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VEHICLE DETECTION AND COUNTING

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Abstract: In an intelligent transportation system, a vehicle detection and counting system is critical, especially for traffic management. Using computer vision technology, proposes a video- based method for vehicle detection and counting. To find foreground objects in a video sequence, the proposed method employs background subtraction. Several computer vision techniques, such as thresholding, hole filling, and adaptive morphology operations, are then used to detect moving vehicles more accurately. Finally, a virtual detection zone is used to count the number of vehicles.

I. INTRODUCTION

Traffic congestion is a major issue in many cities around the world. There are numerous important factors that contribute to the traffic congestion problem. The number of people moving into a city has increased dramatically, resulting in a significant increase in the number of vehicles. The capacity of the roads, on the other hand, has grown slowly and is now insufficient. This results in an imbalance between the number of vehicles and available roads, resulting in traffic congestion, particularly in major cities. The same issue can be caused by insufficient public transportation systems. Another factor is inefficient traffic management caused by a lack of real-time traffic data. If the traffic problem is not addressed properly, it appears to become even worse in the future.

Computer vision, which involves analyzing and interpreting images and videos captured by a digital camera, has grown in popularity in recent years and is now used in a variety of fields, including industry, robotics, and medicine. In addition, computer vision has been used to solve traffic and transportation issues.

So far, several methods for detecting and counting vehicles have been proposed. [1] Proposed a system that detects, tracks, and counts vehicles in real time. To detect moving objects in a video, their proposed system employed an adaptive background subtraction technique. Then it used abinarization process to get the foreground area, followed by morphological operations to get rid of noise and shadow. Third, to avoid an over segmentation problem, the foreground image from the previous step was combined with the edge image from the same frame before the hole filling process was applied.

Then, using a detector that was virtually placed on the road, vehicles were detected and counted. Finally, blob tracking was used to compare vehicles in the current and previous frames. Using a Gaussian mixture model (GMM) and a blob detection technique, Bhaskarand Yong [2] proposed a vehicle detection and tracking method. GMM was specifically trained to model the background before being used to extract foreground pixels using the Mahala Nobis distance. After that, noise was removed using morphological operations. Counting and tracking were completed at the end.

[3] presented a hardware-software system for vehicle detection and counting at road intersections, in which two commonly used techniques, background subtraction and optical flow, failed to detect vehicles stopped by a red signal. To detect the presence of vehicles, three similarity measurements of the area around a detector in two consecutive frames were used instead. The number of vehicles in the detector area was then determined through a patch analysis.

[4] Using virtual detection lines and spatio-temporal contour techniques, a real-time vehicle counting method was proposed. GMM was used to detect moving foreground pixels in each frame's detection line. A vehicle's contour in the spatio-temporal domain could be constructed by combining the information from several consecutive frames. After that,the number of vehicles was calculated usingthe contour. [5,6] proposes some additionalalgorithms for shadow detection and removal.

A computer vision-based vehicle detectionand counting system. To begin, a background subtraction technique is used tolocate a foreground object image. Second, to remove noises and enhance foreground objects, a region of interest in the image is processed using several techniques,including adaptive morphological operations. The centroid of each foreground object is then calculated and used to represent a vehicle's position. Finally,vehicles within a predetermined virtual detection zone are counted and recorded.

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II. RELATED WORK

Image processing-based Tracking and Counting Vehicles are the methods proposed by Mr. Nikhil Chhadikar, Ms.Priyanka Bhamare, Mr. Krushna Patil, and Mrs. Sangeeta Kumari. The proposed system includes the integration of CCTV cameras for car detection. Car object detection will always be the first step. In order to detect a car in the footage, Haar Cascades are used. These cascade classifiers are trained using the Viola Jones Algorithm. By tracking each car in a specified region of interest, we modify it to find unique objects in the video. This is one of the quickest methods for correctly identifying, tracking, and counting a car object, with a 78 percent accuracy.

