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Priority Based Traffic Control in Vehicular Ad-Hoc Network

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ABSTRACT—The convergence of telecommunication, computing, wireless, and transportation technologies facilitates that our roads and highways can be both our communications and transportation platforms. These changes will completely revolution when and how access services, communicate, commute, entertain, and navigate, in the coming future. Vehicular ad hoc networks (VANETs) are wireless communication networks that do not require any fixed infrastructure, and support cooperative driving among communicating cars on the road. Vehicles act as communication nodes and relays, forming dynamic vehicular networks together with other near-by vehicles on the road and highways.This research paper examines the possibility of deploying an priority based traffic signal control system in intersections, a system that can base its control decision on information coming from cars. Thus, each intersection with traffic lights is provided with a wireless infrastructure node that can extract data from an existing VANET. Now, efforts have been made to create traffic lights systems that can respond to the ever increasing traffic. Most of the signal control systems rely on timing plans generated offline by traffic engineers using optimization models. These systems are hard to maintain and do not respond well to traffic events, like a football game or road construction,arrival of emergency vehicle. This research paper is focus on Priority based traffic signal control in VANET. Priority based means change according to arrival of emergency vehicle. So in priority based traffic signal control is give green signal to lane as per the current fixed cycle strategy. For making Priority base first find emergency vehicle on road using loop detector. So after each 60 seconds decision for green is taken based upon vehicle type over lanes. Green signal given to the lane(road) which have emergency vehicle at traffic signal. It may possible that more than one of lane having emergency vehicle at traffic signal. Then as per arrival time of emergency vehicle we give green signal.

Keywords--VANET , MANET , SUMO

I. INTRODUCTION

Advances in mobile computing and wireless communication have offered new possibilities for Intelligent Transportation Systems (ITS). Increasing interest has been focused in the last years to de`ploy these technologies on vehicles and use them as a means of improving driving safety and traffic efficiency. By adding short-range communication capabilities to vehicles, the devices form a mobile ad-hoc network, allowing cars to exchange information about road conditions. This is often referred to in the literature as Vehicular Ad-hoc Networks (VANETs) or Inter-Vehicular Communication (IVC) systems The users of a VANET, drivers or passengers, can be provided with useful information and with a wide range of interesting services. One category of such services includes safety applications, like various types of warnings: ice on road, intersection violation, cars in front braking, and collision avoidance and mitigation in situations like: lane changing, lane merging and preparation for imminent collision. Another important class of applications that can be deployed over VANETs is concerned with traffic operations and maintenance: dynamic route planning, weather conditions publishing and adaptive signal control, priority based traffic signal cotrol in intersections. Commercial and entertainment applications can be implemented as well, electronic payments, reservations, advertisements or gaming and file transfer are just a few examples.

II. MOTIVATION

During the last few years, progress in wireless communications has offered new research fields, providing network connectivity in environments where wired solutions are impossible. Among these, vehicular ad hoc networks (VANETs) are attracting a growing attention due to the promising important applications, from road safety to traffic control and entertainment for passengers. Smart cities would like to plan how to minimize their transportation problems due to the increasing population that produces congested roads. VANETs aim at helping to alleviate this issue improving vehicles' mobility, increasing road safety and also seeking to have more sustainable cities.

At the beginning of the development of vehicular technologies, the main goal was to have more efficient and safer roads. Nowadays, thanks to the huge development of wireless technologies and their application in vehicles, it is possible to use Intelligent Transportation System (ITS) that will change our way to drive, improve road safety, and help emergency services. VANETs may soon allow vehicles to easily communicate among themselves and also with fixed infrastructure. This will not only improve road safety, but also raise new commercial opportunities such as infotainment for passengers.

Traffic jams, increase road safety and improve the driving in the city. Furthermore, from the sustainable and economic perspective, real-time traffic alerting will reduce trip time and fuel consumption and therefore decrease the amount of CO_2 emissions. Traffic professionals and roadway users alike dream about enjoying smarter traffic signals. They dream about signals that optimize themselves under all traffic conditions with the hope to never again be frustrated by poor signal operation. Perhaps one day these dreams will become reality. Certainly there are many intelligent people trying to satisfy this desire, especially motivated now by the Federal Government's focus on Priority Based Traffic Signal Control (PBTSC).

The main benefits of Priority based traffic signal control technology over conventional signal systems are that it can:

- Continuously distribute green light time equitably for all traffic movements.
- Improve travel time reliability by progressively moving emergency vehicles through green lights.
- Reduce congestion by creating smoother flow.

