Fuzzy Data Aggregation Approach to Enhance Energy-Efficient Routing Protocol for HWSNs

Asaad A Alhijaj[1], Baida'a Abdul Qader Khudor[2], Imad S. Alshawi[*3]
Email: asaad.abdulhassan@uobasrah.edu.iq[1], baidaa.khudur@uobasrah.edu.iq[2], emad.alshawi@uobasrah.edu.iq[3]
[*]Imad S. Alshawi
Department of Computer Science, College of Computer Science and Information Technology,
University of Basrah, Basrah, IRAQ

Keywords: cluster partition, fuzzy data aggregation, HWSNs, routing, spider monkey optimization

Received: July 5, 2022

The sensor nodes' computing capability, communication capabilities, and power supply are severely constrained in WSNs, making sensor battery replacement or recharging difficult or even impossible. Therefore, energy is an important challenge to consider while creating WSNs. In hazardous circumstances, accurate data aggregation and routing are crucial, and the energy consumption of sensors must be closely controlled. Due to environmental conditions and short-distance sensors, however, there is a high possibility of duplicating data. Large datasets include a range of data, some of which are helpful while others are entirely unnecessary. This redundancy reduces performance in terms of redundant transmission and computation expense. Data aggregation, on the other hand, may reduce duplicate data in a network, hence reducing the volume of data sent and increasing the network's lifespan. In this context, two novel energy-conscious approaches called Fuzzy Data Aggregation with Spider monkey optimization (FDA-SMORP) for data aggregation in the cluster head and routing to the sink are presented. These strategies attempt to offset the energy consumption among all nodes in a wireless network such that these nodes exhaust all of their energy and die almost simultaneously. To demonstrate the efficacy of the suggested approaches in terms of minimizing delay caused by route planning, balancing energy usage, and extending network lifetime, the proposed methods are compared to some of the most well-known WSN systems.

Povzetek: Razvit je sistem za nadzorovanje potrošnje energije v senzorskih brezžičnih omrežjih.

1 Introduction

A WSN has a large number of nodes that can sense changes in the real-world environment. All aspects of human existence may benefit from a wirelessly networked sensor, such as smart buildings, the Internet environment, battlefields, industry, healthcare, and agriculture, and these are just a few of the uses of WSN[1]. The life of the network decreases as the sensors run out of power. These problems can only be solved if energy is used in the most efficient way possible. Because nodes create comparable data when placed close to each other or sent to data at the same time, this can cause data redundancy issues. This reduces network life energy consumption during processing, sending, and receiving data. To solve this problem, instead of sending each felt value to the sink separately, the data is first collected and aggregated using aggregate functions such as sum, average, etc., and it is then passed through routing protocols to deliver the data to the sink[2], [3].

Data aggregation is the analysis of raw data attributes and the application of correlations. Using a data aggregation approach, sensor nodes turn unprocessed data into a digest before delivering it to the sink. Data aggregation minimizes transmission costs and network overloading as a consequence of the decreased size of the digest. We argue that data aggregation is a critical method for reducing energy consumption in WSNs [4], [5]. However, there are still several obstacles to overcome before data aggregation performance can be improved. Existing contributions describe many aggregation algorithms that organize sensor nodes based on raw data to aggregate information. Nevertheless, aberrant data frequently emerges in raw data. Consequently, data instability has a direct impact on the efficiency of such approaches[6], [7]. In WSNs, there are a lot of ways to reduce the amount of data; like that each sensor collects before sending it to the sink, or while aggregating data in the cluster head (CH). Or use a way for the data packets to be routed like an efficient clustering solution with data aggregation, employing several mobile sinks for heterogeneous WSN[8].
Several researchers have highlighted the problem of data aggregation with routing in WSNs [9], [10]. When it comes to WSNs in general, the most difficult problem is finding ways to improve energy efficiency so that the network can last much longer [11], [8].

Table 1 summarizes the related works with their methodology, performance, and results. So, the current