International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-3, September 2019

# Neuro Fuzzy Controllers Based Multipath Routing Technique in Mobile Adhoc Networks (MANETs)

**V.Rajesh Kannan, A.Charles**

***Abstract*: Mobile ad hoc networks (MANETs) comprise a set of wireless mobile nodes that communicates data between them with no infrastructure. The nature of restricted communication range of wireless network nodes leads to the requirement of multi-hops to communicate data in the network. Multipath routing discovers many routes among an individual source and destination. MANET possesses a network that has a tendency to change its structure frequently; hence the task of accomplishing a prescribed number of pathways between a prescribed source and destination nodes appears to be tedious. A new Neuro fuzzy oriented routing algorithm in MANET (NFRA) has been proposed in this work. The ultimate objective of the NFRA algorithm is to suitably create the fuzzy type controllers with the aim of minimizing the quantity of reconstructions in the wireless ad hoc network. The obtained simulation results have been found to portray both the efficiency and effectiveness of the applications incorporated into the Mobile ad hoc networks.***

***Keywords*** **: MANET,Neuro-fuzzy, Routing, Communication.**

## I. INTRODUCTION

The conventional type of wireless mobile communication medium is usually upheld by means of a fixed wired/wireless foundation. In general a single-hop wireless radio communication mode is adopted by a mobile device for its communication purposes; this incorporation is mainly for the purpose of reaching the concerned base station that effectively correlates the same to the prescribed wired/wireless framework. It has been observed that the mobile ad hoc type of networks (MANETs) do not rely on any type of definite architectures. MANETs are composed of a number of hubs and these are found to communicate among themselves by utilizing the single-hop strategies wherein the multi-hop strategy ways in a peer-to-peer style. Halfway hubs usually exist between a couple of imparting hubs and these preferably go about as a router [1-5]. The above mentioned point clearly indicates that the hub functions both as a host and as a router. The hubs thus incorporated in the ad hoc networks are mobile in nature; hence new routes can be easily accomplished either by inserting or removing the hubs. The change in the structure of the ad hoc network can happen arbitrarily, quickly, and out of the blue [1-5]. The most significant task of prime consideration in the ad hoc network is the efficient and perfect transmission of the data packets among the nodes in movement in a controlled fashion, this appears to be the foremost task of the of ad hoc routing protocols. The above mentioned task appears to be a testing task as the structure of the ad hoc network varies often and that it does not possess a definite structure.

Certain issues such as the hub portability problem, hub disappointment factors, and the dynamic attributes associated with the radio channel turn out the entire course as an invalid one. The overhead of discovering elective courses have been found to be high and the additional deferral in packet conveyance may also be presented. The above illustrated issue can be tackled by adopting the Multipath routing mechanism wherein an additional course would be issued to the concerned goal hub. These issued courses can be utilized by both the Source and moderate hubs as essential and reinforcement courses. Various examinations have been performed around the multipath revelations of the concerned on-request routing protocols for minimizing the various emerging single-way issues [5], for instance, the high course disclosure inertness, the visit course revelation endeavors and the conceivable enhancement associated with the data move throughput. The accomplishment of the investigations on the multipath utilizations of the on-request routing protocols to solve similar issues have been found to be less accessible. Multipath activity is to be monitored with at most care in these regions as it involves the transfer of data contents from one source node to multiple destination nodes. As multiple paths and nodes are involved in the multipath routing procedure it is considered as the most complicated issue [6-9]. As far as the computation of the multipath condition in the ad hoc network is considered certain necessities are to be monitored and presented. The existing multipath computations have been found to lack majority of the necessities [6-9].

In [10, 11], the authors have presented the incorporation and utilization of the fuzzy logic controllers for the energetic rearrangement of the concerned edges and the centre routers.

