Improvement in WEMER Protocol for Data Aggregation in Wireless Sensor Networks

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Abstract - The wireless sensor networks is the decentralized and self configuring type of network in which senor nodes can sense information and pass it to base station. Due to decentralized nature and far deployment energy consumption is the major issues of wireless sensor networks. To reduce energy consumption of wireless sensor hierarchal clustering is the efficient type of clustering technique. In this research work, WEMER protocol is implemented and improved to increase lifetime of wireless sensor networks. In the WEMER protocol, whole network is divided into clusters and cluster heads are selected in each cluster. The proposed WEMER protocol and WEMER protocol are implemented in MATLAB. The simulation results shows that proposed WEMER protocol has less number of dead nodes, high number of alive nodes, send more number of packets and more remaining energy consumption.

Keywords: WEMER, LEACH, Gateway, Leader node

I. INTRODUCTION

The recent enhancements made in the technology involving wireless sensor networks has provided great innovations within the applications that involve it such as the mechanical monitoring, traffic monitoring, cropping, etc. advance creative and productive thoughts are to be generated within this area such that their usage can be more helpful. In the information routing, compression as well as network aggregation, various analyzed methods have been introduced in the recent years [1]. There are numerous nodes deployed within specific area in a wireless sensor network. These nodes are deployed in order to monitor the surrounding area of those nodes. In order to provide communication amongst the nodes present in the network, the sensor hub is present in the network which consists of sensors, actuators, memory and processor. In order to transmit the data through sensor nodes utilizing radio frequencies, infrared, and so on. There is no wired connection present within these networks [2]. A random fashion is set across the nodes and the messages are transferred which thus provides an ad-hoc network environment within the networks. The battery present within the nodes of WSN is of smaller size. Also the nodes are located at really far distances where human is not able to reach. So the major concern within the WSNs is the usage of battery within them. This also affects the overall lifetime of the nodes and thus the deployment of the network [3]. The sizes of various constraints such as battery size, processors, information storing memory and so on are important within these networks. The consumption of energy is required to be advanced within the networks with the help of various optimization algorithms. Various time constraints are present within the detected and routing information sent across the WSNs. Before any alterations, the information can be utilized by the network. For communicating the information across the network, the energy consumed is more as compared to the other executions. Thus, it is very important to address the energy conservation issue in the WSNs. The major issue that arises within the wireless sensor networks is the limited amount of lifetime of a battery of nodes present within the network [4]. There are very limited constraints of size of battery, processors, and memory present within the sensor nodes of the network due to their small sizes. Thus, the major concern here is to upgrade the amount of energy being consumed by these networks. In order to provide solution to this problem, regular time constraints are provided within the network such that the data that is gathered can be transmitted to the destination such that it can be utilized prior to any hazard. There is higher consumption of power due to the communication of data within these networks in comparison the processing occurring in these networks. Thus there is a need to address such issue. There is restricted lifetime of a battery provided within the normal nodes. They cannot be replaced easily as well due to which many problems arise. The scaling up of any number of sensor nodes within the network can be done on the basis of architecture and protocol utilized within these networks [5]. In case there is a method identified which can help in minimizing the measure of communication, the lifetime of the battery can be extended here. By using low power components within the sensing subsystems, the energy consumption can also be minimized. Within these systems, the lifetime of a battery present can be maximized through the minimization of current or power of turning it off when it is not being utilized at all. The clustering method is used in order to save the energy available within the sensor nodes. Each of the nodes present within the network can be divided into several smaller groups which are known as clusters with the help of productive network organization. A cluster head is present within each cluster along with all other individual nodes. The radio frequency based contactless automatic identification expertise is known as Radio Frequency Identification (RFID) [6]. The active and passive RFID are the two sources of power in RFID and out of two uses of passive RFID gives more

advantages than active RFID in terms of size, battery management, tag cost, etc. To store or detect physical information for a long time RFID is produced that add fundamental function and enhance the nature of framework.

