A Clustering Routing Algorithm Based on Max-Energy Path Selection

Hongfei Chen
Shanghai Institute of Technology, School of Computer Science & Information Engineering, Shanghai 201418, China
E-mail: chofei@126.com

Shengzhe Ni
Shanghai Jiao Tong University, Shanghai 200240,China
E-mail: nishengzhe@kyee.com.cn

Huagang Shao
Shanghai Institute of Technology, School of Computer Science & Information Engineering, Shanghai 201418, China
E-mail: shaohuagang@kyee.com.cn

Abstract—A routing algorithm based on optimizing for cluster distribution and max-energy detection is put forward, and it is called ECME in this paper. The advantage of the algorithm is that it can save the communication energy effectively in WSNs because the optimal path is selected to send the maximum amount of messages. In the routing scheme using ECME, the optimizing for cluster distribution is realized by an improved threshold setting, and the optimal path's selection criterion is owning the maximum energy. Therefore, the efficient multi-hop data sending routes from the node clusters to the base station (BS) are found out. The simulation shows that the prosed algorithm can prolong the lifetime of whole network.

Keywords-optimal distribution; max-energy; multi-hop; threshold; base station

I. INTRODUCTION

Wireless sensor network for handling the sensor to the sensor node in the data by multi-hop communication is sent to BS . However, multi-hop data which is transmitted between nodes had an uneven distribution of traffic load. The past study proves, due to wireless transport channel characteristics, using more jump way will data transfer to base station to than directly transport way consumption more less energy, but in more jump Routing Algorithm in the [1], the node forwards the data by looking for next-hop nodes which are closer to the base station that makes much pay for more data transmission and network generating energy in the hole[2],[3], reduces network life and performance. Therefore, reducing the traffic load and its distribution to extend the life network and enhance network performance is essential. Energy-saving requirements for wireless sensor networks are higher than other types of networks, efficient sensor management for improving the life of wireless sensor networks is also important. In the data routing based on cluster technology, traffic load compared to other cluster members of the cluster head node is much higher [4]. Dynamic clustering technology clusters in the role of the head are often replaced by other members of the cluster nodes, which was established when the result in each round stage trigger [5]. Set the trigger in wireless sensor networks often add additional message overhead. Therefore, in each round for the new cluster head selection and formation, large amount of energy is wasted. On the other hand, high load cluster head also increases the residual energy of the network, and the energy will still be preserved after the death of the entire network.

A large number of sensor nodes are generally deployed with intensive energy constraints, and they need a proper network protocol for network control and distribution tasks. Traditional routing protocols for wireless sensor networks have several disadvantages, such as the nature of such networks with power constraints [6]. Main types of energy consumption include energy consumption for sending packets, energy consumption for receiving packets, energy consumption in idle mode and sleep mode.

In this paper, the proposed cluster-based routing algorithm based on some of the key factors such as location of sensor nodes, number of remaining energy, a neighbor and other select the cluster head, efficient management and the sensors node clusters to reduce energy consumption. When the cluster head (or the associated cluster head) has been established between base stations and transmission paths, preferable energy maximum path, which is based on the maximum energy value select the best path.

The rest of this paper is as follows: Part II summarizes the research on the topic; Part III section is about the strategy; Part IV is for simulation and performance testing; and Part V is a conclusion.

II. RELATED WORK

In 2012, Sofy Harold and A. Vija Y Alakshmi proposed [7] the reliability of a new protocol called enhanced power control MAC Protocol, the key idea of this agreement is, by sending all packets with the best transmit power, improve throughput and energy conservation. This form of communication in wireless sensor networks is to improve the throughput and delay performance through the effective use of the spatial diversity. In addition, the rising power of grouping data is

periodically to a suitable level, but not the highest, so that it will avoid interference between the nodes and unnecessary contention.

In 2012, PEYMAN Arebi[8] proposed a new method for estimating based on Energy to restore broken links, and to rebuild their path. Therefore, investigation of topology control in wireless sensor networks influence of broken links and routing process are carried out. Some of these effects are referred to in the network section which pointed out that it is harmful. This work has used energy estimation method of hardware which has a higher speed, eventually found out or surveyed the impact of link in ad hoc networks, it may be found, both routing and topology control structure will also be adversely affected, and in some cases, the entire network will be disorder. These effects may be in different parts of the data transfer and network efficiency leads to some serious problems. For the purpose of this policy is to prevent the link of fracture and disorder. This policy can be routed through a link forecasting and prediction of time to network a number of recommendations.

Gaurav Soni and Ashish Khare proposed in mobile ad hoc networks based on energy of a new thrust to the latest routing scheme in 2011[9]. In this scenario, in order to detect minor nodes in the network, they set the threshold to a mobile node. If the energy value is less than the threshold defined stops the communication between the nodes. Under this method, they know the nodes in the network of energy, in this part they can suddenly lose their direct removal, in turn, extend the life of the sensor network.

