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Research Paper

The new proposed method for texture modification of closed up face image based on image processing using local weighting pattern (LWP) with enhancement technique

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Abstract

The texture is a two- and three-dimensional design element that is distinguished by the visual and physical properties perceived. Textured areas in the image can be marked with uniform or varying spatial intensity distribution. There are many techniques and methods from simple to sophisticated which available including machine learning-based methods to modify the texture map. The texture feature description becomes a new challenge in the field of computer vision and pattern recognition since the emergence of the local pattern binary method (LBP). This study proposes a new method called Local Weighting Pattern (LWP) for modifying textures based on the pixel's neighborhood of an RGB image. The results of this study obtained that LWP method produces a texture with a unique and artistic visualization. The Log function has been used to improve the image quality of the LWP method.

Keywords: *texture image, LWP method, log function*

1. Introduction

A texture in the visual arts is the quality of the perceived surface artwork. These are two- and three-dimensional design elements that are distinguished by their perceived visual and physical properties. Textured areas in the image can be marked with uniform or varying spatial intensity distribution. Its intensity variations reflect some changes in the imaged scenes. A texture map is an image mapped to the surface of a shape or polygon. There are various techniques have evolved in software and hardware implementations to make texture modifications. In the field of image processing, there are many techniques and methods from simple to sophisticated which available including machine learning-based methods to modify the texture map .e.g. filtering, point processing, compositing, half-toning and dithering, and compression.

The texture is defined as a description of the spatial arrangement of color or intensity in the drawing or area of the selected image. Textured areas of the image are marked by a uniform or varying distribution of spatial intensity. The variations in intensity reflect the variations of changes in the imaged scenes. There are several texture properties such as granularity, directionality, randomness or regularity and texture elements [1]. The texture feature description becomes a tremendous challenge in the field of computer vision and pattern recognition since the appearance of a traditional feature texture description method named the Local Binary Pattern (LBP) [2].

The LBP method which has been successfully applied to many various problems including dynamic texture recognition, pattern matching, motion analysis, and environment modeling. Those researches have been conducted in [3-5].

A powerful texture feature extraction plays an important role in different areas of recognition, identification, and classification. If the feature is bad then as good as any method of classification or recognition will fail to achieve good results. Most research in texture classification focuses on developing great feature extraction methods. Some of the high-quality feature descriptor attributes are unique, due to the large number of texture classes, strong against lighting variations, and low dimensional representations. A lot of research effort has been done to meet those requirements, not least on how to do it with high computing speed.

In principle, image feature extraction methods can be divided into two categories: holistic feature extraction and local image. The Holistic feature extraction method is a method based on the statistical information template of a large number of training samples. The local image feature extraction method is used to overcome the disadvantages of holistic feature extraction methods that are highly sensitive to geometric shapes and some variations in lighting and noise. Several studies related to holistic methods have been done in [6-14]. Several studies related to local image methods have been done in [2-5, 15, 16]. Furthermore, machine learning method has also been used in the image feature extraction process. Some research on this has been done in [17-22].

However, both the holistic and local methods can also be used to construct an image texture. Using computer graphics, texture features can also be used to create better texture maps and background images, called mosaicing images. Some research on image mosaics has been conducted in [23-25].

For some certain purposes, the image needs to be improved. In the image processing area, image enhancement is defined as a computational activity to improve the visual appearance of an image, or to provide a better representation of changes for advanced image

processing. Some research on image enhancement has been done in [26-28].
This study proposes a new method called Local Weighting Pattern (LWP) for modifying textures based on the pixel's neighborhood of an RGB image.

2. The proposed method

The pixel neighborhood is a set of pixels, which is determined by their location relative to the center pixel. The neighborhood is a rectangular block, commonly have 8, 16, 32 pixels around the center pixel. A sliding neighborhood operation is an operation performed on central pixel based on all neighboring pixels with changes in central pixel values determined by the application of certain algorithms to the value of the corresponding input pixel's neighborhood. With certain neighborhood, this operation starting in the upper left corner of the image by the general algorithm as follows:

1. Select a single pixel.
2. Determine the neighborhood of the pixel.
3. Apply the certain algorithm as a function of the values of the pixels in the neighborhood to modify the value of the center pixel.
4. Find the pixel in the output image whose position corresponds to the center pixel of the input image and change its value to the output of the function.
5. Repeat steps 1 through 4 until all input pixels have been modified.

