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Performance Improvisation for Longevity Maximization with Ant Colony Optimization in Wireless Sensor Network: A Review

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Abstract- Maximization of longevity of wireless sensor networks is possible by using effective transmission strategy. An optimal-distance-based transmission strategy based on ant colony optimization is put forward to fulfill such a maximization aim. A local optimal distance achievement mechanism is presented by introducing two concepts , most energy efficient distance and most energy balancing distance for high energy efficiency and a good energy balancing respectively in wireless sensor networks. Global optimal distance acquirement scheme will be obtain to achieve the energy depletion minimization for the sensor nodes with the maximum energy consumption throughout the network, by using a network longevity evaluation method. Simulations will prove that our findings significantly give the solutions.

Index Terms-Wireless sensor network, network longevity evaluation, high energy efficiency, good energy balancing.

1. INTRODUCTION

Wireless sensor networks attracted the world wide attention for their large numbers of applications such as civilian applications and military applications [1], [2]. Battery power is used to provide the energy source to the sensor nodes in wireless sensor network. It becomes difficult to change the sensor nodes batteries or the energy providers as the sensor networks can be deployed in the hazard conditions [3]. Data transmission is carried out by using energy. Therefore the energy efficiency is extremely important issue in the packet transmission. Further, data transmission is carried out between multiple nodes and a single sink. Highly non-uniform energy depletion among nodes of the different locations can be obtained as a result by this many-to-one communication manner. The phenomenon called as " energy hole" caused by some parts of nodes that deplete their energy faster , while the nodes which are having closer distance to the sink tends to consume their energy faster than the others[4] ,[5] . Hotspot is the region where the energy is depleted faster. The premature depletion of energy at nodes may result in disjointing of the network and shortening of longevity [6], [7]. Therefore another key concern is the energy balancing in data transmission. So, in such networks how to obtain suitable and effective transmission strategy to achieve longevity maximization plays important role. Most energy efficient distance and most energy balancing distance are the two important concepts, we used is this paper. An effective transmission distance

At every hop has been found in [25] to minimize the total energy usage throughout the transmission path by using multi-hop transmission strategy. Intervening relay nodes divides a data link between a data transmitter and a receiver at distance D into X hops. The minimum energy usage can be obtained when each hops shares the equal transmission distance d = D/X and here the d is then called as most energy efficient distance. If the same amount of energy is consumed by a node in every sector, then the distance d is called the most energy balancing distance. The problem of the network longevity maximization in wireless sensor network, we investigate in this paper and also propose an optimal distance based transmission strategy on the basis of the ant colony optimization. In this transmission strategy, some proactive measures have been taken, in which for both the high energy efficiency and good energy balancing, an optimum transmission acquirement scheme is designed. To achieve the energy depletion minimization for the nodes with maximal energy consumption throughout the network, we use the optimal transmission distance scheme.

2. LITERATURE REVIEW AND RELATED WORK

In the field of data transmission of wireless sensor networks, the concentric corona model has aroused great concern. In the concentric corona model, the optimal transmission ranges of all coronas can effectively improve the network longevity. The concentric corona model consists of a circular multi-hop wireless sensor network. Sensor nodes deployed in the different regions may differ in their maximum transmission range, in concentric corona model. The discussion of such a network model is done by authors in [4] and explained that all the coronas must have the same width and data should by forward by the nodes to the adjacent inner corona. The authors in the [8] advanced a technique that alternating between multi-hop transmission with the fix transmission distance and the single-hop communication directly to the sink, periodically. In [9] the optimum transmission distance for multi-hop communication was obtained by using a single hop transmission and multi-hop communication .The optimal ratio of the number of data cycles operated in a single-hop transmission mode and multi-hop transmission mode over the network lifetime was obtained[19] by proposing a hybrid of single hop communication and multi-hop transmission . To achieve the balance energy usage in the network, a hybrid of two transmission scheme was advanced [10], and in [11], a mixed transmission algorithm including flat and hierarchical multi-hop routing was put forward. Further in [12]-[14], mixed transmission scheme including single-hop and multi-hop where presented.

Ant colony optimization [15] which is a swarm intelligence method has been successfully applied to the large range of combinatorial optimization problems and has also gained the popularity in recent years. Ant colony optimization is a method for solving the computational problems. Ant of some species moves randomly in the natural world and as soon as they find the food return to their colony with lying down pheromone trails. Other ants do not keep travelling at random when they find such a path and follow the trail, returning and reinforcing it if they eventually find food. However, with the time, the pheromone trail reducing its attractive strength and start to evaporate. The more the time the pheromones trail will have to evaporate, more time it takes for an ant to travel down the path and back again. A shorter path gets marched more frequently than that of longer one and thus shorter path have higher pheromone density than the longer ones. In [16] backward ants and forward ants are defined and the ant selects a path according to the actual energy level of nodes and the distance travelled by the forward ant , an energy efficient ant based routing algorithm was presented in it . In [17], the ant selects a path according to the total numbers of the nodes visited by the ant and the energy level of the nodes, a dynamic and the reliable routing protocol was proposed in it. In [18] the distance to the sink and the energy consumption of the path are used to choose the path by the ant. To reduce the energy consumption, an ant colony optimization routing algorithm was introduced in [18]. In [19], the next neighbor node of the routing is select according to the residual energy of the node the distance to the sink and the path of the average energy. Energy-aware ant colony algorithm was proposed to extent the network lifetime in [19]. In [20] the energy efficiency and the energy balancing have been simply considered for longevity maximization of wireless sensor network, an ant colony optimization based transmission scheme was presented in it.

