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MULTIPLE PARAMETER DEPENDENT DYNAMIC APPROACH FOR HANDOVER DECISIONING IN WIRELESS NETWORKS

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ABSTRACT

Wireless networks are designed to meet the ubiquitous demands of the customers. It has been upgraded to solve different issues. However, handover is one of the major issues which attract a significant number of researchers to find the appropriate solution. Handover is the seamless transfer of the call from one base station to another. A literature survey is carried out which delineates that various technologies such as fuzzy logic, ANN, etc have been utilized to create an intelligent system for HO decision. Some limitations from the recent study have been observed which requires being resolved. Therefore, a novel method- Multiple parameter dependent Handover decision (MPDHD) is proposed in this paper which aimed to resolve the previous limitations and attain an efficient HO process. Also a new parameter is considered in this work i.e. load. In the presented work, the dynamic scenario is considered to analyze the performance of the proposed model for dynamic conditions i.e. varying base stations and numbers of users. The simulation is then performed in MATLAB to demonstrate the performance efficiency of proposed model. The handover probability is measured for different cases of dynamic scenario and also comparison is performed with existing approaches which reveals the superiority of the proposed model over existing ones.

KEYWORDS: handover (HO), Fuzzy model, neural network, HO decision.

INTRODUCTION

Handover (HO) is the basic method of allowing subscribers to budge transparently within the heterogeneous wireless network [1]. ETSI and 3gpp [2] described HO as the mechanism in which RAM changes the radio access mode or radio transmitters to offer the services of bearer by maintaining QoS. To be clearer, the approach to transfer all communication sessions of a mobile station (STA) from one access point (AP) or base station (BS) to another is known as a Handoff.

As handoff (or handover) is the process in which the ongoing call gets transferred, so it involves many steps which are required to be performed at the initialization time in handoff system. There is need of taking proper decisions for analyzing the system and its behavior. Two nearby base stations are required in handoff so that it should not affect the behavior of the mobile system. Three different steps taken in handoff are defined below [3] [4]:

i. Handoff Initialization: This handles the initialization of handoff within required time. Information about different parameters is gathered from the mobile unit which helps in taking decisions in later time.
ii. Handoff Decisions: Once the initialization is executed, in next step decisions about handoff are taken. If the signal strength of the neighbor station is detected higher than the present connected base station the decision about executing handover is made.
iii. Handoff Execution: It is the last phase of handover. Handover takes place depending on the decisions taken in second phase. The handoff is executing in such a way that the chances of call drop are minimum and the entire information is transferred to the new base station.

Handoff also contains different parameters which plays crucial role in achieving the continuous and without interruption services [5] in figure 1 the most significant criteria used in HO algorithms is shown [6].

