Improved Grid-Based Clustering to Increase Lifetime of Wireless Sensor Networks

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Abstract-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. 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 grid based routing is the efficient approach to reduce energy consumption of wireless sensor networks. In this research work, the cache nodes are deployed in the network which can transmit most frequent data to base station. The proposed algorithm is implemented in MATLAB and simulation results shows that it performs well in terms of certain parameters.

Keywords-*LEACH;Grid-Based Clusterin; Energy Efficient*

I. INTRODUCTION

The deployment of large number of sensor nodes within a particular region such that their surroundings can be monitored and important information can be accessed is known as wireless sensor network (WSN). The sensor nodes that are deployed within these networks are very small in size and use wireless mode for communicating amongst each other. The military applications were the first ones to recognize the need of deploying such networks in the regions such that the human work load can be reduced and all time surveillance could be provided [1]. Few of the operations being performed in these networks are broadcasting, multicasting and routing. The three important components included in the sensor nodes are to sense, process and transfer the data. Depending on the types of applications, there are various networks included. The sensor nodes are dispersed randomly within the terrestrial target areas within the applications of WSNs. The deployment of WSNs includes various sensor nodes that are resource-constraint. However, there is limited processing capability as well as storage capacity of these nodes. Further the bandwidth that these networks use is also limited [2]. These networks face several problems since the physical size and energy of these nodes is very limited. Also, generating security techniques for these networks becomes difficult. The security in WSNs is the major requirement such that secure communication can be ensured amongst the nodes. There are very less resources available within the sensor nodes and thus, the protection of important information that is gathered by them is a basic priority to be accomplished [3]. There are certain functionalities that are to be provided by these networks. Because of certain vulnerabilities and opportunities available within the networks, it is possible for the attackers to attack these networks. In the complex network where the uneven clustering has been done the clusters are formed without considering the available energy of the nodes. The nodes that are located near the sink node needs to perform the tasks of data sensing as well as to act as relay nodes for transferring the data received from other cluster heads to the base station along with the data from its own cluster to the sink node. This results in use of high amount of energy as compared to the other nodes available in the network. This gives rise to the Hotspot problem. The energy holes problem is associated with the sensor nodes available in the network. In case, clustering has not been considered in the network [4]. The sensor devices follow the flat network model where each node after gathering some data will transfer that data towards the sink node by relaying it with the help of intermediate devices. Because of this the devices that are receiving more amounts of data from other nodes to transfer it to the neighbor node result in high energy utilization. This issue can also be seen in case the energy distribution in non-uniform among the sensor nodes or the network consists of heterogeneous network devices. LEACH-M or Mobile LEACH protocol is advancement over the existing LEACH and LEACH-C protocols. These protocols provide efficiency in forming clusters to simplifying the complex networks formed by wireless sensor nodes. In case the sensor nodes have the ability to move i.e. they possess the mobility function, the protocols LEACH and LEACH-C becomes ineffective to provide the efficient clustering services [5]. In such cases,

LEACH-M will be used. LEACH-M efficiently provides adaptive routing schemes when the network topology changes more frequently. The concept of LEACH-M identifies the capability of the mobile nodes in communicating with the specified cluster head within a specified time period as provided under Time Division Multiple Access. In LEACH-M after two successive time slots in TDMA scheduling when the node has not received any request from the cluster head that nodes considered to be moved out of the cluster [6]. This mobile node can now join the new cluster by transmitting the request message for joining the other cluster and got success on receiving the acknowledgement from cluster head. For determining the receiving and transmission costs for specified L-bits of messages over a distance d following equations will be helpful. Fuzzy term represents the things that are not clearly defined. The values instead of only being true or false will be given by the fuzzy logic. It resembles to the decision-making techniques in the natural language processing or human decision making. In our work fuzzy logic has been used to map the multiple input parameters and generate a specified output. For the selection of the appropriate cluster head based on the energy, distance, density and mobility parameter the fuzzy logic is helpful [7]. Node that possesses high energy, less mobility, high density and least mobility will be elected as cluster head. The selection of competitive radius, an output parameter will be based on the fuzzy rules. Linguistic variables for the remaining energy are low, medium and high. For the distance parameter the linguistic variables selected are close, medium and far. Dense, normal and sparse represents how densely the nodes have been deployed. At last the mobility parameter is based on the linguistic variables as more mobility, intermediate or less mobility.

