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AN ADAPTIVE DATAGATHERING TO IMPROVE THE NETWORK LIFETIME IN WIRELESS SENSOR NETWORK

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Abstract - Nowadays, wireless sensor networks (WSNs) seen as an emerging technology due to its multi serviceable, low cost and low power sensor nodes that are deployed randomly and densely over a network to collect useful information from there. Since the nodes are deployed densely, makes it hard to recharge or replace their batteries. In this paper introduce the new protocol Energy Efficient Low Cost Clustering (EELCC) four-layer framework is proposed for mobile data collection in wireless sensor networks, which includes the sensor layer, cluster head layer, least cost routing layer, mobile collector layer, here cluster heads send a short range advertisement broadcast message. The sensor nodes receive the advertisements and choose their cluster heads based on the signal strength of the advertisement messages. Each sensor node sends an acknowledgment message to its cluster head. Moreover, in each iteration, the cluster heads choose a set of associate heads based on the signal strength of the acknowledgments. A head-set consists of a cluster head and the associates. The head-set member is responsible to send messages to the base station. Each data transfer phase consists of several epochs. Each member of head-set becomes a cluster head once during an epoch. A round consists of several iterations Results show that this protocol reduces energy consumption quite significantly and prolongs the life time of sensor network as compared to Low-Energy Adaptive Clustering Hierarchy (LEACH).

Keywords-WSNs, Data aggregations, Energy consumption, Network lifetime, Sensor node, Clustering.

1. INTRODUCTION

1.1 WIRELESS SENSOR NETWORKS

Wireless Sensor Network (WSN) is a collection of spatially deployed wireless sensors by which to monitor various changes of environmental conditions (e.g., forest fire, air pollutant concentration, and object moving) in a collaborative manner without relying on any underlying infrastructure support. Recently, a number of research efforts have been made to develop sensor hardware and network architectures in order to effectively deploy WSNs for a variety of applications.

Due to a wide diversity of WSN application requirements, however, a general-purpose WSN design cannot fulfill the needs of all applications. Many network parameters such as sensing range, transmission range, and node density have to be carefully considered at the network design stage, according to specific applications. To achieve this, it is critical to capture the impacts of network parameters on network performance with respect to application specifications.

Wireless sensor networks are deployed to monitor the sensing field and gather information from it. Traditionally, two approaches can be adopted to accomplish the data collection task: through direct communication, and through multi-hop forwarding. In the first case, sensor nodes upload data directly to the sink through one-hop wireless communication, which may result in long communication distances and degrade the energy efficiency of sensor nodes. On the other hand, with multi-hop forwarding, data are reported to the sink through multiple relays, and the communication distance is reduced. However, since nodes near the sink generally have a much heavier forwarding load, their energy may be depleted very fast, which degrades the network performance.

1.2 NATURES OF ROUTING

Since a distributed network has multiple nodes and services many messages, and each node is a shared resource, many decisions must be made. There may be multiple paths from the source to the destination. Therefore, message routing is an important topic. The main performance measures affected by the routing scheme are throughput (quantity of service) and average packet delay (quality of service). Routing schemes should also avoid both deadlock and livelock (see below). Routing methods can be fixed (i.e. pre-planned), adaptive, centralized, distributed, broadcast, etc. Perhaps the simplest routing scheme is the token ring [Smythe 1999]. Here, a simple topology and a straightforward fixed protocol result in very good reliability and precomputable QoS. A token passes continuously around a ring topology. When a node desires to transmit, it captures the token and attaches the message. As the token passes, the destination reads the header, and captures the message. In some schemes, it attaches a 'message received' signal to the token, which is then received by the original source node.

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Then, the token is released and can accept further messages. The token ring is a completely decentralized scheme that effectively uses TDMA. Though this scheme is very reliable, one can see that it results in a waste of network capacity. The token must pass once around the ring for each message. Therefore, there are various modifications of this scheme, including using several tokens, etc.