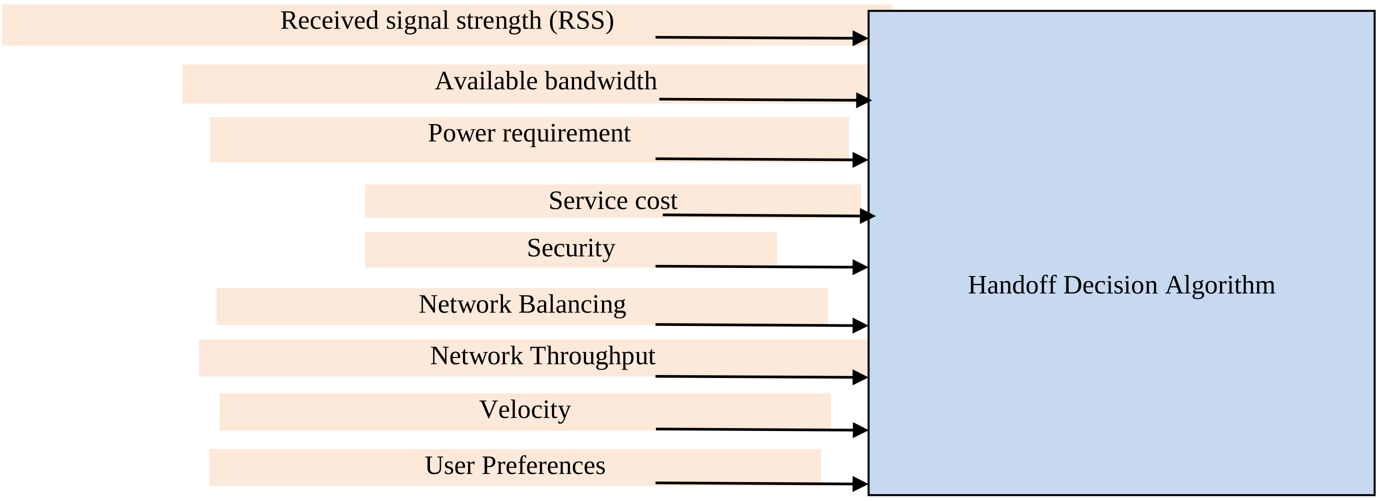

Figure 1: Handoff Decision Criteria

Making decisions on the basis of the manually calculated RSS evaluated in the MS, which endorse' Always Best Connected,' is part of conventional research of horizontal transfer. These typical handoffs are activated by lowering a specified threshold to the RSS value of the serving BS. The MS will, on the other hand, switch between various ANs with different functions and properties (bandwidth, latency, power consumption, costs, etc.) in a heterogeneous wireless setting that cannot be compared directly. Therefore, RSS is not enough for effective and intelligent handoff decisions itself in the event of vertical handoffs; other device approaches, including but not limited to costs, network loading and performance, bandwidth available, safety and also, user preferences should be considered. On the other hand, the introduction of several metrics makes decisions of vertical HO more complicated and eventually, the whole system become more difficult [7].

Number of researches has been carried out in this field to make the efficient communication during the handover process. Some of the related works are discussed in the following section:

RELATED WORK

In order to improve the process of handover and to make the communication efficient, various authors have presented different techniques, some of which are reviewed as below:

In article [8], at first, the author introduced a k-partite graph basis modeling approach for VHD process. After that, Dijkstra’s algorithm and cost basis lightweight and robust algorithm was utilized to select best path.

In article [9], the author introduced a hybrid artificial intelligent handover decision approach. This is developed with fuzzy logic and prediction model based on hybrid of ANN (artificial neural network).

In article [10], the author presented a detailed state-of-the-art of VHD algorithms along with their merits and demerits, overview of various researches done in this field and the detected issues in VHO management.

The paper [11] introduced a speed adaptive system discovery scheme in order to improve update rate of the candidate network set. Then, vertical handoff decision algorithm collaborated with fuzzy logic and pre-handoff decision method has been designed to take effective decision.

The author [12] introduced a RSS (received signal strength) detection basis handover trigger time selection technique.

The paper [13] presented an approach based on preemptive priority for voice handoff request calls having higher priority.

In article [14], the author introduced a handoff technique based on artificial neural network.

The author [15] presented a fuzzy logic based hand off decision approach for wireless networks.

The author [16] introduced a two-tier machine learning basis handover management approach. In first tier, for taking handover trigger decisions, a recurrent neural network model is utilized for the prediction of receiving signal strength whereas a stochastic Markov model is utilized in the second tier, for the selection of upcoming access point.

Also, in paper [17], author presented a multilayer feed-forward ANN in order to make HO decision in the heterogeneous wireless networks. This approach was regarded as the most efficient one to make the HO decisions as it gives efficient system performance. However, it is analyzed that the ANN consists of various drawbacks that results in inefficient HO processing.

Thus, a novel mechanism is required to make the handover decision more efficient.

PRESENT WORK

On reviewing the literature, it is analyzed that ANN prove the most illustrious and efficient mechanism for HO decisions. 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. Also, the ANN also has following disadvantages:

- Requires more processing time
- Less sensitive
- Non adjustable

Therefore, a novel mechanism is required that can overcome all these drawbacks and make the HO efficiently.

Therefore, a novel approach is proposed in this paper which is the combination of fuzzy logic and neural network, Thus, in this hybrid model, the advantages of fuzzy logic and NN can be captured that can overcome the existing drawbacks. Also, to provide a high quality communication service for mobile subscribers and to enhance a high traffic-carrying capacity when there are variations in traffic, network load must be paid attention. Therefore, in the proposed work another parameter i.e. load is also taken into account along with other previous parameters i.e. received signal strength indicator (RSSI), data rate, service cost, velocity of mobile device, load. Therefore, by implementing neural network and fuzzy logic algorithm and with respect to aforementioned parameters an adaptive and efficient handover system: Multiple parameter dependency Handoff decision model (MPDHD) is achieved.

