A REVIEW ON VEHICLE SPEED DETECTION USING IMAGE PROCESSING

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ABSTRACT
Detecting the speed of vehicles is an important aspect for observing speed limitation law and traffic condition. This paper gives review on speed detection of vehicle using image processing. Given a sequence of real-time video of traffic images, different approaches like edge extraction, object tracking, motion vector technique, absolute difference, centroid method, background image subtraction are useful in detection of vehicles speed.
Keywords: Graythresh, erosion, dilation, grayscale.

I .INTRODUCTION

Image processing has been widely applied to traffic analysis for a variety of purposes. As traffic research field is very wide and it has many goals that include detection of queue, detection of incident, classification of vehicles, and counting vehicles. One of the most important of these purposes is to estimate the speed of a vehicle, a vehicle. Traffic congestion poses lot of problems for people. Because of this, many accidents occur. To reduce this problem, new approach has been developed for estimating the speed of vehicle. A radar technology was used to determine the speed on highways. But it has a disadvantage of high cost. Then a lidar detector was designed to detect the infrared emissions of law enforcement agencies lidar speed detection devices and warn motorists that their speed is being measured. Its disadvantage is it has to be held or placed at a static point. These drawbacks of speed detection techniques motivated to develop new technique for that purpose.

II.LITERATURE REVIEW

In image processing morphological operations highly experimented [16] in improving the appearance. To reduce the noise the MM is also applied it uses structuring element to probe the image and thereby useful information from the image can be obtained and noise can be reduced while preserving the features. This paper is on an experiment in which four morphological operations are working to reduce the noise from the gray scale image and thereby enhancing the quality of the images. In the literal [7], authors introduce the first step towards developing the Speed Detection Radar, where he explains a new approach in object detection technique, which is "adaptive background subtraction".

Rad A. G. et al. [8] developed a system in which they used video and image processing toolbox which calculates the speed of vehicle. It resulted in average error of speed +7km/h and -7km/h. This system could operate on images with various resolutions and different video sequences.

Shedbalkar K. et al. [9] developed a speed estimation technique which was based on extended kalman filter for permanent magnet synchronous. System is developed in MATLAB in SIMULINK model Blockset.

Leite A.V. et al. [10] determined a way for estimation of speed in induction motor with sensor less control. Extended kalman filter was used as speed detection technique. This algorithm used reduce order state space model.

Kassen N. et al. [11] proposed a vehicle speed estimation technique which was reliable and strong. This helps the user with driving guide and lets him not to join the traffic jam. This approach is based on RF. This system gives accuracy of

100% for speed estimation and with accuracy of 90% in typical streets.

III.TECHNIQUES USED

A. Proposed System [1].

In this approach the sequence of images are first converted into monochrome images. Then its edges are extracted then detect the vehicle which may be tracked in various frames. Then the speed it calculated by comparing with ground truth.

Sequence of steps used are:

1. Reading the video: Record the video in the Matlab workspace, which then must be read using (*aviread*) function which read the video from Matlab workspace.

2. Convertion of the Video Frame to an Image: The function *frame2im in MATLAB* converts the single movie frame into an indexed image and an associated color map.

*3. Computing the Images Absolute differenc*e: The function *imabsdiff* subtracts each element in current image from the corresponding element in the previous image and returns the absolute difference in terms of array elements.

4. Converting the image to Black and white: The image is converted to black and white by using the function *im2bw. It* converts an image to binary image, based on threshold, the function *graythresh is used to compute threshold* automatically which computes a global threshold.

5. Labelling the objects in the Image and Finding the Center of the vehicles to keep track of them: All the components in the image must be marked, which helps to determine the number of labeled objects that is found in *numobjectsbase* parameter, this step is related with another step which will measure all the properties of the image components.

6. Convex Hull Extraction: Then the moving edges are filled which would appear as solid moving blobs. We use a convex hull which characterize the blobs, which would approximate the contour of the vehicles.

7. Bounding Box Extraction: To obtain scaling information directly from the image known geometric relationships in the images is exploited, which is done by constructing a bounding box to enclose the convex hull.

8. Geometric analysis: By keeping the direction of motion of each vehicle fixed, the best fit line is computed through the centroids of the convex hulls that are found in a series of images. The function *bwdist* computes the distance between the centers of the convex hull.

B. Proposed System [2]

This presents a new Speed Detection Camera System (SDCS) which is an alternative to Radar. It makes use of various image processing techniques on video stream in online that are captured from single camera or offline mode, which makes it capable for calculating speed of vehicle. Radar limitations are overcome here by offering an in-expensive approach with the same accuracy or better. Phases of SDCS are divided into 4 phases;

1. Object Detection: Here an hybrid algorithm is used which will detect the moving object. It is based on the combination of adaptive background subtraction technique and a three-frame differencing algorithm.

