Inter-Clustering Communication using PRIM Algorihm based on Adpative MCFL in WSN

Aastha Tiwari
M.Tech Scholar
TIEIT Bhopal

Dr. Amit Sexana
Hod CSE & IT Dept
TIEIT Bhopal

Prof. Kaptan Singh
CSE & IT Dept
MANIT Bhopal

Dr. Deepak Singh Tomar
CSE Dept
MANIT Bhopal

Abstract— **Clustering is a competent method for limiting node energy consumption and amplifying lifetime of network. But only clustering could not reach to reduce more energy therefore for communication between the clusters we are using minimum spanning tree PRIM algorithm. An adaptive multi clustering algorithm with fuzzy logic (Adaptive MCFL) is utilized for clustering in WSN. The proposed algorithm prevents the selection of new cluster heads by relying on past cluster heads and messages and saving energy in reducing the leader. The proposed methodology is in two separate situations, for example, the rest of the energy, the first node died (FND), half nodes died (HND), and the last node died (LND).**

Keywords—clustering,wireless sensor netwrk, Adaptive MCFL, prims algorithm.

I. INTRODUCTION

The Wireless Sensor Network (WSN) has wide scope of uses in the field of monitoring, surveillance, customer gadgets, remote monitoring of patients, etc [1]. The functionalities of sensor networks are expanding step by step with progressions in advancements. The span of the sensor hub is reducing, with the expansion in applications. Be that as it may, scaling down of the sensor hub impacts the extent of the battery [2]. The capacity limit of the battery is decreased as the span of the sensor hub is diminished. The sensor network comprises of collection of sensor hubs which are deployed in the scenario as shown in Fig 1.

After the deployment of the node it is hard for the humans to replace the nodes. Due to the size of the sensor node, the capacity of battery becomes limited. Every sensor hub assumes a noteworthy position in expanding the survivability of the nodes. The grouping system in sensor node empowers effective transmission of data from end hubs to the sink. Many energy saving techniques has been proposed for WSNs [1-2]. In a clustered WSN, sensor nodes are assembled to generate distinctive clusters, every cluster has a controller called cluster head (CH) and alternate individuals from the group are called cluster members (CMs). Each sensor node has a put with a specific bunch. The CMs of each cluster sense their local information and then sends it to its corresponding CH. The CHs gathers data from its CMs and after that ahead it to the BS.

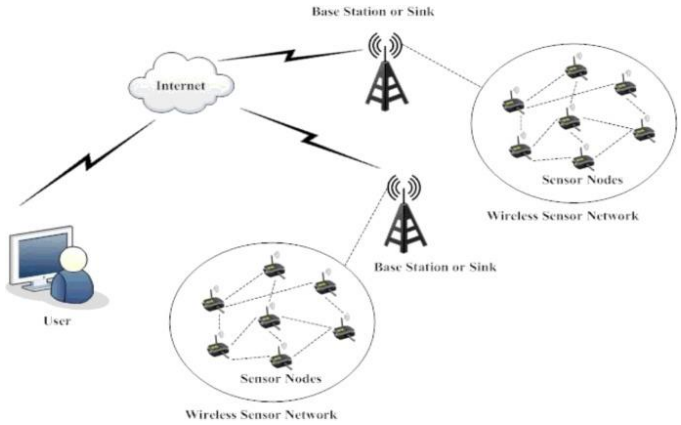

Fig. 1: Wireless Sensor Network

In this paper we have utilized clustering using fuzzy logic which uses three algorithms for clustering. The communication between the cluster heads to the base station is done by applying prim's algorithm which is proposed in this paper. The selection of cluster heads is done in different rounds.

The remainder of the paper is as follows: in section 2, related work regarding this field is explained. The system model has been explained in Section 3. In Section 4, the proposed methodology has been depicted in very detail. Section 5 discusses the experimental setup and results comparing with existing algorithm. And finally, Section 6 deals with conclusion and the future work.

II. LITERATURE SURVEY

Different clustering-based routings in numerous settings have been proposed to limit the energy utilization of the WSNs. In this section we will study different energy efficient clustering algorithms.

