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Review on Structural Signatures for Passenger Vehicle Classification in Video

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Abstract - This paper focuses challenges in pattern recognition system. Classification is done by taking rear view video of vehicles and compute angle of orientation of the camera image plane and road plane. This paper introduces a new technique called as structural signature. Classifying the vehicle according to their structural signatures. Classify the vehicle by capturing there rear view video. First camera is placed on the top of highway .that camera capture video of vehicle traveling in fast speed. That constant speed of vehicle is taking negligible while capturing the vedio.they use multiframe matching instead of frame to frame matching.multiframe matching is cost-effective than frame to frame matching. After computation of structural signatures classify the vehicle according to that variation of structural signature.

Index Terms—Image motion analysis, object recognition, Multiframe matching, vehicles

I. INTRODUCTION

Vehicle classification system plays very important role in real time applications and industrial applications. Pattern recognition is used for vehicle class information. All the previous method used for vehicle classification on their only appearance feature or blob feature. In appearance feature or blob feature only taking consideration of view of vehicle or structure of vehicle .Vehicle classification system must robust from the change detection in vehicle, partial detection or shadow detection. It also robust from the camera viewpoint changes and, changes in imaging system [1].

These features are not included in previous vehicle classification system. In this paper we compute the structural signature and classifying the vehicle in three classes like sedan, pickup, and sports utility vehicle. We analyse this system using the large video data set .Ghosh and bhanu[12] uses multiframe technique for the study of 3D images for vehicle classification. Vehicle classification system can be used in traffic monitoring; class based tolling, security applications, low enforcement.

II. LITERATURE SURVEY

1. Gupte *et al.* [1] they use the vehicle dimensions for classify the vehicle by taking their side view of vehicle. This classification is limited only for car/noncar.
2. Avery et al. [2] they use technique change detection and vehicle length based classification. This classification is limited for passenger vehicle and long vehicles.
3. Ma and Grimson [3] they use edge based system and oblique side view technique and from that they classify vehicle car verces taxis, car verses minivan only. They take side view of vehicle for the classification.it is complex than capturing front or rear view.
4. Thakoor and Geo [4] they use change detection and hidden Markov model techniques for classification. They capture side profile of vehicle.
5. Zhang et al. [5] they use change detection, support vector machine, principle component analysis. Accuracy level is 45to 85%
6. Morris and Trivedi [7] they use side view of vehicle and appearance features for the classify vehicle.
7. Kafai and Bhanu [8] they use location, dimension, features for the classifying the vehicle.

All this paper are classifying the vehicle according to their appearance features that features are change when surrounding condition is change.so application of all these method have limited scope. They have low accuracy. None of these method can use structural singeture.structural signature of vehicle have high accuracy of classification than other methods.

III. OBJECTIVES

1. Using new concept name is structural signature they have developed the classification system by taking rear view video of the vehicle. And according to that classify the vehicle into three group sedans, pickups, and minivans/sport utility vehicle.
2. Introduce a new concept is structural signature that is very helpful for classifying the vehicle very accurately than previous vehicle classification system.
3. Gather the information from multiple video using large dataset.
4. Thousand of vehicle sequences are extracted from real world video.

IV. MOTIVATION

The main motivation of this paper is minimizes the complexity and computational burden.so they use bilateral symmetry from their rear side for the vehicle classification system.it is easy to establish bilateral symmetry from rear side. Axis of symmetry avoids from partial detection as well as modified regions. For example shadow of car is detected as part of that car.so axis of symmetry is very useful in vehicle classification.
Structural signature creates high accuracy in vehicle classification. Structural signature does not change if we compute any structural modification in vehicle**.**

I. *Classification using bilateral symmetry*

Axis of symmetry is assumed to be always vertical in bilateral symmetry .surfaces of the all vehicles are nearly same from top surface at center. When vertical axis should place then horizontal black line is parallel to road plane and vertical white lines are perpendicular to road plane. And from axis of symmetry they classify vehical into three classes' first sedan, second pickup, and third Sports utility vehicle.

