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ENHANCED Q-LEACH ROUTING PROTOCOL FOR WIRELESS SENSOR NETWORKS

Deepa S.[1], C. N. Marimuthu[2] and Dhanvanthri V.[3]
[1]Karpagam University, Coimbatore, India
[2]Research & Development, Nandha Engineering College, Erode, India
[3]Communication Systems, Karpagam College of Engineering, Coimbatore, India
E-Mail: deepaa.selva@gmail.com

ABSTRACT

Wireless sensor network (WSN) defined as a group of spatially dispersed and committed sensors for sensing and recording the physical situation of the environment and arrange the collected data at a base station. WSNs measure environmental surroundings like temperature level, sound effect, pollution levels, humidity, wind speed and direction, pressure condition, etc. Sensor network is battery power operated. The major limitation of wireless sensor network is energy and network life time. To solve this problem Enhanced Quadrant based Low Energy Adaptive Clustering Hierarchy (Enhanced Q-LEACH) protocol is used. For each round routing protocol will check if energy of cluster head has fallen which is referred as threshold level than it will undertake cluster head and cluster formation operation. Otherwise same cluster head will continue its procedure by considering residual energy. This is how much of energy that goes wasted in cluster head formation action can be saved. Moreover, control overhead is also limited. Experimental results show that when compared to the existing system, in the proposed system is highly efficient in terms of network life time, energy consumption, Routing overhead and Average end to end delay.

Keywords: wireless sensor network, clustering, energy consumption, threshold.

1. INTRODUCTION

Wireless sensor networks participate an important role in the wireless communication. Wireless sensor networks are benefits in various applications such as civil, military field, and health care applications.

This network consists of sensor nodes. That is capable to sense the temperature level, pressure condition, humidity etc. This network is used to collect data from the physical environment and process the data and transmits to the base station [1].

Sensor networks consist of various types of sensors such as seismic, low sampling rate magnetic sensors, thermal, visual sensors, infrared sensors and radar. Benefits of the WSNs include to monitor a wide various ambient conditions like, vehicular movement, lightning condition, pressure level, soil makeup, noise levels, In Military for target field imaging, Earth Monitoring, Disaster management Fire alarm sensors, Sensors planted underground for precision agriculture, intrusion detection and criminal hunting [2].

In that important issue that persists is to handle bulk of packet sensed and passed to every node of a network. (A WSN include thousands of nodes). For that information aggregation and information fusion algorithm technique work, however there is always a room for betterment. In an effective wireless sensor network, we need efficient routing protocol that has low routing overhead and well organized packet aggregation process to improve good throughput of network and to save limited power of sensor node [3].

A WSN include huge number of sensor nodes prepared with various sensing procedure to observe various technique changes in the real world. A sensor node is composed of four units. First unit is sensing unit: - sense the desired information from the interested region. Second is Memory unit: - store the information until it is sent for prospect use. Third is Computation unit: - computes the aggregated information. Final unit is power unit: - it provides power supply for whole procedure. Since sensor nodes are battery powered equipment therefore they have some degree of energy. WSN are usually deployed in inhospitable terrain such as mountainous region where it's very complicated to recharge or put back batteries. Therefore the main contribution of any energy efficient routing protocol is to prolong the network lifetime which is possible by decreasing energy consumption of individual nodes. In addition it is also essential to ensure that the common rate of consumption of energy by every node is also same [4].

A sensor network is an ad hoc network includes hundreds of nodes set up on the fly for unattended process. Every sensor node is prepared with a sensing mechanism, a small computational capacity processor, a short-range wireless transmitter-receiver and a inadequate battery-supplied energy. Sensor nodes monitor some neighboring environmental condition, the data obtained and forward this data towards a central point located on the periphery of the sensor network. Base station(s) gather the information from the sensor nodes and pass on this information to particular remote control station.

In order to take benefit of this description of wireless sensor nodes, we need to account for certain

constraints related with them. In particular, reduce energy consumption is a key condition in the design of sensor network protocols and technique. Since the sensor nodes are equipped with small, often irreplaceable, batteries with limited power ability, it is necessary that the network be energy efficient in order to take full advantage of the life span of the network [5, 6]. In addition to this, wireless sensor network design also demands other constraints such as fault tolerance, scalability, production costs, and reliability. It is therefore crucial that the designer takes these factors into account when designing protocols and techniques for wireless sensor networks [5].