Manuscript published on 30 September 2019
* Correspondence Author
**V.Rajesh Kannan***, Assistant Professor, Department of Electronics and Communication Engineering, Government College of Engineering, Bargur, Tamilnadu, India. Email: kannan.813@gmail.com
**Dr.A.Charles**, Assistant Professor, Department of Electronics and Communication Engineering, Government College of Engineering, Bargur, Tamilnadu, India. Email: maryarputhamcharles@gmail.com

The accomplishment of this reconfiguration happens by considering the necessity adjustments to be made in the network provisioning as illustrated by the approaching traffic rates and the QoS levels. Fuzzy logic is mainly incorporated because of the existing vulnerability in the traffic computation procedures and due to the absence of numerical models which are to be utilized in the traffic computation procedure. Fuzzy set definitions (enrolment work) and standards (principle base) are used for the representation of a fuzzy controller. Evidently the need file for every packet is resolved with respect to the quantity of hops and the cradle size the packet has endured respectively [11].

This work introduces a Neuro fuzzy oriented routing algorithm in MANET (NFRA). The ultimate objective of the NFRA computation is to develop the fuzzy controllers with the assistance to minimize the amount of recreations in the ad hoc network. The following sections of the paper are classified as follows: In segment 2, works associated with the ad hoc network is presented. Segment 3 illustrates the fuzzy controller. The required recreation outputs are portrayed in segment 4. Section 5 concludes the entire work of the paper.

## II. MULTIPATH ROUTING IN MANET

Multipath routing is viewed as a methodology that assists in the identification of multiple paths among the selected source and destination nodes for the data transmission process by making use of the single route revelation mechanism. Multipath routing protocols enables us to identify certain issues such as the node disjoint, the link-disjoint, or the non-disjoint routes. Hub disjoint routes are found to restrict themselves from sharing the existing hubs or links for all purposes. On the other hand the Link-disjoint routes are again found to restrict themselves from sharing the links for all purposes, yet they may share their hubs for all intents and purposes. The Non-disjoint routes are permitted to share their hubs and links for all intents and purpose. Comparing the multipath and single way types of routing it has been observed that the multipath types are preferred more as they are found to offer certain benefits such as load adjusting, adaptation to non-critical failure, and higher amassed bandwidth.

The objective of the Multipath routing mechanism is to identify numerous routes between a selected source and destination hub. The presence of numerous pathways among the source and destination hub sets is to make up for the required zestful and flighty nature of ad hoc networks. The routing protocols are expected to conserve the routing tables in order to reserve the following hops towards the ideal destination.

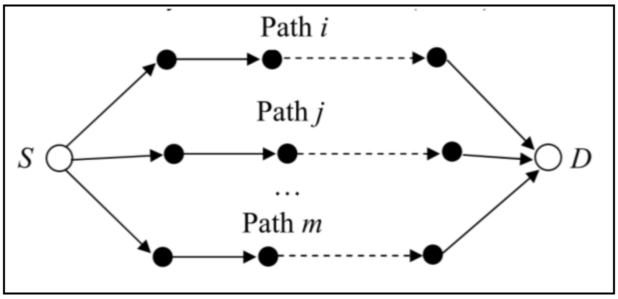


**Fig 1. Multipath routing mobile ad hoc network**

Another mechanism adopted by the routing protocol is to possess a reserving system by means of which multiple pathways to a similar destination can be stored. This Multipath routing mechanism turns out to be the basic requirement for the load adjusting process, offering the required nature of administration. Fig. 1 illustrates a multipath routing mobile ad hoc network.

The Ad Hoc On-Demand Distance Vector (AODV) routing [5] is a responsive type of protocol, in spite of making use of the qualities of a proactive protocol. AOMDV [6] stretches out the unmistakable AODV to determine several circles free and link-disjoint ways between the selected source and the selected destination in each of the route disclosures. It adopts and makes use of the dispelling statistics previously obtainable and accessible in the AODV protocol to an extent as intended. Monitoring of the multiple pathways is accomplished by considering the rundown of the hops contained in the routing sections of the concerned destination. All the following hops would be grouped under a similar grouping number. The responsibility of a hub is to keep up the advertised hop check for each of the individual destinations, which is thus viewed as the most extreme hop mean. Another function of the protocol is to process the multiple circles. On the other hand this Circle opportunity is preferably ensured by utilizing a notion of "advertised-hop count". Another specific observation here is that the link disjoint of several ways is established by adopting a specific stuff of the overflowing mechanism. AOMDV is incorporated for the purpose of identifying hub disjoint or link-disjoint routes. In the hub disjoint route identification procedure the hubs do not reject the RREQ copies travelling straight away, wherein each of the RREQ copies travelling through an alternate neighbor of the source would characterize the node disjoint. The individual hubs are expected to maintain an initial catalogue for each RREQ for the purpose of monitoring the rundown of the existing neighbours of the selected source node via a duplicate of the RREQ would be obtained.

