

# A Novel Framework to Control and Optimize the Traffic Congestion Issue in VANET

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## Abstract

In the recent times due to the increase of vehicular nodes in a vehicular communication network, there is a need of developing efficient systems in order to optimize the vehicular traffic congestion issues in urban areas. The current research trends shows that most of the conventional studies focused on developing fuzzy inference systems based vehicular traffic congestion model which has gained lots of attention on detecting and minimizing the congestion levels. We have proposed a new approach towards detection and controlling of traffic congestion in VANET. The proposed system utilizes the communication channels very efficiently and irrespective of any kind of overload. This proposed system aims to introduce a novel framework for identifying traffic jam on Vehicular Ad-hoc Networks. In order to detect and minimize the level of congestion our approach will use a fuzzy logic based approach to notify the drivers about available routes during the traffic congestion. An experimental prototype will be set up to enable the graphical simulation.

## 1. Introduction

Vehicular communication has become very fast growing field in the area of communication which has been integrated between vehicle to vehicle (V2V) and Vehicle to road side infrastructures (V2I). Recent advancements in the wireless communications leads towards and efficient and dynamic connectivity in between vehicles and infrastructures [1].

In the recent times, there is a need of vehicular traffic congestion control as now days the users of vehicular ad hoc networks hope to reach work stations from their home within an estimated time. Therefore, a concept has been introduced considering the individual decision making during the time of traffic congestion where individual vehicular nodes will update and broadcast their respective route information to the other vehicles thus it leads towards an unbalanced use of roads during the peak times of heavy traffic. The concept of intelligent transport system has been derived in order to detect and minimize the vehicular traffic congestion. The current research trends associated with Intelligent Transport Systems and WAVE (Wireless Access in Vehicular Environments) have gained lot of attentions due to reducing the negative effects of traffic congestion on the roads. It also assists drivers to reach their destination safely within an estimated time periods. The following figure 1 shows an overview of vehicle to vehicle communication [2] [3].

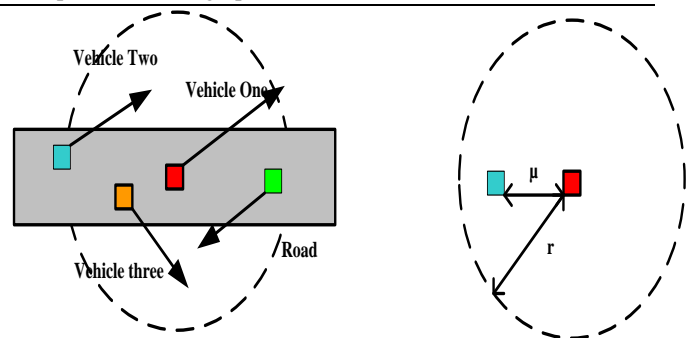


Figure 1: An overview of V2V communications and optimal distance in between every vehicle

In this project a novel fuzzy system based vehicular traffic congestion detection and control model is introduced. The proposed study aims to identify the level of congestion using the Fuzzy logic based inference systems [4] [5]. The proposed model exploited the concept of fuzzy systems in order to detect the level of congestion very effectively and it is also used in the treatment of qualitative information. The performance metrics associated with the proposed system ensures and efficient collaborative communication between different channels and avoidance of collisions as well as break downs.

The proposed study aims to develop a novel fuzzy logic based vehicular traffic congestion control systems in order to achieve high data rate transmission as well as optimized congestion over a vehicular wireless medium. The performance of the proposed system has been improved considering speed and density as well as fuzzy inference systems. The performance analysis of the proposed system shows how efficiently level of congestion in traffic jam has been detected and minimized with respect to vehicular speed and density variations. The paper is organized as follows Section II

discusses about the recent studies towards efficient mobile WiMAX mechanisms which is followed by problem statement in Section III. Section IV discusses about proposed system followed by discussion of algorithm implementation in Section V. Section VI discusses about the result analysis followed by conclusion in Section VII.

## 2. Related Work

### Review Stage

This section discusses about the existing studies that has been carried out in the past regarding achieving efficient vehicular congestion control mechanisms.

