Prioritizing The Emergency Vehicle By Using Emqif Technique for Smart Transport System

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Abstract

Traffic is the biggest problem in cities these days. Monitoring and controlling traffic for peaceful driving is the most necessary for intelligent transportation. The accidents and collisions cause heavy traffic and lead to human losses. For an effective traffic management system, it is necessary to clear traffic as quickly as possible by providing an alternative route. In addition, emergency vehicle (EV) has to reach the nearest hospital in time to rescue the victims. In order to avoid delay, an alert about the speed and location of the EV has to be communicated to the other vehicles. By considering this situation, a proposed algorithm distinguished the EV from other vehicle by the tag mounted on the EV and sends an alert message to the other vehicles about EV crossing on the particular path. Therefore, EV can reach the hospital within the stipulated time and reduce travel time by using two techniques, NaVIc and Edge Computing. The main aim is to make the EV to reach the hospital on time. The proposed algorithm reduces the time delay of an EV to reach the medical centreupto 90%.

KeyWords: Emergency vehicles, priority, delay, Edge computing, NaVIc, Siren

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Introduction

In heavy traffic or during peak hours driver often struggle to react when a siren sound is heard from an EV. Drivers are worried they may resort to reacting at a slow rate and taking highways at random. This can lead to an accident, causing crashes. When researchers analyzed the data, it was found that in a large majority of the cases, accidents are caused by errors of the driver of the emergency vehicle. In 30 percent of the cases, wrong behavior by other drivers is the main issue. 44% of such accidents take place at junctions [10].

To resolve this, the EV may fail to reach its destination on deadlines due to the heightened traffic. Thus, it is necessary to provide additional alerts to normal vehicles so they can react accordingly and avoid collisions.

The above situation can be considered if an EV could send an alert message to the nearby vehicles occasionally to inform about its current location and speed. These data can be collected through the Road Side Unit (RSU) and sends to the traffic light control system to turn green signal only to the EV and block other normal vehicles by red signal.To travel the EV rapidly, a lot of priority systems have been proposed by A. K. Mittal and D. Bhandari [7], R. C. Poonia [3], P. Handel, J. Ohlsson, M. Ohlsson, I. Skog, and E. Nygren [8], B. Ghazal, K. ElKhatib, K. Chahine, and M. Kherfan [4] and V. Pattanaik, M. Singh, P. Gupta, and S. Singh [5]. These works focused to reduce the collisions by making the traffic signal green for EV.

But still it sends the alert message to the other vehicles and reaches the medical centre with some delay due to improper network issue. All the above works use s GPS (Global Positioning System) to trace the vehicles for communication.Sometimes it fails to provide accurate location and also leads to signal failure.

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The paper [2] describes that 5%-16% of the time taken for call processing time, whereas only 84%-95% is taken for response time. Due to high collision,the response time increases and cause some delay to provide emergency services. Vehicles become effective with the embedded systems and sensors. Sensors gather essential data about the condition on the road and this information is exchanged in order to suggest the driver to make a suitable decisions.

This paper is structured as follows. Section II focus on literature review, Section III on methodology, and Section IV deals with the simulation results. Finally, Section V discusses with the conclusion and its future work.

Problem Statement

As vehicles are increasing day by day everywhere, it may cause a huge traffic. Most of the time, the green signal is provided in sequence without considering the EV on a road. Therefore, an EV may stuck in between the normal vehicles on a heavy traffic and cause some delay in reaching the hospital. This may be the reason to loss human lives. During this situation, it is necessary to prioritize the EV from normal vehicles to provide a clear path in order to reach the spot on time without getting stuck into the traffic.

Fig1: Emergency Vehicle on busy road

Motivation

There were many research have been made for an emergency vehicle to travel smoothly with minimum delay. But yet it was a great challenge to reach the hospital on time. The early system provides a path only based on the siren sound from the emergency vehicle. The main issue was, the driver couldn't able to react suddenly how to provide a free path for the ambulance by hearing the siren. This can lead to further collisions or even accidents, and EV can get stuck between vehicles, as shown in Fig:1. Therefore it will be better if the driver gets the prior information about the ambulance .To achieve this our proposed work will pass the information to other normal vehicles about passing an EV on a particular path . This process will help the EV to travel freely without a delay in order to reach the hospital on time to rescue the human lives.

Literature Review

The researchers use RF (Radio Frequency) emitters to communicate with every traffic signal system on a road to alert them about the arrival of EV. This aids in offering a different approach to EV[1].

