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An Enhancing the network lifetime Using hybrid meta-heuristic-based Optimization Technique in Wireless Sensor Networks

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ABSTRACT: Managing energy efficiency is a sturdy process in any wireless sensor application. Several protocols were proffered to ameliorate network lifespan in Wireless Sensor Networks(WSN). Efficient energy management and reliability achievement is a demanding mission. In this research work, a spanking energy-efficient multi-hop routing protocol is intended to sort out the aforementioned issues. A novel model is presented to perform clustering and energy-efficient routing. The network model is designed with a Super-Cluster Head (SCH) that manages the members termed as Cluster Heads (CH). The network information is maintained by the SCH. The stability of the path and reliability ratio of the route is computed to provide stable energy-efficient network management. The network is simulated using a powerful simulation tool, MATLAB to analyze various performance factors in the network considered. Next, a metaheuristic approach that promotes load balancing and energy-efficient data transmission using the Fruit Fly Optimization Algorithm (FFOA) is presented. The approach combines the existing protocol with Differential Evolution (DE) to select the optimum cluster head in every cluster. Based on the osphresis and vision foraging behaviour of fruit flies, the algorithm is designed to provide energy-efficient data transmissions. The selection of cluster head is drawn on the aspects like node concentration, prevailing energy, and the inter-space between the nodes to the base station. It provides an optimal solution for the nodes in over lapping CHs and energy problem that occurs due to uneven clustering newline.

KEYWORDS: - Hybrid meta-heuristic-based Optimization, Super-Cluster Head Selection, Fruit Fly Optimization Algorithm, Network Lifetime, Energy efficiency.

I.INTRODUCTION

Wireless Sensor Network is an organization of auto-configured sensor nodes with each node connected to several autonomous sensors that are distributed spatially over a geographic area to supervise environmental surroundings like temperature, humidity, pollutants, etc. The aggregated data are transferred from the node through wireless medium to a central gateway that is linked to an external network using the controller and communication system.

The sensor network consists of a group of sensor nodes which are randomly distributed and collect the information from the environment through the intermediate node. The sensor nodes are restricted in computation and processing resources, as they are operated using a battery source.

The essential components of WSN include the sensor nodes, control and power unit, sink, and communication network. The sensor nodes amass raw records from the physical environment and commute them to the sink node through the wireless communication network.

The sensor nodes are miniature in size, economical by the price, with a limited resource of energy and transmission range. A sensor performs sensing, transmission, processing of data using the components. The sensor network is grouped into a set of clusters, and every cluster is controlled by the node as a cluster head. The main role of cluster head is to coordinate the data transmission activities of the cluster nodes and aggregation of the information to the base station.

II. RELATED WORKS

Previous research has explored various optimization algorithms in Wireless Sensor Networks (WSNs) to improve network lifetime. Genetic algorithms, particle swarm optimization, and ant colony optimization have been applied to extend network longevity. Studies have investigated the effectiveness of metaheuristic approaches in WSNs. Metaheuristic algorithms such as simulated annealing and tabu search have been adapted to address energy efficiency and network lifetime challenges. Some recent works have proposed the combination of multiple metaheuristic techniques, resulting in hybrid strategies. These hybrid approaches aim to leverage the strengths of different algorithms to achieve better network lifetime and energy utilization.

III.EXISTING METHOD

Metaheuristic is an approach method based on a heuristic method that does not rely on the type of the problem. The metaheuristic method can be distinguished into two which are metaheuristic with single-solution based (local search) and metaheuristic based on population (random search). Combine multiple metaheuristic optimization techniques, such as Genetic Algorithms (GAs) and Particle Swarm Optimization (PSO), to find the optimal network configuration. Implement a local search mechanism within the metaheuristic approach to improve the solution quality.

IV.PROPOSED SYSTEM

We employ a hybrid metaheuristic optimization technique, which combines multiple optimization algorithms to efficiently manage the network's energy resources. This hybrid approach aims to strike a balance between various optimization criteria, including energy efficiency, network coverage, and data routing. The system will implement energy-efficient routing protocols that consider the remaining energy levels of sensor nodes. This ensures that energy is distributed evenly, preventing premature depletion of certain nodes. This system will employ adaptive data rate control to adjust the transmission power and rate based on the network's requirements. This helps in conserving energy without compromising data delivery.

