Big Data Solution for Improving Traffic Management System with Video Processing

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Abstract:
The problem of traffic congestion increases rapidly, due to the growing number of vehicles and the limited resources in our country. There is a high need for the introduction of new technology to improve the traffic control. This paper introduces a new technique using image processing and big data to build a better traffic management system. The system takes CCTV videos installed at various checkpoints as input and converts the video into image frames. Thereafter, background subtraction is performed on these image frames to obtain only objects of relevance. Based on the density the signal will be processed. Using Hadoop Distributed File System as back end.

Keywords: Intelligent traffic system, smart city, reduce traffic congestion, vehicle density, video processing.

I. INTRODUCTION

One of the major problems faced by cities today is traffic congestion. Traffic jams causes a rise in the cost of transportation as well as it affects the routine lives of people. The problem of traffic congestion pervades everywhere, but mega cities are the ones that are most affected by it. The ever increasing nature of traffic makes it difficult to estimate the road traffic density in real time so as to make better traffic related decisions and manage the traffic more efficiently. The main reason can be attributed to rise in the population which in turn has caused rise in the number of vehicles on the road. Apart from this, congestion also occurs due to for congestion like insufficient capacity of roads, large red light delays, incomplete information regarding traffic, inefficient transport management, unrestrained demand etc. Insufficient capacity and unrestrained demand are interrelated but signal delays are hard coded and do not depend on the amount of traffic density. Therefore there is a need to optimize the traffic control system and make it more dynamic so as to accommodate the varying traffic density. In this paper we propose a dynamic traffic management system using video monitoring and traffic surveillance techniques. The proposed system uses CCTV cameras installed on traffic checkpoints as an input method to capture videos and converts them into image frames. Further image processing is performed on these image frames and vehicle density is calculated in each frame also check the ambulance presence. Accordingly the traffic cycle for each lane will be increased or decreased based on the traffic density value.

II. EXISTING SYSTEM

In the existing system, the vehicle travelling in road details are captured using various cameras in all directions and the video data is saved. Then they are split into frames. The images are converted into gray scale so that the image processing is fast. Then edge detection applied. The vehicle count is carried out and the density is calculated where the vehicles are in red signal. Then based on the density, the green signal duration is calculated and adjusted for next signalling.

A. Drawbacks of existing system

- No special signalling is provided for ambulance
- The scenario is static in all moment.

III. PROPOSED SYSTEM

The proposed system covers all the existing system approach. Ambulance emergency is taken in to account and signalling is immediately changed based on presence of ambulance. The scenario is dynamic in all moment. The system uses Hadoop Distributed File System for better performance.

IV. SYSTEM DESIGN

The general system design is as shown in figure 1. First of all the videos are captured from the CCTV cameras installed at traffic junctions. We consider here a four-way intersection having signals L1, L2, L3 and L4. From every intersection the videos are captured and stored in the database of the traffic department. The system first acquires the traffic video data i.e. live traffic feed from the traffic department database. The videos are converted to image frames for further processing. These image frames are given as an input to the Image processing toolbox. This system convert video into image frames and performs further image processing steps such as background subtraction and object detection. After object detection, vehicle density is determined and ambulance presence is checked. Accordingly the traffic signal is varied as follows:
If (vehicle density at L1 > vehicle density at L2, L3, L4 || Check Ambulance Presence at L1 == “true”)
  Then status for S1 = on;
Else if (vehicle density at L2 > vehicle density at L3, L4 || Check Ambulance Presence at L2 == “true”)
  Then status for L2 = on;
Else if (vehicle density at L3 > vehicle density at L4 || Check Ambulance Presence at L3 == “true”)
  Then status for L3 = on;
Else (Check Ambulance Presence at L1 == “true”)
  Status for L4 = on;

Here status is a Boolean value depicting the status of signal i.e. whether it will remain on or off. A higher vehicle density means or ambulance presence means the status will be on for that particular signal. Apart from this hardware also includes connection of these cameras to the Traffic department server to receive live feed of traffic data from the server and a server capable enough to handle the huge processing requirements.

V. METHODOLOGY

The bmp image frames are converted to grayscale images. A grayscale image is stored as an individual matrix. One image pixel in a grayscale image is stored in the form of Elements of this matrix. To convert into grayscale image first we get the image height and width:

\[
\text{bmpsize_totalpixels} = \text{bmp.Width} \times \text{bmp.Height};
\]

The RGB values of the image are extracted and added to get the decimal code for grayscale image.

For i=0:height For j=0:width
  C = getRGB(image)
  red = getRed * 0.299
  green = getGreen * 0.587
  blue = getBlue * 0.114
  Sum = red + green + blue
  Color(sum,sum,sum)
End End

Then sobel edge detection was applied for object detection. Conversion matrix loops are applied for every pixel in ht image.

\[
pixel = \text{GetPixel(width + wi, height + hw)};
\]

\[
c = (\text{pixel.B + pixel.R + pixel.G}) / 3;
\]

\[
\text{new}_x += \text{gx}[\text{hw} + 1, \text{wi} + 1] \times c;
\]

\[
\text{new}_y += \text{gy}[\text{hw} + 1, \text{wi} + 1] \times c;
\]
After applying edge detection the image frame was shown in fig.2. Object density was calculated as follows:

\[
\text{Density} = \frac{\text{detecting pixels}}{172800.0} \times 100
\]

Based on density the signal will be assigned.

**VI. RESULTS**

This system uses four different scenarios of traffic: North traffic, south traffic, east and west traffic. For every scenario a video file is given as input to the system and based on density signal was processed and the details are shown in Table 1.

**Table 1: Signal Log Table**

<table>
<thead>
<tr>
<th>Date</th>
<th>North</th>
<th>South</th>
<th>East</th>
<th>West</th>
<th>Ambulance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2/2017</td>
<td>Red</td>
<td>Green</td>
<td>Red</td>
<td>Red</td>
<td>-</td>
</tr>
<tr>
<td>1/2/2017</td>
<td>Green</td>
<td>Red</td>
<td>Red</td>
<td>Red</td>
<td>-</td>
</tr>
<tr>
<td>1/2/2017</td>
<td>Red</td>
<td>Red</td>
<td>Green</td>
<td>Red</td>
<td>-</td>
</tr>
<tr>
<td>1/2/2017</td>
<td>Red</td>
<td>Green</td>
<td>Red</td>
<td>Red</td>
<td>South</td>
</tr>
</tbody>
</table>

**VII. CONCLUSION**

This paper proposes a new design to improve the traffic issues in the city. By using big data techniques the traffic management system’s response time can be improved to a great extent. Also this system is more cost-efficient as it requires only one time installation cost of the CCTV cameras and the maintenance cost is also negligible. Thus by making the traffic management system more dynamic this system tries to reduce the waiting time of vehicles, reduce traffic congestion and also controls air pollution. The proposed system encounters only the traffic management problem. For future prospects this system can also be used for prediction of traffic by determining the vehicle count on all the days of the week. The data obtained can be given to a predictor to predict the vehicle count. This prediction could be forecast to the citizens for them to find alternate routes in case of emergencies.

**VIII. REFERENCES**


[15]. Rajat & Nirbhay Kumar (2007) “RFID Resolution: Your cars will be tagged”, The


