System Model of VANET using Optimization-Based Efficient Routing Algorithm

S Kannadhasan¹, M Shanmuganantham², R Nagarajan³
¹Assistant Professor, Department of Electronics and Communication Engineering, Cheran College of Engineering, Tamilnadu, India
²Lecturer (S.G), Department of Electrical and Electronics Engineering, Tamilnadu Government Polytechnic College, India
³Professor, Department of Electrical and Electronics Engineering, Gnanamani College of Technology, Tamilnadu, India
¹kannadhasan.ece@gmail.com

Abstract: - A wireless networking strategy is the VANET (Vehicular ad hoc network). This approach is used to connect between vehicles and to raise the question of traffic quality. The most important aspect is the connection between V2v and V2i, so it is essential to ensure appropriate protection and privacy techniques. VANET safer, effective and avoid illegal vehicle interference with other cars, this work suggests an authentication scheme based on the hash feature. Only an authenticated vehicle may use the party key agreement scheme using the Chinese residual theorem. The forward and backward confidentiality was done in this manner. Security and privacy are fulfilled by our scheme. The most favorable aim is to create more useful, productive and safer roads across vehicle networks by educating the basic authorities and drivers in the future on a timely basis. Another aim is to identify wireless technology for the development of VANET. The aim is to protect and render feasible commercial requests by means of a variety of short to medium communication systems and/or other VANET networks. This technology will help the primary concern for safe contact in crucial time and meet the QOS criteria of other interactive multimedia applications or e-commerce.

Keywords: - VANET, System Model, Established Route and Node Pair

1. Introduction
VANET seeks to offer appealing facilities such as protection services, including alerts of curve level, notifications of emergency vehicles, lane shift assistance, warnings of pedestrian walking, warnings of traffic breaks, warnings of road crossings, and warnings of road condition. In addition, weather details, traffic information, the position of the gas station or restaurant and other conveniences and interactive facilities such as Internet connectivity may also be offered. The Intelligent Transportation System (ITS), the growing amount of automobiles in the region, is one of the most promising recommendations for the effective management of urban transport [1]-[5]. The VANETs were introduced by researchers and vehicle manufacturers on the basis of the Mobile Ad-hoc Network (MANET) concept to develop next-generation transport systems. VANET is a distributed, less infrastructural, self-organizing communication network that is developed between moving vehicles as a variant of MANET.

VANET implies Ad hoc vehicle network which is the infrastructure used to transfer vehicles and build a transportable network as a joint throughout the network. Participating vehicles become a VANET
wireless link or router to enable the vehicles to attach almost 100 to 300 meters to each other and other
vehicles are linked to each other in order to establish a broad range network such that the mobile internet
is created. For protection purposes, it is believed that the first networks to adopt this technology are fire
and police mobiles to communicate with each other [6]-[8].

In VANET or Intelligent Vehicular Ad-Hoc Networking, genius methods of utilizing vehicular
networking are described. Multiple VANET-integrated ad-hoc networking technologies such as ZigBee,
IRA, WiMAX IEEE, and Wi-Fi IEEE for easy, effective, reliable, quick and simple connectivity inside
active mobility vehicles. Useful procedures such as media contact inside vehicles may be permitted, as
well as the process of trailing automotive cars is often preferred. In cars, protection measures are
characterized by VANET, flowing automotive contact, edutainment and telemetry. Wireless
infrastructure collection is expected to be introduced as DSRC (Dedicated Short Range Communication)
in VANET, which is used in Wi-Fi. Satellite, WiMAX, and Cellular are additional incoming wireless
innovations [9]-[12].

