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ANN BASED HANDOFF CONTROLLER FOR MICROCELLULAR MOBILE NETWORKS

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Abstract

In mobile cellular system handoff refers to the process of switching the ongoing call from one base station to another in an efficient way. Before switching the call or performing handoff an efficient handoff decision has to be taken. The handoff decision, in traditional approach were taken on the basis of three parameters such as Distance between BS and MT, Network Load and RSS which refers to the Received Signal Strength from base station. But selection of few parameters was not sufficient for increasing the handoff decision capability. Hence in order to enhance the handoff decision capability a new technique neuro fuzzy is proposed under this research which considers five input parameters distance, RSS, Load, Velocity and SIR respectively.
In this approach, a single output is generated corresponding to five input parameters. The results section proves the efficiency of the proposed work on the basis of fixed network load and fixed distance parameters.

Index Terms— Base Station, Handoff, Received Signal Strength, Artificial Neural Network.

I. INTRODUCTION

With the advent of time, lots of changes have been observed in the technology. Drastic changes have been observed in the communication systems. Wired communication is the base of all sort of communications, it included use of wires or a physical link between devices was set up to enable communication between them. As the time passed, evolvements in the technology took place and so did the communication mediums changed. Wired communications were replaced by wireless communication that gave birth to cellular phone services. The advantages that wireless communication have over wired communication are more reliability, less complexity and lesser cost because it do not involves use of any wires. Wireless communication provides access of communication to remote users as it has made communication possible is handoff.

A. Handoff

Handoff is a process that arises when the on-going call is to be transferred from one base station to another. The region of the cellular network is divided into smaller regions for efficient network coverage and the network to the mobile units is provided by the base station. When there is a mobile user, on the basis of received signals strength from BS, the call keeps on switching from one base station to another. Handoff also refers to condition, when the call is transferred from one base station to another without dropping the call. The signal strength of the next base station is compared with the signal strength of the current base station and the call switches to one having maximum signal strength. This whole process should happen without dropping of the call. For wireless communication to be efficient the call drop rate should be minimum and the handoff occurs successfully in it.

B. Phases Of Handoff

Since, handoff is the process of transferring an on-going call so this may involve some steps that needs to be performed while initiating handoff in a system. It is necessary that the decisions are taken after properly analysing the system and its behaviour. Handoff involves participation of two neighbouring base stations so the decision of handoff should be taken such that it does not affect the service of the cellular system. The whole process of handoff involves three phases and these are described below:

- Handoff Initialization: This phase deals with the initialization of handoff in time. The information about the various factors of the mobile unit is collected in this phase which will help in taking decisions later.
- Handoff Decisions: This is the second phase in handoff that deals with taking decisions whether there is a requirement of handoff or not. In this phase the signal strength of the current base station is compared with the signal strength of the neighboring base station. The handoff decision is taken in the case if the signal strength of the neighboring base station exceeds the current one.
- Handoff execution: As the name implies, this is the last and the final phase of handoff. The execution of handoff occurs on the basis of decision made in the second phase. If the call is to be transferred to the next base station it is done in this step. The handoff execution should be such that the whole information is passed on to the next base station and the chances of call dropping are minimal.

C. Types Of Handoff

There are three types of handoff occur in cellular systems such that:

- Soft Handoff: This is a make before break type of handoff. In this type of handoff the call with the next base station is connected first and after that it breaks from the current connected base station. It is considered to be efficient handoff because in this chances of call dropping are less as the connections are first made.
- Hard Handoff: This is break before make type of handoff. In this type, the call from the current base station is first terminated and then it is connected with the neighboring base station. The user may experience call dropping in this case as the connection is first broken with the existing base station.
- Intersystem Handoff: This type of handoff is initiated when the call is to be transferred to another MSC. This type of handoff is experienced when user moves in a roaming region.

