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A Model for Multiple Vehicle Speed Detection by Video Processing In Matlab

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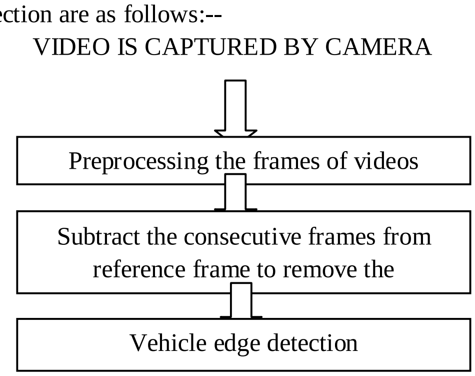
Abstract-- As the traffic increases in the cities, this video processing technique can be used to control the over-speeding vehicles by detecting their speeds, so that roads becomes less prone to accidents. Improved management of traffic is expected to alleviate present and future congestion and over speed safety problems in a broad field of traffic applications (highways, airports etc.)The vehicle speed detection system developed using video processing technique. A video is captured through an uncaliberated camera. Then we preprocess the video frames after that we do the multiple tracking of the ve. hicles that are in the video. After this we go for the vehicle speed detection of the multiple vehicles. The vehicle speed detection from a video frame system consists of 5 major components: 1) Image Acquisition, for collecting a series of single images from video scene and storing them in the temporary storage. 2) Image Enhancement, to improve some characteristics of the single image in order to provide accuracy and better future performance. 3) Image Segmentation, to perform the vehicle position detection using image differentiation by Gaussian mixture model 4) Image Analysis, to analyze the positions of the reference starting point and the reference ending point, of the moving vehicles by multiple vehicle tracking. 5) Speed Detection, to calculate the speed of each vehicle in the single image frame using the, detection vehicle position and the reference point positions.
Keywords-- video processing, uncaliberated camera, image acquisition, image segmentation, Gaussian mixture.

I. INTRODUCTION

Image processing techniques have been applied to traffic scenes for a variety of purposes including: queue detection, incident detection, vehicle classification, and vehicle counting. In this paper, we present a new algorithm to estimate speed using a sequence of video images from an un-calibrated camera. To analyze and develop the Techniques for the Vehicle Speed Detection Using frames of video Processing and to measure the vehicle speeds with software algorithms, using only a single camera to obtain the monocular traffic video. Apparently, in order to calculate the vehicle speed, the vehicle should be firstly detected in the obtained images. Then the distance the vehicle passes through in a short period of time should be measured. The speed is then the distance divided by the time period. The main idea of software algorithms for vehicle speed calculation is to measure the time period a vehicle spends on to pass through a distinct short distance, or to measure the distance a vehicle pass through during a distinct short period of time, and both methods should theoretically have the same result of speed calculation. In order to measure the speed of a vehicle, a camera model should be proposed to map the pixel positions in the image to the real coordinates in the real world. Many approaches are presented for extracting vehicular speed information, given a sequence of real-time traffic images, where we extract moving edges and process the resulting edge information to obtain quantitative geometric measurements of vehicles. The video is converted into frames. Since the video had 30 frames per second. Reference frames are then converted into grayscale images that reduce the computation.

A. General Methodology

The basic steps for the vehicle speed detection are as follows:--



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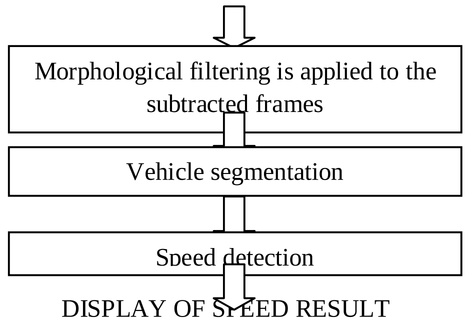


Work flow of general methodology

II. METHODOLOGY

The captured video is converted into frames. Since the video had 15 frames per second. Reference frames are converted from RGB to grayscale images that reduce the computation. After that we reduce the noise if any noise is present in the video frames. In this we reduce the complexity of computation done in mapping stage as given below. And then we have done the segmentation of moving object in each frame with respect to their static background and then we calculated the displacement of each moving object by tracking them individually. And we will track each vehicle in the video and find their individual speeds simultaneously by tracking them.

Proposed Steps for the Speed Detection:-

A. Preprocessing

The traffic images have a noise component from several interference sources. One of the major noise--

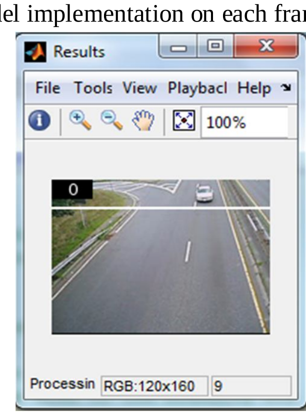
Salt-and-pepper noise:--It occurs when image is transmitted over a noisy channel then pixel intensity get lost at that location. We can remove this by median filter.

