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Optimized Selection Of Dynamic Cluster Heads Using Redundant Node Active Algorithm

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Abstract: ***A wireless sensor network (WSN) consists of spatially disributed autonomous sensors that cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion, or pollutants, at different locations. Although the recent advances are intended to maximize node coverage, minimize coverage overlap and gap, and deploy nodes uniformly, they do not maintain the longer survival time of the network at the same time. In summary, this algorithm can deploy sensors to cover the maximum working area with the longest survival time of the network. Optimized selection of dynamic cluster heads using RNA (Redundant Node Active) algorithm is put forward in order to solve the problem of unreasonable cluster head selection. The algorithm overcomes disproportion of the energy consumption, improves the lifetime of the wireless sensor network.***

Keywords: ***Wireless Sensor Networks, Network life time, RNA, Energy Consumption***

I. INTRODUCTION

Wireless sensor network (WSN) is generally composed of hundreds and thousands of distributed mobile sensor nodes, with each node having limited and similar communication, computing, and sensing capabilities. Such sensor networks have many special characteristics. The resource-limited sensor nodes are usually thrown into an unknown environment without a preconfigured infrastructure. Before monitoring the environment, sensor nodes must be able to deploy themselves to the working area. At the same time, the sensor nodes organize themselves into a network. Although sensor nodes are designed with low energy consumption in mind, they can survive for only a very limited lifetime with current technologies. Furthermore, the constraints of the sensor node energy determine that the survival time of the sensor is limited, and the entire network cannot meet the monitoring demand if some nodes cannot work efficiently. Note that the energy consumption of the network can be effectively reduced while the sensor nodes are organized in the form of clusters.

The need for energy-efficient infrastructures for sensor networks is becoming increasingly important. Wireless sensor networks are networks consisting of many sensor nodes that communicate over a wireless media. A sensor node is equipped with a sensor module, a processor, a radio module and a battery. Since the battery limits the lifetime of the sensor nodes it also limits the lifetime of the sensor network, thus energy efficiency is a major issue for sensor networks. An important goal in many sensor networks is to monitor an area as long time as possible.

Hence, it is important to distribute energy consumption evenly across the network. When the energy consumption is evenly distributed, the major part of the sensor nodes will stay alive approximately equally long time. This enables continued information gathering throughout the whole network area during the lifetime of the network. The most power-consuming activity of a sensor node is typically radio communication. Hence, radio communication must be kept to an absolute minimum. This means that the amount of network traffic should be minimized. In order to reduce the amount of traffic in the network, we build clusters of sensor nodes as in the proposed System. Some sensor nodes become cluster heads and collect all traffic from their respective cluster. The cluster head aggregates the collected data and then sends it to its base station. When using clustering, the workload on the cluster head is thus larger than for non-cluster heads. The cluster heads should therefore be changed several times during the lifetime of the sensor network in order to distribute the extra workload and energy consumption evenly.

II. RELATED WORK

LEACH (Low-Energy Adaptive Clustering Hierarchy) [3] is a TDMA cluster based approach where a node elects itself to be cluster head by some probability and broadcasts an advertisement message to all the other nodes in the network. A non cluster head node selects a cluster head to join based on the received signal strength. Being cluster head is more energy consuming than to be a non cluster head node, since the cluster head needs to receive data from all cluster members in its cluster and then send the data to the base station. All nodes in the network have the potential to be cluster head during some periods of time. The TDMA scheme starts every round with a set-up phase to organize the clusters. After the set-up phase, the system is in a steady-state phase for a certain amount of time. The steady-state phases consist of several cycles where all nodes have their transmission slots periodically. The nodes send their data to the cluster head that aggregates the data and send it to its base station at the end of each cycle. After a certain amount of time, the TDMA round ends and the network re-enters the set-up phase. LEACH-C (LEACH-Centralized) [2] is a variant of LEACH that uses a centralized cluster formation algorithm to form clusters. The protocol uses the same steady-state protocol as LEACH. During the set-up phase, the base station receives information from each node about their current location and energy level. After that, the base station runs the centralized cluster formation algorithm to determine cluster heads and clusters for that round.

LEACH-C uses simulated annealing [4] to search for near-optimal clusters. LEACH-C chooses cluster heads randomly but the base station makes sure that only nodes with “enough” energy are participating in the cluster head selection. Once the clusters are created, the base station broadcasts the information to all the nodes in the network. Each of the nodes, except the cluster head, determines its local TDMA slot, used for data transmission, before it goes to sleep until it is time to transmit data to its cluster head, i.e., until the arrival of the next slot.