Vehicular Ad-hoc Networks (VANET) may be viewed as ITSS equipment (Intelligent Transportation
Systems). Vehicular networks were conceived by the Intelligent Transportation Systems. IVC (Inter-
Vehicle Communication) enables cars to connect with each other at the same time as RVC (Roadside-
to-Vehicle Communication) makes way side stations. The benefit of proactive routing protocols is that
because the destination route is processed in the past, no route exploration is needed, but the drawback
of this protocol is that it allows low latency for real-time application, it often contributes to the
management of unused data routes, allowing the usable bandwidth to be limited. TORA is part of the
link reversal routing family in which a cyclic graph is designed that guides the packet flow and
guarantees its capacity to enter all nodes. The directed graph will be built by a node by broadcasting
question packets. If the node has a downward connection to the destination when receiving a question
packet, it will broadcast a return packet; otherwise, it will simply drop the packet. A reply packet
receiving node can only change its height if the height of the answered packet is the minimum of all
other reply packets [13]-[15]. The drawback of the TORA Algorithm is that it offers a path to network
nodes, but it is impossible for VANET to manage all these routes. In intra-zone communication, a
constructive routing protocol (IARP) is used in ZRP, and in intra-zone communication, an inner-zone
reactive routing protocol (IARP) is used. If all are in the same routing field, the source sends data directly
to the target, otherwise the IERP reactively initiates a path discovery. There are two levels of routing in
HARP: intra-zone and inter-zone, based on the destination location. In intra region and inter-zone
routing, respectively, it utilizes constructive and reactive protocols. It is not acceptable to ad hoc
networks of high versatility.

2. System Model of VANET

The suggested algorithm discovers a perfect route to a source and sends the message using the route that
it has identified. To figure out the optimal path, it utilizes the multi-objective bio-inspired heuristic
cuckoo search optimization algorithm. The steps as defined for finding the best path. The VANET model
is used, based on the following assumption, to choose the best routes between the source and its
destinations. Network routing is a particular category of network that offers a number of resources to its
users, such as message notifications, driver forecasts, and information services.

The road network has played a very important role in many ITS-related applications, such as brake
warning, weather forecasts, traffic and automobile protection. There is also a significant necessity for a
vehicle-to-vehicle contact device that is secure, stable and entitled to include a safety warning in due
course. There have been many efforts to standardize the design and deployment of road networks. The
network model is to be considered for the road model layout to be built. Let N be the statistic for the
average number of network vehicles containing a number of segments. The route exploration approach
here offers the origin with awareness of the destination direction.
3. Optimization-Based Efficient Routing Algorithm

For VANET routing, the easiest way to pick a path is typically to forecast traffic between the source and destination locations. For efficient route selection, the choice of a low traffic density is preferred as a high traffic density improves the movement of vehicles on the lane. Therefore, an active prediction approach is important for choosing the right route. The key step in the current system of application is path discovery. To provide the details effectively, the suggested algorithm selects the best multipath routing. It is important to configure the parameters for the purpose of successful route detection. The nest size and mutation probability must be determined to initialize the parameters for the upper and lower bands. It is important to select a suitable nest

\[ \beta = \beta_{\text{max}} - \left( \frac{N_{\text{iter}}}{N_{\text{iter (Total)}}} \right) \times (\beta_{\text{max}} - \beta_{\text{min}}) \] \[1\]

where, \( \beta_{\text{max}} \) and \( \beta_{\text{min}} \) represents the maximum and minimum nest size
\( N_{\text{iter}} \) represents the current iteration number
\( N_{\text{iter (total)}} \) represents the total iteration number respectively.

As expressed in the equation-1 nest size will decreases with increase in the iteration number.

According to MOBHCSNO-ER algorithm mutation probability is associated with the fitness,

\[ P_f = \left\{ P_{\text{min}} + (P_{\text{max}} - P_{\text{min}}) \right\} \] \[2\]

where \( f = \text{fitness}(I) - f_{\text{min}} \).

