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Consolidate Data Collecting Based On Even Clustering For Wireless Sensor Networks

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Abstract— Consolidate data gathering (CDG) based on compressed sensing (CS) theory for wireless sensor networks (WSNs) greatly reduces the amount of data transmitted compared with the traditional acquisition method that each node forwards the aggregate data directly to the next node. The method of inconstantly selecting projection nodes as cluster heads to collect the weighted sum of sensor nodes outperforms the non-CS (without using CS) and hybrid-CS (applying CS only to relay nodes that are overloaded) schemes in decreasing the transmission cost and distributing the energy consumption loads. However, the irregular selection of projection nodes causes the overall energy consumption of the network to be unstable and unbalanced. In this paper, we offer two compressive data gathering methods of balanced projection nodes. For WSN with constant distribution of nodes, an even clustering method based on spatial locations is proposed to distribute the projection nodes evenly and balance the network energy consumption. For WSN with unsteadily distributed nodes, an even clustering method based on node density is proposed, taking into account the location and density of nodes together, balancing the network energy and prolonging the network lifetime.

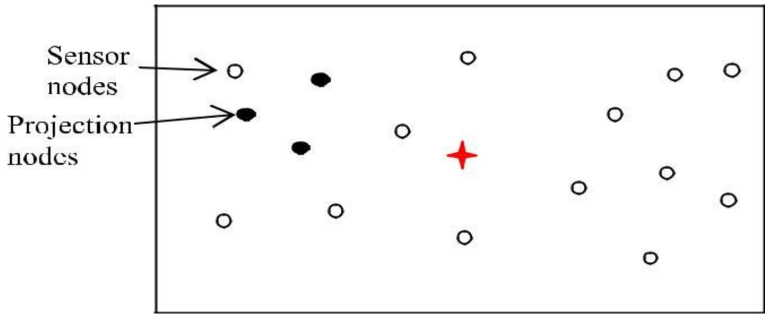
Keywords— compressive data gathering (CDG), even clustering, random projection, sensor node, wireless sensor networks (WSN).

I. INTRODUCTION

The goal for wireless sensor networks (WSN) is to collect data. The sensor nodes have limited resources and the sink node has strong performance, which is suitable for the simple coding and complex decoding of compressed sensing theory. The sensor nodes have limited resources and the sink node has strong performance, which is suitable for the simple coding. This document is a template. An electronic copy can be compute from the conference website. For questions on paper guidance, please contact the conference publications committee as indicated on the conference website. Information about end paper submission is available from the conference website and complex decoding of compressed sensing theory. Each row of entries of the M N dimension measurement matrix 8 are projected on N sensor nodes. Each node multiplies the projection coefficient by the locally collected data and passes it to the next node. In this way, each node calculates and transmits a weighted sum along the route. Eventually, the weighted sum of all nodes is transmitted to the sink node, thus the sink gets a measured value. After each node transfers M times, the sink can get M measurements. There are different ways to choose M projection nodes: one is random selection, such as the scheme in [1]. In N net-work nodes, M projection nodes are randomly selected with probability M/N. This method allows each node to rotator projection, the load will be evenly distributed on the network. However, there is no guarantee that an ideal projection node of a suitable location, high energy and accurate quantity will be selected. Another is condition selection, according to certain conditions choose a satisfactory projection node to meet the requirements of balance and high efficiency. The rst major problem of this scheme is that the selection of projection nodes is random. Because of its randomness, the selected projection node has no advantages at all. It is easy to face the situation that the distribution of the projection node is not ideal, it is far away from the sink node, or the node's remaining energy will quickly be depleted Further-more, there is also no guarantee that M projection nodes will be exactly chosen because each node has a M/N probability selected. Therefore, it is possible to randomly choose a little more or less nodes. Second, since the locations of non-zero co- efficients in each row of the measurement matrix are also random, a group of nodes with different distances will transmit the weighted sum to the projection nodes with indent positions.

II. RELATED RESEARCH

This section introduces the related work of compressive data gathering (CDG) and the basic theory of compressed sensing (CS). In this paper is a random number generated by network address and seed value. Its formation is complicated, which increases the amount of storage and computation. And k measurements generated by each sensor are sent directly to the cluster head or the sink node, thus increasing the storage capacity of the cluster head or the sink node.



Uneven distribution of projection nodes

Random walk (RW) has been effectively used for data collection in wireless sensor networks. It does not require global information as the shortest path route, in addition, it enables network load balancing. These papers show the effective implementation of compressed data collection for WSN and some methods of reducing network energy consumption, and illustrate that the application of sparse random projection together with routing structure can greatly reduce the amount of data transmitted. In view of the above problems, according to whether the distribution of WSN nodes is even, we proposes two compressive data gathering methods of even projection nodes. Aiming at WSN with uniform distribution of nodes, we propose an even clustering method based on spatial location. In order to make the projection nodes evenly distributed, the grids are uniformly divided in the monitoring area. Each grid selects the projection nodes according to the energy and the distance to ensure the uniform distribution of the projection nodes. Aim in WSN with uneven distribution of nodes, an even clustering method based on the distribution density of nodes is proposed in this paper. As the nodes in some places are dense, while the nodes in some places are scarce, if the projection nodes are selected by location only, the equalization of the projection cannot be guaranteed. Therefore, the spatial location and the node density are considered together to select the projection nodes, which ensures the balanced distribution of projection nodes. The validity of the proposed method is verified by comparison with the method of random projection nodes and the method of random walk.

