Development of Multihop clustering algorithm for the simulation of VANET

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Abstract

Automobile communication using Vehicular Ad hoc Network security (VANET) is a promising area for traffic safety and management. The communication between vehicle to vehicle (V2V), vehicle to infrastructure (V2I) using wireless communication provide infotainment to drivers. Vehicles are built with on board unit (OBU) having sensors are used to communicate with vehicle and also to the infrastructure. Dedicated short range communication (DSRC) and wireless access vehicular environments (WAVE) are the communication standards on these transportation services. This research was systematically explains the simulation of VANET and a multihop clustering algorithm for the communication between vehicles is developed. Multihop clustering makes neighbourhood connectivity among the vehicles. Security is important for information and dissemination. Establishing trust is a challenge while one or more malicious nodes attempt to disrupt route discovery or data transmission in the network.

Keywords: VANET, Vehicle to Vehicle, Multi-hop, Cluster.

I. INTRODUCTION

The vehicular ad hoc network (VANET) has emerged with the fast growth of wireless technology that allows vehicle-to-vehicle communication. VANET is one of the main mechanism of an intellectual transport scheme because it presents huge possible in accident warning, traffic management, also providing infotainment.

Wireless sensor network (WSN) Architecture is built a "nodes" from a small number of more than hundreds or even thousands, where each node is connected to one or sometimes several sensors. A sensor network consists of several detection station called sensor node [1]. These sensor nodes can automatically self-organize into an ad hoc network. Every sensor nodes having similar operation and perform conforming to the identical rules in routing. WSN are widely used in many domains, such as environmental monitoring, target tracking, security surveillance [2]

Clustering in VANET exhibits good scalability, because clustering can provide a simple information management mechanism and improve communication in effectively. Clustering algorithms for VANET are attracting increasing attention [3]. Single hop clustering which only allows communication between a cluster member (CM) and its cluster head (CH) with single hop distance. The coverage of clusters is small in single hop clustering, which leads to excess CHs and high maintenance overhead. Multihop clustering algorithm extend the coverage of clusters, reduce the number of CHs[3]. Multihop distance vehicle can choose their CH between multihop neighbours.

Generally, Road is divided into two different region and which vehicle is entered first to same direction is selected as CH direction, where similar direction vehicles are grouping mutually and vehicle announce itself as a CH else it does not receive any of the invitation message from other cluster head within duration period[3]. Finally everywhere single-hop clusters is only for direct communication. Multi-hop clustering algorithm in VANET, packet delivery delay to find the next of the mobility between the nodes. Carry-and-forward type heuristic methods have been mainly used for routing packets over multihop communications in VANET [6].
Fig 1 represents a initial message HELLO sends from a cluster member the invitation sends to neighborhood cluster over the receive vehicles list. If member get a response from requested member. It will be the Cluster head for this member. It allows the transmission. Cluster member contains vehicle id, number of followers list and forward history record list. The elements of this list contain the id of forwarding vehicle and forwarding time. Cluster member waits until the time expiration. If it’s expired cluster member approach to next target.

The goal of this paper is to design a constant multi-hop clusters with minimum number of cluster heads in VANET. A cluster has a CH, which is directly or indirectly followed by other vehicles [5]. CHs are then chosen according to the obtained relationship among vehicles, and other vehicles directly or indirectly follow CHs to form clusters. A neighborhood follow method is initiated for vehicles to choose and follow stable target vehicles from multi-hop neighbours.

II. SYSTEM MODEL

Nodes of vehicle is to create clusters, every cluster have a cluster head, these nodes are communicate with their cluster head in two way that i) one hop ii) multi-hop. One hop and multi-hop clustering method shown in Fig.2. Centered vehicle is the Cluster Head(CH), others are the Cluster Members(CM). This design is to reduce the count of CH and diminish the cost of communication.

![Figure 1: Cluster formation](image1)

![Figure 2: Clustering method](image2)
In One hop cluster vehicles are communicate directly to it’s CHs and indirectly communicate with other vehicles by the help of CHs. One hop cluster scheme barely certify the interconnection among CHs, CMs. In Multihop cluster vehicles are communicate directly to it’s CHs. Multihop mechanism agree to CHs to indirectly communicate with CMs likewise CMs can communicate with their CHs throughout other midway of CMs. These conditions allow CMs and CHs to move in a stretchable manner.

Figure 3: Neighbourhood Structure

Directional communication: Vehicle A is reveal a direct connection with vehicle B,

\[ C: A \rightarrow B \quad A, B \in NBHD \]

NBHD(a) defines the one hop cluster neighbours of vehicle A. A vehicle can choose it’s target by the way of which of the following vehicle is stable.