3. ANALYSIS OF PROBLEM

However, the above mentioned strategies have some limitations, which are explain as follows:

- Single-hop communication having long transmission distance causes heavy energy consumption while in the case of multi-hop transmission; there is too much traffic load around the sink due to the multi-hop with the fix transmission distance. Because of the above two mentioned reasons, the single-hop transmission and multi-hop communication with fixed transmission distance would certainly result in low energy efficiency and poor energy balancing respectively further the hybrid transmission strategy having the part of the multi-hop and the single-hop is also no much better.
- Some passive methods which consider residual energy of the nodes are the energy balanced approach which is far away from the network longevity maximization. According to us the network longevity can significantly improved by the proactive methods with the both high energy efficiency and the good energy balancing.
- The importance of the relationship between the transmission distance and node location has not been sufficiently considered in the current ant colony optimization based transmission methods. The energy efficiency and the energy balancing have a significant impact on the relationship between the transmission distance and the node location.
- The single-hop transmission in which there is a long distance between the sensor and the sink is far from the high energy efficiency and this is because the transmission power is proportional to square of the transmission distance.
- No enough load balancing measures have been taken in the multi-hop transmission strategy and the energy–aware ant colony algorithm. There is more traffic load close to the sink and thus the energy consumption of these two transmission strategies slowly drop down with increase of the distance to sink.
- For the nodes near to the sink due to the less transmission distance needs less energy depletion due to single-hop transmission. While in the case of the multi-hop transmission having the nodes near to sink, it suffers from the larger traffic to be delivered .On the other hand for the nodes far away from the sink, the single-hop is subjected to the larger energy consumption because of longer transmission distance while multi-hop has less traffic to be forwarded.

In our paper, we take proactive measure to resolve such problems and investigate the problem of network longevity maximization.

4. PROPOSED WORK

We present performance improvisation for longevity maximization of wireless sensor network to achieve our goal on the basis of the ant colony optimization.

- For both the high energy efficiency and the good energy balancing in wireless sensor networks , we present a 'local optimal transmission distance acquirement scheme' by introducing the two concepts 'most energy efficient distance and 'most energy balancing distance' and these schemes contributes to the network longevity maximization.
- To achieve the energy depletion minimization for the nodes with maximal energy consumption throughout a network, we propose a 'global optimal transmission distance acquirement scheme' by designing a network longevity maximization approach. This scheme further helps to extend the network longevity.

4.1. *The proposed transmission strategy*

As shown in the fig.1, we consider a wireless sensor network where nodes are evenly deployed on a disk with a radius R centered at the sink. M disjoint concentric coronas divide this disk. An arbitrary wedge subtended by an angle Θ is also considered. This is partitioned into M sectors, which are denoted as Ω_1 , Ω_2 ,....... Ω_M by its intersection with M concentric coronas. Suppose each node generate the particular bits of data per second and having the initial uniform energy. This type of sector division can be called as a clustering technique which has some advantages such as more robustness and more scalability [21], [22]. Such a sector division can also be regarded as an effective method of achieving the load balancing with non-uniform clustering manner and this is because of different sizes of sector distribution.

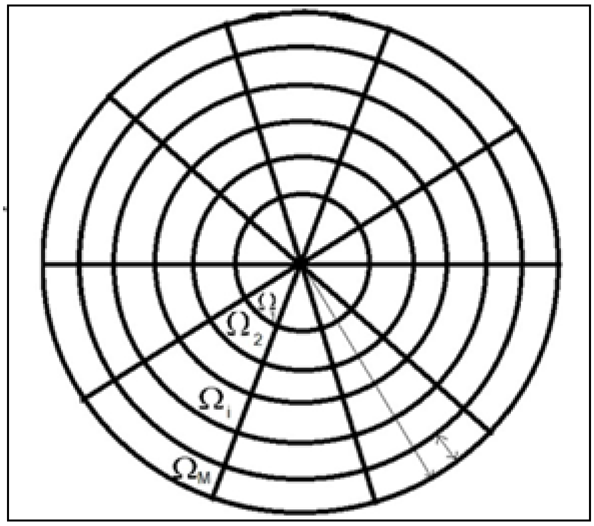

Fig.1. Network model

To seek an optimal transmission distance for nodes of each sector is our goal. There is an ant on the every sector initially; here the search is performed by the ant colony optimization. As shown in the fig.2, according to the specific probability, every ant moves from a sector to another towards the sink.

