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Design and Development of Traffic Control System using Image Processing

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Abstract: Traffic congestion is now a big issue. Although it seems to penetrate throughout the world, urban towns are the ones which are most effected. And it is expanding in nature that it is necessary to understand the density of roads in real time to better regulate signals and efficient management of transport. Various traffic congestions, such as limited capacity, unrestricted demand, huge Red Light waits might occur. While insufficient capacity and unlimited demand are somehow interconnected, their delay in lighting is difficult to encode and not traffic dependant. The necessity to simulate and optimise traffic controls therefore arises in order to better meet this growing demand. The traffic management of information, ramp metering, and updates in real-time has been frequently used in recent years for image processing and monitoring systems. An image processing can also be used for the traffic density estimation. This research describes the approach for the computation of real-time traffic density by image processing for using live picture feed from cameras. It focuses also on the algorithm for the transmission of traffic signals on the road according to the density of vehicles and therefore aims to reduce road congestion, which reduces the number of accidents.

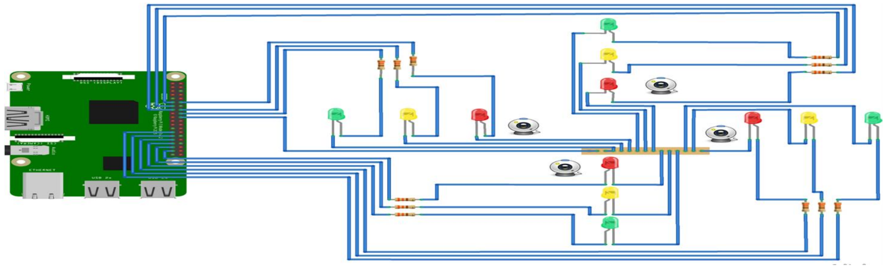
Keywords: Raspberry pi, image processing, real time video capturing, vehicle detection, traffic lights.

I. INTRODUCTION

In the recent decade, the acceptance and use of technologies such as Mobility, Cloud and Social Platforms has enabled ordinary middle-class consumers to make life easier and convenient by means of small, targeted applications. Whether it's simply paying your utilities charges via mobile banking, or just clicking a few buttons for that favourite film ticket, technology has transformed our way of living, playing and working. Though we've been talking about Smart Cities and communities for a while, let's take a look at how we can use the information and data that's accessible to us to create some smart services that truly give us with a better way of life. We'll look at a crucial case that affects us virtually every day: traffic management. Use of this technology and real-time analysis can lead to more efficient traffic management. Poor traffic prioritisation is a typical cause of traffic congestion; in such cases, one lane has less traffic than the other. The pace of increase in vehicular congestion is increasing at an exponential rate. Consider the situation of Chandigarh, one of India's Union Territories. Chandigarh has the most automobiles per capita in India. According to the Chandigarh Transport Undertaking, more than 45,000 automobiles were registered in Chandigarh this year, bringing the total number of vehicles on the road to more than 8 lakhs. So by using Auotomatic Traffic control system using image processing techniques we can control the real-time traffic so that we can reduce the waiting time, accidents.

II. COMPONENTS USED

Automatic Traffic control system using Image processing requires both hardware and software.
Raspberry pi
Traffic light modules
Open CV
Raspberry pi OS



