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Research paper

Improved AODV protocol for path establishment using nature inspired techniques in manets

Ateef Altaf [1] *, Sandeep Singh Kang [2]

[1] *M. Tech Scholar, department of Computer Science and Engineering, Chandigarh University, Gharuan, Mohali, Punjab, India*
[2] *Professor, department of Computer Science and Engineering, Chandigarh University, Gharuan, Mohali, Punjab, India*
**Corresponding author E-mail: ateefaltaf123@gmail.com*

Abstract

The mobile adhoc networks is the decentralized type of network which has routing, security and quality of service as the major issues. This research work is based on the path establishment from source to destination. The most popular routing protocols like AODV, DSR and DSDV are compared in terms of certain parameters. The best performing AODV routing protocol is improved for path establishment. The hybrid protocol is derived using bee colony and ant colony algorithms. The proposed protocol is implemented in NS2 and simulation results shows improved in the results.

Keywords: *Ant Colony; Bee Colony; AODV.*

1. Introduction

A mobile Ad-Hoc network (MANET) is the temporary network in which group of node are interconnected with each other. In the wireless sensor network, there is ad-hoc networks which are infrastructure less and no central controller present in it due the randomly distribution of the nodes [1]. This mobile network contains the different set of communicating devices which require no prior existing infrastructure for connecting suddenly. There is continuous change in the network topology as nodes are moving freely from one place to another at varying speeds due to no fixed infrastructure. This network can be configured in two ways i.e. static or dynamic.

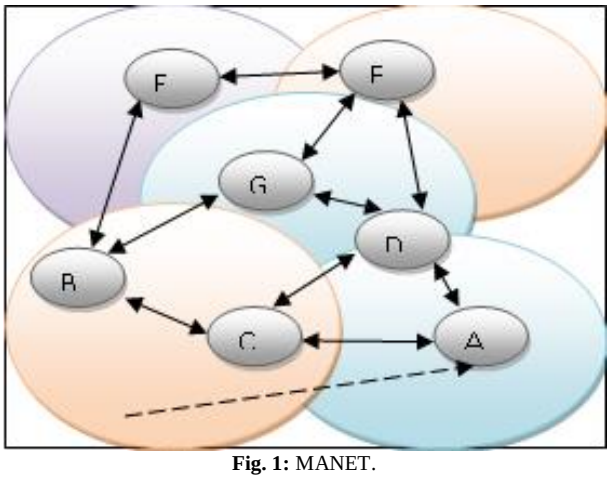

Fig. 1: MANET.

1.1. Routing issues in MANET

In routing the MANET there are various issues are faced due to the continuous movement of nodes as they are randomly distributed within the network. Due to the movement of intermediate nodes in the path and end nodes there is breakdown in the path. For routing protocol in the MANET, it is necessary to have feature of effective mobility management for dynamic MANETs. Bandwidth constraint is the other major design issue faced in MANETs [2]. Due to the limited bandwidth in the wireless network, it is necessary to design the routing protocol in such way so that bandwidth is utilized optimally by minimizing the network overhead. Collision and congestion are the issues faced by the wireless sensor network. Due to the sudden movement of the nodes within the network, there are collisions of data and control packets while transmitting packets in MANET. The dynamic MANET faced the issues of hidden terminal and exposed terminal. Collision of the packets at the receiving node is referred as hidden terminal problem due to the simultaneous transmission of those nodes that are not within the direct transmission range of the sender but present within the transmission of the receiver. It is the major issues faced by the mobile ad-hoc networks as on the basis of transmission characteristics there is change in links due to which there is interference between nodes. This leads to damage of the total transmission [3]. Collision in the network occurs when both nodes are unaware of each other and transmit packets at the same time due to which they interfere with each other and damage the terminals. Hence, it is required to minimize the issues of hidden and exposed terminal issues while designing the protocols.

