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A Smart Traffic Management System using the Spatio-Temporal Relationships for an Emergency Vehicle

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Abstract

In recent years, Traffic management system is working automatically in dissimilar types of automization, which is used in different places and various locations, but this system is not fully automated. The automation of Traffic Management System must require the partial representation of manual interaction. Existing techniques such as "stop line detectors, video based detectors, counter" designed for the maintenance of Traffic Management that requires manual controller. Proposed framework uses the technique, which is fully automated and also specially designed for an emergency vehicle in the modern world, thereby introducing sensor, messages passing and also by assigning a specified region or boundary. Whenever an emergency vehicle enters into the boundary, The sensor detects the emergency vehicle and also pass the message to the traffic signal intersection. According to the message, traffic light signals work under the flow of direction of emergency vehicle. It will be done without affecting the other vehicle that passes on the roads. The proposed technique is effective and efficient method for Traffic Management System.

Keywords

Traffic Management, Signal change over, Vehicle mobility, Message Passing.

I. Introduction

Nowadays traffic system will be more complicated to ambulance in the modern world, Because day to day no. of vehicle increasing enormously, To Change the Traffic system it gives huge issue, But To improve the current traffic management as semi-automated traffic system into fully-automated traffic system for and emergency vehicle system by using the Gps, sensor node and message passing technique and also changes as made as Suitable for Road Scenarios.

A. Vehicular Ad Hoc Network (VANET)

VANET is a Booming Technology in the present world. VANETs are a class of Ad-Hoc Networks (MANETs). They can provide communication between the vehicles (nodes) and also It has many possible applications most important. Because inter-vehicle communication and file sharing by message passing to obtaining real-time traffic information such as jams and blocked streets.

In VANET Communication is based on two types, They are Vehicle-to-vehicle (V2V) communication and/or communication between vehicles and the road side infrastructure (V2I) communication. In Vehicle-to-vehicle (V2V) communication can be either done directly between vehicles as one-hop communication, or vehicles be capable of retransmit messages, in that way enabling multi-hop communication. To increase the Boundary and strength of communication relays the roadside can be deployed. Roadside network can also be used as a gateway to the Internet and thus data and context information can be collected, stored and processed between Vehicle-to-vehicle (V2V). In Vehicle -to- infrastructure (V2I) communication. The vehicles and the associated road network (all nodes) are equipped together data, process it to decide present traffic conditions and broadcast it over longer distances and provide other traffic related services, That are related to collision warning, road signal alarms, toll ticketing, monitoring, road signal alarms and so on. One More importance it provides safety and comfort for passengers through quick use of networking. Latest research efforts have placed a strong prominence on novel VANET design architectures and implementations. Prominence has been laid on areas like distribution, steering, safekeeping and superiority of service. Based on the type of communications, VANETs can bear countless appliances in entertainment, safety, and vehicle traffic optimization. Now vehicles generate and analyze large amounts of data, although typically this data is self-contained within a single vehicle.

B. Characteristics Of VANETS

1. Highly Dynamic Topology is defined by the speed of the vehicles and their path.
2. Frequently Disconnected Network is that the link has to be re-established with other nodes as soon as possible for seamless connectivity to be maintained.
3. Mobility Model and Prediction are Maintaining connectivity ensure that the positions of the nodes and their movements are to be predicted.
4. A mobility model and node prediction based on a study of predefined roadways model and vehicle speed is of paramount importance for an effective network design.
5. Communication Environment is used to node prediction design and routing algorithm need to adapt depending on the different mobility scenarios.
6. Hard Delay Constraints is safety issue (such as disasters, brake incident) of VANET application guarantees on time delivery of message to relevant nodes.

The above mentioned characteristics are used to build the proposed concept.

VANET applications and technical aspects established by short-and medium-range communication primarily based on ireless local area network technology.

Vehicles can be seen as probes that locally detect traffic status. Various applications that target transport efficiency could make use of the vast information collected from the vehicles; however, this collection of information needs to be transported over larger distances, for this purpose broadcasting message is used.

In VANET, an emergency vehicle efficiency and performance will be reduced by traffic jams which occurred in two places:

1. Traffic signal Intersection.
2. The accident Zone.

The traffic jams occurred at the accident place would be resolved by many approaches like neighbor node message, warning message passing and so on. To resolve traffic jams at traffic signal intersection many approaches like top line detectors, video based detectors, counter are used and it requires manual controller. All these approaches are semi-automated only. To resolve traffic jams at traffic signal intersection in proposed system is fully automated approaches and also it is used for an emergency vehicle especially designed for modern world. Thereby introducing techniques are sensor, message passing by assigning a specified region or boundary.

