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Advanced Handover Scheme for Wireless Network to Avail High Performance Signal Handling

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Abstract: These days, heterogeneous networks are one of the most used networks. Customers are using these networks to access various services. However, Handover/Handoff (HO) is one of the major problems which are being faced in every network. Different criteria are used by the researchers in order to execute effective handoff in order to avoid disconnection and interruption in the call. When the ongoing call reaches beyond its base station, the call is needed to be transferred to other BS to maintain its continuity. Thus, HO is initiated and the call is transferred. It is important to perform this process seamlessly. Thus, neural networks are also introduced in this field to take HO decisions. HO decision relies on data rate; monetary cost, RSSI and speed of MS. Neural networks are proficient for this process as it involves deep analysis of the data HO parameters. In this paper, a novel technique is involved to make neural networks efficacious to take HO decision. The proposed model is the amalgamation of artificial neural network and Fuzzy logic which in turn resulted in ANFIS model. This model utilized four parameters namely, RSSI, cost, data rate and velocity as imperative factors to determine the supremacy of the designed model. Further, MATLAB is used to perform the simulation analysis. Eventually, obtained results are compared with existing techniques which ensures the efficacy of proposed model in terms of velocity and HO probability.

Keywords: Handover. fuzzy logic, Artificial neural network, ANFIS.

I. INTRODUCTION

Recently, due to union of different communication networks and usage of mobile devices having multi-mode, there are many communication paths generated between the core network and mobile user devices. These paths can be used as alternatives of each other. The process of path selection is carried out while establishing the session and occurrence of handoff between different networks. Generally, in the conventional algorithms for handover, signal strength is taken as the handover criterion. Traditionally, handover algorithms only take into account the signal strength as standard parameter. Though, researchers have considered different parameters for selecting the path to communicate from one end to other such as features of communication path and mobile devices- (security, Quality of Service (QoS), monetary costs) and (battery level, location) respectively. Due to multiple criteria for taking decision about HO, it has become meaningful and more sensitive [1]. However, Artificial Neural Network (ANN) is very prominent mechanism that is implemented to multi-criteria decision algorithms [2].

In conjunction with the proliferation of Mobile Terminals (MTs), with several network interfaces, and growth of IP-based applications (non-real time or real time), the introduction of wireless technologies (2G, 3G, WLAN, WMAN, etc) has allowed the user to access IP services in every part of the network, at any time. 4G of mobile communications [3] is a groundbreaking move powered by this open wireless access. Heterogeneous platform is presented by the next generation wireless infrastructure which incorporates multiple bandwidths, latency or cost based different access network technologies. Mobility management is a fundamental issue in this type of environment that supports the roaming of users between systems. One of the components of mobility management is Handover Management which monitors the change in the attachment point of the MT during active communication [4].

Basically, the term “handover” or “handoff (HO) [5] [6] is referred to the process in which a mobile station (MS) is transferred from a base station (BS) to other BS. For an instance, handover is when an ongoing voice or video call is seamlessly transferred from a channel to another through the core network. To be more specific, it is process of using other communication channels related to the existing connection during an under way communication call or session.

HO management is the approach of keeping the link of mobile device active while moving from one access point to another access point. There are three phases in process of handoff. In first phase, the handover is initiated either by triggering of network agents or mobile devices or by varying network conditions. Second stage is used for generating

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the new connections, where network looks for new resources for connection in handoff. In last phase, data-floe control is required to manage the delivery of data from previous connection route to new connection path [7][8].
Handoff may be categorized as either horizontal or vertical, depending on the type of network technology involved [9]. Standard handoff, also known as a horizontal HO, happens if the MS moves between various BSs or APs of the same network. For instance: This is common as users switch around 3G cellular network's two geographically adjacent cells. In contrast, vertical handoffs or inter-systems handoffs include two different wireless access network or technology network interfaces, e.g. BS in IEEE 802.16 and an AP in IEEE 802.11. Two handoff forms of heterogeneous wireless networks are illustrated in Figure 1 [10], where horizontal transfer takes place between two WLANs, and vertical transfers occur among a WLAN and a CDMA network.

