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Energy Aware Geographic Routing Protocol using Evolutionary Algorithms for Improving QOS in MANET

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ABSTRACT

An energy-saving geographic routing is a crucial problem when trying to increase QoS and network life. In order for their adjacent neighbours to be able to reach effective routing performance, geographical routing nodes are necessary. However, the network's lifetime for efficient transmission has not been improved. In order to dynamically regulate the frequency of the position updates according to node movement dynamics, an updated position strategy for geographical routing is implemented. Various optimized geographical routing protocols have been designed to prevent interference between nodes, so that the data transmission did not improve easily. Nodes cannot easily save energy when transmitting data, which results in reduced network lifetime. On other hand, the reduction in the packet delivery ratio affects the overall throughput of the network. Anevolutionary technique based on geographical routing technology is introduced in this work to address the above limitations in current methods. To adopt evolutionary algorithms on Geographic Routing Protocol (GRP) to find optimal routing paths with reduced energy consumption and increased network lifetime. The work also carries out effective ways to avoid latency in delivering the packets from source to destination nodes.

Keywords:**MANET, Geographic Routing Protocol, Evolutionary Technique, Optimization**

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I. INTRODUCTION

Geographic Routing Protocol (GRP) is an active MANET technique since the end-to-end path is not known before data transfer. Geographic Routing transmits these data packets. For improved communication, Request-To-Send (RTS) packets are sent to neighbours whenever a source node needs to broadcast packets. Clear-To-Send (CTS) packets may be sent by nearby neighbours to potential forwarding nodes. Based on a selection principle, the source node picks one node as the successor transmission.

Geographical services-based position-driven routing techniques actively monitor GPS nodes. Geographical routing techniques locate the node. Network packets effectively locate neighbouring and target nodes. A source node checks data before sending it to surrounding nodes. These protocols ignore route identification, repair, and topology. Geographical Routing Protocols are ideal and dependable for MANET in mobile contexts. When network architecture and mobility change, traditional geographical routing techniques improve efficiency and flexibility.

No need to update communication routing databases or follow global analysis and geographical routing. MANET prioritised geographical routing. Geographical routing creates stateless routers from destination and one-hop neighbours. Unorganised network paths lower overhead. Jin et al. (2019) increased Unusable Robotic Networks (URN) performance with Q-learning Geographic Routing (RFLQGeo) rewarding function learning. Geographical protocols struggle to route mobile and changing robotic nodes. QGeo delays learning and increases network overhead.

Hu and Sosorburam (2019) suggested a geographical routing rule for sparse MANETs to address important communications gaps. The suggested forwarding node selection method finds relay candidates heading to destination nodes using geographic location and two-hop neighbourhood information. Particulate-swarm resource enabled MANET spatial routing by Nallusamy and Sabari (2019). Network particle mobility starts in the normal local search space. Particles speak. Fitness picks network-optimal particles.

The Hameed et al. (2020) Energy-Efficient Geographic (EEG) routing scheme optimises network efficiency

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and sensor node energy utilisation. This prevents network voids. The method reduces sensor node power consumption discrepancy. The simulation shows that the suggested technique delivers energy and packages better than a modern geographical routing system.

According to QoS metrics including throughput, latency, PDR, and PLR in two distinct situations, Kedir Lemma Arega et al. (2021) compared the performance characteristics of proactive and reactive protocols. R. Menaka et al.'s evaluation of the DSR protocols' performance in an unreliable MANET environment was done in 2021. A set of rules for ant colony renewal and control status processing were put out by Liqiang Liu et al. in 2022. Pushpender Sarao (2022) compares and contrasts the efficacy of active and reactive treatments.

Surendra H. Raut et al. (2022) discussion of active and reactive protocols' functionality, benefits, and characteristics. Sujata V. Mallapur and colleagues' (2019) discussion of network environments and technologies. By looking into CBR, jitter, PDR, and throughput for various protocols, Kumar et al. [18] assess the efficacy of the networks. P. Deepalakshmi et al. (2021) use a novel adaptive, on-demand QoS algorithm technique to improve network performance indicators. In their research from 2022, Nilesh Chandra et al. compare and contrast the AODV, DSDV, and DSR methods. PravinGhosekar et al. (2021) examined the requirements, mindsets, and uses of MANET. The efficacy of the EAODV protocol, developed by P. Samundiswary et al. (2022)has compared to that of conventional AODV.