Circuit Diagram

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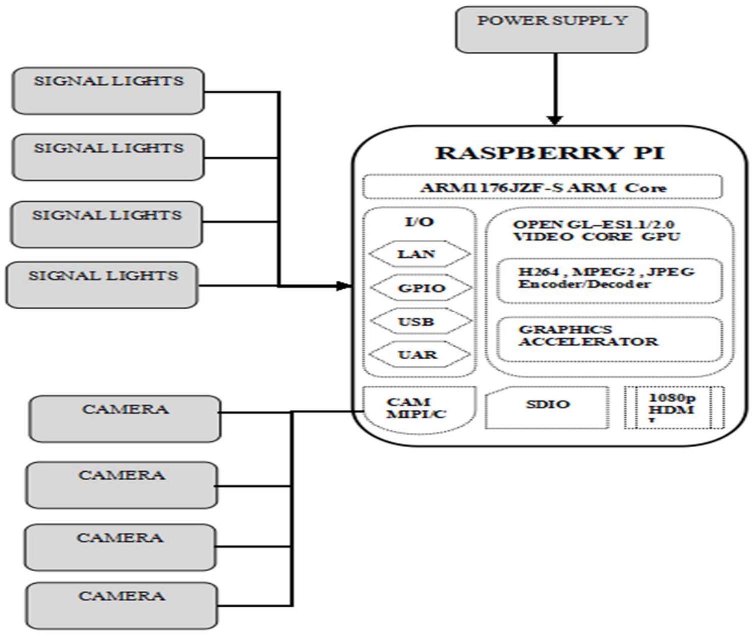
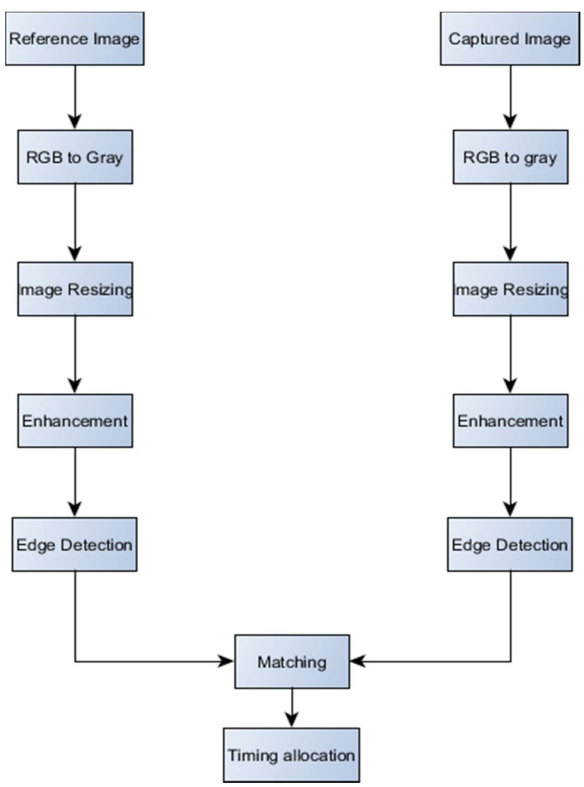
III. METHODOLOGY

A. Block Diagram

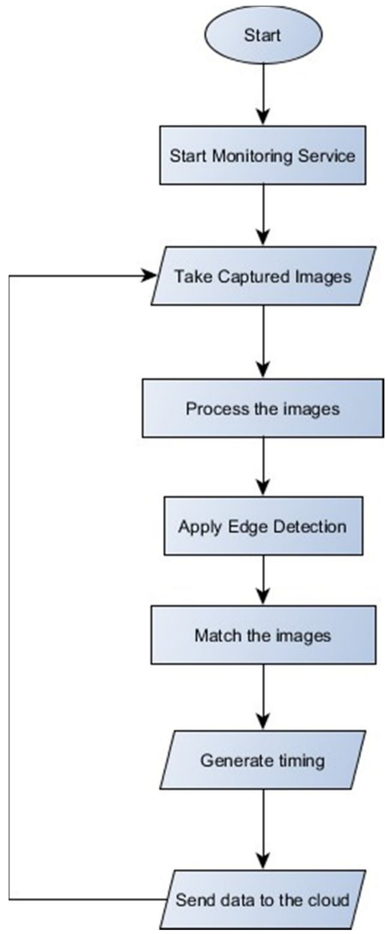


Block diagram of vehicle detection and traffic controlling

B. Flow Charts



Flow chart of " Image Processing" (proposed algorithm)



Flow chart of Raspberry pi operation

IV. MODELING AND ANALYSIS

A. Vehicle Detection

The term "video analysis" refers to the detection of a moving vehicle. It can be used for a variety of purposes, including as people tracking, traffic monitoring, and video surveillance. Segmentation techniques are classified into three types: optical flow, entropy mask, and frame difference. The frame difference method does not extract the entire shape of a moving vehicle well, but it is good in implementation and computation.

The adaptive background removal approach employs a reference image as well as the current frame. The difference between the reference and current frames determines whether or not a vehicle is moving. Moving vehicles can be detected by the optical flow method even when the camera is moving, but it is very sensitive to noise and requires more time due to its computational complexity. Because the optical flow method employs local computation, the resulting image is quite noisy. As a result, the optical flow method cannot be used to detect moving vehicles.

