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LEACH with Dynamic Sink Approach by applying Energy and Distance factor in determining Sink Position and Cluster Heads in Wireless Sensor Networks

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Abstract: Wireless sensor network is a network that consists of large number of small nodes .The major aspect for concern in this field is energy. LEACH protocol has been proven to produce handsome result as per energy criteria is concerned. In this paper, we propose a method 'LEACH with Dynamic Sink Approach' in which we improve the LEACH and reduces the energy consumption by using distance and energy factor to determine the cluster head and sink position after each round. The position of the sink is change after each round according to the energy left in the node and the cluster head is selected according to the distance between the sink and sensor node. The main aim of the proposed task is to improve the overall network lifetime. To simulate the 'LEACH with Dynamic Sink Approach' protocol and data analysis we use the MATLAB network simulation.

Keywords: Wireless Sensor Network; Low Energy Adaptive Clustering Hierarchy (LEACH); LEACH with Dynamic Sink Approach; E-LEACH; EE-LEACH; MATLAB Simulation.

1 Introduction

Wireless Sensor Network (WSN) is inclining research topic within the world. It possesses a large application prospect within the application of the three technologies of computing, communication and sensor. The wireless sensor network consists of the many small sensor nodes. These nodes possess the ability of communication and processing, so that they can cooperate with each other and use the wireless communication to realize the information transmission of some special functions [1]. Some main points about the wireless sensor network are:

1. All the nodes within the sensor network are the source nodes and sends data to the only destination sink node.

2. Because of the large number of nodes deployed in or near the target the collected data is same or similar. This requires that the routing protocol should have the ability of data fusion.

3. The processing power and the storage capacity of the nodes are very limited, so the development of efficient routing protocols for WSN has become a hot and difficult problem in the field of wireless sensor networks.

That's why a lot of research has been done to reduce power consumption in wireless sensor network and still going on.

2 Related Works

2.1 LEACH protocol model

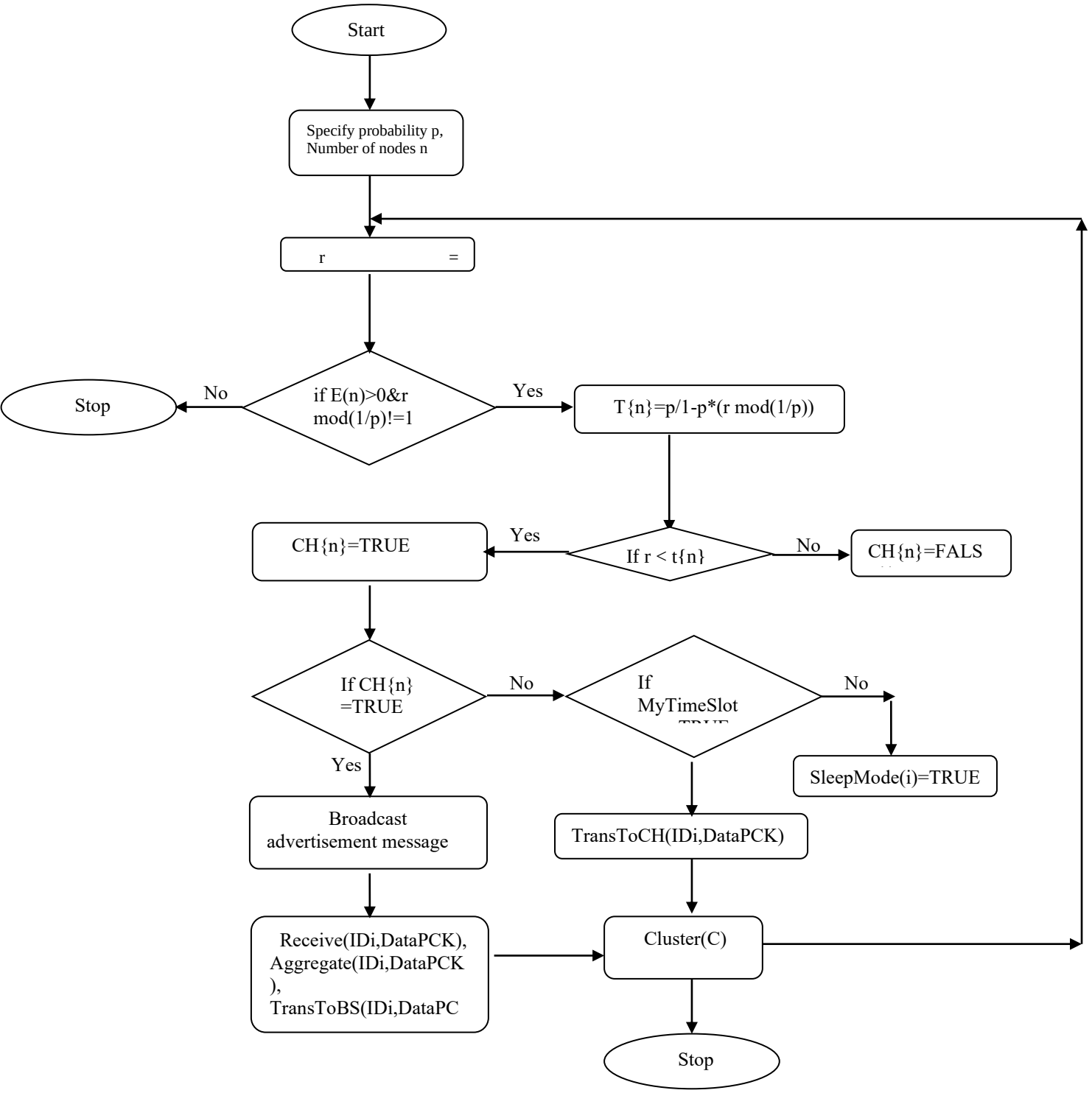
Low Energy Adaptive Clustering Hierarchy (LEACH) is a low power adaptive clustering routing algorithm for wireless sensor networks. LEACH defines the concept of "wheel" (round) which consists of two stages.

