Survey On Ant Colony Optimization (ACO) Algorithm

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ABSTRACT

A Mobile Ad-Hoc Network (MANET) consisting of mobile nodes which are connected by wireless links to form an arbitrary topology without the use of existing infrastructure. In order to improve the Mobile Ad-Hoc Network a new routing algorithm is implemented called Ant Colony Optimization. we take close look at algorithms used for Ant Colony Optimization(ACO) in order to find best possible path.
Keywords: Ant Colony Optimization, MANET, Ant Colony Optimization Routing algorithms(ACORA).

1. INTRODUCTION

Now a days, there is a problem in routing protocols in ad hoc network of wireless hosts. There are many routing protocols presently proposed for ad hoc networks. Ad hoc network is also called as mesh network[1,3].

Mobile ad hoc network is a type of self configuring Ad-Hoc network that is mobile and change locations and configure itself on the fly. Mobile ad hoc network use wireless connections to connect to various type of networks. One of the major research area in the mobile ad hoc network is routing. Routing refers to the best path for transmit data from one node to other node because topology in MANET cannot be stable.

Ant Colony optimization is a probabilistic method it is used for searching optimal path in the graph based on behaviour of ants seeking a path between their colony and finds the best possible path. It is a Meta-heuristic optimization technique[2]. ACO system can be implemented by many meta-heuristic algorithms. The three most successful ones are:

- Ant-System
- Ant-Colony system(ACS)
- MAX_MIN Ant System(MMAS)

Ant system algorithm is an one of the best example of Ant Colony Optimization method from the field of Meta-heuristics and computational intelligent. Ant System algorithm is a baseline for Ant Colony optimization method for popular extensions such as Elite Ant system, Max-Min Ant system, Ant Colony System. Ant system algorithm is inspired by behaviour of ants, specifically the pheromone communication between ants regarding a good path between the colony and source .

Ant-Colony systems(ACS) is designed for problems like TSP, knapsack problem, quadratic problems and others. MAX_MIN Ant system (MMAS),an Ant Colony Optimization algorithm is derived from Ant System but MIN_MAX Ant System is differs from Ant System in several way, and usefulness we demonstrate by means of an experimental study. the characteristics specific to MMAS- using a greedier search than Ant System -results from the search space analysis of the combinatorial optimization problems[5]. The computational results on Travelling salesman problem and Quadratic Assignment Problem shows MMAS this is currently among the best performing algorithms for these problems.

The main advantages of ad hoc network are:

- It is independence from central network administration.
- The self-configuring, nodes are also routers.
- self-healing through continuous reconfiguration.
- scalable-accommodates addition of more nodes.
- Flexible is similar to being able to access the internet from much different location.

In this paper we have done survey on Ant Colony Optimization using MANET.

The proposed algorithm combines the idea of Ant colony Optimization(ACO) and link state Routing (OLSR) protocol to identify constant paths in between source and destination nodes.

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2. ANT COLONY OPTIMIZATION

The Quality of Service of routing protocols can be enhanced by minimizing the routing overhead[9].
The different optimization techniques can be used for them. The Ant Colony Optimization techniques is one of them. When the ants are searching for a food , these ants wander randomly in any direction after finding the food or resource they get it returned to their nest position.
Figure 1 shows that how Ant Colony Optimization works with respect to the quality of service of routing protocols. Many ants can take different routes to reach the same food source.
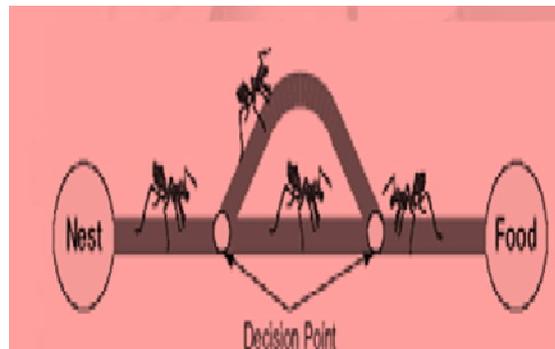

Figure 1

3. COMPARISON BETWEEN MANETs AND ANTs

Table1:Comparison between MENETs and ANTs

Parameters	MANETs	ANTs
Packet Delivery Ratio	Less	More
Overhead	MOre	Less
Route Discovery procedure	Route Request/Reply Message are used	Pheromone value is used
MOtive	Find shortest path for routing	To provide difinite shortest path
Path Discovered	Single path,partially mulltipath	multipath

4. ANT COLONY OPTIMIZATION ROUTING ALGORITHM(ACORA)

This algorithm has three phases:
- **Route Discovery phase:** In this phase new routes are created. The use of a Forward (FAnt) and Backward Ant(BAnt) requires a creation of new routes. a FAnt is an agent to the source node it establishes the pheromone track. a BAnt it establishes the pheromone take to the destination node.

The FAnt is a small packet and it has aunique sequence number. On the basis of sequence number and source adress of FAnt nodes are able to distinguish duplicate packets.
A Forward Ant is broadcasted by the sender and it is relayed by neighbors of the sender. FAnt for the first time in its routing table creates a record.
A record in the routing table is a triple and consists of pheromone value,destinaion address, and next hop. The node interprets the source adress of Forward Ant as destination address, address of previous node as the next hop, and depending on number of hops the FAnt needed to reach the node and it computes the pheromone value. Then the node

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relays the FAnts to the neighbors. Duplicated FAnt are identified by the unique sequence number and destroyed by the nodes. if FAnt reaches the destinatin node, it is processed in a special way.

