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Neural Network Based Handoff Controller for Signal in Cellular Mobile Network

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Abstract *- Cellular communication is a technology in which information is carried from one end to other end through mobile phones. In cellular communication system, the mobile users do not stay at a one place i.e. they move from one place to another. To maintain the Quality of service (QoS) at optimum level in cellular mobile network, handoff control mechanism plays a vital role. Handoff is generally used to transfer a call from one base station to another. There are various proposed techniques for handoff management which includes Neural Networks, Fuzzy Logics etc. In this thesis, a highly efficient handoff control technique based on neural network is proposed the neural network takes a decision on handoff on the basis of signal strength, distance and traffic intensity the results are analyzed and found to be optimum. After finding the Handoff status, next step is to find the optimized path. The Neural Network generated various parameters as output namely Efficiency of system, Handoff status, Distance between Nodes and Processing time of proposed system. Thus, Overall system performance is optimized and controlled by Neural Network techniques.*

Keywords *- Quality of Service, Neural Network, Received Signal Strength, Handoff, Traffic Intensity etc.*

I. INTRODUCTION

Since last few years, wireless communication has been a very active research area. Wireless communication has mainly three types of communication- Radio communication, Cellular communication and satellite communication. Cellular communication is one of the important parts of wireless communication in which communication is carried from one end to other through mobile phones. But as all knows that mobile users does not stay at a particular place means moves from one place to another. So, in order to maintain the continuous communication without any termination of call when users migrate from one cell site to another, Cellular communication give rise to the concept of handoff. Handoff is a very important process which is mainly used to provide reliable communication in cellular mobile network.. Handoff is a mechanism that transfers an ongoing call from one base station to another as the user moves away from the coverage area of cellular system. The phenomenon of handoff is initiated when the power received by the target base station is higher than that of the serving base station. The conventional handoff decision depends upon signal strength which is not suitable for modern small size cellular mobile network. To maintain reliable communication in cellular mobile system, better and new handoff algorithm is needed to keep the Quality of Service (QoS) as high as possible. In the older generation system to achieve handoff efficiently was not that much difficult as the cell size in those systems is large enough, but in modern cellular system the size of cell site is kept small in order to accommodate maximum number of users by implementing frequency reuse concept. Handoff decision becomes more challenging in case of smaller cell size with increased probability of the mobile system crossing a cell boundary. This problem becomes further complicated by the fact that there is an overlap of the signals from different base stations in the vicinity of the cell boundary. Therefore many artificial intelligent techniques also known as soft computing approaches based on Genetic Algorithm (GA), Fuzzy Logic (FL) and Artificial Neural Network (ANN) can prove to be efficient for next generation wireless network. In this work, neural network is used for taking efficient and accurate handoff decisions.

There are the two main objectives achieve in this work. First one is use neural network based approach for handoff decision means handoff decisions has been taken by using one of the soft computing approaches known as neural network on the basis of three input parameters RSS (Received Signal Strength), TI (Traffic Intensity) and distance. Next one is to achieve best path with handoff ready nodes in cellular mobile network.

After getting handoff status of all nodes in a network then select source and destination node in a network and find all neighboring nodes of source node and then select next node on the basis of handoff criteria means handoff, immediate handoff and distance. This process is continued in order to select all nodes up to destination node. So, in this way best path will achieve with handoff ready nodes in cellular mobile network.

II. NEURAL NETWORK

An artificial neural network is an information processing system that tries to simulate biological neural networks or also known as information processing paradigm that is inspired by the way biological nervous system. Artificial neural network (ANN) is distributed, adaptive, generally nonlinear learning machines built from many different processing elements (PE). Each PE receives connections from other PE and/or itself. The interconnectivity defines the topology. Neural networks

are typically arranged in layers. Each layer in a layered network is an array of processing elements or neurons. Information flows through each element in an input-output manner. An artificial neural network (ANN) is configured for a specific application, such as pattern recognition or data classification through learning processing. The most commonly used structure of neural network is shown in Figure 1.1. This neural network is formed in three layers, called the input layer, hidden layer, and output layer. Each layer consists of one or more nodes, represented in this diagram by the small circles. The lines between the nodes indicate the flow of information from one node to the next.

