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Smart Sleeping Policies for Energy Efficient Tracking in Sensor Networks

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Abstract: Scheduling sensor activities is an effective way to prolong the lifetime of wireless sensor networks (WSNs). In this paper, we explore the problem of wake-up scheduling in WSNs where sensors have different lifetime. A novel Probability-Based Prediction and Sleep Scheduling (PPSS) strategy is proposed to prolong the network lifetime with full coverage constraint, tracking performance can be improved if the target motion can be predicted and nodes along the trajectory can be proactively awakened. In the PPSS strategy, to improve energy efficiency of proactive wake up. We start with designing a target prediction; based on the prediction results, PPSS then precisely selects the nodes to awaken and reduces their active time, so as to enhance energy efficiency. We enhance the proposed PPSS algorithm to detect and Track multiple mobile Targets with improved energy efficiency a recently published Energy-Efficient Local Wake-up Scheduling in Wireless Sensor Networks are used for comparison. Simulation results reveal that PPSS yields better performance compared with the Energy-Efficient Local Wake-up Scheduling algorithm.

Keywords *- Energy efficiency, target prediction, sleep scheduling, target tracking, sensor networks*

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I. INTRODUCTION

WIRELESS sensor networks (WSNs) are increasingly being envisioned for collecting data, such as physical or environmental properties, from a geographical region of interest. WSNs have been used in various applications such as education, warfare, and traffic monitoring. WSNs are composed of a large number of low-cost sensor nodes, which are powered by portable power sources, e.g., batteries [1]. Measurements on existing sensor device radios show that idle listening consumes nearly the same power as receiving.[2]. In sensor network applications where the traffic load is very light most of the time, it is therefore desirable to turn off the radio when a node does not participate in any data deliver.[3],[2]. A sensor network is composed of a large number of sensors.
Nodes, which are densely deployed either inside the Phenomenon or very close to it. The position of sensor nodes
Need not be engineered or pre-determined. This allows random deployment in inaccessible terrains or disaster relief operations. On the other hand, this also means that sensor network protocols and algorithms must possess self-organizing capabilities [4]. In current literature employing redundancy to allow some nodes to go to sleep without jeopardizing sensory coverage. These approaches imply that a minimum number of nodes must remain awake for the right degree of coverage to remain satisfied. A trade-off exists between energy savings and coverage.[3]. In a target tracking system required to ensure continuous monitoring [1]. Exist nodes that can detect the target along its trajectory with low detection delay [1], [5] or high coverage level [3]. Therefore, the most stringent criterion of target tracking is to track with zero detection delay or 100 percent coverage. In target tracking applications listening of idle nodes is major source of energy waste. For reduction of energy consumption during idle listening, duty cycling is one of the most commonly used approaches [3]. 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 [1][3].

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 [1]. In fact, it is sometimes unnecessary to awaken all the neighbor nodes 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,[3] ,[4] 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. In this paper, we present a prediction based target prediction and sleep scheduling protocol (PPSS) to improve the efficiency and enhance the energy efficiency of proactive wake up with limited loss on the tracking performance. PPSS enhances energy efficiency by reducing the number of proactively awakened nodes and controlling their active time in an integrated manner [6].

II. RELATED WORKS

Probability base prediction and sleep scheduling for energy efficient target tracking in sensor network was presented also in other papers.

The solution from reference [2] focuses on Delay efficient sleep scheduling and also show that by carefully choosing multiple wake-up slots for each sensor significant delay savings can be obtained over the single wake-up schedule case while maintaining the same duty cycling.

Reference [3] describes, the framework is optimized for rare event detection and allow favorable compromises to be achieved between event detection delay and lifetime without sacrificing coverage for each point.

Reference [4] reports describe the concept of sensor networks which has been made viable by the convergence of micro electro- mechanical systems technology, wireless communications and digital electronics.

The paper from reference [5], analyze and evaluate the energy consumption models in wireless sensor networks with probabilistic distance distributions.

In reference [6], derive closed form results for predicting surveillance performance attributes, represented by detection probability and average detection delay of intruding targets, based on tunable system parameters, represented by node density and sleep duty cycle.

In reference [7], examine the fundamental theory of sleeping in sensor networks for tracking, as opposed to the design of protocols for this sleeping.

