iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** V **Month of publication:** May 2020

DOI: http://doi.org/10.22214/ijraset.2020.5357

Emergency Vehicles Traffic Management System

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Abstract: The term Big Data means huge amount of data which refers to some applications and study of sets of big and complex data. The traditional systems were not equipped to handle such huge volume of data. In the current advanced technical environment there are various applications to deal with these kinds of data. Big Data applications are prevalent in various fields that include remote sensing, Internet of vehicles, security analytics, architecture design for smart grid, greening big data, fuzzy based scalable clustering algorithm, novel pipeline approach, visual analytics in urban computing etc. In today's world enormous vehicular data is generated in terms of traffic safety, all this data is generated by vehicles and the traffic signals and other navigational services. This data is used to manage the activities of vehicles for emergency services. Today lots of lives get lost due to delay in emergency services, many approaches for this problem had been proposed but they were not efficient. In this paper, a new emergency vehicle (EV) traffic management system is proposed to cope up with this problem. The system uses Geo Location to track the distance between traffic signal and EVs, and change the traffic signal to green and shows the lane from which EVs is coming on the Traffic signal when it is within range of Traffic signal. This system will results in less delay in terms of EVs reaching the destination which in turn will help in saving more lives.
***Keywords**: Emergency Vehicles (EVs), Road side units(RSU), Vehicular ad-hoc Networks (VANET), Roadside storage unit (RSU), Electronic Fuel Injection (EFI),Engine Control Unit (ECU), Vehicle to Vehicle(V2V) and Emergency Vehicle Management System (EVMS), Internet of Vehicles (IoV), Hewlett Packard Enterprise (HPE), Data Quality Improvement (DQI).*

I. INTRODUCTION

The term Big Data means huge amount of data which refers to some applications and study of sets of big and complex data. The traditional systems were not that much equipped to handle huge volume of data. Now days in this advance technical environment there are various applications to deal with these kinds of data. Big Data is one of these applications that include various challenges like data storage, capturing data, sharing, data analysis, search, visualization, querying, information privacy, updating & data source. Big Data is associated with number of concepts mainly volume, variety, velocity. It also addresses another factor termed veracity i.e., amount of noise in data and value. Big Data application used in various fields include remote sensing, internet of vehicles, security analytics, architecture design for smart grid, greening big data, fuzzy based scalable clustering algorithm, novel pipeline approach, visual analytics in urban computing etc. Big data is very messy and unstructured in nature (50% to 80%). It requires filtering or sorting the information, so that it can be used wisely. Only few are capable in the cleanup of data, to do this cleanup some special tool and techniques are used like Hadoop and HPE. Data has been a commodity that can be used to generate money, as information is the most important thing as it can be used in various aspects in the market as major companies rely on this data or piece of information to make their new products or services that result in money generation. Real time use-case of big data include: doctors can predict heart attacks before time, air traffic control can be managed well that may result in less air crashes and much more. If big data is not handled securely or any security measures are not taken then this huge data can be used for ill practices that can lead to cybercrime, terrorist attacks, leakage of personal or very important data that are sensitive.

In today's world enormous vehicular data is generated in terms of traffic safety, all this data is generated by vehicles and the traffic signals and other navigational services. This data is of different type and it is in huge volume. All these kinds of data are collected from vehicle to vehicle (V-V), vehicle to ground (V-G), vehicle to air (V-A), air to air (A-A), sensors, geo-location of vehicles, and navigation. All these data are processed further to gather the useful information from it. This information can be used in traffic control, travel time prediction, vehicular communication, information about vehicle like engine health, pollution emission, tyre pressure, and other type of services. All these data are very difficult to handle, so different strategies are used to manage data and provide useful information. One of the strategy that is commonly or widely used is Big Data. Here big data plays a major role in the management of data that is generated by IoV's and big data gives some characterization such as IoV big data sourcing, IoV big data support, IoV big data services and applications. All these type of data is processed further and used to gather the valuable information from the processed data; this information can be used for managing traffic and monitoring vehicle health, etc.

