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An optimized approach to enhance the network lifetime through integrated data aggregation and data dissemination in wireless sensor network

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ABSTRACT

Wireless sensor network (WSN) is an integral part of internet of things (IoT), it comprises multiple sensor nodes to sense that data for various applications; also, sensor nodes have limited energy. Hence, several researchers to improvise the network lifetime and reduce energy through machine learning approaches like clustering have used data aggregation; considering the WSN architecture and development of novel use cases and dynamic behavior, data aggregation cannot solve the problem of efficiency solely. Hence integrating data aggregation and data dissemination can provide a research scope to achieve optimal efficiency. This research work introduces an integrated-data aggregation and data dissemination (DADD) to develop an efficient WSN-based model for lifetime enhancement. Integrated-DADD follows two sub-mechanisms; the first part of the mechanism introduces an optimal clustering technique to perform the clustering and optimal parameter tuning is formulated and efficient data aggregation takes place. The second part of the integrated-DADD introduces optimal data dissemination through optimal path selection, which helps in finding the suitable path for data dissemination. Integrated-DADD is evaluated considering the parameters like energy consumption, network lifetime in terms of rounds; active node participation, and communication overhead, comparative analysis indicates that integrated-DADD outperforms the existing model.

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1. INTRODUCTION

Cloud computing, big data, artificial intelligence, networks using 5G communication, and edge computing promote the expeditious development and application of the internet of things (IoT) is done widely [1]. The investment that is produced by IoT is rapidly increasing along with increasing development due to the industrial prospects, massive applications, and large potential value commercially. The widespread IoT development also faces major difficulties [2]. Although there is the rapid growth of IoT devices that are interconnected along with a lot of IoT systems emerging that include smart grids, intelligent transportation, smart home, and many more, the count of the data is necessary for the network to collect, transmit, store and process exponentially increases. Therefore, there exists a contradiction between the exceeded data growth, the capacity of transmission in the network, and the limited resources of the spectrum. Data in large amounts causes congestion, this issue becomes serious leading to an increase in delay of data transmission. Quality of service (QoS) is denied and quality of experience (QoE) eventually detreats. The data that is produced by the growth of IoT along with the growing count in the number of users may lead to corresponding problems where the delay in transmission massively increases and reduced the quality of data. It is highly essential to analyze and resolve the stated problems for the good development of human-machine interconnection [3].

Wireless sensor network (WSN) is defined as an infrastructure-less and self-configured wireless network that is used for monitoring and recording the environment's physical conditions and storing the data that is collected at the central location. Lately, WSNs have gotten a lot of attention for various kinds of applications as they are inexpensive, small in size, and can be applied in various fields including military, healthcare as well as underwater monitoring. Recently, the network, device, and technologies of data management for WSNs are extended to various fields including smart factories in which sensor nodes are used for the collection of data on machines and products for operations on smart factories. Consider Smart cities, WSNs are used in the creation of efficient delivery service platforms for the municipal workers and the public for efficient management of resources in the city [4]–[7]. Figure 1 presents the typical data transmission that occurs in WSN and further comprises cluster head (CH), sensor nodes and base station.