D. Factors Causing Handoff

Handoff occurs in wireless systems due to following reasons:

- Received signal strength from the current base station
- The speed at which the device is moving
- When the received signal strength of the current connected base station becomes lesser than the signal strength received from the neighboring base station.
- Amount of interference mobile unit obtains from the adjacent channels.

II. PROBLEM FORMULATION

Handoff is the process of transferring a call from one base station to another during an ongoing call and when a user is mobile. Handoff decisions should be taken such that the signal do not drops and the call is not cut in between. A system is considered to be most efficient if it do not faces signal drop and successful handoff is obtained. The problem of handoff occur because frequencies cannot be reused in adjacent cells, when a user moves from one cell to another, a new frequency must be allocated for the call. If a user moves into a cell where all available channels are in use or being occupied, the user's call must be terminated. Earlier various parameters are considered for making the handoff decision .Then the fuzzy system came into existence for taking the handoff decisions. Though the fuzzy systems were considered to be efficient but it too had some limitations like fuzzy systems were only transparent for simple problems. Since the handoff decision were taken on the basis of the various parameters. So if the numbers of parameters are increased the complexity of the system is increased. Increase in the number of parameters reduces the decision taking capability of the system which in turns affects the Quality of service. This results increase in the complexity of the system that can reduce the efficiency of the system. So there is need to design the system in which complexity is reduced and the system is made efficient so the handoff decisions are taken accurately.

III. PROPOSED SYSTEM

Handoff is generally observed when user is moving and the signal strength of the next base station exceeds the signal strength of the base station that is currently connected to the mobile device. In previous techniques the handoff is firstly dependent on random selection. Later on many approaches has been developed one of them was on basis of static approaches. After that the Fuzzy system based approaches were introduced that were able to increase the capability of the handoff controller. The major problem faced in these systems was that the complexity of the system increases as the numbers of the parameters are increased that in turn reduces the efficiency of the system. So in this proposed work a new approach is proposed to reduce the complexity of the system. In this work neuro fuzzy system uses two fuzzy controllers are used in which parameters are defined according to their specified categories. Along with this the weight values are defined. On the basis of the weight value the final result are obtained according to which the handoff decision are taken. In this work the handoff decision is taken on the basis of five parameters that will help in taking the handoff decision. This method will reduce the system complexity as two fuzzy controllers are used. Also the efficiency of the system is increased.

International Journal Of Core Engineering & Management
Volume-3, Issue-10, January-2017, ISSN No: 2348-9510

IV. METHODOLOGY

- Initially we will generate the rules for Handoff. According to which further steps are taken.
- Now increase the Quality of Service to increase the performance of the signal.so that no can be able to reduce handoff.
- Next is to create the Network. For creating the network we need to define ANN.
- To get the output after creating the network, training of ANN will be performed.
- Now pass the received output to the Fuzzy Controller, where it will take the decision whether to perform the handover or not.
- In this step the final hybridization of the intelligent system with Neural Fuzzy system is done.
- Since the controller is used for making decision, so the condition is defined for the controller.
- In this step, the condition which is given to the controller is evaluated with the Neural Fuzzy hybrid controller.
- Now decision is finally made by the controller after the evaluation of the condition with the Neural Fuzzy Hybrid controller.

