Snake-based Side-view Car Detection Approach

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Introduction

Recent studies in object detection have shown that a component-based approach is more robust to natural pose variations, than the traditional holistic approach. These component-based object detectors are built hierarchically, where simpler detectors first locate components of an object, and a combination classifier makes the final detection with the outputs from each of the component detectors as features. Detecting cars is a challenging task as the structure of a car will vary more between samples, because their shapes and configurations have been designed with product differentiation in mind.

Motivation

Most of the car detection techniques depend on manually segmented part-based learning which needs more computational resources. In our method we propose a fully automated detection technique for side-view cars.

Methodology

In this work we propose a side-view car detection technique. Our method, first identifies the wheels of a car using an ellipse extraction technique [1] and rejects the irrelevant ellipses from the car. Thereafter an edge detection technique is applied to find the top and bottom parts of the car's body, from which we formulate an initial active contours of the car. Finally, this active contours are used to determine the final contour of the car by using the Snake algorithm. Thus, segmentation of foreground (i.e. car) and background is achieved.

Our approach involves …

- A hierarchical approach for fast and robust ellipse or circle detection used to detect the car wheels.
- Sobel edge detection technique is used to detect the horizontal edges.
- Snake algorithm is used to detect the contour of the car.
- The angle threshold and distance threshold in ellipse extraction are found from a trainingset and is used to detect the ellipses in the image.

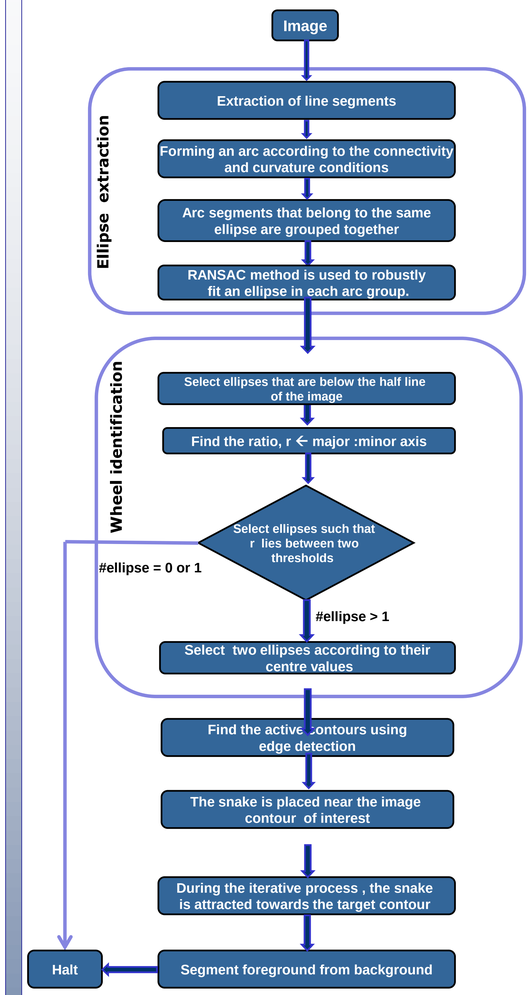


Figure 1: Flow diagram of the proposed method.

Experimental Setup

To evaluate our approach we used 20 car images taken from the PASCAL VOC 2007 dataset.

Evaluation criteria

$$\frac{n(Ro \cap Do)}{n(Ro)} * 100\ \%$$

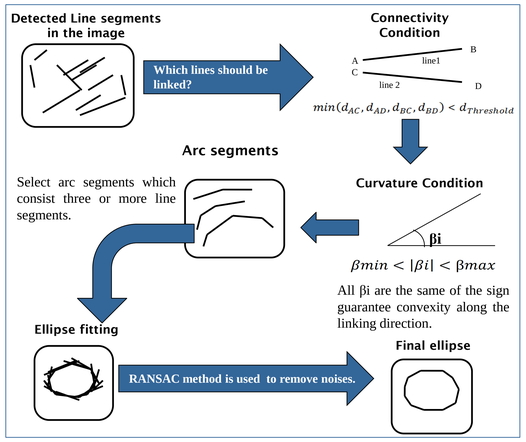
where,

Ro is the real object and Do is the detected object in which both Ro and Do are regions of a silhouette image.

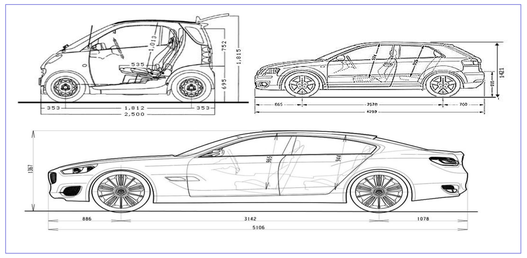
Test image

Extracted ellipses in test image

Irrelevant ellipses are removed



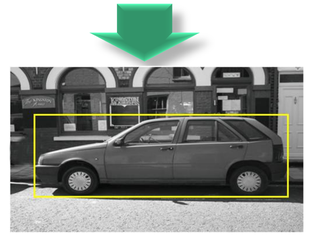
Ellipse extraction technique



Different type of cars that are considered to learn about the width to height ratios. This is used with the edge detection technique to form the initial active contour.

Segmented car from the background

Car detected by the snake algorithm



Formulated bounding box

Figure 2 : Experimental setup of our approach

Results

The average object detection rate is 93.33%

Discussion & Conclusion

- ☞ Our technique failed to detect a car in the case of a single or no ellipse is found. One of the reason is the poor quality of the image. The other reason is the selection of the optimal parameter involved in the ellipse detection method.
- ☞ The ellipse extraction method can be further improved depending on the selection of angular and distance thresholds.
- ☺ The main advantage of this method is that there is no manual work involved in segmenting the side-view cars.

Reference

[1] F. Mai, Y. S. Hung, H. Zhong and W. F. Sze, A Hierarchical Approach for Fast And Robust Ellipse Extraction, Image Processing, In proceedings of the IEEE International Conference on Image Processing, pp. 345 – 348, 2007.

[2] M. Kass, A. Witkin, and D. Terzopoulos, Snakes - Active Contour Models International Journal of Computer Vision, pp. 321-331, 1987.

[3] Brian Leung, Component-based Car Detection in Street Scene Images, Massachusetts Institute of Technology, Doctoral Thesis, 2004.