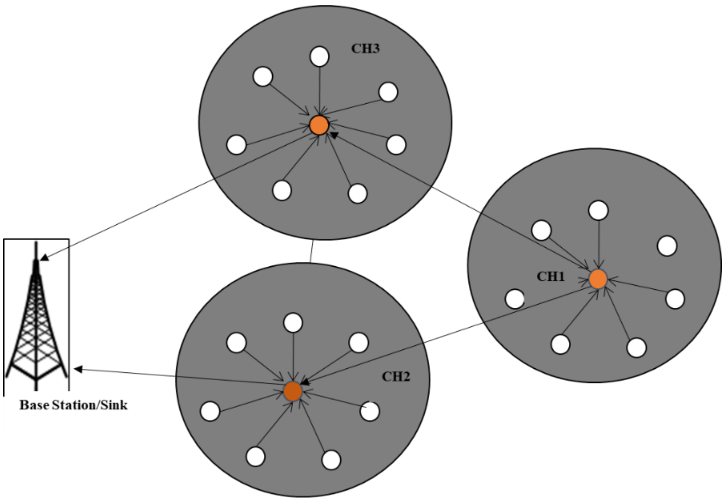

Figure 1. Typical data transmission in WSN

In WSN, over a large area, various sensors are used for the collection of observation data which is sent to a server or sink. Hence, there is a requirement for multi-hop transmission for delivering the data collected to the server successfully which is located beyond the range of transmission of the source of sensor nodes. This causes a requirement to collect sensor nodes for the calculation of optimal routes to the server. The primary challenge faced is energy efficiency for successful WSN applications since there is limited energy in the nodes and is not possible to easily recharge once the nodes are deployed. However, since the energy is largely consumed by radio devices, there is a design that is an energy-efficient routing algorithm for essential communication. The research that is being conducted now a day is mostly on energy-aware routing which comprises two objectives: to ensure the routing path has minimal energy consumption overall and maintenance of even levels of residual energy. The minimum shortest path distance or minimum hop count path is used generally for WSN routing since the overall consumption of energy is dependent on the distance between the nodes and the count of the intermediate nodes. Every node has a level of residual energy or power drain rate which is considered to avoid the disconnection of the path and the network partition. These measures could be used to prolong the lifetime of the network since the energy dissipation is done equally throughout the nodes [8]–[10]. The redundancy present in source data is due to the data collected by various sensors in any given area based on a common phenomenon.

In WSNs, data aggregation in the form of “in-network-processing” is used widely for data collection in a manner of energy efficiency by redundancy elimination and reducing the size of data or the number of transmissions. Considering various WSN applications, at every node, the actual measurement of raw data is not necessary for delivering the exact form to the server. Compression or abstraction of raw data can be performed in the network. Considering the applications based on monitoring purposes, multiple techniques of aggregation could be used which include minimum value, maximum value, abstracting (variance, mean), feature domain, data prediction, loss prediction, and reduction. The increase in data aggregation efficiency occurs when the correlation of the data that is collected is high by many sensors. Data aggregation solely cannot handle efficient transmission, thus one of the phenomena of data dissemination is used; data dissemination is nothing but a routing protocol where the data transmission is carried out through a particular path [11]–[13].

In recent years, machine learning has been proven as one of the beneficial approaches irrespective of the domain; in WSN, it accurately helps in data transmission; in general machine learning is parted into three types i.e. supervised, unsupervised and reinforcement learning. Anunsupervised approach like clustering has been exploited lately by several researchers, hence this research also exploits the unsupervised learning approach (i.e. clustering) to transmit the data. Data aggregation is an efficient way of reducing the amount of data; the concept of data aggregation is the redundancy between data of the many physical phenomena by which it is perceived caused by the deployed nodes' high density in WSNs. During the routing to the server by a meeting of multiple packets, fusion of data through multiple data packets is done and the volume of data is less after the data fusion as compared to the summation of the volume of data at the initial multiple data packets which reduce the data that is needed to be transmitted. Formachine-to-machine communication scenarios, actuators subscribing to sensor measurements may also be present, in which case data should be not only aggregated and processed in-network but also disseminated to actuator nodes. Hence, motivated by the data aggregation and data dissemination (DADD); we design and develop an integrated-DADD approach, which helps to increase the network lifetime; contribution of research work is given as:

- This particular research work analyses the DADD approach distinctively and finds the shortcoming.
- Thisresearch work proposes an integrated-DADD mechanism for network lifetime enhancement; the proposed work comprises two sub-mechanisms. at first optimal clustering technique is developed further data dissemination path selection is carried out to select the path for suitable transmission.
- Optimizationthrough parameter tuning is carried out to increase the network lifetime in terms of rounds; integration of DADD possesses anadvantage over the other technique, as it tends to transmit the data flexibly.
- Integrated-DADD is carried outby considering energy consumption, network lifetime, active node participation, and communication overhead; further evaluation is carried out by comparing with the existing model by varying the number of sensor nodes in the network.

2. RELATED WORK

A lot of analysis has been performed on the maximization of data aggregation and the network lifetime [14] that is addressed to trade-off between efficient and effective data aggregation and minimizing the cost of the total link. Comprehensive weight is used which is named as a weighted data aggregation routing strategy for resolving trade-offs. The node paths are overlapped in the WSN-based cluster, the data aggregation efficiency is maximized and a longer network lifetime is provided. In [15], an algorithm for data-aggregation-aware-efficient-routing is proposed where the data is received by a mobile agent from the sensor nodes and is transmitted and aggregated data to the server. The packet loss and delay are solved by routing protocols by the use of mobile agents' movement schemes. In [16], addresses issues related to security by application of conventional routing algorithm among wide-area IoT. This study proposes a structure that is lightweight based on data aggregation routing, a security protocol is used in conventional routing protocols for route data aggregation for the routing of data. In [17], a framework that is based on fusion is proposed for the reduction of the data amount which has to be transmitted along with a multimedia sensor network that is wireless using intra-node processing.

