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A HYBRID APPROACH OF FUZZY C-MEANS CLUSTERING AND NEURAL NETWORK TO MAKE ENERGY-EFFICIENT HETEROGENEOUS WIRELESS SENSOR NETWORK

Harish Morwani
Research Scholar, Department of Computer Science, Calorx Teachers University, Ahmedabad, Gujarat India
MuktaAgarwal
Asst.Prof, Department of Computer Science, Calorx Teachers University, Ahmedabad, Gujarat India

Abstract

The Wireless sensor network has been exceptionally engaged examination region as of late because of its wide applications and versatility to various conditions. The energy-compelled sensor nodes are consistently getting looked at to expand their lifetime. In this paper, we have utilized the benefits of two methodologies i.e., fluffy c-implies grouping and neural network to make an energy productive network by drawing out the lifetime of the network. The group arrangement is finished utilizing FCM to shape similarly estimated bunches in-network and the choice of picking bunch head is finished utilizing neural network having input factors as distance from the base station, heterogeneity, and energy of the node and so forth Our Approach has effectively expanded the lifetime and information limit of the network and outflanked various methodologies applied to the network present in writing.

Keyword: FCM Neural network Sensor node Wireless sensor network.

I. Introduction

Wireless Sensor Network (WSN) is a self-designing network which is exceptionally versatile to various climate situations. They are exceptionally helpful network in human-distant climate for observing purposes. It is made out of a bunch of sensor nodes (which are likewise called bits). The lifetime of WSN is consistently a subject of examination in light of the fact that the sensor nodes are compelled in term of battery life and it isn't practical to re-energize the battery at ordinary premise as a result of their network in Wireless and unfriendly places. So, we really want those steering conventions or approaches which can amplify the information limit and furthermore drag out the lifetime of sensor node. So, the test is to foster low power correspondence approaches with minimal expense on-node handling and self-coordinated availability/conventions. A few conventions were created to make the correspondence energy-successful to build lifetime of the networks. The Wireless sensor networks can be classified into homogenous and heterogeneous networks as indicated by the sort of nodes the network is utilizing. The homogenous network is the network where all nodes have equivalent energy and all have equivalent likelihood to become bunch heads. The heterogeneous networks have distinctive sorts of nodes having diverse energy also probabilities of becoming cluster heads. In this paper, we will chip away at heterogeneous networks. Various conventions have been for homogenous and heterogeneous networks. These conventions utilized unique ways to deal with work on the correspondence and transmission of the parcels in the network. Be that as it may, they need various things, for example, to have an ideal circulation of nodes in the network, similarly, estimated groups, the job of leftover energy in the appointment of bunch head and so forth The non-ideal conveyance often make the dispersal of the energy more quickly in the group than the ideal dissemination in the network. The inconsistent estimated groups lead to the lesser information limit of the network when contrasted with the equivalent estimated groups. Various conventions have been made to make the directing effective, for example, LEACH [1, 2], [3], SEP [4], DEEC [5], and so on These allconventions depended on idea of bunching in the network to save the energy of the nodes. This wasfirst and foremost applied in the LEACH convention. Drain convention was created as grouping based steering conventionin which the bunch head is chosen utilizing likelihood-based thresholding component.

T(i)=p/(1-p(rmod1/p)) (1)

Where i is node, p is the probability of choosing the cluster head and r is round number. A random no 's' is generated between 0 and 1 and is compared with T(i). If T(i) is greater than s then node i become cluster head otherwise not. But as it was based on probability-based cluster-head election which can lead to non-optimal and unequal-sized cluster and also did not take account the residual energy factor in determination of cluster heads.

The [3] was to make further develop the LEACH convention by eliminating its disparities by taking theelement of leftover energy in assurance of bunch head.

The SEP [4] presented the heterogeneity in the Network by making two sorts of Nodes for example ordinaryfurthermore progressed having various energies and probabilities to get chosen as bunch head. Thisheterogeneity is amazingly useful to improve the lifetime of Network [8].

The DEEC [5] utilized the proportion of remaining and normal energy in ascertaining the limit for theappointment of bunch head which further developed the SEP further. In any case, this likewise outlined non-ideal group in thenetwork.