II. LITERATURE REVIEW

M. Benaddy, et.al (2017) presented applications of wireless senor network in almost every field such as medical, crisis management, environmental, military, transportation, emergency, security applications and many more. Reliable data collection and achievement is the main requirement of this application [7]. The proposed algorithm is based on multipath principle. It also focused on the energy consumption constraints on the basis of which each node is separated from other node according to the sensor node components and the distance. The proposed algorithm is implemented and simulated for the evaluation purpose and the calculation of performance and also compared with other algorithms in order to check the efficiency of this method. **K. Praghash, et.al (2017)** presented cluster head can be defined by which different functions can be performed in order to secure the sections of the networks using clusters. One node is helped by other node in transferring data, if nodes are unable to reach the sink directly [8]. Better performance can be achieved by wireless sensor network with the help of sleeping nodes that increase the lifetime of the network, better latency, and reliability. A temp cluster head mechanism can be utilized by the network, if it is unable to cluster head mechanism. When new input is not processed by the cluster head in this method it will attach the cluster to activate the nearby node in order to elevate as a cluster head due to which there is decrease in power consumption due to which there is no disturbance in the process of communication. **Pallavi Yarde, et.al (2017)** presented the performance of the wireless senor network can be analyzed with the help of number of ways [9]. It is necessary for the designer check properly the consumption of energy by each sensor node in the network, in order to make protocol energy efficient. They discussed various methods by which energy efficiency of the LEACH protocol can be improved. As per performed experiments, it is concluded that equal amount of energy is consumed by the LEACH and the proposed protocol TH-LEACH. As compared to LEACH-TLCH protocol proposed method consumed less amount of energy due to which it leads more delay. Therefore, for the LEACH and TH-LEACH protocol, there is less amounts of dead nodes present in the network as compared to LEACHTLCH protocol. **Abdelbari Ben Yagouta, et.al (2017)** presented with the help of LEACH routing protocol they simulated three sink mobility models such as Random Walk, Random Waypoint and Gauss Markov. This method has been utilized for the consumption of energy, throughput, reliability and packet latency time. It determines the best configuration with reference to number of nodes and packet rate [10]. The most suitable tradeoff between energy conservation and QoS metrics has been offered by this configuration. As per simulation result, it is demonstrated that optimal results are obtained by this method. More energy is consumed by the network beyond these last values of node density and packet rate due to which there is sharp decrease in the metrics of QoS. **Qasem Abu Al-Haija, et.al (2017)** presented for the consumption of energy in the WSN security based DH-EKE key agreement cryptographic scheme they proposed a mathematical model. This model has the variable key sizes, communication distance is fixed and various number of neighbor nodes proposed in this paper [11]. On the basis of obtained results from the energy analysis, it is demonstrated that encryption/decryption key sizes and neighboring node numbers along with sensor node features widely affect the communication energy consumption of WSN. In this they studied the more energy consumption metrics such as the processing energy and sensing energy which is considered as the random distribution of sensor nodes and its mobility. **Yang Liu, et.al (2018)** proposed an optimal decentralized solution and analyses its union as all the existing solution in the previous methods are based upon the centralized system [12]. They also affected the issues of the throughput maximization, consumption of power and EE problems. They also developed a decentralized algorithm whose main concept is based upon the dual-decomposition and block successive upper-bound method in order to optimize these two metrics. These two runs in parallel as it provide the semi-analytical solutions and also have strong convergence. They also provide the conditions which are sufficient for the validation of the decentralized method.

III. RESEARCH METHODOLOGIES

The wireless sensor networks are the self configuring type of network and size of the sensor nodes are very small. Due to which energy consumption is the major issue of wireless sensor networks. The LEACH is the energy efficient protocol which is used to reduce energy consumption of the network. The various improvements in the LEACH protocol is done in the recent times to reduce energy consumption of the network. In the proposed improvement three level of architecture is proposed in which leader nodes, cluster heads and gateway nodes are involved in the data communication. The proposed technique involved following phases:-

Phase 1: Cluster head selection

The cluster head is the first phase of the network. The network is deployed with the finite number of sensor nodes. The base station is deployed at the centre of the network. The base station flood the message in the network. The base station calculates the signal strength and nodes which have signal strength above threshold value will be eligible to be selected as the cluster head. The threshold value will be defined by the below equation:-

$R_{CH} = R_{min} * [1 + \left(\frac{d_{BS} - d_{BSmin}}{d_{BSmax} - d_{BSmin}}\right)]$ (1)

In the given equation R_{min} is the radius of the cluster, d_{BS} is the node distance from the base station, d_{BSmin} is the minimum distance from the base station, d_{BSmax} is the maximum distance from the base station.

