Object Tracking Mechanism for Wireless Sensor Network Environment

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Abstract: ***In Object Tracking Sensor Networks (OTSNs), the movement of the object generally follows some definite patterns. The tradeoff between energy efficiency and accuracy of the tracking, moving object location, and arrival time, path are then used to predict the next location of the object? Our method predicts the next location of the object more accurately and increases the network lifetime. The sensor networks can be used for various application areas (e.g., health, military, home). We propose a heterogeneous tracking model, referred to as HTM. Due to the hierarchical scenery of HTM, multi resolution object moving patterns are provided. The proposed HTM is able to exactly predict the movements of objects and thus reduces the energy spending for object tracking sensor networks.***

Keywords: Data Mining, Heterogeneous Tracking Model (HTM), Object Tracking Sensor Networks (OTSNs)

1. Introduction

The important applications of WSN include environmental monitoring, object tracking application, personal healthcare, and military monitoring. Energy consumption is the primary consideration in designing an object tracking. The use of a sleeping mechanism is one of the most effective energy saving methods. Energy can be conserved in OTSNs by putting a sensor node to sleep when there is no object in the node's sensing region and turn on a sensor node when an object is to enter the node's sensing region. two types: non-prediction tracking and prediction tracking. In non-prediction tracking, the sensor nodes are periodically put to sleep in order to conserve energy and they wake up after some time to monitor the sensing region and collect the object movement information. The prediction based tracking uses the latest detected location of the object, its average speed and direction of travel to predict the next location of the object. By this way, only the sensor nodes at the predicted location of the objects can be active and thus saving significant amount of energy. a data mining methodology is proposed for discovering the region-based movement patterns of moving objects in OTSNs. Moreover, they also proposed the corresponding prediction strategies for tracking objects in an energy-efficient way.

The authors proposed a seamless data mining algorithm named STMP-Mine to efficiently discover the temporal movement patterns of objects in sensor networks without predefining the time segment. Advances in wireless communication and microelectronic devices technology have enabled the development of low-power micro-sensors and the deployment of large scale sensor networks.

The prediction-based energy saving schemes (PES) to conserve the scarce energy resource by exploiting the latest detected or average velocity of an object to predict the next node(s) that the object might visit.

- We present and compare several basic energy saving schemes for object tracking sensor networks, and point out the direction for designing an energy-aware OTSN.
- We conducted an extensive performance evaluation by simulating the OTSN and various energy saving schemes we proposed. The study provides profound insights for designing an energy aware OTSN.

2. Problem Definition

The object tracking application, develop energy saving schemes which minimize overall energy consumption and power saving using apriori algorithm, pridict the next location of the OTSN .

- The base station is permanent and positioned far from the sensors.
- All nodes in the network are harmonized and energy constrained.

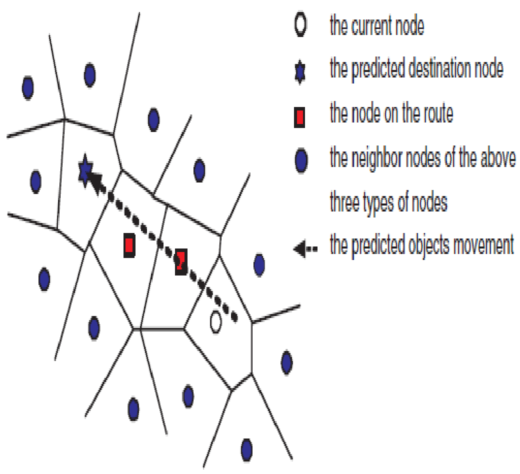

Figure 1: Sensor wake up mechanisms

- Collect information about neighborhood and neighbor priorities.

- Compute subgraph of one-hop neighbors with higher priority.
- If this subgraph is connected and if each onehop national is either in this subgraph or the neighbor of at least one node in this subgraph, the node chooses base station to move the data mining.

3. Sensor Networks Applications

Sensor networks may consist of many different types of sensors such as seismic, low sampling rate magnetic, thermal, visual, infrared, acoustic and radar, which are able to monitor a wide variety of ambient conditions that include the following.

- temperature,
- humidity,
- vehicular movement,
- lightning condition,
- pressure,
- soil makeup,
- noise levels,
- the presence or absence of certain kinds of objects ,mechanical stress levels on attached objects, and the current characteristics such as speed, direction, and size of an object.

Sensor nodes can be used for nonstop sensing, event detection, event ID, location sensing, and local control of actuators. The concept of micro-sensing and wireless connection of these nodes promises many new application areas. We categorize the applications into military, environment, health, home and other commercial areas.

2.1. Military applications

Sensor networks can be an integral part of military command, control, communications, computing, intelligence, surveillance, reconnaissance systems.