2. RELATED WORK

Azim *et al.* [7] introduced fixed LEACH algorithm depends on the relay of nodes. The battery power in WSN nodes is saved by using LEACH protocol and its different versions with clustering methods to reduce the energy used up by maintenance of more of the nodes in sleeping mode but give a good quality of service (QoS). But LEACH suffer on optimizing the life time of the network because of loosing huge amount of energy of sensor nodes elected as Cluster head during information transmissions. But relay node based technique used independent great relay nodes as heads to safeguard the energy in the small energy sensor nodes. These relay based technique also get trouble from a number of troubles like placement of relay nodes, blind spots and immature death of CHs. LEACH and modified LEACH except fixed LEACH, experience the problem of spending huge energy in the sensor nodes because of forming frequent cluster for each fixed time interval. Fixed LEACH solved the frequent clustering formation by build fixed clusters only once, but it wasted much energy and loss of information occurs because of premature death of cluster heads before expiring after a constant number of times. Therefore, LEACH-F can be used after the death of all the relay nodes, and the round time of fixed LEACH can be adjusted dynamically to decrease the probability of premature death of CHs.

Wang and Yong [8] introduced cluster head selection by the pseudo cluster technique. Load monitor and Load leisure technique is used to equilibrium the load and stability of the topology of the network. In that Simulation r LEACH-P Protocol effectively improve energy utilization efficiency, lengthens network lifetime and balances network load. Bhadeshiya *et al.* [9] proposed a routing scheme to select 4 or 5 % of constant number of clusters in WSN depends on the residual energy.

Mu Tong *et al.* [10] introduced LEACH-B algorithm technique to balance the number of cluster heads depends on the residual energy of the nodes. Initial CH selection is depends on simple LEACH algorithm technique and from the second round LEACH-B is utilised. LEACH-B is a near optimal routing technique. L-LEACH is a modified LEACH proposed by Qian Liao to choose CHs depends on residual energy and location identification of nodes and optimize the threshold for electing cluster-head. Cost function is designed to get better the optimal cluster-head selection. The experimental results proved L-LEACH balances the node energy better than LEACH.

Farooq *et al.* [11] proposed Multi-hop Routing with Low Energy Adaptive Clustering Hierarchy (MR-LEACH) protocol for WSN.MR-LEACH divides the whole coverage area of the network into various layers of clusters. Cluster heads in one layer coordinate with the CH of neighbouring layers to passed the sensor's data to the central base station. Non Cluster head nodes link with cluster heads depends on the Received Signal Strength Indicator (RSSI). The communication of nodes is coordinated by a central Base Station (BS) which defines the Time Division Multiple Access (TDMA) scheme for every cluster-head. Usually, BS uses the Top layers of CHs to perform as super cluster heads for Cluster Heads at the lower layer. Thus, MR-LEACH utilise multi-hop routing process from cluster-heads to a central station to accumulate energy, in contrast with the LEACH protocol. When estimate the performance, it is proved that MR-LEACH yields important improvement when comparing to the LEACH protocol and energy efficient routing for WSN.

A centralized version of LEACH, LEACH-C, is introduced. Unlike LEACH, sensor nodes are self-configure itself into clusters, LEACH-C use the base station for cluster configuration. During the setup phase of LEACH-C, the base station receives data regarding the location and energy level of every node in the sensor network. Using this information, the base station discovers a predetermined number of cluster heads and configures the sensor network into clusters. The cluster groupings are chosen to decrease the energy required for non-cluster-head nodes to broadcast their information to their respective cluster heads.

3. ENHANCED Q-LEACH ROUTING PROTOCOL FOR WIRELESS SENSOR NETWORKS

Q-LEACH protocol is a combination of conventional Quadrant based directional routing protocol and Low Energy Adaptive Clustering Hierarchy (LEACH) protocols. These two protocols merged to form a hybrid based routing protocol. That protocol is named as Q-LEACH. This protocol takes the benefits of both Q-DIR routing protocol and LEACH protocol. The proposed system introduces new enhanced Q-LEACH protocol for efficient routing. That system contains two major operations there are cluster formation and data transmission.

a) Cluster formation

Normally wireless sensor network contains number of sensor nodes which are used for gather the information from environment. In that existing Q-LEACH gives the clustering technique which is deal the energy conservation. However it does not deal the residual energy of nodes. To address this problem efficient Cluster head Replacement is proposed.