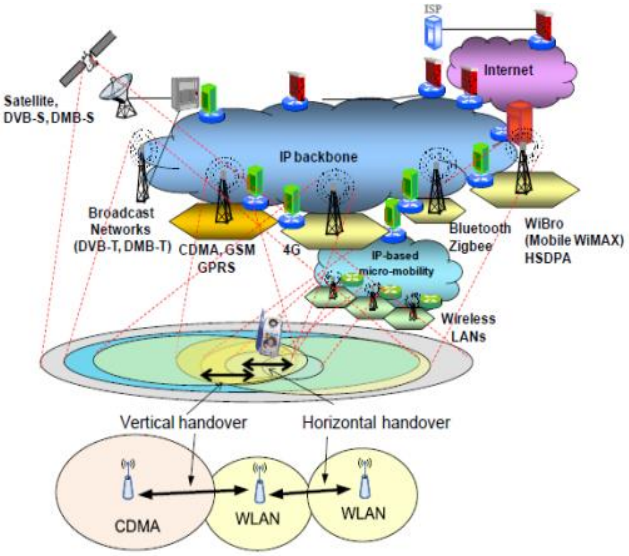

Figure 1: horizontal and vertical handoff in HetNets [10]

This paper presents a technique to take efficient handover decision by amalgamating fuzzy logic and neural network. Further, this paper is structured into five sections which present a literature survey, overview of neural network and fuzzy logic, proposed work and its model, and then results are explained along with the comparison. Finally, the last section winds up the paper.

II. RELATED WORK

For wireless network, authors of [11] proposed a feed forward ANN based on multiple layer for taking the HO decision. Neural network helps in handover depending on the data rate, cost of service, speed of moving mobile station and received signal strength. From the experiments output it was found that the proposed system reduced the handover count as compared to other present techniques. Probability of the handover was also enhanced.
In [12], [13] presented an approach of taking HO decision based on fuzzy rule. This method was used to take decision on the basis of multiple criteria. In [13] HO decision is made for call in 4G networks and WLAN. This scheme was effective in terms of fulfilling demands in various purposes in HetNet environment. From analysis and comparison with vertical handoff algorithm it was found that proposed system performed better than traditionally used schemes in terms of various traffic classes.
In [14], the brief about the advantages and disadvantages of HO decision is given. Active research area in the process to take HO decision in HetNets is discussed in the paper and various challenges associated in these researches are also discussed. Based on ANN, authors designed an algorithm for reducing HO latency in [15]. RSSI, cost and data rate was taken into account as different parameters. This algorithm was proved best as compared to other algorithms designed to reduce HO latency.
In [16], author studied the classical and existing fuzzy schemes chosen for vertical handoff to provide the smooth mobility over heterogeneous networks. Author also proposed an algorithm to take decision about vertical HO. A neuro-fuzzy model was designed which is based on multi-parameter. Performance assessment was done using quality indicator which takes ESA, effect of ping pong and throughput. It was found that vertical HO decision algorithm (VHDA) achieve better results than present vertical HO schemes.
A discovery scheme based on adaptive system was introduced in [17] in order to improve candidate network set's update rate. Then, VHDA collaborated with fuzzy logic and pre-handoff decision method has been designed to take effective decision. The developed algorithm was then evaluated with the traditional algorithm. The results acquired

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from the simulation concluded that proposed algorithm improved the performance in view of reducing unnecessary handoffs while balancing the resources of network. Also rate of call drops and blocks was reduced to a great extent.

