Data Disseminated Energy-Efficient Clustering Algorithm For Avoid Load and Bandwidth Consumption In WSN Integrated IoT Platform

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Abstract- In the current scenario, wireless sensor networks (WSNs) are embedded in the "Internet of Things (IoT) " platform where sensor nodes automatically link and use the Internet to communicate and execute their activities. WSNs are well suited for the collection of long-term IoT representation environmental data. The WSNs includes wireless communication capabilities, computation process, and nodes with sensing capabilities. Data dissemination methods, power management, and many routing procedures have been mainly designed for WSNs integrated IoT platform. Also, we consider load and bandwidth consumption as an essential issue in our design. Hence, this paper introduces a data disseminated energy-efficient clustering algorithm using multiple parameter decision-making for selecting an optimal clustering algorithm. For the cluster head selection process, we consider different kinds of parameters such as Initial Energy, Average Energy of the Network, Energy Consumption Rate, and Residual Energy. By considering these factors, nodes are continually monitored, and the cluster header is selected according to the maximum energy value. The respective cluster members are chosen in the cluster coverage area using the swarming techniques. In other words, we used swarm techniques as a cluster head selection process to avoid load and bandwidth consumption. The excellence of the system is evaluated using simulation results which show that this introduced method is more effective in terms of preventing bandwidth and load consumption. In this context, we use network simulator 2 (NS2) to simulate different kinds of metrics such as a packet delivery ratio, network lifetime, and energy consumption.

Keywords: Wireless Sensor Network, Internet of Things, cluster algorithm, Swarming Energy Consumption Rate, load, bandwidth.

1. Introduction

Internet of things (IoT) [1] can be defined as interrelated computing devices, digital machines, mechanical devices, and objects that are used to transfer the information and interact mutually via a network without human or computer intervention. The IoT devices [2] record every activity in the organization, the human body, and transmit the data using the Internet Protocol (IP). This IoT based data collection and transmission process utilized in different industries due to the effective decision-making enhanced customer services [3] and improve the overall business growth. The IoT technology plays an essential role in most of human life interactions including business management because it minimizes labor costs, improves functions, fewer manufacturers cost, less information collection cost, and offering transparency in customer transactions [4]. Due to these reasons, IoT is widely utilized in most applications including wireless sensor technology that able to gather information from
surroundings and transmit the data with minimum effort. The low-level maintenance and a small amount of power, sensors support the IoT applications [5]. However, the arrangement of sensing nodes in the region of interest is one of the biggest problems due to their nature of randomly and unpredictable distributed in the environment [6]. The distribution of nodes creates complexity while making the data transmission. During the data transmission process, data dissemination is one of the severe problems in wireless integrated IoT environments [7].

As discussed earlier, the sensor networks consist of a collection of nodes, which are operated for an extended period without the support of human intervention. Therefore, that network must require updating continuously for an effective data transmission process [8]. However, manual network updating is more complicated, which is called as the dissemination. The data dissemination happens in multiple nodes or single nodes [9]. The data dissemination is the data routed in the sensor networks, which means the new nodes are identified to perform the specific event. Sometimes, the nodes in the system having low energy, which reduces the entire information transmission process in the sensor networks. Therefore, the data dissemination process selects only the optimized nodes for making the information broadcast process. The valid selection of nodes reduces data failure, data loss; link failure also improves the quality of services [10]. In addition to this, the selected nodes consume low cost, minimum functionalities, low energy consumption, small physical size, and short radio coverage. The entire node characteristics only achieved with the help of a load-balancing concept [11]. Load balancing can be defined as every node in the network must have the same level of transmission and balance the work that will be used to improve the network lifespan [12]. If the network nodes work the same workload, each node reduces the energy level at the same rate for every network operation. More ever, the balanced network operations adjust the network bandwidth and improve the overall data transmission process.

