International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347 - 6435 (Online)) Volume 4, Issue 9, September 2015)

A Brief Review of Antnet

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***Abstract*--Antnet is a software agent (ie.Application) based routing algorithm. Practically the terminology is defined as the technique in which, ants deposit some kind of chemical substance that is pheromone which marks the path that they used and on their way back they choose the path with the maximum pheromones which becomes the optimal path. Ants are nothing but software agents which are used in antnet update the probabilistic distance vector routing table entries and to collect traffic information. The existing Antnet Algorithm deals with only feedback provided to the system by the software agents and is the round trip time from source to destination. Then the distance vector table is updated using this feedback signals. As in the real life scenario chemical substance deposited by the ants evaporates over time in the same way routing table entries based on link usage statistics also evaporates with time. The performances of packets delivery ratio and average end-to-end delay are superior to the traditional dynamic routing protocol and ant-colony based routing algorithm as per our research survey in the forward and backward (Hybrid) AntNet scheme.**

I. INTRODUCTION

An ant in isolated way has no effectiveness but when they are in a well-organised colony, they becomes powerful agents, working for the development of the colony. The ant lives for the colony and exists only as a part of it. Sometimes ants are described as superorganism as it appears to operate as a unified entity. Ants have the ability to communicate, learn, cooperate, and they are capable to develop themselves and colonise a large area. Their main reason for success is their incresed number and being exceptionally well organised. Their self organising nature allow a highly coordinated behaviour of the colony, moreover it makes them to accomplish complex tasks, whose difficulty far exceed the individual capabilities of a single ant.

The social behavior of insects was first investigated by Pierre Paul Grassé, a French entomologist. He found that these insects are capable to react signals that activate a genetically encoded reaction which he called "significant stimuli,". He observed that the effects of these reactions can act as new significant stimuli for both the insect that produced them and for the other insects in the colony.

Grassé used the word "*stigmergy"* to describe this particular type of indirect communication in which "the workers are stimulated by the performance they have achieved".

The term Stigmergy means a method of indirect co-ordination in a self-organizing network system where its individual members communicate with one another by changing their local network.The communication between ants occurs by putting down pheromones along their path.

The concept of ant based network is that ants walk from source to food or from food to source and deposit a substance on the ground called *pheromone*. This attracts other ants to smell the substance called pheromone and other ants follows the path of the pheromone deposited by previous ones. A pheromone trail is being formed by the pheromone deposited on the ground, which allows the ants to find good sources of food that have been previously identified by other ants. After some time, the way being used by the ants will converge to the shortest path.

1.1 Routing

The word routing defines the process of selecting paths in a computer network through which data is send. This process can be defined as routing protocol. Routing protocol is used to exchange information about network links and a routing algorithm.

There are two approaches for routing algorithms-

- distance-vector algorithms
- link-state algorithms.

Bellman Ford's algorithm, is based on the concept of assigning a number, called cost, to each of the links between every node in the network. The information is sent from a source node S to a destination D via the path with the optimal cost. Dijkstra's algorithm which uses a data structure that contains all nodes. It starts with a tree containing only itself. From the set of nodes it adds one node at a time which it has not yet added to the tree, it adds the node which has optimal cost to reach an adjacent node which already appears in the tree. It iterates until every node appears in the tree. Then, this tree is used to build the routing table.

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A classical approach to routing is the Open Shortest Path First (OSPF) protocol. In OSPF, the link-state information is exchanged by routers by flooding the network. The updates in link state are generated only when the link status changes. Routing algorithm affects two main metrics which are throughput (quantity of service) and average packet delay (quality of service). Coordination is needed between nodes, link and nodes can fail, and congestion can arise in some areas. Thus, the routing algorithm needs to modify its routes, redirecting traffic and updating databases.

Dynamic Source Routing is a reactive protocol which uses source routing algorithm rather than hop-by-hop routing,with each packet to be routed carrying in its header the complete, ordered list of nodesthrough which the packet must pass. The key advantage of source routing is thatintermediate nodes do not need to maintain up-to-date routing information in orderto route the packets they forward, since the packets themselves already contain all the routing decisions.

