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Using Bayesian Algorithm To Improved Routing In VANET

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Abstract:

The vehicular ad hoc network (VANET) tend to operate without infrastructure, allowing any vehicle to be tied to the network and being able to send, send or transmit messages with other features. In this way, vehicles can provide real-time information for exchanges and drivers to road traffic conditions and any information that continues to be of value. One of the well-known routing protocols in VANET networks is the AODV routing protocol. There are also problems with applying this routing protocol in VANET. In this paper, to improve routing in VANETs using Bayesian algorithm, we have simulated package delivery rate, packet loss rate and average end-to-end delay in ns 2 simulator software and compare the simulation results with AODV algorithm.

Keywords: vehicular ad hoc network, Bayesian algorithm, AODV protocol, increase of package delivery rate, reduce of package loss rate, average end-to-end delay.

1.INTRODUCTION

The increasing number of cars and the expansion of road trips, as well as the high costs of human traffic, lead to the use of new technologies to avoid traffic and reduce its risks and costs. One of the new technologies that can be used in this regard is VANET. VANET is one of the new technologies that will attract a lot of attention in the near future. These networks have become a key module of the intelligent transportation system, which due to their unique features, such as high node mobility, dynamic topology changes, wireless link breakdown, network stability and network scalability, increase many new challenges. One of the most challenging issues in such networks is a well-organized routing protocol(1, 2).One of the well-known routing protocols in VANET is the AODV routing protocol. Applying this routing protocol on VANET also has problems that with increasing network scale and number of nodes, the number of control messages in the network increases. In this paper, two routing methods are presented that somewhat improve the mentioned problems. The first proposed method is a clustering method that has been proposed to reduce the number of control messages. The second proposed method is proposed to solve the problem of route selection that uses Bayesian algorithm for route selection. The criteria used to evaluate the performance of these methods are increasing the packet delivery rate and decreasing the packet loss rate and the average end-to-end delay. The main purpose of VANETs is to provide safety for passengers and other road users. Each independent vehicle acts as a node in independent networks to provide passengers with connection to special electronic networks in roadside units, which can send messages over the network and The receiver will give road sign warnings, crash warnings and traffic visions to drivers to choose the best route to their destination along the way. It will also provide passengers with other services such as multimedia and internet connection(3). Applications such as car accident warning, safety distance warning, driver assistance, road information dissemination, internet access, map location, automatic parking and drone are examples of applications of these networks(4).Challenges in this area include the key factors of increasing package delivery rate and reducing package loss rate and measuring them in different nodes, which in this study first describes the AODV algorithms(5-7). Then, by using Bayesian algorithm, by increasing the number of nodes, the package delivery rate also increases, and by reducing the packet loss rate, we simulate the simulation results and bring the simulation results to your hearing and opinion. The history of the first attempts to realize the dream of communication between cars while moving dates back to more than forty years ago. At that time, they tried to establish a radio and quasi-telephone connection by installing an antenna on certain vehicles, such as police or emergency vehicles, and adjusting the antennas to a specific frequency in a geographical area. In 1999, the United States Federal Communications Commission approved the standards and bandwidth required to connect vehicles to stationary roadside equipment, effectively creating a new phase of VANETs. This move was completed with the adoption of the DSRC standard in 2003. In this standard, 5.9 GHz bandwidth is allocated to inter-vehicle communications and on this frequency is defined between seven to ten channels (5,850 GHz to 5,926 GHz). Among these channels, one channel is specifically dedicated to increasing the security factor of vehicles and other channels to specific applications. Following these events, various types of communication between vehicles were introduced based on different technologies and infrastructures, and each took a separate path to develop and equip the vehicles with network facilities(8). One of the challenges in this area is the key factor of increasing the package delivery rate and reducing the package loss rate at different speeds and directions. Here we are going to compare the implementations we have done using the simulator program with the AODV algorithms and also measure the speed of the vehicles relative to each other. In the past, there were other algorithms that used other methods to implement, such as algorithms. Ant optimization has been used in a variety of ways to ensure optimal and reliable information routing in intercity networks(9-11). efficient assignment and scheduling of tasks is one of the key elements in effective utilization of heterogeneous multiprocessor systems. The task scheduling problem has been proven to be NP-hard is the reason why we used meta-heuristic methods for finding a suboptimal schedule. The basic idea of this approach is to exploit the advantages of heuristic-based algorithms to reduce space search and the time needed to find good solutions. The proposed algorithm improves the performance of genetic algorithm through significant changes in its genetic functions and introduction of new operators that guarantee sample variety and consistent coverage of the whole space. The achieved results of running this algorithm on the graphs of real-world applications and random graphs in heterogeneous computing systems with a wide range of characteristics, indicated significant improvements of efficiency of the proposed algorithm compared with other task scheduling algorithms(12). Vehicular ad hoc networks are intended with various new smart features and make the inter communication systems for transportation and provide safety and comfort on the roads and establish the