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Robust and Balanced Data Aggregation with Flexible Transmission Scheme in Wireless Sensor Networks

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Abstract: Data gathering is a common but critical operation in many applications of wireless sensor networks. Modern techniques enhances the energy efficiency to protract the network lifetime which were required extremely. Clustering is an effective topology control approach in wireless sensor networks, which can increase network scalability and lifetime. The framework employs distributed load balanced Clustering and dual data uploading, which is referred to as LBC.A distributed load balanced clustering algorithm is proposed for sensors to self-organize themselves into clusters. This work used mobile divider for split the data about cluster and cluster head calculation. 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. The trajectory planning for Mobile collector is optimized to fully utilize dual data uploading capability by properly selecting polling points in each cluster. By visiting each selected polling point, Mobile collector can efficiently gather data from cluster heads and transport the data to the static data sink. Extensive simulations are conducted to evaluate the effectiveness of the proposed LBC schemes.

Keywords: Wireless Sensor networks, load balanced clustering algorithm, Data uploading, Efficient Data Gathering.

I INTRODUCTION

A Wireless Sensor Network is a self-configuring network of small sensor nodes communicating among themselves using radio signals, and deployed in quantity to sense, monitor and understand the physical world. WSN provide a bridge between the real physical and virtual worlds. Allow the ability to observe the previously unobservable at a fine resolution over large spatial-temporal scales. Have a wide range of potential applications to industry, science, Transportation, civil infrastructure, and security. The construction of "nodes" is WSN from a few to several hundreds or even thousands, where every node is associated to one sensor. Every sensor network node has several parts: a radiotransceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node's size may differ from that of a shoebox down to the size of a grain of dust, even though functioning "motes" of authentic microscopic dimensions have however to be generated. The price of sensor nodes is alike the variable, which ranges from a few to hundreds of dollars, which is based on the difficulty of the single sensor nodes. Size and cost restrictions on sensor nodes result in respective constraints on resources like energy, memory, computational speed and communications bandwidth. Recently those networks were utilized in various industrial and consumer applications, like industrial process monitoring and control, machine health monitoring, and so on.

II RELATED WORK

Survey on Sensor Networks. In [1] this paper explains the idea of sensor networks which were created workable by the convergence of micro-electro-mechanical systems technology, wireless communications and digital electronics. Initially, the sensing tasks and the potential sensor networks applications were analyzed, and a survey of factors which determines the design of sensor networks is given. The sensor node's count in a sensor network can be several orders of magnitude greater than the nodes in an ad hoc network.

A Coordinated Data Collection Approach: Design, Evaluation, and Comparison. In [2] we consider the issue of gathering a lot of information from a few distinct hosts to a single destination in a wide-range network. This issue is imperative because upgrades in information accumulation times in enormous applications, for example, wide-range transfer applications.

Relay node deployment strategies in heterogeneous wireless sensor networks. In [3] 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.

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Data gathering mechanism with local sink in geographic routing for wireless sensor networks. In [4] 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.

Constructing maximum- lifetime data-gathering forests in sensor networks. In [5] 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.

Adaptive data collection strategies for lifetime- constrained wireless sensor networks. In [6] thisinvestigate data collection strategies in lifetime-constrained wireless sensor networks. Given a network lifetime requirement, we are interested in determining which sensor readings to send to the base station.

An application-specific protocol architecture for wireless micro sensor Networks. In [7]Networking together hundreds or thousands of cheap micro sensor nodes allows users to accurately monitor a remote environment by intelligently combining the data from the individual nodes. These networks require robust wireless communication protocols that are energy efficient and provide low latency.

Distributed clustering in ad-hoc sensor networks: A hybrid, energy-efficient approach. In [8] Prolonged network lifetime, salability, and load balancing are important requirement5 for many ad-hoc sensor network applications. Clustering sensor nodes is an effective technique for achieving these goals. In this work, we propose B new energy-efficient approach for clustering nodes in adhoc sensor networks.

Energy-efficient clustering in lossy wireless sensor networks. In [9] This work propose a novel clustering scheme for WSNs with mobile collectors, with the objective to maximizing network lifetime (number of rounds of data collection until the first node dies), by taking the lossy nature of wireless links into consideration.

