Journal of Data Acquisition and Processing
ISSN: 1004-9037
https://sjcjycl.cn/
DOI: 10.5281/zenodo.754726

NOVEL LOAD BALANCING APPROACH USING MULTI AGENT MODEL FOR INFINIBAND-BASED MECHANISM IN MANET

[1]Dr. A. Devi, [2]Mr. R. Kevin Kingsly, [3]Mr. K. Kaviyarasu.
[1]Associate Professor, Department of Computer Applications, Dr. SNS Rajalakshmi College of Arts & Science, Coimbatore.
[2]PG Student, II MCA, Department of Computer Applications, Dr. SNS Rajalakshmi College of Arts & Science, Coimbatore.
[3]PG Student, II MCA, Department of Computer Applications, Dr. SNS Rajalakshmi College of Arts & Science, Coimbatore.

Abstract: - Considering that a MANET has no infrastructure and its multi-hop in nature, each node acts as a router. The nodes are relocating arbitrarily, and the topology of the network is dynamic. Routing poses a number of problems in MANET considering that mobility explanations radio links to interrupt on the whole. When any link or route breaks, this direction desires to be both repaired by using finding an additional hyperlink if any and changed with a newly found route. This rerouting operation cost the radio resource and battery vigour even as rerouting prolong may have an impact on great of provider (QoS) for purposes and degrade the community performance. In practice, some routes get congested, at the same time different routes stay underutilized. The basic idea of our approach is to enhance the load balancing and thus reduce congestion on overloaded links. This mechanism has enabled us to give critical applications higher priority when routing their packets across the network, and effectively manage frequent connections and disconnections and thus reduce link failures and packet loss rates, and reduce the overall power consumption as a consequence of the previous gains. In this paper, to increase the community performance is made utilizing the multi agent centered load balancing algorithm. Moreover through the simulation, it is proven that the proposed modified AODV protocol can participate in higher than the traditional AODV. Additionally, the effect of interface queue size and hyperlink high-quality on normalized routing load, common throughput and common end to finish extend are determined.
Keywords: - Quality of Service, Multi Agent, Load Balancing, MANET.

1. INTRODUCTION

Mobile ad hoc networks (MANETs) are basically peer-to-peer, multi-hop mobile wireless networks, which have neither any communication infrastructure nor fixed base stations (BSs). MANETs have been originally introduced for use in dangerous situations such as rescue operations and battle fields. On the other hand, they are now being explored for numerous applications due to their convenience and proliferation of mobile communication devices like PDAs and laptops. Mobile stations (MSs) in a MANET have full freedom to move; hence the network topology may change continuously [1]. In addition, the characteristics of wireless channels such as the limited data transmission range, low bandwidth, high error rate environment, and limited battery power, makes routing in a MANET a difficult problem to deal with.

Ad hoc routing protocols can be classified into two categories: table-driven approach (or proactive protocols) and on-demand approach (or reactive protocols). Proactive protocols such as DSDV and TBRPF periodically exchange routing information among MANET MSs and maintain/update available routes for all MSs, being somewhat similar to the link-state routing protocol in the Internet. These protocols, however, consume significant amount of energy to periodically disseminate routing information, which could be a critical overhead for MANETs with limited battery power. In contrast, reactive protocols initiate route discovery mechanism only when a route is actually required. The most prominent among existing reactive protocols are AODV and DSR. AODV tries to find a new route by broadcasting route request (RREQ) messages only when a current route is stale and maintains only one route for a destination. On the other hand, DSR performs source routing and maintains more than one route for a given source–destination pair. Therefore, if a current route is not available, DSR selects one of the alternate routes as a new route without triggering the route discovery mechanism [2].

A principle task within the design of advert hoc networks is the progress of effective routing protocols that may furnish high-quality verbal exchange between two cell nodes. Numerous routing protocols had been developed for advert hoc mobile networks. These protocols could normally be categorized as table-pushed and on-demand routing. Table pushed routing protocols are [3] try to preserve up to date routing expertise of every node.

Such protocols, and even though a route to every different node is continually available, incur vast signaling traffic and strength intake. Since each bandwidth and battery electricity are scarce assets in mobile computer systems, this will become a extreme hindrance to table-pushed routing protocols. On the opposite hand, on-demand routing protocols [9] conquer this challenge. This kind of routing protocols does now not hold routing statistics at each node; however create routes only whilst desired by means of the source node. When a source has a packet to transmit, it invokes a route discovery mechanism to locate the route to the destination. The direction stays valid till the destination is handy or till the route is not needed. In truth, on demand routing is dominating the tendency for wireless ad hoc verbal exchange. Fig. 1.1 represents the ad hoc community; right here first connection will set up in between sender S and destination D then switch records through intermediate nodes.

