A Novel Data Aggregation Approach in WSN for Energy Conservation with Delay Constrained

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ABSTRACT

Now a day the “big data” is a hot topic because of the tremendous growth of the Information and Communication Technology (ICT). The key cause of the big data in the networks is the distributed Wireless Sensor Networks (WSNs). The data generated by an individual sensor node may not appear to be significant; the overall data generated across numerous sensors in the densely distributed WSNs can produce a significant portion of the big data. The researchers introduce data-gathering technologies for large-scale wireless sensor networks by introducing mobility into the network. A mobile-sink starts the data-gathering tour periodically from the static data sink, polls each sensor while traversing its transmission range, then directly collects data from the sensor in single-hop communications, and finally transports the data to the base station. We mainly focus on the problem of minimizing the length of each data-gathering tour. We have a data-gathering algorithm where mobile-sink traverse through several shorter sub tours concurrently to satisfy the distance/time constraints. Simulation results will try to demonstrate that the proposed data-gathering algorithm can greatly shorten the moving distance of the collectors and significantly prolong the network lifetime.

Keywords - data gathering, energy harvesting, Life time, WSN.

I. INTRODUCTION

A WSN consists of sensor nodes. These sensor nodes gather information from the environment and communicate with each other via wireless transceivers. The data gathered by these sensor nodes will be delivered to one or more sinks, generally via multi-hop communication. The sensor nodes operate with batteries. These sensor nodes are deployed to not-easily accessible or hostile environment, sometimes in big quantities. It is very difficult or impossible to replace the batteries of the sensor nodes. The sink is typically rich in energy. Since the sensor energy is the most important resource in the WSN. The communications in the WSN has the many-to-one property in that data from a large number of sensor nodes tend to be concentrated into a few sinks. Since multi-hop routing is generally needed for long distant sensor nodes from the sinks to save energy. The sensor nodes near a sink can be burdened with relaying a very large amount of traffic from other nodes. Sensor nodes are resource constrained in term of sensor energy, processor and memory and low range communication and bandwidth. Limited battery power is used to operate the sensor nodes and is difficult to replace or recharge it, when the nodes die. This will affect the network performance. Energy conservation and harvesting increase lifetime of the sensor network. Optimize the communication range and minimize the sensor energy usage, we need to conserve the energy of sensor nodes .Sensor nodes are deployed to gather information and desired that all the nodes works continuously and transmit information as long as possible. This address the lifetime problem in wireless sensor networks. Sensor nodes spend their energy during transmitting the data, receiving and relaying packets. Hence, designing the routing algorithms that maximize the lifetime until the first battery expires is a very important consideration. Designing energy minimized algorithms increase the lifetime of sensor nodes. In some applications the network size is larger so we need scalable architectures. Energy conservation is the primary objective of WSN, for efficient working of wireless sensor networks it includes other objectives like scalable architecture, routing and latency. The WSN is built of nodes from a few to several hundreds or even thousands, where each node is connected to one or more sensors. Components of sensor nodes are as follows: a radio transceiver, 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 might vary in size from that of a shoebox down to the size of a grain of dust. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of sensor nodes. Size and cost constraints on sensor nodes result in
Collecting the large volume of the sensed data is indeed, difficult as a number of important domains of human endeavor are becoming increasingly reliant on this remotely sensed information. For example, in smart-houses with densely deployed sensors, users can access temperature, humidity, health information, electricity consumption, and so forth by using smart sensing devices. In order to collect these type of data, the WSNs are constructed whereby the sensors relay their data to the “sink”. In case of widely and densely distributed WSNs for e.g. in schools, urban areas, mountains, and so forth, there are two problems in gathering the data sensed by millions of sensors. First, the network is divided in to sub-networks because of the limited wireless communication range. For example, sensor nodes deployed in a building may not be able to communicate with the other sensor nodes which are distributed in the neighboring buildings. Therefore, limited communication range may raise a challenge for data collection from all sensor nodes. Second, the wireless transmission consumes the energy of the sensor nodes.

Even though the volume of data generated by an individual sensor is not significant, each sensor node requires a lot of energy to transmit the data generated by surrounding sensor nodes. Especially in dense WSNs, the life time of sensor nodes will be small because each sensor node transmits a lot of data generated by tremendous number of surrounding sensors. To solve these problems, we need an energy-efficient method to gather large volume of data from a large number of sensors in the distributed WSNs. To achieve energy-efficient data collection in densely distributed WSNs, there have been many existing approaches. For example, the data compression mechanism is capable of shrinking the volume of the transmitted data. Although it is easy to be implemented, the data compression mechanism requires the nodes to be equipped with a big volume of storage and high computational power.

