Enhanced Clustering Technique to Improve the Network Lifetime for Wireless Sensor Network

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Abstract— **Wireless sensor network consists of large number of sensor nodes that capable of sensing data and transferring those data to the base station (BS). Cluster is a way to divide sensor nodes as several groups in the network. Formation of cluster is based on information required in certain region within the network topology, and cluster head is elected by availability of nodes within the cluster. In general, cluster has one head that act as a leader and responsible to gather data from all nodes then promote it to BS. This paper concentrates on multiple cluster head to maximize battery efficiency and prolong the lifetime of network. To perform the task of node, energy requirement plays an important role in this system. In this paper, our proposal is to reduce the task of cluster head by transaction of data with another cluster head and maximize battery lifetime.**

Keywords— **Cluster, lifetime, sensor node, wireless sensor network (WSN).**

I. INTRODUCTION

Wireless sensor network (WSN) is constructs by various amounts of node. Sensor node is able to execute sensing information from its area and communicating with each other nodes in the system. Nodes are usually projected to function based on battery lifetime. It is very complicated to renovate batteries of sensor node in the region, nodes are expensive, and energy is constrained for each and every node in WSN. To keep trace of each sensor with its cost, they are equipped with small batteries that can store at most 1 J [1]. An important constraint on the power offered for communications, thus limiting both the transmission range and power consumption, and hence it is advantageous to put in order the sensors into clusters. Operation of efficient energy is prolonging the lifetime of network. Data transmission can be optimized using efficient clustering algorithm. Clustering technique is used data aggregation methods for data transmission route from cluster-head to base station (BS) to save energy of sensor nodes in the network.

Creation of cluster is depends on user preference. Scalability is one of the essential requirements of a WSN system [7]. When numerous devices are involved in the network to perform the required operation clustering is used. Clustering sensor node is an effective and efficient technique for achieving the entire requirement. To form a number of clusters the required can be selected either by equal or unequal probabilities of selection after dividing the population of nodes into specified clusters [8]. The advantage of cluster is to collect data from neighboring node is operationally more convenient then observing units spread over a region.
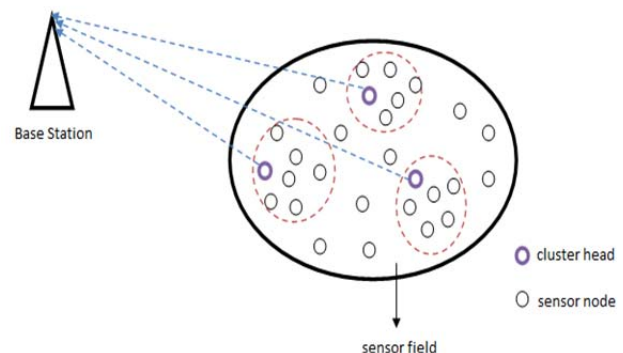

Fig. 1 A simple architecture of WSN

II. RELATED WORK

Vaibhav et al. [1] described to improve the network lifetime of clustering is a method for energy distributing in WSN. Those sensor nodes have multiple cluster head within the same cluster of the sensor nodes. Energy reduction of cluster head failure and other head continues the work without distressing the network topology for maximizes the network lifetime.

Mittal et al. [2] explained on leach communication protocol for WSN, this communication procedure of LEACH is customized by clustering routing protocol that divides the network by the numeral clusters. That the cluster contains cluster head selected from the existing sensor nodes and the same cluster contains another subcluster head that can extend network lifetime.

Meenakshi and Anand kumar [3] explained on performance of battery life of sensor nodes can be extended by the data routing method, this method communicates from node to BS using two-cluster head to reduce the intelligibility of any one-cluster head. Handling of second-cluster head increases the reliability of data communication.

Taruna and Sakshi [4] explained on cluster- based routing protocol, they propose the cluster-based routing protocol to categorize the decrease of energy consumption and progress the network survivability. The routing protocol considers remaining energy of nodes to increase the network lifetime [4].

Nurhayati et al. [5] explained on cluster-based energy efficient routing protocol elaborated on wireless sensor is made up of batteries power-driven device with a restricted quantity of energy resources. The routing protocol is used to exploit energy efficient and expand the

network lifetime. CELRP in WSN has the procedure of routing involves the clustering of nodes and the selection of cluster head, and in each cluster there will be the messenger that sends all gathered data to the cluster head to sink node.

