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A Survey on Energy Efficient Target Tracking in Wireless Sensor Networks

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Abstract***: A wireless sensor network is a set of sensor nodes to collect environmental data and send it to the base station. It is used in numerous applications such as wild life monitoring, security applications for buildings, Target tracking, Robot control, etc. The objective of this paper is to analyse various energy efficient target tracking methods such as Lagrangean relaxation based object tracking, MCTA, Dynamic Clustering, Continuous object detection and tracking, PPSS, Tree based and optimized power aware target tracking. The performance of these methods are analysed based on energy utilization, speed, response time, missing rate level.***

Keywords: Target tracking, Energy consumption, Drain state, Candidate node, Proactive wakeup

I. Introduction

Wireless sensor network is group of sensor nodes which are small in size, movable and predictable that is associated by a wireless medium to form a sensor field. The sensor are used to sense the environmental condition such as pressure, temperature ,humidity, pulsation, wind direction, sound intensity, speed, etc. Each sensor associated with four components namely power unit, sensor unit, processing unit, communication unit.

There are several application metric to be consider for developing the algorithm and examine the object tracking such as cluster formation, tracking accuracy, cluster head life time, missing rate level, total energy consumption, distance between source and destination object, speed,etc.

WSNs tracking a mobile target are main goal. It frequently required ensuring nonstop monitoring, i.e.; here always survive nodes that can identify the target along its trajectory. Nodes often run on batteries that are generally difficult to be recharge once deployed.

A sensor node, also known as a 'mote', is a node in a wireless sensor network that is capable of performing some processing, gathering sensory information and communicating with other connected nodes in the network.

The main apparatus of a sensor node as seen from the figure are power source, microcontroller, external memory, transceiver and one or more sensors.

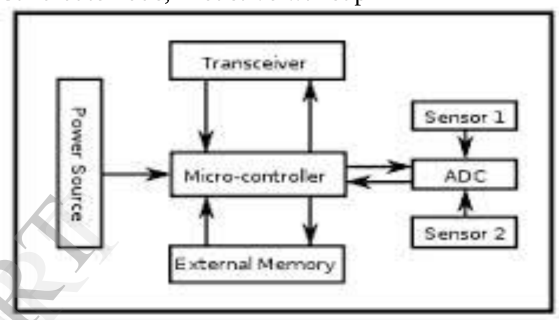

Fig.1: Architecture of sensor node

Microcontroller performs everyday jobs, process information and controls the functionality of other components in the sensor node.

In a tracking application, the sensor node sense the data at an exacting time kept in active mode and the remaining nodes are kept in sleep mode to save energy until it reach the target node. To constantly monitor mobile target, a set of sensor nodes to be in active mode just earlier than destination reaches to them. Collections of sensor nodes vary based on broadcast information to the base station and the speed of moving object.

II. APPLICATIONS

WSN consist of many applications such as Automated and smart homes, Industrial automation, Video surveillance, Monitoring of weather conditions, Traffic monitoring, Air traffic control, Medical device monitoring, Robot control etc.

Target tracking is one of the challenging significant applications in WSN and it has ability to energetically changing the environments in a monitored region. Object tracking sensor node mainly used to track the object in a monitored region and it report to the end user. The main task of the tracking sensor node is to track the object in a current location with acceptable time and dynamic process of sensing and reporting the network resources under the heavy stress.

III. LITERATURE SURVEY

All WSN used to monitor activities comparison and report events.

A. Lagrange an Relaxation-based Object Tracking

Hierarchical object tracking tree to record information about presence of the object and keep this information up to date. The leaves of the hierarchy are sensor nodes, and they are essential to identify and follow the moving states of portable objects. The further nodes are message nodes, and the information about presence of the detect objects is store at these message nodes.

In Langrangean decompose problem into sub problem. Each communication node stores in particular the set of objects that was detect equally by its descendants. The rest is called the detected set. The dilemma of energy-efficient target tracking in WSNs is modelled as a graph, G (V, L), where V is a set of communication nodes and sensor nodes random deployed in a 2D sensor field, and L is a set of relations (links) join a couple of adjacent message nodes or between a pair of a sensor node and a message node.

Using the LaGrangean relaxation method, successfully adopted to solve many famous NP-complete problems. The relaxation of the primal problem is developed first, which provides a lower bound (LB) on the optimal solutions. Since we relax three constraints of the problem (IP2), the boundary is used to design a heuristic approach to reach a primal feasible solution.

To solve the original problem near-optimally and minimize the gap between the primal problem and the Lagrangean dual problem, we improve the LB by solving the four sub-problems optimally and use the sub gradient method to adjust the multipliers per iteration. Then, subgradient optimization procedure is used for further improving these solutions by updating the Lagrangean multipliers.

Drawbacks:

Trade-off between total message cost and different other system issues, such as report frequency, response time and number of sinks, etc.

B. Minimal Contour Target Tracking (MCTA)

MCTA conserves energy by letting only a minimum number of sensor nodes participate in communication and perform sensing for target tracking. *MCTA* use the smallest tracking region based on the vehicular kinematics. The modelling of target's kinematics allows for pruning out part of the tracking area that cannot be mechanically visited by the mobile target within scheduled time. So, *MCTA* send the tracking region in sequence to only the sensor nodes within smallest tracking area and wakes them up.

