A Multihop approach based Fuzzy C-Means Clustering in Wireless Sensor Network

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Abstract*—In the last few years, the potential use of Wireless Sensor Network (WSN) has been seen in several areas, including disaster management, battlefield surveillance, and border security surveillance. large numbers of sensor nodes (SNs) are organized, which are regularly overlooked & autonomous in some applications. Cl clustering is an important method that is utilized towards increase lifespan of the sensor NW using decreasing energy ingestion. It may too improve NW scalability. Sensor nodes are deliberated towards being homogeneous due to their research in the WSN area, but in such nodes, there can be some energy towards increase lifespan and reliability of wireless sensor network. we proposed a new approach to decrease energy consumption & improve NW life in this paper. Better method built proceeding CH selection technique. Also into the current research work, we are working on multihop routing and Elbow method for the optimal number of cluster head. Yhr simulation results show the betterment in the efficiency of the performance and enhance NW life span.

Keywords-Clusters, wireless sensor network, FCM, Threshold

I. INTRODUCTION

A Wireless Sensor Network is a group of randomly deployed wireless nodes in a targeted location in the fundamental changing environment. These nodes may understand, process & forward the information towards neighboring nodes & base stations (BS). In addition, these minor campaigns have restricted capabilities for example small memory, less computing, minimal processing, & most significantly, a trivial power unit (generally equipped by batteries). SNs are disseminated in a big geographical area comprising hundreds of nodes towards observer the board area. Routing is significantly aimed at transferring information after node to node or BS because sensitive data should be sent to BS for more necessary steps. [1–4].

Wireless Sensor Network is one of the greatest significant technologies of the 21st century. A small, low-cost device with sensors proceeding the board, which is associated to wireless using its ability to organize, control the environment, homes, offices, cities and more [5] from the Internet to monitor Can be connected. These SNs may be organized proceeding ground, underwater and anywhere into the body (WBAN - Wireless Body Area Network, Air, Buildings, Even Vehicles (VANETs - Vehicle Ad-hoc Networks)). (P. I) the sensor has been used. In various technologies, such as DDA), want mobile phones & Internet of Things (IoT). [6].

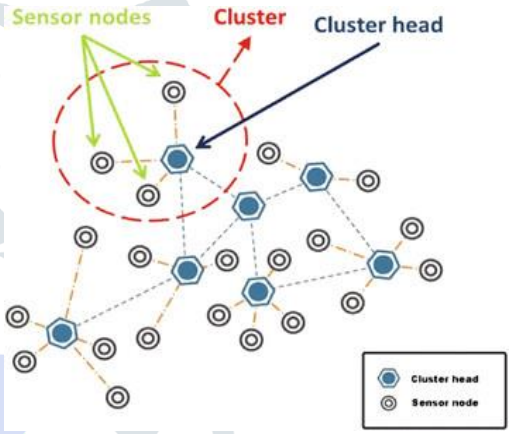

Figure 1 Clustering in Wireless sensor network

In WSN, various hierarchical techniques have been proposed, especially for efficient use of batteries available resources. the aim is to achieving energy efficacy & increase the NW life. In the hierarchical path, clustering is greatest generally utilized technology towards accomplishing these objectives. By design, clustering systems end up unnecessary messages in the creation of efficient cluster & intelligent selection/review of cluster head. In the literature, researchers have suggested several clustering protocols, however more research is needed on problems, for example, energy efficacy & load balancing. In addition, in terms of grid-based approaches to network efficiency, topology-building is also important for distributing nodes across a cluster or grid. Periodic upgradation of groups and re-selection of CH are consuming unnecessary energy, which can lead to bad NW presentation [7].

Clustering into WSN

Due to the lack of resources in the wireless sensor network, direct communication of SNs using BS or multi-hop communication of sensor nodes for BS, is not possible because the power consumption is high, which outcomes into initial completion of SNs. As presented in Fig 2. Direct communication or single-level mass network communication is not possible because WSN cannot support long distance communication. High power consumption of energy for direct communication, duplication of data (sensor nodes transmit data with each other, with very little difference), and most nodes die quickly. To overcome these problems, the hierarchical approach uses secondary communication, where the nodes are divided into clusters. Leader node, as well

known as CH, is responsible aimed at compiling information & transferring it towards BS.

