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Vehicle Speed Determination Using Image Processing

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Abstract: With the growing population, vehicular usage has increased consequently traffic problem also got increased. Many traffic surveillance systems got introduced in order to reduce such issues. Problems like these require 24/7 monitoring. Video based surveillance systems are much attracted, cost effective and doesn't even require man's presence. This project is used to triumph over the shortcomings of conventional methods by replacing every other thing with MATLAB software. It mainly consists of four steps moving vehicle detection, Thresholding, background subtraction, feature extraction.In this paper, a video based vehicle speed estimate method is presented, which is potential enough of calculating speed with higher precision economically.

Keywords—Vehicle detection, Thresholding, Morphological operations, Vehicle tracking, Feature extraction.

1. INTRODUCTION

Significance for radar systems has been developingnot only for military applications but also for civilianapplications. It also serves operation areas like monitoring speeds of vehicles on high ways, sportcompetitions, aeroplanes, etc.Conventionally radar systems were used for many applications but couldn't become that popular in traffic surveillance system due to its high cost and less accuracy. It also requires line of sight correlation between vehicle and radar apparatus. The other method to calculate speed is by using inductive loops. But drawback for this method is it requires high maintenance and installation cost, also it doesn't presentadequateamount of information about traffic parameters.

To overcome the limitations in active methods, diverse techniques have been developed for determining vehicle speed using image processing. The field of image processing is broadly used for a range of applications commonly in video surveillance systems.Video processing and image processing techniques were introduced for vehicle speed detection. These speed measurements are based on image frame difference, calibrated cameras, optical and digital video images and frame rate. So, video structures are in use for tracking moving objects, extracting trajectories, finding traffic intensity or estimating vehicle speed etc. Using video to track a vehicle reveals additional information tricky to obtain using loop detectors. This system might be helpful for extending real-time surveillance.

2. METHODOLOGY AND SYSTEM ANALYSIS

This part converse the problem description, study and analysis of this system. This method is used for approximating speed of vehicle that which comes just before the camera by tracking the action of vehicle through sequence of images.The projected scheme mostly consists of steps as shown in block diagram.Initially, the video is rehabilitated into frames. The Background Subtraction is used to detect a vehicle in motion. Averaging all frames, surroundingsnot includingmoving object is extracted. Output after Background Subtraction is then processed for Thresholding and Morphological Operations. Connected Component Method **(CMM)** is used to distinguish object and centroid of that particular object. Centroid is tracked above numerous frames. Then velocity is calculated by formulating distance travelled by vehicle and frame rate of video. This method serves in traffic constraint supervision. Below figure shows the block diagram for this method.

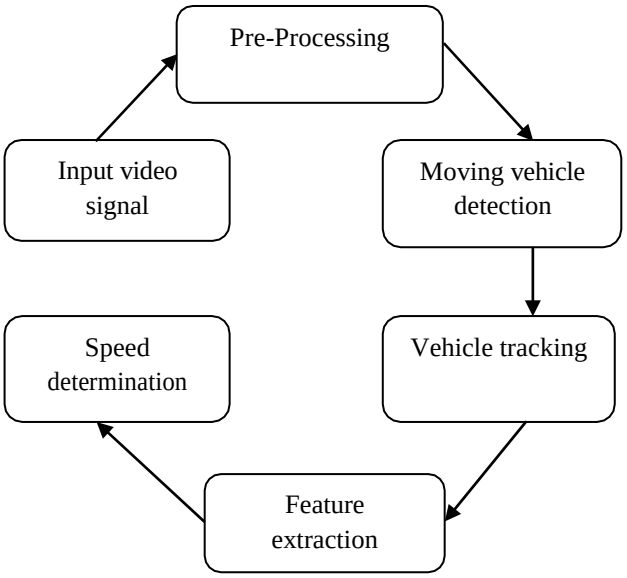

Fig 1: Proposed Block diagram

- ***A)Input video signal:***The given input should be in video format (sequence of images). This video is introduced into pre-processing stage with the help of MATLAB software. This is enough information for further processing.
- ***B)Pre-Processing:*** The video can be recorded using any camera having pixels. In this step the recorded video has to betransformed into the multiple frames. Variety of parameters such as number of frames, frame rate, colour format, frame size are extracted. In this video we have 372 frames in total. It has frame rate 30 frames per second. The frame size is of 640x480 pixels. At this stage available data is converted to double than that of original one as it is useful for further operations.