It has 3 steps

i. Constructing the motion matrix
ii. The masked subtraction
iii. Generating new background threshold matrix

2. *Objects Tracking:* Frame by frame tracking of object which has been detected is very difficult task but at the same time it is important. It is the significant part of the systems as without object tracking, the system will not be able to extract cohesive temporal information about objects and any higher level behavior analysis would not be possible. On the other hand,

tracking will be difficult if the foreground object segmentation is inaccurate because of shadows, reflectance and occlusions.

Object tracking has 3 phases;

i. Object segmentation
ii. Object labeling
iii.Object center extraction

3. Speed Calculation: After tracking each object in video the next step is to save the frame number that the object entered the scene at (*Fr0*), and the frame number that the object left the scene at (*FrN*), then speed calculation can be carried out by calculating the number of frames consumed by the object to pass-by the scene and as the duration of each frame is known, the total time taken by the object to pass-by the whole scene can be calculated.

4. *Capture Object's Picture:* The best position to capture a picture with good resolution is when the object is at the center of the screen. So at that time system stores the captured picture as current

frame. Then the system marks the targeted object in the frame so that there will be some difference between it and other moving objects within the scene.

C. Proposed System[3]

In this approach 2 extracted images are selected to apply the motion estimation process in the developed MATLAB algorithm. Standalone images is segmented into 16 × 16 small blocks using the division technique. Then the blocks are extracted from video coding to be compared with its respective image in current image and the previous image. This blocks are compared to detect the changes in pixels which is used to estimate the velocity of the respective moving vehicle.

The flowchart is shown in Fig1

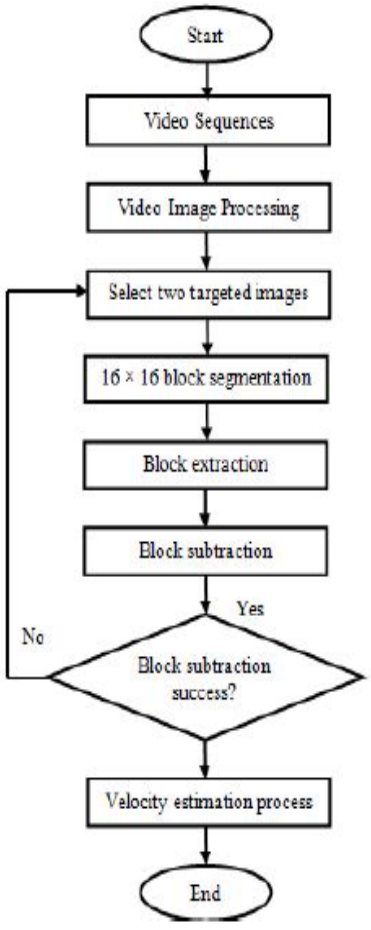

Fig1. Vehicle speed detection algorithm organization

The successive steps are

1. Video image processing: Block extraction and subtraction technique is applied into region of interest instead the complete video sequence or images.

2. Vehicle velocity estimation: Once the image is extracted and segmented into blocks, the motion vector technique is applied to calculate the pixels changes among the two blocks to measure the speed of the moving vehicle. The motion vector is applied with the vector valued function to demonstrate the vehicle speed detection algorithm for the video from surveillance cameras.

3. Vector-valued function for vehicle motion velocity: This is to verify the respective number of changes in blocks within two consecutive images. The input of a vector valued function may be a scalar or a vector where as the output is a vector. When vector valued function is applied, the vehicle speed can be determined.

4. Digital Video Recorder (DVR) card setting estimation: If we want to associate the sequence images with vector valued function algorithms, a digital video recorder (DVR) card is required. It is installed to capture the video from the camera and save into a particular folder in the hard drive.

D. Proposed System[4]

It presents a method which determines the vehicle speed in accident prone areas by using the video frames that are captured from the camera which are fixed on the road. It works as follows:

1. Frame Differencing Operation: One frame is taken as the reference frame and then two different frames are taken to calculate the absolute difference between those two frames with the reference frame as in Fig2.

(a)Frame X

(b)Frame Y

Fig 2: Result of Frame differencing being performed on (a) Frame X and (b) Frame Y with background frame

2. *Thresholding Operations:* Image Thresholding is a method in which image is effectively partitioned into a foreground and background. This is one of the segmentation types which isolates objects by converting them from grayscale images into binary images. It is converted into binary image because it easy to perform the motion operations on the binary image than the grayscale image.

3. *Morphological Operations:* This is performed to remove all the isolated points that are observed in the thresholding operations. After removing the isolated points image is left with some disconnected components. All these disconnected components are connected together than calculating centroid of all these disconnected component as in Fig6. Then morphological closing is performed to connect the vehicle disconnected components together for Frame X and Frame Y as in Fig3.

