An Ant based Algorithm for Vehicular Ad-hoc Networks

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Abstract— Vanet is the most promising area of research. As like other network, this network also suffers by the problems of security and efficiency. The proposed work is about to improve the qos in terms of path selection over the network. Here we have proposed a new bio-inspired routing algorithm and use ant colony optimization approach to find solutions to the vehicle routing problem (VRP) i.e. to find an efficient vehicle route. For that we make use of one of the commonly used vanet protocol called DYMO, here we are improving the DYMO protocol by combining it with ACO. The work is about to provide an intelligent solution to avoid the problem of congestion in case an accident happen in vehicular network. ACO will be used to identify the safe path from the network at some early stage.

Index Terms— ACO, DYMO, routing, QoS, VANET.

1 Introduction

One of the most promising areas of research is the study of the communications among vehicles and road-side units, or more specifically the Vehicular Ad-hoc Networks (VANETs). This kind of networks are self-configuring networks composed of a collection of vehicles and elements of roadside infrastructure connected with each other without requiring an underlying infrastructure, sending and receiving information and warnings about the current traffic situation. Nowadays, WiFi (IEEE 802.11 based) technologies are the most commonly used for deploying VANETs. The vehicles are equipped with wireless network interfaces which use either IEEE 802.11b or IEEE 802.11g standards for access media. However, these are general purpose standards and they do not fit properly the requirements of high dynamic networks such as VANETs. Currently, DSRC (Dedicated Short-Range Communication) [20] has been proposed as the communications standard specifically for VANETs, it is a short medium range communications service that offers very low latency and high data rate. DSRC is based upon the standards IEEE 802.11p and IEEE 1609 family.

Vehicular networks have special behavior and characteristics, distinguishing them from other types of mobile networks. In comparison to other communication networks, vehicular networks come with unique attractive features, as follows

- **Unlimited transmission power**: Mobile device power issues are usually not a significant constraint in vehicular networks as in the case of classical ad hoc or sensor networks, since the node (vehicle) itself can provide continuous power to computing and communication devices.
- **Higher computational capability**: Indeed, operating vehicles can afford significant computing, communication, and sensing capabilities
- **Predictable mobility**: Unlike classic mobile ad hoc networks, where it is hard to predict the nodes' mobility, vehicles tend to have very predictable movements that are (usually) limited to roadways. Roadway information is often available from positioning systems and map based technologies such as GPS. Given the average speed, current speed, and road trajectory, the future position of a vehicle can be predicted.
- **High mobility**: The environment in which vehicular networks operate is extremely dynamic, and includes extreme configurations: on highways, relative speeds of up to 300 km/h may occur, while density of nodes may be 1–2 vehicles 1 km on low busy roads.
- **Partitioned network**: Vehicular networks will be frequently partitioned. The dynamic nature of traffic may result in large inter vehicle gaps in sparsely populated scenarios, and hence in several isolated clusters of nodes.
- **Network topology and connectivity**: Vehicular network scenarios are very different from classic ad hoc networks. Since vehicles are moving and changing their position constantly, scenarios are very dynamic.

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1.1 Ant Colony Optimization

Among the different works inspired by ant colonies, the Ant Colony Optimization metaheuristic (ACO) is probably the most successful and popular one. The ACO metaheuristic is a multi-agent framework for combinatorial optimization whose main components are: a set of ant-like agents, the use of memory and of stochastic decisions, and strategies of collective and distributed learning. It finds its roots in the experimental observation of a specific foraging behavior of some ant colonies that, under appropriate conditions, are able to select the shortest path among few possible paths connecting their nest to a food site. The pheromone, a volatile chemical substance laid on the ground by the ants while walking and affecting in turn their moving decisions according to its local intensity, is the mediator of this behavior.

In our work we will make use of Ant Colony Optimization (ACO) procedures to propose our algorithm and to design a bio-inspired protocol that performs well in the dynamics of such networks. We will adapt an existing Dynamic MANET On-demand (DYMO) routing protocol for the designing of this new protocol. Performance evaluation will be done in the urban scenario. The obtained results will suggest that making use of environmental information can make ACO algorithms more suitable for routing in vehicular ad hoc networks.

2 Review of Literature

Maxim Raya and jean-Pierre Hubaux proposed in [23] a model that identifies the most relevant communication aspects; they have also identified the major threats. Since VANETs is vehicular ad-hoc networks are likely to become the most relevant form of mobile ad-hoc networks. The communication b/w vehicle and to the road side infrastructure should be free from all type of attacks so that the vehicles can share information in a secure network. They provide a set of protocols and shown that public key cryptography is fit for the security of these networks by analyzing their robustness. V.Gligor et.al proposed in [31] that among civilian communication systems, vehicular ad-hoc networks emerge as one of the most convincing and yet most challenging instantiations of the mobile ad-hoc networking technology. They outline security requirements for the vehicular communication systems and provide models for the system and communication, as well as models for the adversaries. They also proposed a set of design principles for future security and privacy solutions for vehicular communication systems. Gabriele Goldacker el.al proposed in [18] security architecture follows a clean and modular design. By description of different architectural perspectives, they identify the stakeholders and their responsibilities. Then, they focus on the functional layer view and highlight the concepts which jointly secure the vehicular communication. Based on these concepts, they present an implementation approach which introduces the security concepts into the protocol stack of vehicular communication system. A. Kung el.al proposed in [16] security architecture for vehicular communication. The primary objectives of the architecture include the management of identities and cryptographic keys, the security of communications, and integration of privacy enhancing technologies. Their design approach aims at a system that relies on well-understood components which can be upgraded to provide enhanced security and privacy protection in the future

