Poster: Just-Microsecond Deblurring System on the Mobile Phone

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Abstract

Digital pictures captured by mobile device for information sharing play an important role in this rapidly growing social network. Posting of image ads, events and other announcements are also important. However, photos are subject to blurring caused by motion or virtual focus. The current solution, only in the computer desktop with complex system to deal with these fuzzy photos. With the development of camera-embedded mobile devices, timely release of clear pictures has been used in various fields. In this paper, we present Just - a forthright system for improving the quality of picture on the mobile device. The tags are automatically classified for the digital pictures according to the degree of blurring and deblurring the original images based on Wiener filter. Initial deployment and experimentation prove the effectiveness of Just.

1 Introduction

With the rapid development of social networking, social software gets very popular in the global users. Timely sharing of fresh things sounding is one of the major social software role. What users are looking for is the ability to take clear photos anywhere and anytime. However, in the real world, the user may be sitting in the car or walking. Wrist vibration results in low quality photos, which called motion blur or virtual focus blur[1]. Therefore, we designed a system that can perform deblurring processing for blurred pictures directly on a mobile device.

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The existing mainstream algorithm of image restoration is linear algebra reconstruction algorithm[4] in the literature proposed. However, the above algorithm is directly transplanted to mobile devices, there are two problems: (1) The above methods assume that the point spread function(PSF) is known, but it's difficult to obtain in practical world. (2) They involve a large amount of calculation. Its not realistic on resource-constrained mobile devices. Therefore, there are two challenges of our work:

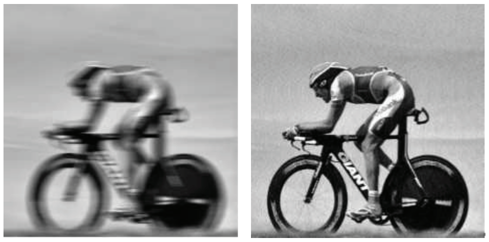
(1) Design a general deblurring system that can estimate the PSF in advance, and deblurring photos directly according to the blur levels.

(2) The improved Wiener filter does not require a large number of iterative computation. It can greatly reduces the computational complexity.

In this paper, we proposed Wiener filter, which is an optimal estimate based on the minimum mean square error criterion[2]. Wiener filter is suitable for a wide range of applications but needs to know the PSF in advance. It's difficult, so we proposed Just - a forthright system for improving the quality of picture on the mobile device. Just will constitute Blind recovery[3] and Wiener filter, estimate PSF according to the degradation of the image, and divided into three levels according to degree of blur, then perform deblurring processing, which is very important to take pictures and timely sharing of clear pictures with friends for mobile devices. Wiener filter has a good performance on blurred gray image. As shown in fig.1. In this paper, we have two contributions:

(1) Color image deblurring processing. With the demand for high-quality color images, our work not only can deal with gray scale images, but also can handle color images.

(2) Performance on a mobile device. Let Wiener filter out of the plight of the computer, it will be transplanted to mobile devices.



(a) (b)

Figure 1. (a)fuzzy image of movement. (b)After processing use Wiener filtering.

2 DESIGN OF WIENER FILTER

The framework of data processing of Wiener filter shown as fig.2. This linear filtering problem can be considered as an estimation problem. Response is h(n), when the input is a random signal x(n), and we have:

$$x(n) = s(n) + v(n) \tag{1}$$

Where x(n) represent signal, v(n) express the noise, the output y(n) as:

$$y(n) = x(n) * h(n) = \sum mh(m)x(n-m) \tag{2}$$

We hope to get the y(n) after x(n) was dealed by the linear system h(n), as close to s(n), so called y(n) for the estimates of s(n), represented with s(n), that is:

$$y(n) = s'(n) \tag{3}$$

If we are using s(n) and s'(n) to represent the true value of the signal and the estimated value, e(n) indicates that the error between them, we have:

$$e(n) = s(n) - s'(n) \tag{4}$$

Obviously e(n) may be a random variable. Therefore, the mean square error is minimum:

$$\xi n = Ee2(n) = min \tag{5}$$

In order to shown minimum mean square error criterion in equation(5) to determine the impact of the Wiener filter response h(n), n of the derivative of h(j) is equal to zero, then:

$$Rxs(m) = Xih(i)Rxx(m-i), \forall m \tag{6}$$

In the equation(6), Rxs(m) is correlation function of s(n) and x(n), Rxx(m) is the autocorrelation function x(n), is defined as: Rxs = E [x(n)s(n + m)] and Rxs = E [x(n)x(n + m)]. Equation(6) is called the Wiener-Hof equation. If Rxs(m) and Rxx(m) are known, then the impulse response of Wiener filter can be obtained by solving this equation.

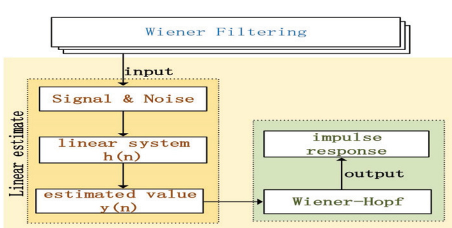
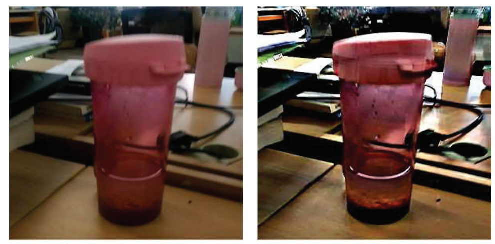


Figure 2. Framework of data processing.

3 PERFORMANCE EVEALUATION

We choose a glass as the target object, in the process of user walks to the target and shoots a photo. The fuzzy picture shown as fig.3(a), after dealing with our method is shown as fig.3(b). We learn that the effect of our method processing fuzzy images from the vision is well through the result. Then according to the color histogram comparison as fig.4. After processing for fuzzy image, pixels occupy all possible gray levels and are evenly distributed, so images have high contrast and variable gray tones, it's more clear. We have a conclusion that Just has the lowest number of pixel point. It's to say that the performance of our method is better.



(a) (b)

Figure 3. (a)Taking fuzzy image when user is standing. (b)After processing use Wiener filtering.

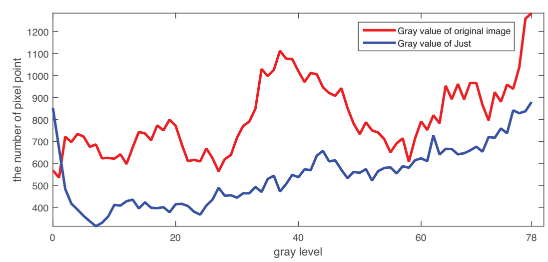


Figure 4. Histogram comparison.The blue is relatively evenly distributed over all gray levels. Indicating that picture is more clear.

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