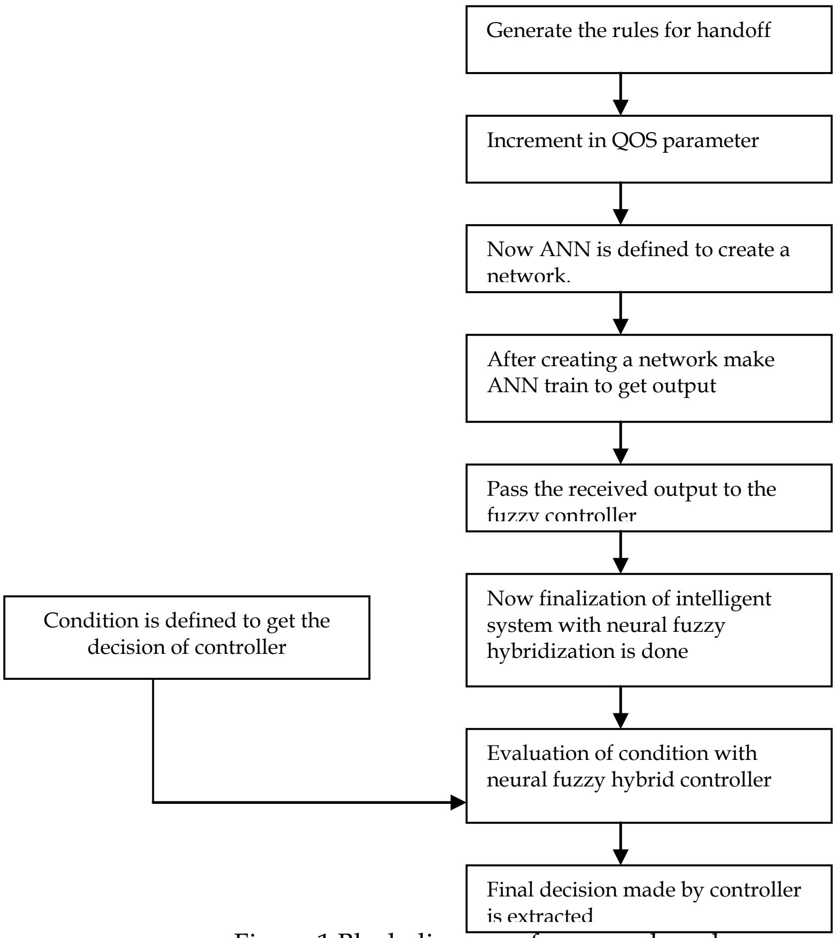

Figure 1 Block diagram of proposed work

International Journal Of Core Engineering & Management
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V. RESULTS AND DISCUSSIONS

This section represents the graphs of results which are obtained after implementing the proposed method for handoff decision making. This work purposes a neuro fuzzy system for increasing the handoff decision making capability. The technique produces output on the basis of five parameters are as follows:

1. Distance
2. Signal Strength(RSS)
3. Load
4. Velocity
5. SIR (Signal to Interference Ratio).

The designed neuro fuzzy system generates a single output on the basis of above five parameters. The following graph shows the membership function corresponding to first input. The first input has 4 membership function ranges from 1 to 3. The degree of membership function lies between 0 and 1. The first input parameter refers to the distance between base station and mobile stations.

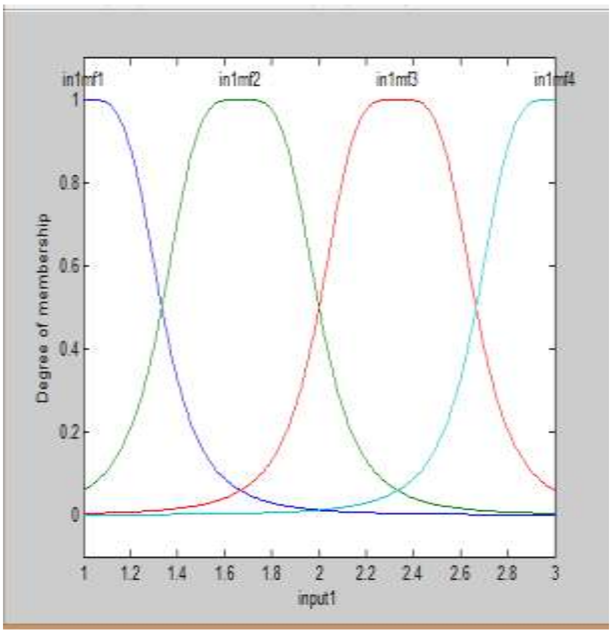

Figure 2 Graph representing membership function of Input1 i.e. Distance

The following graph shows the membership function corresponding to second input. The second input has 4 membership function ranges from 1 to 3. The degree of membership function lies between 0 and 1. This input parameter refers to the RSS i.e. Received Signal Strength from base stations.

