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BLIND DETECTION OF LOCAL DEFORMATION OF COLOR IMAGE BASED ON BAG

Forensic Science

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ABSTRACT

Image retouching can have varying degrees of impact on people's physical and mental health. When calling for reduced image retouching, the media should be supervised to minimize image retouching or to mark retouching images. In the supervision, image forensics methods are indispensable. For the local deformation of the image, this paper finds that the method based on BAG can detect the image tampering. The author adds the information of different color channels based on BAG to better locate the deformation. At the same time, this paper puts forward an idea about the detection of deformation direction based on block effect.

KEYWORDS

BAG, Image forensics, color channel, local deformation

INTRODUCTION

Now a days, image processing technology and social networks have risen rapidly. People are keen to share a variety of good-looking images on social networks. For the pursuit of good things, people always deal with them before they release pictures. This increases the appeal of the picture, but the modified picture may cause embarrassing problems. On the other hand, for the release of the character image, in order to pursue the face, long legs, and good figure, people use the retouching software to modify. In addition, many social media and advertising magazines will modify the cover of the magazine to attract more consumers. For example, merchants selling slimming drugs will use the retouching software to increase the contrast strength before and after the use of the products, so that their products are more reliable. However, this kind of over-promotion and the beauty that does not conform to human health will make people believe that the unreal "beauty" is normal. The pursuit of this unreal beauty will affect people's health and cause psychological problems. It is need to monitor while reducing the use of retouched images by the media, in this case, the blind evidence of retouching images is indispensable.

Image local deformation is a common image retouching operation. People can easily twist and deform the image by means of liquefaction tool in photoshop. Figure 1 shows the deformation of the face in the image.

(a) the original image   (b)the tampered image

Figure 1. An example of local deformation of an image

Andreas Gustafsson[1] believes that a complete deformation is derived from the combination of primitive deformation, and classifies the common deformation into local translation deformation, local scaling deformation and local rotation deformation.In figure 1, the girl's face on the left is deformed, which is obtained through the Liquefy Tool(Liquefy Tool) belong to a translation deformation.

The existing image forensics can be divided into two aspects, active forensics and passive forensics. In terms of passive forensics, Farid h. [2] classified the image forensics methods into the following categories, inclouds pixel based, compression based, camera based, physics based and geometry based. At present, many passive forensics techniques have been studied, including the block effect (BAG) [3][4] method. BAG refers to that the DCT transform adopted in the compression process of the compressed image is all block-based. It divides the image into 8-by-8 cubes. This compression method will cause the loss of high-frequency information, resulting in the "fault" reconstruction of the edge of the image block, resulting in BAG [5].

BAG is often used to detect copy-paste tampering [6][7].

Distortion of the image on the compressed image also changes the blockiness of the image tampering position. We use this feature to detect local distortion of the image. Color channels have proven to be better for detecting image forgery than single color channels, and many studies have taken advantage of this [6]. In this paper, we will combine blockiness and color features to better detect local deformation of images.

This paper first reviews the extraction of the BAG method, and then studies the BAG extraction effect of the color channels in different color spaces. Then, the features extracted by the better color channels are sent to K-means for clustering. Experiments show that the method can show better detection results. In addition, the paper also proposes an idea to detect the local distortion direction of the image as the research direction of future work.

PROPOSED METHOD
The method flow chart of this paper is shown in Figure 2.
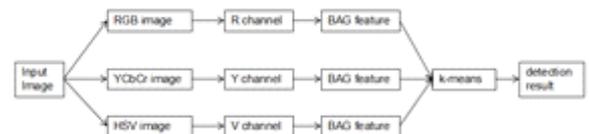

Figure 2 The flow chart of the proposed method

For the input color picture, the author first converts it into three common color spaces, and extracts the RGB R channel, the Y channel of the YCbCr space and the V channel of the HSV space, and extracts the BAG mesh for the three color channels, and then the offset features are extracted, and the three features are sent to the k-means method for clustering to obtain the test result graph.

EXTRACTION THE BAG GRID
The method in reference [3] is used to extract the block effect grid in the image.The feature of BAG is that its grid is composed of horizontal and vertical lines, and its periodicity in both directions is 8.

Extraction of weak horizontal lines E_h
For image I of size M×N, first extract its weak water horizontal edge E_h, using Eq.1.

$$d(y,x) = |2I(y,x) - I(y-1,x) - I(y+1,x)| \qquad (1)$$

Where $(y,x)I$ is the pixel in image I and $d(y,x)$ is an element of the absolute second-order difference D of the image, and to reduce edge effects, the method ignores all differential values greater than 55. Then, every 33 columns are horizontally added to enlarge the weak horizontal line in D, using Eq.2

$$e_I(y,x) = \sum_{i=x-16}^{16} d(y,i) \qquad (2)$$

The weak horizontal edge E_h is obtained by Eq.3,

$$e(y,x) = e_t(y,x) - Mid[\{e_t(i,x) \mid y-16 \le i \le y+16\}] \quad (3)$$

where function $Mid[A\{\}]$ returns the average value in set $A\{\}$ and $(y,x)e$ is the element of image E_h.

Extract a line with 8 cycles from the image E_h

To reduce the effects of noise, periodic median filtering of weak horizontal images is performed using Eq.4.

$$g_h(y,x) = Mid[\{e(i,x) \mid i = y-16, y-8,$$
$$y, y+8, y+16\}] \quad (4)$$

where g_h is the element in the extracted horizontal BAG line image G_h.

