Emergency Vehicle Monitoring System

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ABSTRACT

Emergency vehicles such as ambulances, fire fighting vehicles and police force vehicles are required to reach their destination as quickly as possible. One of the most important delays is the time that is consumed in intersections with these traffic lights, especially when their intersections are highly congested. In this paper, we discuss the design and implementation of an automatic pre-emption traffic control system that ensures to give preferences to all the emergency vehicles. It is significant to identify the density of traffic on real-time mainly in metropolitan cities for signal control. This system is capable to sense the density of vehicles for intelligent traffic management and this will prioritize the emergency vehicle among other vehicles and provide a better route and time management using the database collected. Traffic light posts positioned at the traffic junction set the lights to green for a specific period of time which will help the emergency vehicle to move free without getting stuck in any congestion. The proposed system will have RFID readers at the traffic junctions that will read all the RFID tags attached to the vehicles coming towards the junction.

Keywords: Radio Frequency Identification, Congestion Detection, Global Positioning System.

1. INTRODUCTION

Nowadays there is no efficient method to recognize and transport emergency vehicles in the least possible time. So the objective is to avoid the ambulance and other emergency vehicles waiting in traffic by automatically clearing the track of the vehicle from traffic blocks and signals.

Traffic congestion is a major problem in cities of developing Countries like India. Growth in urban population leads to significant rise in the number of vehicles in the cities. Congestion on roads eventually results in slow moving traffic, which increases the time of travel, thus stands-out as one of the major issues in metropolitan cities. So, there is a loss of life due to the delay in the arrival of an ambulance to the hospital in the golden hour. The main reason is that traffic signals are used to manage conflicting requirements for the use of road space often at road junctions by allocating the right side of a way to different sets of mutually compatible traffic movements during distinct time intervals.

In the daily life, we always see that there is always a problem with an emergency vehicle such as ambulance to pass through traffic light because it was red and it’s disturbing the drive. This situation is often happening because of traffic congestion or lack of cooperation from civilian and sometimes the driver doesn’t have the experience of this situation and so he waits till the signal turns to green. The emergency vehicle recognition system is used to co-ordinate with driver and guides him on a cleared path avoiding delay in the traffic. It helps driver reach the destination with in less time. A wireless alert will be given to the traffic wardens in case of any difficulty for the E-vehicles to clear the way.

It is known that India’s road network has grown at an annual rate of 4% since 1951 but the number of vehicles has increased nearly 11%, this clearly means that the roads don’t have the capacity to hold this increasing number of vehicles. It has been reported that one serious road accident in the country occurs every minute and 16 dies on Indian roads every hour.
frequency modulation to the receiver. The receiver demodulates the received code and the red traffic light will trigger at all the junctions. Thus, emergency vehicle will have a special route from another vehicle to reach the destination [1].

W. L. Mitchell has designed a traffic light control system which had overcome the traffic congestion problem and provided an emergency path for the emergency vehicle where the radio transmitter and antenna placed on the emergency vehicle. The radio will transmit the signal to the other vehicle that nearby. The radio receiver had been placed at four junction traffic light will receive the emergency signal from an emergency vehicle that passed by the junction. The first signal code contains a frequency for the emergency vehicle while the second signal code contains a frequency for another vehicle. The transmitted signals provide miscellaneous traffic light pole in normal condition or emergency. When the receiver received the signal from an emergency vehicle transmitter, traffic light system for an emergency vehicle will be activated [1].

W. E. Brill introduced an emergency vehicle detection system for alerting a driver of an approaching emergency vehicle includes a sound signal-producing unit mounted on an emergency vehicle, a sound signal detection unit mounted on a non-emergency vehicle, and a display unit remotely located on the non-emergency vehicle. The sound signal-producing unit has a sound generator for producing and transmitting a sound signal. A switch is used for controlling the operation of the sound generator in combination with a siren [1].

A new scheme called AARS (Automatic Ambulance Rescue System) to reduce the time for the ambulance to reach the hospitals in time and thus minimizing the expiration of the patients by controlling the ambulance to know the accident spot through sensors, choose an appropriate route to reach the hospital and controls the traffic lights.

