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Automated Traffic Control for Rescue Vehicles

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Abstract: Because of the population boom, there is an exponential rise in the number of physical objects or vehicles on the road. As a result of the increased traffic volume, the number of road accidents rises. In this article, traffic flow is controlled using a computer vision paradigm, in which images or a series of images improves the road view. This research work employs the camera module of the Raspberry Pi along with the Raspberry Pi 3 to detect cars, track, and estimate traffic flow using low-cost electronic devices. It also intends to create a remote access system based on the Raspberry Pi that will identify, track, and count vehicles only when certain variations occur in the monitored region. The proposed system collects video streams such as vehicles in the monitored region in order to compute information and transmit the compressed video stream in order to provide a video-based solution, which is primarily implemented in Open CV using Python programming. The proposed method is considered as an economical solution for industries in which cost-effective solutions are developed for traffic management.

I. INTRODUCTION

It has been observed that the main impediment on the road is caused by heavy traffic flow during peak hours, especially when people commute to work. The total number of vehicles or items exceeds its capability, creating a blockage for emergency vehicles such as fire fighters and rescue vehicles; however, fuel waste contributes to environmental contamination, which is unsuitable for a country's economy growth In order to create a more effective, dependable, cleaner, and safer system, It is important to make the mode of transportation. As far as possible, the road transportation system has been automated.it is likely

The primary research focus is on the identification and monitoring of objects, where it eventually keeps track of the number of vehicles in the monitored region. The need for a traffic surveillance system is to enable construction engineers and other associates to prepare in an economical manner and make proper decisions based on vehicle density and statistics collected by low-cost electronic devices. [1]. Furthermore, it offers solutions to major issues such as car collisions, vehicle theft prevention, parking lot management, and other security risks. The primary reason for the interest in traffic management operation is the ability to use computer vision techniques in real-time environments. [8]. The main impediment to our work has been vehicle segmentation in various atmospheric conditions such as night, snowy, or dusty weather. As a solution, we used a different [2] pre-processing unit based on Histogram Equalization to increase video resolution and morphological processing to add or delete pixels in object boundaries, where video depends on the shape and size of the structuring elements before processing to the next level.

It has also been observed that vehicles moving towards the same point, whether in a lighter or darker area, or vice versa, can have the same colour as the background, making detection of the vehicle more difficult, resulting in a fault in the vehicle count [7]. As a result, we used the context subtraction technique to register the vehicle ID if it crossed the given threshold.

II. PROPOSED DIAGRAM

This paper uses a well-known platform called Linux server for surveillance and recording video using Raspberry-Pi. The approach uses Raspberry pi to record a video when something moves inside the monitored area.

The proposed device reliably distinguishes vehicles from the ambient environmental variability and enhances low resolution videos using the Histogram equalisation technique to preserve video resolution uniformity and to remove noise from videos. The implementation of the context subtraction algorithm then aids in the detection and tracking of artefacts based on the particle filter algorithm. Tracked vehicles are counted based on the threshold assigned to various vehicle sizes based on the location.

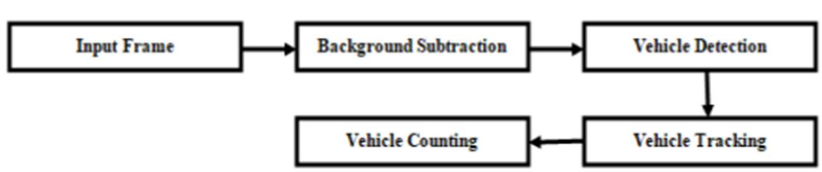

Figure 1: Proposed system design

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III. SYSTEM DESIGN

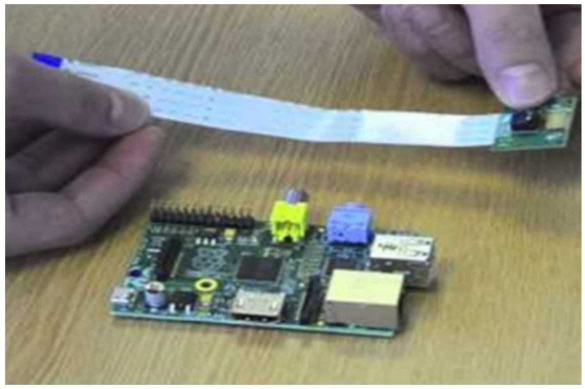

Figure 2: Raspberry-Pi

This paper employs, as shown in Figure 2.

