 m
SeNISng Range	3 m
Initial Energy	$50\ nj/bit$
Information Packet size	2000 bit

Figure 1 shows a graphical depiction of simulation results for network lifetime with increasing number of rounds and total number of nodes using the proposed NISC model and a node size of 500. Figure 2 shows the simulation results for network lifetime as the number of rounds and total number of nodes increase, with node size set at 750. Figure 3 shows the simulation results for network lifetime as the number of rounds and total number of nodes increase, with node size set to 1000. All simulation results are compared against state-of-the-art methodologies LEACH to see how well they perform. The results show that the suggested NISC model is better than the LEACH. The proposed NISC paradigm significantly increases the network lifetime of a WSN. The lifetime of a sensor network is limitedto 'N' number of rounds in state-of-the-art approaches such as LEACH , and increasing the number of rounds increases energy consumption, reducing the lifetime to a set duration. This constraint, however, is well-handled by the proposed NISC model, as demonstrated in Figures 1 and 3.

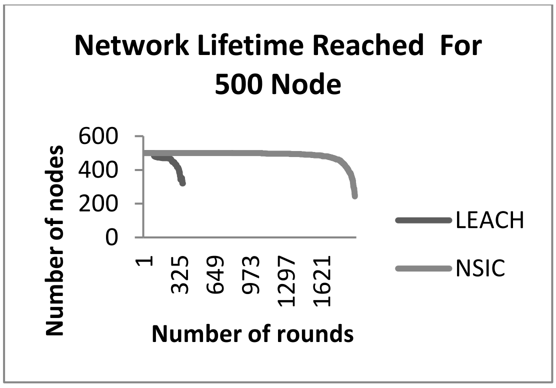

Figure 1: Network Lifetime Comparison with state-of-art-techniques considering 500 sensor nodes

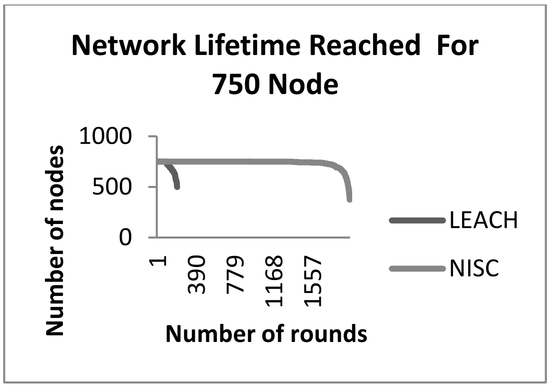

Figure 2: Network Lifetime Comparison with state-of-art-techniques considering 750 sensor nodes

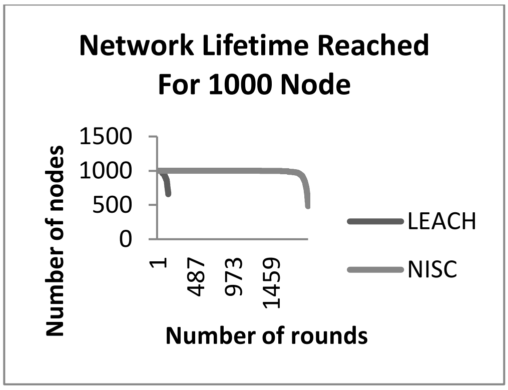

Figure 3: Network Lifetime Comparison with state-of-art-techniques considering 1000 sensor nodes

Figure 4 shows a graphical depiction of simulation results for energy consumption for total nodes of 500, 750, and 1000 utilising the suggested NISC model in comparison to LEACH and AODV. Figure 5 shows simulation results for failed sensor nodes utilising the suggested NISC model in comparison to LEACH and AODV for total nodes of 500, 750, and 1000. Similarly, simulation results for communication overhead utilising the suggested NISC model with total nodes of 500, 750, and 1000 are displayed in Figure 6 in comparison to LEACH and AODV.

