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Good Nearest Neighbour for Minimizing the Duplication of RREQs in MANET

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Abstract: Human race has become progressively reliant on smart phones and other hand-held devices those are portable. One of the greatest tensions that lodge the attentions of such users is the deficit of battery back-up. When the applications are being updated with current trends and heeding to the requirements of mundane life, the amount of data and energy occupied does increase as well. This has become the prime problem confronted by the researchers who study on routing protocols for Mobile Ad hoc Networks (MANET). This paper aims to propose an energy efficient routing algorithm – Good Nearest Neighbour for Minimizing the Duplication of Route Requests (RREQs) in MANET (GNN-MIDURR).

Keywords: MANET; Routing; Energy Efficient; RREQs;

I. INTRODUCTION

The growth of laptops and 802.11/Wi-Fi wireless networking have made MANETs a popular research topic since the mid-1990s. Many academic papers evaluate protocols and their abilities, assuming varying degrees of mobility within a bounded space, usually with all nodes within a few hops of each other. Different protocols are then evaluated based on measures such as the packet drop rate, the overhead introduced by the routing protocol, end-to-end packet delays, network throughput, ability to scale, etc[1].

MANETs is the collection of nodes that can send and receive packets from one node to another within the network. The topology in MANET is highly dynamic as it tolerates any node to move freely in-and-out of network. It is infrastructure-less, adapting to the changes in the environment specially in the situations where it is difficult or impossible to establish a fixed physical infrastructure. This allows it to be used in areas that include, exchanging information in battlefields, search and rescue operation, natural disasters, etc.

Due to its increasing demand, plenty of applications are up-and-coming. One of the greatest bottle-neck that remains a threat in MANET is the limited energy. Since most of the hand-held devices are manufactured with less battery storage, the users are more prone to battery drain. This allows certain nodes to behave selfish to save the battery. The purpose of MANETs is to make proper utilization of network resources to gain maximum throughput, increase packet delivery ratio and reduce delay to prolong the network lifetime. The lifetime of a mobile node depends upon the limited battery energy.

To ensure the highest degree of utilization of limited battery power, routing protocols should design and implement in proper way. An efficient routing mechanism can improve the network performance significantly to assure the maximum use of the limited power or resources. In this paper, the proposed routing approach is called Good Nearest Neighbour Routing to Minimize the Duplication of Route Requests (RREQs) in MANET (GNN-MIDURR), where a source node can discover a stable and efficient route to its desired destination node.

II. RELATED WORKS

Prasanna et al., [2] researched to find Shortest Path based on Genetic Algorithm (SPGA) to get location information of the mobile nodes and selected the route by considering the nodes that promise maximum Expiration Time (ET).

Jayakkumar et al., [3] develops a new technique called MIDURR to Minimize the Duplication of Route Requests in MANET. Because of the MIDURR technique, it minimized the route request to save the energy and increased the lifetime of the nodes in the network. However, the MIDDUR technique leads to control packets overhead.

Nismon et al., [4] developed An Approach to Select Optimum Path (AASOP) technique to select a path from multiple paths based on minimum number of neighborhood nodes calculation and delay. Also, it ensured the performance enhancement in terms of packet delivery ratio and delay.

Calduwel et al., [5] considered that there is more energy backup for routing the packets. Such nodes have done better performance in the process of packet transmission when compared to the nodes with less energy backup. To estimate the performance of the work, number of RREQs and RREPs were sent and received in the network during the whole process of control packets transmission. The results proved better performance of EAR-MIDURR when compared to that of MIDURR. It is achieved by mitigating the unnecessary RREQs.

Logesh et al., [6] proposed a new method for identifying good neighbor node that transmit multimedia packets with QoS requirements within network. Every node in MANET may not perform as desired in every situation. The proposed method utilizes the node which is having high capacity of bandwidth, efficient scheduling process and transmission range using Enhanced QoS – Good Neighbor Node Detection Technique and this protocol compared with existing QOS – GNDA protocol in terms of security of data network. The objective here is to reduce overhead when breakage happen in route. Probabilistic scheme in route discovery process is applied.

Jayashreeet al., [7]proposed an Optimal Node Selection and Alarm Exchange Technique for Reducing the Security Cost and False Positives in MANET. This technique raises an alarm if any node detects its neighbor to be malicious and then it is validated to check for false alarm. In this way, network performance is enhanced by utilizing the nodes with lesser security costs for further traffic handling. Thus, ensuring that the node selection process is optimal and the security costs as well as the false alarms raised in the network is minimal.