II. Smart Traffic Management

A. Assumption

The following assumption for the paper frame work.

1. GPS equipped Ambulance.
2. Static Sensor node Embedded with GSM Module located away from some fixed distance (approx 5 KM).
3. Sensor node Embedded with Traffic Signal at Intersection.

also in static point (fixed distance)

Fig. 1(a): Overall Route Map

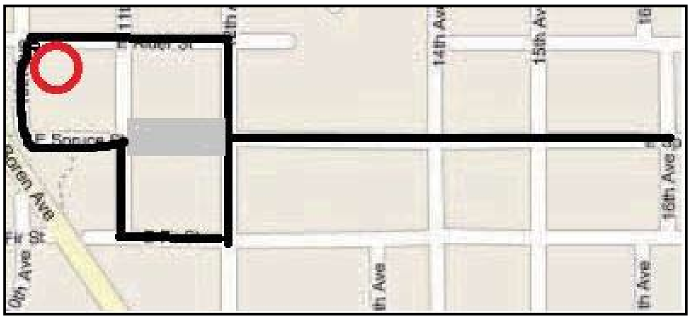

Fig. 19(b): Shortest Route Map

Many researches are improved traffic system. In this regards the related works such designing the optimize route, optimize the traffic signal, warning method, Detecting the dual emergency vehicle and passes the context to the emergency vehicle are discussed in this section.

B. Design the Optimize Route.

VANET based efficient navigation system for ambulances in real time traffic congestion is estimated through a decentralized and it avoids unexpected congestion and follow the shortest path to the destination (hospital) based on historical data and the updates of real time traffic information. A dynamic routing [3] (for simulation AODV routing prepared) system has been developed in road transport system to guide ambulances in real time scenarios. We considered for a metropolitan city over an unpredictable high density of vehicles and STE's algorithm has been employed to compute the shortest conduit using the historical data and time variable considering nonrecurring congestion as a result of unforeseen incidents, thus arriving at the shortest path in minimum time to the destination. Consequences demonstrate that inclusion of metro reduces the travel time by a good quality border, declining the answer time of ambulances. So that First, it needs to estimate or predict target positions, so that estimate the route for emergency vehicle from source to destination with the help of Google, Bing or any other map services, It suggests some routes favor to the source to destination. The overall route in fig 1, in that travelling route has highlighted in it. The STE algorithm applied on to the suggested route ,then the algorithm will be classify the route based on traffic signal and peak time that will be taken from the data set. According to the data set fig 2 illustrated. In fig 2 a) shows the local route for the source to destination. In fig 2 b) shows the Global route for the source to destination. As the result of STE algorithm gives the local & global route. The emergency vehicle will bechoosing the route based on the STE algorithm. It has contain the sensor node at traffic signal intersection and from the traffic signal. The STE system algorithm improved the existing system performance, measurement information additional competently. Our outcome reveal that the proposed algorithm provides good track estimation performance and can quickly reach the destination or target. In this paper, we study the problem of mobile target positioning in a sensor network that consists of stationary sensors and a mobile sensor. The goal is to calculate approximately the end position and to control flow emergency on track towards moving target. For target tracking and addition to the use of motionless sensors, a number of other works focused on mobility management and control of sensors for better target tracking and location estimation. Zou and Chakrabarty [1].

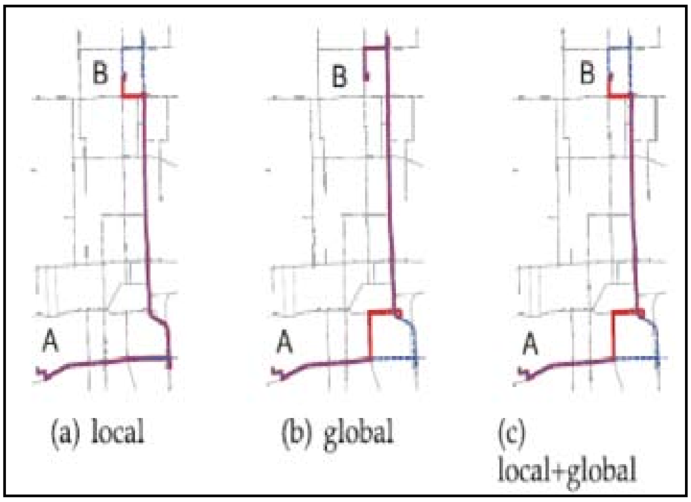

Fig. 2: STE Algorithm Route Map

C. Warning Method

The present warning method of combined emergency lights and sirens draws attention to the emergency vehicle but is inadequate to prevent dangerous situations and slow-down of emergency vehicles. The warning is often distinguished too late and drivers

