# Energy Efficient ESDAD Protocol for Wireless Sensor Networks

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***Abstract-***The wireless sensor is deployed to sense large amount of data from the far places. The Energy efficient structure-free data aggregation and delivery (ESDAD) is the protocol which is hierarchal in nature. The ESDAD protocol can be further improved to increase lifetime of wireless sensor networks. In the ESDAD protocol, the next hop node is selected on the basis of cost function for the data transmission. In this research work, improved in ESDAD protocol is proposed in which gateway nodes are deployed after each level for the data transmission. The sensor node will sense the information and transmit it to gateway node. The gateway node aggregates data to the base station and simulation results show that improved ESDAD protocol performs well in terms of energy consumption and number of throughput.

***Keywords-****ESDAD;Energy Efficient; Clustering; Routing.*

## I. INTRODUCTION

A distributed type of network in which there are large numbers of sensor nodes deployed such that the surroundings of the area can be monitored and important information can be gathered is known as wireless sensor network. The sensor nodes present within the network are very small in size and have very less power for processing the tasks. The users can gather, process and then transmit the important information that is available within the surroundings as per the changes [1]. There are very strict computing and processing capabilities available. The small sized computers that gather information from the network are known as motes. They provide multi-functioning and are also energy efficient. There are several industrial applications that are including motes within them. For accomplishing specific objectives of an application, the information is gathered from surroundings with the help of group of motes [2]. For achieving highest performance results, links are made by these motes with each other with respect to various configurations. Transceivers are used by the motes to for communicating with each other. There can be either hundreds or thousands numbers of sensor nodes present within WSN. Within the area of interest, there are several small sized, low cost and multi-functioning sensor nodes deployed such that a wireless sensor network is generated. The data can be sensed, processed and communication facilities can also be provided by the sensor nodes due to the available sensors, microprocessors as well as radio transceivers, even though they are small in size [3]. A wireless medium is used for providing short distance communications and for accomplishing a common task, these nodes collaborate with each other. There are several unique properties as well as characteristics of wireless sensor networks which differentiate them from other existing networks. The most important factor to be considered within WSNs is the energy. It is important to save energy within the hardware and software solution such that the lifetime of network can be maximized. Through several researches it is found that in comparison to data sensing and processing, the data communication process consumed highest amount of energy within these networks [4]. Thus, due to the required amount of transmission power, it is prominent to use only the short-range communications amongst the sensor nodes and avoid any long-rage data transmissions. Close to the area of interest and at distance from the sink nodes, it is possible to sense events within most of the WSNs. Thus, the intermediate nodes can be used to forward the data packets along multi-path path, by using the short-range communication [5]. In comparison to conventional routing that was used in fixed networks, the routing of wireless sensor networks is very different. There are unreliable wireless links since the network is infrastructure less. There is failure of sensor nodes and strict energy-saving needs are to be provided through the routing protocols. Generally, there are several routing protocols introduced by different researchers. The information about location of sensor nodes plays an important role within the location-based protocols [6]. In order to calculate the distance amongst two specific nodes, most of the routing protocols need the information about the location of sensor nodes. Since the data is transmitted here from the source sensors towards the sink, the data-centric protocols are very different from other protocols. The data is sent independently by each sensor to the sink by each source in which appropriate data is available in case of the address-centric protocols. Some kind of data aggregation can be performed on the data that is being

originated from multiple source sensors in case of data-centric protocols in case when the data is transmitted by the sensors to the sink. There are several viewpoints with respect to which the hierarchical clustering in WSN has been studied by different researchers over time [7]. For transmitting the sensed data towards the sink, an energy-efficient communication protocol known as clustering is utilized.

## II. LITERATURE REVIEW

Ramin Yarinezhada, et.al (2018) presented the closeness of sensor nodes towards the sink leads to more traffic loads in the wireless sensor network, due to which large amount of energy is depleted [8]. There is more consumption of energy and increase in the delay of network when the nodes are informed about the sink position. They proposed a routing algorithm in this paper based on the virtual grid infrastructure and mobile sink. With the help of this proposed method and with the use of virtual infrastructure some of the nodes are selected using which the position of the sink is maintained. On the basis of obtained results, it is concluded that better performance is shown by the proposed method as compared to the other methods in terms of energy efficient and compared delay.