Fig. 1.1: - Ad Hoc Network Design

It has been long believed that the performance of ad hoc networks routing protocols is more desirable while nodal mobility is reduced. This is real while considering overall performance measures together with packet transport fraction and routing overhead.

2. LITERATURE REVIEW

Mobile Ad-hoc networks have a excessive-powered dynamic topology due to the fact the nodes are extraordinarily mobility, inadequate of wireless medium, restrained power of a node, and many others. In these dynamic surroundings updating the routing desk of each node during the conversation is playing a very important position in terms of providing a highest quality direction according to the contemporary trade of topology [10]. Routing in MANET is difficult task due to no valuable coordinator compared to different wi-fi structure in which base station or fixed routers manage routing selections. For green routing, the MANET routing protocol must offer much less packet Loss Ratio, excessive packet delivery ratio, much less routing overhead, less stop-to-quit delay, Minimum hop, less electricity intake per packet, less Jitter. So it's far essential to balance a majority of these objectives however it's far quiet now not viable. For the optimization of the said goals, the meta-heuristics method ACO is extra dependable than different routing algorithm in MANETs.

Chandravanshi, K., et al., (2022), addressed the Routing decisions for mobile communication is a challenging task because the continuous movement of nodes increases the routing overhead and energy consumption [4]. Mobile Ad Hoc Network (MANET) is a collection of spontaneous nodes that form a dynamic network without any centralized administration. The authors proposed an adaptive Multipath Multichannel (N-channel) Energy Efficient (MMEE) routing approach in which route selection strategies are dependent on predictive energy consumption per packet (calculated accustomed data delivery), available bandwidth, queue length, and channel utilization. Multipath provides multiple routes and balances network load, whereas multichannel reduces network collisions via a channel ideal assignment mechanism. In the multichannel mechanism, link bandwidth is divided into multiple sub-channels. Multiple source nodes access the channel bandwidth in a simultaneous manner that minimizes the network collision. The collaborative multipath multichannel mechanism provides more than one path between a single source or multiple sources to the destination without collision and congestion. The path selection is based on the MMEE routing approach. In the proposed MMEE, a load and bandwidth aware routing method selects the path, based on node energy and predicts their lifetime, which increases the network reliability.

Dholey, M. K., & Sinha, D. (2022), introduced a novel routing protocol, called ACOLBR (ACO based load balancing routing), is design to control the congestion and balancing the load among the multiple paths in between source to destination [5]. The similarity between the environment of Ant Colony and the MANET inspires the authors to apply ACO (Ant colony optimization) technique during routing in MANET to control congestion and balance the load in the network. In the proposal, two colonies of ants (red/blue) carry their packets based on the network condition. A decision variable is designed to select red/blue ant for transferring packets based on different network parameters such as bandwidth, energy, mobility, and distance. The selection of red ant means the route where the concentration of red pheromone is maximum and reverse is true for blue ant. This protocol is also concerns about the link failure during packet transmission in a route. Simulation results using OMNET++ show that ACOLBR outperforms ARA, ANTHOCNET, FACO, AODV, DSDV, DSR, CA-ARTT, and MOAODV in terms of load balancing efficiently in the route for data transmission in between source to destination.

Venkatraman, S., & Sarvepalli, S. K. (2018), finds the solution for position updates and load distribution. There is a concern with load distribution when it comes to dense network where

there are large number of connections and huge traffic [6]. Load balanced, Adaptive Position Update (LAPU) routing protocol solves the problem of load distribution among paths in a network with reduced position updates occurring adaptively and next hop decisions based on node's congestion status in geographic routing. In the proposed work, to achieve load balancing, a node selects two best nodes available to the destination based on node mobility and queue length and it divides the load among them, i.e., it transfers the packets in both paths. Parameters such as end-to-end delay of packet transmission, energy consumption, throughput, and routing overhead are considered to compare the performance of the proposed work.