LEACH algorithm is a classic clustering routing algorithm; the nodes in the cluster gather information and send the information to CH nodes, which coordinate the information furthermore, send incorporated information specifically to the BS [3]. Each node in the wireless sensor network randomly selects the value of 0-1; In this situation, the random value selected by the node is less than the threshold value t(n), the node is picked as the CH node [4]. The LEACH expects that all nodes can control transmission capacity to achieve the sink and CHs can specifically speak with the sink.

HEED (Hybrid Energy-Efficient Distributed Clustering) [5] is a clustering process which requires a number of iterations. Amid the cycle, a node turns into a CH with a specific probability. It includes a hybrid of energy and communication cost while choosing group heads. The remaining nodes select their cluster heads based on reducing intra-cluster communication costs. Each of these node, directly communicate with its cluster head. In contrast to LEACH, HEED makes very much adjusted groups. HEED uses two radio transmission control levels, one for intra-group correspondence and the other for the between bunch correspondence. HEED depends on the presumption that CHs, which frame an associated graph, can converse with another.

CHEF (Cluster Head Election strategy by Fuzzy logic) is a sort of clustering algorithm which conveys fuzzy logic into WSNs to improve the imperativeness utilization of the structure [6]. CHEF picks nodes residual energy and distance among nodes & BS (base station) like I/P values to process the likelihood of every node to be CH. Although the algorithm offers a good decision scheme for wireless sensor networks in distributed CH election, it ignores the influence of nodes degree on the energy usage proficiency for grouped systems.

DFLC is furthermore a disseminated clustering algorithm utilizing fuzzy methodology for WSNs [7]. This reduces the number of unnecessary data packages, for which the recipient needs to receive and forward the message, which moves the relay nodes from the leaf node to the root node. Moreover, it eliminates the message of the nodes which have a lower probability to be a new root. In other words, it adds a filter mechanism before CHs election to improve the quality of the candidate nodes. In this algorithm, it chooses node residual energy, distance to the base station and nodes density as consideration factors for the input of fuzzy approach. The consequent part "probability" is a fuzzy linguistic variable with 5 periods of fuzzy partition. The COA technique is transformed keen on crisp value. Though, it overlook the hotspots setback in multi-hop communication, and this can be the reason for the load imbalance and the cause of the death of hand-off nodes preserve 1st, which influences the general execution of the whole system framework. Moreover, the distance among the nodes and the BS isn't considered very appropriate in the dynamic system on the grounds that the area of nodes is speculative in the dynamic systems, it will cause a lot of energy consumption if all the nodes have to communicate with the BS to get the current distances in real time in each round.

DUCF is a disseminated clustering algo which depends on fuzzy logic for unequal clustering n/w, which selects node residual energy, node degree, and the distance among nodes & BS as the i/p, and selects the probability to be voted as the CH and the dimension of the cluster as the o/p [8]. This scheme not only takes the node's own factors, but also the cluster size into consideration, and enhances the overall performance of the networks. Like the decrease in DFLC, accomplishing the separation amongst the nodes and the BS continuously expends a great deal of energy in a dynamic system, which contrarily effects the lifetime of the sensor nodes.

Another approach to cluster WSNs is MOFCA [9]. Here, cluster heads are resolved dependent on distance to BS and residual energy. Aside from the chance, the span of the bunch head is exceptionally indisputable, which implies that if the group head is near the base station and has more energy, and then it is capable of collecting and transmitting more data. As a result, the competitive radius of Cluster Head is high. After CHEF, this method allows some nodes to participate in the selection process by comparing random numbers with thresholds. Therefore, the reduction in violation of CHEF law is also present in this method. Like other clustering methods, the algorithm is selected in every round and enhances energy consumption.

III. SYSTEM MODEL

In this paper the cluster-heads are viewed as settled and is rehashed in each round. Keeping WSN in mind, it has been deployed on a geographical area whose main purpose is to collect sensing and information, we believe that the nodes have minimum mobility, in this manner sending the area data amid the underlying stage is sufficient. Wireless communiqué among nodes is symmetric. A common node and CH node swap the *L*-bit data. The distance between the transmitter and the receiver node is calculated for the transmission of energy and k bit for the energy spent during the reception

$$E_{Tx}(L,d) = E_{elec} * L + \varepsilon_{amp} * L \quad (1)$$

$$E_{Rx}(L,d) = E_{elec} * L \quad (2)$$

where d is the distance from transmission node to receiving node, energy is consumed during the transmission phase of $E_{Tx}(L,d)$ L-bit packet, and during the phase of obtaining $E_{Rx}(L,d)$ energy is consumed. E_{elec} Transceiver sensor node utilize a bit of electronics. ε_{amp} is the amplifier energy utilization amid the period of transmission, which can be determined as

$$\varepsilon_{amp} = \begin{cases} \varepsilon_{fs} * d^2, when\ d \leq d_0 \\ \varepsilon_{mp} * d^4, when\ d > d_0 \end{cases} \quad (3)$$

