

VEHICLE CLASSIFICATION AND ANALYZING MOTION FEATURES

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Abstract— This research work can identify, recognize, follow multiple vehicles and provide the information about the vehicles. Digital Image processing techniques are used in the object detection. Once the potential objects are identified, related information will be considered and used to analyze the hazardness of the vehicle with the host vehicle and it is useful in parking lots and in the traffic signal.

Keywords— Vehicle Detection, Tracking, Motion Analysis

I. INTRODUCTION

This research work focuses in applying image processing concepts for detecting and tracking vehicles.

Videos collected from different conditions in which vehicles were moving are used for analysis. Videos have been used as it is non-intrusive process and can be analyzed offline.

Vehicle should follow traffic rules and move inside a lane for implementing the proposed algorithms. If the vehicle is moving inside lane, false rejection of an actual vehicle or false identification of an object which is not a vehicle can be minimized. The following steps show how to identify a vehicle and direction in which vehicle is moving.

Step 1: Identify if it is a vehicle. Discard other objects.

Step 2: Verify if the vehicle is moving.

Step 3: For each vehicle identified in a frame, a vector consisting of {width, height, segmented object, average intensity value, road brightness (dark/light/bright) is created. This step is required for tracking the vehicle in the subsequent frames.

Step 4: Find the change in the vehicle size, and the direction of vehicle can be obtained. If the vehicle size grows, it indicates that the vehicle is coming towards the camera.

The next position of vehicle-1 to vehicle-N are obtained in the frames (n+1)s by finding the x,y locations of the vehicles-1 to N as mentioned below:.

$$V_{1(n+1)x,y} - V_{1(n)x,y}$$

$$V_{2(n+1)x,y} - V_{2(n)x,y}$$

⋮

⋮

$$V_{N(n+1)x,y} - V_{N(n)x,y}$$

A vehicle can miss in some of the frames due to the following:

1. Overlap with other vehicles inline.
2. Has taken a left or right turn.

II. PROBLEM DEFINITION

There is an increase in traffic flow due to development of vehicle technologies and transportsystems. Improved monitoring techniques are evolved to weather conditions. Detecting the movement of the vehicle in video sequence is difficult because of illumination condition, background images, and occlusion, unexpected object motion, change in form of the object pattern, non-rigid structures of object. The problem is to evolve new techniques to

1) Improve vehicle identification.

2) Track continuously in the subsequent frames of video.

Vehicle tracking is implemented using non-intrusive technology such as ultrasonic, microwave and image processing. Image processing is used to detect vehicles by analyzing the images in the successive frames taken from a traffic scene. The change between successive frames helps in identifying the presence of vehicle. The black and white images are examined. Group of pixels with the gray level deviation is considered in the video frame. The algorithms are designed to eradicate gray level variations in the image background which are caused by climate conditions, shadows, and daytime or nighttime artifacts and retain objects identified as automobiles, trucks, motorcycles, and bicycles. The successive video frames are analyzed to calculate the Traffic flow parameters color imagery can also be exploited to obtain traffic flow data. However, somewhat reduced dynamic range and sensitivity have so far inhibited this approach.

Three categories of vehicle detection is adopted in videos.

1) **Tripline:** User defines the detection zone in the roadway. Sensors are utilized to identify the estimate vehicle speed measure the time it takes an identified vehicle to traverse a detection zone of known length.

When the vehicle crosses one of the user identified zones, changes in the pixels are monitored. Surface - based and Grid - based analyses are utilized to detect vehicles in the Tripline video image processing (VIP)s. The Surface - based approach identifies edge features, while the grid based classifies squares on a fixed grid as containing moving vehicles, stopped vehicles and no vehicles

2) **Closed-loop tracking:** It is an extension of the tripline approach. It is applicable for the longer roadway sections. Vehicles are indentified in a particular track as multiple selections. Validation can be performed and that particular vehicle has been taken into account for counting and speed of the vehicle is calculated using tracking algorithm. It is useful to alert the driver in a critical situation and to avoid the accident.

