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Original Article

Traffic Automation Using Computer Vision

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Abstract *- Traffic these days are increasing day by day, and the prolonged waiting in traffic signals are getting into the nerves. The process of traffic monitoring is predominantly carried out manually in our country. This leads to many difficulties like wastage of time, higher fuel consumption, increase in pollution, the higher chance of collisions between vehicles. Our project aims to completely avoid or reduce this waiting time and all the problems associated with it. Furthermore, we're also providing an extra module that identifies the emergency vehicles stuck in traffic and allows them to move without having to wait. This will help save lives. The project mainly has two phases – Vehicle detection and Traffic scheduling. The former comprises three sub-phases that are Image acquisition, object detection and density calculation. Real-time traffic data is taken as input and is sent to the vehicle detection phase. YOLOv3 is the model used for object detection, which is a single shot detector. It uses a single neural network and predicts the bounding boxes and probabilities of each region. YOLO will display the current frame and the predicted classes as well as the image with bounding boxes drawn on top of it. From this, the density of each road is obtained and is sent as the input data for the next phase. Subsequent processes are carried out in a novel Traffic Scheduling algorithm, which is similar to that of the Round Robin algorithm but with a variable quantum. Instead of turning on the green light for a fixed amount of time, the duration will be managed dynamically based on the amount of traffic on each road. This helps in solving many of the difficulties faced in conventional systems, and also the data obtained from this can be used for further applications.*

Keywords *- component, formatting, style, styling, insert*

I. INTRODUCTION

Traffic congestion is one of the major problems in today's life. Population boom and urbanization has led to an increase in the number of vehicles. Poor road infrastructure is another reason for the problem. The use of inefficient traffic management techniques in a densely populated country like India can cause real worries. The practice of these techniques leads to wastage of time, higher fuel consumption, higher pollution. The number of accident cases that get reported daily is another concern. Surveillance and automatic traffic monitoring are important for road usage and management. Detailed studies are going on for traffic management. In major junctions, traffic is heavy in all directions. Therefore vehicles come to a point where they have to compete with each other for road usage. For the development of an Intelligent Transportation system(ITS), Traffic parameter estimation has been an active research area. Image measurement, in addition to the quantitative description of road congestion, can describe traffic flow. The conventional traffic system follows a timing mechanism that changes light after a fixed time interval. It does not take the number of vehicles into account. [1] The duration of the green light remains constant whether or not the traffic is congested. The traffic automation system that uses image processing is a method that checks the density of vehicles and then gives the signal. The CCTV footage of all the directions is taken as the input. Object detection is done here. The exact density of vehicles in all directions is taken into account. Based on the vehicle count, traffic lights are operated. So the direction that has more vehicle density gets more access to the green light. The direction that has less vehicle density gets a lesser amount of time. The use of this method reduces wastage of time, pollution, and fuel consumption.

II. EXISTING SYSTEM

A. Adaptive Traffic Light Control System

The system makes use of a network of an array of sensors for traffic management. The infrared sensor assembly is mounted on the roads to detect vehicles. The timing intervals of red and green lights at each crossing of roads are intelligently decided and varied so as to keep the waiting time. Optimization of traffic light switching saves time, increases road capacity and reduce traffic congestion. The performance evaluation factors are the efficient operation of the sensor assembly, time saved per cycle, signal switching frequency and satisfactory operation of

SMS using GSM mobile. The main drawback of the system is that emergency vehicles like ambulances and fire engines get stuck. The lesser importance is given to this area. [1]

B. Intelligent Traffic Light Controller using Inductive loops for Vehicle Detection

The system makes use of the induction process for the detection of vehicles. The induction loop is placed at the surface of the road or just beneath it. When the vehicle passes through the loop, the magnetic field in the loop changes. The change in the magnetic field inside the loop detects the vehicle. The information about the traffic density on different lanes as measured by the inductive loops is received by a microcontroller. An audio transmitter is present, which senses the arrival of emergency vehicles like ambulances and fire engines. The drawbacks of the system are poor detection of small vehicles, damages caused to the loop by heavy vehicles, temperature fluctuations that affects the loop. [2]

III. PROPOSED SYSTEM

The system makes use of image processing techniques for the management of traffic congestion. The successful implementation results in good control over traffic in cities and reduced waiting time for vehicles. It covers the major drawbacks of the previous system and makes traffic management more effective and flawless. Accurate results are achieved by the use of appropriate image processing techniques. The system focuses on reducing waiting time for vehicles. Emphasis is given for real-time data analysis. The basic input for the system is the real-time CCTV footage. Traffic management with live data can control traffic more efficiently. The reduced waiting time for vehicles results in lower fuel consumption and reduced pollution. The other main feature of the system is the focus given to ambulance vehicles. It works in such a way that ambulances can travel smoothly. The system checks for the presence of an ambulance constantly after short intervals. When an ambulance is detected, the system allocates a green signal for that road immediately, allowing the ambulance to pass. This literally will save lives. The system mainly has 2 phases - Vehicle detection and Traffic Scheduling.