II. LITERATURE REVIEW

Hajer Ben Fradj et.al (2018) proposed [8] Opportunistic routing (OR) for energy consumption in wireless sensor network (WSN). It is widely concerned approach as is able to improve the energy consumption and its reliability on WSN. Moreover, the sensor nodes are fully equipped with limited number of non-rechargeable battery power. The optimal routing strategy is most difficult task in the wireless sensor networks. The objective of this paper is to minimize the energy consumption and increase the lifespan of the network. Although, a new technique was also proposed called ECS-OR (Energy Candidate Set-opportunistic Routing) this balances the energy consumption. Therefore, the researchers conclude that the proposed technique can improve the performance of network during energy consumption and wireless connectivity as compared to other existing wireless sensor networks.

Huseyin Ugur Yildiz et.al (2018) proposed [9] a hybrid energy harvesting model which is used to exploit both solar and electromagnetic energies. It develops a Mixed Integer Programming (MIP) method to minimize the energy dissipation of sensor nodes. The utilization of power transmission control by adjusting the powers according to the natural conditions was the method to reduce the energy consumption. Hence, the researchers had drawn some conclusions from the results that developed method of energy harvesting can minimize energy consumption by 91.46% when solar energy is used. But, when the solar energy cannot be used then the proposed technique can decrease the energy consumption at the rate of 81.40%.

Satyasen Panda et.al (2018) proposed [10] an Artificial Bee Colony (ABC) algorithm in which clustering model is used to improve the capacity of the energy is nay wireless sensor networks. The proposed technique was used to improve the internal dynamics of both i.e. cluster heads as well as sensor nodes. The proposed technique is used to balance the energy consumption power, conserve energy and enhances the lifespan of the clustered network. Therefore, the researcher had concluded that the proposed algorithm increases the lifespan of the clustered networks which in turn optimizes the ability of network just have increased number of communication rounds. The approach is quite useful in various technical appliances like smart homes, smart manufacturing and plant automation etc.

Madiha Razzaq et.al (2018) proposed a K-means clustering-based routing protocol and considers an optimal fixed packet size a [11] according to the radio parameters and channel conditions of the transceiver. Different amount of power is required for the transmission from cluster head to cluster member and base station. An optimal fixed packet size is required for the data transmission in order to conserve energy and to increase the network lifetime. Therefore, the result concludes that the proposed method has the capacity to conserve huge amount of energy and prolongs the lifespan of the networks. The simulation result provides better performance than any other conventional K-mean based energy and enhances the overall networks security.

Nazia Suraia Usha et.al (2017) introduced [12] a new management scheme for the duty cycle based MAC protocol for the reduction of energy consumption by the sensor nodes and improves the network lifetime. The total duty cycle is divided into two equal halves, one half is used for transmission of data and the other half is used for transmission of data from the neighbor's node data. The duty cycle will reduce the only listening period in order to save energy as we as increases the network lifetime. Hence, the author concludes that performance of the energy consumption was evaluated using numerical simulations. The performance was compared with the already existing schemes which show that the respective method increases the lifespan of the network and shows better energy consumption performance.