SofianHamad et al., [8] developed new techniques that suggest reducing the broadcast of the RREQ packets in the network when the reactive routing protocols are used. These techniques are Closest Candidate Neighbors for Rebroadcasting the RREQ (C-CNRR) and Furthest Candidate Neighbors for Rebroadcasting the RREQ (F-CNRR). Methodology. The key concept behind these two routing protocols is to divide the transmission range for each node that needs to find a path to a specific destination to four equal zones. Then, if no route is found in its routing table, one node per zone will be smartly selected to rebroadcast the received RREQ. In terms of overhead, the C-CNRR and F-CNRR have better performance than the traditional ad hoc on-demand distance vector (AODV) routing protocol. This technique reduces the overhead by more than 15%, increase the network throughput and minimize data dropping.

ManoharChaudhari [9] in his research studied various energy efficient routing mechanisms/techniques to prolong network lifetime of resource constrained networks MANET and WSN and proposes an energy efficient sustainable routing architecture for MANET. Different techniques are evolved to save energy in MANET. The essential services in MANET are routing, connectivity, and end-to-end communication. These services are likely to be continuously provided even in the occurrence of undesired events such as malicious attacks, natural disasters, or network failures. In this work a sustainable routing architecture for MANET is proposed.

KomalBadhe et al., [10] proposed mobility and QoS-aware anycast routing protocol which performs better in terms of this QoS parameter and provides better throughput and packet delivery ratio, energy efficient paths. Stability of nodes, congestion of nodes, channel load is important QoS parameter. Different routing protocols perform poor in terms of QoS support for anycast routing in MANET. MQEAR increases network lifetime, reduce delay, reduce energy consumption and find a non-congested path.

KhagendraPrasai et al., [11] suggested a new technique named Weight based Clustering Algorithm (WCA). There are different clustering algorithms in MANET for selection of cluster head in a network. The selection of cluster head has many advantages like increase in efficiency and stability of the network, larger life time, low energy consumption, aggregation of topology information, lower communication bandwidth, spatial reuse, routing efficiency etc. The concept of clustering is implemented in different networks due to its growing advantage, but the method of formation of a cluster in MANET, showing the orientation of node movement and then selecting the cluster head is a field of interest. Weight based Clustering Algorithm (WCA) for the selection of cluster head considers combined weight metric. The co-efficient used in weight calculations are w1, w2, w3 and w4, the sum of these co-efficient is 1. They are used to normalize the factors like node degree, transmission power, and mobility and battery power. Any of these factors in a weight metric can be used for the election procedure of cluster head.

HariPriya et al., [12] proposed a consensus-based algorithm for detection and prevention of malicious nodes. This increases the efficiency and security in data transfer and the performance of routing is increased. The techniques proposed are used to eliminate and identify the malicious nodes present in the network. Due to the presence of these nodes the performance, throughput, packet delivery ratio is reduced and the impact of the AODV protocol is dropped. These attacks make the node malicious so that the transmission of the packets from the source to destination never happens.

Yasertaheri et al., [13] proposed an algorithm based on the game theory that models interactions between nodes in the mobile ad hoc networks. In this algorithm, all nodes playing in the game save some information about the interactions with neighbor nodes in a table. The data used in the next sending interaction help the nodes to interact with its neighbours through a rational approach and do not send and receive packets blindly. In specified time, this information is gathered and used to detect malicious nodes.

Baisakh et al., [14] proposed a novel Grid Based Dynamic Energy Efficient Routing (GBDEER) approach which is aimed to construct an energy efficient path from source to destination based on grid area, where each grid will have three deferent levels of transmission power. Every grid has its own grid supervisor node who takes the responsibility during data communication, especially when the data is been passed through that specific grid.

Nismon et al., [15] reduced the number of RREQ packets by using TeReLf technique. The RSS values were classified in terms of High, Medium, and Low. Thus, it reduced the number of RREQ packets and in turn, it minimized the link failures in MANET.

III. PREVIOUS CONTRIBUTIONS

MIDURR

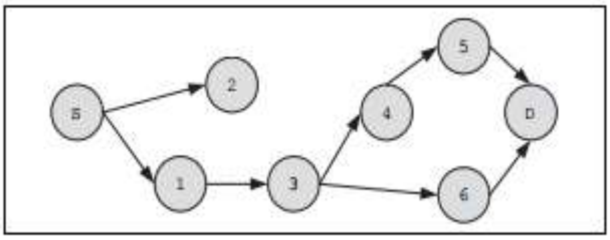

Figure 1: Sample Network Scenario

In MIDURR technique, initially the source node (S) broadcast the RREQs to its neighbors (A, B, and C). When B sent RREQs to its neighbors except A and C because B knows that A and C were neighbors of source node S. Similarly, all the nodes will check their neighbours list and forward their RREQs until the destination is reached. Eventually, it sends 21 RREQs to identify the path to destination [2].

