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Research Article

Design and analysis of various edge detection and object counting methods to obtain the most efficient technique for image processing for traffic applications

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Keywords

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Emergency vehicles,
Image Processing.

Abstract

Edge detection is the name for a set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges.The frequent traffic jams at major junctions call for an efficient traffic management system in place. The resulting wastage of time and increase in pollution levels can be eliminated on a city-wide scale by these systems.

1. Introduction

The purpose of detecting sharp changes in image brightness is to capture important events and changes in properties of the world. It can be shown that under rather general assumptions for an image formation model, discontinuities in image brightness are likely to correspond to:

1. discontinuities in depth,
2. discontinuities in surface orientation,
3. changes in material properties and
4. variations in scene illumination.

The application of image processing and computer vision techniques to the analysis of video sequences of traffic flow offers considerable improvements over the existing methods of traffic data collection and road traffic monitoring.

Existing methods include the detectors such as loop, radar, infrared, ultrasonic, and microwave detectors which are expensive with limited capacity and involve installation, maintenance, and implementation difficulties. Image processing offer a relatively low installation cost with little traffic disruption during maintenance.
Edges extracted from non-trivial images are often hampered by fragmentation, meaning that the edge curves are not connected, missing edge segments as well asfalse edges not corresponding to interesting phenomena in the image – thus complicating the subsequent task of interpreting the image data.

Edge detection is one of the fundamental steps in image processing, image analysis, image pattern recognition, and computer vision techniques.

Also they provide wide area monitoring allowing analysis of traffic flows and turning movements, speed measurement, multiple-point vehicle counts, vehicle classification and highway state assessment (e.g. congestion or incident detection). Image processing also finds extensive applications in the related field of autonomous vehicle guidance, mainly for determining the vehicle's relative position in the lane and for obstacle detection.

2. Lane finding

Canny also introduced the notion of non-maximum suppression, which means that given the presmoothing filters, edge points are defined as points where the gradient magnitude assumes a local maximum in the gradient direction. Looking for the zero crossing of the 2nd derivative along the gradient direction was first proposed by Haralick It took less than two decades to find a modern geometric variational meaning for that operator that links it to the Marr–Hildreth (zero crossing of the Laplacian) edge detector. That observation was presented by Ron Kimmel and Alfred Bruckstein.

Although his work was done in the early days of computer vision, the Canny edge detector (including its variations) is still a state-of-the-art edge detector. Unless the preconditions are particularly suitable, it is hard to find an edge detector that performs significantly better than the Canny edge detector.

Automatic lane finding (ALF) is an important task for an adaptive traffic monitoring system. It enables applications in active vision systems, where the camera viewing angle and the focal length of the camera lens may be controlled by the system operator.

2.1 Lane region detection

Some edge-detection operators are instead based upon second-order derivatives of the intensity. This essentially captures the rate of change in the intensity gradient. Thus, in the ideal continuous case, detection of zero-crossings in the second derivative captures local maxima in the gradient.

The early Marr-Hildreth operator is based on the detection of zero-crossings of the Laplacian operator applied to a Gaussian-smoothed image. It can be shown, however, that this operator will also return false edges corresponding to local minima of the gradient magnitude. Moreover, this operator will give poor localization at curved edges. Hence, this operator is today mainly of historical interest.

This class relates the detection of the lane with the changing intensity distribution along the region of a lane. This class considers just the changes in the gray-scale values within an image sequence.

2.1.1 Color based segmentation

In this case, the features are defined by the spectral response of the illumination at the red, green and blue bands. At each pixel, the (R, G, B) value defines the feature vector and the classification can be performed directly on the (R, G, B) scatter diagram of the image.

Fig (1): Color Based Segmentation

2.1.2 Texture based segmentation

Advantages:

1. Sharp and thin edges lead to greater efficiency in object recognition.
2. If Hough transforms are used to detect lines and ellipses, then thinning could give much better results.
3. If the edge happens to be the boundary of a region, then thinning could easily give the image parameters like perimeter without much algebra.

In this case, the texture of the image has been used as a feature for classification. The texture of the road is normally smoother than that of the environment. The texture calculation can be based on the amplitude.

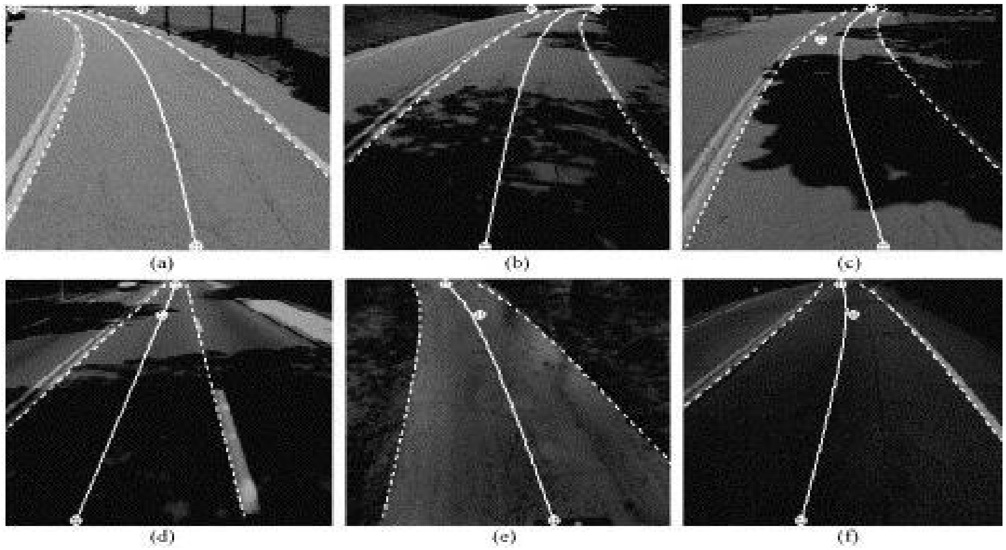

Fig (2): Texture Based Segmentation

Conclusion

Automatic lane detection based on region and texture .In object detection we have studied Thersholding, Background Subtraction, Boolean Edge Detector. Thus Emergency vehicle Detection can be well implementated using Edge Detector which tracks the red signal for more accurate detection.

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