In addition, in the previous work, the dynamic scenario has not been considered. However, it is possible that the results for dynamic scenario can vary due to variation in the number of parameters and thus cannot give efficient performance in all cases. Therefore, in the proposed work, the dynamic scenario is considered, which the main aim of this work is. In this scenario, the efficiency of the proposed model for varying conditions can be analyzed and thus its performance efficiency can be demonstrated. In this scenario, the location of BS and number of users are considered to be dynamic.

Now, to analyze the performance of proposed approach for dynamic scenario, the simulation is carried out and the results are obtained which are discussed in the next section. Simulation results will be obtained in the MATLAB environment which will be compared with that of the existing techniques in order to check the efficiency of the projected model (MPDHD).

RESULTS AND DISCUSSION

The simulation is carried out in order to analyze and demonstrate the performance of the proposed approach. The simulation results obtained are represented and discussed in this section. The dynamic scenario is taken into consideration in which the base station is deployed randomly and different users and base station counts are taken. The results are analyzed in terms of this scenario with varying base station and users. In this, firstly, the results are analyzed for dynamic number of base station and fixed number of users, and secondly, the results are analyzed for dynamic number of users with fixed number of base station.

Thus, the first case with dynamic number of base station and fixed number of users are analyzed the results of which are shown below.

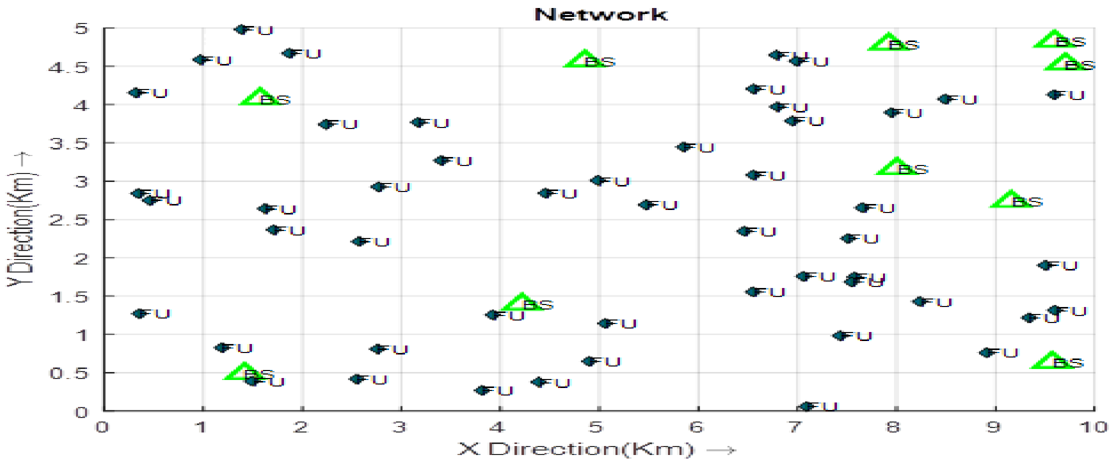

Figure 2: For BS=10, users= 50 (a): Network design of present method for dynamic scenario