The EDEEC [6] expanded the heterogeneity by another Node for example ordinary, progressed and super Nodein the Network. The typical has most reduced energy and likelihood to become bunch head in the group. Thiscalculation joined parts of heterogeneity and proportion of leftover and normal energy per round to improvethe soundness time frame and lifetime of the Network.

TADEEC [7] steering calculation utilized the best of heterogeneity and TEEN [8] to build the possibilitiesof high energy Nodes to become bunch heads more than the low energy Nodes. Like-wise it eliminated therepetition of the information at bunch heads and sensor Nodes by carrying out the two edges for example hard anddelicate limit with the goal that equivalent information don't need to be spread to the group heads and basestation [9]. Thisutilized four heterogonous Nodes in the Network for example ordinary, progressed, super and supadvanced having theirexpanding energies and probabilities of picking as bunch heads in the Network. This beat theFilter, SEP, DEEC and EDEEC as far as solidness period, lifetime and information limit of the Network.

The [10] utilized the notable bunching method dependent on fluffiness for example fluffy c-implies bunchingto outline the bunches in the Network. The ideal and adjusted groups are outlined by the FCM calculation.The Fuzzy c-implies bunching essentially partners to every Node a comparing member worth to eachgroup number which must be shaped. The bunches are framed by the most significant level ofbelongness (otherwise called level of relationship) to a specific bunch number. After the bunches areframed the group heads are picked dependent on the most extreme lingering energy Node among the bunch individualsand furthermore its nearness to comparing group focus. The group heads further convey the informationgathered through the bunch part sensor Nodes to the base station.

[11] Realized the fuzzy c-means clustering algorithm on wireless sensor network.This paper realized the 50 sensor nodes in the hardware having TinyOS operating system.This hardware implementation successfully proved the effectiveness of FCM in wireless sensor network and this implementation outperformed the LEACH.

[12] Proposed a fuzzy-based simulation system for sensor networks and calculation of the lifetimeof a sensor by considering the remaining battery power, sleep time rate and transmission time rate.

[13] Used the fuzzy logic mechanism in heterogeneous network where it applied the energy,heterogeneity and proximity to basestation factors in fuzzy inference system in determination of cluster heads.

II. Research Methods

In this paper, we have applied two strategies for advancement of the remote sensor Networks. The fluffy c-implies grouping which has been utilized to bunch the sensor Nodes and neural Networks which has been utilized to take the choice of appointment of group head among the bunch individuals in the group. The FCM calculation is outlined in figure 1. The level of belongness of Node I to group j is given by u_{ij}. For each Node I and group j, u_{ij} is determined and most extreme worth is chosen to which the Node has a place. In a bunch the group head is the prevailing Node as the further correspondence to the base station would be finished by the group head. A few variables must be thought of while choosing the group heads. In a heterogeneousnetwork the sensor nodes have different energies and probabilities of getting elected as cluster heads. The heterogeneity factor plays an important role in election of the cluster head.

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Algorithm

for j = 1 to N **do**

Node j is given the coefficient u_{ij} for being a member of cluster i

end for

repeat

for i = 1 to c **do**

Compute the centroid of each cluster

$$pos(center_i) = \frac{\sum_{j=1}^{n} u_j^m pos(node\ j)}{\sum_{j=1}^{c} u_j^m}$$

end for

until the algorithm is converged

Figure 1. The FCM algorithm

In this paper, the heterogeneity factor is determined from the likelihood of getting chosen as bunch head and energy of the Node, so a higher energy Node would have a bigger probability of chosen as a group head and eventually would have a higher heterogeneity factor. The remaining energy additionally plays a critical part in the appointment of the bunch head. The leftover energy is the energy left in the Node after correspondence has been done. A Node having high leftover energy would have more opportunities to be picked as group head than a low energy Node as correspondence needs dispersal of energy. The Energy needed to send the parcels is relative to the distance between the sensor nodes. So, the Node which is at the littlest separated from the base station among all bunch Nodes ought to be chosen as group head in the cluster. So, in this paper, these three variables for example Heterogeneity of the Node, the lingering energy of the Node, and the distance to the base station are thought of while choosing the bunch head. The neural Network fills in as a fake human cerebrum which fundamentally takes the choice dependent on the given data sources and applied loads. The weight applied to info implies the significance of that contribution to taking the choice or ascertaining the result of the Network. In this approach, the neural network has accepted these elements as contributions for every Node in the relating group and applied the loads on these elements and the amount of result of information factors and loads take the choice of choosing as group head or not. The sources of info play various parts in the computation of the result as one information plays a positive part while different plays a negative part. The loads are chosen dependent on how decidedly or adversely the factor is influencing the choice or result of the Network. The weight is negative when it's worth contrarily influences the choice of picking as group head such in the event of the distance of Node from the base station as we need to smother the job of the result of information and weight in summation and positive if there should be an occurrence of heterogeneity and energy as their high qualities lead to all the more likely group heads.