1.2. Routing protocols in MANET

a) Proactive or table-driven protocols

This routing protocol is also known as the table driven routing protocols in which a routing table is maintained by each and every node in which information about the network is present [4]. It contains the information about the network topology even when it is not required to maintain. For the data gram traffic, acquiring substantial signaling traffic and power consumption this feature has been utilized. With the change in the network topology there is change in the routing table up gradation. These protocols are not

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utilized for the networks which are larger in the size as every time each and every node is need to maintain in the routing table. Different number of routing tables is maintained by these protocols which vary in protocols. The example of various well known proactive routing protocols is DSDV, OLSR, and WRP.

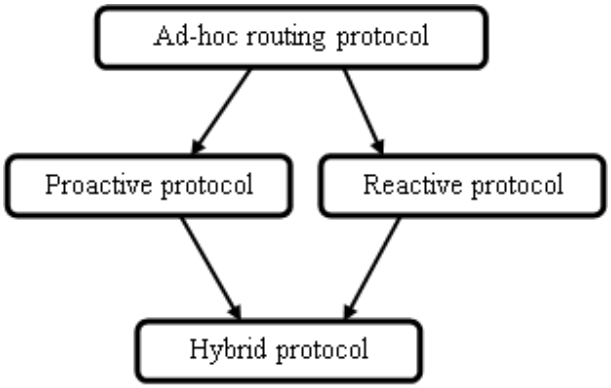

Fig. 2: Classification of Routing Protocols.

b) Reactive protocols

This routing protocol also termed as on demand routing protocol. It is utilized for the route discovery process and finds the optimal path whenever it is required [5]. On the basis of demand a route is discovered by the nodes. The route is discovered by the source node from the route cache if the route is not available in between source and destination, in this condition, a route is initiated by the source node using route discovery process. There are two major components of the on- demand routing protocols such as route discovery and route maintenance. In order to increase the performance, various routing protocols have been proposed so far such as DSR, AODV, TORA and LMR.

c) Hybrid Protocol

The combination of the both reactive and proactive routing protocols features is known as hybrid protocol [6]. Proactive systems are utilized for the reduction control traffic overhead while reactive protocol maintain the some form of routing table by reducing the route discovery delays of reactive systems. A route discovery strategy has been utilized for determining the routes to far away nodes and for maintaining routes to nearby nodes. The most commonly used hybrid routing protocol is the zone routing protocol. This protocol maintained the balance between the two protocols due to which it is termed as the enhanced version of both.

1.3. Optimization techniques

a) Bee Colony Optimization:

This technique is based on the swarm intelligence technique. This technique is based on the natural phenomena. In the search of memory a widely used techniques has been utilized and it is known as meta-heuristic technique [7]. The process of this technique is to choose best path from the given solutions. There are hundreds of result is provided for the single problem among those solution best result is identified by this optimization technique. In order to solve the multifaceted combinatorial problems bottom-up approach is utilized. This technique has no centralized system and it also act as self organizing to build itself. The beehive contains two types of bee in it and they are present in the large amount in order to work together. Many bees in this hive but main is Queen Bee lay eggs and function accordingly [8].

In ABC algorithm there are mainly three groups of bees:

- Onlookers
- Employed
- Scouts

Onlookers is referred as the behavior, in which bee took the decision for a food source.

When it goes to previously visited place, it is named as employed bee.

The random search carried out by the bee is referred as scouts.

b) Ant Colony Optimization (ACO):

It is a probabilistic and meta-heuristic technique [9]. It is also natural insipid technique which is meta-heuristic in nature and used to solve complex combinatorial problems. It uses the previous results to find out the present optimal paths. It is dynamic in nature. It gives the idea for team coordination, their behavior and functionality. It is also based upon swarm intelligence. Ant starts from nest to reach to destination and follow different paths. Each ant secretes pheromone trails to attract other ants following that path [10]. The path which has the highest pheromone trails are the optimal paths compared to others. So the path is depending upon the trails. It is also upgradeable technique according to the secrete pheromone trails.

