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Implementation of Extensive Method for Mobile Relay Configuration in Wireless Sensor Networks

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Abstract: ***Wireless Sensor Networks (WSNs) are increasingly used in data-intensive applications such as microclimate monitoring, precision agriculture, and audio/video surveillance. A key challenge faced by data-intensive WSNs is to transmit all the data generated within an applications lifetime to the base station despite the fact that sensor nodes have limited power supplies. We propose using low cost disposable mobile relays to reduce the energy consumption of data-intensive WSNs. Our approach differs from previous work in two main aspects. First, it does not require complex motion planning of mobile nodes, so it can be implemented on a number of low-cost mobile sensor platforms. Second, we integrate the energy consumption due to both mobility and wireless transmissions into a holistic optimization framework. Our framework consists of three main algorithms. The first algorithm computes an optimal routing tree assuming no nodes can move. The second algorithm improves the topology of the routing tree by greedily adding new nodes exploiting mobility of the newly added nodes. The third algorithm improves the routing tree by relocating its nodes without changing its topology. This iterative algorithm converges on the optimal position for each node given the constraint that the routing tree topology does not change. We present efficient distributed implementations for each algorithm that require only limited, localized synchronization. Because we do not necessarily compute an optimal topology, our final routing tree is not necessarily optimal. our proposed simulation results show that our algorithms significantly outperform the best existing solutions.***

Keywords: WSN, OMRC, Energy Optimization, Mobile Node etc

1. Introduction

Recent advancement in mobile sensor platform technology has been taken into attention that mobile elements are utilized to improve the WSN's performances such as coverage, connectivity, reliability and energy efficiency. The concept of mobile relay is that the mobile nodes change their locations so as to minimize the total energy consumed by both wireless transmission and locomotion. The conventional methods, however, do not take into account the energy level, and as a result they do not always prolong the network lifetime. Several different approaches have been proposed to significantly reduce the energy cost of WSNs by using the mobility of nodes [1]. A wireless sensor network (WSN) is a wireless network consisting of spatially distributed autonomous devices that use sensors to monitor physical or environmental conditions. Fig.1 show that Wireless sensor networks are expected to be deployed inaccessible and hostile environments such as habitat monitoring applications, battlefields for enemy troop movement monitoring, etc. Al though, it faces the problem to send all the data sensed by the sensor nodes to the base station within an application's lifetime due to the limited power supplies. These WSNs are needs to maintain sufficient energy of the sensor nodes to transmit all the data generated within the lifetime of the applications to the base station. Many different approaches have been proposed to significantly reduce the energy cost of WSNs by using the mobility of nodes[2].

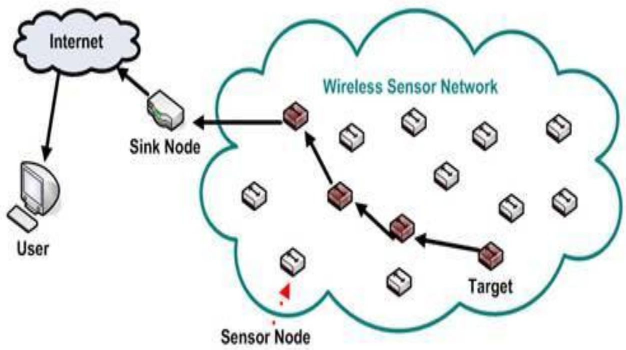


Figure 1: Wireless Sensor Node

2. Related Work

2.1 Literature Review

Mobile Relay Configuration in Data-Intensive Wireless Sensor Networks

In this paper Fatme El-Moukaddem, Eric Torng, and Guoliang Xing, these authors propose that wireless Sensor Networks (WSNs) are increasingly used in data-intensive applications such as microclimate monitoring, precision agriculture, and audio/video surveillance. A key challenge faced by data-intensive WSNs is to transmit all the data generated within an application's lifetime to the base station despite the fact that sensor nodes have limited power supplies. We propose using low-cost disposable mobile relays to reduce the energy consumption of data-intensive WSNs. Our approach differs from previous work in two main aspects. First, it does not require complex motion planning of mobile nodes, so it can be implemented on a number of low-cost mobile sensor platforms. Second, we integrate the energy consumption due to both mobility and wireless transmissions into a holistic optimization framework. Our framework consists of three main algorithms. The first algorithm computes an optimal routing tree assuming no nodes can move. The second algorithm improves the topology of the routing tree by greedily adding new nodes exploiting mobility of the newly added nodes. The third algorithm improves the routing tree by relocating its nodes without changing its topology [12].