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are confused about the position and way of the emergency vehicle. This then leads to wrong reactions. In this section, system devises a warning system that spreads warning messages in a geographic region ahead of the vehicle through the vehicular network. The aim is to balance the existing warning methods and extend the range of emergency warnings. Other road users can be warned earlier and are provided with detailed information about the route of the approaching emergency Vehicle. This enables them to react timely and correctly so that they do not block the emergency vehicle. In the Junzhao Du, et. al. [2] App-MAC: An Application-Aware Event-Oriented MAC Protocol For Multi Modality Wireless Sensor Networks proposes the system was designed to minimize the Accident at the traffic signal intersection, for that they used sensor node, cluster node and the simulation part was carried out by TOSSIM Simulator. In that they used to design and implement an application-aware event-oriented MAC protocol (App-MAC), this App-MAC protocol consist of sensor MAC (S-MAC), time-division multiple access (TDMA), and traffic-adaptive medium access (TRAMA). It proposed for the traffic management enhancement via in an urban target at traffic signal intersections, that has alarmed a pedestrian or notify drivers by App-MAC leverages the advantages of contention- and reservation-based MAC protocols to coordinate channel access and propose channel contention and reservation algorithms to adaptively allocate time slots according to application requirements and current event status. Their evaluation results via simulation in TOSSIM and empirical studies with Berkeley TelosB motes show that the proposed App-MAC protocol is able to support the prioritized delivery of events, provide inter-event fairness, and improve the performance of channel-utilization efficiency while reducing energy consumption. System needed a set of requirements for a VANETbased emergency vehicle warning system. Flexibility- The warning system should be flexible enough to support different possible applications. E.g., warn vehicles about an approaching or standing emergency vehicle, but also support controlled switching of traffic lights. Time- Warning messages have to reach other nodesearly sufficient for them to perform proper actions. Relevance. Warnings should only be displayed to drivers or acted upon if relevant, e.g., when driving towards the same intersection as the emergency vehicle but not when moving away from it. Reliability. The warning system must provide awarning to drivers when they expect one, e.g., when a siren can be heard. The system should also inform drivers if it is not working. Protection. Warning messages have to be authenticated and integrity protected so that only certified emergency vehicles can generate them. Otherwise, other vehicles could illicitly send emergency vehicle warning messages to gain a driving advantage, e.g., clear a crowded road ahead. Privacy. Personal information on involved individuals must not be sent, e.g., the final destination of an ambulance should not be included in warning messages to protect privacy of the patient. Coordination. The system has to organize and merge warnings from several emergency vehicles, e.g., when presenting a warning to other drivers. Autonomous coordination of traffic lights can also help to form green waves or clear roads from traffic, According to STE algorithm . Usability. The system should be modest, perceptive, and easy to use, i.e., the crossing point should not nduce stress but support drivers in a hectic situation.

