CONGESTION REDUCING SYSTEM THROUGH SENSORS, IMAGE PROCESSORS AND VANET IN V2I SETUP

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Abstract- Traffic congestion is a major universal problem. As vehicle population increases, the existing infrastructure at many places is unable to cope up with the vehicular footprint. This leads to congestion on busy streets, intersections and often highways which can in turn lead to fatal or non-fatal collision between vehicles. This paper discusses the use of technology in a V2I setup, namely- image processing, IOT including data transfer through cloud and Vehicular ad hoc network which aims at improving alert systems to internet enabled cars with minimal human involvement to increase accuracy of the process. The implementation of this setup is seen to be brought into the V2I ecosystem as internet enabled cars become more common and affordable for possessing a potential for maximum reach.

INTRODUCTION

Due to increasing human population and vehicle affordability, congestion in traffic and accidents due to that congestion are starting to occur more commonly as years pass by. It is important that emerging technology is put into use to reduce congestion and traffic problems, especially in spurning metropolises. The setup described used in this system facilitate traffic detection and send alerts to the nearby connected labels using real time sensors, image processors IoT gateways and VANET. The implementation of this setup would help the car drivers get a better idea of the condition s on roads ahead which would help them divert from a route of potential congestion circumstances. The system explains the working of vehicle to infrastructure data transfer mechanism efficiently and taking minimal possible time and human involvement for the same.

1. EXISTING SYSTEMS

Although there is still no fully functional existing system, but different Tech Companies have introduced ideas related to this system and many of them are already in implementation. Some of these companies are Ford, General Motors, Nissan, Tesla and Mercedes.

Some of the measures to reduce traffic conjugation and further accident prevention are- (i)Adaptive Traffic Signals (ii)Vehicle-to-infrastructure Smart Corridor (iii)Autonomous Vehicle Technology (iv)Real-Time Traffic Feedback.

Adaptive Traffic Signals

These lights are used to get a more efficient idea of traffic flow and the amount of time a vehicle idles at traffic lights. This helps in modifying traffic signal timing based on the traffic throughout the day.

Vehicle-to-Infrastructure Smart Corridor

The Adaptive traffic signals are one of the piece of smart corridors. They are the technology closest to our idea which address traffic congested roads as well as possible hazardous areas. To do this, short-range communications units are installed along the ringway that can connect with the other units and the vehicles that have devices installed. These corridors are expected to reduce the travel time on the avenue by 25%.

Autonomous Vehicle Technology

Autonomous vehicles are likely to reduce congestion. One example of the example of an autonomous vehicle technology is Platooning. If all vehicles on the road had autonomous technology, these vehicles would then be able to speed up and slow down, and merge onto and off freeways without human direction, and thus . Platooning is a kick-offfor self-driving cars as it requires vehicles on a highway to communicate with each other about speed and conditions, allowing the vehicles to travel frequently. This would eradicate human error that causes issues like Phantom Traffic which is caused by the ripple effect of a driver braking in the middle of a freeway.

Real-Time Traffic Feedback

Real-time traffic feedback makes concepts like Congestion Pricing a little uncomplicated to sell to consumers who are used to using roads for free. In place of the typical toll for express lanes, this would change the pricing structure based on high traffic hours and for high-occupancy or exempt vehicles, with the motive of discouraging single-passenger drivers to be on the road at peak travel hours.

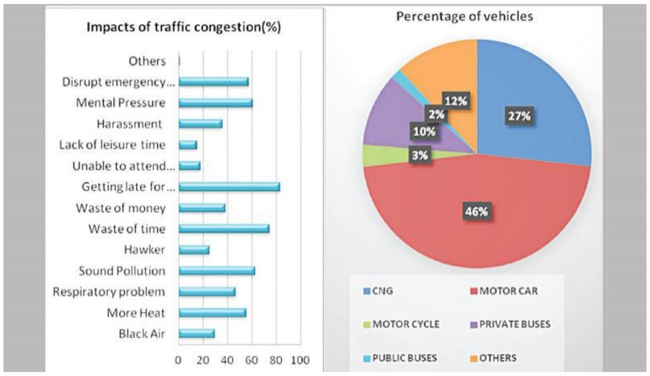

Fig 1: impacts of traffic congestion(Source-NewAgebd).