The entire sensor network is divided into four quadrants i.e., (q1, q2, q3, q4).Where sensor nodes are equally disturbed in each quadrant. The source and the corresponding destination nodes are placed in the same quadrants. Then the overall sensor network is divided into n quadrants such that the source and destination falls under the same quadrant. In clustering, entire network is separated into constant or variable sized clusters containing sensor nodes in it. Initially sensor nodes are grouped to form a cluster. Every cluster is characterize by a cluster head that is responsible for communication among base station/ sink and other non cluster head nodes. Sensor node chooses a arbitrary number between 0 and 1. If choosing value is less than threshold value, then that node develop into CH for current round. The threshold value is estimated by,

T (n) = $P/\{1 - p * (r \bmod (1$ **if nεG**

0 **Otherwise**

Where p denotes percentage of cluster head is the current round and G represents set of nodes. The efficient cluster head replacement is introduced in the enhanced Q-LEACH algorithm. Cluster head replacement was done by checking the energy of present cluster head node with the threshold. If the residual energy is larger than the threshold value, then the Cluster head same for the after that round.

Residual energy > Threshold

Because the Cluster head did not spend much energy in earlier round, the residual energy remains approximately same .That cluster head can be used for further or future rounds. If the residual energy is below the threshold the new cluster head node is replaced for further process. Initially the threshold value is used for compute CH in current round. And then compare if the residual energy is below the threshold the new cluster head node is replaced for further process otherwise the same cluster head used packet transmission.

b) Data transmission

In that transmission gathered information of sensor nodes are passed to the cluster head. The cluster head gather the all sensor nodes packets in that cluster. And then cluster head transmit the packets or information to the base station through the intermediate gateway node (IGN).The IGN node energy is drained out the another node will be choose for intermediate gateway node.

If source and target node placed in similar quadrant which formed by base station or else the vertices is adjusted by base station in which both source and destination comes under same quadrant, then restricted flooding technique is exploited.

c) Comparison of Q-LEACH and enhanced Q-Leach

Q-LEACH	Enhanced Q-LEACH
It does not deal the residual energy of nodes	Enhanced Q-LEACH consider residual energy of nodes.
Life time of network will be less	Network life time is high compared to that of Q- LEACH.
End to End delay will be more.	End to end delay of Enhanced Q-LEACH is low compare to Q-LEACH.
Total energy dissipation will be more	Total energy dissipation will be less.

d) Restricted flooding

In this system, node that is located closer to the destination or in a forwarding zone will transmit information. It can be put into practice whereby limited nodes will participate in the flooding and not network – wide participation and also reduce the number of routing packets. If the destination node that is base station is extreme away from source node or the node is not in the forwarding zone, then the restricted flooding concept is not involved.

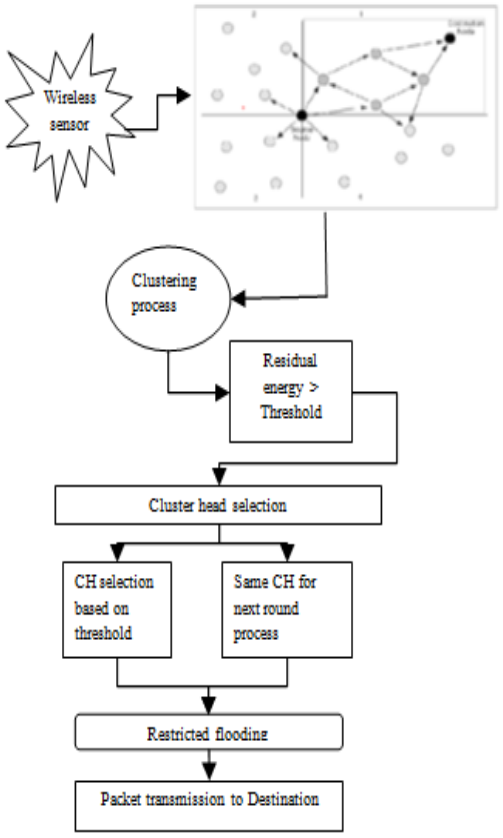

Figure-1. Restricted flooding.

