Survey on Density Based Traffic Controlling Systems

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Abstract— Traffic control system is the need of the hour today since the traffic scenarios are changing enormously. However, the techniques used to control traffic have not changed. In case of any catastrophic scenario in real time, density of vehicles and intelligent traffic routing decisions are not taken into consideration in managing the traffic. In this paper, several existing techniques for road traffic management are discussed along with their Limitations. Researchers have used several methodologies like Image Processing, Fuzzy Logic and Artificial Neural Networks, Embedded Systems, Wireless Sensor Networks for effective road traffic management, considering density of vehicles as an important parameter. A survey on these methodologies has been done and a comparative analysis has been presented.

Key words: IT, RFID Tags, Image Processing

I. INTRODUCTION
Information technology (IT) has transformed many industries, from education to health care to government, and is now in the early stages of revamping transportation systems. While many think improving a country’s transportation system solely means building new roads or repairing aging infrastructures, the future of transportation lies not only in concrete and steel, but also increasingly in using upcoming technologies in IT. It is said that the high viscidity of vehicles, the improper infrastructure and the irrational distribution of the development are main reasons for increasing traffic menace. The major cause leading to traffic congestion is the high number of vehicle which is caused by the increasing population and the development of economy.

Controlling traffic during peak hours is very crucial else the waiting time of vehicle increases and leads to human frustration. If automation is our main goal, then technology should be efficient enough to cut down human intervention. This paper presents a survey on the various traffic management schemes like Image Processing, Fuzzy Logic and Artificial Neural Network, Embedded Systems, Wireless Sensor Networks and RFID Tags.

II. EXISTING TRAFFIC MANAGEMENT METHODOLOGIES
A. Traditional Traffic Controlling System
This is the most ancient and simplest form of traffic management, which includes a supervisor in the system. In this scheme, a traffic guard stands on each and every cross-section of roads and controls flow of traffic. In event of logjam, the traffic guard gives signals to the vehicle driver whether to drive or stop. If an ambulance or fire brigade appears on a particular lane, then the guard assigns priority to the emergency vehicle and controls the traffic. This scheme is simple and efficient. If a catastrophe takes place in real time on any of the lanes, then managing the traffic becomes challenging.

B. Time Based Traffic Management System
The most prevailing traffic management scheme is the static-time traffic signal plan. In the static-time traffic signal plan, the duration of the traffic signals are preset in the database and are executed periodically and repeatedly. The configurations of the traffic signal durations are done based on the historical traffic statistics gathered for a long period. The setting of the static time traffic signal plan will not be changed until the next review on the statistic traffic information. As the number of vehicles increase day by day, managing this dynamic traffic environment is becoming difficult and this method has therefore become blemish. In the event of failure, human intervention is required to manage the traffic scenario.

III. LITERATURE SURVEY
In this section, we present researchers solution to traffic congestion by applying various technologies.

A. Image Processing:
In this paper [1], morphological edge detection and fuzzy logic techniques are used to solve traffic congestion and a comparison has been done between these two techniques. In morphological edge detection, cameras are used to capture the density of vehicles on the streets and initially an empty road image is captured and saved as a reference image. Then a real time image of the same street is captured and RGB to grey conversion is performed and the image is enhanced. Dilation and erosion is performed and the difference between dilated and eroded image is used to obtain the edges. Once the edge detection procedure is done, both reference image and the captured image are matched and traffic lights are controlled depending on the percentage of image matching. If the match is between 10-20%, then green light is kept on for 90 seconds and if the match is 90-100%, then red light is kept on for 60 seconds.

The second technique used in this paper is fuzzy based traffic controlling system. Fuzzy logic mimics human brain by formulating if-then rules. The system makes use of sensors to count the number of vehicles and if the traffic scenario fluctuates then the fuzzy controller changes the signal lights accordingly.

Limitations: Morphology based controlling system is a lengthy procedure and faces issues in detecting edges during night. On the other hand, cost of sensors is very high in fuzzy based controlling system as compared to high end cameras which are used in morphological based system.