2. OBJECTIVE

Due to increase in population, the number of vehicles on road has also increased. Because of this, congestion on road has also increased. Thus, our objective was to design a setup that helps forecasting of a congestion and helping drivers divert their routes accordingly thereby keeping the main intersections, streets and highways congestion free to the maximum possible level. Our system allows the drivers to know the location of the abnormal road conditions in the nearby areas. The system uses Image Processing and Cloud Computing and VANET data transfer to check for the congestion or accidents and storing and sharing of that information.

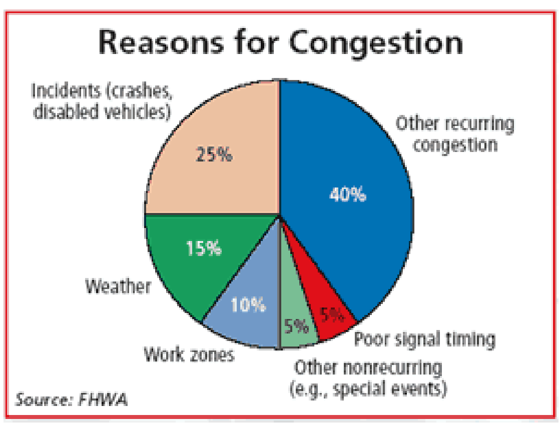

Fig 2: reasons for congestion.(Source-US DT)

3. PROPOSED SYSTEM

A. Real time sensors.

Real time monitoring sensors are attached on busy crossings and intersections. Through the sensors following readings are taken down.

1. Number of cars passing in every 2 minutes.
2. Average speed of the vehicle in the past 2 minutes.
3. Average occupation ratio of the lane in those 2 minutes.
4. Date and time information.

The sensor is attached such that it has optimal placement to that of the road under observation. This makes sure that the readings taken by the sensor have increased accuracy. The readings are noted and processed, once an anomaly major that usual is noticed among the readings which differs from the conditions of normal functioning, the image processing system is activated.

B. Image processing system

Once the real time sensor combines with the image processor after noticing anomalous readings, the image processor camera is activated. The camera is attached as part of the system which includes the image processing unit. An image is processed using following techniques stepwiseGrayscale Conversion

The first step in image analysis is the conversion of the RGB image into grayscale using standard techniques.

I. Median Filtering

After grayscale conversion, the noise within the image is smoothened using a median filter. A median filter modifies an image pixel such that the new pixel value is selected as the median of the neighboring values within a specific range. This filtering has the effect of removing random noise in images while still maintaining the overall integrity of image regions and it's boundaries

II. Thresholding

The next step in processing involves conversion of the grayscale image into a black and white image through the process called thresholding. This process involves the selection of a certain threshold value in the grayscale range which acts as a cutoff for determining which pixels should be converted to white or black in the resulting image.

III. Line Detection

Using the obtained threshold image, a Hough Transform (HT) is performed. HT algorithm maps all points in the image space into sinusoids within an alternate polar coordinate parameter space. Polar coordinates defined within this parameter space define the angle and magnitude or length of vector normal for probable lines in the image space. Using these parameters, it's possible to map points in the HT parameter space to lines in the image space. Each point in parameter space is associated with a numerical value which relates to the likelihood of that line defined by polar coordinates actually existing in the real scene from the image. Local maxima of this space defines the most prominent lines within the image scene and provides the basis for use of HT parameter space to detect road paths.