Shelke et al. [6] explained on energy management in WSN that has dynamic power management method, which can reduce power consumption by each sensor node by complete of some mechanism of sensor. That has excellent savings and also improving lifetime of WSN. The attribute of position and picking of node allows advanced organization of network in the occurrence of sensor failures.

Chand et al. [7] on OEERP briefly discussed on cluster-based protocol in which node act as cluster head is indistinct in each time slot. In their point of view, there are two reasons to improve lifetime of network. First, uniform battery depletes of each nodes. Second, no such nodes which are based on signal transmission for long time to attain the right of entry point. This idea offers life time improvement of sensor network in specific range of more than 30 percent.

Datta et al. [8] discussed on clustering techniques for WSN is difference to random sampling, which is low cost due to economy of reduction in amount of communication and response at each node that are valuable to increase all over network lifetime. They have studied on complete theoretical aspects of the clustering trouble to increase energy optimization in WSN.

Hesham and Yang [9] discussed on energy aware optimization in cluster and cluster-head, they proposed a new system to validate the amount of cluster and choose the finest node to be the cluster-head based on highest energy level of sensor nodes. This system is built in three clusters that establish in the network. Therefore, it will increase the lifetime of the network.

Coyle and Bandyopadhyay [10] discussed on energy efficient hierarchical clustering, a circulated randomized cluster algorithm to categorize the sensor in a WSN in its cluster. The energy savings increase with the number of stages in hierarchy. The hierarchy of clusters is a purpose of reducing the entire energy used up in the system to communicate the gathered data by those sensors to the information dealing out center.

A. Problem Definition

Sensor nodes are typically expected to operate with limited battery power, and it is very difficult to replace the battery when the nodes are dies. When nodes are in operation, there are two methods in the case of battery performance. When nodes sense anything it may consume some sort of energy and when forwarding those sensed data then also it consume more power. While comparing with two of them, second method occupies more battery energy and node may goes down very earlier. For that problem clustering technique is used to increase the lifetime by reducing the energy consumption. The proper cluster-head selection and efficient routing are used to increase the network lifetime of WSN.

III. PROPOSED APPROACH

ECATCH Algorithm:

Steady state
Step 1: Create more than one cluster with number of sensor nodes (N), based on the location of x, y.
Step 2: Provide energy for each node in its cluster.
Step 3: Select two high energy node as cluster head (PH & SH).
Step 4: Nominate PH as Leader, Leader send join message to other sensor nodes in its cluster.
Step 5: PH=idle, SH=sleep.
Step 6: Begin data transmission N to PH then PH to BS
Step 7: After completing transmission
Check energy level for head
  If PH < SH
PH → SH (swapping head node) then (go to step 8)
Else
PH continues work

Change State
Step 8: SH=idle PH=sleep
Step 9: Begin data transmit N to SH then SH to BS
Step 10: After completing the task of SH to BS
Step 11: then go to step 3 for changing cluster head.

To improve the network lifetime, our proposed approach is efficient clustering algorithm for two cluster-head (ECATCH).

The ECATCH is divided into two phases.

A. Steady State

We first create three clusters in an environment with number of sensor nodes. We provide some energy then limited constrain for two cluster head, which we going to perform further. By selecting two high-energy nodes that act as cluster head and named it as primary head (PH) and secondary head (SH) in single cluster, the primary node is nominated as cluster-head for the beginning task. Then, the PH assumed as Leader and it sends join request message to all subnodes except SH. The status of PH is idle that has to communicate with BS. The status of SH is in sleep mode. Data transmission is beginning from node to PH then it sends data from PH to BS.

