Adaptive Clustering Algorithm for Stable Communication in Vanet

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Article History: Received: 10 January 2021; Revised: 12 February 2021; Accepted: 27 March 2021; Published online: 20 April 2021

Abstract: Clustering in VANET is important for recent days due to more number of vehicle present in urban area. In future Intelligent Transportation System (ITS), VANET is capable of providing safety related applications, Internet accessing and various user applications for drivers and passengers. Clustering based topology an efficient data interaction among vehicles, can be applied to the groups of vehicle nodes in geographical vicinity together that supports direct interaction between the intercluster data interaction through cluster heads (CHs). In existing method, so many algorithms developed Related to clustering based VANET communication, but due to high mobility of vehicle and their parameters like position, velocity and acceleration is improve the complexity and reduce the performance. In this research, we propose an adaptive self-learning approach based hybrid clustering. In hybrid clustering, the process divided in three steps. In first step Type1, it used for Road side unit (RSU) act as a static cluster head. In second step, divide the multiple zones with whole area and apply zone sensitive based clustering algorithm. It is used for predict the efficient centroid/weight value for each Vehicles. Finally in the third step, from the above algorithm, in neuro- fuzzy training samples we got. Neuro fuzzy prediction based cluster head selection was applied. Percentages of cluster-Head for each zone assign the purpose of reduces the end-to-end delay and reduce congestion. In simulation results shows that demonstrate the efficiency of proposed algorithm compare to existing method.

1. Introduction

In recent days VANET is important for both safety and important message transformation. It may be Road traffic or emergency situation around us. In Recent years VANET have many surveys for performance improvement. Data transfer importance and complex due to Spontaneous network architecture and mobility based communication. Unlike WSN model, VANET have these parameters. We have to improve the performance in both Network Cluster and Routing as well. VANETs takes support from vehicles which interconnect each other and road side unit to offer services to numerous applications like street status, lane change indication, accident prevention, map update, etc., VANETs can provide safety related information that contains effects of road traffic along with suggestions to vehicle application or the vehicle driver application [1].

In clustering to limiting channel contention VANETs into small groups, which efficiently controls the network topology.VANETs are a special form of MANET, aim to share the safety related information among the vehicles in the group. Where the vehicles are having wireless communication facility (On Board Unit-OBU) to provide ad hoc connectivity. The Types of different flavors are vehicle-to-sensor, vehicle-to-vehicle, vehicle-to-Internet, and vehicle-to-road infrastructure.

Communication is an essential Research theme in VANETs. The primary purpose of VANETs technology is to support application that driven in the network provides safety and non-safety related applications by using V2V and V2I among vehicles. VANETs have many challenges due to its dynamic nature. Adapt with the structure need an effective and efficient routing scheme needed for data transmission in the dynamic structure of VANETs. In the absence of an efficient routing scheme, vehicles may not be able to exchange information and will lose all the advantages offered by advanced VANETs technology. The proposed Routing schemes have been described in the literature to tackle with the dynamic structure of VANET. VANET have high communication overhead on the Broadcast-based protocols disseminate a large number of messages. The traditional single-hop clustering algorithm does not show good performance affected by the dynamic change of topology in VANET.

2. Related Work

The purpose of the related work is the most misunderstood by young authors. Therefore, it is very important to writing this section. In 802.11 EDCA mechanisms outline four access categories (ACs) with altered parameter to compete for a channel. Authors demonstrate that the performance of VANETs depends on cluster size, vehicle velocity, traffic demand and contention window size. However, no RTS/CTS packets are exchanged before Data transmission. Another paper proposed the clusterbased multichannel MAC protocol for VANETs which is based on TDMA. The TDMA-based MAC a protocol is mentioned in [2-5] it cannot utilise all the time slots of a frame due to lack of neighboring nodes in the network which wastes time slots. In [6] Ren et al. proposed a novel cluster-based routing scheme aim to form a stable group of vehicles leading by an optimal CH. The CH