2.1 Intelligent Transportation System

Gang Liu and Han Guo, proposed in [9] a design of framework of intelligent transport system. The main task of the road condition information transferring module is deal with the information exchange of the car inside, car to car and car to road. They concern the security issues of VANETs from some aspects and provide the appropriate solving measures. To make sure the ITS can be used under the security pattern. Rajesh Rajamani et.al in [28] proposed a spacing policy which is a nonlinear function of speed. It provides string stability and traffic flow stability as well as a higher traffic flow capacity compared to the standard time-gap controller. The spacing policy used autonomously available information. Analytical calculations showed that the spacing policy would guarantee string stability and traffic flow stability while maintaining smaller steady state spacing and hence providing larger traffic flow capacities in the speed range 20–65 m/h. this spacing policy can be readily implemented on ACC vehicles on today's highways. Ahmad et.al. proposed the path tracking problem in[30] for a class of vehicles distinct by a) consisting of two, front and rear, single axle units hinged together, and b) travelling at a relatively low speed. This type of vehicle is frequently used in underground mines. This formulation which becomes necessary for the automation of path tracking is relatively more difficult for this vehicle because of the rather ambiguity of the tracking errors. Jason Carbaugh et.al proposed in [11], two tools which help in comparing the safety merit safety of potential vehicles designs that incorporate various automation devices. The tool kinematically derives a probability distribution for the worst case collision velocity caused by the front vehicle suddenly applying full brakes. From this distribution, measures of collision frequency and severity can be derived and used to compare various vehicle automation systems. The General Maneuver Analysis Tool extends the first tool to analyze two vehicles involved in a maneuver in which the speeds and relative spacing of the vehicles varies according to a maneuver trajectory. Graham parker et al. in [12] proposed a forward looking debris detection system that provides an understanding of the brushing process allows a model to be created for sweeping control purposes. Brushing action may vary according to the relative importance of cutting and flicking actions so different commercial brushes need to be categorized. The wide variety of debris conditions on the road can be sensed by cameras and laser striping devices and a good compromise can be found in between the various computational requirements for real time operation. Paul C. Richardson in [13] proposed an adaptive protocol, ARTNP, to support the timely transmission of critical messages under nominal conditions and during transient overloads. ARTNP considers a several parameters (e.g., message deadline, relative importance, time sensitivity, and network state) to order message transmissions. Under nominal conditions, ARTNP guarantee all message time constraints at optimal levels of resource utilization. A fully distributed mechanism is provided to manage transient surges. This mechanism is able to detect and estimate the severity of a transient surge. Sabir Biswas et al. in [14] presented an overview of vehicle cooperative collision avoidance (CCA) application using the emerging Dedicated Short-Range Communication (DSRC) infrastructure for inter-vehicle wireless networking The concept of CCA has been introduced with an overview, and its implementation issues have been analyzed in light of specific requirements from the MAC and routing-layer protocols of the underlying wireless networks. Specific constraints and future research directions have been identified for packet-routing protocols to support an effective CCA system within the DSRC environment.

2.2 Routing Protocols

Jing Tian et al. in [32] proposed"geographic source routing' (GSR), which combines position-based routing with topological knowledge, as a promising routing strategy for vehicular ad hoc networks in city environments. Ch.vijay Durga et al, in[1] proposed a DV-CAST protocol on highways under mul-

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tiple traffic conditions. This works efficiently under the conditions of heavy traffic during rush hours, very light traffic during certain hours of the day and low market penetration rate of cars using DSRC technology. Raphal Frank et al. present in [10] a TrafRoute, an efficient and robust forwarding scheme for vehicular networks, suitable for both Vehicle-to-Vehicle and Vehicle-to-Infrastructure communications. TrafRoute introduces a novel approach to routing that involves landmark-based routes and forwarder self-election, exploiting the knowledge of the underlying road network. M. chuan et al proposed a robust data transfer protocol (RDTP). That supports two types of vehicular services, namely the traffic monitoring and the roadside message transfer applications. The traffic monitoring application (TMA) allows drivers to query traffic conditions at some distance ahead of themselves so that they can make decisions on route changes. The roadside message transfer application (RMTA) allows data messages to be delivered between roadside entities e.g. emergency messages via moving vehicles. RMTA, RDTP achieves higher data throughput and lower delivery latency when compared to an existing approach.

