A MODE SWITCHED BASED ROUTING PROTOCOL FOR MULTIPLE SINK IN WIRELESS SENSOR NETWORK

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Abstract
A Wireless Sensor Network (WSN) consists of enormous amount of sensor nodes. These sensor nodes sense the changes in physical parameters from the sensing range and forward the information to the sink nodes or the base station. Since sensor nodes are driven with limited power batteries, prolonging the network lifetime is difficult and very expensive, especially for hostile locations. So, routing protocols for WSN must strategically distribute the dissipation of energy, so as to increase the overall lifetime of the system.
Keywords: Wireless Sensor Networks, grid-based routing, Grid Head, mobile sink, energy efficiency.

I. INTRODCUTION

Recent study shows that Geographic routing is the most important routing in wireless sensor networks (WSNs). It serves with simplicity, scalability, and efficiency. This routing principle relies on geographic position information. To improve the efficiency of route search towards destination, location information is used.

Routing in Geographic domain is also useful for large multi-hop wireless networks where the nodes are not reliable and network topology is frequently changing. This type of routing requires propagation of single hop topology information that is the best neighbor, to make correct forwarding decisions.

The efficiency of this scheme is decided by Network density, accurate localization of nodes and the forwarding rule.

Some advantages of Geographic Routing are as follows:

- High mobility support decides the system efficiency. Each node sends its data to its coordinates periodically and all its neighbors update their routing tables accordingly. Thus all nodes are aware of its alive neighbor nodes.

- Scalability- It is also an important factor for geographic routing. The size of routing table depends on network density and not on network population. Hence, wider network with large number of nodes can be used without cluster formation.

Minimum overheads- All the interaction in the network are localized. This results in bandwidth minimization. It saves processing and transmission of energy and reduces routing table dimension. Instead of using the network address, a message is sent to the geographic location of destination by the source. The determination of routing path from source to destination is by forwarding the selected node at each intermediate node in a fully-distributed manner. Thus the forwarding decision is determined purely on the basis of the location of each node instead of the network size.

The research of Geographic routing has now moved towards duty cycled wireless sensor networks (WSNs). Duty Cycled WSN aims at reduction in use of power consumption. According to some sleep scheduling algorithm, some nodes are made to sleep and awake alternately. It selects a specific node while the other nodes in the network are inactive. Thus it leads to lesser power consumption.

Geographic routing is usually based on distance as its main parameter. This routing uses geographic routing oriented sleep scheduling (GSS) & geographic-distance-based connected-k neighborhood (GCKN) algorithm. But Geographic routing using distance as a parameter has many disadvantages too. The path selected using distance as a parameter causes delay and increases retransmission cost. The existing research was done to find out the shortest path from source to destination in Duty-Cycled Mobile sensor networks along with geographic routing as shown in fig 1. But, there may be the case where the path is shortest and the nodes are heavily loaded. Therefore, all these works overlook the fact that Load balancing is equally important factor. Thus, there is no load consideration in the earlier research. It leads to increase in Delay and transmission cost, decreases packet delivery ratio, throughput and hence the shortest path obtained is not optimal. These are some of the problems identified in the existing work.Hence, the need of research is to explore the various possibilities to determine the best optimal paths with load balancing. All paths in Duty-Cycled Mobile sensor networks along with geographic routing and network efficiency can be explored.

This dissertation is organized as follows- The II section describe the survey work related to the proposed system. Section III describes the proposed system to determine the best optimal path along with the load and delay. Section IV describes experimental setup with result analysis and lastly, conclusion and future scope of research is presented in section V.