1) *Raspberry Pi 3 (Raspberry Pi 3B+):* Raspberry-Pi 3 has 512 MB of RAM and runs at 1.2GHz.
2) *Camera Module for the Raspberry Pi:* The Raspberry-Pi has a connector for connecting a camera module to capture video.
3) *Power Source:* Raspberry-Pi consumes 400mA of current when plugged into a micro USB port.
4) *Micro SD Memory Card:* Raspberry-Pi stores and instals libraries on SD cards, as well as running the operating system for this computer.
5) *USB Wi-Fi Adapter:* It connects the camera to the computer as well as network [2].

A. Remote Access of Raspberry-Pi

To operate under Raspberry-Pi, it is necessary to install all the recent features and drivers for updated operating system with a correct access to an internet connection.

B. Commands to be followed in Raspberry-Pi

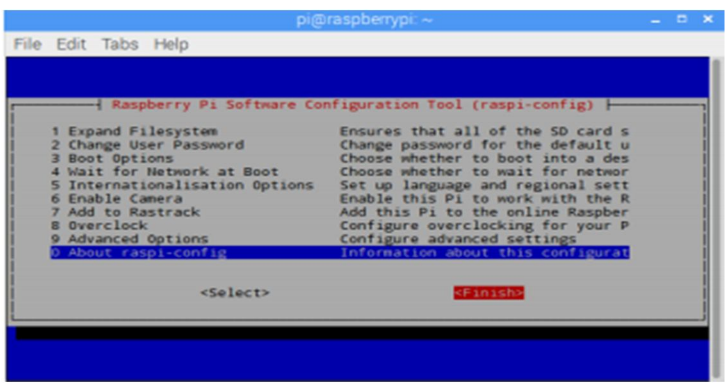

Figure 3: Raspberry-Pi configuration

$ sudo apt-get update
This command updates the operating system with recent features and drivers.
$ sudo raspi-config
raspi-config opens the configuration tool that is written and maintained by raspbian operating system. Raspi camera module can be enabled by using Up and Down keys as shown in figure 3
To capture image from camera module use command $ raspistill -o veh_img.jpg Raspistill captures the still images where –o indicates the output to be saved in veh_img in jpg format.
To capture video from camera use command.$ raspivid -o video.h264 -t 1000 Raspivid captures the videos for 1000sec in encoded in h264 format.

