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A SURVEY ON ENERGY EFFICIENT DATA GATHERING WITH LOAD BALANCING

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ABSTRACT: The framework employs distributed load balanced clustering and dual data uploading, which is referred to as LBC-DDU. The objective is to achieve good scalability, long network lifetime and low data collection latency. At the sensor layer, a distributed Load Balanced Clustering (LBC) algorithm is proposed for sensors to self-organize themselves into clusters. In contrast to existing clustering methods, our scheme generates multiple cluster heads in each cluster to balance the work load and facilitate dual data uploading. At the cluster head layer, the inter-cluster transmission range is carefully chosen to guarantee the connectivity among the clusters. Multiple cluster heads within a cluster cooperate with each other to perform energy-saving inter-cluster communications. Through inter-cluster transmissions, cluster head information is forwarded to Base station for its moving trajectory planning. At the mobile collector layer, Base station is equipped with two antennas, which enables two cluster heads to simultaneously upload data to Base station in each time by utilizing Multi-user Multiple-Input and Multiple-Output (MU-MIMO) technique.

Keywords: [ENERGY EFFICIENT DATA GATHERING, LOAD BALANCING MOBILE AD HOC NETWORKS]

1. INTRODUCTION

The proliferation of the implementation for low-cost, low-power, multifunctional sensors has made wireless sensor networks (WSNs) a prominent data collection paradigm for extracting local measures of interests. In such applications, sensors are generally densely deployed and randomly scattered over a sensing field and left unattended after being deployed, which make it difficult to recharge or replace their batteries. After sensors form into autonomous Organizations, those sensors near the data sink typically deplete their batteries much faster than others due to more relaying traffic. When sensors around the data sink deplete their energy, network connectivity and coverage may not be guaranteed. Due to these constraints, it is crucial to design an energy-efficient data collection scheme that consumes energy uniformly across the sensing field to achieve long network lifetime. Furthermore, as sensing data in some applications are time-sensitive, data collection may be required to be performed within a specified time frame. Therefore, an efficient, large-scale data collection scheme should aim at good scalability, long network lifetime and low data latency. Although these works provide effective solutions to data collection in WSNs, their inefficiencies have been noticed. Specifically, in relay routing schemes, minimizing energy consumption on the forwarding path does not necessarily prolong network lifetime, since some critical sensors on the path may run out of energy faster than others. In cluster-based schemes, cluster heads will inevitably consume much more energy than other sensors due to handling intra-cluster aggregation and inter-cluster data forwarding. Though using mobile collectors may alleviate non-uniform energy consumption, it may result in unsatisfactory data collection latency. Based on these observations, in this paper, we propose a three-layer mobile data collection framework, named Load Balanced Clustering and Dual Data Uploading (LBC-DDU). The main motivation is to utilize distributed clustering for scalability, to employ mobility for energy saving and uniform energy consumption, and to exploit Multi-User Multiple-Input and Multiple-Output (MU-MIMO) technique for concurrent data uploading to shorten latency.

1.1 MOBILE AD HOC NETWORKS

As the wireless network technology exploded, it has opened a new view to users and expanded the information and application sharing very conveniently and fast. Mobile ad hoc networks (MANETs) use wireless technology without a pre-existing infrastructure (access points). As the name states, MANETs consists of mobile nodes, which can vary from notebooks, PDAs to any electronic device that has the wireless RF transceiver and message handling capability. Mobility and no-infrastructure forms the basis of this network type. Mobility gives maximum freedom to users, as they can be connected to the network, whether they are fixed or moving, unless they are in the range of the network. Also, it is highly dynamic, as the new nodes come, they can be connected to the network very easily. Unlike the fixed networks or traditional wireless networks, MANETs don't need any infrastructure to create and maintain communication between nodes. This property provides the ability to create a network in very unexpected and urgent situations very quickly, also without any extra cost.