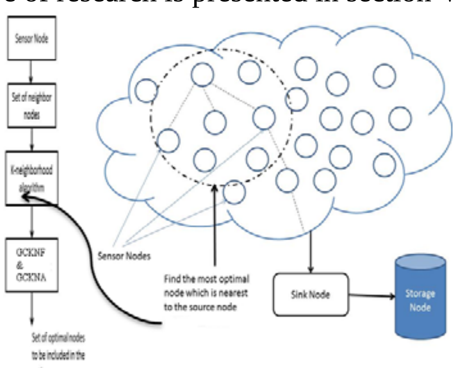

Figure: 1. Scenario of Existing System

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II. LITERATURE REVIEW

According to the taxonomy presented by Chunsheng Zhu, Laurence T. Yang, Lei Shu, Joel J. P. C. Rodrigues and Takahiro Hara in [2], a geographic routing oriented sleep scheduling (GSS) is proposed in order to deal with the latency issue imposed by duty cycling on geographic routing. The author examined the working of first transmission path of the two-phase geographic forwarding (TPGF) in a CKN based WSN and proposed a geographic routing oriented sleep scheduling (GSS) algorithm to reduce the first transmission path of TPGF in duty-cycled WSNs. TPGF can be executed repeatedly to find multiple paths and nodes in any path explored by TPGF cannot be reused, which makes the first transmission path of TPGF have access to all neighbor nodes thus tend to be the shortest and most likely utilized path compared with other paths. As geographic routing is moving towards sensor networks with duty-cycle, it can be used to save energy consumption which is a very important design factor in practical WSN application scenarios.

The author S. Sharma has proposed a paper “MSGR: a mode-switched grid-based sustainable Routing protocol for wireless sensor networks [1]” that describes a method builds a routing path using each active Grid Head which leads to the sink. For handling the mobile sink movement, the routing path changes only for some Grid Head nodes which are nearer to the grid in which the mobile sink is currently positioned. Data packets generated at any source node are routed directly through the data disseminating grid head nodes on the routing path to the sink.

The author I.F.Akyildiz has proposed a paper “Wireless sensor networks: A survey” [2] in the year 2002 that describes 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 sensing tasks and the potential sensor networks applications are explored, and a review of factors influencing the design of sensor networks is provided. It also outlined the communication architecture for sensor networks, as well as the algorithms and protocols developed for each layer. Open research issues for the realization of sensor networks are also discussed.

The author H. Luo has proposed a paper “TTDD: Two-tier data dissemination in large-scale wireless sensor networks” [3] in the year 2005 which describes an approach that provides scalable and efficient data delivery to multiple, mobile sinks. Each data source in TTDD proactively constructs agrid structure, which enables mobile sinks to continuously receive data on the move by flooding queries within a local cell only. TTDD's design exploits the fact that sensors are stationary and location-aware to construct and maintain the grid infrastructure with low overhead.

The author L. Buttyan has proposed a paper "PANEL: Position-based aggregator node election in wireless sensor networks" [4] in the year 2010, which describes the motivation for the design of PANEL i.e. to support reliable and persistent data storage applications. PANEL ensures load balancing, and it supports intra and inter-cluster routing allowing sensor-to-aggregator, aggregator-to-aggregator, base station-to aggregator, and aggregator to-base station communications.

The author Y-P. Chi has proposed a paper "An energy-aware grid-based routing scheme for wireless sensor networks" [5] in the year 2013 thatpresents the Energy-aware Grid-based Routing Scheme (EAGER) for WSN with mobile observers, which is an approach that seeks to save more energy in the context of dynamic topology. EAGER uses a rerouting method to reduce rerouting frequency and also a time-scheduling method to manage the energy consumption of the grid.

The author S. Sharma has proposed a paper "VGBST: A Virtual Grid-Based Backbone Structure Type Scheme for Mobile Sink Based Wireless Sensor Networks" [6] in the year 2015 that introduced VGBST to maintain optimal routes to mobile sink latest location and to minimize sensor nodes routes reconstruction cost.. This scheme makes sensor nodes to obtain the latest location of the mobile sink with optimal routes and reduces network overhead by using only certain cell headers.

