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Research paper

Congestion control technique for mantes with neural networks

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Abstract
The Mobile Ad hoc network is the network which is established for short duration of time and without central controller. Due to such unique properties of the network, quality of service is the major issue which affects network performance in terms of quality of service. The routing protocols are used for the path establishment from one end to another. The AODV is the most efficient reactive routing protocol for path establishment. In the AODV protocol, no counter measure is proposed yet for the congestion avoidance. The AODV protocol is modified in this research work for the congestion avoidance in the network. In the modified AODV protocol, the neural networks is applied for the error reduction in the network. The mobile node, which has least chances of error, is selected as best node for the data transmission. The proposed AODV protocol is implemented in NS2 and results are analyzed in terms of certain parameters. The proposed AODV protocol shows high performance than existing AODV protocol in terms of throughput and packet loss

Keywords: *AODV; Neural Networks; Back Propagation.*

1. Introduction

A mobile ad-hoc network is the network in which all the present nodes are mobile in nature as randomly distributed. There is no central controller within the network and it is the infrastructure less due to the mobility of the nodes. The network is established here in a completely different manner. There is no infrastructure within these networks and the cost of these networks is very genuine. The low level ad hoc network related facilities can be provided within this network with the help of IEEE 802.11 Wi-Fi protocol. These networks can operate either alone or can combine with the larger networks in order to provide connection [1]. A user can make it possible for the user to be connected anywhere all around the world. The disaster recovery and military operations are some of them amongst numerous applications in which these networks are deployed. These are the networks using which devices can be connected anywhere at any time without requiring any fixed infrastructure.

1.1. Challenges of data routing

i) Dynamic Links: In case of the ad-hoc networks nodes are distributed randomly and moving freely within the network instead of the wired networks where nodes are fixed on the symmetric links [2].
ii) Routing Overhead: In this network, there is change in the location of nodes due to which old routes are generated in the routing table that increase the routing overhead within the network.
iii) Interference: It is the major issues faced by the mobile ad-hoc networks as on the basis of transmission characteristics there is change in links due to which there is interference between nodes [3]. This leads to damage of the total transmission.
iv) Dynamic topology: There is a change in the position of the nodes leads to change in characteristics since the topology is not constant. These changes are reflected in the routing table with a change in the topology that must be adapted by routing algorithms.

1.2. Data routing in MANET

Due to Dynamic nature of the mobile ad hoc network, the network topology can be changes any time and network is without central controller [4]. All the nodes in the network are distributed randomly in the network due to this is infrastructure less network. The nodes of the network by which it engage itself in the multi hop forwarding have utilized the same random access wireless channel. The mobile devices in the network behave like the routers for the data forwarding. In this network, there is no particular infrastructure for the nodes as there is no destination node is out of the range of the source node, hence it requires routing protocols to transfer data packets. The protocols of data routing select the best path from source to destination. There is no need of routing protocols within the cell as base station can easily reach all mobile nodes. Some of the routing protocols are discussed here given below:
The routing protocols, which do not gather, network information for the path establishment that protocol is called proactive routing protocol [5]. The routing tables are maintained on each node in the network for the data routing. All the routing information is maintained in the routing tables and with the change in the topology, it is also updated. With the help of the link state routing, there are various routing protocols have been established under this category, there are different types of protocols in which routing information is updated in each routing table. A different number of tables is maintained by these routing protocols. These type of protocols do not performs well in the large and highly dynamic networks because whole network need to update when any node

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leave the network. Due to this process, there is more consumption of the bandwidth in the network that causes overhead in the routing table.