Energy Efficient Schemes for Wireless Sensor Networks with Multiple Mobile Base Stations

In this paper authors, S.R. Gandham, M. Dawande, R. Prakash, and S. Venkatesan describe One of the main design issues for a sensor network is conservation of the energy available at each sensor node. We propose to deploy multiple, mobile base stations to prolong the lifetime of the sensor network. We split the lifetime of the sensor network into equal periods of time known as rounds. Base stations are relocated at the start of a round. Our method uses an integer linear program to determine new locations for the base stations and a low-based routing protocol to ensure energy efficient routing during each round. We propose four evaluation metrics and compare our solution using these metrics. Based on the simulation results we show that employing multiple, mobile base stations in accordance with the solution given by our schemes would increase the lifetime of the sensor network [13].

Goal

In this project we have main aim is present efficient method for mobile relay configuration with goal of improving performance of energy consumption.

In this project we have main aim is present efficient method for mobile relay configuration with goal of improving performance of energy consumption:

- To present literature review different methods for energy consumption minimization in WSNs.
- To present the design of proposed approach and algorithms.
- Present the practical analysis proposed algorithms and evaluate its performances.
- To present the comparative analysis of existing and proposed algorithms in order
- To claim the efficiency.

2.2 Scope of the Work

In current process we are using some algorithm that allows some nodes to move while others do not because any local improvement for a given mobile relay is a global improvement. The scope is to handle additional constraints on individual nodes such as low energy levels or mobility restrictions due to application requirements

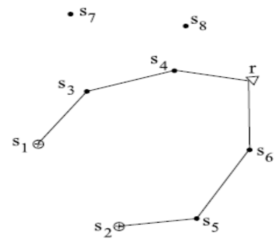
Motivation

In wireless sensor networks, nodes consume energy during communication, computation, and movement, but communication and mobility energy consumption are the major cause of battery drainage. Radios consume considerable energy even in an idle listening state, but the idle listening time of radios can be significantly reduced by a number of sleep scheduling protocols. Therefore, there are many methods presented recently on reducing the total energy consumption due to transmissions and mobility.

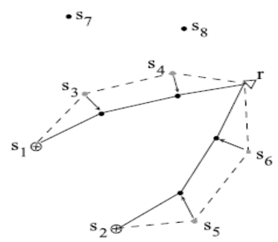
Such a holistic objective of energy conservation is motivated by the fact that mobile relays act the same as static forwarding nodes after movement. The method presented in [1] showing that 45 % energy consumption is reduced. However this method further need to address the issues related handle additional constraints on individual nodes such as low energy levels or mobility restrictions. Mobile relay has been studied in order to reduce the energy consumption in WSNs.

Energy Optimization Framework

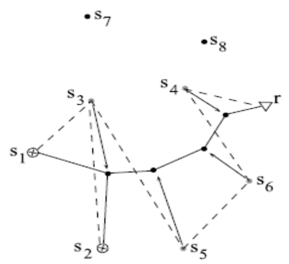
The Optimal Mobile Relay Configuration problem is challenging because of the dependence of the solution on multiple factors such as the routing tree topology and the amount of data transferred through each link. For example, when transferring little data, the optimal configuration is to use only some relay nodes at their original positions. As the amount of data transferred increases, three changes occur: the topology may change by adding new relay nodes, the topology may change by changing which edges are used, and the relay nodes may move closer together. In many cases, we may have restrictions such as no mobility for certain relay nodes or we must use a fixed routing tree. These constraints affect the optimal configuration.



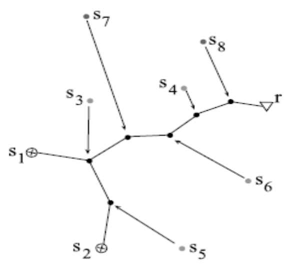
(a) Optimal routing tree for $0 \leq m \leq 15$MB.



(b) Optimal configuration for 15MB$\leq m \leq$ 25MB: same topology but nodes relocate.



(c) Optimal configuration for 25MB$\leq m \leq$ 60 MB. A new topology is used.



(d) Optimal configuration for 100MB$\leq m \leq$ 150MB: a new topology with more nodes.

2.3 Static Tree Construction

We start at the first step of constructing the tree. When the given tree must be loosely preserved, we start with the relay insertion step. Finally, with fixed routes, we apply directly our tree optimization algorithm.

