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DISTANCE AND PACKET DELIVERY RATIO ENHANCEMENT USING NEURO FUZZY LOGIC IN MANETS

Deeksha Mengi[1], Anita Kumari[2]

[1]Student, Department of Electronics and Communication, Rayat Bahra University, Mohali, India [2]Professor, of Electronics and Communication, Rayat Bahra University, Mohali, India

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Abstract: *Data in the mobile ad hoc network transfers from one node to another node through an intermediate node. This intermediate node should be trusted node in order to avoid any failure in the system. Considering this fact, a new technique has proposed in this paper which uses the hybridization approach of neural network and Fuzzy logics referred as ANFIS. The proposed work evaluates the trust of each node in the network and the node formulating maximum trust node has chosen as the intermediate node for the transferring of data. Furthermore, the proposed technique optimizes the route by enhancing the number of factor which helps in route selection decision making efficiently and appropriately. The experimental analysis have been performed using proposed work and compared with the traditional technique to conclude the performance individually. Consequently, proposed technique outperforms the traditional technique in terms of each performance parameter such as Packet Delivery Ratio, Packet Loss and Throughput.*

Keywords—Mobile ad hoc networks, ANFIS, Trust value, Packet loss, PDR, Throughput

I. INTRODUCTION

Mobile ad hoc networks are independently self-organized networks without the support of infrastructure. Nodes move arbitrarily in a mobile ad hoc network, therefore the network may experiences quick and unpredictable topology variations [1]. In addition, because nodes in a mobile ad hoc network normally have restricted transmission ranges, therefore some nodes cannot directly communicate with each other. Hence, in mobile ad hoc networks, routing paths potentially hold several hops, and each node in mobile ad hoc networks has the responsibility to act as a router [2].

Mobile ad hoc networks created from the DARPA Packet Radio Network (PRNet) and SURAN project [3]. Being independent on pre-established infrastructure;

Mobile ad hoc networks have advantages such as

- Rapid and ease of deployment,
- Improved flexibility and
- Reduced costs.

Mobile ad hoc networks are suitable for applications of mobile either in unfriendly environments where no infrastructure is available, or momentarily established mobile applications which are cost critical [4]. In recent years, application domains of mobile ad hoc networks achieve more and more significance in non-military public societies and in commercial and industrial areas. The typical application scenarios consist of the rescue missions, the operations of law enforcement, the cooperating industrial robots, the traffic management, and the educational programs in campus [5].

In the mobile ad hoc networks, the sending of data through the trusted node is the main requirement of routing. Several techniques have been proposed till now to select the optimal node for the transferring of data [6]. In the proposed work, hybridization of two techniques is done i.e. neural network and fuzzy logics. Fuzzy logic is a form of many-valued logic in which the truth values of variables may be any real number between 0 and 1. In Boolean logic, by contrast, the truth values of variables may only be 0 or 1. Fuzzy logic has been stretched to handle the concept of partial truth, where the truth value may range between absolutely true and absolutely false. In addition, when linguistic variables are used, these degrees may be managed by particular functions. Fuzzy logic has been applied to several fields, from control theory to artificial intelligence [7].

Classical logic only permits propositions having a value of truth or falsity. The notion of whether 1+1=2 is an absolute, immutable and mathematical truth. However, there exist certain propositions with variable responses, such as asking different people to recognize a color [8]. The notion of truth doesn't fall by the wayside, but rather on a means of demonstrating and reasoning over partial knowledge when afforded, by accumulating all possible outcomes into a dimensional spectrum [9]. The advantages of fuzzy logics over the classical logic help them to use it with the proposed method.