II. METHODOLOGY

2.1 Firefly Optimization Algorithm

An optimisation problem is a kind of computational issue in which one of the primary objectives is to identify the most effective solution to the problem. We might make the assumption that the objective of optimisation is to find a solution that is within the range of values of the target function that encompasses either its minimum or its maximum value. The kind of mathematical link between an optimisation issue's goal, constraints, and decision variables impacts how difficult it will be to solve the problem, as well as the types of methods or algorithms that may be used to discover the really optimal solution to the problem.

Algorithm 1.Firefly Algorithm

Input: Nodes properties
Output: List of Nodes
Initialize Firefly Algorithm: Network Area, No. of nodes and no. of rounds
Step 1: To define Fitness function and properties of nodes
Step 2: For (I=0 to Rd)
Step 3: For (J=0 to R)
Step 4: For all Pop
Step 5: The calculated value of R and find R_{best} node’s property
Step 6: If value (R) < value (R_{best})
Step 7: Update light intensity of node = I_L
Step 8: End
Step 9: End
Step 10: End
Step 11: Best Node = Sort (=I_L, FitFun)
Step 12: Create a list of nodes
Step 13: End
Step 14: Return; List of Nodes = Genuine
Step 15: End

Fireflies are nocturnal insects that generate light and flicker continuously throughout the night. Fireflies have wings. The light is not bioluminescent, which emits infrared; rather, it is ultraviolet (UV) radiation, which is created chemically by the lower abdomen. Bioluminescence produces infrared light. When fireflies utilise their torches to attract possible mates or prey, the torch also performs the function of a protection mechanism that sounds an alarm in the event that the fireflies are attacked by a predator. The following assumptions were made by Wang while developing the Firefly algorithm, which was a metaheuristic algorithm inspired by the flashing movements and bioluminescent contact systems of fireflies.

i. Although Firefly are unisexual, they will be attracted to each other regardless of the sex of the individuals involved.
ii. The level of attractiveness is proportional to the intensity of their shine; a firefly with a weaker glow will be drawn to one with a stronger glow. The attraction, on the other hand, is diminished when there is a greater distance between the two fireflies.

When the firefly' light is uniform; if not, they may switch at random. A random stroll draws the contemporary thought waves to the firefly. The objective function of the pertinent issue should be connected to the firefly's light. Their popularity enables them to divide into more manageable groups, and each division fuses with regional models.

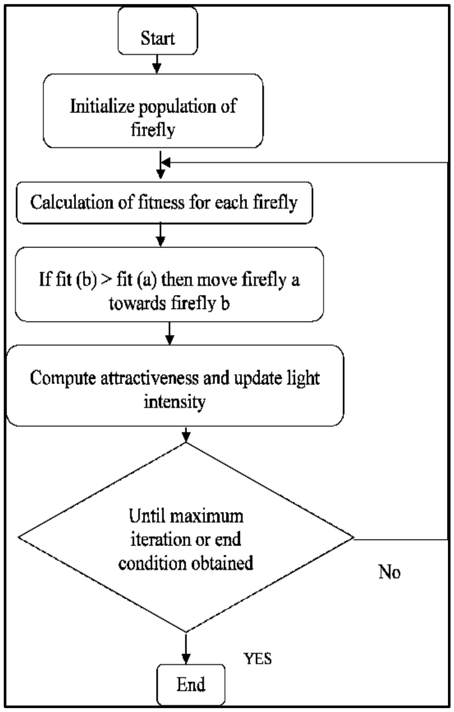

Figure 1. Firefly Algorithm

The flow chart of the firefly algorithm is depicted in figure1, in which firstly start the algorithm means initialize the population of firefly. After that, compute the fitness of every firefly, and the comparison between the obtained fitness of one firefly with the next one is performed. If the fitness of the next firefly is greater than the previous value of fitness function, then move towards the next firefly. After that, the computation of attractiveness and modify the intensity of light, until higher iteration obtained.

2.2 Improved geographical routing using Firefly Optimization Algorithm (IFOA)

The IFOA can quickly find the ideal balance between exploration and operational capacity, efficiently addressing a wide range of complicated issues. A protocol that uses Firefly optimization methods to optimize geographical routing regularly sends Hello messages to neighbors to keep track of each other. Below are the processes for delivering packets through a node.

Algorithm 2.Improved geographical routing using Firefly Optimization Algorithm

Input: Nodes properties
Output: List of Nodes
Step 1: Node n receives the data message and updates its location database with sink and intermediate forwarding node information.
Step 2: If node n is the sink and routing ends, application layer processes data messages.
Step 3: Firefly algorithm considers node n's neighbour information and if the sink is more than two hops away to choose the next forwarding node. Data message adds sink and node n locations. Updated sink location finds candidate node and regions.
Step 4: If the candidate node is empty, proceed to step 6; otherwise, proceed to step 4.
Step 5: Utilising the Firefly method, assess each node's location, energy level, nearby node, and network density.
Step 6: Depending on how the firefly ranks the next forwarding node, choose it or go on to the next node in the chain.
Step 7: Send the packets to the subsequent neighbourhood nodes and then verify that they arrive at their intended location.

