Dynamic Traffic Signal Using Image Processing

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Abstract— Currently, the traffic control system in place in our country is non-flexible and non-adaptive to the ever-growing number of vehicles on the road. It does not take into account the changing density of traffic during the different hours of the day. Consequently, the roads get congested frequently and intersections get blocked. Time and fuel, two highly important resources get wasted in this inefficient working of the present-day system. In this article, we propose a dynamic system that overcomes all these drawbacks. Our system uses cameras installed at the red lights and intersections to monitor the traffic dynamically. It then processes this information using image processing, computes the volume of the real-time traffic, sets the timer of the signal accordingly. Simultaneously, it monitors if there is any scope of congestion at the intersection and adjusts the timer to prevent it.

Keywords— *Raspberry Pi, vehicle density, traffic, signal, congestion, image processing.*

I.   INTRODUCTION

To analyze and maintain the traffic of Vehicles, it is mandatory to determine the density and volume of the traffic. Once we detect and separate out traffic, we can ensure that at any given point of time there is the maximum density of traffic will have high throughput and less waiting time for all the vehicles. We are able to process, analyze and detect the different density packets of traffic in the image. One issue faced while using the edge detection algorithm is that of having shadows of huge objects such as buildings or bridges being cast on the road below. These shadows mess up the thresholding process as the static global threshold values often either introduce noise or get rid of important information.

II.   EXISTING SYSTEM

A.   Current Situation

India is a country with the second largest network of roads in the world, Out of 5.4 million km long network of road, 97,991 km is covered by national highways. It is a huge challenge for the Indian government to provide high-class road transport networks due to a steep increase in commercial vehicles. The current traffic control system in the metro cities of India are inefficient due to randomness in the traffic density pattern throughout the day. The traffic signal timers have a fixed time period to switch traffic between different directions. Due to this, the vehicles have to wait for a long time span even if the traffic density is very less. If the traffic signal timer can be programmed to be manipulated with the continuously varying traffic density, the problem of traffic congestion can be reduced to a significantly lower level. Thus, traffic jam is a serious issue in every big city that causes several problems for commuters on day to day basis.

B.   Disadvantages of Existing System

1.   The magnitude of traffic not only creates congestion problems but also give rise to a lot of other issues. Air pollution and sound pollution are two major issues that are rising to alarming proportions in recent years.
2.   Traffic jams are frustrating and waste a lot of time causing unnecessary delays in reaching one's destination.
3.   Commuting on the roads has become unsafe and has resulted in the increasing number of road fatalities because of traffic jams.
4.   The other problems caused due to traffic jams are road rage, wastage of fuel, wear and tear on vehicles.
5.   Emergency vehicles get stuck up in traffic jams that cause a delay in reaching the location where they need to reach urgently. This may lead to a serious loss for some people.

6. The other negative effect of the population is the emission of greenhouse gases in the atmosphere leading to the issue of global warming which has a negative impact on the health of people and our environment.

III.   LITERATURE SURVEY

A. Paper Name: Design of Adaptive Road Traffic Control System through Unified Modeling Language

Author: K. Ranjini, A. Kanthimathi, Y. Yasmine

Explanation: In recent years, the Unified Modeling Language (UML) has become the most popular among modeling languages. UML is commonly used in the design and implementation of any system and software architectures. UML models help to achieve functional and non-functional requirements of the system. Furthermore, UML tools have enabled the creation of source code from UML diagrams in order to initiate the programming phase of building software. However, due to lack of clearly defined semantics in UML, creating source code from UML models have become challenging. Hence different UML diagrams have been used to represent the functionality of the system. The main objective of this paper is to model an Adaptive Road Traffic Control System using UML. Traffic congestion is an ever increasing problem in towns and cities all over the world. Local authorities must continually work to maximize the efficiency of their road networks and to minimize any disruptions caused by accidents and events. In this paper, we proposed a UML model for an Adaptive Road Traffic Control system which provides a technique for controlling the traffic in highway network using signals that are automatically controlled by detectors. It coordinates the operation of the traffic signals in the entire area (city or town) to give good progression to vehicles through the road network.

