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Enhancement of Blur Detection for Digital Images using Circular Averaging Filter

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Abstract: Digital photos are massively produced while digital cameras are becoming popular; however, not every photo has good quality. Blur is one of the conventional image quality degradation which is caused by various factors like limited contrast; inappropriate exposure time and improper device handling. Blurry images make up a significant percentage of anyone's picture collections. So, an efficient tool is requiring for detecting blurry images and labeling or separating them for automatic deletion in order to preserve storage capacity. There are various methods to detect the blur from the blurry images some of which requires transforms like DCT or Wavelet and some don't require transform. A new technique is presented which automatically detect blurry images and separate them for later processing. The method will find out key points for both original and filtered image by using SIFT algorithm. After that calculate variance value for both the key points. Draw and analyse the plotted graph to determine whether the image is blurry or not. According to the type of image whether it is sharp or blur it is save in respective folder for later processing and also calculate time needed for processing.

Keywords: Blur, DCT, DWT, Harr-wavelet, SIFT.

I. Introduction

Due to advancement in digital technology high-quality digital cameras gain increasing attention. Users can take hundreds of pictures a day. However, it is not easy for them to look through all these pictures to decide which of them can be deleted , if the storage is full or which of them should be taken for an enhancement process. So some techniques are requiring for image quality estimation for telling the blurry images from the sharp ones. Imperfect focusing and/or motion are the main source of blurriness in digital photographs. The common objective of this proposed method is same as the previous methods to preserve storage capacity and more clear image will give the more information of the image than the blurred image .Other than this , with this we are trying to find better accuracy and reducing time required for processing than the other methods. The main objective is to automatically detect blurry images for automatic labelling and potential removal. The targeted application is low-cost digital cameras for conventional users. The presented approach is generic in the sense that it does not make assumptions on the cause of blurriness. The aim of blur analysis usually is to identify the image and blur model parameters of a degraded image in order to restore it. Accurate parameter estimation is therefore needed since the degradation process has to be somehow "reversed" based on the accurate estimation.

There are already some existing methods for blur detection or image quality estimation for digital images. However, most of them are time-consuming, computation intensive, need different kinds of transformations (e.g. DCT or DWT) or the detection ratio is not very high .Also there is one new research algorithm for automatic real time detection of blurry images. The algorithm is based on computing variance values of the local key points that are extracted from the given image through implementing Scale Invariant Feature Transform (SIFT) algorithm in a scale space. No transforms (DCT or DWT) are required to be applied to the images, and no edge locations need to be identified.

In this paper, one new technique is proposed which process the image already present in memory or real time image captured by camera, no extra pre image is require to give as an input. The algorithm will process the same image to find out whether that image is blur or sharp. As per the output image is same in respective folder as well as calculate time needed for processing the same image. This paper is organized into following sections. Section II describes an overview of related work. Implementation details for blur detection method are mentioned in section III. Experimented results are shown in section IV. Finally, the conclusions are in section V.

II. Related work

Tong et al[5] propose to employ coefficients of the image transformed by Haar wavelet with the decomposition level. It can not only judge whether or not a given image is blurred, which is based on edge type analysis, but also determine to what extent the given image is blurred, which is based on edge sharpness analysis. The scheme takes advantage of the ability of Harr wavelet transform in both discriminating different types of edges and recovering sharpness from the blurred version. It is effective for both Out-of-focus blur and Linear-motion blur. its effectiveness will not be affected by the uniform background in images.

Marichal x., ma w.y., zhang h.j[6] has developed a technique which uses a new solution to aim at exploiting the available DCT information in MPEG or JPEG compressed video or images while involving a minimal computational load , the technique is based on histograms of non-zero DCT occurrences, computed directly from MPEG or JPEG compressed images. For MPEG compressed video, the scheme is suitable for all types of pictures: I-frames, P-frames or B-frames.The objective of blur detection in this application is to provide a percentage indicating the global image quality in terms of blur: 0% would mean that the frame is totally blurred while 100% would mean that no blur at all is present in that particular frame. This blur indicator characterizes the global image blur caused by camera motion or out of focus. Since we focus analyzing MPEG compressed video data, it is desirable that the blur indicator can be directly derived from the DCT layer of an MPEG video bit stream.

