Routing Hole Mitigation by Edge based Multi-Hop Cluster-based Routing Protocol in Wireless Sensor Network

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Summary
In Wireless sensor network (WSNs) due to the harsh environments the degradation of energy is major issue. For addressing this issue, clustering techniques equalize energy utilization by distributing the workload among different clusters but energy-unaware path selection in multi-hop clustering technique leads to routing hole problem. To reduce the routing hole problem in WSNs, an energy-efficient least-edge computation (ELEC) cluster-based algorithm is proposed, which consider the value of edge count, link cost and energy level in selecting the next hope neighbor in data transmission. Results of our simulation reveal that ELEC achieves nearly double network lifetime by equal energy consumption in various parts of the network in addition just 5% energy left unused, as compared to existing routing strategies such as LEACH, GRACE, and AODV-EHA. Furthermore the percentage of node failure is half of the other existing routing strategies and 60% of packet drop noticeable decrease is noticed in ELEC as compared to GRACE, LEACH, and AODV-EHA.

Key words:
Wireless sensor network; Multi-hop clustering; routing hole problem; Energy-efficient clustering protocol

1. Introduction

Energy efficiency is a core issue in sensor networks because of dangerous environments that prevent recharging or changing of sensor node batteries in the networks. Thus, the development of processing techniques that can enhance energy efficiency and reduce power requirements across networks is an urgent concern. Balancing the energy consumption of transmission is crucial because transmission costs more than processing. With the routing protocols tasked to direct data from source to sink, significant efforts are being directed toward the design of novel [1-6] routing techniques and protocols to balance the energy consumption of the communication process.

The routing hole problem [7] is a primary concern in current routing protocols because of several shortcomings, including lack of coverage, random deployment, and ineffective routing techniques. Clustering methods equalize energy consumption by removing redundancy via aggregation and distributing the workload among different clusters. Cluster networks generally use single-hop routing in individual clusters [8]. However, the efficiency of single-hop communication lessens when the communication distance increases. By comparison, multi-hop communication is a more energy-efficient approach in large networks where inter-node distance is crucial[9]. Therefore, the present study proposes the use of a multi-hop communication technique based on combined low-energy adaptive clustering hierarchy (LEACH) and MTE protocols in clustered routing architecture to save transmission energy [10]. By equalizing energy expenditures, the proposed method increases energy performance for wireless sensor networks (WSNs). However, this method only accounts for the multi-hop communication of member nodes; the inter-cluster communications continue to be directed to the sink.

A routing hole problem emerges from the use of an energy-unaware path selection strategy in multi-hop clustering routing protocol as shown in Fig 1. A Routing Hole's consist of a region in the sensor network where a group of sensor nodes stops working and the area occupied by these nodes do not participate in the routing of the data [11]. A Routing Hole is a state where all the neighbor nodes are farther away from the destination than the node holding the current packet. The sensor node where the packet may get stuck or when the sending node failed to find the next valid node to reach the destination nodes is called as a routing hole or void node [12, 13].

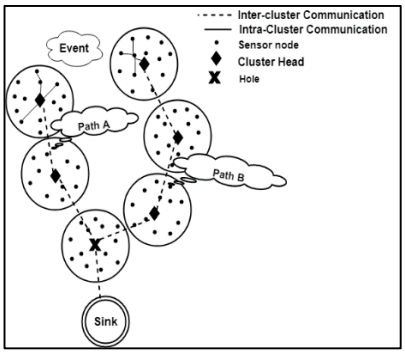

Fig. 1 Routing hole problem in the multi-hop clustering routing protocol.

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