The design of the sensor node is made for object detection by the use of techniques used for machine learning that uses a methodology for the accuracy increase where the amount of data is reduced. Considering the network of sensor routing, a cluster-based routing algorithm is used which consumes lower power. An essential technique for data aggregation, energy efficiency, and topology control in WSN is clustering. Various machine learning techniques have been applied by researchers for the optimal routing path to be obtained with a low cost and overhead. In [18], the application of the genetic algorithm and k-means algorithm is used for the optimization of multi-objectives. In the network, the sensor nodes were clustered by the use of a k-means algorithm. Fitness function construction is used on a generic algorithm for the maximization of network lifetime. In [19], an efficient energy-clustering algorithm that is based on neuro-fuzzy is proposed which uses membership function that compromises the energy and distance information of the modes to the use of efficient energy clusters for minimizing packet loss. The study [20] proposes an efficient energy routing protocol based ona reinforcement learning algorithm. These nodes are reinforced for the calculation of optimal routing path by the use of reward policy by maximizing the network lifetime and energy efficiency. In [21], an ant colony optimization algorithm (ACO) was used for addressing the WSN of the mobile sink routing protocol. This study proposes an improvised ACO algorithm that considers the distance among cluster heads (CH) that are selected other than the energy and time and the calculation of the optimum mobile trajectory by the mobile sink. In [22], a low-energy adaptive clustering hierarchy (LEACH)-based fuzzy cluster head selection algorithm was proposed, this determines the chance of using the membership function which consists of expected efficiency, residual energy, and close base station. The nodes having a higher value of chance in the round are selected as the cluster head selection (CHS). In [23], the LEACH algorithm is improved in mobile sensor networks by the use of fuzzy logic. In the network, the location change of nodes leads to packet loss.

Hence, the membership function is obtained by movement speed, residual energy, and the node's pause time. By the use of the membership function, every node has a value of chance for electing CH nodes that are calculated. In [24], an enhanced clustering hierarchy is proposed for efficient energy to be obtained in WSNs using the mechanism of sleeping-walking for neighbouring nodes as well as overlapping. Therefore, there is a minimization in data redundancy and maximization in network lifetime. In [25], a modified clonal selection (CLONALG-M) algorithm is proposed which is used to determine the membership function’s output in approximate form for the improvement of fuzzy routing performance that is ruse based. It is well known that the fuzzy approach has been superior in comparison to the well-defined methodologies, mainly when there are unclear boundaries among clusters. Through the brief related work, it is observed that research gaps exist in the following area: Thus, considering the research gap in related work, this research work design an integrated-DADD mode developed and designed in the next section of the research work.

a) An optimal number of clusters.
b) Distribution of cluster heads in the monitoring area with minimum communication overhead.
c) Formation of static and balanced clusters.
d) Rotation process of CH.
e) Efficient data transmission with data aggregation and data transmission.

3. PROPOSED METHODOLOGY

WSN is formed through deploying the sensor within the area that hasthe capability of sensing, communicating, and processing the information; the sensor not only senses the data but also tends to process the data and send it for data transmission; in the sensing area when the sensor node detects any event, it is considered as the source node. A node that collects the data is referred to as a sink node, hence designing an optimal data transmission for network lifetime enhancement. DADD are two approaches where the network lifetime can be enhanced. Thus, in this section of the research, we design and develop an optimally integrated clustering routing mechanism; this mechanism helps in optimizing the data aggregation process and enhances the network lifetime; Figure 2 shows the workflow of integrated-DADD which comprises five blocks; the first network is designed initiallyconsidering the preliminariesand assumptions. the second block deals with designing of optimal clustering mechanism concerning the cluster head. the third block is optimized parameter tuning considering the number of rounds in the network. the fourth block indicates the data dissemination wherein an optimal path selection algorithm is introduced to perform data dissemination. The fifth block introduces optimal data transmission.