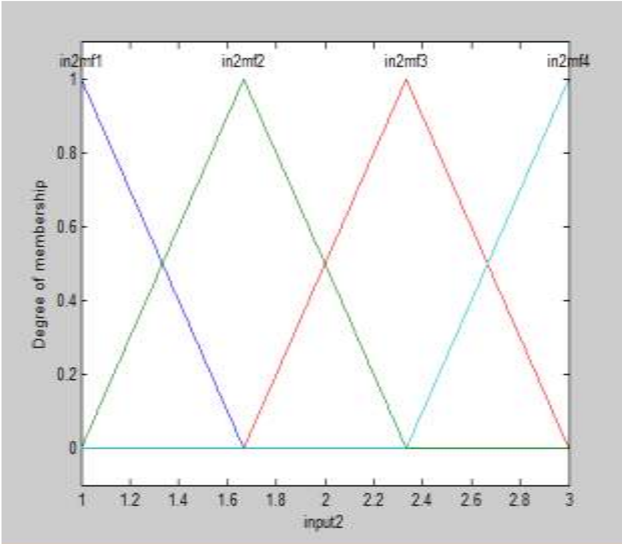

Figure 3 Graph representing membership function of Input1 i.e. Signal Strength (RSS)

The following graph shows the membership function corresponding to third input. The third input has 4 membership function ranges from 1 to 3. The degree of membership function lies between 0 and 1. This input parameter refers to the network load.

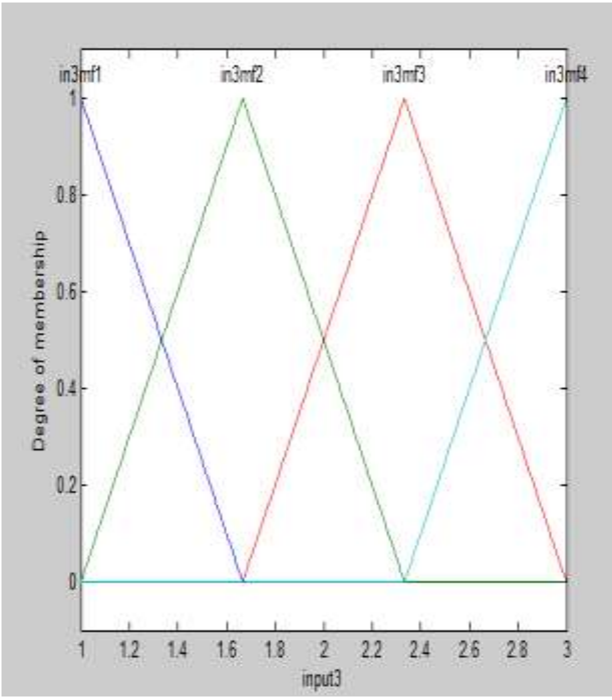

Figure 4 Graph representing membership function of Input1 i.e. Load

The following graph shows the membership function corresponding to fourth input. The fourth input (Velocity of MT) has 4 membership function ranges from 1 to 3. The degree of membership function lies between 0 and 1.