By considering these network transaction considerations, different routing protocols such as A hierarchical data aggregation scheme [13], A Greedy multi-path routing algorithm [14], Energy Efficient Clustering Algorithms [15], etc. are designed to manage the node energy, data dissemination, load balancing and quality of services. Even though these algorithms ensure valid results, still the power management, data dissemination, load, and bandwidth consumption are some of the significant challenges. Therefore, in this work, the effective clustering algorithm is introduced to overcome the discussed issues. During this process, optimal clusters are selected by applying the data disseminated energy-efficient clustering process. The algorithm chooses the cluster node according to the energy consumption rate, network average energy, initial energy, and residual energy. Based on that, the cluster head is selected by using a multiple parameter decision-making process. Afterward, the swarming technique is applied to select the cluster nodes, which helps to minimize the discussed sensor network issues. Then the considered system efficiency is evaluated using simulation results such as a packet delivery ratio, network lifetime, and energy consumption.

The remaining structure of the paper is organized as follows: various researcher opinions about wireless sensor data transmission process and problem is analyzed in section 2. Data Disseminated Energy-Efficient Clustering Algorithm process is discussed in section 3; the efficiency of the system is evaluated in part 4 and concludes the work in part 5.

2. Related work
This section analyzes the various researcher's work for getting the idea for transmitting data in sensor networks by avoiding load and bandwidth consumption. Masdari, M. et al. [17] Developing effective multi-sink wireless sensor networks for balancing load using fuzzy logic-sink selection techniques. The introduced method helps to resolve the congestion problem while transmitting data from source to destination. During this process, one-hop sensor network is used to select the sink node independently. This process reduces the congestion problem also avoids the load issue. The created system helps to transmit the data to the destination with minimum delay and energy consumption. Due to the low energy utilization sensor, network lifetime is improved and reduces the number of data retransmission. The efficiency of the system is evaluated using simulation results.
Edla, et al. [18] Introducing shuffled complex evolution approach for managing load balancing in wireless sensor networks. This approach helps to resolve the cluster head selection difficulties because it is the main reason for high-energy consumption, minimum network lifetime. So, the optimal cluster head is selected according to the shuffled complex evolution fitness function. After selecting the cluster head, node-local density, simple genetic algorithm load balancing, and score-based load-balancing techniques are applied to reduce the load balancing issue. Due to the successful computation of load balancing process minimize the heavily loaded sensor nodes, execution time also manage the network energy and lifetime.

Rajpoot, P. et al. [19] Maximizing network lifetime using an optimized load balancing clustering algorithm with a multi-attribute decision-making approach. Traditionally, the cluster head is a challenging task to select, which leads to creating several quality-related issues. Therefore, in this work, 16 factors are analyzed before deciding the cluster head, and the multiple attribute decision-making process is applied to select the optimized cluster head. From the cluster head, respective members are chosen and form a valid cluster. After that, information is transmitted via the group to the sink node that reduces the quality-related issues successfully. Then the efficiency of the system is evaluated using simulation results.

Gherbi, C. et al. [20] Introducing the distributed energy-efficient adaptive clustering approach for managing the load balance in wireless sensor networks. The primary intention of this method is to reduce high-energy consumption, balancing the energy dissipation, and maximizing the network lifetime. The cluster head is chosen depending on the load and energy factor, and the information is transmitted via the node with a fixed time duration with sleeping control rules. This process minimizes the high-energy consumption also enhances the overall network lifetime. Then the efficiency of the system is evaluated using NS2 simulation in which the network transmits the information, and the effectiveness is evaluated with every 20s. The created system ensures the maximum throughput and reduces the high-energy consumption.

Yarinezhad, R. et al. [21] Creating the data dissemination model in wireless sensor networks for making the effective data transmission process. During this process, the mobile sink-based routing protocol is proposed to transmit the data. The information is broadcasted via virtual cellular structure, and the routing process is continuously updated for minimizing the delay and maximum energy consumption. The efficiency of the system is evaluated using experimental analysis and results.