III. Result & Discussion

In this venture, we have reenacted our methodology in MatLab. The area is taken as 100*100 square meters where the base station is situated at (50,50). The sensor nodes are haphazardly disseminated in the field around the base station. The confinement method has not been utilized in our Network. The nodes are circulated physically around the base station and areas of the sensor nodes have been known ahead of time during the Network handling. The nodes structure the group and the chosen bunch head among bunch individuals total the information from every one of the individuals and send it further to the base station. We have utilized the heterogeneous Network where we have four kinds of nodes i.e., typical, progressed, super, and supadvanced. These nodes have energies in this manner [7]:
normal=Eo, advanced =Eo(1+a),super=Eo(1+b)
supadvanced=Eo(1+c) where a<b<c
The distribution of nodes is done using m and m0 [7]. As
Normal=n*(1-m)
Advance=n*m; super=(m0*m*n)/2; supadvanced=(m0*m*n)/2;
We have used two mobility models i.e., free space and multipath model as used in[14].

$$E_{tx} = E_{elec} * l + E_{fs} * l * d^2 \quad if\ d > d0 \qquad (2)$$

$$E_{tx} = E_{elec} * l + E_{mp} * l * d^4 \quad if\ d < d0 \qquad (3)$$

Eq. (1) is applied in free space network model and Eq (2) is applied in multipath network model where d0 is calculated as:

$$d0 = \sqrt{\frac{E_{fs}}{E_{mp}}} \qquad (4)$$

And l is the size of the message, E_{tx} is the energy required to transmit the message and d can be the distance between the nodes or node and basestation. The E_{fs} is the amplification energy for the free space model while E_{mp} is the amplification energy in multipath network model. The heterogeneity of each node is given as.
normal: P*E(i)/ter;
advanced: P*(1+a)*E(i)/ter;
super: P*(1+b)*E(i)/ter;

supadvanced: P*(1+c)*E(i)/ter;
where ter=(1+a*m-m*m0*(a-((b+c)/2)));
In these c>b>a; where c=1; also,the simulation parameters have been in table 1. The table lists out all the values for the initial energy, the nodes percentage in network, the size of packets etc.
The aftereffects of our methodology have been displayed in figure 3, 4 and 5. The sensor nodes structure groups and group individuals send their detected information to their relating bunch heads. The group heads then, at that point, further give this information to the basestation. The information sending has been observed in two ways for example the information sent by the nodes per round to the bunch heads and information sent per round by the group heads to the basestation. These throughputs have been displayed in figure 6 and 7.In this paper we have contrasted our proposed approach with the two distinct methodologies introduced in writing overview for example FCM just and LEACH calculation. We have taken various boundaries on which we have contrasted our calculation and these current methodologies. These are alive nodes for example nodes which are alive in the networks and it has been followed in each round, dead nodes which have passed on in the networks in each round, information limit of the bunches and throughput of the network for example thebundles sent per round to the basesstation and bunch heads. The examination taking various boundaries basedon figures given has been done in the accompanying focuses.
1. In figure 3, we have plotted the information that has been sent by the group individuals to their comparinggroup heads with the expanding adjust. We have seen that information has highly totaled at group head in our methodology. This information conglomeration is subject to the energy of the bunch part nodes and Our methodology is attempting to not choose the low energy node as group head as major correspondence is finished by this node. The throughput for bunch level information has additionally been noticed also plotted in Figure 6. This throughput is the number of bundles being created by a solitary node in a network. This boundary shows the normal information send by a bunch part node as a component of networks.In both observations, we have beaten the other two strategies utilized in past.
2. The subsequent boundary being taken for checking the effectiveness of our methodology is to count the number of nodes is as yet alive in the network as efficient convention consistently keeps up with high alive in the network. This boundary is determined by the degree of energy nodes are having as nodes having no battery or sending or getting capabilities are viewed as dead as they can do advance correspondence. We can see thatlevel of alive nodes in our calculation beat the FCMonly and LEACH calculations in figure
4. In our calculation significantly over half of the nodes are alive in 10k rounds.
3. figure 5 shows a similar instance of dead nodes so just 20-30 % of nodes have been passed on in 10k rounds wherein LEACH all nodes have been dead and the FCMonly approach has 60-70% nodes have been dead.

