VEHICULAR ADHOC NETWORK (VANET) BASED CONTROL SYSTEMS FOR SMART TRAFFIC LIGHTS

A PROJECT REPORT

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in partial fulfillment for the award of the degree of

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BONAFIDE CERTIFICATE

This is to certify that the project report entitled " **Vehicular Adhoc Network (VANET) based control systems for Smart Traffic Lights** " submitted by

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INTERNAL EXAMINER EXTERNAL EXAMINER

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Abstract

Vehicular ad-hoc networks (VANET) is a famous and special kind of wireless mobile ad hoc network. It is ad-hoc network where each network node acts an independent and self-organized network. In VANET various routing protocols have been proposed and used and they are of high importance for desirable VANET applications. In this project we plan to propose an improved routing algorithm to facilitate faster communication between clusters. The simulation results of position based routing protocols are discussed in terms of packet delivery ratio and throughput metrics.

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List of Abbreviations

AODV AdHoc On-Demand Distance Vector

IASC Improved Ant System-based Clustering

QoL Quality of Link

QoS Quality of Service

VANET Vehicular AdHoc Network

Chapter 1

Introduction

1.1 Background

VANET is one of the type of MANET (mobile adhoc networks), in which vehicles are simulated as nodes. Access points and vehicles are two important parts of VANET. The vehicles keeps moving as distributed point and access points are connected to the internet network and are fixed. Vehicle to vehicle and Vehicle to infrastructure access point are two types of communication in VANET. When the messages are transferred between the vehicles the communication is called vehicle-to-vehicle communication, and when the messages are transferred between vehicle and access point is called vehicle to access point communication.VANET is special case of MANET because of different road structures and high mobility of vehicles and since there is no restriction on network size of number of nodes, these special environment of VANET is a challenging task for developing its routing protocols.

1.2 Problem Statement

Rapid urbanization has put increasingly pressure on traffic management in urban areas. Conventional traffic signal with fixed or pre-defined variable cycles

setting can slightly alleviate the increasing traffic problem, but cannot deal with continuously growing vehicular traffic in rapidly growing urban areas. Hence we propose a VANET based traffic control system, that helps to identify traffic density and control the traffic signal timers accordingly.

1.3 Specific Objectives

We intend to use a two level cluster based system to communicate between nodes and between clusterheads. The proposed system takes into account metrics such as the distance of the node, the velocity of the node, the direction of the node and the transmission power of the transmitted signal (ST). The purpose to use cluster based routing is the feasibility of self-organization and maintain routing if the topology of network keeps altering.

1.4 Findings

In networks with high velocity, AODV suffers from more delay since the number of hops increases due to broken links or establishing entirely new routes to destinations.In the proposed routing protocol, since the most reliable links are selected between members of cluster and between cluster-heads, the node will be selected at the lowest cost (better velocity, closer distance with the current node), hence the probability of a link failure is reduced and the packet delivery ratio in the destination is increased.

Chapter 2

LiteratureSurvey

In [1], a new two level cluster based routing protocol is proposed. In the first level communication between node and clusterhead is done based on link strength evaluation.If the node has a strong link to the clusterhead, it will send the packet to the clusterhead immediately. Otherwise, on the basis of metric feasibility condition, it chooses the best neighbor from the neighboring cluster which has a strong link to the clusterhead and sends the packet to it. The second level of the proposed method is used for routing between clusterheads. Here the clusterhead makes use of greedy algorithm to the best next clusterhead.

In [2], a QoS-based unicast routing protocol is proposed. This protocol consists of: a clustering algorithm and an artificial bee colony algorithm based on QoS criteria to find the best route from a source to a destination. Available bandwidth, end-to-end delay, jitter, and link expiration time are the criteria used in this method.

In [3], the accident vehicle is considered the cluster head and all others are considered cluster member. CH broadcasts emergency message first, then, only farthest vehicle performs a re-broadcasting the received emergency event among the vehicles in the transmission range which will be the next CH. Similarly, the other clusters can be formed with the same steps.

In [4], Continuous broadcasting is done whether any vehicle is in range or not; communication is established or not.Warning message module then sends the data to the traffic density calculation module. Then calculations are made in this module and traffic density of each road is calculated. The first two module then sends the data to the decision making module and the appropriate decision is made here and hence best congestion free path in provided to the particular vehicle whenever it come in the given ITL coverage range. Every ad-hoc node set on the scenario is configured with Ad hoc On-Demand Distance Vector (AODV)[5] routing protocol.

In [5], This paper starts with the basic architecture of VANET and provides a detailed description of various existing routing techniques with its advantages and disadvantages. Finally, this paper discusses an overview of the existing routing protocols for VANET.

In [6], two new ant colony based systems are proposed as IASC1 and IASC2. IASC1 uses SC (Silhouette Coefficient) and IASC2 utilizes GA (Average distance between two clusters).Proposed algorithms take the speed and the location of nodes into consideration during five sub-procedures Divide, Agglomerateobj, Agglomerate, Remove and CH selector.

Paper	Year	Parameters
Parisa Saraj Hamedani , Arshin Rezazadeh. "A New Two Level Cluster-Based Routing Protocol for Vehicular Ad Hoc NETwork (VANET)."	IEEE 2018	QoL(quality of link), distance of the node, the velocity of the node, the direction of the node and the transmission power of the transmitted signal
Mohammed El Amine Fekair, Abderrahmane Lakas , Ahmed Korichi. "CBQoS-Vanet: Cluster-based Articial Bee Colony Algorithm for QoS Routing Protocol in VANET"	IEEE 2016	Available bandwidth, end-to-end delay, jitter, and link expiration time and degree to determine QoS. Multipoint relays selection algorithm for inter cluster communication.
Wenxiao Dong , Fei Lin , Hongling Zhang , Yuping Yin. "A cluster-based recursive broadcast routing algorithm to propagate emergency messages in city VANETs."	IEEE 2017	Traffic accident vehicle elected as cluster head. Next farthest message receiving node considered as next cluster head.