II. LITERATURE REVIEW

Arboleda et al. [8] An evaluation survey was presented among the various clustering protocols. Authors of the survey analyzed certain basic perceptions associated with clustering procedure, i.e. cluster system, cluster type, clustering characteristics, & concisely leach-based protocol, along with active & responsive algos into Wireless Sensor Networks. key features of these protocols have been associated, & they are presently designed to be used.

Kumarawadu et al. [9] Survey available clustering algos aimed at Wireless Sensor Networks & categorized them built proceeding cluster formation constraints & cluster head election standards. authors of survey too considered major enterprise tasks & conversed issues related to presentation built proceeding arrangement of identity-based clustering algos, built proceeding categorization of neighborhood information based clustering algos, potential clustering algos and biological induced clustering algos.

Devstar et al have discussed various clustering schemes. [10] By special emphasis proceeding their selective selection approaches, built proceeding assortment scheme, adaptive plan, and classification of the integrated metric system. cost of selecting cluster head was related to the creation of cluster construction, distribution of CH and cluster construction. In addition, a more scalable, energy effective & sustainable clustering system was proposed aimed at information collection into Wireless Sensor Networks.

Jiang et al. [11] We conversed 3 main benefits of clustering approaches aimed at Wireless Sensor Network, for example, more scalability, less overhead & easy maintenance, & before classified Wireless Sensor Network clustering systems built proceeding total 8 clustering characteristics. authors considered 6 general wireless sensor network clustering algos, for example, LEACH, PEGASIS, EEUC, & HEED & related these wireless sensor network clustering algos with several features.

Maimour et al. [12] Clustering routing protocols (RPs) have been considered aimed at efficiency in Wireless Sensor Networks and an overview of clustering algorithms has been presented from the point of view of information routing. A simplified organization of clustering RP is recommended in the review. 9 standard clustering protocols are summarized, comprising 2 segments, pre-installed clustering routing algos & on-demand clustering routing algos respectively. In addition, several future research suggestions have been offered into the assessment.

III. METHODOLOGY

a. Problem Statement

In previous research, the transmission was done using LEACH algorithm which was single hop. One hop means towards influence the last destination address of a packet, no. of several NWs has to go done. In our research, we are using multihop transmission. The reason behind opting multihop is mentioned in the further lines which can also be understood through figure 2.

Single hop network:— On a single hop NW, while a packet leaves basis, it proceeds a single hop before reaching the destination address (You can tell if it is passing through another network or passing through another router on another network Used to be).

Multi-hop network:— A multi-hop NW requires 2 or further NWs towards influence the destination address of a packet. Although taking a hop on any other NW, a packet can pass by different campaigns, such as a router, network bridge, and switch.

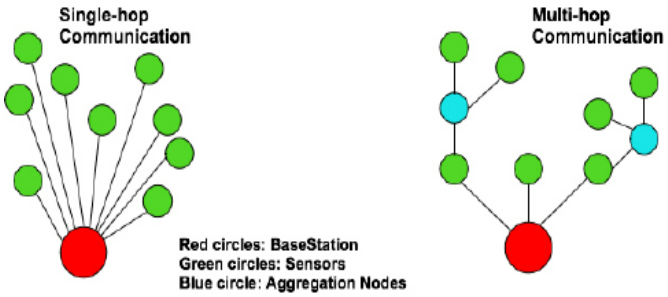

Figure 2 Single-hop and multi-hop wireless sensor networks.

The major difference among a single and multi-hop NW is no. of packets it proceeds towards reach its final destination. Therefore using single hop for data transmission can result in path loss, more energy consumption, data congestion.

Another problem which was found in the previous research was the neighborhood election method for CH election.

b. Proposed Methodology

In the previous research, due to the CH election method, a number of issues were found which results in delay and loss of packets and rises the time consumption of energy and therefore results in less amount of remaining energy. Therefore to overcome these issues, we have opted the new technique of CH selection & clustering technique aimed at the network. Here we are electing the CH by electing only those clusters which are near to the center and which has the highest energy. Here cluster formation is done using Fuzzy C-Means and the optimal number of CH are chosen using Elbow method.