Reactive Protocols: The routing protocols which do not use network pre-defined information for the path establishment that is called reactive routing protocols [7]. The source node when wants to establish path to destination, then it will send the route request messages in the network. The nodes which have required information will revert back to the messages. The parameters are defined which select optimal path from one end to another end. The performance of these type of routing protocols are quite high as compared to proactive routing protocols in terms of certain parameters

Hybrid protocol: Hybrid protocol is defined as the combination of both the proactive and reactive routing protocols. It contains the feature of both protocols. Zone routing protocol is the most commonly used hybrid routing protocol. The working capability of both these methods proactive and reactive protocols is optimal in the network. The balance between the two protocols is maintained by this protocol hence, it is called the enhanced version of both. The distance-vectors method has been utilized by this protocol in order to determine the optimal path to the destination. In case, there is a change in the network topology this protocol inform all the changes happen in the routing information. In order to transfer data packets from source node to its destination, this routing requires less processing power and memory [8].

1.3. Ad hoc on-demand distance-vector routing (AODV)

This routing protocol is very useful for the path establishment in the dynamic and wireless type of networks [9]. In this protocol, the path establishment procedure is initiated when required to establish path to destination. Using this protocol both unicast and multicast routing can be performed. These routes are present in the protocol until they are demanded by the source. A tree is created by this protocol by which 14 multicast group members can be connected easily. The group members are present in the trees and for connecting the member's nodes are required [10]. AODV utilizes the sequence numbers in order to ensure the freshness of routes. The AODV protocol give high performance as it loop free and path establishment procedure initiated immediately when required path to destination.

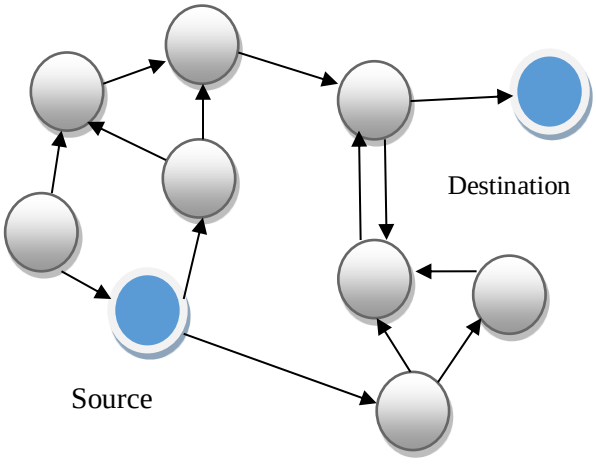


Fig. 1: RREQ.

When one node wants optimal path to destination node, then it will broadcast the route reply packets in the network. The messages are forwarded by each node to its adjacent node until it reaches to destination [11]. The path which is established is loop free and best path is selected on the basis of hop count, sequence number.

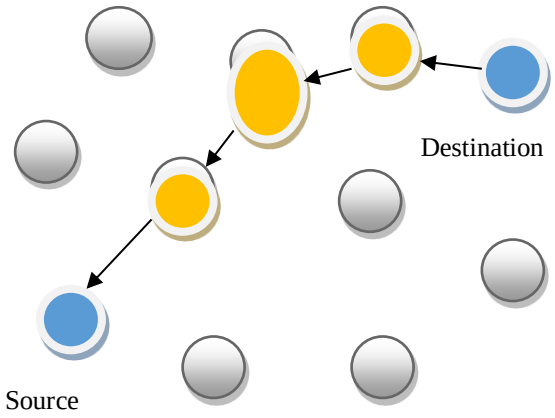


Fig. 2: RREP.

The node sends the RREP packet message back to the source, this node can be either destination node or contains a valid route to the destination. The route reply packets are send on the selected path in the reverse order. Each neighboring node rebroadcasts the received RREQ packets until a route is established. For the source, this RREP is unicast in a hop-by-hop fashion. A route is created by each intermediate node to the destination with the propagation of RREP [12], [22], [23]. The destination node send the route reply packets and source node maintain list of the nodes which are in the path. The source start transmitting data on that path and path can be changed in case of link failure. Each intermediate node invalidates the route to the destination when the RERR propagates towards the source. When the RERR us received by the source, the route is invalidated and new route discovery is initiated if required. Hello, messages provide the information about the neighborhood. A hello message is broadcasted to its neighbor by each node at regular interval of time. Only for one hop hello messages are propagated for the neighborhood of a node.