Figure 2.1: Comparative Study of Base Papers

Chapter 3

Proposed System

3.1 System Architecture

Our proposed system is going to be a combination of [1] and [2]. Here we plan to implement a two level cluster based routing protocol. The first level uses QoS based Bee colony algorithm to elect a cluster head and to communicate between cluster heads and cluster members. The next level uses a greedy method to choose the nearest cluster head to communicate with.

3.2 System Specification

1. Communication control unit 2. Application unit 3. Human machine interface 4. ITS Vehicle station 5. ITS Roadside station 6. ITS control station

3.3 Methodology

1. Cluster Head Election

The cluster head is responsible for selecting the appropriate path between

the source and destination by routing packets according to an Artificial Bee Colony (ABC) algorithm based on specific QoS requirements.

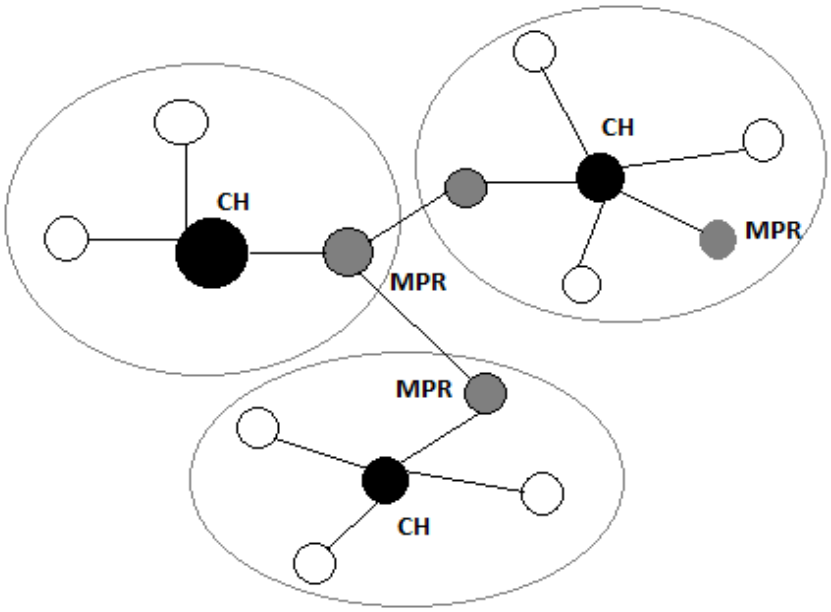

Figure 3.1: Cluster Head Election

2.Communication Principle

CBQoS-Vanet protocol is inspired by the way a swarm of bees communicate and their forage for food. Here, the protocol uses two types of packets. The first type of packets, called scout is used to discover route between the cluster head to a given destination, a route that satisfies a certain QoS condition. Thus, the discovered route should satisfy a combination of conditions based on the available bandwidth, the end-to-end delay, jitter, and link stability. The second type of packets, called forager is used to transmit the data between nodes.

3.Greedy Algorithm

The greedy algorithm performs the best choice according to the problem conditions and determined criteria. It hopes optimization is done with continuing the same procedure in every step. In a greedy way, the element that is best based

on a certain criterion is selected at each step.