AODVM [9] is observed as an augmentation of the AODV for identifying multiple node disjoint ways. The condition implied here is that the middle of the road hubs would not be permitted to transmit a pathway answer straight to the concerned source. Another possibility is that these copy RREQ packets would not be disposed of by the middle of the road hubs. One can observe the presence of a RREQ table at the middle of the road hubs which is suitably adopted for the purpose of recording and updating the obtained RREQ packets. The duty of the end node is to reply back with a RREP for all the obtained RREQ packets. Further a halfway hub would suitably transmit an obtained RREP packet to an adjacent node in the RREQ table through the determined shortest pathway to the concerned source. Hubs usually prefer transmission through a single pathway, which clearly indicates its dislike in multiple ways towards a particular destination. The above point can be clearly proved by its activity wherein the hub would grab a neighbor broadcasting a RREP packet and would essentially erase the same from its RREQ table.

As the hub selects a single route from the existing multiple pathways for its transmission the other unselected routes would preferably act as a hub disjoint.

## III. FUZZY CONTROLLER

### 3.1 Fuzzy Controller

The fuzzy logic was illustrated by L. Zadeh [12] as a generalization of the Boolean logic. Fuzzy set theory offers a shape to the existing vulnerabilities, in sense it provides answers to certain conditions which may be false either partly or completely, this appears to be the contrast between these logics. Random uncertainty can be efficiently handled by the Fuzzy logic set, i.e., when the assumption of an arrangement of occasions is preposterous in nature. There are two common two sorts of fuzzy logic controllers [13, 14]. The first type is the so called criticism controller, which appears to be inappropriate for the elite type of communication networks. The second type of controller is thus incorporated in this paper, fig. 2 illustrates the same. The ultimate aim of this fuzzy logic controller is to tune the controlled framework's parameters with respect to the existing framework's conditions. This control system possesses a different form when compared with the traditional criticism command and thus observed as an adaptive command. The model leveled output and the performance estimation factors contribute to the highlight of the fuzzy controller. It is evident that in the fuzzy controller we tend to traverse the verifiable and unequivocal associations existing within the framework at the fundamental level and hence we observe the ideal fuzzy control governance system just as a comprehension base.

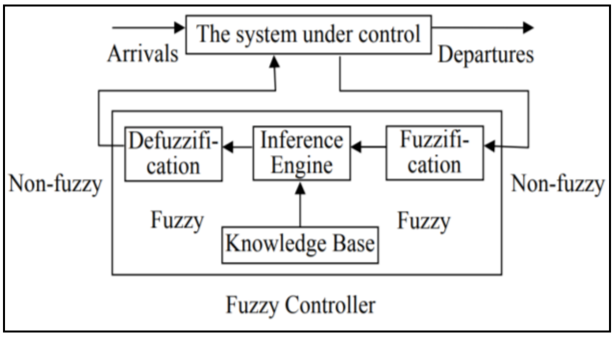


**Fig 2. The fuzzy controller**

### 3.2 Scheduler Controller

In this work the priority record of the individual packets is clearly portrayed by the introduced fuzzy scheduler. Selection and consideration of the various source nodes is thus accomplished by considering all the available sources of information related to the priority concerns unlike the previous booking plans. The fuzzy scheduler has been observed to make use of the available three information factors and the one yield variable for its scheduling procedures. The considered information factors are to be appropriately fuzzified and these are as follows, the termination time, the data rate of the packet and the Queue extensions or distances of the hubs to which the concerned packet is related. Following which the data sources would be then fuzzified, suggested, collected and defuzzified in order to arrive at a crisp estimation of the yield i.e., the priority list. The semantic factors related with the information factors are low (L), medium (M), high (H), and very high (VH). For the yield variable, priority file, 4 etymological factors are adopted and used suitably. They are as follows, low (L), medium (M), high (H), and very high (VH). The enrolment function of these factors has been illustrated in Fig. 3.