Nilakorn Seenouvong, Ukrit Watch are eruetai, and Chaiwat Nuthong used a computer vision-based video-based method for vehicle detection and counting. To find foreground objects in a video sequence, the proposed method employs the background subtraction technique. Several computer vision techniques, such as thresholding, hole filling, and adaptive morphology operations, are then used to detect moving vehicles more accurately. Finally, a virtual detection zone is used to count vehicles.
Background Subtraction Technique and Prewitt Edge Detection for Fast Vehicle Detection and Counting In this paper, he proposes a new, fast method for identifying highway vehicles using image processing techniques such as background subtraction, Prewitt filter, and various morphological operations. To extract the moving objects of the current frame, we first used adaptive background subtraction, and then we used morphological operations to remove the unrelated objects to the vehicles.
The best way to Vehicle Detection and Counting, according to Shaif Choudhury, Soummyo Priyo Chattopadhyay, and TapanKumar Hazra, is to use Haar feature Based Classifier.Based on image processing techniques such as background subtraction, Prewitt filter, and various morphological operations, this paper proposes a new, fast way to identify vehicles on highways. To extract the moving objects of the current frame, we first used adaptive background subtraction, and then we used morphological operations to remove the unrelated objects to the vehicles.

Camera Calibration, Background Subtraction, Morphological Operation, Vehicle Detection, and Vehicle Tracking were among the methods presented in this paper by Naresh Singh Chauhan, Naresh Singh Chauhan, Rahul Sarker, and Md. Mahmudul Hasan Pious. To detect the vehicles, a video is taken and then subtracted into masks. To remove the noisefrom the video, the Binary Morphological operation is used. The vehicle path is then predicted using simple linear quadratic estimation (LQE), and all detected vehicles are counted. Our proposed method is less complicated and achieves a success rate of nearly 99 percent.

According to G. N. Swamy, S. Srilekha, vehicle detection is based on the colour space model. The foreground objects are detected, and vehicle counting is enabled. To remove the noise, the filtering method is employed. Various videos were used to test the proposed algorithm. We will be able to classify vehicles in the not-too-distant future.
Video Processing for Vehicle Detection and Counting the Kalman filter is used to create a vehicle counter-classifier based ona combination of video-image processing methods such as object detection, edge detection, frame differentiation, and the Kalman filter. The proposed technique has been implemented using the Matlab programming language. The method's accuracy in vehicle counts and classification was evaluated, yielding a classification accuracy of about 95% and a vehicle detection target error of about 4%.
For traffic researchers, traffic sensing is critical, but there are few infrastructure systems that support it. The Robust and Fast Side View Vehicle Detection and Counting project proposed a computer vision-based traffic sensing approach that is both robust and fast. Vehicles' side views were captured by static cameras installed on the side walk. The detection algorithm is trained using an SVM and is based on HOG features. The approach, when combined with fast motion detection and tracking algorithms, can achieve high vehicle counting accuracy while computing quickly.

Real-time vehicle counting with computer vision was proposed by Swetha Rameshkumar, Swathi K, Sangeetha A, and Sophia Sindhuja N. This project generates outputs in multiple domains. It can use the methods mentioned above to count and classify vehicles on highways, assisting in highway management and toll collection. Itcan also calculate traffic density on busy roads for better monitoring. In order to reduce the occlusions in the image, more work will be required.

By developing a three-step approach, a new and robust vehicle detection and counting approach was proposed in this work. The proposed method uses a CNN-based classifier with connected component labelling to detect the vehicles, then analyses vehicle feature motion to remove noise and cluster the vehicles. Finally, by considering the intersection area between the detected and tracked point information,a method for assigning detected vehicles to their corresponding cluster is introduced, ensuring a non-repeated counting process. The proposed strategy outperforms other existing methods, according to experimental results on various datasets.

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III. METHODOLOGY

The details of the proposed method aredescribed in this section. The proposed method's flowchart is shown in Fig. 1. Thefollowing subsections will go over eachstep-in detail.

a. Video frame
b. Gray-scale conversion
c. Background subtraction
d. Thresholding
e. Adaptive Background Subtraction
f. Establishing region of interest
g. Vehicle counting

A. Video frame
The video frames captured by the cameras are fed into the vehicle detection and counting system as input video.

B. Gray-scale conversion
RGB to gray-scale conversion (Figure3(a)). Because grey scale has only one layer, whereas RGB has three layers: red, green, and blue. In comparison to grayscaleimages, processing an RGB image is very difficult.

C. Background subtraction
To begin, pixels that belong to a moving vehicle are detected using a background subtraction technique (Figure 3(b)). Abackground image of a road with no vehicles and the current frame in the video,in particular, are converted from colour (RGB) to gray-scale images. The grey intensity of the background image is then subtracted from that of the current frame foreach pixel (x, y). The absolute result isstored in the same location in a different image, which is referred to as a difference image. But what if do not have a background image. what is you only havinga dynamic video. For this reason. I am using Background subtraction. so, i am using Gaussian mixture model algorithm for Background subtraction. GMM has beenapplied on video frame to differentiate foreground mask from background mask. so, the object which can be foreground(white) and then remain static can be the background (black).