At the first stage the cluster head is selected by the following mechanism. The sensor nodes generate random number between 0, 1. Now, all those node which has random generated number greater T than those nodes are selected as the cluster head T's calculated as follows:

$T(n) = \frac{P}{1-P*(r\ mod(1/P))}$ where **'n'** belongs to **G**

$T(n) = 0$ where **'n'** does not belong to **G**

In the second stage, the nodes continuously collect and monitor the data and transmit the monitoring data to the cluster head node (DATA). The cluster head node is sent to the sink node, which is a reasonable working mode to reduce the amount of communication traffic. After a period, the entire network goes into the next round of work cycle, reselect the cluster head node.
Dynamic transfer cluster head method is used in the LEACH protocol to control consumption of the energy in the network, so that the nodes with energy exhaustion are disseminated unsystematically, so the LEACH can prolong the network lifetime by 15%. As the selection of cluster head node cannot achieve the best, it's possible that the cluster head node is selected in such a way that node may be at the edge of the network or in between the two cluster head node. Certain nodes have to transmit an elongated distance to the cluster head communication, which leads to a lot of energy ingesting. Besides, the LEACH protocol employs the continuous data transmission mode and single hop path selection mode to communicate with the sink protocol, so that the energy consumption of the cluster head nodes is gigantic, subsequently it is not appropriate for large scale sensor networks[8].



2.2 E-LEACH

E-LEACH improves the efficiency of traditional LEACH by some appreciable value. E LEACH algorithm uses two steps to make cluster. Firstly collecting nodes selected to encounter energy condition and from threshold condition. Secondly cluster head selection step here the algorithm randomly selects cluster head from a pool of nodes that fulfill the energy requirements.

By formula

$$\mathbf{E(r)} = {}^{\mathrm{KpEr}}/_{\mathrm{m}}$$

Where,

E (r) of the r- round of the energy threshold
K is an energy threshold factor
p is the desired percentage of the share of all valid node cluster head node
Er total energy of selected nodes in r rounds
m is the total number of nodes of the cluster head round r

2.3 EE-LEACH

This EE-LEACH protocol [12] uses many rounds to find out optimal cluster head. Firstly the neighbour's information are retrieved by some beacons (could be though of smoke signal) message through the network. Then according to hop distance all neighbours nodes are retrieved. When the two hop neighbours are not enclosed then this algorithm analysis all the members one by one and elects two hop neighbour as candidate for cluster head. Lastly sorts the nodes according to residual energy. The protocol is based on function of special density.