II. OVER VIEW OF NEURAL NETWORK AND FUZZY LOGIC

- **ANN**

This ANN is based on the idea that human brain works by making connections with neurons. This resemble with the connection of wires with silicon.
Brain is made up of the 86 billion nerve cells named as neurons. Axons connect these nerves. Information is passed on to the other nodes and based on them operation is performed. The node giving the output is known as the output node. This same concept is used in WSNs for information transfer and decision making in combination with FL. various benefits of the ANN includes, less statistical need of training, detection of the complex relations in networks variables and multiple training facility [18] [19]. ANN is a model of processing the information. It is inspired by bio-nervous systems e.g. the brain. The new structure of the information processing system is the key element of this model. A significant number of processing neurons (neurons are interconnected with each other) are comprised in this network, which work together to overcome such problems. ANNs learn like a human brain learns. It is designed in the course of a learning process for a specific application, for example recognizing patterns or information classification. Training in biological systems requires the modification of the neuronal synaptic connections. This is also true for ANNs.

- **FUZZY LOGIC**

FL is the reasoning scheme which is similar to the reasoning of human. All the approaches used in fuzzy are similar to the approaches followed by humans for decision making. These situations involve the decision in terms of values like 1 for yes and 0 for NO. It was firstly discovered by "Lotfi Zadeh" [20] for human decision making.

III. PRESENT WORK

Handover in cellular networks is the method to maintain a user's active sessions during the movement of the mobile terminal to access network from its connection point. HO decision relies on different parameters. From the literature review, it is observed that many approaches have been used to take efficient HO decisions and ANN is countered as prominent mechanism for this domain. In Neural network, HO decision and best candidate selection is done on the basis of service cost, data rate, velocity and received signal strength indicator (RSSI). Despite, ANN does not met the user preference metrics and network conditions in an efficient way as it is input dependent and less adaptable that leads to the inefficient handover processing. Therefore, a novel approach has been proposed in this work which aims to develop an adaptive and efficient method for handover processing. Thus, ANFIS approach is used in the presented work as it is the combination of ANN and Fuzzy Logics which therefore creates a hybrid artificial intelligence technique. The learning ability, as well as relational structure, of the artificial neural networks among decision-making method of the fuzzy logic is combined in ANFIS. In ANFIS, the fuzzy logic analyzes the data and accordingly defines the rules which are then followed for taking the efficient handover decision. The conventional fuzzy logic system does not perform such action, thus in this, that drawback has overcome. Also, the artificial neural network of its ANFIS, trains itself according to the defined rule for performing the handover process, whereas the conventional ANN lacks in this.

IV. PROPOSED MODEL

ANFIS is the hybrid model of these two above mentioned schemes namely ANN and FL. In the proposed system Sugeno model is used. ANFIS is provided with four input parameters: RSSI, cost, data rate and velocity. Besides this, 16 rules are generated in ANFID model to make decision about handoff according to the situation. The proposed system is designed as follows

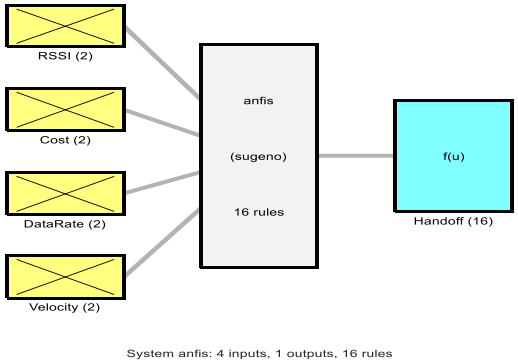

Figure 2: Proposed ANFIS Model

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V. RESULTS AND DISCUSSION

This model is designed in order to take effective decision regarding handoff in the heterogeneous network. Different parameters are used to perform simulation of the proposed work. Experimental analysis performed using MATLAB which is a software tool. The parameters involved in this model are recorded in the tabular form (table 1.). The network area used to perform experimental analysis is $200m^{2.}$