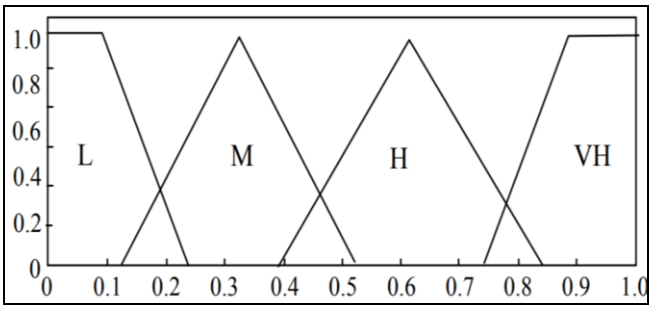


**Fig 3. Scheduler membership functions**

## IV. SIMULATION EXPERIMENTS

### 4.1 Simulation Model

Randomly created networks have been utilized for the purpose of executing the simulation ponders [15]. Here it has been ensured that the obtained simulation outputs are unconventional of the qualities of a specific network structure. On the other hand the after effects of the simulation are sure regarding the performance factors. NFRA assessment has been accomplishment by the ns-2 simulator [16]. NFRA's performance assessment involves the adoption and use of a popular multicast routing protocol, namely the AOMDV [6]. AODVM [9] can be used in the information control task and for regulating the normal link-connect time. Further it can be incorporated for determining the achievement rate in identifying the route and the element of the data communication process. Here a mimicked field is represented as 1000m × 1000m in which N=100 hubs are found to move in close proximities. Simulation time is considered for the runs in a time span of around 600 seconds. The hubs are found to move randomly at a speed of around 10 meter/sec. Table 1 records the obtained simulation attributes that are meant to be used as default esteems only if they are generally indicated. The NFRA is considered for a major part from packet delivery ratio, routing overhead ratio, and normal end-to-end deferral of data packets. The packet delivery ratio, routing overhead ratio, and normal end-to-end postponement of data packets are thus selected by the supporting formula:

Packet delivery ratio — the packet delivery ratio is defined as the ratio of the total number of perfectly conveyed data packets, and is gotten as pursue.

Packet delivery ratio (PDR)= (No.of packets delivered)/(No. of packets sent)

Routing overhead ratio — the routing overhead ratio is represented as the ratio of the network control packets overhead and the correctly transmitted data packets, and is gotten as underneath.

Routing overhead ratio= (No.of control packet sent)/(No.of packets delivered)

Normal end-to-end delay of data packets — it corresponds to the normal computation of the time that the gotten data packets utilize for the purpose of reaching the concerned destination from their beginning point. This parameter has been found to incorporate the time the hubs utilize for retaining itself in the inner lines, the required retransmissions at the MAC level, and the number of forwarding transmissions through the multiple middle hubs.

Routing overhead ratio= (No.of control packet sent)/(No.of packets delivered)

### 4.2 Simulation Results

The proposed algorithm deals with the transmission productivity of the network; this has been suitably expressed by the packet delivery ratio. Fig. 4 portrays the packet delivery ratio of the concerned routing techniques with respect to the expansion of the hub's greatest speed. With an increase in the hubs greatest speed, the packet delivery fraction of the strategies vanishes. Another observation is that an increased number of link breakages in the network may lead to an expansion of the packet misfortune fraction. At higher rates increased numbers of link breakages are expected and hence the expansion of a packet's misfortune fraction. It is this figure that proves the efficiency of our proposed algorithm in comparison with the other tried techniques. The proposed approach appears to be the best in all ways. It is thus evident that the introduced NFRA algorithm is more dependable than the AOMDV and the AODVM.


**Fig 4. Comparison of packet delivery ratio.**

The control packets in this approach takes the form of route revelation (RREQ, RREP) and pathway support packets (RERR, HELLO) respectively. The degree of transmission overhead expenses associated with a network is denoted by the routing overhead ratio, this computation is done with respect to a prescribed protocol. Fig. 5 portrays a collation of the routing overhead ratio. It is evident from fig. 5 that an expansion in the hub's development speed would ultimately decrease the NFRA's routing overhead ratio smaller than that of the AOMDV and the AODVM.