A. *Basic Principles Of Even Projection Method*

Select the rst round of projection nodes and clustering: Determine the number of clusters. Divide the entire monitoring area into the same size of grids and calculate the number of clusters. In each cluster, select the higher energy nodes around the cluster center as projection nodes.

Send the information of the projection node to each cluster's projection node. Each sensor node chooses its corresponding projection node based on the shortest distance (least hop). After a round of clusters is established, the data can be collected. The data in the cluster is transmitted to the intra-cluster projection node via the route. The data collected by the projection nodes of all the clusters are transmitted to the sink, and then the collected data are added up correspondingly, that is, all the measurement values. Then the original data can be recovered through reconstruction.

III. EVEN CLUSTERING METHOD BASED ON SPATIAL LOCATION

The network with uniform density distribution of nodes, an even clustering method based on spatial location is proposed. In order to uniformly distribute the projection nodes, the monitoring area is divided into grids of equal size, and the node with the best performance is selected as the projection node in each grid. Then the projection node collects the weighted sum of the cluster and sends it to sink.

The implementation process is as follows:

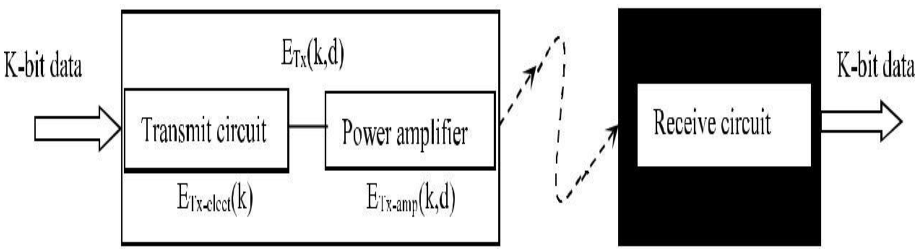
Select the rst round of projection nodes and clustering:

(1) Determine the number of clusters.

(2) Divide the entire monitoring area into the same size of grids and calculate the number of clusters.

(3) In each cluster, select the higher energy nodes around the cluster center as projection nodes.

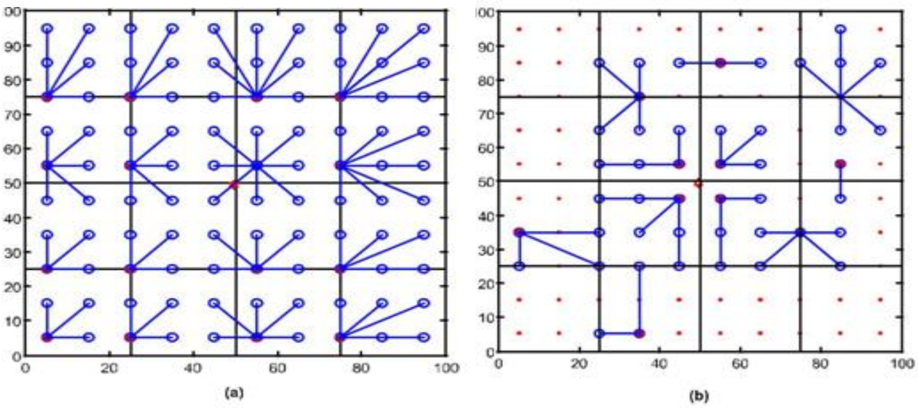
(4) Send the information of the projection node to each cluster's projection node.



Each sensor node chooses its corresponding projection node based on the shortest distance (least hop). After a round of clusters is established, the data can be collected. The data in the cluster is transmitted to the intra-cluster projection node via the route.

B. *Determine The Number Of Cluster head*

The rst factor to be considered in the design of routing algorithms for networks is the energy problem; the design of routing algorithms is closely related to the channel energy loss model in WSN. Fig.3 is a simplified network channel loss model. For transmitting or receiving a *k* bit message data to a distance of d, the radio dissipates energy as following, respectively. Where *k* is the number of bits of information per data, E_{elect} is the energy consumed per bit of data in the transmit or receive circuit. E_{fs} and E_{mp} are the energy dissipation values to run the amplifier for close and far distances. Depending on the distance between the transmitter and the receiver, free space (E_{fs}) or multi-path fading (E_{mp}) channel models is used, and d_0 is the critical value between the two models. Suppose there are N sensor nodes randomly distributed in an area with radius R, where the number of the cluster heads is h, then the average coverage area of cluster head nodes.