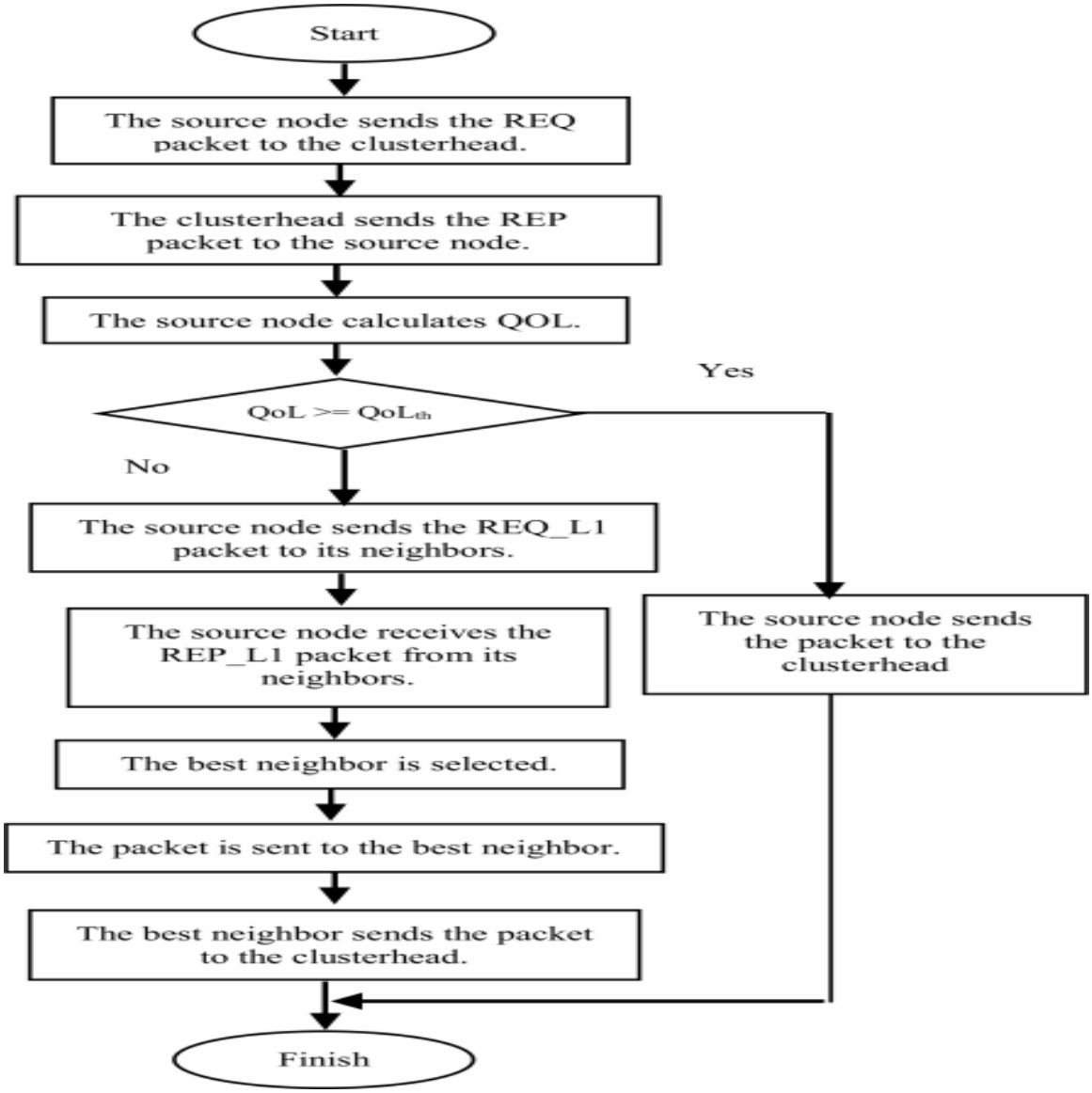

Figure 3.2: Greedy Algorithm

3.4 Implementation

The cluster head election algorithm works as follows: -each node n broadcast Hello messages to its one-hop neighbors, containing it QoS value every time period.

-Within a Wait Time , if no new neighbor has joined the cluster, then all

existing nodes in the neighborhood will send an Elect message to the node with the best QoS value selecting it as the cluster head.

-In the case a node has received an elect message before the Wait Time has expired, and the node does not have the best QoS value, then it will send an Elect message to the nodes in its neighbors list with the highest QoS value.

-The node which has received an Elect message from all its neighbors will change its class to cluster head and assume this role by broadcasting an Ack message to all its neighbors. Upon receiving the Ack message, all the other nodes will assume their role of Cluster member.