C) Moving Vehicle Detection:Detecting a vehicle in motion from video precisely is toughjob. To detect moving object there are various approaches such as temporal differencing method, optical flow algorithm, background subtraction algorithm. Temporal differencing procedure utilizes two adjacent frames only to attainbackdrop image. But this method has one drawback; it couldn't differentiatedeliberate changes precisely. Optical flow algorithm detects entity alone using camera motion. Optical flow algorithm is computationally complex and it is not suitable for real time application. In background subtraction absolute difference between background model and each instantaneous frame is taken to detect moving object. Background model is an image with no moving object.In this work, background subtraction algorithm isdetecting moving vehicle. The background subtraction algorithm mainly consist of three stages BackgroundExtraction, Thresholding, Morphological Operations.

In designing this project, the algorithm we use is background subtraction. Background subtraction is furtherly operated based on three sub operations. These operations are Background extraction, Thresholding, Morphological operations.

1. Background Extraction*:* The main part in Background Subtraction is background extraction of that image in frame. When we are yet to travel on road where there will be heavy vehicle flow we couldn't able to get the desired image. For capturing such an image which is called as background or background model, background extraction is used. In this process, averageof all frames pixel valuesis to be taken such that we obtain a stationary image without disturbances or distortions.

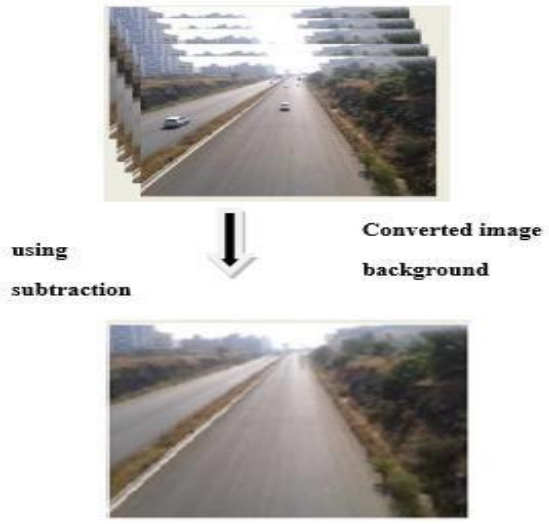

Fig 2: Background Extraction

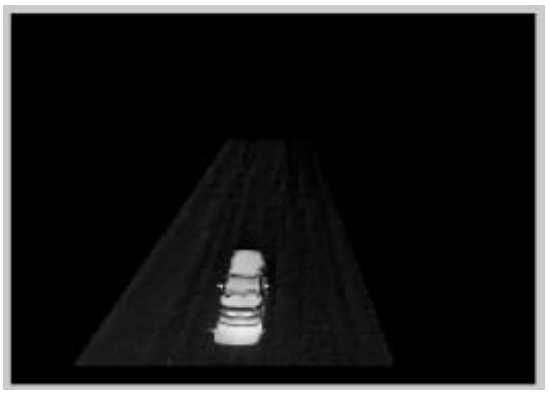

Fig 3: Resultant Image after background subtraction The obtained extracted image is called **ROI** image i.e, Region-Of-Interest. Each frame is then multiplied with the extracted ROI image. Before performing all this process actual image is to be converted into gray scale image because it elements unwanted moments in the image.

2. Thresholding*:* Thresholding is a way of image segmentation which converts grey scale image to binary image. First most important step of thresholding is selecting threshold value carefully. Thresholding is used to separate wanted from unwanted in desired image. Mathematically it is represented as follows,

(x, y) = 0; for f(x, y) < T
1; for f(x, y) >= T

This equation can be changed accordingly with respect to our requirement. Where g(x, y) is threshold image, T estimated threshold value, f(x, y) is instantaneous image frame. Thresholding is done following an algorithm as shown.

