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RESEARCH ARTICLE

Energy Efficient Resource Allocation in Wireless Sensor Networks

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ABSTRACT:

Energy efficiency is a critical feature of wireless sensor networks (WSNs), because sensor nodes run on batteries that are generally difficult to recharge once deployed. Sensing and communications of sensor node consume energy, therefore a proper power management and sensors scheduling is needed for better resource allocation and for maximized the network lifetime. In this paper we proposed mc-ACO (ant colony optimization) method with SSMTT (sleep scheduling multiple target tracking) algorithms. By using both of this method we can schedule the sensor node and make them awake from sleep mode to active mode when needed. It gives better resource allocation of sensor node as well as prolongs the network lifetime.

Keywords: Wireless Sensor Network, Nodes, Battery power, Energy Efficiency, Network lifetime

I. INTRODUCTION

Wireless sensor network (WSN) is an important and most useable technique in today's world. It provides various new applications in all areas such as military, environment, medicine, agriculture, mobile communication and so on [1]. The nodes in WSN are small devices each of which carries microprocessor (with an energy efficient operating system), one or more sensors (e.g. light, acoustic) or (chemical sensors), a low power and low bit rate digital radio transceiver and also a small battery. Each sensor in WSN monitors its environment and the objective of this network is to deliver some global information or an inference about the environment to an operator who could be located at the periphery of the network or they could be remotely connected to the sensor network. For example, the deployment of sensor in the border areas of a country to monitor intrusions, monitoring and control systems such as those for the environment of an office building or a large chemical factory.

Sensor or nodes in WSN are battery powered device which are generally not recharged after once deployed. Wireless communications consume significant amounts of battery power i.e. energy and that's why energy efficient operations are critical to enhance the life of such networks and also some amount of power is lost even when a node is in idle mode. A recent study shows that the more power will consumed in transmitting and receiving data or packet in standard Wave LAN cards range from 800 mW to 1200 mW. Therefore during the last few years, there has been increasing demand and interest in the design of energy efficient techniques for wireless sensor networks. Thus energy efficiency is of vital importance in the design of protocols for the applications in WSN and efficient operations are critical to enhance the network lifetime for better used. Since the Nodes in WSN are generally battery-powered; thus energy is a precious resource, that has to be carefully used by the nodes in order to avoid an early termination of their activity, and hence the study and implementation of energy-efficient algorithms for wireless sensor networks, quite constitutes a vast area of research in the field of WSN.

To improve the performance of nodes in network and prolonged the network lifetime we schedule the nodes in network and awake the sleep node when the object node or awake node wants to communicate and sensed the data in network. In Wireless sensor network, sensor or node has two operation modes one is active mode and another is sleep mode. A sensor in active mode can done its function such as monitoring task and that's why it needs energy on the other hand sleep node which are in idle mode not perform any task and it consume little energy. Here is the one issue that when node is in idle it still consumes energy, which minimized the network lifetime. To better prolong the network lifetime and resource allocation of node, this paper proposed mc-Ant Colony Optimization (ACO) technique and Sleep Scheduling Multiple Target Tracking Algorithm (SSMTT). By using both of this method the sensor node works better way.

The rest of the paper is organized as follows: Section II reviews the related work on existing energy resource allocation technique in WSN. Section III illustrates proposed work. The simulation studies are present Section IV. And finally, Section V draws the conclusion.

II. RELATED WORK

Author Jing-hui Zhong et al [3] was proposed a novel local wake-up scheduling (LWS) strategy to prolong the network lifetime with full coverage constraint. Based on the LWS strategy, author presents an mc-ACO method based on ant colony optimization, for to maximize the network lifetime. The LWS strategy divides sensors into a first layer set and a successor set. Sensors of the first layer set are activated when the network starts working, while other sensors are scheduled into sleep mode to conserve energy. Once an active sensor runs out of energy then some sensors in the successor set will be activated to satisfy the network requirements where as other sensors remain in active mode. In the proposed mc-ACO technique two different construction graphs are designed to guide the search. The first construction graph is with pheromone trails deposited on vertexes used for finding a first layer set. On the other hand the second construction graph also with pheromone trails deposited on edges, used for finding successor cover sets.

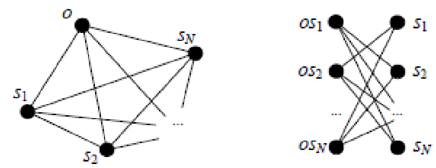
The advantage of this method is that it can completely utilize the residual energy of sensors even when sensors have different lifetime. And also it does not require the sensors changing working mode frequently. The network connectivity constraints and the routing strategy is an issue in this technique.

Author Bo Jiang et al. [6] is proposed sleep scheduling algorithm called SSMTT to support multiple target tracking sensor networks. When a node wakes up, it changes its sleep pattern according to the scheduled result and then sets the wakeup timer for the subsequent wake-up. On this active period, it may detect a target or receive an alarm message and corresponding interrupt handlers for them will be released for execution.