The paper has planned by Soni and Shrivastava [6] a brand new notion for overcrowding management and packet forwarding in Vehicle area Network (VANET). The planned methodology is partial the broadcasting of traffic position by watching the numeral of neighbors or so the radio assortment. The planned method presentation is measured with the conventional VANET situation in V to V communication and also the simulation outputs vicinity element demonstrates that the presentation of planned topic vicinity element offers the superior presentation and gets better the network recital with economical information measure exploitation.

Sampigethaya et al. [7] have presented a system called AMOEBA that presents location solitude by exploiting the group steering of vehicles. Through simulating vehicular mobility in freeways and roads, the presentation of the presented system is evaluated beneath Vehicle Adhoc Network (VANET) submission constraints and two inert opponent models. They create employ of vehicular collections for nameless access to location depend examine applications in Vehicle Adhoc Network, for consumer privacy defense.

Djahel et al. [8] addressed the balefire overcrowding issue in vehicle adhoc Networks owing to its overwhelming impact on the presentation of ITS submissions. The episodic balefire transmit might devour an outsized a part of the offered information measure resulting in Associate in Nursing increasing variety of collisions among MAC frames, principally just in case of elevated vehicle thickness. This will strictly involve the presentation of the Intelligent Transportation Systems protection based submissions that need timely and dependable distribution of the event-driven caution messages.

The paper have proposed by Samara et al. [9] a variety of types of security issues and confronts of Vehicle Adhoc Network (VANET) been examines and converses; they also converse a place of solutions obtainable to resolve these challenge and issues. Sasikala et al. [10] presented, the communal key management structure is depend ahead the supportive message verification, where the contribute keys are agreed precedence in this technique which is not complete in dispersed key management structure..

The paper have demonstrated by Sari et al.[11] of Vehicle Adhoc Nwtwork (VANET) and expansion of presented methods and completion woutyld augment security amid road users and get better the console for the equivalent passengers, drivers and also additional road users, and a immense development in the traffic competence would be attained. This research paper examined the present and obtainable security problems associated with the Vehicle Adhoc Nwtwork (VANET) and depictions any slack between them in arrange to ease probable issue domains in the field.

Hao et al. [12] have presented a distributed framework of key management for VANETs using Cooperative message authentication, which provides privacy in VANETS. The RSU in the framework acts as key distributor for entire group, in which semi-trust RSUs are compromised. A security protocol is developed to detect the compromised RSUs. The framework is

implemented in 802.11 and in performance is evaluated by extensive Network simulator (Ns-2).

Milojevic et al. [13] have illustrated a method to enable each & every vehicle in the internet to detect and qualify the level traffic congestion in entirely distributed way, independent of any sustaining infrastructure and additional information such as traffic data from local authorities. Depend on observations of traffic obstruction by every vehicle, and by acclimatize the transmit interval, it enables distribution of the traffic in sequence to additional vehicles.

Cohen et al. [14] have presented an algorithm for intelligent decision creation about travel path preparation in mobile vehicular ad-hoc networks (VANETs), for situation where agents in place of vehicles swap reports about traffic. One tackle that arises is how finest to model the trustworthiness of those traffic reports.

The author has illustrated by Venkatesh et al. [15] on key features such as network planning, submissions maintains, routing strategies, promoting strategies, mobility models and benefit of fix metrics.

Dok et al. [16] have presented two key ingredients which are:

- [1] A precise definition of privacy that reflects citizens concern and perceptions.
- [2] An upstanding of the types of attack in vehicle adhoc networks. The author has presented a workable definition of privacy and focus on tracking attacks that they search to lacking.

The paper has been proposed by Qureshi and Abdullah [17] on localization supplies, localization techniques and methods, and the problems for vehicular ad hoc networks (VANETs). Besides, the author illustrates how these localization methods and data mixtures are joint and employed in protection submissions to improve network presentation.

The paper have presented by Diwakar et al. [18] of moving vehicles communicating with every additional. One of the major confronts in Vehicular Adhoc Network (VANET) is to pathway the data capably from source-to-destination. As well since of wireless average it is inclined to more than a few attacks. Because attacks mislead the network procedures, security is obligatory for victorious operation of such tools.

Singla and Shurma [19] proposed explanation intended to conquer these confronts like steadily transmit data from sender to receiver by employing Pretty Good Privacy (PGP) security and remove the traffic overcrowding or ignore the pointless load of network by selecting dynamic path for data broadcast. In this, the hybrid procedure that is Ad-hoc on demand distance vector and Ad-hoc on demand multipath distance vector (AOMDV) is employed for to choose the active pathway in Vehicle Adhoc Network.