Neural networks process information in a similar way the human brain does. The network is composed of a large number of highly interconnected processing elements (neurons) working in parallel to solve a specific problem. Neural networks learn by example. They cannot be programmed to perform a specific task.

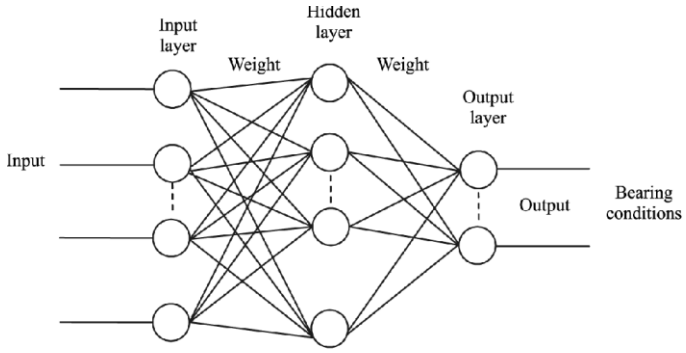

Figure 1.1: Neural Network

There are many different applications and advantages of neural networks are character recognition, Image compression, travelling salesman's problem, stock market prediction. In this paper neural network is used for taking accurate and fast handoff decision and its performance is studied by getting optimized path in a network for a handoff. Neural networks learn by example. They cannot be programmed to perform a specific task. The example for neural network must be selected carefully otherwise useful time is wasted or even worse the network might be functioning improperly. The work of neural network is divided in to three distinct sets called training, testing and validation sets. The training set is the largest set and is used by neural network to learn patterns present in the data. The testing set is used to evaluate the generalization ability of a supposedly trained network. A final check on the performance of the trained network is made using validation set. In this work neural network takes handoff decision on the basis of three input parameters RSS (Received Signal Strength), TI (Traffic Intensity) and distance which will clearly shown in the result section.

III. METHODOLOGY

This work is started with the training of the neural network on the basis of three input parameters RSS (Received Signal Strength), TI (Traffic Intensity) and distance. Neural network is trained on the basis of three input parameters RSS, TI and distance by constructing a matrix pattern and each input parameter is classified in to three parts low, medium and high. At the output of neural network training part a pattern is generated on the basis of handoff criteria. In the testing part generate levels of each parameter with each node in the network randomly. And finally check the original status of all nodes in order to get the knowledge of handoff of each node by using neural network training and testing part. Final status of each node is generated on the basis of handoff criteria in the form of handoff, immediate handoff, no handoff and wait handoff. Then after perform localization of nodes means to form cluster and then is select cluster head among them on the basis of routing algorithm. After achieving the handoff status of all nodes in a network the next step is to generate best path in a network. This has been done by calculating distance among all the nodes with respect to base station. Means each node selects a range of 25 meters i.e. one- fourth of the total distance. Then according to the determination of distance basis find the neighbors of each node respectively. Again keep a check on handoff of all the nodes. Now choose the node which is close but also ready to take handoff, means give priority to handoff and immediate handoff node with distance determination. Then keep on selecting nodes on the procedure following and reach the destination.

IV. RESULTS AND DISCUSSION

On the basis of above methodology all results were generated after running the matlab code in a MATLAB version 7.10.0.499(R2010a).