SSMTT can achieve better energy efficiency and suffer less performance loss than single target tracking algorithms. In this technique future work include further enhancement in energy efficiency on the alarm message transmission with collaboration among the sub areas of multiple targets and discuss the energy efficiency given specific tracking performance requirements.

III. PROPOSED WORK

The ACO is a continuous-valued met heuristic based on the ant's behavior when looking for food. Note that it was first proposed for combinatorial optimization problems. In its discrete version, each ant walks through the points of the input set and deposits pheromone on its edges. The next point selection is done probabilistically, considering the amount of jointly with the heuristic information available in the current algorithm iteration. Here we used multiple construction graphs in ACO to guide the search. The artificial ant travels the first construction graph to search for a first layer set, and then it travels the second construction graph to find a series of successor cover sets. Specifically, an artificial ant constructs a solution by the following two steps



(a) For finding first layer SNs (B) For finding successor SNs

1) Finding a first layer set: In the first construction graph, o, si and N respectively represent the starting point, the i-th sensor and the number of sensors. Pheromone is deposited on the vertexes. Starting from vertex o, artificial ants move to other vertexes one by one, and gradually find a first layer of sensors. Supposing the k-th ant is located at si, the next vertex to be visited is chosen by

$$j = \begin{cases} \max_{l \in F}\{\tau_l \eta_l^{\beta}\}, & \text{if } q \le q_0 \\ \text{proportion-selection-rule}, & \text{otherwise} \end{cases}$$

where F is the set of feasible vertexes, β is a parameter, τ_l is the pheromone value on sl, and η_l is a heuristic value which can be computed by

η_l= number of uncovered grids that can be covered by s_l

The proportion-selection-rule returns a vertex in a stochastic manner, where the probability of returning s_j is

$$p_j^k = \begin{cases} \dfrac{\tau_j \eta_j^{\beta}}{\sum_{l \in F} \tau_l \eta_l^{\beta}}, & \text{if } j \in F \\ 0, & \text{otherwise} \end{cases}$$

The ant selects sensors according to until the full coverage constraint is satisfied. These selected sensors form a first layer set and are activated when the network starts working.

Step2 – Finding successor cover sets: Once an active sensor runs out of energy, the second construction graph is utilized to search for successor sensors to satisfy the coverage requirement. The pheromone is deposited on the edges. Supposing s_i runs out of energy, the artificial ant will move to vertex os_i, and chooses a successor sensor.

Here pheromones are deposited on edges, hence τ_i should be replaced by τ_{ij} , which denotes the pheromone on the edge between os_i and s_j. If the full coverage constraint cannot be satisfied, the ant returns to os_i and selects a new sensor again until finding a new successor cover set. Then the ant continues to find a new successor cover set by the above methods. This process repetitively until no successor cover set can be found.

The another algorithm we present an energy-aware, Sleep Scheduling algorithm for Multiple Target Tracking (or SSMTT). In the proactive wake-up mechanism for target tracking, a node that detects a target (i.e., the "root node) broadcasts an alarm message to activate its neighbor nodes (i.e., member nodes) toward preparing them to track the approaching target The basic steps of the SSMTT algorithm include the following:

- Describe the target movement, especially its potential moving directions, with a probabilistic model;
- manage tracking sub areas to reduce the number of proactively awakened nodes;
- leverage the overlapping broadcasts for multiple targets to reduce the energy consumed on proactive wake-up alarm transmission; and
- schedule the sleep patterns of the sub area member nodes to shorten their active time.

IV. SIMULATION

The proposed algorithm is implemented in Network Simulator (NS2). It is a discrete event driven simulator developed at UC Berkeley. NS2 is built using object oriented methods in C++ and OTcl (object oriented) variant of Tcl**.** The goal of NS2 is to support networking research and education. It is suitable for , comparing different protocols, designing new protocols and traffic evaluations. It is developed as a collaborative environment. NS2 is distributed freely and open source. Maximum amount of institutes and people in development and research use, maintain and develop NS2. The versions are available for Linux, FreeBSD, Solaris, Windows and Mac OS X. The mobile node is designed to move in a three dimensional topology. However the third dimension (Z) is not used i.e. the mobile node is assumed to move always on a flat terrain with Z always equal to 0. Thus the mobile node has X, Y, Z(=0) co-ordinates that is continually adjusted as the node moves. There are two different mechanisms to induce movement in mobile nodes. In the first one, starting position of the node and its future destinations may be set explicitly. These directives are normally included in a separate movement scenario file.

