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An Efficient Method for Selection of Cluster Heads Based Upon the Neighbourhood Characteristics in WSN

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Abstract— In the wireless sensor network (WSN) the main work is to gather the data and involves the data transmission. For this purpose the main resource used in this task is the energy consumption and residual energy. The resources in WSN can be saved with the help of data aggregation in the clusters. For the same to be managed we require the cluster head to be selected. The selection of the cluster head in our proposed system is based on the characteristics of the nodes that are in the immediate neighbourhood of the node under consideration. Some of the parameters are distance from the node, residual energy, some other performance metrics. The neighbors of the neighbors are also taken under consideration for the and in pre-time unit are selected as the vice- cluster head which can be considered as the cluster head if the cluster head dies. The system will be efficient in terms of time constraint along with the energy consumption during cluster head selection.

Keywords— Wireless Sensor Network, Node, Base Station, LEACH, V-LEACH, Residual Energy, Cluster Head.

I. INTRODUCTION

A wireless sensor network is a network of sensors used for monitoring the physical environmental conditions such as pressure, temperature, etc. and pass their data to the main location. The WSN are usually used in military applications, industrial and consumer applications [1]. The WSN is made up of sensor nodes and each node is connected to the other. A sensor node are driven with the help of the battery. Basically a sensor node consist of the 4 units which are as follows: A sensing unit A processing unit A communication unit A power unit The following figure 1 depicts the architecture of the sensor node in general.

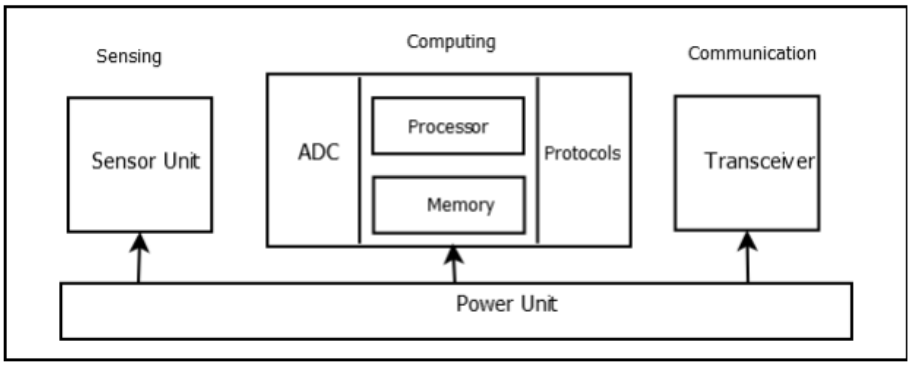

Fig. 1. Architecture of the node[13]

The WSN is built in different topology depending upon the network architectural point such as Flat architecture and hierarchical architecture. In flat architecture each node plays the same role in performing sensing task all the node are peers. Similarly, in the hierarchical architecture the nodes are organized clusters and inter-communication takes place with the help of sink. The following figure 2 depicts the variation of the flat sensor network architecture. The possible variation of the flat architecture are single hop network architecture and multi-hop network.

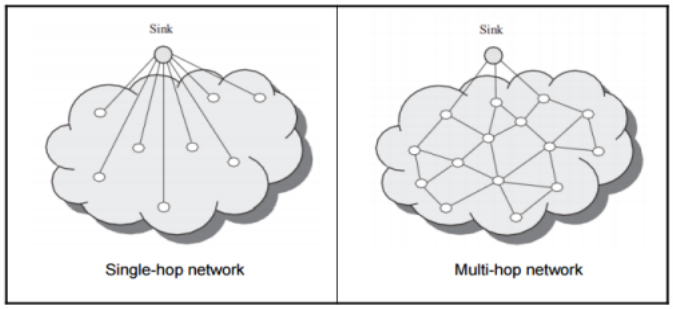

Fig. 2. Flat Architecture of WSN[13]

The following figure 3 depicts the variation of the hierarchical sensor network architecture. The possible variation of the flat architecture are single hop clustering network architecture and multi-hop clustering network. We will be concentrating on the hierarchical network architecture for our proposed system. The proposal mainly deals with the selection of the cluster head node in the cluster of the hierarchical architecture. There are certain challenges for the cluster head selection and network maintenance. Some of them are -Limited energy capacity, massive and random deployment of the nodes, power management, connection and communication management. To sort these issues we first have to analyse the energy issues in the WSN0s.