4. The information shipped off the base station by the group heads has additionally been checked and it is seen that the throughput of a network utilizing our methodology is higher than different methodologies. The group heads are totaling the information gathered from 10 group individuals from their relating bunch.
5. The ideal and comparable estimated bunches capability of our methodology can be checked from figure 8. The nodes in each group have been plotted as a number of nodes in each bunch incomparable in nature and furthermore non-optimality issue has been settled at a further degree. In our network, we have taken 10 groups and FCM is utilized to allot the nodes to each group. Not very many groups are showing non-closeness in the count of their cluster member nodes. In our network in each cluster has been assigned average 8-10 clsuter nodes.

Table 1. Simulation Parameters for the Network

Parameters	Value
Area	100*100 square meters
Basestation	(50,50)(in m)
Initial Energy	0.5J
Transmission Energy	50nJ/bit
Receiver Energy	50nJ/bit
No Of Nodes	100
Free space Amp Energy	10pJ/bit/m^2
Multipath Amplification Energy	0.0013pJ/bit/m^4
Message Size(B)	4000 bits
Round	10000
Aggregation Energy	5nJ/bit/packet
P	0.10
m	0.5
m0	0.2

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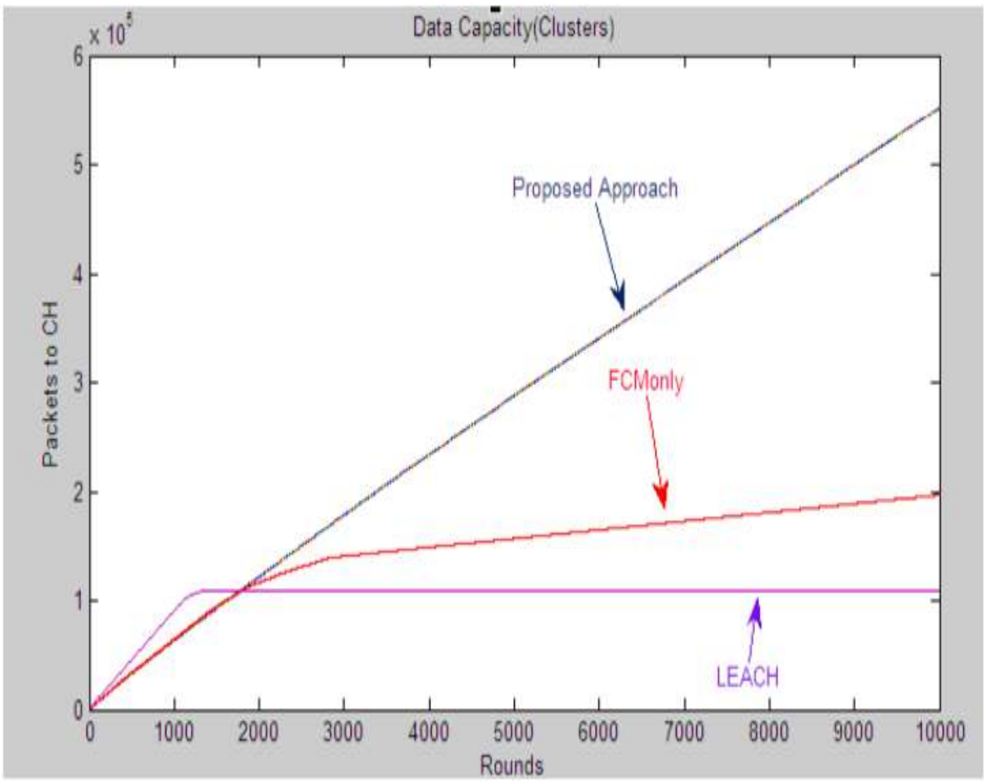

Figure 3. The data capacity of the network using different approaches at cluster level