Fixed routing schemes often use Routing Tables that dictate the next node to be routed to, given the current message location and the destination node. Routing tables can be very large for large networks, and cannot take into account real-time effects such as failed links, nodes with backed up queues, or congested links.

Adaptive routing schemes depend on the current network status and can take into account various performance measures, including cost of transmission over a given link, congestion of a given link, reliability of a path, and time of transmission. They can also account for link or node failures.

Routing Protocol

Routing has two main functions: route discovery and packet forwarding. The former is concerned with discovering routes between nodes, whereas the latter is about sending data packets through the previously discovered routes. There are different types of ad hoc routing protocols. One can distinguish proactive and reactive protocols. Protocols of the latter category are also called on-demand protocols. Another type of classification distinguishes routing table based protocols (e.g., DSDV) and source routing protocols (e.g., DSR).

The major requirements of a routing protocol :

- *Minimum route acquisition delay*
- *Quick route reconfiguration in the case of path breaks.*
- *Loop-free routing*
- *Distributed routing protocol*
- *Low control over-head*
- *Scalability with network size*
- *QoS support as demanded by the application*
- *Support of time-sensitive traffic and*
- *Security and privacy*

Proactive Routing Protocols (Table-driven)

- *Nodes exchange routing information periodically in order to maintain consistent and accurate information.*
- *To transmit data to a destination, path can be computed rapidly based on the updated information available in the routing table.*
- *The disadvantage of using a proactive protocol is high overhead needed to dynamic topology that might require a large number of routing updates.*
- *Each node maintains a routing table, with an entry for each possible destination address, next hop on the shortest path to that destination, shortest known distance to this destination, and a destination sequence number that is created by the destination itself.*

Reactive Routing Protocols (On-demand)

- *Route discovery mechanism is initiated only when a node does not know the path to a destination it wants to communicate with.*
- *In case of mobile ad hoc network, reactive routing protocols have been demonstrated to perform better with significantly lower changes that may occur in node connectivity, and yet are able to reduce/eliminate routing overhead in periods or areas of the network in which changes are less frequent.*
- *A reactive routing has two main operations. Route discovery (usually broadcasting using a form of controlled flooding) and route maintenance. Various reactive protocols have been proposed in literature such as Ad Hoc On-demand vector (AODV), Dynamic source routing (DSR),*
- *Temporary Ordered Routing Algorithm (TORA), etc*

1.3 GENERAL PROJECT DETAILS

In a large-scale sensor network, hundreds or thousands of tiny sensor nodes are randomly deployed into a monitoring field to gather data. The complexity of computation and communication increases with the number of active sensor nodes tracking the target. The amount of energy used in the network is proportional to the number of active sensor nodes. It is best for sensor nodes to be arranged into collaborative m groups.

Group collaboration should be limited to a tracking area around the target so that the communication and computation will be independent of the size of the network. Multiple nodes surrounding the target may collaborate and gather information. The tracking accuracy and performance is limited to the information in those sensors. In a large-scale sensor network, it is important to locate the target with high accuracy while consuming the least amount of energy. Some of the existing studies have focused on energy efficient methods to track mobile targets. Our objective is to propose a simple routing metric that is composed of the energy expenditure and battery power of a node. Therefore, the cluster activation phase has a great importance not only in minimizing energy consumption but also improve the optimized tracking accuracy.

2. SYSTEM MODELS

2.1 SENSOR NETWORK FORMATION MODULE

We contribute to a more systematic understanding and treatment of sensor deployment issues. For this purpose, we studied the existing literature on deployment experience and present a classification of common problems encountered during deployment of sensor networks. A wireless network that is temporarily installed alongside the actual sensor network during the deployment process. Parameters considered during sensor network formation.

Transmission range: nodes communication depends under transmission range which is placed nearly close to each other thus gets better link.

Local information system: Nodes must be grouped under specific feature like battery power, processing capability, bandwidth, memory etc. so according to those, nodes are partitioned using driver methods.