In which d_0 is a threshold value regarding the transmission model of sensor node and ε_{fs} and ε_{mp} are communication energy parameters. d_0 is computed as

$$d_0 = \sqrt{\frac{\varepsilon_{fs}}{\varepsilon_{mp}}} \qquad (4)$$

IV. PROPOSED METHODOLOGY

As we know, the clustering reduces the energy consumption of the network. In this paper, the clustering process is similar to adaptive MCFL [10] and then construct minimum spanning tree according to prim algorithm.The clustering task is followed by three different clustering algorithms. In the 1st clustering, the factors of remaining energy and the no. of neighbors of every node are viewed as fuzzy input. Every node broadcasts the o/p got to its neighbors, and at last the node comprising the most astounding yield is chosen as the group leader of that node. In the wake of choosing the CH, the nodes transmit their information to the group headers, and group heads, thusly, send information to the base station subsequent to gathering the information. Toward the finish of this stage, the best nodes within the neighboring radius have been chosen as group heads.

In the 2nd group, the nodes whose CH have not yet achieved the threshold in grouping, they are permitted to stay in the other grouping, while those who have reached the threshold; they have passed in the third clustering. The threshold value is calculated as

$$Th = \left(\frac{1}{\frac{r}{2450}}\right) - \left(\frac{x^2}{2}\right) \qquad (5)$$

Where x is the fuzzy output of each node and r is the number of current rounds. After reaching the power level threshold of the cluster head, all its nodes enter the third clustering so that the selection of new cluster heads can be started. In the primary clustering, the best nodes in every cluster are chosen as group heads. By depending on them in the second clustering, similar CHs are available and along these lines, no choice will be made and we can decrease the number of messages got from the choice procedures. But since many groups have not changed the cluster heads, they are suffering from lack of energy, while it is possible that each cluster has some nodes that are in a better position to be selected as a cluster head. Therefore, the third is chosen in clustering.

V. EXPERIMENTAL RESULTS

Experimental studies were performed to analyse the given scenario. The simulator was programmed using MATLAB R2018a. In this we are comparing different parameters in different scenarios. Then again, factors, for example, the rest of the energy of the system, the no. 1st node passes on in all round (FND), HND, and LND are observed in each circumstance.

Scenario1:

The reference network comprises of 100 nodes arbitrarily disseminated over a region of 100×100 meters. The base station is located at centre of Area-of-Interest (50, 50). In the first phase of the simulation each node has energy of 0.5J. The data packet length for this model is 500 bytes and the control pkt. is 25 bytes. Fig.2 shows the three one of a kind parameters with respect to the no. of rounds, for instance, FND, HND & LND.

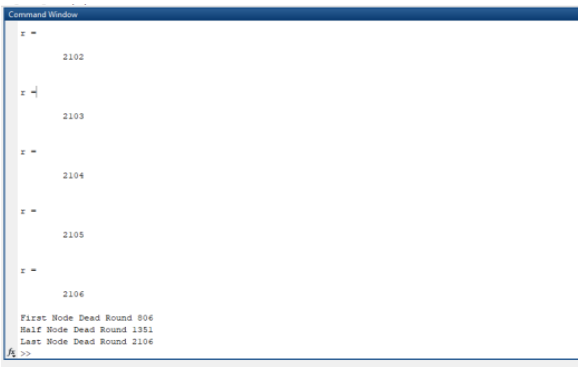

Fig 2: Number of rounds of FND, HND and LND

Fig 3 shows the proposed structure of the given scenario. The structure is formed using minimum spanning tree (PRIM). CH of all clusters creates a tree for inter-cluster communication.