Hassan Oudani, et.al (2017) presented the lifetime of the network is affected due to the more consumption of the energy by each node within the wireless sensor network. The performed the survey on the energy-efficient using hierarchical cluster-based approach namely LEACHES which is their main objective in this paper [9]. They also proposed a new method in order to maximize the lifetime of network sensor. With the help of this method large amount of energy is consumed when data is transmitted to the base station. The evaluated the performance of the LEACH protocol with the proposed method on the basis of obtained simulation results. They utilized the Matlab Simulink for the purpose of simulation.

Nukhet Sazak, et.al (2017) presented the most significant design issues faced while deploying the nodes in the constrained of resources in the remote location, issue is energy efficiency as these nodes are left unattended for long time within the wireless sensor network [10]. Therefore, in order to improve the energy efficiency, they proposed an active node determination method (ANDM) in this paper for WSN MAC design. They presented the integration of ANDM with ETDMA and compared it with E-TDMA concluded that it provides better energy usage up to 31 % approximately.

Harshita Jain, et.al (2017) presented the limited lifetime of the battery is considered as the major issue in the wireless sensor networks. It is not an easy task to change the battery of WSN all the time as it is not possible for a human to reach in the region of difficult area where nodes are deployed. They discussed the some energy efficient routing protocols of WSN in this paper. The frequently updation of the routing tables leads to the reduction in packet overhead due to which energy consumption can also reduced [11]. In this paper, they combined the dynamic source routing (DSR) with power efficient gathering in sensor information system (PEGASIS) with the help of which optimal path is determined as it used the GA and BFO.

Vivek Kumar Singh, et.al (2017) presented the communication infrastructure having the set of independent transducers and utilized at different locations for recording and monitoring known as wireless sensor network [12]. The efficiency, reliability, heterogeneity, scalability, robustness, privacy and security are some of the major challenges faced by the WSN. Both parameters are not utilized by the researchers in order to address the major challenges of WSN. They proposed a method in this paper using which the life of sensor in wireless sensor network can be enhanced, make more reliable and energy efficient using new cluster based approach. The prevention of the crashes of cluster head node means the network reliability and the election of cluster head is take care by energy efficiency within the new cluster technique.

Sheikh Tahir Bakhsh, et.al, (2017) proposed a new algorithm of adaptive sleep efficient hybrid medium access control (AEH-MAC) in this paper has been widely utilized in the improvement of scheduling in the wireless sensor network. This proposed method also minimizes the scheduling time for which it adjust the sleep times of the nodes [13]. In order to improve the waiting time of the source code, further improvement is required for which ACK packets are generated which are transferred to the receiver as they take short packets. A conflict-free time slot for itself up to two-hop neighboring nodes is taken by each node in this proposed method. As per simulations results, it is concluded that the proposed algorithm has high performance in terms of runtime, number or rounds energy consumption, and slot reservation.

## III. RESEARCH METHODOLOGY

The IESDAD protocol is improved version of ESDAD protocol for the data aggregation in wireless sensor networks. In the ESDAD protocol, the logical topology is constructed for the data transmission [18]. When the logical topological is constructed cluster heads are selected in the network. The cluster heads select its next hop in the step of judicial data transmission. In the IESDAD protocol, gateways are deployed after each hop to forward data to next hop. The cluster head select its nearest gateway using Euclidian distance. The cluster heads need not to next its next hop for the data transmission which reduce routing overhead and also improve network lifetime.

In the last phase of the algorithm, the gateway nodes are deployed in the network. The gateway node depends upon the total number of nodes which is described by the Eq 3:

$$G_{nodes} = n/4 \quad \text{--- (3)}$$

Here, G stands for Gateway node. The total numbers of nodes are denoted by n. The gateway nodes are the forth part of the total nodes. The best node is selected from the all gateways nodes to send data to the base station [28]. The distance between the base station and G is calculated using Eq 4:

$$\text{Distance} = \sqrt{(x(i)-x)^2+(y(i)-y)^2} \quad \text{---(4)}$$

In order to transmit the packet of its own or for data aggregation towards the base station, the gateway node is chosen by the sensor node. The gateway is chosen sensibly in order to sense unique data by the sensor node. Within the structure-free aggregation and routing, the selection of next hop is a major concern. On the basis of distance function, the gateway node is chosen within the proposed protocol. The distance calculation formula is given in the equation (6). The sensor node which is nearest to the gateway node is selected as the data forwarding gateway.

