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A Review on Ant Colony Routing Protocol

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Abstract*— In this article we present a survey on ant colony routing protocol. Routing, the act of moving information across an Internet work from a source to a destination is one of the major issues in computer network literature. Recently nature inspired algorithms have been explored as means of finding an efficient solution to this routing problem. Ant colony optimization(ACO) is a technique used for solving complex computational problems, such as finding optimal routes in networks.In the natural world ants (initially) wander randomly and upon finding food return to their colony while laying down pheromone trails.If other ants find such a path, they are likely not to keep travelling at random, but to instead follow the trail,returning and reinforcing it if they eventually find food.These pheromones are attractive, nearby ants will be inclined to follow, more or less directly the track.Returning to the colony,these ants will strengthen the route.If there are two routes to reach the same food source then in a given amount of time, the shorter one will be traveled by more ants than the long route.The short route will be increasingly enhanced and therefore become more attractive. This paper surveys the ACO based routing in various Networking domains like Wireless Sensor Networks and Mobile Ad Hoc Networks.

Keywords: Ant colony optimization, Routing, Mobile Ad Hoc Networks, Wireless Sensor Networks.

I. INTRODUCTION

MANET is a collection of mobile, decentralized and self organized nodes.The distributive nature, infrastructure-less and dynamic structure make it an easy prey to security related threats. A **mobile ad hoc network** (**MANET**), sometimes called a mobile mesh network, is a self-configuring network of mobile devices connected by wireless links.Each device in a MANET is free to move randomly in any direction, and will therefore change its links to other devices again and again. Each must forward traffic unrelated to its own use, and therefore can acts as router. The major challenge in building a MANET is making each device to monitor and maintain the information required to traffic routing.

Such networks may operate on their own or may be connect to the huge Internet MANETs are a kind of WAHN that usually has a networking environment on top of a Link Layer ad hoc network. They can also be called as a type of mesh network, but many mesh networks are immobile or not wireless.

In the natural world, ants (initially) wander randomly, and upon finding food return to their colony while laying down pheromone trails. If other ants find such a path, they are likely not to keep travelling at random, but to instead follow the trail, returning and reinforcing it if they eventually find food. Over time, however, the pheromone trail starts to evaporate, thus reducing its attractive strength. The more time it takes for an ant to travel down the path and back again, the more time the pheromones have to evaporate. A short path, by comparison, gets marched over more frequently, and thus the pheromone density becomes higher on shorter paths than longer ones. Pheromone evaporation also has the advantage of avoiding the convergence to a locally optimal solution. If there were no evaporation at all, the paths chosen by the first ants would tend to be excessively attractive to the following ones. In that case, the exploration of the solution space would be constrained. Thus, when one ant finds a good (i.e., short) path from the colony to a food source, other ants are more likely to follow that path, and positive feedback eventually leads to all the ants' following a single path. The idea of the ant colony algorithm is to mimic this behavior with "simulated ants" walking around the graph representing the problem to solve.

The first ACO algorithm was called the Ant system and it was aimed to solve the travelling salesman problem, in which the goal is to find the shortest round-trip to link a series of cities. The general algorithm is relatively simple and based on a set of ants, each making one of the possible round-trips along the cities. At each stage, the ant chooses to move from one city to another according to some rules:

a) 1.It must visit each city exactly once;
b) A distant city has less chance of being chosen (the visibility);
c) The more intense the pheromone trail laid out on an edge between two cities, the greater the probability that that edge will be chosen;
d) Having completed its journey, the ant deposits more pheromones on all edges it traversed, if the journey is short;
e) After per iteration, trails of pheromones evaporate.