B. Change State

When the energy of PH decrease from the limited range then swapping is made at the appropriate time constrain as PH to SH. Now leader of the cluster-head act as SH and join message is taken place and data are routed to SH in the next section meanwhile by doing this we can reduces the work load of single cluster and multiple cluster head extends the lifetime of network. PH and SH collects information from its cluster and transmit to BS. If SH energy limit also goes down, then create two cluster-head with the existing node within the cluster based on high energy availability.
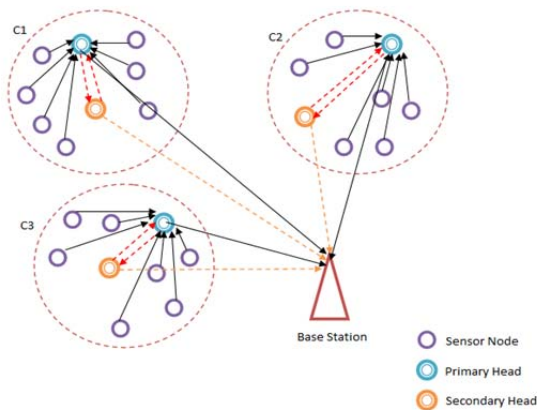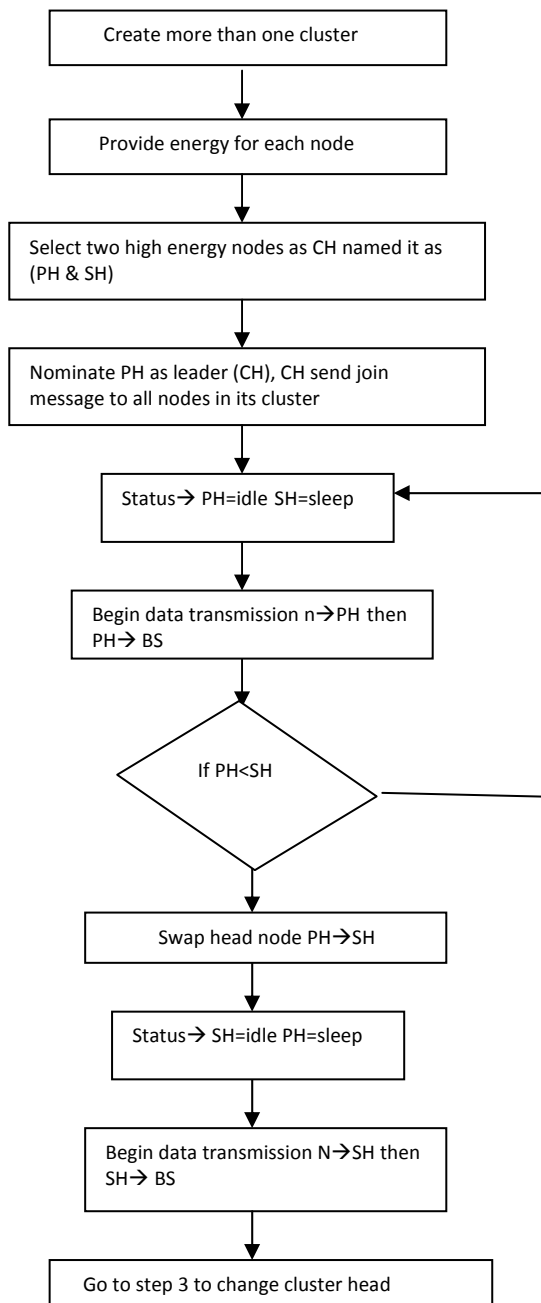
C. Proposed Architecture

Fig. 2 The proposed architecture

IV. FLOW CHART

V. EXPERIMENTAL RESULTS

A. Experimental Setup

In this scenario, the sensing region is covered with 700 m × 700 m with 25-sensor nodes. Those nodes divided into three clusters and deployed statically. Static deployment is achieved by choosing the (*x, y*) locations of the sensor field. These are carried out based on simulation of proposed ECATCH algorithm. To find the usage of two cluster-head in a single cluster algorithm it runs with dual cluster-head. Orange color node indicates primary cluster-head and rose color indicates secondary cluster-head. When the energy of PH goes fall, then SH is activated for the rest of the task. By doing this, the period of time of cluster and network lifetime is prolonged.
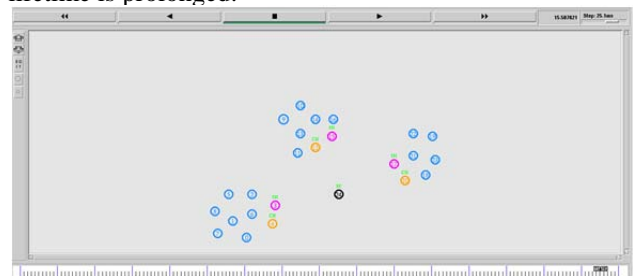

Fig. 3 Multiple cluster-head in single cluster

Fig. 3 shows three clusters, each cluster having a multiple cluster-head (PH and SH), the leader of the cluster that nodes are no. 3,4 in first cluster, no. 12,15 in second cluster and no. 17,20 in third cluster.
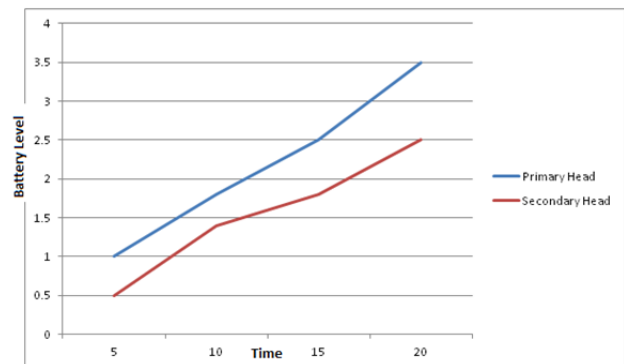
B. Result