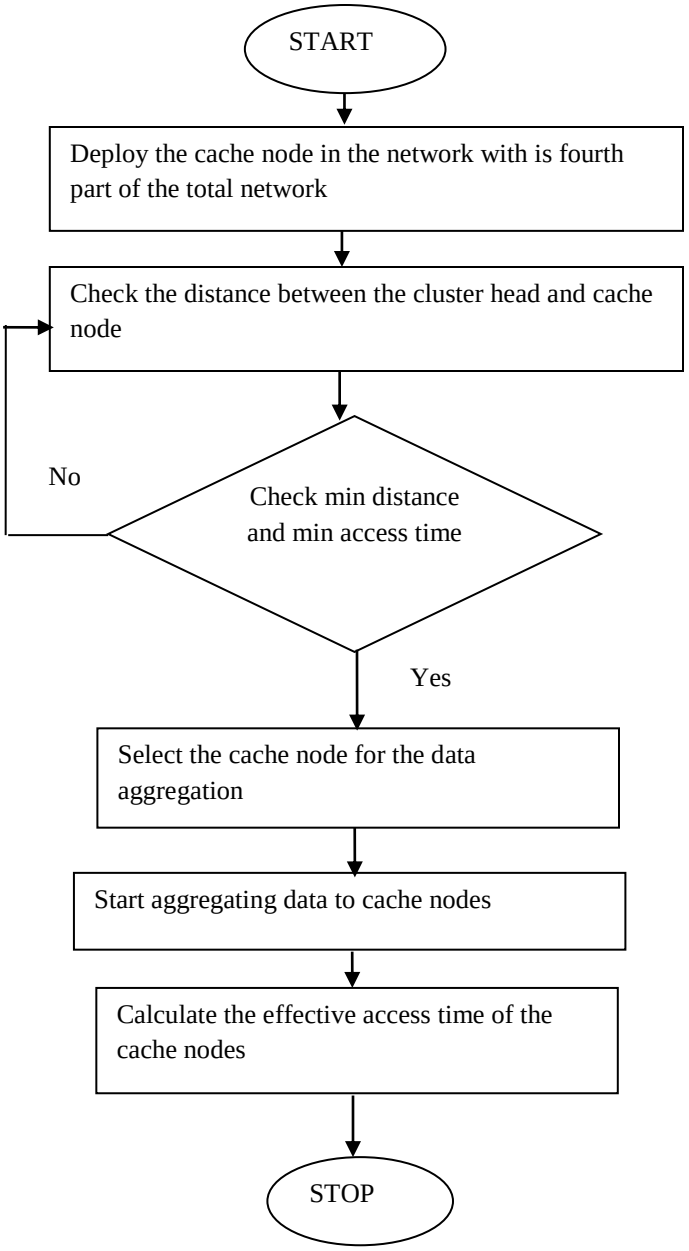
Walid Abushiba et.al (2017) proposed [13] a CHleach technique in which performances are compared using simulations. The calculation is purely depends on the metrics of wireless sensor networks like energy-efficiency and the network's lifetime. Particularly, battery-powered sensors having limiting amount of energy which is not reversible in many cases. Low Energy Adaptive Clustering Hierarchy (LEACH) is one of most common energy saving sensor networks. Therefore, the researcher concludes that the proposed protocol improves the lifespan by 91% and 43% more than the LEACH and DEEC protocols respectively. CH-leach reduces energy consumption as compared to the LEACH and DEEC.

III. RESEARCH METHODOLOGY

Within the sensor networks, data fusion plays an important role since the amount of transmissions made and the energy consumed within WSNs can be minimized through node computing and storage capability. Data fusion technique is introduced. Here, in order to attain the true value, the fusion information is computed with the help of weighted formula. In order to minimize delay of WSNs, the data growth factor is introduced and the data fusion rate is fixed. Thus, there is no replacement of data fusion here. However, it is not possible to receive the information absolutely to the base station through transmission.

Cluster-heads establishment stage: The probability that a node becomes better cluster head can be depicted on the fact that less energy is consumed by it. There are two broader classifications of nodes which are ordinary nodes as well as advanced nodes. The part in which energy is higher in comparison to ordinary node is denoted by α.

