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Energy-Efficient Routing Hybrid Wolf Optimization for Cluster Head Selection in MANET

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Abstract - ADHOC-WSN can be seen as a system network covering of hundreds or thousands of remote sensor hubs which gather the data from their encircling condition and direct their information detected to sink hub or the Base Station .A process named routing protocol represents a procedure to choose reasonable way for the information to venture out from source to goal. The procedure experiences a few troubles while choosing the course (route), which relies on, sort of system, channel qualities and the exhibition measurements. In the technology of WSNs, the system (network) layer is generally cast-off to actualize the mechanism of routing or directing of the approaching information and the protocol for routing is a significant factor in structure of a stack-based communication. The protocols for routing are intended for the sensor-based networks, essentially these should achieve high dependability. Firstly, according to the energy level of cluster head states in the 'LUT' should be changed to notify all other nodes about the new cluster head and now they have to send the data to new cluster head. The backup node identity number should also be maintained in the look up table as this will give the address of the new cluster head to all other members nodes. Secondly, when new cluster head replace the old cluster head at that time cluster will also reform and choose the new members nodes that will fall within its threshold value of distance. The most challenging task is to maintain the efficient delivery of data packet therefore a performance analysis of a infrastructure less network is done using two advance protocols which is implemented in a virtual traffic scenario with active mobility concept. By using (SL-ZRP & IR-AODV) the estimated result is achieved in the form of lesser end to end delay & improved PDR. The most practical applicability of this work is in defense sector where spontaneous communication setup is organized.In proposed approach use Adaptive, optimize and hybrid optimization approaches. These approaches improve clustering parameters and energy efficiency.

Key Words: (Size 10 & Bold) Key word1, Key word2, Key word3, etc (Minimum 5 to 8 key words)…

1. INTRODUCTION

A usual WS-MANET operation state comprises of introducing Ad hoc Wireless sensors into an offered domain to detect current condition and report the outcomes remotely for preparing area wherever proper choices are in use about the condition being restricted. Implanting sensors in roadbeds close by parkways, or extension structures and setting cameras at road crossing points to monitor traffic stream and recognize petty criminal offenses is of regular practice in numerous cutting-edge urban areas. These sensors are organized to form a network so as for building an elegant road network transportation utilizing making streets more secure, lessen blockage, help individuals discover the closest accessible parking spot in a new city, accomplish steering help, or give early alerts on climate related circumstances [3]. The productivity of these organizations might be estimated by

1. The life span of the WS-MANET usually calculated as the distinction among time spanning as of the outset of the WS-MANET as well as when the battery of former sensor is exhausted,
2. The throughput calculated by the extent of the data detected in the nature that has effectively achieved the destination, also
3. The delay as well as time used by the data gathered by the MANET to go through the detecting zone to passage wherever the data is to be processed.

1.2 ARCHITECTURE OF ADHOC WIRELESS SENSOR NETWORK

Architecture could be measured like group of rules as well as regulations which are for the implementation of functions with a group of interfaces, protocols as well as physical hardware. Before going further, it is needed to be understood that in a WS-MANET each sensing elements is responsible in itself to collect and process the data, which further leads to its aggregation and transformation into knowledge [4].

1.2.1 Communication Model in MANET

The structural design of MANET technology depends on the OSI architectural model, also referred as sensor network communication architecture. The model referred or used for this communication in a sensor network is represented.

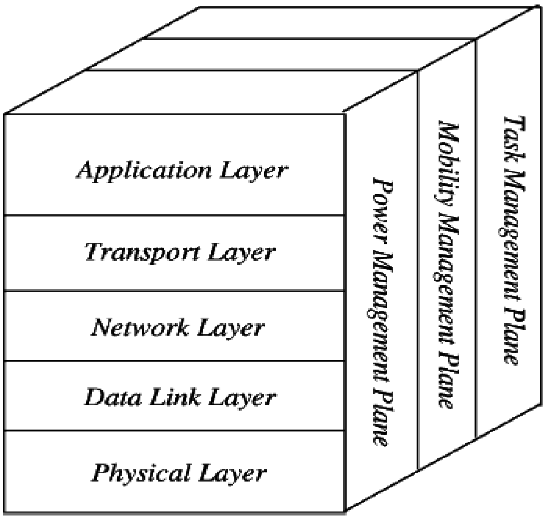

Figure 1.2: Communication Architectural Model of MANET [5]