D. Atomize Traffic Signal.

At the present traffic system is an more complicated ,and also it is an semi automated, because to control the traffic at the intersection needed any manual controller or else centralized controlling person monitors the traffic situation at a particular time interval, same technique will be in stop line detector, cluser based vehiclur ad hoc network, currently counter based traffic signal method will be used in many location in india and many country in the world, this all the technique will be suitable for normal travelling vehicle, in concern for emergency vehicle is creates very hazardous issue for the vehicle and inside patient, as the reference of Andreas Buchenscheit et. al.(YEAR) VANET Based Emergency Vehicle Warning System describes the concept of providing a clear pathway for the emergency vehicle which reduces accident risks in turn saves valuable time during the emergency response trip. Surveillance camera installed in emergency vehicle monitors the action on the road, during the action of the EV, on the way of response trip the surveillance video camera records the each and every second movement in the response trip path of the other vehicle and also captures the behaviour of the other road users. The video document clearly describes the response trip of the EV by in which way they are delayed. In that they mentioned two major obstacles for the EV during the response trip. One is at the traffic signal intersection, where its the other vehicles are blocked by the red signal and the other one obstacle, which is run before the EV. The EV is known by the siren, the other vehicles are known the EV but they are not able to get the movement of the EV, because they don't know about the EV's movement, like it comes right side of their vehicle or to the left side. In case they are slow down the vehicle means, the following vehicle will be having change for the accident. It gives the solution when the EV with right of the way, on that one method of time the EV sends the warning by two way one is prepare relevant information, like the EV is speed and distance from to them and the other one is disseminate warning like random warning by its siren sound and the other method of time the road user receive and display the detailed warning message, which could helpful for the EV, by this case of action three different types of ways are carried out by the receive/ forward warning. It will be passes the message to other forward vehicle and it will be the chain action. The local relevance decision will be given for the EV and also for the other vehicle. Then the initiate node dependent action will be taken action for the EV during the response trip. The video analysis emergency response trip can pass a significant danger to traffic safety using the VANET technology to deliver the additional information about the traffic participants and infrastructure can help to make the operation safer and faster. The above mentioned the concept of providing a clear pathway for the emergency vehicle which reduces accident risks in turn saves valuable time during the emergency response trip used in this project

E. Optimizing Minimum and Maximum Green Time

H. Michael Zhang et. al. Optimizing Minimum and Maximum Green Time Settings for Traffic Actuated Control at Isolated Intersections describes the Optimization of signal control at isolated intersections has been an important research focus on traffic engineering over the times of yore few years. Due to its flexibility and reasonableness, fully actuated organize has been expansively installed. In the conventional actuated manage scheme, two significant parameters, i.e., minimum and maximum green time, are arbitrarily pre specified, although it is widely recognized that they can significantly impact system operations. Earlier studies have rigorous on computing these parameters using deterministic models. Due to the stochastic characteristics of traffic arrival, such statically elected green time margins cannot sufficiently handle various traffic loads. To resolve this problem, a stochastic model is recognized to dynamically optimize the minimum and maximum green times using real-time queue lengths and traffic arrival characteristics for each phase. Various criteria are combined and oppressed as be in command of objectives, such as avoiding cycle collapses, minimizing have power over delays, and maximizing total traffic throughputs. However, two of the most important timing parameters, i.e., maximum green time and minimum green time, are not updated. These two parameters stay in the pre specified values throughout the operation process in most control strategies. A major barrier for this is the lack of reliable models for extracting the stochastic characteristics of traffic arrival patterns and to further integrate such a model with real-time detection data. Therefore, the authors are motivated to develop a stochastic model to dynamically update the minimum and maximum green times. Such adaptive green time boundaries are integrated into a standard actuated control scheme to demonstrate its practicality in this study. Such as in present traffic pattern, The Traffic signal (green, yellow, red) will be scheduled by the seconds, like 75/90/120 Sec, according to the population of the vehicle and the some other method also used like, After the emergency vehicle chosen the road, the traffic signal will be atomize based on the condition. The sensor is embedded with each and every traffic signal and addition to that, one more node will be placed on fixed distance from the traffic signal. In the node embedded with the sound sensing sensor. It will detect the emergency vehicle by its sound. When the node detects the emergency vehicle it activated its mobile and SMS will be sent to the traffic signal. Till the mobile node is in passive state. After the node detects the emergency vehicle, then the mobile changes in active state. All this operation will be finished within a fraction of a second.

Default condition

Traffic signal (green, yellow, red) will be scheduled by the seconds, like 75/90/120 Sec. It is in present traffic pattern.

Project based condition.

Message received direction will be green signal, until the emergency vehicle passes through the traffic signal.According to the condition, the traffic signal will be green in the particular direction, until the emergency vehicle passes through the traffic signal. Thereafter the traffic signal will be work under the default pattern likewise the traffic signal will be atomized for the emergency vehicle.

