Introduction of various Soft Computing Techniques in Mobile Ad-hoc network

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Abstract- Mobile Ad-hoc Network is a collection of mobile nodes that dynamically create a wireless network amongst them without using any pre-defined environments. In such an environment, it may be necessary for one mobile host to enlist the aid of other hosts in forwarding a packet to its destination, due to the limited range of each mobile host's wireless transmissions. In any network, Quality of Service is the basic requirement and when we talk about the MANET this is the highly constraint requirement of the user. Mobile ADHOC Networks (MANET) the mobile transceivers or sensors are randomly deployed in the sensor field which brings the problem of coverage for all or some of the nodes. As the coverage problem can increase overall effective distance of all nodes from the sensor which further affects overall throughput & power required by the system. It is a unique problem and in maximizing coverage, the sensors need to be placed in a position such that the sensing capability of the network is fully utilized to ensure high quality of service. Neural Networks (NNs) promise solutions to such complicated problems, they have been used successfully in various practical applications. This network uses two different types of protocols. They are proactive protocol and reactive protocol. Proactive protocol maintains routing table information. Reactive protocol is a path between source and destination and also called as on-demand protocol. Genetic algorithm (GA) is used to find the optimal path between the source and destination nodes. Fuzzy logic is proposed which having low communication overhead and storage requirements.

Keywords:- MANET's, Routing Protocol, Genetic Algorithm, Neural Network, Fuzzy Logic.

I. INTRODUCTION

A MANET is a type of ad hoc network that can change locations and configure itself on the fly. Because MANET's are mobile, they use wireless connections to connect to various networks. Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. Each nodes must forward traffic unrelated to its own use, and therefore be a router. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. A Mobile Ad-Hoc Network is an ad-hoc network but an ad-hoc network is not a MANET. It is also called a mesh-network.

The set of applications for MANETs is diverse, ranging from small, static networks that are constrained by power sources, to large-scale, mobile, highly dynamic networks. The design of network protocols for these networks is a complex issue. Regardless of the application, MANETs need efficient distributed algorithms to determine network organization, link scheduling, and routing. However, determining viable routing paths and delivering messages in a decentralized environment where network topology fluctuates is not a well-defined problem. While the shortest path (based on a given cost function) from a source to a destination in a static network is usually the optimal route, this idea is not easily extended to MANETs. Factors such as variable wireless link quality, propagation path loss, fading, multiuser interference, power expended, and topological changes, become relevant issues. The network should be able to adaptively alter the routing paths to alleviate any of these effects. Moreover, in a military environment, preservation of security, latency, reliability, intentional jamming, and recovery from failure are significant concerns. Military networks are designed to maintain a low probability of intercept and/or a low probability of detection. Hence, nodes prefer to radiate as little power as necessary and transmit as infrequently as possible, thus decreasing the probability of detection or interception. A lapse in any of these requirements may degrade the performance and dependability of the network.

MANET node can be used for monitoring heat, temperature, humidity, intrusion detection etc. Major challenge for MANET is to manage the energy constraint of nodes that form the network. For multimedia traffic delay and energy parameters are sensitive in network. Hence Quality of Service support can be achieved for an efficient routing and establish effective path between source and destination with negligible end to end delay.

Genetic algorithm is a programming methods and evaluation of problem solving method. The genetic algorithm then evaluates each candidate to fitness function. This algorithm is best of the searching algorithm. The proposed genetic algorithm using best optimal path between source and destination nodes in ad hoc networks and evaluate of fitness function for cost and bandwidth.

In a Mobile Ad-hoc Network, the communication between two adjacent nodes needs the relative movement information of nodes. Generally speaking, the state of a node includes the position, the movement speed and the movement direction. The following are the attribute description of one node. Node:- N_i (p, v) Where i denotes the No. of one node, p denotes the position of Node i . According to GPS location information, each node has one unique

position. v denotes the velocity of node i . It is a vector includes value and direction.