Bidirectional communication: Incase of b vehicle not fit in NBHD(A), but the connection is extended to B mean

\[ A \rightarrow C \rightarrow D \rightarrow B \] also mean as \[ A \rightarrow B \]

Neighbourhood nodes:

\[ FC_c = \{ A | A \rightarrow C, \forall A \rightarrow C \rightarrow A \} \]

where FC_c denotes a cluster whose CH is vehicle a, which is directly or indirectly followed by other vehicles, between the CM vehicles in the left cluster, vehicles 1,2,4,5 and 6 directly follow vehicle 3 which is also indirectly followed by vehicles 14 and 15 shown in Fig.3

Follow Uniqueness:

A CM directly follows only one one hop neighbour and directly or indirectly follows only one CH. each vehicle in the relationship only has one target to follow. That is represents in Fig.3, no other follow relationship exists from vehicles 9 to 11. Moreover, vehicle 11 only indirectly follows vehicle 9.

Choosing Target:

Vehicle a is trying to follow a target which is already followed by many vehicle. When choosing which target to follow, vehicle a considered a number of followers of possible target

\[ Gain - f_{CA} = f_{CB} \sum_{i \in NBHD(A)} f_{Ci} \]

where \( B \in NBHD(a) \) if a vehicle followed by many vehicle, then these vehicles are relatively stable with it.
Selecting cluster head:

CHs transmit the packet for communication to other vehicles over a network. Selecting stable vehicle as CHs for reduce the packet loss.

\[ ch_b = (a \rightarrow b) \land (c > fc_a) \land (AvrgRelMob_a, AvrgRelMob_b) \]

\[ AvrgRelMob_a = \sum_{b \in NBHD(a)} RelMob_{(a,b)} / |NBHD(a)| \]

Initial message

Step 1: Get the nearest transmission time from vehicle receive id(rcv_id)

Step 2: find the latency of packet by current time – predefined time

Step 3: if some latency in packet transmission.

Step 4: calculate the value of relationship of movement and set the value to the neighbour list [rply_id].relMob, condition end.

Step 5: whether packet is dropped. Starts from first, the value of forward count is 0

Step 6: if element id and receive id is same

Step 7: forward count added

Step 8: if forward count value is become 2 then drop the packet, else send the packet to vehicle rply_id.

Step 9: current state of the vehicle is waiting for next cluster head turn after that a cluster member

Reception of a Head message

Step 1: Each vehicle in neighbourhood list is FOLLOWER and then it’s a CLUSTER_HEAD or a CLUSTER_MEMBER

Again do the process & Drop the received packet, stop the process

Step 2: If state == CLUSTER_MEMBER then

Step 3: Drop the packet else

\[ Ch = ch_id \]

Step 4: Broadcast the messages to all followers
III. RESULTS AND DISCUSSION

CH duration is the time interval of a vehicle changes from one state to another state during the communication process. Average cluster head duration is calculated by whole count of cluster head duration into number of state changes form one state to another state. Fig.4 indicates that CH duration decreases with increase of vehicle velocity. This is difficult to maintain CH being stable with neighbourhood vehicles. If it is not able to maintain the state, demote CH to CM and also increase the count of state changes from cluster head to cluster member. CH stability is believes with neighbour vehicle’s followers and their targets. This will enhance the robustness of vehicle velocity. The measured values for the CH duration is tabulated in Tab. 1.

The transmission range aspect control the stability of CH vehicle and CH duration increases with increasing the transmission range. The vehicle again choose the new target once its loss the target. CH change number is the number of vehicles whose state changes from CH to CM during the process. A minimum amount of CH change number leads to a stable cluster structure. The measured value for the CH change number is tabulated in Tab. 2.

Fig. 5 shows the visualization of CH change number during different transmission and velocity scenarios. In this the CH change number moderately increases with increasing velocity that vehicles satisfy the conditions for CH, which is having stable followers.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
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<tbody>
<tr>
<td>Area range</td>
<td>200 metre</td>
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<tr>
<td>Maximum velocity</td>
<td>35 m/s</td>
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<td>Number of vehicles</td>
<td>50</td>
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<td>Velocity interval value</td>
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<tr>
<th>Velocity m/s</th>
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<th>H160</th>
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Table 1: Cluster head duration
Table 2: Cluster head number change

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Figure 4: Cluster head duration

Figure 5: Cluster head number change
IV CONCLUSION

A multihop clustering algorithm for the VANET with enhanced communication is derived. Clustering model is presented based on the neighbourhood follow strategy. Multihop clustering allows vehicles to choose its own targets from neighbours. This clustering method reduce the count of the CHs. This strategy improve the strength of clusters during network evolution. Multihop clustering save us from the traffic delays and save our valuables time.

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