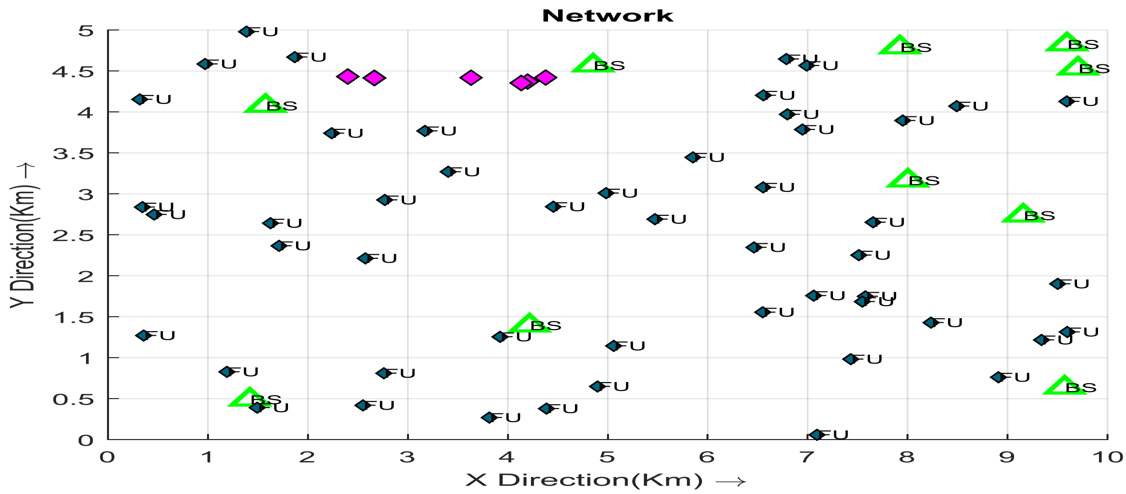

Figure 2 (b): Distribution of mobile users for dynamic scenario

In the first case, total numbers of base stations considered are 10 which are deployed randomly and the total numbers of users are 50, the network model of which is shown in the figure 2 (a). The 50 mobile users are distributed randomly in the network as illustrated in figure 2 (b). From the graph, it is observable that users are distributed in the network between 2 km to 5 km area as represented on x axis. These distributed mobile users are shown by pink diamond shape.

The comparative analysis is performed among proposed MPDHD and conventional MFVHO approach in terms of number of handover for varying MS velocity as illustrated in figure 3. The obtained graph demonstrates that the number of handovers increases with increase in velocity for both the approaches; however, the results of proposed approach are more efficient than previous one as it has low value of handovers.

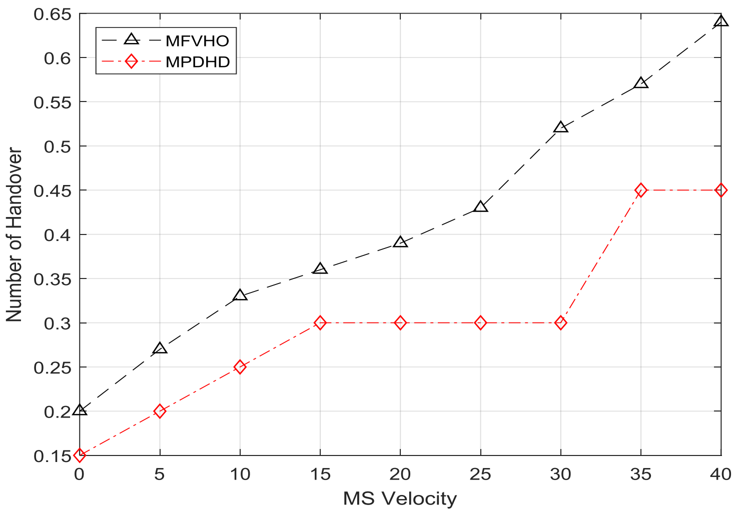

Figure 3: Number of handovers in terms of velocity of mobile users for dynamic scenario.

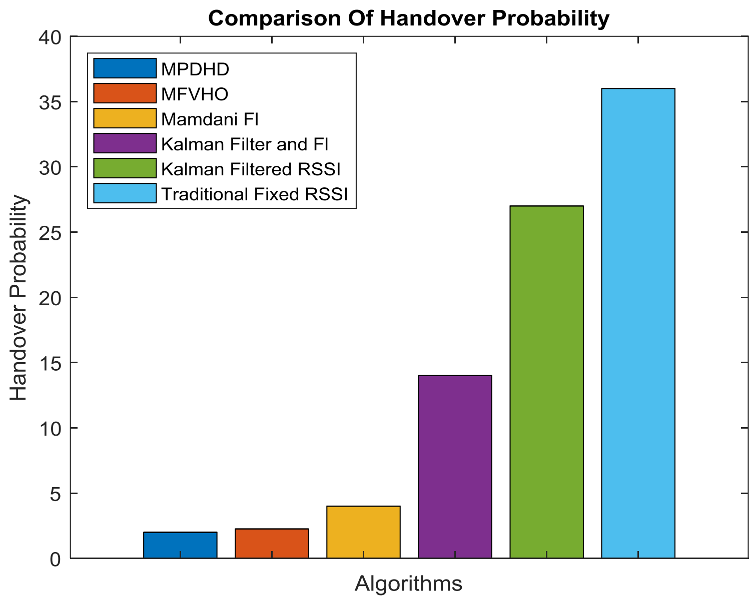

Figure 4: Handover probability with respect to different algorithms for dynamic scenario

