Highway Background Identification and Background Modeling Based on Projection Statistics

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ABSTRACT

Background images are identified by analyzing the changes in texture of the image sequences. According to the characteristics of highway traffic scenes, in this paper, the author presents a new algorithm for identifying background image based on the gradient projection statistics of the binary image. First, the images are blocked by road lane, and the background is identified by projection statistics and projection gradient statistics of the sub-images. Second, the background is reconstructed according to the results of each sub-image. Experimental results show that the proposed method exhibits high accuracy for background identification and modeling. In addition, the proposed method has a good anti-interference to the low intensity vehicles, and the processing time is less as well. The speed and accuracy of the proposed algorithm meets the needs of video surveillance system requirements for highway traffic scenes.

Keywords: Background Identification, Background Images, Background Modeling, Highway Monitoring System, Projection Statistics

1. INTRODUCTION

The highway is the inevitable product of economic development, which reflects the transportation development level as well as the overall economic development level of a national and regional, and it also shortened the temporal and spatial distance between people. However, the traffic on the highway is heavy, fast, and could be easily affected by the rain and snow ice fog and other inclement weather factors, which make it vulnerable to major accidents. So the intelligent monitoring and management to the highway traffic is very important. Background identification and background modeling approach is a crucial step, an accurate and fast identification and modeling methods have a very important practical significance.

The traditional method of background modeling have its own shortcoming: the mean method of background modeling is to get the average of the image sequences in a period of time. This algorithm is simple and easy to calculate, and when the objects move fast and its area is small relative to the entire frame, the
results of the method will be better. However, if the brightness is too high or too low of a row of vehicles, or the area of moving objects is relatively large, the obtained background image will contain a lot of noise, which will produce large errors in background modeling (Cucchiara, Piccardi, & Prati, 2003). The kernel density estimation algorithm (Sun, Chen, & Ji, 2008; Huang & Dai, 2007; Sun, 2010) overcome the shortcomings of large operations, but it need time to train a large number of samples, and the speed of iterative calculation is slow, which make it difficult to use in practice. Gaussian mixture model (Kita, 2010; Kan, Li, Tang, & Du, 2010; Charoenpong, Supasuteekul, & Nuthong, 2010; Zhong, Yao, & Liu, 2010) assume that each pixel brightness distribution is a Gaussian mixture model in video frame, and establish the background model according to the brightness of the pixel histogram, but the assumption is not necessarily true and the computational complexity is proportional with the number of Gaussian model.

This paper proposes a method to identify and model the background image based on statistics, according to analyzes the characteristics of the highway. The speed and accuracy of the proposed algorithm have made very good results when test the experiment on road.

Figure 1. Background images contrast with the vehicle images

2. BACKGROUND IDENTIFICATION BASED ON STATISTICS

2.1. Highway Scene Features

We can find that the road is flat, the color is single and texture information is not obvious in the background images, while the color is rich and texture information is obvious in the Vehicle images, from the image sequences. The reason is that the edge of the vehicle front part in images is rich, such as the lights, heat sinks, plates, etc., which is depicted in Figure 1. According to this feature of the highway image sequences, firstly this paper identifies the background images roughly. Secondly, do the background modeling using the images of the previous step results.

2.2. General Principle

We divided the images by lanes, for the image data and the storage space are large enough for the high-definition digital images. (Simply, we assume that each sub-image is a rectangular.) In this paper, we divide the picture into three rectangular sub-pictures which can be left the overlapping parts between each other, according to the lane position. If N is the number of lanes of the image, the picture is divided into N sub-pictures, the description can be formulated as
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