Kim, B. et al. [22] Multicast routing protocol is introduced in a big data-based wireless sensor network for avoiding the data dissemination problem. The system uses the (m,k) firm to support the unicast communication process, which delivers the packet to the sink node effectively. The constructed multicast tree process uses the distance-based priority value that helps to minimize the delay and high-energy consumption. In addition to this, the multicast routing protocol maximizes the network lifetime. According to the various researchers work, sensor network faces the load balancing, energy consumption, data dissemination problem while transmitting data from source to destination. Therefore, several authors use different clustering and routing techniques to resolve the issues. By considering their opinion, in this work, Data Disseminated Energy-Efficient Clustering Algorithm is used to improve the overall network quality, lifetime and reduces the high-energy consumption. The detailed working process is explained in the next section.

3. Data Disseminated Energy-Efficient Clustering Algorithm for Avoiding Load and Bandwidth Consumption in WSN

This section discusses the detailed working process of data disseminated energy-efficient clustering algorithms (DDEEC) for eliminating the load and bandwidth consumption in a wireless sensor network. In the sensor network, information is transmitted from source to destination at the time, the wrong selection of transmission path or nodes create several transmission issues such as path failure, node failure, data failure, quality of services, heavy load, high bandwidth consumption, and high-energy utilization [22]. These problems are reducing the entire information broadcasting efficiency and the quality of services. If the network has a minimum load and consumed low bandwidth while transmitting
data, the whole transmission problems are overcome easily. Therefore, in this paper, the best nodes are selected from the collection of nodes to maximize the quality of services.

3.1 Network Model

The data disseminated energy-efficient clustering algorithm is used for forming the clusters in the network before making the data transmission process. The system consists of a variety of nodes that used to transmit any kind of information like data, audio, video, and images. The network is covered in a particular region consider n*n and the n number of nodes which are having specific properties and assumptions. Network region has high-density nodes, which are motionless with the same energy after deployment, nodes, can data disseminate at the time of data transmission process, location of each node is identified using the global positioning system. Once the node location is determined, sensor nodes are ready to send the data from the source to the destination. During this process, an energy-efficient node must be selected because that helps to manage the network lifetime and QoS. For this purpose, the first cluster head (CH) [23] must be chosen because it helps to perform quantitative and qualitative data process while sending data from source to destination. The CH is determined based on the node energy consumption; every node consumes a particular level of energy from source to sink node. The energy level depends on the distance between the transmitted and received nodes. Consider the packet ‘p’ is sent to the sink node where the distance is represented as ‘d.’ Then the transmission energy [24] is referred to as follows,

\[ T_e = E_{ele}^{(p)} + E_{mp}^{(p,d)} \]  

(1)

Here, d is the distance between the source and sink nodes. P is the transmission data or packet, T_e is the required transmission energy, ele is the electric energy, which is based on the digital coding, modulation, spreading, filtering, and so on equation (1) is further defined:

\[ T_e = \begin{cases} 
  p \cdot E_{ele} + p \cdot \epsilon_{fs} \cdot d^2 & \text{if } d < d_0 \\
  p \cdot E_{ele} + p \cdot \epsilon_{mp} \cdot d^4 & \text{if } d \geq d_0 
\end{cases} \]  

(2)

In equation (2), amplifier energy is defined as \( \epsilon_{fs} \cdot d^2 \) and \( \epsilon_{mp} \cdot d^4 \) which works according to acceptable bit error rate and receiver distance. For simulation purpose, the amplitude energy level is 0.0013 PJ/bit/m and \( \epsilon_{fs} \) value is 10pJ/bit/m. Based on energy consumption, the number of cluster head CH [24] is estimated using equation (3).

\[ k_{opt} = \frac{\sqrt{n}}{\sqrt{2\pi}} \frac{\sqrt{\epsilon_{fs} \cdot M}}{\epsilon_{mp} \cdot d_{tobs}^2} \]  

(3)

Here, deployment area is n*n, n is the number of nodes, the distance between cluster head and the base station is referred to as \( d_{tobs} \). During the cluster head selection process, different factors such as cluster head coverage, the standard deviation of cluster members, the average lifetime of cluster head, base station connectivity, the standard deviation of residual energy, maximum distance to the base station, the standard deviation of the average lifetime of cluster head must be considered.

