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Node mobility prediction in Wireless Adhoc Network

Sandeep Raskar, kamatchi Iyer

Abstract*: Generally, Link between any two nodes in the wireless network is a bottleneck in process of selecting a path in a network, or among or across multiple networks. Nodes are moving in the network unknowingly. So even if an algorithm selects the node during the path initialization process for the transmission of data among source and destination node, we cannot predict that node will be on the same position in the network when actual data transmission starts. There are many algorithm defined in selection of path in ad hoc network. This paper proposes new concept called Neural Network (NN) model. It predicts the node movements in ad-hoc network during data transmission. Algorithm can predicts the movement of a node in a network on the basis of information of previous movements of that node.

Index Terms: Network Model; shortest path routing; Neural Network.

I. INTRODUCTION

Mobile Ad hoc Networks (MANETs) are usually the distinctive wireless networks, which include mobile nodes of different mobility where the base station infrastructure is not present [9]. The mobile nodes that available in MANETs [10] [13] [14] act either as simple node and router and thus multi-hop networks. MANET also gains great attention through the range of applications as it has certain special features like (i) The MANET node configures itself as routers. (ii) It is possible for self–healing. (iii) Dynamic alteration of Network Topology is possible without the necessity of central administration. (iv) This network is quite simple to design as well as install. [1]

Sometimes ad-hoc network suffers from many challenges because of these MANET [15] [16] [17] [18] [19] special features. The topology changes of MANET highly minimizes the Quality of Services (QoS) granted [10]. However, granting QoS is very much required since MANET is mostly used almost in all applications (critical). The QoS [20] of MANET is mostly exaggerated by interference among the mobile nodes [11] [12]. The QoS measures are Data transmission rate, Guarantee of message delivery, End to End delay and Jitter.

The MANETs requirement come out from a condition where nodes such as laptops and handheld devices require in clustering together and also in the situation of creating network that could maintain services such as resource sharing, messaging and information-sharing. Thus the main aim of a MANET [21] [22] [23] routing is 'Quick and efficient establishment of one (unicast) or more (multicast) reliable end-to-end routes (paths) among nodes, and so it facilitates in their reliable communication [4]. Over the past few decades, number of reactive as well as proactive protocols has been enriched for efficient, reliable communication. Moreover, Hybrid protocols are also there in the dice, and this is attained by enchanting benefits of both protocols: proactive and reactive. The analytical results have highly proven that reactive protocols are more superior over the proactive protocol with respect to certain measures like throughput, routing overhead, packet delivery ratio [13] and so on. However, routing [24] [25] [26] [27] [28] in MANET faces number of challenges [14]. Among them, the first challenge is; due to the random and unpredictable movement of nodes, the network topologies may experience lot of dynamic changes. Second is, protocols should be adaptable since the node gets either join the network or leaves from the network. In the last, though no service assurance can be provided, the protocol [29] must have the ability to increase the data packets reliability in network for the respective (given) constraints. [4] In addition to this, frequent leaving and joining of nodes in MANET network is very high and hence the discovery of reroute always results in waste of the time, and it also improves the network overhead [3]. This paper proposes NN model to predict the node movements in ad-hoc network. The remaining things of the paper is organized as follows: Section 2 does the review of literature work. Section 3 explains the prediction model. Section 4 concludes the paper.

II. LITERATURE REVIEW

A. Related Works

M.Malathi and S.Jayashri [1] have developed a new routing approach for communicating between Mobile ad hoc nodes that has reduces the failure of route while transmitting a data over the network. The new routing protocol has used following salient parameters for determine the path that ensures the reliable communication between source and destination. Node's link quality, energy level as well as channel quality are the considerable reasons for the node failure. So these three parameters has been mainly considered to develop new algorithm for selecting the effective intermediate node. Data communication in a reliable way was also attained by data transmitting through the selected path by new routing algorithm, it is also proved by using network simulator (NS2). Song et al. [2] has proposed a model for the assessment of link stability that was on the basis of change in the link connectivity,

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*****Correspondence Author(s)
Sandeep Raskar, Amity University, Mumbai, Maharashtra, India
Dr. kamatchi Iyer, Amity University, Mumbai, Maharashtra, India

and that will be performed on network layer. For this, there requires no low layer data or peripheral devices. Moreover, the estimation approach was not controlled for recognizable network topologies. Next, to this, author has proposed a routing approach that could adjust sits operating mode on the basis of assessed link stability. Simulation outcomes have shown that the developed approach could grant correct assessment in both scenarios: Stationary as well as Non-stationary. The offered routing protocol has shown its better performance over existing routing approaches without link stability assessment process.