Batten c.f., holburn d.m., breton b.c., caldwell n.h.m [7]developed a simple method for blur detection without using transform.As a pre-processing, only converting the input images from RGB colors to grey-level luminance values is needed for the tool described below. The algorithm calculates the ratio of sample variance values between the pre-image and finally stored image. When the button is half-pressed, the digital camera records this auto-focused image in the internal memory. This image is termed as 'pre-image' .The pre-image is used to compare with the actual taken image that is saved in external memory after pressing the shutter button.

E. Tsomko H.J. Kim E. Izquierdo[8] developed a technique based on Linear Guassian method for detection of blurry digital images.In order to estimate images, first step is to apply SIFT algorithm, that is, detecting local key points of the images objects. Then, generate additional images from the given one through the linear diffusion process. And finally, analyze the variance values calculated for the local key points of the original and its filtered images generated in the scale space. Since variance is a statistical measure of data dispersion, key points are selected randomly so that every significant area of the image is estimated. The behavior of curve evolution of these variance values in the blur graph is similar to one of the differences between subsequent low-pass-filtered images.Therefore in order to evaluate the curve we estimate the speed of image degradation through calculating the differences between consecutive variance values and weighting them by the maximum value of it. The behavior of curve and weighted sum together will helps to determine whether image is blur or sharp.

Boult and Chiang propose local blur estimation metrics, where they find edges' localisations using cubic polynomials first, and then they model blurred edges with two components: a step edge and a blur kernel. The blurred edges can be obtained by applying the blur kernel to the step edge[9].

Another measure proposed by Shaked and Tastl is based on localised frequency analysis where the edges are used as an indicator of a common scene in a given image[10]. The algorithm is based on unsharp masking, which modifies the high-frequency band in a predictable way while keeping the low-frequency band relatively constant.

The maximum of the difference ratio between an original image and its two re-blurred versions has been proposed by Hu and Haan[11] to identify the edges and estimate the blur radius in the original image. Their method has been shown to have robust estimation, especially for the interference from neighboring edges. However, the authors also mention that their blur estimation does not require any edge detection pre-processing since the identification of the local maximum of difference ratio can not only estimate the blur radius but also locate the edge position[8].

III. Research Method

The proposed technique's working can be divided in to 3 phases. To understand each and every step we take one sample image and show the processing.

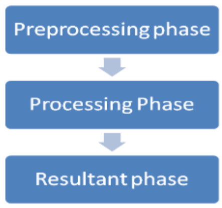

Fig 1 Phases of proposed system

1. Preprocessing phase

In this phase, if the image to be processed is colored, convert that image to Gray scale for fast processing.

Fig 2a.sample image

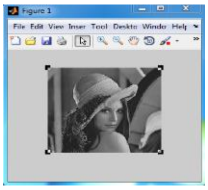

Fig.2b.Gray conversion of sample image

2. Processing phase

In order to estimate images, first we apply SIFT algorithm, that is, detecting local key points of the images objects. Then, generate additional images from the given one through the linear diffusion process. And finally, analyse the variance values calculated for the local key points of the original and its filtered images generated in the scale space. The algorithm for research method is described as follows:

1 Select image
2 Convert image into gray scale and display it
3 apply SIFT to obtain key points of the image;
4 randomly select a 300 number of key points from the given image and fixed their location;
5 apply scale-space low-pass averaging filtering with Gaussian noise to the original image;
6 take the key points in the filtered images from the same locations fixed previously in the original image;
7 calculate variances for the taken key points in the original and filtered images and build the plot of it;
8 Calculate Weighting Factor w.
9 Analyze the curvature given in the plot and w to determine whether the selected image is blur or sharp.
10 If weights < 3
11 Yes image is sharp save in sharp folder then goto step 13
12 No image is blur save image in blur folder goto step 13
13 Display the result
14 Calculate the time needed for calculation and display it.