1.5. Advantages and disadvantages

AODV protocol has been utilized for the establishment of the routes on demand for which a destination sequence number is utilized in order to find out the most recent route to the destination. There is less delay in setting up connection. There is no network overhead as routes maintenance supported by the HELLO message is limited in range.

The contradictory routes are leaded by the intermediate nodes which is one of the major disadvantages of this protocol [13-24]. There is heavy control overhead due to the multiple Route Reply packets when connecting with the Route Request packet. Unnecessary bandwidth consumption is the other disadvantage of this protocol [25].

2. Related works

Saurabh Sharma, et.al presented the detailed study of congestion issue and congestion control techniques in wireless networks are the major concern of this paper [14]. The nodes in the network are mobile in nature due to which these networks can be termed as the simple networks or ad hoc network or most typical Mobile Ad hoc network. The congestion is the major issue which needs to be addressed to increase network performance Various challenges have been posed by the change in the network topology and shared nature of the wireless channel as it becomes difficult to deal with congestion in the network. In this paper, for the control of the congestion and to overcome this comparative analysis between the clustering; queuing and cross-layer protocols were presented.

Ashish Kumar Mourya, et.al presented the main reason behind the occurrence of congestion in the mobile ad-hoc networks are the limited resources. The special properties of a shared wireless channel are not handled by the standard TCP congestion control

mechanism. On the internet the working of the TCP congestion control is optimal. Due to unique properties of the mobile ad hoc networks it is hard to design efficient protocol for the network. Hence, in the difference in the environment is a problem to the standard TCP. Therefore, various methods have been proposed to overcome this issue [15]. In order to avoid congestion in the ad-hoc network, they proposed a mobile agent based congestion control Technique in this paper. There is dynamic network topology of the nodes due to which help is provided to the mobile agents. They also presented a mobile agent based congestion control mechanism in this paper.

Som Kant Tiwari, et.al presented it becomes a monotonous task to proposed or design efficient protocols by which congestion problems can be handled effectively due to highly dynamic nature of Mobile ad hoc networks [16]. It is required to design a network by which source in the network is notified using congestion control mechanism by which the transmission rate is minimized. In the existing methods, the information about congestion issue is provided to the source as TCP has been utilized by them. When the link failure happened in the network it leads to packet loss which affects network performance. Due to which the moving of the mobile nodes reduced and also network throughput

Heena Gupta, et.al presented an essential role is played by the mobile network communication in the field of wireless network communication. Nodes are randomly distributed in the MANETs which are temporary network and infrastructure less. In this network, over the wireless link nodes are communicating with each other and due to the movement of the node, there is a change in the network topology [17]. Due to the absence of router in between source and destination, routing issues are faced in the MANETs due to nodes act as a router. Hence, controlling congestion is the major issue faced by this network. The congestion is caused in the network when the data sending rate is high as compared to data receiving rate. This leads to reducing the performance of the network as congestion drop all the required packets. Therefore, the author used a fuzzy based algorithm in this paper for the avoidance of the congestion issue in this network.

Abinasha Mohan Borah, et.al presented there is no central controller in the network, and mobile nodes are distributed randomly this network is known as mobile ad-hoc networks. These networks are infrastructure less in which nodes act as both routers as well as hosts. This property of the network faces major challenges such as network overhead and loss of packets [18]. The congestion in the network occurs due to the increase in the size of the data packets by which loss of packets occurred. So far, various congestion control algorithms are introduced by various researchers so that congestion in the network can be detected easily. The author of this paper, highlight various congestion avoidance algorithms. The author design technique which reduce chances of congestion in the network

Gurmeen Kaur, et.al presented mobile ad-hoc network that establishes a communication link between nodes in which interference of an external device is not allowed. This network is the branch of networking [19]. The performance of the network is degraded due to various issues within the network. Among all these issues, network congestion is major which occur in peer to peer communication. It is not necessary that bulk of nodes can carry a large amount of data sometimes a single node can carry huge quantity to the destination. Due to the presence of the congestion on the node, there is a loss in the data. There are various algorithms was proposed so far for minimizing the effects of congestion in MANET but due to their complexity, network overload and consumption of time they are not utilized currently.