- Ant Solution Construct: through adjacent states of problem these artificial ants moved.
- Pheromone Update: pheromone trails are updated, once the solution is built completely
- Daemon actions: in the optimal solution an additional pheromone is applied.

2. Literature review

Manuela Graf, et. al. presented for planning the optimal path for the drone flight a solution is provided in this paper. The issue of the dynamic vehicle routing problem is solved by converting the issue into static problems for the optimization after which ant colony optimization technique is followed on it. This solution is derived by doing several studies, learn all restrictions and specialties taken into consideration. After performing all the examination, it is determined that proposed system can be utilized for the main objective [11]. However, it requires improvement before implementation in order to enhance the overall efficiency of the method. Proposed method is compared with other existing methods so that further enhancement can be made for the selection of the appropriate path.

Ronald Uriol, et. al. presented the issue of the path planning for the mobile robot in complex environments has been resolved by the ant colony optimization algorithm in this paper. They analyzed all the parameters of the algorithms and used different methods that minimize the obstacles of different number, sizes and shapes [12]. In the different working area this algorithm was tested or evaluated in order to check the performance of the proposed method. With the help of this method, it becomes possible to find out an optimal path from source to destination without facing issues of collisions or wall-borders. Therefore, it is concluded that, this method provided minimum length paths for travelling from one place to another.

Deepshikha Sethi, et.al presented a movie recommender system in this paper in which collaborative filtering technique has been utilized for the recommender system. They utilized the Ant Colony Optimization and Artificial Bee Colony Optimization for this purpose [13]. These systems are the essential part of the electronic commerce sites like amazon.in, netflix and flipkart.com. These systems help to achieve better customer satisfaction and also help them by filtering those products that are not easily available on every site. Hence, these systems increase the business of such e-commerce sites. They compared above mentioned algorithms for the evaluation of performance on the basis of CPU Time and two standard functions.

Mandeep Kaur Bedi, et.al presented two meta-heuristic technique based on the swarm intelligence. These two optimization techniques are Bee colony optimization and ant colony optimization. These techniques are based on the self organizing properties and there is no central element to control all the activities. In case of ACO, pheromones are used to find the route for the food source by ant. Instead of using same path to get back to its original position, bee use the direct path integration to come back to hive in vase of BCO [14]. Bee colony optimization algorithm is superior to ant colony optimization algorithm due to loss computational

time. It is also best method as it finds the best path for the collection and searching of the food by taking lesser steps.

Razif Rashid, et.al presented the issues of the mobile robot path planning has been resolved in this paper using ant colony optimization technique. Researchers utilized various techniques for the evaluation of the effectiveness of ACO in solving the MRPP problem. They used various maps to learn the complexity found in the previous methods [15]. There are different stationary obstacles present in arrangement in each map. There are equal number of rows and columns in each map which are represented in the grid form. On the basis of the given set of maps, the performance of the proposed ACO was evaluated in this paper. On the basis of the performed experiments, it is concluded that proposed method is effective and efficient for the path planning.

Jerry Kponyo, et al. presented a system based on the ACO and utilized for the prediction of the optimal path for the destination, this system is DTPOS. Using this method, the mean travel time is improved by 47%. When the proposed method is utilized with the combination of PPR method, there is improvement of 56% in the results, demonstrated as per done experiments [16]. They also focused in the development of the data dissemination scheme using which traffic information is collected by the cluster-heads. These can be transmitted to the traffic information storage devices at the junctions.

Brendan Englot, et al. presented in order to solve the issue of multi-goal planning in the presence of obstacles, a new algorithm is proposed in this paper. The ant colony optimization algorithm is extended to the multi-goal feasible path planning from its well-known application of traveling salesman problem. This extension was done for inspection and surveillance applications [17]. They combined the framework of the ant colony with the sampling-based point-to-point planning algorithm. After which, this combination is compared with two successful sampling-based multi-goal planning algorithms in an obstacle-filled two-dimensional environment. For the comparison purpose they utilized the total mission time and a function of computational cost and the duration of the planned mission. On the basis of the done experiments, it is identified that the ACO algorithm is optimal in determining the minimum mission time.