Although sleep scheduling and target tracking have been Well studied in the past, only a few efforts [17], [18] Investigated them in an integrated manner. In [17], the Authors utilize a “circle-based scheme” (Circle) to schedule the sleep pattern of neighbor nodes simply based on their Distances from the target. In such a legacy Circle scheme, all the nodes in a circle follow the same sleep pattern, without Distinguishing among various directions and distances. In [18], Jeong et al. present the MCTA algorithm to enhance Energy efficiency by solely reducing the number of Awakened nodes. MCTA depends on kinematics to predict the contour of tracking areas, which are usually much smaller than the circles of Circle scheme. However, MCTA keeps all the nodes in the contour active without any Differentiated sleep scheduling. Typical target prediction methods include kinematics based Prediction [18], [19], dynamics-based prediction [21], and Bayesian estimation methods [20], [22].

III. DESIGNS OVERVIEW

In this section, we introduce system models, our assumptions, and overview the design of PPSS protocol.

A. System Models and Assumptions

We consider a homogeneous, static sensor network, in which sensor nodes work in a duty cycling mode. In each toggling period (TP), a node keeps active for TP _ DC, where DC is the duty cycle. Although the active period of neighbor nodes may be different, the communication among them can be guaranteed based on a MAC protocol such as B-MAC [2],[1].

B. PPSS Design

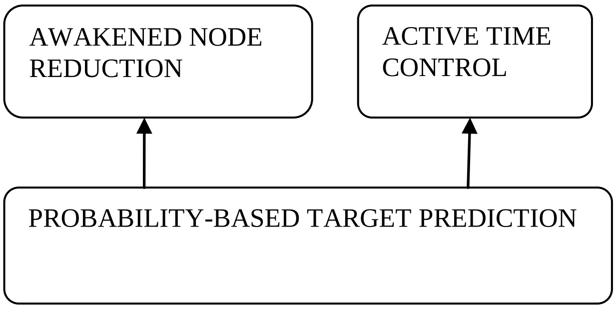

Figure.1. PPSS design overview.

PPSS is designed based on proactive wake up. When alarm node detects a target & broadcasts alarm signal to proactively awaken its neighbor nodes awakened node to prepare for the approaching target. To enhance the energy efficiency we modify this basic proactive wake up method to sleep scheduling nodes precisely. Particularly, PPSS selects some of the neighbor candidate node that is likely to detect the target to awaken. A decision on whether or not to be an awakened node, and if yes, when and how long to wake up.

For reduction of energy consumption during this proactive wake up process:

a) Reduce the number of awakened nodes.

b) Schedule their sleep pattern to shorten the active time.

Both of these energy reducing approaches are built upon target prediction results.

Figure. 1 shows the three components of PPSS:

A. Target prediction. This target prediction scheme consists of probability based prediction.

B. Awakened node reduction. The number of awakened nodes is reduced with two efforts: controlling the scope of awake regions, and choose a subset of nodes in an awake region.

C. Active time control. PPSS schedules an awakened node to be active, so that the probability that it detects the target is close to 1.

C. Target Prediction Design:

In this target prediction design nodes are divided in three categories, which are Active, Stand- by and Sleep. That nodes are describes their status of scheduling sleep pattern based on target prediction.

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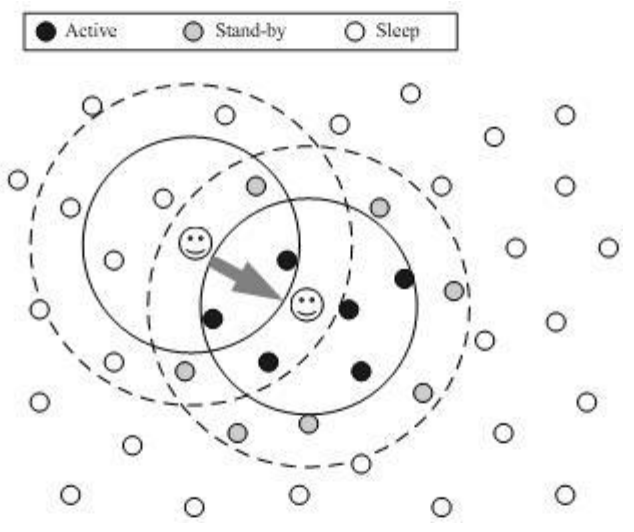


Figure.2. Scheduling sleep pattern based on Target prediction.

D. Modules:

A. Topology Formation.
B. Predicting the target and creating Local Active environment.
C. Probability prediction and sleep scheduling.
D. Modified PPSS protocol.

A. Topology Formation:

All sensors are deployed initially. Each sensor updates their information to its neighbor sensor. This is called Initial Neighbor Discovery.

B. Predicting the target and creating Local Active environment:

All sensors communicate with each other and updates the routing information once object is detected creates a Local Active environment predicts the Target movement and sends the information to base station.