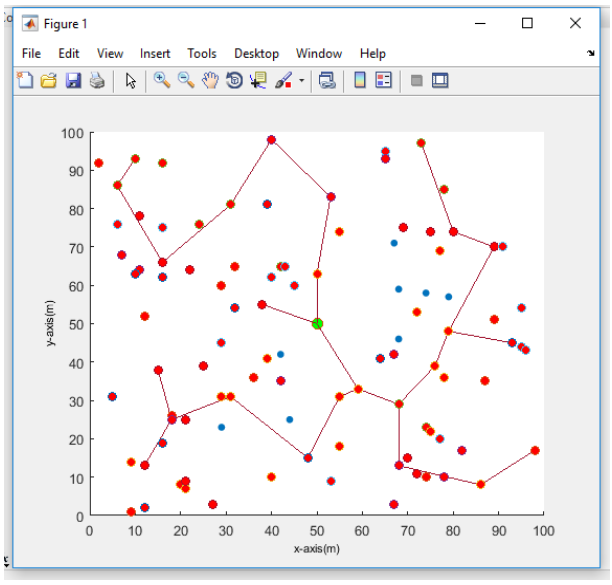

Fig 3 inter-cluster communication using PRIM

Fig 4 shows the variance of dead nodes in different rounds. And fig 5 shows the variance of energy in different number of rounds.

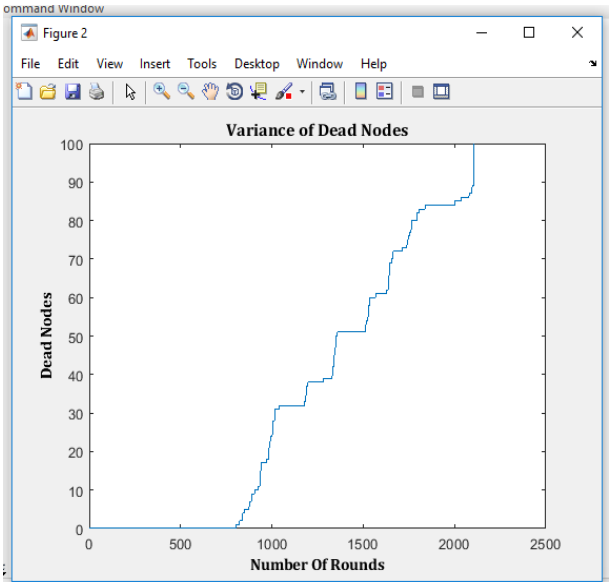

Fig 4 Comparison of number of dead nodes in each round

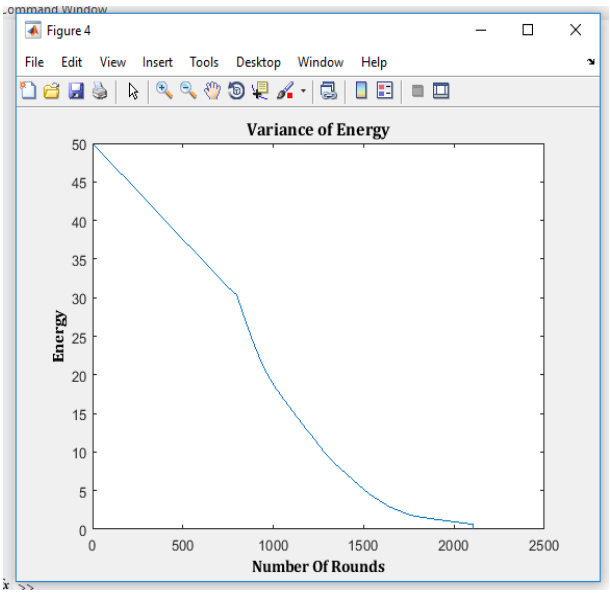

Fig 5 Comparison of energy in each round

Scenario 2:

The reference network consists of 200 nodes randomly distributed over an area of 200×200 meters. The base station is located at centre of Area-of-Interest (100, 200). In the first stage of simulation, 1J has the energy of each node. The length of the data packet for this re-enactment is 500 bytes and control packets 25 bytes. Fig.6 exhibits the three extraordinary parameters concerning the number of rounds, for instance, first node die (FND), last node die (LND), & half node die (HND).