A. Vehicle detection

Vehicle detection is the most significant process for intelligent traffic management systems. It is the initial step for the whole process. The result of this process matters the most since all other process depends on the detection mechanism. The problem of different sizes of vehicles and directions have been addressed here. With the increasing number of surveillance camera installations, detection analysis is becoming common. CCTV cameras are installed at every traffic light signal. It allows the access of images continuously, and these images are used for analysis. CCTV footage is the input data for the system. The system uses efficient techniques for detection that has a high accuracy rate. The phase comprises three sub-phases that are Image acquisition, object detection and density calculation.

a) Image Acquisition

It is the basic step in the image processing technique. It is basically the retrieval of required data from the source. Image sequences are captured. Image sequences are analyzed using image processing for Vehicle detection. Here from the CCTV footage, the required images are captured. Image is considered as a 2 Dimensional function. The value of the function at any point is called the intensity or grey level of the image at that point. These 2 Dimensional values need to be converted to finite discrete values to form an image.

Fig. 1 Surveillance camera

b) Object Detection

It is the process in which instances of objects are detected from the image. It involves methods for object recognition, object localization and object classification. The object there is vehicles. The input footage can contain vehicles, trees, pedestrians. Only vehicles need to be considered. From the image, vehicles alone are identified. YOLOv3 is the model used that is used for object detection. It is a single shot detector that uses a neural network. The network predicts bounding boxes and class probabilities directly from images. The neural network splits the input into a grid of cells. Each cell directly produces a bounding box and object classification. A large number of candidate bounding boxes are solidified to a final prediction by the post-processing step. The key feature in the system is the detection of ambulances. A separate module is present that works on detecting ambulances.

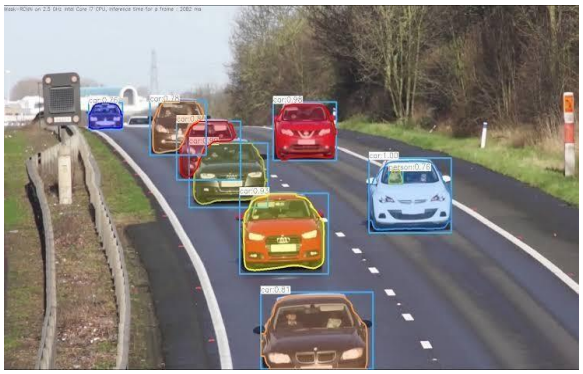

Fig. 2 Detection of objects

c) Density Calculation

Intelligent vehicle counting is becoming increasingly important for traffic management. For controlling traffic, it is essential to know the density of vehicles in the area. In the previous sub-phase, Vehicle detection is done. That is taken as input for this sub-phase. From that, the count of vehicles is determined for each direction. Effective vehicle count gives important live information about the roads. It gives details of the traffic flow, accident occurrences and traffic peak times in an area.

The count of vehicles and the traffic peak times in an area can be used for statistical analysis.

Fig. 3 Counting of vehicles

B. Traffic Scheduling

Time is allocated for each direction of the road in this phase. Traffic scheduling is similar to that of a round-robin algorithm but with a variable quantum. Time allocated for each direction of the road is a fixed amount of time in conventional systems. Here time is allocated based on the count of vehicles on each of the roads. In the previous systems, the roads that have high vehicle count gets equal time intervals of that of a road having a lesser count. The less exposure of green signals for a busy road leads to congestion. In this system, time is allocated for roads based on the vehicle count. Roads with a higher count of vehicles get more time than those roads with a lesser count. The higher exposure of green signals to the crowded direction reduces traffic. The vehicles need not have to compete with each other for road usage. The idea is each vehicle is given one 1second. If there are 20 vehicles, 20 seconds are allotted for that direction. The minimum time allotted is 5 seconds, and the maximum is 30 seconds. If a particular direction of road reaches the 30-second mark continuously for 2times, extra time is allotted accordingly. So the direction containing high vehicle density traffic is controlled efficiently. Emphasis is given to ambulances. Ambulances are detected on the road. The road containing ambulances are given higher priority. Those road gets green signals quickly, which allows them to travel without being stuck in traffic. The data generated can be used in the future for statistical analysis.

IV. METHODOLOGY

There are various techniques for recognizing vehicles within the city, for example, development area, presenting lasers on the 2 sides of the road, etc., which is dull and incorporates an unlimited measure of kit. This method uses picture addressing frameworks to count the number of vehicles within the city and measure the thickness. The quantity of vehicles found is used for investigating or controlling the light. There are two stages - Vehicle recognition and Traffic planning.