The suggested system in [1] receives the message to administer first aid to the victims, helps to communicate to the doctor about the victims' status, and uses GPS to manage traffic light signals.

The algorithms in [2] use an image processing technique to calculate the number of cars. Only good weather would make this appropriate.

The work in [9] uses the FFT (Fast Fourier Transform) approach to detect siren noises, but it is unable to send an alternate message to change the traffic signal.

The paper [7] employs a costly image processing technique to give the driver a different notice regarding an EV crossing.

Roadside cameras were employed by the author in [11] to identify EV. But fails to identify when it's windy or pouring outside.

Proposed Methodology

The proposed work's main goal is to stop more crashes and accidents while also enabling timely arrival at the hospital to save the injured.

Working process of proposed work

RSU use edge computing and NaVic to capture the traffic data such as speed, location etc., of the EV and pass immediately within stipulated time to other vehicles.

A marking affixed on the emergency vehicle will help the RSU to distinguish it from a normal vehicle (NV).

Finally, the traffic signal will shine in green to clear the primary path for an ambulance to travel after sending information to the TMU (Traffic Management Unit) regarding the location and speed of an EV.

An EV must provide higher priority in traffic than

an NV on a road. Currently, the traffic system has several problems since there is a lack of awareness of vehicle density. The main difficulty was the latency issue. When an accident happens, the RSU relays the information to the ambulance. Once the ambulance has taken the victim from the scene, it is important to get to the hospital as soon as possible.
Let's assume that the intersection is represented by the symbol 'INT', 'n' for nodes, and 's' for signals. When the signal is opened, traffic will flow through the intersection. The other vehicles at the intersection have to wait until a certain period has passed before moving. The ambulance frequently gets caught in traffic, which causes a delay in getting there. There should be some modification in the traffic laws because this results in a human loss. The ambulance must be given top priority in the suggested system to proceed via the path. Therefore, the emergency vehicle's signal will be activated.
Let us take the two situations mentioned above.
EV passing in intersections
EV passing in normal road.

EV passing in intersections

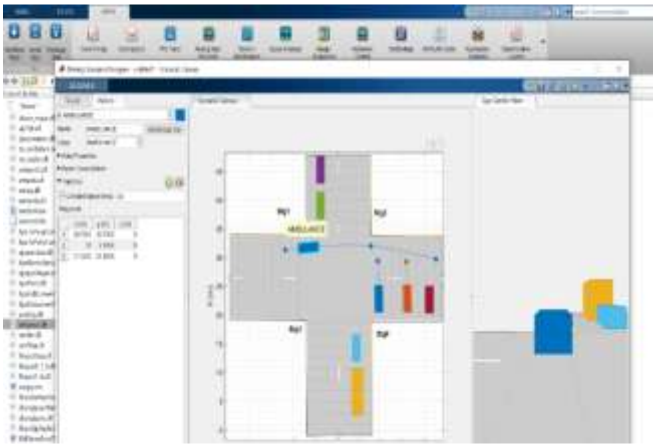

Fig.2: EV passing through the intersection

In Fig:2, the intersection at INT and EV has four signals marked sig1, sig2, sig3, and sig4 with eight nodes (n1, n2, n3, n5, n6, and n8), all of which are colour blue. Here, Nodes n1, n2, and n3 will receive advance notice of the EV approaching from behind, enabling them to give the EV a free passage by instantly repositioning themselves, as shown in Fig. 1. Additionally, the program will automatically activate the signal that points the EV in the direction of the closest hospital. The following equation (1) is used by the Node to determine its priority.

$\boldsymbol{\sigma = EV * \frac{lc}{t} * po}$-- (1)

Where,

σ = Priority of the vehcile
EV = Emergency Vehicle
lc = Lane change
po = Position of the vehcile
t=travelling time.

The signal opening time is calculated by the equation (2).

$\Omega = \forall \leq \sum_{a=1}^{n}(\Delta_a - \mathcal{E}_a)$ ---------------------------------- (2)

Where,
Ω -Total open time of intersection
$\forall$ - Maximum time of the signal remains open
a = Lane at the intersection,
Δ_a = Vehicle Density in a lane,
$\mathcal{E}_a$ = Vehicle load in the intersection
n=Maximum number of lanes