A further development is LEACH-F (LEACH with Fixed clusters) [2]. LEACH-F is based on clusters that are formed once - and then fixed. Then, the cluster head position rotates among the nodes within the cluster. The advantage with this is that, once the clusters are formed, there is no set-up overhead at the beginning of each round. To decide clusters, LEACH-F uses the same centralized cluster formation algorithm as LEACH-C. The fixed clusters in LEACH-F do not allow new nodes to be added to the system and do not adjust their behavior based on nodes dying.

III. ARCHITECTURE

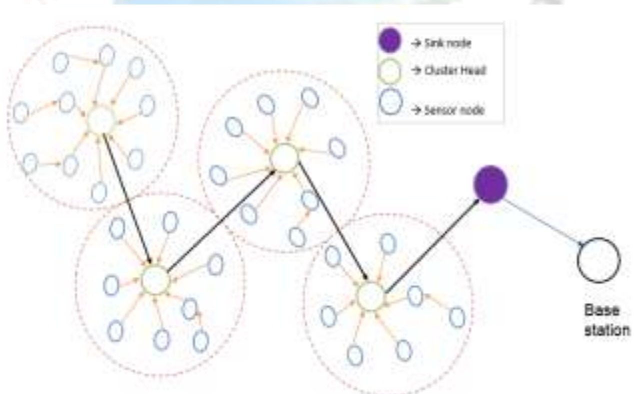

Fig. 1: Sensor Network Architecture

The sensor nodes are deployed in an inaccesible area.The clusters are formed according to the number of nodes deployed

And the cluster heads are selected according to the RNA algorithm.All the nodes send the information to the cluster head which passes it along to the sink node.If the sink node is too far away it passes it along to the adjacent cluster head.

Redundant Node Active Algorithm

Forming the clusters based on node density. Calculate the distance for each node and find the most redundant node in the cluster. Make the redundant node as the cluster head.In the second stage of cluster head formation the cluster is selected based on the residual energy of the nodes.The node having highest residual energy is selected as the cluster head.

Distance formulae

$$d = ((x2-x1)^2 + (y2-y1)^2)^{1/2}$$

Residual Energy = Total energy – operating energy

Operating energy = SE + TE + RE

SE = Sensing energy

TE = Transmission energy

RE = Receving energy

IV. NODE ARCHITECTURE

Sensor network nodes typically consist of six components: processor, sensor, local storage, transceiver and power supply

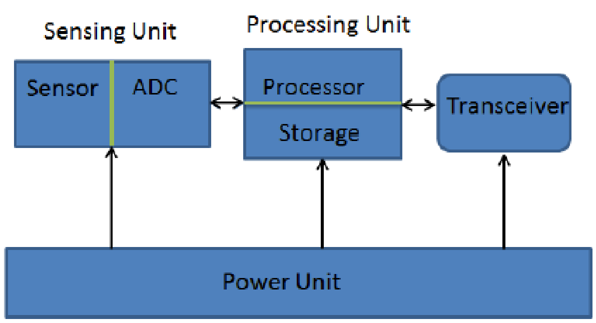

Fig. 2: Sensor Node Architecture

4.1 *Processor*

The processor performs tasks, processes data and controls the functionality of other components in the sensor node. Some other alternatives that can be used as a processor are: a general purpose microcontroller, digital signal processors and FPGAs (field-programmable gate array). A processor is often used in many WSNs such as sensor nodes because of its low cost, flexibility to connect to other devices, ease of programming, and low power consumption.

4.2 *Storage*

Depending on the overall sensor network structure, the requirements for storage in terms of fast and nonvolatile memory at each node can be sharply different. For example, if one follows the architecture model where all information is instantaneously sent to the central node, there is very little need for local storage on individual nodes. However, in a more likely scenario, where the goal is to minimize the amount of communication and conduct significant part of computation at each individual node, there will be significant requirement for local storage.

4.3 *Power Supply*

There is a wide consensus that energy will be one of the main technological constraints for SN nodes. For example, the current generation of smart badges and Motes enable continuous operations for only a few hours. There are at least two conceptually different ways that energy supply can be addressed. The first is to equip each sensor node with a (rechargeable) source of energy

4.4 *Sensor*

The importance of sensors cannot be overstated. The purpose of sensor network nodes are neither computing, nor communicating, but rather sensing. The sensing component of SN nodes is the current technology bottleneck. The sensing technologies currently are not progressing as fast as semiconductors.