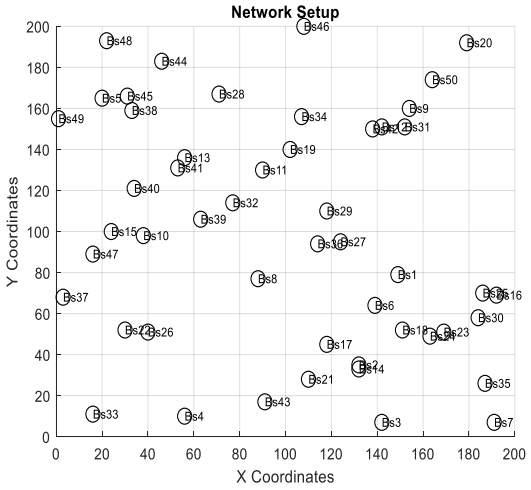

Figure 3: network area of the proposed work

In order to begin with the setup, the first process is to set a network. For the proposed work, 200m X 200m network area is taken into consideration. This network area comprises of 50 base stations which are arbitrarily distributed in the network as shown in figure 3**.** The above figure represents the graphical view of the network. X and y co-ordinates of graph represents the range of the area.

Table 1: Simulation Parameters

Parameters	**Values**
Fuzzy Type	Linear
Membership Function	Triangular
Decision variables	4
Network Area	200 m X 200m
Effective BS antenna height	50 m
Base Station Candidacy Value	0.28
Effective receiver antenna Height	2 m
Propagation model	cost231hata

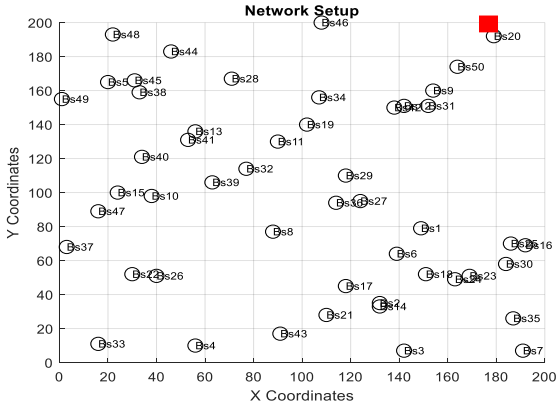

Figure 4: Mobile user in the network area

Graph in figure 4 demonstrates the mobile user in the network area. This mobile user will move in the network with different velocities and eventually handoff will take place. However, when the user will go beyond the range of the BS

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in which currently the call is going on, then another base station near the mobile user will be assigned to the user in order to avoid the interruptions and disconnection in the call.
Number of HOs obtained by the proposed work is than compared with that of existing technique (MFVHO) in order to check the effectiveness of the proposed approach. The comparison is delineated in figure 5. The graph clearly shows the significant difference between the number of HOs in both traditional and anticipated mechanism. The highest number of handoff in the proposed approach accounted to 0.35 however, for MFVHO, it constitutes to 0.64 i.e. just below the double of highest value of the projected model. The HO occurs rapidly in the conventional method.

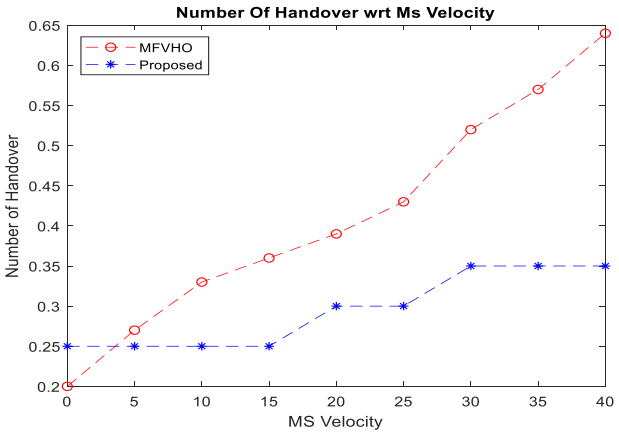

Figure 5: HO in the proposed work with respect to the velocity

The steep increase can be seen with increasing velocity (figure 5). The corresponding values for each value of the velocity are presented in tabular form in table 5.2. Thus, the proposed technique is proves as more efficient than existing technique n terms of velocity. Less number of handoffs are generated in the network using ANFIS based proposed method.