Flow chart

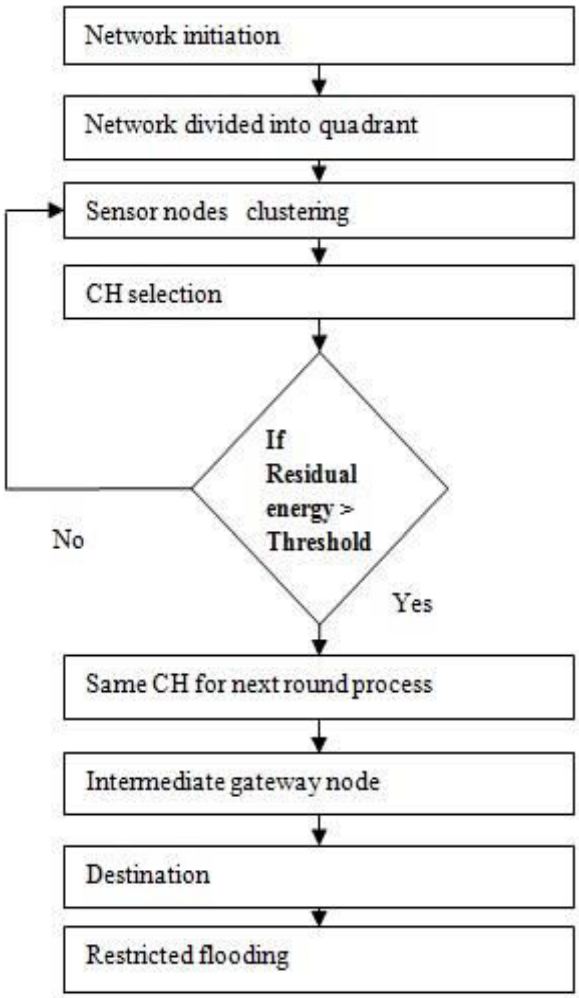

Figure 2. Flow chart.

Algorithm

1. Initialize the N number of nodes in the network $N = n$.
2. Network into Q

   // are quadrant
3. Clustering formation
4. To compute the threshold value by

$$T(n) = \begin{cases} P/\{1 - p * (r \bmod 1/p)\} & \text{if } n \varepsilon G \\ 0 & \text{Otherwise} \end{cases}$$

//p -percentage of cluster head, r - current round, G -set of nodes.

5. If
   Residual energy > Threshold
   Same cluster used for next round
6. Else
   Select New CH
7. Transmission of packets through (IGN).
8. Restricted flooding
9. End process

4. PERFORMANCE VALIDATION

In this experimental analysis, the performance of the existing and the proposed system is compared. The parameters like Routing overhead, Average end to end delay, energy consumption and network life time are evaluated for comparison of the existing and the proposed system. Wireless sensor network is battery power operated so energy consumption and life time of network is very important.

A. Energy consumption

Energy consumption is the consumption of energy or power.

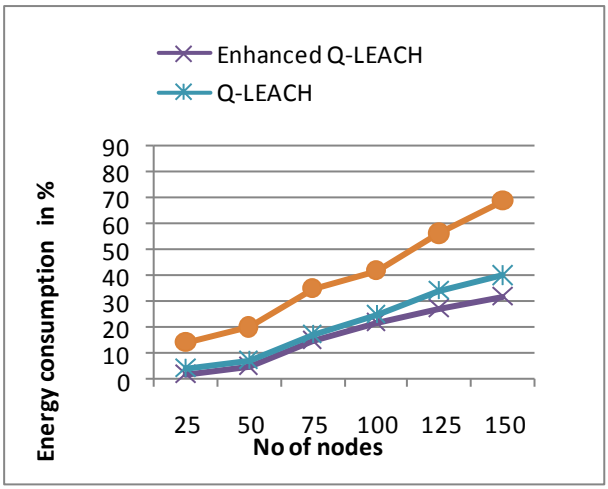

Figure-3. Energy consumption.

Figure-3 shows that energy consumption comparison. The proposed Enhanced Q-LEACH Routing methods consider residual energy. So it energy consumption is efficient compare to Q-LEACH Routing and LEACH Routing. Here the energy consumption is compared to the existing method and the proposed method.

B. Network life time

The lifetime of a sensor network is most commonly defined as the time to the first sensor node failure - seemingly over-pessimistic in many envisaged deployment scenarios.

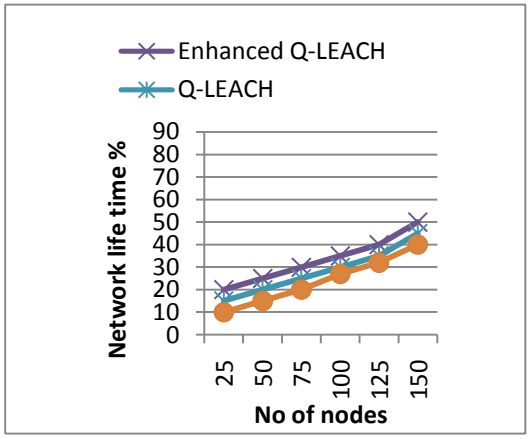

Figure-4. Network life time.

Figure-4 shows that network life time comparison. The proposed Enhanced Q-LEACH Routing method having efficient network life time compared to Q-LEACH Routing and LEACH Routing. Here network life time is compared with the existing method and the proposed method.