When the redundant wireless transmissions are minimized, the required energy for wireless transmissions can be also minimized. Furthermore flow control and routing can choose the path which consists of nodes having high remaining energy. However, these technologies are not able to deal with the divided networks problem. To deal with both the divided sub-network problem and the energy consumption issue, the mobile sink technology have received great attention in literature. In such schemes, the data collector, referred to as the “sink node” or simply the sink is assumed to be mobile such as Vehicle, Unmanned Aerial Vehicle (UAV), and so on. As the sink node moves around the sensing location, the sensors send data to the sink node when the sink node comes in their proximity. Thus, energy consumption can be minimized by reducing the amount of transmissions in the WSN. Since the mobile sink schemes aim to reduce wireless transmissions, the trajectory of the sink node is decided based on the sensor nodes’ information (e.g., location and residual energy). The sink node divides the sensor nodes into a number of clusters based on a certain condition. Then, the sink node roams around in these clusters.

II. OVERVIEW

In WSNs data gathering and routing are difficult tasks because of their dynamic and unique properties. Many routing protocols are developed, but among those protocols cluster based routing protocols are very energy efficient, scalable and prolong the network lifetime. The sensor nodes are idle most of the time in the event detection environment and active at the time when the event occurs. Sensor nodes periodically send the collected information to the base station. Routing is an important issue in data gathering sensor network, while sleep-wake synchronization is the key issues for event detection in sensor networks. Recent years have witnessed the emergence of WSNs as a new information-gathering paradigm, in which a large number of sensors scatter over a surveillance field and extract data of interests by reading real world phenomena from the physical environment.

In a WSN, energy consumption is a primary concern, as it is important for the network to functionally operate for an expected period of time. To reduce the data packets are forwarded to the data sink via multi-hop relays among sensors. Due to the inherent nature of multi-hop routing, packets have to experience multiple relays before reaching the data sink. As a result of multi-hop, more energy is consumed on data forwarding along the path. Instead of reducing energy consumption on the
forwarding path does not necessarily prolong network lifetime as some popular sensors on the path may run out of energy faster than others, which may cause non uniform energy consumption across the network. A type of wireless networking which is comprised on number of numerous sensors and they are interlinked or connected with each other for performing the same function collectively or cooperatively for the sake of checking and balancing the environmental factors. This type of network is called as Wireless sensor network (WSN). A WSNs consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, enabling also to control the activity of the sensor nodes. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on. Energy is the scarcest resource of WSN nodes, and it determines the lifetime of WSNs. WSNs are meant to be deployed in large numbers in various environments, including remote and hostile regions, where ad-hoc communications are a key components. They usually consist of a processing unit with limited computational power and limited memory, sensors or MEMS (including specific conditioning circuitry), a communication device (usually radio transceivers or alternatively optical), and a power source usually in the form of a battery.

III. RELATED WORKS

W. Heinzelman, A. Chandrakasan, and H. Balakrishnan proposed Energy efficient communication protocol for wireless microsensor networks [1] in Jan. 2000. Distributed WSNs will enable the reliable monitoring of a variety of environments for both civil and military applications. In communication protocols, which can have significant impact on the overall energy dissipation of these networks. The conventional protocols of direct transmission, minimum-transmission-energy, multihop routing, and static clustering may not be optimal for sensor networks, we propose LEACH, a clustering-based protocol that utilizes randomized rotation of local cluster base stations to evenly distribute the energy load among the sensor nodes in the network.

N. Li, J. Hou, and L. Sha proposed Design and analysis of an MST-based topology control algorithm[2] in May 2005. They introduced a Minimum Spanning Tree (MST) based topology control algorithm, called Local Minimum Spanning Tree (LMST), for wireless multihop networks. In this algorithm, each node builds its local minimum spanning tree independently and keeps only on-tree nodes that are one-hop away as its neighbors in the final topology.

C.-C. Lin, M.-J. Chiu, C.-C. Hsiao, R.-G. Lee and Y.-S. Tsai proposed Wireless health care service system for elderly with dementia [3] in 2006. The purpose of this is to integrate the technologies of radio frequency identification, global positioning system, global system for mobile communications, and geographic information system(GIS) to construct a stray prevention system for elderly persons are suffering from dementia without interfering with their activities of daily livings. Their aim is to improve the passive and manpowered way of searching the missing patient with the help of the information technology. This system provides 4 monitoring schemes, such as indoor residence monitoring, outdoor activity area monitoring, emergency rescue, and remote monitoring modes. They have developed a service platform to implement these monitoring schemes.

I. Bisio and M. Marchese proposed Efficient satellite-based sensor networks for information retrieval [4] in Dec. 2008. This considers a packet-based telecommunication network architecture used as an Environmental Monitoring System (EMS) over wide areas. It can be employed to extract the measures of physical quantities, such as temperature, humidity, and vibrations intensity (physical information) together with the geographical position where the position information or measures are taken. The telecommunication network hold up the EMS is constitutes: a network of sensor nodes, a group of base stations called Sinks, a satellite backbone, and a destination. Each sensor nodes collects physical and position information, encapsulates it into packets and forwards it towards the sinks which give access to the satellite backbone that connects the sinks to the destination.

