A New Fast Local Laplacian Completed Local Ternary Count (FLL-CLTC) for Facial Image Classification

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ABSTRACT Face recognition is one of the most interesting areas of research areas because of its importance in authentication and security. Differentiating between different facial images is not easy because of the similarities in facial features. Human faces can also be covered obscured by eyeglasses, facial expressions and hairstyles can also be changed causing difficulty in finding similar faces. Thus, the need for powerful image features has become a critical issue in the face recognition systems. Many texture features have been used in these systems, including Local Binary Pattern (LBP), Local Ternary Pattern (LTP), Completed Local Binary Pattern (CLBP), Completed Local Binary Count (CLBC) and Completed Local Ternary Pattern (CLTP). In this paper, a new texture descriptor, namely, Completed Local Ternary Count (CLTC), is proposed by adding a threshold value for the CLBC to overcome its sensitivity to noise drawback. The CLTC is also enhanced by adding the Fast-Local Laplacian filter during the pre-processing stage to increase the discriminative property of the proposed descriptor. The proposed Fast-Local Laplacian CLTC (FLL-CLTC) texture descriptor is evaluated for face recognition task using five different face image datasets. The experimental results of the FLL-CLTC showed that the proposed FLL-CLTC outperformed the CLBP and CLTP texture descriptors in term of recognition accuracy. The FLL-CLTC achieved 99.1%, 86.93%, 93.21%, 84.92% and 99.15% with JAFFE, YALE, Georgia Tech, Caltech and ORL face image datasets, respectively.

INDEX TERMS Face recognition, texture descriptor, local binary pattern, local binary count, fast local Laplacian.

I. INTRODUCTION

Face recognition is one of the most widely used systems in the field of security [1], [2]. An efficient face recognition system should be able to recognize similar faces even with the noise, wearing glasses, different facial expressions [3], different views, postures or illumination [4]. Figure 1 shows that different images of same person could look quite different because of various conditions. The first process for the face recognition system is the face detection. This step involves determining whether an image contains a face. If the image has a face, it will proceed to the next step, which is

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face extraction, wherein some descriptors from of the face can be extracted. Different types of feature descriptors have been presented for use in the feature extraction process. These features showed a good performance as powerful features and can be used to differentiate between different facial images. Local Binary Pattern (LBP) is one of the most commonly known texture descriptors, which was initially proposed for texture image classification, but its use has since expanded to various kinds of image processing tasks [5]–[11]. From LBP texture descriptor, different types of texture descriptors have been proposed such as Local Ternary Pattern (LTP) [12], Completed Local Binary Pattern (CLBP) [13], Completed Local Binary Count (CLBC) [14] and Completed Local Ternary Pattern (CLTP) [15], [16]. The superiority of LBP