D. Establishing region of interest
There is a defined region of interest (ROI) that will be processed further. The return on investment (ROI) (Figure 3(e)) that wasused to count the number of cars on the road.

E. Thresholding
Only pixels in the ROI are considered in this step, while the rest are deleted (Fig. 3(c)). The difference image is subjected to a thresholding operation in order to distinguish foreground pixels from background pixels based on their intensity.A pixel in the difference image will be set to 255 (white) if its intensity is greater thana predefined threshold value; otherwise, it will be set to 0. (black).

On the basis of intensity, this operation is used to distinguish foreground and background pixels. The pixel will be whiteif its intensity is greater than a predetermined threshold value, otherwise itwill be black. 16 is the default. The binary image contains both spurious and missing foreground pixels at this stage, it should benoted. To eliminate noise and enhance foreground objects, a variety of techniquesare employed.

F. Adaptive background subtraction
To recover some missing foreground pixelsand join foreground fragments together, an Adaptive Background Subtraction (Figure 3(d)) is used. In the fields of image processing and machine vision, adaptive background subtraction is one of the techniques. By subtracting the currentframe from the background model, itextracts the information of objects in the current frame.

Adaptive background subtraction can beused to determine the area of moving objects after all of the above methods havebeen applied. The background subtraction technique is widely used in fixed cameras to detect moving objects. We can detect object movement by calculating the difference between the current frame and the average total of several previous frames, referred to as the "background frame" or "background model."

G. Vehicle counting
Following vehicle detection, we can count the vehicles by drawing an imaginary line on the video. Whenever a vehicle crosses the line, the count is automatically increased.

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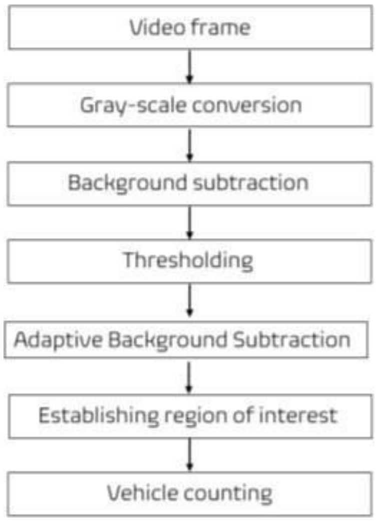

Figure (1). Work flow of the proposedsystem

IV. EXPERIMENTAL RESULTS

A digital camera was mounted on a flyoverto collect a database of road videos.

Using the OpenCV library, the proposed method was implemented in python. When an input video is fed into the proposedmethod, the number of vehicles detected bythe method is displayed and compared to those obtained by manual counting (ground truth). The test was carried out on a laptop with an Intel(R) Core i5 processor and 8 GB of RAM.

Figure (2) Input Video

(a) (b)

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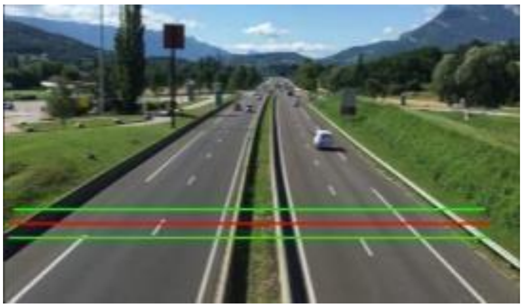
(c)

(d)



(e)

(f)

Figure (3)

(a) Gray-scale conversion (d) Backgroundsubtraction
(c) Thresholding (d) AdaptiveBackground Subtraction
(e) Establishing region of interest (f) Vehicle counting

V. CONCLUSION

The use of computer vision techniques in avehicle detection and counting system was described in detail in this paper. Toaccomplish this, we first used thebackground subtraction technique to locateforeground objects in each video frame.Second, we established conditions to manage vehicle counting by controlling theregion of interest to detect and count vehicles in order to perform vehicle detection and counting. Then, to remove noise and enhance foreground objects, several computer vision techniques wereused, including thresholding and morphology operation.

The contours of detected foreground objects were then extracted and their centroids calculated. Finally, when the vehicles' centroid entered the Region ofInterest, they were detected and counted.

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