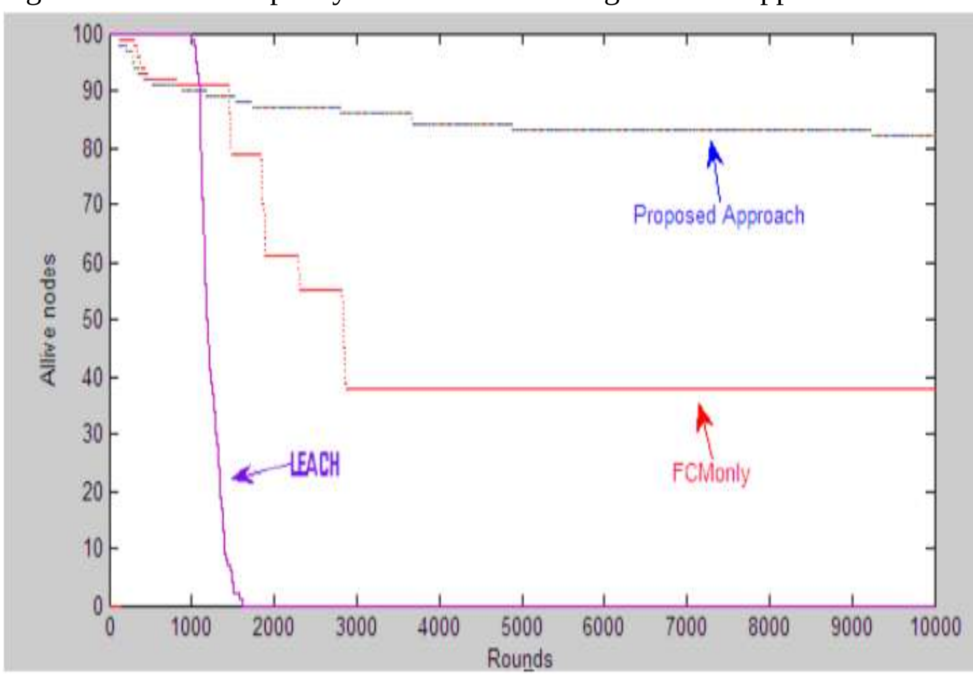

Figure 4. Alive nodes vs rounds in different approaches

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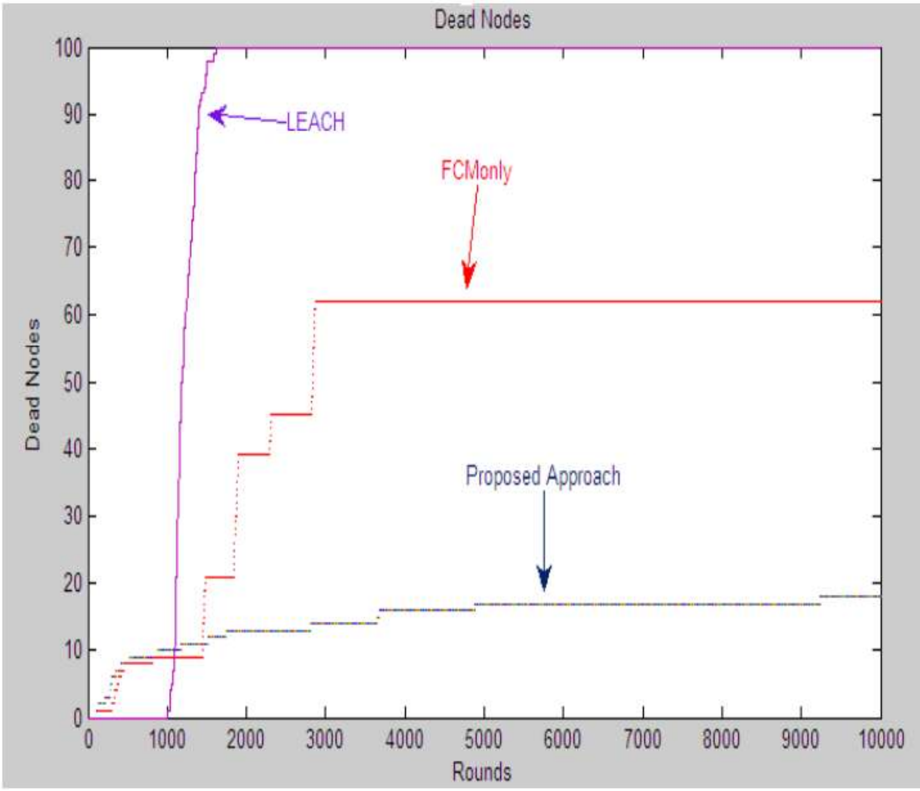