2.3 Intelligent Driver Model

Jing et al proposed in [1] several vehicle-assisted data delivery (VADD) protocols [12] which supports delay tolerate applications in sparsely connected vehicular networks. This protocol works on the idea of carry and forward, where a moving vehicle carries the packet until a new vehicle moves into its vicinity and forwards the packet. Jing jhao et al in [11] propose a vehicle-to-vehicle relay (V2VR) scheme which extends the service range of roadside Apes and allows drive-thru vehicles to maintain high throughput within an extended range When the link quality between a drive-thru vehicle and the AP is poor, a relay with good link quality to the vehicle and the AP is chosen to improve the performance. This technique selects forward and backward proxies based on the mobility pattern of the vehicle. Ali et al proposed system in [ ]to reduce/eliminate traffic waves by integrating Artificial Intelligence, and Vehicular Ad-hoc Network (VANET) to create a driver aid that helps in combating traffic congestion as well as embedding safety awareness by dynamically rerouting traffic. Tracy Camp et al in [25] gives several mobility models that represent mobile nodes whose movements are independent of each other (i.e., entity mobility models) and several mobility models that represent mobile nodes whose movements are dependent on each other (i.e., group mobility models). The goal is to present a number of mobility models in order to offer researchers more informed choices when they are deciding upon a mobility model to use in their performance evaluations. Thomas et al in [06] propose and present a message-dissemination procedure that uses vehicular wireless protocols for influencing traffic flow, reducing congestion in road network. M.C. Schut et al in [13] proposed a solution that is decentralized and which makes faster information dissemination possible. A vehicle-to-vehicle communication protocol (called SOTRIP) that works by letting cars on opposite lanes exchange information about the traffic situation on the road ahead for the receiving car. By the cars communication to each other, less cars will end up in a traffic jam.

3 PROPOSED SYSTEM

Software development for vehicular scenarios is a very complex process because of the many factors that can impact on the overall result, ranging from the mobility of the nodes to the radio transmission and the end-to-end delay. In order to overcome or at least reduce the probability of failures in terms of application functionalities, simulation becomes a very important and mandatory step in software design before any implementation. Moreover, simulations are fast, cheap, repeatable and make it possible to investigate in the single parameter variations. A large number of network nodes can be simulated which is not feasible in real-world experiments. In case of new protocols' design, it is imperative to use a mobility model that accurately represents the mobile nodes (MNs) that will eventually utilize the given protocol. Only in this type of scenario it is possible to determine whether or not the proposed protocol will be useful once implemented. The faithfulness of the simulation results is proportional to the realism of the parameters and the accuracy of the models used in the simulation, in particular, the mobility model (MM) which of mobility models used in the simulation of networks: traces and synthetic models. Traces are those mobility patterns that are observed in real life systems and provide accurate information, especially when they involve a large number of participants and an appropriately long observation period. However, new network environments (e.g. ad hoc networks) are not easily modeled if traces have not yet been created. In this type of situation it is necessary to use synthetic models. Synthetic models, instead, attempt to realistically represent the behaviors of MNs without the use of traces. Note the movements of the mobile nodes within the simulated area during the simulation. Obviously, the rules that describe the movements can vary according to model we want to simulate.

In this proposed work we have defined the network with a new protocol that is modification of existing protocol, 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 and congestion status also. In case of proposed algorithm that is inspired from ACO concept, as a vehicle get some collision or the congestion problem it will inform to the its follower vehicles about its status so that they can perform the decision regarding the route change at earlier stage.

To perform the required procedure vehicle need to capable with following feature.

- vehicle has to pass the accident as well as congestion information with higher priority to its follower vehicles
- It will pass the information regarding the distance from accident location.
- It has to define the information if path is already changed by the vehicle.
- It has to pass the congestion status
- The time stamp is also required to pass on to all the followers.

On the basis of this information a vehicle has to take the earlier decision about the path change or to stay with same route.

The proposed algorithm will also find the alternate optimized path to avoid the accident location.

3.1 Algorithm

1. At regular interval any node s (Source) is selected to send data to some destination node d.
2. Each forward ant selects the next hop node using the routing table information. The next node selected depends on some random scheme. If all nodes already visited a uniform selection will be performed
3. If the selected node is some attack or damage node or it is not currently available. The forward ant waits to turn in the low priority node from the queue.
4. It will identify any of the next non visited nodes and pay some delay on it.
5. If some cycle detected the ant is forced to turn on the visited node.
6. When the ant reaches the destination node a backward ant is generated to transfer all its memory.
7. Backward ant uses same path generated by forward ant.

4 CONCLUSION

The proposed work is about to develop a new routing algorithm for vehicular network. The major problem is to find the proper route for packet to be traveled along its destination when some accident held in the path or the congestion occur. The proposed ACO based routing system will resolve the problem and provide the efficient routing approach.

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