Mobility: Mobility refers the node movement procedure so need to consider the mobility options with limitation in maximum and minimum speed.

According to the critical event monitoring process, sensor network formed under local information system with sleep wake scheduling mechanisms.

2.2 ROUTING PROTOCOL DESIGN MODULE

A routing protocol is a protocol that specifies how routers communicate with each other, disseminating information that enables them to select routes between any two nodes on a computer network, the choice of the route being done by routing algorithms. Each router has a prior knowledge only of networks attached to it directly. A routing protocol shares this information first among immediate neighbors, and then throughout the network. This way, routers gain knowledge of the topology of the network. Design a Routing protocol named as PPOSS (Probability-based Prediction and Optimization-based Sleep Scheduling protocol), which is going to implement in OSI layer that need to get and deliver the messages from other layers for that make some more changes in supported layers. The routing protocol is implemented in the layered architecture of the GloMoSim simulator.

2.3 SLEEP WAKE SCHEDULING MODULE

Measurements have shown that the energy that a sensor node spends while idly listening amounts to 50%-100% of the energy required for receiving. Furthermore, typically, a sensor node would spend a substantial fraction of the time in the idle state. Therefore, idle listening has been recognized as one of major sources of energy waste in sensor networks and sleep scheduling has been widely studied. The mainstream of research on sleep scheduling can be divided into two approaches. One approach, the “periodical packet-arrival based approach”, assumes periodical packet arrival, thus proposing a periodic active/sleep (i.e., ON/OFF) schedule. The second approach is “coverage-based approach”, which assumes large density of sensor nodes, thus maintaining the connectivity of the network by a subset of nodes which are ON all the time, while letting the other nodes sleep. There are also various strategies for adaptation of the sleeping schedule, that is ending the ON period according to different criteria, such as the overheard messages, the network topology, the residual energy of the nodes, the most recently updated neighbor sleeping schedule, the database of neighbor nodes’ sleeping schedule, the number of packets queued in the MAC layer, and the waiting time of packets and the length of waiting queue in the previous node.

2.4 TARGET TRACKING APPROACH MODULE

In this module, we quantify the benefits of our approach in terms of energy consumed and accuracy of tracking for different mobility patterns. The key issues in tracking a mobile target are accuracy of tracking and energy expenditure. The accuracy of tracking is strongly influenced by the number of active sensor nodes. The more sensor nodes that are active, the higher will be the accuracy in tracking. Too few will result in inaccurate tracking. On the other hand, energy expenditure is proportional to the number of active sensor nodes; the larger the size of the active tracking region, the higher the energy consumption. To accurately track the target and minimize energy, a minimum set of sensors nodes need to be active.

2.5 CLUSTERING SCHEME

A cluster-based scheme is proposed, where sensors are statically divided into clusters, and each cluster consists of a single Cluster Head (CH) and a bunch of slave sensors. At every sampling instant, only one cluster of sensors is triggered to track the target. When a target enters the wireless sensor network, the CH that detects the target becomes active while other nodes are in sleep mode. Then the active CH selects three sensor nodes of its members for tracking in which one node is selected as Leader node. The selected nodes sense the target and current target location is calculated.

2.6 INITIAL CONFIGURATION SETUP

We need to configure some attributes which is supported to execute our routing protocol like Number of nodes, Mobility, Mac protocol, Simulation time, Band width, Transmission range etc… by setting these kinds of attributes we execute out routing protocol with layers interaction. We setup the layer wise results in the configuration process.

2.7 PERFORMANCE EVALUATIONS

First, we need to specify the necessary input parameters in the Config.in file as said above. For our simulation procedure, we have been specific about certain parameters as mentioned below to enable hassle free simulation

Terrain range – (500,500)

Number of nodes – 20 (This is a scalable simulator. Hence number of nodes can be increased at will).

These parameters were adhered to for the whole process of experimentation with the new protocol.

The performance of the proposed algorithm is evaluated via glomosim simulator. Performance metrics are utilized in the simulations for performance comparison:

Packet arrival rate. The ratio of the number of received data packets to the number of total data packets sent by the source.