B. Vehicle Tracking

Vehicle tracking can be accomplished by continuously identifying the vehicles in the video sequences as well as the boundaries around the vehicles. Vehicle tracking is the most difficult problem. Due to camera motion, vehicle-to-scene and vehicle-to-vehicle occlusion, no rigid vehicle structures, changing vehicle pattern, and abrupt vehicle motion, vehicle tracking becomes more hard. Vehicle tracking is typically performed in high-level applications that can pinpoint the exact location of the vehicle.

C. Color Identification

With the help of the intensity of the threshold image, the slandered colour module can be used to identify the vehicle colour. Color spaces can be used to separate the illumination and chromatic components. The concept of reducing computational costs while increasing intensity components leads to RGB space.

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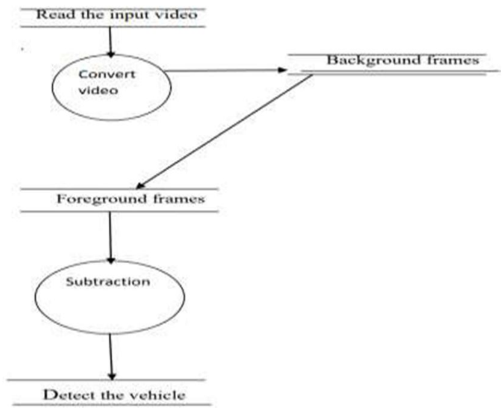
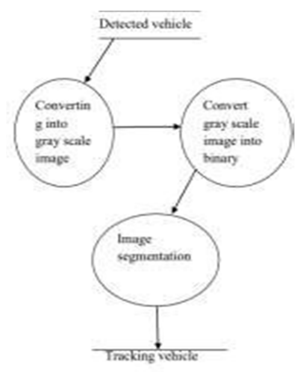
D. Vehicle Detection Dataflow Diagram



Vehicle Detection Dataflow Diagram

As shown in the block diagram, the read image is converted to frames and used as the input image. The converted frame differs from both the background and foreground images. To detect the vehicle in the frame, image subtraction is used. Video analysis can be used in vehicle tracking systems, traffic monitoring, and surveillance to detect moving vehicles.

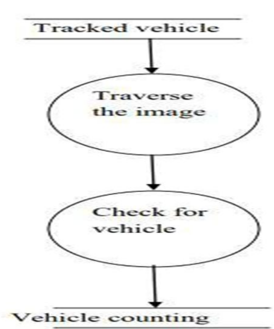
E. Vehicle Tracking Dataflow Diagram



Vehicle Tracking Dataflow Diagram

Vehicles that are detected are converted to grayscale images, which are then converted to binary images. The converted binary image is segmented in order to identify the vehicle and remove any unknown objects. Every moving object in the frame is considered a vehicle and is successfully tracked.

F. Vehicle Counting Dataflow Diagram



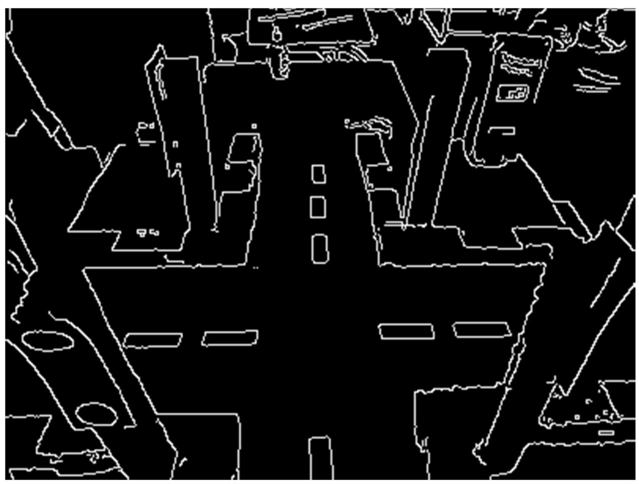
Vehicle Counting Dataflow Diagram

The tracked binary picture is utilised as the input image for vehicle counting. To detect the presence of a vehicle, the binary picture is scanned from top to bottom. Two variables are stored to count the number of vehicles and to retain information about the registered automobiles. When a new vehicle is spotted in the frame, it is checked against the buffer to see if it was present in the previous frame. If it is not present, the count is increased; otherwise, it is treated as part of an existing image, and the vehicle's existence is removed. This is used to figure out how many automobiles there are in total. Two images are occasionally blended into a single image as a result of the occlusion process.