4.5 *Transceiver*

Short range radios are exceptionally important as the communication components because the energy dedicated to sending and receiving messages usually dominates the overall energy budget. During the design and the selection of transceiver, one has to consider at least three different abstraction layers: physical, media access control (MAC), and network

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V. PROPOSED SYSTEM

In this Proposed System there are 5 different modules which are:

5.1 Node Creation and Node Configuration

5.2 Cluster Formation

5.3 Selection of Active Nodes

5.4 Selection of Cluster Heads

5.5 Performance Evaluation

5.1 *Node Creation and Node Configuration*

Node creation is nothing but the creation of the wireless nodes in the network scenario that is decided. Node configuration essentially consists of defining the different node characteristics before creating them. They may consist of the type of addressing structure used in the simulation, defining the network components for mobile nodes, turning on or off the trace options at Agent/Router/MAC levels, selecting the type of ad-hoc routing protocol for wireless nodes or defining their energy model. Simulator::node-config accommodates flexible and modular construction of different node definitions within the same base Node class. For instance, to create a mobile node capable of wireless communication, one no longer needs a specialized node creation command.

5.2 *Cluster Formation*

Sensor nodes in the monitoring area are generally and randomly distributed, which may lead to existing the overlapping sensing field. Firstly, make part of the nodes active and the other nodes asleep in the initialization phase of the clustering network, then the node coverage model is proposed based on Voronoi diagram. This process mainly includes mesh generation, the selection of active nodes and the generation of Voronoi diagram. The monitoring area can be divided to the regular polygon mesh, and the regular hexagonal mesh is used in this paper. For the same monitoring area, the network divided with regular hexagonal mesh requires the minimum number of nodes but covers the largest area, which makes the amount of the forwarded data in the network the least. Therefore, the total energy consumption of the network is the least.

5.3 *Selection of Active Nodes*

The monitoring area could be divided into some hexagonal grid. Sensing field of the node can be completely covered by other nodes in each grid. And these are the ones taken as the active nodes and the remaining nodes enter into sleep. With the characteristics of the Voronoi diagram known, the distance between the remaining nodes and the active node in the Voronoi polygon is minimum, therefore, these nodes in the monitoring area form an active node centered cluster according to their different Voronoi polygons. Hexagonal mesh ensures the equal distribution of active nodes, so the size of the Voronoi polygons is similar. Nodes can choose to join a certain cluster to reduce the data transmission, distance according to the location of the Voronoi polygons, along with the energy consumption.

5.4 *Selection of Cluster Heads*

At the beginning, the cluster head is selected based on the most redundant node in the cluster and the most redundant node in the cluster is selected by calculating the distance from each node and finding the neighboring nodes of each node in the cluster. The most repeating neighboring node for each node in cluster is selected as the cluster head of that cluster. Sending and receiving message are the highest energy consuming processes, and the relationship between the energy and the communication distance After the first class of the cluster head node died, a new class of cluster head nodes are selected from the remaining nodes based on the ratio of their energy and the residual energy of the network, and all nodes in the cluster should take turns to become the cluster head. Obviously, the node with higher residual energy has a greater opportunity to become a cluster head node, which not only adapts to the changes in energy, but also prolongs the network lifetime.

5.5 *Performance Evaluation*

During simulation time the events are traced by using the trace files. The performance of the network is evaluated by executing the trace files. The events are recorded into trace files while executing record procedure. In this procedure, we trace the events like packet received, Packets lost, Last packet received time etc. These trace values are write into the trace files. This procedure is recursively called for every 0.05 ms. so, trace values recorded for every 0.05 ms.

Fig.3: Performance Evaluation Graph Of The Proposed System

As seen in figure 3,The packets received in the proposed system is significantly more than the existing system.

VI. CONCLUSION AND FUTURE WORK

Optimized selection of Dynamic cluster heads using redundant node algorithm is proposed in this paper by analyzing the sensor network energy consumption based on the redundant nodes and energy heterogeneity. The experiment analysis are carried on from four aspects, including coverage, life cycle, the active nodes and the average residual energy. The method proposed in this paper overcomes the disproportion of the energy consumption, improves the information redundancy in the process of transmission , reduces energy consumption and extends the life time of the network. The extension of this work would be a further discussion of the redivision of the monitoring area after the death of all the redundant nodes under the same coverage area, also we should do more work to extend the time of the first period and to prolong the lifetime of networks consist of mobile nodes.

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