In today's time, the major problem is the increasing traffic and the management of traffic efficiently is very important as numbers of vehicles are increasing day by day. In this tough scenario, certain vehicles doing critical work need to reach the destination at correct time and if they are not able to reach within time then some adverse effects may be there. These vehicles are known as emergency vehicles, these vehicles include police patrolling cars, fire brigade trucks, and ambulance. Due to insufficient traffic management, these higher priority vehicles are not able to reach a particular destination on time. To solve this problem, we have proposed an idea that we will be discussing in the section III with help of a scenario, images and block diagram.

II. RELATED WORK

Today's vehicles are generating huge amount of data [1]. In big metropolitan cities, traffic is a major problem. Internet of Vehicle is very helpful to control traffic and provide easy driving environment. In this work, they performed monitoring of real-time data to prevent network failure. They also used aggregate signature for quick data verification. Internet of Vehicles also faces challenges regarding performance and security. To overcome this problem, Diffie-Hellman algorithm was applied for better performance and to decrease extra computation.

Internet of Vehicle enables content sharing and exchange of information among vehicles [2]. In this, they go through merging of social layer and physical layer information, to get to know how the data is spreading from one device to another device and vehicles. In this, they can perform various equations and algorithm for better communication and to solve the problems like channel selection, power control. It also cover-up many challenges like collision warning, traffic monitoring, route planning, and so on. Finally, results of these equations and algorithm help to analyses the resulted data.

In [3], they dealt with the problems that occurred in holding the big amount of data related to the geo location of the moving vehicles and the speed at which the accurate geo-location is updated so that it helps the user in navigation. To overcome these problems, they worked with Hadoop for handling the Big Data and JTS and Java AWT for effective mapping.

In [4] they showcase the ways in which the vehicles can stay connected to the Internet and exchange the useful information or communicate with each other inside the network, the connectivity to internet proposed by 4G and WLAN, etc. To improve the communication speed and response what things or ways that should be done is discussed.

To estimate or predict the travel time of a vehicle and make decision [5] according to the time to "travel prediction" time, this can be useful in traffic management and to find the optimal route. To achieve this they used artificial neural network (ANN). How information is gathered: Mobile GPS, In-Vehicle GPS, Cameras, Sensors onboard or on road.

In [6] they focused on how the RSU (Road side units) can help to gather the information. And the main aim of this work was to improve the performance of the RSU's, which may help in the management of traffic and other things. They performed clustering of intersections using Markov clustering algorithm. Due to the economic conditions it is not feasible to install RSU units at each and every station. So, we have to find some other way to improve the performance to gather more reliable information from limited number of RSU. This paper is about the false information that is provided by the peers or any vehicle that can lead to bad safety management in VANET [7]. To reduce such problems, they make use of standardized alert messages (I.E DENM) to carry the needed information. They established a trusted vehicle to carry out the broadcast to maintain the reliability. Techniques used: Trust-based unicast routing in VANETs, Trust-based alert dissemination in VANETs, Decentralized Environmental Notification Messages (DENM), Inter-vehicular trust establishment.