The author A.W.Khan has proposed a paper "VGDRA: A Virtual Grid-Based Dynamic Routes adjustment Scheme for Mobile Sink-Based Wireless Sensor Networks" [7] in the year 2014 that presents a VGDRA scheme that aims to minimize the routes reconstruction cost of the sensor nodes while maintaining nearly optimal routes to the latest location of the mobile sink. It propose a set of communication rules that governs the routes reconstruction process thereby requiring only a limited number of nodes to re-adjust their data delivery routes towards the mobile sink.

The author X. Meng has proposed a paper "A grid-based reliable routing protocol for wireless sensor networks with randomly distributed clusters" [8] in the year 2016 that introduce GBRR technique which is achieved by the creation of virtual clusters based on square grids from which the next hop choice is made based on intra-cluster and inter-cluster communication quality.

The author D. Koutsonikolas has proposed a paper "Grid-based Coordinated Routing in Wireless Sensor Networks" [9] in the year 2007, which explores and compares the energy available in the network over time for different grid sizes. This work is mainly focused on energy analysis and simulation of routing and flooding in densely populated wireless sensor networks.

The author D. Koutsonikolas has proposed a paper "Hierarchical geographic multicast routing for wireless sensor networks"[10] in the year 2010 which explains HGMR, a new location-based multicast protocol that seamlessly incorporates the key design concepts of GMR and HRPM and optimizes them for wireless sensor networks by providing both forwarding efficiency (energy efficiency) as well as scalability to large networks.

The author O. Banimelhem has proposed a paper "GMCAR: Grid-based multipath with congestion avoidance routing protocol in wireless sensor networks" [11] in the year 2012, that proposes a new grid-based multi-path routing protocol which is intended to route packets fast, utilize and extend sensor nodes energy in addition to avoiding and handling network congestion when happens.

III. OBJECTIVE

The main objective of this work focuses on -

a. Determining the best optimal paths from source to destination by consideration the load and delay on each node.

b. Reducing end to end delay

c. Ensuring the better packet delivery.

d. Improving the network efficiency.

IV. APPROACH

The proposed system focuses finding the most optimal first transmission path and all transmission paths in duty cycled mobile WSN's employing geographical routing. The system introduces the concept of Load Calculation and delay as the main parameter in finding the optimal paths with Geographic Distance Based Connected k-neighborhood sleep scheduling algorithm.

In the methodology of finding optimal path, firstly, neighboring nodes of source is searched. The neighboring nodes are searched using Distance as main criteria. The load of the individual neighboring nodes of source is then calculated. Calculation of Load involves Packet Delivery Ratio (PDR) as the important parameter. Then for the same set of neighboring node we calculate the delay. Delay and PDR are chosen as main parameter as it plays an important role in maintaining efficiency of a network. Slight increase or decrease in the parameter directly affects the network efficiency.

Thus, by using all the three parameter, we get the set of nodes arranged in increasing order of distance say S1, set of nodes arranged in increasing order of delay say S2, and set of nodes arranged in increasing order of PDR (as PDR is inversely proportional to load) say S3. Finally, a node will be selected from the three sets in each iteration.

DISTANCE CALCULATION

Initially, we find the distance between the neighboring nodes as shown in the above figure2. The distance between the two nodes and all the neighboring nodes is calculated by using two geographic-distance-based connected-k neighborhood (GCKN) sleep scheduling algorithms. First is geographic-distance-base connected-k neighborhood for first path (GCKNF) sleep scheduling algorithm, which is designed to explore shorter first transmission paths for geographic routing in duty cycled mobile WSNs, while the second is geographic-distance-based connected-k neighborhood for all paths(GCKNA) sleep scheduling algorithm aims at shortening all routing paths for multipath transmissions in duty-cycled mobile WSNs. TheseGCKN algorithms incorporate the connected-k neighborhood requirement and geographic routing requirement to change the asleep or awake state of sensor nodes. Thus we get set of nodes sorted according to distance.