3) **Data association tracking:** Data association tracking systems identify and track a particular vehicle or groups of vehicles as they pass through the field of view of the camera by connecting the unique pixels. These areas are then tracked from frame – to – frame to produce tracking data for the selected vehicle. The markers that identify the objects are based on gradients and morphology. Gradient markers utilize edges, while morphological markers utilize combinations of features and sizes that are recognized as belonging to known vehicles or groups of vehicles

III. DATA COLLECTION

Video database has been created by shooting video in hand DIGICAM. The videos are transferred to laptop. OSS decompiler has been used to extract the frames of the video. The video has been taken in the day time, cloudy time, late evening and at night. All the information is processed using MATLAB R2011a. It is a high-level language and interactive environment for numerical computation, visualization, and programming. Using MATLAB we can get the solution faster than traditional programming languages. The following frames show distinctly the road, track lines and vehicles when viewed inclined, straight and curved. Figure 1 presents sample frames of video taken by fixing camera in a car.

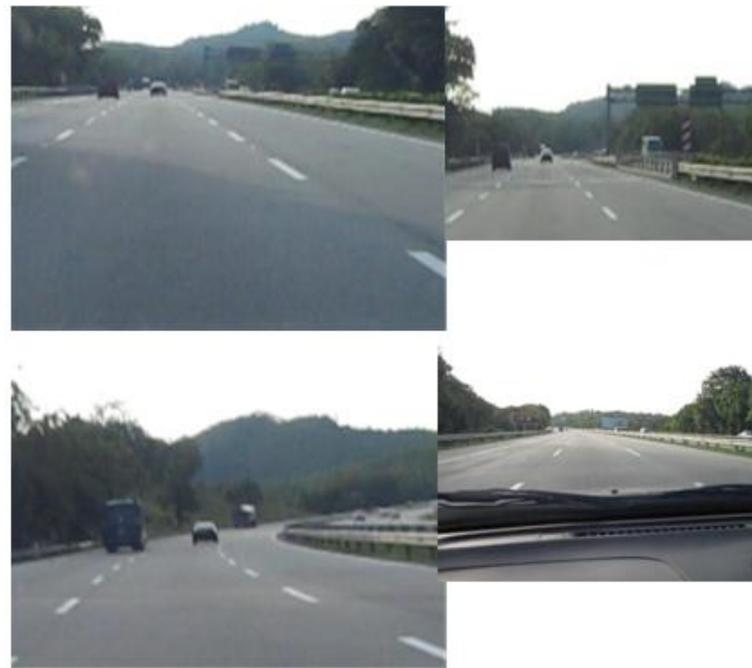


Fig.1 Sample frames

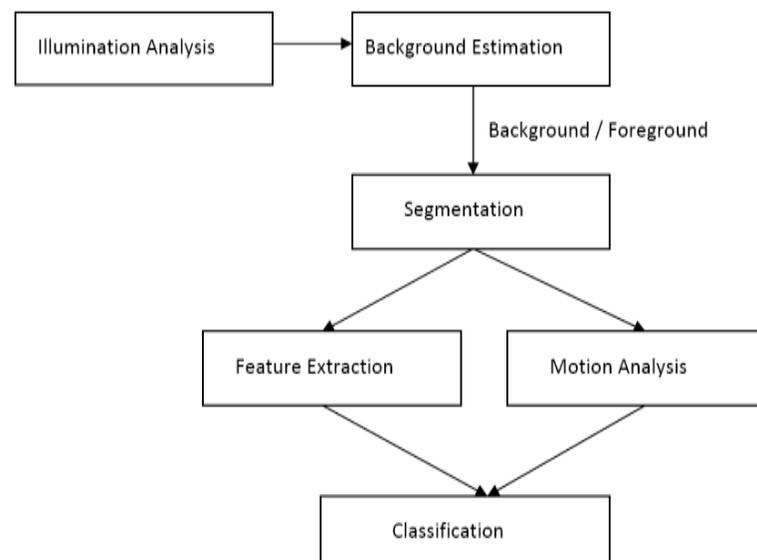


Fig. 2 Classification by proposed algorithms

IV. PROCEDURE FOR OBJECT CLASSIFICATION

In the Figure 2 shown, each single rigid and moving/static object is tracked. Each object is enclosed with rectangle, with the following properties: X and Y coordinates of the top left and bottom right of the rectangle, X and Y coordinates of the contour points of the tracked objects. Motion features extracted will be current speed, acceleration value, deceleration value, change in size, change in velocity.

The movement of the vehicle is determined based on the previous frames to current frame and are listed as follows: static to static, static to moving, moving to moving, moving to static, sudden stop, sudden speed.

Illumination Analysis: Basic input for this objective is to capture a video sequence of frames. Raw image is captured by the video camera using optical sensors. Determining the perfect illumination is important for the quality of the captured images. Variations in the illumination must be avoided in the image.

Background Estimation: A captured image is preprocessed to reduce the noise in the images. Then the image is enhanced to identify the background difference from the object.