This paper is about how the IoV works and the role of Big Data in IoV [8]. They also discussed the need of the communication of data between the vehicles and the communication between Road to vehicles, Air to Air, Road to Air, etc. With all these communication, large amount of data was generated and it was termed as Big Data. Big Data supports Big Data Acquisition, Big Data Transmission in IOV, Big Data Storage in IOV, Big Data Computing in IOV. In today's time the technology is very advancing such as [9] wireless sensor, embedded system, cloud computing, fuel cell technology, high performance battery, etc. Apart from these technologies, there are many other technologies such as users on road, infrastructures like buildings, etc. They should work together to maintain sustainable mobility and cleaner environment. Big data has great impact on automotive industry. The main issues in the automotive industry include depleting non-renewable energy resources, global warming, safety, accessibility, affordability, globalization and connectivity. Through big data and its applications they overcome these issues to sustain the mobility and environment. This paper deals with various improvements in quality of data [10]. In IOV's (real-time services) sometimes there may be issues regarding low-quality diagnostics, traffic prediction, safety alerts, etc., they all work properly if there is good data quality. Further, Hadoop for automotive applications include processing issues and compromises the dependability of data-dependent services. To share data and use services in IOV a system name CARSTREAM is used which provides high accuracy and service dependability, which has a subsystem DQI which handles different data quality issues. DQI techniques enhance the reliability of Info-centric services in IoVs. Major problem causes due to low Data Quality are inaccurate results which leads to complexity of processing in logic used, application using pre-processing data also produces errors and has to be updated accordingly. To tackle these problems and assure service dependability they focused on DQI.

Today data is generated at a very high level of which very less or fraction of data is required for different applications [11]. To handle this data intelligent services are used like Hadoop, which is an open-source software facilities and utilities for data storage and runs different applications on bundles of computer hardware. In this they discussed that what are the applications and datasets which are suitable for Hadoop. How can a variant tools and set of frameworks be managed on multi-tenant Hadoop bundles of data and how do these tools combined with existing RDMS? Automotive Industries are facing problems like: Autonomous vehicles have number of sensors which produces large and variety of data. Intelligent transport systems services which help in vehicles execution mgmt., SQL frameworks, Advance analysis, data governance and security.

In VANET, data is produced heterogeneously and in large volume [12]. In this paper they used "Bayesian Coalitional Games" (BCG) to analyze the problem in which the players don't have complete information of other players, but they have beliefs with known probability distribution. For each individual, action performed by automaton process, it may get a prize or a penalty from the environment. Further they discussed how the players collaborate and deal with each other and environment. They considered about connected vehicles in IoVs as an environment, where game players execute the learning algorithm and take adaptive and appropriate decisions. Each player revises its action in a probability vector after getting input from the environment. Then an explicit comparison has been presented by examining cooperative and non-cooperative nature of players in the game.

This paper shows traffic flow of an urban region [13], as more and more people moving towards urban areas, so there is a necessity of providing a healthy lifestyle and better city planning. To do so, different time periods of day considered by them, and then they generate many detailed functional correlation matrices between zones. Then, they derive optimal sparse representation of these matrices that reveals existing roads network connectivity b/w zones and also reveals latent links b/w zones. An optimization problem is calculated which is used to deduce the sparse effective traffic network from data of traffic flow at different time periods. Experimental study of cities of Doha and Qatar are taken in which data is collected through Bluetooth sensors installed across the city to record vehicular activity, through the traffic zones in the city. Further these results help in urban planning and real-time city's traffic planning.

VANETS are becoming more popularized in the field of safe driving support systems and safety systems. [14] Vehicular Visualization is an efficient way to improve safety applications and safe driving. It uses VANETS to enhance the drivers view field and includes optimized mechanism to reduce broadcast packets and by evaluating these mechanisms through real time VANETS experiments to see visualization performance. Due to high mobility of vehicles in VANET, VANET topology changes rapidly. For rapid and accurate data communication various broadcasting algorithm techniques are used like Probability Based Broadcast, Location Based Broadcast, and Cluster Based Broadcast. Efficient Vehicle Visualization System also used to show surrounding vehicles on a map of an in-vehicle display device, including those hidden by other vehicles or building features. They achieved this through Self-driven Broadcasting, Neighbor driven Broadcasting. They proposed an IOS based prototype to corroborate the feasibility of EVVS through real time VANET experiments.