communication platform. However, because of unpredictable dense and sparse traffic conditions in urban areas, data communication is a challenging task for effective and reliable data links. This paper presents a distance and signal quality aware routing protocol (DSQR) for vehicular networks. DSQR is using nodes location and especially designed for urban environment to select the next forwarder node from appropriate region and coupled with other significant routing metrics. Mid-region of transmission range and link quality is the main priorities for optimal node selection. Traditional greedy-based methods have more outage probabilities to exit from transmission range and cause packet loss and disconnectivity. To address these issues, the weighting factors are considered to design the proposed protocol. Proposed protocol is able to handle high mobility and optimal choice for dense and sparse situations and reduces the link failure probability. The performance of DSQR is analyzed with vehicle speed and traffic density and compared with existing geographical routing protocols and evaluates the packet delivery, throughput, network delay and link failure(13).This requires creating goal functions to determine the best path among multiple paths or to find an alternative path during link failure. Other work done in the past includes the use of fuzzy logic to improve AODV routing between cluster members(14). The framework for clustering and data transfer is presented in the research of Dr. Aravindahan et al. In 2019, which includes two algorithms: First, a hybrid clustering algorithm is presented. Hybrid clustering combines geographic and text-based clustering approaches designed to reduce overhead control and network traffic. Second, the destination routing protocol is provided for inter-cluster routing, which improves the overall packet delivery ratio and reduces end-to-end latency(15). VANETs are a type of independent network that provides communication between adjacent vehicles, as well as between vehicles and fixed equipment that is usually installed on the side of the road. The main purpose of VANET is to create more comfort and security for passengers. They are an example of mobile networks designed to communicate with adjacent vehicles as well as vehicles with adjacent stationary equipment, usually roadside equipment. VANETs can communicate wirelessly without the need for a central access point. These networks have special features that distinguish them from mobile networks(16).A previous study by Chen et al. In this study presented a method for routing messages in urban settings that uses trust management to improve routing performance on VANET. This research tends to satisfy performance criteria: end-to-end latency and bit rate error. This scheme uses a trust-based routing protocol. The trust that a node has in a neighboring node is the building block of our trust model. The proposed trust assessment technique, which is run independently by each node on the network, uses only local information and therefore scales it(17).In a 2017 study by Ananda Kumar et al., The results were calculated to take advantage of the spectrum-focused PSO algorithm, which includes a large number of secondary links along with primary links with coexistence and guaranteed cognitive learning-based dynamic delivery. Detect secondary user security holes using VLR data learning, optimize results using the supervised machine learning algorithm, increase to 93.27% in the existing range. Security techniques can reduce the risks to some extent. Data collection, sharing and analysis are performed to obtain representative characteristics and decision making in this model(3).At the same time, misbehaviors suffer from many methods in terms of limitations in the method of detection and non-interference with the features and requirements of intercity networks during design. A new method of detecting misbehavior based on machine learning techniques, namely ANN classification, is presented for advertising(18). In this paper, researchers have successfully proposed and implemented a new algorithm to improve the performance of a system based on VANET in terms of almost all parametric parameters. Such as overhead routing, packet drop, end-to-end latency and throughput. The proposed OD-LAR protocol reduces the packet drop rate and end-to-end latency, in addition to the power and data transfer in the proposed mode. In this mode, we used spatial prediction and node link stability to solve the problem of link breakage. To show the performance of the OD-LAR protocol simulation was performed in NS2 and compared with the existing D-LAR and LAR protocols(19).Routing and implementation issues of the new method of routing and communication, are considered as basic strategies to prevent abuse and negative behaviors of wireless networks between vehicles and finally the most important factor to increase the efficiency of these networks are introduced. In the proposed model of this paper, on the topic of routing and the disadvantages of not having appropriate models in order to establish efficient and purposeful communication, "considering the event-to-node ratio with the aim of increasing routing speed and accuracy" and also covering VANET features including high node speed. In route calculations, VANET has been considered and the aim is to remove the limitations and challenges in the field of research problem and improve routing. Previously proposed models have focused on different strategies for implementing routing; However, due to the characteristics of occasional wireless networks, including high dynamics, as well as the different architecture of these networks compared to other networks, these models are suitable for the development and implementation of routing. Routing models in VANET are especially effective in managing the dynamics of network nodes in the network, but these models and methods will meet the desired expectations, depending on the decision-making situation with appropriate accuracy and speed to in addition to routing evaluations, the resulting decision and its consequences, have the best use. This issue is based on the nature of wireless networks and is one of the main limitations of previous research in the field of communication (route). The proposed method consists of two phases. The first phase is the clustering of nodes in the network and the second phase involves examining the probabilities of selecting nodes to receive control packets, which with these phases try to reduce the sending of control packets. The means K-algorithm is used for clustering and the Bayesian theory algorithm is used to investigate the probabilities for path discovery and recording.