II. LITERATURE SURVEY

D. Karthikeyan ,M. Dharmalingam[1] :MANET is a group of mobile nodes which communicate with each other without any supporting infrastructure. Routing in MANET is extremely challenging because of MANETs dynamic features, its limited bandwidth and power energy. MANET nodes operating on battery try to pursue the energy efficiency heuristically by reducing the energy they consumed. Literature shows though they maintain acceptable performance of certain tasks, for multi-hop routing this is not optimal strategy. Swarm intelligence is a computational intelligence technique that involves collective behavior of autonomous agents that locally interact with each other in a distributed environment to solve a given problem in the hope of finding a global solution to the problem. We propose an energy efficient algorithm for MANETs based on ACO for minimizing energy consumption of the nodes and prolong the life of overall communication system.

Ms. **Shradha**. **A**. **Thakare**, **Dr**. **S**.**A**. **Ladhake[2]** says that Mobile Ad Hoc Networks (MANETs) are infrastructure less network consisting of mobile nodes, with constantly changing topologies that communicate via a wireless medium. Therefore, routing is a challenging issue in MANETs. Swarm Intelligence(SI) is an artificial intelligence technique based around on the study of collective behavior in decentralized, self-organized systems. Ant Colony Optimization is popular among other Swarm Intelligent Techniques. In this paper a detailed comparison of different Ant based algorithms is presented. The algorithms discussed here are Ant Net Routing, Ant Colony based Routing Algorithm Routing, Ad hoc Networking with Swarm Intelligence Algorithm.

R.Geetha, G.**Umarani Srikanth[3]:** Routing, the act of moving information across an Internet work from a source to a destination is one of the major issues in computer network literature. Recently nature inspired algorithms have been explored as means of finding an efficient solution to this routing problem.Ant colony optimization (ACO) is a probabilistic technique used for solving complex computational problems, such as finding optimal routes in networks. In the natural world ants (initially) wander randomly and upon finding food return to their colony while laying down pheromone trails. If other ants find such a path, they are likely not to keep travelling at random, but to instead follow the trail, returning and reinforcing it if they eventually find food. These pheromones are attractive, nearby ants will be inclined to follow, more or less directlythe track.The short route will be increasingly enhanced and therefore become more attractive. This paper surveys the ACO based routing in various Networking domains like Wireless Sensor Networks and Mobile Ad Hoc Networks.

K. Saleem, N. Fisal, S. Hafizah, S. Kamilah, and R. A. Rashid[4]: Wireless sensor networks (WSNs) is becoming a progressively important and a challenging research area.Advancements in WSN enable a wide range of environmental monitoring and object tracking applications.Therefore, the self-optimized and self-aware mechanism is required to handle the problems arise very frequently in WSNs. The ant colony optimization has shown excellent results in discovering routes for WSN. In this paper, the model of self-optimized multipath routing algorithm for WSN and its results are presented. Certain parameters like energy level, delay and elocity are considered. These decisions will come up with the optimal and organized route for WSN. In addition, the stated algorithm is enhanced with the multipath capability to avoid congestion state in WSN. Eventually, the enhanced feature helps WSN in maximizing the data throughput rate and minimizing the data loss.

Zulfiqar Ali, **Waseem Shahzad**[**5]:** There are various bio inspired and evolutionary approaches including genetic programming (GP), Neural Network, Evolutionary programming (EP) exploited for routing optimization in MANETs and WSNs. The Swarm Intelligence based algorithmic approaches; Particle Swarm Optimization (PSO) and Ant Colony Optimization (ACO) are more promising in providing loop free, energy-aware, and multi-path routing in mobile ad hoc and wireless sensor networks.We study in this research work a probabilistic performance evaluation frameworks and Swarm Intelligence approaches (PSO, ACO) for routing protocols. The performance evaluation metrics employed for wireless and ad hoc routing algorithms is , (a) routing overhead, (b) route optimality, and (c) energy consumption. This survey provides collection of Swarm Intelligence based algorithms for mobile ad hoc and sensor networks and their critical analysis. The study concludes that PSO and ACO based protocols are advantageous than other approaches applied for the routing optimization in ad hoc and wireless sensor networks.