The start-position and future destinations for a mobile node may be set by using the following APIs:

$node set X_ <x1>

$node set Y_ <y1>

$node set Z_ <z1>

$ns at $time $node set dest <x2> <y2> <speed>

At $time sec, the node would start moving from its initial position of (x1,y1) towards a destination (x2,y2) at the defined speed. In this processes the node-movement-updates are triggered whenever the position of the node at a given time is required to be known. This may be triggered by a query from a neighboring node seeking to know the distance between them, or the set dest directive described above that changes the direction and speed of the node.

In an Environmental Settings, we set val(nn) 50 which is number of mobile nodes, set val(x)1250 which is x co-ordinate value and set val(y) 900 which is y co-ordinate value. In Trace File to record all the Events, we used new trace and we create flatgrid topology. The two communication protocols are used DSDV and AODV.

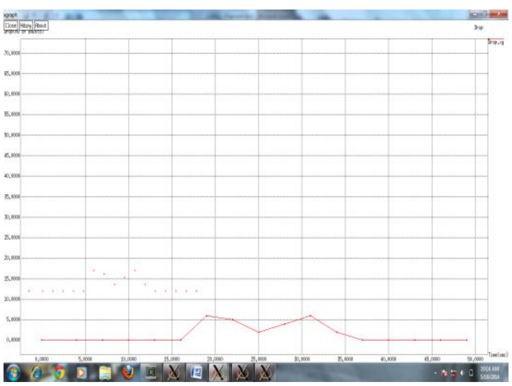


Fig 1: Drop packets

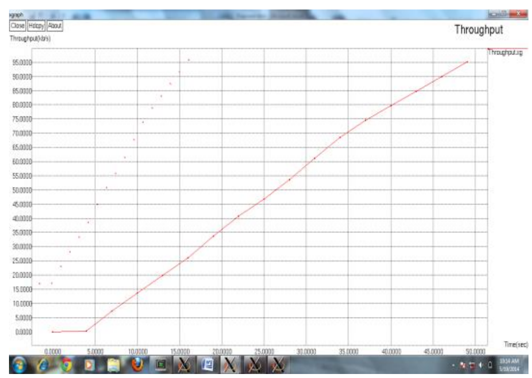


Fig 2: Throughput

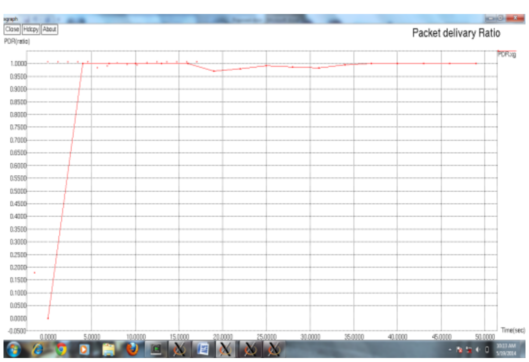


Fig 3: Packet delivery ratio

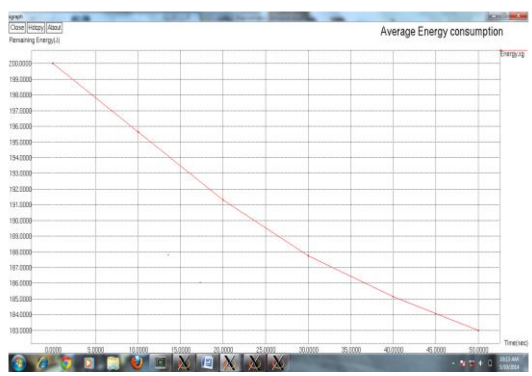


FIG 4: Average energy consumption

Fig1 shows the number of drop packets in network. The X axis shows time in second and Y axis shows number of packets drop in network. Graph show that number od packets drop in network in very much less.

So that collision, aviodances happened in network is minimum, it decreases the energy consumption and communication speed is increases. Throughput is shown in fig 2, form above graph we see that as the time increases and simulation run the data send and received in kb/sec is increases and in that particular time period it shows high throughput value which maximized the communication speed in minimized energy consumption. Fig3 shows that from starting time to end of simulation the packet delivery ratio have highest value sometime it goes little down because of some number of drop packet but overall PDR gives maximum speed of communication in network Fig 4 shows the complete networks average energy consumption. On X axis represent the time in second of simulation run and on Y axis represent energy consumption in joule. We see that when simulation starts networks consume maximized energy because hello message broadcast in network and the time goes and sleep node increases the energy consumption is reduce

V. CONCLUSION

In wireless sensor network the sensor node works prolonged in minimum energy consumption is most important aspect. In this paper we described two algorithm mc-ACO and SSMTT for better resource allocation and maximized network lifetime. In the proposed mc-ACO algorithm provides mobile or movable object node to find the shortest and successful path towards another node in network for communication and sensing the data or information which increases the speed and minimized the time consumption of sensor nodes. The SSMTT algorithm schedules the sensor node and awakes the sleep node when needed. The method implemented in this paper increases the throughput, packet delivery ratio and decreases the numbers of drop packets. So the overall network lifetime is maximized and energy consumption is minimized.

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