Selection criterion was contention based on a back-off timer is to calculated from relative speed, distance and lifetime (LLT)). In [7] Hartmann et al. says that the current evolving graph model did not use the reliability of vehicles links. The existing model is extended to VANET-oriented Evolving Graph (VoEG) model aimed at fulfilling the requirements of a vehicular network. Eiza and Ni [10] proposed VoEG (VANET oriented Evolving Graph) model for reliable and stable vehicular communication. The VoEG model is further extended to a new routing scheme called EGRAODV (Evolving graph, Reliable Ad hoc onDemand Distance Vector). In [11] Li et al. proposed a clustering algorithm CCA (Criticality based Clustering Algorithm) based on critical metrics. CCA utilizes both passive and critical measures to cluster, but it does not consider the coverage and scalability. Hafeez [8], Dror et al. [9], Liu and Zhang [12], Javaid et al. [13], and Zhang et al. [14] proposed a clustering algorithm based on fuzzy logic, he used fuzzy process to deal with link reliability problem to improve the cluster stability, since speed is the main reason for link instability. A multi-hop clustering algorithm is proposed by Zhang et al. [15] each vehicle node is required to broadcast the beacon information to its one-hop neighbor node. The neighbor node receives two consecutive Hello beacon packets from a certain vehicle to calculate the Aggregate Mobility (AM) value and then the AM value are broadcast to the N-hop range.

Clustering based on rule base condition like velocity, distance, acceleration of vehicle. In the traditional multi-hop clustering algorithm, vehicle nodes and cluster head nodes with less relative mobility are added to the cluster as cluster members to form a stable cluster structure. By using the Clustering based on the acceleration of vehicle the Scalability is low when network is dynamic.

Khan and Fan says that the conventional Kmeans to organize VANET into three clusters. The main issues with K-means are the prespecified number of clusters, and secondly it may not classify vehicles, which are nonlinearly separable in input space. In evolving VANETs, topology structure changes at every moment and the number of clusters may not be maintained. K-means is non-convex which can’t be optimized. Cluster formation using kmeans like advanced algorithm latency is high. GPSR Routing Under GPSR, packets are marked by their destination locations. The forwarding node can makes an optimal and greedy choice in choosing a packet’s next hop. Specifically, if a node knows its radio neighbors positions the locally optimal choice of next hop is the neighbor geographically closest to the packet’s destination.

Adaptive Disjoint path vector Routing The destination node then selects the path which is maximally disjoint from the shortest delay path. If more than one maximally disjoint path exists, the tie is broken by choosing the path with the shortest hop count. Cluster has two types the Intra-cluster communication and Inter-cluster communication. In Intra-cluster communication is managed through link state routing, and the inter-cluster communication is through gateway nodes that are present in both the clusters. When a source node in one cluster has to determine multiple disjoint paths to a destination node in another cluster, it sends a RREQ Message to its adjacent clusters. The Routing latency is high and greedy process is iterative.

In Proposed system we have divided the number of zones and apply region based clustering. In this region based clustering taken as a reference of Neuro-Fuzzy model. This Neuro-Fuzzy model predicts, the output based on Training Data. Thus our self-learning mechanism give higher performance. In our proposed work divided into threesection

1. Section-II has explained the concept of clustering related work.
2. Section-III has System model, algorithm and all details.
3. Section-IV have simulation Result and Analysis

3. System Model

In VANET nodes are Dynamics in nature. The vehicle to vehicle communication and vehicle to RSU Communication link breaking or data loss due to fast movement of node. To overcome the problems so many methods develop by using cluster head method. But most of the Existing CH Method only consider about selection of CH. Since initial condition doesn’t follow after some time interval. So we need initial CH Selection and frequency updating of CH with fast & efficient manner. At the same time congestion overhead also important problem, all datatransfer by single CH means it’s create congestion or delay in data communication. To overcome the above problem in proposed method, initial case we have assign percentage of cluster head assign in each zone. In example, Nearest to sink node have high percentage of cluster head for avoid data congestion. In second step develop static zone based clustering based on node position, velocity & Buffer size parameters number of cluster assign based on PCH. After assign initial cluster with CH selection. In VANET have high dynamic condition is nature, so CH Validate & update also important based in initial clustering we have extract the learning data and it’s apply to Neuro-Fuzzy Rules predicted by self-learning mechanism used in initial clustering method. This self learning mechanism predicate the rules based on these rules we create or update the CH efficiently.

Initialize no of node their X, Y position, velocity and Buffer size of each node. Initially selected the high buffer size node selected as a cluster head.

Sl.No	Notation	Description
1	N	Total no. of nodes in network

2	RSU	Total no. of RSU
3	maxW	Maximum width of Road
4	Len	Length of Road
5	Vel	Velocity of Vehicle

Table 1. 1 Important Notations

a) Zone Division & Pch Estimation

In VANET we have analyze static zone clustering method. Initial the Region divided by zones. In our method equal zone division approach is applied. Normally zone division is calculated by sensor radius of vehicle node. Then only increase the coverage area.In Pch estimation process is thoroughly to avoid data congestion. So each zone vehicle divided initially estimate maximum Buffer size node in each zone compute the distance between the source & sink node in each zone. Finally develop the rules for each condition like distance < 100 then Pch =10 likewise this details explained in