We construct the tree for our starting configuration using a shortest path strategy. We first define a weight function w specific to our communication energy model. For each pair of nodes si and sj in the network, we define the weight of edge sisj as: $w(si, sj) = a + b\|oi - oj\|^2$ where oi and oj are the original positions of nodes si and sj and a and b are the energy parameters. We observe that using this weight function, the optimal tree in a static environment coincides with the shortest path tree rooted at the sink. So we apply Dijkstra's shortest path algorithm starting at the sink to all the source nodes to obtain our initial topology.We improve the routing tree by greedily adding nodes to the routing tree exploiting the mobility of the inserted nodes. For each node sout that is not in the tree and each tree edge sisj , we compute the reduction (or increase) in the total cost along with the optimal position of sout if sout joins the tree such that data is routed from si to sout to sj instead of directly from si to sj using the LocalPos algorithm described in algorithm 1. We repeatedly insert the outside node with the highest reduction value modifying the topology to include the selected node at its optimal position, though the node will not actually move until the completion of the tree optimization phase. After each node insertion occurs, we compute the reduction in total cost and optimal position for each remaining outside node for the two newly added edges (and remove this information for the edge that no longer exists in the tree). At the end of this step, the topology of the routing tree is fixed and its mobile nodes can start the tree optimization phase to relocate to their optimal positions.

```
Algorithm 1
function LOCALPOS(oi, ui, ui-1, ui+1)
  ⊳ Consider case si moves right
  valid ← FALSE;
  xi ← 1/2 (xi−1 + xi+1) − Yi;
  if xi > pi then
        valid ← TRUE;
  else
        ⊳ Consider case si moves left
        xi ← 1/2 (xi−1 + xi+1) + Yi;
        if xi < pi then
              valid ← TRUE;
        end if
  end if
  ⊳ Record if new position is different from previous one
  if valid then
        yi ← (xi−1+xi+1−2pi)
             ------------------------ (xi − pi) + qi;
             (yi−1+yi+1−2qi)
        u'= (xi, yi);
        if ‖u'i – ui‖ > threshold then
            return (ui, TRUE);
        end if
  end if
  ⊳ not beneficial to move, stay at original position
  return (oi, FALSE);
  end function
```

2.4 Tree Optimization Algorithm

We consider the sub problem of finding the optimal positions of relay nodes for a routing tree given that the topology is fixed. We assume the topology is a directed tree in which the leaves are sources and the root is the sink. We also assume that separate messages cannot be compressed or merged; that is, if two distinct messages of lengths m1 and m2 use the same link (si, sj) on the path from a source to a sink, the total number of bits that must traverse link (si, sj) is m1 + m2. Let the network consists of multiple sources, one relay node and one sink such that data is transmitted from each source to the relay node and then to the sink. We modify our solution as follows. Let si be the mobile relay node, S(si) the set of source nodes transmitting to si and sdi the sink collecting nodes from si. The cost incurred by si in this configuration U is:

$$ci(U) = k\|ui - oi\| + ami + bmi\|ud - ui\|2$$

$$x_i = p_i + \frac{-Bx(\sqrt{pB^2_x + B^2_y} \pm k)}{A\sqrt{pB^2_x + B^2_y}}$$

$$y_i = q_i + \frac{-By(\sqrt{pB^2_x + B^2_y} \pm k)}{A\sqrt{pB^2_x + B^2_y}}$$

Where

$$A = mi + \sum_{sl \in S(si)} ml$$

$$Bx = mixd + \sum_{sl \in S(si)} mlxl + Api$$

$$By = miyd + \sum_{sl \in S(si)} mlyl + Aqi$$

These values correspond to two candidate points moving in each direction (left/right). The optimal position is the valid value yielding the minimum cost. Our algorithm starts by an odd/even labeling step followed by a weighting step. To obtain consistent labels for nodes, we start the labeling process from the root using a breadth first traversal of the tree. The root gets labeled as even. Each of its children gets labeled as odd. Each subsequent child is then given the opposite label of its parent. We define mi, the weight of a node si, to be the sum of message lengths over all paths passing through si. This computation starts from the sources or leaves of our routing tree. Initially, we know mi = Mi for each source leaf node si. For each intermediate node si, we compute its weight as the sum of the weights of its children. Once each node gets a weight and a label, we start our iterative scheme. In odd iterations j, the algorithm computes a position uj i for each odd-labeled node si that minimizes Ci(Uj) assuming that uj i−1 = uj−1i−1 and uji+1 = uj−1i+1 ; that is, node si's even numbered neighboring nodes remain in place in configuration Uj . In even-numbered iterations, the controller does that the node si is always making progress towards the optimal position ui. Our iterative algorithm is shown in algorithm the same for even-labeled nodes. The algorithm behaves this way because the optimization of uj i requires a fixed location for the child nodes and the parent of si.By alternating between optimizing for odd and even labeled nodes, the algorithm guarantees.

```
Algorithm 2
procedure OPTIMALPOSITIONS(U^0)
  converged ← false;
  j ← 0;
  repeat
      anymove ← false;
      j ← j + 1;
      ▷ Start an even iteration followed by an odd iteration
      for idx = 2 to 3 do
        for i = idx to n by 2 do
            (uji ,moved) ← LOCALPOS(oi, S(si), sdi );
            anymove ← anymove OR moved
            end for
      end for
      converged ← NOT anymove
  until converged
end procedure
```