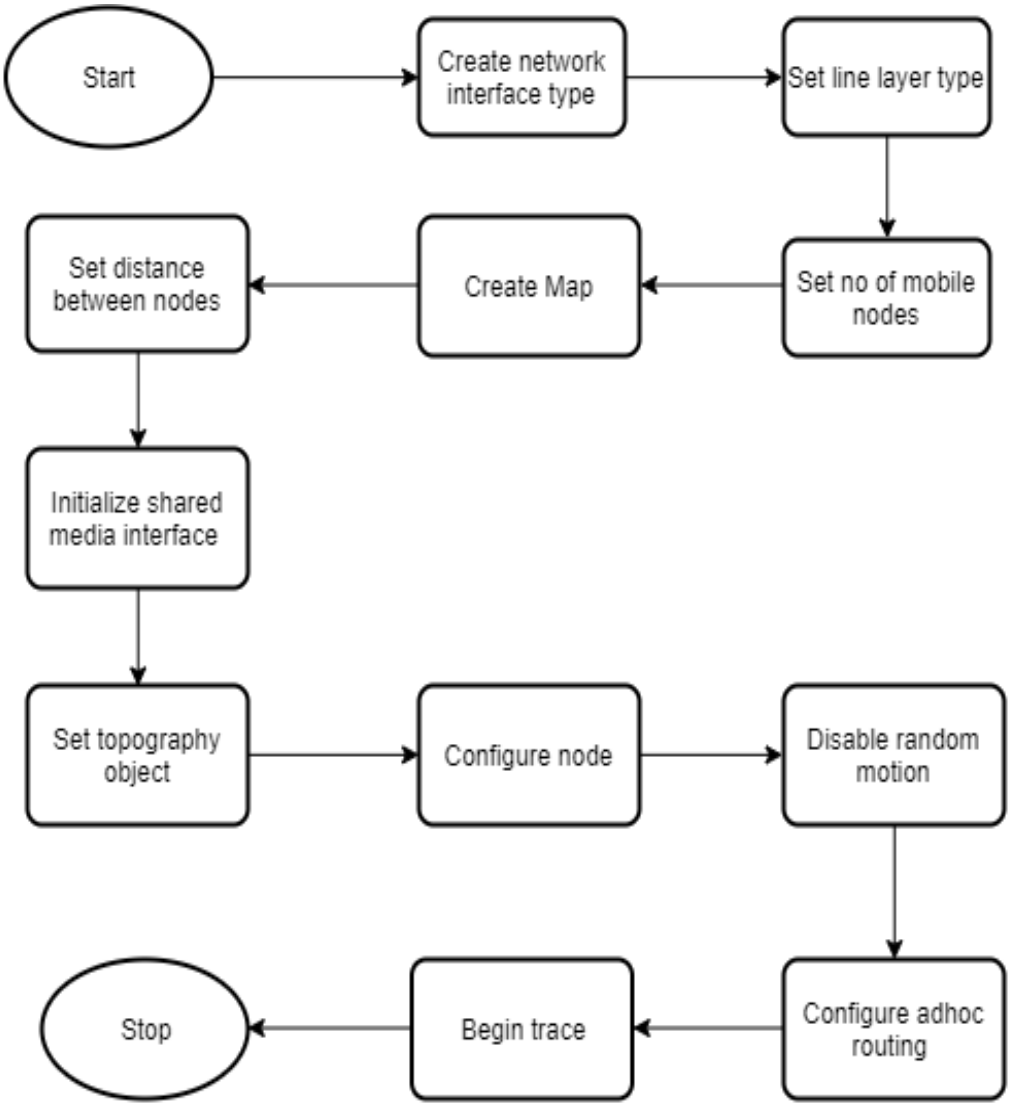

Figure 3.3: Creating Vanets

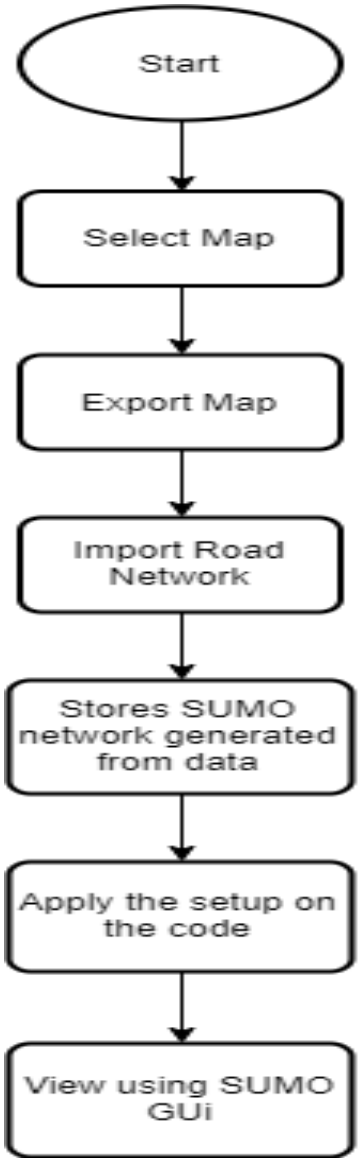

Figure 3.4: Creating Realtime Traffic

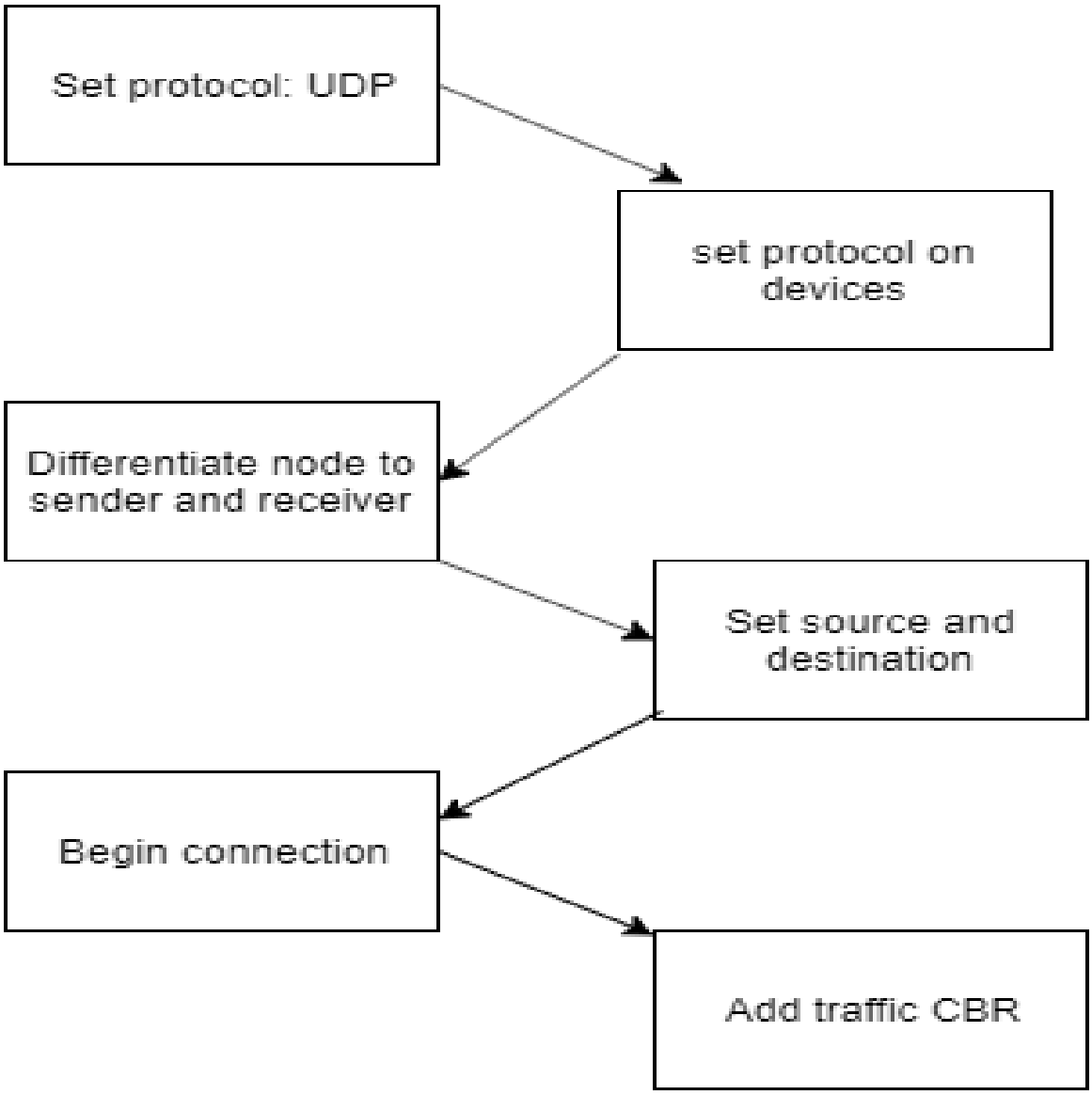

Figure 3.5: Message Broadcasting in VANET

Chapter 4

Results and Discussion

This project was proposed with a sole objective of clearing the clattering and traffic present on traffic signal, generally positioned at junctions. The timers on the signals have proved to become inefficient with increasing number of vehicle owners, there is free flow for certain vehicles and a close to indefinitely long waiting time for other vehicles. To enforce a change in the system, the idea, that if vehicles could provide particular parameters they would help in coordinating the traffic by adjusting the timer value on the traffic signal. However a mode of communication was necessary to implement this. Recent advances in hardware, software, and communication technologies are enabling the design and implementation of a whole range of different types of networks that are being deployed in various environments. One such network that has received a lot of interest in the last couple of years is the Vehicular Ad-Hoc Network (VANET). Thus brought the initiation of VANET to compensate for the network and methodology to transfer the necessary details. Vehicular Ad hoc Network (VANET) are treated as mobile sensor networks and characterized with special characteristics such as high node mobility and rapid topology changes. This enables them to sense a variety of data in its surrounding area to offer several services including traffic monitoring and speed controlling. However it is required that vehicles move within the specified network boundary. Thus the range is limited, hence we have only considered vehicles within a radius of 200m

surrounding the traffic signal. Clusters are formed for ease of message passing using two algorithms. To efficiently send and receive data we appoint cluster heads using a greedy search algorithm , and the grouping is done using a bee cluster format , this enables a more clear and efficient method of message passing . The parameters that are passed are then further evaluated and processed, the result is used in the calculations of the timer value. This timer value would be present on the timer for each direction in a given junction. When this architecture was pitted against the standard timer count methodology that is followed in our Indian streets we were able to observe the following results:

•There was a more efficient manner of traffic clearance.

