Energy Efficient and Reliable Mobile Sink Routing Protocol in Wireless Sensor Networks

P.Balamurugan, J Santhosh, G Arulkumaran, M Vijayakumar

ABSTRACT--- In past growing of WSN, there are so many algorithms for energy efficient routing have been developed. However, one challenge in WSN is how to address the hot spot problem since nodes close to base station (static since) trend to die earlier than other nodes. Mobile sink node can address this problem since sink node can go along certain transmission causing hot spot nodes are more evenly distributed. In this paper, the energy efficient routing technique with multiple mobile sinks support is focused. The network is divided into several clusters and the influence of mobile sink nodes or number on network lifetime is studied. Simulation results are shown that the good network performance happens when mobile sink number is more than 3 under simulation environment.

Keywords: Sink node, energy, cluster and sensor

I. INTRODUCTION

With the development of MEMS, system on chip and wireless communication technologies, low cost sensors are produced. The nodes are randomly deployed in region of internet, gathering the dates surrounding sending the collected data to the sink nodes by single hop or multiple hops and creating WSN. Now a days WSNs are used in natural disaster monitoring, military tracking agriculture monitoring and industrial monitoring etc. Energy saving and balancing is always a challenging issue in reason for WSNs. Research shows that sensor nodes hear the static sink node will have heavier transmissions burden than other nodes. These nodes will make themselves not spots and this phenomenon is called as energy holes problem [2,3].

In this paper the mobile sink nodes are used in order to utilize energy of each sensor node and balance their energy consumption in WSN as much as possible [4,5]. During the mobile process, these nodes speed in the network and collect in data of surrounding nodes. When the sink nodes get moving at a constant speed, there will not be some nodes being always close to the sink nodes to become not spots and the energy consumption of nodes around sink nodes are balanced.

Revised Manuscript Received on February 14, 2019.

P.Balamurugan, Vel Tech Rangarajan Dr.Sagunthala R & D Institute of Science and Technology, Chennai, TN, India. (E-mail: pookumbala@gmail.com)

J Santhosh, Vel Tech Rangarajan Dr.Sagunthala R & D Institute of Science and Technology, Chennai, TN, India.

G Arulkumaran Vel Tech Rangarajan Dr.Sagunthala R & D Institute of Science and Technology, Chennai, TN, India.

M Vijayakumar K. S. R.College of Engineering, Tiruchengode, Chennai, TN, India.

II. RELATED SURVEY

The authors [6] have developed an energy efficient routing protocol based on clustering method, which is applicable for WSNs with obstacles. In this paper [6] the mobile sink starts from staring point to cluster head gathering data from the cluster head through single hop transmission, return to starting point called as one round of data collection. Experimental research were shown that the network life time is extended and

The complexities of scheduling problems in networking with obstacles are solved by the scheduling mechanism. A low energy consumption routing protocol for the constrained problem of sink nodes in WSNs has proposed [7]. The collected data transferred to nearest next arrival location of the mobile sink node, which ensured that the data transmission part B shortest. This protocol B robustness and low energy consumption and also it is suitable in networks of delayed tolerance.

The authors have developed a model [10] which is an optimization framework for mobile data collection. In this paper, the authors followed two step processes for mobile data collection. This is to select a part of sensor nodes when are used to transport data directly to the mobile sink node. The secured is destined the distribution algorithm for adjusting the data rate and link scheduling to improve the network utilization.

The author [9] has proposed a method of increasing network throughput called practical opportunistic data collection. In this paper, it is followed by three step process (i) Putting forward a new routing metric and contact aware et and evaluated the transmission delay caused by the packet transmission. (ii) The routing standards routing protocols are defined to realize the CA – ETX. (iii) An opportunity back pressure collection routing. Result stated that the proposed work improves network throughput and reduces network latency.

III. NETWORK MODEL

The innumerable sensor nodes are deployed in the circular field of the radius which is C, denoted as $\{C_1, C_2 ....., C_n\}$.

The sensor field is divided into several parts evenly and each sensor node belongs to a part based on its position.

IV. ENERGY MODEL

This paper considers the first order radio model for calculating energy consumption. Energy consumption holds two parts namely, transmission consumption and receiving consumption.

Energy consumption for transmission K-bit message is shown formula 1

$$E_{tx}(k,d) = \begin{Bmatrix} k.E_{ele} + k.\in_{ff} .d^2, ifd \geq d0 \\ k.E_{ele} + k.\in_{mf} .d^2, ifd \geq d0 \end{Bmatrix} \quad (1)$$

Where E_{ele} denotes the energy consumption to run transmitter or receiver circuit.

$\in_{ff}$ and $\in_{mf}$ denotes the amplification coefficient for the tree field model and to multi path fading model.

Receiving consumption can be calculated as shown in formula 2

$$E_{Rx}(k) = k.E_{\text{ele}} \quad (2)$$

V. PROPOSED ROUTING ALGORITHM

(i) *Clustering Phase*

The network is divided into N parts and every part will hold a cluster .Each sensor node finds its cluster based on its position. At the first round, cluster heads (CHs) will be conducted based on the residual energy of each node and the distance b
etween node x and mobile sink. The node which closes to the mobile sink sends its weight in the cluster and gets a tentative CH. Finally, the node with the maximum weight is selected as the CH in each cluster.

(ii) *Inter cluster communication phase*

The cluster members can communicate with its CH in two ways which are direct transmission and multi hop transmission and multi hop transmission. Cluster member which are available in the network can directly communicate with its cluster head and then energy consumption calculated using the given formula 3.

$$E_x(ms_x, CH_{msi}) = \begin{Bmatrix} kE_{ele} + k.\in_{ff} d(ms_x, CH_{msx})^2, d(ms_x, CH_{msx}) < d0 \\ kE_{ele} + k.\in_{mf} d(ms_x, CH_{msx})^4, d(ms_x, CH_{msx}) \geq d0 \end{Bmatrix} \quad 3$$

A convey node is chosen for forwarding the data if cluster member is far away from the cluster head.