The sensor network communication architecture includes 5 layers known as; *transport, application, network, datalink* and *physical layer* along with 3 cross planes i.e. *task, mobility* and *power management* planes. Such layers accomplish the network operation and helps in functioning of the sensors together to boost the network efficiency.

a) **Application Layer:** It is responsible for managing the network traffic as well as provides software for large functions converting the data into a clean and apparent shape in order to discover the information in a positive manner[6]. Depending upon the requirements or the sensing task a variety of applications can be designed, implemented and used on this layer so as provide a user-friendly interface to the end user to communicate in the network.
b) **Transport Layer:** This layer aims and functions to maintain reliable operation and to avoid the problem of congestion. The protocols used in this layer use distinct mechanisms for loss recovery and recognition and such a layer is basically needed where a system thinks or plans to contact with other form of networks. But this process consumes a large amount of energy that is one such big reason of not being fit for the MANET technology. Generally, this layer can get separated into an event driven or packet driven form.
c) **Network Layer:** The important position of this level is the process of routing. But the main issue here is that as the communication medium contains noise and nodes communicating can also be mobile in nature, therefore the protocols working in this layer should be energy aware and avoid data collisions with the other broadcasts being carried out in its neighborhood. Primary tasks of this layer are to minimize the memory usage, avoid buffer overflow and power conservation [7]. A lot of protocols already exist for such type of layer that could be separated into hierarchal routing as well as flat routing or could be a time, event and query driven.
d) **Data Link Layer:** It is usually liable for process of data multiplexing, MAC and error control, data streams, also confirms the reliable operation that may be ether point to point or point to multipoint [8]. It is the responsibility of this layer to address the collision problems in order to provide smooth flow of data between the nodes.
e) **Physical Layer:** It basically provides an edge for the process of transferring the bit streams above the medium. This layer relies on generating carrier frequency, frequency selection, modulation, data encryption, along with signal detection[9]. It is suggested in MANETs that if cost, communication range, and density are low then the battery life can be boosted to be used for the working operation.
f) **Vertical Planes:** Power, Mobility, as well as Task Management planes oversee the power, association, with distributions of assignment between the sensor nodes. With the assist of these planes sensor nodes correlative with the sensing tasks along with it reduced on the whole utilization of power.

1.3 ROUTING PROTOCOLS IN WS-MANETs

Due of its specific characteristics, MANET routing protocols vary from the standard routing protocols. The key aim in developing a routing protocol is to reduce energy usage, as the data transfer cycle leads to the maximum energy usage in MANETs. The routing strategies followed differ according to the appropriate procedure.

1.3.1 Routing Protocol Classification in MANETs

In fact, the routing protocols in MANETs may be fixed. They are graded based on various characteristics such as layout of routing, judgment of routing as well as adaptive design, timing as well as positioning, type of contact, topology used it and usability issues. The routing protocols for MANETs may be separated into flat-based routing, hierarchical-based routing, as well as location-based routing protocols predicated on the network structure. The routing composition is termed the flat-based routing structure, in which all nodes have the same roles as well as functionality. Every node has various functions in the network in Hierarchical routing. For routing the role of the sensor node is utilized in location-based routing technique. The routing protocols in which the different parameters may be modified to conform to situations, and the current energy rates belong to the group of adaptive routing[10].

They are also classified depending on the operation, based on the methods of coherence, negotiation, QoS routing. In addition to those classifications, the routing protocols are further classed as reactive, reactive, as well as hybrid groups depend on the technique of routing data through source to location. In the case of constructive protocols, advance path calculation is performed, whereas on-demand routes are determined for reactive protocols. Hybrid protocols use a mix of both constructive as well as reactive concepts. Cooperative routing protocols are yet different routing protocol type, in which the nodes are transmitting data to a central node. The collection as well as storage of data is carried out at the center node as well as decreases the expense of the energy usage path[11].

Network configuration relies on distribution of nodes. In certain networks the nodes are continuously and arbitrarily arranged, in other situations. The key feature of network layout category routing protocols is the method nodes are linked to route the details. This culminated in two groups of node deployments, nodes with the same link level known as flat protocols as well as nodes with specific hierarchies named hierarchical protocols [12].