Similarly, the BAG line image G_v in the vertical direction can be extracted, and then G_h and G_v are combined using the Eq.5 to obtain a final BAG image.

$$g(y,x) = g_h(y,x) + g_v(y,x) \quad (5)$$

where $g_v(y,x)$ is the element in the extracted BAG line image G_v in the vertical direction, and $g_v(y,x)$ is the element in the extracted final BAG map G. Figure 3 shows a GAB map in the extraction of a color image R channel.

(a) R channel   (b) the BAG of R channel
Figure 3: R channel and the GAB of Rchannel

The BAG grid in Figure 3 clearly shows the extracted BAG map, which is not affected by the edges of the image.

Calculate the BAG offset characteristic of image G

The BAG grid of a complete image is consistent, and the location of image tampering is determined by detecting the inconsistency of the grid map in the image. For each 8x8 block in image G, if the BAG is at the abnormal position $A=[a]_{8\times8}$ of the block, a BAG line will appear in the 6x6 center matrix. B is used to represent the BAG position, subtracting the smallest sum at the block boundary along the maximum sum of 6 and 6 columns, as shown in Eq.6.

$$b = Max\left\{\sum_{i=2}^{7} a(i,x) \mid 2 \le x \le 7\right\}$$
$$-Min\left\{\sum_{i=2}^{7} a(i,x) \mid x = 1,8\right\}$$
$$+Max\left\{\sum_{i=2}^{7} a(y,i) \mid 2 \le y \le 7\right\}$$
$$-Min\left\{\sum_{i=2}^{7} a(y,i) \mid y = 1,8\right\} \quad (6)$$

Among them, the functions $Max[A\{\}]$ and $Min[A\{\}]$ return the maximum and minimum values of the set $A\{\}$, respectively.

EXPERIMENTAL ANALYSIS
Color space detect results display

This paper consider the full use of color space information, and consider several common color spaces, including RGB space, HSV space, and YCbCr space. In this paper, the BAG maps of the images are extracted using the color channels of the three color spaces, and the offset results are detected. The experimental results are shown in Fig. 4
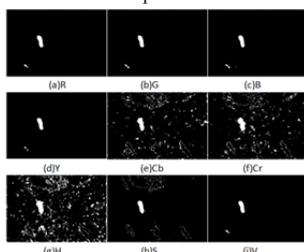

Figure 4: BAG offset calculation for different color channels.

The first row in Figure 4 shows the BAG offset for each channel in the RGB space, the second row shows the BAG offset for each component of the YCbCr space, and the third row shows the offset for the HSV spatial component BAG. The black portion of the figure indicates where the image BAG has not shifted, and the white portion indicates that the BAG has shifted. This paper is using the example of the tampering diagram in Figure 1. It can be seen from the image that the color channel of the RGB space can detect the offset of the GAB almost, and the Y channel in the YCbCr space has a better effect, while the other channels have more false detection points. The HSV space V channel works best. In this paper, the BAG offset feature of the color channel with good effect is selected and sent to k-means for clustering, namely R channel, Y channel and V channel.

the guess of Deformation direction

This section of the paper will present a conjecture on detecting the direction of local distortion.
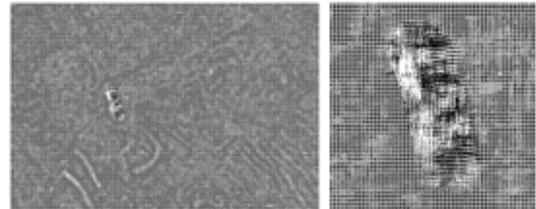
(a)BAG diagram of the tempered image (b)Tampering magnified image
Figure 5: Research on BAG change in image tampering

Figure 5 shows a BAG diagram of the tamper image and a picture that magnifies the BAG at the deformation. It can be seen from the image 5 that the falsified BAG map is not complete, and it has a directional tendency, which is about the same as the pixel moving direction. In the future, the direction of local distortion of the image can be judged by studying the characteristics of the tampering position GAB movement.

ANALYSIS OF DETECTIONS

The images in this paper are all selected in the image library. The image is first compressed, and then the image is warped locally using tForward Warp Tool in the Liquefy Tool on the compressed image. Then use our method to detect the image, the experimental results are shown below.
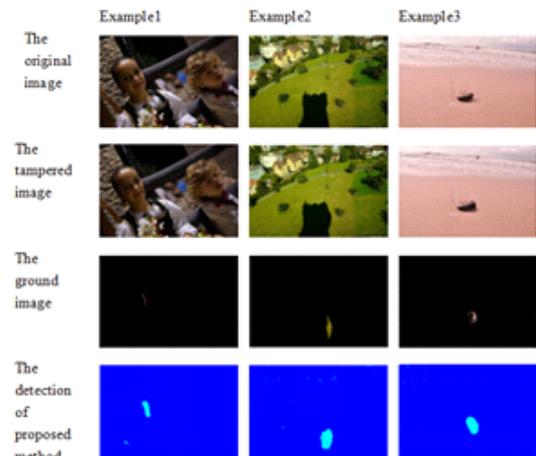

Figure 6: the result of the proposed method.

The figure shows three examples in our experiment. The first line shows the original image, the second line shows the tempered image, the third line shows the ground image, and the last line shows the detection of our method. Experiments show that our method can better detect the location of local distortion of the image.

CONCLUSION

BAG-based color images can be used to detect local distortion problems in compressed images. This method is able to detect local distortion of the image. In addition, since the image pixels are moved by using the push tool on the image, this movement can be observed in BAG grid, and the subsequent work can study the direction of local deformation of the image for this feature.

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