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A Review on Enhanced GPSR protocol For Wireless Sensor Networks

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Abstract

Greedy Perimeter Stateless Routing (GPSR), a novel routing protocol for wireless datagram networks that uses the positions of routers and a packet's destination to make packet forwarding decisions. It also offers routing support for Wireless Sensor Network (WSN). However, GPSR was designed for the symmetric links (bidirectional reachable), but sensor networks are often asymmetric in nature. So, when the destination is outside the boundary GPSR suffers by energy inefficiency as it has to trace through all the nodes in the boundary for reaching the destination. In this paper a modified version of GPSR is proposed which identifies optimal route based on energy utilization and overcome problems in GPSR so that the feasibility of using GPSR in asymmetric WSN can be increased. The simulation results prove that the energy and delay is minimized and hence the proposed protocol outperforms the existing routing protocol for WSN.

Keywords: Wireless sensor networks, GPSR, Ad hoc, Routing protocol

1. **Introduction**

A Wireless Sensor Network (WSN) is a network consisting of individual nodes that are spatially distributed devices using sensors to cooperatively monitor physical or environmental conditions at different locations as shown in Fig.1. These nodes have to collaborate in order to fulfill their tasks and wireless communication is used to enable his collaboration [1].

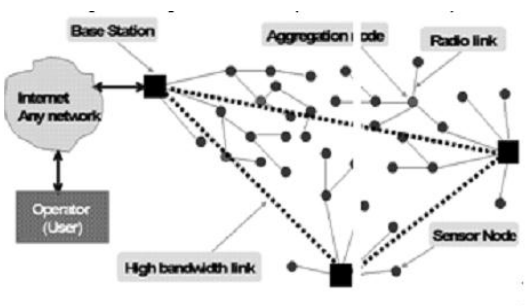

Fig. 1 Architecture of Sensor networks

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WSN nodes are battery powered, the routing protocol should consume less energy and also it should be ensured that the information transfer delay should be less. Various routing protocols are available for wireless networks are Dynamic Source Routing (DSR) [2] and Ad-hoc On-demand distance Vector (AODV) [3] are arguably the most popular of all routing protocols. Location Aided Routing (LAR)[4] introduces the concept of routing using geographical positions of nodes. It also demonstrates the use of smart flooding to build the routes. Nevertheless, it is still the source routing protocol for ad hoc networks.Low Energy Adaptive Clustering Hierarchy (LEACH) is the first routing protocol for WSN. However, LEACH is unsuitable for use in most environments that do not involve base station routing or data aggregation.Greedy Perimeter Stateless Routing (GPSR) protocol makes use of the IEEE 802.11 MAC layer [5] and suits well for symmetric ad hoc networks. However, none of these protocols support an optimal mode for delivering messages efficiently in a WSN.In this it is found GPSR happens to be a better choice and a modified GPSR is being proposed in this paper and proved to support for delivering messages efficiently and effectively in WSN.

2. GPSR

GPSR protocol [5] is the earliest geographical routing protocols for adhoc networks which can also be used for SN environment. The GPSR adapts a greedy forwarding strategy and perimeter forwarding strategy to route messages.In Greedy Forwarding under GPSR, packets are marked by their originator with their destinations' locations. As a result, a forwarding node can make a locally optimal, greedy choice in choosing a packet's next hop. Specifically, if a node knows its radio neighbors' positions, the locally optimal choice of next hop is the neighbor geographically closest to the packet's destination. Forwarding in this regime follows successively closer geographic hops, until the destination is reached.Greedy forwarding's great advantage is its reliance only on knowledge of the forwarding node's immediate neighbors. The state required is negligible and dependent on the density of nodes in the wireless network, not the total number of destinations in the network. On networks where multi-hop routing is useful, the number of neighbors within a node's radio range must be substantially less than the total number of nodes in the network.Whenever a message needs to be sent, the GPSR tries to find a node that is closer to the destination than itself and forwards the message to that node. However, this method fails for topologies that do not have a uniform distribution of nodes or contain voids. Hence, the GPSR adapts to this situation by introducing the concept of perimeter routing utilizing the right-hand graph traversal rule. Every packet transmitted in GPSR has a fixed number of retransmits [1, 5]. This information is given to the node by the medium access (MAC) layer that is required to be compliant to the IEEE 802.11 standard. This may render the GPSR protocol unusable in its normal form for WSN.