The study used an 8-pixel neighborhood. The function applied to each block processing is a new method called Local Weighting Pattern (LWP). The basic idea of LWP is the binary code built by the threshold of a neighborhood with its center gray value. There are two types of, positive and negative LWP code, which is declared as:

$positive\ \ code:$

$$binarycode(i)=\begin{cases}1 & if \quad P(x_c,y_c)-P(x_i,y_i)\geq 0\\ 0 & if \quad otherwise\end{cases} \tag{1}$$

$negative\ \ code:$

$$binarycode(i)=\begin{cases}1 & if \quad P(x_i,y_i)-P(x_c,y_c)\geq 0\\ 0 & if \quad otherwise\end{cases}$$

where $P(x_c,y_c)$, $P(x_i,y_i)$, and i are a center pixel, its neighbors, and the sequence number of binary code, respectively. This process as shown in Figure 1.

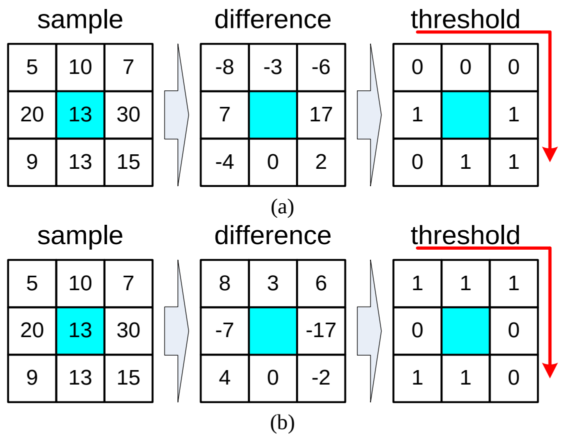


Fig. 1: Calculating the LWP code: (a). positive code, (b). negative code

From figure 1, the positive LWP code is [0 0 0 1 1 1 0 1] and the negative LWP code is [1 1 1 0 0 1 1 0]. The LWP operator is the sum of all binary number of LWP code which declared:

$$P(x_c,y_c)_{new}=P(x_c,y_c)_{old}*weight$$
$$weight=\sum_{i=1}^{8}binarycode(i) \tag{2}$$

Firstly, the rows and columns of the image are expanded so that block processing can be performed on each pixel that is on the edges of the image, as shown in Figure 2 (a).
After the LWP operation has been applied, each pixel value needs to be normalized with the maximum pixel value in the image to obtain an 8-bit image using the formula:

$$P(x,y)_{new(i)}=\frac{P(x,y)_{old(i)}}{\max\left(P(x,y)_{old}\right)}\times 255 \tag{3}$$

This operation is shown in Figure 2 (b).

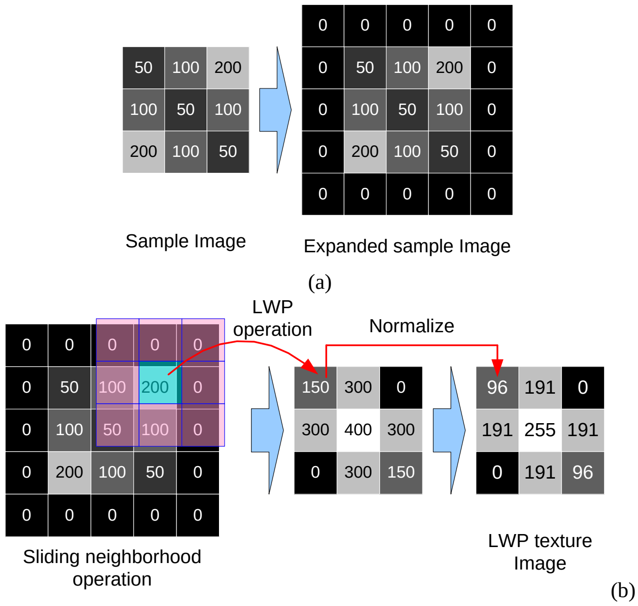


Fig. 2: (a) Image expansion, (b) Block processing which performed at each pixel

Improved image quality is done with reference to the concept of gray-level dynamic range compression, which mathematically expressed by:

$$g(x,y)=c.\log\left(1+abs\left(I(x,y)\right)\right) \tag{4}$$

With c = 1, the graph of the dynamic range compression transformation function is shown in Figure 3.

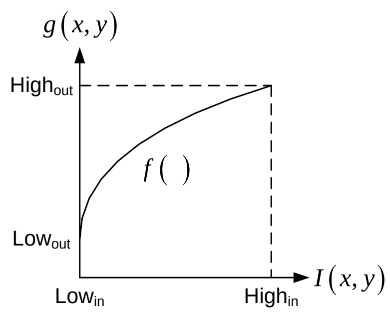


Fig. 3: Representation of gray-level dynamic range compression mapping function (Log function)

In this study, to enhance the quality of texture image is to use Eq. (4) after being modified which expressed by:

$$I_{new} = c * \log\left(b + \left|I_{old}\right|\right) \qquad (5)$$

where I_{old}, I_{new} are before and after enhancement of the image component (R, G, and B), respectively. The constants c and b are contrast and brightness factor, respectively.
To apply the LWP method to an RGB image need to be split into R, G, and B component, then LWP method is applied to each component. The algorithm as shown in Figure 3.