Figure 5. Dead nodes vs rounds in different approaches

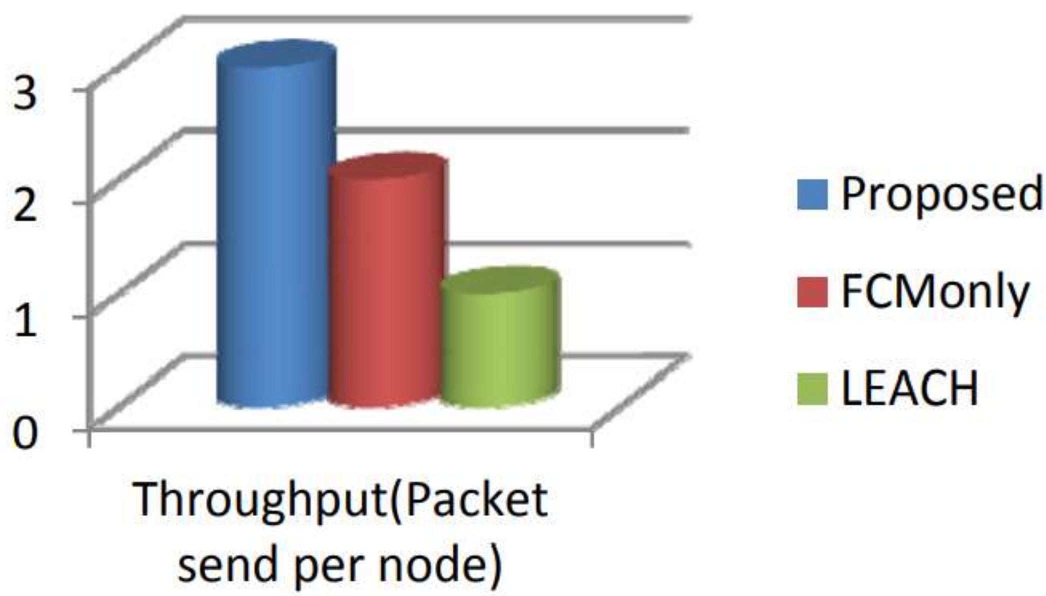

Figure 6. The throughput of the network observed at basestation

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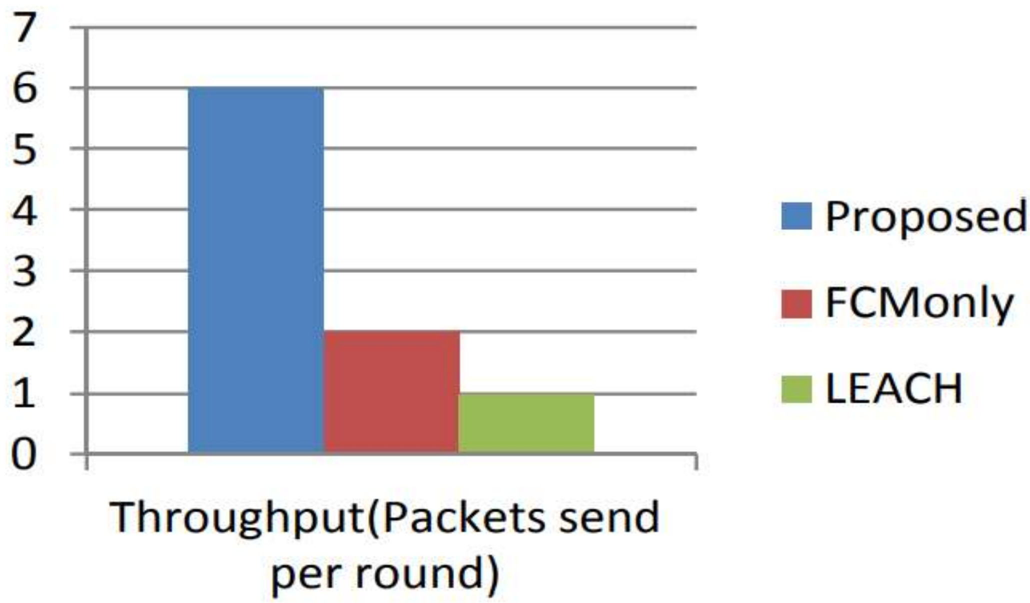