II. ANFIS

ANFIS combines the characteristics of fuzzy system and neural network under an umbrella. ANFIS stands for Adaptive Neuro Fuzzy Interference System [10]. It is technique which implements various learning method for training an Artificial Neural Network to Fuzzy model as name shows. FIS is implements non-linear mapping of the inputted data. The mapping is done by using various if-then rules of the fuzzy system. Each and every rule of system describes the nature of the mapping [11]. The input

space is referred by the parameters used in if-then rules of fuzzy network. The output space is defined as the output corresponding to input space. Hence the working and the output generated by fuzzy is sensitive to the selected parameters [12]. The selection of the parameters is not guided by any of the available procedures itself. Hence ANFIS is a solution to this problem. ANFIS facilitates the Fuzzy network for which the membership functions or parameters can be adjusted by using various algorithms such as least square method and back propagation etc. ANFIS enables a Fuzzy system to be trained from the data which is being modeled [13]. Fuzzy network or rules should be chosen efficiently when they are going to incorporate in the form of ANFIS.

Sugeno: Sugeno is a fuzzy model [14]. It works as follows:

1. Let's consider that fuzzy inference two inputs x and y respectively and generate corresponding single output z.
2. A first-order Sugeno model will have following rules: Rule 1:
   If x is A_1 and y is B_1 then $f_1=p_1x+ q_1y+ r_1$
   Rule 2:
   If x is A_2 and y is B_2 then $f_2=p_2x+ q_2y+ r_2$

III. PROBLEM FORMULATION

Routing is the process of selecting best paths in a network which can be achieved by various routing techniques. There are many routing techniques developed that can help to generate the efficient path for communication. But all the traditional routing techniques select the route on the basis of shortest distance. Thus, a single parameter for the selection of route is not accurate as the shortest path may suffer from the lower trust value. Moreover, in the base paper, the number of factors i.e. energy, speed and number of hop counts considered for the selection of route is less which may resultant into less reliability and efficiency for the system. The less number of factors are not able to support a route selection decision making process effectively.

Hence there is a need to develop such a system or technique which can overcome the shortcomings of previous routing algorithms by optimizing. In order to develop such a system some other parameters can also be taken into consideration for the optimized route selection.

IV. PROPOSED WORK

As routing differs from conventional routing in wireless sensor networks so an approach needs to be introduced which will be better than the earlier routing algorithms. The problem which occurs due to traditional routing algorithms is that they were not capable to generate the optimized route to any destination. So in this work we developed a hybrid approach which has the capability to generate the optimal path for data transmission. In our work we have used neural network and fuzzy logics in order to optimize the efficient path or route on the basis of following parameters:

1. Energy
2. Speed
3. Number of Hop Counts
4. Distance
5. Packet Delivery Ratio

In this first of all the most eligible or candidate nodes are selected on the basis of trust values. Then on the basis of these trust values next adjacent node is selected. Then by using these adjacent nodes an efficient route is generated. Consequently, the proposed ANFIS system makes decision effectively about selecting a route based on the trust.

V. METHODOLOGY

The methodology of proposed work is as follows:

1. First Step is to initialize the fuzzy System.
2. After the system is initialized, next step is to initialize the parameters of the system. These parameters can be number of inputs required and the outputs. After this the membership function are defined. With the help of these membership functions the calculation is done.
3. Next Step is to initialize the various network parameters such as Number of nodes in the network, area of the network etc.
4. Then calculate the trust values of the nodes by using hybrid approach.
5. A route will be created based on the maximum trust value, if it reaches at its destination, loop will be stop.
6. Finally calculates performance parameter.