C. Probability prediction and sleep scheduling:

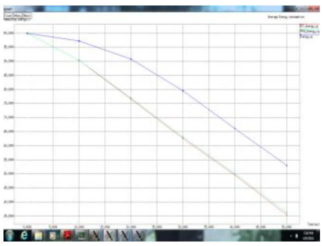
Once Target is detected creates an awake region and based on the prediction results assigns Sleep scheduling to individual sensors at synchronized time and the graph is plotted for Energy efficiency in comparison with the Existing concept along with Throughput, Packet Delivery ratio.

D. Modified PPSS protocol:

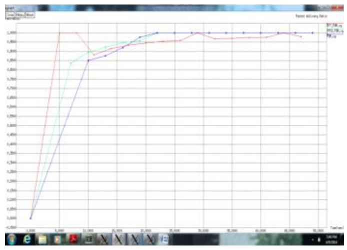
In this phase we are synchronizing the proposed PPSS protocol, i.e., Local Active environment with Boundary selection nodes in which the sensors along the boundary of the field region are activated, thus the Mobile target that comes from different directions are detected, once it detects the Moving object along the boundaries, it will start sending the information about the mobile target to the base station, so we are enhancing the proposed concept to detect multiple target along with improved power efficiency.

IV. SIMULATION RESULTS IN GRAPHICAL FORM

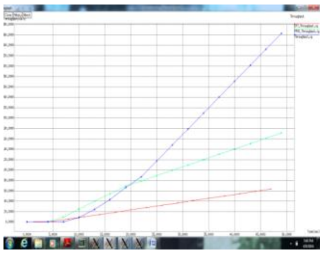
Energy consumption



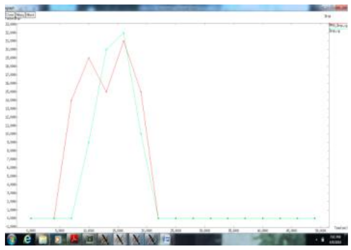
Packet delivery ratio



Throughput



Drop



A. Comparison Table Existing and Proposed system

PARAMETER	EXISTING SYSTEM	PROPOSED SYSTEM
Average energy consumption in Joules	155J In 50sec	136 J In 50sec
Packet delivery ratio	10000 Packets In 48sec	10000 In 22sec
Throughput in kbps	361 Kbps In 48 sec	171 Kbps In 48sec
Packets drop	22 Packets In 20sec	21 Packets In 20sec

V. CONCLUSIONS AND FUTURE SCOPE

The wake-up scheduling of sensors has significant impact on the lifetime and coverage of a WSN. In this paper, a duty-cycled sensor network, proactive wake up and sleep scheduling can create a local active environment to provide guarantee for the tracking performance.

Thus we efficiently schedule sleep and wake up patterns for each sensors based on the probability of the direction in which the Mobile Target moves and we have also enhanced the proposed concept to detect and track multiple Mobile Target efficiently by activating the boundary nodes. Simulation results on different networks demonstrate that the proposed PPSS yields better performance than the previous defined protocol. Future work is to extend the algorithm framework to other network models such as those take into account the network connectivity constraints and the routing strategy.

We improve Energy efficiency with an acceptable loss on the tracking performance and increase the through put, packet delivery ratio and reduce the packet drop so in future we can further optimize the PPSS protocol to increase the through put and tracking performance. we synchronizes the proposed PPSS protocol, i.e., Local Active environment with Boundary selection nodes in which the sensors along the boundary of the field region are activated, thus the Mobile target that comes from different directions are detected, once it detects the Moving object along the boundaries, it will start sending the information about the mobile target to the base station, so we are enhancing the proposed concept to detect multiple target along with improved power efficiency.

In future we can further optimize the PPSS protocol to increases the throughput, decreases the drop packets and increases the packet delivery ratio and tracking performance ratio.

REFERENCES

[1]. Bo Jiang, Student Member, Binoy Ravindran, Senior Member, and Hyeonjoong Cho, Member, 'Probability-Based Prediction and Sleep Scheduling for Energy-Efficient Target Tracking in Sensor Networks',VOL. 12, NO. 4, APRIL 2013

[2]. Gang Lu_, Narayanan Sadagopan†, Bhaskar Krishnamachari_†, Ashish Goel‡ 'Delay Efficient Sleep Scheduling in Wireless Sensor Networks'

[3] Qing Cao, Tarek Abdelzaher, Tian He, John Stankovic Department of Computer Science, University of Virginia, Charlottesville, VA 22904'Towards Optimal Sleep Scheduling in Sensor Networks for Rare-Event Detection'

[4] I.F. Akyildiz, W. Su*, Y. Sankarasubramaniam, E. Cayirci 'Wireless sensor networks: a survey' 2002.