Algorithm (1). The Proposed model based on static zone method. In static zones we have arrange more no of nodes let assume we have 2 lane with height h=200 and width=400

No of Zone = Total Width/Zone
Width x 2 ----(1)
The 2 lane region divided the zones based on equation (1) and sink nodes shows in Right top end.
Pch –Percentage of Cluster Head.
Chm – Max Buffer size each Zone
Chm dist = abs (Chm position-sink node position)
Pch = f (Chm dist)……….(2)
According to Equation (2) computes the percentage of cluster head.
Algorithm 1 Initialize: N, Rsu, 2-node division
Input: position, buffer size
Output: Compute Pch(Percentage of CH)
Initialize zones and assign equal no. of zones
for each zones
index = max Buffer size node
Dist = (sink node position-index node position)
if (Dist<100)
Pc=30
elseif (Dist>10 && Dist<=200)
Pc=10
elseif (Dist>200 && Dist<=300)
Pc=5
else
pc=3
end
end zones

b) Weight based Clustering

In this section developed static zone based clustering. In most of the existing method only given importance in zone region only but in our proposed method we need to add additional parameters like velocity & Buffer size of each node. In clustering the node in each zones separately. So each zone have cluster member and cluster head. No of cluster head assign based on Pch Value.

Each node position (x1, y1), (x2, y2)…….. (XN, YN)
Each zone node indicate
[X (index), Y (index)]……..(X1, Y1) Zone center position indicated by
[zX + 50, zY+ 50] …. (X2, Y2)
Position distance = $\sqrt{}\ ((X1 - X2)2 + (Y1 - Y2)2)$

Each zone assigns weight value in 3 parameters like position velocity & Buffer size. The velocity of each vehicle & Buffer size of each vehicle assign some weight value like w1 =0.6; w2 =0.2, w3= 0.2

The final weight value calculation based on clustering. W=w1 position distance + w2 x velocity + w3 x Bs

The weight based clustering performed by k-means algorithm. Ineach iteration, calculate the weighted centroid value. In this algorithm our main aim is intra cluster value should be minimum and inter cluster distance should be maximum. These proposed concepts explained in Algorithm (2).

Algorithm 2(Modified)
Initialize: N, RSU, zW
Input: position, velocity and buffer size of each vehicle, pch

Output: cluster head selection
Initialize nodes and assign equal no. of zones for each zones
if (zones! = Rsu) pos=[x,y] vel=velocity of vehicles
Buff=Buffer size w= w.pos + w2.vel +w3.Buffer;
Objective function of clustering
F= K/((1/ik)
Update the value xk based on k-means Iterate k-means until get optimal centroid Else No clustering Rsu unit assign as cluster head
End Result: multi-centroids (cluster with cluster head)

c) Neuro-Fuzzy Prediction

In previous step, CH selects made by clustering Algorithm. After ktime zone update & validate of CH also important. For creation of this model, we create Neuro-Fuzzy prediction method. At first fuzzy based membership function will be created we have to Gaussian –bell shape membership function is used for more information. For efficient creation of rules, Neuro-fuzzy modelbased training sample acquired by initial clustering Algorithm (2). In Neuro-Fuzzy given i/p for node position [X,Y], Velocity Buffer size of vehicle. A self learning mechanism is nothing but the fuzzy rules are created by initial clustering algorithm. So we don't need any additional training Neuro-Fuzzy easily turning depend upon initial condition nodes.Based on training data fuzzy rules create and updated. Totally we use 40 iteration for minimum training error in neuro-fuzzy. This updated neuro-fuzzy engine called as selflearning CH predictor. After the vehicle/node movement in each zone, our CH predictor, predict the particular node CH or not. It's a fast process, so CH formation delay also very less. All details explained in Algorithm 3

Algorithm 3: (Neuro-Fuzzy Training)
I/p: i) Node member with Centroid value
ii) Membership function model of Fuzzy
O/p: Rule Prediction a) Initialize zones and compute
Pch→Percentage of CH
PCHzones = Total no. Of nodes in particular zone / Total nodes
b) Neural N/w used for Training the Fuzzy Model
yik = f(n, Dik)
c) Rules Creation by using Neural N/w
d) Predicted rules

d) Routing

After CH formation & validation the data communicate to source to destination. Initially compute the distance b/w each CH to CH distance and velocity the distance is greater their sensor radius we have assign the link reliability is infinite. Apply dijkstra algorithm for routing, so we consider both like forward and backward searching. The routing path estimated with minimum cost.

