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Real-time detection of vehicles using the haar-like features and artificial neuron networks

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Abstract

In this document, a vehicle detection system is presented. This system is based on two algorithms, a descriptor of the image type haar-like, and a classifier type artificial neuron networks. In order to ensure rapidity in the calculation extracts features by the descriptor the concept of the integral image is used for the representation of the image. The learning of the system is performed on a set of positive images (vehicles) and negative images (non-vehicle), and the test is done on another set of scenes (positive or negative). To address the performance of the proposed system by varying one element among the determining parameters which is the number of neurons in the hidden layer; the results obtained have shown that the proposed system is a fast and robust vehicle detector.

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Keywords: vehicle detection, haar like features, the integral image, artificial neuron networks.

1. Introduction

Road safety is the set of measures to prevent road accidents or mitigate their consequences. While many passive systems (seat belts, airbags, laminated glass …) and assets (ABS, ESP, Sips, LSD ...) were planned and led to avoid or reduce the consequences of accidents, other more intelligent driver assistance systems can also contribute to finding solutions for the prevention of road safety. In doing so, the study of intelligent systems constitutes an area that requires technical and highly advanced image processing algorithms to extract useful information to provide a driving assistance[1]. It is also a very active area of research that aims to reduce the number of road accidents[2]. The

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objective of these techniques and algorithms is to provide information to the driver on the state of the environment, the location and distance between other vehicles, traffic signs and other road users[3].

The vehicle detection is essential in intelligent systems that aims to detect potentially dangerous situations with vehicles in advance to warn the driver[4]. Different types of sensors, such as ultrasonic sensor, a laser scanner and a camera, have been used to detect vehicles in the literature[5]. Active sensors such as radar can operate in different environments, but they are unable to distinguish between the various obstacles (car, pedestrian and cycling). Thus the cameras are adapted to detect the automobiles because they are similar to the human visual perception system and provide rich information for applying pattern recognition techniques such as the case of the artificial neural networks[6].

All vehicle detection systems aim to detect the presence of one or more cars in a complex digital image from a CCD camera. And this goal is a difficult task considering the complexity of the outdoor scenes (environment) and their constraints[7].

In the literature, several image processing algorithms have been used for the detection of vehicles, among others, citing HOG transformed[3] and haar like features[8] that are used in computer vision to detect objects in digital images.

This paper presents a robust and fast vehicle detection system, which combines two algorithms, the first is an image processing algorithm and the second is an algorithm of artificial intelligence. The image processing algorithm aims to extract the features of a vehicle using the descriptor haar, and the algorithm of artificial intelligence uses artificial neural networks to classify and detect these vehicles.

This paper is a contribution in the field of intelligent detection vehicles. The first contribution is the use of the concept of the integral image for the calculation of haar like features. The second is the use of artificial neural networks as being a classifier with the Haar features. And the third is to present a thorough analysis of the performance of this system.

The paper is divided as follows. The following section presents previous research on the detection of the vehicle. Section 3 describes in detail the descriptor and the classifier that we have studied and its combination. Various experimental results are presented and analyzed in Section 4. The last section is devoted to the conclusion.

2. Related work

Until now, many researchers have proposed vehicle detection algorithms. A trivial solution for vehicle detection is the exhaustive search of all possible positions in the processed image. But this solution remains unsatisfactory for applications necessitates a calculation speed[3] To solve this problem many researchers have proposed robust and fast algorithms for detecting vehicle; these algorithms have an attentional process that can be divided into two stages[9]:

- Learning: this step consists in learning the class features of the vehicle from a set of images. Each image of the training is represented by a[10] feature vector extracted by an image processing algorithm. A classifier is trained to estimate the class of vehicles and not vehicles.
- the detection: this step consists in cutting the original image into zones and then extract the feature vector of each zone with the same algorithm used during the learning phase[11], Finally using the same classifier that will detect as role, this time, the presence of the vehicle in the treated area image or not.

Among the most known systems for detecting objects, one proposed by Viola and Jones[8], which consists in extracting the haar like features[12,13] and to cascade a set of called weak classifiers to construct a strong classifier, forming a boosting algorithm named.

In[14], the authors used a 2 step approach for the detection of vehicle. The first step is to find the shadow areas of the vehicle in the lower part by applying Haar algorithm and as AdaBoost classifier. The second step consists of applying the combined treatment of regions of interest with HOG and SVM algorithm as the classifier to verify the presence of the vehicle and then use the K-means algorithm to increase the detection rate.

In[4], the authors proposed a comparative study of two image processing algorithms: haar like features and the histograms oriented gradient (HOG). The classifier used in this article was AdaBoost. This method gives very satisfactory results.