3. Proposed methodology

This research work is based on to increase performance of AODV routing protocol for path establishment. The improved technique is developed using Bee colony, ant colony and AODV protocol for the path establishment. The source and destination is defined in the network, the source node send route request packets in the network and adjacent nodes of destination respond back with route reply packets. The best path is selected from source to destination on the basis of hop count and sequence number. Let suppose the path which is selected between source and destination is [2 4 6 8 10 12]. When the ant colony technique is applied based on the distance between each mobile node, the best path is selected is [2 3 6 9 10 12]. In the third step, the union is calculated between the AODV path and ant colony path. To complete the path, the nodes are selected which has least distance. In the fourth step, the bee colony technique is applied which select best path from source to destination. Let suppose the best path is [2 3 7 9 10 12] In the last step, the path which is selected by the bee colony and hybrid path derived in path three is again hybrid by taking union of both paths. To complete the path distance is calculated between the two nodes. The procedure is described in the figure 3.

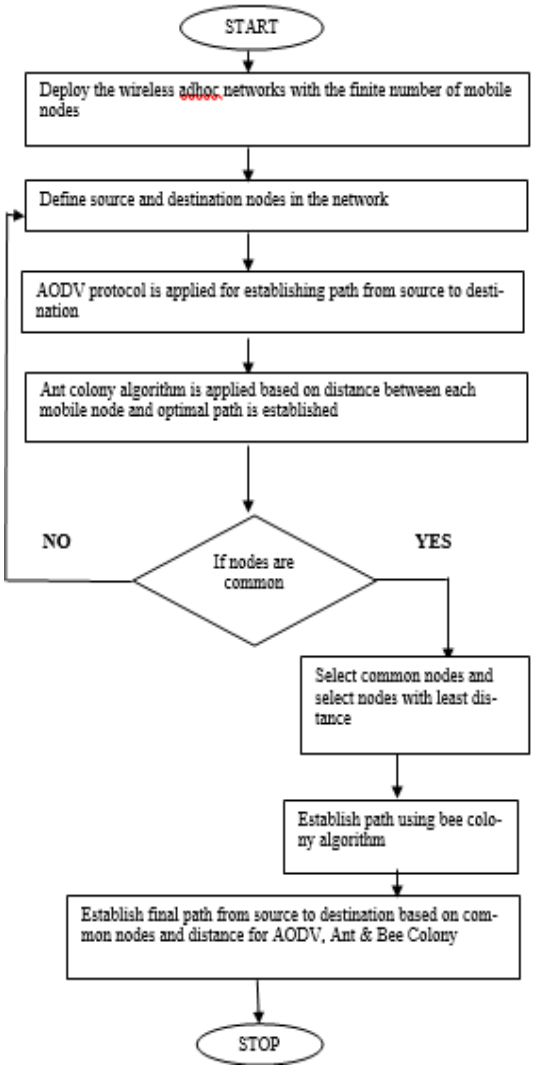

Fig. 3: Flowchart.

4. Result and discussion

The proposed approach is implemented in NS2 to analyze performance. The proposed approach is compared with the AODV, DSR and DSR routing protocol for the establishment. The proposed approach establish efficient path from source to destination, which has least changes of congestion, and also maintain quality of service. The simulation parameters are given in table 1.