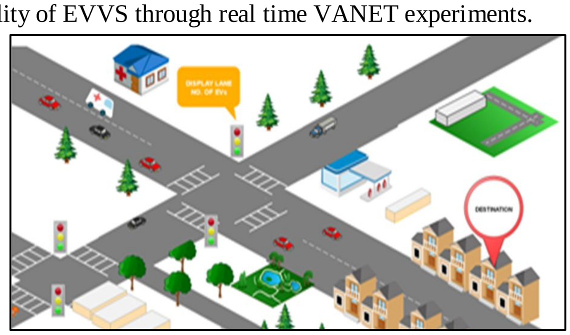

Figure 1 Ambulance going towards destination without any interruption

III. PROPOSED METHODOLOGY

A. System Overview: EVMS(Emergency Vehicle Management System)

To effectively manage the emergency vehicles, we have to implement a new system that works to eliminate the problem of managing emergency vehicles traffic. So to manage them, first we need to track at what path they are coming and we need to alert the other vehicles on the road about the coming of emergency vehicle so that they can move ahead and the emergency vehicle will be able to reach its destination on time. To achieve this, we are proposing our idea to manage this situation. Firstly a digital board and buzzer will be installed at every traffic light that will show at what particular lane the vehicle is coming so that other vehicle on road know about the expected incoming of emergency vehicle. As the emergency vehicle comes closer to the traffic light the lights of the traffic signal will turn to Green (if the current status of signal is Red) and all the vehicles in the lane where emergency vehicle is coming will move ahead. When the emergency vehicle crosses the traffic signal, the lights of the signal will be back to their previous state (if the lights were Red then it will again go to Red).

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue V May 2020- Available at www.ijraset.com

The driver of an emergency vehicle will be provided with a mobile friendly application in which they shall enter the login credentials. After login successfully, the user can start the trip by simply entering the destination and will start the journey. Now our system will detect all the traffic signal in the path and update all the digital board and buzzer about EV arrival on a particular lane. As the EV comes closer (e.g. 500 meters) to the traffic signal, the signal will turn green and buzzer starts beeping and as soon as it crosses the traffic signal the traffic lights will set to their previous state i.e. if the signal was red it will again be red and the digital board will be reset. If there is another emergency vehicle coming on the same path the digital board will be set according to that.

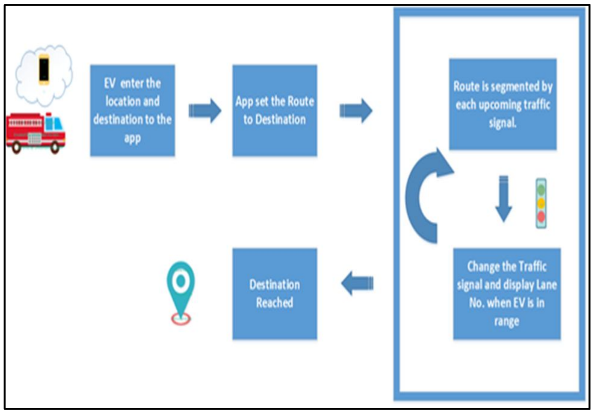

Figure 2 EVMS Work Flow

B. Implementation Steps

1) User will open the Mobile application “Emergency Path”.
2) Unique user credentials will be provided to each and every user. So, that no one can misuse the system (EVMS).
3) After successfully login into the application, user can start the trip by simply tapping on the start button provided.
4) The destinations for the EVs are predefined by the system. User just needs to select the destination from the table provided.
5) The location of the user is captured through GPS sensor available in the mobile phone of the user, and also through GPS device placed inside the vehicle. The user location as well as the destination gets processed on the server.
6) To enable synchronization between traffic lights, the predefined algorithm will make the segment of traffic lights which comes between the source and the destination.
7) As the EV comes closer to the traffic signal (e.g. 500 meters), the traffic signal will change to green. As soon as the EV crosses the signal, the signal will be set to its previous state.