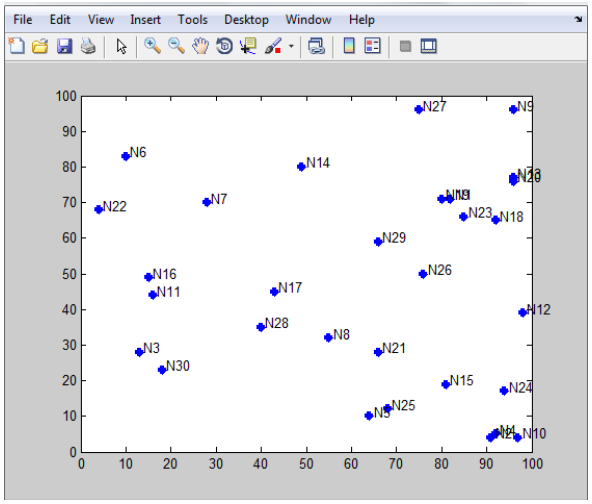

Figure 1.2 Nodes status

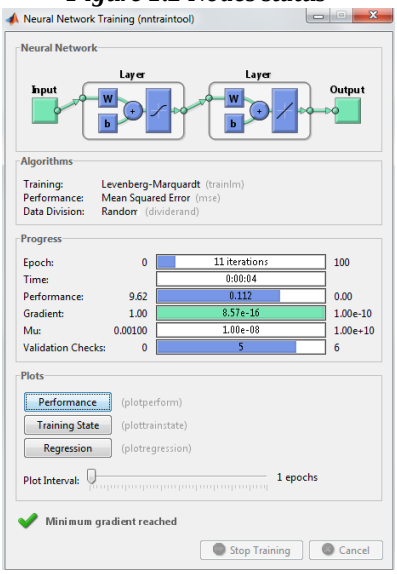

Figure 1.3 Neural Network Training Window

Table 1: Input Parameters Classification

Strength	Nomenclature
Low	1
Medium	2
High	3

Table 2: Output Parameters Classification

Handoff status	Nomenclature
No Handoff	1
Wait	2
Handoff	3
Immediate handoff	4

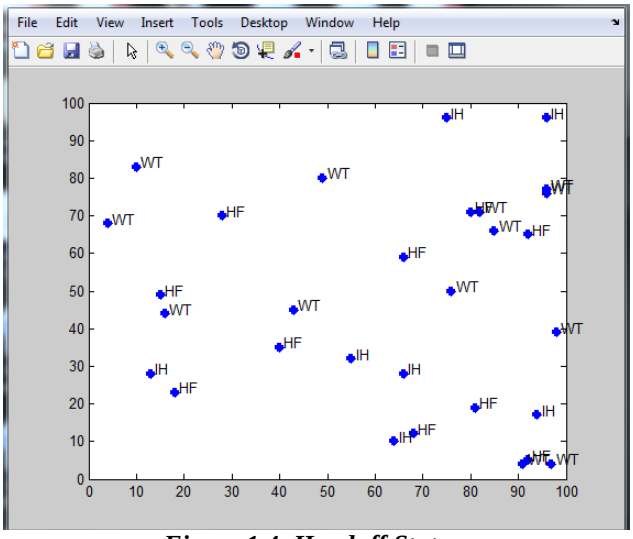

Figure 1.4: Handoff Status

Figure 1.2 represent the user defined data, firstly user create a network environment with defined area of 100*100 means 100 for X-axis and 100 for Y-axis in which we take 30 nodes also known as base stations(BS). Location of all nodes shown in a network is generated randomly. Then after neural network is used in order to take the handoff decision of all nodes shown in a network above. Neural network works in three distinct parts training, testing and validation checks. Here three parameters were considered to train the neural network RSS (Received signal strength), TI (Traffic Intensity) and distance. Figure 1.3 represents the neural network training window which is mainly used for providing training of each node in a specific network. So, in order to take handoff decision, this window of neural network generates itself when we compile or run the mat lab code. All the three parameters are classified in to three parts low, medium and high shown in table 1. At the output of training part a handoff criterion is defined on the basis of which neural network takes the handoff decision shown in table2. At the testing part neural network generates different parameters to each node randomly. And at the validation check part neural network generates the result on the basis of table2 shown in figure 1.4. The next step is to achieve best path in a network which is generated by defining all neighboring nodes for each node within a fixed defined range. Firstly choose one source node and one destination node in order to get the path. Selection of next node from source node is done on the basis of handoff, immediate handoff and distance shown in figure 1.5.