The rapid deployment, self organization and fault tolerance characteristics of sensor networks make them a very promising sensing technique for military since sensor networks are based on the dense deployment of disposable and low-cost sensor nodes, which makes sensor networks concept a better approach for battlefields. Some of the military applications of sensor networks are monitoring friendly forces, equipment and ammunition, battlefield surveillance, reconnaissance of opposing forces and targeting. Battle spoils assessment, and nuclear biological and chemical (NBC) attack detection and reconnaissance. Every troop, vehicle, equipment and critical ammunition can be attached with small sensors that report the status. These reports are gather in sink nodes and sent to the troop leaders. The data can also be forwarded to the upper levels of the command hierarchy while being aggregated with the data from other units at each level.

2.2 Battlefield surveillance

Critical terrains, approach routes, paths and straits can be rapidly covered with sensor networks and closely watched for the activities of the opposing forces. As the operations evolve and new operational plans are prepared, new sensor networks can be deployed anytime for battlefield surveillance Reconnaissance of opposing forces and terrain: Sensor networks can be deployed in critical terrains and some valuable, detailed, and timely intelligence about the opposing forces and terrain can be gathered within minutes before the opposing forces can intercept them.

Targeting: Sensor networks can be incorporated into guidance systems of the intelligent ammunition. Battle damage assessment: Just before or after attacks, sensor networks can be deployed in the target area to gather the battle damage assessment data. Nuclear, biological and chemical attack detection and reconnaissance: In chemical and biological warfare, being close to ground zero is important for timely and accurate detection of the agents.

2.3. Environmental applications

Environmental applications of sensor networks include tracking the movements of birds, animals, and insect. monitoring environmental conditions that affect crops and cattle irrigation macro instruments for large-scale Earth monitoring and planetary exploration; chemical/ biological detection, accuracy Agriculture, Biological, Earth, and environmental monitoring in marine, soil, and atmospheric contexts, forest fire detection, meteorological or geophysical research ,flood detection.

Forest fire detection: Since sensor nodes may be intentionally, randomly, and closely deployed in a forest sensor node can transmit the correct origin of the fire to the end users before the fire is spread uncontrollable. Number of sensor nodes can be deployed and integrated using radio frequencies/ optical systems. They may be equipped with effective power scavenging methods, such as solar cells, because the sensors may be left unattended for months and even years. The sensor nodes will collaborate with each other to perform distributed sensing and overcome obstacles, such as trees and rocks that block wired sensors’ line of sight.

Bio complexity mapping of the environment a bio complexity mapping of the environment requires sophisticated approaches to integrate information across temporal and spatial scales. The advances of technology in the remote sensing and automated data collection have enabled higher spatial, spectral, and temporal resolution at a geometrically declining cost per unit area . Along with these advances, the sensor nodes also have the ability to connect with the Internet, which allows remote users to control, monitor and observe the bio complexity of the environment. Three monitoring grids with each having 25– 100 sensor nodes will be implemented for fixed view multimedia and environmental sensor data loggers.

Flood detection Example of flood detection is the ALERT system deployed in several types of sensors deployed in the ALERT system are rainwater, water level and weather sensors.

Accuracy Agriculture Some of the benefits is the ability to monitor the pesticides level in the drinking water, the level of soil erosion, and the level of air pollution in real time.

2.4. Health applications

Some of the health applications for sensor networks are providing interfaces for the disabled, integrated patient monitor, diagnostics, drug management in hospitals monitor the movements and internal processes of insect and animals, human physiological data, and tracking and monitoring doctors and patients inside a hospital.

2.4.1 Tele monitoring of human physiological data

The physiological data collected by the sensor networks can be stored for a long period of time , and can be used for medical exploration . ‘‘Health Smart Home’’ is designed in the Faculty of Medicine in Grenoble France to validate the feasibility of such system. Tracking and monitoring doctors and patients.

2.4.2 Inside a hospital

Each patient has small and light weight sensor nodes attached to them. Each sensor node has its specific task. For example, one sensor node may be detecting the heart rate while another is detecting the blood pressure. Doctors may also carry a sensor node, which allows other doctors to locate them within the hospital. Drug administration in hospitals. If sensor nodes can be attached to medications, the chance of getting and prescribing the wrong medication to patients can be minimized, because, patients will have sensor nodes that identify their all ergies and required medications. Computerized systems as described in have shown that they can help minimize adverse drug events.

2.5 Home applications

2.5.1 Home automation

The smart sensor nodes and actuators can be buried in appliances, such as vacuum cleaners, micro wave, refrigerators. These sensor nodes inside the domestic devices can interact with each other and with the external network via the Internet or Satellite. They allow end users to manage home devices locally and remotely more easily. Smart environment: The design of smart environment can have two different perspectives human centered and technology centered. For human centered, a smart environment has to adapt to the needs of the end users in terms of input/ output capabilities.