International Journal Of Core Engineering & Management
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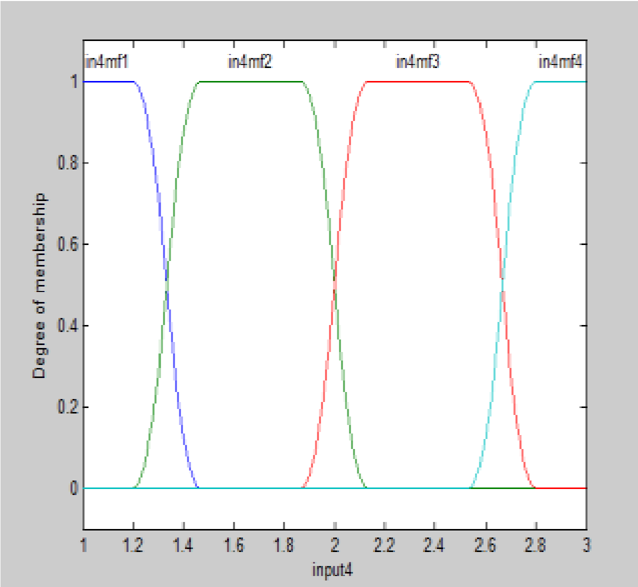

Figure 5 Graph representing membership function of Input1 i.e. Velocity

The following graph shows the membership function corresponding to fifth input. The fifth input i.e. SIR has 4 membership function ranges from 1 to 3. The degree of membership function lies between 0 and 1. SIR refers to the Signal to Interference Ratio.

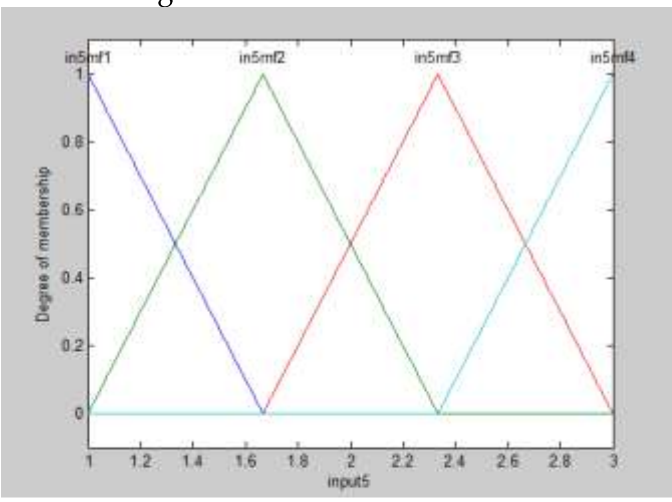

Figure 6 Graph representing membership function of Input1 i.e. SIR

The figure below shows the Rule viewer corresponding to the proposed neuro-fuzzy system in order to enhance the handoff decision making capability. It shows that the system takes five parameters as input parameters and generates a single output corresponding to input parameters.

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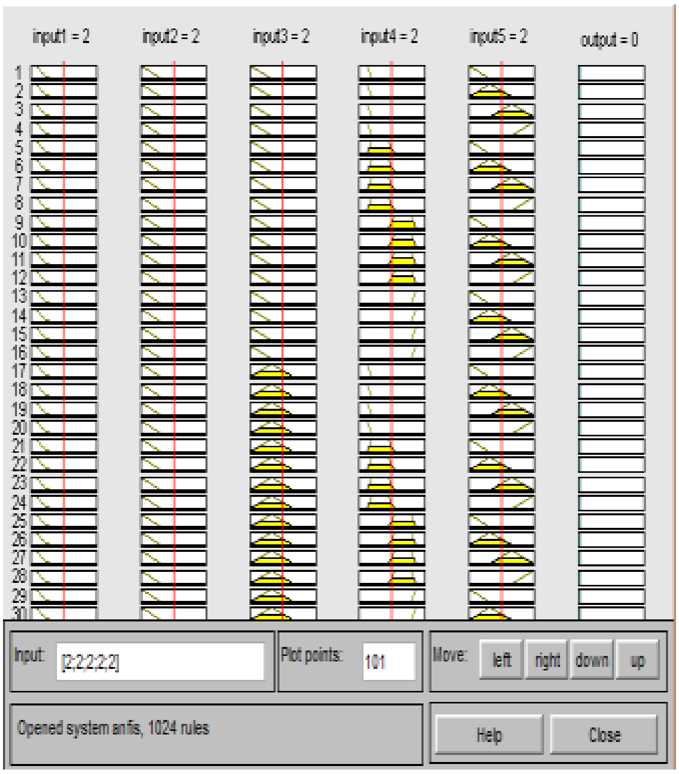

Figure 7 the rule viewer corresponding to generated neuro-fuzzy network

The Figure below shows the comparison graph between Distance (ranges between 0-10) and handoff decision making capability (ranges between 0-8) in fixed network load conditions such as network load 2 and load 10 while implementing the proposed work.