A. Vehicle Detection

The following are the libraries used in vehicle detection.

a) OpenCV

Open CV is an open-source C++ library that we used for the detection of vehicles. Video is distributed as input for the working. This helps in capturing the video as frames at the required time. It also saves each frame as different files.

b) Tensor Flow and Keras

These are mainly accustomed to detecting objects. TensorFlow could be an open-source and free programming library for dataflow and differentiable programming over an extent of tasks. Keras is a library with an open-source neural network. It is written in Python. YOLOv3(you simply Look Once) is the model used for object detection.

B. Traffic Scheduling

a) Tkinte

Tkinter is the standard GUI library for Python. This GUI is employed within the automation for a temporary output display. The canvas is split into four equal parts. Each quadrant represents a road at the junction. Each quadrant contains a sign made employing a button. This button displays the corresponding traffic signal at different times.

b) Jupyter

Anaconda may be a Python prepackaged distribution of Python, which contains a variety of Python modules and packages, including Jupyter. The Jupyter Notebook is an open-source web application that helped us in making and sharing archives that contain live code, conditions, discernments, and enlightening substance. It's the way of working with Python inside a virtual "notebook".

FLOW CHART

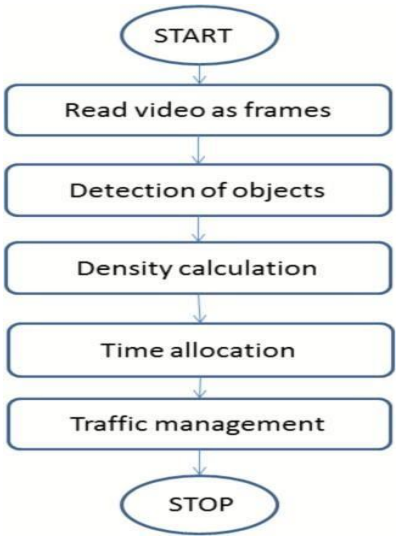

Fig. 4 Flow chart

V. RESULT

Fig. 5 Working of code

VI. CONCLUSION

Improvement of traffic regulation and control in the cities is mainly dependent on using intelligent systems for monitoring and regulating traffic. An efficient adaptive traffic regulation system can be implemented by sensing the traffic density on all the roads at a traffic light junction. It is highly efficient in case of a tedious accumulation of traffic. The adaptive nature of this system proves to be very efficient in dealing with the variable traffic densities on roads. Also, by providing traffic density information to drivers, the traffic can be well managed. Regulated traffic avoids congestion and prevents accidents. This project shows image processing to be a more efficient method of traffic control when compared to traditional techniques. By using this technique, we remove the need for extra hardware. One to be mentioned is sound sensors. For the prevention of loss of life, we need to increase the response time for vehicles. Variation in signal time is the main advantage that controls appropriate traffic density using Image matching.

With this system, the excess and unnecessary waiting time on the roads is reduced and thus the total travelling time of vehicles is reduced. The system also reduces pollution along with a reduction in fuel consumption and money. It is observed that the proposed system is more efficient than the conventional fixed time traffic light control system with respect to reduced waiting time on roads more distance travelled.

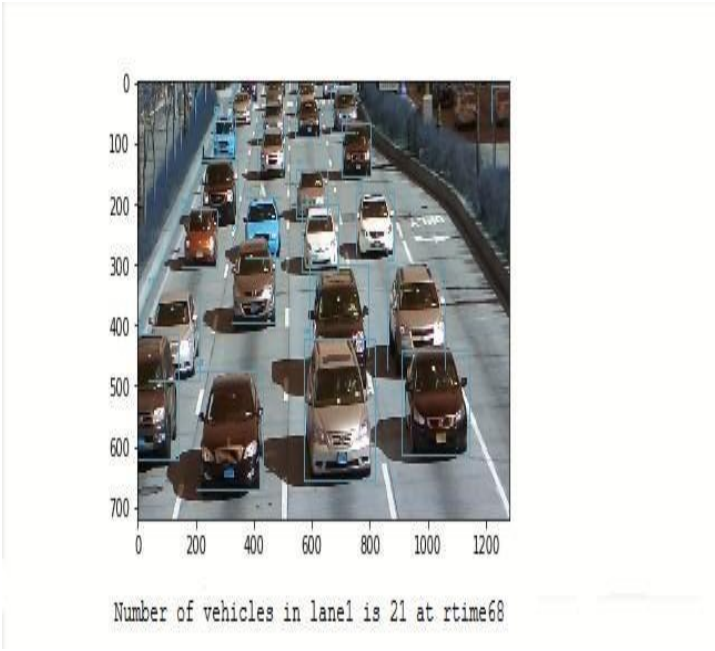

Fig. 6 Working of code

Runtime	Road1	Road2	Road3	Road4
10	green	yellow	red	red
15	red	yellow	red	red
15	red	green	red	red
32	red	green	yellow	red
37	red	red	yellow	red
37	red	red	green	red
52	red	red	green	yellow
57	red	red	red	yellow
57	red	red	red	green
68	yellow	red	red	green
73	yellow	red	red	red
73	green	red	red	red
94	green	yellow	red	red

Fig. 7 Working of code

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