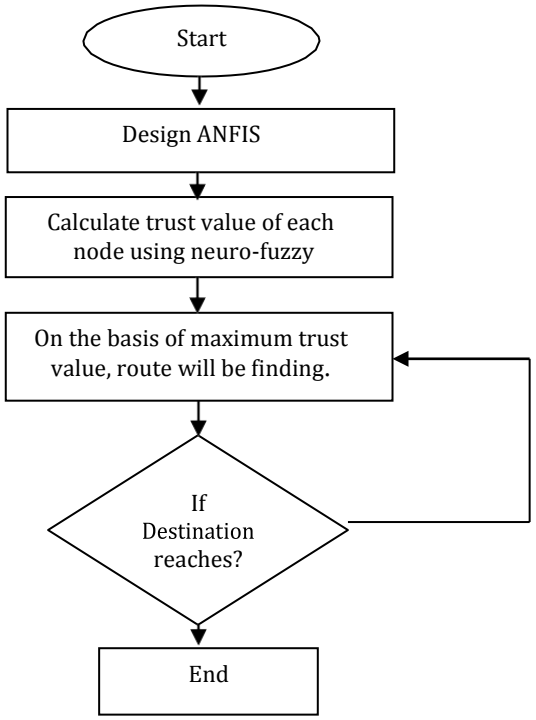

Fig-1: Block Diagram of proposed work

VI. RESULTS AND DISCUSSION

In this section of Results and discussion we have discussed the results that were obtained by applying proposed method and the traditional method of routing. The graphs represent the network performance like delivery ratio, packet loss and throughput. These results are obtained to show the efficiency of the proposed method. Thus, the following result shows the efficiency of the proposed technique in terms of identifying the optimal path from source to the destination. Parameters considered for the simulation are Throughput, Packet Loss and Packet Delivery Ratio. Each technique is compared with these parameters in order to confirm the optimality of the proposed work. The application of the proposed work is done using MATLAB software and results acquired from the proposed work are given below.

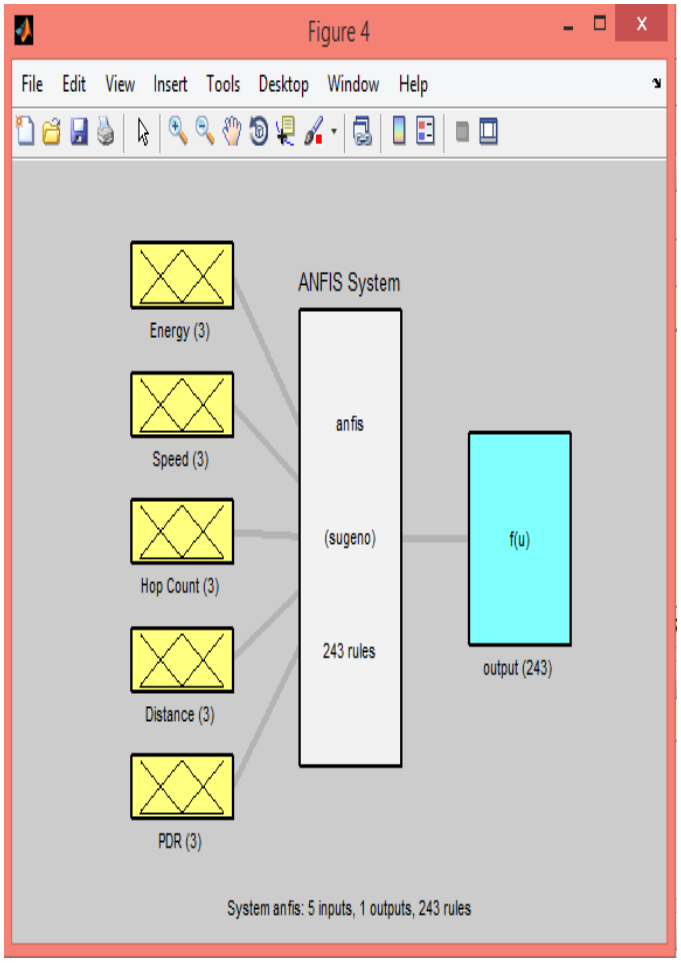

Fig-2: Fuzzy Interface System of the proposed model

Figure 2 shows the Fuzzy Interface System of the proposed model where number of inputs are five i.e. Energy, Speed, Hop Count, Distance and Packet Delivery Ratio which proceeds to the ANFIS system and then an output is obtained based upon these input parameters.