In hierarchical networks, nodes are organized into clustered in which a node with high residual energy performs the function of a CH organizing operations inside the cluster as well as forwarding information among clusters. Clustering decreases electricity usage, which increases the network's lifetime [13].

Evolved in a routing protocol, the Coordination Paradigm recommends the direction to route packets throughout the network. The strength of such protocols being the fast data transfer efficiency for the transmission as well as point-to-point paradigms over a certain number of resources. Yet the percentage of data transmission is even smaller, which could not be assured. Within this system, the protocols are listed as Query-Based, Coherent as well as Non-Coherent-Based Protocols but also Negotiation-Based Protocols. Dependable routing protocol strategies are more immune to path failures, because they produce greater efficiency by providing means for load harmonization while satiating other QoS metrics. Multipath-based Protocols and QoS-based Protocols are the categories of protocols in this umbrella [14].\

METRICS FOR PERFORMANCE EVALUATION IN MANETs

The efficiency measurement of the system's functionality is performed using various measures, depending on the task. The MANET categorization of output parameters could be made depend on signal power, active probes, agility as well as capacity. Metrics focused on topology rely on the set of neighbor nodes as well as the hop counts. The signal intensity for evaluating the consistency of the communication is as a good pointer. Just of making the measurements at the edge, successful probing techniques can be used to get accurate measurements on the move. The flexibility-based output assessment measures are primarily focused on the Received Signal Strength (RSS) measures as well as their rate of variance. Time, capacity, packet distribution ratio, energy usage, remaining resources, efficiency, latency as well as scalability are the most widely used parameters for performance measurement in MANETs. The sum of energy needed for a packet to be transmitted from source to source is measured as energy per packet. Quality is an essential performance factor for time-driven or delay-constrained applications. Network lifespan is also a efficiency measure. This is generally measured as the time of death of the first node or any part or all of the nodes deplete the capacity. Life span of the network is often defined as the time that the network starts running. As network life cycle is a significant metric, the shortest paths are often chosen to ensure the durability of the network [27,28].

Another measure for measuring the life of the network is the total energy dissipated. For the different operations it is the average debauchery of energy per node. Another measurement measure is the low energy usage of the net function. The whole numeral of nodes alive, instead amount of packets that perhaps the average packet delay reached the BS always calculates the system's output quality. Packet distribution ratio is a significant consideration for efficiency of data transmission. It is calculated as the average of amount of packets sent by the source but entering the target. Many of the other output measurement indicators are the period before the main node or last node ends, the resources expended each session, unused listening period etc.

Research Methodology

The methodology for the proposed technique is a hybrid model consisting of two phases; Phase-1, for optimized selection of Cluster Head using Grey wolf Optimization Algorithm along with Tabu Search mechanism. Phase-2, in which, cluster size for routing is optimised using Grasshopper Optimization Algorithm.

The proposed approach works in order to get the optimised value of energy on the basis of various quality of service parameters such as delay, throughput and Packet loss. The optimization algorithms used in the methodology are briefly described in this section and the ways these algorithms are used in our work are explained further.

Grey Wolf Optimization: It is a novel meta-heuristic algorithm. This method is inspired from the hunting behavior and leadership quality of grey wolves. There are four types of wolves' alpha, beta, delta and omega. The leader of wolves is alpha, which makes decision. The second is beta which helps alpha to take decision. The third level is delta, which is submit to alpha and beta but govern the omega. The lowest rank is omega, it has ability to satisfy the whole grey wolves group . Used for Cluster Head selection.

Tabu Search Mechanism: It is a deterministic metaheuristic approach based on local search. It carefully explores the neighborhood of each solution. It uses a search procedure to keep on moving from one budding solution x to an enhanced solution x' in the locality of x until some stopping condition is met.

Grasshopper optimization: This algorithm is used for solving optimization issues. The GOA mimics the behaviour of a grasshopper taking into consideration the unique aspect of the grasshopper swarm which is that the swarming behaviour is found in both nymph and adulthood and the size of the swarm varies from a single grasshopper to a continental scale. The proposed GOA was implemented to simulate repulsion and attraction forces between the grasshoppers. Repulsion forces allow grasshoppers to explore the search space, whereas attraction forces encouraged them to exploit promising regions. Used for optimizing the cluster size in our research.