## 3. Problem Statement

The current scenario in the field of vehicular Ad-hoc networks has become so problematic as the users of Vehicular Ad-hoc networks cannot reach their destination within an estimated time due to the traffic congestion and absence of proper collaboration in between the traffic management systems. The above mentioned scenario leads to an unbalanced use of roads where each user takes their individual decision about taking routes without having proper guidelines and information. In vehicular systems, because of the uncommon way of the environment, reproductions must consider two imperative perspectives that describe this kind of system: the high versatility of hubs and the radio correspondence between the hubs. Nonetheless, as versatility and radio correspondence have altogether different qualities, diverse sorts of test systems for vehicular systems are utilized. In test systems are isolated into three sorts: (i) system test systems, (ii) versatility and movement generators and (iii) VANET test systems. In any case, a few system and versatility test systems don't coordinate with other devices, which upset the likelihood of reproducing situations more like a genuine domain. Taking after the requirement for

continuous correspondence between these tests systems, a few structures were executed. This coordinated environment, known as VANET test system, gives more palatable and practical results while reenacting vehicular systems.

### 4. Proposed System

**Local Estimation Module:** The proposed system initially executes the local estimation of the vehicular traffic in order to execute the traffic LOC. This module obtains the information related to the periodic exchange of bacon messages in between the vehicles.

The fuzzy framework which has been intended for the proposed model additionally utilizes vehicle velocity and thickness as data parameters. Velocity is an effortlessly reachable quality and can be ascertained from the separation went in a brief span interim. The fuzzy framework utilizes two sorts of semantic variables (fuzzy sets) as inputs: velocity and thickness. Speed levels can be delegated quick, direct, moderate and moderate. Thickness levels can be named low, medium, high and high. The yield fuzzy set extents between [0, 1], as per the accompanying grouping: 0 - denotes to free flow; 1/3 - denotes to powerless flow; 2/3 - denotes to moderate flow; 1 - denotes very rough condition.

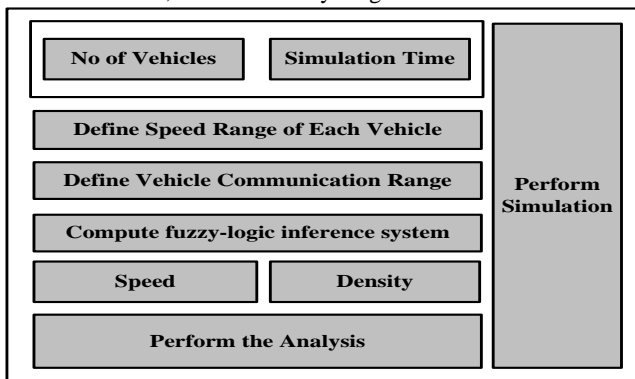


Figure 2: System architecture of the proposed model

The above figure 2 shows the system architecture of the proposed framework to control and optimize the traffic congestion issues associated with VANET.

**Congestion substantiation Model-** This module uses a collaborative process in order to validate the level of congestion which has been detected by the Fuzzy Inference Systems. This module initializes a congestion threshold (Cth) which is zero in the first stage but after detecting the congestion, this module evaluates a collaborative process of congestion detection.

**Congestion Control and Minimization Model-** This module evaluates a heuristic based traffic congestion module. This module aims to reduce the time spent by a driver on a road during the time of congestion. It also suggest optimal routes when each and every vehicle start to accumulate with respect to a given time stamp.

### 5. Implementation

The implementation of the proposed system has been carried out using MATLAB, This project uses the concept of fuzzy based systems in order to detect and optimize the vehicular traffic congestion issues. The following are the pseudo codes implemented for each and every module.

#### 1. Pseudo Code for Deploying Vehicles

The Pseudo code of the deploying vehicles is described below with its input, variable initializations, computational statements and functions.