$F_{CH-value} = \alpha * N_{deg} + \frac{\beta}{MSD_{deg}} + \frac{\gamma}{d_{BS}}$ (2)

In the equaton 2, the N_{deg} is the number of neighbor nodes of the particular node, MSD_{deg} is the mean distance of all nodes in the network, α, β and γ is the three threshold values whose total is 1. The sensor node in the network generates random value which lies between 0 and 1. When the sensor node will be selected as the cluster when it satisfy the condition given in the equation number 3

K(i)> $F_{CH-value}$ (3)

The K(i) is the random value generated by the sensor node individually.

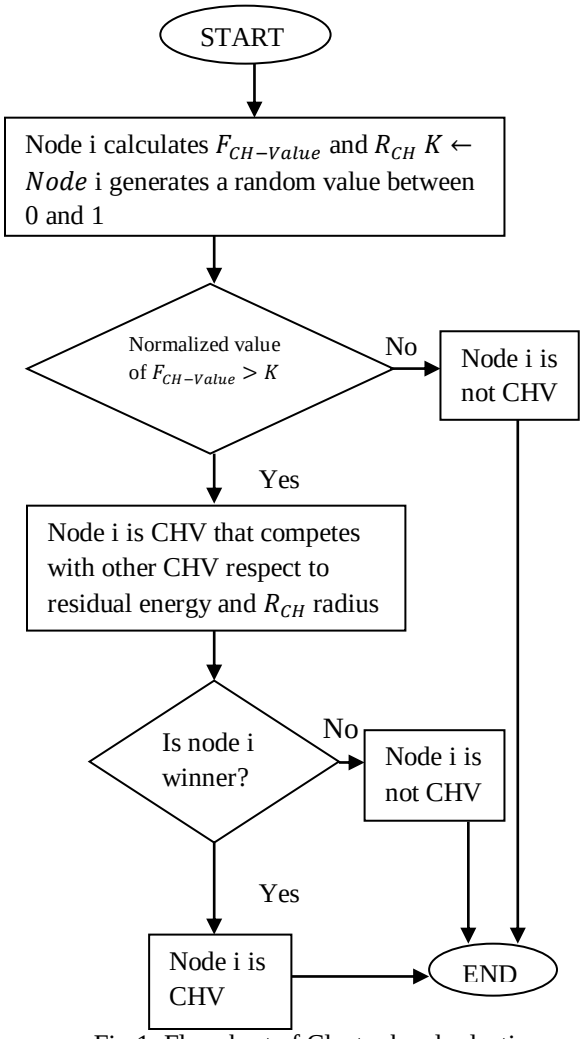

Fig 1: Flowchart of Cluster head selection

Phase 2: Leader node Selection

The second phase of the proposed technique is the selection of leader nodes in the network. The nodes which are not the cluster head will be selected as the leader node. The leader nodes are responsible to collect the data from the sensor nodes and pass the sensed data to the cluster head. The volunteer leader node will be selected by the equation number 4

$F_{LN-value} = \eta * M_{deg} + \frac{\lambda}{K_{LN}}$ (4)

Mdeg is the number of leader nodes which is volunteer to selected as leader node. K_{LN} Is the number of nodes which comes under the defined radius. η, λ are the two constants whose total will be 1. The nodes which are the volunteer to be selected as leader node will generate random number from 0 to 1 and nodes which satisfy condition 5 will be selected as leader node. K(i)> $F_{LN-value}$ (5)

