A Testbed for Experimental Verification and Development of Cluster-Based Routing Protocol

Kaur, Tanveer (MS Electrical Engineering)
Hule, Ajitesh (MS Electrical Engineering)

Introduction

Background

In today’s era, Intelligent Transportation Systems (ITS) applications stand strong and Vehicular Ad-hoc Networks (VANETs) is one of the examples of it. Beside Mobile Ad-hoc Networks (MANETs), VANETs consider to be the widely use application in Intelligent Transportation System. Since VANETs is used widely now, problem like scalability is taking place largely. VANETs can make two or more vehicle communicate each other while they are in motion. VANETs can analyze the traffic problem, road safety, any natural challenges taking place on the way of vehicles, traffic efficiency and ensuring the driver about the problem took place in the further way, avoiding the dangerous situation ahead [1].

VANET architecture has its architecture majorized in communication style. Communication take place in VANET are divided in four types:
1. Vehicle to a roadside unit (V2R) communication
2. Vehicle-to-vehicle (V2V) communication
3. Vehicle-to-cloud (V2C) communication
4. Inter-vehicle communication

During the time of communication between vehicles the three metrics are considered to be vital and those are velocity of the vehicles, distance between vehicles and direction of the vehicles. Primary goal of the project involves measuring all these metrics as accurate as possible. With the help of these three metrics, vehicles which are in motion can be located appropriately in a real time.

Task 1

The first step involved was to create a network of different hubs/nodes (VANets) that travels at random speed and direction so that later they could be grouped together based on these parameters. So, in order to do that the key challenges were faced i.e. collision, number of nodes and speed of all the nodes. We designed a code using various formulas and we could set parameters for each node at the same time in a network. While building this solution certain scenarios need to be adjusted for such as collision between two nodes, dynamic parameter modifications and incorporating variable sample size. After implementing these changes in solution, we created a simulation to observe the desired movement between the nodes in a network.

Task 2

The second goal is to make clusters which should be in such range that clusters can communicate with each other. Also, area covered by the cluster should be large enough which can accommodate many vehicles as the cluster members. Formation of clusters makes work easier because it helps the base station or UAV to communicate with only one vehicle i.e. cluster head and with all the cluster members.

Methodology

Task 3

The third task is to use above mentioned parameters and assign one node as the cluster head of each cluster. These cluster heads are responsible for any type of communication between each node of the cluster. These cluster heads are even responsible for making any kind of the communication between different clusters as well (inter clusters). And the last goal of the project is to implement a python code which helps to overcome above two goals. The code can measure the metrics properly as well as make cluster heads communicate each other. Code gives raise for demonstration of various clusters and shows the agents in motion.

The main objective of the optimized solution was to implement a code and design a network using multi-layer clustering techniques using python. The hubs/node architecture is designed in such a way that there exist a Cluster Head (CH) as well as cluster members (CM) connected to each CH. Each CH is assigned to various DMs in similar manner as cluster member are formed (based on speed, direction and sample size).

In earlier VANet communications, any vehicle could send data packets to any other vehicle via hopping techniques and leads to increase in complexity but in cluster based VANets, complexity decreases because each CH is responsible for maintenance of their network cluster on its own and help nodes to communicate with each other.

Analysis and results

Considering to the limitation highlighted in the VANET technique and mentioned in the literature survey, a more standardized and scalable ways are created to improvise the model. The objective of the project is to form improvised VANET architecture.

Primarily worked on to analyze the project’s improvisation areas by going through literature surveys mentioned. When analyzed the key roadblocks in the project which is to improve VANET architecture. I implemented the code where now it shows that it is more stable and scalable from three metrics aspects and those are distance, velocity and position of the UAVs. Used python 3.7 to implement the code for this project.

Taking a situation in consideration, whenever any incident occurs the first step is about V2VIncidentEventHeader which will be containing the information sent as soon as incident begins, following to that V2VClusterInfoHeader always help in updating the neighbor information while these both entities are busy exchanging the messages for cluster formation. Till now, there wasn’t any awareness about Vehicle to vehicle (V2V) communications but after there was an update in the ns-3 version, it encouraged the researchers to develop the algorithms for the implementation of clusters as well as for the V2V applications. In this paper, author focused on how to form the stable clusters, and shows the results they obtain from cluster algorithm stability as well as cluster forming.

Summary/Conclusions

A current issue of cluster based VANETs is examined here in the project report. A straightforward technique to execute and implement the Time division multiple access in this kind of network design is examined and executed. Progressing research on the subject is talked about in this report. The report principally focuses on scaling the previously existing VANETs calculation using cluster-based routing algorithm.

Further improvement in the process can be shown by the demonstration or actual working of the project.

Key References


Acknowledgements

I would like to express sincerest gratitude to my esteemed mentor Jonathan Ponniah, Professor, at Charles Davidson college of Engineering, San Jose State University for his regular devotion and valuable guidance throughout the completion of the dissertation. It has been a matter of privilege to get the opportunity to learn great insights of in-depth knowledge under their mentorship.

A current issue of cluster based VANETs is examined here in the project report. A straightforward technique to execute and implement the Time division multiple access in this kind of network design is examined and executed. Progressing research on the subject is talked about in this report. The report principally focuses on scaling the previously existing VANETs calculation using cluster-based routing algorithm.

Further improvement in the process can be shown by the demonstration or actual working of the project.

Key References


Acknowledgements

I would like to express sincerest gratitude to my esteemed mentor Jonathan Ponniah, Professor, at Charles Davidson college of Engineering, San Jose State University for his regular devotion and valuable guidance throughout the completion of the dissertation. It has been a matter of privilege to get the opportunity to learn great insights of in-depth knowledge under their mentorship.