F. Control Flow Diagram

GPS equipped vehicle started means its primary point location will be a source position then the destination will be entered, according to the data, suitable route will be suggested to the emergency vehicle, In that route data, it contains all the information about the route like traffic signal intersection, vehicle density, peak timecongestion and etc.
STE Algorithm Fig. 4.2 Control Flow Diagram

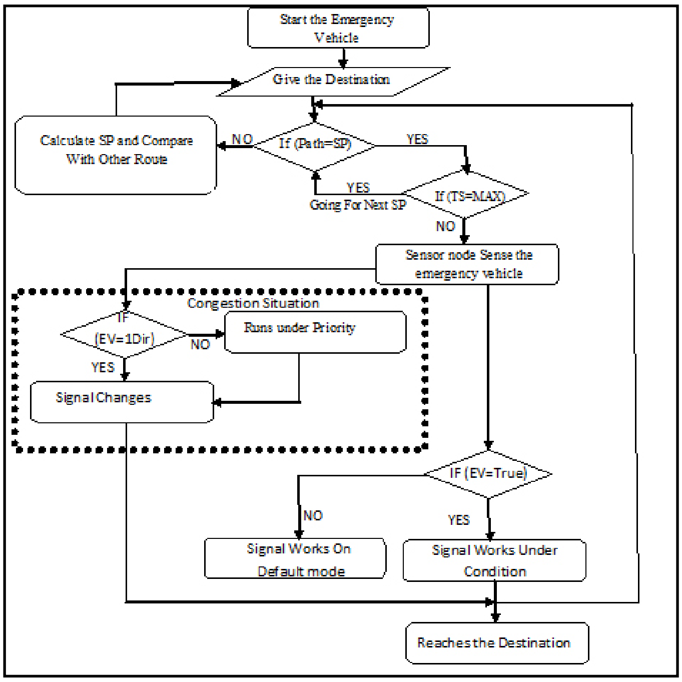

Fig. 4.2 Control Flow Diagram

Based on the data, algorithm will be working step by step.
Steps:
1. Start the Emergency Vehicle(EV).
2. Enter the destination.
3. Checks the shortest path(SP), If its true Checks Traffic signal Intersection(TS), Its MAX, again check SP, else calculates the SP and Compare with other Routes.
4. IF TS !=MAX , Sensor Node Sense the EV.IF EV detected, traffic Signal works under the condition, else traffic signal works on default mode.
5. Under the Congestion situation, sensor sense the EV more than one at the different direction, algorithm gives the Priority for the EV. Else the Signal works for single EV.

III. Simulation And Performance Evolution

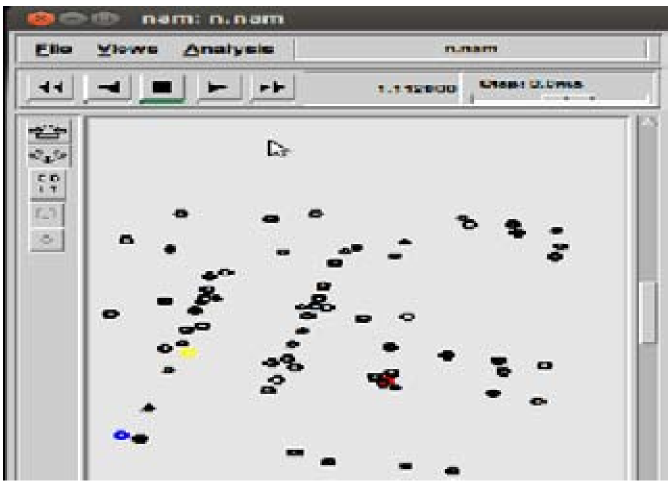

Fig. 3: Overall node Representation in NS2

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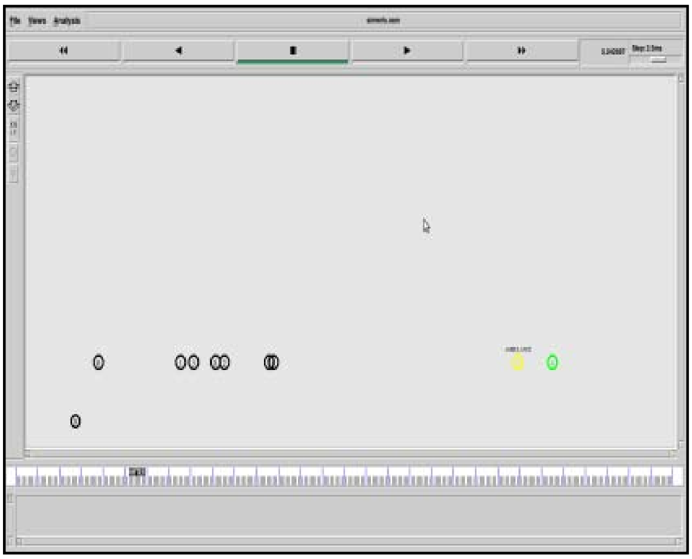

Fig. 4: Narrow Road Representation

Fig. 3 Random Generation of Vehicle Movements: The Specified Node is taken from the nam file and then the traffic signal Intersection and Emergency Vehicle are highlighted, Where the Yellow is indicated for Emergency Vehicle and Red is denoted Traffic Signal. Starting Point of Emergency Vehicle, Where the Emergency Vehicle and Traffic light signal intersection are designed in a narrow road, both are indicated by the Yellow and Red color.