2 PROPOSED TECHNIQUE

In this part of the current research, the proposed model is presented and explained in order to improve the research problem and achieve the research objectives. K-means algorithm is used for clustering and Bayesian theory algorithm is used to investigate the probabilities for path discovery and recording.

2.1 K-means clustering algorithm

The K-Means method is one of the clustering methods. This method is an exclusive and flat method. Different forms have been expressed for this algorithm. But they all have iterative routines that try to estimate the following for a fixed number of clusters: Everlasting points as centers of clusters These points are actually the average points belonging to each cluster. Attribute each data sample to a cluster that has the shortest distance to the center of that cluster. In a simple version of this method, the required number of clusters of points is first randomly selected. Then, according to the degree of proximity (similarity) to the data, they are attributed to one of these clusters, and thus new clusters are obtained. By repeating the same procedure, new centers can be calculated for each iteration by averaging the data and re-assigning the data to new clusters. This process continues until the data is no longer changed. The following function is considered as the objective function. In K_means algorithm, first k members (k is the number of clusters) are randomly selected from n members as the centers of the clusters. The remaining n-k members are then assigned to the nearest cluster. After allocating all members, the cluster centers are recalculated and assigned to the clusters according to the new centers, and this continues as long as the cluster centers remain constant.

2.2 Cluster formation

Each cluster has at least one cluster center, which is selected by the other nodes in each cluster. The proposed protocol includes two types of nodes, threaded node and member node. The sending of control packets is managed through clustered nodes, and the other nodes are cluster member nodes. The K-Means algorithm is used to cluster the nodes, which is done in certain time periods. In this algorithm, the nearest distance criterion is used for clustering, but here the nearest distance criterion is used. This criterion is considered to be fuzzy, in which the fuzzy output determines the priority of each node belonging to the clusters. The following equation 1 used to obtain the distance of each node from the center of the cluster. The distance between two nodes (X_1, Y_1) shows the coordinates of the center of the cluster and (X_2, Y_2) represents the coordinates of the current node.

$$dist = \sqrt{(x1 - x2)^2 + (y1 - y2)^2} \quad (1)$$

2.3 Bayesian theory

Bayesian theorem is a method of probabilistic calculations, and the probability of what will happen in the future depends on what happened before. This theory has the ability to self-learn in the intelligent system, which is widely used. Bayesian theory can be used to predict future events based on present events according to the theory of statistics and probability. Bayesian classification is based on the Bayesian theorem and the hypotheses of predictor independence. A Bayesian model is simple and easy to build without the complex iterative parameter that makes it useful for very large datasets. Equation 2 is the standard formula of Bayesian algorithm.

$$P(C|X) = \frac{P(X|C)P(C)}{\mathrm{P(X)}} \quad (2)$$

- P (c | x): The posterior probability of the class (purpose) is predictive (exclusivity).
- P (c): is the previous probability of the class.
- P (x | c): This is the probability that the prediction class probability is given.
- P (x): The previous probability is predictive.