Bee Swarm Optimization Algorithm: It is a Swarm Intelligence based energy-efficient hierarchical routing technique for ADHOC WSNs, which mimics the natural swarming behaviour of honey bees. These are eco-friendly species of this planet and their swarming

Step 1: The initial step is to deploy the ADHOC WSN network, in which we have to set the initial parameters which in our case are the number of nodes, the network area.

Step 2: After deploying, the selection of CH is made by the prediction method, which in our case shall be original LEACH algorithm. The reason for this choice is that LEACH is a TDMA based protocol and each node in it uses a stochastic approach at each round to determine if it can be a cluster head or not and the nodes that have been a cluster head once cannot be a cluster head again.

Step3: Initialization of Grey Wolf Optimization (GWO) is done. GWO mimics the leadership hierarchy & hunting mechanism of grey wolves which are 4 basic types namely alphas, betas, deltas & omegas. The basic steps are to search for prey, encircle the prey & attack the prey for hunting.

Step 4: Update the value of α, β, δ in GWO. Where, α is the leader and is responsible for making decisions, β is subordinate to alpha that help α in decision making and reinforce the inputs from alphas to its subordinate groups i.e., gammas & deltas. In order to mathematically simulate the hunting behaviour, we suppose that the alpha, beta & delta have the better knowledge about the network nodes.

Step 5: Once the values of α, β, δ are updated, the optimization process starts. If it is optimized then next steps are started otherwise the control is returned to the Step 3.

Step 6: After the optimization is done, two steps are taken. Firstly if the Search space as obtained after the executing of GWO is less than 3 then the analysis of stability parameters of ADHOC WSN is started. In case the search space is greater than or equal to 3, then the next step is to save the search space and initialize the Tabu search algorithm for determining the optimized node that can be selected as a cluster head. Clusters here are referred to as search space.

Step 7: After initialization of Tabu search algorithm, all the cluster heads saved in the search space are reached and checked one by one.

Step 8: After checking cluster heads the next step is the optimization of cluster head, if it is successful then the analysis of stability parameters of ADHOC WSN is started otherwise the control is returned to step 6 for re-initialization of the Tabu search algorithm. This can be repeated till the optimised cluster head is not selected from within the search space greater than3.

Step 9: Analysis of different parameters i.e., Cluster Head, Throughput, Dead Node and Alive Node, Energy, PDR is done.

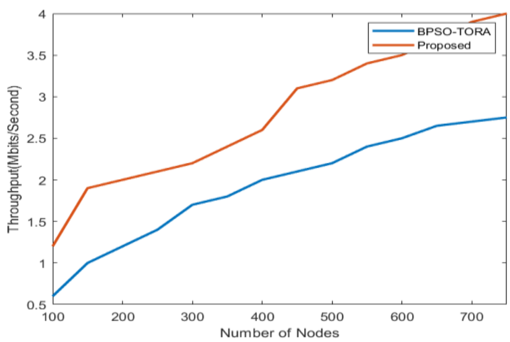

Fig 5.2 Throughput comparison in different number of nodes

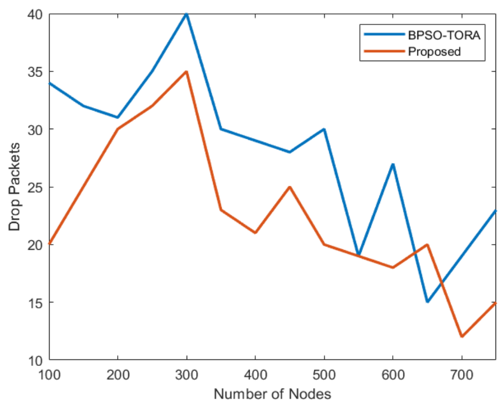

Fig 5.3 Drop Packet comparison in different number of nodes

1) Analysis

As shown in fig 5.3 and table 5.3, analysis of the drop packet is done between proposed (Hybrid GWO) optimization techniques and existing (BPSO-TORA) techniques in the different number of nodes. All the approaches run on 700 rounds. Fig5.2 shows BPSO-TORA representing very high drop packet Hybrid GWO achieved a throughput of less respectively at the end of 700 nodes . throughput in the Adhoc Wireless Sensor Network in comparison to Hybrid GWO and other existing approaches. It also enabled us to say that the proposed scheme fits best for the network scenario represented in table 5.1 as it delivers the less drop packet and provides better quality 0f service support in the network.