3 LEACH with Dynamic Sink Approach

Through the study of LEACH we have found some points where if we can modify then it is possible that we can get better result in terms of throughput or in the lifecycle.

As we have talk about the point of modification like:-

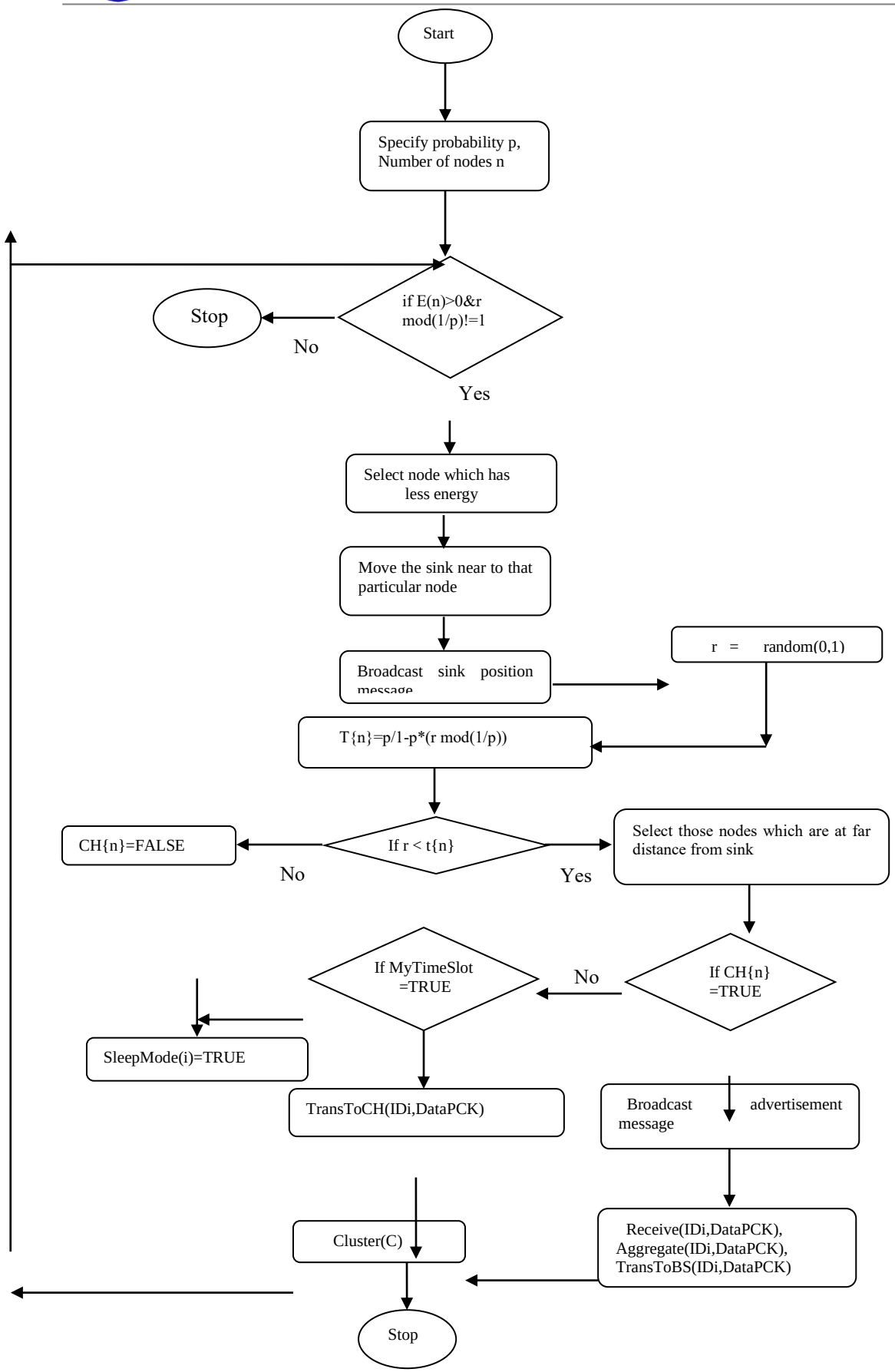
1. In LEACH the sink is in static mode means there is no movement of sink in the area of range.