1.2 Simple Rules

The ant approach to route-finding is quite different from the way humans navigate their environment. We would visually study the environment as a whole and try to "plan" the best route ahead of time. Of course, the ant method has advantages over our "high level" approach. For example, the ant method works fine in complete darkness. When it comes to navigating without visual cues, humans are comparatively helpless.

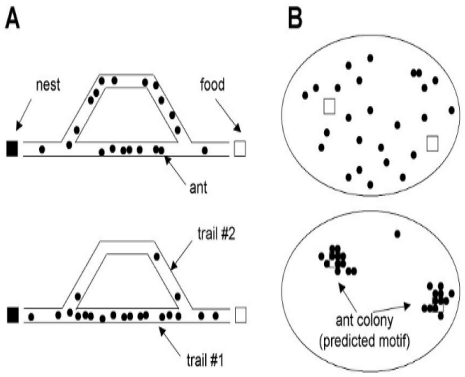
The ant method can be explained into simple rules followed by each member of the colony:

Condition:	**Action:**
Not carrying food not on pheromone trail	walk randomly lay pheromone
Not carrying food on pheromone trail	follow pheromone trail lay more pheromone
Reach home without food on pheromone trail	turn around follow trail in opposite direction
Reach food	pick up food turn around follow trail in opposite direction
Carrying food	follow trail lay more pheromone
Reach home with food	deposit food turn around follow trail in opposite direction

1.3 Simplifying Nature

The table given above contains seven "Simple Rules" which are relatively easy to understand. Also, there is a bit of sub-optimal behavior lurking: an empty-jawed ant may follow a pheromone trail in the wrong direction, all the way back to the nest. Of course, when an empty-jawed ant reaches the nest, it turns around and eventually makes its way back to the food, but this is still a wasted trip. The major drawback seems to be the lack of directionality in the trail, and it is certainly difficult to represent direction when all you have to work with are spots of chemical scents.

If the ants are augmented with two types of pheromone instead of one and if this pheromone is given directionality, then the first pheromone can be thought of as a "this way home" marker, and we will call it a home-finding pheromone moreover the second pheromone will be the food-finding pheromone, because it points in the direction of the food source. If a roaming ant ever encounters a food-finding trail, it follows that trail to the food source, leaving more home-finding pheromone as it goes.



This simple modification reduces the complexity of our rule set:

Condition:	**Walk:**	**Mark Ground With:**
Not carrying food	on food-direction trail, or randomly otherwise	home-direction pheromone
Carrying food	on home-direction trail	food-direction pheromone

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Trail Pheromone

The trail of pheromone laid down by most ants attracts and guides other ants to the food. This process renews until food holds out. As soon as the trail pheromone evaporates other ants stop coming to the site and are not confused by old trails when food is found elsewhere. A stick treated with the trail pheromone of an ant can be used to make an artificial trail which is followed closely by other ants emerging from their nest. The trail will not be maintained by other ants unless food is placed at its end.

II. ANTNET

In the Antnet algorithm, the general behaviour of each packet used for routing table generation can be described as follows:

Forward mode, no pheromone trail	In forward mode, the ant packet searches for the destination node. Choose random next destination that is not the parent node. Record a pheromone vector in the current node's routing table.
Forward mode, pheromone trail found	Follow the pheromone vector in the local node's routing table & the nodes from multiple nodes are choosen from among the next node with the best pheromone strength. Now we multiply the pheromone vector that was used by a scaling factor, and reduce all other pheromone vector entries such that the total probability adds to one.
Reverse mode	Here the packets arrived at the destination must make its way back to the source. Now Follow the reverse pheromone vector in the current node's routing table and If multiple candidates are found, use a probability distribution as previously described.

The pheromone vectors in each node are recorded as, the sum of which must add to one. A simple 4 node ring topology may have the following pheromone table:

For Node 1

Node 2	Node 2: 1
Node 3	Node 2: 0.5 Node 4: 0.5
Node 4	Node 4: 1

Because two possible routes are possible from 1->4, the probabilities of both are recorded in the pheromone table. Depending on network congestion and other factors, one route may be favoured over the other.