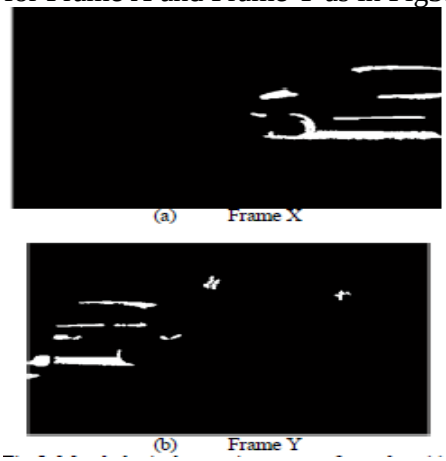

Fig 3: Morphological operations are performed on (a)Frame X and (b) Frame Y to clean up all the isolated points.

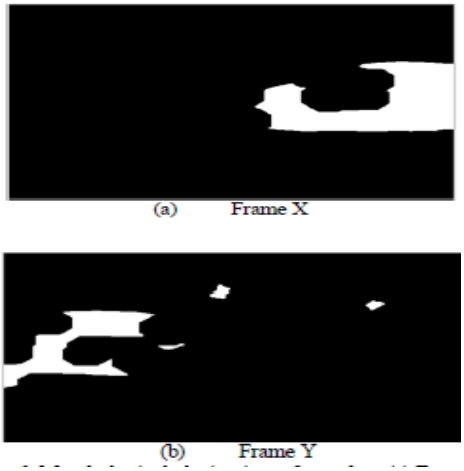

Fig4 : Morphological closing is performed on (a) Frame X and (b) Frame Y to join the disconnected vehicle components together.

E. Proposed System[5]

The core technique used to determine vehicle speed in this approach is centroid method. The centroid value of vehicle is calculated when it is at position A. After traversing distance, when it reaches at position B find the centroid value of vehicle again. From these values, distance is calculated and from this the speed is derived in meter per second.

Steps are:

1. Image from camera: Input image is taken as the images captured from CCTV camera, installed at junction or freeway.

2. Reading Template Image: Individual vehicle images are stored in database. From that, read template images of vehicle.

3. Convert into Gray Scale: Both the input image and template image has been converted into gray scale images as it gives better result on comparison.

4. Dividing into blocks: Input image is divided into blocks. Same sized blocks are extracted from each column and from each row with each image having size of block.

5. Matching of blocks: Template image is matched with each individual block by using co-relation function with matching factor as 9. If both are matched then the information about matched block is retrieved.

6. Computing coordinates value of matched block: After matching of block, coordinates value of matched block has been calculated. Block has a shape of rectangle. So it will have four coordinates. First two coordinates have been calculated by finding the starting and ending coordinate of block in first row. Other two coordinates are calculated by adding the size of block to that coordinates.

7. Computing centroid value: Area of block is calculated followed by calculating the Centroid value of matched block.

8. Read vehicle image after traveling distance: After traveling distance, vehicle image has been taken from camera.

9. Converting into Gray scale: Then the image is converted into gray scale for comparison. Afterwards it is divided into blocks. Again blocks are matched with template image and information about most matched block is retrieved.

10. Computing coordinates value of matched block: After traveling distance, coordinates value for matched blocks is calculated as in step 6.
11. Computing centroid value: Centroid value is calculated in the same way as in step 7.
12. Calculating distance: Distance traveled by vehicle either in horizontal or vertical direction, calculated by using distance formula. This formula has been applied on centroid coordinates for two most matched blocks with template image.
13. Notify time from CCTV camera: Time taken by vehicle to travel distance is notified from CCTV camera.
14. Calculating speed of vehicle: Speed of vehicle is then calculated by distance traveled by vehicle in particular instant of time. It is calculated by using mathematical concept of speed, time and distance.

F. Proposed System [6]
It proposed a real time to detect moving vehicles which violate the speed limit. It makes use of digital signal processing for estimating the speed of the moving vehicles.

1. Partitioning the road into disjoin region: In order to reduce the computational cost, time and the problems occurred in measurement that are caused by multiple vehicles moving side by side or one after each other, the road area is partitioned into disjoint regions. The parts of the image that do not belong to any region are not considered in the calculations. Each region is processed separately to reduce the computational cost.
2. Binary image generation: The speed measurement is performed in binary image in which each pixel is transformed into either "1" or "0" according to its motion information. To binarize the incoming input image and only detect the moving pixels, two different techniques are used:
i. Inter-frame difference and
ii. Background subtraction.
3. Tracking the moving object: The sequential approach to track the moving objects and to find the velocity of objects are as follow.
i. Segmentation: Process which separates multiple regions in image
ii. Feature Extraction: Process to analyze the regions in image
iii. Tracking: Used to analyzing the position, velocity and direction of moving object.

IV.CONCLUSION

1. This paper gives review on vehicle speed detection technique using different approaches.
2. Different approaches are edge extraction, object tracking, motion vector technique, absolute, centroid method and background image subtraction**.**
3. The processing is done in MATLAB.
4. By using any of these methods, traffic can be controlled and vehicle speed detection will be maintained.

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