1.2 STRUCTURE OF AD HOC NETWORKS

As we said any electronic device that has the wireless transmission capability with proper processing hardware can be a part of a MANET. So, firstly the nodes have to have RF wireless transceivers as the network interface. But since the wireless transmission ranges according to transmission type of the antenna (omnidirectional, bidirectional), and the variations between transceivers at different nodes effect the network structure of the MANETs. However, members of the MANETs can be fixed without any constraint, they consist of mobile nodes. So, their processing capability is limited. Also, power consumption of the mobile nodes is a very great factor on the structure of the MANETs. So, to make MANETs applicable and get maximum performance from them, we have to consider these two factors, and design any algorithms appropriately. MANETs are autonomous and decentralized networks. So, they can operate no matter which nodes are connected or not connected to the network. Connectivity of nodes only affects the topology and routing of the network, not the general operations. Since, MANETs don't have any centralization; operations are done distributed, so each node has to have sufficient information about the network and have to operate independently. Two nodes that want to communicate with each other can send and receive messages directly, if they are both in their transmission range. Otherwise, every node is also capable to be a router, and the messages between nodes are relayed by the intermediate nodes, from the originator of the message to the destination. Since the nodes are mobile and the members of the network changes without any notice, the network structure is very dynamic. So, the route the messages are sent by, are dynamic also. Routing is a very vital and performance critic issue for ad hoc networks. So, we are going to handle that procedure in deep.

2. BACKGROUND OF THE STUDY

The concept of sensor networks which has been made viable by the convergence of micro-electro-mechanical systems technology has been studied, wireless communications and digital electronics. First, the sensing tasks and the potential sensor networks applications are explored, and a review of factors influencing the design of sensor networks is provided. The number of sensor nodes in a sensor network can be several orders of magnitude higher than the nodes in an ad hoc network. Sensor nodes are densely deployed. Sensor nodes are prone to failures. The topology of a sensor network changes very frequently. Sensor nodes mainly use broadcast communication paradigm whereas most ad hoc networks are based on point-to-point communications. Sensor nodes are limited in power, computational capacities, and memory. Sensor nodes may not have global identification (ID) because of the large amount of overhead and large number of sensors.

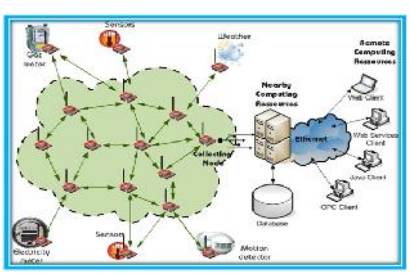

Figure 2- Wireless Sensor Networks

The flexibility, fault tolerance, high sensing fi-delity, low-cost and rapid deployment characteristics of sensor networks create many new and exciting application areas for remote sensing. In the future, this wide range of application areas will make sensor networks an integral part of our lives. However, realization of sensor networks needs to satisfy the constraints introduced by factors such as fault tolerance, scalability, cost, hardware, topology change, environment and power consumption. Since these constraints are highly stringent and specific for sensor networks, new wireless ad hoc networking techniques are required. Our aim is to provide a better understanding of the current research issues in this field. We also attempt an investigation into pertaining design constraints and outline the use of certain tools to meet the design objectives.

2.1.1 A Coordinated Data Collection Approach: Design, Evaluation, and Comparison

The problem of collecting a large amount of data from several different hosts to a single destination in a wide-area network is the major problem. This problem is important since improvements in data collection times in many applications such as wide-area upload applications, high-performance computing applications, and data mining applications are crucial to performance of those applications. Often, due to congestion conditions, the paths chosen by the network may have poor throughput. By choosing an alternate route at the application level, we may be able to obtain substantially faster completion time. This data collection problem is a nontrivial one because the issue is not only to avoid congested link(s), but to devise a coordinated transfer schedule which would afford maximum possible utilization of available network resources. Our approach for computing coordinated data collection schedules makes no assumptions about knowledge of the topology of the network or the capacity available on individual links of the network.