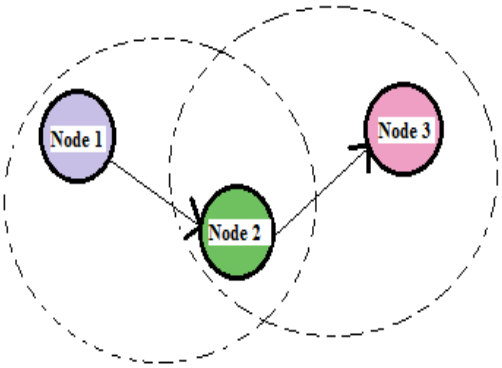

Figure 1 Example of mobile ad-hoc network

II ROUTING PROTOCOLS IN MANET's

Routing protocols have been proposed and can be categorized into topology-based (Royer & Toh, 1999) and position-based protocols (Giordano et al., 2004). Topology-based routing protocols route packets based on information about the network links while position-based routing protocols uses physical information about the participating nodes to decide on how to route packets. Topology-based protocols can be further divided into proactive, reactive and hybrid routing protocols. The network links are determined long before routing process in proactive protocols, when routing in reactive protocols and a combination of before and when routing in hybrid protocols. In the position-based protocols, location information of the destination are known and used. There are two sub-divisions in position-based routing protocols, namely greedy forwarding and restricted flooding. In greedy forwarding, nodes that have the best progress will be selected and data packet will be forwarded to these nodes. Ideally, this process is repeated until the packet arrives at the destination. Note there is no route discovery in greedy forwarding. Restricted flooding, on the other hand, will mitigate broadcast storm problem where only nodes in the direction of the destination will participate in the route discovery until the route to destination is found. The participation of nodes in routing will optimize broadcasting in MANET. Restricted flooding will broadcast messages to a selected number of nodes which is usually more than one that are located closer to the destination. It will significantly reduce not only energy but also reduce the probability of packet collisions of messages rebroadcast by neighbours using the same transmission channel (Stojmenovic, 2002; Mauve et all, 2001; Giordano et al, 2004).

(2.1) Proactive Protocols:- Proactive, or table-driven routing protocols. In proactive routing, each node has to maintain one or more tables to store routing information, and any changes in network topology need to be reflected by propagating updates throughout the network in order to maintain a consistent network view. Examples of such schemes are the conventional routing schemes: Destination sequenced distance vector (DSDV). They attempt to maintain consistent, up-to-date routing information of the whole network. It minimizes the delay in communication and allows nodes to quickly determine which nodes are present or reachable in the network.

(2.2) Reactive Protocols:- Reactive routing is also known as on-demand routing protocol since they do not maintain routing information or routing activity at the network nodes if there is no communication. If a node wants to send a packet to another node then this protocol searches for the route in an on-demand manner and establishes the connection in order to transmit and receive the packet. The route discovery occurs by flooding the route request packets throughout the network. Examples of reactive routing protocols are the Ad-hoc On-demand Distance Vector routing (AODV) and Dynamic Source Routing (DSR).

(2.3) Hybrid Protocols:- They introduces a hybrid model that combines reactive and proactive routing protocols. The Zone Routing Protocol (ZRP) is a hybrid routing protocol that divides the network into zones. ZRP provides a hierarchical architecture where each node has to maintain additional topological information requiring extra memory.

(2.4) Greedy Forwarding: - Greedy forwarding requires an up-to-date local topology via periodic beaconing which eliminates route discovery and hence, only data packet forwarding are employed until it reaches the destination. There are several forwarding strategies proposed that differ in the way the node selects the next hop among its neighbours.

(2.5) Restricted Flooding: - The main approach in restricted flooding is to limit the flooding region which can be based on distance, angle and distance covered by the next intermediate node. Using distance, only nodes that are nearer to the destination will participate in the route discovery. Nodes that are further away from source will not participate.

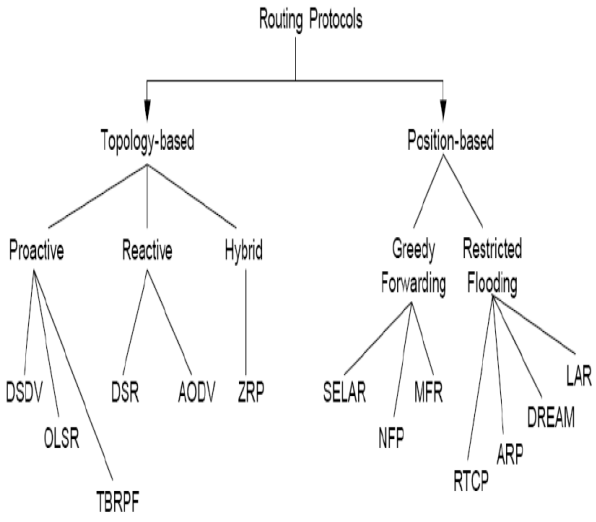

Figure 2 Protocols in MANET's

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III Basic Algorithm's For MANET's

