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A Survey on Intelligent Traffic Management System for Emergency Vehicles

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ABSTRACT: In the arrival of ambulances to the hospital there occurs a delay also the fire trucks do not reach the fire site on time. This delay is mainly caused by the waiting of the emergency vehicles at traffic signals. It would be of great use to these vehicles if the traffic signals in the path of the hospital or fire site are intelligently managed so as to clear the traffic in front of these Vehicles. This paper focuses on how traffic signals can be intelligently managed in a developing country like India using android platform, GPS data, Map APIs, hadoop platform. The intelligent Traffic management system will then alert the traffic police at every traffic junction in order to free the path of emergency vehicle.

KEYWORDS: Emergency vehicles, traffic signals, intelligent management of traffic signal, android, GPS, Maps APIs, hadoop.

I. INTRODUCTION

India is a fast growing economy and the second most popular country in the World. Infrastructure growth is slow as compared to the growth in number of vehicles, due to space and cost constraints. India is seeing terrible road congestion problems in its major cities like Mumbai, Delhi.

Also, Indian traffic is non-lane based and chaotic. It needs a traffic control solutions, which are different from the developed Countries. In recent years, wireless networks are widely used in the road transport as they provide more cost effective options. Intelligent management of traffic flows can reduce the negative impact of congestion. The traffic lights simply operate on timers set depending on what day it is and what time period it is during the day. Emergency vehicles are prevented from having their own access on roads in India. As a result Emergency vehicles are blocked from reaching their destination on time. Moreover, when lights flash and sirens are on, drivers at intersections are supposed to give way to emergency vehicles. Unfortunately, many distracted drivers do not pay attention to emergency vehicles. "With all the horns, whistles, lights, on the ambulance, still not everybody give way to us" says rescuer Pradeep Mishra from Emergency Medical Services quoted in the article "Emergency Medical Service in India." The proposed system will prove to be very useful in driving way for emergency vehicles.

II. RELATED WORK

This section surveys the similar projects designed to provide priority access to emergency vehicles in other countries. In the United States, multiple traffic signal pre-emption systems were implemented to facilitate priority routing to emergency vehicles [3, 4]. The pre-emption system in general gives a green light in the direction of emergency vehicles and makes all other directions have red lights. Another benefit from the pre-emption system is the reduction in response times. Pre-emption systems have different designs. This includes strobe light or an infra-red emitters, acoustic systems,

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RF systems, and GPS. Most of these are built in the emergency vehicle to activate a detector attached to the traffic light at the intersection.

A. *The Strobe Light Pre-emption System:*

The pre-emption emitter is activated, when an emergency vehicle activates its siren. The emergency vehicle whose emitter develops first, line of site communication with the detector on the traffic mast will activate the pre-emption system. This triggers a series of actions. First, the traffic lights will instantly start blinking from green, to yellow, to red in the opposing directions. Second, the light in the direction of travel of the emergency vehicle will cycle to green. In addition, there is a small white light mounted on the traffic signal mast. When the pre-emption system is activated this light will flash. Once the light has been fully pre-empted it will burn steady. If the light is out, it means the signal is operating in normal mode.

Some of these systems are commercially available through different manufacturers. An example design of the strobe light pre-emption system is the Texas Optical Based Pre-emption System. Emergency vehicles are fitted with what is known as an 'Emitter', a device that contains a strobe light. This emitter is programmed with an identification binary code, and it sends a “priority” or “pre-emption” signal as a light flash to the receiver installed on the traffic light pole. The emitter sends strobe light (pattern) signals rapidly until it reaches any receiver installed on traffic light junctions. The flash pattern sends binary data to a receiver. As the vehicle approaches the intersection, the receiver detects the signal being sent by the emitter and decodes it. It then informs the traffic controller that an emergency vehicle is approaching from that direction, and the controller executes a pre-programmed plan of what to do in such a situation. Generally, this is to immediately give amber, and then red indications to any conflicting vehicle phases, and give every vehicle phase relevant to the emergency vehicle's approach, a green indication.

Exposure to weather conditions is the main issue with those optical pre-emption systems. The receiver part may be alerted by natural lights of thunder causing the program plan of the traffic light to work in an undesired time. Any maintenance of an intersection should involve inspection, cleaning, re-aiming, and replacing any bad pre-emption receivers. Another issue is the security, since the strobe light code can be seen by experienced civilians with access to any strobe light source, this could lead to the misuse of the system on any time for personal illegal benefits. Figure (i) shows the transmitting part of the system installed on vehicles while Figure (ii) shows the detectors installed on the traffic light phases. Figure (iii) shows an indicator light which indicates the operating mode as normal or emergency.

Figure(i) Vehicle Mounted Pre-emption Emitter

Figure (ii) Strobe Light Detector

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Figure (iii) Traffic Signal Mast Detector and Indicator Light

B. *RF Systems:*

RF is the most recent technology used for traffic lights pre-emption systems. The system consists of low power transmitters and multiple antennas at the intersection to detect the direction of the signal. The advantages of using this technology over light emitters or acoustic systems include activating the system from a much further distance, working around obstacles, and not being affected by weather conditions. One vendor for such systems is Collision Control Communications Inc.'

C. *Acoustics Systems:*

Acoustic systems work by installing a detector at the traffic lights to recognize sirens. The detector is usually equipped with a processor that can match the siren sound to a stored waveform and detect the direction of the signal. One of the systems available in the market is the SONEM 2000 provided by Traffic Systems, LLC.