II. NEED FOR ENERGY EFFICIENCY IN WSN

The primary requirement for the energy efficiency of the network is the ensure the network performance in various conditions and the locations depending upon the nodes are located. The other requirement is the prolong network life time which means the network is alive till the communications are happening in between all the nodes in inter cluster and intra-cluster. In all the studies made on the WSN the power consumption depends on the communication, processing and sensing. The communication takes more time and power compared to processing and sensing. Also processing takes more time and power than sensing.

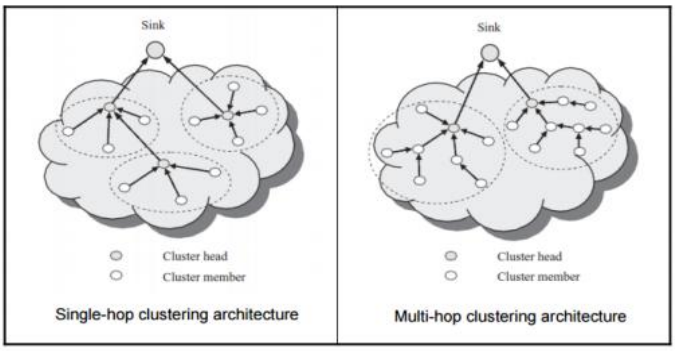

Fig. 3. Hierarchical Architecture of WSN[13]

Usually the listening, collisions, controlling are the major sources of the energy waste. After the energy loss the residual energy is becomes the major factor for the cluster head selection. Thus we will consider the factors of energy and neighbors for the cluster head selection.

III. LITERATURE SURVEY

In this chapter, we are describing the various factors we are going to consider for the cluster head selection in detail. It will also includes the details of other system developed by other authors for the same.

A. Factors for the proposed system

Distance between the nodes: The physical distance between the nodes can be evaluated by their geographical co-ordinates. This plays as important role as in our project we will be taking the neighbor nodes for the cluster head selection. The distance between those nodes are taken as one of the crucial factor to find whether the node is the neighbor node or not. Residual Energy: The energy is used in all the functions of the sensor nodes. The energy that is retained for the node for these functions to be performed in future is termed as residual energy.

This is energy level decides the life of the node in the network for efficient working of functions in the network. Distance for the Base Station(BS): The node under consideration for the cluster head selection is checked for its distance from Base station or the sink node for its communication to happen. The distance of node from the sink node is required to calculate the time and speed of communication in the intracluster which is main factor of the energy consumption. Number of Hops to reach the Base Station(BS): The hop is the part of the path that carries data in the packet from one point of the cluster to the intermediate point between source to destination. The number of hops required for a node is directly proportional to the energy consumption of whole cluster and node. Thus the number of hops from the node under consideration for cluster head selection to the sink node play its role for the selection procedure. Performance Metrics: There are various QoS requirement for the cluster to be satisfied during the network creation and maintenance. These QoS are thoroughly satisfied by the nodes in the cluster. So we are going to use the performance metrics of QoS for our proposed algorithm.