Karmel, A., et al., (2021), proposed A-EEBLR approach chooses the next hop node based on metrics like delay, energy drain rate, congestion, link quality. Based on these metrics the probability of choosing next hop node as neighbor node is determined [7]. The next hop probability determines the forward and backward ant agents to establish multiple paths among which the most optimal path is selected for transmission. The implementation results shows that the proposed A-EEBLR approach outperforms the existing A-ESR approach when evaluated by varying the number of packets, number of nodes and node mobility.

Aouiz, A. A., et al., (2019), addressed dense network areas; MANETs suffer mainly from frequent link failures and longer delays [8]. These dense network areas are generally located in the core of the network, where the number of nodes as it is for network traffic is higher. A new parameter to measure the centrality of the network based on the channel busyness ratio is proposed. The proposed protocol called CBMLB is an enhancement of the already existing multipath protocol AOMDV. CBMLB tries to reduce load on central congested nodes that have a raised channel busyness ratio, by distributing load among available alternative paths. The proposed protocol relies on the least congested disjoint paths to route packets. A performance comparison with AODV, AOMDV and QMLB protocols shows that CBMLB performs well in terms of packet delivery ratio, end to end delay and communication overhead.

3. EXISTING METHODOLOGY AND DIFFICULTIES

Existing routing protocols for Mobile Ad Hoc Networks (MANETs) can be either primarily based on unmarried-route or more than one path mechanisms. In a unmarried route routing, there is a committed route between the supply and the vacation spot, in which the packet header consists of the complete direction with all hops' facts until the vacation spot is reached [11]. On the alternative hand, multipath routing schemes build a couple of paths from a supply to a destination, and therefore, can achieve higher performance, and might solve a number of the unmarried direction performance issues together with scalability, protection and network lifetime through the usage of opportunity paths.

InfiniBand (IB) mechanism turned into brought to offer a high overall performance computing with QoS and load balancing as center capabilities. IB is a centralized network model which combines managers and retailers collaborating to offer the best community overall performance that everyday Internet protocols can not reach [12]. By adapting the IB multipath (Pathbits) with Virtual Lanes (VLs) the network overall performance may be expanded.

3.1. Existing Methodology

InfiniBand has emerged as an appealing cloth for building big virtualized compute clouds, supercomputing grids, clusters, and storage systems — where high bandwidth and occasional

latency are key necessities. As an open well-known, InfiniBand provides a compelling preference over proprietary interconnect technologies that rely on the fulfillment and innovation of a single seller [13]. Similar to unmarried GbE and 10 GbE, InfiniBand represents a serial factor-to-factor full-duplex interconnect. The InfiniBand Architecture (IBA) is a brand new enterprise-trendy structure for server I/O and inter-server communique. It was advanced by using the InfiniBandSM Trade Association (IBTA) to provide the degrees of reliability, availability, performance, and scalability necessary for present and future server systems, stages notably higher than may be done with bus-oriented I/O systems.

InfiniBand is supported by way of the entire main OEM server companies as a way to make bigger beyond and create the next era I/O interconnect well-known in servers. For the first time, a high extent, enterprise widespread I/O interconnects extends the position of conventional "inside the field" busses. InfiniBand is particular in imparting both, an "in the field" backplane answer, an external interconnect, and "Bandwidth Out of the container", for this reason it offers connectivity in a manner previously reserved handiest for classic networking interconnects [14]. InfiniBand Elements: The InfiniBand structure defines more than one gadget for machine communication: a channel adapter, transfer, router, and a subnet manager. Within a subnet, there ought to be at least one channel adapter for every end node and a subnet manager to installation and preserve the hyperlink. All channel adapters and switches have to comprise a Subnet Management Agent (SMA) required for dealing with verbal exchange with the subnet supervisor.

The Disadvantages of the Existing methodology are as follows,

- Cannot capture Flow Control Packets (FCP)
- Packets may get lost if the data rate is high, e.g. FDR (56Gbits/s)
- Works only on Mellanox HCAs – Doesn't work between switches because it is software running on nodes
- Max capture size depends on the available host RAM or Disk space
- Inaccurate packet timestamps (in microsecond)

4. PROPOSED METHODOLOGY AND ITS CONTRIBUTIONS

Multi agent Ant primarily based routing Algorithm: - Multi agent Ant based routing Algorithm bureaucracy a hybrid of each ant based totally routing and Multi agent structures approach to triumph over some of their inherent drawbacks [15]. The hybrid approach enhances the node connectivity and decreases the give up-to-end delay and route discovery latency. Route status quo in conventional ant based routing strategies is depending on the ants traveling the node and offering it with routes.