First, GPSR is designed under the assumption of symmetric wireless links. That is, whenever a node receives a beacon from another node, it considers that node as its neighbor and they are bidirectional reachable. Such an assumption may not be realistic for practical sensor networks, since wireless links in sensor networks often are asymmetric. In sensor networks, packet destinations are often marked with locations instead of identifiers like IP addresses and packets finally reach the node geographically closest to the destination, the home node of the target location.Because sensor nodes may become irregular after running for a period of time or due to unattended deployment, it is highly possible that the target location in a packet is located outside the exterior perimeter of the sensor network. In such cases, GPSR's planar perimeters algorithm does not work efficiently and all such packets have to visit all nodes on the border of the network topology before returning and recognizing the home node. This process is very energy expensive. Therefore, the concept aggregation ode is introduced where energy is efficiently used. Data consistency problem, which means data retrieved from a location in sensor networks should be consistent with data sent to the other location, becomes a challenge due to the .dynamic nature of sensor networks.Hence the selection of path needs to be enhanced to analyze proper

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routing technique with optimization in all aspects. The main objective of the paper is to propose a routing protocol for WSN so as to ensure successful data delivery, less packet delay and optimal energy consumption by modifying GPSR.

3. Enhanced GPRS

The proposed routing scheme is based on the fact that the energy consumed to send a message to a distant node is greater than the energy needed for a short range transmission. GPSR protocol is extended using aggregation node or head set node. Aggregation node is responsible for transmitting messages to the distant base station and routing is decided using the respective head set members. The head set is decided on a routine basis with reference to the energy level of the signal received to the base station at the time of reception of "hello packets". At one time, only one member of the head set is active and the remaining head set members are in sleep mode. The task of transmission to the base station is uniformly distributed among all the head set members similar to LEACH protocol. Each cluster has a head set that consists of several virtual cluster heads.The head set is decided on a routine basis with reference to the energy level of the signal received to the base station at the time of reception of "hello packets". At one time, only one member of the head set is active and the remaining head set members are in sleep mode.

The task of transmission to the base station is uniformly distributed among all the head set members similar to LEACH protocol. Each cluster has a head set that consists of several virtual cluster heads. The operation on this network involves two process. The sensor nodes receive the advertisements and choose their cluster heads based on the signal strengths of the advertisement messages. Each sensor node sends an acknowledgment message to its cluster head. Moreover, the cluster heads choose a set of associates based on the signal analysis of the acknowledgments. A head set consists of a cluster head and the associates. The head set, which is responsible to send messages to the base station, is chosen for each time based on the energy level of the signal received to the base station. Election of headsets for the clusters and members of head set transmits data to the base station.The non-cluster head nodes collect the sensor data and transmit the data to the cluster head, in their allotted time slots. The cluster head node must keep its radio turned on to receive the data from the nodes in the cluster. The associate members of the head set remain in the sleep mode and do not receive any messages. After, some pre-determined time interval, the next associate becomes a cluster head and the current cluster head becomes a passive head set member.Cluster is being optimized based on the energy level consumption in the network [10]. Head set size and energy consumption are directly proportional to each other; such that the head set size optimization in turn decides the power consumption of the network.

Once the cluster is being decided with their respective headsets then the source and destination is being decided from the base station. The network is being monitored from the base station to have entire control over it. The "hello packet" is sent from the source to the destination by means of partial flooding using the right hand rule [8]. The flooded packet is being tracked by the base station to form the routing table, to decide the optimal route with respect to energy consumption, shortest path and less delay. The optimal route decision is based on the shortest delay path and less energy consumption in

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the network as shown in flowchart represented in Fig.2. The routing table is used to decide the path for the transmission of data in the network.