Which depends on the current quality of \( I^\text{th} \) solutions; fitness of the population, respectively \( I \); \( P_{\text{max}} \) and \( P_{\text{min}} \) represent the maximum and minimum of mutation probability \( p_a \), respectively. From the equation-2 it can be seen that the fitness of the solution gas adjusted and the mutation probability can generally vary with respect to the amount of the iteration. After the parameter gets initialized the nest position gets analyzed.

\[ \alpha_v = \left( \gamma \left( 1 + \beta_p \right) \right) * \sin \left( \pi * \beta_p / 2 \right) / \left( \gamma \left( 1 + \beta_p^2 \right) * \beta_p \beta_{p-1/2} \right) * \left( \beta_{p-1/2} \right) ^{1/(\beta_p-1/2) / \gamma} \] \[3\]

where \( \sigma_v \) represents the random size of the nest.

The equation-3 can be rewritten as,

\[ n_p = \text{rand} \left( \tau_{\text{ran}}, 1 \right) * \left( u_{b-1} + l_b \right) \] \[4\]

when \( n_p \) represents the random position of the nest.

After that the objective function needs to be computed to find out nearest node path. The objective of node localization is to estimate the coordinates of the unknown nodes based on the anchor vehicular nodes. Separable each unknown node and its anchor node can be calculated.

\[ \sigma^2 = \gamma * e_{ij}^2 \] \[5\]

Where \( \sigma^2 \) is the error variance and \( e_{ij}^1 \) is the original distance of the unknown node.

The measured distance between the unknown distance node and the anchor node was represented by using the equation-6

\[ e_{ij} = e_{ij} = N_{ij} \] \[6\]
where $N_{ij}$ represents the error of the unknown vehicular node.

Then the objective function should be calculated which is a combined mean error of the unknown node and the anchor nodes.

$$f \left( x_i, y_i \right) = \frac{1}{n} \sum_{j=1}^{n} \left( e_{ij} - e_{ij}' \right)^2$$

The unknown vehicular node can be estimated by its co-ordinates by running the MOBHCSNO-ER algorithm. The alpha, beta and gamma locations are then changed. It is easy to locate the path after upgrading it. Multiple routes would be sent to the source after the route answer is received from the endpoint. Each node's remaining capacity, load and hop count are attached to the reply packet. The node of origin then analyses the response packets received from multiple routes and calculates the level of fitness for each path direction. The highest degree of exercise and the $n$ route positions is that pick the number of paths $n$. A source node routing table that has the fitness values of each of the routes in the descending order of the data transmitted through the fitness route. If the route succeeds, the next fitness merit path transmits it. Then, if all $n$ paths are struggling to relay knowledge, then according to the algorithm, it begins to locate and repeat the process. If REPLY sends via the destination node to the neighbor node before the send hits that node, the routing table is changed by dragging it up until the receiver vehicle node is reached. The fitness value at the node of the sender vehicle is now calculated by applying the formula described in the algorithm.

The downward order of the routing table and the data is to be processed in the downward order type. In reality, the sender vehicle node now starts sending data according to the route that has the highest fitness value in the sender vehicle node routing chart, if the path fails, if the sender sends it with the second best fitness path, etc. Where $F$ is the fitness value of every route that the source node has obtained and is to graded. The residual energy for each of the nodes and the distance of the bandwidth between each of the nodes can be determined here. In order to evaluate health, the power, metric delay and shortest route are used. Below is the approach to the technique proposed? The data packet sent by the source vehicular node here is the cuckoo's egg. Here, along with the data packets, the vehicular source is sent via the multi objective route that can be transmitted to the designator node. Data is passed by inadequate power or fallen out of heavy traffic routes.