Fig.1. Motivation behind priority based traffic signal control

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III. PROBLEM DEFINITION

Priority based traffic signal control is a type of system that allows the normal operation of traffic lights to be preempted, often to assist emergency vehicles. The most common use of these systems is to manipulate traffic signals in the path of an emergency vehicle, stopping conflicting traffic and allowing the emergency vehicle right-of-way, to help reduce response times and enhance traffic safety.

In our current system of traffic signal control green signal is given to each lane after 60 seconds. Sometimes it might happen that emergency vehicle have to wait for green signal. It create problem like emergency vehicle can not reach their destination within time.

In priority based traffic signal control loop detector is used to detect the vehicles. So after each 60 seconds decision for green signal is based upon emergency vehicle on each lane at traffic signal. Priority based traffic signal control give green signal to lane which have emergency vehicle. When more than one emergency vehicle present at traffic signal control then priority based traffic signal give green signal based on arrival time of emergency vehicle. So it solve the problem of time delay of emergency vehicle.

IV. SUMO SIMULATOR

Thedevelopment of"**S**imulationof**U**rban**MO**bility",or"SUMO"forshort,startedintheyear2000.The majorreasonforthedevelopment ofanopensource,microscopic roadtrafficsimulationwastosupportthe trafficresearchcommunitywithatoolintowhichownalgorithmscanbeimplemented andevaluatedwith, withouttheneedtoregardalltheartifactsneededtoobtainacompletetrafficsimulation,suchas implementingand/orsettingupmethodsfordealingwithroadnetworks,demand,andtrafficcontrols .By supplyingsuchatool,theDLRwantedtoi)maketheimplemented algorithmsmorecomparable, asa commonarchitectureandmodelbaseisused,andii)gainadditionalhelpfromothercontributors.

Features

•Completeworkflow(networkandroutesimport,DUA,simulation)

• Simulation
  ◆Collisionfreevehiclemovement
  ◆Differentvehicletypes
  ◆Multi-lanestreetswithlanechanging
  ◆Junction-basedright-of-way rules
  ◆Hierarchyofjunctiontypes
  ◆AfastopenGLgraphicaluserinterface
  ◆Managesnetworkswithseveral10.000edges(streets)
  ◆Fastexecutionspeed(upto100.000vehicleupdates/sona1GHzmachine)
  ◆InteroperabilitywithotherapplicationonruntimeusingTraCI
  ◆Network-wide,edge-based,vehicle-based,anddetector-basedoutputs.

• Network
  ◆Manynetworkformats(VISUM,Vissim,Shapefiles,OSM,Tiger,RoboCup, XML-Descriptions)maybeimported
  ◆Missingvaluesaredeterminedviaheuristics

• Routing
  ◆Microscopic routes-eachvehiclehasanownone
  ◆DynamicUserAssignment

•Highportability

◆Onlystandardc++andportablelibrariesareused
◆PackagesforWindowsmainLinuxdistributions exist
•Highinteroperabilitythroughusageof XML-dataonly.