If a node needs to send facts packets to a destination for which it does now not have a fresh sufficient direction, it's going to ought to keep the data packets in its send buffer till an ant arrives and gives it with a path to that destination. Also, in ant routing algorithms applied thus far there's no nearby connectivity protection as in AODV. Hence whilst a number of data packets being dropped. AODV then again takes too much time for connection status quo due to the put off within the route discovery technique whereas in ant based routing if a node has a route to a destination it simply begins sending the facts packets with none delay. This lengthy put off in AODV earlier than the actual connection is hooked up might not be relevant in real-time communication applications [16].

It uses conventional routing tables, one entry in line with destination. Route Request (RREQ), Route Replies (RREP), and Route Error (RERR) are the message types defined via AODV. These message types are acquired thru User Datagram Protocol (UDP), and regular IP header processing applies. We have to provide QoS and cargo balancing capabilities we add extensions and a QoS flag (one bit of the reserved bits is used) to the RREQ and RREP messages. The period of every extension is sixteen bits. A node receiving a RREQ could replace Cost discipline and Delay area (if there's put off constraints) earlier than rebroadcast the RREQ. In case of having multiple routes, the originator of a RREQ will choose the direction with the minimum value (but pleasing QoS requirements if any) to permit load balancing [17]. When a route to a brand new vacation spot with QoS is needed, the node has to broadcast a brand new RREQ message, with QoS flag set to one, Delay subject set to the maximum delay bound, and Cost subject set to 0. If, after established order of such a path, any node along the route detects that the requested QoS parameters can no longer be maintained or the path itself is not available anymore, that node originates a RERR message back to the node which had in the beginning asked the now unavailable QoS parameters.

4.1. Module Description

In Ant based course discovery, the transmission put off of each hyperlink, processing delay at each node, the to be had bandwidth ability of every hyperlink, and the wide variety of hops visited are accumulated through the ant retailers to estimate the path preference opportunity. Then the course with better desire chance is mounted.

The following set of core properties characterizes ACO circumstances for routing issues:

1. Providing traffic-adaptive and multipath routing.
2. Relying on each passive and active expertise monitoring and gathering.
3. Utilizing stochastic add-ons.
4. Not enabling nearby estimates to have global affect,
5. Setting up paths in a less egocentric method than in pure shortest route schemes favoring load balancing.
6. Displaying restricted sensitivity to parameter settings.

The route from source node to destination node changes in the MANET considering that it contains cell nodes. Detection of dynamic topology, iteration of path between nodes and dealing with route failures are carried out with the aid of the routing algorithm. It has three phases.

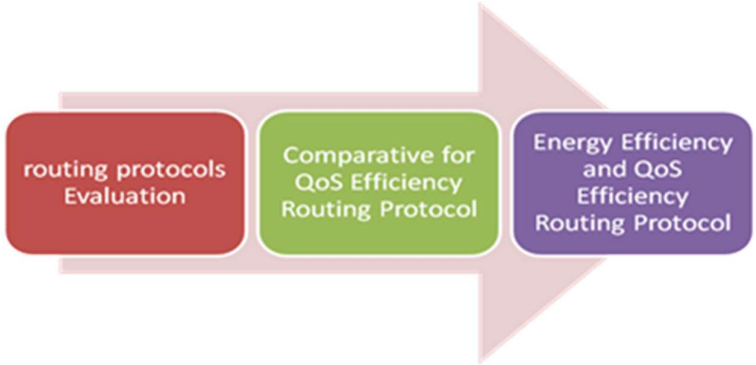

Fig. 4.1: - Proposed Approach Modules

The proposed approach consist of following set of modules, such as,
Module 1: Routing protocols Evaluation.
Module 2: Comparative for QoS Efficiency
Routing Protocol.
Module 3: Energy Efficiency and QoS Efficiency
Routing Protocol.

When the statistics transmission is going on, the trails are strengthened positively making it greater appropriate for similarly choice. Also whilst session goes on, the weight on the chosen path may also growth causing more put off and much less to be had bandwidth; Nodes might have moved causing link failures. In such case, the direction choice possibility will routinely decrease and therefore change routes may be used which can be discovered at some point of direction discovery phase. The trade routes are also periodically checked for their validity even though they may be no longer presently used.