C. Through put

Throughput or network throughput is the rate of successful message delivery over a communication channel.

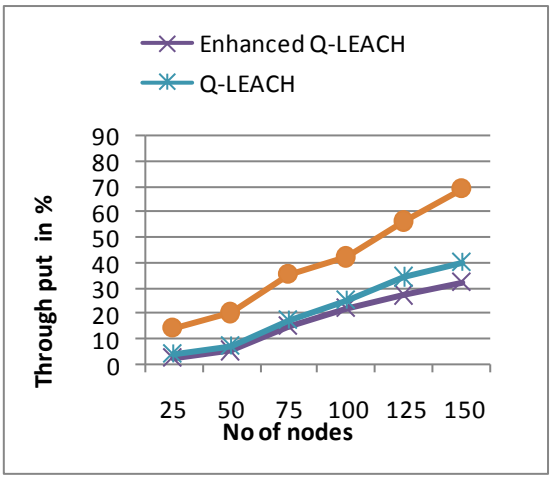

Figure-5. Throughput consumption.

Figure-5 shows that Throughput comparison. The proposed Enhanced Q-LEACH Routing method the information delivery is highly successful. So it throughput is high compare to Q-LEACH Routing .Here the throughput is compared to the existing method and the proposed method.

D. Average end to end delay

The average time taken for packets to reach the destination is known as average end to end delay.

$$\frac{\sum (\textit{arrive time} - \textit{send time})}{\sum \textit{Numberof connections}}$$

The lower value of end to end delay means the better performance of the protocol.

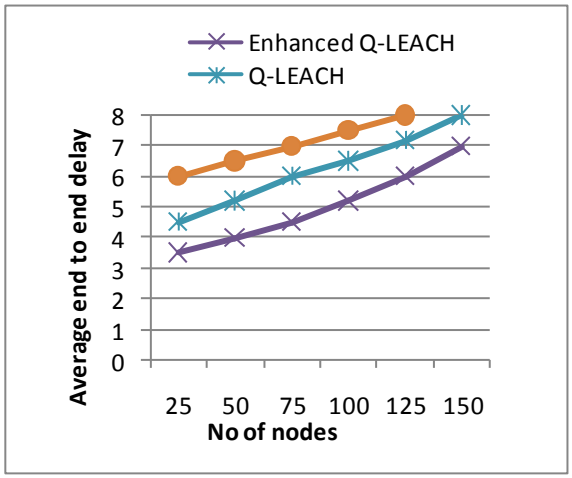

Figure-6. Average end to end delay.

Figure-6 shows that Average end to end delay comparison. In the proposed Enhanced Q-LEACH Routing method average end to end delay is low compare to the existing methods. Here Enhanced Q-LEACH is compared with LEACH and Q-LEACH methods.

E. Routing overhead

The ratio between total number of control packets and the total number of packets delivered successfully. That is called routing overhead.

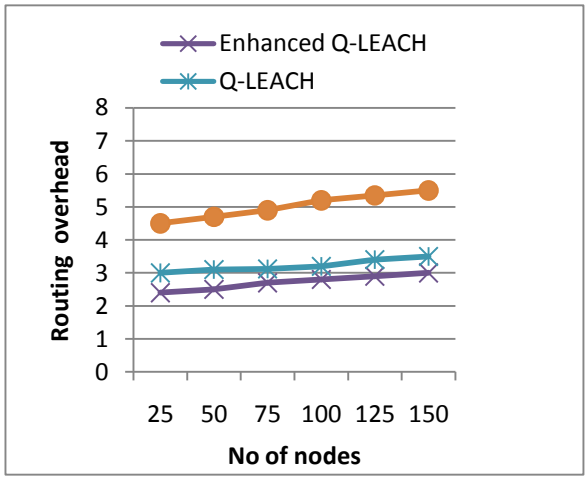

Figure 7. Routing overhead.

Figure-7 shows that Routing overhead comparison. The proposed Enhanced Q-LEACH Routing method with compare with LEACH and Q-LEACH. Here the routing overhead is low compared to the existing methods.

5. ACKNOWLEDGEMENTS

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6. CONCLUSIONS

In sensor network the sensor nodes are gather the information and transmit that into neighbouring node or base station. In wireless sensor network battery power is an important thing. The proposed system considers the residual energy for further clustering process. In that process same CH is used for further process. The experimental results shows that the proposed Enhanced Q-LEACH is efficient compare to the existing method in terms of energy consumption, network life time, average end to end delay, routing overhead and throughput.

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