DYNAMIC TRAFFIC MANAGEMENT SYSTEM

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Abstract - Traffic Congestion has become a serious issue nowadays. Increasing traffic congestion can result into major cities being gridlocked. This scenario worsens during rush hours when the number of road users keeps increasing rapidly but the resources provided by the current traffic management system is unable to control this increasing traffic. There can be various causes of traffic congestion like incompetent traffic control system, unconstrained demand, long strings of Red Light etc. As unconstrained demand arises due to the economic growth and industrialization, incompetent traffic control system refers to the lack of flexibility of modification on real time basis and the delay of respective light being hard coded and not dependent on traffic demands a dynamic traffic management system to cater to the needs of increasing traffic congestion. This paper presents a Dynamic Traffic Management System that uses live video feed from the cameras located at traffic junctions for real time traffic analysis using video and image processing. It also focuses on the algorithm for switching the traffic lights according to vehicular count on road, which in turn will reduce the traffic congestion on roads which will result in reduced waiting time at the traffic signals. This reduced waiting time will help reduce fuel consumption.

Key Words: **Hard-coded versus Dynamic traffic control, Reduced Traffic Congestion, Signal Control,Optimal Switching Algorithm, Vehicular count Calculation, Wait Time determination, Video and Image Processing.**

1.INTRODUCTION

In the existing traffic light system after every particular time the light switches back to red according to a hardcoded algorithm. Therefore, we take a scenario considering a four-way junction, so at any side green light remains for 60 seconds and red for 180 seconds i.e. every side gets green light for a fixed time interval of 60 seconds, one after another. This is the general algorithm of current hard-coded traffic systems. Hence, an attempt is made to propose a system which can provide a quick and effective movement control framework.

Therefore, we have tried to address the problem with the help of our proposed model. We have achieved this with the help of video processing of the live feed that can be obtained from surveillance cameras and eventually to deploy a feedback mechanism in the working of the traffic lights where the vehicular count of the traffic would also be factored in the decision-making process.

Controlling the traffic light by image processing:

One of the techniques used in processing will be image processing for controlling the traffic light i.e., for deciding which traffic signal will be turned green in the next cycle and for how much time.

Vehicle detection using a camera:

The input will be collected using the cameras installed for each traffic signal in the form of live feed which will be used for detecting the vehicles and this input will be used for further processing.

Traffic light will change according to the computed vehicular count:

In the proposed system, traffic light will change according to the computed vehicular count unlike the existing traditional traffic management system which operates according to a hard-coded algorithm.

This framework will allow for quick and easy movement of traffic with less waiting time:

This will in turn result into an efficient traffic management system which will lead to reduction in the waiting time and accidents, easy movement of traffic and reduced fuel consumption.

2. PROPOSED SYSTEM

The proposed system calculates the vehicle count of traffic in real time and determines the wait time for oncoming traffic for each lane of the junction under consideration. The vehicle count is calculated on the basis of recordings from the cameras at the junction using image processing and filtering techniques to identify whether the approaching object is a vehicle or not. Greater number of vehicles will result in lower waiting time for that lane of the junction to ensure the optimal waiting time and efficiency of transit.

The project is mainly divided into five modules. They are:

2.1 Database

Database is created to keep a log of all the traffic recording and a table which consist a list of all the timer readings and vehicle detection count.

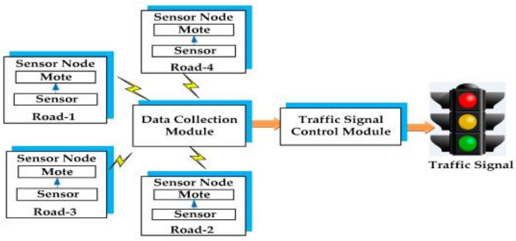

Fig -1: Database

2.2 Image Processing

Image Subtraction Image subtraction or pixel subtraction is a process whereby the digital numeric value of one pixel or whole image is subtracted from another image. This is primarily done for one of two reasons levelling uneven sections of an image such as half an image having a shadow on it, or detecting changes between twoimages. This detection of changes can be used to tell if something in the image moved.