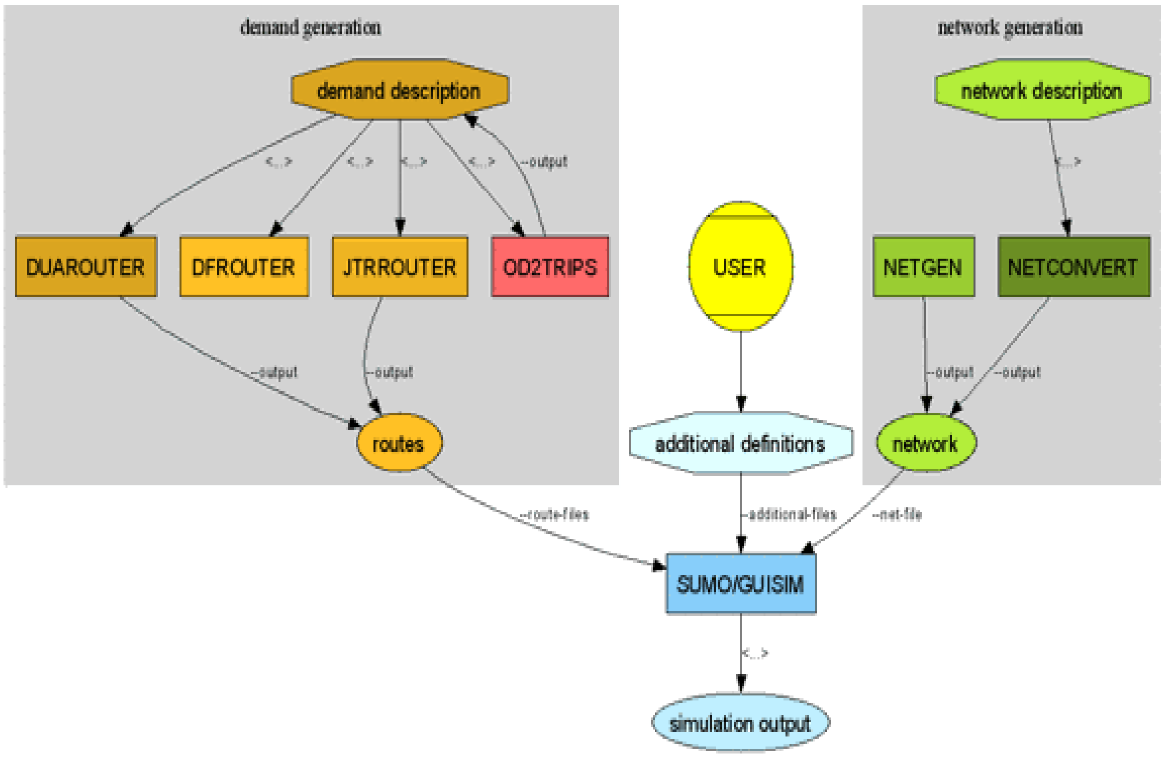

Fig.2. Process of simulation with SUMO (rounded: definite data types; boxes: applications;octagons: abstract data types)

SUMOisnotonlyatrafficsimulation,butratherasuite ofapplications whichhelp toprepare and toperform the simulation of traffic. As the traffic simulation "sumo" requires the representation of road networks and traffic demand to simulate in an own format, both have to be importedorgeneratedusingdifferentsources.

V. PROPOSED ARCHITECTURE

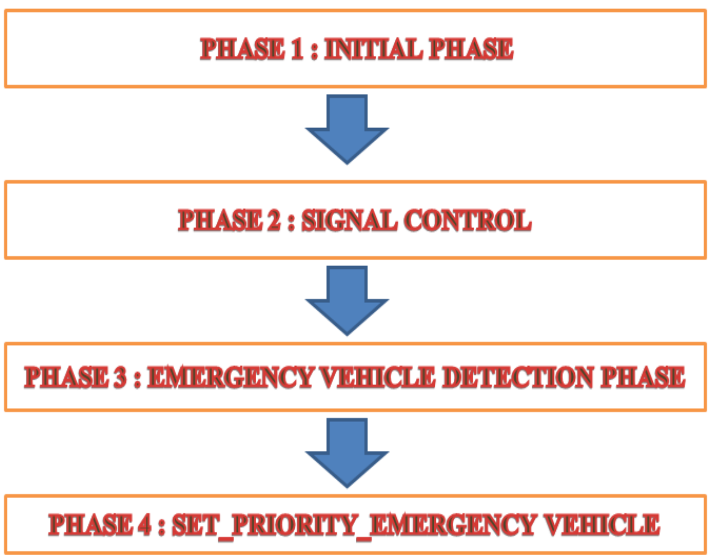

Fig.3.Proposed Architecture

Phase 1 : Initial Phase

In this phase we first initialise all variable to zero.then actual simulation is strat and we take current time and signal with the use of get current time and get current signal fuctions respectively. In next step to detect emergency vehicle we call Emergency Vehicle Detection Phase.

Phase 1 : Initial Phase

```
Lan1=0,lan2=0,lan3=0,lan4=0,  Emergency_vehicle=0

Start simulation

Time = get current time of traffic signal ()

Signal = get current signal of traffic signal ()

Emergency_vehicle = Call emergency vehicle detection phase
```

Phase 2 : Signal Control

In this phase first we check that time is multiple of 60 or not. If time is multiple of 60 means we have to make decision of green signal. In next step we check emergency_vehicle variable to identify that at this time any emergency vehicle on traffic signal. If emergency vehicle is not detected then green signal is given as per our (fixed cycle) current scheme.

Phase 2 : Signal Control

```
If time%60 == 0 then
        If Emergency _vehicle ! = 0
                Next_lane = assign next lane no as per current stretegy
                Call set_priority_emergency_vehicle phase
        Elseif lan1 > 0
                give green signal to lan1
                lan2 = 1
                lan1 = 0
        Elseif lan2 > 0
                give green signal to lan2
                lan3 = 1
                lan2 = 0
        Elseif lan3 > 0
                give green signal to lan3
                lan4 = 1
                lan3 = 0
        Elseif lan4 > 0
                give green signal to lan4
                lan1 = 1
                lan4 = 0
End If
```

If emergency vehicle is detected then we first store next lane turn for further refernce and then we call Set_priority_emergency_vehicle phase to identify the priority emergency lane.