EAR-MIDURR

EAR-MIDURR is the extension of MIDURR technique to address the issues identified in MIDURR. EAR-MIDURR is Energy Aware Routing MIDURR which is a simple and innovative technique that avoided the nodes with less energy backup. EAR-MIDURR technique computed the threshold value based on average energy of all the nodes. Nodes with less energy could not efficiently participate in the transaction process. Such nodes were the primary reason for denial of service attacks that causes link breakages. Ultimately, it was taken 12 RREQ to identify the path to destination [7].

MIRO – MIDURR

The aim of MIRO – MIDURR technique is to identify the partial selfish nodes based on the transactions from routing table. Selfish nodes are those that degrade the entire functionality of the network. Hence in this study, the nodes that are more selfish in nature are identified and not used in the routing process. By doing so, the energy spent unnecessarily wasted is avoided. MIRO – MIDURR is tested to scale it's performance with that of the previous contributions like MIDURR and EAR-MIDURR. The results obtained were satisfactory.

IV. Proposed Algorithm – GNN-MIDURR

An algorithm GNN-MIDURR is proposed which tries to reduce the energy consumption in the network to promise longer and sustaining service to the users. This is achieved by considering two factors in the proposed work. One important factor is the Nearest node consideration. When comes for a decision making on which node to select as next hop node, GNN-MIDURR will only choose the node that is closer. The next factor that is considered is the *Good Node*. What makes a good node should be next challenge. GNN-MIDURR considers the nodes with more next-hop nodes as the good nodes. This is because, the nodes with more next-hop has more chances to take part in the routing process which could help the packet reach the destination. It is obvious that the nodes with less next hop nodes has fewer chances in involving in the transaction process.

To implement the GNN-MIDURR, the routing table is modified to have the details of two factors those considered in this proposed work. The following figure-1 is a sample network scenario.

The following Table 1 *GNNtab*(T) is the new routing tabled for the network scenario shown in Figure 1.

Table I. GNNtab – T

Node	**Table Column Head**		
	Next-Hop	***Distance from the Node in (D)***	***Number of Next Hops (H)***
S	1	3	1
	2	4	0
2	0	0	0
1	3	3	2
3	4	4	1
	6	5	1
4	5	3	1
5	D	3	1
6	D	3	1

GNN-MIDURR (Good Nearest Neighbour Routing to Minimize the Duplication of Route Request):Let the node S (Source node) require a transaction to node D (destination).

Step0: [Initialize] Choose the source node S. Set ROUTE←S

Step1:[Broadcast to all nodes] S initiates a *Path_Request*to destination D through all its neighbours which are in 1-hop distance from S.

Step2: [Update the GNN-tab]: Two parameter (Distance and Good Node) is maintained in the routing table (*GNNtab-T$_i$*) for all the 1-hop distance nodes from source.

V_S – Source Node and

V_j – each 1-hop node from V_S. { 1 >= j <= n}

Step3: [Choose next edge] Choose the next node by considering the two most promising factors from the T_i

$$Next_j = min\{D_1^n(T_{ij}) from\ S: ij \in V_{neighbors}\}\ AND$$
$$\max\{H_1^n(T_{ij}) from\ S: ij \in V_{neighbors}\}$$

D – Distance from Source Node

H – Number of Hop-nodes

Step4: [Complete route] Set ROUTE←ROUTE + (V_S, V_{Nextj})

Step5:[Is $Next_j$ ==D?] Check if the $Next_j$ is the destination D.

If($Next_j$ == D)
{ Route is generated and transaction starts}
else
{Set S ←$Next_j$
Goto **Step1: }**

Step6: Stop

Traditional Algorithm

Figure 2 explains the way Route Request (RREQs) is being forwarded in most traditional Optimization algorithms.

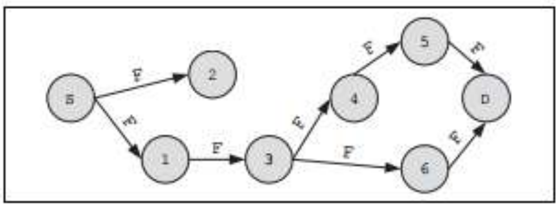

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Figure 2: RREQs forward in Traditional Algorithm

F→ Forward RREQs

In the above figure, a total of 8 RREQ has been forwarded. If we consider that a device consumes 0.2 J for each RREQ, the total amounts of energy consumed is 1.6J.