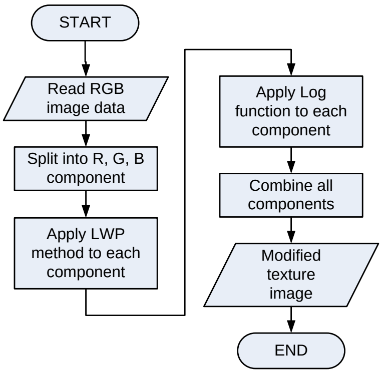


Fig. 3: The algorithm of LWP method with enhancement technique for texture modification on RGB image

Illustration of LWP implementation is shown in Figure 4.

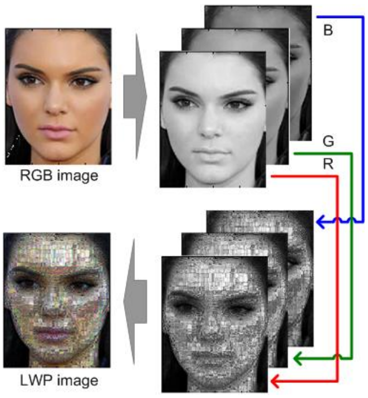
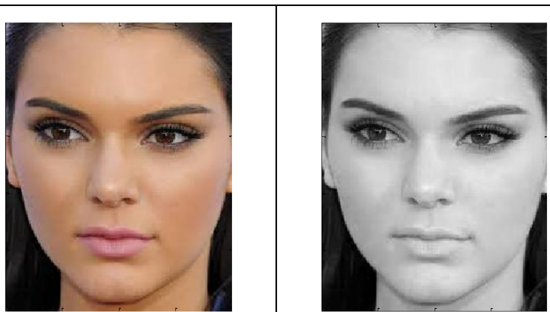


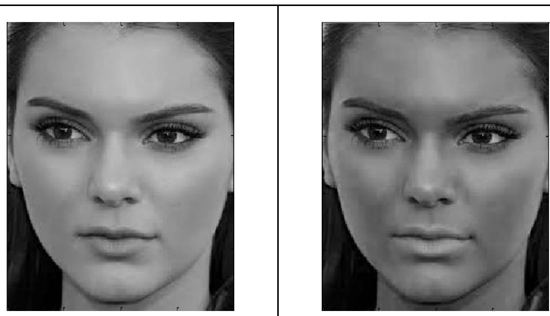
Fig. 4: Illustration of LWP implementation

2.3. The proposed method implementation

This research uses jpg image with 253 x 199 pixels size as sample image to test the proposed method as shown in Figure 5.



(a) RGB image (b) R component



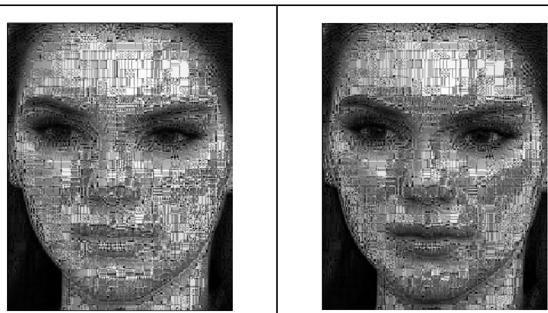
(c) G component (d) B component

Fig. 5: Image sample and its components

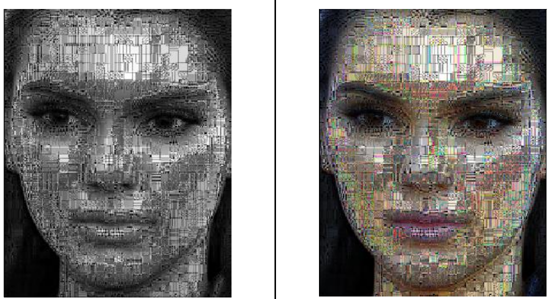
The LWP method is applied to each component (R, G, and B) using Eq. (1) – (3), through image expansion and block processing as in Figure 2.

3. Results and discussions

The implementation result of LWP method as shown in Figure 6 & 7. Figure 8 & 9 shows the result of enhancement technique using log function with the variation of c and b value.