TEEN: A Routing Protocol for Enhanced Efficiency in Wireless Sensor Networks. In [10] Wireless sensor networks are expected to find wide applicability and increasing deployment in the near future. In this paper, we suggest a formal classification of sensor networks, which works on their mode of functioning, as proactive and reactive networks. Reactive networks, as contrasting to passive data collecting proactive networks.

III PROPOSED METHODOLOGY

We propose a three-layer mobile data collection framework, named Load Balanced Clustering. The main motivation is to utilize distributed clustering for scalability, to employ mobility for energy saving and uniform energy consumption, and to exploit Multiple-Input and Multiple-Output (MIMO) technique for concurrent data uploading to shorten latency. The main contributions of this work can be summarized as follows.

First, we propose a distributed algorithm to organize sensors into clusters, where each cluster has multiple cluster heads. In contrast to clustering techniques proposed in previous works our algorithm balances the load of intra-cluster aggregation and enables dual data uploading between multiple cluster heads and the mobile collector. Our work mainly distinguishes from other mobile collection schemes in the utilization of MIMO technique, which enables dual data uploading to shorten data transmission latency. We coordinate the mobility of Mobile collector to fully enjoy the benefits of dual data uploading.

3.1. METHODOLOGIES:

3.1.1. Load Balanced Clustering:

The distributed load balanced clustering algorithm at the sensor layer. The essential operation of clustering is the selection of cluster heads. To prolong network lifetime, we naturally expect the selected cluster heads are the ones with higher residual energy. Hence, we use the percentage of residual energy of each sensor as the initial clustering priority.

The LBC algorithm is comprised of four phases:
(1) Initialization; (2) Status claim; (3) Cluster forming and (4) Cluster head synchronization. Next, we describe the operation through an example in Fig. 3, where a total of 10 sensors (plotted as numbered circles in are labelled with their initial priorities and the connectivity among them is shown by the links between neighboring nodes.

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3.1.2. Cluster Head Selection:
The cluster head layer, aforementioned the multiple cluster heads in a CHG coordinate among cluster members and collaborate to communicate with other CHGs. Hence, the inter-cluster communication in LBC is essentially the communication among CHGs.

By employing the mobile collector, cluster heads in a CHG need not to forward data packets from other clusters. Instead, the inter-cluster transmissions are only used to forward the information of each CHG to Mobile collector. The CHG information will be used to optimize the moving trajectory of Mobile collector, which will be discussed in the next section. For CHG information forwarding, the main issue at the cluster head layer is the inter-cluster organization to ensure the connectivity among CHGs.

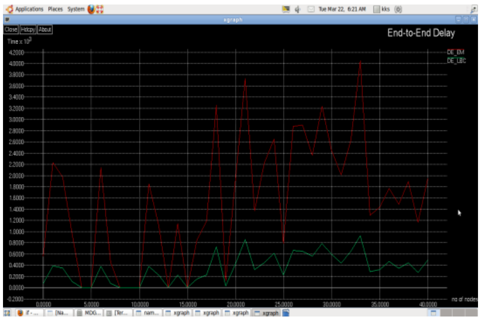
3.1.3. Trajectory Planning:
How to optimize the trajectory of Mobile collector for the data collection tour with the CHG information, which is referred to as the mobility control at the Mobile collector layer. As mentioned, Mobile collector would stop at some selected polling points within each cluster to collect data from multiple cluster heads via single-hop transmissions.
Thus, finding the optimal trajectory for Mobile collector can be reduced to finding selected polling points for each cluster and determining the sequence to visit them. To guarantee successful decoding when Mobile collector receives the mixed streams, we need to limit the number of simultaneous data streams to no more than the number of receiving antennas. In other words, since Mobile collector is equipped with two receiving antennas, at most two cluster heads in a CHG can simultaneously send data to Mobile collector in a time slot.