Image Acquisition The first stage of any vision system is the image acquisition stage. After the image has been obtained, various methods of processing can be applied to the image to perform the many different vision tasks required today. However, if the image has not been acquired satisfactorily then the intended tasks may not be achievable, even with the aid of some form of image enhancement.

2.3 Vehicle Detection and filtering

Pre-processing In computer science, image processing is the use of computer algorithms to perform image processing on images. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing.

Grey scale conversion A grayscale or greyscale image is one in which the value of each pixel is a single sample representing only an amount of light, that is, it carries only intensity information. Images of this sort, also known as black-and-white or gray monochrome, are composed exclusively of shades of gray.

Image Binarization Binarization is the process of converting a pixel image to a binary image.

Color Histograms In image processing and photography, a color histogram is a representation of the distribution of colors in an image. For digital images, a color histogram represents the number of pixels that have colors in each of a fixed list of color ranges, that span the image's color space, the set of all possible colors.

Spatial Binning Spatial binning (spatial discretization) discretizes the location values into a small number of groups associated with geographical areas.

HOG (Histogram of Oriented Gradients) The histogram of oriented gradients (HOG) is a feature descriptor used in computer vision and image processing for the purpose of object detection. The technique counts occurrences of gradient orientation in localized portions of an image

2.4 Vehicle Counting

Vehicle counting includes the number of Vehicles crossing the junction and it also takes into account time required by a vehicle to cross the junction.

2.5 Traffic Signal Time Control

By considering the previous computation regarding the number of vehicles the wait time is determined. So, the total vehicles present divided by the number of vehicles that can pass in three second provides us with the amount of time for which signal is to be kept green. Since the Based on this Real Time wait time computation the Dynamic signal is chosen.

3. IMPLEMENTATION

In the proposed system, traffic light will change dynamically by using image processing. A four-way junction is required for demonstrating the functioning of the proposed system. Consider a four-way Traffic junction (S1, S2, S3 & S4) with cameras (C1, C2, C3 & C4) respectively. The live feed obtained from the cameras serves as an input to the system for further processing. The live feed is processed frame by frame to determine the vehicular count. For further understanding lets focus the received feed to only one side of the road (say S1) and convert it into black and white as shown in **Fig. 2.** and then we compare this frame with a frame when the lane was empty i.e., the background image as shown in **Fig. 3**. This empty lane image is obtained manually and required to be done only once since the same background image can be used until the structure of the road is changed. This process returns the approximate vehicular count of that particular side(junction). This process is repeated for every second and for all sides. As a result, we get the vehicular count of all the sides to perform further computation.

Fig -2: Real time Image

Fig -3: Background Image for subtraction

The proposed algorithm first determines the vehicular count and then uses this vehicular count to estimate the waiting time for each traffic signal. Consider a side which is currently red. On this side we will add number of vehicles present every second, so it keeps on getting calculated for all the sides where light is red. Now, just before 5 seconds when the green light of a lane is going to finish, we look into total vehicular count of each lane having red light, and the one with maximum is provided with the green signal. For the one which was green earlier its vehicular count is made zero, count of other two red lights remain the same, and the process of determining up the count repeats.

The time of green signal is calculated using the number of vehicles divided by number of vehicles that can pass in three seconds plus 10 sec as shown in **Table.1**

$$\text{Wait time} = \frac{\text{Total Number of vehicles (Vehicular Count)}}{\text{No. of vehicles that can pass in 3 seconds}} + 10$$

Here, 10 is added because if there are no vehicles present at a particular junction then that junction will be green for at least 10 seconds. As the minimum amount of green light provided to a lane would be 10 sec and maximum is 60 for practical reasons. Thus, the switching of traffic light occurs in accordance with the vehicular count computed by the proposed algorithm and not according a hard-coded sequence.

Table -1: Wait-Time Computation

Lane No.	Total count of cars	Computation For wait time {(No. of vehicles/3) +10} **(Note here 3 vehicles can pass in 3 seconds)**	Wait Time (s)
1	10	10/3 + 10	14
2	18	18/3 +10	16
3	8	8/3 + 10	13
4	13	13/3 + 10	15

In the developed prototype, hardware used includes Raspberry pi with OpenCV installed in it as shown in **Fig. 4.** and **Fig. 5.** shows a traffic signal prototype for demonstrating the switching of traffic lights according to the computations performed by the algorithm.