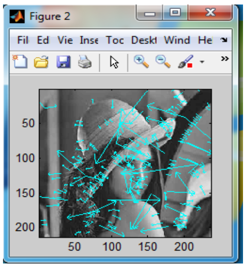

Fig. 2c.Key point using SIFT algorithm

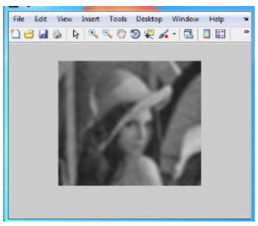

Fig 2d.Blur version of sample image

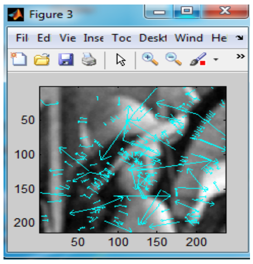

Fig. 2e.Keypoints for blur image using SIFT

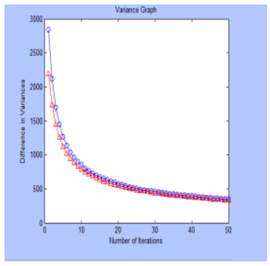

Fig.2f Variance Graph

3. Resultant phase

In this phase , depending on the number of key points obtained and variance value ,we can determine whether image is blurry or not . The graph structure also helps to determine whether image is blur or sharp.

The flow diagram of proposed system is given below

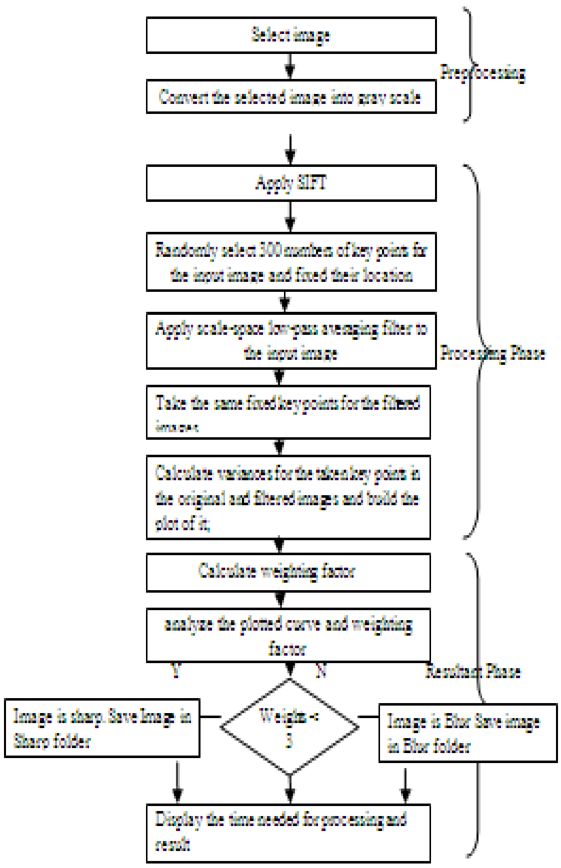

Fig.3 Flowchart for proposed method

The SIFT operator provides the number of key points found in the image and their position information. The number of key points varies from several hundreds to even hundreds of thousands per one image depending on the quality and structure of the image. To speed up the process and to minimize the time for calculation algorith select m=300 number of key points by using random function and fixed their locations.

After defining the values for key points in each scale space low pass filter image, algorithm calculate variance values for each image.

Later some key points are randomly selected for further estimation process, and their locations are fixed ,so that in a scale-space linear diffusion process no need of applying SIFT operator to the images at each iteration but simply use the locations of the chosen key points obtained from the original image.