2.4Routing by Bayesian algorithm

The following steps describe the mechanism for sending the route request package and responding to the route request:

1. When the source node(s) sends the path request packet to the destination node (D)
2. If S does not recognize the next step for D, then it broadcast the route request message
3. The RREQ message is spread in all directions to reach destination D
4. All intermediate nodes that receive the RREQ message pass the packet to their one-hop neighbors.
5. If the destination D, receives an RREQ message via the M node, then by sending it to M, it sends the RREP to S, because M may have at least one routing table for S.
6. Upon receiving the RREQ message through different nodes, destination D sends the RREP message through different nodes and they may reach the source node through different routes.

7. Finally, the S node of origin will select the various paths discovered based on the defined criteria.

In this RREQ mechanism, we intervene to improve RREQ performance and use a modified version of Bayesian theory (Bayesian probability). In this section, the proposed method will be presented, along with a detailed explanation of our proposed algorithm.

In the proposed method, we use Bayesian probability theory, which is modified based on two main assumptions:

1. The posterior probability Pi is the forward probability of five nodes, which is 1 (100%). In this case, when we have only five nodes or less, the probability of progress is 100%.
2. The possible forward pattern, Pi depends on the minimum expected neighbors (d) and the number of neighbors (n). In this case, Bayesian coefficient Pi is multiplied by ½ (n / d) which can be calculated according to Equation 3.

The RREQ mechanism was modified using this method to distribute only the percentage of nodes to detect the path. An example of how the Bayesian technique is performed and how it affects the AODV protocol is described in detail. Suppose a node D sends messages (forward) to node Di and then uses the default Pi probability scheme.

$$P(D|D1) = \frac{P(D|D1) * P(i)}{(D1|D) * P(D1) + \mathrm{P(D2|D)} + \cdots \mathrm{p(Dn|D)} * \mathrm{P(Dn)}}$$

If it is assumed that there are 9 nodes, in this case Pi is the posterior probability that the probability of transferring five nodes is equal to 1 (in the case where we have only five nodes or less, the forward probability is 1). The forward probability is calculated from the above equation:

Example for 9 nodes:

$$\boldsymbol{P(D|Di)} = \frac{\frac{1}{2} * 1}{\frac{1}{2}*\frac{1}{2} + \frac{1}{2}*\frac{1}{2} + \frac{1}{2}*\frac{1}{2} + \frac{1}{2}*\frac{1}{2} + \frac{1}{2}*\frac{1}{2} + \frac{1}{2}*\frac{1}{2} + \frac{1}{2}*\frac{1}{2} + \frac{1}{2}*\frac{1}{2} + \frac{1}{2}*\frac{1}{2}} = \mathbf{0.22}$$

2.5 Simulation scenario

Based on Table 1, we set the network parameters and bring the results of the scenario into three parts: packet delivery rate, average number of lost packets, and average end-to-end latency. In this scenario, the number of nodes is variable (50-60-70-80-100) and the simulation time is constant. The details of the simulation scenario are given in full in the table below.