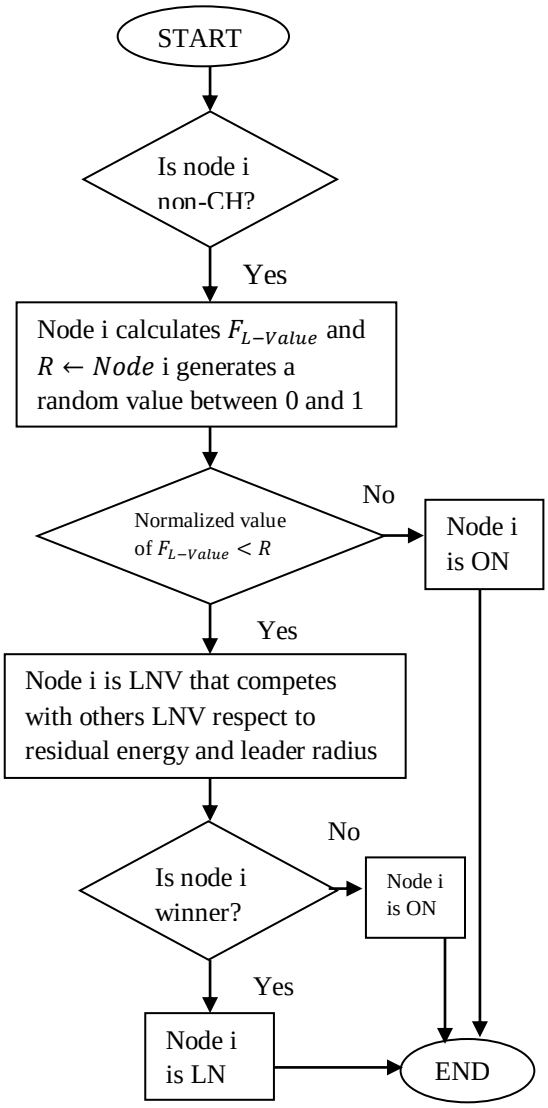

Fig 2: Leader node selection process

Phase 3: Gateway node selection

In the last phase of the algorithm, the gateway nodes are deployed in the network. The gateway nodes depends upon the total number of nodes which is described by the equation 5

$$Gateway_{nodes} = \text{total number of nodes } /4 \quad (5)$$

The gateway nodes are the forth part of the total nodes. The best nodes are selected from the all gateways nodes to send data to the base station. The distance between the base station and gateway node calculated with equation 6