V.BLOCK DIAGRAM

The block diagram of this system typically consists of several key components. At its core, sensor nodes collect data from the environment. This data is then routed through a network, which may include cluster heads or base stations. The hybrid metaheuristic optimization technique comes into play during data transmission and routing. It optimizes the routing paths, cluster formation, and energy management strategies. This technique often combines various metaheuristic algorithms such as genetic algorithms, particle swarm optimization, and simulated annealing. The outcome is an efficient, energy-aware network, which prolongs the lifetime of WSNs by reducing energy consumption and improving data reliability. This, in turn, facilitates the seamless and extended operation of wireless sensor networks in various applications, such as environmental monitoring, healthcare, and industrial automation.

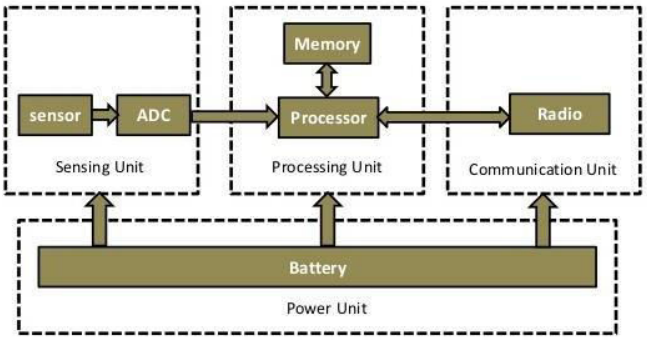

Fig 1. Flow diagram for proposed method

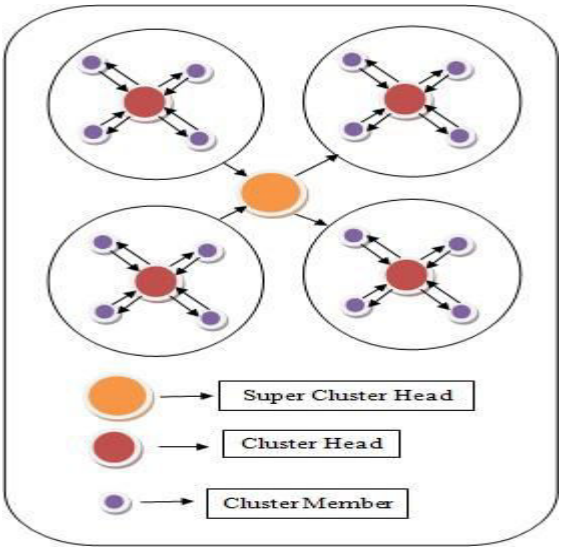

Fig 2. Network model

The sensor node with maximum energy is elected to be the Super Cluster-Head (SCH) as displayed in Figure 2.

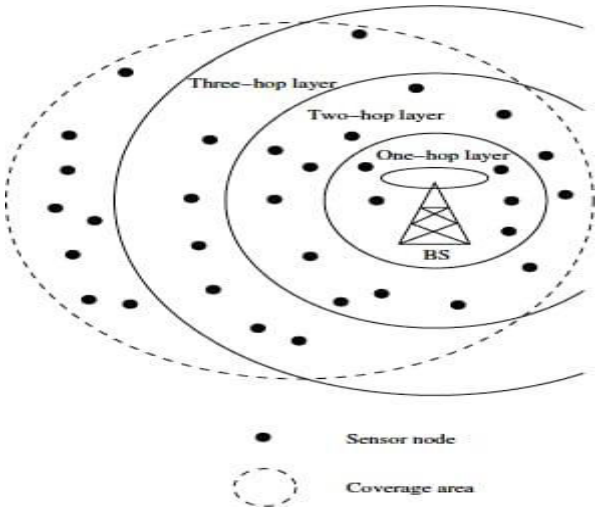

Fig 3. Layered Architecture

VI. EXPERIMENTAL RESULTS

The MATLAB simulation tool is used for simulation purpose. It evaluates the performance of the proposed technique with existing technique i.e. GSTEB on the following metrics i.e. stability period, network lifetime, residual energy (average remaining energy), and throughput by taking 100 sensor nodes.