3.2 Cluster Head Coverage

First, the cluster head coverage must be computed because if the node is within the range, then the node consumes minimum energy. Otherwise, it consumes high-energy while making the data transmission process. So, the cluster head distance must be equal to or less than the \( d_0 \). Then the cluster head coverage is computed as follows,
cluster head coverage = \left( \frac{\text{count nodes}}{n} \left( \min \text{distance}_{\text{node}-CH} \leq d_0 \right) \right) * 100 \quad (4)

In equation (4), $d_0$ is computed as $\sqrt{\frac{E_{fs}}{E_{mp}}}$; distance_{node-CH} is the distance between node and cluster head; count node is the number of nodes in network space. After collecting the gap between the nodes and cluster head, base station connectivity must be estimated.

3.3 Base section connectivity
Here the distance between the cluster head and base station must be computed. The minimum distance indicates that the information is transmitted with minimum energy and time. so, the base station connectivity is estimated as follows,

$\text{Base station connectivity} = \left( \frac{\text{count CH}(\text{Distance}_{CH-BS} \leq d_0)}{\text{Total CHs}} \right) \quad (5)$

In equation (5), Distance_{CH-BS} is represented as the distance between cluster head and base station, the number of cluster head is denoted as count CH. Then the average residual energy should be computed which helps to determine the lifetime of the network.

3.4 Average residual energy
Next, cluster residual energy [26] must be computed in which the cluster head should have the high power after transmitting the data. The higher value indicates that nodes having a good life. The average residual energy is computed using equation (6).

$\text{Average residual energy} = \frac{\sum_{i=1}^{\text{total CH}} \text{Residual energy}_{CHi}}{\text{Total CHs}} \quad (6)$

In equation (6), chosen cluster head remaining energy is represented as Residual energy_{CHi}. Then the standard deviation of residual energy must be computed using equation (7)

$\text{standard residual energy} = \sqrt{\frac{\sum_{i=1}^{\text{total CH}} (\text{residual energy}_{CHi} - \text{average residual energy})^2}{\text{Total CHs}}} \quad (7)$

According to equation (7), if the computed residual energy value is low, it indicates that the entire cluster head having equal energy. In addition to these parameters, the standard deviation of the number of members in the cluster should be computed.

3.5 Number of members in clusters-standard deviation
Standard deviation must be computed for every member in the cluster if the calculated value is shallow, then each group having the same number of nodes it helps to reduce the load. The cluster member standard deviation is estimated as follows.

$\text{cluster member standard deviation} = \sqrt{\frac{\sum_{i=1}^{\text{total CH}} (\text{member}_{i} - \text{average}(\text{member}))^2}{\text{Total CHs}}} \quad (8)$

After computing the cluster member’s standard deviation, the average lifetime should be calculated. It helps to get an idea about sensor QoS.
3.6 Cluster head average lifetime

In this stage, the average lifetime [27] is computed for the entire selected cluster head. The lifetime is estimated until the cluster head performs the data collection process. If the cluster head has a high value, then it has a maximum lifetime. Then the computation is defined as follows.

\[
\text{cluster head average lifetime} = \frac{\sum_{i=1}^{\text{Total CHs}} (\text{Cluster head residual energy}) \times \text{average transmission power required}}{\text{Total CHs}}
\] (9)

Here, the average transmission power required is represented as average energy to transmit the data from the source to the base station. Along with this, the standard deviation of cluster head lifetime should be computed which is done by using equation (10)

\[
\text{Standard deviation of CH lifetime} = \text{standard deviation (cluster head average lifetime)}
\] (10)

3.7 Maximum distance to Base station

In this process, the gap between the cluster head and base station should be computed. If the calculated distance is shallow, then the data transmission process consumes minimum energy. The distance measure is estimated using equation (11).

