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Blur Detection Using Hybrid Classifier

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Abstract— Popular entertainment and communication services of internet or mobile applications is multimedia content such as image, audio and video that may suffer from low quality problem. Blur is the one of the factors that degrades the quality of image or frames in video. Enhancement or restoration of blurred image requires detection of blurred region or kernel. Therefore, blur detection is the initial and main step of blur phenomena followed by blur classification and restoration process. In this paper, we presented overview on a few defocus and motion blur detection methods with their applications. Some of this methods based on features of blurred kernel while others not. These methods can be either direct or indirect. Direct methods only identify the blurred region and segment it from un-blurred one. While indirect methods first detect and then restore the blurred region. We discussed both type of blur detection methods.

Keywords— Blur detection, Feature vector, Image enhancement, restoration and segmentation.

I. INTRODUCTION

Blur detection, one of the popular research areas in computer vision system is showing an increasing research trend. It is expected that computer vision technology will be the future of the manufacturing line, replacing most of the human operator works and cut operational cost in long term basis [1]. However, it is worth noting that up to this day, human work still has an upper hand on most of the industries over computer vision work [2]. Blur detection method can be applied as initial stage for de-blurring when the machine vision of manufacturing line is out of focus or due to rapid movement of the inspected product. There are applications for blur detection method for crime solving purposes, as part of the image enhancement for video surveillance system for a clearer picture of the criminal. In daily life routine, blur detection application can be used to de-blur precious image which is blurred. The blurring of image may due to many causes; the two commonly studied classification of the blur type is near-isotropic blur, which includes out of focus blur, and directional motion blur.

Fig 1 Block diagram to relate blur detection, blur classification, and image restoration.

As study of the characterization and detection for blur region are needed in order to understand image information and evaluating image quality [3], developing of the blur detection algorithms for automatic detection and classification has become very functional in terms of computation and cost. Blurry regions in image are more invariant to low pass filter process. The idea of their works has been widely accepted by researchers and it becomes an interesting research feature to classify blurry and non-blurry region.

(a)

(b)

Fig 2 Two image examples with (a) motion blurred regions and (b) out-of-focus blurred regions.

The restriction of blur detection method has attracted many researchers to extend the edge of limitation. Many researchers have proposed extension, composite or improved algorithms which contributed to the development of the blur detection method. Thousands of reliable literatures based on blur detection method can be found online these days. Although we belief that there are much more research papers available but not online, the online literature alone is sufficient to give an overview of the research trend. Based on analysis on the past researches on the blur detection methods, blur detection can be classified in to seven categories. They are:

A. Edge Sharpness Analysis Blur Detection in Digital Image

- Common edge sharpness analysis methods use the contrast edge of object in the image for blur analysis.
- Using the Harr wavelet transform, to detect blur and extend of blurring [7].
- Using perceptual-based no-reference objective image sharpness/blurriness metric by integrating the concept of just noticeable blur into a probability summation model [8].
- Using standard deviation of the edge gradient magnitude profile and the value of the edge gradient magnitude with weighted average [9].

B. Depth of Field (D.o.F.) Blur Detection in Digital Image

- Focusing on object detection in Object of Interest (OOI) technique in image by photographer.
- Works on low Depth of Field.

C. Blind De-Convolution Blur Detection in Digital Image

- Blind de-convolution works more efficient with correctly estimated blurring Point spread Function (PSF).
- Blind de-convolution can be non-iterative or iterative process.

D. Bayes Discriminant Function Blur Detection in Digital Image

- Based on statistical analysis of the image gradient of both sharp and blur regions.

E. Non-Reference Block Blur Detection in Digital Image

- No reference to the original image signal information.
- Most convenient and robust compared with reduce-reference and full-reference methods.

F. Directional Frequency Energy Blur Detection in Digital Image

- Direction estimation of the blur region is performed.
- Blur detection without PSF.

G. Wavelet-Based Histogram Blur Detection in Digital Image

- Discrimination of the gradient distributions between blurred and non-blurred image regions.

- Probability map can be constructed with wavelet gradient histograms

Each of the blur detection method has its own advantages and disadvantages. Therefore, each of the application has their research value based on the type of application and signal input of data.

II. LITERATURE REVIEW

Blur detection methods are of two types: direct and indirect. Direct methods only identify the blurred region and segment it from un-blurred one. While indirect methods first detect and then restore the blurred region. We discussed both type of blur detection methods.

Both video based and single image based blur detection methods are also surveyed in this paper. We first review video based methods but our focus is on image based methods. For blur detection and estimation, previous approaches aim at measuring blur extent of edges and are based on the analysis of edge sharpness.

R. Fergus [10] proposed Blind image deconvolution aims to estimate the blur filter and latent unblurred images. It is a severely ill posed problem. Although recently many methods have been proposed in image deblurring, most of them only tackle spatially-invariant blur, i.e., all pixels in the input image are blurred by the same PSF.

Zhang and Bergholm [11] defined Gaussian Difference Signature, which functions similarly to the first-order derivative of Gaussian, in order to measure the diffuseness caused by out-of-focus objects. Note that all these methods assume that the Point Spread Function (PSF) is modelled by a Gaussian blur filter. They cannot be applied to detecting ubiquitous non-Gaussian blur.

L. Bar [12] were proposed to tackle the partial blur problem with the help of user interaction or blur kernel assumption. For all these methods, if the PSF can be correctly reconstructed, the type of blur is also known using the structure of PSF. However, in practice, blind deconvolution usually performs unsatisfactorily even by making restrictive assumptions on image and kernel structures. It does not handle well our partially blurred images. Besides, a visually plausible deconvolution result does not imply that the PSF is correctly estimated. These factors make blind deconvolution not a good choice for general blur detection in terms of efficiency and accuracy, especially for handling images in a large database. Another type of blur analysis is Low Depth of Field (DoF) image auto-segmentation. Low DoF is a photography technique which abstracts the photographer's intention by giving a clear focus only on an Object of Interest (OOI).

C. Kim [13] proposed methods for automatic OOI extraction are not suitable for our blur detection because they only work on low DoF input images containing out-of-focus background. Low DoF images are detected by calculating a low DoF indicator, defined by the ratio of wavelet coefficients in high-frequency of the central regions of the whole image. This method simply assumes that low DoF images contain focused object near the centre and surrounding pixels are out of focus. This method also does not suit our general-purpose blur detection.

Razligh and Kehtarnavaz [14] proposed an image de-blurring method for the use in cell phone. This de-blurring method takes considerations on the brightness and the contrast of the blurred input images and also corrects low exposure images.

Algorithm proposed by Levin in 2006 [15], on the other hand, uses a method based on inferred blur kernel. This kernel is used to build an energy function to divide the image into two distinctive layers; which are the blur layer, and the non-blur layer.

Elder and Zucker [16], only the blur extent is being measured; without designing a method that distinctly labels the image's region into blurry or non-blurry areas.

IV. CONCLUSIONS

Blur detection is a challenging and interesting problem as it attempts at solving grand challenges of image restoration, segmentation, and enhancement; and object recognition. In this paper, we attempt to provide a comprehensive survey of research on blur detection. From the review, we perceive that most of methods deal with specific blur type and cannot work correctly on images with complex features. There is also a lack of equality in how methods are used and for what purpose. It is impulsive to explicitly declare which method is best. Therefore, there is a need to develop and share already available datasets to report results about which methods are competitive in which domains and significant development of already available methods need to be made in this field to produce truly effective blur detection methods.

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