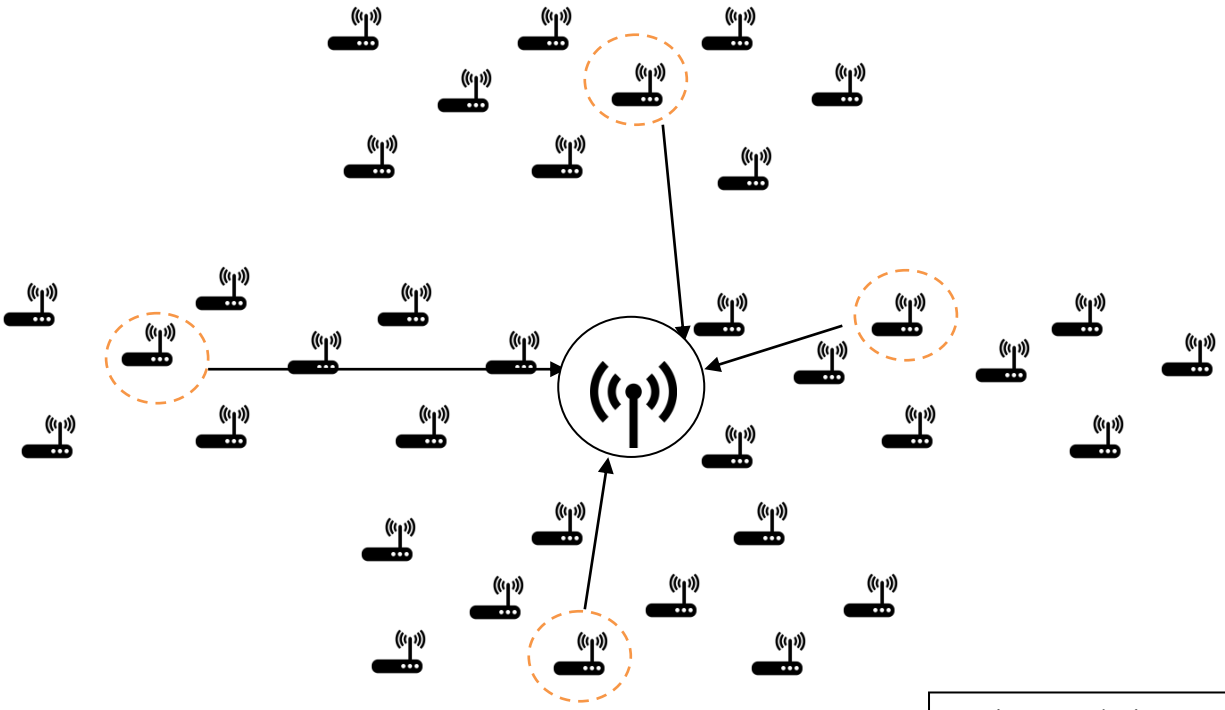
2. The Cluster Heads are selected randomly.

We have modify following two area in our 'LEACH with Dynamic Sink Approach' and we get better result.