IV. SYSTEM IMPLEMENTATION

Proposed system mainly makes use of three important modules namely

1) Vehicle detection
2) Vehicle tracking
3) Vehicle counting

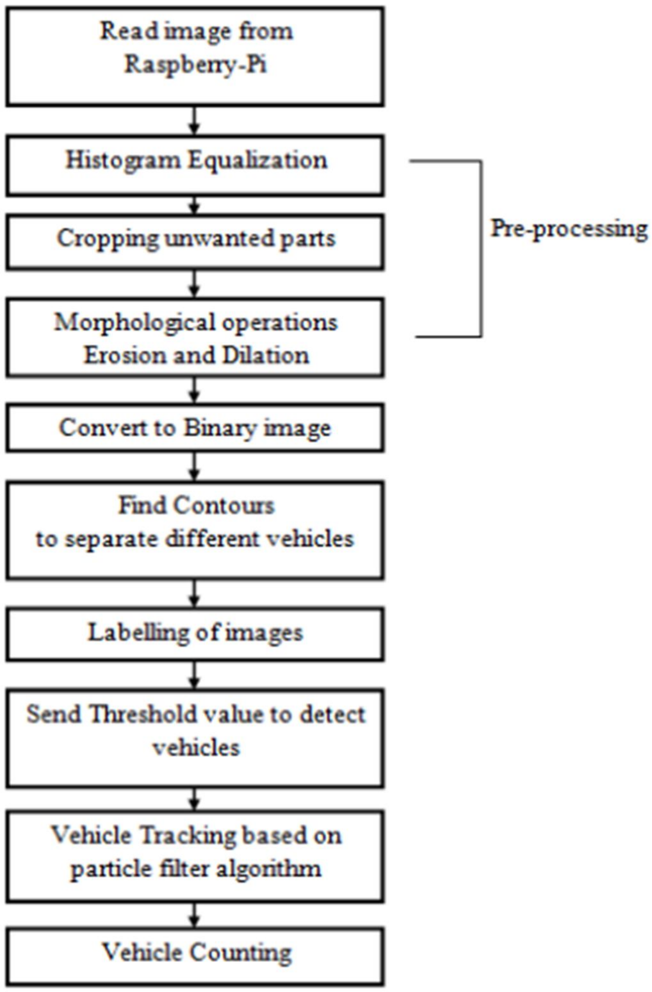

Figure 4: Flowchart for Proposed System

A. Vehicle Detection

In a video, the computer vision paradigm offers vision for identifying objects that belong to groups such as a vehicle or an individual. The application of an entity The aim of detection in the computer vision paradigm [4] is to solve real-world problems in fields such as image search and to track an individual or car, use video surveillance. To detect vehicles, we deduct an image of the road without vehicles from another image of the road with vehicles. The background pixels will cancel each other out, revealing the vehicles or objects in the foreground. Background subtraction is simple to enforce, and a reasonable threshold for detecting vehicles is given in a region that is less than 20000. Figure 6 depicts the detection of artefacts within a given threshold. It has been noted that vehicles are not the only objects moving on/across the lane. There are pedestrians, animals, carts, and so on. Objects also change size and shape as they pass around the screen [5].

Figure 7 depicts the masked image of the detected objects. Masking is used to highlight specific items in a video frame. Objects with a region less than the threshold value are ignored. The selection of a Region of Interest (ROI) aids in the identification of objects, for vehicle detection, and for further implementation by monitoring the detected vehicles

1) Background Subtraction

Background subtraction is process of extracting the target image from original image. ID

Origin: It is the original image is coloured or grayscaled image of 8-bit or 32-bit floating point.

Target: The target image is either 32-bit or 64-bit floating point.

Alpha: Weight of input image. Speed of updation is decided by alpha, set a lower value for this variable in existing frames.

$$Target(x,y) = (1-alpha).target(x,y) + alpha. Origin(x,y)$$

Figure 5: Masked image for video frame

Figure 5 shows the masked image of objects detected. Masking is done to highlight the desired objects in a video frame.

B. *Vehicle Tracking*

An object follows a path in order to establish the observed position of a point on a close distance. For traffic control, there is real-time surveillance and security. without disturbing the presence of a human machine. The main objective of monitoring is to figure out what you're looking for. Video frames in a sequential order. In such cases, objects change shape and size over time [3,] necessitating the use of a motion model to recover trajectories and high-accuracy models for a limited number of vehicles.

A detection object is surrounded by bounded boxes. The object detected is described by the centroid of bounding boxes. As an example, we match the input centroids to existing object centroids and calculate the distance between each pair of objects using the Euclidean distance [8] for tracking current objects. If the number of consecutive frames of the objects disappears, the object needs to be registered. The number of input centroids must be greater than the number of existing centroids in order for a new centroid to be registered as a trackable entity

C. *Vehicle Counting*

When vehicles leave the frame or cross a line at one of the frame's exit points, they are counted [4].Counting lines, red and blue, are used to count vehicles travelling in opposite directions. The perimeter of the bounding box is used to classify the vehicles: if the perimeter is less than 300, the vehicle is classified as a bike, if the perimeter is less than 500, the vehicle is classified as a car, and if the perimeter is greater than 500, the vehicle is classified as a truck or bus. Figure 6 depicts the vehicles that were counted and listed using the specified threshold and the vehicles are counted and classified based the threshold given to them.

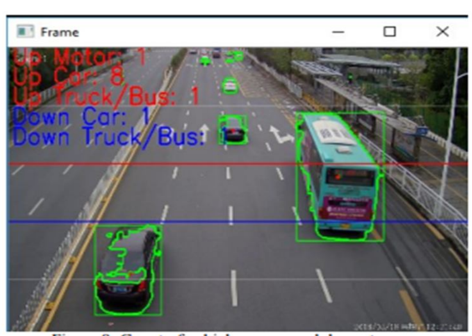

Figure 6: Count of vehicles on up and downstream

V. FUTURE SCOPE

Significant changes may be made in the future by updating to newer models of the Raspberry Pi. The loading time is significantly reduced as a result of this. Rescue vehicle can reach destinations very fast. More lifes can be saved. Alarm system might be incorporated as an additional future enhancement.

VI. CONCLUSION

We have introduced unitized strategies for improving and outperforming the vehicle detection and counting method in this paper. The use of a context subtraction algorithm is a popular technique for improving vehicle detection. The suggested approach removes the extraneous information and more accurately distinguishes the vehicles. Experimental results, implemented with Open CV, indicates that the accuracy rate reaches to 97.1% for object detection, and 98.4% for object tracking.

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