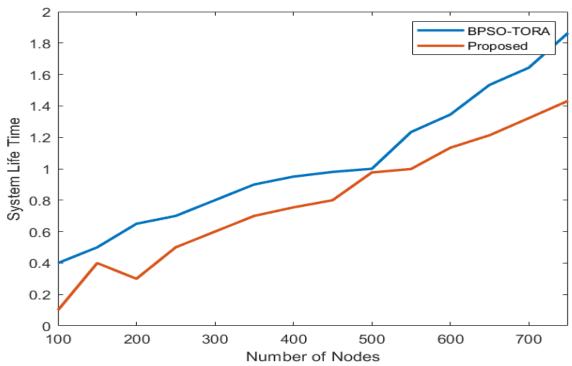

Fig 5.4 System Lifetime comparison in different number of nodes

2) Analysis

As shown in fig 5.4 and table 5.4, analysis of the system life time is done between proposed (Hybrid GWO) optimization techniques and existing (BPSO-TORA) techniques in the different number of nodes. All the approaches run on 700 rounds.

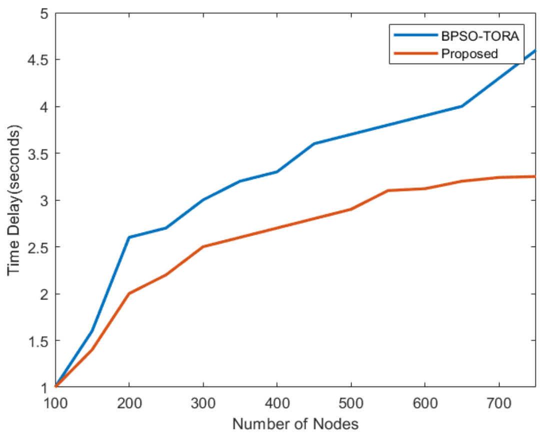

Fig 5.5 time delay comparison in different number of nodes

Analysis

In fig 5.5 and table 5.5 analysis of the time delay is done between proposed Hybrid GWO) and existing (BPSO-TORA) techniques in a network of 700nodes deployed in 1000mt² area for 5000 rounds. Fig 5.5 shows that Hybrid GWO delivered a time delay of 16019ms with only the optimized selection of cluster head which was much higher than that of existing

Analysis

As shown in fig 5.2 and table 5.2, analysis of the throughput is done between proposed (Hybrid GWO) optimization techniques and existing (BPSO-TORA) techniques in the different number of nodes. All the approaches run on 700 rounds. Fig5.2 shows BPSO-TORA representing very less throughput Hybrid GWO achieved a throughput of high respectively at the end of 700 nodes . throughput in the Adhoc Wireless Sensor Network in comparison to Hybrid GWO and other existing approaches. It also enabled us to say that the proposed scheme fits best for the network scenario represented in table 5.1 as it delivers the highest throughput and provides better quality f service support in the network.

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2. CONCLUSIONS

In this work, a protocol for energy conservation i.e. Hybrid GWO was submitted. This technique is applicable to multi-hop wireless networks without infrastructure. This technique can also pick backbones from all nodes in the network and circulate them within an appropriate time limit. The Proposed approach backbone nodes appear to be stimulated. These backbone nodes operate the data packet path of multiple hops. An adjacent sensor node remains in the power budgeting mode and needs to be tested periodically to get them excited and backbone. A retreat holdup was used inadvertently to find out whether the node is a backbone node. This interruption will depend on the amount of other nodes. A consumer was introduced to forecast the non-responding sensors in a certain geographical area and to control firmness, which saves energy with firmness. The Proposed approach was introduced using the 802.11 aptitude scheme choices, in which nodes occur from time to time and pay attention to advertising that requires immediate responses. As a result, the energy saved by GWO will increase as the density increases. This technique has been found to be very expensive.

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