Segmentation: Segmentation is a process that partitions the image into regions. The enhanced image is segmented and used to identify the required object for detection and tracking. The profile of the object (X,Y) with respect to coordinate position of the frame is identified. The points are plotted as a map in the continuous frames.

There are 2 ways for object map: 1) Feature Extraction and 2) Motion Analysis.

Feature Extraction: The features of the object such as shape and the edges of the object are identified.

Motion Analysis: Identify the (X, Y) position of the required object in the first frame. This process is repeated for the remaining frames. By applying affine transformation for the frames given in Figure 3, find the change in position of the object in the frame, and hence the movement of the object can be confirmed.

Classification: Object features and the objects position information are given to the classification module.

Framework of Motion analysis component

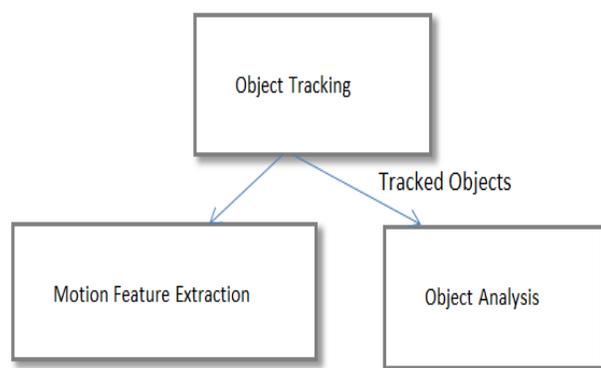


Fig.3 Motion analysis module

Motion analysis component consists of three major modules: Object Tracking, Motion

Feature

Extraction and Object Analysis. The inputs and outputs of each module and their relationships with other modules are highlighted in Figure 3. Three main outputs in the motion analysis component are:

Tracked Object: Each single rigid and moving / static object is tracked and highlighted in different colors. Each object is enclosed with rectangle, with the following properties:

X and Y coordinates of the top left and bottom right of the rectangle

ii) X and Y coordinates of the contour points of the tracked objects

Motion Features: The extracted features for each object are listed as follows: Change in size, Current speed, Acceleration value, Deceleration value and Change in Velocity.

Object Status and Label: Types of object status in terms of movement are determined based on the previous frames to current frame and are listed as follows: Static to Static, Static to Moving, Moving to Moving, Moving to Static, Sudden Stop, Sudden Speed.

V. CONCLUSION

This paper has presented sample frames extracted from video. The different parameters that will be calculated is presented. The potential objects are identified along with the related information such as predicted direction, change in size, change in velocity, ellipse related parameters (major axis, minor axis and angle), static to static, static to moving, moving to moving, moving to static, sudden stop, sudden speed, occlusion with two or more separate objects, split of one object to more than one objects are recognized.

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