Colour occurrence descriptor based on local neighbourhood

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1 ABSTRACT

Content-based image retrieval requires efficient retrieval approaches to index and retrieve the most similar images from the huge image databases.

This project uses a robust color occurrence descriptor of local neighborhood to encode the color information present in the structure of the image.

The colour information will be processed in two steps:

1. The number of colour is reduced into a less number of shades by quantizing the RGB colour space.
2. the reduced colour shade information of the local neighbourhood is used to compute the descriptor.

A local colour occurrence binary pattern is generated for each pixel of the image by representing each reduced colour shade occurrence in its local neighbourhood using a binary pattern.

The descriptor is constructed by summing the local colour occurrence binary patterns of all the pixels in the image.

It will be tested over the natural and colour texture databases for content based image retrieval.

The performance of the proposed descriptor is promising in the case of illumination difference, rotation and scaling also and it can be effectively used for accurate image retrieval under various image transformations

2 INTRODUCTION

The demand of efficient image retrieval is rapidly increasing for the purpose of retrieving most visually appropriate similar images.

Broadly, image retrieval is categorized into three types according to its usability:

1. text-based
2. content-based
3. semantic-based.

In the early days, text based approaches were being used for image retrieval but the scope of such methods got reduced upon the existence of Content Based Image Retrieval (CBIR) because retrieving images from its content are more visually accurate.

The main aim of CBIR is to facilitate efficient searching, browsing and matching over large databases either offline or online opening an active research area in the field of computer vision for more than decades.

3 WORKING MECHANISM

The colour information is processed in the following steps:
1. The number of colour is reduced into a less number of shades by quantizing the RGB colour space.
2. The reduced colour shade information of the local neighbourhood is used to compute the descriptor.
3. A local colour occurrence binary pattern is generated for each pixel of theimage by representing each reduced colour shade occurrence in its local neighbourhood using a binary pattern.
4. The descriptor is constructed by summing the local colour occurrence binary patterns of all the pixels in the image.
5. LCOD is tested over the natural and colour texture databases for content based image retrieval and experimental results suggest that LCOD outperforms other state-of-the-art descriptors.

4 Color Quantization

RGB colour images contain three channels representing Red (R), Green (G) and Blue (B) colours respectively.
According to the RGB colour space, the range of shades is [0, l-1], where l is the number of distinguished shades in each channel.
The number of different colours possible in this colour space is l3, which is a large number.
The steps involved in the quantization are as follows:
1. Divide each Red, Green and Blue component of image I into q shades from l shades respectively. The reduced colour components (i.e. R red, G red and B red) are computed as

$$Rred = \frac{R+1}{stp}$$

$$Rgreen = \frac{G+1}{stp}$$

$$Rblue = \frac{B+1}{stp}$$

where stp = q/l

2. Combine all three components Rred, Gred and Bred into a one-dimension to construct the reduced colour image Ired as follows

$$Ired = q^2 * (Rred - 1) + q * (Rgreen - 1) + Rblue$$

We quantize each colour of the RGB image into equal number of shades which retains the symmetric information.
We quantized RGB colour space into 64 shades and quantized HSV colour space into 72 shades amd quantized L*a*b* colour space into 90 shades.
The value of q is chosen as 4 which lead to the 64 number of different shades after quantization.

5 DESCRIPTOR CONSTRUCTION

The construction process of proposed Local Neighbourhood Based Robust Colour Occurrence Descriptor (LCOD) will be computed over quantized image obtained.
Here, we focus to constructing the descriptor only on the basis of colour features of the image.

$$des(z) = \sum_{i=D+1}^{m-D} \sum_{j=D+1}^{n-D} \mathfrak{F}\mathfrak{P}_{(i,j)}^{D}(z) \quad \forall z = [1, \quad k \times q^3]$$

Figure 1: Bitwiseand binwise operator function

The whole construction consists of two steps.
1. A local colour occurrence binary pattern is generated for each pixel in the image in its local neighbourhood.
2. The binary patterns of all pixels of the image are aggregated to find a single pattern.