•Provide up-to-the minute obstacle reports to a vehicle

•Ad-hoc networks can be formed by cars and such networks can help overcome blind spots, avoid accidents

•There was no lag and unnecessary waiting of vehicles for long periods of time.

Output Screenshots:

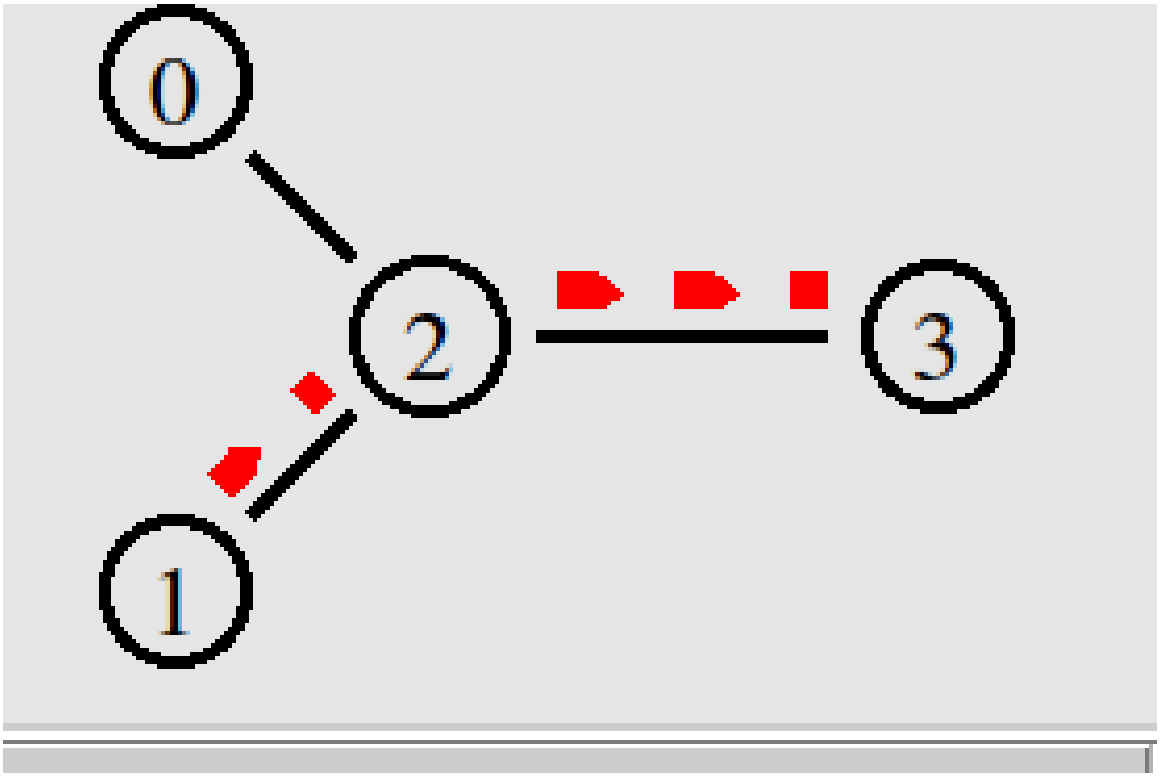

Figure 4.1: Nodes in NS2

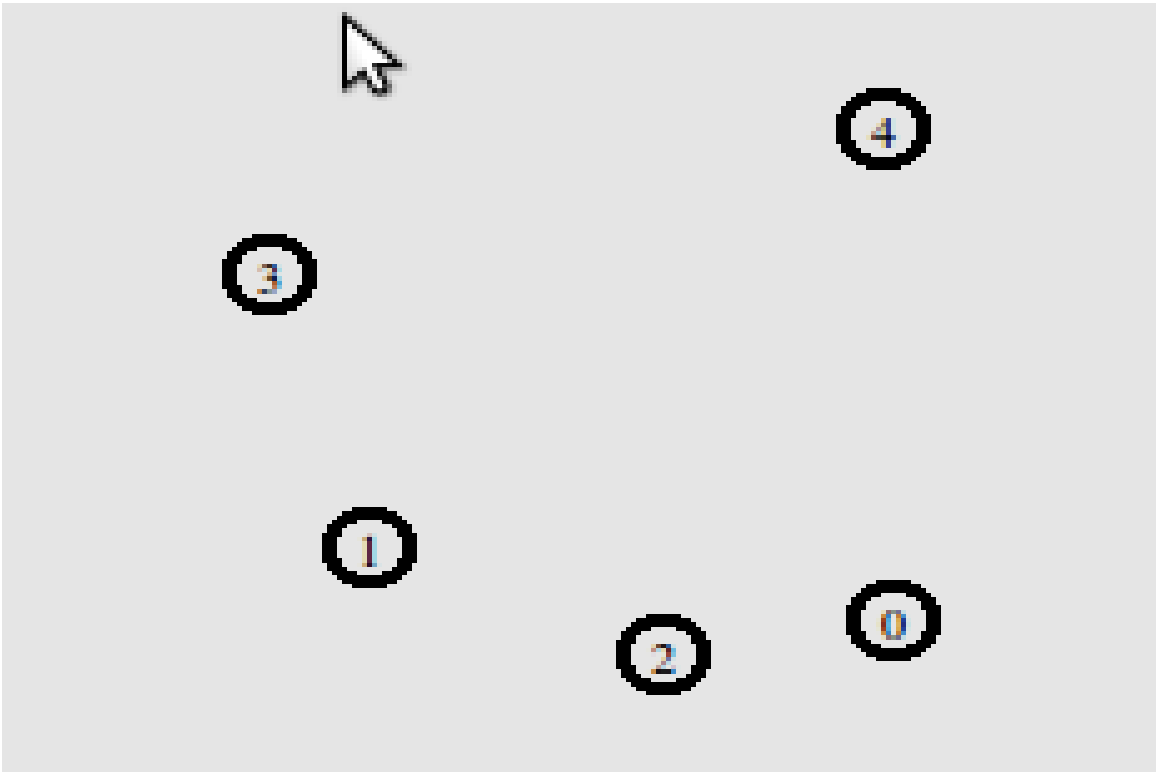

Figure 4.2: Nodes communicating with AODV while moving

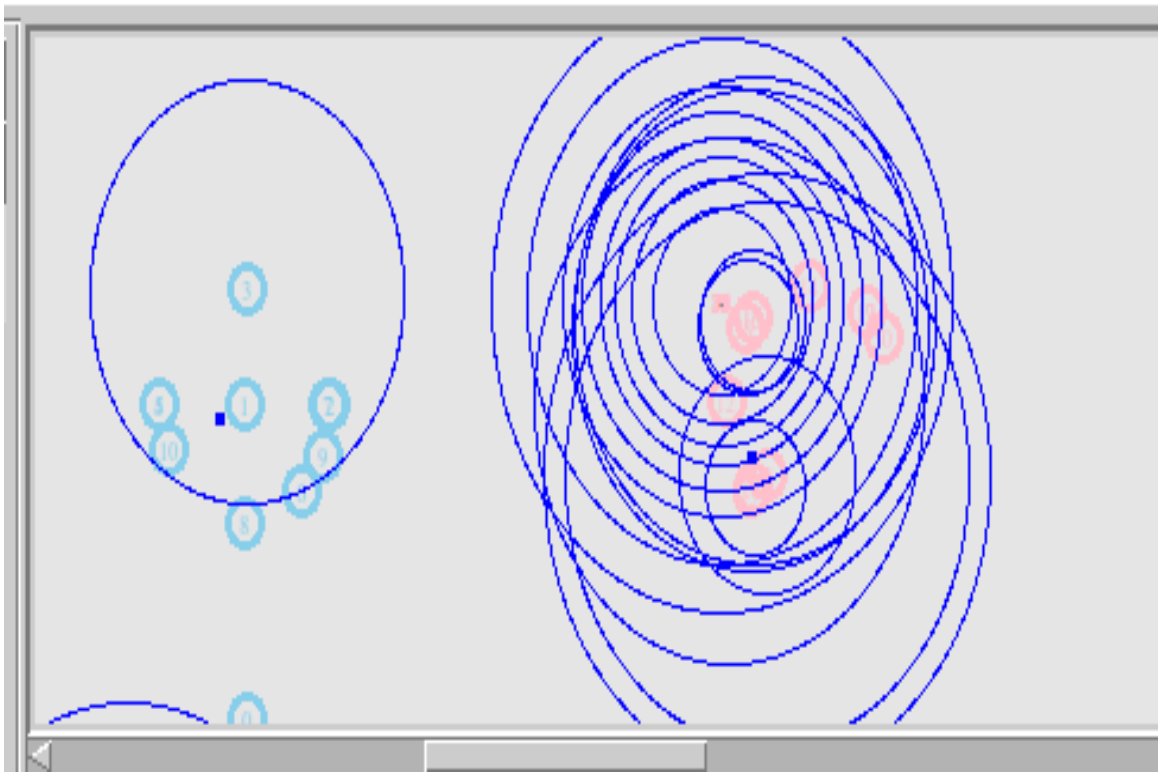

Figure 4.3: Formation of clusters based on clustering algorithm

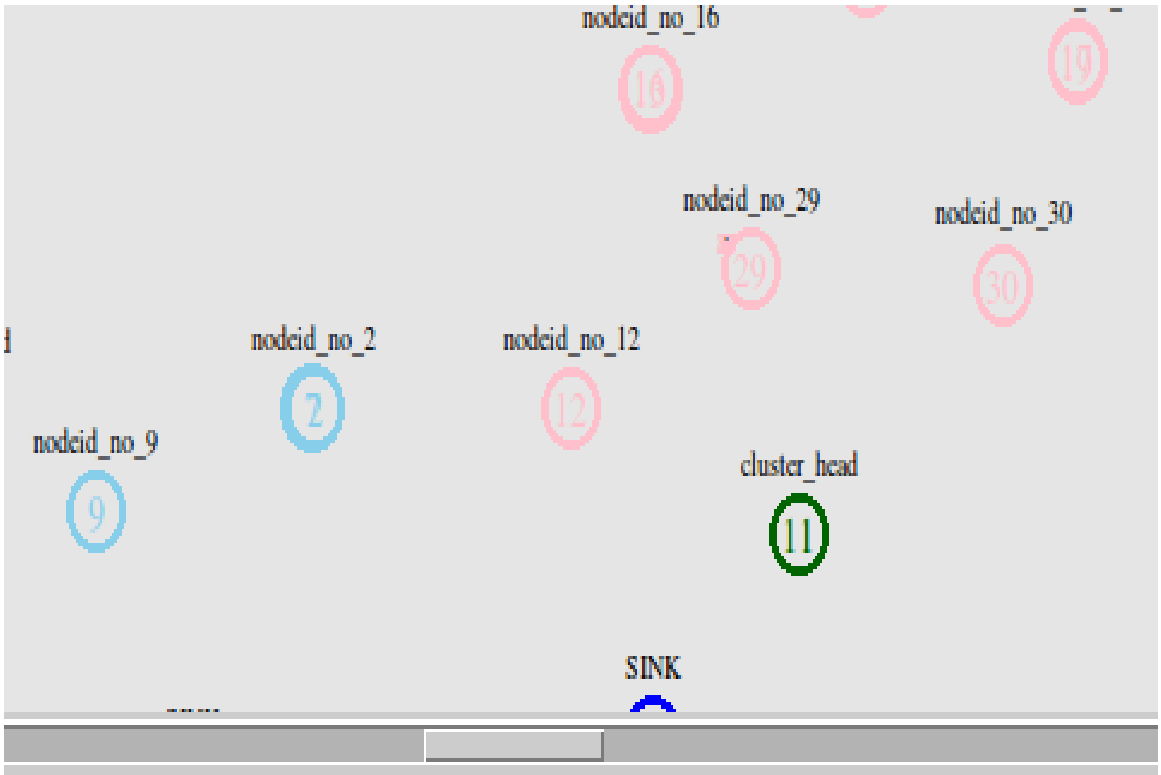

Figure 4.4: Post Cluster Formation

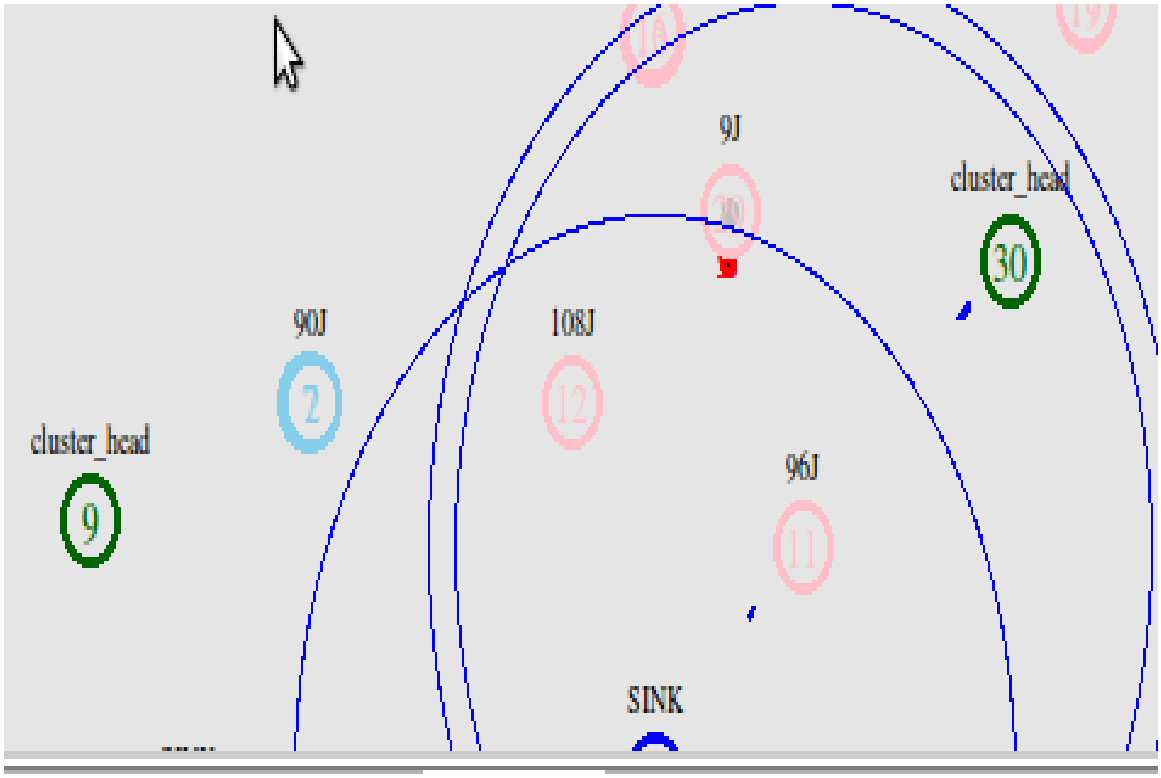

Figure 4.5: Cluster Adaptation

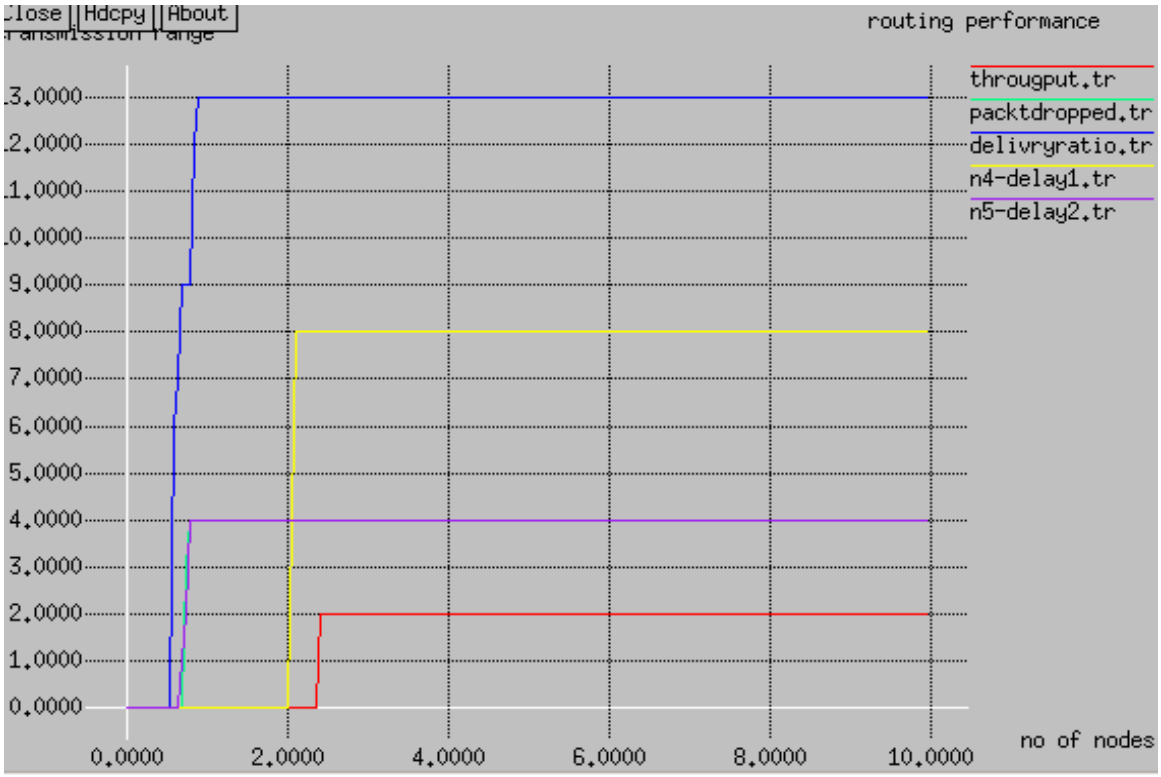

