Effective Data Aggregation in Wireless Sensor Networks by WEMER Protocol

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Abstract

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

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 the mechanical monitoring, traffic monitoring, cropping, weather monitoring etc. Advance creative and productive thoughts are to be generated within this area such that they can be utilized more efficiently. 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. A sensor hub is established to provide communication amongst the nodes present in the network, which consists of sensors, actuators, memory and processor 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 Wireless Sensor Networks is of smaller size. Also the nodes are located at really inaccessible locations, out of reach for humans. 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 components such as battery, processors, information storing memory and so on are important within these networks. The consumption of energy is required to be optimized 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. Also, it is imperative that information is utilized by the network without any alterations.

The most of the energy is consumed in communication of information as compared to its reception, storage or processing. 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]. Thus, the major concern here is the optimum utilization of 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 by 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 these, 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

R. Rajeshwari, et al [7] in this paper author conveys that Sensor networks are combination of many sensor nodes. These sensor nodes sense the data from its surroundings and send that collected data to the base stations in the form of data packets. Because the lifetime of sensor node is based on the energy of battery, so it is mandatory to utilize the energy consumption by these nodes. To minimize the traffic and the data that is transmitted to the base station are important for minimizing the battery consumption of the network. . By using clustering approach scalability, reduced energy consumption and better performance of network can be obtained.

Parul Saini et al [8] In this author defines that there are many routing techniques which are used to enhanced the lifetime and efficiency of the system. These protocols are helpful to increasing the fault tolerance and robustness in the system. In this the author use a technique EDEEC is the modification in traditional DDEEC technique. The results of EDEEC shows that the proposed technique much reliable to enhance the lifespan of the WSN as compared to traditional DEEC.

R. Renuga Devi et al [9] In this author conveys that the recent advancements in integrated circuit technology, Ad hoc network routing protocol, distributed signal processing and embedded systems have enabled the development of low cost, and low power, network enabled or multifunctional wireless sensor network environment. The major concern of all efficient WSN is optimal power consumption and maximum. Earlier WSN was used for monitoring and reporting events only but

now it has variety of applications. As we know that each application has distinct requirement single Routing protocol is inefficient. In this author defines the energy efficient routing protocols into three main schemes as location based routing. The comparison shows the important design issues that need to be taken into consideration at the time when designing and evaluating network protocol is performed.

Georgios Smaragdakis Ibrahim et al [10] In this paper the author explains the effect of heterogeneity of hubs, as far as their strength, in remote sensor arranges that are progressively bunched. The author accept that the rate of the number of inhabitants in the sensor hubs are outfitted with extra vitality assets—this is a wellspring of heterogeneity which may come about because of the following setting or as the operation of the system develops. The likewise accept that the sensors are arbitrarily (consistently) conveyed and are not portable.

Sunita Rani, et al [11] In this author defines that the WSN i.e. wireless Sensor Network is a network consist of many small nodes. It is a kind of ad hoc network. In WSN each every node is a sensor node which senses the surrounding environment like temperature, light, sounds etc each sensor node works on the basis of energy allotted to them because energy is consumed by them in order to perform various operation like data transfer etc. Energy is the major factor on which the performance of the network depends. So the main focus for researchers is to improve the algorithm for less consumption of the energy so that the performance increases .The delay in data transferring can also be reduced by using various protocols. This protocol creates a chain structure along with a single cluster head and only this cluster head is used to transfer data to the sink node. The cluster head is only used by the member of that related chain. In this way the rounds are decreased and energy and time for data transferring is consumed to an extent. In this author introduces a new scheme which proves that selecting the next neighbour node provides much efficiency in the network.

III. RESEARCH METHODOLOGIES

The wireless sensor networks are the self-configuring type of network and size of the sensor nodes are very small. Since these nodes cannot be directly accessed, 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:-

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

In the given equation is the radius of the cluster, is the node distance from the base station, is the minimum distance from the base station, is the maximum distance from the base station.

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

In the equation 2, the is the number of neighbor nodes of the particular node, is the mean distance of all nodes in the network, , and 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

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

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

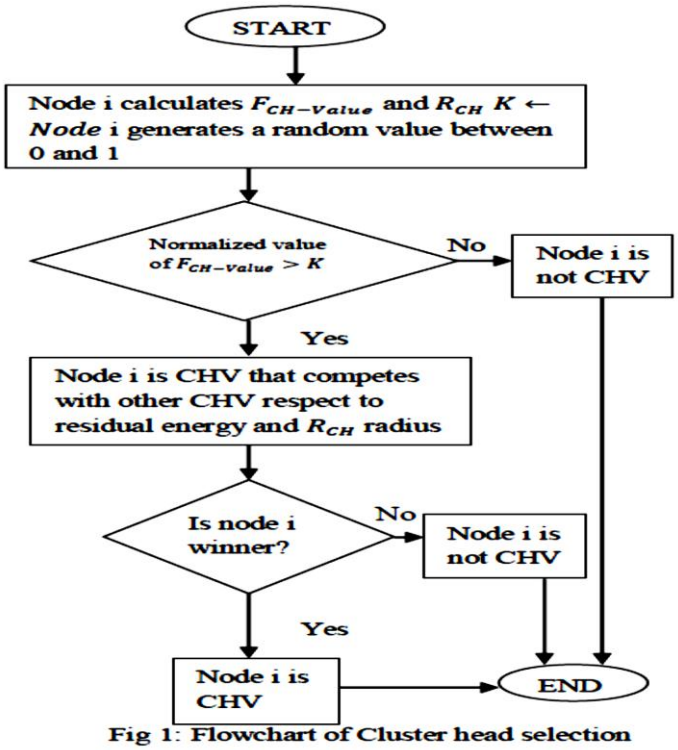

Fig 1: Flowchart of Cluster head selection

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

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

Mdeg is the number of leader nodes which is volunteer to selected as leader node. *KLN* 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.