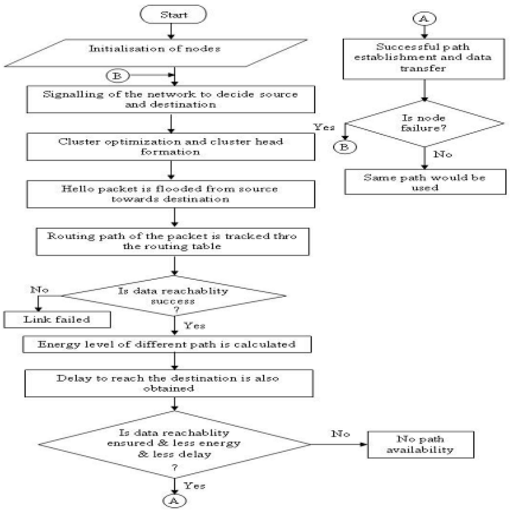

Fig. 2 Flow Chart Of Modified GPSR Algorithm

4. Result of GPSR

The source node and destination node are assumed. The source node transmits the “hello packet” to all neighbourhood nodes through right hand flooding technique. The flooded packets are tracked and a routing table is formed at the base station. Different path to deliver thepackets is found, data reachability is ensured and a routing table is formed with all the successful routes. Once the routing table is formed, the optimal route is selected based on packet delivery delay, less energy consumption and number of hops.

Fig. 3shows the energy consumption with respected the number of clusters. As expected, the energy consumption is reduced when the number of clusters is optimised. If the head-set size increases then the energy consumption decreases as shown in the graph. Thereby, even if the head-set size keeps on increasing more than the optimised value energy consumption in the network would be high. Therefore optimisation of head-set size and the number of clusters ormed is also necessary for the energy efficiency in the network.

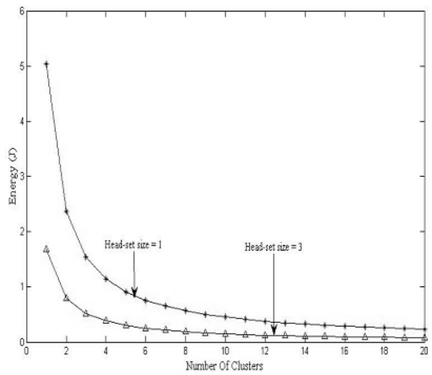

Fig. 3 Maximum number of clusters

A network should transmit the data successfully and quickly with less energy consumption. Once successful elivery and energy optimization is obtained, packet delivery delay (PDD) can be evaluated.

A hello packet is transmitted through the network and the time taken to reach the destination is identified. Fig. 4 shows the transmission time for different routes. These routes are compared with the energy optimised routes and optimal route is selected based on both energy consumption and delay.

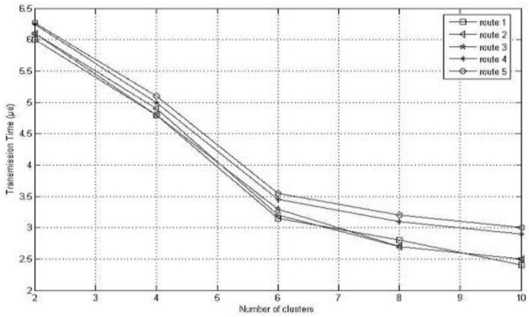

Fig. 4 PDD for HELLO packets

5. Conclusion

The modified GPSR routing protocol strives to address the unique requirements for sensor network applications. It provides a robust, energy-efficient routing protocol with the ability to route messages from node to node and guarantees the delivery of packets under situations where non-uniform transmission ranges exist. A geographical routing protocol was developed and implemented for successful data delivery to any destination within the network or to the base station. The results of proposed optimal routing indicate that the energy consumption can be systematically decreased by optimizing the clusters and head set size which also increases the efficiency of the network. The energy efficiency of the etwork is increased by ensuring the data reachability using proper routing technique. If the path is being established from source to destination, the particular path might get loaded due to the traffic conditions. If traffic density is more, then an alternative path needs to be selected from the routing table with optimal energy conservation and shortest path with less traffic. This selection of path will further improve the routing technique by reducing the PDD and energy consumption.

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