Figure 4.6: Routing Performance Analysis

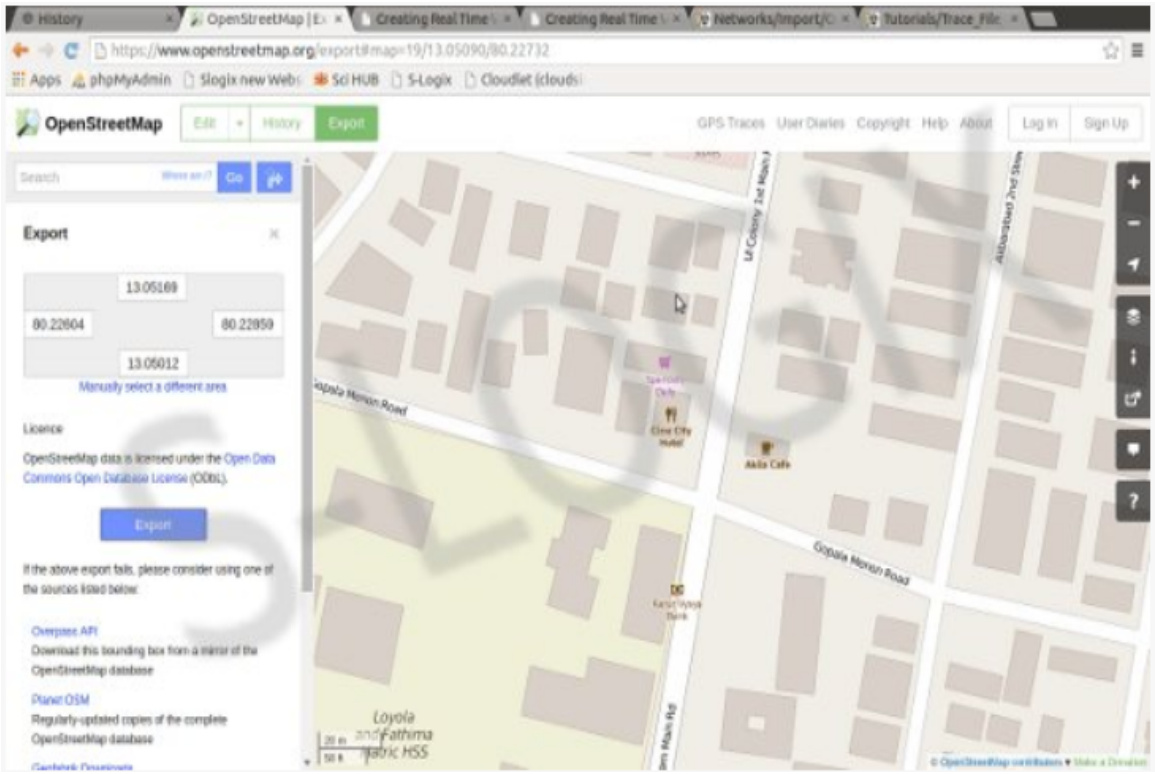

Figure 4.7: Open Street Map

Chapter 5

Conclusion and Future Work

From this project we are able to conclude the following :-

-Using thee cluster based algorithms by stacking them on top of each other helped in improving the accuracy and helped build a better communication network.

-The traffic was better efficiently resolved in comparison with the traditional approach to the traffic signal timers.

-By using VANET the vehicles were able to efficiently communicate with each other and assist in packet forwarding.

This project could be further improved by adding or improving certain functionalities such as :-
-Vehicle damage detection using VANET