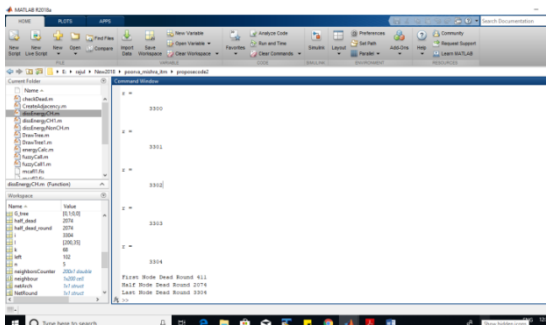

Fig 6 Number of rounds of FND, HND and LND

Fig 7 shows the proposed structure of the given scenario. The structure is formed using minimum spanning tree (PRIM). CH of all clusters creates a tree for inter-cluster communication.

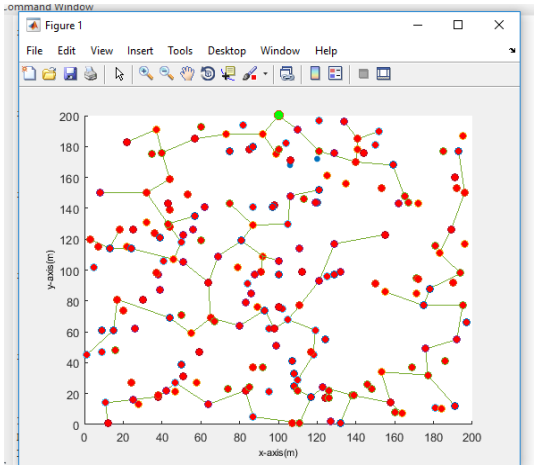

Fig 7 inter cluster communication using PRIM

Fig 8 and fig 9 shows the variance of dead nodes in different rounds and variance of energy in different number of rounds correspondingly.

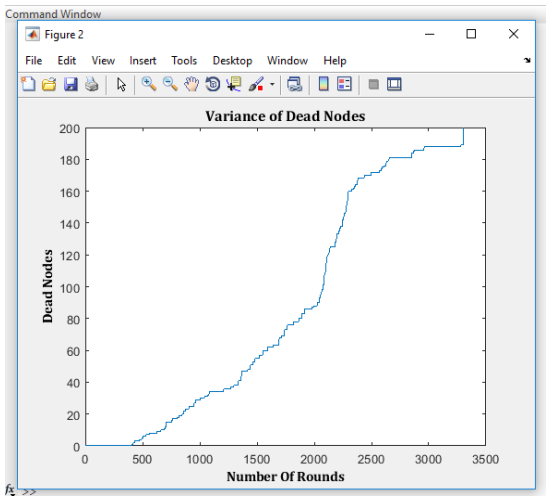

Fig 8 No. of dead nodes over no. of rounds

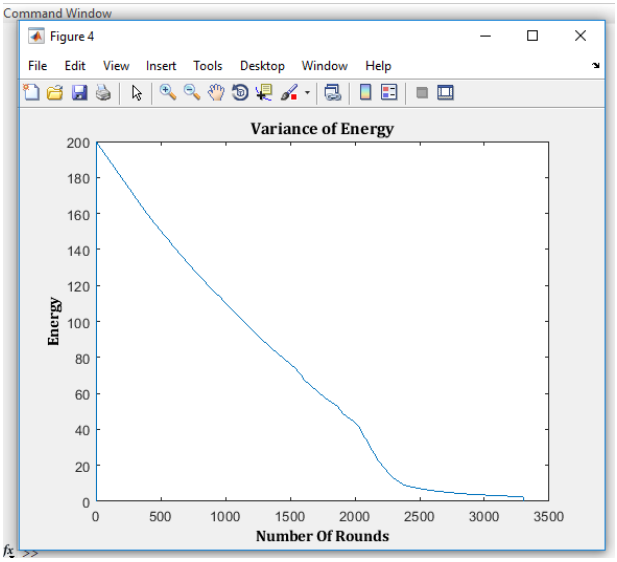

Fig 9 Variance of Energy level

VI. CONCLUSION

This article presents inter-clustering communication using prim algorithm (to generate a minimum spanning tree) in Adaptive MCFL to minimize the energy utilization in WSN nodes. Experimental outcome demonstrates that this methodology diminishes the energy consumption in various situations.

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