III. RESULTS AND DISCUSSION

The network simulator is used for conducting the simulation. In a two-dimensional area of 1000×1000 m2, this technique with different network densities between 50 and 500. Each sensor node operates inside a 250-meter zone at a speed between 10 and 40 m/s.

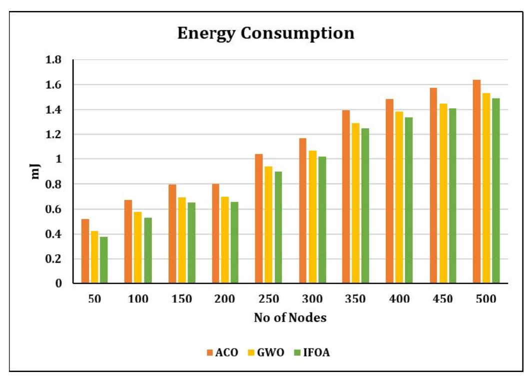

Figure 2. Energy Consumption in Joules

Figure 2 compares the energy use for a sensor node over time for the IFOA proposal, the existing GWO, and the ACO. The findings are shown in mJ. The Improved Firefly Scheme uses less energy than the GWO and ACO based GRP when route creation is optimum.

The resulting results are that as the number of nodes in the network grows, the life of the sensor nodes diminishes as computation-intensive packets are sent further between the source and destination nodes. Additionally, IFOA uses less power than GWO and ACO since wolves contribute more to the iterative process of people towards optimum outcomes. The outcomes are thought to be better.

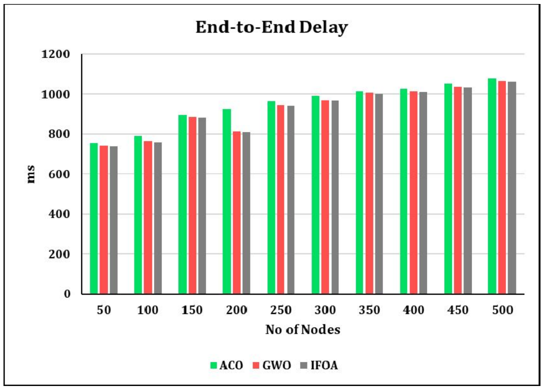

Figure 3. End-to-end delay (ms)

Figure 3 depicts the consequence of the typical delay in milliseconds from the IFOA to the current GWO and ACO. Simulated outcomes are obtained for the different node densities. The outcome demonstrates that the suggested strategy shortens the time restriction when compared to other ways already in use. The packets are now transmitted more quickly than with previous approaches thanks to the construction of routes in the best possible way.

The findings indicate that as the network's nodes grow in number, network latency also grows. It takes the number of individuals in each iteration a certain amount of time to obtain the desired value in the ideal zone. The calculation also grows with network density, which is another factor contributing to a longer average latency.

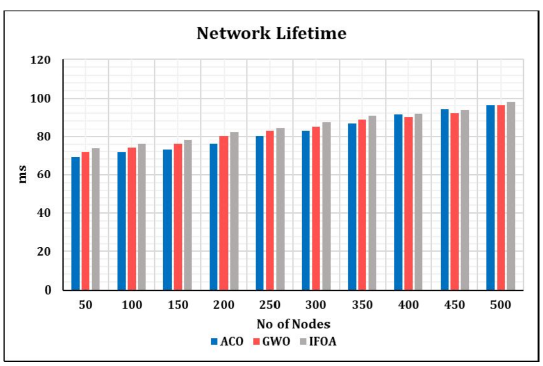

Figure 4. Network Lifetime (ms)

Figure 4 compares the network lifespan outcomes between the proposed IFOA and the current GWO and ACO in terms of milliseconds. The network's lifespan and the durability of each sensor node are both shortened by the rising computation of the ideal values. The findings, however, shown that the wolves in the suggested technique discover the values more effectively than in previous methods, which lengthens the network lifespan.

IV. CONCLUSION

The research investigated geographic routing protocol based on the firefly optimisation algorithm, extending network lifespan via optimal node selection for GRP. From the source to the destination, the packets are effectively routed. This is how the firefly algorithm is used to GRP; GRP chooses the initial sensor nodes, and the firefly algorithm chooses the best number of GRP nodes for routing. When compared to alternative methods, routing increases network life and decreases energy use while reducing latency.

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