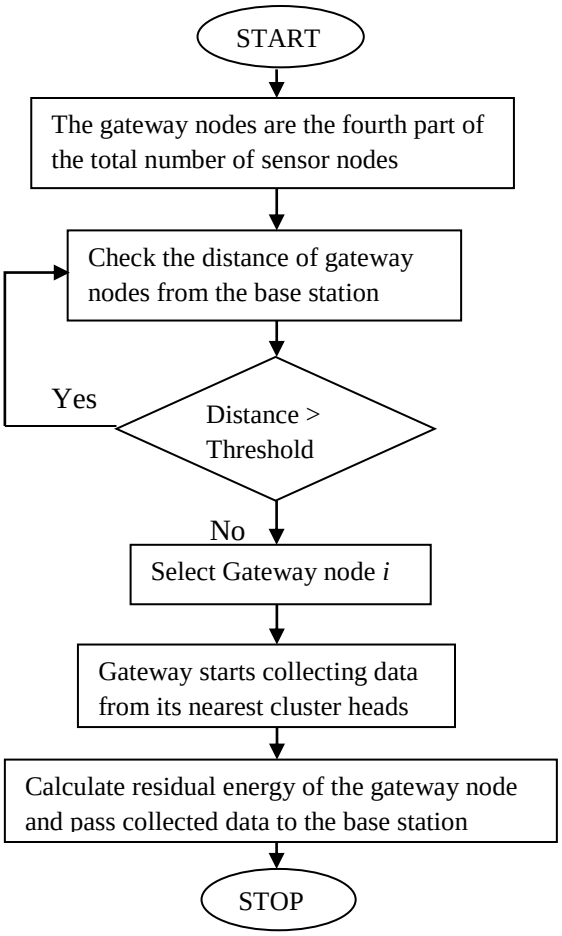


*Fig.1: Proposed Flowchart*

## IV. EXPERIMENTAL RESULTS

The proposed work has been implemented in NS2 and the results have been evaluated by making comparisons against proposed and existing work in terms of several parameters.

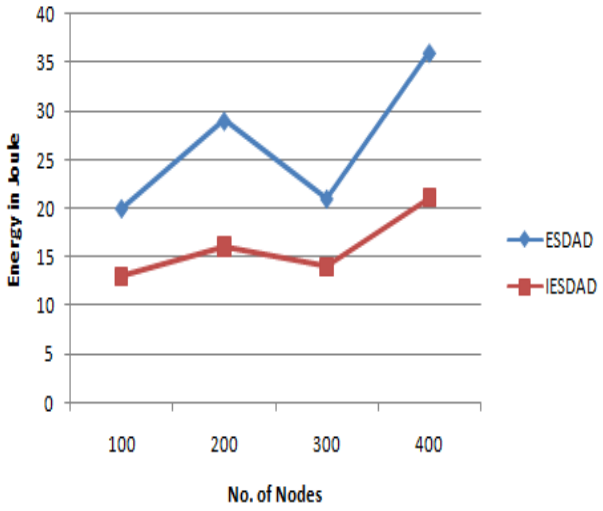


*Fig.2: Energy Consumption Comparison*

As shown in figure 2, the performance of ESDAD and IESDAD protocol is compared in terms of energy consumption. It is analyzed that energy consumption of IESDAD protocol is low as compared to ESDAD protocol

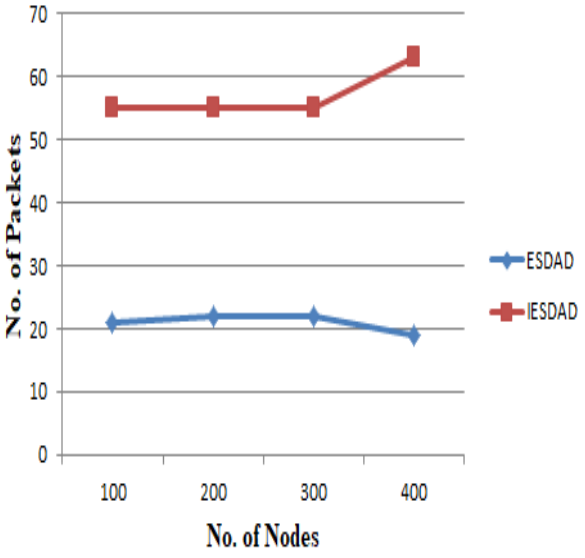


*Fig.3: Throughput Comparison*

As shown in figure 3, the ESDAD and IESDAD protocols are compared in terms of number of throughput. The throughput of the IESDAD protocol is high as compared to the ESDAD protocol.