The functions used for are:

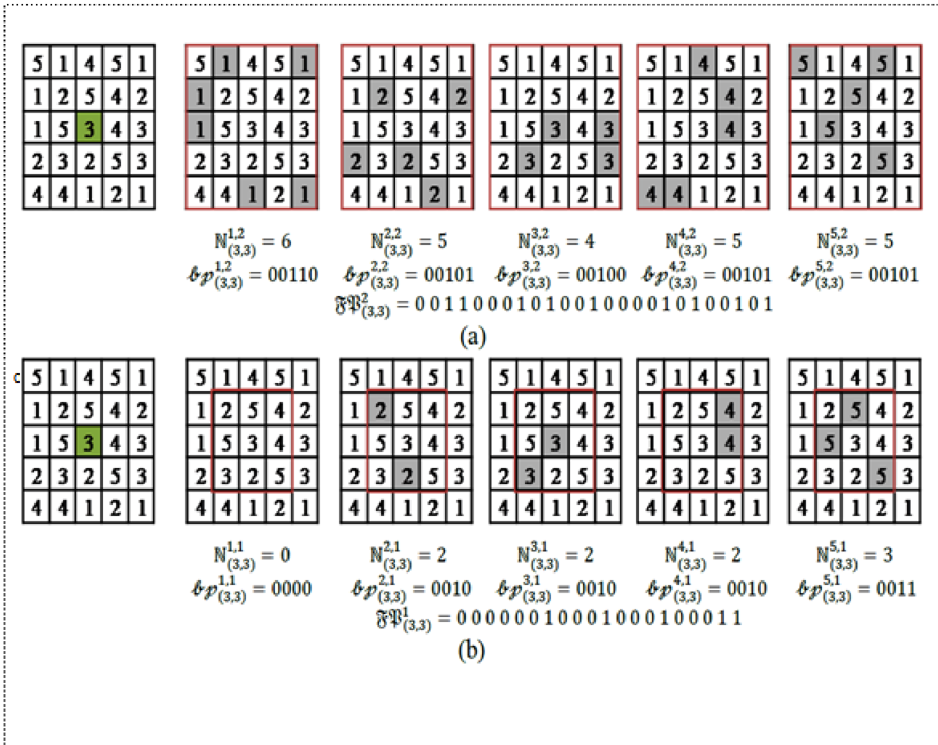

Figure 2: An illustration to compute the local colour occurrence binary pattern for (a) D = 2, and (b) D = 1.

$$LCOD(z) = \frac{des(z)}{\sum_{t=1}^{k \times q^3} des(t)} \quad \forall z = [1, \quad k \times q^3]$$

Figure 3: Normalization Function for finding LCOD

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Input:    Quantized Image (I_red)
           Quantization bin (q) for each channel
Output:  Descriptor (LCOD)
Initial:   t ← 0, des ← [ ]

Begin
    [s1, s2] ⟵ size(I_red)
    D ⟵ 1                                   // Set local neighbourhood size to 1
    k ⟵ ⌈log2((2D + 1)^2)⌉
    For i ⟵ −D : D
        For j ⟵ −D : D
            t = t + 1
            tmp(1:s1,1:s2,t) = I_red(D + i + 1:s1 − D + i, D + j + 1:s2 − D + j )
        end
    end
    iter ← q^3
    For c ⟵ 1 : iter
        tmp1 ⟵ (tmp == c)          // Set to 1 if true
        tmp2 ⟵ sum(tmp1,3)         // Summation in 3rd dimension
        tmp3 ⟵ de2bi(tmp2, k)      // Decimal to binary conversion of tmp2 into k bits
        tmp4 ⟵ sum(tmp3)           // Summation in 1st dimension
        des ⟵ [des tmp4]           // Concatenation
    end
    LCOD ⟵  des/sum(des)
    return (LCOD)
end
```

Figure 4: Algorithm for LCOD descriptor construction

6 CONCLUSION

This project presents an efficient colour based image feature description for CBIR.

The proposed descriptor used the concept of finding the quantized colour occurrences into the local neighbourhood of any pixel to achieve the inherent rotation invariance.

RGB colour space is quantized into 64 shades to represent the colour feature of the image and local colour occurrences is used to represent the colour feature most efficiently.

We extracted the colour occurrences and represent it in the binary form to generate a local colour occurrence binary pattern for each quantized colour shade independently.
In this way, proposed local neighbourhood based robust colour occurrence descriptor (LCOD) captures the most relevant local colour information of each quantized colour shade.
Proposed descriptor is rotation invariant inherent and describes the image features more efficiently.
The experimental results on natural and colour textural databases including rotation, scale, and illumination cases suggest that the LCOD descriptor performs better than other descriptors and can be effectively applied in the CBIR system.
LCOD is more robust towards scale and rotation and outperforms state-of-the-art colour and texture descriptors, especially in the case of geometric and photometric transformations.

7 REFERENCES

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THANK YOU