Vandana, et.al presented the number of active flows and the total storage in the network is the main reason behind the congestion loss in the bust network [20]. Buffer memory and packets are the routers present in the total storage for the long links in flight. In this paper, a simple flow counting algorithm is proposed. In this algorithm, one bit of state per flow was utilized in which few instructions per sender were transferred. By changing the number of packets per sender in proportion to the queue length, this algorithm provides the congestion feedback. The queuing delay has been reduced using this algorithm and provide favorable results due to which there is an increase in a loss when a number of flows increases. This results in the long and unfair timeout delays that degrade the performance.

3. Proposed methodology

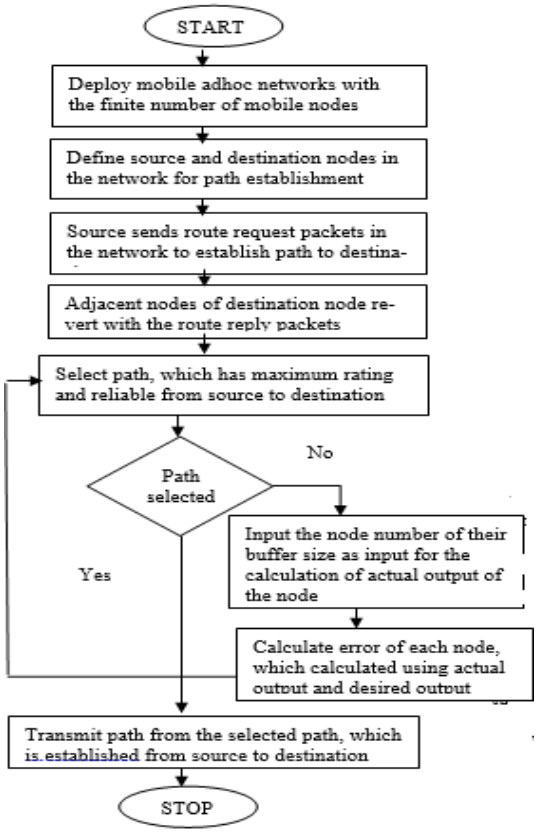


Fig. 3: Flowchart.

Due to dynamic nature of the network routing, quality of service are the various issues of mobile ad hoc networks. The congestion happened in the network when data transmission rate is high as compared to data receive rate. The technique of neural networks is proposed in this work to avoid congestion in the network. The neural network technique calculate the error on each node and node which has least error is selected for the data transmission . In back propagation algorithm learns from the previous experience and drive new values. The back propagation algorithm takes input node number and their buffer size. It will calculate the actual value of the congestion on a particular node.

$$\text{Actual value} = \sum_{\substack{x=0 \\ w=0}}^{\substack{x=n \\ w=n}} x_n w_n + bais \quad (1)$$

The actual value of congestion is calculated with the equation number 1. The error is calculated with subtracting desired value from the actual value

$$\text{Error} = \text{Desired Value} - \text{Actual Value} \quad (2)$$

The mobile node on which error is least is selected as the best node for the path establishment. The proposed improvement is the AODV protocol for the congestion avoidance in mobile ad hoc network. The AODV protocol establishes a path through the nodes which have the least error, minimum hop count, and maximum sequence number.

4. Result and discussion

This research work is based on congestion avoidance in mobile ad hoc networks. The AODV routing protocol will be improved using neural networks. The performance of proposed AODV protocol is compared with the existing AODV routing protocol for path establishment. To simulation parameters are described in table 1.