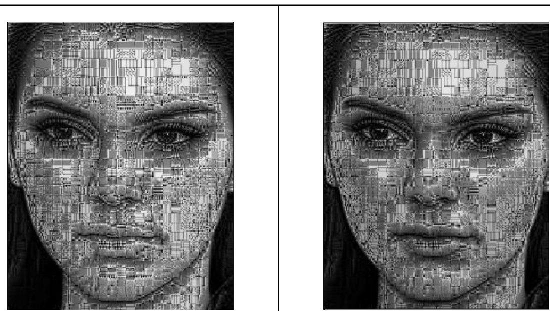


(a) R component (b) G component

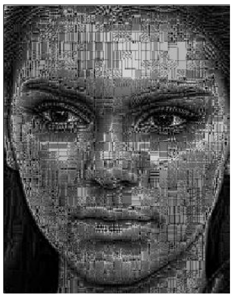
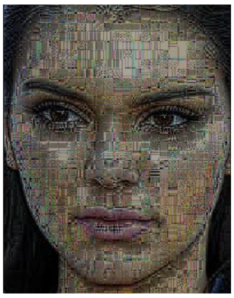


(c) B component (d) RGB image

Fig. 6: Positive LWP Image and its components

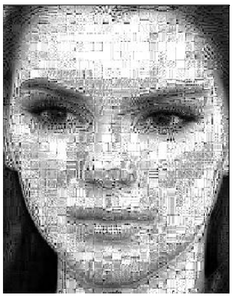
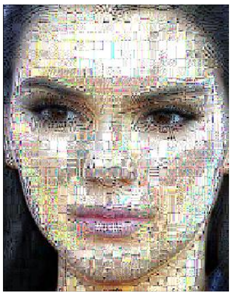


(a) R component (b) G component

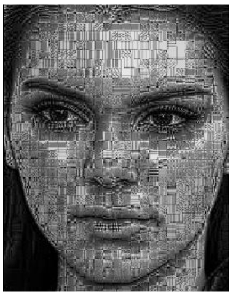
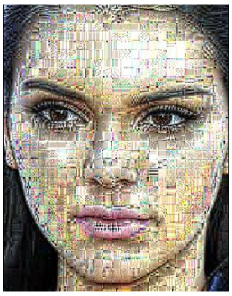
(c) B component | (d) RGB image

Fig. 7: Negative LWP Image and its components

Gray image | RGB image

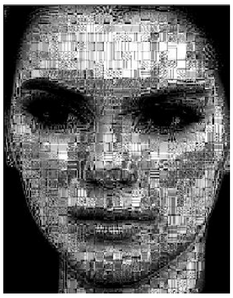
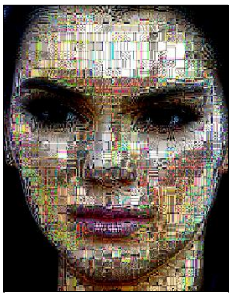
Positive LWP

Gray image | RGB image

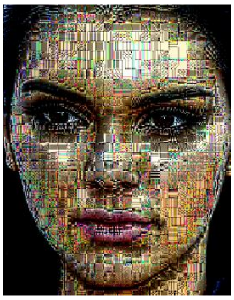
Negative LWP

Fig. 8: LWP Image with enhancement (c=2, b=1)

Gray image | RGB image

Positive LWP

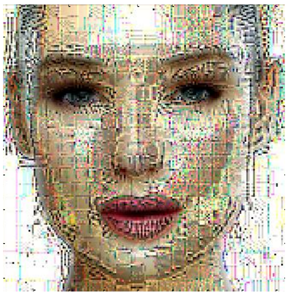
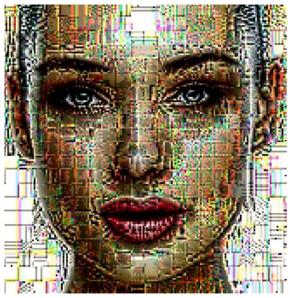



Gray image | RGB image

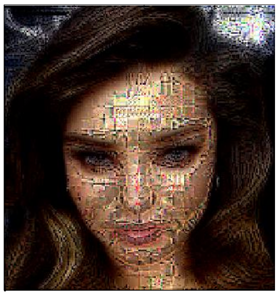
Negative LWP

Fig. 9: LWP Image with enhancement (c=2, b=0.8)

Figure 10 shows the different visualization for RGB image with brighter and darker background color.

LWP texture image with brighter background color




LWP texture image with darker background color

Fig. 10: LWP texture Image with the different background color

4. Conclusions

From the results of this study obtained that LWP method produces a texture with a unique and artistic visualization. Image quality can be improved by applying a log function through setting c and b values as contrast and brightness correction factor respectively. Typically, a positive LWP produces a sharper texture, otherwise produce a less sharp texture. Sample Image with darker background colors provides better visualization than sample images with brighter background colors.
Future work is how to improve the performance of the proposed method in order to be able to anticipate the effect of the background brightness of the image.

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