(3.1) Genetic Algorithm:- Genetic algorithm is a search technique used in computing to find true and approximate solutions to optimization and search problems. A genetic algorithm maintains a population of candidate solutions. Each candidate solution is called a chromosome. Subsection of the chromosomes, which are called genes (or) each character in the string, is called a gene. Genetic algorithms are example of evolutionary computing methods and optimization-type algorithms. The basic for evolutionary computing algorithms is biological evolution, where over time evolution produces the best fittest individuals. A set of chromosomes from a population, which is evaluated by a fitness function.

A genetic algorithm (GA) is a computational model consisting of five parts.

(a) Set of individuals, p.
(b) Crossover technique
(c) Mutation algorithm
(d) Fitness function
(e) Algorithm applies to crossover and mutation technique

Genetic algorithm for ad hoc network worked as a connected graph with nodes. The optimization is the cost of path between nodes. The goal of algorithm has to find the shortest path with minimum cost between source and destination nodes.

A. Representation of a Chromosome:- A chromosome corresponds to possible solution of the optimization problem. Each chromosome represents a path consist of sequence of positive integer that ID.

B. Evaluation of Fitness Function:- The fitness function translating the chromosome in terms of physical denoted and evaluate of fitness based problem solution. The fitness functions in the shortest path routing problem to find the minimal cost path and fitness of bandwidth.

C. Selection of Best Fit:- The selection process of the best fit is to improve the average quality of the selection. The selecting individuals from the population. There are two basic types of selection process.

(a) Proportionate.
(b) ordinal-based selection.

Proportionate selection is chromosome based on their fitness values to the fitness of the other chromosomes in the population. Ordinal –based selection schemes select chromosome based not their fitness. The chromosomes are ranked by according to the fitness values.

D. Crossover:- Crossover process of two mating solutions and exchanging data between them finding new solutions. Crossover is performed on strings using midpoint crossover.

E. Mutation:- The mutation operator randomly alters genes to partially shift the search to new locations in the solution pace.

(3.2) Neural Network: - A neural network approach named shortest path neural networks (SP-NNs) is proposed for real time online path planning. Path planning is a crucial and an indispensable topic for robot navigation. Some methods like artificial potential field (APF) method, vector field histogram (VFH) and behavior-based path planning methods do have good performance in simple environments with a relatively low computational cost. However, they suffer from undesired local minima sometimes and generally the generated path is not a global shortest.

The shortest path problem is a classical combinatorial optimization problem arising in numerous planning and designing contexts.

The schematic architecture for NN consists of two modules:

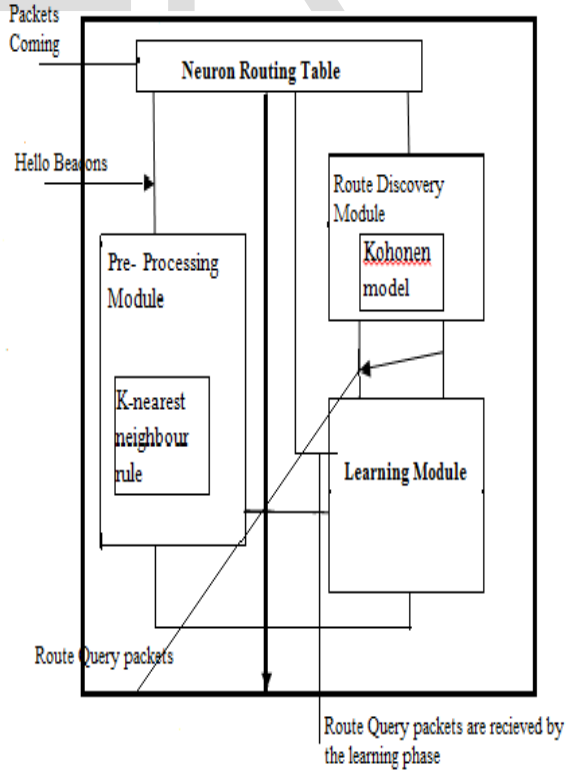
(a) Preprocessing Module
(b) Route discovery module

(a) Preprocessing Module: Preprocessing module adapts the K-nearest neighbors' rule sensing the continuous topology changes of the network which is based on sending hello requests and reply packets during an interval of time.