B. RGB to BINARY Image Conversion

In this we convert each frame of the video into binary image from the RGB image. It will reduce the complexity at the time of processing each frame.

C. Background Subtraction

Reference frame is a frame that does not consists of moving objects and is used to remove the background of the image which is out of our interest. We can do background subtraction by XOR operation or by Gaussian mixture model according to our video resolution. In Gaussian mixture model cluster of moving pixel is formed that help us to find moving objects in the video frames. We do the Gaussian mixture model implementation on each frame to get moving objects



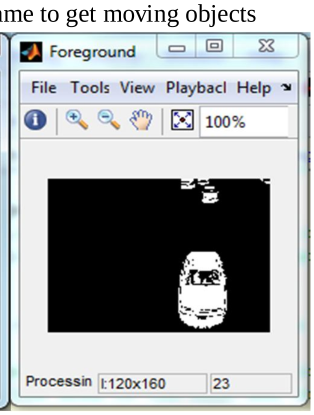


Fig.1 A frame consists of static background and

Fig.2 Background subtracted image having moving clusters

D. Morphological Operation

In morphology, the image is processed based on shape of an image. In order to remove gaps obtained along the edges, we need to enhance the moving edges. This enhancement uses the morphological operator's *dilation* and *erosion* with an appropriate structural element.

Fig.3 Before morphing

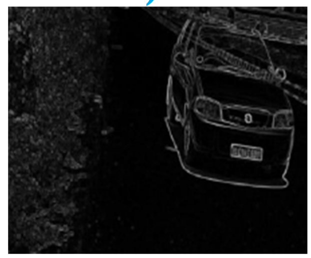


Fig.4 After morphing

Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries.
The number of pixels added or removed from the objects in an image depends on the size and shape of the *structuring element* used to process the image.

E. Bounding Box Creation For The Vehicle

In this, after Gaussian mixture model applied we find the cluster of the moving pixels. After getting cluster of moving pixels we surround that moving cluster into bounding box. By this we get bounding box to each moving vehicle. After getting bounding box for each vehicle in each frame we generate centroid for every bounding box. Centroid will help us to reference each vehicle.

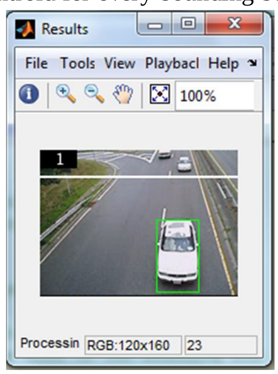


Fig.3: Bounding box is created for the moving vehicle

F. Speed Detection

In our video we have to identify each vehicle and to find their corresponding distance covered in consecutive frames. In our approach we track each vehicle and trace their centroid in upcoming frames to get the distance travelled by that vehicle. In this approach we use the array of structure to store centroids of each vehicle. In this as vehicle is arrived into the region of interest in the video their corresponding bounding box is created by that we generated the centroid of the bounding box. As new vehicle arrived we store its centroid value to the tracks. And updating its centroid value in upcoming frames, and updating its track value of centroid until that vehicle passes out by the video. If in the video we have no. of vehicles then we have to track them all simultaneously. And we store their centroid values into the track structure that we created. And updating the centroid of all vehicles simultaneously as the new frame arrived. We keep on updating the centroid values until it is in the region of interest.
For the updating of the centroid of the vehicles in consecutive frames. We use the method in that tracked cars update their centroid in their next upcoming consecutive frame by calculating the minimum distance centroid of the current frame. As we know the movement of the vehicle is major in the one direction only. So therefore we update tracked centroid to the minimum distance current centroid. We used the loops for comparing each track distance to each current centroids. As we get the minimum distance centroid we assign that current centroid value to that track . and we run this process for each tracked cars previously.
Here 3 cases arise as follows:-

1) *If (Tracked Cars==Current Frame Centroids):* In this we get to know that no. of vehicles remain same in consecutive frame. Therefore we update all tracked vehicle to the current centroid and measure their distance covered.

As shown below in the figures.

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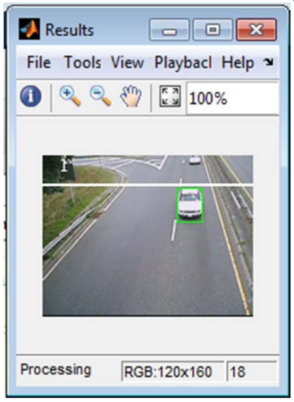

Fig.4 Tracked car

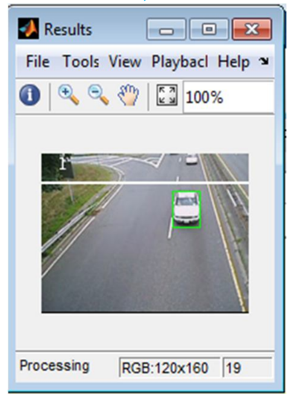

Fig.5 Current frame centroid

2) *If(Tracked Cars< Current Frame Centroids):* In this we get to know that no. current frame centroid is more than the tracked cars that means new vehicles are arrived into the frame video. So firstly we assign and update the previous tracked cars after that we add new vehicles to the tracked structure.