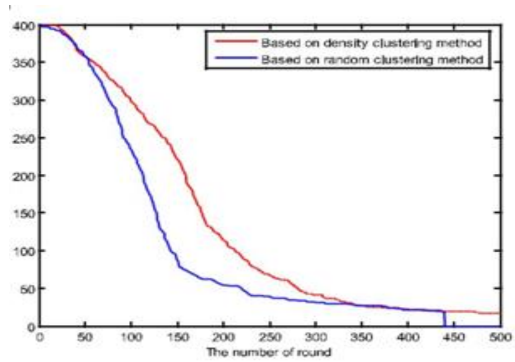


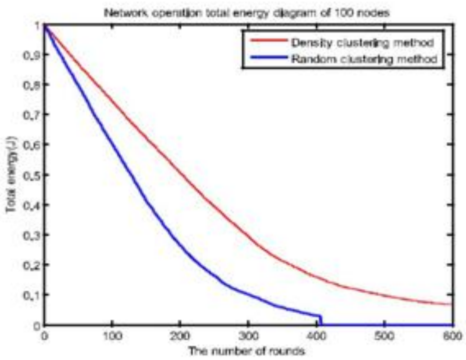
IV. SIMULATION RESEARCH

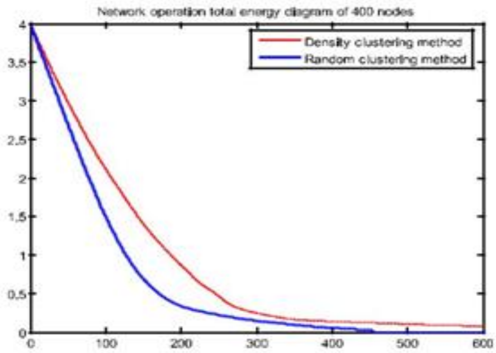
In the simulation experiment, we make the following assumptions about WSN and sensor nodes: The sink node location xed the sensor nodes are static, not mobility The sensor nodes can know its own location information The cluster head fusing unit data has the same energy consumption The unit area of the network needs to detect the same amount of data The coverage area of each node is the same Wireless channel symmetry. The network based on location clustering has still survived nearly 40% of nodes this moment and the network can still run. Supposed the remaining nodes number is 20, which is taken as the critical value for the normal operation of the network. This is to say that when the network nodes number is below 20, the network cannot be connected. As a result, the network based on location clustering extends the lifetime of network by about 35% compared with that based on random projection nodes.

V. ANALYSIS OF NETWORK ENERGY CONSUMPTION

The energy consumption of the network is related to the size of the monitoring area, the number of configured nodes, the number of clusters, the threshold of density of density-based even clustering, and the compression ratio of compressed data collection. In some grids, above parameters are separately studied using the density-based even clustering method (DEC) proposed in this paper, and compared with the random clustering method (RC) through simulation.







E. Even Clustering Based On Node Distribution

The number of nodes is slightly larger. After these nodes form a cluster, they can perform the data transmission functions between nodes and nodes, nodes and the cluster head the cluster heads and the sink well. It is also possible to allocate some nodes that collect the same kind of information into sleeping mode, saving the energy consumption

VI. COMPRESSIVE DATA GATHERING BASED ON EVEN CLUSTERING

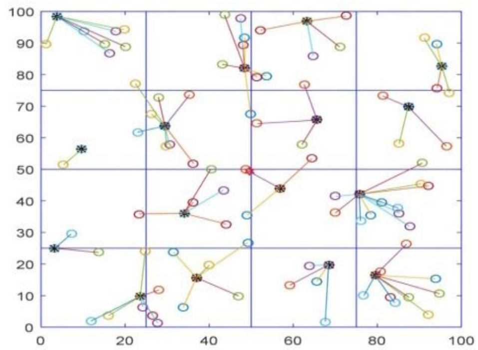
(1) The network parameters, determine the number of grids.

(2) Even selection of projection nodes. For the WSN with uniform distribution of nodes, an even clustering method based on spatial locations is used. The WSN with uneven distribution of nodes adopt even clustering based on distribution density of nodes, thus the projection nodes are evenly distributed with more energy. The projection nodes are equivalent to the cluster head.

(3) Establishment and rotation of the cluster. After a projection node is selected for the rst time, a cluster centered on the projection node can be established, and the rotation and rules of the next cluster can be determined.

(4) Construction of projection matrix. The sensor nodes that need to transmit data in each round of transmission are determined by the measurement matrix in terms of CS theory. Therefore, the structure of the measurement matrix deter-mines the number of sensing nodes, the transmission distance. Routing mechanism of transmission node. The sensor node's transmission path, that is, the routing mechanism, is the key to the energy consumption and efficiency of the entire network transmission.

Clustered schematic of compressive data gathering based on even clustering.



VII. CONCLUSIONS

For the problems of random selection and unbalanced position of projection nodes, this paper proposes a compressed data gathering method based on even projection. For the WSN with uniformly distributed nodes, a location-based even clustering method is proposed. The clustering is implemented with the same size of the grids, which ensures the positional balance of the projected nodes. For the WSN with uneven distributed nodes, a node density-based even clustering method is proposed. . In the next step, we will consider the application of artificial intelligence to further optimize the routing topology of the network and make more in-depth research on signal reconstruction to obtain better compressed data collection results.

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