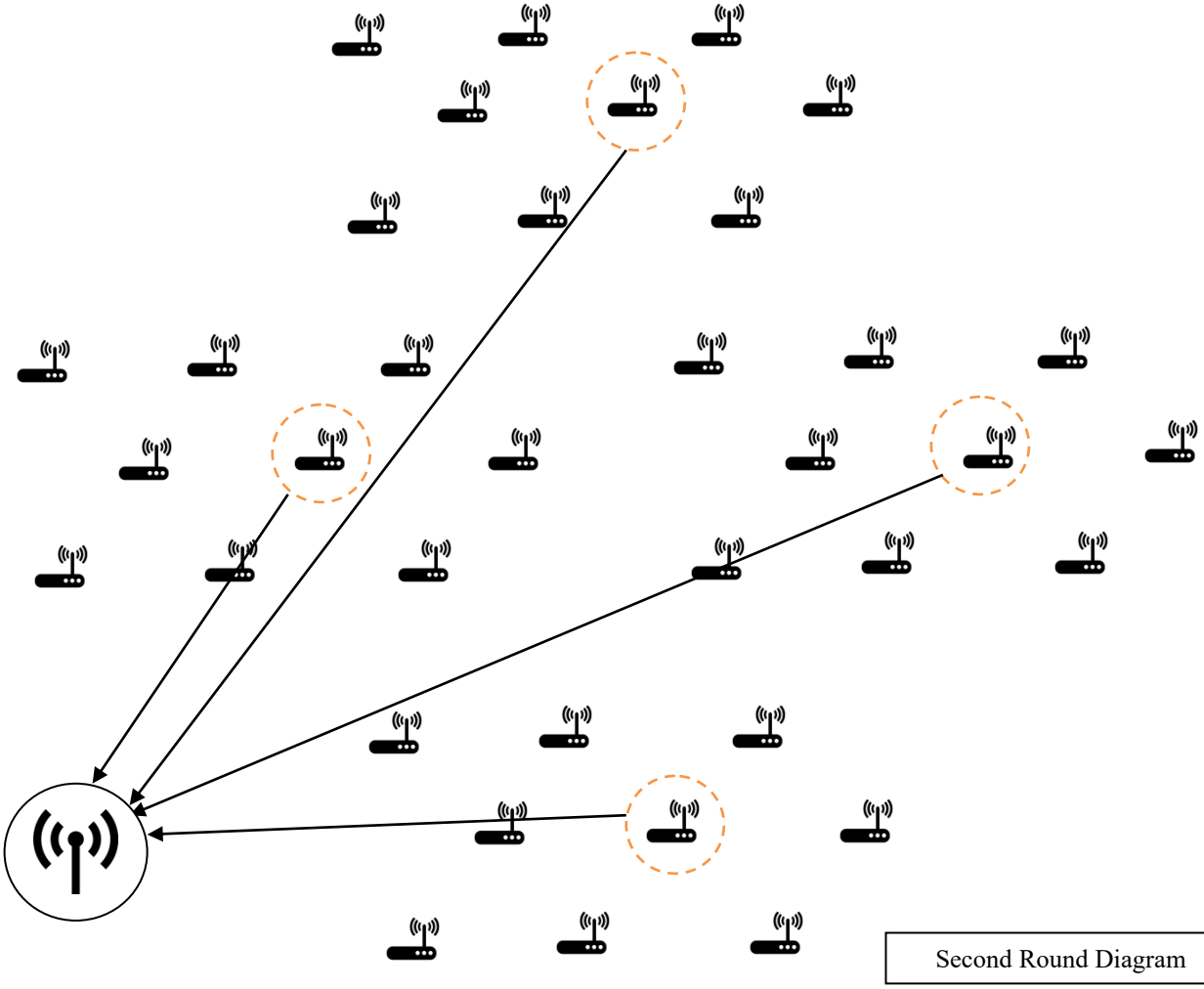
As we know that the LEACH protocol have static sink so, in order to remove this static sink we introduce mobile sink whose position changes according to the energy level of the sensor node present in the network.
The position of the sink changes after each round means the sink changes its position after each round complete.
The position of the sink means where the sink has to be moved is determine by the energy present in the node of the network. The sensor node which has less energy after each round the sink moves closer to that particular node for that particular round again after one round sink move to that node which has less energy except nodes which are taken in the previous rounds.

Now, after selecting the sink position for the particular round our next job is to determine the Cluster Heads for that particular round. For that first we have to calculate the distance between the node and the sink. And a random generated number for each node between 0 to 1 and also we calculate T now the process of formation of Cluster Head starts for that we have to see that which node has greater random number then T all those node are eligible to become cluster head for that particular round now select all those node from eligible nodes which has less distance with the sink will become the Cluster Head.