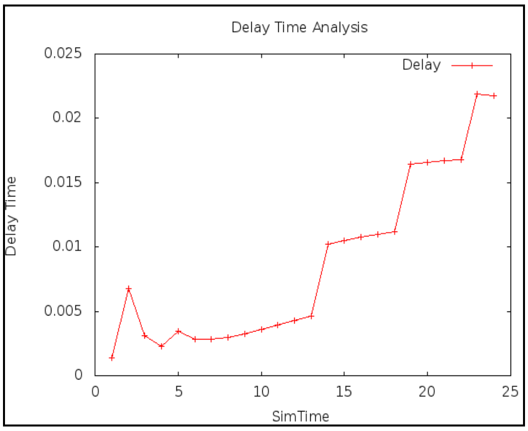


**Fig 5. Comparison of delay time analysis.**

Fig. 6 illustrates the simulation results of the normal end-to-end postpone productions of the various routing strategies by means of modifying the hub's most extreme development speed from 0 to 10 m/s to develop versatility. Growth in the developmental speed has been found to actuate the continuous topology modifications which trigger the development of broken links respectively. Broken links may tend to cause additional route recuperation procedures and route disclosure processes. As a result of the above mentioned issues the normal end-to-end deferral of the packets enhances as the hub speed increments. Figure 6 illustrates the fact that the proposed algorithm's data transmission rate decreases with an increase in the hub's portability speed in comparison with the various other strategies. This is due to the fact that the multipath augmentations possesses soundness pathways and require very little pathway disclosure overheads. The proposed approach readily offers an increased number of exchange ways during the breakage of an essential way, thus producing a less normal end-to-end delay in a highly versatile environment.

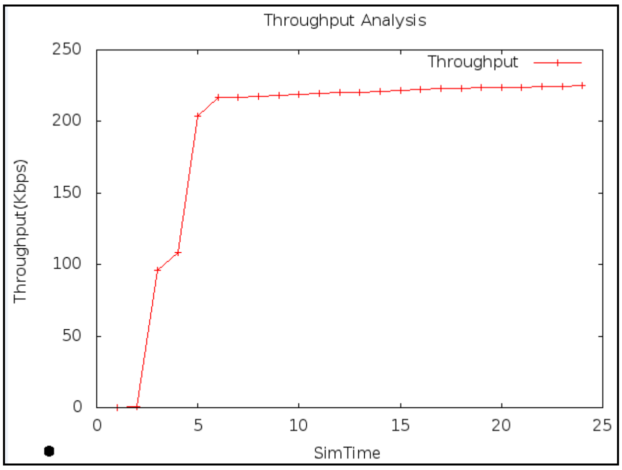


**Fig 6. Comparison of end-to-end delay**

## V. CONCLUSION

The network topology modification in a stipulated period of time is because of the versatile nature of the hubs existing in the ad hoc networks.

*Retrieval Number: C4562098319/19©BEIESP*
*DOI:10.35940/ijrte.C4562.098319*
*Journal Website: www.ijrte.org*



*Published By:*
*Blue Eyes Intelligence Engineering*
*& Sciences Publication*

The job of an effective routing algorithm is to possess a significant job for enabling better executions in the ad hoc networks. The ultimate aim of this work is to identify the multipath routing issues in the ad hoc network. Further a fuzzy controller based multipath routing algorithm is thus portrayed in MANET (NFRA). The ultimate idea of the NFRA algorithm is to develop the fuzzy controllers with suitable assistance with a view of minimizing the quantity of course reconstructions in the ad hoc network. Selection of the various types of courses was accomplished in a productive manner in a way of enhancing the packet delivery ratio, lowering the quantity of routing packets and minimizing the end-to-end delay. NS-2 has been used for the simulation procedures and thereby the viability of the introduced strategy has been approved in the high load conditions. The above appears to be an accessible way for dealing with the multipath type of routing decisions.