B. Various strategies for cluster head selection by other authors

In this section, we are going to discuss various algorithms and strategies developed by them for the cluster head selection and cluster maintenance during the lifetime of the network. In LEACH protocol (Low energy Adaptive Clustering Hierarchy), proposed by Wendi B. Heinzelman, et al. was the very first developed protocol for the efficient clustering in the WSN with the hierarchical and adaptive cluster formation. It outperforms classical clustering algorithms by using adaptive clusters and rotating cluster-heads, allowing the energy requirements of the system to be distributed among all the sensors. Instead, when the cluster-head die, the cluster will become useless because the data gathered by cluster nodes will never reach the base station. So, there is a requirement to improve LEACH protocol to enhance the performance. The main problem with LEACH protocol lies in the random selection of cluster heads. There exists a

probability that the cluster heads formed are unbalanced and may remain in one part of the network making some part of the network unreachable. This problem is resolved by using the concept of V-Leach. For the improvement V

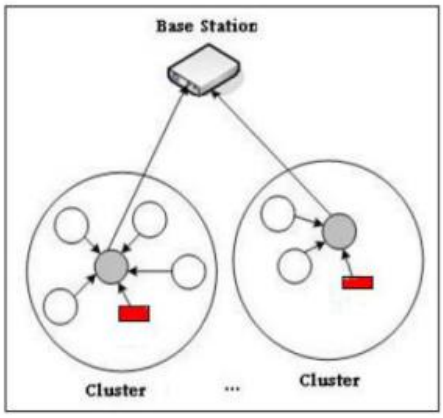

Fig.4. Architectural way of V-LEACH[1]

LEACH was produced, new version of LEACH protocol, the cluster contains; CH (responsible only for sending data that is received from the cluster members to the BS), vice-CH (the node that will become a CH of the cluster in case of CH dies), cluster nodes (gathering data from environment and send it to the CH). In the original LEACH, the CH is always on receiving data from cluster members, aggregate these data and then send it to the BS that might be located far away from it. The CH will die earlier than the other nodes in the cluster because of its operation of receiving, sending and overhearing. When the CH die, the cluster will become useless because the data gathered by cluster nodes will never reach the base station. In V-LEACH protocol, besides having a CH in the cluster, there is a vice-CH that takes the role of the CH when the CH dies because the reasons we mentioned above by doing this, cluster nodes data will always reach the BS; no need to elect a new CH each time the CH dies. This will extend the overall network life time. Depending on the distance between nodes a the system was proposed in [7]. Like LEACH, the operation of LEACH-MP is also divided into rounds. Each round begins with a set-up phase and steady phase. We do not change the way LEACH elects its cluster heads but changed the cluster formation algorithm. After the cluster heads are selected, cluster-heads broadcast an advertisement message that includes their node ID as the cluster-head ID and location information to inform non-cluster head nodes. Non-cluster head nodes first record all the information from cluster heads within their communication range. Then the node finds the cluster head which is closest to the middle-point between the node itself and the sink and joins that cluster. In other words, we changed the way how nodes join the cluster in order to decrease the total energy cost of the network and prolong the network lifetime. The following figure 5. depict the round working of this protocol.

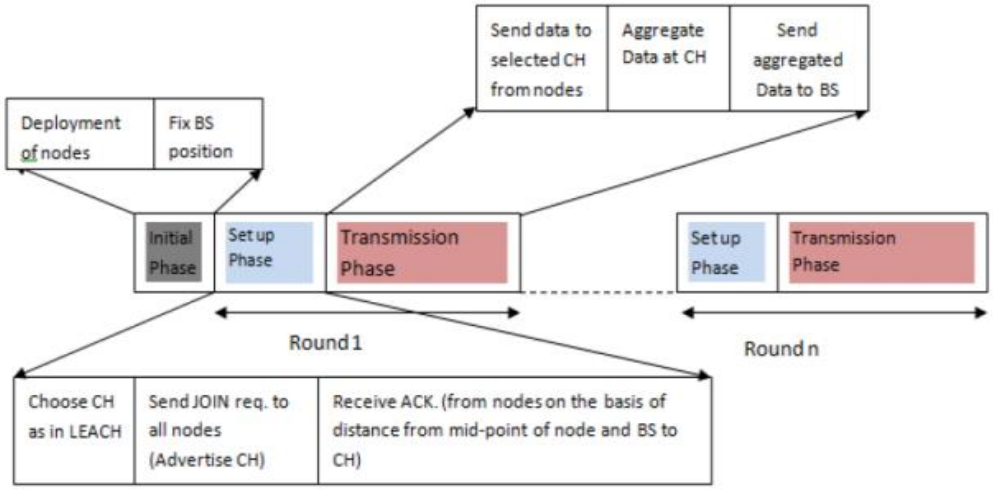

Fig. 5. Round working of LEACH-MP[6]