Amandeep Singh1, **Sunny Behal2**[**6]:** Wireless sensor networks is very important field in today's technology and one may concern about the life time of sensors as they have no facility to change the battery of those sensors inside the field. Wireless Sensor Networks are prone to node failure due to power loss. In order to provide reliable service through the network, the network should be self-adjusting and must have adaptable properties as required from time to time. Here in this research we have proposed a new algorithm which is capable of not only to do optimize routing even with that it has the benefit to overcome through pits creating problem around the sink.In this research, we have investigated the impact of sink mobility on network lifetime. In a typical WSN, all the data generated in the network are routed to a static sink. We have simulated four routing algorithms in two scenarios; static sink and mobile sink. It has been observed from the results, that the network lifetime has been improved by the proposed algorithm in comparison to other algorithms.

K.**Syed Ali Fathima**, **Mr**.**K**.**Sindhanaiselvan**[**7**]: Wireless Sensor Networks consisting of nodes with limited power are deployed to gather useful information from the field. In WSNs it is critical to collect the information in an efficient manner. It is applied in routing and difficult power supply area or area that cannot be reached and some temporary situations, which do not need fixed network supporting and it can fast deploy with strong anti-damage. This paper defines implementation of WSN and comparison of its performance with AODV routing protocol based on ant algorithm is done in terms of packet delivery ratio, throughput and energy level. Performance of our algorithm in comparison of AODV is much better.

Devee Prasan.**U**,**Murugappan**.**S**[**8]:** Wireless sensor network (WSN) is a collection of autonomous, tiny, large number of densely deployed sensor nodes; these sensor nodes are smart, effective which offers very powerful and versatile networking where traditional wired and wireless networking is unable to deploy. The collection of sensor nodes by enabling cooperation, coordination and collaboration among sensor nodes is formed Wireless Sensor Network (WSN); the WSN consists of multiple autonomous nodes with a base station.

Ahmed M.**Abd Elmoniem**,**Hosny M**.**Ibrahim**,**Marghny H**.**Mohamed**, **and Abdel-Rahman Header**[**9]:**In this paper, we propose two methods to improve the Ad-Hoc On-Demand Distance-Vector (AODV) protocol. The main goal in the design of the protocol was to reduce the routing overhead, buffer overflow, end-to-end delay and increase the performance. A multi-path routing protocol is proposed which is based on AODV and Ant Colony Optimization (ACO). This protocol is refereed to Multi-Route AODV Ant routing (MRAA). Also we propose a load balancing method that uses all discovered paths simultaneously for transmitting data. In this method, data packets are balanced over discovered paths and energy consumption is distributed across many nodes through network. This protocol is refereed to Load Balanced Multi-Route AODV Ant routing algorithm.

III. PROPOSED WORK

We are working further on the implementation to improve the algorithm. Our further investigations include experiments with high network load and multimedia data. Additionally, analysis of the maintenance of the pheromone concentration is needed. There are different ways to manipulate the pheromone concentration on the edges, which influence the performance of the routing algorithm.

IV. CONCLUSION

We have discussed an overview of the existing ant colony routing protocol in MANET.Mobile multi-hop ad-hoc networks are flexible networks,which do not require pre-installed infrastructure. With pcoming wireless transmission technologies and highly so phisticated devices their application will increase. However the main challenge in mobile multi-hop ad-hoc networks is still the routing problem, which is aggravated by the node mobility. Various approaches were introduced in the recent years which try to handle the problems in this kind of networks,but no one fits best for all applications.In this paper we presented a new on-demand routing approach for mobile multi-hop ad-hoc networks. The approach is based on swarm intelligence and especially on the ant colony optimization meta-heuristic. These fascinating family of algorithms try to apply the ability of swarms to mathematical problems and were applied successfully to several optimization problems. We have discussed the adaptation of the method to mobile multi-hop ad-hoc networks and showed through simulations its ability to perform well in such kind of networks.

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