5. RESULTS AND DISCUSSIONS

The proposed algorithm is an adaptive routing algorithm. So, it's far appropriate for the network in which node mobility is higher and no centralized control exists. This algorithm unearths more than one paths between source and the destination [18]. Again, ACO continually now not find shortest course, as an alternative on the time of course installation it additionally sorted the QoS requirements and for this, link best is improved. Use of multi path routing additionally will increase the packet delivery ratio, decreases the packet loss charge. It additionally utilizes the bandwidth well and for this, throughput and community balance or lifetime boom. This proposed set of rules's layout is aimed toward minimizing the mixture bandwidth by means of minimizing the manage packets. It additionally minimizes the conversation overhead with the aid of localizing algorithmic reaction to topological modifications.

i) Energy Consumption
The energy consumption for the entire network is including transmission and processing energy consumption for both the data and control packets.

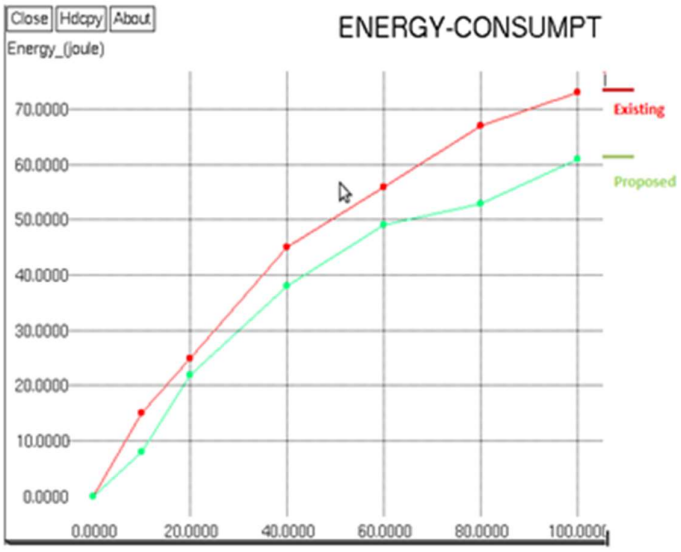

Fig. 5.1: - Comparison of Energy Consumption

The above Fig. 5.1., shows that the proposed Novel load balancing approach of Energy consumption is decreased when compared with the existing protocols.

ii) Packet Delivery Ratio

The ratio between the, number of received data packets to the number of total data packets sent by the source.

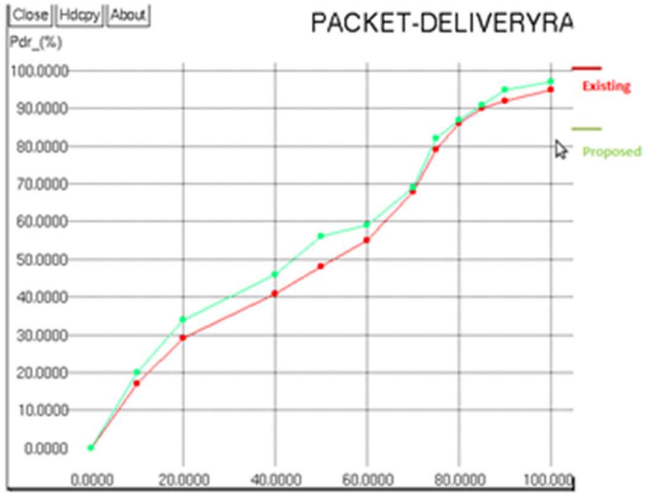

Fig. 5.2: - Comparison of Packet Delivery Ratio

The above Fig. 5.2., shows that the proposed Novel Load Balancing approach of packet delivery ratio is increased when compared with the existing protocols.

6. CONCLUSIONS

Most of the preceding routing solutions for MANET simplest cope with the quality-effort information site visitors to provide shortest path routing and reaching a excessive diploma of availability in a dynamic surroundings where the community topology changes quickly. QoS routing and cargo balancing features are not supported. This paper contributes in two areas. First, reporting adjustments to a well-known and green on-demand MANET protocol, specifically the AODV routing protocol. The paper proposes some upgrades to the AODV protocol to provide QoS and cargo balancing capabilities with the aid of including extensions to the messages used for the duration of path discovery. The first extension (Delay discipline) specifies the service necessities, which must be met via nodes rebroadcast a Route Request or returning a Route Reply for a destination. The following two overall performance metrics are used to evaluate the performance of the protocols: (a) electricity consumption, (b) packet shipping fraction. The proposed protocol plays well in supporting the QoS feature. It has high overall performance for low network hundreds (low number of resources) by way of pleasing the QoS requirements with an average quit-to-quit delay almost half the postpone required, in this case packet shipping fraction and normalized routing load are corresponding to the authentic AODV protocol.