IV. Angle of Rotation

Once the vanishing points of the current image and training image have been determined, it is possible to calculate the distance between the two points and hence the road line relative to stationary traffic camera to determine the heading direction or angle or rotation of the camera in two-dimensional space. The relative rotation of roadway in this image relative to a training or reference image roadway allows for determination of angular rotation of the camera. This angular rotation is easily mapped to real world directional coordinates based on the calibration information for our camera and reference image. This approach assumes a fixed camera location and knowledge of certain camera calibration settings.

C. IoT gateway

After the image is processed and it is determined that major anomaly in traffic flow is detected by the image processor, the data received is to be filtered to be transferred. This is done by an IoT gateway.
IoT Gateway makes the devices available online through sensors and cloud

An IoT gateway performs several critical functions from

- translating protocols to encrypting
- processing
- managing data
- filtering data.

The Gateway Software :

The software application is heart of the IoT gateway.

The gateway software is responsible for

- collecting messages from sensors
- storing data appropriately until it can be pre-processed
- pre-processing the data
- Decides if data at a given stage of processing should be temporary, persistent, or kept in-memory.

In this setup, the data from the image processor and real time monitoring systems are collected and transferred to the data centers through the IOT gateway to the cloud where the useful data is filtered and further processed through big data to be converted in an understandable code by the recipient.

Once the data is processed and filtered, the next step is transferring the data in the form of alerts to the connected cars in the nearby radius.

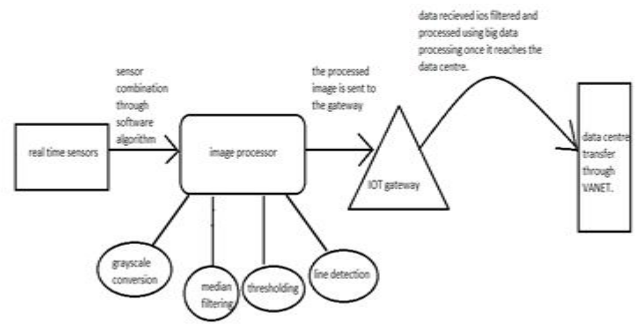

Fig 3: block diagram representation of the process

D. Alerts to the drivers through VANET.

The Vehicular Ad-Hoc Network, or VANET, is a relatively new technology that uses moves cars as nodes in a network to create a mobile network. VANET turns every participating car into a wireless router or node, allowing cars and road side data centers approximately 100 to 300 meters of each other to connect which in turn, creates a network with a wide range.

Data is transferred through the system of VANET(vehicular ad hoc networks) in the form of alerts to the drivers. It forms a network range between the data center and the vehicle where data flow can be proceeded through wireless path. This can be done through a wi-fi or a cellular connection, wherein in the drivers are alerted on their car screens about any nearby congestion or an accident with the location of the road provided where the incident occurred. The alerts are sent on apps for cars on the screen where a notification pops out and the driver receives the message.

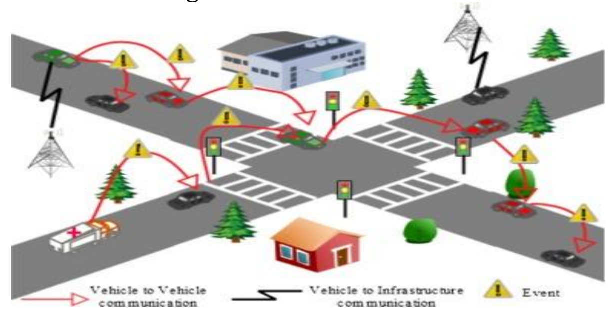

Fig 4: use of VANET in V2I and V2V

4. CONCLUSION

This paper elaborates the vehicle to infrastructure setup with the use of real time sensors, image processors, IoT gateway and Vehicular ad-hoc networks. This setup was formulated with the initial idea of implementation in the nearby future when IoT enabled cars become more common and affordable so as to make this system functional. The goal remains detect potential congestion to reduce abnormal traffic congestion which would in turn reduce collision accidents on roads full of traffic by alerting riders and advising them to divert routes.

5. REFERENCES

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