\[
\text{Maximum Distance to BS} = \text{Max} (\text{Distance}_{\text{CH} - \text{BS}})
\] (11)

In addition to this, the distance between the cluster head and other nodes should be estimated. As discussed earlier, the minimum distance value indicates that the node consumes low power while making the data transmission.

\[
\text{Average distance to CHs} = \frac{\sum_{i=1}^{n} \text{Dist (Nodei – Nearest CH)}}{n}
\] (12)

According to the above computation, the cluster head is selected based on energy consumption, residual energy, lifetime, and distance measure. Once the cluster head is selected, respective cluster members should be chosen from the remaining nodes. During this process, remaining nodes are arranged in the network search space, and the swarming technique is applied to estimate the optimal cluster members. Here, particle swarm optimization technique [28] is used to choose the best cluster members. The algorithm works according to the behavior of flocking animals like fish or birds. During the cluster member searching process, node position, velocity is updated continuously to select the best cluster member. The cluster member chosen should consume low bandwidth while making the data transaction. For that purpose, the particle swarm optimization algorithm executes in each BS for selecting the best node. So, the relationship between the network bandwidth and the input node must be computed as follows.

\[
[\text{BR}_B = \text{C} \circ P_B \circ \text{BW}_{\text{CH}} \circ \left(\frac{1}{D}\right)]
\] (13)

Here, B is the reserved bandwidth for cell or node, C is the constant, A probability value of the cluster head move is represented as \(P_B\), D denotes the distance between the cluster head and nodes.

After computing the node bandwidth, the efficiency of cluster member selection process is further improved by using a non-linear relationship, which is estimated using equation (14)

\[
\text{BR}_B(t) = C \cdot (P_B(t))^{x_1} \cdot (\text{BW}_{\text{CH}}(t))^{x_2} \cdot \frac{1}{(D_B(t))^{x_3}}
\] (14)

In the equation (14) PSO approach, the determined of the expected value is \(x_1, x_2, \text{and} x_3\). By considering the node factors, fitness value is applied to select the best node. Here, maximum is the fitness value because the node that is having a high-energy value that helps to support the network lifetime as well as balance the load while making the data transmission process. After selecting the best node, node velocity is revised to get the next optimized node. The velocity has been changed as follows.
\[ V_{ij}(t) = V_{ij}(t - 1) + c1 \cdot r1 \left( x_{pbestj}(t) - x_{ij} + c2 \cdot r2 \cdot (X_{gbest}(t) - x_{ij}(t)) \right) \] (15)

Here random numbers are represented as \( r1 \) and \( r2 \) whose value is 0 and 1. Positive acceleration constant is \( c1 \) and \( c2 \). According to the process, cluster members are selected, and the information is transmitted via the selected nodes in the network region. Based on the discussion, the energy-efficient multiparameter clustering algorithm is discussed in Table 1.

**Table 1. Clustering algorithm for minimizing the band consumption and load.**

| Step 1: Prepare the network search region n*n |
| Step 2: Collect the node's information in the search space to compute the parameter. |
| Step 3: Compute cluster head coverage |

If the CH coverage value is high then
- Compute the base station connectivity
- Estimate the *Average residual energy* value of CH and respective node
- Compute average lifetime of the node
- Calculate the cluster member standard deviation value
- Estimate the distance between the base station and cluster head
- Arrange the cluster head and members according to the obtained values.

Else
- Analyze the node in the respective coverage region according to the residual energy, base station connectivity, etc.

Step 4: Then the highest value is chosen as a cluster head

Step 5: Select the cluster members from the remaining nodes using swarming techniques

Step 6: Compute the node energy value, coverage value, residual energy, and node probability value is estimated

Step 7: Estimate the fitness value of the node value

Step 8: Select the specific region, and maximum value nodes are cluster member

Step 9: update the velocity of each node using equation (15)

Step 10: Repeat the step from 5 to 9.