In an Enhanced Cluster-Head Selection Scheme for Distributed Heterogeneous Wireless Sensor Network [6], the selection of the cluster head depends on the optimal number of clusters in the network, Forecasting of node residual energy, Different CH selection probability assignment based on node energy threshold. As per various studies we came up with the combinational system with V-LEACH along with the different parameters used in some papers and some extra parameters to be used for efficiency and long time of the network.

IV. PROBLEM DEFINITION

The main purpose of the work is to increase the lifetime of the network along with efficient intra and inter cluster communication. So, selection of cluster heads based upon the characteristics of the nodes that are present in the immediate neighbourhood of the node. The node which has most number of neighbours which can be considered as

future cluster heads i.e the nodes which are the vice cluster head can be considered as the cluster head itself. When the cluster head is about to die i.e the energy theta (threshold), the data would be transferred to the most eligible vice cluster head depending on minimum distance between cluster head and the node, minimum distance from the BS, Residual Energy, performance metrics. This should improve the performance of the network.

V. PROPOSAL

The candidature of every node in the network for election as cluster head will be based upon the characteristics of the nodes that are in the immediate neighbourhood of the node. The parameters on the basis of which the neighboring nodes will be evaluated are 1. Distance from the node 2. Residual Energy 3. Distance from the BS 4. Number of hops to reach the BS 5. Performance Metrics This evaluation is done to identify the potential vice cluster heads i.e. the nodes which are capable of becoming the vice cluster head. Thus the system will be having multiple vice cluster heads. In the event of failure of cluster head, one candidate can take the position of cluster head. The vice cluster heads will be ready to take the position of cluster head as and when needed but to maintain continuity in service, when the energy of cluster head falls below a particular threshold say, the data will be copied into the most eligible vice cluster head. Since, the redundancy is maintained to elect more than one vice cluster head, thus even in the event of failure of vice cluster head and cluster head, the system will be up and running because we have selected multiple vice cluster heads. The election of cluster head also will be dependent on the number of vice cluster heads exist as an immediate neighbour for a node.

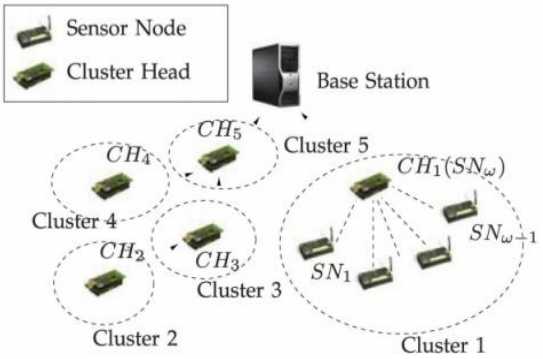

Fig. 6. Basic working of WSN

In figure 6 cluster 1 has w nodes in the cluster and CH1 to CH5 are the cluster heads for Cluster 1 to 5. Considering only the scenario of Cluster 1. The Nodes which are the immediate neighbours of SNw will be considered as Vice Cluster heads and this indicates that SNw has the highest number of nodes which are immediate neighbours of it and can become the cluster heads thus establishing SNw as the cluster head. Thus in reality, there are multiple potential vice cluster heads. out of which one can become the cluster head as and when needed.

A. Proposed Algorithm

The section discuss the algorithm for the proposed system. In the system we are going to make one of the eligible node as the cluster head and the remaining nodes are used for the selection of the vice cluster head which can be a cluster head in future if the cluster head dies. Depending on the parameters discussed above we discuss the following algorithm.