Mathematical Model

1. Input: fP,S,O g
a. Where P is the packet
b. S is the nodes
c. O is the locations
2. Output: for optimized energy
3. LocalPos(oi; ui; u(i□1); u(i+1))
oi:is the original position
ui is the final position of the node
u(i□1) the neighbour node position
u(i+1) the neighbour node position
Ci(U) = kjjui oijj + am + bjjui + 1uijj2m
Ci(U) = ci(U) + am + bjjuiui 1jj2m
Where ci(U) is the position to be calculate
Ui-1 is the neighbor nodes
For each pair of nodes si and sj in the network we define the weight of edge si; sjas:
w(si; sj) = a + bjjoi ojjj2
Where oi and oj are the original position of node si ans sj and a and b are the energy
parameter
4. Optimal position:
a. Optimalpos(U0)
U0 is the configuration start node
Let uji = (xji ; yji) be the position if node si
After the jth iteration for
j _ 0andUj = (uj1;:::; ujn)

2.5 H/W Requirement

Processor: pentium iv 2.6 ghz
Ram: 512 mb dd ram
Monitor: 15 color
Hard disk: 20 gb
Floppy drive: 1.44 mb
CD drive: lg 52x
Keyboard: standard 102 keys
Mouse: 3 buttons

S/W Requirement
Front End: C#.NET
Tools Used: VS2010
Operating System: Windows XP/7

3. Data Set

1. Displacement table of Existing system

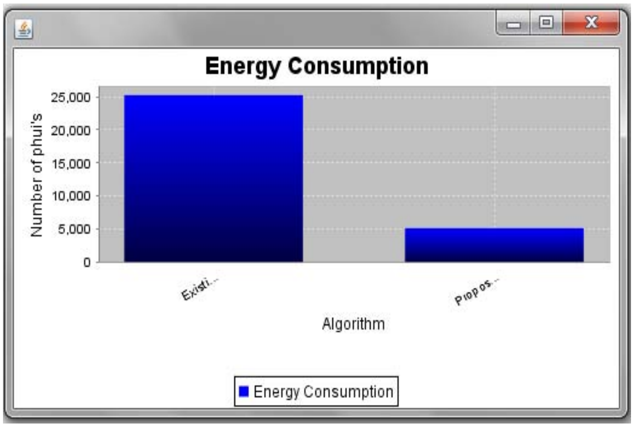
Nodes	Lat	Log	Displacement lat	Displacement log
User2	37.84665	122.48653	42.84665	127.48653
User5	37.847893	122.48781	42.847893	127.48781

2. Displacement table of proposed system

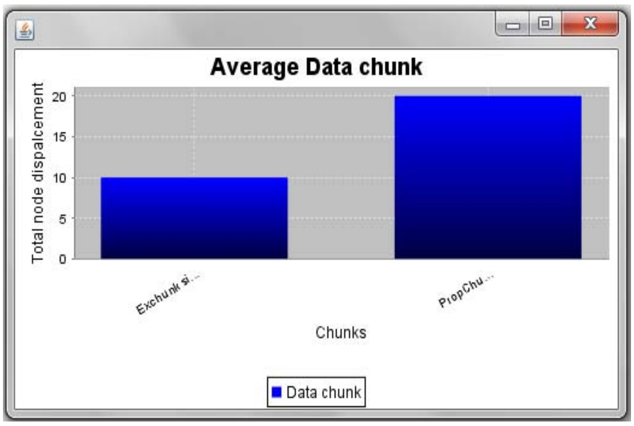
Nodes	Lat	Log	Displacement lat	Displacement log
User4	37.770172	122.41962	42.84665	127.48653
User5	37.770172	122.41962	47.770172	132.41962

3. Timing Result

Existing System	Proposed System
25219 ms	5132 ms



Graph 1: Energy Consumption



Graph 2: Average Data chunk

4. Conclusion

Our approach improves the initial configuration using two iterative schemes. The first inserts new nodes into the tree. The second computes the optimal positions of relay nodes in the tree given a fixed topology. This algorithm is appropriate for a variety of data-intensive wireless sensor networks. It allows some nodes to move while others do not because any local improvement for a given mobile relay is a global improvement.

This allows us to potentially extend our approach to handle additional constraints on individual nodes such as low energy levels or mobility restrictions due to application requirements. Our approach can be implemented in a centralized or distributed fashion. Our simulations show it substantially reduces the energy consumption by up to 45 percent.

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