C. Results

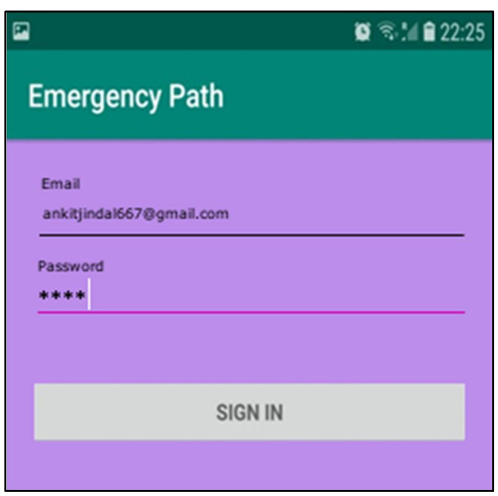

Figure 3 Login Page

Figure 3 shows login page of the application where user need to enter unique credentials given to him/her to get access to the system. The credential system protects the EVMS from misuse, because this system only allows authorized users to get access to the application.

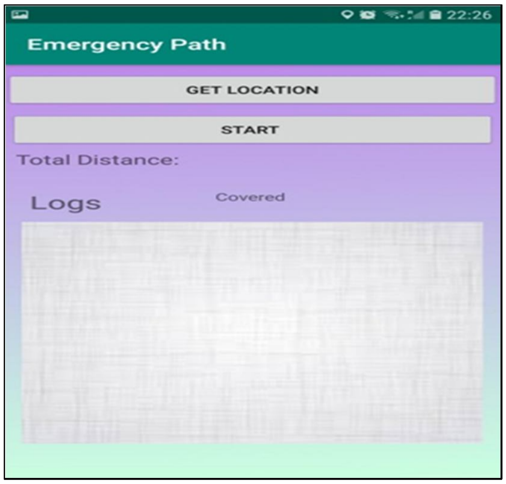

Figure 4 Trip Setter

Figure 4 shows after successful login in the application, one can set the trip in the application. After tapping on Get Location button predefined destinations will be shown.

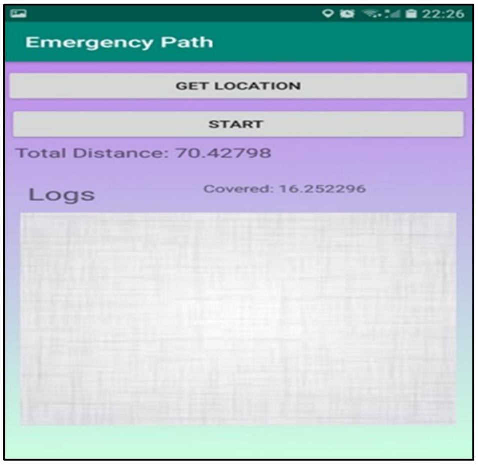

Figure 5 Trip Starts on tapping Start button

Figure 5 shows after selecting the destination the distance between source and destination is displayed. The distance covered is also displayed as soon as the vehicle moves towards the destination.
Now all the operations that performed on mobile application will affect the hardware of the project. In our case we use arduino Uno board, Raspberry pi 3, GPS Sensor, Potentiometers, LCD display, etc.

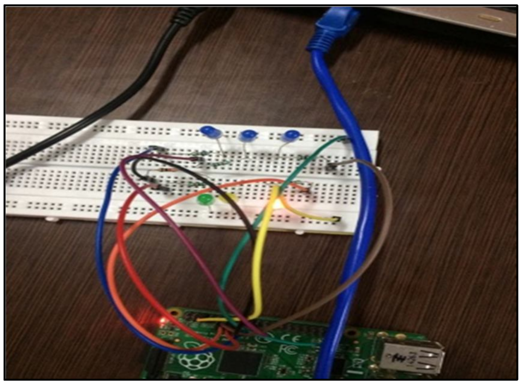

Figure 6 Signal is transmitted to the lights

Figure 6 shows when the trip is started by the user of EV then the signal is transmitted to the traffic lights which come between the source and the destination.