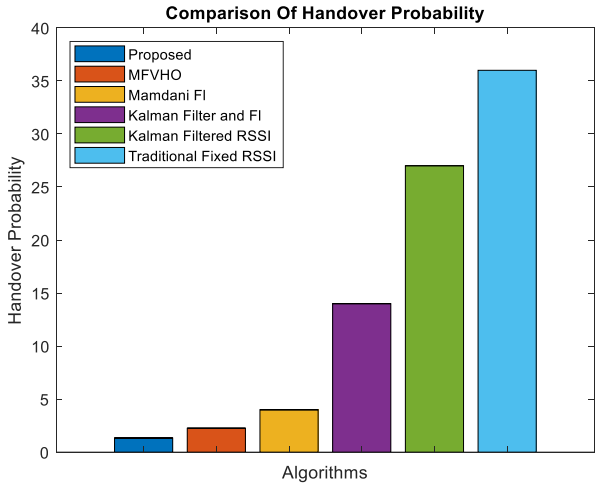

Figure 6: HO probability of proposed algorithm

Again, the efficacious system is evaluated by performing a comparative analysis with different existing techniques. The results obtained from the comparison are displayed in figure 6. the techniques used for comparison are MFVHO, Mamdani FI, Kalman Filter and FI,Kalman Filtered RSSI and traditional fixed RSSI. The probability of each approach is shown in the graph with different colored bars. It can be seen that the proposed technique represented by the blue bar has the minimum HO probability, thus it reduces the interruption in the cal and avoids disconnection during an ongoing call. Furthermore, traditional fixed RSSI based technique generates the maximum probability which make it least efficient from all other models. The probability accounted for this technique is 36 which is extremely higher. Moreover table 2 shows the probability for each technique. The proposed technique is effective and generates better results than other existing techniques which ensure that it surpasses the MFVHO and other present approaches.

Table 2: comparison of proposed and existing in terms of HO probability

Algorithms	Handover Probability
Proposed	1.3317
MFVHO	2.25
Mamdani Fl	4
Kalman Filter and Fl	14
Kalman Filtered RSSI	27
Traditional Fixed RSSI	36

VI. CONCLUSION AND FUTURE SCOPE

An ANFIS Model is proposed to take effective HO decisions. By amalgamating ANN with fuzzy logic, the method become more proficient as ANN deeply analyze the parameters of HO and fuzzy logic provides better decisions according to every situation. The parameters such as RSSI, data rate, velocity and monetary cost are used to analyze the performance. Simulation is carried out in MATLAB software. A comparative analysis is performed for novel and traditional approach in terms of velocity. Eventually HO probability of anticipated work is also analyzed with different existing techniques such as , Mamdani FI, Kalman Filter and FI,Kalman Filtered RSSI and traditional fixed RSSI. The comparative analysis showed that proposed work is effective and generates better results than other techniques.
Different criteria are opted for taking the Handover decision in which various factors are comprised. Existing techniques generates better results in terms of velocity, RSSI, cost data rate etc, however more parameters can be taken to execute HO process. Parameters such as decision timing and delay are not much emphasized, but these parameters have impact on the HO decision. Thus, in future such parameters can be considered to initiate the HO process.