(b) Route Discovery Module:- Kohonen model, which it is used to select the next route in the MANET network based on a competitive learning procedure. Route discovery phase is divided into three steps:

- Broadcasting
- Selection of the "winner"
- Adaptation

Figure 3 Schematic Architecture for NN



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(3.3) Fuzzy Logic: - Fuzzy logic offers a natural way of representing and reasoning the problems with uncertainty and imprecision. Fuzzy logic is a suitable way to be applied in the mobile ad hoc network routing decision. The fuzzy routing protocols presented find a maximal set of disjoint paths from source to destination, and then employ a fuzzy logic controller to determine how to use those paths to carry the traffic. Fuzzy logic has been applied in control systems either to improve performance or to avoid difficult mathematical problems. Researchers have considered fuzzy logic for bandwidth allocation in broadband networks.

A fuzzy set is a generalization of the indicator function in classical sets. Fuzzy logic represents the degree of truth as an extension of valuation. Degrees of truth are often confused with probabilities through they are conceptually distinct. Fuzzy truth represents membership in vaguely defined sets, not even the likelihood of some event or condition.

For any set X, a membership function on X is any function from X to the real unit interval [0, 1]. Membership functions on X represent fuzzy subset of X. The membership function set is usually denoted by μA. For an element x of X, The value μA(x) is called the membership degree of x in the fuzzy set. $\mu A(x)$ quantifies the grade of membership of the element x to the fuzzy set. $\mu A(x) = 0$ means that x is not a member of fuzzyset. The value of $\mu A(x)=1$ means that x is fully member of fuzzy set .The value of $\mu A(x)$ between 0 and 1 charctarize fuzzy members , which belong to set partially. Fuzzy inference rules are given for categorizing the nodes based on trust levels.

Fuzzy Rule

1. IF trust value is VERY_HIGH THEN node is TRUSTED
2. IF trust value is HIGH THEN node is TRUSTED
3. IF trust value is MEDIUM THEN node is TRUSTED
4. IF trust value is LOW THEN node is MALICIOUS
5. IF trust value is VERY_LOW THEN node is MALICIOUS

Fuzzy logic rules are used in FLWMR to determine whether to route messages through zero, one, multiple, or all available paths in a network. These rules depend on the priority of the messages and the traffic congestion in the network. For example, if we wish to discard low importance messages when the network is congested, we would include a rule: If message precedence is Routine AND network status is Poor THEN Discard the message.

The Fuzzy Logic Controller (FLC) has two inputs: message precedence and network status, and one output: the routing decision.

The rules are expressed in Mamdani form:

R_i : IF **x** is A_i and **y** is B_j THEN **z** is C_k

AUTHORS OF ALGORITHM	LIMITATIONS OF ALGORITHM PROPOSED	ADVANTAGE OF ALGORITHM
Rauch and Winarske	Need to know the number of hops required for shortest path in advance	First development towards the field of NN based routing solutions.
Zhang and Thomopoulos	Not adaptable to external conditions	Finds a path with as many as N hops (N= No. of nodes in graph = Max. no. of hops SP can have)
Ali and Kamoun	NN fails to converge towards a valid solution a no. of times. Above problem intensifies as no. of nodes in graph increases	Aims at the NN adaptability to external varying conditions.
Park and Choi	Fails to coverage too many times. Poorer behavior with increasing no. of graph nodes.	Multi Destination routing problem. Single Destination routing version – Here extends the range of operation of former method.

Table 1 NN based routing algorithm

IV CONCLUSION

The Ad-hoc network has wireless communication between randomly moving nodes without fixed Infrastructure. Mobile ad-hoc network has very enterprising applications in today's world. Mobile ad-hoc networks are full of uncertainties because of dynamic topologies, dynamic traffic and different application contexts. Mobile ad-hoc network using various soft computing techniques have been done using various algorithms and routing protocols. Routing in MANET using soft computing technique is the solution to improve quality of service and route optimization in MANET.

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