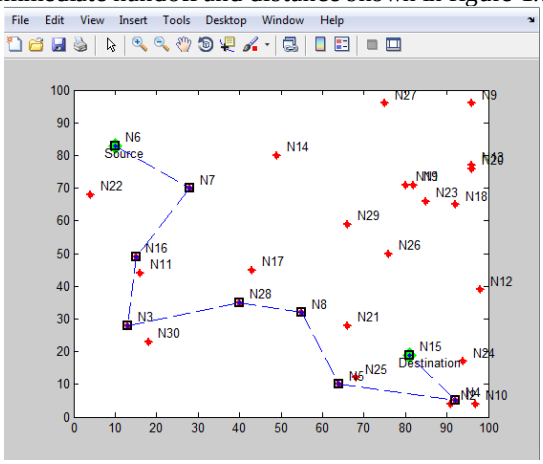

Figure 1.5: Optimized path in a network

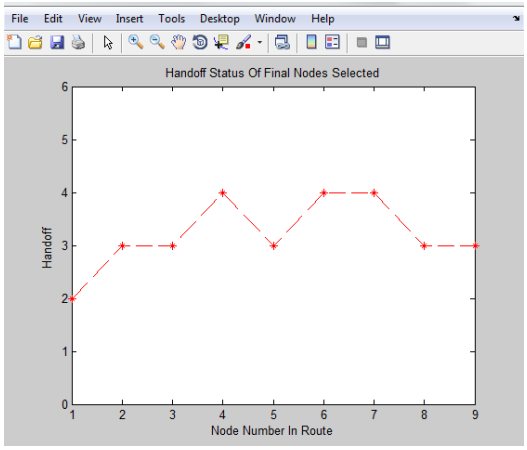

Figure1.6: Handoff Status of Final Nodes Selected

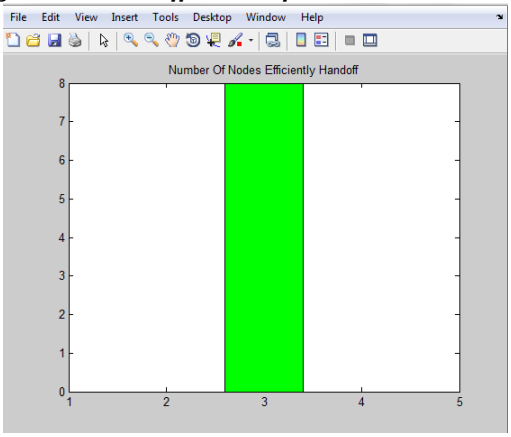

Figure 1.7: Efficiency of Nodes

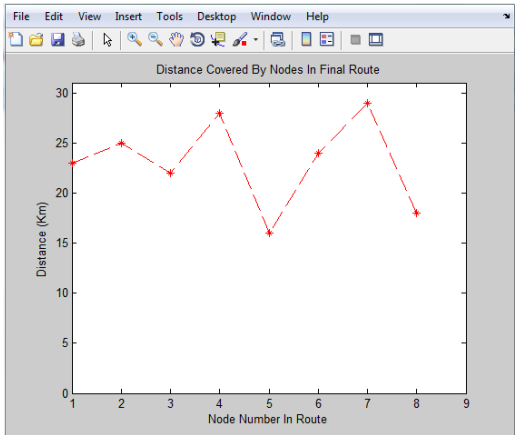

Figure 1.8: Distance Covered By Nodes in Final Route

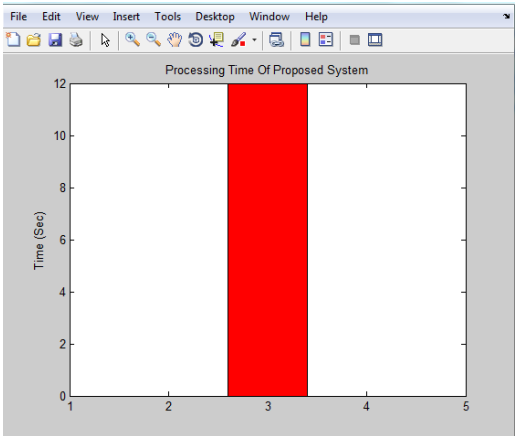

Figure 1.9: Processing Time of Proposed System

After achieving handoff status of all nodes and best path in a network shown in figure 1.4 and 1.5 there are some parameters were generated like handoff status of final node selected, efficiency of all nodes, distance covered by node in final route and processing time of proposed system. All these parameters indicate that the handoff status achieved by the use of neural network is accurate and fast because processing time of proposed system is 12 seconds which is too less. And the path generated in figure 1.5 is the best path because handoff status of final node selected for best path is in the form of handoff and immediate handoff so, its efficiency is maximum.

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