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ADVANCED SCHEME FOR TOPOLOGY CONTROL WITH CONNECTIVITY LEARNING IN WIRELESS NETWORKS

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ABSTRACT

The network topology will change over time due to the variation in link characteristics. The most important feature for energy saving and to improve the lifetime of the wireless sensor network is the Topology control. In this paper topology control and maintenance scheme is used which learns the varying network link characteristics using reinforcement learning technique and gives an optimal choice of paths to be followed for packet forwarding. This scheme also ensures strong connectivity in the network so that reachability between any two nodes is guaranteed. Analysis and simulation results illustrate the effectiveness of the proposed system.

Key terms*:* Wireless sensor network, reinforcement learning technique, topology control, lifetime**.**

INTRODUCTION

A Wireless sensor network is a group of specialized transducers with a communications infrastructure intended to monitor and record conditions at diverse locations. Commonly monitored parameters are temperature, humidity, pressure, wind direction and speed, illumination intensity, vibration intensity, sound intensity, power-line voltage, chemical concentrations, pollutant levels and vital body functions. These networks are subject to frequent and unpredictable changes in topology and environmental parameters. Topology control algorithms are helpful to improve energy utilization, reduce interference between nodes and extend the lifetime of the networks operating on battery power. As the nodes in the wireless network can hear the messages transmitted by many nodes within its vicinity, the causes of interference with this neighbouring nodes are very high. So it is more challenging to design a network topology for energy efficient routing. The energy utilization is more for transmission/reception compared to processing. Therefore reducing redundant paths in the network can effectively improve the lifetime of the network. The system utilizes reinforcement learning technique to learn the varying link characteristics and generates a neighbour list for each node. Transmitting packets in this neighbour list balance the network traffic and generates an optimal topology.

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EXISTING SYSTEM

In existing system the Q-learning technique is taken as a solution approach for the lifetime extension for the application area Under Water Sensor Networks based on the adaptive routing protocol. In this UWSN, the nodes only keep the routing information of their direct neighbour nodes and thus overcome the drawbacks of both reactive and proactive protocols .Shortest path nodes will drain more quickly thus reducing the lifetime of the network. In this approach the nodes energy is taken into consideration and chosen optimal paths for packet forwarding thereby increasing the lifetime of the network. Since this technique uses local information at each node and is fully distributed, it can be adapted to wireless network as well. But this Q-learning technique is a less exploited path and not so familiar in Wireless Sensor Network.

PROPOSED SYSTEM

In the proposed system the above mentioned Q-learning technique is therefore implemented in Wireless sensor networks .It consists of hundreds to thousands of small, low cost, low-powered autonomous sensor nodes that are densely deployed across environmental threatened geographical areas to monitor physical or environmental conditions and to pass cooperatively their data through the network. These sensor nodes in the network have a certain limitations as they are energy-driven devices, thus their storage, computation power, radio communication capabilities, bandwidth, life of the network is directly affected. Consider a wireless sensor network, modelled as an undirected nearest neighbourhood graph G (V, E) with set of vertices V as its nodes and link between the nodes as edges E in the graph.

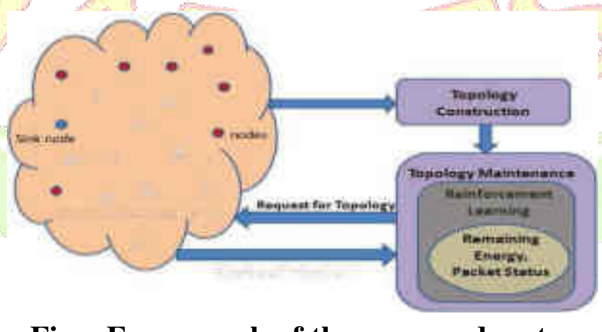

Fig a Framework of the proposed system

The model consists of two main phases, topology construction and topology maintenance. Topology control algorithm generates an initial topology which utilizes minimal total cost of communication. To maintain a strong connectivity in the network, we used minimum node degree as Log (V) and the maximum node degree as 3Log (V), where V is the number of node in the network. For selecting neighbours among the neighbour list of a node, we use three parameters Distance between two nodes, SNR value and energy. Best neighbours are chosen by considering these parameters.

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FRAMEWORK OF THE PROPOSED SCHEME

It consists of three Phases:

- Random topology Generation
- Topology Construction Phase
- Topology Maintenance Phase

RANDOM GRAPH GENERATION

In first phase, the system will generate a random topology based on Algorithm1. In the simulation environment, for the initial traffic generation, AODV or OLSR protocol have been used. Using this random topology, the topology construction algorithm generates a topology with the above mentioned node bounds and minimal total cost. In topology maintenance phase, nodes monitor the link status and trigger topology maintenance when the quality of the links goes below a threshold.