## REFERENCES


1. Blaho, M., Urban, M., Fodrek, P., &Foltin, M. (2012). Wireless network effect on PI and type-2 fuzzy logic controller. International Journal of Communications, 6(1), 18–25.
2. Ayyasamy, A., and K. Venkatachalapathy. "Context aware adaptive fuzzy based QoS routing scheme for streaming services over MANETs." Wireless Networks 21.2 (2015): 421-430.
3. E. M. Royer, C. K. Toh, A review of current Routing Protocols for Ad-hoc Mobile Wireless Networks, IEEE Personal Communications Magazine, vol. 6, pp no. 46-55, 1999.
4. Lu, X.; Wang, P.; Niyato, D.; Kim, D.I.; Han, Z. Wireless networks with rf energy harvesting: A contemporary survey. IEEE Commun. Surv. Tutor. 2015, 17, 757–789.
5. Agiwal, M.; Roy, A.; Saxena, N. Next generation 5G wireless networks: A comprehensive survey. IEEE Commun. Surv. Tutor. 2016, 18, 1617–1655.
6. M. Yaghmaei, M. Baradaran, H. Talebiana Fuzzy QoS Routing Algorithm for Communication Network, proc. 10th IEEE International Conference on Communication systems, ICCS 2006, pp.1-5, Singapore, October 2006
7. G.Parissidis, V. Lenders, M. May, B. Plattner, “Multi-path Routing Protocols in Wireless Mobile Ad Hoc Networks: A Quantitative Comparison”, Lecture Notes in Computer Science, 2006, Vol. 4003, pp. 313-326.
8. D.B. Johnson, D.A. Maltz, Dynamic source routing in adhoc wireless networks, in: T. Imielinski, H. Korth (Eds.),Mobile Computing, Kluwer Academic Publishers,Dordrecht, 1996, pp. 153–181.
9. S.Motegi, K. Yoshihara, H. Horiuchi, “Proposal on Multipath Routing for Ad hoc Networks”, IEIC Technical Report, 2002, 102(441): 51-56, IN2002-125, Nov. 2002 (in Japanese).
10. R. Zhang, and Y. Phillis, “Fuzzy Control of Queueing System with Heterogeneius Servers”, IEEE Trans. Fuzzy Systems, 1999, Vol. 7, No. 1, pp. 17–26.
11. A V.D. Park, M.S. Corson, A highly adaptive distributed routing algorithm for mobile wireless networks, in Proceedings of INFOCOM _97, April 1997.
12. L. A. Zadeh, “Fuzzy sets”, Information and Control, 1965, Vol. 8, pp. 338–353.
13. G.Alandjani, and E. Johnson, “Fuzzy Routing in ad hoc networks”, In Proceedings of the IEEE International Conference on Performance, Computing and Communications, Phoenix, Arizona, April, 2003, pp. 525–530.
14. C. Gomathy, and S. Shanmugavel, “An Efficient Fuzzy Based Priority Scheduler for Mobile Ad hoc Networks and Performance Analysis for Various Mobility Models”, 2004 IEEE Wireless Communications and Networking Conference (WCNC 2004), Atlanta, USA, March, 2004, pp. 1087–1092.
15. B. Waxman, “Routing of Multipoint Connections”, IEEE Journal on Selected Areas in Communications, 1988, Vol. 6, No. 9, pp. 1617–1622
16. Georgios Kioumourtzis, ”Simulation and Evaluation of Routing Protocols For Mobile Ad-hoc Networks (MANETs)”, NAVAL Postgraduate School Monterey, California, Thesis, Sept. 2005


## AUTHORS PROFILE

**Dr.A.Charles** received his B.E degree in Electronics and Communication Engineering, Jeppiaar Engineering College in 2007, M.E. degree in Process Control and instrumentation, Annamalai University in 2011 and Ph.D in MANET, Annamalai University in 2018. Currently Working as a Assistant Professor in the Department of Electronics and Communication Engineering, Government College of Engineering, Bargur. His research interest include Mobile Communication, Ad-Hoc Network.

**V.Rajesh Kannan** received his B.E degree in Electronics and Communication Engineering, Annamalai University in 2007, M.E. degree in Process Control and instrumentation, Annamalai University in 2012 and Currently pursuing Ph.D degree at Annamalai University. Currently Working as a Assistant Professor in the Department of Electronics and Communication Engineering, Government College of Engineering, Bargur. His research interest include Mobile Communication, VANET, Image Processing, Ad-Hoc Network.