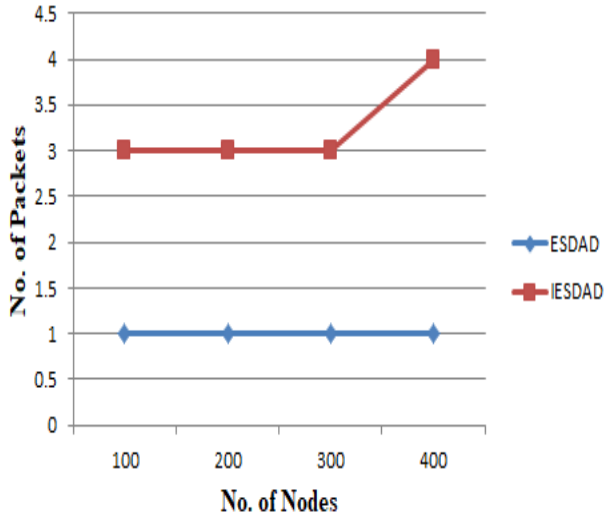


*Fig.4: Lifetime comparison*

As shown in figure 4, the ESDAD and IESDAD are compared in terms of network lifetime. It is analyzed that IESDAD protocol has higher lifetime as compared to ESDAD.

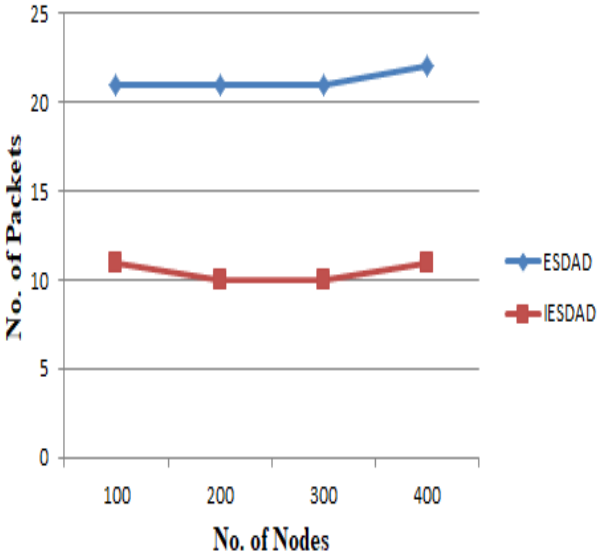


*Fig.5: Packet loss comparison*

As shown in figure 5, the packet loss of the ESDAD and IESDAD protocol is compared and it is analyzed that delay of IESDAD protocol is less as compared to ESDAD protocol.

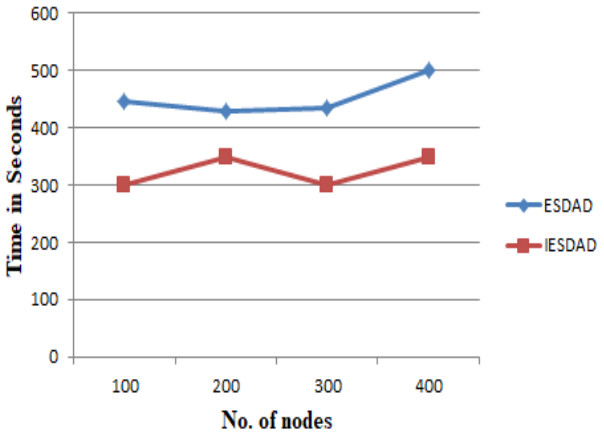


*Fig.6: Delay comparison*

As shown in figure 6, the delay of the ESDAD and IESDAD protocol is compared and it is analyzed that delay of IESDAD protocol is less as compared to ESDAD protocol.

## V. CONCLUSION

In this work, it is concluded that wireless sensor network is the decentralized type of network. The energy consumption is the major issue due to far deployment and small size of the sensor nodes. The ESDAD protocol is the energy efficient protocol in which the sensor nodes can sense information and pass it to next hop node. The next hop node is selected on the basis of cost function. In this research work, gateway nodes are deployed in the network in which sensor nodes transmit data to gateway node. The gateway node then sends data to the base station. The simulation results show 15 to 20 percent improved in improved ESDAD protocol as compared to ESDAD protocol.

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