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Optimizing the Ad-hoc applications in Vehicular Network using Max-Min Ant system

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***Abstract*— VANET is the most popular mobile Ad-hoc network which is called Vehicular Ad Hoc Network. The researchers work a lot on this network on various parameters of the same. From the Literature review, VANETs works on the basis of real time system where the vehicles act as mobile nodes and travel with a very high speed on the roads in the urban areas. There are a number of security issues like authentication, intelligent system approach, collision detection, jamming avoidance, communication system approach etc. We basically deal with the delay issue in case of accident on the route. Here we are presenting an intelligent route identification approach in case of accident occurrence for V2V communication. If some accident takes place over the network, the neighbor node information flow will be performed to perform the route analysis. An optimal path is selected from the existing one using the min and max variants of ACO. In this work a bio inspired V2V communication approach is suggested to identify the safe path over the network. We have used the Max-Min ant system (MMAS) to achieve our goal of finding the optimal path for vehicles thus reducing the delay caused due to collisions.**

***Keywords*— Wi-Max, Ant Colony, VANET, MMAS**

I. INTRODUCTION

Vehicular ad-hoc network is a wireless network where all the vehicles form the nodes of the network. Vehicular ad-hoc network is a subclass of mobile ad hoc networks which provides a distinguished approach for intelligent transport system. Vehicular ad hoc network is special form of MANET which is vehicle to vehicle and vehicle to roadside wireless communication network. It is self-directed and self-organizing wireless communication network, where all the nodes in VANET engage themselves as servers or client for exchanging and sharing information. We use Wi-Fi IEEE 802.11 based technology which is very commonly used for deploying VANETs nowadays. All the vehicles are connected with the wireless network interface and 802.11b or 802.11g are the two standards for access media. These standards are general purpose standards and they do not fit properly with the requirements of high dynamic network such as VANETs. The DSRC (Dedicated short-range communication) has been proposed as the communication standard for VANET. It is used where short medium range communication service is offered at very low latency and elevated data rate. IEEE 802.11 standard implies that vehicles communicate with in limited range while moving. Vehicular Ad-hoc networks are important in today's world to know about the traffic condition well in advance in order to avoid congestion in the network. For this reason there are V2V (Vehicle to vehicle), V2I (Vehicle to infrastructure) and vice versa communications in this kind of network. So here we discuss various methods that have already been employed to optimize various parameters and then explain the proposed technique for the same.

II. LITERATURE REVIEW

Lalit Kumar and Dheerendra Singh (2013) in their paper present an artificial bee colony (ABC) algorithm for NP-Hard problems. This algorithm is considered as one of the latest nature-inspired swarm-based optimization algorithms and has a promising performance. Shortest Common Super sequence is a classical problem in the field of string and it is classified as NP-Hard problem, such as Genetic algorithms, Majority Merge algorithm and Ant Colony Algorithm [2]. This approach obtains better results than the original artificial bee colony algorithm. Rakesh Kumar and Mayank Dav (2012) present a paper based on the VANET vehicular ad-hoc networks providing a wireless network environment for intelligent transportation system. In this paper they mainly define the VANET applications based on the various broadcasting data dissemination protocols which are surveyed separately and their fundamental characteristics are revealed. At the end of this paper all the protocols are compared for performance [3]. Amiour med tahar, Bilami azeddine present a paper on VANET where vehicles like

car, bus, truck are assumed as mobile nodes of the network. The inter-vehicle communication became an important subject of much scientific research recently for driver comfort and road safety. In VANET, routing protocols have a great consequence where AODV is one of the most popular routing protocol dedicated to ad-hoc network that can use the flooding techniques for locating the destinations and possibly cause an overhead in the network. To overcome this problem the multi point relay algorithm in the AODV protocol is used in order to reduce the number of messages broadcasted during the flooding techniques [4]. Rakesh Kumar, Mayank Dave present a paper in (2011) on vehicular ad-hoc network showing that it is a subclass of mobile ad-hoc network which provide a distinguished features for intelligent transport system (ITS). According to the survey it is very necessary to use the ITS with the help of VANET routing protocol. They also discuss the advantages and disadvantages, applications of different routing protocols for vehicular ad-hoc networks. At last this paper also shows the tabular comparison with various routing protocols for VANET [5]. Jason J. Haas and Yih-Chun Hu present a paper based on the performance measurements obtained from simulations of the vehicular ad-hoc networks. These simulations are used as input traces of vehicle movements that have been generated by traffic simulators which is based on the traffic model theory. In this paper mainly work is based on the actual large scale recordings of vehicle movements. To our knowledge, no one has published any work on actual large scale recording of vehicle movements. In order to enable analysis on this scale, we have developed a new VANET simulator which can handle more number of vehicles than ns2 [6]. . Stutzle and Holger H. presented their paper on Max- Min ant system where they have explained the features of Min-Max Ant system also called as MMAS. They have shown how MMAS differs from Ant System in several important aspects which they have demonstrated by means of an experimental study. Additionally, they have related one of the characteristics specific to MMAS that of using a greedier search than Ant System to result from the search space analysis of the combinatorial optimization problems attacked in this paper. The computational results on the Travelling Salesman Problem and the Quadratic Assignment Problem show that MMAS is currently among the best performing algorithms for these problems. They have discussed that this MMAS is in any way better than the conventional ACO algorithms we use because of the limit they provide for the pheromone values in the same [9].