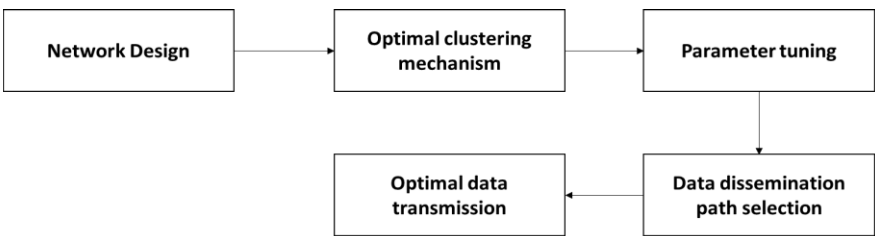

Figure 2. Integrated-DADD workflow

3.1. Preliminaries and system modelling

This research work develops a model which is designed on the model; the same model is used for the evaluation. Thisparticular model works on a model where the member of the WSN sends the data to the cluster head using single-hop communication. The cluster Head collects these data and aggregates them. Theseaggregated data are transmitted to Base Station through a multiple-hop routing mechanism; also proposed model makes several pre-assumptions about the model. The first assumption includes that the sensor node tends to change the initial position, thus node displacement does not require further energy consumption. The second assumption includes the Nodes that can be deployed randomly through the uniform distribution model and also sink can be found anywhere. The third assumption includes a parameter introduced to compute the distance among the nodes.

Let's consider a Y vertex graph denoted as I that comprises the edges R and vertices P; both vertices and edges are denoted and can be represented through the mathematical notation as given in (1). Our energy consumption is inspired by the first order model, energy consumption in the transmission of l bit of data packets is computed through (2),

$$I = (P, R)$$

$$P = \{1, \dots\dots Y\} \tag{1}$$

$$G^{Tx}(l, d) = \begin{cases} lG_{elec} + l\vartheta_{fs}e^2, e < e_0) \\ lE_{elec} + l\vartheta_{mp}e^2, e \geq e_0 \end{cases} \tag{2}$$

also, consider the distance from one node to another node while data transmission is formulated in these equations. In (2), ε_{mp} indicates the energy consumption of bit in amplifier and G_{elec} indicates the energy consumption per bit while receiving the data packets.

$$G^{Rx}(l) = G^{Rx-elec}(l) = lG_{elec} \tag{3}$$

3.2. Integrated-data aggregation and data dissemination (Integrated-DADD)

In this research, we design and develop an integrated architecture that includes two distinctive parts i.e. DADD; this research work designs one particular methodology focusing on enhancing network lifetime. Further, this work is dividedinto DADD; the whole process is involved in DADD. In optimal clustering, CH selection is carried out to increase the network lifetime by optimizing the energy consumption of the WSN.Inthesecond part of the work, data dissemination is carried out which chooses the suitable routing path from the selected cluster head to the base station.

3.2.1. Optimal clustering

Clustering is considered the unsupervised problem in machine learning to find the natural groups in the given feature space of input data; there is several clustering algorithms, and considering the dataset different algorithms are used. Hence, this research work develops an unsupervised machine learning task. The proposed protocol is designed considering three distinctive parameters i.e. energy consumption, scalability parameter, and optimization parameter; the proposed model utilizes the local specification of CH selection and radius. Threeparameter constraints are introduced i.e. residual energy, relative connectivity, and distance. Table 1 presents the optimal clustering mechanism.

In the optimal clustering algorithm designed in Table 1, there are three different concerns are addressed concerningthree distinctive parameters i.e. route to the BS, residual energy, and connectivity among the node. In Table 1 algorithm G_k indicates residual energy, $\mathfrak{m}_k$ indicates cluster radius, $D_k$indicatesrelative connectivity. Theseconcerns are taken in parameter to compute the radius for alternate Cluster Head indicated through $\mathbb{X}$. The proposed mechanism uses the probabilistic model to choose the alternate model; also proposed mechanism is designed in a distributed manner as the sink is not required at any stage. There is no assignment of any dependent parameter till this stage as it is carried out in the next stage; also the exchanging message through a designed clustering protocol is discussed in the optimal clusteringalgorithm. When the optimal clustering starts, a random number gets generated in the case of each node with interval, when the random number parameter of a particular node is lesser than the $\complement$, then a particular node turns into the additional cluster head. In the case of aggregation, initially, the range is computed for the output variable in a given function; hence, the centre is computed through (4). In (4), y indicates the linguistic variable and $ymax$,$ymin$ is a particular range of variables; relative connectivity of alternate CH is computed through (5).