Preetha et al. [3] proposes a innovative approach for minimizing the path failure via alternate path information storing in intermediate nodes. Here, in the implemented algorithm, intermediate nodes are also evolved in the route discovery process. This has been reduced the overhead of the time required for finding the reroute at the time of link failure and corresponding route establishment.

Chatterjee and Swagatam [4] proposes an enhanced version of well-known Dynamic Source Routing (DSR) approach, which was on the basis of Ant Colony Optimization (ACO) algorithm. This could generate high ratio of data packet delivery with less delay (end to end) and also with less overhead and consumption of energy too. In this approach, if a corresponding node wants to transmit a packet to some other node, such as DSR, initially, it confirms the cache for conventional routes. If no routes are identified, in order to identify the routes, the sender node broadcast (locally) the request packet for finding the routes. Similarly, they have evaluated the route's pheromone level, which was on the basis of hops number in route and route congestion. They have also proposed a new pheromone decay model for maintaining route. Finally, the implementation outcomes have shown that the proposed DCR that was on ACO basis exceeds the conventional DSR and other routing algorithms.

Rahat et al. [5] has introduced an evolutionary approach (i.e. multiple objective) for finding out the routing paths that optimizes to-and-fro among a lifetime of network as well as robustness. They have also introduced a new measure of robustness, the fragility. Moreover, By resolving the suitable linear program it was also shown that the packets distribution among all identified paths in given multi-path approach optimizes either the lifetime or fragility that might have identified. Moreover, author has used an evolutionary algorithm (multiple objective) for solving the conjunctional optimization issue of selected routings paths. Efficiency was attained by eliminating the search space by paths like braided as well as edge-disjoint paths and k -shortest paths. The demonstration of the method was done in real network that arranged at the Victoria & Albert Museum, London. At last, the demonstration has shown that the evolutionary multi-path routing could attain major performance enhancement over a braided multi-path approach.

Omar et al. [6] have focussed on routing difficult in MANET, and the contribution took place by developing DS2R2P (On-Demand Source Routing with Reduced Packets Protocol). This proposed work was on the basis of source routing. Not like the conventional algorithm, the proposed model includes the data packet header in a reduced integer value. The corresponding value was considered as the routing path summary, which also comprises the whole information that allows data packet for reaching the destination. The performance of proposed solution was evaluated via simulation work, and the results have proved that the supermacy of proposed model with respect to data routing delay and communication overhead.

Misra et al. [7] have proposed an ideas of ants foraging behaviour, and under this idea, author has proposed an energy-aware routing protocol. The protocol comprises the power consumption impact in routing a packet, however, it has also exploited the properties of multi-path transmission and, thus it could improve the nodes' battery life. The efficiency of the proposed protocol measured with respect to conventional ones has also established via simulation work. Author also observed that the loss of packets was around 12% and the network consumed less energy as compared to MMBCR algorithm.

Wu et al. [8] has proposed opportunistic routing that could make finest broadcast property usage of radio propagation. In the proposed routing method, packet forwarding decisions are on the basis of number of neighbours available. It requires no network-wide flooding for establishing the routes. To nourish the latest neighbour information and also to reduce the cost of energy of gathering information, author has also proposed a light weight time series that was on the basis of routing metric prediction approach for dealing with greatest communication cost acquired by gathering the latest routing measures among nodes. Then the simulation results have attained 30 percentage high PDR(Packet Delivery Ratio) as compared to conventional AODV routing protocol. This proposed model has attained less energy consumption when compare to existing routing algorithm.

B. Review

The literature work has come out with the following review: Reliable and Power proficient routing (P2R2) protocol [1] increases the speed of mobility and also minimizes the node failure. However, the representation of mobility links comes with a complex process. Routing combination protocol [2] is flexible for dynamic link state as well as simpler, Increase in fluctuations of links are the major drawback of this system. Some of the authors also says that path protection method [3] reduces the network overhead and time delay, but these methods require an additional algorithms. Ant Colony Optimization [4] process reduces the evaluation effort of distinct nodes. But, it requires additional validation to be perform. The batteries might view the nonlinear behaviour in spite Evolutionary algorithm [5] finds the precise traffic division. DS2R2P [6] improves the performance of routing protocol with respect to transmission time and communication overhead. Energy-aware routing protocol [7] concludes good route and recovery algorithms. The major challenge with this approach is its practical implementation is quite complex. it could not support other mobility models too.