Fig -4: Raspberry pi

Fig -5: Traffic Signal Kit

4. UML DIAGRAMS

4.1 Use Case Diagram

A use case diagram at its simplest is a representation of a user's interaction with the system that shows the relationship between the user and the different use cases in which the user is involved.

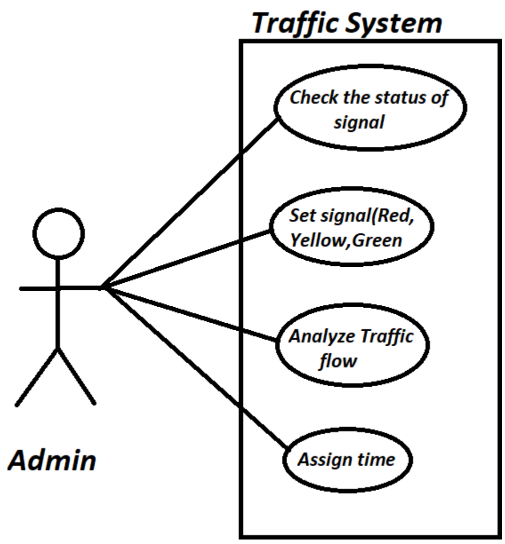

Fig -6: Use Case Diagram

4.2 Entity Relationship Diagram

An entity relationship diagram (ERD) shows the relationships of entity sets stored in a database. An entity in this context is an object, a component of data. An entity set is a collection of similar entities. These entities can have attributes that define its properties.

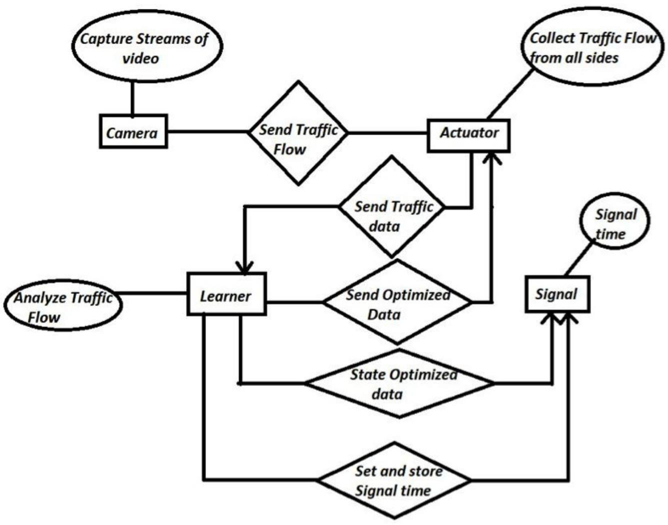

Fig -7: ER Diagram

5. FUTURE SCOPE

The proposed system can be used in fire detection in cases of major accidents. The vehicle objects can also be categorized into various classes depending upon the geometrical shape of vehicle for blocking the passage of large vehicles e.g. trucks during day time. The emergency mode can be refined further by installing a GPS receiver in ambulance so that the base station will keep track of the ambulance location on a continuous basis and clear the road whenever will be required. The proposed system can also be modified to implement E-challan System by using RLVD (RED LIGHT VIOLATION DETECTION) Cameras for detection of any traffic rule violations.

6. CONCLUSION

In this proposed system, a method for estimating the traffic using OpenCV is presented. This is done by using the camera images captured from the road lanes installed at every signal. Each image is processed separately and the number of cars has been counted. The proposed system estimates traffic flow using Image Processing. It aims at reducing traffic congestion thus reducing the number of accidents. This system guarantees that the average waiting time of the vehicle in front of traffic signal will be lesser than present traffic control systems, also the techniques and algorithms used in this project promises to be more effective as compared to the previous system. The advantages of this new method include such benefits as use of OpenCV over sensors, low cost, easy setup and relatively good accuracy and speed. Because this method has been implemented using OpenCV software, production costs are low while achieving high speed and accuracy.

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