Input: Vehicle Node-Vn, Node Coordinates-Vc, Maximum Bound-Vx, Vy, Energy Parameter-Ve.
Output: Priced-$\phi_p$ and optimized-$\gamma_{ii}$ (best nest and route path)

Step 1: initiates the parameters,

$[V_x, V_y]=$ [Upper Limit lower limit]
Max - iteration max $\text{iter}=100$;
Lower band $l_b=V_c(1)$*$V_c(2)$;
Upper band $u_b=\max(V_c, 2)$;
Best near $n_b$ Dimensions $db=size(u_b, 2)$;

Step 2: initialize the nest position $n_b$,

$N=\text{size}(n_p)$

$\text{Beta}_p=3/2$;

$\sigma_j=(\gamma(1-\beta_p))\sin(\pi*\beta_p/2)/(\gamma(1+\beta_p/2)*\beta_p(1-2/\beta_p)\beta_p(1/2-1/2))$ for $j=1: n$

$s=\text{n}_p(j,:)$

$u=\text{randn(size(s)}*\sigma_j)$

$v=\text{rand(size(s))}$

Let compute nest position, $n_p=\text{rand}(\tau_{\text{ran}}, 1)*u(1,b) + l_b$
4. Results and Discussion
Create a TA (Trusted Authority) to track the vehicle approaching the relevant area of coverage and provide the customer with authentication. If the source vehicle has no path to the destination vehicle, the route exploration is initiated in an on-demand manner by the source vehicle. The node looks up its own neighbour table after creating RREQ to find out whether it has a neighbour vehicle closer to the destination vehicle in Figure 1.

The RREQ packet is redirected to that vehicle if a closer neighbour vehicle is available. If the RREQ packet is not a closer neighbour car, all adjacent vehicles are flooded. Only in the following three situations does a destination vehicle respond to a received RREQ packet with a Path Reply (RREP) packet:

1. If the RREQ is the first packet to be obtained from this source car,
2. If the RREQ packet includes a higher source sequence number than the RREQ packet to which the destination vehicle has previously replied,
3. If the RREQ packet includes the same source sequence number as the RREQ packet that the destination vehicle has previously referred to, however the new packet suggests that a higher quality route is usable, is shown in Figure 2

![Figure 1. Roadmap of VANET System Model](image1)

![Figure 2. Node Pair Prediction](image2)
Both VANET users should have their data reported with the RSU. The RSU can provide the customer with one initial packet key after registration. The consumer can get details about the other surrounding vehicles from the TA using this initial packet key. We're adding a routing protocol in this module to pass messages via RSUS between the vehicles. Such correspondence should be service-oriented in order to take account of the different forms of data from the RSU. The RSU is a system for wireless networking that uses the DSRC protocol. It is a way of coordination between the car and the TA. Vehicles in the same RSU range also allowed confidential knowledge to be shared. In Figure 3, the contact between the vehicle and the facilities is primarily between the vehicle and an RSU fixed on the side of the lane. The short-range wireless communication protocol, called the dedicated short-range communication protocol, regulates all vehicle to vehicle and vehicle to infrastructure communications, which increases the overall protection and reliability of the transport system. Through unreliable wireless networking media, RSU links to TA. RSU is not fully trusted; TA needs to control and track it. Vehicle to vehicle connectivity is seen in Figure 4 only by the RSU. Without support from the RSU, automobiles do not interact explicitly with each other.
5. Conclusion
In urban settings, routing inside VANETs is a dynamic activity. Because of the enhanced mobility in the nodes, routing difficulties will arise. Therefore, the reasons of the reduced efficiency of the facilities would find the problem impossible to minimize. To substitute this problem with the usage of the Stochastic Discriminate Random Forest Node Classifier and TAXGBNC-SR, if the solution is to weighted end-to-end delay is to be used. A shortest secure route has been calculated here using this methodology. Finally, the findings of the simulation revealed that the Stochastic Discriminate Random Forest Node Classifier can provide the radio, latency, throughput and execution period of the packet distribution that performs well, indicating the method's effectiveness.