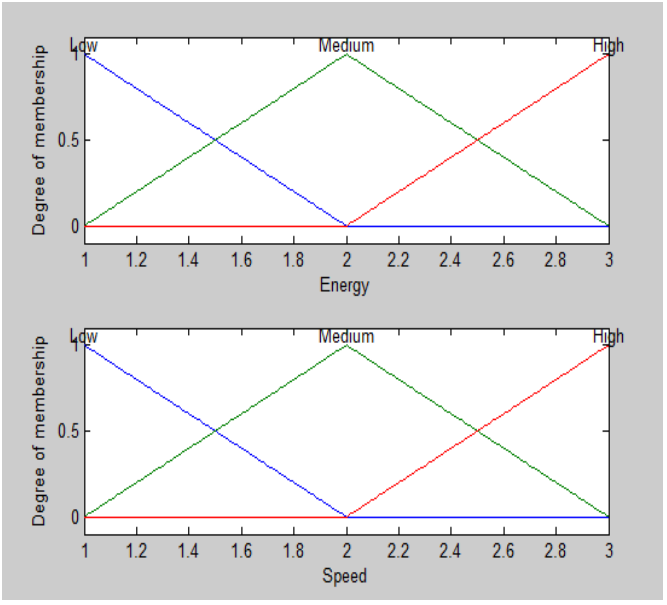

Fig- 3: Membership Function of Energy and Speed Input

The figure 3, 4, and 5 shows the Input membership functions of the proposed work. The membership function of the proposed work is defined using the triangular type of membership functions. In the proposed model total five inputs are taken shown below