$$neutral_{center} = \left(\sum_{ymin}^{ymx} g(y)dy\right)\left(\sum_{ymin}^{ymax} h(y)dy\right)^{-1} \tag{4}$$

$$D_k = connectivity\ z_k(mx(connect)^{-1})$$

Table 1. Optimal clustering technique

Input: Random number of nodes deployed Output: optimal clustering	
Step1:	Initialization of threshold parameter as $\complement$
Step2:	Initialization of cluster members parameter through $\mathrm{U_k}$
Step3:	Initialize $\mathrm{u_k} = \phi$
Step4:	$\mathbb{Y} = \mathrm{self_{declared}CH}$
Step5:	$\mathbb{X} = \mathrm{true}$
Step6:	IF($\mathbb{O}$ is less than $\complement$) then
	compute the parameter$\mathfrak{m}_\mathrm{k}$
	establishcommunication($\mathrm{D_k}, \mathrm{G_k}, \mathfrak{m}_\mathrm{k}, \mathbb{I}$)
	on receiving the candidate from Node j
	IF($\mathrm{G_k}$is less than $\mathrm{G_l}$) then
	$\mathbb{X}$ is false
	Establish the communication $\mathbb{Z}(\mathbb{I})$
	Else if (($\mathrm{E_k}$is less than or equal to$\mathrm{E_l}$) and ($\mathrm{G_k}$is equal to $\mathrm{G_l}$))
	Then
	Establish communication $\mathbb{Z}(\mathbb{I})$
Step7:	IF ($\mathbb{Z}$ is true) then
	Substep1: establish communication clusterhead_com($\mathbb{I}$)
	$\mathrm{U_k} = \mathrm{Clusterhead}$
	Join CH($\mathbb{I}$) from node l
	Clustermembers = add(l)
	Else
	If received all message
	$\mathbb{Y} = \text{nearest Cluster}_\mathrm{Head}$
	Establish communication Join CH($\mathbb{I}$) to the nearest $\mathrm{Cluster_{Head}}$
Step8:	Exit

3.2.2. Optimization through parameter tuning

In this section, we introduce the parameter tuning approach which optimizes the WSN metrics and two distinctive parameters i.e. maximum probable radius indicated as A and threshold as $\complement$ in an optimized manner has introduced. Table 2 presents the parameter tuning algorithm, parameter tuning algorithm shows the optimization through parameter tuning, and these parameters are not treated independently. It is optimized in an integrated manner to enhance the network lifetime and this network lifetime is defined in terms of around where Θ indicates the search parameter.

Table 2. Parameter tuning algorithm

Step1:	$Input\ (\mathrm{A}, \complement)_{int} output\ (\mathrm{A})_{opt}$
Step2:	Pass $(\mathrm{A})_{initial}$ to the algorithm
Step3:	$pass\ operating\ Conditions\ to\ \Theta$
$Step4$:	$trigger\ the\ optimization\ framework$
Step5:	$trigger\ \Theta\ to\ evaluate\ teh\ novel\ pair$
Step6:	$Return\ the\ parameter\ score$
Step7:	$Return\ (\mathrm{A})_{optimal}$

3.3. Data dissemination

Data dissemination approaches, which are also referred to as routing schemes, form one of the major problems in the design of WSNs. These approaches define the method by which sensor nodes transmit their sensed data to their designated sink node, which is also referred to as the base station (BS), where data processing occurs. Extensive research into the topic of the development of efficient routing approaches that put these special aspects of WSN into consideration has been conducted.

3.3.1. Data dissemination path selection

The design of the optimal routing phase is based on the two-parameter i.e. energy factor and a parameter for network lifetime, the sink node is not included in selecting the data dissemination path and hence it acts in a distributed manner. The data dissemination path selection algorithm is explained in Table 3, which presents the data dissemination path selection (DDPS) algorithm. IntheDDPSalgorithm, ζ_t indicates remaining energy, $Cluster_{head_t}$ indicates the probability of a particular route t, Υ_t indicates the relative distance and these parameters are computed through (5).

$$\zeta_t = \mathbb{D}_R(\max(\mathbb{D}))^{-1} \tag{5}$$

$$\psi = \sum_{k=1}^{o} \iota_k \, (o)^{-1} \tag{6}$$

In (5), ζ and ψ are the two different parameters whose value can be set in three manners i.e. low high or medium. Infinding the data dissemination path, at first cluster head sends the route request to the base station and gathers the route reply which is broadcasted. Data packets arrive through various trans receiver nodes which consume less energy.