TOPOLOGY CONSTRUCTION PHASE

The system takes a random topology for the first phase as input. Each node will find out its neighbours list from the radio range. If the node bound exceeds the number of nodes in the neighbour list by more than 3log(V), then the algorithm will form a reduced topology by deleting the edges that are not in the best list. Best list is created based on the three parameters. But if the number of nodes in the neighbour list is less than log v, then add a link to the next best node for the current situation. During topology reduction, the algorithm checks for the strong connectivity of the network and selects the topology as optimal, only if it is strongly connected. Construction of the topology which meant edge detection among the nodes in the network is done in such a way that, it ensures the objectives such as minimal energy consumption, maximum network connectivity and high reliability.

TOPOLOGY MAINTENANCE PHASE

In topology maintenance phase, nodes monitor the link status and trigger topology maintenance when the quality of the link goes below a threshold. That node initiates the topology change in the network. While monitoring the network, if the power level of the node is critically low then that node will affect the overall connectivity of the topology. Thus make the node inactive and guarantee a new alternative connection in the network. The maintenance algorithm modelled with the energy calculation as start, ignites the learning algorithm within the nodes. Calling the learning function for each node is where the best links have been predicted. The neighbour node selection for a particular node is visualized in Fig.

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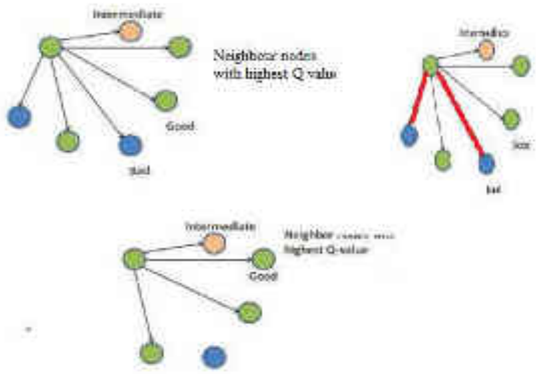

Fig b Neighbour node selection

When a node is connected to its neighbour nodes, the selection of neighbour which can provides with an effective route is chosen by considering the Q-value of the nodes. The highest Q-value nodes are selected from the neighbour list by each node. The situation where, if the number of nodes in the neighbour list is reduced to less than log(v), while removing the effected node from the network. Then add a link to the next best node according to the present scenario. Q-value is again calculated by adding up the three parameters such as distance between two nodes, SNR value and energy of each node. Looking up the connectivity details such as packet delivery and energy dropped, the learning algorithm has been executed and predicts the decision for the better node to be connected.

EXPERIMENTAL RESULTS

Implementation is done using NS 2. The Q-value and selection of best neighbour nodes is developed in NS 2. This implementation is used to forward the packets with the best nodes based on the Q-value calculated.

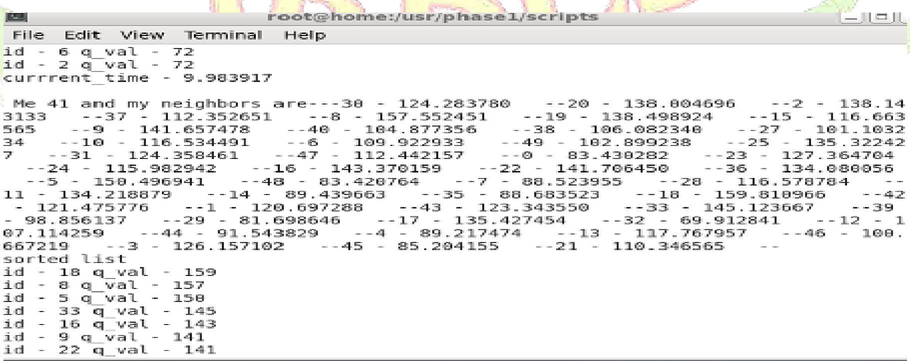

Fig 1 Q-value of each neighbour node and its Sorted list

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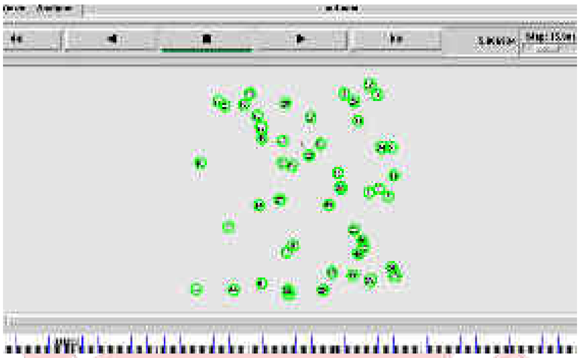