S. Katti, H. Rahul, W. Hu, D. Katabi, M. Medard, and J. Crowcroft proposed XORs in the air: practical wireless network coding [5] in Jun. 2008. This proposes COPE, a new architecture for wireless mesh networks. In addition to convey packets, routers mix (i.e., code) packets from different sources to maximize the information content of each transmission. We show that intelligently mixing packets maximize network throughput. The design is rooted in the theory of network coding. Prior work on network coding is mainly theoretical and focuses on multicast traffic.

for nodes in a mobile ad hoc network. The main contribution is to generalize the cluster definition and formation algorithm so that a cluster consists of all nodes that are at distance at most k hops from the cluster head. They also describe algorithms for modifying cluster structure in the presence of topological changes.

K. Miyao, H. Nakayama, N. Ansari, and N. Kato proposed LTRT: An efficient and reliable topology control algorithm for ad-hoc networks [7] in Dec. 2009. Transmission is a costly operation in the context of ad-hoc networks, and thus topology control has been introduced to achieve efficient transmission with low interference and low energy consumption. By topology control method, each node optimizes its transmission power by maintaining network connectivity in a localized manner. Local Minimum Spanning Tree (LMST) is the topology control algorithm, which has been proven to provide satisfactory performance.

S. He, J. Chen, D. Yau, and Y. Sun proposed Cross-Layer optimization of correlated data gathering in WSNs [8] in Jun. 2010. They consider the problem of gathering correlated sensor data by a single sink node in a wireless sensor network. They assume that the sensor nodes are energy constrained and design efficient distributed protocols to increase the network lifetime. Many existing approaches focus on optimizing the routing layer only, but in fact the routing strategy is often coupled with link access in the MAC layer and power control in the physical layer. This represents an effort on network lifetime maximization that jointly considers the three layers. They assume that link access probabilities are known and consider the joint optimal design of power control and routing.

C. Jiming, X. Weiqiang, H. Shibo, S. Youxian, P. Thulasiraman, and S. Xuein proposed Utility-based asynchronous flow control algorithm for WSNs [9] in Sep. 2010. Here they formulate a flow control optimization problem for WSNs with lifetime restriction and link interference in an asynchronous setting. Their formulation is based on the network utility maximization framework, in which a general utility function is used to distinguish the network performance such as throughput. L. Ramaswamy, V. Lawson, and S. Gogineni proposed Towards a quality centric big Data architecture for federated sensor services [10] in 2013. As the Internet of Things (IoT) paradigm obtains popularity, the next few years will likely witness 'servitization' of domain sensing functionalities. We visualize a cloud-based eco-system in which high quality data from large numbers of independently managed sensors is shared or even traded in real-time.

IV. EXISTING SYSTEM

The Existing System of this project is energy minimized clustering algorithm by using the Expectation-Maximization (EM) algorithm for 2-dimensional Gaussian mixture distribution. This system aims to minimize the sum of square of wireless communication distance since the energy consumption is proportional to the square of the wireless communication distance.

Moreover, we first focus on the “data request flooding problem” to decide the optimal number of clusters. The data request flooding problem refers to the energy inefficiency that occurs when all the nodes broadcast data request messages to their respective neighboring nodes. This problem wastes energy, particularly in the high density WSNs.

Previous research work advocates increasing the number of clusters to reduce the data transmission energy. However, in this method, we point out that an excessive number of clusters can result in performance degradation, and therefore, we adopt an adequate method for deriving the optimal number of clusters.

V. PROPOSED SYSTEM

The aim of this project is to achieve energy efficient Data Collection in densely distributed WSNs using Mobile-sink. The K-medoids algorithm is used for the clustering. In this proposed system new data-gathering mechanisms for large-scale sensor networks when mobile-sink is used. In our data-gathering scheme mobile-sink needs to visit the transmission range of the nodes. While the entire network can be divided into sub networks.

In each sub network, a mobile-sink is responsible for gathering data from local sensors in the subarea and then, uploads data to the base station.

Fig.2: Architecture of proposed System

Fig.3: Cluster formation
IV. CONCLUSION
The mobile data-gathering scheme for large-scale sensor networks increases the performance of the network. A mobile-sink starts the data gathering tour periodically, traverses the entire sensor network, polls sensors and gathers the data from sensors one by one, and finally returns and uploads data to the base station. In addition, it can prolong the network life time significantly compared with the scheme that has only a static data collector and scheme in which the mobile-sink can only move along straight lines.

REFERENCES