D. *GPS Systems:*

The work proposed the use of a mobile application that sends GPS coordinates to a web server, which subsequently communicates with microcontrollers controlling the different intersections. The disadvantage of this approach is having a centralized web server. If the server is down for some reason or connection is lost, the whole emergency system breaks down.

III. PROPOSED DESIGN

The Intelligent traffic light management system is a cheaper alternative and more efficient solution to the previously surveyed systems. Instead of using strobe light or infra-red emitters, a better technology is to use GPS communication system. The benefits of using GPS, apart from the ones previously mentioned, are:

1. GPS will work in every possible weather
2. Can work without internet
3. Lesser hardware cost
4. More Reliable

The GPS system is implemented using android based devices (mobile phone). One device lies with emergency vehicle while the other is with the traffic police standing at the different traffic junction. The system is driven by these two android based devices.

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The android device on the emergency vehicle side will have a GPS tracking system which will continuously update the co-ordinates of the vehicle as soon as the services for emergency are requested from the ITMS (Intelligent Traffic Management System) application which lies on the android device itself.

The android device with traffic police provides information about the emergency vehicle arriving at the junction. The application also provides the traffic authority about the recent checkpoint the emergency vehicle has crossed, also the direction in which emergency vehicle is arriving, the estimated time required for the vehicle to reach the junction. On receiving this information the traffic authority will take the required action.

The application requires a lot of pre processing. This pre- processing is done on "Google maps android API". The maps API allows user to add user defined places to the map. The location of different traffic signals will be fed into the Google maps. The map along with user defined data is stored at the server. Using GPS and Google maps, current location of the emergency vehicle is monitored continuously once the service is requested by the emergency vehicle.

The proposed system also makes use of checkpoints. At each traffic junction 'n' checkpoints are added corresponding to 'n' roads such that one checkpoint lies on each road. The checkpoint chosen is a famous place such as a restaurant or a shopping mall or any other place so that the traffic authority assigned to junction can get sufficient information about the arrival of emergency vehicle in well advance and can take necessary steps so that emergency vehicle can pass safely, quickly and save time. Figure (iv) provides an idea of checkpoints where active traffic authority within range are send notification of the arriving ambulance.

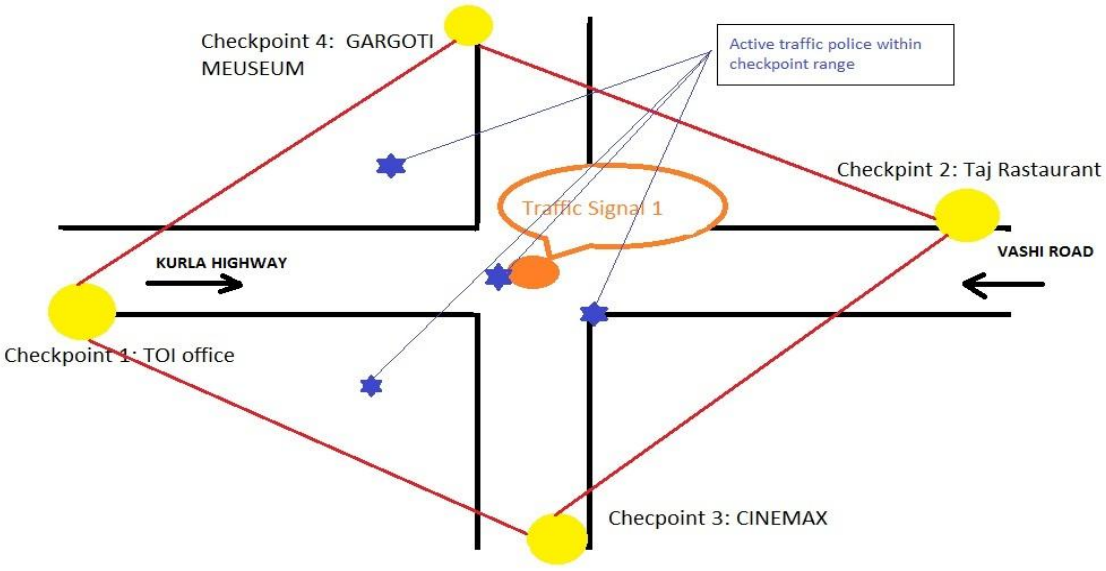

Figure (iv) Idea of Checkpoints

The checkpoint will also help the system to fetch the names of traffic authority assigned at a particular junction. The system fetches information about the co-ordinates of active traffic police who are within the range of checkpoints assigned to the corresponding junction and thus message will be send to the traffic police. When the traffic authority gets an alert that a vehicle is approaching, he will adjust the signal lights appropriately and allow emergency vehicle to pass. This approach can be improvised and be used in a much advanced way. If the traffic lights are made centralized the lights can be changed appropriately by the system itself.

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IV. CONCLUSIONS

The main purposes of developing a secure traffic control system is to give emergency vehicles a safe navigation environment, shortening the attendant time, safely and quickly delivering patients to hospitals. Based on these points, the efficiency of running the system is a key feature.

Since the traffic condition is constantly changing, if we can quickly grasp more traffic information, it will be more helpful for the emergency vehicles to effectively, quickly and safely complete its assigned task. The system focuses on the key aspect of emergency vehicles i.e. speedy travel of emergency vehicles and thereby facilitates it by using efficient GPS system.

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