Phase 3 : Emergency Vehicle Detection Phase

This phase is useful to detect vehicle at traffic signal control using induction loop. To detect vehicle we are using getVehicleData(loopID) function. If emergency vehicle is detected then we first increment the emergency_vehicle variable and then we add the entry of arrival time and lane no of emergency vehicle.

```
Phase 3: Emergency Vehicle Detection Phase

Vehicle_type = getVehicleData ( loopID )
If vehicle_type = emergency_vehicle then
        Increment emergency_vehicle variable
        note arrival time and lane id of emergency vehicle.
End If
```

Phase 4 :Set_priority_emergency_vehicle phase

In this phase we set the priori ty of emergency vehicle that are present at traffic signal at same time. When more than one priority vehicles are present at same time then we have to make decision regarding oder of green signal to emergency vehicle.

In this phase we first check no of emergency vehicle. If one emergency vehicle present at traffic signal then give green signal to that lane. if more than one emergency vehicle then we first check arrival time of emergency vehicle and give green signal to lane as per arrival time of vehicle.

```
Phase 4 : Set_priority_emergency_vehicle phase

If emergency_vehicle < 2 then
        Give green signal to lane which having emergency vehicle
        If next_lane == emergency_lane then
                next_lane = next_lane + 1
        End If
Else
        Give green signal as per arriv al time of emergency vehicle
        If next_lane == last_emergency_lane then
                next_lane = next_lane + 1
```


VI. EXPERIMENT EVALUATIONS

A. Current Strategy

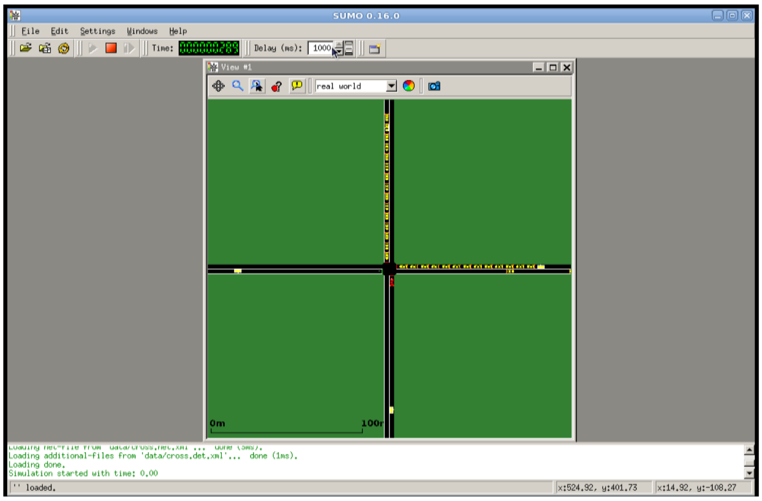

Fig.4. Current Strategy

As shown in above figure, in the current strategy, even emergency vehicle is there in any of the lane, then also, green signal will be given as per traditional system.