DELAY CALCULATION

Delay is an important Quality Of Service (QoS) parameter for forwarding data in a time constraint WSNs environment. Many Event-driven applications tend to have stricter delay constraints; the sink must be able to receive notification that a particular event has occurred in a particular region of the network within a short time period after the occurrence so that it can react appropriately. However, stringent delay requirements can severely deteriorate the network lifetime. Thus finding the occurrence of delay is very important.

Delay is the main parameter used in this work. Sometimes the nodes may be heavily loaded along the shortest path. Such cases may leads to either packet drop or packet loss and are unsuccessful in reaching the destination. This may result in causing delay in entire network.

Hence, in this work, the delay occurred at each node is calculated by sending hello packets. Initially few packets are sent from source to the neighboring nodes. Sending time and receiving time of each node is recorded respectively. The values of sending time and receiving time of packets are obtained from the trace file in Network Stimulator- 2.35. Then, by using the formula "Sending time – Receiving time," delay occurred at each node is obtained. Finally delay from the set of neighboring nodes is calculated and the node in the set is arranged in increasing order of delay.

V. SENSOR NETWORK APPLICATIONS

Sensor networks may consist of many different types of sensors such as seismic, low sampling rate magnetic, thermal, visual, infrared, and 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 continuous 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. It is possible to expand this classification with more categories such as space exploration, chemical processing and disaster relief.

1. Military applications

Wireless sensor networks can be an integral part of military command, control, communications, computing, intelligence, surveillance, reconnaissance and targeting (C4ISRT) systems. The rapid deployment, self-organization and fault tolerance characteristics of sensor networks make them a very promising sensing technique for military C4ISRT. Since sensor networks are based on the dense deployment of disposable and low-cost sensor nodes, destruction of some nodes by hostile actions does not affect a military operation as much as the destruction of a traditional sensor, 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 terrain; targeting; battle damage assessment; and nuclear, biological and chemical (NBC) attack detection and reconnaissance.

2. Environmental applications

Some environmental applications of sensor networks include tracking the movements of birds, small animals, and insects; monitoring environmental conditions that affect crops and livestock; irrigation; macro instruments for large-scale Earth monitoring and planetary exploration; chemical/ biological detection; precision agriculture; biological, Earth, and environmental monitoring in marine, soil, and atmospheric contexts; forest fire detection; meteorological or geophysical research; flood detection; bio complexity mapping of the environment; and pollution study.

3. Health applications

Some of the health applications for sensor networks are providing interfaces for the disabled; integrated patient monitoring; diagnostics; drug administration in hospitals; monitoring the movements and internal processes of insects or other small animals; telemonitoring of human physiological data; and tracking and monitoring doctors and patients inside a hospital.

4. Other commercial applications

Some of the commercial applications are monitoring material fatigue; building virtual keyboards; managing inventory; monitoring product quality; constructing smart office spaces; environmental control in office buildings; robot control and guidance in automatic manufacturing environments; interactive toys; interactive museums; factory process control and automation; monitoring disaster area; smart structures with sensor nodes embedded inside; machine diagnosis; transportation; factory instrumentation; local control of actuators; detecting and monitoring car thefts; vehicle tracking and detection; and instrumentation of semiconductor processing chambers, rotating machinery, wind tunnels, and anechoic chambers.

VI. CONCLUSION

This work will focuses on finding optimal path in wireless sensor network with consideration of load and delay at every node. In this research we will be using ns-2.35 the optimal path calculations. The shortest path found by using distance as a parameter may result in delay, as the nodes along the path may be heavily loaded. Hence only distance parameter is not sufficient and thus we understand the motivation behind load consideration.

Throughput, Delay and PDR are important QoS parameter.slight increase or decrease in these parameter may affect network performance. Our simulation result will show considerable improvement over existing system, that will take distance as a parameter for optimal path finding.

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