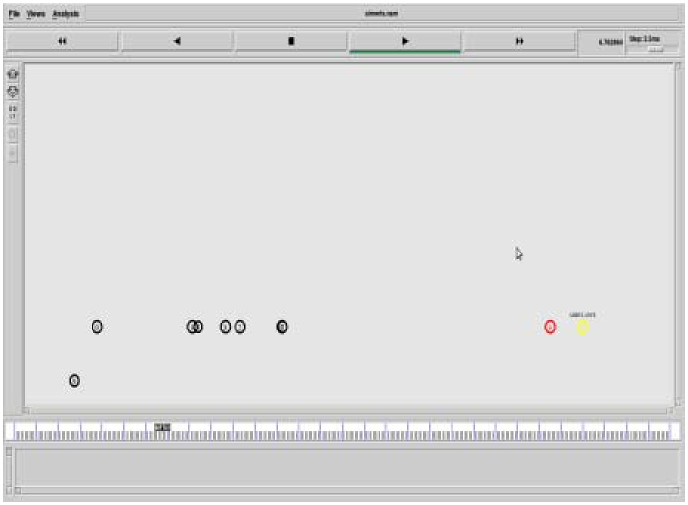

Fig. 5: Traffic Signal Changing at Intersection

Fig. 4: Emergency Vehicle Near to Traffic Signal Intersection. The Traffic signal is changed into Green, when the Emergency Vehicle enters into the sensor Node range it sends message to Traffic signal intersection, which is placed Nearer to Traffic Signal Intersection. Fig. 5: Emergency Vehicle Crossed Traffic Signal Intersection. The Traffic Signal light is changed, when the Emergency Vehicle is crossing the Traffic signal intersection

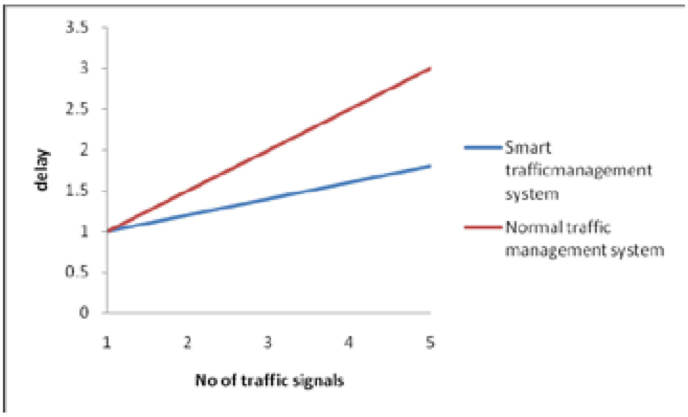

Fig. 6: Variation between Smart & Normal Traffic Management System.

Fig 6 denotes the delay variation between the Smart & Normal Traffic Management depending on the No. of traffic signal. This graph indicates efficiency of the Smart Traffic Management

IV. Conclusions

The condition will be given to the traffic signal. When the emergency coming through one direction means, the signal will be shows green in that direction. In case of the emergency vehicle comes from two or more direction means the congestion will be occur at traffic signal intersection. At that time, the sensor node which is held in traffic signal intersection will pass the message to both the drivers. The priority will be given FIFO First in First Out consideration at the time of emergency vehicle detected by the sensor node which is held in fixed distance from the traffic signal intersection. The node is held approximately 5 km away from the traffic signal. So that the unnecessary waiting will be reduced at the traffic signal intersection, This enhances and improves the emergency vehicle efficiency and performance. When the driver receives the message they are aware of the other emergency vehicle position. The indication will be given by color notation. So that the unnecessary waiting will be reduced at the traffic signal intersection, this enhances and improves the emergency vehicle efficiency and performance and adds to that sound alarm is given to the pedestrian at the traffic signal intersection.

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