REFERENCES

[1]. Ernst, Jason B., Stefan C. Kremer, and Joel JPC Rodrigues. "A survey of QoS/QoE mechanisms in heterogeneous wireless networks." Physical Communication volume:13 pp: 61-72, 2014.
[2]. N. Nasser, S. Guizani, E. Al-Masri, Middleware vertical handoff manager: a neural network-based solution, IEEE International Conference on Communications, pp. 5671–5676, 2007.
[3]. J. McNair, F. Zhu, “Vertical handoffs in fourth-generation multi-network environments”, IEEE Wireless Communications, volume:11, issue: 3, pp:8– 15, 2004.
[4]. I. Akyildiz, S. Mohanty, J. Xie,,”A survey of mobility management in next-generation all-IP-based wireless systems”, IEEE Wireless Communications volume:11, issue 4, pp:16–28, 2004.
[5]. I. F. Akyildiz, J. S. M. Ho, J. McNair, H. Uzunalioglu and W. Wang, "Mobility management in next-generation wireless systems," Proceedings of the IEEE, volume 87, pp. 1347-1384, 1999.
[6]. E. Gustafsson and A. Jonsson, “Always best connected,” IEEE Wireless Communications Magazine, volume 10, issue. 1, pp. 49–55, 2003.
[7]. Ms. S. Vinothini1 , Mr. V. Thiruppathy, Ms. M. Rethina, “Secure Handoff Management In Wireless Sensor Networks”, Volume 3, Issue 5, May 2015, PP 33-37
[8]. N. M. Alotaibi and S. S. Alwakeel, "A Neural Network Based Handover Management Strategy for Heterogeneous Networks," 2015 IEEE 14th International Conference on Machine Learning and Applications (ICMLA), Miami, FL, 2015, pp. 1210-1214
[9]. F. Zhu and J. McNair, "Multiservice vertical handoff decision algorithms," EURASIP J.Wirel.Commun.Netw., vol. 2006, pp. 52-52, April, 2006.
[10]. J. Kang, J. Strassner, S. Seo and J. W. Hong, "Autonomic personalized handover decisions for mobile services in heterogeneous wireless networks," Computer Networks, vol. 55, pp. 1520-1532, 5/16, 2011
[11]. Archa G. Mahira and Mansi S. Subhedar, “Handover Decision in Wireless Heterogeneous Networks Based on Feedforward Artificial Neural Network”, 2017
[12]. Kantubukta Vasu et al, “QoS-aware fuzzy rule-based vertical handoff decision algorithm incorporating a new evaluation model for wireless heterogeneous networks”, pp.322, 2012.
[13]. B. Zineb, A. Mohamed Ayadi, and S. Tabbane. "Fuzzy MADM based vertical handover algorithm for enhancing network performances." Software, Telecommunications and Computer Networks (SoftCOM), 2015 23rd International Conference on. IEEE, 2015
[14]. A. Ahmed, L. M. Boulahia and D. Gaiti, "Enabling Vertical Handover Decisions in Heterogeneous Wireless Networks: A State-of-the-Art and A Classification," in IEEE Communications Surveys & Tutorials, vol. 16, no. 2, pp. 776-811, Second Quarter 2014
[15]. Çeken, C. & Y. Serhan & A. Huseyin., “Interference aware vertical handoff decision algorithm for quality of service support in wireless heterogeneous networks”, Computer Networks, volume:54, pp:726-740, 2010,
[16]. Singhrova, Anita & Prakash, N., “Vertical handoff decision algorithm for improved quality of service in heterogeneous wireless networks” Communications, IET. Volume 6, pp: 211-223, 2012.
[17]. Peng Yang et al, “A novel fuzzy logic based vertical handoff decision algorithm for heterogeneous wireless networks”, Wireless Personal Multimedia Communications (WPMC), 2013 16th International Symposium on, June 2013
[18]. P. P. Bhattacharya, "Application of Artificial Neural Network in Cellular Handoff Management," International Conference on Computational Intelligence and Multimedia Applications (ICCIMA 2007), Sivakasi, Tamil Nadu, 2007, pp. 237-241.
[19]. P.P. Bhattacharya, “Application of artificial neural network in cellular handoff management”, ICCIMA, pp. 237–241, 2007.
[20]. Zadeh Lotfi. A., “Fuzzy sets, Information and control”, pp: 338-353, 1965,