Average end-to-end delay. The average time elapsed for delivering a data packet within a successful transmission.

Communication overhead. The average number of transmitted control bytes per second, including both the data packet header and the control packets.

Energy consumption. The energy consumption for the entire network, including transmission energy consumption for both the data and control packets.

3. EXISTING SYSTEM

In spite of the diverse applications, WSNs face a number of unique technical challenges due to their inherent energy and bandwidth limitations, ad hoc deployment, and unattended operation, etc.,. Unfortunately, very little previous works on distributed systems can be applied to WSNs, since the underlying assumptions have changed dramatically. Therefore, innovative energy-aware, scalable, and robust algorithms for distributed signal processing in WSNs are highly required. A problem that is closely related is the localized topology control, which maintains energy-efficient network connectivity by controlling the transmission power at each node, or selecting a small subset of the local links of a node.

Since nodes often run on batteries that are generally difficult to be recharged once deployed, energy efficiency is a critical feature of WSNs for the purpose of extending the network lifetime. Target tracking in WSNs has been studied extensively. Due to the limited sensing capability and limited resources for communications and computation, collaborative resource management is required to trade-off between the tracking accuracy. Therefore, **energy-efficient target tracking** should improve the tradeoff between energy efficiency and tracking performance—e.g., by improving energy efficiency at the expense of a relatively small loss on tracking performance. For target tracking applications, **idle listening** is a major source of energy waste. To reduce the energy consumption during idle listening, **duty cycling** is one of the most commonly **used approaches**. The idea of duty cycling is to put nodes in the sleep state for most of the time, and only wake them up periodically. In certain cases, the sleep pattern of nodes may also be explicitly scheduled, i.e., forced to sleep or awakened on demand. This is usually called **sleep scheduling**.

As a compensation for **tracking performance loss caused by duty cycling** and **sleep scheduling**, **proactive wake up** has been studied for awakening nodes proactively to prepare for the approaching target. However, most existing efforts about proactive wake up simply awaken all the neighbor nodes in the area, where the target is expected to arrive, without any differentiation. Based on target prediction, it is possible to sleep-schedule nodes precisely, so as to reduce the energy consumption for proactive wake up. For example, if nodes know the exact route of a target, it will be **sufficient to awaken those nodes that cover the route** during the time when the target is expected to traverse their sensing areas **but not achieve that much target performance.**

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3.2 DRAWBACKS

- *As a compensation for tracking performance loss caused by duty cycling and sleep scheduling, proactive wake up has been studied for awakening nodes proactively to prepare for the approaching target.*
- *However, if energy efficiency is enhanced, the quality of service (QoS) of target tracking is highly likely to be negatively influenced. For example, forcing nodes to sleep may result in missing the passing target and lowering the tracking coverage.*
- *Sleep scheduling inevitably increases the probability of losing track of the object when the sensor nodes that should be active are asleep.*

4. PROPOSED SYSTEM

Our proposed work, present a probability-based target prediction and sleep scheduling protocol (PPSS) to improve the efficiency of proactive wake up and enhance the energy efficiency with limited loss on the tracking performance. With a target prediction scheme based on both kinematics rules and theory of probability, PPSS not only predicts a target's next location, but also describes the probabilities with which it moves along all the directions.

4.1 PPSS ROUTING PROTOCOL

PPSS is designed based on proactive wake up: when a node (i.e., alarm node) detects a target, it broadcasts an alarm message to proactively awaken its neighbor nodes (i.e., awakened node) to prepare for the approaching target. To enhance energy efficiency, we modify this basic proactive wake-up method to sleep schedule nodes precisely. Specifically, PPSS selects some of the neighbor nodes (i.e., candidate node) that are likely to detect the target to awaken. On receiving an alarm message, each candidate may individually make the decision on whether or not to be an awakened node, and if yes, when and how long to wake up. We utilize two approaches to reduce the energy consumption during this proactive wake-up process:

1. Reduce the number of awakened nodes.
2. Schedule their sleep pattern to shorten the active time.

First, the number of awakened nodes can be reduced significantly, because:

1) Those nodes that the target may have already passed during the sleep delay do not need to be awakened;

2) Nodes that lie on a direction that the target has a low probability of passing by could be chosen to be awakened with a low probability. For this purpose, we introduce a concept of awake region and a mechanism for computing the scope of an awake region.