Once key points are defined in each scale space low-pass filtered image, variance values for each subsequent image is calculated

Since variance is a statistical measure of data dispersion, key points are randomly choosen to be sure that every significant area of the image is estimated.

The behavior of curve evolution of these variance values in the blur graph is similar to one of the differences between subsequent low-pass-filtered images.

Therefore in order to evaluate the curve algorithm estimate the speed of image degradation through calculating the differences between consecutive variance values and weighting them by the maximum value of it as follows

$$S^2p = 1/p\text{-}1 \sum_{K=1}^{p} [\,V(k)-v]^2$$

$$W = \sum_{i=1}^{n-1} \frac{|(var(i)-var(i+1)|}{max\,|(var(i)-var(i+1)|)} \qquad i \in [1, n-1]$$

var= variance, w=weighted sum and n=number of iterations in scale space.

The graph is plot by using var and n values. The behavior of curve and weighted sum together will helps to determine whether image is blur or sharp.

According to the experiments carried out with the different kinds of images, we found that if the weighted sum is more than 2, then the image is blurry; else if the number of detected key points is less than 3000, then we can conclude that the given image is highly likely to be blurry. Otherwise, the image is not blurry.

IV. Result

To test the system we take 100 different images like people, flowers, land, nature etc captured by different digital cameras with different resolution and size. These images are given as a input to the system. After processing the image the system gives a result whether the image is blur or sharp and time needed for peocessing. Results of some images are given below.

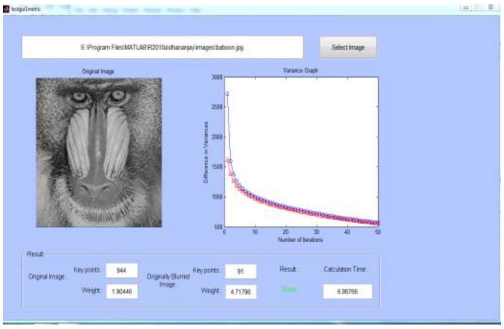

Fig.4 Result of sample image 1

As shown in above figure system detects 944 key points with 1.90 weights for original image. After applying
Filtering system detect 91 key points with 4.71 weights.As image is sharp it will take more processing i.e 6.86 seconds for calculation and gives result as Sharp.

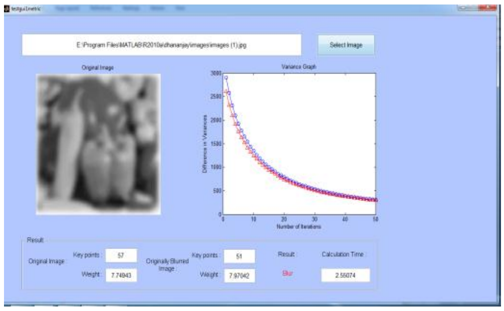

Fig.5 Result of sample image 2

As shown in above figure system detects 57 key points with 7.75 weights for original image. After applying filtering system detect 51 key points with 7.97 weights. As image is originally blurred it will take less time i.e 2.55 seconds for calculation and gives result as Blur Image.

V. Conclusion

In this paper, the main target of the research method is to detect blurry images and delete or separate them from digital camera storage, so that it will allow saving external memory and deleting unnecessary low-quality images. The method is reliable in terms of high accuracy, low computation cost and easy to implement. In order to reduce computational cost, only certain amount of local key points is used in the algorithm for image quality estimation, which allows using it for real-time applications. The only drawback of the method is that SIFT operator finds all the key points that is sometimes time consuming if the image is sharp.

The same method can also extending our experiments for more detailed image evaluation, for example, to decide whether the image is partially blurry and how much of the image area is blurred. The method is applicable for real digital cameras. No additional ‘pre-images’ are required. Only taken pictures should be processed in the camera.

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