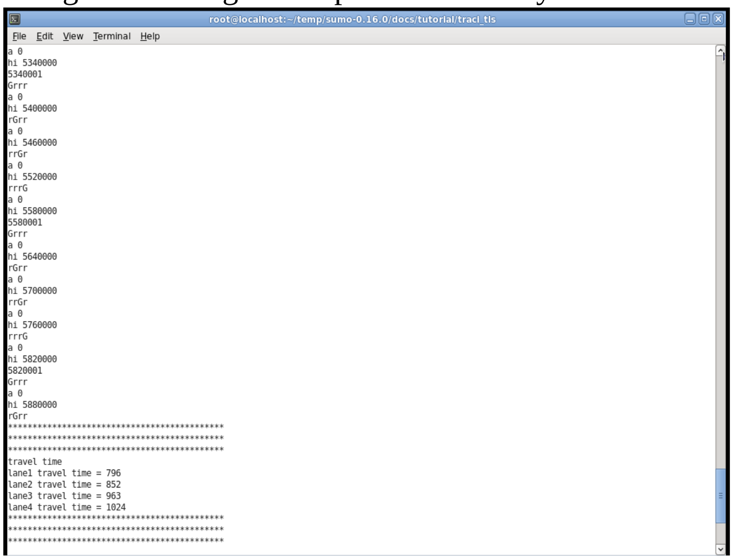

Fig.5. Travelling time in current strategy

B. Proposed System

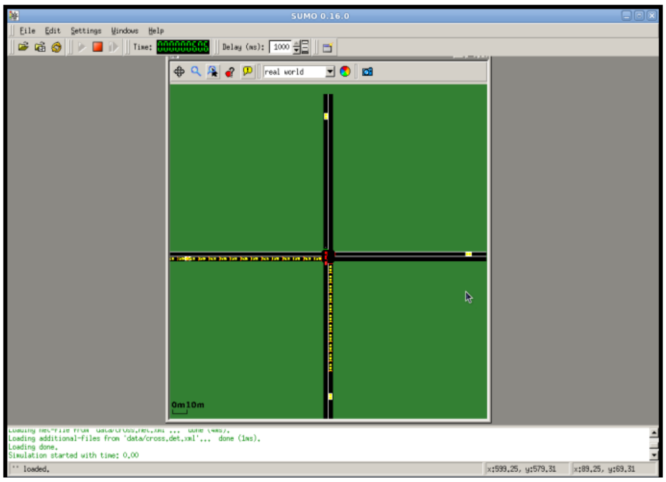

Fig.6. Proposed System

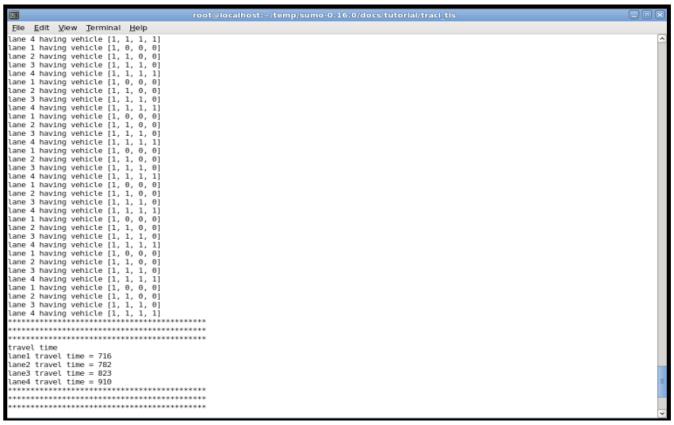

Fig.7. Travelling time in proposed system

In proposed system, green signal is given to that lane which having the emergency vehicle. And travelling time is reduced than current stategy.

C. Comparison Graph

In proposed system, travelling time of emergency vehicle in particular lane is reduced as shown in figure 7.

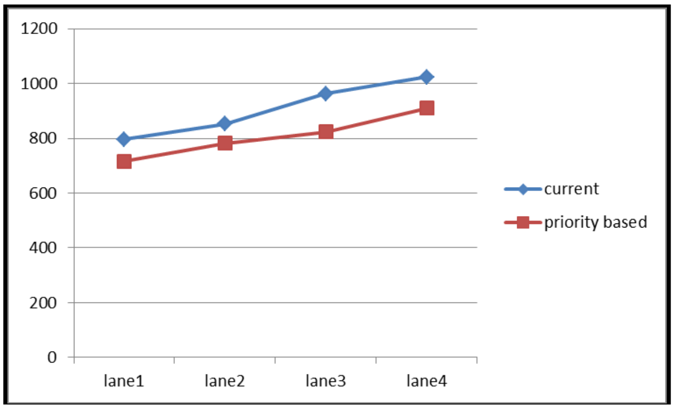

Fig.8. Comparison Graph

VII. CONCLUSION

Conclusion of the research paper is current traffic signal control give green signal to each lane in traditional manner . It may create problem of time delay for emegency vehicle. It can cause serious problems like death. Priority based traffic control detect emergency vehicle on lane and give green signal to that lane which having emergency vehicle rather than giving green signal to next lane as per current strategy. We have created scenario in which , based on random function, system generate emrgency vehicle on any of four lane at traffic control. We also detect emergency vehicle which passes over the induction loop which grounded on each lane also noted the arrival time of emergency vehicle on prticular lane. After every 60 sec cycle,before giving green signal to next lane, it is checked whether any emergency vehicle is there in any lane. If it is, then green signal will be given to the emergency lane. After giving green signal to the emergency lane, next lane is taken as per the current strategy. By this proposed system, travelling time of emergency vehicle in particular lane is reduced as compared to the current strategy.

VIII. FUTURE WORK

As this proposed system already works on green signal preemption,this can be extended to make the system which allow the emergency vehicles to get green signal as per their priorities.

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