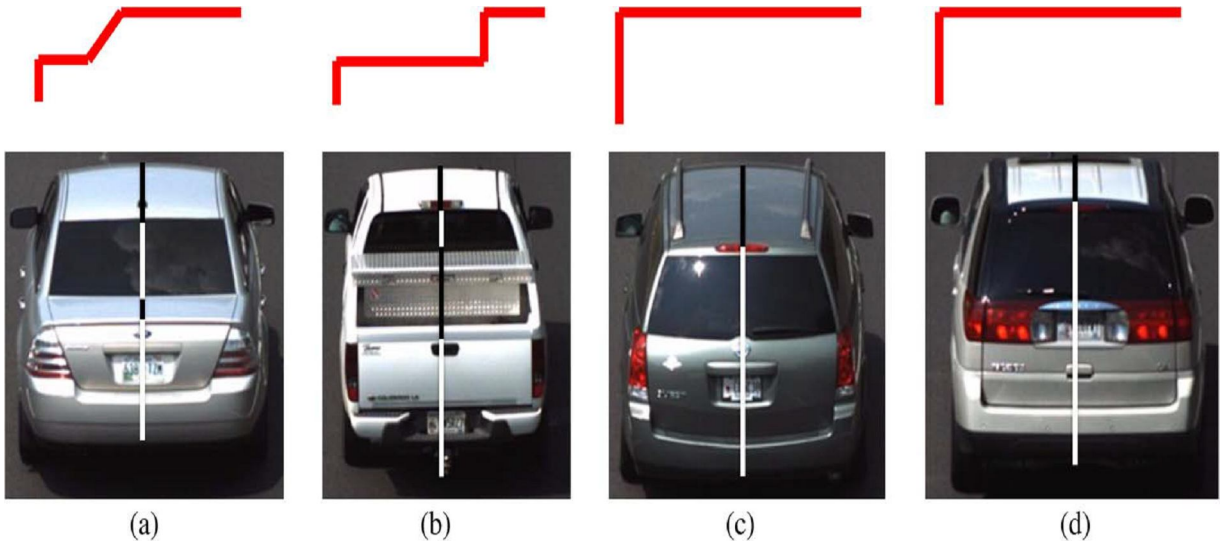


Fig.1 (Top) Canonical structures for different vehicles. (Bottom) Rear views (black line: parallel to the road; white line: almost perpendicular to the road). (a) Sedan. (b) Pickup. (c) Minivan. (d) SUV. [1]

V. TECHNICAL APPROCH

I. *System Overview*

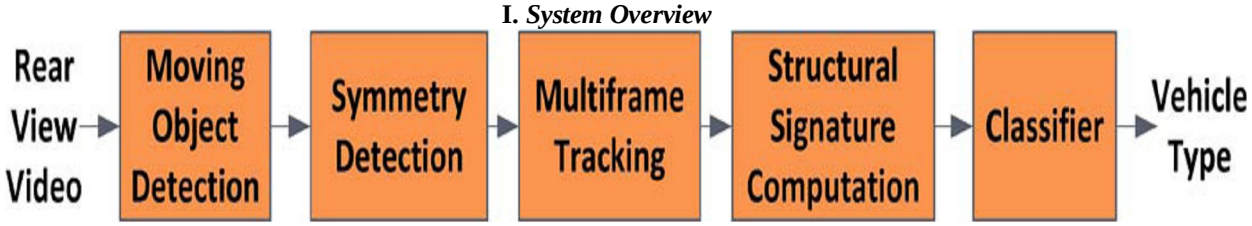


Fig. 2 System for vehicle classification.[1]

From above fig.shows the complete system overview. First they take rear view video from camera mounted on top of highway. After that take the video of moving object by using the method of road to image homography. Homography is denoted by H. *T*hen compute bilateral symmetry to avoid partial detection, shadow and robust to illumination changes. multiframe tracking is used to compare two frames. Calculate structural signature using angle of orientation to camera image plane and road plane. this structural signature is different for different vehicle. And finally uses classifier for the classification of vehicle.

VI. METHODOLOGY

A. *Moving object Detection*

When vehicle traveling at constant speed. Vehicle surface create relationship with road .they analyse relationship of vehicle surface with road instead of camera. For the detecting the moving objects they use region of interest.

B. *Road-to-Camera Mapping*

To map the angle of vehicle surface to the road. And also calculate the relationship between camera image plain and road plane .This relationship is nearly similar. This similarity called as homography. Homography is calculated by minimum four points on the road marking.

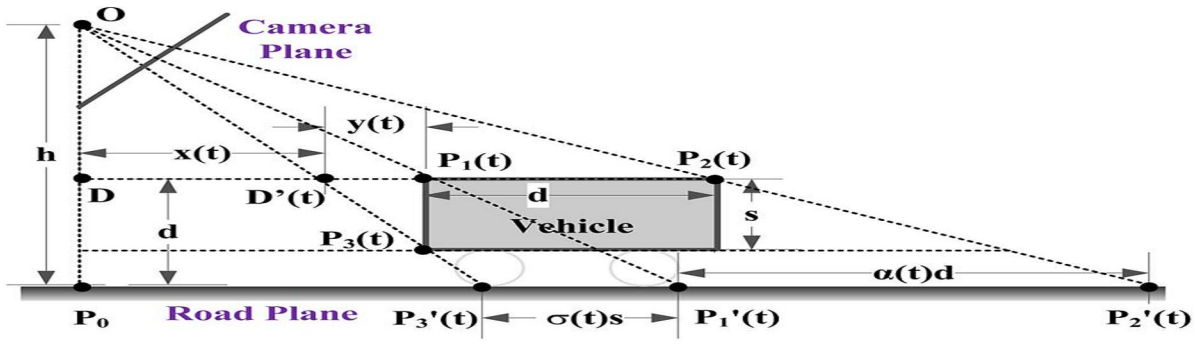


Fig. 3. Scene geometry of projection on the road. [1]