A system called ITLS (Intelligent Traffic Light system to provide a smooth flow for the emergency vehicles like an ambulance to reach the hospitals in time and thus minimizing the delay caused by traffic congestion by automatically controlling the traffic lights in the path of the ambulance making use of GPS was introduced.

AmolDhumal, AmolNaikoji, and YutikaPatwa proposed system allows organizations to track their vehicles and to get the exact location of the vehicle. The system allows those companies to monitor the traveled routes through a web client that uses the Google Maps API and shows colors on the map to indicate if the devices on route. The general evaluation result is that the system proved to be reliable as to view the positioning of the devices.

A traffic light control system invented by Carl J. Obeck consists of two-way communication between emergency vehicles approaching a busy intersection with one or more traffic lights. The system temporarily pre-empts the sequence of the traffic light and provides the most effective method of routing the vehicle through the intersection while redirecting general traffic. As part of the invention, the traffic light control system will inform the emergency vehicle which it has received the transmitted signal. The stored present traffic patterns may in one representation is responsive to manual intervention from a dispatching center or to time-of-day conditions. The traffic light control apparatus may be operated under control of data or voice transmitted from the
emergency vehicle’s regular two-way voice communications system to a central control station.

Bohnke and Pfanner still acknowledged a need for more reliable traffic data acquisition than localized data collection generated by traditional loop detectors (1986). The pair introduced a pattern recognition algorithm which could utilize unique vehicle presence signatures generated by successive series of inductance loop detectors. By identifying platoons of vehicles traveling across links bounded by loop detection equipment, vehicle travel times could be obtained. In energy-efficient protocols which are used to improve traffic safety using WSN were proposed and widely used to implement an intelligent & smart traffic management system. In vehicle to vehicle communication (V2V) scheme between neighboring vehicles and in the absence of a central base station was proposed earlier. Traffic Management System using Density Calculation and Emergency Vehicle Alert has the potential to revolutionize traffic surveillance and control technology because of its low cost, easy to use and potential for large-scale real-time deployment.

The already existing system for Intelligent Traffic Control System (ITCS) proposed in [2] for emergency vehicles implements signal change by using IR sensors or RFID technology. They don’t have an alternative method to control the flow if anyone of the technology fails. They don’t survey whether the ambulance is in emergency state or not. Because ambulance may also use in non-emergency situations to provide facility to humans due to their health condition. In such cases, time limits are not considered. So it is not needed to make a change in signals of traffic control system in non-emergency cases. So in this paper special implementation for the non-emergency condition has been included.

The work proposed a traffic control system based on the wireless sensor network and an alerting system for red light crossing scenario to alert the drivers on other sides to save their lives. This technique is based on the queue length of the vehicles standing by the sides of traffic post.

Intelligent Traffic Signal Control System by Dinesh Rota & Prof. SwapniliKarmor. Here the embedded system uses IR sensors, AVR-32 microcontroller with the programmable flash memory, with built-in 8-channels ADC. IR (i.e. Infrared) sensor is programmed to identify emergency vehicle and microcontroller is designed in such a way that it gives the red signal to all other lane but one with the emergency vehicle. Limitations: In this system, IR sensors are used, due to various climate conditions present in developing countries like India, IR sensors may need to keep in safe place or a strongbox. The Price factor of implementation of this system is high. So it is not advisable to implement this kind of system.

The problem of an ambulance getting stuck in a traffic jam can be addressed by ensuring that the lane in which the ambulance is traveling is cleared. That is, the arrival of the ambulance is to be communicated to the nearest traffic signal so that it can turn the light to green and hence clear the traffic. To overcome this difficulty, a system combining RF Module and GPS was designed.

ManasiPatil et al., suggested a better traffic management system using Raspberry pi and RFID technology. The vehicle has a raspberry pi controller fixed in it which is interfaced with sensors like gas sensor, temperature sensor, and shock sensor. These sensors are fixed at a predetermined value before the accident. When an accident occurs, the value of one of the sensor changes and a message to a predefined number (of the ambulance) is sent through GSM. The GPS module which is also interfaced with the controller also sends the location of the vehicle. When the message is received by the ambulance, a clear route has to be provided to the ambulance. The ambulance has a controller ARM which is interfaced with the RFID tag sends electromagnetic waves.