Start
Specify probability p, Number of nodes n
if E(n)>0&r mod(1/p)!=1
Stop
No
Yes
Select node which has less energy
Move the sink near to that particular node
Broadcast sink position message
r = random(0,1)
T{n}=p/1-p*(r mod(1/p))
If r < t{n}
CH{n}=FALSE
No
Yes
Select those nodes which are at far distance from sink
If CH{n} =TRUE
No
If MyTimeSlot =TRUE
SleepMode(i)=TRUE
TransToCH(IDi,DataPCK)
Broadcast advertisement message
Receive(IDi,DataPCK), Aggregate(IDi,DataPCK), TransToBS(IDi,DataPCK)
Cluster(C)
Stop



First Round Diagram



Second Round Diagram

4 'LEACH' and 'LEACH with Dynamic Sink Approach' simulation results

In the MATLAB programming environment, we first generate a 300 x 300 region and in its internal random generation of a 100 nodes of the connected graph. It is supposed that each node is identified to need a data type before the network is formed. It can be detected in the event of its detection range. Sink in the network area; do not ponder on the energy consumption of Sink. The initial energy of the common node is 5J. The experimental results in MATLAB are shown in Fig.1 to 5.

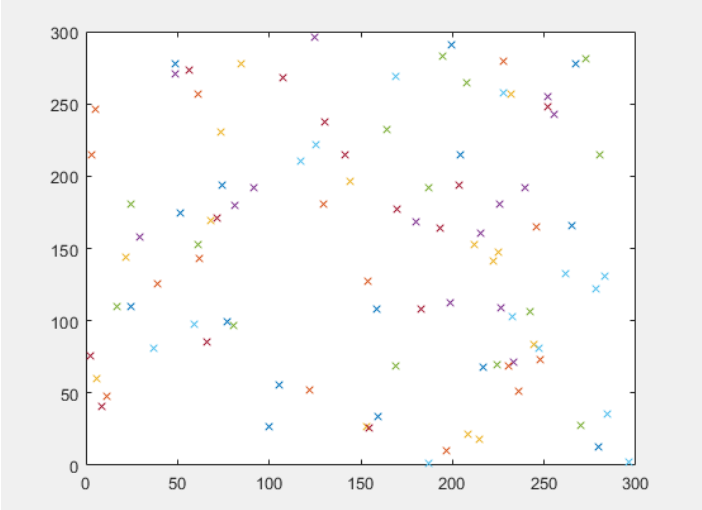


Fig. 1. Node Distribution

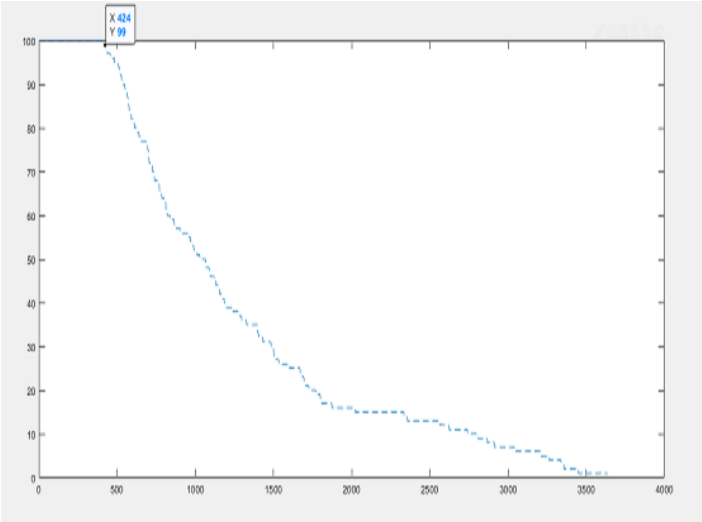


Fig. 2. In LEACH protocol first node dead after 424 rounds

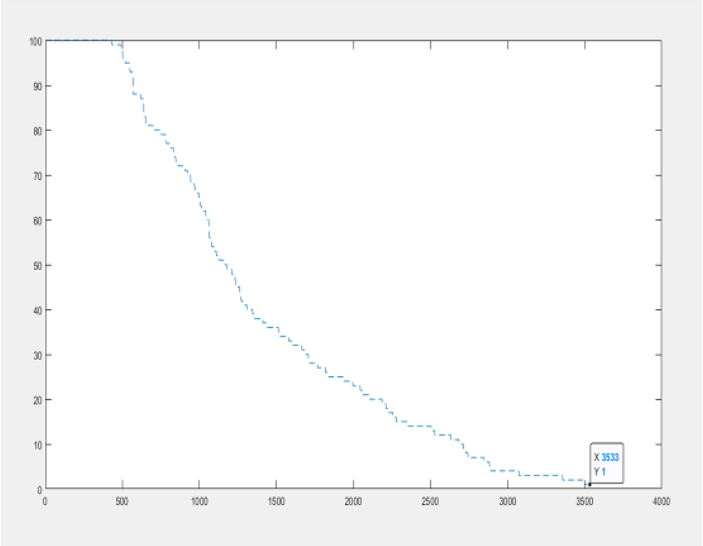


Fig. 3. Last node dead in LEACH protocol after 3533

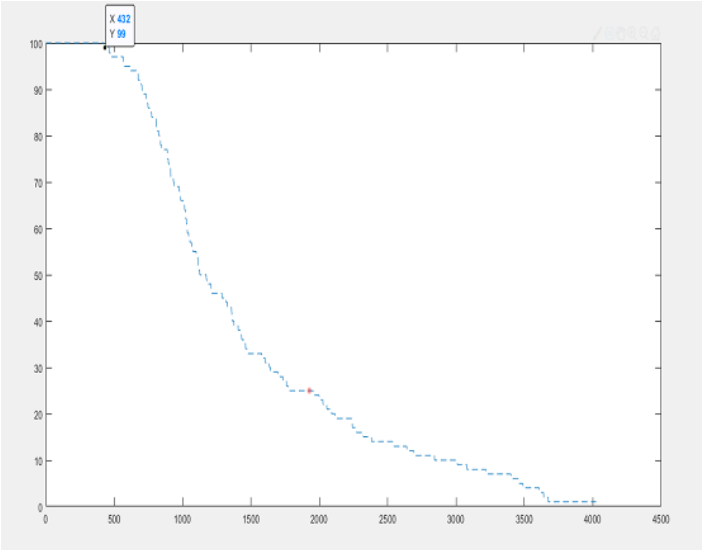


Fig. 4. First node dead after 432 rounds in proposed method

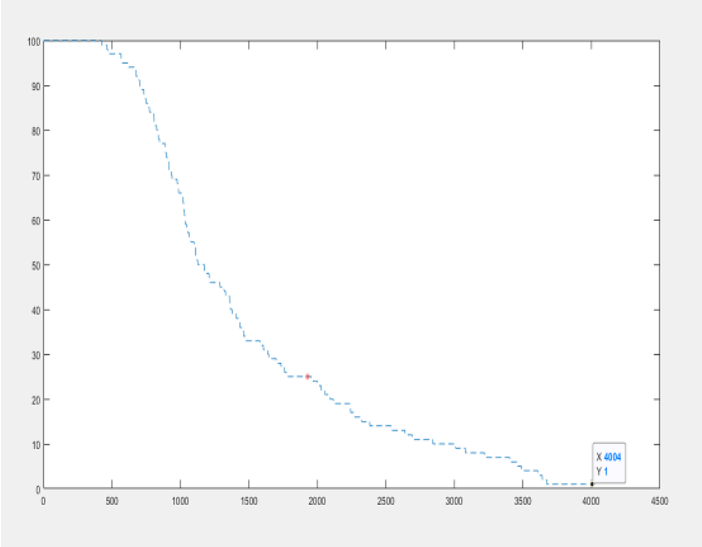


Fig. 5. Last node dead after 4004 rounds in proposed method

5 Conclusion

In this paper, we carefully examine the up-to-date research on LEACH protocol detail and particularize the pros and shortcomings of them. The conventional hierarchical routing algorithm LEACH is scrutinized and deliberated. The amended 'LEACH with Dynamic Sink Approach' algorithm is recommended. The 'LEACH with Dynamic Sink Approach' algorithm is planned by setting different energy level of node at each round to determine the sink position in each round and distance between the sink and node to determine the cluster head in each round.