4. Simulation Results

All the simulations performed by using MATLAB 2019a. We design both animator and CH Selection with Routing. At first define the zone area & division second apply zone clustering and CH Selection. Third update/Validate the CH by using Neuro Fuzzy method. Finally Routing happen by Dijkstra algorithm.

a) Simulation Test case:Simulation Test Case model with different No of Vehicles like [100,160,200], we have evaluate the performance in two condition, One is based on different velocity delV= [5, 10, 15, 20] and another one test case for different sensor radius R = [100,120,150,170].

The Simulation Environment carried over two different conditions. Like with RSU and without RSU. Totally USE 4KM distance with 2 lanes.

Sl.No	Parameter	Value
1	No. of Lane	2
2	Length	4
3	Zones	8
4	PacketSize	500
5	No of Vehicle	[100 160 200]
6	Sensor Radius	[100 120 150 170] m
7	Change in Velocity	[5 10 15 20] Km/h

Table 2.1 Simulation Parameters

The efficiency measure method described below Packet delivery Ratio:The average ratio of successfully received packers as sink node and total packet generated in source node.

Average End-to-End Delay: It is the time difference b/w communication the data source from destination. Data transfer b/w source to destination may be loss due to node coverage area or their position. CH formation

Delay:Initially CH Selection based on clustering algorithm, after t- time slot CH updates /validate based on Neuro fuzzy prediction. This time duration of CH update called as CH formation delay.

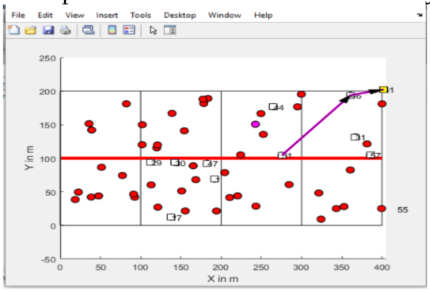

Figure 1. Routing path

In this fig. [1], totally 60 nodes, sink node indicate as yellow color find cluster head node shows white square color. Routing path shows in magenta color. The Routing path shows communicate via, source to destination.

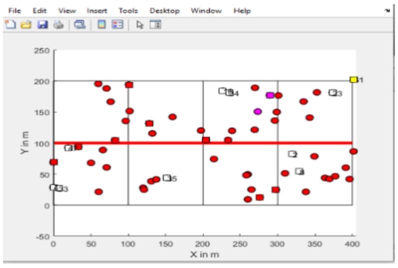

Figure 2. Updated cluster head

In this fig. [2], after t-time slots, here also use 60 nodes with different velocity of nodes white node as cluster Head updated by NeuroFuzzy. The routing path shows in magenta color.

a) Performance Related to Sensor Radius (R):

In first test case performance Analyzed with different sensor Radius like

R= [100,120,150,170] m. I. Packet delivery Ratio

Packet Delivery Ratio

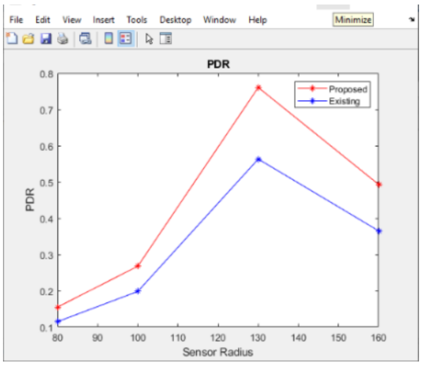

Figure 3

The above fig. [3] Compares the Packet Delivery Ratio (PDR) with sensor Radius. If the sensor radius is low, the communication path breakage maybe happen, so it's automatically reduce the PDR if sensor radius increases more most of the communicate data from source to sink with low number of hopes in this time due to packet congestion, the PDR may be decrease. But compare to existing method proposed method have high PDR.

End to End Delay

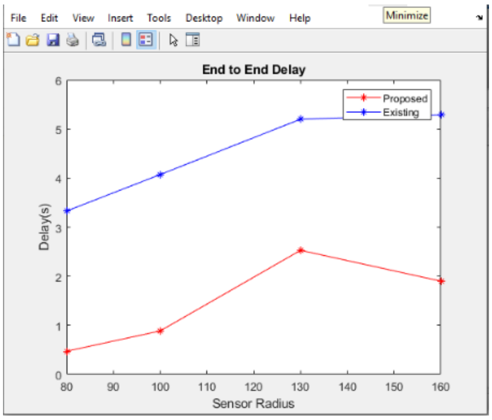

Figure 4. End to end delay

Fig. [4] End to End delay varies based on sensor radius. The sensor Radius in low value, the path breakage may ne happen. So normally in low sensor radius End to End delay is high .When sensor radius increases the End to End decreases compare to exiting method proposed method have low End to End delay.