When an ambulance reaches the traffic signal the RFID reader which is placed on the joints detect the electromagnetic waves of the tag. If the traffic signal is red, then the readers go through the database in fraction of seconds and turn the red light green. And automatically in such condition, the RFID on opposite joints turn the opposite signal red. This provides a clear route to the ambulance. [8].

3. MOTIVATION

Bottlenecks are the most significant factor, accounting for 40 percent of all the congestion and reflecting the fact that the number of vehicles on the road has been increasing at a faster rate than the growth in road system capacity. Completely removing the congestion is never possible but controlling the congestion is what, that can be done. Congestion makes a major impact on the emergency vehicles as it fails to reach the destinations in time in case of emergency vehicles like ambulance it can even take human life. So our major problem is to reduce the effect of congestion on the emergency vehicles.

4. METHODOLOGY ADOPTED

**4.1 Block Diagram Description**

Our aim is to make the path of the emergency vehicle unaffected by the traffic congestion. The major steps involved are

a) The RF trans-receiver placed 1-2Km ahead the intersection collect the data when an emergency vehicle approaches. The emergency vehicles are placed with unique RF ID which is stuck on to the vehicle. The RF trans-receiver receives the data and send it to the cloud.

b) With the help of the GPS placed in each emergency vehicle entire route of the vehicle can be tracked. The data which is sent out to the intelligent transportation system is of the emergency vehicle are those about the destination and the route. The information which is received by the vehicle is of the path ahead like the intersection of roads. So a GPS enable to do those jobs.
c) The information sent by the RF transceiver to the cloud is received by the microcontroller present in the signal in an intersection and it detects the less congestion path through the congestion detection algorithm. Then depending on the result, the signals give to the less congested area so that other vehicles can move according to the signal and the emergency vehicle can take the direction of the destination irrespective of the signal.

4.2 Component Description

a) Congestion Detection

The main problem with sensors is that they are expensive to repair and maintain. Of this reason it is very interesting to look into alternatives. The purpose of this project is to look at using FCD as an alternative to road sensors for traffic monitoring. In particular, the purpose is to use FCD for both automatic and manual detection of traffic queues. The automatic detection is based on analyzing GPS data from mobile traffic report units.

Traffic Queue Detection Algorithm

To be able to detect traffic queues we define the following two concepts. Measuring stretch which is a part of the road network where it is assumed that cars will always drive the maximum allowed speed unless there are traffic queues. These measuring stretches are selected such that they are not close to road intersections, parking lots and other obstacles that may slowdown traffic. Report stretch which is a part of the road network well-known to the road users. The central idea in the traffic queue detection algorithm is to detect traffic queues on a report stretch if there is a queue on any of the measuring stretches on the report stretch [3].

<table>
<thead>
<tr>
<th>Congestion Level</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>User reported queue dissolved</td>
<td>-10</td>
</tr>
<tr>
<td>No congestion</td>
<td>-2</td>
</tr>
<tr>
<td>Insignificant congestion</td>
<td>0</td>
</tr>
<tr>
<td>Initial congestion</td>
<td>1</td>
</tr>
<tr>
<td>Huge congestion</td>
<td>2</td>
</tr>
<tr>
<td>Critical congestion</td>
<td>4</td>
</tr>
<tr>
<td>User reported queue started</td>
<td>10</td>
</tr>
</tbody>
</table>

To detect traffic queue we have data provided manually by the drivers (pressing the queue button) and we have automatic data provided as GPS data. To get the best quality in reporting traffic queues these two data sources need to be combined. We assume that the manual data is a more reliable source for traffic queue detection than the GPS data. For this reason, we assign different weights to these two data sources. The weights used are shown in the table. As can be seen, we put the highest weights on the user reported queue started and dissolved, the values 10 and -10, respectively. The remaining weights are assigned accordingly [4].

(b) RFID

Radio frequency identification (RFID) is a generic term that is used to describe a system that transmits the identity (in the form of a unique serial number) of an object or person wirelessly, using radio waves. A typical RFID tag consists of a microchip attached to a radio antenna mounted on a substrate. The chip can store about 2kB of data. Data stored on the RFID tag is retrieved using a reader. A reader is a device that has one or more antennae that emit radio waves and receive signals back from the tag.