In UCRA[10], the authors use the Clustering algorithm and the voting mechanism to select the cluster head. In the group stage, the node through the exchange of information calculates the number of votes, and then selects the node that has the largest number of votes as the family head, and notifies other nodes by radio control messages. Retention of nodes based on selection criteria or other mechanism is for selecting the best cluster. This process is repeated until all nodes of a cluster head covers at least. WCA requires many iteration times, which is to ensure connectivity between cluster head.

III. ECMC ALGORITHM

A. *Energy model and its problems*

Formula (1) stands for the typical energy consumption in wireless sensor networks model type [11]. It assumes that the energy launches b bits data loss E_T; loss of power amplifier based on the distance between the sender and receiver respectively use free-space model (d<d) and multi-path attenuation model ($d \geq d_0$).

$$\begin{cases} b\times E_{elec} + b\times\varepsilon_{fs}\times d^2, & d < d_0 \\ b\times E_{elec} + b\times\varepsilon_{mp}\times d^4, & d \geq d_0 \end{cases} \quad (1)$$

E_{elec} is the loss of energy transmitter, ε_{fs} is the power amplifier energy under spatial channel model for freedom, ε_{mp} is the power amplifier power in multi-path fading channel model. Energy consumption of the received bits data is:

$$E_R = k \times E_{elec} \quad (2)$$

According to (1) , when cluster head is via relay nodes to the base station, closer nodes of lower energy consumption. Generally, the distance of clusters is greater than the distance between inter-cluster, reducing the distance from cluster head to relay or based cluster-head can reduce the power consumption of cluster head. The smaller the weight of a relay node owns the more suitable it acts as a next-hop routing node. The weight value of nodes formula is (3):

$$W = \arg\min\left\{ (1-\frac{E_{res}}{E_{ini}})^{(1-\frac{\sum_{j=1}^{N}(\frac{d_j}{r_{i\max}})^2}{N})} + \frac{\sum_{i=1}^{N}(\frac{d_i}{r_{a\max}})^2}{N} + w \right\} \quad (3)$$

In (3) , E_{ini} is initial energy for a node , E_{res} is the current residual energy, d_i is the distance between nodes with a back-stage cluster-head, d_j is the distance between the neighbor node and the current node, $r_{i\max}$ is maximum communication covering radius within the cluster nodes, $r_{a\max}$ is maximum communication covering radius among the cluster heads, w is later-stage cluster-head weight factor.

Some of the energy loss of a node will result in the loss of some of the other node communications capabilities, the result will be a network division problems. Network question of the separatist cause can not predict when a node goes into sleep, which makes network node also have enough traffic in energy out of the data transfer process, resulting in data loss.

B. $ECME$ *Algorithm*

In this section, taking into account the performance, power, distance sensor nodes, the number of neighbor nodes, and other factors which make an efficient routing algorithm, the associated cluster heads gather data from the cluster head and forward it to the BS , which does not lead to other changes. Members of the cluster nodes are through the mesh data to the cluster head. Each member of a cluster node from the adjacent node selects the minimum loading nodes and maximum energy paths to data transfer.

In the cluster head selection phase, the threshold value of the node itself generates a random number between 0 and 1. The random numbers are then compared with (4) improved threshold .

$$T(n) = \begin{cases} \frac{p}{1-p[r \bmod (1/p)]}\left[\frac{E_{cur}}{E_{avg}}\times\frac{Nb_n}{Nb_{avg}}\times\frac{d_{avg}}{d_n}+(1-\frac{E_{cur}}{E_{avg}})\frac{p}{T_{CH}+T_{VCH}+1}\right] & n \in G \\ 0 & \text{otherwise} \end{cases} \quad (4)$$

E_{cur} is a sensor node the remaining energy; E_{avg} is the average energy in this round of the network; N_{bn} is

the neighbor nodes of n node; N_{bavg} is the average number of adjacent nodes in the network ; d_{avg} is the average distance sensor nodes to the base station, and d_n is the distance from BS to the sensors node. T_{CH} (or T_{VCH}) is to select a cluster head (or the associated cluster head) Amount of time.

If the random number is less than $T_{(n)}$ value, the sensor node is selected as the family head, cluster head of information and broadcasting ADV message notification itself; if the random number is greater than or equal to the threshold, the node itself is taken as a normal node, awaiting ADV message from the cluster head. When normal node received ADV messages have sent from the surrounding cluster head, compare the received signal strength of the first packet of the cluster, select the strongest cluster nodes as they are about to join the cluster head node, and send $JOIN$ messages to it; the cluster head node sends $JOIN$ messages, when receiving regular node to the cluster nodes in the cluster members and is recorded; Cluster head nodes receives all of the data, then data integration and cluster routing to BS . Before the next round starts, cluster head will analyze each member node of the residual energy, then select one of the largest member of the energy node as the ACH .

C. *Step of Max-Energy Select*

In this algorithm the sender is not in the usual route transmits data, it uses the maximum energy value routing technology, that is, if the path has been established between the sender and the receiver, then compares its alternative energy value of the path, elects on the basis of the best path based on the maximum energy value.