EV passing in normal road

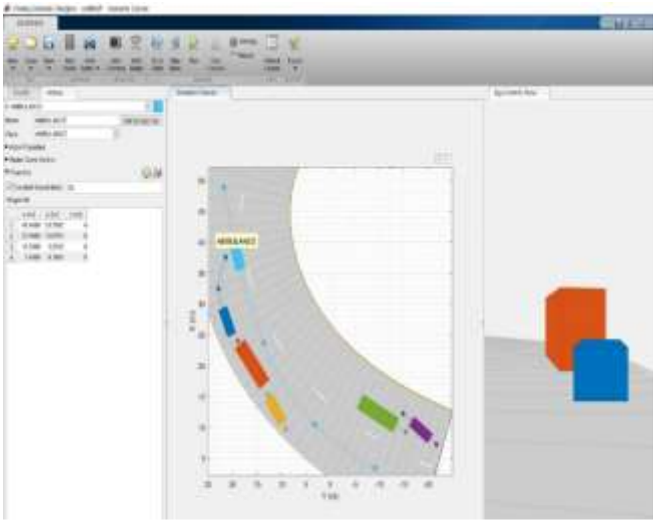

Fig.3: EV passing through the normal road

There are 6 Nodes are moving down a path in Fig:3, and EV is distinguished by the blue color. To give the EV a freeway, the conventional vehicle receives information about the EV. This is achieved by considering the parameters such as speed and distance.

Speed = ∑s/t/NR -- (3)

S = speed of the vehicle,
t = time,
NR=Number of vehicles connected to RSU.

The distance is calculated between the source node and its adjacent nodes as follows.

Dis=$M_{1=1}^{n}\, dis_i$--- (4)

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Where,
Dis=distance
M=Maximum nodes
disi=distance between source node and its neighbour's node.

EMQIF(Embellished Maximum quality Increment First) Algorithm:

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Input:    Intersection 'INT", Signal opening time 'OTI', Emergency vehicle 'EV', Travelling time't'
          Destination Lane 'destL' ,Lane change 'lc' ,Direction of a vehicle from an intersection 'dir '
Output: Priority for EV
for lane l in each Intersection -signals in INT  do
    for NV in l do
        Priority=EV
    end for
    Sort NV[][] in descending  order based on EV-priority
     if EV-pririty>NV then
         OTI=EV
     end if
 end for
lc=1/abs(destL-t)+1)
dir=getdir(EV)
EV-pririoty=EV*1/t*lc*1/dir
EV-pririoty,t
```

Simulation Results

The system gives the EV precedence both at intersections and on common roads. The scenario was constructed using Matlab's driving scenario. The findings are contrasted with the recommended and existing algorithms in terms of travel duration, speed, and latency, in addition to demonstrating how well the proposed approach operates under three different types of congestion (Low, Medium, and High). Tables 1, 2, and 3 compare the performance of EMQIF using the High degree method.

Table 1: EV Latency

Algorithm	Congestion Level		
	Low	Medium	High
High degree algorithm	76.2	78.4	80.7
EMQIF	0	0	1.43

Table:1 shows the comparison between the proposed EMQIF algorithm and the high degree algorithm in terms of latency for three different congestion levels. The proposed works demonstrate that there is no delay in access to the medical center for the type of low and medium congestion Overall, the proposed work is reduced by 98% compared with existing work.

Table 2: EV Travelling time

Algorithm	Congestion Level		
	Low	Medium	High
High degree algorithm	105.3	120.5	153.8
EMQIF	70.7	68.8	66.15

A comparison of the proposed and existing algorithms is presented in Table 2 in terms of travel time. The proposed work takes the mean passage time of EV is about 56.98%.

Table 3: EV Velocity

Algorithm	Congestion Level		
	Low	Medium	High
High degree algorithm	59.5	55.9	50.3
EMQIF	60.9	62.4	65.8

Table 3 shows that the EMQIF reaches the hospital with speed of 30.81% faster than the current method.
Using characteristics like latency, trip time, and velocity on the three levels of congestion, Fig: 4, 5, and 6 demonstrate how the suggested method is superior to the current system. Thus, the suggested EMQIF algorithm is the effective way to arrive at the hospital quickly with the least amount of latency. Fig. 4 shows the smallest latency for high congestion and zero for low and medium levels of congestion, since the NV receives the EV's prior knowledge. EV takes a maximum of 70 seconds to reach the hospital, as shown in Fig. 5. Fig: 6 depicts the speed at which the EV will arrive at the destination in 60 to 65 seconds.

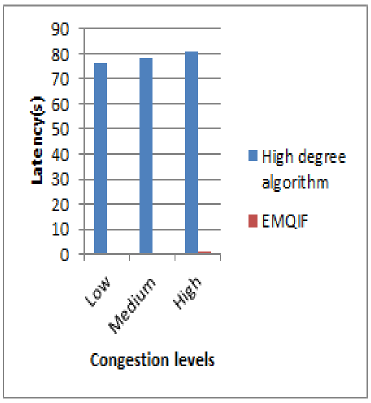

Fig:4 EV- Latency

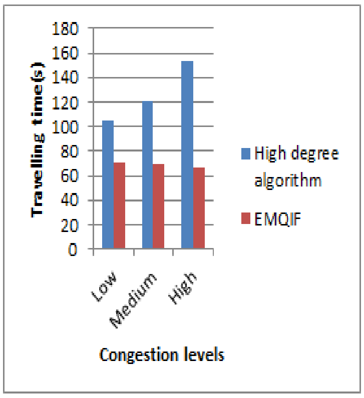

Fig:5 EV- Travelling Time

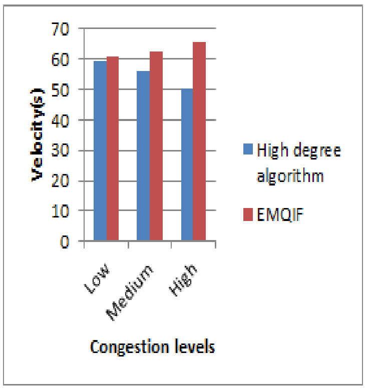

Fig:6 EV- Velocity

Conclusion and Future Work

In this study, we have given the EV priority to travel the path by lowering the average waiting time at an intersection or on the regular road by taking into account the three levels of congestion. In comparison to the previous approach, the EMQIF algorithm's results reveal that it is the best way for an EV to get to its destination without experiencing any latency at any intersection or along the direct route. As a result, EMQIF improves overall performance by about 85.79% compared to traditional algorithms. In future, the performance of the proposed approach will eventually be evaluated using real-time traffic. We also aim to use the proposed algorithm to monitor the condition of victims and notify hospital units before their arrival at the hospital using machine learning techniques.

References

GourKarmakar, Member, AbdullahiChowdhury, Student Member, JoarderKamruzzaman, Senior Member, and IqbalGondal, Member, "A Smart Priority Based Traffic Control System for Emergency Vehicles". IEEE Sensors Journal, Volume: 21, Issue: 14, 15 July 2021, pp15849 – 15858.

V. A.-G. Report. (2015) Emergency service response times. (Last accessed on: 15/05/2018). [Online]. Available: https://bit.ly/3iSw2vt

R. C. Poonia, "Integration of traffic and network simulators for vehicular ad-hoc networks," Journal of Information and Optimization Sciences, vol. 39, no. 7, pp. 1583–1589, 2018.

B. Ghazal, K. ElKhatib, K. Chahine, and M. Kherfan, "Smart traffic light control system," in 2016 third international conference on EECEA. IEEE, 2016, pp. 140–145.

V. Pattanaik, M. Singh, P. Gupta, and S. Singh, "Smart real-time traffic congestion estimation and clustering technique for urban vehicular roads," in 2016 IEEE region 10 TENCON. IEEE, 2016, pp. 3420–3423.

David, A.; Stefan, L.; Marc, F.; Dieter, K. Emergency Vehicle Detection with Digital Image Sensor. Availableonline:https://docs.google.com/viewer?url=patentimages.storage.googleapis.com/pdfs/US20150161458. pdf (accessed on 20 February 2015).

A. K. Mittal and D. Bhandari, "A novel approach to implement green wave system and detection of stolen vehicles," in 3rd IEEE IACC. IEEE, 2013, pp. 1055–1059.

P. Handel, J. Ohlsson, M. Ohlsson, I. Skog, and E. Nygren, ¨ "Smartphone-based measurement systems for road vehicle traffic monitoring and usage-based insurance," IEEE systems journal, vol. 8, no. 4, pp. 1238–1248, 2013.

Miyazaki, T.; Kitazono, Y.; Shimakawa, M. "Ambulance siren detection using FFT and dsPIC". In Proceedings of the First IEEE/IIAE International Conference on Intelligent System and Image processing, Kitakyushu, Japan, 26–27 September 2013; pp. 266–269.

Andreas Buchenscheit, Florian Schaub, Frank Kargl, and Michael Weber In stitute of Media Informatics, ULM University, Germany," A VANET based Emergency Vehicle Warning System", IEEE Vehicular Networking Conference (VNC),2009.

R. Sundar, S. Hebbar, and V. Golla, "Implementing intelligent traffic control system for congestion control, ambulance clearance, and stolen vehicle detection," IEEE Sensors Journal, vol. 15, pp. 1109–1113, 2014