Fig 2 Random Traffic generation and forwarding of packets through best node

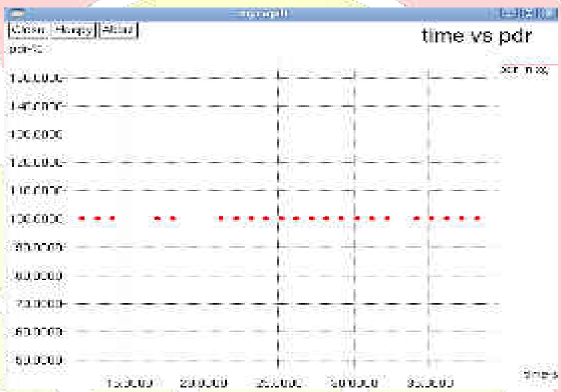

Fig 3 Packet Delivery Ratio Vs. Time

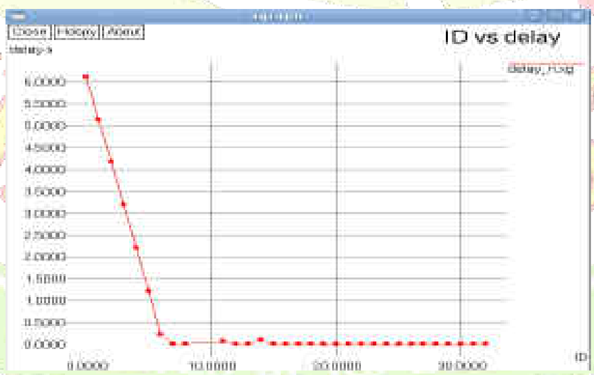

Fig 4 Delay Vs. Node ID

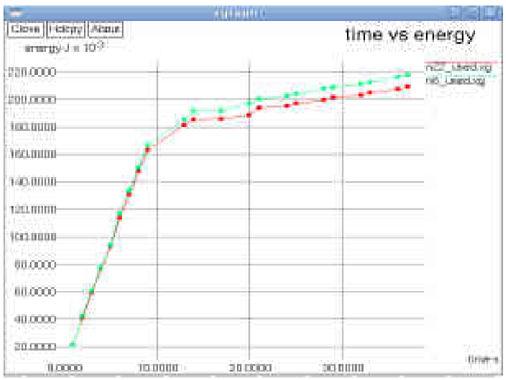

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Fig 5 Used energy of Source nodes Vs. Time

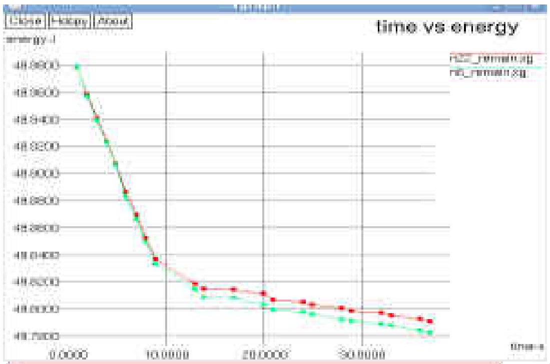

Fig 6 Remaining energy of Source node Vs. Time

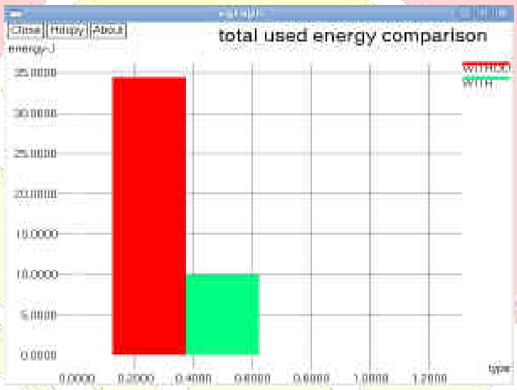

Fig 7 Used Energy Comparison of Topology control Vs. Without Topology Control

CONCLUSION

In this system, depending on the Q value of the neighbouring nodes, each node selected its neighbour list of nodes for packet forwarding. Thus numbers of message transmissions are decreased. This reduced topology generated by connectivity learning minimized the energy utilisation to a great extent. Thus a power efficient topology is generated. Due to dynamic changes there is a need to rearrange the network links. Properly maintaining topology in a dynamic network improved the lifetime of the network significantly. As the topology maintenance phase handled the unexpected link problems.

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