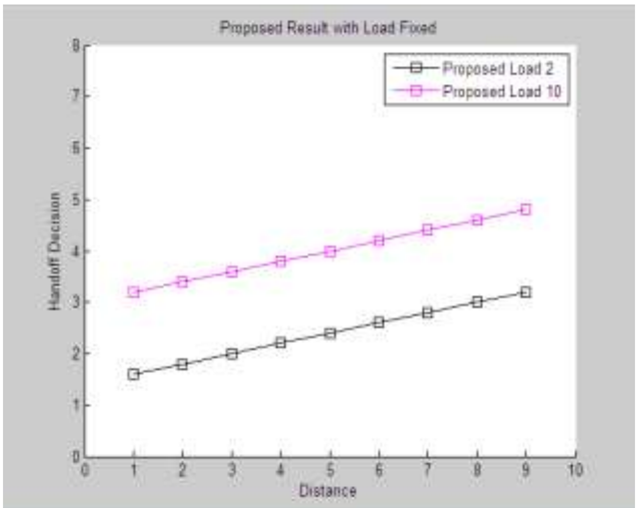

Figure 8 the comparison between Handoff decisions and distance with respect to fixed network load in Neuro-fuzzy network.

International Journal Of Core Engineering & Management
Volume-3, Issue-10, January-2017, ISSN No: 2348-9510

The figure below shows a comparison graph between proposed and traditional work on the basis of handoff decision and distance along with the fixed network load i.e. Network load 2 and Network load 10. Here the term network load refers to the number of users in the network. From graph below the difference is clear that the proposed work is much efficient or capable of decision making in condition of both network loads without any fluctuations whereas in traditional approach there are many fluctuations. Hence it is proved that the proposed work enhances the handoff decision making capability even in the condition where network load can be 2 or 10 respectively.

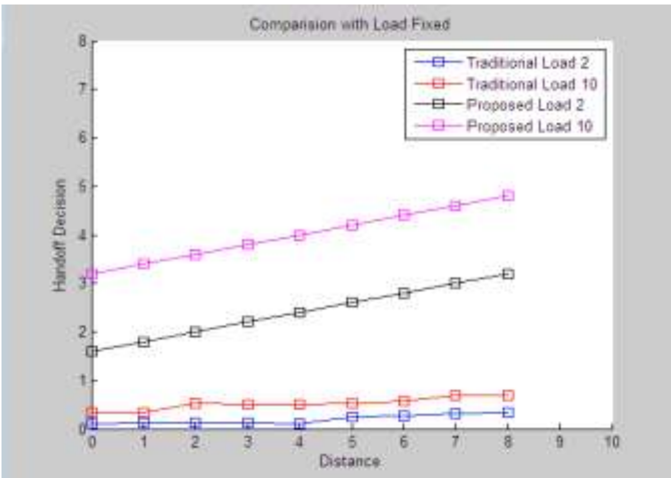

Figure 9 the comparison between proposed and traditional work on the basis of Handoff decisions and distance with respect to fixed network load

The Figure below shows the comparison graph between Load (ranges between 0-15) and handoff decision making capability (ranges between 0-8) in fixed distance form base station to mobile stations i.e. Distance is 4 and 7 while implementing the proposed work.

