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Mathematical Model Used to Compute Packet Energy Consumption-Based Control Topology for WSN

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Abstract

Several recent scientific papers have been proposed on power consumption in Wireless Sensor Networks (WSN). Still, the work focused on control topologies of WSN in the field of increasing and prolonging the whole network is limited. This results from their function as routers that send data from edge nodes to the sink. The nodes around the sink node quickly die while delivering much data through intermediate nodes from one node to the sink node. The network lifetime was reduced because the sensor nodes adjacent to the sink consume twice as much power as the others. This problem is not recognized and addressed in more visual detail by the authors. The nodes closest to the sink node will die first. Therefore, this paper proposed a mathematical model to represent packet energy consumption with control topology for WSN. Due to the simulation, more than 90% of sensors are still operational and optimally arranged. The overall battery power remaining in the sensors was greater than 70%.

Keywords: Data frame, Energy efficiency, Network lifetime, Network topology, Power consumption

1. Introduction

In WSN, energy efficiency is one of the main objectives of many authors. Where sensors have limited power. The routing protocols are the set of defined rules used to improve the performance of wireless networks [1]. Hence, some nodes may use the same route, leading to the exhaustion of intermediate nodes of this route. Each node's tasks require it to function independently as a host. In addition, some environments might be sensor nodes distributed in very hazardous areas. Hence, the nodes of WSN power are supplied through batteries with finite energy [2]. Consequently, it is important to increase the prolonged lifetime of WSN by minimizing energy requirements across all levels of the network. [3]. Control topologies are very important in growing prolonged networks in the WSN [4]. In addition, the IEEE 802.15.4 standard is intended to provision a long battery lifetime [5]. Whereas the Media Access Control (MAC) and PHY layers of Low-Rate Wireless Personal Area Networks (LR-WPANs), which are a low-cost, low-data-rate wireless access technology for devices that are operated or work on batteries, serve as the foundation for other higher-layer standards like ZigBee, 6LoWPAN, and MiWi [6]. However, some measures must be taken to make the standard applications for sensor network systems operate longer. Routing is a crucial component of every network and is crucial for reducing the power consumption of wireless sensor networks [7], [8]. Finding the optimum route increases the lifespan of WSN. To obtain energy savings over the entire network [9] that depend on allocating energy usage in the whole network evenly will be sufficient. When a high volume of data is sent by using intermediary nodes to connect one node to another, this causes a rapid dyeing node for individuals near the sink node [10]. Consequently, the whole network could crash. The sensor node closest to the sink drew more power than the others and failed more quickly, which reduced the network lifetime.

In 2018, Yang et al. [11] presented a novel carrier sense multiple access collision avoidance and time division multiple access hybrid scheme protocol medium access control on the MAC layer, improved performance while reducing energy consumption for mobile WSNs with 3-D position prediction algorithms. Shojafar et al. [12] presented and tested an adaptive energy approach for Networked Fog Centers (NetFCs) that could offer quality-of-service guarantees for traffic provided to vehicle clients, immediate rate jitters, and overall processing delays. In 2021, Asuti and Basarkod [13] showed that their suggested simulation results exceed DSME-GTS techniques regarding performance parameters, including packet delivery