Fig.4 Comparison result of PH and SH

PH work is examined with each time slot and energy consumption are also determined with battery level. When it reaches battery limit, then SH work is begin without affecting the cluster. Comparing with the single cluster-head, multiple cluster-head saves the cluster lifetime. As shown in the result, the proposed ECATCH clustering algorithm mechanism improving the lifetime of network.

VI. CONCLUSION

In this paper, the clustering algorithm with multiple cluster heads is determined within the cluster of sensor nodes to improve lifetime of WSN. Simulations results show that our algorithm has extended lifetime for the network using clusters. Using each cluster, multiple cluster heads are selected to accumulate the battery of cluster head

by swapping head node based on the ECATCH algorithm. When one cluster-head fails due to energy depletion, then another cluster-head works routine without affecting the rest of the node in the cluster. ECATCH algorithm is dynamic selection of cluster-head that are not exist for balancing node energy level based on the parameter defined for it. This proposal becomes more reliable for making network lifetime extended when comparing with rest of the algorithm in WSN. This method helps to maximize the network lifetime in WSN.

REFERENCES

[1] Vaibhav V. Deshpande and A.R Bhagat Patil "Energy Distributed Clustering for Improving   Lifetime of Wireless Sensor Network", IEEE journal of emerging science and engineering, vol.1 May 2013.

[2] Nitin Mittal and Davinder Pal Singh "Improved each Communication Protocol for WSN", National Conference on Computational Instrumentation, 19-20 March 2010.

[3] Meenakshi and P.Anandhakumar "Lifetime Extension of Wireless Sensor Network by selecting two Cluster Heads and hierarchical routing", International Conference on Advances in computing, communication and Informatics, August 3-5, 2012.

[4] Taruna and Sakshi Shringi "A Cluster Based Routing Protocol for Prolonging Network Lifetime in Heterogeneous Wireless Sensor Networks", International Journal of Advanced Research in Computer Science and Software Engineering, vol.3, April 2013.

[5] Nurhayati, Sung Hee Choi and Kyung Oh Lee, "A Cluster Based Energy Efficient Location Routing Protocol in Wireless Sensor Networks", International Journal of Computers and Communications, vol.5, 2011.

[6] Rupali shelke and Gurudatt Kulkmi, "Energy Management in Wireless Sensor Network", International Conference on Computer Modeling and Simulation, 2013.

[7] K. Kishan Chand, p Vijaya Bharati and B.seetha Ramanajaneyulu, "Optimized Energy Efficient Routing Protocol for Life-Time Improvement in Wireless Sensor Networks", International Conference on Advances In Engeneering, Science and Management. March 30-31, 2012.

[8] A. Raju Dutta, B.Sajal Saha and Asish K.Mukhopadhyay, "Efficient Clustering Techniques to Optimize the System Lifetime in Wireless Sensor Network", International Conference on Advances In Engineering Science and Management, March 30-31, 2012.

[9] Hesham and Shuang-Hua Yang "Energy-aware Optimization of the Number of Clusters and Cluster-Heads in WSN", International Conference on Innovations in Information Technology, 2012.

[10] Edward J. Coyel and Seema Bandyopadhyay, A Energy Efficient Hierarchical Clustering Algorithm for Wireless Sensor Networks", IEEE 2003.

[11] Tony Ducrocq, Nathalic Mitton and Michael Haluspie, "Energy-based Clustering for Wireless Sensor Network Lifetime Optimization", IEEE wireless communications and Networking Conference, 2013.

[12] Yonas G. Debessu, Hsiao-chum Wu, "Lifetime Analysis for Wireless Sensor Network With Hexogonal Clustering", IEEE, 2011.

[13] Torsha Banerjee and Dharma P.Agarwal, "Increasing Lifetime of Wireless Sensor Networks Using Controllable Mobile Cluster Heads", IEEE, 2008.

[14] Vinay Kumar, Sanjeev Jain and Sudarshan Tiwari, "Energy Efficient Clustering Algorithms in Wireless Sensor Networks: A Survey", International Journal of Computer Science Issues, vol.8, Sep. 2011.