RFID transponders are placed on the road surface. The transponders are then interrogated by an RFID reader and the received data are exchanged with all nearby vehicles via wireless communication. After the exchange of data, the system can monitor the condition of traffic and issue alerts in dangerous situations. It should be noted that interference would not be a problem since the reading range is limited to the distance between a single vehicle and a transponder. The RFID transponders contain a device-specific identification number, which will be used to determine the position of the vehicle.

RFID consists of two main units. The first unit is the reader module or interrogator and the second unit is the transponder or tag. The purpose of the interrogator is to wirelessly retrieve data that is stored on the transponder by means of inductive coupling. In this research, the transponder is designed by doing research on the appropriate reading range necessary for this research work. Two design considerations are present with regards to transponder design: an active transponder design, or a passive transponder design [5].

An active tag design allows for the interrogator to have a built-in power source. This allows for a dramatic increase in the interrogation distance, but a significant increase in the cost of transponder production. A passive tag design does not include a built-in power source; hence the tag relies solely on the reader module to provide the necessary power. In a passive transponder design, the maximum interrogation distance that can be achieved will be less compared to active transponders, however, the production costs are also...
significantly reduced. The different frequency bands in which tags can operate should also be considered. RFID tags can operate in the following frequency bands: Low frequency (125–134 kHz), High frequency (13.56 MHz), Ultra high frequency (865–868 MHz), and Microwave (2.45 GHz).

Lower frequencies such as the low frequency and high-frequency ranges allow for the design of passive transponders. Inductive coupling is considered to be the method of choice for power transfer and data transmission for tags in lower frequencies. When higher frequency transponders are desired, active transponders are used. One of the benefits of an RFID transponder is that no line-of-sight is required and, more importantly, no human intervention is required. This allows for better time management and better human resource utilization. Furthermore, the use of a unique ID allows for the identification of individuals or individual objects.

It is clear that RFID technology, though an emergent technology already has a significant impact on multiple fields. By incorporating this technology into the field of intelligent transport, a complete system can be created that allows for accurate tracking and monitoring in a wide variety of applications.

The use of RFID can be expanded in this sphere to develop smart vehicles. The RFID technology can be integrated with NFC devices (Near Field Communication) to make payments at petrol pumps, payment of fines etc., and also record these payments for future use. For example, a traffic police officer with an RFID reader can access previous fine and payment details of a vehicle from the RFID tag located near the rear of the vehicle [6].

(c) GPS Module

GPS stands for Global Positioning System and used to detect the Latitude and Longitude of any location on the Earth, with exact UTC time (Universal Time Coordinated). GPS module is the main component in our vehicle tracking system project. This device receives the coordinates from the satellite for each and every second, with time and date. GPS module sends the data related to tracking position in real time, and it sends so many data in NMEA format. NMEA format consists of several sentences, in which we only need one sentence. This sentence starts from GPGGA and contains the coordinates, time and other useful information. This GPGGA is referred to Global Positioning System Fix Data. Know more about Reading GPS data and its strings here. We can extract coordinate from GPGGA string by counting the commas in the string. Suppose you find $GPGGA string and stores it in an array, then Latitude can be found after two commas and Longitude can be found after four commas. Now these latitude and longitude can be put in other arrays [7].

5. CONCLUSION AND FUTURE SCOPE

The vehicle classification system is used to automate the process of traffic monitoring system by making identification and classification of moving vehicles on road. Automatic traffic density estimation and vehicle classification through video processing is very important for traffic management especially in mega cities. With automatic traffic signal control based on the traffic density in the route, the manual effort on the part of the traffic policeman is saved. As the entire system is automated, it requires very less human intervention. If they spend a lot of time in traffic jams, precious lives of many people may be in danger. With emergency vehicle clearance, the traffic signal turns to green as long as the emergency vehicle is waiting in the traffic junction. The signal turns to red, only after the emergency vehicle passes through. Further enhancements can be done to the VI by testing it with RFID readers. Also GPS can be placed into the emergency vehicle detection VI, so that the exact location of emergency vehicle is known. Currently, we have implemented system by considering one road of the traffic junction. It can be improved by extending to all the roads in a multi-road junction.

6. REFERENCES

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