To evaluate the effectiveness of the proposed technique, it has been compared with two well-known meta-heuristic based energy efficient protocols. These meta-heuristic techniques are Genetic algorithm and Ant Colony Algorithm. To compare the proposed technique with other techniques residual energy and throughput metrices have been considered.

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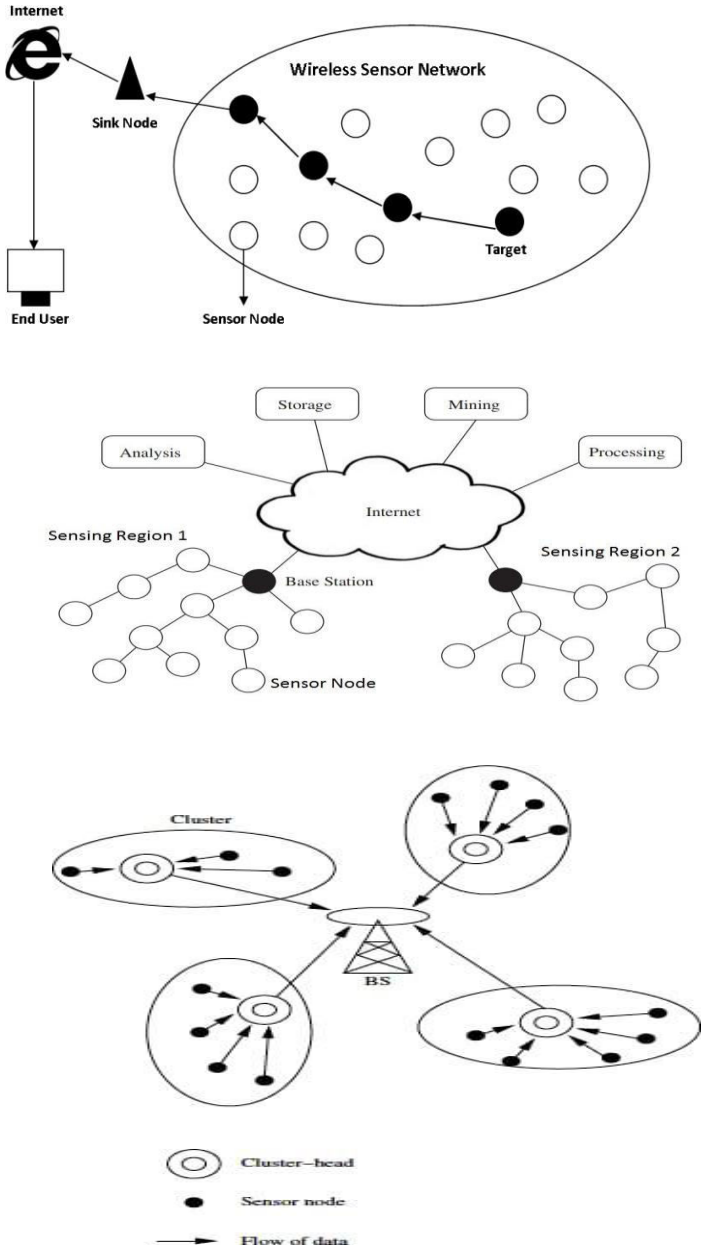

Fig 4&5. Traditional Wireless Sensor Network

VII. FUTURE SCOPE

The future scope for enhancing the network lifetime in Wireless Sensor Networks through hybrid meta-heuristic based optimization techniques holds great promise. This approach can lead to significant advancements in energy-efficient communication and sensor management. By combining multiple optimization methods, we can achieve superior results in terms of network longevity and data reliability. This research can pave the way for more sustainable and robust wireless sensor networks, enabling applications in various fields, such as IoT, environmental monitoring, and smart cities. Additionally, as technology evolves, the integration of machine learning and AI into these optimization techniques is a compelling avenue for further exploration, offering even more sophisticated solutions for network enhancement.

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VIII. CONCLUSION

The application of hybrid meta-heuristic optimization techniques in wireless sensor networks represents a promising avenue for significantly enhancing network lifetime. By intelligently combining multiple optimization strategies, this approach has the potential to address the energy efficiency and resource management challenges in sensor networks, leading to longer network lifetimes and improved performance. This research paves the way for more robust and sustainable wireless sensor network deployments, contributing to the advancement of IoT and smart technology applications.

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