$$K(i) > F_{LN-value} \quad (5)$$

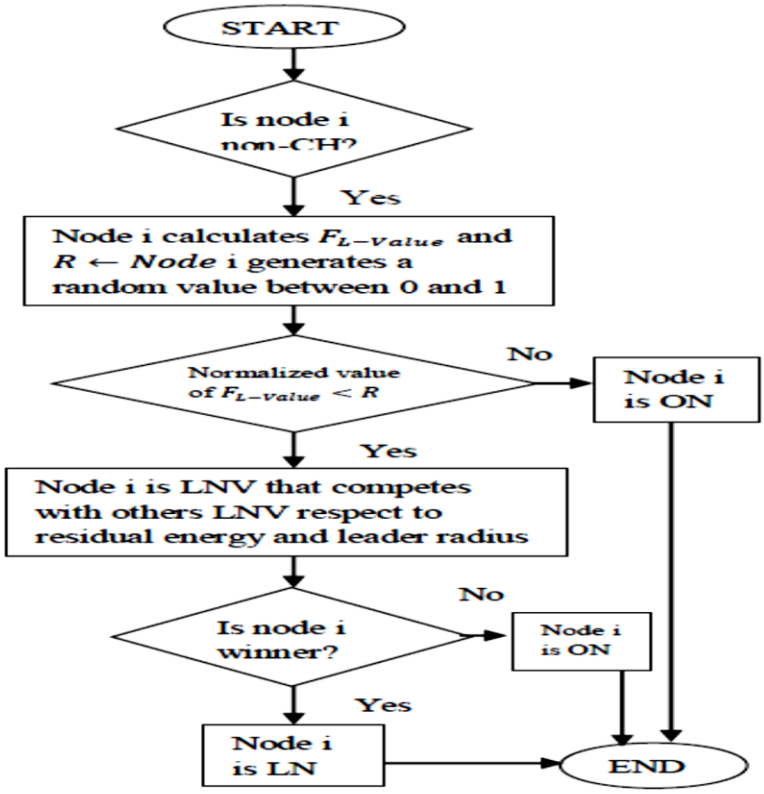

Fig 2: Leader node selection process

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

Gatewaynodes =total number of nodes /4 (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

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

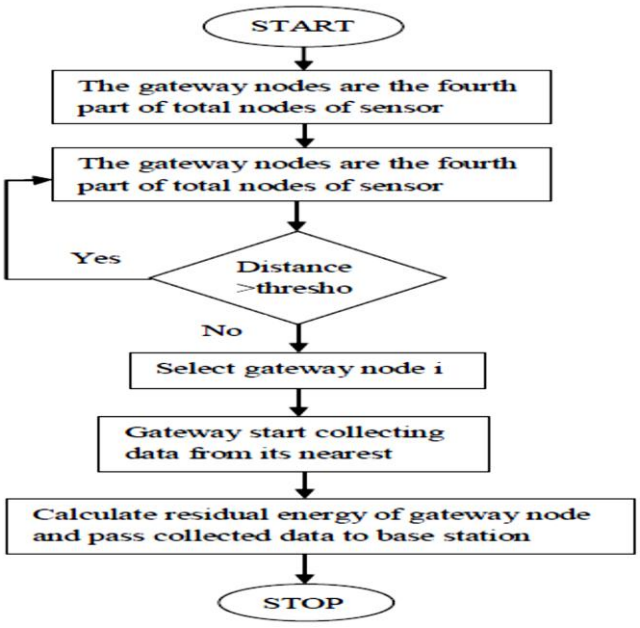

Fig 3:Selection of Gateway Nodes

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 gateway 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.

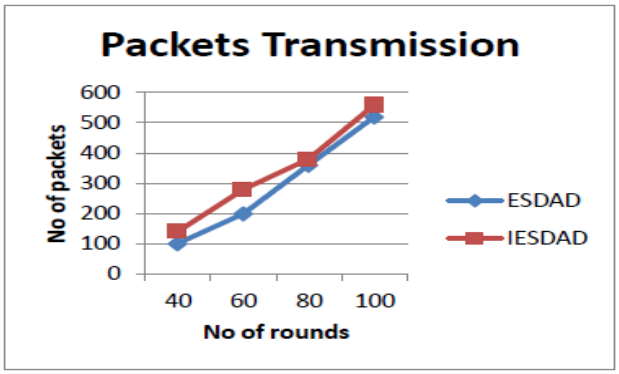

Fig 4: No. of Packets Transmitted

As shown in figure 4, 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.

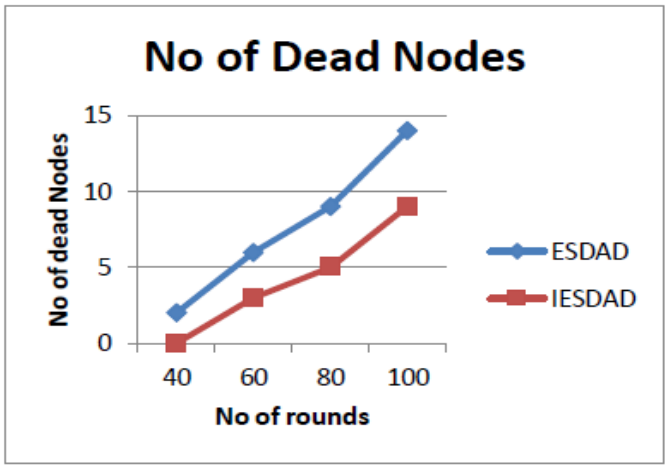

Fig 5: No. of Dead Nodes Comparison

As shown in figure 5, 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.

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