III. ANT COLONY OPTIMIZATION AND MMAS

Ant communication is accomplished primarily through chemical called pheromones. Ants communicate with one another by laying down pheromones along their tail. Other ants acquire the existence of pheromone and tend to follow path where the pheromones concentration is higher. Pheromone trail starts to evaporate with time, thus reducing its attractive strength. Ants follow that path which is shorter and the pheromone density remain high as it lies on the path as fast as it can evaporate [3].This can be well explained with the help of following figure which shows the ant behaviour when they are in search of food and they cover the distance from source to destinations even through the hurdles.

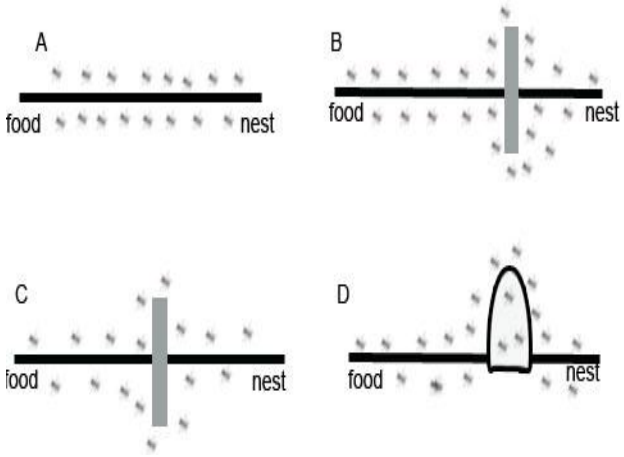

Figure 1: Ant Behaviour

In the figure A, ants are shown in the pheromone trail between nest and food whereas on other side in figure B an obstacle interrupts the trail and in figure C ants find two paths to go around the obstacle. As compared to other sides in figure D new pheromone trail is formed along the shorter path. Pheromone evaporation also has the advantage of avoiding the convergence to locally optimal solution. If there was no evaporation at all, the path chosen by the first ant would tend to be excessively attractive to the following ones. Ants find an optimal path from food to destination and other ants follow that path and positive feedback eventually leaves all the ants followings a single path. ACO is basically the optimization approach that speeds up the algorithmic process. In a wireless network the ACO is basically used to optimize the communication process. This approach is used in the nodes to find the optimal path over the network. Ant places the pheromones on the located path so that all the other nodes can follow these pheromones to communicate on this optimized path. Max- Min ant system also called as MMAS is also a type of Ant Colony system with a difference that there is no stagnation in the solution because there are some specified limits for pheromone trail updates in this. The limits are min to max and that have to be respected by ants while updating their pheromone values. Also the pheromone values for each node are initialised to the maximum value and they keep decreasing as the pheromones evaporate. Because of this, the optimal path is established earlier and accurately. The probability for an ant to select one out of two nodes depends on the pheromone trail values.

IV. WI-MAX

Wi-Max is a wireless system that is designed for metropolitan area. Therefore, it supports non-LOS channel, pedestrian mobility and high data rate. The core technique of Wi-Max is based on the IEEE802.16 family standard. Wi-max combined with wi-fi technique, which is most popular local area wireless scheme offers a metropolitan wide coverage. The Wi-max signal is converted into the Wi-Fi protocol using the local hotspots because it is compatible with most the existing wireless devices. Wi-max interoperability for microwave access is currently one of the

hottest technologies in wireless. The institute of electrical and electronics which sets networking standards such as Ethernet 802.3 and wi-fi 802.11 has published standards. Wi-Max is based on RF technology called orthogonal frequency division multiplexing which is very effective means of transferring data when carriers of width of 5MHz or greater can be used. Below 5MHz carrier width, current CDMA based 3G systems are compatible to OFDM in terms of performance. WiMax is standard-based wireless technology that provides high throughput broadband connection over long distance, hotspots and high speed connectivity for business customers [7].