GNN-MIDURR Algorithm

GNN-MIDURRwill rely on the*GNNtab* (T) for choosing next hop node in constructing a routing path. The below table is shown in colors to represent the most promising nodes in green.

Table II. gnntab– T showing Promising nodes

Node	Table Column Head		
	Next-Hop	*Distance from the Node in (D)*	*Number of Next Hops (H)*
S	1	3	1
	2	4	0
2	0	0	0
1	3	3	2
3	4	4	1
	6	5	1
4	5	3	1
5	D	3	1
6	D	3	1

The corresponding network scenario representing the (GNN*tab-T*) is shown in Figure 3. In the below figure, the numbers on the edges represent the distance and the number of hops as '*d,h*'. For example, an edge 3,2 represent that the distance of the node from previous node is 3 and total number of next-hop nodes is 2.

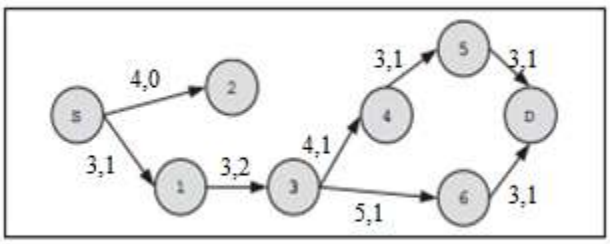
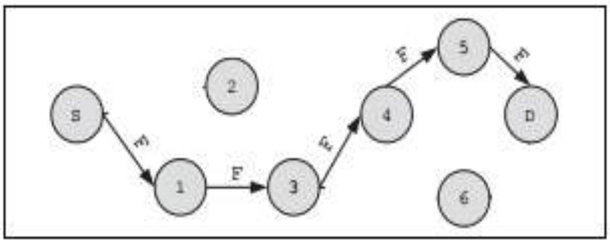


Figure 3: Network scenario based on Table II.

From Figure 3, it is possible to identify the nearest and good nodes in the network. Each edge is marked with the distance from the previous node to the next node and the total number of hop nodes that this is in contact with. The distance is represented as 'd' and the number of hop nodes as 'h'.

Consider the first node 'S' in the above scenario. When 'S' wish to broadcast RREQ, it will first decide which are the neighbouring nodes and also consider the *'d,h'* parameter.

S → 2 (d=4 & h=0)
S → 1 (d=3 & h=1)
Since (d=3 & h=1) is more promising than (d=4 & h=0), GNN-MIDURR will consider to broadcast RREQs only to node 2.



Following the above example throughout the network, the RREQs forwarded by GNN-MIDURR algorithm by using the table (GNN*tab-T)* is represented in the following Figure 4.

Figure 4: RREQs forward in GNN-MIDURR

According to Figure 4, there are 5 RREQs broadcasted. If we consider that a device consumes 0.2J for each RREQ, the total amount of energy consumed is 1.0J.

Comparison of Traditional and GNN-MIDURR

A comparison of number of RREQs forwarded by traditional algorithm and GNN-MIDURR algorithm for the given scenario in Figure 1 is presented in the graph is shown in Figure 5 and Table III.

Table III. Comparison of RREQ forwarded

Algorithm	No. of RREQ forwarded	Total Energy Consumed
Traditional Algorithms	8	1.6 J
GNN-MIDURR	5	1.0 J

Figure 5: Comparison of RREQs forwarded.

The following graph shown in Figure 6 represents the amount of energy consumed in joules in the network.

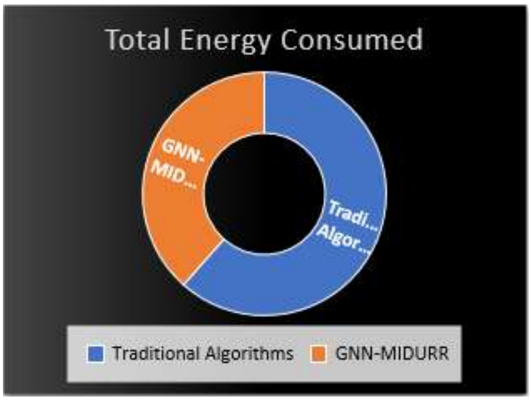


Figure 6: Comparison of Energy Consumed

V. CONCLUSION

GNN-MIDURR is intended to improve the performance of MANET by considering distance (d) and number of hops (h) as Optimization method. The proposed algorithm does outperform Traditional algorithms in terms of energy consumed. It is also true to accept that the fact that the nodes that are ignored by GNN-MIDURR may be a better node. A keener observation before ignoring a node from the routing process is always desired.

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