This algorithm works by subscribing towards every information point according to to the cluster center built proceeding space among cluster center & information point. More That data is located near the cluster center, the higher the membership of the special cluster center. The membership summary for every information point must be equal to one. When updating every periodic subscription & cluster centers conferring towards formula:

$$\mu_{ij} = 1 / \sum_{k=1}^{c} (d_{ij} / d_{ik})^{(2/m-1)}$$

$$v_j = (\sum_{i=1}^{n} (\mu_{ij})^m x_i) / (\sum_{i=1}^{n} (\mu_{ij})^m), \forall j = 1, 2, \ldots . c$$

where 'n' is a number of data points.

'vj' denotes jth cluster center.

'm' is fuzziness index m € [1,∞].

'c' denotes no. of the cluster center.

µij' denotes membership of ith data towards jth cluster center.

'dij' denotes Euclidean distance among ith data and jth cluster center.

One way to confirm no. of clusters is knee method (fig. 3). The concept of knee method is towards run aimed at a series of values of K-means clustering (1 to 10 k in the above examples), and calculate class errors (SSE) for each value.

Plot a line chart of SSE aimed at every value of K Uncertainty line chart alike a hand, before "elbow" proceeding the hand is best k-value. idea is that we need a minor SSE, then when we multiply K, the SSE decreases to 0 (the data in the SSE dataset is equal to no. of points since every information point has its specific cluster & its There is no error among & center of cluster). Thus our objective is to select a minor value of K which is still less SSE.

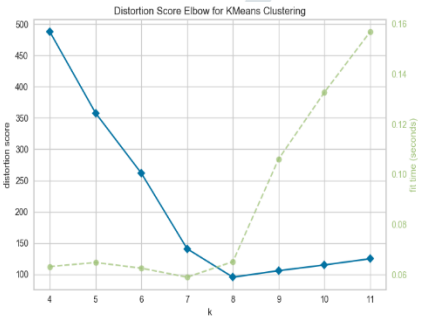

Figure 3 Elbow method using K-Means

ALGORITHM

Step 1. n = no. of rounds deployed
Step 2. r = current round
Step 3. RoundFlag = 1
Step 4. Th = 0.7
Step 5. Calculate the optimal number of CH using Elbow method
Step 6. energy(i) = remaining energy of node i
Step 7. CH(i) = cluster head of node i
Step 8. if (Round = 1) before
Step 9. for each integer i in n do
Step 10. CH= nodes which are near to the center of the cluster and having the highest energy
Step 11. en(i) = energy(i)
Step 12. end for
Step 13. Round = 2
Step 14. else if (Round = 2) then
Step 15. If (energy(CH(i)>th_1*en(CH(i))) then
Step 16. Round = 2
Step 17. Else
Step 18. Round = 3
Step 19. endif
Step 20. end for
Step 21. else if (Round = 3) then
Step 22. Check if (energy(CH)<Th_2(0.05)
Step 23. Then re-elect the clusters
Step 24. end for
Step 25. endif
Step 26. Connect all CH to the center node making the shortest path to connect to Base station
Step 27. Send(data(i), CH(i))
Step 28. Cluster head will wait for the join request message
Step 29. Broadcast a message includes the number of its own nodes to all clusters
Step 30. Sensor nodes will sense data to its CH
Step 31. Aggregate data on CH
Step 32. Forward data to Base Station
Step 33. endif
Step 34. end for

In the algorithm, it is mentioned that if the node has the highest energy & is near to the center of the cluster, then the node will be elected as CH. Here first node dead round is 22 and the average energy consumption is 0.001452.

IV. RESULTS AND DISCUSSIONS

the suggested method is replicated with MATLAB 2015a. WSN represents 100 sensor nodes positioned in 100 100 square meters 2 square areas. BS (50,175) is positioned. primary energy for every SN is 5J.

Table 1 Simulation parameters

Parameters	Values
No. of. Rounds	100
P	0.1 or 100%
E_{elec}	50 nJ/bit
E_{fs}	10 pJ/bit/m2
E_{DA}	5 nJ/bit/message
E_{amp}	0.0013 pJ/bit/4
Control Packet Size	25 bytes
Data packet size	500 bytes

measured outcomes of suggested replication & comparison of further protocols are built proceeding 4 presentation metrics, no. of CHs, NW lifetime, no. of packets established aimed at assistance on BS & full energy dissipation. Suggested replication constraints are presented in Table 1.