Table 1: Simulation Parameters

Parameters	Values
Propagation Model	Two Ray
Antenna type	Omi directional
Number of nodes	28
Queue	Priority Queue
Area	800*800 meters
Standard	802.11

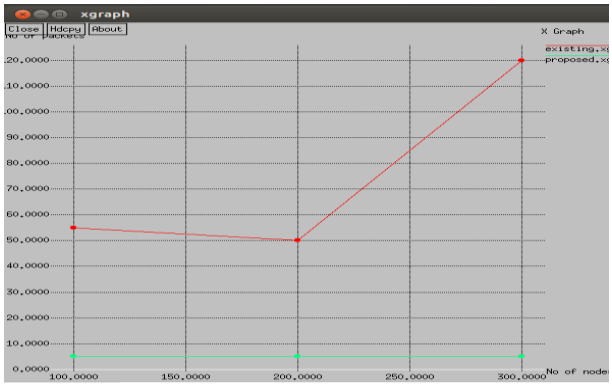


Fig. 4: Packet loss Comparison.

As shown in figure 4, the packet loss of proposed AODV protocol and existing AODV protocol is compared. It is analyzed that packet loss is reduced in proposed technique due to congestion avoidance in the network. The x-axis of the graph defines a number of nodes and on the y-axis the number of packets.

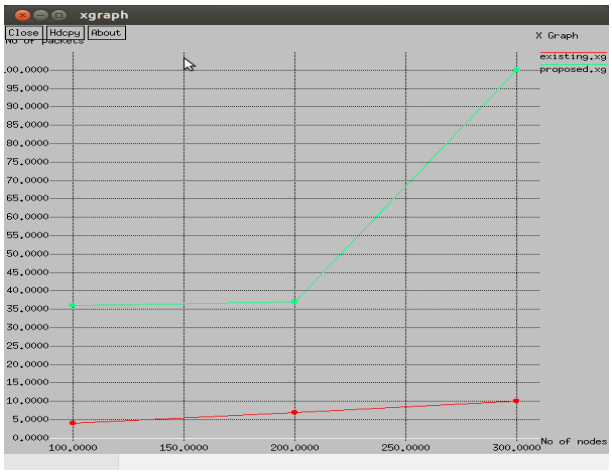


Fig. 5: Throughput Comparison.

As shown in figure 5, the throughput of the proposed and existing protocol is compared. In the proposed technique neural networks are used with the AODV protocol which reduces chances of congestion due to which throughput is increased at a steady rate.

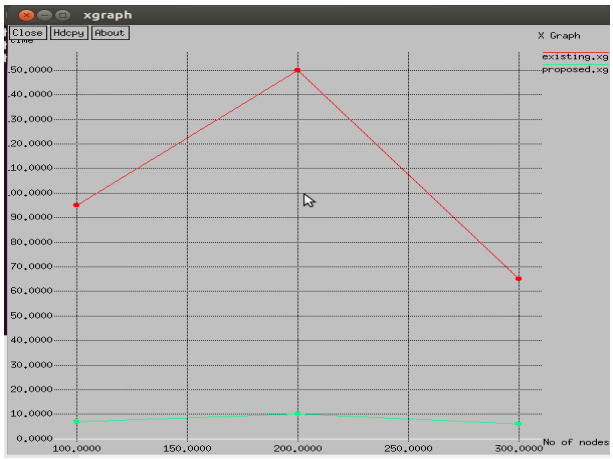


Fig. 6: Average End to End Delay Comparison.

As shown in figure 6, the end to end delay of the proposed and existing algorithm is compared for the performance analysis. It is analyzed that delay of the proposed algorithm is less as compared to the existing algorithm.

5. Conclusion

In this work, it is concluded that mobile ad-hoc network is decentralized in nature due to which it has high chances of congestion in the network. In this research work, neural network approach is proposed for the congestion avoidance in the network. The back propagation approach calculates the future possibilities from the current information for the congestion avoidance. The proposed technique is implemented in NS2 and simulation results show an increase in throughput, reduction in packet loss.

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