Center Symmetric Local Descriptors for Image Classification

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ABSTRACT

Local feature description forms an integral part of texture classification, image recognition, and face recognition. In this paper, the authors propose Center Symmetric Local Ternary Mapped Patterns (CS-LTMP) and eXtended Center Symmetric Local Ternary Mapped Patterns (XCS-LTMP) for local description of images. They combine the strengths of Center Symmetric Local Ternary Pattern (CS-LTP) which uses ternary codes and Center Symmetric Local Mapped Pattern (CS-LMP) which captures the nuances between images to make the CS-LTMP. Similarly, the authors combined CS-LTP and eXtended Center Symmetric Local Mapped Pattern (XCS-LMP) to form eXtended Center Symmetric Local Ternary Mapped Pattern (XCS-LTMP). They have conducted their experiments on the CIFAR10 dataset and show that their proposed methods perform significantly better than their direct competitors.

KEYWORDS

Image Classification, Local Binary Pattern, Local Feature Descriptor, Local Mapped Pattern, Local Ternary Pattern, Texture Classification

INTRODUCTION

Texture Analysis is one of the most important tasks in image processing and computer vision applications. Factors such as changes in illumination, camera jitter, inclement weather, dynamic environments, noise and shadows make it difficult to perform efficient analysis. Hence, tolerance to illumination changes, scale and rotation invariance, robustness to noise and the ability to capture nuances between images are highly desirable features in a good texture descriptor.

Local Binary Pattern (LBP) has recently witnessed considerable usage for local feature description of images owing to its simplicity of computation and robustness to illumination variations. In this method, a histogram of binary patterns computed over a region is used for texture description. However, the LBP operator only considers the first-order gradient information between the center pixel and its neighbors and is sensitive to noise. We aim to overcome this by adapting the CS-LTP texture operator and combining it with CS-LMP operator in our method of feature description. The methods that we present for feature description use only the pixel orders and completely neglect the pixel intensities. Unlike the LBP operator, which encodes the order in two levels, the CS-LTP operator encodes the order in three levels which we believe has led to a better feature descriptor.

In this paper, we propose the CS-LTMP operator by combining Gupta, Patil, and Mittal (2010) with the technique suggested by Ferraz, Pereira Jr. and Gonzaga (2014) so that the resulting method can capture nuances between images while preserving the advantages of the Gupta et al. (2010)
technique. In the same way, we also propose to modify Parsi, Tyagi and Malwe (2017) with the help of the technique suggested in Ferraz et al. (2014) to form the XCS-LTMP operator.

The rest of the paper is organized as follows. First, we give a brief literature review of the presently followed local description methods. Second, we give the basic idea and definitions of a few existing descriptors. Third, we present our proposed methods. Fourth, we consider a few existing local descriptors and compare their performances with our proposed methods. And fifth, we conclude our paper.

LITERATURE REVIEW

We present here a brief review of the various methods for texture classification that are proposed in the literature. Ojala, Pietikainen and Harwood (1996) introduced the Local Binary Pattern (LBP) as an approach for texture classification. Owing to its success in the texture classification task, the LBP operator then finds its way into various classification problems such as facial recognition as proposed in Ahonen, Hadid and Pietikainen (2006). Rotation invariance is something the LBP operator does not possess which is a disadvantage of this operator. Thus, in Ojala, Pietikainen, and Maenpaa (2002) a rotation invariant extension of LBP was introduced. Later it was found out that LBP was sensitive to global intensity variations and also to local intensity along edge components. To handle these shortcomings in Jun and Kim (2012) a new method was introduced called Local Gradient Pattern (LGP). LGP was shown to have higher discriminant power than LBP in the case of facial recognition.

Gupta et al. (2010) generalize the CS-LBP operator by using ternary code instead of binary code to encode the order of pixels, thus creating the Center Symmetric Local Ternary Pattern (CS-LTP). CS-LTP is robust to Gaussian noise and captures the local gradient properties. The CS-LTP operator does not consider the center pixel in its calculations, hence there was scope for more texture information being extracted (Wu & Sun, 2011). The Completed Local Ternary Pattern (CLTP) as given in Rassem and Khoo (2014) is insensitive to noise and is rotation invariant as well. Later, in Silva, Bouwmans and Frélicot (2015) a new method called extended center-symmetric local binary pattern (XCS-LBP) was introduced which combines both the strengths of CS-LBP and CS-LDP operator. Also in Ferraz et al. (2014) a method called center-symmetric local mapped pattern (CS-LMP) is presented which outperforms CS-LBP. In Abdesselam (2013), two LBP histograms were constructed one for edge pixels and one for non-edge pixels. The final feature vector is the weighted combination of the two histograms. Zheng, Sheng, Hartley and Huang (2010) propose two approaches i.e. dense center-symmetric local binary patterns (CS-LBP) and pyramid center-symmetric local binary/ternary patterns (CS-LBP/LTP). Tan and Triggs (2010) split the LTP code into positive and negative LBP code for the task of facial recognition. Yadav, Anand, Dewal and Gupta (2015) propose multi-resolution local binary pattern (MRLBP) variant based texture feature extraction techniques. They first use a discrete wavelet transform to decompose the image up to 7 levels and then apply six different variants of the local binary pattern to obtain the features of the images at different levels.

In the spectral domain, Pham, Mercier, and Michel (2015) propose a method for local texture feature extraction based on a pointwise approach embedded into a graph model. They exploit the radiometric, spectral as well as the spatial information in the image. Mirzapour and Ghassemian (2015) propose a method that extracts features from hyperspectral images such as morphological profiles, global Gabor features and conventional and segmentation-based grey-level co-occurrence matrices.

LOCAL DESCRIPTORS

In this section, we define the LBP, CS-LBP, CS-LDP, CS-LTP, CS-LMP and XCS-LMP operators and give brief explanations about them.
Online Evolution of Adaptive Robot Behaviour
www.igi-global.com/article/online-evolution-of-adaptive-robot-behaviour/113296?camid=4v1a

Simulating the Spread of an Epidemic in a Small Rural Kansas Town
www.igi-global.com/article/simulating-spread-epidemic-small-rural/54750?camid=4v1a