An Energy Efficient Routing Algorithm using Chaotic Grey Wolf with Mobile Sink-based Path Optimization for Wireless Sensor Networks

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***Abstract*—The task of deploying an energy-conscious wireless sensor networks (WSNs) is challenging. One of the most effective methods for conserving WSNs energy is clustering. The deployed sensors are divided into groups by the clustering algorithm, and each group's cluster head (CH) is chosen to gather and combine data from other sensors in the group. Mobile Wireless Sensor Networks, which enable moving the sink node, aid in reducing energy consumption. Thus, this paper introduces an energy efficient clustering algorithm and optimized path for a mobile sink using a swarm intelligence algorithms. The Chaotic Grey Wolf Optimization (CGWO) approach is used to form clusters and identify CHs. While utilizing the Slime Mould Algorithm (SMA) for determining the shortest path between a mobile sink and CHs. The effectiveness of the suggested routing strategy is evaluated against that of other current, cutting-edge protocols. The findings demonstrate that in terms of overall energy consumption and network lifetime, the suggested algorithm performs better than others. While for stability period the proposed algorithm outperforms three of compared algorithms and was close to the fourth.**

Keywords—Wireless sensor network; clustering algorithm; grey wolf optimizer; slime mould algorithm; mobile sink

I. INTRODUCTION

Mobile Wireless Sensor Networks (MWSNs) enable the movement of entities within a network, functioning as sensor nodes or sinks through mechanisms like wheels, humans, animals, or robots [1, 2]. MWSNs offer a solution to the hotspot problem often encountered in traditional Wireless Sensor Networks (WSNs). In a hotspot scenario, sensor nodes situated near a sink used as a relay tend to deplete their energy rapidly, as the sink increases the communication load on these nearby sensors [1]. MWSNs find applications in various domains, including but not limited to the military, industrial monitoring, habitat observation, healthcare, home networks, disaster management, and security [3]. These applications encompass fire detection systems in forests, battlefield surveillance, traffic monitoring, smart homes and hospitals, pollution control, rescue missions [4] and oil well monitoring.

Clustering algorithms play a crucial role in reducing energy consumption within WSNs. These algorithms partition the sensor nodes into distinct groups or clusters, with each group having a designated cluster head (CH) responsible for coordinating communications between its members and the sink. Clustering can be implemented through various approaches, such as distributed, centralized, or hybrid methods [5]. Sensors consume a significant amount of energy due to their tasks, which include environmental sensing, data transmission, mobility, cluster head (CH) selection, and frequent cluster formation [6]. Additionally, energy demands increase with larger data sizes and greater distances between sensors and the sink.

Numerous algorithms have been proposed to mitigate energy consumption, with clustering being a widely adopted approach. Clustering involves selecting CHs and forming clusters to reduce the number of sensors communicating directly with the sink, thus optimizing communication. Therefore, the process of CH selection is pivotal in clustering. Recent research [6, 7] has explored the use of intelligent swarm algorithms to aid in CH selection, such as ant, firefly, and Grey Wolf Optimization (GWO) algorithms.

This paper investigates the reduction of energy consumption in MWSNs by introducing an enhanced clustering algorithm and optimizing the path for a mobile sink using a swarm intelligence algorithm. Specifically, it employs the Chaotic Grey Wolf Optimization (CGWO) algorithm [8] for CH selection and the Slime Mould Algorithm (SMA) [9] to determine the shortest path between a mobile sink and CHs to reduce energy dissipation, and hence extends the WSN's life cycle.

The proposed algorithm has the following contributions:

- Employing the CGWO algorithm as a clustering mechanism in MWSNs which to the best of our knowledge has not been investigated up to now in this field.
- Utilizing the SMA algorithm for sink node route determination in MWSNs has not been well studied up to now, and this study aims to fill this gap.
- The results of the proposed algorithm are compared to those of four other state-of-the-art algorithms GWO [10], ACO [11], FA [12], and PSO [13]. in terms of several performance metrics such as network lifetime, stability period, and total consumed energy.

The rest of this paper is structured in five sections. Section II presents the related work. Section III provides the