Table 1: Simulation Parameters

Parameter	Parameter value
Antenna type	Omi Directional
Mac Standard	802.11
Number of nodes	100,200,300
Routing Protocol	AODV, DSDV, DSR
Simulation Time	8 Seconds
Area	800*800
Pause time	0.1 sec
Physical medium	Wireless physical medium
Link layer	LL
Range	18 Meter
Packet Size	1000 bytes
Transmission Power	2.4 GHz
Traffic Type	CBR

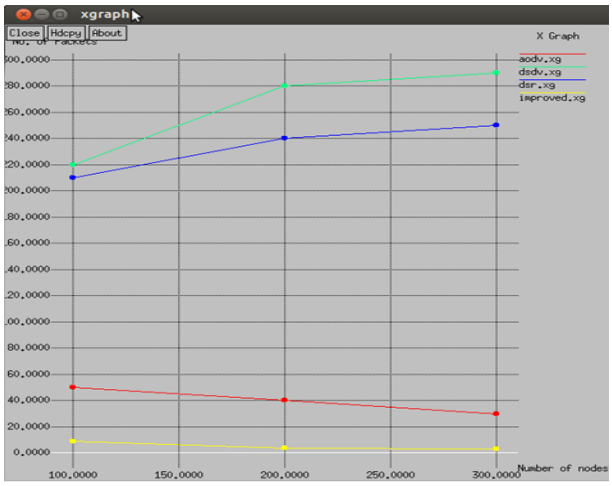

Fig. 4: Packet loss Comparison.

As shown in figure 4, the packet loss of AODV, DSR , DSDV and Hybrid routing protocol is compared for the performance analysis. It is analyzed improved routing protocol has least packet loss as compared to other packet loss.

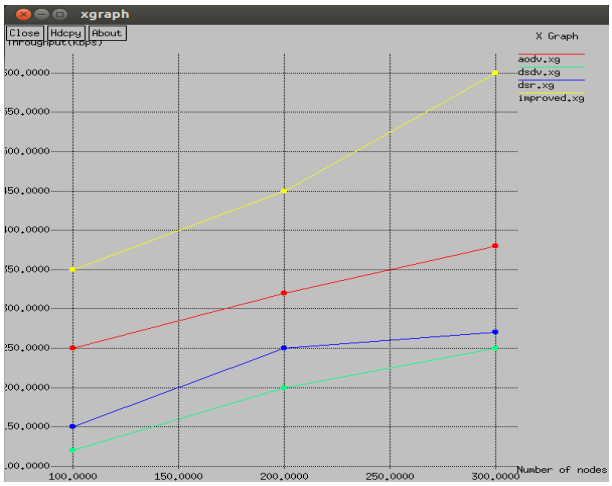

Fig. 5: Throughput Comparison.

As shown in figure 5, the throughput of the AODV, DSR, DSDV and improved protocol is compared correspond to number of nodes. The throughput increased at steady rate due to generation of efficient path from source to destination. It is analyzed that improved protocol has maximum performance as compared to other protocols.

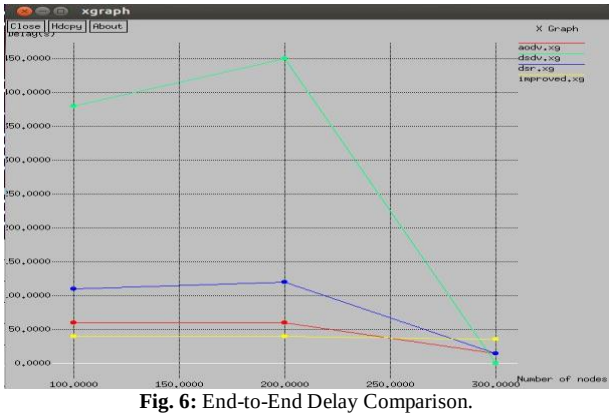

Fig. 6: End-to-End Delay Comparison.

As shown in figure 6, the End to End Delay of AODV, DSR, DSDV and Improved routing protocol is compared for the performance analysis. It is analyzed improved routing protocol has least delay as compared to other delay.

5. Conclusion

In this work, it is concluded that routing is the major issue of mobile adhoc network. The AODV, DSR and DSDV are the high performance routing protocols for path establishment in the network. It is analyzed that AODV protocol is best performing protocol. In this work, improved protocol is generated from AODV, bee colony and ant colony algorithm for the path establishment. The simulation is performed in NS2 and results shows improvement in terms of throughput, packet loss and end to end delay.

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