Based on the algorithm steps, the cluster head and respective members are selected expertly. From the chosen nodes, information is transmitted from source to destination. Due to the practical computation of different parameters from equation (1) to equation (12), helps to choose the best node that reduces the high bandwidth consumption and minimize the high-energy utilization. The minimum energy consumption leads to maximize the network lifetime. Then the efficiency of the system is evaluated using simulation results, which are discussed in the next section.

4. Simulation Results

This section discusses the excellence of the Data Disseminated Energy-Efficient Clustering Algorithm. As discussed in the above sections, the data is transmitted by selecting the energy-efficient cluster head and cluster member that reduce the unwanted energy consumption which improves the overall network lifetime. In addition to this, the distance between the nodes, base station, and other factors are helping to reduce the unwanted bandwidth consumption. The explained energy-efficient clustering algorithm-based data transmission process implemented using NS2 simulation results. During the implementation process, Table 2 simulation setup is used. According to Table 2, the simulation step is created, and the efficiency of the system is evaluated using different parameters such as network lifetime, packet delivery ratio, and energy consumption. First, the delay of the network must be computed before analyzing the efficiency of the system. The suspension is calculated from the processing delay, queuing delay, and propagation delay. Due to the effective formation clusters, cluster head selection, and the distance
between the base stations, all of these factors, helps to improve the data transmission rate. That means an energy-efficient swarm technique-based clustering process minimizes the end-to-end delay. The efficiency of the system is evaluated with a different number of nodes and the existing methods such as fuzzy logic-sink selection techniques (FLSS), shuffled complex evolution approach (SCE), distributed energy-efficient adaptive clustering approach (DEEAC), optimized load balancing clustering algorithm (OLBC). Then the obtained result is depicted in Table 3.

### Table 2. Simulation parameter.

| Parameters                  | Symbol | Values  | Unit  |
|-----------------------------|--------|---------|-------|
| Network region              | S      | 100*100 | M2    |
| Coordinates of the sink node|        | (50,100) | M     |
| Number of nodes             | N      | 100     |       |
| Initial energy              |        | 2       | J     |
| Communication radius        | R      | 20      |       |
| Radio disperses             | $E_{elec}$ | 50 | nJ/bit |
| Amplifier transmit          | $\varepsilon_{amp}$ | 0.0013 | pJ/(bit.m$^{-2}$) |
| Distance (reference)        | $d_0$  | 87      | M     |
| Single sampling packet size | K      | 4000    | Bit   |

### Table 3. End to End Delay.

| Number of Nodes | FLSS  | SCE  | DEEAC | OLBC | DDEEC |
|-----------------|-------|------|-------|------|-------|
| 10              | 57.44 | 52.12| 48.90 | 45.2 | 40.23 |
| 20              | 64.13 | 61.34| 58.23 | 56.24| 53.23 |
| 40              | 79.52 | 65.33| 55.5  | 67.24| 50.13 |
| 50              | 112.88| 98.19| 78.3  | 72.4 | 65.8  |
| 70              | 147.34| 121.34| 83.0 | 77.34| 68.34 |
| 80              | 175.19| 138.13| 92.4 | 89.48| 74.89 |
| 100             | 210.34| 169.42| 134.7| 104.5| 87.35 |
| 120             | 264.23| 175.08| 148.5| 137.35| 103.45|

Table 3 illustrated that the end-to-end delay time value in second of data disseminated energy-efficient clustering algorithms (DDEEC) approach which is compared with the existing load balancing techniques like FLSS, SCE, DEEAC and OLBC. From the analysis, the DDEEC approach attains minimum delay value (67.92s) compared to other methods such as FLSS (138.32s), SCE(110.188s), DEEAC(87.44s) and OLBC(81.28s). From the results, the graphical representation of end-to-end delay is depicted in Figure 1.

It is clearly that the introduced approach has low end-to-end delay value for different number of nodes compared to other load balancing techniques. The minimum delay indicates that the system transmits the information from source to destination effectively. Moreover, the system avoids the load and high bandwidth consumption, which leads to an increase in the overall packet delivery ratio. equation (16) is used to compute the packet delivery ratio.

\[
PDR = \frac{\text{No of packets transmitted successfully}}{\text{No of packets generated}} \times 100
\]

(16)
Figure 1. End–to-End Delay.