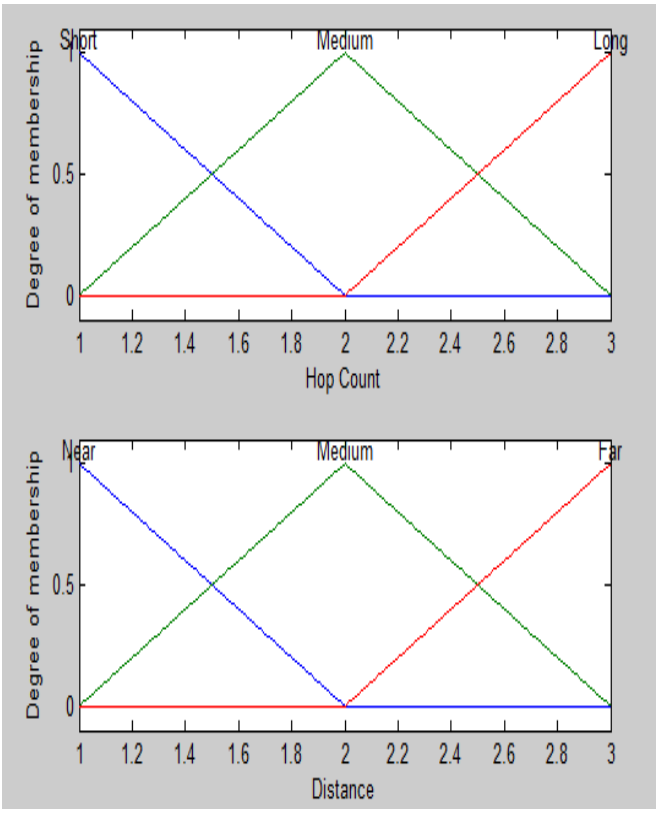

Fig- 4: Membership Function of Hop Count and Distance Input Parameter

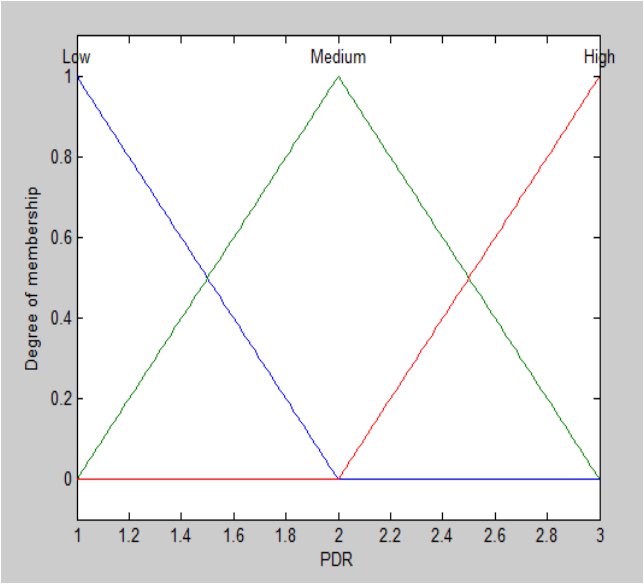

Fig- 5: Membership function of Packet Delivery Ratio Input

After analyses the traditional fuzzy approach, the comparison between the traditional Fuzzy and Proposed ANFIS have compared to evaluate the proficiency of individual. The throughput of the proposed technique is higher i.e. 452.7190 whereas the throughput of the traditional fuzzy approach is 425.7190. Consequently, the throughput of the proposed technique is high in comparison with traditional approach with respect to different cases. Considering all the cases, the below graph 6 and table 1 shows that the proposed approach's throughput is better, efficient and more stable than conventional approach.

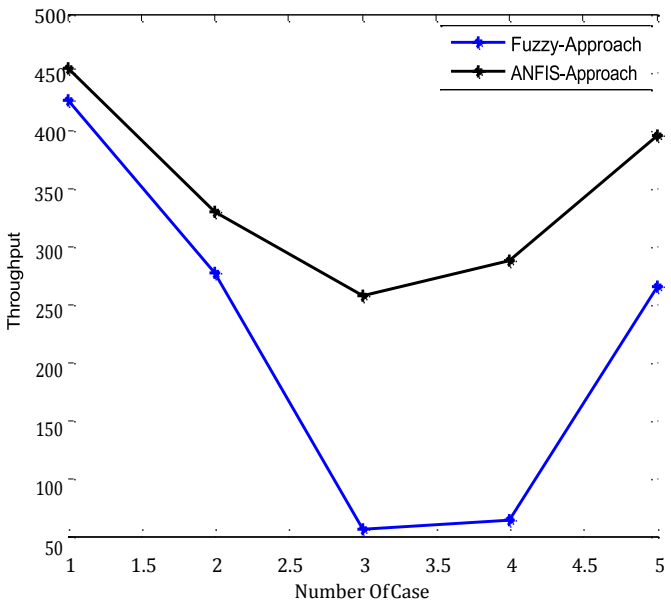

Fig- 6: comparative analysis of traditional and proposed Approach in terms of throughput

Table- 1: Throughput of the traditional and proposed technique

No. of Cases	Traditional	Proposed
1.	425.2410	452.7190
2.	276.5788	329.0053
3.	56.0632	257.4213
4.	63.3602	288.1315
5.	264.5420	395.1952

The proposed approach and traditional approach have compared on the basis of Packet loss. The graph 7 and table 2 below depicts the number of packet loss in the transmission. In the proposed approach, the numbers of packets lost are lesser in comparison with the number of packet losses in the traditional approach. There are only 72 to 244 number of packets have lost whereas in the traditional approach it is around 556. Therefore, the high numbers of packets are lost in the traditional approach.