Second, the active time of chosen awakened nodes can be curtailed as much as possible, because they could wake up and keep active only when the target is expected to traverse their sensing area. For this purpose, we present a sleep scheduling protocol, which schedules the sleep patterns of awakened nodes individually according to their distance and direction away from the current motion state of the target.

ADVANATGES

- *In a duty-cycled sensor network, proactive wake up and sleep scheduling can create a local active environment to provide guarantee for the tracking performance.*
- *PPSS improves the energy efficiency with an acceptable loss on the tracking performance.*

Drawback

- *Proactive awake, it is sometimes unnecessary to awaken all the neighbor nodes.*

5. CONCLUSION

In this paper, a system is developed in such a way that target tracking in WSN is done in efficient way using an energy efficient prediction based sleep scheduling algorithm. In a duty-cycled sensor network, proactive wake up and sleep scheduling can create a local active environment to provide guarantee for the tracking performance. By effectively limiting the scope of this local active environment (i.e., reducing low value-added nodes that have a low probability of detecting the target), PPSS improves the energy efficiency with an acceptable loss on the tracking performance. Given some limitations in tracking accuracy, the potential future work includes optimization-based sleep scheduling and target prediction for abrupt direction changes. So as a future enhancement, the tracking algorithm can be extended by forming clustering as one of the optimization methods.

6. FUTURE ENHANCEMENT

PPSS has limitations as well. **First,** it does not use optimization methods, i.e., PPSS imposes no performance constraints when reducing the energy consumption. Without performance constraints, it is difficult to configure the protocol toward the best energy performance tradeoff for a specific network environment.

Second, the prediction method of PPSS cannot cover special cases such as the target movement with abrupt direction changes. This is the expense that PPSS pays for the energy efficiency enhancement. Given these limitations, the potential **our work includes optimization-based sleep scheduling and target prediction.**

Probability-based Prediction and Optimization-based Sleep Scheduling protocol (PPOSS)

Besides, a cluster-based scheme is proposed, where sensors are statically divided into clusters, and each cluster consists of a single Cluster Head (CH) and a bunch of slave sensors. At every sampling instant, only one cluster of sensors is triggered to track the target. Resource consumption of the network is thus restricted to the activated cluster, where intra cluster communication is dramatically reduced so achieves optimization based sleep scheduling. Therefore, the cluster activation phase has a great importance not only in minimizing resource consumption but also in tracking accuracy. First, all the CHs need to measure the distances between the target and themselves at every sampling instant; then, a comparison among them is required to choose the nearest one. When a target enters the wireless sensor network, the CH that detects the target becomes active while other nodes are in sleep mode. Then the active CH selects three sensor nodes of its members for tracking in which one node is selected as Leader node. The selected nodes sense the target and current target location is calculated.

In this approach three sensor nodes are selected each time in which two nodes calculates its distance from the moving object and sends the data to the leader node. The localization of the moving object is done by leader node whereas in previous methods it's done by CH. Using prediction based clustering method energy consumed in the network will be reduced since the transmission power of the nodes is directly proportional to the distances. The three nodes selected for tracking are close to each other, thus the energy consumed for sending a data between the nodes is lower than sending a data from one of the selected nodes to its CH.

In this work, a system is developed in such a way that target tracking in WSN is done in efficient way using an energy efficient prediction- based clustering algorithm. Energy efficient prediction based Clustering algorithm, reduces the average energy consumed by sensor nodes and thereby increase the lifetime of the network. The tracking of the moving object is accurately done.

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