Figure 7. The throughput observed per node in the network

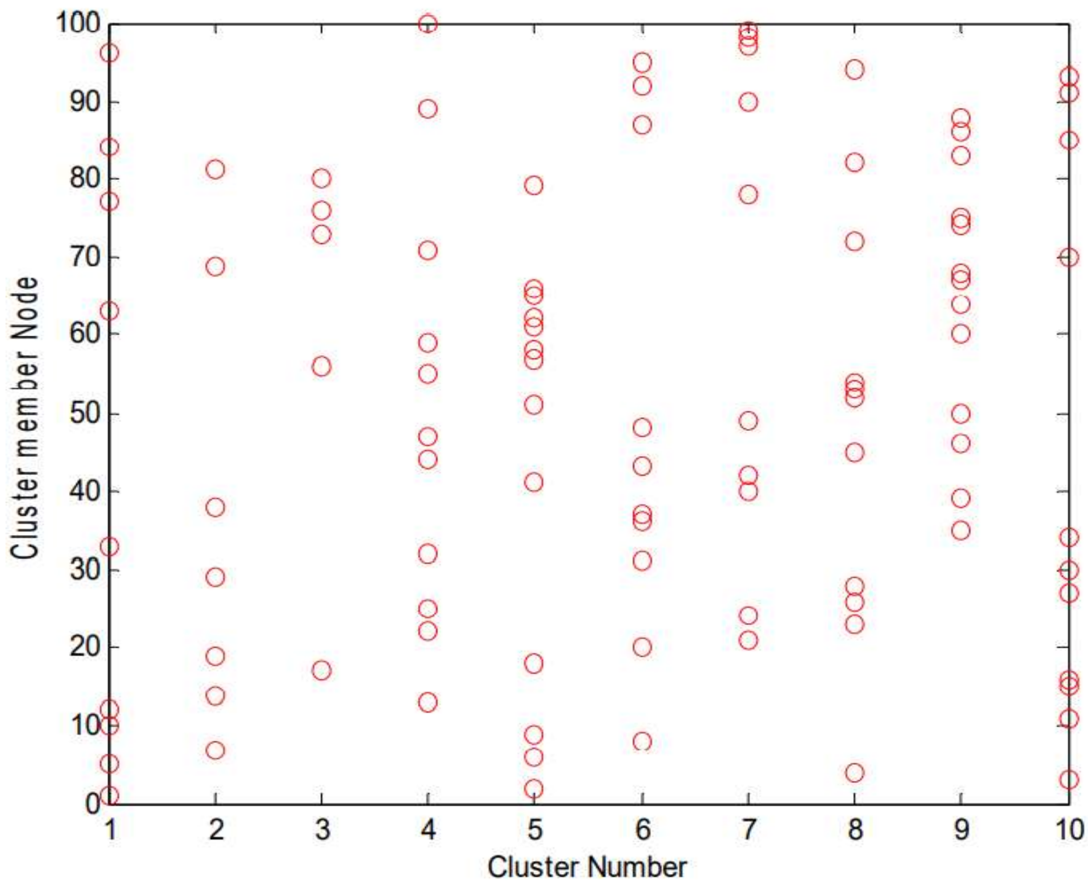

Figure 8. The Cluster member nodes in each cluster

IV. Conclusion

The proposed approach utilized the fluffy C-implies bunching in every one of the groups our calculation attempted to have comparable estimated clusters of sensor nodes and furthermore, neural networks, utilizing the various variables have chosen the bunch heads. Our methodology dealt with the optimality of bunch and persistency of nodes in-network and effectively beat the current methodologies. The throughput at both group and network levels is exceptionally appreciated and shows the viability of utilizing this crossbreed approach. Diverse factors play a dominant job in choosing bunch head as just one variable cannot pass judgment on a node as group head and furthermore, the probabilistic point of view does not guarantee us about choosing a decent group head so we can say our methodology has taken into consideration all these elements and dealt with these and effectively moved toward that proficient directing method. Our future work will be to consolidate the other grouping and choice methodologies in sensor networks and perceive how they influence our methodology.

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