VI. SIMULATION SETUP AND PERFORMANCE EVALUATION & RESULTS

The proposed algorithm is tested using a MATLAB simulation environment. In order to improve the optimal performance the radius of the mobile sink is changed to explore the performance. The proposed algorithm is tested about 50 times with different WSNs topologies.

This paper analysis the effect of mobile sink number to the life time of the network using simulation. At first it uses single mobile node and then increases the number of mobile sinks. The performance of the network like time is improved in order to increase mobile sink number. The simulation result is shown in figure 1. This paper also attention that the life time is slowing down when increasing mobile sink. The three mobile sink are most suitable because of more expensive of mobile sink than ordinary sensor nodes.

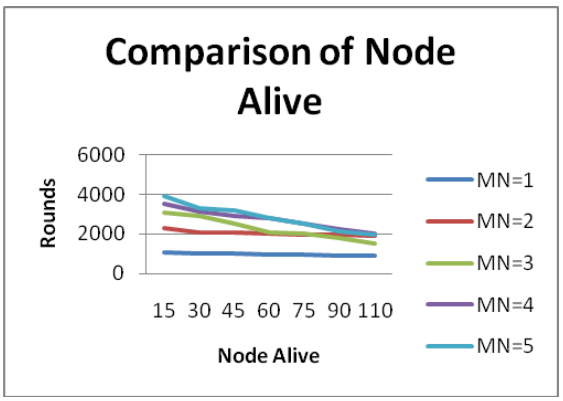

Figure1. Different Mobile sink number

The cluster head is chosen through the residual energy of nodes but nodes have chosen by the way are usually for away from mobile sink which have high residual energy. By this way the distance between cluster head and mobile sink is increased and energy consumption of the entire network is also increased so, in order provide a balance between residual energy and the distance from CH to mobile sink to prolong the lifetime of the system, it needs to calculate the weight of each node through using residual energy dividing distance between node and the mobile sink as a standard for selecting a CH. Simulation result is shown in figure 2.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

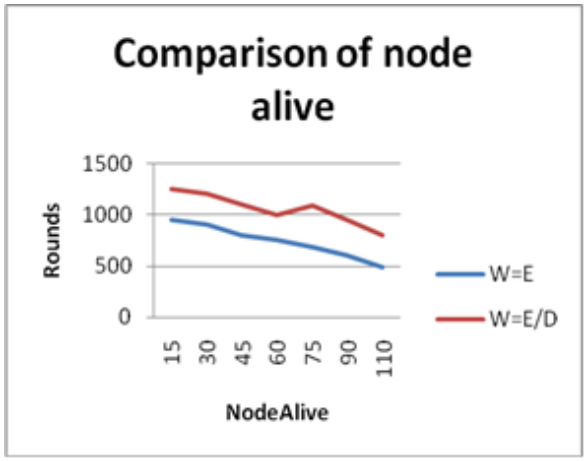

Figure2. Different ways to calculate weight

VII. CONCLUSION

This paper has proposed a energy efficient clustering algorithm for WSNs with mobile sink support. The system model and hierarchical routing algorithm are discussed. The performance of proposed algorithm is evaluated using simulation environment which used MATLAB. When the three mobile sink numbers is used simulation results are given the better performance. This paper is also evaluated the selection criteria of two metrics during the selection of CHs. In future it will consider some more factors such as moving velocity, other methods on WSNs performance.

REFERENCES

1. F. Akyildiz, W. Su, Y. Sankarasubramaniam, E. Cayirci, A Survey on Sensor Networks, IEEE Communications Magazine, 2002, 40(8):102-14.
2. G. Anastasi, M. Conti, M. Di Francesco, and A. Passarella, Energy conservation in wireless sensor networks: A survey, Ad Hoc Netw., 2009, 7(3): 537–68, 2009.
3. S. Olariu and I. Stojmenovic, Design Guidelines for Maximizing Lifetime and Avoiding Energy Holes in Sensor Networks with Uniform Distribution and Uniform Reporting, IEEE INFOCOM, 2006.
4. Y. Gu, F.J. Ren, Y. Ji, and J. Li, The Evolution of Sink Mobility Management in Wireless Sensor Networks: A Survey, IEEE Communications Surveys and Tutorials, 2016, 18(1):507-24.
5. J. Luo, J. P. Hubaux, Joint Mobility and Routing for Lifetime Elongation in Wireless Sensor Networks, IEEE INFOCOM, 2005.
6. G. Xie, F. Pan, Cluster-Based Routing for the Mobile Sink in Wireless Sensor Networks With Obstacles. IEEE Access, 2016, 4: 2019-28.
7. M. T. Nuruzzaman, Ferng H W. A low energy consumption routing protocol for mobile sensor networks with a path-constrained mobile sink, 2016 IEEE International Conference on Communications (ICC'16). 2016.
8. C. Wang, S. Guo, Y. Yang, An Optimization Framework for Mobile Data Collection in Energy-Harvesting Wireless Sensor Networks, IEEE Transactions on Mobile Computing, 2016, 15(12): 2969-86.
9. Mehrabi, K. Kim, Maximizing Data Collection Throughput on a Path in Energy Harvesting Sensor Networks Using a Mobile Sink, IEEE Transactions on Mobile Computing, 2016, 15(3): 690-704.
10. S. Yang, U. Adeel, Y. Tahir, J.A.McCann, Practical Opportunistic Data Collection in Wireless Sensor Networks with Mobile Sinks, IEEE Transactions on Mobile Computing, 2016, 16(5): 1420-33.