It can be seen that the first node of the LEACH protocol is dead faster that is at after 424 rounds the than the 'LEACH with Dynamic Sink Approach' in which the first node dead at the after 432 rounds, also the LEACH protocol survive much less rounds then the 'LEACH with Dynamic Sink Approach' which can be seen in the Fig: 1 to 5 that is in LEACH protocol the last node dead in after 3533 rounds where as in the 'LEACH with Dynamic Sink Approach' the last node dead after 4004 rounds. This is due to the 'LEACH with Dynamic Sink Approach' protocol using the energy level of the node to determine the sink position and the distance between the sink and node to determine cluster head. Compared with the LEACH protocol, the 'LEACH with Dynamic Sink Approach' protocol is extended the lifetime.

6 The References Section

References

[1] W. B. Heinzelaman , A. P. chandrakasan , H.Blakrishnan,"Energy-Efficient Communication Protocol for Wireless Microsensor Network," Proceeding of the Hawaii International Conference on System Science , 2000

[2] Improved LEACH Cluster Head Multi-hops Algorithm in Wireless Sensor Networks. in Distributed Computing and Applications to Business Engineering and Science (DCABES),by Xu, L.-l. and J.-j. Zhang. 2010 Ninth International Symposium on. 2010.

[3] An efficient heuristic control algorithm for wireless sensor networks. in Educational and Network Technology (ICENT),by Lu Xiang, Q. and Y. Tian. 2010 International Conference on. 2010.

[4] Design of greenhouse control system based on wireless sensor networks and AVR microcontroller. By Song, Y., et al., Journal of Networks, 2011. **6**(12): p. 1668-1674.

[5] Research and simulation of energy efficient protocol for wireless sensor network. by Danlin, C. and Z. Daxin. in International Conference on Computer Engineering and Technology (ICCET), 2010 2nd International Conference on. 2010.

[6] MuMHR: Multi-path, multi-hop hierarchical routing. in Sensor Technologies and Applications, by Hammoudeh, M., A. Kurz, and E. Gaura. 2007. SensorComm 2007. International Conference on. 2007: IEEE.

[7] CRPCG--Clustering Routing Protocol based on Connected Graph. By Li, F. and L. Huang, International Journal of Intelligent Systems and Applications, 2011. **3**(3): p. 11.

[8] International Journal Of Computational Engineering Research (ijceronline.com) Vol. 2 Issue. 5 Issn 2250-3005(online) September| 2012 Page 1179 Performance Analysis of SPIN and LEACH Routing Protocol in WSN Geetu,and Sonia Juneja ,Deptt. Of Comp. Sc. & Engg HCE, Sonepat ,India

[9] Modern Clustering Techniques in Wireless Sensor NetworksBy I.S. Akila, S.V. Manisekaran and R. Venkatesan Submitted: February 26th 2017Reviewed: July 13th 2017Published: October 4th 2017 DOI: 10.5772/intechopen.70382

[10] SEP: A stable election protocol for clustered heterogeneous wireless sensor networks. in Second international workshop on sensor and actor network protocols and applications (SANPA 2004). 2004. By Smaragdakis, G., I. Matta, and A. Bestavros.

[11] Evaluation of WSN Hierarchical Routing Protocols According to Energy Efficiency by Al-Hilal, A. and S. Dowaji,

[12] ‘’EE-LEACH: development of energy-efficient LEACH Protocol for data gathering in WSN “ by Arumugam and Ponnuchamy EURASIP Journal on Wireless Communications and Networking (2015) 2015:76

[13]A survey on routing protocols for wireless sensor networks. Ad hoc networks, by Akkaya, K. and M. Younis, 2005. **3**(3): p. 325-349.

[14]J.Hu, Y. Jin and L. Dou, “a Time-based Cluster-Head Selection Algorithm for LEACH,” IEEE Symposium on Computers and Communication , 2008,1172-1176