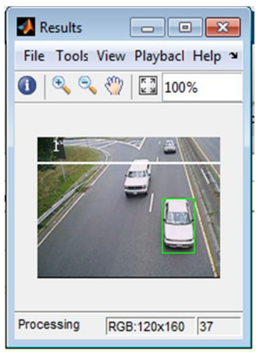

Fig.6 Tracked car corresponds to bounding box

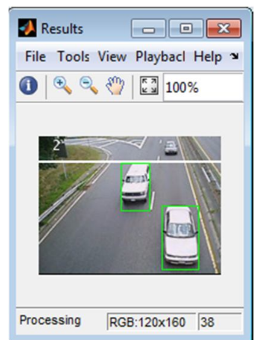

Fig.7 current frame centroids

3) *If(Tracked Cars> Current Frame Centroids):* In this tracked cars are more than the current frame centroids, it means that some vehicles crossed their region of interest and passes by their video window frame. So we delete that tracked cars and update remaining tracked cars centroid to the current centroids.

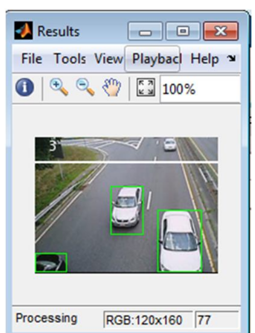

Fig.8 Tracked cars

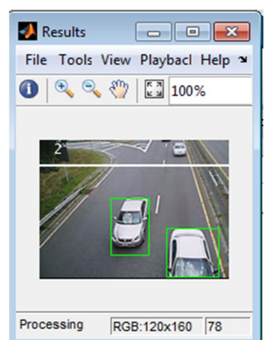

Fig.9 Current centroids

By measuring the distance travelled by a vehicle in a particular time.

Here, we calculated speed by measuring the distance covered by the cars from one frame to another by using the formula of speed = (distance covered in unit of pixels)/ time . And as we know captured video has frame rate of 15 frames per second. Therefore, rate of change of one frame to another consecutive frame is 1/15 seconds.

Speed = (distance covered in unit of pixels) / (1/15)

And the unit of speed is no. of pixels transferred per second.

G. Output

The speed is calculated in the number of pixel travelled per second unit, and then we change it into the km/hr unit by taking the actual distance measure of the area covered by the camera view.

III. RESULT AND ANALYSIS

The accuracy of detection of vehicle in the video frame depends upon the Gaussian mixture model parameters for training the frames for the background. Vision.ForegroundDetector function is used for training the data for the background using Gaussian mixture model. The parameter name called 'NumTrainingFrames' of the function vision.ForegroundDetector changes the result for the detection of the vehicle. Here in the proposed approach we have taken the starting 5 frames of the videos for training of background. Depending upon the no. of training frames the vehicle detection varies according to it.

In this, result shows that as the vehicle exit from the frame window frame no.-104 after it exit in the next loop of the frame we counted the speed for car2 as a 98.1818 km/hr.

A. *Quantitative Result*

We captured the video of real traffic of resolution 240*426 with 30fps. The real distance of the highway that is covered by the view of camera is nearly 15 metre. In video we have single vehicle travelling with the speed of 60 km/hr.
We did the experiment on that vehicle by this proposed approach we get the result as shown below:--

Resolution	Fps	Real speed	Traced speed	Error
240*426	30	60	64.80	8 %

IV. CONCLUSION AND FUTURE WORK

Speed is detected for multiple vehicles by processing the video frames. The video taken is of resolution 120*160 pixels with 15fps. During the mapping process we transform the 3d view of real world coordinates into 2d camera coordinates. Then work is done on each frame, here reference frames are converted into grayscale images from RGB that reduce the computation and we are able to detect multiple vehicles simultaneously by drawing the bounding box surrounding to it. Results show that the proposed model gives relatively good performance. But occasions for bad weather such as heavy fog, weak illumination and night scenes and front mirror glare produce poor performance. The main problem under these conditions is the inaccurate detection of vehicles as a result bounding box will not be created for the consecutive frames and if vehicle is not recognized by their bounding box then it is not possible to calculate their speed. And we will take care of the shadow emerged on to the vehicles that produces the error rate in identification of the vehicle in the frame. So there is a research scope in future where we have to accurately detect vehicles in each consecutive frame by drawing bounding box surrounding to it. The video camera-based automatic vehicle speed detection is a very accurate and promising technology for future application in traffic monitoring. It could be a very powerful and cost-effective tool in helping enforcing the speed limit law and automatic real-time traffic information reporting.

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