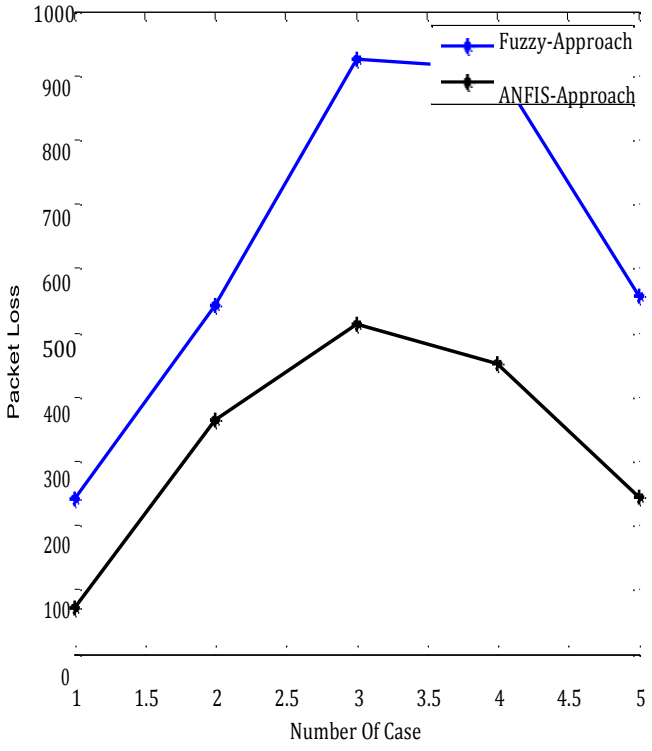

Fig- 7: comparative analysis of traditional and proposed Approach in terms of Packet Loss

Table- 2: Packet Loss of the traditional and proposed technique

No. of cases	Traditional	Proposed
1.	241	72
2.	541	365
3.	924	512
4.	910	452
5.	556	244

In the figure 8 and table 3, traditional and proposed approach has been compared in terms of Packet Delivery Ratio.

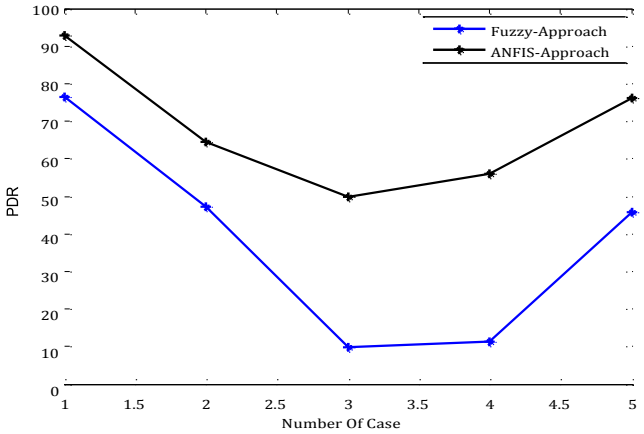

Fig- 8: Comparative analysis of traditional and proposed Approach in terms of Packet Delivery Ratio

The overall packets received at the destination are shown as packet delivery ratio in the figure. The proposed technique's PDR is 92.9688 whereas in the traditional technique it is around 76.4648 which is relatively less. Moreover, in each case, the proposed technique outperforms in terms of packet delivery ratio at individual case.

Table -3: Packet Delivery Ratio of the traditional and proposed technique

No. of cases	Traditional	Proposed
1.	76.4648	92.9688
2.	47.1680	64.3555
3.	9.7656	50.0000
4.	11.1328	55.8594
5.	45.7031	76.1719

VII. CONCLUSION AND FUTURE SCOPE

The traditional used techniques are not able to perform efficiently due to which a new technique has proposed in this thesis termed as Neuro-Fuzzy which is the hybridization of neural network and fuzzy system. The number of parameters is enhanced in the proposed work in order to acquire optimal path. Experimental analysis has performed in terms of performance metrics such as Throughput, Packet Delivery Ratio and Packet Loss with respect to number of cases. From the analysis it has concluded that the proposed technique outperforms in comparison with traditional fuzzy system. The proposed NFIS produces high packet delivery ratio, less number of packet loss and high throughput which is good enough for the reliability of the system.

The proposed system uses the hybrid approach of Neuro and fuzzy system which can be improved more in the future by updating the proposed model with the Optimization algorithms such as particle swarm optimization, Genetic Algorithm etc. With the increased number of parameters in the proposed system can enhance the complexity which can reduce in future by dividing a single proposed fuzzy system into two different fuzzy systems.

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BIOGRAPHIE

My Name is Deeksha Mengi. I have done my **M.Tech. in ECE ENGENEERING** from Rayat Bahra University. Trainee in Power Grid Corporation of India Limited for 6 months. My hobby is Reading Novels.