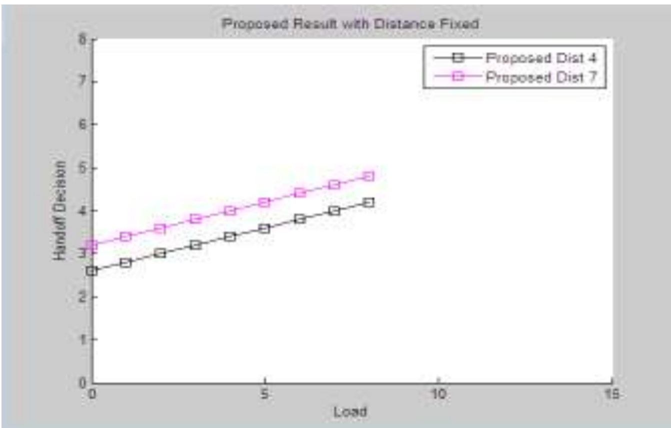

Figure 10 the comparison between Handoff decisions and Load with respect to fixed distance in Neuro-fuzzy network.

International Journal Of Core Engineering & Management
Volume-3, Issue-10, January-2017, ISSN No: 2348-9510

The figure below shows a comparison graph between proposed and traditional work on the basis of handoff decision and load along with the fixed distance i.e. distance 4 and distance 7. Here the term distance refers to the distance between base station and mobile stations. From graph below it is clear that the proposed work is much efficient or capable of decision making in condition when the distance is 4 and 7 respectively whereas in traditional approach there are many fluctuations. Hence it is proved that the proposed work enhances the handoff decision making capability even in the condition where distance between BS and MT is fixed.

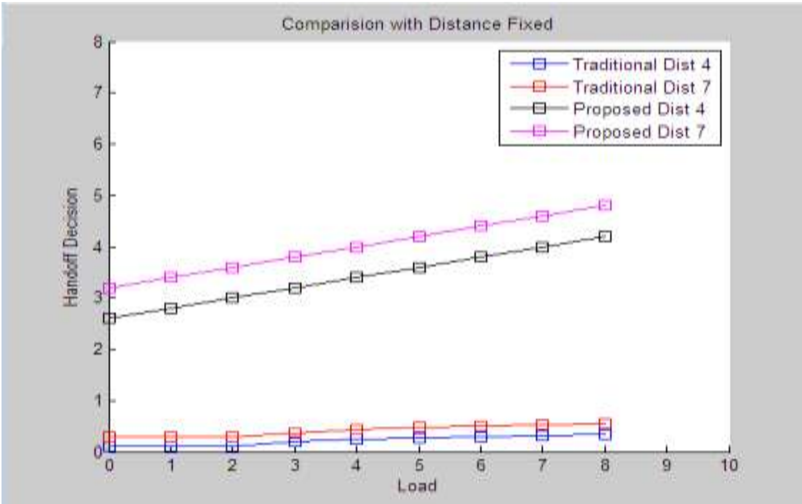

Figure 11 the comparison between proposed and traditional work on the basis of Handoff decisions and load with respect to fixed network distance

VI. CONCLUSION AND FUTURE SCOPE

Handoff is an important element of wireless cellular communications. Efficient handoff algorithms are a cost-effective way of enhancing the capacity and QoS of cellular systems. In this work neuro-fuzzy based approach for hand-off decisions has proposed. The proposed work of this is hybridization of two intelligent systems ANN and fuzzy logic in order to give better results along with increased input parameters i.e. distance, Received signal strength, load velocity and signal to interference ratio. These parameters are used for enhancing the system performance and the output of system is handoff decision probability. The proposed system simulation results much better than traditional approach and increase handoff decision probability.

In future data set can be normalized so that system complexity reduces and speed of system for handoff decision increases.

places where it was impossible to set up communication link using wires. Now, since each system has some pros and cons and so wireless communication also have some demerits. The problems in the network occur due to some human errors or sometimes due to environmental conditions like bad weather. One major issue that is to be taken care of in cellular systems is handoff.

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