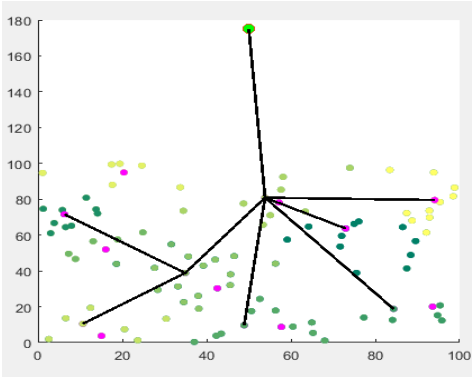

Figure 4connectiivity between CH and BS through hierarchical representation

Figure 4 depicts the multihopping of the cluster head which is making the shortest path as they are joint to the base station with a minimum coverage area.

RESULTS:

Number of cluster heads

Many clusters move efficacy of leading WSNs. Such no. of cluster heads increases, energy used by these cluster head nodes is huge because of big no. of aggregation procedures. Conversely, because no. of cluster headnotes has decreased, so it is difficult to use G-energy for a large amount of information composed through each cluster head node & full length of time, to communicate with each cluster head to BS Bulk collected data will be rendered for Thus, it died CHS early. Figures 5 and 6 show a comparison of the formation of groups for both experiments.

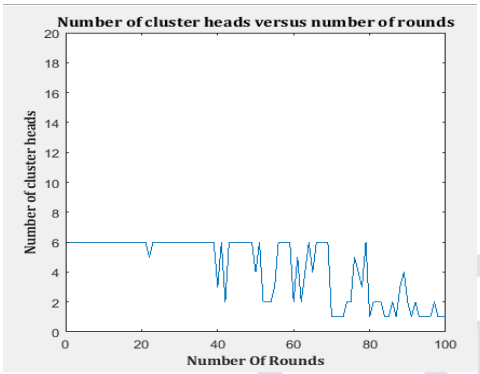

Figure 5 Number of clusters chosen varying in each round in the previous work

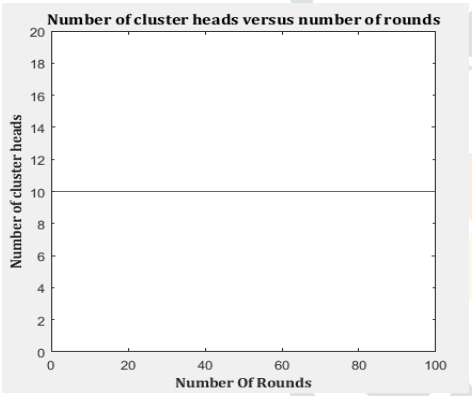

Figure 6 Fixed Number of clusters using FCM

Network lifetime

Network lifetime is definite like supreme time among First Node Death (FND) and Last Node Death (LND) Losing long data constancy of SN is a major need for network loss because it affects the end result. Figures 7 and 8 show the lifetime network compared to two research tasks.

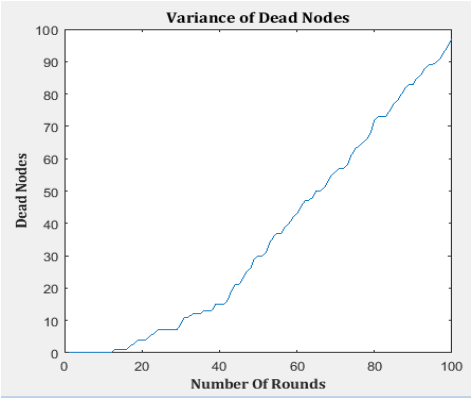

Figure 7 Number of dead nodes in each round of the existing work.

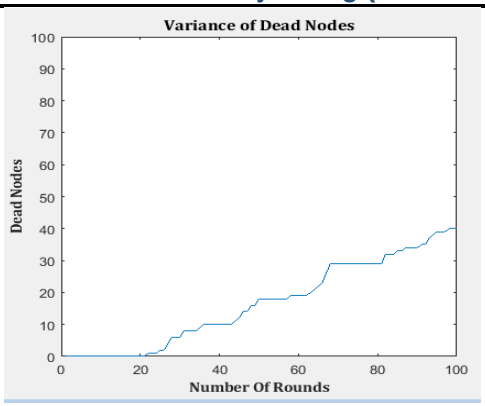

Figure 8 Number of dead nodes in each round using FCM.