The destination node it collects the information of the FAnt and destroys it.at the same time ,it creates a BAnt and it sends to the source node. The BAnt also it establishing a track to this node.when the sender receives the BAnt from destination node to the source node, the path is established and data packets can also be sent.
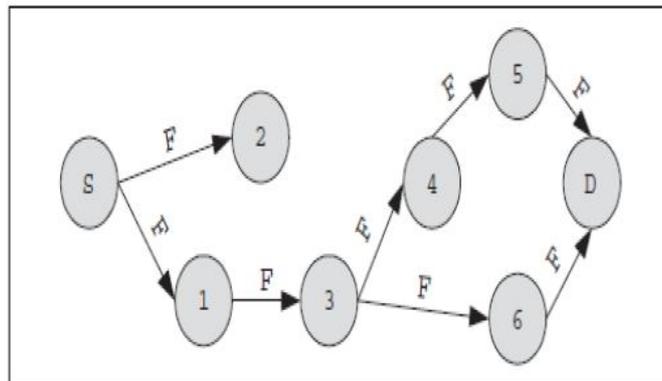
Figure 2(a). Route discovery phase.

A forward ant (F) is send from source to the target address (destination node) D. Routing table and pheromone values initialize , forward ant which is relayed by other nodes.
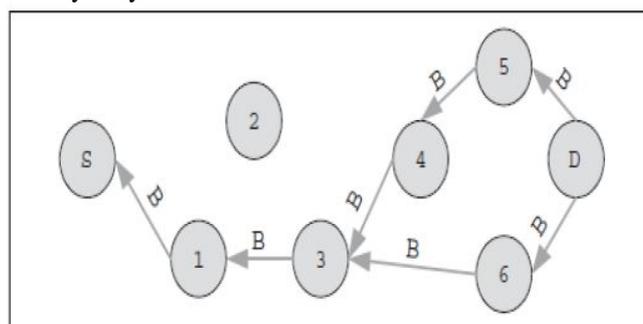
Figure 2(b). Backward ant(B) has same task as the forward ant during Route discovery phase.

Forward ant send by the destination node towards the source node.

- **Route Maintenance:** Both FANs a nd BANTs once it established the pheromone tracks for the source and destination node, Ant Colony Optimization routing algorithm does not need any special packets for maintenance of route.
- **Route Failure Handling:** Through a missing acknowledgement ARA recognizes a route failure. if a node gets any ROUTE ERROR message for certain link, by setting the pheromone value to 0 it first deactivates this link. then the node searches for alternative link in the routing table through that link it sends the packet. otherwise the node informs its neighbors, hoping that they can realy packets.

5. PROPERTIES OF ARA(ANT COLONY ROUTING ALOGORITHM)

Dynamic topology: It is responsible for bad performance of several routing algorithms in ad hoc network.The ant colony optimization meta-heuristic it is based on agent system and works with individual ants.

Local work: Ant colony optimization meta-heuristic is based only on local information that is no routing tables or other information blocks have to be transmitted to all nodes of the network.

Link quality: Integrate the link quality into comutation of the pheromone concentration, into the evaporation process.with respect to the link quality this wil improve the decision process. it is here important approach to be modified so that nodes can also manipulate the pheromone concentration independent of ants, that is data packets.

Support for multi-path: Each nods has a routing table with entries for all its nodes, which contains pheromone concentration to select next node decision has to be made according to rule based on the pheromone concentration on the current node, which is provided for each possible link. Thus ,the approach support multi-path routing.

Overhead of ARA: the over head of ARA is very small, because there are no routing tables which are interchanged between the nodes. The FANT and BANT packets does not transmit much routing information .only the unique sequence number is transmitted in routing packets and more route packets maintenance is performed .

6. APPLICATIONS OF ACO

1. Ant Colony Optimization(ACO) algorithms is applied to many optimization problems, ranging from quadratic assignment to routing vehicles and lot of derived methods have been used in dynamic problems and parallel implementations.

2. It has also been used to near optimal solutions to the travelling salesman problem.

3. The first ACO algorithm was called the Ant System and The main goal is to solve the travelling salesman problem, and to find the shortest round-trip to link a series of cities.

4. At each stage, the ant chooses to move from one city to another according to some rules:
- Exactly once, it must visit each city;
- A distant city has less chance of being chosen;
- The more intense the pheromone trail laid out on an edge between two cities, edge will be chosen with respect to greater probability.
- After completed its journey, the ant deposits more pheromones on all the edges it traversed, if the journey is short:
- After each iteration, trails of pheromones evaporate.

Because of these features ACO is found in many applications

7. CONCLUSIONS

This paper gives a overview of various Ant Colony Optimization algorithms and its properties and its applications. The routing algorithm which are used in ad hoc network. MANETs and ANTs they both possess same physical structure but still possess different overhead rate and packet delivery ratio. according to our view, ACO has ability of simple ants to solve a complex problem. Thus ACO is the better algorithm and efficient algorithm to work with MANET.

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