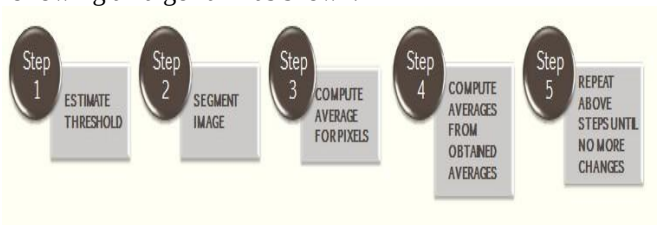

Fig 4: Flow Chart

Based on the obtained threshold value after this process, an image is obtained but with some added noise in it. Elimination of this noise happens in further steps.

Fig 5: Image obtained after thersholding.

3.Morphological Operations:These operations in general are

used to eliminate noise from faulty segmentation. Morphological operations are especially suitable for binary images. These operations are performed on image which is output of thresholding. General operations performed in this process are opening, closing and dilation. Opening and closing are used to eliminate holes in the detected foreground. Dilation is interface of structuring element and foreground pixels. The structuring element is also called small binary image. In the method of dilation the size and shape determination of structuring element is very essential. The results after morphological operations are as shown.

Fig 6: Image obtained after morphological operation

4. Feature Extraction:One very significant area of application of feature extraction is image processing, in which algorithms are used to distinguish and segregate assorted required features of a digitized image or video stream. It is predominantly essential in the area of optical character reorganisation.

Features extraction classifies image based on some of the characteristics of detected vehicle such as position, speed, colour, shape, centroid, edges etc. Bounding boxes are drawn based on the selected feature. These bounding boxes are surrounded around the vehicle considering histogram of the image and centroid of the image. The resultant image would look as follows,

Fig 7: Resultant image after feature extraction.

5. Vehicle Tracking: Vehicle tracking depends on feature tracking. The extracted features are tracked over sequential frames. From the features extracted any one is considered and selected. In this process a threshold value is set, later distance travelled by a vehicle is calculated where after this process both are compared to each other. If the distance is less than threshold value then the object in actual image frame and instantaneous image frame remains the same. Match ID's are given to the vehicle according to this. Shortly amount of speed exceeded will be shown in the respective window.

6. Speed Determination: The estimated threshold value helps in displaying speed of tracked vehicle. Determination of vehicle speed is done by tracking a vehicle over all the frames. Among the total available frames we need to calculate a vehicle speed that is present in limited frames. To obtain its speed first we need to know the number of frames that the vehicle has existed.

Total frames= frame (m)-frame (0)

Where frame (0) is starting frame that the vehicle has entered and frame (m) is final frame that vehicle has existed.

Speed of vehicle is calculated by considering three main parameters distance, total frames and frame rate. Distance remains same for all the vehicles i.e. the path distance which we actually consider. And frame rate is the frequency at which consecutive images called frames get displayed. From these speed is calculated as

Speed= Distance/ (total frames*frame rate)

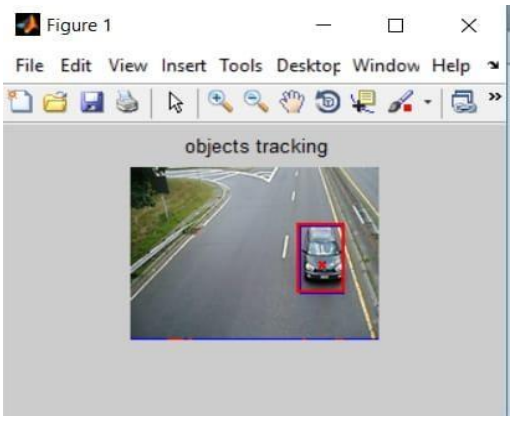

Fig 8: Resultant image after tracking.

3. CONCLUSION

There are several other approaches to perform this task. One better method is by using image processing. Background subtraction is toughaligned withelucidation changes in real world. Also immunity towards noise is reduced due to ROI extraction. As distance assumed is just virtual, obtained speed is also virtual but assumed to be real. It is a cost effective project that gives accurate results with minimal amount of noise which can be used in real time applications.

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