Energy consumption

Consumption energy consumption is total energy consumption networks for transmission, reception and data collection Comparison of CH SNs & cluster member sensor nodes is completed on the basis of energy consumed in different consumption. Figure 9 and 10 shows that due to proper clustering of nodes and better CH election, the dissipation of energy is less in the new research work as compared to that of previous work.

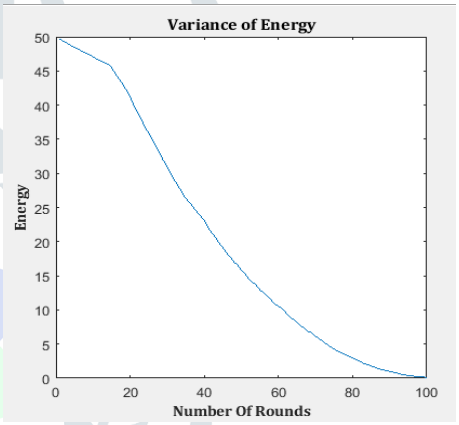

Figure 9 Energy consumption rate in each round of previous work

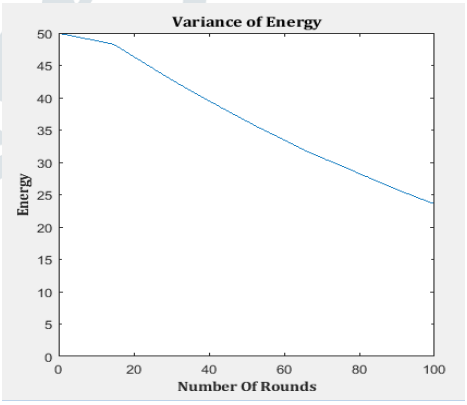

Figure 10 Energy consumption rate in each round of proposed work

Number of packets at the base station

In the suggested method, no. of packets established at BS is above no. of packets established for current perspective, as presented into Figures 11 and 12. No. of packets is counted as per energy consumption, the stability of maximum energy consumption, no. of packets conventional at BS is high. It increases is because of CH selection method, which confirms balanced CH in every cluster. This balance stabilizes the Cluster Head selection, which causes constant energy dissipation.

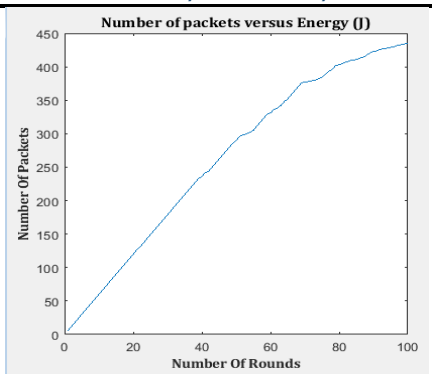

Figure 11 Number of packets versus Energy (J) in the base work.

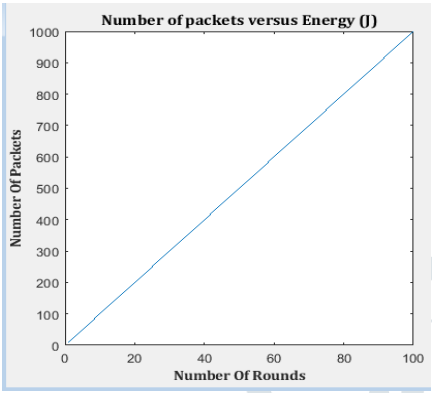

Figure 11 Number of packets versus Energy (J) using FCM

V. CONCLUSION

In this paper, in the existing work, the LEACH protocol was used in which some modifications were made previously which were not efficient and accurate as the model should be. Like the improper cluster head election and cluster formation, single hop routing, etc which leads to face some limitations by the model like reduced network lifetime, more energy consumption and likewise. Therefore for solving these issues, we have introduced FMC clustering algorithm & K-means based clustering algo aimed at optimal no. of clusters. results of the implementation of the suggested method were proved with MATLAB 2015a replication. Using its execution, suggested method compares no. of packets sent to BS, with NW lifetime, cluster head, energy consumption, and revised leach already used and other improvements in the protocol.

we will try toward providing security mechanism over this network model for the secure and private wireless network in the future. Also, we will discover some new and innovative technique of cluster head election which resultant additional proficient into terms of energy consumption & NW life span.

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