Chapter 17
Moving Vehicle Detection in Traffic Video Using Modified SXCS–LBP Texture Descriptor

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ABSTRACT

In this chapter, the authors proposed background modeling and subtraction-based methods for moving vehicle detection in traffic video using a novel texture descriptor called 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 chapter proposed a novel texture descriptor called 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 is carried out using precision and recall metric, which is obtained using experiments conducted on popular dataset such as BMC dataset. The experimental result shows that the method outperforms existing methods.

INTRODUCTION

Nowadays, there is an increasing demand for the computerized visual video surveillance system. The video surveillance cameras installed in highways and roads intersections helped to record different types of abnormal events, most common abnormal events like vehicle collisions, traffic jam, near pass, lane cross, and sudden vehicle stop. In demand to detect the abnormal events in traffic video, one of the significant preprocessing steps is moving vehicle's detection in a video sequence captured by a stationary camera. In the last two decades, the investigators have proposed many approaches for detection of moving vehicles in traffic video and not reached good accuracy due to many challenges such as illumination variation, dynamic background, and shadow. These challenges are usually noticed using background

model-based approaches where the background model is constructed, and its parametric quantity can track changing illumination, and it can more accurately represent complex backgrounds. The process needed in the background model-based technique is that subtract the background modeled frame with the current video frames, which first constructs an adaptive dynamic background model, and then new pixel that is unlikely to be generated by this model is labelled as moving vehicles.

The state-of-art have proposed background model-based systems for detection of moving objects in video captured by a stationary camera. Among all these current background model systems, the Local Binary Patterns (LBP) (Ojala et al., 2002) texture descriptor based background modeling system show the outstanding result for moving object's detection. Perhaps the most significant properties of the LBP texture operator are its tolerance against illumination changes and its computational simplicity. Still, the original LBP descriptor is not efficient for constructing background system because of its sensitivity to noise where a small change of the central value significantly affects the resulting code (Caroline Silva et al., 2014). It produces the long histogram and does not study temporal moving information of objects (Gengjian Xue et al., 2010). Marko Heikkila et al. (2006) have proposed the moving object's detection in the video sequence using Center Symmetric Local Binary Pattern (CS-LBP) descriptor. The CS-LBP descriptor is an extension of LBP and has various advantages compared to LBP descriptor 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 system is that temporal moving information of the object is not considered. Hence, the CS-LBP descriptor failed to detect slow-moving objects in the video sequence. Gengjin Xue et al. (2010) have proposed Spatial Extended Center-Symmetric Local Binary Pattern (SCS-LBP) for moving the object's detection in video based on background modeling. It extracts both spatial and temporal moving information concurrently, but not considered central pixel value while calculating binary patterns, which leads to omitted 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 mixture of original LBP and CS-LBP descriptor. The XCS-LBP descriptor yields a small histogram as related to LBP and extracts more texture details in video frame compared to CS-LBP and SCS-LBP descriptor. However, the disadvantage of XCS-LBP descriptor is that it is delicate to noise because in order to produce 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 video frame information, considers only spatial information. Some other disadvantage of XCS-LBP descriptor is that it produces same binary code for different local structures.

In order to overcome the drawbacks of XCS-LBP, in this chapter, we proposed a new texture descriptor called as Modified SXCS-LBP descriptor, which is an addition of XCS-LBP descriptor for moving objects detection in the video sequence. In order to make our approach most robust against background noise, the value of each central pixel in a 3x3 local area is changed by its average local gray level (Zhao et al., 2013). Related to gray value, an average local gray level is more robust to noise. In order to avoid the same binary code produced for two dissimilar structures, the neighbors of each neighbor pixel are also considered (Zhao et al., 2013). In our approach, with these modifications to original XCS-LBP, we also consider the temporal moving object information in addition to spatial information, which helps to detect slow-moving objects in the video sequence.

Our main contribution involved in this chapter is that we proposed a new descriptor called Modified SXCS-LBP texture descriptor, which extracts detailed spatial texture features with the temporal moving object information. For adaptive background modeling and subtraction, we adopted the method proposed by Marko Heikkila et al. (2006), which involves two major steps. In the first step, we extract the texture

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