-Vehicle route mapping for avoiding traffic
-disturbance detection in roads

Chapter 6

Bibliography

[1] Parisa Saraj Hamedani , Arshin Rezazadeh. "A New Two Level Cluster- Based Routing Protocol for Vehicular Ad Hoc NETwork (VANET)." IEEE 2018

[2] Mohammed El Amine Fekair, Abderrahmane Lakas , Ahmed Korichi. "CBQoS-Vanet: Cluster-based Artificial Bee Colony Algorithm for QoS Routing Protocol in VANET", 2016 International Conference on Selected Topics in Mobile Wireless Networking (MoWNeT)

[3] Wenxiao Dong , Fei Lin , Hongling Zhang , Yuping Yin. "A cluster-based recursive broadcast routing algorithm to propagate emergency messages in city VANETs."IEEE 2017

[4] Ganesh S. Khekare , Apeksha V. Sakhare. "A smart city framework for intelligent traffic system using VANET." IEEE 2013

[5] R. Brendha , Dr.V.Sinthu Janita Prakash. "A Survey on Routing Protocols for Vehicular Ad Hoc Networks", 2017 International Conference on Advanced Computing and Communication Systems (ICACCS -2017)

[6] Mohammad Fathian, Gholam Reza Shiran, Ahmad Reza Jafarian-Moghaddam, "Two New Clustering Algorithms for Vehicular Ad-Hoc Network Based on Ant Colony System", Springer Science+Business Media New York 2015

[7] N. Maslekar , M. Boussedjra , J. Mouzna , H. Labiod. "VANET Based Adaptive Trac Signal Control" IEEE 2011

[8] Miao Wang , Hangguan Shan , Rongxing Lu , Ran Zhang , Xuemin Shen , Fan Bai. "Real-Time Path Planning Based on Hybrid-VANET-Enhanced Transportation System." IEEE 2014