Table 3. DDPS algorithm

	Input: χ , output: υ
$Step1$:	$Let's\ initialize\ minimum\ packet\ is\ 1\ and\ optimal\ route\ as\ null$
$Step2$:	$Initalize(route\ \mathrm{t})$
$Step4$:	$If\ (count(\mathrm{t})\ is\ less\ than\ minimum\ packet)\ then$
	$\upsilon\ is\ null$
	$Exit$
$Step5$:	$Else\ if\ (Count\ (\mathrm{t})\ is\ equal\ to\ Min)\ then$
	$The\ optimal\ \mathrm{t}\ is\ the\ only\ route$
	$Exit$
$Step6$:	$ELSE$
	$FOREACH\ (route\ t\ belongs\ to\ routes)\ do$
	$Using\ the\ inputs\ from\ Cluster_{head_t}$
	$Cand_{route}g_t(\mathbb{I}_t, Cluster_{head_t}, \zeta_t)$
	$Optimal\ route = \not{f}_1$
Step7:	$For\ i = 2\ to\ Count\ (Routes\ t)\ do$
	If ($cluster_{head_k}$ is less than $Cluster\_head_{optroute}$) then
	Else if ($CH_i is\ equal\ to\ CH_\upsilon$) and ($\zeta_k$ is less than or equal to $\mathbb{I}_\upsilon$) then
	Else
	Optimal route =$\not{f}_k$
	exit

Source creates the $parmater\ for\ minimum\ value$ which is assigned, this value is used only for the comparison and it is assigned in the data dissemination path selection (DDPS) procedure; in case if there does not exist any possible routes then cluster head avoids data transmission. Ifthe number of possible routes is greater than the minimum value then the process of path selection aka routing gets initiated. theproposed mechanism uses the relative distance and average link remaining energy together to get the optimal chances of getting the path, proposed operation in step6 and the dissemination path are produced accordingly.

The above-proposed research work integrated-DADD involves the three distinctive algorithms i.e. optimal clustering, optimal parameter tuning, and data dissemination path selection; these three algorithmshelp in enhancing the network lifetime in steps. Optimal clustering makes the clustering approach easy and aggregation of datais carried outoptimally. To reduce the energy and perform data dissemination, path selection is carried out which selects the path to transmit the data.

4. PERFORMANCE EVALUATION

Efficient data transmission has been one of the primary issues in WSN; this research aims to develop efficient data transmission by proposing the integrated-DADD. In this section of the research, we evaluate the proposed approach i.e. Integrated-DADD; evaluation is carried through designing the prototype with sensoria as a simulator with consideration of sensor nodes as 500, 750, and 1000. The system environment uses Windows 10 operating system, 64-bitprocessor along with 16 GB RAM and 2GB Nvidiagraphics card. Python is used as the programming language at the front, and C Sharp is used at the backend as it supports the simulator. LEACH is considered one of the state-of-art techniques for WSN-based applications; thus, LEACH is considered an existing model to compare. Details about the network are presented in Table 4.

4.1. Energy consumption

Energy consumption is considered one of the main parameters for performance evaluation as it directly impacts the network lifetime; Figure 2 shows the energy consumption comparison considering several nodes as 500,750 and 1,000. In Figure 3, it is observed that for 750 nodes, existing methodologies require 36.41mj of energy whereas the proposed model requires 24.58mj of energy. for 750 nodes, energy consumption through the existing model is 54.31 mj in comparison with the proposed model of 37.03 mj. Similarly, for 1,000 sensor nodes, the existing methodology requires 70.77mj whereas the proposed model requires 49.52 mj.

Table 4. network parameter

Network Parameter	Value
Sensor nodes	500, 750, 1,000
Network Size	50m * 50m
Number of Sinks	1
Data packet processing delay	0.1 ms
Initial energy	0.2 J
Bandwidth	5,000 bit/s
Radio energy dissipation	50 NJ/bit
Data packets length	2,000 bits
Transmission speed	100 bit/s
Idle energy consumption (Eel)	50 mj/bit

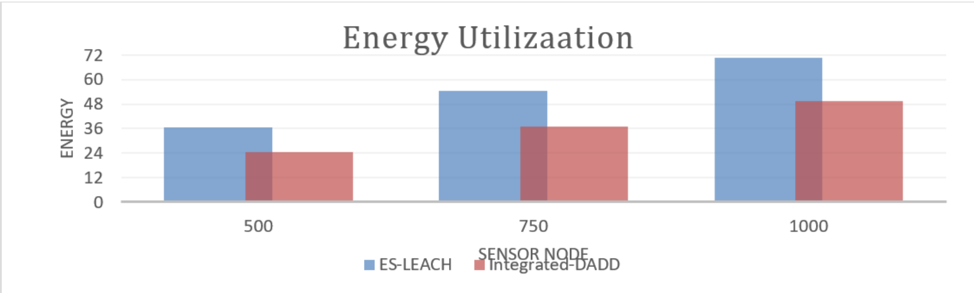

Figure 3. Energy consumption comparison

4.2. Network lifetime

Network lifetime is nothing but the amount of time where a WSN would be in operational mode; it is one of the eminent parameters used for the network evaluation; Figures 4 to 6 shows the network lifetime concerningseveral rounds. More rounds indicate a better network lifetime. Hence, considering these figures, the proposed methodologies observe more rounds than the existing methodologies.