3.1.4 Data Collection:
When there are time constraints on data messages. In practice, it is common for some emergent data messages to be delivered within a specified deadline. If the deadline has expired and the message is yet to arrive at the destination, it would carry less value and cause performance degradation. In mobile data collection with dynamic deadline was considered and an earliest deadline first algorithm was proposed. The results show that LBC can greatly reduce energy consumptions by alleviating routing burdens on nodes and balancing workload among cluster heads, which achieves 20 percent less data collection time compared to SISO mobile data gathering and over 60 percent energy saving on cluster heads.

IV EXPERIMENTAL RESULT AND DISCUSSION

PERFORMANCE ANALYSIS:

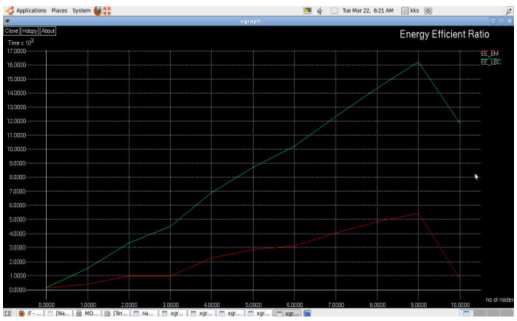
4.1. Delay ratio:



Above figure mention delay ratio of our proposed and existing comparison.

Here, we distinguish the current and proposed delay ratio, the red line indicates the proposed delay ratio and green line is existing delay ratio, as a result, the proposed work minimizes the delay when distinguished with the current process.

4.2. Energy efficiency rate:



Above figure mention energy efficiency ratio of our proposed and existing comparison.

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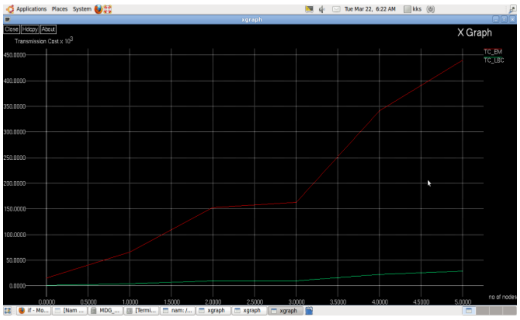
Here, we distinguish the current and proposed energy efficiency rate, here green line indicates the proposed efficiency rate and red line is existing efficiency rate, as a result, the proposed work enhances the efficiency of energy distinguished with the current process.

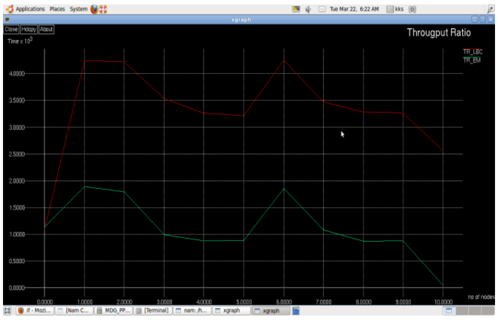
4.3. Transmission cost:



Above figure mention Transmission cost of our proposed and existing comparison.

Here, we distinguish the current and proposed Transmission cost rate, here red line indicates the proposed transmission rate and green line is existing transmission rate, as a result, the proposed work minimizes the Transmission cost when distinguished with the current process.

4.4. Throughput ratio:



Above figure mention Throughput ratio of our proposed and existing comparison.

Here, we distinguish the current and proposed Throughput ratio, here red line indicates the proposed Jitter ratio and green line is existing Throughput ratio, as a result, the proposed work enhances efficiency of Throughput ratio t when distinguished with the current process.

V CONCLUSION

LBC framework for mobile data collection in a WSN. 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 Mobile collector mobility to fully enjoy the benefits of MIMO. Our performance study demonstrates the effectiveness of the proposed framework. The results show that LBC can greatly reduce energy consumptions by alleviating routing burdens on nodes and balancing workload among cluster heads, which achieves 20 percent less data collection time compared to SISO mobile data gathering and over 60 percent energy saving on cluster heads. We have also justified the energy overhead and explored the results with different numbers of cluster heads in the framework.

Future Work, first, is how to find polling points and compatible pairs for each cluster. A discretization scheme should be developed to partition the continuous space to locate the optimal polling point for each cluster. Then finding the compatible pairs becomes a matching problem to achieve optimal overall spatial diversity.

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