Based on equation (16), the PDR value is estimated, and the obtained value is depicted in table 4. Table 4 illustrated that the packet delivery ratio of (DDEEC) algorithms approach, which is compared with the existing load balancing techniques like FLSS, SCE, DEEAC and OLBC. From the analysis, the DDEEC approach attains minimum delay value (98.32%) compared to other procedures such as FLSS (91.94%), SCE (93.08%), DEEAC (94.45%) and OLBC (96.16%). From the results, the graphical representation of the packet delivery ratio is depicted in Figure 2.

| Number of Nodes | FLSS | SCE  | DEEAC | OLBC | DDEEC |
|-----------------|------|------|-------|------|-------|
| 10              | 90.388 | 91.34 | 93.68 | 95.76 | 98.27 |
| 20              | 90.34 | 92.67 | 94.27 | 96.24 | 98.35 |
| 40              | 91.349 | 91.79 | 92.67 | 95.37 | 98.75 |
| 50              | 92.68 | 93.56 | 94.28 | 96.39 | 97.86 |
| 70              | 92.78 | 93.62 | 95.24 | 97.34 | 98.42 |
| 80              | 91.56 | 92.78 | 94.78 | 96.85 | 97.987 |
| 100             | 92.77 | 94.24 | 95.72 | 96.73 | 98.31 |
| 120             | 93.67 | 94.65 | 95.76 | 98.24 | 98.65 |

We can see from Figure 2 that DDEEC approach is attaining the higher packet delivery ratio compared to other methods. Even though the technique ensures minimum delay and high delivery ratio, it should consume low energy while transmitting data from source to destination. According to the section 3 discussion, cluster head and cluster members are selected by considering the different factors that directly indicate that the system ensures minimum energy. Then the obtained energy value for the different number of nodes is depicted in Figure 3.
Figure 2. Packet delivery ratio.

Figure 3 illustrated that the energy utilization value of data disseminated energy-efficient clustering algorithms (DDEEC) approach, which is compared with the existing load balancing techniques like FLSS, SCE, DEEAC and OLBC. From the analysis, the DDEEC approach attains minimum power (3.63J) compared to other methods such as FLSS (6.80J), SCE (5.93J), DEEAC (5.35J) and OLBC (5.95J). The minimum energy factor directly shows that system has a high network lifetime compared to baseline approaches. The obtained network lifetime is depicted in Figure 4. From the analysis, the DDEEC approach attains a high network lifetime (827.98103s) compared to other procedures such as FLSS (238.88/103s), SCE (510.11/103s), DEEAC (612.44/103s) and OLBC (706.23/103s). Due to low energy, high network lifetime, minimum delay, and high packet delivery ratio directly indicate that the introduced approach able to manage the network load and consume the minimum bandwidth while transmitting data from source to destination.

Figure 3. Energy Utilization.
5. Conclusion
The paper analyses the data disseminated energy-efficient clustering algorithms (DDEEC) approach-based data transmission process in the wireless sensor integrated IoT platform. During this process, first, the cluster head is examined according to the residual energy. In addition to this, base station connectivity, standard deviation cluster member, average network lifetime, average residual energy, and other factors are continuously examined. By considering these factors, nodes are continually monitored, and the cluster header is selected according to the maximum energy value. Then the respective cluster members are chosen in the cluster coverage area using the swarming techniques. Here, particle swarm optimization technique is applied to determine the right cluster member. Every time, the node positions are updated to predict the right cluster member. After selecting the cluster member, information is transmitted to the respective cluster. Then the efficiency of the system is evaluated using simulation results in which the DDEEC approach transmits the data with 98.322% of packet delivery ratio, 62.7s delay, and minimum energy utilization. In the future, the optimized techniques are used to select the cluster head, which improves the overall data transmission performance.

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