1. Initialize the sensor nodes.
2. Get the residual energy of all the nodes
3. Check the residual energies against threshold. If no make node as the Non-CH node
4. Select the nodes which are at the 1-hop distance from the base station .
5. Compute the distance of those nodes and the neighbours
6. Select the node which are having highest average residual energies of the neighbours.
7. Select the node as the Cluster Head and broadcast.
8. Check whether the vice-cluster is selected. If no, Go to step 2. Else Stop.

As per the algorithm the election of the eligible nodes keep through the parameters been used in our proposal which are residual energy, hop distance between node and the base station, distance between the node and the neighbor nodes and their residual energy. As we are following the proposed system we go through the selection of the vice-cluster head also and thus in near future we save the time and energy for the selection of the cluster head again. Thus, it reduces the time complexity when the cluster head dies during the network operation.

VI. CONCLUSIONS

We have studied the various factors that affect the working of the WSN nodes right from the creation to communication to maintenance. Those factors we are considering for our proposal for the network to have long lifetime and easy, efficient in terms of time and communication. Some of the factors are the degree of the node, residual energy, distance between the sensor nodes and from the Base station and the number of hops required for the communication within the cluster and among the clusters. The system proposes as the improvement to the V-LEACH protocol with the use of various network QoS parameters viz. throughput transit delay, network availability.

REFERENCES

[1] Wireless sensor network, 2015.
[2] Shreesha Bhat, Vasudeva Pai, and Pranesh V Kallapur. Energy efficient clustering routing protocol based on leach for wsn. International Journal of Computer Applications, 120(13):1720, 2015.
[3] Hongwei Chen, Chunhua Zhang, Xinlu Zong, and Chunzhi Wang. Leach-g: an optimal cluster-heads selection algorithm based on leach. JSW, 8(10), 2013.
[4] Heena Dhawan and Sandeep Waraich. A comparative study on leach routing protocol and its variants in wireless sensor networks: A survey.International Journal of Computer Applications, 95(8):2127, 2014.
[5] Teng Gao, Ren Cheng Jin, Jin Yan Song, Tai Bing Xu, and Li Ding Wang. Energyefficient cluster head selection scheme based on multiple criteria decision making for wireless sensor networks. Wireless Pers Commun, 63(4):871894, 2010.
[6] D Gupta and R Verma. Enhanced cluster head selection scheme for heterogeneous wireless sensor network. Advances in Computing, Communications and Informatics (ICACCI, 2014), pages 1684 1689, 2014.
[7] Songhua Hu, Jianghong Han, Xing Wei, and Zhen Chen. A multi-hop heterogeneous cluster-based optimization algorithm for wireless sensor networks. Wireless Netw, 21(1):5765, 2014.
[8] Sang H. Kang and Thinh Nguyen. Distance based thresholds for cluster head selection in wireless sensor networks. IEEE Communications Letters, 16(9):13961399, 2012.
[9] Vipin Kumar and Avadhesh Kumar Gupta. Measuring parameters of quality of service in wireless sensor networks. International Journal of Advanced Research in Computer Engineering and Technology (IJARCET), 3(11), 2014.
[10] Ramesh and Somasundaram. A comparative study of clusterhead selection algorithms in wireless sensor networks. International Journal of Computer Science and Engineering Survey, 2(4):153164, 2011.
[11] Rathi. Two phase clustering method for leach protocol for effective cluster head selection. Journal of Computer Science, 10(3):366375, 2014.
[12] Hiral Shah and S. R Bhoyar. Improved v-leach protocol in wireless sensor network with data security. IOSRJECE, 9(5):4954, 2014.
[13] Nutan Sindhwani and Rohit Vaid. V-leach: an energy efficient communication protocol for wsn. 2(2), 2013.
[14] S Taruna. Distance based energy efficient selection of nodes to cluster head in homogeneous wireless sensor networks. IJWMN, 4(4):243257, 2012.
[15] Ya Xing Zhai, La Yuan Li, and Chun Lin Li. An energy efficient communication routing protocol based on leach for wsn. AMR, 905:595599,2014.