Cache Node Deployment:The cache nodes are deployed in the network to aggregate data from the cluster heads. In this phase, the cache nodes are deployed which are one fourth part of the total network. The cache node deployment is given by the equation



Fig,1:Proposed Flowchart

IV. EXPERIMENTAL RESULTS

The proposed work is implemented in MATLAB and the results are evaluated by making comparisons as shown below. As shown in figure 2, the proposed and existing algorithms are compared in terms of number of dead nodes. In the existing approach the grid based clustering is used for the efficient data transmission in the network. In the proposed approach, the cache nodes are used for the data transmission which reduces number of dead nodes in the network. It is

analyzed that number of dead nodes are less in the proposed technique s as compared to existing technique

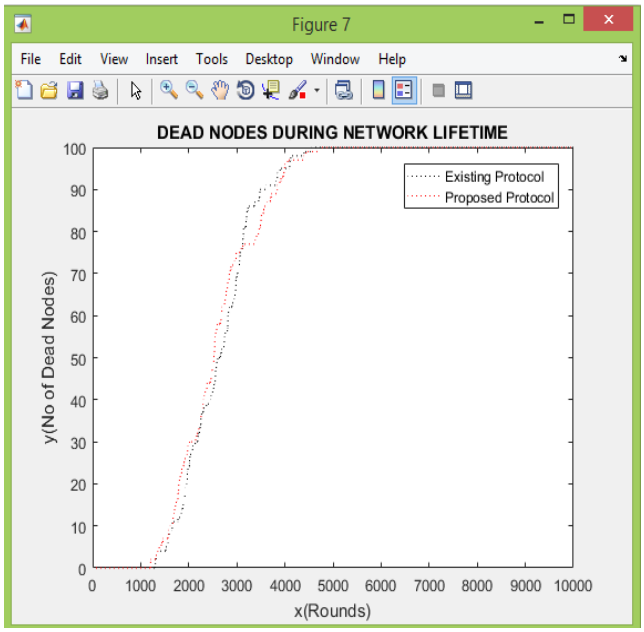


Fig.2: No of Dead Nodes

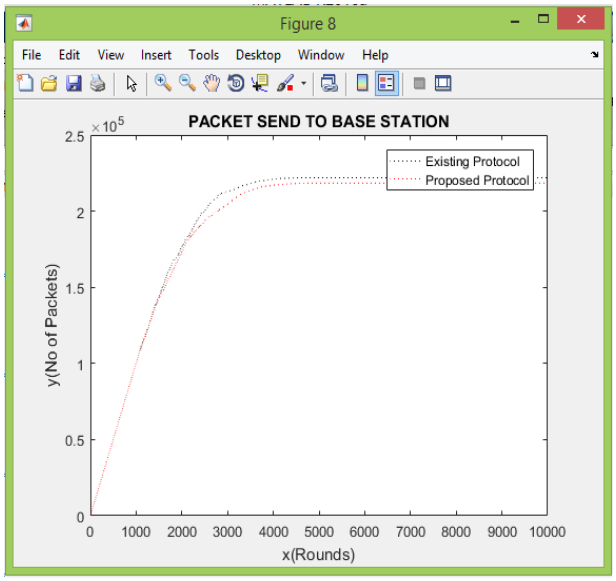


Fig.3: Number of Packet Transmission

As shown in figure 3, the existing and proposed algorithms ate compared in terms of number of packets transmitted. It is analyzed that when cache nodes are not deployed in the network the less number of packets are received by the base station. On the x axis the numbers of rounds are described and on the y axis the numbers of packets are described.

V. CONCLUSION

The wireless sensor network is the decentralized type of network in which sensor nodes sense information and transmit to base station. The energy consumption is the major issue of the wireless sensor network due to far deployment. The clustering is the efficient approach which is applied to cluster whole network. The clustering approach has various types like grid based clustering, partitioned based clustering. This research work is based on the grid based clustering to improve network lifetime. The cluster heads are selected in each cluster based on the energy and distance. In this work, the cache nodes are deployed which will take data from the cluster head and forward to base station. When the cache nodes are deployed in the network, the frequent data can be passed by the cache nodes to base station. The proposed algorithm is implemented in MATLAB and results are analyzed in terms of certain parameters. It is analyzed that number of dead nodes are less in the proposed work as compared to existing. The more number of packets are transmitted to base station by the sensor node in the proposed work as compared to existing work.

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