

# Chapter 14

## Energy Optimization of Routing Protocol in Wireless Sensor Network

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### **ABSTRACT**

*In many modern situations, wireless sensor networks play a crucial role, used for monitoring things like environmental conditions, transactions, and various statuses. These networks gather a large amount of data, sending it to a central hub for analysis. However, a significant problem is that traditional wireless sensor networks heavily rely on energy, and this limits how long they can operate. This chapter develops an optimization approach for a variable clustering routing protocol to address the issue. The objective is to enhance the cluster structure in wireless sensor networks while reducing energy loss in cluster heads. The first step involves employing a dynamic estimation method for clustering to determine cluster heads, utilizing core concentration to establish the head within the cluster radius. The authors also introduce a fuzzy logic algorithm to handle uncertainties in selecting cluster heads. The residual energy of the cluster's head nodes, maintaining a balanced distribution of cluster heads, and optimizing node use of energy are all taken into account by this fuzzy logic approach. An ant colony algorithm-based technique*

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*for optimizing inter-cluster transport is presented in this outline. The primary objective is to optimize energy consumption while simultaneously reducing the data communication overhead among cluster heads. Chaotic mapping is utilized by this technique to update and perturb pheromones, ensuring optimal performance. Energy utilization among cluster heads is optimized by selecting the optimal path based on considerations of energy dispersion parameters and distance coefficients. Our experiments show that compared to traditional algorithms, Researchers provide a non-uniform clustering approach for route optimization that dramatically extends the network lifespan by 75% and lowers overall energy consumption by about 20%. This effectively optimizes network energy utilization and significantly extends the network lifetime, demonstrating the practical effectiveness of our method.*

## **INTRODUCTION**

WSN are essential in many different domains like national defense, military, and industry. The communication protocol for these networks involves multiple layers, with energy management being critical for extending the system's lifespan. Wireless sensors, which make up the network, are small units tasked with data-related functions, relying on small batteries for power. In challenging environments, timely battery replacements are difficult, leading to network downtime.

In the context of the IoT, this study emphasizes the critical necessity of optimizing energy nodes and maximizing the network lifecycle to address pressing concerns regarding energy balance in WSN. The main goal is to maximize energy use across the board and strive to achieve fair distribution and lengthen tenure (Liu et al., 2018).

At routing protocol level, the paper discusses hierarchical and planar routing protocols. The planar protocol focuses on broadcasting data to adjacent nodes but lacks scalability and energy balance advantages. In contrast, the hierarchical protocol, based on clustering, involves cluster head and conventional nodes for efficient data transmission to the base station.

The research introduces a nonuniform clustering protocol for routing optimization, which begins with the efficient utilization of energy in head clusters before proceeding to clustering, addressing issues present in conventional routing protocols. To overcome uncertainties in selecting cluster heads and achieve balanced allocation and energy consumption, the method employs fuzzy logic and adaptive estimation clustering.

An intercluster routing optimization approach leveraging ant colony algorithms is proposed to enhance efficiency. Chaotic mapping is introduced to ensure optimal pheromone development, considering variables such as energy dispersion and distance for effective energy expenditure between cluster heads.

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