7. REFERENCES

[1] Jabbar, W. A., Ismail, M., & Nordin, R. (2017). Energy and mobility conscious multipath routing scheme for route stability and load balancing in MANETs. Simulation Modelling Practice and Theory, 77, 245-271.

[2] Dalal, S., Seth, B., Jaglan, V., Malik, M., Surbhi, Dahiya, N., ... & Hu, Y. C. (2022). An adaptive traffic routing approach toward load balancing and congestion control in Cloud–MANET ad hoc networks. Soft Computing, 26(11), 5377-5388.

[3] Kushwaha, A., & Doohan, N. V. (2016, March). M-EALBM: A modified approach energy aware load balancing multipath routing protocol in MANET. In 2016 Symposium on Colossal Data Analysis and Networking (CDAN) (pp. 1-5). IEEE.

[4] Chandravanshi, K., Soni, G., & Mishra, D. K. (2022). Design and analysis of an energy-efficient load balancing and bandwidth aware adaptive multipath N-channel routing approach in MANET. IEEE Access, 10, 110003-110025.

[5] Dholey, M. K., & Sinha, D. (2022). ACOLBR: ACO Based Load Balancing Routing in MANET. Wireless Personal Communications, 126(3), 2483-2511.

[6] Venkatraman, S., & Sarvepalli, S. K. (2018). Load balance technique with adaptive position updates (LAPU) for geographic routing in MANETs. EURASIP Journal on Wireless Communications and Networking, 2018, 1-9.

[7] Karmel, A., Vijayakumar, V., & Kapilan, R. (2021). Ant-based efficient energy and balanced load routing approach for optimal path convergence in MANET. Wireless Networks, 27, 5553-5565.

[8] Aouiz, A. A., Hacene, S. B., & Lorenz, P. (2019). Channel busyness based multipath load balancing routing protocol for ad hoc networks. IEEE network, 33(5), 118-125.

[9] Sahu, M., & Gour, S. (2023). INTSM: A Novel Approach for Load Balancing in MANET Route Discovery. Int. J. Advanced Networking and Applications, 15(02), 5837-5852.

[10] Naseem, M., & Kumar, C. (2017). Queue-based multiple path load balancing routing protocol for MANETs. International Journal of Communication Systems, 30(6), e3141.
[11] Mallapur, S. V., Patil, S. R., & Agarkhed, J. V. (2017). Load balancing technique for congestion control multipath routing protocol in MANETs. Wireless Personal Communications, 92, 749-770.
[12] Francis Antony Selvi, P., & Manikandan, M. S. K. (2017). Ant based multipath backbone routing for load balancing in MANET. IET Communications, 11(1), 136-141.
[13] Murugan, S., Jeyalaksshmi, S., Mahalakshmi, B., Suseendran, G., Jabeen, T. N., & Manikandan, R. (2020). Comparison of ACO and PSO algorithm using energy consumption and load balancing in emerging MANET and VANET infrastructure. Journal of Critical Reviews, 7(9), 2020.
[14] Gherbi, C., Aliouat, Z., & Benmohammed, M. (2019). A novel load balancing scheduling algorithm for wireless sensor networks. Journal of Network and Systems Management, 27, 430-462.
[15] Rath, M., Pati, B., Pattanayak, B. K., Panigrahi, C. R., & Sarkar, J. L. (2017). Load balanced routing scheme for MANETs with power and delay optimisation. International Journal of Communication Networks and Distributed Systems, 19(4), 394-405.
[16] Kushwah, R., Tapaswi, S., Kumar, A., Pattanaik, K. K., Yousef, S., & Cole, M. (2018). Gateway load balancing using multiple QoS parameters in a hybrid MANET. Wireless Networks, 24, 1071-1082.
[17] Dalal, S., Dahiya, N., Seth, B., Jaglan, V., Malik, M., Surbhi, S., ... & Hu, Y. C. (2021). Adaptive Traffic Routing Practice for Load Balance and Congestion Control in AdHoc Network in Cloud-MANET.
[18] Qun, R., & Arefzadeh, S. M. (2021). A new energy-aware method for load balance managing in the fog-based vehicular ad hoc networks (VANET) using a hybrid optimization algorithm. IET Communications, 15(13), 1665-1676.