[5]. Yanyan Zhuang Jianping Pan Lin Cai University of Victoria, Victoria, BC, Canada,'Minimizing Energy Consumption with Probabilistic Distance Models in Wireless Sensor Networks'

[6] Qing Cao, Ting Yan, John Stankovic, Tarek Abdelzaher Department of Computer Science, University of Virginia Charlottesville Virginia 22904 ,'Analysis of Target Detection Performance for Wireless Sensor Networks '

[7] Jason A. Fuemmeler, *Member*, *IEEE*, and Venugopal V. Veeravalli, *Fellow, IEEE* 'Smart Sleeping Policies for Energy Efficient Tracking in Sensor Networks, VOL. 56, NO. 5, MAY 2008'

[8] Georg Wittenburg, Norman Dziengel, Christian Wartenburger, and Jochen Schiller, 'A System for Distributed Event Detection in Wireless Sensor Networks'April 12–16, 2010

[9] Yu Gu and Tian He, 'Data Forwarding in Extremely Low Duty-Cycle Sensor Networks with Unreliable Communication Links'∗ November 6–9, 2007

[10] Tian Hex, Pascal Vicairey, Ting Yany, Liqian Luo_, Lin Guy, Gang Zhouy, Radu Stoleruy, Qing Cao_, John A. Stankovicy and Tarek Abdelzaher, Achieving Real-Time Target Tracking Using Wireless Sensor Networks

[11] Yanyan Zhuang Jianping Pan Lin Cai, Minimizing Energy Consumption with Probabilistic Distance Models in Wireless Sensor Networks2010.

[12] Chao Gui and Prasant Mohapatra, Power Conservation and Quality of Surveillance in Target Tracking Sensor Networks

[13] Yingqi Xu Julian Winter Wang-Chien Lee, 'Prediction-based Strategies for Energy Saving in Object Tracking Sensor Networks',2004.

[14] Meenakshi Diwakar1and Sushil Kumar2, 'AN ENERGY EFFICIENT LEVEL BASED CLUSTERING ROUTING PROTOCOL FOR WIRELESS SENSOR NETWORKS', Vol 2, No.2, April 2012.

[15] Abolfazl Akbari , Arash Dana , Ahmad Khademzadeh and Neda Beikmahdavi, 'Fault Detection and Recovery in Wireless Sensor Network Using Clustering', Vol. 3, No. 1, February 2011.

[16] Delan Alsoufi, Khaled Elleithy, Tariq Abuzaghleh and Ahmad Nassar, SECURITY IN WIRELESS SENSOR NETWORKS IMPROVING THE LEAP PROTOCOL', Vol.3, No.3, June 2012.

[17] C. Gui and P. Mohapatra, "Power Conservation and Quality of Surveillance in Target Tracking Sensor Networks," Proc. 10th Ann Int'l Conf. Mobile Computing and Networking, pp. 129-143, 2004

[18] J. Jeong, T. Hwang, T. He, and D. Du, "MCTA: Target Tracking Algorithm Based on Minimal Contour in Wireless Sensor Networks," Proc. IEEE INFOCOM, pp. 2371-2375, 2007.

[19] Y. Xu, J. Winter, and W.-C. Lee, "Prediction-Based Strategies for Energy Saving in Object Tracking Sensor Networks," Proc. IEEE Int'l Conf. Mobile Data Management, pp. 346-357, 2004..

[20] S. Arulampalam, S. Maskell, N. Gordon, and T. Clapp, "A Tutorial on Particle Filters for Online Nonlinear/Non-Gaussian Bayesian Tracking," IEEE Trans. Signal Processing, vol. 50, no. 2, pp. 174-188, Feb. 2002

[21] A. Arora et al., "A Line in the Sand: A Wireless Sensor Network for Target Detection, Classification,and Tracking," Computer Networks, vol. 46, no. 5, pp. 605-634, 2004.

[22] R.M. Taqi, M.Z. Hameed, A.A. Hammad, Y.S. Wha, and K.K. Hyung, "Adaptive Yaw Rate Aware Sensor Wakeup Schemes Protocol (A-YAP) for Target Prediction and Tracking in Sensor Networks," IEICE - Trans. Comm., vol. E91-B, no. 11, pp. 3524-3533, 2008.