$$\text{Distance} = \sqrt{(x(i)-x)^2+(y(i)-y)^2} \quad (6)$$

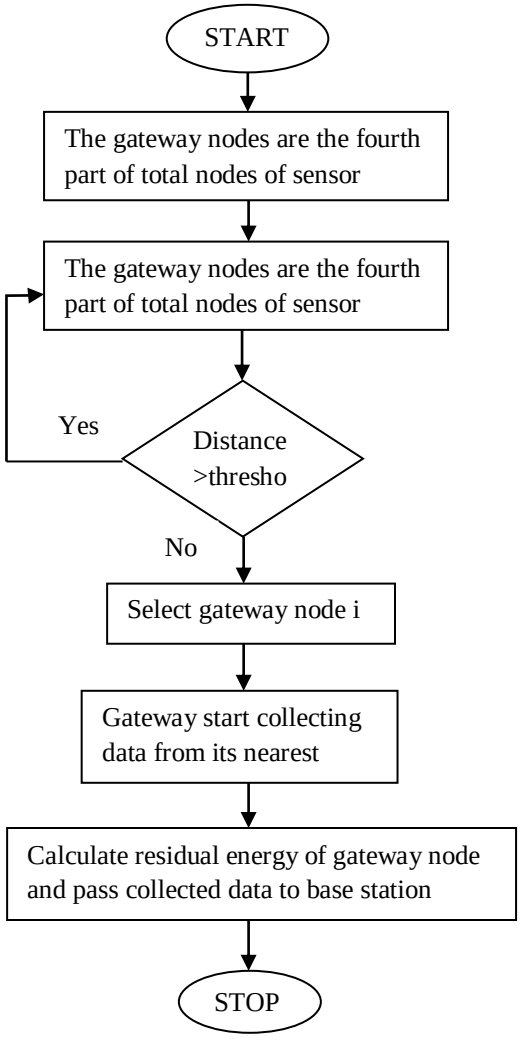

Fig 3: Selection of gateway nodes

In the proposed technique, the leader nodes will aggregate data from the normal sensor nodes. The leader nodes will pass the sensed data to cluster head nodes. The cluster head 0gateway node which is nearest to the base station will pass the data to the base station.

IV. EXPERIMENTAL RESULTS

The proposed technique is implemented in MATLAB and the results are evaluated by making comparisons with the existing approach in terms of packet transmission and number of dead nodes.

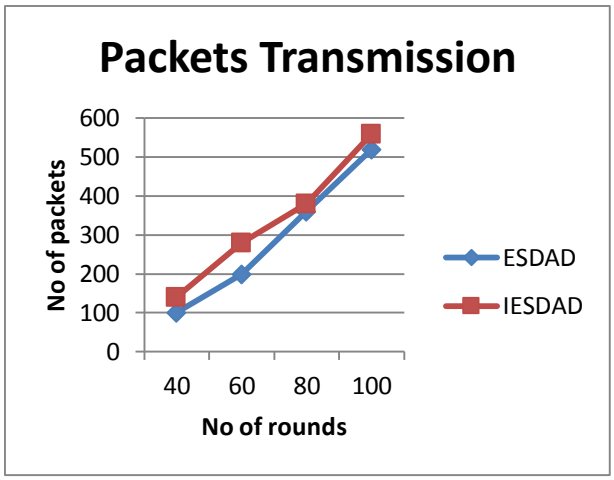

Fig 2: Number of Packets Transmitted

As shown in figure 2, the ESDAD and IESDAD protocols are compared in terms of number of packets transmitted. It is analyzed that more number of packets are packets in IEDAD protocol as compared to ESDAD protocol.

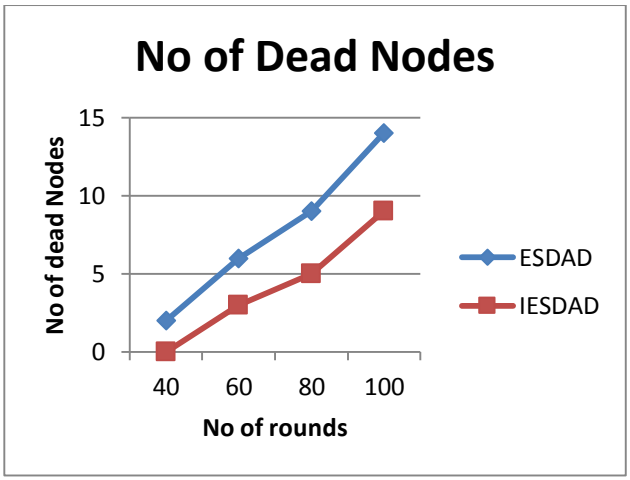

Fig 3: Number of Dead Nodes Comparison

As shown in figure 3, the ESDAD and IESDAD protocol is compared in terms of number of dead nodes. It is analyzed that due to gateway node deployment in the network the number of dead nodes are reduced in IESDAD protocol as compared to ESDAD protocol.

V. CONCLUSION

The wireless sensor network is self configuring type of network which is deployed on far places to sense environmental conditions. Due to far deployment of the network energy consumption is the major issue which reduces network performance. The WEMER is the protocol in which cluster heads and leader nodes are formed in the network. The cluster head send information to leader which forwards it to base station. In this research work, the WEMER protocol is improved using the gateway nodes. The cluster head send information to leader node which forward information to leader node. The leader node then forward information to gateway node. The proposed protocol is implemented in MATLAB and simulations show up to 20 percent improvement in the results.

VI. REFERENCES

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