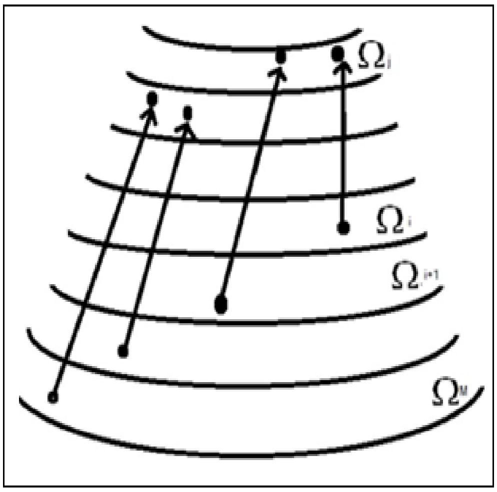

Fig.2. the moving mode

In order of the largest to the smallest number of the sector, these ants move one after another. Generally, every ant moves after the ant of the adjacent outer sector has completed its trip, the ant on the most outer sector moves firstly. When any ant moves only one hop, it has finished its full work. A corresponding path is created by an ant when it moves from Ω_i to sector Ω_j towards the sink and whose distance is'd'. 'd' is the transmission distance of the nodes in sector Ω_i , path is transmission route of this sector. Thus, the routing abstraction is the moving of ant. The solution that is the transmission distance of the nodes for all sectors have been obtained when all the ants completed their task of moving. The best solution is updated and reserved after several iterations. The sector Ω_i is named a direct source sector of Ω_j , if an ant moves from sector Ω_i to sector Ω_j towards the sink. Both sector Ω_i and sector Ω_{i+1} are the direct source sectors of the sector Ω_j as both of the ants of the sector Ω_i and sector Ω_{i+1} moves to sector Ω_j as shown is fig.2. Owing to the in-order moving, the ant on the sector Ω_i must has visited all the direct source sectors of the sector Ω_i when it wants to choose the candidate sector Ω_j and must be informed about the total amount of its received data. When any ant starts to move, the ant must be aware of the total volume of the data required to be delivered by sector and all the ants in its outer sector have finished their trips. Thus, great convenience for data calculation can bring by this moving manner.

5. RELATED CONCEPTS;

5.1. *The most energy efficient distance and the most energy balancing distance*

In multi-hop transmission manner, to minimize the total energy usage along the transmission path, an optimal transmission distance at each hop has been found in [25]. Intervening relay nodes divides the D into X hops and this distance D is the data link between a data transmitter and a receiver .It is proved that for the number of the hops X and the given distance D, the total energy usage along the path can be obtain the minimum when the each hop shares the equal d=D/X transmission distance'd'. Thus the distance'd' is called as most energy balancing distance, if nodes in the every sector consume equal amount of energy. To search for the optimal solutions, ant colony optimization utilizes the transition probability. Domain knowledge and search experiences these are the two important factor which are used to accelerate the search process in this algorithm. Domain knowledge is expressed by the heuristic information and search experiences are expressed by the pheromone intensity.

5.2. *Local optimum transmission distance acquirement scheme based on the high energy efficient distance and the good energy balancing*

The heuristic desirability and the pheromone intensity are related to a few considerations, including the transmission range and the data volume, etc. in the optimal distance based transmission strategy. It is simple to know that, the better effect of high energy efficiency is obtained when the transmission distance is closer to most energy efficient distance. Similarly, the stronger ability of good energy balancing is obtained when the transmission distance is closer to the most energy balancing distance. The heuristic value of the path is larger when'd' is nearer to d_{MEED}. Likewise, the heuristic value of the path is larger when'd' is nearer to d_{MEBD}. Hence, to select the path that can obtain both good energy balancing and high energy efficiency, the definition of heuristic value in our transmission strategy guides the ant. Thus, the degrees of good energy balancing and high energy efficiency are distinctly reflected in the definition of heuristic value which generally contributes to the network longevity maximization. This concept is known as local optimal distance acquirement scheme as in the ant colony optimization the heuristic factor is local value of any path. This scheme contributes to obtain network longevity maximization.

5.3. *Global optimum transmission distance acquirement scheme based on the network longevity maximization*

It is known that the network longevity is maximum when the maximal per node average energy consumption is smaller. The pheromone intensity on every path is updated after all ants finish their trips in our transmission strategy. So, to select an efficient path with minimal value of the maximal per node average energy consumption of different sectors, such pheromone updating rule can guide ants and according obtain network longevity maximization. This approach is named global optimal transmission distance acquirement scheme and this is because the pheromone updating is a global process in ant colony optimization. This scheme further gives the realization of network longevity maximization.

6. CONCLUSION

In this paper, the problem of network longevity maximization in the wireless sensor networks is investigated, and on the basis of the ant colony optimization an optimal-distance based transmission strategy is proposed. In this transmission strategy Some proactive measures have been taken , in which an optimal transmission-distance acquirement mechanism is designed for both good energy balancing and high energy efficiency, and another optimal transmission-distance acquirement scheme is given to obtain energy depletion minimization for nodes with maximal energy consumption along the network. Furthermore, in order to validate the effectiveness and superiority of our findings, simulations are used.

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