References
1. Tomar, R.S., Sharma, M.S.P., Jha, S., &Chaurasia, B.K. (2019). Performance Analysis of Hidden Terminal Problem in VANET for safe Transportation system. In harmony Search and Nature Inspired Optimization Algorithm- Springer, Singapore, pp. 1199-1208.
2. Loganathan, G. B.(2019). Vanet Based Secured Accident Prevention System. International Journal of Mechanical Engineering and Technology, 10(6).
3. Karimzadeh Motallebiazar, M., Mariano de Souza, A., Zhao, Z., Braun, T., Villas, Z., L., Sargento, S., & Loureire, A.A. (2019). Intelligent Safety Message Dissemination with Vehicle Trajectory Density Prediction in VANETs., IEEE Transactions on Vehicular Technology Special Issue on Vehicular Networks in the era of 6G: IEEE
4. Koti, R.B., & Kakkasageri, M.S. (2019, march). Intelligent Safety Information Dissemination Scheme for V2V Communication in VANETs. 2019 IEEE International Conference on System, Computation, Automation and Networking (ICSCAN), pp. 1-6.
5. Jose, a. a., Pramod, A., Philip, G., & George, S.J. (2019). Sybil attack detection in vanet using spidermonkey technique and ecc. International Journal of Wireless Communications and Networking Technologies, 8(3).
6. Nguyen, V., Khanh, T.T., Oo, T. Z., Tran, N.H., Huh, E.N., & Hong, C.S. (2019). A Cooperative and Reliable RSU-Assisted IEEE 802.11 P-Based Multi Channel MAC Protocol for VANETs. IEEE Access, 7, pp.107576-107590. 10.1109/ACCESS.2019.2933241
7. Tomar, R.S., Sharma, M.S.P., Jha, S., & Sharma B. (2019). Vehicles Connectivity-Based Communication Systems for Road Transportation Safety, Soft Computing: Theories and Applications, pp 483-492, Springer, Singapore.
8. Li, W., Song, W., Lu, Q., & Yue, C. (2020). Reliable Congestion Control Mechanism for Safety Application in Urban VANETs, Ad Hoc Networks, 102033. https://doi.org/10.1016/j.adhoc.2019.102033
9. Naja, A., Boulmalf, M., & Essaaidi, M. (2019). Toward a New Broadcasting Protocol to Disseminate Safety Messages in VANET Environment, International Conference on Mobile, Secure, and Programmable Networking, pp. 163-172. Springer, Cham.
10. Benkirane, S. (2019, April). Road Safety against Sybil Attacks Based on RSU Collaboration in VANET Environment. International Conference on Mobile, Secure, and Programmable Networking, pp. 163-172. Springer, Cham.
11. Cui, J., Wu, Zhang, J., Xu, Y., & Zhong, H. (2019). An Efficient Authentication Scheme Based on Semi-Trusted Authority in VANETs. IEEE Transaction on Vehicular Technology, 68(3), pp. 2972-2986.
12. S.Kannadhasan, G.Karthikeyan and V.Sethupathi, A Graph Theory Based Energy Efficient Clustering Techniques in Wireless Sensor Networks. Information and Communication Technologies Organized by Noorul Islam University (ICT 2013) Nagercoil on 11-12 April 2013, Published for Conference Proceedings by IEEE Explore Digital Library 978-1-4673-5758-6/13 @2013 IEEE.
13. Erskine, S. K., & Elleithy, K. M. (2019). Real Time Detection of DoS Attacks in IEEE 802.11 p Using Fog Commuting for a Secure Intelligent vehicular network, Electronics, 8(7), 776 MDPI.

14. Limbasiya, T., & Das, D. (2019). ESCBV: energy-efficient and secure communication using batch verification scheme for vehicle users, Wireless Networks, 25(7), pp. 4403-4414, https://doi.org/10.1007/s11276-019-02104-5

15. Hasrouny, H., Samhat, A. E., Bassil, C., & Laouiti, A. (2019, April). A Trusted Group-Based Revocation Process for Intelligent Transportation System., International Conference on Digital Economy, pp. 133-146. Springer, Cham.