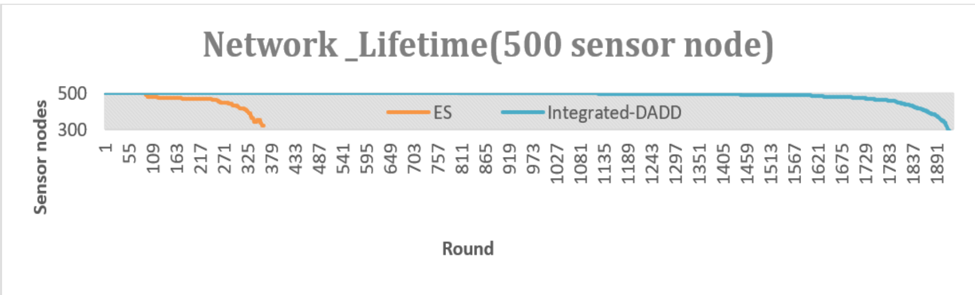

Figure 4. Network lifetime (in terms of round) comparison for 500 sensor nodes

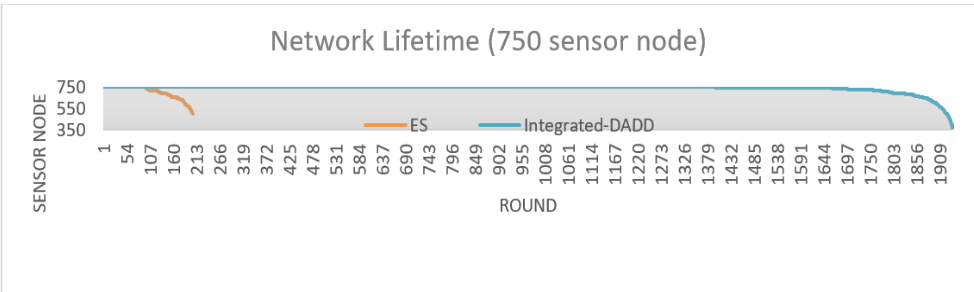

Figure 5. Network lifetime (in terms of round) for 750 nodes

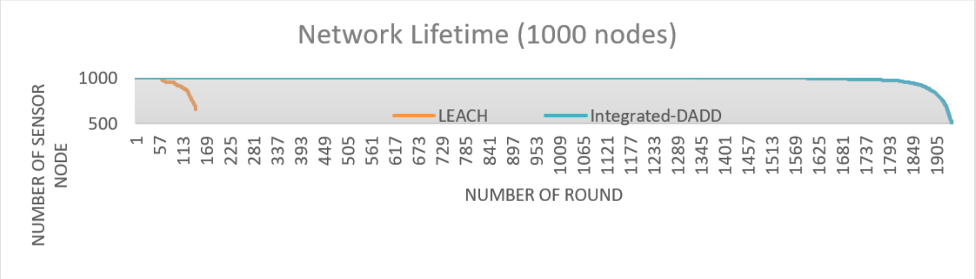

Figure 6. Network lifetime (in terms of round) for 1,000 sensor nodes

4.3. Active node participation

In general, when the network is in progress, the node fails to survive due to various reasons such as energy exhaustion or environmental factor; more active nodes directly impact efficient data transmission. Hence the network should be designed in such a way that a maximum number of a node should be participants in the network as long as the data transmission is occurring. Figure 7 shows the comparison of existing and proposed methodologies through varying the number of nodes; in the case of 500 and 750 nodes, existing methodologies have 67.2 and 66.53 active nodes that are participating whereas the proposed model observes 99.8 and 99.86 respectively. Similarly, in the case of 1,000 nodes, existing methodologies have 65.7 active nodes whereas proposed methodologies have 99.9 active nodes.