From fig. vehicle moving on road is captured by camera placed on top of the high way. Assume that vehicle is cuboid. They map the vehicle surface and road surface

Theorem 1: The height of the projection of the surface parallel to the road does not change with time. Theorem one shows that Δ*ODP*1 (*t*) □ Δ*OP*0*P*_1 (*t*), Δ*ODP*2 (*t*) □ Δ*OP*0*P*_2 (*t*). [1]

Theorem 2: The height of the projection of the surface perpendicular to the road changes with time.

Δ*ODP*1 (*t*) □ Δ*OP*0*P*_1 (*t*), Δ*ODD*_ (*t*) □ Δ*OP*0*P*_3 (*t*). [1]

C. Bilateral Symmetry Detection

Before placing the bilateral symmetry first vehicle should be detected, this vehicle is detected by moving object detection method. [19]. Then the bilateral axis of symmetry is established. Vertical axis is taken for placing the symmetry.by Placing symmetry according to their region of interest.To estimate the axis of symmetry, we first estimate edge magnitudes and the orientation of the image using Gabor filters. To avoid texture edges; we apply surround suppression [20] to the Gabor response.

D. MultiFrame Matching

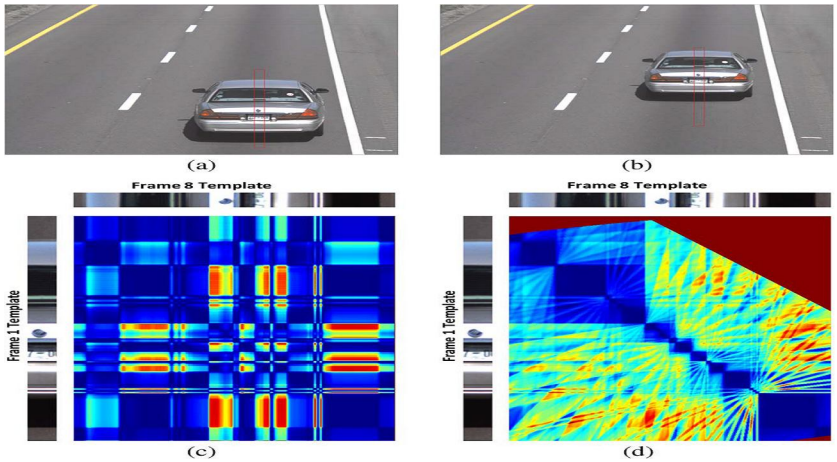
In multiframe matching row to row matching is achived.by two techniques by matching the row to row template frame matches with adjacent frame and propagating matches and second one is performing one multiframe with all other multiframes in single operation.

Multiframe matching have more advantages than frame to frame matching.

1)multiframe matching provide more accuracy than frame to frame matching.

2) The matching can recover in subsequent frames after failure in a certain frame.

3) As errors and failures do not propagate, matches generated after each frame are independent.



[1] Fig. 4 Multiframe matching

Fig shows the difference between frame to frame matching and multiframe matching.in a) and b) they shows template matching mean frame to frame match using template. Image c) Shows frame to frame cost matrix with rectangular block. d) Shows multiframe matching cost matrix with streaks.in both frame template darker color shows lowest cost and brighter color shows highest cost.

E. ***Structural signature computation***

For calculating structural signature first vehicle surface is divided into surface elements .this surface element have equal hight.edges that separating surface element are E1,E2,E3…..En,En+1.Adjecent pair of edges are(En,En+1).it

creates a surface element are (SN,Sn+1). Projection of surface element on the road is Pn, Pn+1.for calculating structural signature of two frames i, j.

$$S_{i,j} = \left(\frac{P^i_{1,2} - P^j_{1,2}}{P^i_{1,2}}, \ldots, \frac{P^i_{N-1,N} - P^j_{N-1,N}}{P^i_{N-1,N}} \right) \quad [1]$$

F. ***Classification:***

All the experiments are conducted with two databases that is database1 and database2. By taking validation of these two databases for the classification accuracy. Database 1 is used for training and database2 is used for testing or vice versa. Using multiframe matching and frame to frame matching we compute structural signature for compare two frames and classify according to their results.

VII. CONCLUSIONS

Structural signature concept is used as one of the feature for the vehicle classification system.by taking rear video of vehicle they compute multiframe matching and from that integrate the information about vehicle structure. Here they can't cannot consider structural appearance of vehicle for classification.multiframe matching id cost effective than frame to frame matching. Use of the road projection allows significant variations in camera angles .real time implementation is possible and gives output more accurately than other previous methods used.

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