III. RELATED WORK

This paper introduces AntNet, a novel approach to the adaptive learning of routing tables in communications networks. The concept of AntNet is a distributed, mobile agents based Monte Carlo system inspired by recent work on the ant colony metaphor for solving optimization problems. The indirect & asynchronous communication among the agents is mediated by the network itself. This form of communication is called stigmergy. We compare our algorithm with six state-of-the-art routing algorithms coming from the telecommunications and machine learning fields. Set of realistic test beds are used to evaluate the Performance of algorithm. With the help of increasing number of nodes and under several paradigmatic spatial and temporal traffic distributions several experiments are run experiments over real and artificial IP datagram networks. We analyze the main characteristics of the algorithm and try to explain the reasons for its superiority [1].

AntNet algorithm is presented as a promising approach to be applied for dynamic traffic routing of road networks which acts as a threshold version. The exploitation of the pre-known good travel times as threshold values accelerates, not only, convergence of a good route discovery, but also, recovery from a derogated route. Theoretically performance of the threshold algorithm for a given network of n nodes was computed to be at worse case O(n2) still the processing time for a discovered route decreases significantly to become a constant that depends, only, on the number of nodes in the given route (as it is monitored, only, by the check ant). This performance last until the route became derogated. A rapid coverage of the network changes (more forward ants will traverse and discover good routes for the remaining destinations) is exhibited by this behavior.

The concept of standard AntNet algorithm is amenable to the associated changes in traffic load. Dhillon and Mieghem , showed that it has better performance than that of the shortest path routing algorithms. The influence of the modification were measured by comparing the modified algorithm performance with that of the standard Antnet. Experiment results indicated 11.88%, increase in the number of launched ants and a 3.13% decrease in the average travel time. These results were validated, even, further by applying a one-tailed t-test. In general it proved the significance of the enhancement provided by the Threshold-based AntNet algorithm. In particular, it validated the significant performance of ant's travel time during 60% of the simulation time, as shown in The improvement in the performance was highlighted in the time efficiency that reduces computational time. Whereas, reduction in the average travel time, allows significant increase in the number of launched ants which accelerates the search for new good routes. The presented modifications, allowed the algorithm to preserve the discovered good routes and to, rapidly, converge toward good routes. The inspired agent, ' check ant', assist in preserving good routes and, better yet, exposes and discards the degraded good route [2].

To find the best solution by adjusting pheromone at each iteration and by eradicating the chance of falling into local optimal solution using Ant colony optimization. All the paths satisfying it can be considered as feasible paths for any pair of source and destination in packet switched network moreover it also sets the QoS constraints [3].

The control problem in the shop floor takes the help of pheromone-based coordination approach. This paper aims at handling dynamic changes and disturbances and the proposed approach is applied to control manufacturing system . The calculation of pheromone quantum of manufacturing cell is inversely proportional to the cost, which can guarantee minimal cost to process the orders. Automatically finding efficient routing paths for processing orders can be done using this approach.

This approach has excellent optimization performance for the static environment and adaptability to disturbances as relvealed by experiments. Pheromone-based coordination approach in manufacturing system is focused on basic control problems and is only tested in the laboratory, therefore, it is still in the primary phase and further investigation is needed. Future work will consider following issues:

(1) improving the proposed control algorithms so as to decrease the adaptation time, (2) further exploring ant agent coordination for dynamic re-scheduling control which can provide a schedule immediately and efficiently, and (3)applying the proposed control approach to real industrial cases [4].

A routing metric for judging the situation of routing paths is adopted to maintain the optimal path during the transmissions. The simulation results establish the fact that our proposed Antnet Scheme with routing metric not only improve the total throughput and end-to-end delay but also achieves the load balance [5].

IV. Proposed Work

Our future work will include applying our Hybrid Ant-Net scheme to the wireless network with various scales and node densities to test its performance, and to further improve the algorithm .Through this study we are going to find the load balancing of the communication network with less failure of network and optimize the flow of traffic around the network using the AntNet routing algorithm.

V. Conclusion

The performances of packets delivery ratio and average end-to-end delay are superior to the traditional dynamic routing protocol and ant-colony based routing algorithm as per our research survey in the forward and backward (Hybrid) AntNet scheme. In this study we find the load balancing of the communication network with less failure of network and optimize the flow of traffic around the network using the AntNet routing algorithm.

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