C. Dynamic Clustering for Object Tracking

Dynamic clustering's mechanism for object tracking in wireless sensor networks. With form the cluster enthusiastically according to the direction of moving, the proposed method cannot only decrease the missing-rate but can also decrease the energy consumption by reducing the number of nodes that participate in tracking and minimize the message cost, thus can extend the lifetime of the entire sensor networks.

A well-organized dynamic clustering mechanism which can decrease missing rate by prediction and prolong the lifetime of the whole sensor network by minimizing energy consumption. And the energy consumption is mainly reduced in two ways: First, minimizing the number of nodes involved in tracking by constructing cluster dynamically along the target's travelling route. Second, minimizing the communication cost between sensor nodes when forming a cluster.

Drawbacks:

It cannot find with the moving information of the target, which can minimize both the missing rate and the energy consumption in dynamic cluster structure.

D. Continuous Object Detection and Tracking Method

The Continuous Object Detection and Tracking mechanism enables each sensor node to detect and track the moving boundaries of objects in the sensing field.

Monitoring continuous objects without incurring excessive communication costs requires an efficient target detection mechanism. In developing the CODA mechanism, a static backbone comprising a designated number of static clusters is constructed during the initial network deployment point.

In each static cluster, any sensor detects the object in their vicinity transmit the detected information openly to the CH. Upon acceptance this information, the CH executes a local boundary estimation function to determine the boundary sensors of the continuous object boundary which lies within its cluster. After forming these boundary sensors into a dynamic cluster, it then sends the boundary information of this dynamic cluster to designated sinks. CODA has two principal advantages.

First, the boundary sensors of the continuous objects are identified by the CHs of the static cluster rather than via a process of message exchange among the local sensors, and thus the communication overhead is substantially reduced. Second, selecting the CHs in each dynamic cluster from the boundary sensor set is not necessary.

Drawbacks:

Explicit header election scheme is not shown and excessive message exchanges are avoided.

E. Probability based prediction and sleep scheduling for energy efficient target tracking

PPSS to improve energy efficiency of proactive wake up based on both kinematics and probability. Three components of PPSS are target prediction, Awakened Node Reduction Active Time Control. Nodes operate in duty cycling mode to improve tracking performance with prediction of target motion nodes along trajectory proactively awakened. Node awakened proactively in WSN negatively influence energy efficiency and constrain benefits of duty cycling. Target prediction of PPSS precisely selects nodes to awaken controls active time enhance energy efficiency minimize tracking performance loss.

Drawbacks:

Difficult to configure protocol towards the best energy performance trade-off for a specific network environment. Overhead cost increased due to energy efficiency enhancement. Determining candidate nodes for active state was ambiguous.

F. Tree-based object tracking

Tree-based approach in which a cost is assigned to each link calculated by Euclidean distance between the two nodes.

The leaf nodes are used for tracking the moving object and then sending collected data to the sink through intermediate nodes. The intermediary nodes maintain a documentation of detected object and whenever there is a change in that documentation, they send efficient information to the sink.

More statistically-oriented algorithms for mobile target identification and localization are projected within, which allows the designer to directly model the distributional properties of sensor signals.

As physical topology of the network is considered, thus reducing the total communication cost. The object tracking involves two steps: update and query. In first step; location update cost is reduced by Deviation Avoidance Tree (DAT) algorithm and in Second step; query cost is reduced by query cost reduction algorithm.DOT; a unique protocol reports the tracking information of moving entity to moving resource. First of all, the expression neighbours are known by Gabriel graph. In target discovery step, source sends request to sensor nodes and the node close to the target replies back.

To detect moving target constantly, the spatial neighbours of next to sensor node are awaken up. In sobject tracking step, resource send enquiry to beacon node which reply back target’s next location and the source moves towards next beacon node. The process is repeated until the source catches the target.

Drawbacks:

Drain and balance tree does not replicate physical sensor network as it is a valid tree, hence a border may consist of several communication hops and may raise message cost. Second, the structure of DAB tree does not think about query price.

G. Optimized Power aware Target Tracking

Proposed Optimized Power aware Target Tracking (OPTT) scheme for energy efficient sensor node surveillance. OPTT balance energy level of target tracking based on candidate node sleep scheduling strategy Provide adequate target tracking coverage area reduced overlapping area. Optimal sensor node energy drain rate determine candidate node to be in awake state other nodes to be in sleep state for efficient target tracking.

Power levels of the candidate sensor nodes is measured to find successive candidate nodes Once candidate sensor runs out of energy highly powered successor is utilized to cover the target identification Optimal powered candidate nodes are identified based on high coverage target

Prediction, lower energy drain rate ability to predict more number of targets. Investigated the impact of target mobility on network lifetime. Awakened node with minimal energy consumption search for target objects prediction Sleep schedule state varies on the candidate node in due course of target object prediction.

Advantages:

Provide Power aware optimized sleep scheduling strategy for candidate sensor nodes .Performance constraints is imposed based on balanced energy consumption for target tracking. Better energy performance trade-off for specified application scenario. Determining candidate nodes for active state become clear. Reduced overhead cost.

V.CONCLUSION

This paper discussed various object tracking algorithms. Based on our study and analysis lagarangaen relaxation object tracking and continuous detection methods are suitable for the application which requires high speed object tracking. Probability based prediction and sleep scheduling and optimized power aware target tracking are suitable for the application which requires energy efficient target tracking. Tree based object tracking and Dynamic clustering is used to minimize the missing rate level.

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