Step1: create a mobile node: N

Step2: set N = { V_t , V_r , V_a , V_b , V_c , V_1, V_2 … V_n }// The number of mobile nodes

Step3: set sender = V_t ; set destination = V_r

Step4: set the initial energy of each node E ={ e_t , e_r , e_a , e_b , e_c , e_1 , e_2 … e_n }

Step5: calculate route line (V_t , V_r , E , RR)

Step6: if (from V_t to V_a && V_a != V_a build path,)

increase the pointer V_a as V_b and V_t as V_a

broadcast routing packets to the next hop

At the same time (generated from V_a to V_b && V_b != V_r build path)

increment the pointer V_a and V_b

Step7: if (V_b == V_r)

Create energy tables: V_t - V_a - V_r

Step8: if (path is greater than 1)

(paths from T to R is V_{tabr} and V_{tc1r})

{

V_t through the path V_{ab} to V_r create R-table

Create energy table e_t via the path e_{ab} to e_r

V_t through the path V_{c1} to V_r create R-table

Create energy table e_t via the path e_{c1} to e_r

}

Step9: looking for the lowest energy (e_a , e_b), if is e_b ;(e_c , e_1), if is e_c

Step10: looking for maximum energy (e_b , e_c)

if (is e_c)

Select routing path V_t - V_{c1} - V_r

Using the method, the effective energy utilization and the decrease for unnecessary energy consumption make the connection between the sender and the receiver reliable and powerful.

IV. SIMULATION AND PERFORMANCE EVALUATION

The simulator used to simulate the ad-hoc routing protocols is the Network Simulator 2 (NS-2) [12]. In this section a set of simulation experiments is presented to evaluate the protocol. Results are obtained after doing simulation of Average Energy based $AODV$, $AODV$ with threshold and $ECME$ Algorithm.

A. *Throughput Analysis*

Throughput is one of the major factors to measure the performance of network. In this graph, throughput of all the three energy aware techniques is shown, through putting mean value delivery in per unit of time. Here it is clearly visualized that when the throughput of threshold scheme nearly reached to 100 but after that the throughput in case of ECME are very high. Red line shows ECME energy throughput' time is the maximum out of other two methods, which means the approach throughput is better as

compare to other.

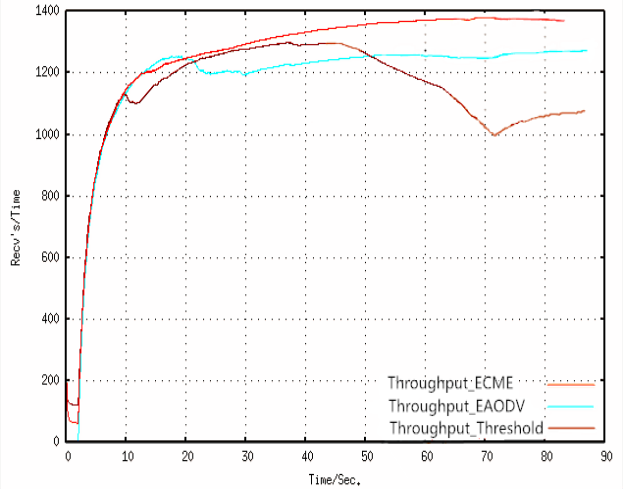

Figure 1. Throughput Analysis

B. *Packet Delivery ratio Analysis*

Packet delivery ratio means percentage of data receiving at receiver end, that parameter is important for performance measurement of the network, in this graph packet delivery ratio in three energy base techniques are compared under wireless sensor network and ECME energy approach gives nearly 90% of data delivery that is maximum and minimum performance which gives normal energy base scheme (without energy check), here X-axis shows time unit in seconds and y-axis shows performance in percentage format.

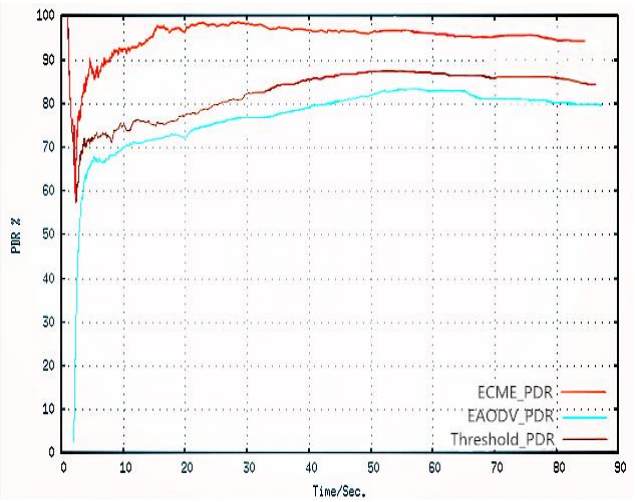

Figure 2. Packet Delivery ratio Analysis

V. CONCLUSION

In this proposed figure, the total cluster head node send their data to the base station by correlating cluster heads, and to transfer data to the cluster head by members of the cluster nodes load balancing in multi-hop communication method ,and always choose the best path from all available paths. The program for the network to scale, to quickly form clusters and data transformations is useful. The program's performance shows that compared to other existing routing cluster technologies, the one which is based on the data is more efficient. Use the max energy efficient routing and network efficient energy can achieve the best results and better extend the life of wireless sensor networks.

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