CH Formation Delay

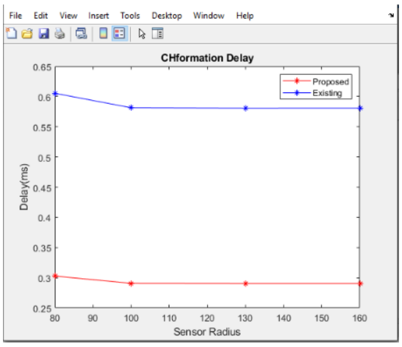

Figure 5. Cluster head formation delay

If Sensor radius increases doesn't affect the cluster head formation delay. Since every particular event check the CH validate (update) based on Neuro fuzzy prediction, prediction &update new CH). The overall delay process charge based on No of vehicle only. Compare to exiting method proposed method have low CH formation delay. If change in velocity increases it doesn't after the cluster head formation delay. Since every particular event check the CH Validate/Update based on Neuro fuzzy prediction predict & Update new CH.

Ada Boost Algorithm

Boosting technique is used to train predators step by step, with each step it tries to correct its predator. AdaBoost is very much similar to Random Forest where they both try to convert weak classifier into strong one. In our proposed system we used the real time dataset which is created in the running project using 2000 nodes at a time

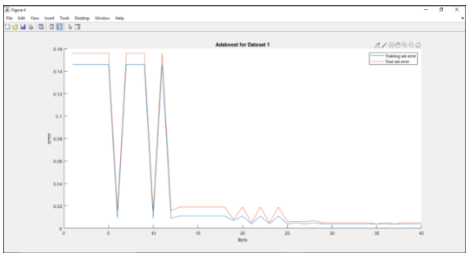

Figure 6. Training set error

In the above graph which is created by using adaboost algorithm it shows the relation between Training set error and Test set error. Red colour graph indicates the test set error

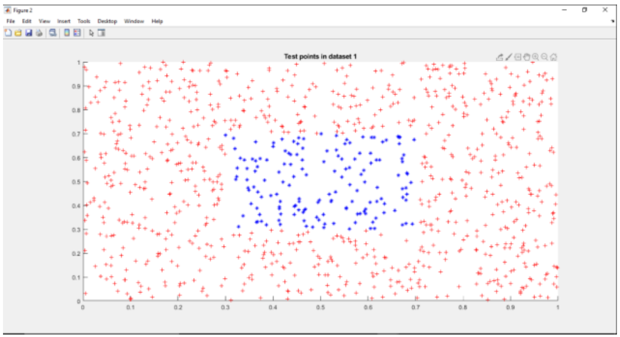

Figure 7

This fig. [7] represent the test points in dataset 1.

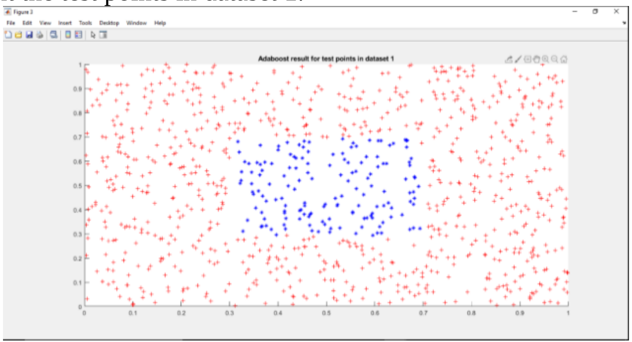

Figure 8

This fig. [8] shows the Adaboost result of test points in dataset 1.

5. Conclusion

In this paper, we propose an adaptive self-learningapproach-based hybrid clustering. In hybrid clustering, the process divided in three steps.

In first step Type 1, it used for Road side unit (RSU) act as a static cluster head.

In second step, divide the multiple zones with whole area and apply zone sensitive based clustering algorithm. It is used for predict the efficient centroid/weight value for each Vehicles. Finally in third step, from the above algorithm, in neuro- fuzzy training samples we got. Neuro fuzzy prediction based cluster head selection was applied. Percentages of clusterHead for each zone assign the purpose of reduces the end-to-end delay and reduce congestion. The simulation results demonstrate the efficiency of proposed algorithm in-terms of PDR, Avg end-to end delay and cluster Formation delay all are efficient compare to existing method. Acknowledgement This Proposed Analysis, with the help of MATLAB. Thank you for Trial Version, it is having versatile option for any analytics in simulation made easy. A better tool for researcher's for single window application.

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