Moving Vehicles Detection in Traffic Video Using Modified SXCS-LBP Texture Descriptor

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ABSTRACT

Background modeling and subtraction based method for moving vehicle's detection in traffic video using a novel texture descriptor called as Modified Spatially eXtended Center Symmetric Local Binary Pattern (Modified SXCS-LBP) descriptor. The XCS-LBP texture descriptor is sensitive to noise because in order to generate binary code, the value of center pixel value is used as the threshold directly, and it does not consider temporal motion information. In order to solve this problem, this paper proposed a novel texture descriptor called as Modified SXCS-LBP descriptor for moving vehicle detection based on background modeling and subtraction. The proposed descriptor is robust against noise, illumination variation, and able to detect slow moving vehicles because it considers both spatial and temporal moving information. The evaluation carried out using precision and recall metric, which are obtained using experiments conducted on two popular data-sets such as BMC and CDnet datasets. The experimental result shows that the authors' method outperforms existing texture and non-texture based methods.

Keywords: *Background Modeling, Background Subtraction, CS-LBP, LBP, Modified SXCS-LBP, Moving Vehicle Detection, Texture Descriptor, XCS-LBP*

INTRODUCTION

Nowadays, there is an increasing demand for computerized visual surveillance system. The surveillance cameras deployed in roads and intersections helped to detect abnormal events like vehicle collisions, traffic jam, near pass, lane cross, and sudden vehicle stop. In order to detect the abnormal events in traffic video, one of the preprocessing steps is moving vehicle's detection in a video sequence captured by a static camera. In last two decades, the researchers have proposed many methods for detection of moving vehicles in traffic video and not achieved good accuracy due to many challenges such as illumination variation, dynamic background, and shadow. These challenges are usually addressed using background model based methods where the background model is built, and its parameters can track changing illumination, and it can more accurately represent complex backgrounds. The process involved in the background model based technique

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is that subtract the video frames with background modeled frame, which first builds an adaptive dynamic background model, and then new pixel that is unlikely to be generated by this model is labeled as moving vehicles.

The researchers have proposed background model based techniques for detection of moving objects in video captured in an outdoor environment. Among all these existing background model techniques, Local Binary Patterns (LBP) texture descriptor (Ojala et al., 2002) based background modeling techniques show excellent performance for moving object's detection. Perhaps the most important properties of the LBP operator are its tolerance against illumination changes and its computational simplicity. However, the original LBP descriptor is not efficient for background modeling because of its sensitivity to noise where a little change of the central value greatly affects the resulting code (Caroline Silva et al., 2014). It produces the long histogram and does not consider temporal moving information of objects (Gengjian Xue et al., 2010). Marko Heikkila et al. (2006) have proposed the texture descriptor called as Center Symmetric Local Binary Pattern (CS-LBP) descriptor for moving object's detection in video. The CS-LBP descriptor is an extension of LBP and have several advantages compared to LBP such as tolerance to illumination changes, robustness on flat image areas, computational efficiency and produced short histograms. The drawback of CS-LBP descriptor based background modeling technique is that temporal moving information of the vehicle is not considered. Hence, the CS-LBP descriptor failed to detect slow moving vehicles in traffic video. Gengjin Xue et al. (2010) have proposed Spatial Extended Center-Symmetric Local Binary Pattern (SCS-LBP) for moving object's detection in video based on background modeling. It extracts both spatial and temporal moving information simultaneously, but not considered central pixel value while computing binary patterns, which leads to missing of central pixel information. Caroline Silva et al. (2014) have proposed the method called as eXtended Center-Symmetric Local Binary Pattern (XCS-LBP) descriptor, which is the combination of original LBP and CS-LBP descriptor. The XCS-LBP produces a small histogram as compared to LBP and extracts more image or frame texture details compared to CS-LBP and SCS-LBP descriptor. However, the drawback of XCS-LBP descriptor is that it is sensitive to noise because in order to generate binary code, the value of central pixel value is still used as the threshold directly and the second drawback is that it does not consider temporal moving information, considers only spatial information. Another drawback of XCS-LBP descriptor is that it produces same binary code for different local structures.

In order to overcome the drawbacks of XCS-LBP, we proposed a new descriptor called as Modified XCS-LBP descriptor, which is an extension of XCS-LBP descriptor for moving vehicle's detection in traffic video. In order to make our method robust against noise, the value of each central pixel in a 3x3 local area is replaced by its average local gray level (Zhao et al., 2013). Compared to gray value, an average local gray level is more robust to noise. In order to avoid same binary code produced for two different structures, the neighbors of each neighbor pixel are also considered (Zhao et al., 2013). In our method, with these modifications to original XCS-LBP, we also consider the temporal moving information in addition to spatial information, which helps to detect slow moving vehicles.

Our main contribution involved in this paper is that we proposed a new descriptor called as Modified XCS-LBP descriptor, which extracts detailed spatial texture features and temporal moving information. For background modeling and subtraction, we adopted the technique proposed by Marko Heikkila et al. (2006), which involves two major phases. In the first phase, we extract the texture features using Modified XCS-LBP descriptor; the extracted features are used to initialize and update the background model. In the second phase, we subtract the current frame and the constructed background frame, which yields segmented or detected moving vehicles. The pipeline of our approach is shown in Figure 1.