**Start**

*Input: No of Vehicles*  
*Output: Vehicle deployment in each lane*  
 Initialize Fuzzy Inference Systems  
 Define X axis coordinates for 50 kms  
 Define Y axis coordinates  
 Plot(road boundaries)  
 Define  $\leftarrow$  Vehicle range  
 Plot  $\leftarrow$  Lane separator  
 Speed  $\rightarrow$  range  
 Define  $\leftarrow$  Probability(each vehicles)  
 Deploy vehicles in each lane.  
 Compute  $\leftarrow$  X positions of each vehicles  
 Generate obstacles  $\leftarrow$  linespace()  
 Compute total no of vehicle;  
**End**

#### 2. Pseudo Code for Computing Level of Congestion

**Start**

*Input: Density and speed of each vehicle*  
*Output: Plot the level of Congestion*  
 Compute  $\leftarrow$  total number of deployed vehicle  
 Create  $\leftarrow$  empty structure to store information of each vehicle  
 For ( $i \leftarrow 1:N$ )  
 Stores the values into structure  
 End for  
 Initialize vector to store accurate values  
 Initialize simulation;  
 Compute LOCvec  $\leftarrow$  Zeros(1,100);  
 For ( $i \leftarrow 1:Nsim$ )  
 Move each and every vehicle  
 Update x values based on the speed  
 Generate new speed  
 Evaluate the communication in between the vehicles  
 Identify vehicles  
 For each cars calculate neighbors  
 Find out which car having the less distance than range  
 If ( $Dist(Vehcile1) < Rv$ )  
 For  $n2 \leftarrow 1:length(optimal dist)$ ;  
 Perform communication in between neighbors  
 End for  
 Plot()  
 Calculate LOC  
 Store no. of neighbors  
 Find out the average no of neighbors  
 Pause(0.000001)  
**End**

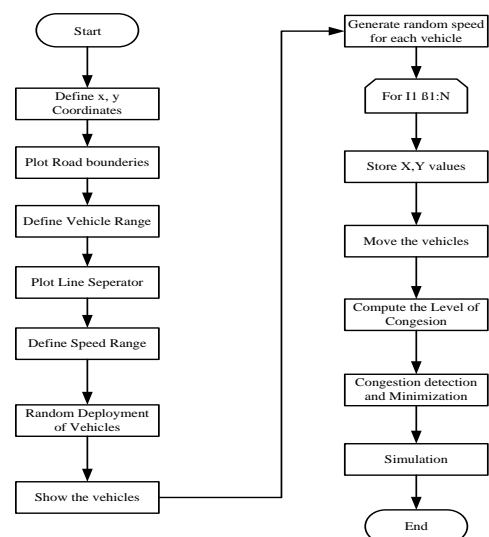


Figure 3: Process flow diagram of proposed model

Figure 3 highlights the process flow diagram of proposed fuzzy inference system based vehicular traffic congestion model.

## 6. Result Discussion

This section discusses about the important findings of the proposed study. It also highlights experimental outcomes of the proposed fuzzy systems based vehicular traffic congestion detection model.

The following figure 4 highlights the experimental outcomes of the proposed system where the level of congestion for different values associated with vehicular speed and density has been computed. The performance evaluation of the proposed model shows the effectiveness.

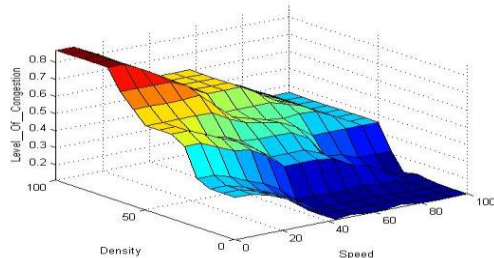


Figure 4: 3D LOC Evaluation using speed and density

It can be seen in the figure 4 that how level of congestion has been computed using the fuzzy inference systems. It also shows that how level of congestion increases with respect to the density of vehicles in a particular area.

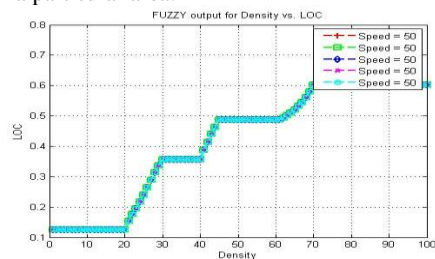


Figure 5: 3D LOC Evaluation using speed and density

The performance graph also shows that level of congestion has been evaluated for a constant speed of 50.