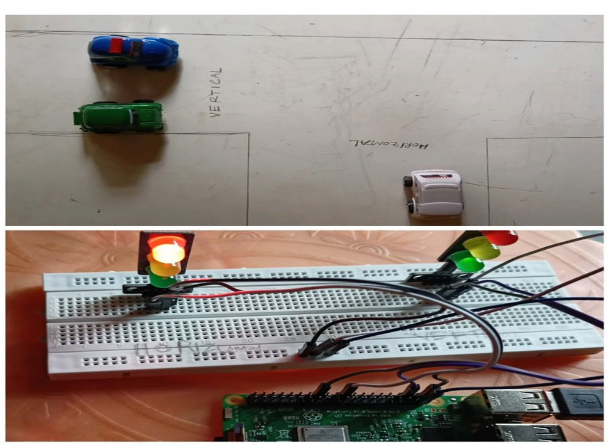
V. RESULTS AND DISCUSSIONS

A. Algorithms

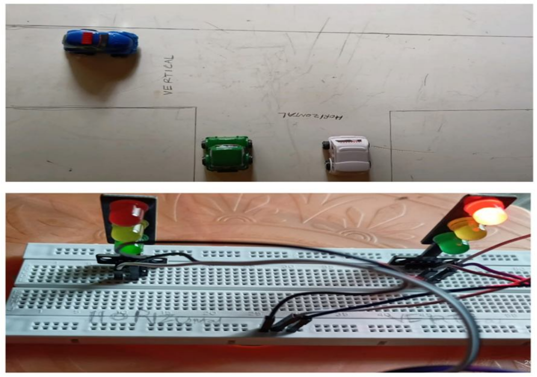
The proposed model explains four major steps involved in detecting vehicles. The video clips are divided into frames in the first step. The second step entails identifying the registered background image and determining the frame difference. Finally, in the final step, post processing is performed and background is removed, allowing vehicle counting to continue. This algorithm's primary purpose is to count the number of automobiles and changing the lights. The input video is divided into a set number of frames. Each frame is considered an image. The RGB image is converted to a greyscale image. In the following phase the difference between the pictures is achieved. The time between frames is determined by the speed of the video sequence. Some morphological operators are employed in the segmentation of the vehicle edge counting and detection and then changing the lights of Traffic light module. Once the vehicle is detected, the counts are incremented and displayed in the command window.



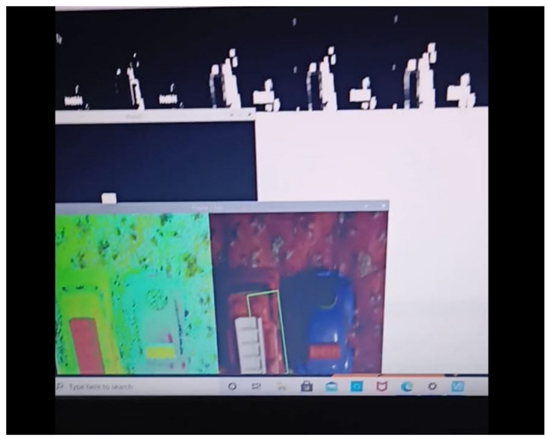
The Edge Detected Image for the given sample image



The Traffic control image with vertical has priority



Traffic control image with Horizontal has priority



Edge detected and greyscale image of vehicles

VI. CONCLUSION

Our solution offers a way to reduce road traffic jams by replacing the antiquated hard coded lighting system that leads to unnecessary delays. Reduced congestion and waiting times reduce both the amount of accidents and fuel usage, which help in air pollution control. Furthermore, our project's scope can be expanded to include Coordination Control, which places traffic signals on a coordinated system so that cars meet extended runs of green lights. This will also give data for future road planning and development, as well as where upgrades are needed and which are urgent, such as which junctions have the longest wait times. Some improvements to the project can be made in the future. Overcoming disadvantages is one such advancement. We can utilise infrared cameras and appropriate image processing algorithms to enable the system to control traffic efficiently in low-light conditions and at night. Another improvement is the elimination of flaws. We can use appropriate image processing techniques to enable the system to detect emergency vehicles such as ambulances and fire trucks and let them to pass as quickly as possible, so saving many lives and property.

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