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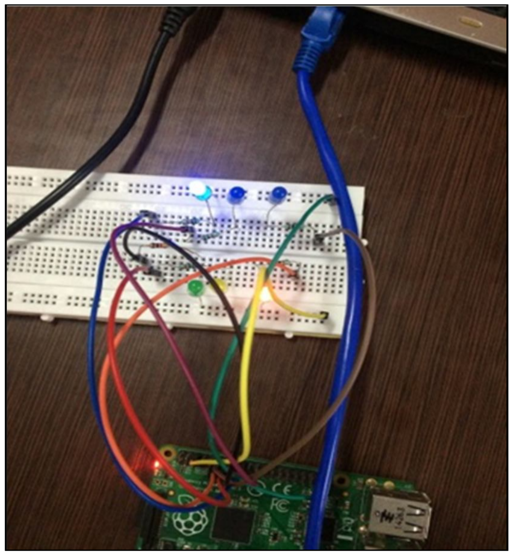

Figure 7 Light Changes on arrival of EV

Figure 7 shows when the EV comes closer to the traffic signal for example 500m – 700m then the signal turns to Green so that EV can pass the signal without any obstruction.

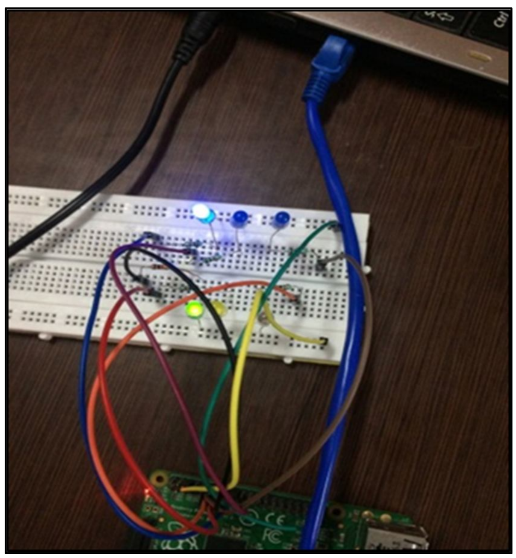

Figure 8 Signal set back to its previous state

Figure 8 show that the signal restores itself to its previous state after the crossing of EV. Means if the previous state of signal was RED then it changes back to RED; if previous state was Green then it changes back to Green.

IV. ANALYSIS

Here, we are doing comparative analysis with a previous system on the basis of Accuracy, Technology, Lane detection and Security. Presently emergency vehicles using the concept of **Strobe light** is not effective in managing *high priority vehicles*.

1) *Accuracy:* The system (EVMS) proposed in our work is of high accuracy as it uses the geo location. On the other hand accuracy in strobe light system is low, because weather condition affects the accuracy.
2) *Technology:* The technology used in EVMS is GPS and Internet. On the other hand strobe light system uses the Physical strobe light.
3) *Lane Detection:* EVMS system detects the lane from which vehicle is coming. On the other side there is no provision of lane detection in strobe light system.
4) *Security:* In the system that we proposed (EVMS), it uses Mobile application so unauthorized users cannot misuse the system. On the other hand anyone can manipulate the traditional system by installing their own strobe light.

V. CONCLUSION

In our research work, we talk about big data in Internet of Vehicles. Internet of vehicle is a new emanating area in which we can connect to various vehicles through Internet and share valuable/important information. IoV can support the storage of different sets of data, computing on them, Big Data acquisition etc. IoV is very helpful in traffic management system like we proposed a new concept for Emergency Vehicles to reach the destination without any traffic obstructions. For this we develop an application for current location of Emergency vehicle and this location sent to the traffic control room and according to the distance between EV and traffic signal, the traffic lights start working according to the predefined parameters. This kind of system will help society and our roads in future. This will be of great help to properly manage traffic in optimized manner.

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