Now, the comparison is performed with regards to handover probability among different approaches i.e. proposed MPDHD and conventional MFVHO, Mamdani FI, Kalman Filter and FI, Kalman Filter RSSI, traditional fixed RSSI approaches, the results of which are exemplified in the graph shown in figure 4. The bar graph shown above depicts that the high handover probability is attained for traditional fixed RSSI, followed by kalman filter and RSSI, kalman filter and FI, mamdani FI, MFVHO and the lowest handover probability is attained for proposed MPDHD approach. Thus, it demonstrates the efficacy of proposed approach over all other previous approaches.

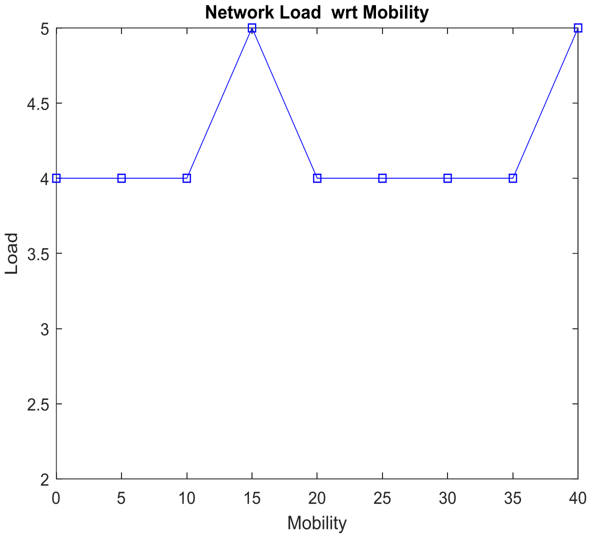

Figure 5: Network load with respect to mobility

The network load of the proposed work with respect to mobility for 10 number of base station and 50 numbers of users, is shown graphically in figure 5. In the graph, the value of load is calibrated along y-axis that varies from 2 to 5, and the value of mobility is calibrated along x-axis which ranges from 0 to 40. It can be seen from the graph that the value of load of the proposed approach for the considered dynamic scenario ranges between 4 and 5.

Now, the analysis performed for all other dynamic base stations and fixed number of users is shown in the tabular form as below:

Table 1: Handover probability for fixed users and dynamic base stations

Users	**Base Stations**	**Handover Probability**
50	10	1.9921
50	20	0.85118
50	30	0.67804
50	40	0.41674
50	50	0.40569

The handover probability values obtained for all the dynamic number of base stations and fixed number of users are recorded in table 1. The dynamic number of base stations are 10, 20, 30, 40 and 50, and the fixed number of users are 50. The attained values represent that with the increase in number of base station, the value of handover probability decreases.

Table 2: Handover probability for fixed base stations and dynamic users

Base Stations	**Users**	**Handover Probability**
50	10	0.33929
50	20	0.35783
50	30	0.3592
50	40	0.3712
50	50	0.3987

Now, the values of handover probability attained for dynamic number of users and fixed number of base stations are recorded in table 2. The dynamic values of users considered are 10, 20, 30, 40 and 50, and the fixed numbers of base stations are 50. The values recorded in the table reveal that with the increase in number of users, the values of handover probability increases.

However, the overall results represents that the proposed approach is efficient for both the considered cases.

CONCLUSION

This paper proposed a multiple parameter dependency Handoff decision model (MPDHD) for efficient HO in the wireless system. This model is designed in order to attain better handover process. Efficiency of this network is determined by using neuro-fuzzy model. In this, the simulation is performed for dynamic scenario. In the dynamic scenario, firstly, the fixed users and dynamic base station numbers are considered, and secondly, fixed base station and dynamic users are considered and then the handover probability is recorded for both the cases. The results represent that with the increase in number of base station, the value of handover probability decreases and with the increase in number of users, the values of handover probability increases. Also, the proposed and conventional approaches are compared in terms of handover probability. It is analyzed from the results that the overall performance of the proposed approach is efficient than the previous one. Also the comparison shows that handover probability is also reduced to a great extent than the conventional approach. Thus, the proposed approach can be regarded as an efficient approach for handover process even in the dynamic scenario.

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