The sensor nodes can be embedded into furniture and appliances, and they can converse with each other and the room server. The room server can also converse with other room servers to learn about the services they offered, printing, scanning, and faxing. These room servers and sensor nodes can be integrated with existing embedded devices to become self organizing, self regulated, and adaptive systems based on control theory models as described. Another example of smart environment is the ‘‘Residential Laboratory’’ at Georgia Institute of Technology. The computing and sensing in this environment has to be reliable, persistent, and transparent.

4. Network Environment

3.1. Sensor Network Topology

Hundreds to several thousands of nodes are deployed throughout the sensor field. They are deployed within tens of feet of each other. Deploying a high number of nodes densely requires careful handling of topology maintenance.

Pre deployment and deployment phase Senso rnodes can be either thrown in as a mass or placed one by one in the sensor field. They can be deployed by dropping from a plane, delivery in an artillery shell, sky rocket, or missile, and placed one by one by either a human or a robot.

Post deployment phase after deployment, topology changes are due to change in sensor nodes position, available energy, malfunctioning, and task details.
Redeployment of additional node phase
Additional sensor nodes can be redeploy at any time to replace malfunctioning nodes or due to changes in task dynamics.

3.2. Transmission Media

In a multi hop sensor network, communicating nodes are linked by a wireless medium. These links can be formed by radio, infrared, or optical media. To enable global operation of these networks, the chosen transmission medium must be available worldwide. Much of the current hardware for sensor nodes is based on RF circuit design.

3.3. Power Consumption

The sensor nodes being a microelectronic device, in some application scenario replacement of power resources might be impossible. Sensor node lifetime, power management and power administration take on additional importance.

5. Object Tracking Sensor Nodes

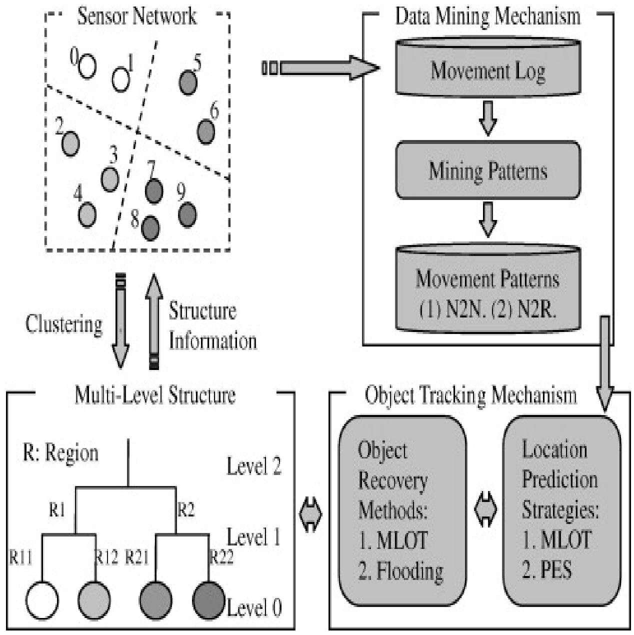

Figure 2: Object Tracking Mechanism

The energy saving, power consumption, pridict the next location in object tracking sensor networks (OTSNs).

Area coverage: maintaining full coverage of the monitoring area. Spreading Request: broadcasting from the monitoring station to the covering nodes. Data aggregation transmitting information from nodes to the monitoring center.

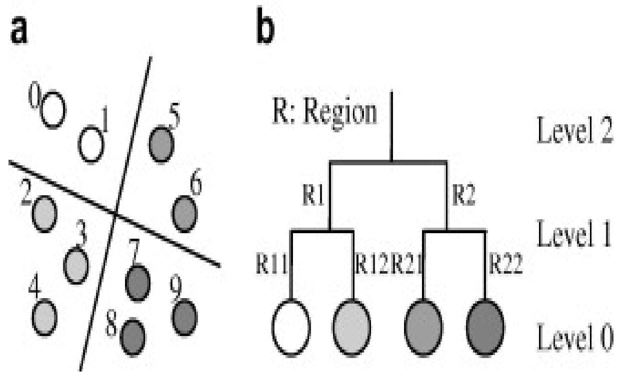

Figure 3: Sensor nodes and regions

6. Conclusion

In this paper, we have proposed an object tracking sensor networks For(OTSN). We have improved the Apriori algorithm for energy-efficiency and accuracy of tracking the field of energy saving in OTSNs; we proposed a heterogeneous tracking model, called (HTM) is able to accurately predict the movements of objects and thus reduces the power consumption ,energy saving. We have improved the (Health, Home, Environmental, military application), our approach considers past movement behavior of the object in predicting its next location.

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