B. Fuzzy Logic and Artificial Neural Networks:
In this paper [2], major traffic logjam scenario at a “+” junction in a Nigerian city was identified. A fuzzy based system was used to monitor and control the traffic lights. A
sensor based network was formed where two sensors were used to count the density. The first sensor was placed behind the traffic lights and the second sensor was placed behind the first sensor. The results were simulated and density of vehicles varied as per real time scenarios. It was observed that fuzzy systems proved beneficial in terms of total moving time and total waiting time.

Limitations: In case of real time catastrophe like accidents, traffic management is a bit difficult and re-routing facility is absent.

C. Embedded Systems:

In this paper [3], an Intelligent Traffic Light Controller (ITLC) has been developed to reduce the traffic congestion by using microcontroller AT89c51 and infrared sensors. After developing the ITLC, the performance of the system is evaluated based on the criteria like average waiting time, average distance travelled by vehicles, switching frequency of green light at a junction, efficient emergency mode operation and satisfactory operation of SMS using GSM Mobile.

The infrared sensors on the roads detect the presence or absence of vehicles and notify the sensor assembly mounted on each road. This serves as the initial input to the ITLC unit. The ITLC unit generates red and green signals by taking into account the vehicle density, which is obtained from the input unit. If a driver sends an SMS to the ITLC unit via a GSM mobile phone to know the status of traffic congestion, then he/she will be notified with the status of congestion on roads, and an alternate route will also be provided to the driver. An emergency mode is activated for emergency vehicles like ambulance, fire brigade and police van. For this mode, appropriate signals are generated so that vehicles on that route are notified about the arrival of emergency vehicle and those vehicles on crossing the route of emergency vehicles get an alert and the red signals is turned off till the emergency vehicle passes by.

The performance evaluation results for a sample of 50 vehicles show that the average waiting time of vehicles using ITLC was reduced during peak hours as well as nonpeak hours as compared to that of the fixed mode traffic system. This was because ITLC took into consideration the density of vehicles and queue lengths of vehicles for controlling traffic lights. As the waiting time of vehicles reduced, the total distance the vehicle can travel also increased as compared to the fixed mode traffic system. Limitations: In the event of network congestion, it may happen that the driver’s message may not reach the system or the systems reply may not reach the driver on time. Hardware cost is a bit high.

D. Wireless Sensor Networks:

In this paper [4], sensor networks are used for managing traffic. The researcher has focused on two objectives. Firstly, calculating the density of vehicles using IR sensors and secondly priority based signaling for emergency vehicles using GPS. If the density of vehicles on one of the road is very high and that on the other part of the road is less of the same junction, then green signal will turn on for a longer time. An emergency vehicle alert system will track the location of the emergency vehicle and send a signal to the traffic signal. The signal remains green till the vehicle is within the GPS range.

Limitations: Once the signal turns green, it turns red only when the density reduces. In this span it does not check for the density of vehicles on other lanes.

E. RFID Tags

In this paper [5], RFID chips allow emergency vehicles like ambulances to move faster and IR sensors contribute in invigilating whether the road is idle or jammed and thereby control the traffic lights. A predefined green signal interval is allotted to every signal. Roads are categorized as high density road and low density road. For a high density road, an additional 10 seconds green signal is allotted to that road. In case of low density road, only 5 seconds green signal is allotted. If there is absolutely no density on the road, then that particular junction is skipped to save time. An emergency vehicle must be equipped with a RFID chip below it and an RFID reader must be placed on the roads, not necessary that it should be in the line of sight of the RFID chip. This scheme will allow emergency vehicles to move their way out faster.

Limitations: Manufacturers of cars need to install an RFID chip below each car which increases cost.

IV. CONCLUSION

A comparative analysis of different density based traffic controlling systems has been presented. Table 1 compares the five technologies on 3 parameters as shown:

<table>
<thead>
<tr>
<th>Technology</th>
<th>Performance</th>
<th>Implementation Complexity</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image Processing</td>
<td>Good</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Fuzzy Logic and ANN</td>
<td>Very Good</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Embedded Systems</td>
<td>Good</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Wireless Sensor Networks</td>
<td>Very Good</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>RFID tags</td>
<td>Good</td>
<td>Low</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Table 1: Comparison of Traffic Management Technologies

REFERENCES

International Conference on Advances in Engineering & Technology – 2014 (ICAET-2014).