## 7. Conclusion

In the recent times the congestion control in vehicular communication using radio frequency data transmission has become so much challenging. This study introduces a Robust Framework to Control and Optimize Traffic Congestion Issues in VANET. The framework is designed by considering the realities and characteristics of vehicular networks to achieve the optimized traffic congestion in VANET. The proposed system aims to find the traffic congestion locally in a VANET and also reduces the congestion level by applying a fuzzy logic based route selection algorithm. The experimental prototype simulation result shows the effectiveness of the proposed system with respect to the current research trends. The proposed framework utilizes the concept of fuzzy inference systems in order to detect the level of congestion. The performance analysis of the proposed model shows the effectiveness of the fuzzy based systems towards optimizing the level of congestion during any kind of traffic jam in vehicular network.

## References

- [1] Hartenstein H & Laberteaux KP, "A Tutorial Survey on Vehicular Ad Hoc Networks", *IEEE Communications Magazine*, (2008).
- [2] Yousefi S, Mousavi MS & Fathy M, "Vehicular ad hoc networks (VANETs): challenges and perspective", *Proceedings, 6th International Conference on ITS Telecommunications*, (2006), pp. 761-766.
- [3] Veeraraghavan M, "A survey of research literature on Vehicular Networking", *University of Virginia*, (2011).
- [4] Shrivastava D & Agrawal A, "Traffic congestion detection in vehicular adhoc networks using GPS", *IEEE International Conference on Computational Intelligence and Computing Research (ICIC)*, (2014).
- [5] Mohandas BK, Liscano R & Yang OW, "Vehicle traffic congestion management in vehicular ad-hoc networks", *IEEE 34th Conference on Local Computer Networks*, (2009), pp.655-660.
- [6] Soni S & Shrivastava G, "Efficient Mechanism for Congestion Control and Bandwidth Utilization of VANET", *International Journal of Engineering Research & Technology (IJERT)*, Vol.3, No.5, (2014).
- [7] Sampigethaya K, Li M, Huang L & Poovendran R, "AMOEBA: Robust location privacy scheme for VANET", *IEEE Journal on Selected Areas in communications*, Vol.25, No.8,(2007), pp.1569-1589.
- [8] Djahel S & Ghamri-Doudane Y, "A robust congestion control scheme for fast and reliable dissemination of safety messages in vanets", *Wireless Communications and Networking Conference (WCNC)*, (2012), pp.2264-2269.
- [9] Samara G, Al-Salihy WA & Sures R, "Security analysis of vehicular ad hoc networks (VANET)", *Second International Conference on Network Applications Protocols and Services (NETAPPS)*, (2010), pp.55-60.
- [10] Sasikala G & Dhanalakshmi KS, "Key Management Techniques for VANETs", *International Conference on Electronics, Communication and Information Systems*, (2012).
- [11] Sari A, Onursal O & Akkaya M, "Review of the Security Issues in Vehicular Ad Hoc Networks (VANET)", *International Journal of Communications, Network and System Sciences*, (2015).
- [12] Hao Y, Cheng Y, Zhou C & Song W, "A distributed key management framework with cooperative message authentication in VANETs", *IEEE Journal on Selected Areas in Communications*, (2011).
- [13] Milojevic M & Rakocevic V, "Distributed road traffic congestion quantification using cooperative VANETs", *13th Annual Mediterranean Ad Hoc Networking Workshop (MED-HOC-NET)*, (2014), pp.203-210.
- [14] Cohen R, Zhang J, Finnson J, Tran T & Minhas UF, "A trust-based framework for vehicular travel with non-binary reports and its validation via an extensive simulation testbed", *Journal of Trust Management*, (2014).
- [15] Indra A & Murali R, "Routing Protocols for Vehicular Adhoc Networks (VANETs): A Review", (2014).
- [16] Dok H, Fu H, Echevarria R & Weerasinghe H, "Privacy issues of vehicular ad-hoc networks", *International Journal of Future Generation Communication and Networking*, (2010), pp.17-32.
- [17] Qureshi KN & Abdullah AH, "Localization-Based System Challenges in Vehicular Ad Hoc Networks: Survey", *Smart CR*, (2014), pp.515-528.
- [18] Diwakar M, Kumar A, Kumar D & Thapliyal N, "VANET (Vehicular Ad-Hoc Networks): Avoidance of Risk Factor in Secure Communication", *International Journal of Engineering and Innovative Technology (IJEIT)*.
- [19] Singla R & Sharma N, "Dynamic path selection with hybrid protocol and secure data transmission with PGP security in VANET", *International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)*, (2014), pp.1-5.