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III. PREDICTION OF INTELLIGENT MOBILITY

A. Knowledge Construction

In this paper, we adopt NN to anticipate the node displacement in the wireless Ad-hoc network. Hence, the creation of knowledge database is required for quick node displacement prediction. Knowledge database constitute apriori information about the movement of the sensor nodes. It is represented by antecedent A and subsequent movement E, which is defined in Equation (1). Let's consider S_1 sensor node, it moves from positions O to O' in N_s steps. The knowledge which is to be constructed for S_1 is defined as per Equation (2), where E_1 denotes the location of S_1 after N_s steps and A_1 denotes a series of movements.

$$A_1 \rightarrow E_1 \quad (1)$$

$$A_1 = \{X_A, Y_A\} \quad (2)$$

where X_A represents the x coordinate of S_1 node at positions $O_i, O_{i+1}, \ldots\ldots\ldots, O_{i+N_s}$, Y_A represents the y coordinate of S_1 at positions $O_i, O_{i+1}, \ldots\ldots\ldots, O_{i+N_s}$. In this case, E_1 represents the x coordinate of S_1 at the position O_{i+N_s+1}. An commendable knowledge construction is illustrated in Fig. 1.

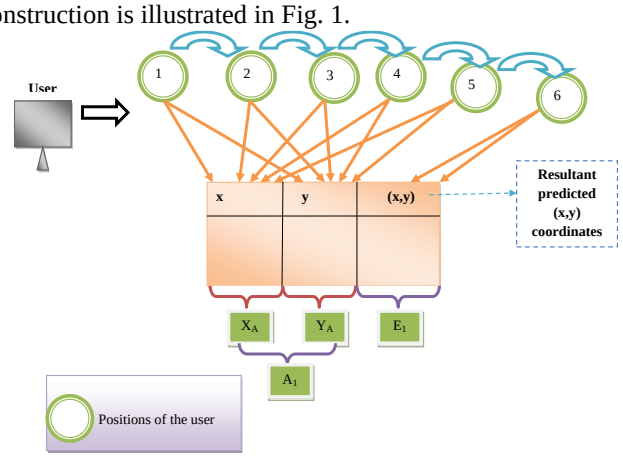

Fig. 1. The Knowledge constructing mechanism.

B. Network Prediction

The adopted Neural Network [30] based anticipation model equation are represented in Equation (3), (4) and (5), where refers the hidden neurons, $W_{ji}^{(H)}$ denotes the weight of the hidden neurons, $W_{(bi)}^{(H)}$ represents the bias weight to the ith hidden neurons, Here, the input is the antecedent A ; $A = (a_1, a_2, \ldots\ldots a_N)$: $X_A = \left\{a_1, \ldots a_{\frac{N}{2}}\right\}$, $Y_A = \left\{a_{\frac{N}{2}+1}, \ldots\ldots a_N\right\}$

The final output of the hidden layer is denoted as B^H, which is defined in Equation (3), and $NF(\bullet)$ represents the non-linear function.

$$B^H = NF\left(W_{(bi)}^{(H)} + \sum_{j=1}^{N(I)} W_{ji}^{(H)} A_j\right) \quad (3)$$

The output of the network model is denoted as $\hat{E}$, which is defined in Equation (4), where $W_{bk}^{(O)}$ refers the output bias weight to the kth layer, $W_{ik}^{(O)}$ denotes the output weight from i^{th} hidden neuron to k^{th} layer. The weight W^* is selected optimally by lessening the objective function and it is defined as given in Equation (5), where $N_{(O)}$ denotes the number of output neurons and E refers the actual output.

$$\hat{E} = NF\left(W_{bk}^{(O)} + \sum_{i=1}^{N(H)} W_{ik}^{(O)} B_i^H\right) \quad (4)$$

$$W^* = \underset{\left[W_{(bi)}^{(H)}, W_{ji}^{(H)}, W_{bk}^{(O)}, W_{ik}^{O}\right]}{\arg\min} \sum_{k=1}^{N(O)} \| E - \hat{E} \| \quad (5)$$

IV. CONCLUSION

This paper has focused on prediction of the node movement in the wireless ad hoc network. This can be use while route establishment process as well as during data sending process. During the node selection process between the source and destination NN can be used so that node movement can be predicted at the initial stage. As we are predicting the node movement using NN, the nodes which may go far away from the other selected nodes will not consider for the future path. Due to this link breakage between any two nodes will be reduced which results into less end-to-end delay, more throughputs and less overhead due to link failure. So that any general algorithm that transfers packets from source to destination can take decision while selecting nodes in the path. We can also use NN during data transmission process between source and destination where proposed algorithm will use NN to predict next movements of nodes which are participating in data transmission process. NN predicts that node may go out of reach from intermediate node after some time and that time complete data transmission may not takes place then source can find alternate path before link breaks without disturbing current path.

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