Table 1 Simulation scenario parameters

parameter	Value
Dimensions of simulation	500 * 500
Number of nodes	50-60-70-80-100
routing protocol	AODV
Simulation time	200 seconds
The speed of the nods	10 meters per second
Type standard MAC	Standard 802.11
Node stop time	0 seconds

3 SIMULATION RESULTS

Here we implement the proposed method in NS2.35 software and compare it with the AODV routing protocol. We have made these comparisons in packet delivery rates and end-to-end latency and the average number of lost packets in the network and measured the performance of the above methods in these sections. Due to the complexity of the network, simulation has a very important role in determining the current behavior of the network and also in determining the possible effects of the proposed changes on network performance. In order to find the independence of the results from the network parameters, we will perform the results in several graphs between these two methods. Figure 1 shows the values obtained from the average package delivery rate relative to the increase in the number of nodes in the proposed protocol and the AODV routing protocol. The results show that the proposed method has the highest delivery rate in all the simulation times presented by the network. As the number of nodes increases, the packet delivery rate across the network progresses by a routine, increasing by 8% compared to the Aodv routing protocol.

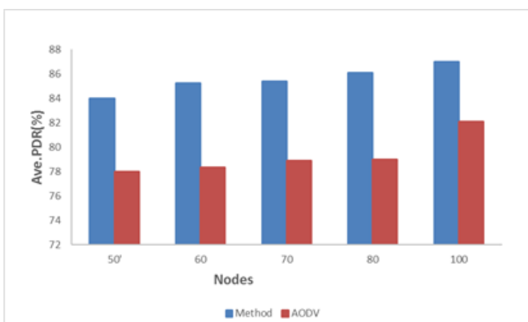

Figure 1 Network packet delivery rate relative to the increase in the number of nodes

In Figure 2, the values obtained are the average number of packets lost in the network relative to the increase in the number of nodes in the proposed protocol and the AODV routing protocol. As can be seen, the proposed method has a smaller number of lost packets than the other method, and the reason for this is the use of the proposed method to detect the path. In this scenario, the packet loss rate is reduced by 20% compared to the proposed AODV method.

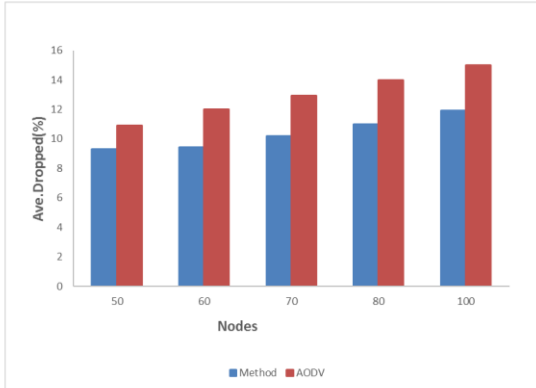

Figure 2 The number of lost network packets relative to the number of nodes increases

Figure 3 shows the values obtained from the average end-to-end latency in the network relative to the increase in the number of nodes in the proposed protocol and the AODV routing protocol. The results show that the proposed total simulation method has the lowest latency in the network with a significant distance compared to the other basic method. As can be seen, the proposed algorithm is 1% less delayed than the AODV algorithm. However, with increasing number of nodes and in fact with increasing network density, the average end-to-end latency in both algorithms increases, which is due to the increase in the number of paths between source and destination, and the choice of intermediate node along the path.

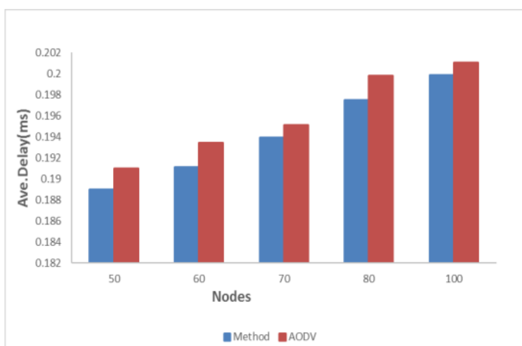

Figure 3 End-to-end latency of the network relative to the increase in the number of nodes

4 CONCLUSION AND FUTURE WORK

In this paper, a solution to some of the problems of the AODV routing protocol is proposed. In this paper, techniques such as Bayesian algorithm and K-means clustering have been used. The proposed protocols have been used NS 2.35 network simulator, which increases the package delivery rate, and We reduced the average end-to-end delay, and the number of packets lost in the network. My suggestion for the future is to use the sumo tools to measure it in the real time, given the problems in the urban scenario.

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