2.1.2 Relay node deployment strategies in heterogeneous wireless sensor networks

In a heterogeneous wireless sensor network (WSN), relay nodes (RNs) are adopted to relay data packets from sensor nodes (SNs) to the base station (BS). The deployment of the RNs can have a significant impact on connectivity and lifetime of a WSN system. This paper studies the effects of random deployment strategies. We first discuss the biased energy consumption rate problem associated with uniform random deployment. This problem leads to insufficient energy utilization and shortened network lifetime. To overcome this problem, we propose two new random deployment strategies, namely, the lifetime-oriented deployment and hybrid deployment. The former solely aims at balancing the energy consumption rates of RNs across the network, thus extending the system lifetime. ur performance evaluation. Both the single-hop and multihop models represent practical system scenarios.

2.1.3 Data gathering mechanism with local sink in geographic routing for WSN

Most existing geographic routing protocols on sensor networks concentrates on finding ways to guarantee data forwarding from the source to the destination, and not many protocols have been done on gathering and aggregating data of sources in a local and adjacent region. However, data generated from the sources in the region are often redundant and highly correlated. Accordingly, gathering and aggregating data from the region in the sensor networks is important and necessary to save the energy and wireless resources of sensor nodes. The local sink is a sensor node in the region, in which the sensor node is temporarily selected by a global sink for gathering and aggregating data from sources in the region and delivering the aggregated data to the global sink. We next design a Single Local Sink Model for determining optimal location of single local sink. Because the buffer size of a local sink is limited and the deadline of data is constrained, single local sink is capable of carrying out many sources in a large-scale local and adjacent region. Hence, we also extend the Single Local Sink Model to a Multiple Local Sinks Model. To address this issue, we first introduce the concept of a local sink in geographic routing. The Local sink is an entity which collects locally data in a local and adjacent region and delivers the aggregated data to a global sink. This local sink is one sensor node selected by the global sink, based on location information of general sensor nodes in the region. Because the buffer size of a local sink is limited and the deadline of data is constrained, a local sink is capable of carrying out many sources in a large-scale local and adjacent region. We next propose an efficient mechanism that gathers data in the region through the local sink and delivers the aggregated data to the global sink.

2.1.4 Constructing maximum- lifetime data-gathering forests in sensor networks

Energy efficiency is critical for wireless sensor networks. The data-gathering process must be carefully designed to conserve energy and extend network lifetime. For applications where each sensor continuously monitors the environment and periodically reports to a base station, a tree-based topology is often used to collect data from sensor nodes. In this work, we first study the construction of a data-gathering tree when there is a single base station in the network. The objective is to maximize the network lifetime, which is defined as the time until the first node depletes its energy.

3. PROBLEMS IN EXISTING SYSTEM

- Here we have limited wireless communication range. Therefore, limited communication range may pose a challenge for data collection from all sensor nodes.
- This algorithm is the worst clustering algorithm when node density is low.

- This algorithm has less energy consumption.
- Here we want to achieve High energy consumption. And more energy efficiency.

3.2 Proposed Approach

The framework employs distributed load balanced clustering and dual data uploading, which is referred to as LBC-DDU. The objective is to achieve good scalability, long network lifetime and low data collection latency. At the sensor layer, a distributed load balanced clustering (LBC) algorithm is proposed for sensors to self-organize themselves into clusters. In contrast to existing clustering methods, our scheme generates multiple clusterheads in each cluster to balance the work load and facilitate dual data uploading. At the cluster head layer, the inter-cluster transmission range is carefully chosen to guarantee the connectivity among the clusters. Multiple cluster heads within a cluster cooperate with each other to perform energy-saving inter-cluster communications.

Process steps:

For ; : maximum number ofrounds

For , is the index for sensor node

Find set(sensors in cluster radius)

Calculate weight

Calculate cluster weight

Perform CH selection

Inform all sensor nodes in the cluster

Cluster formation will begin

End of current round condition

Restart new round condition

CONCLUSION

In this paper, we have proposed the LBC-DDU framework for mobile data collection in a WSN. It consists of sensor layer, cluster head layer and Base station layer. It employs distributed load balanced clustering for sensor self-organization, adopts collaborative inter-cluster communication for energy-efficient transmissions among CHGs, uses dual data uploading for fast data collection, and optimizes SenCar's mobility to fully enjoy the benefits of MU-MIMO. Our performance study demonstrates the effectiveness of the proposed framework.

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