B. Paper Name: Literature Survey on Density Based Signal Management in Traffic System
Author: Shweta N. Pable, Amit Welekar
Explanation: The proposed system is the Traffic Density Based Signal Management in Traffic System which deals with traffic load in each side of the lane during high-density traffic on road at the specific time. Here we are considering the main scenario at a time when the traffic is extended for, less no. of vehicles then signal to activate for less number of time. If the traffic gets on increasing on another side of the lane then, the problem with the previous algorithm is that the vehicles on another side those arrived first as compared to others have to wait. In previous, they introduce equal size platoon. We are proposing such a system that deal with such kind of problem by automatically switching the signal by calculating the time at which the vehicles arrived at the stop line. We first formulate the vehicular traffic signal control problem as a job scheduling problem on processors. In our system we switch the signal if the density of the vehicle is high then the maximum time is allocated. In our system, we do not decide the platoon length or size. Our system show result under light medium & heavy traffic.

C. Paper Name: Smart Traffic System using Raspberry Pi by Applying Dynamic Color Changer Algorithm
Author: K. Kishore Kumar, S. Durai, M. Thanjai Vadivel and K. Antony Kumar
Explanation: Currently, the traffic control system in place in our country is non-flexible and non-adaptive to the ever-growing number of vehicles on the road. It does not take into account the changing density of traffic during the different hours of the day. Consequently, the roads get congested frequently and intersections get blocked. Time and fuel, two highly important resources get wasted in this inefficient working of the present-day system. In this article, we propose a dynamic system that overcomes all these drawbacks. Our system uses cameras installed at the red lights and intersections to monitor the traffic dynamically. It then processes this information using image processing, computes the volume of the real-time traffic, sets the timer of the signal accordingly. Simultaneously, it monitors if there is any scope of congestion at the intersection and adjusts the timer to prevent it. The entire system works autonomously and has a quick turnaround time saving critical resources at every junction. The system also has the potential to adopt machine learning techniques in order to recognize the different emerging patterns of future traffic and reach an optimal solution.

D. Paper Name: Dynamic Optimization Project Study between the Traffic Organization and the Traffic Signal Control of Urban Traffic
Author: Yan Quan, Liu Jin-guang, Liu Xiao-ming
Explanation: Considering the traffic organization project and traffic signal control project of the small and medium-sized cities in China, based on the dynamic optimization theory of operations research, this paper puts forwards the method of optimization design between the traffic organization and the traffic signal control of urban traffic, sets up the frame of the dynamic optimization. The whole design of the dynamic optimization is divided into three stages, the first stage, based on the original traffic organization project, the traffic signal control project is optimized, the second stage, based on the optimized traffic signal control project after the first stage, the traffic organization project is optimized, the third stage, based on the optimized traffic organization project after the second stage, the traffic signal control project is optimized again, finally the best project is got. This paper takes the conference intersection of HuaiRou district, for example, gets the dynamic optimization project between the traffic organization and the traffic signal control, and it is found that this method is better than the past methods after the analysis by computer simulation.

E. Paper Name: Review of Traffic Signal Timing Optimization based
on Fuzzy Logic Controller
Author: Vipul Vilas Sawake, Prashant Borkar
Explanation: In our day to day life increasing the number of vehicles like a motorcycle, car, bus, van, and truck etc. very rapidly. As a result outcome of traffic blocking and enormous problems in metro cities. Due to the traffic jamming problem, some large issues are found such as pollution, wastage of time, fuel, and accidents. Traffic jamming arises terribly often time switch in the contemporary world that has an effect on the means of life and introduces such a large amount of issues and challenge. To resolve this problem by using traffic signal timing optimization is the better solution. Fuzzy theory is broadly applied to several applications and it will simply deal with ambiguity, difficulty, and inaccuracy in several systems. The issues in traffic trade are mostly characterized by the worldwide, uncertain and unsure parameters. Such kind of parameters fuzzy logic technique is a suitable advance for traffic control problem. The presentation of fuzzy logic based mostly controller is superior for two one way street supported extension of time of green light. Afterward fuzzy traffic controller was build up for two ways intersection while not turns, only one intersection through all movements; multiple intersections etc. higher concert of fuzzy logic based on traffic signal timing optimization compare with predictable traffic signal control rising the research field. Fuzzy logic is a very useful method for transportation in future use.