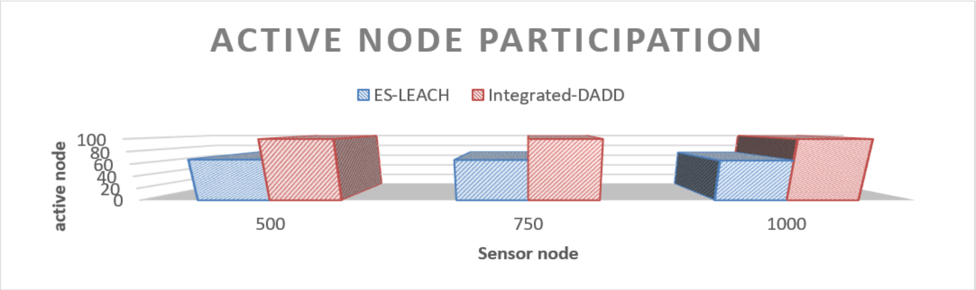

Figure 7. Active nodes comparison

4.4. Communication overhead

Communication overhead is defined as the time used for establishing the communication instead of getting the work done; Figure 8 shows the comparison of communication overhead considering the number of nodes as 500,750 and 1,000 nodes. Less communication overhead indicates a higher model efficiency; in the case of 500 nodes, the communication overhead of existing methodologies is 0.116 whereas proposed methodologies observe only 0.02. Inthe case of 750 nodes existing methodologies observes a communication overhead of 0.30 whereas the proposed methodology has a communication overhead of 0.038. At last, for 1,000 sensor nodes, the communication overhead of the existing model is 0.58 whereas the proposed model has a 0.05 overhead.

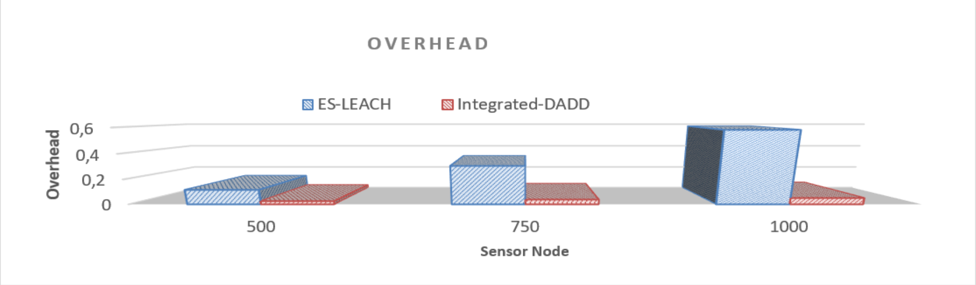

Figure 8. Communication overhead

4.5. Comparative analysis

Table 5 shows the improvisation over the existing model considering the different evaluation parameters and different sensor nodes; through the comparative analysis, it is observed that the proposed methodology simply outperforms the existing methodology as the proposed research model observes improvisation of 32.49, 31.81, and 30.02 for 500, 750 and 1,000 nodes respectively. Similarly, considering the active node participation, the proposed methodology observes improvisation of 48.51, 50.09, and 52.09 for 500, 750, and 1000 sensor nodes respectively. At last, a comparison of communication overhead suggests that the proposed mechanism observes the massive improvisation over the existing model as 81.81, 90, and 91.37 respectively for 500, 750, and 1,000 sensor nodes.

Table 5. Parameter improvisation

Evaluation parameter	Number of sensor node	Improvisation
Energy Consumption	500	32.49
	750	31.81
	1,000	30.02
Active Node participation	500	48.51
	750	50.09
	1,000	52.09
Communication Overhead	500	81.81
	750	90
	1,000	91.37

5. CONCLUSION

WSN is designed using the several numbers of sensor nodes that are deployed for data propagation network formation and used in inaccessible areas; the main role of the network is to observe the process gather the data, and transmit it to the base station. Extensiveutilization of WSN-based applications in different fields constitutes a large volume of data thatcan be processed through an efficient data aggregation process. This research work proposes an integrated-DADD mechanism for network lifetime enhancement; the proposed work comprises several sub-mechanisms. At first optimal clustering technique is developed data dissemination path selection is carried out to select the path for suitable transmission. optimization through parameter tuning is carried out to increase the network lifetime in terms of rounds; integration of DADD possessesthe advantage over the other technique as it tends to transmit the data flexibly. Furthermore, to evaluate the proposed research four distinctive parameters i.e. energy consumption, network lifetime, active node participation, and communication overhead is considered; further evaluation is carried out by comparing with the existing methodology varying the different sensor nodes (500, 750, and 1,000). Comparative analysis suggests that the proposed research observes marginal improvisation over the existing model as in terms of energy consumption, average improvisation of 31% is observed; similarly, in terms of active node participation average improvisation is 50.23%. At last, in terms of communication overhead 87.73% improvisation is observed. Although the proposed research has simply outperformed the existing model considering the above-discussed parameter, there is the future scope for improvisation in the model by considering other parameters like route length, throughput, and failed node; also, future work should be focused on secure data aggregation.

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