V. New Proposed Technique

In this proposed work we have defined the network with a new intelligent algorithm to perform the vehicle to vehicle communication. Each vehicle can pass the information to other regarding the path, speed etc. This information also includes the accident status on the existing route. If a vehicle faces some collisions it will inform the following vehicles about its status so that they can perform the decision regarding the route change at earlier stage. The intelligent bio inspired algorithm is suggested in this work to identify the new route. Ant Colony optimization using Min and max variants which is also called as Min-Max Ant system(MMAS) is used to find out the most optimal path to the destination. According to this, vehicles leave behind the information for following cars in the network like ants leave chemical called pheromone for the following ants when they search for food. The following vehicles then follow the path that has maximum intensity of pheromone value as in the case of ants. The path is chosen based on the probability of an artificial ant which is a node. This probability is calculated by the values of pheromone trails at the nodes between which the choice has to be made. The range specifies the value that has to be accepted as in to follow the new path in that case.

So we have 'n_a' number of artificial ants and e_i is ith node. We introduce an artificial pheromone value τ_i for each of the links say e_1 and e_2. Such a value indicates the strength of the pheromone trail on the corresponding path. Each ant will select between the nodes based on probability as follows:

$$P_i = \frac{\tau_i}{\tau_1 + \tau_2}, \quad i=1, 2 \qquad (1)$$

Where P_i is the probability of an ant following the ith node in the system.

MMAS imposes explicit limits τ_{min} and τ_{max} on the minimum and maximum trails such that for all pheromone trails τ_{ij} (t),

$$\tau_{min} \leq \tau_{ij}(t) \leq \tau_{max} \qquad (2)$$

After each iteration one has to ensure that the pheromone trails respect the limits.

VI. Results And Discussion

The simulation of the proposed technique is done in NS-2. The scenario shows that an accident takes place on the route of the network. The cars or vehicles that follow in the same network get the information from the first vehicle in the row. This information is about the new optimal path that has to be followed which is established using MMAS.

Table 1: Delay Comparison with and without MMAS

Time (sec)	Without MMAS	With MMAS
1.0000	0	0
2.0000	0	11
3.0000	48	11
4.0000	48	11
5.0000	48	11

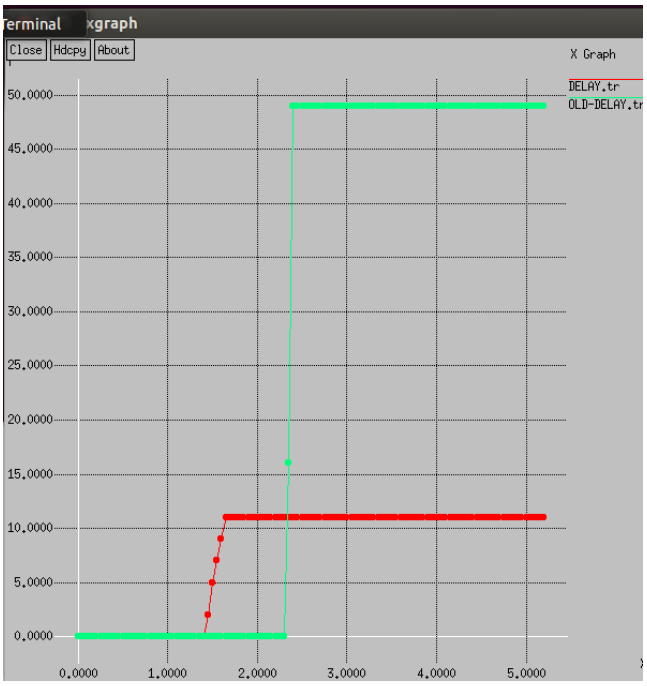

Figure 2: The delay comparison graph

Table 1 shows the comparison of delay before and after using the MMAS technique. It clearly shows the number of packets delayed in the range of 0-50 in the time interval of 0-5 secs. In figure 2, comparison delay graph is shown between the new and previous technique. It shows that the delay can be optimised using MMAS in Vehicular Ad hoc Network. This can also lead to high throughput of the system which can be further calculated using distinct parameters. The delay is reduced in the new technique as compared to the previous technique. This is because the

decision of choosing an alternative path is made in lesser time than before. The green line shows the delay in previous technique and red line shows the delay in new technique which is quite less than the earlier one

VII. CONCLUSION

As we have explained the features and the applications of VANET. There are a number of features that make it the most promising type of network in the coming time. There are also many issues that are to be dealt with when we talk about such a robust and frequently changing technology. There are issues like delay in the network due to accidents or some other miss happening. In this paper we conclude that the Min- Max system of ant colony optimization is an efficient approach for VANET. The accident information should be flooded in the city roads as soon as possible. The accident information is exchanged between the road side sensors using WIMAX. An optimal path is then selected based on the bio inspired algorithm which is then followed by all the vehicles in the row. It tends to propose the technique where the path can be chosen based on pheromone trail values of the artificial ants. The min and max ant system is used in which the range is specified within a limit and the path is chosen based on the min and max variants of the ACO system. The simulation results show that proposed technique is more efficient than the previous techniques. Delay is reduced to a great extent thus making the system more efficient and reliable.

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