IV.   PROPOSE SYSTEM

This model uses high-resolution cameras to sense the changing traffic patterns around the traffic signal and manipulates the signal timer accordingly by triggering the signals to the timer control system. The increase and decrease in traffic congestion directly depend upon the control of the flow of traffic, and hence, on the traffic signal timer. Due to this phenomenon, the vehicles have to face an irregular delay during transit in urban areas. At present, the traffic control systems in India, lack intelligence and act as an open-loop control system, with no feedback or sensing network. The aim in this work was to improve the traffic control system by introducing a sensing network, which provides a feedback to the existing network; so that it can adapt the changing traffic density patterns and provides necessary signals to the controller in real time operation. Our major objective is to optimize the delay in transit of vehicles in odd hours of the day.
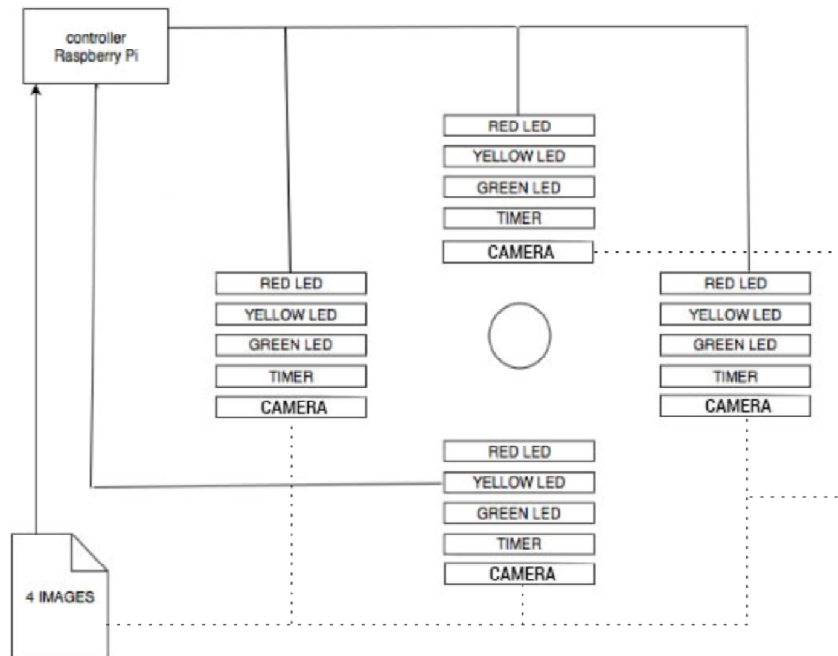
A. System Architecture

Fig. 1 System Architecture

The system architecture working is based on Image Processing. Major Component in the architecture is the controller i.e. Raspberry Pi. Four images will be passed to the Controller and the images will have details about each lane of a road. Details will be computed to calculating the density of vehicles in Images by the Algorithm in Controller. Later, Controller will set the timer or change the signals of each signal lights according to Density/Road which is connected to the controller as shown in figure.

B. Advantages

1. This technique is a cost-effective, reliable & flexible to control traffic.
2. Allows the user to reach the destination in less time.
3. They provide more traffic information, combine both surveillance and traffic control technologies.
4. The overall algorithm has been kept very simple and is thus time-efficient. Also, it will help maintain uniformity in the traffic flow.
5. Reduces the severity and frequency of accidents between vehicles entering intersections.
6. Simplicity in architecture which will provide easy maintenance & control on signals.

V. CONCLUSION

We have investigated the problems associated with the traditional Road Traffic Control and we are proposing a solution to this problem by introducing Adaptive Road Traffic Control system which may react dynamically based on the situation. This model can be utilized by other interested researchers to develop further in real time and can be implemented by the government to improve the traffic system for reduced congestion in the system. Density Based Signal Management in Traffic System shows how the Traffic Light Signal control, including with the implement of Traffic Scheduling Algorithm which is used to gain information from the vehicle position and the speed. The acquired data from Road Side Units reschedule the traffic light timing according to the traffic condition for low or high-density road traffic. If the density of the road traffic is high then the Maximum density of traffic will allow maximum default timing for traffic lights. The minimum density of traffic will allow traffic with minimum timing for traffic lights. If the traffic rate on both sides is Equal or gap within traffic then according to arrival time traffic light signal set to minimized.

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