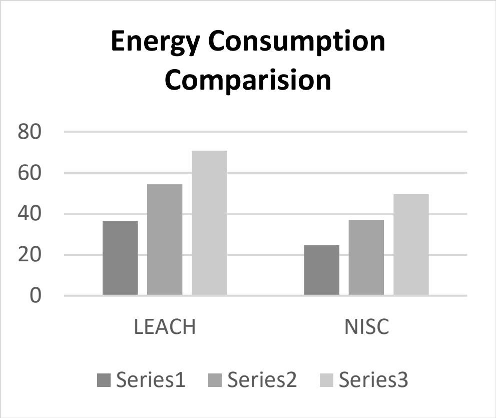

Figure 4: Energy Consumption comparison using Proposed NISC considering 500,750 and 1000 sensor nodes

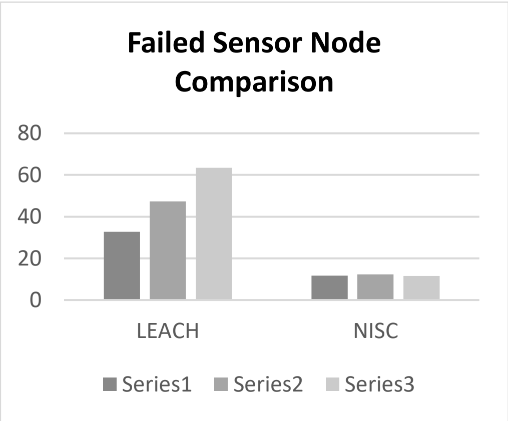

Figure 5: Failed Sensor Nodes in a network Comparison using Proposed NISC considering 500,750 and 1000 sensor nodes

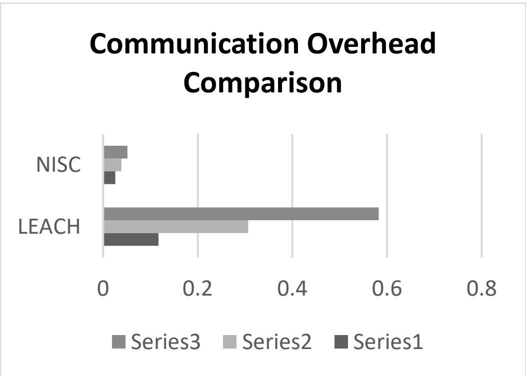

Figure 6:Communication Overhead Comparison using Proposed NISC considering 500,750 and 1000 sensor nodes

a. Percentage Improvement in Simulation Results:

This section compares the proposed NISC model to state-of-the-art methodology LEACH, in terms of simulation results such as energy consumption, and communication overhead for different sensor node sizes in a WSN, such as 500, 750, and 1000. When comparing LEACH with 500 nodes using the suggested NISC model, the percentage reduction in energy usage with increasing number of rounds is 32 percent. Similarly, the percentage reduction in energy consumption when considering 750 sensor nodes is 32%, and when considering1000 sensor nodes is 30%.

Furthermore, when 500 nodes are included, the percentage reduction in information routing distance utilising the suggested NISC model is 33 percent, when compared to LEACH protocol. Similarly, when considering 750 sensor nodes, the percentage decrement is 46 percent, and when considering 1000 sensor nodes, the percentage reduction is 52 percent.

Similarly, when 500 nodes are used using the suggested NISC model, the percentage decrement in sensor node failure is 64 percent, when compared to LEACH. Similarly, when considering 750 sensor nodes, the percentage decrement is 74 percent, and when considering 1000 sensor nodes, the percentage degradation is 82 percent.

Similarly, utilising the suggested NISC model, the percentage reduction in communication overhead as compared to LEACH for 500 nodes, 750 nodes, and 1000 nodes is 78 percent and 99 percent, 87 percent, respectively.

4. Conclusion:

The topological growth of Wireless Sensor Networks (WSNs) in recent years has given enormous strength to a wide range of applications all over the world. However, several of the WSN topological limitations, such as high energy consumption, imprecise routing mechanisms, and communication overhead, remain a worry. As a result, for successful selection and construction of Cluster Heads (CH) in Wireless Sensor Networks, a Node State Information based Clustering (NISC) method is used (WSNs). The suggested NIS-based Clustering Model (NISC) is a self-organizing clustering mechanism that is dynamic. The suggested NISC model includes a detailed mathematical model for lowering energy use and routing distance. Furthermore, the NISC model proposes a method for selecting efficient CH and cluster formation. Information transmission from sensor nodes to CH and CH to Source Station (SS) is strengthened in this article. Finally, employing an effective Cluster Head selection mechanism and energy efficient algorithms based on local information collected from sensor nodes, the proposed NISC model for a WSN extends the lifetime of a sensor network. In terms of energy usage, routing distance, communication overhead, and failed sensor nodes, the suggested NISC model delivers exceptional results. In compared to state-of-the-art LEACHapproaches, the average percentage decrement for failed sensor nodes, improvement is 20 percent, 35 percent and 55 percent for 500,750, and 1000 sensor nodes, respectively. This establishes the suggested NISC model's superiority over LEACH.

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