

# Research on the Processing of Blurred Image Evidence in Criminal Technology

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**Abstract:** The application of digital image techniques in forensic image technology breaks through the traditional concept of “image” and expands the research field of forensic imaging science. Through the techniques of photography, video recording and digital image processing, the information of forensic images can be recorded, fixed, tested, analyzed and identified, which increases the proportion of forensic image technology in criminal science and technology. Through the blurred image processing technology, we can get required information from the processed image, which is bound to provide clues for the detection of cases, and may also provide evidence for the identification of crimes on court.

## 1. Introduction

In the process of image acquisition, transmission and preservation, there are various factors that can decline the image quality, such as the interference of bad weather (fog, rain, wind and so on), uneven illumination, the atmospheric turbulence effect, diffraction of the optical system in the camera, and the aberration of the optical system itself. They can cause the loss or annihilation of image information and affect the visual effect. These images are often referred to as blurred images. They come from photos taken by digital cameras and monitoring videos recorded by the video monitoring system, as well as the follow-up photos posted to the Internet through microblogging. Nowadays, the coverage rate of monitoring systems is increasing day by day. The main function of the existing monitoring system is to analyze the macro scene. Due to various reasons, the resolution and quality of these photos and video images can not fully meet the needs of micro information acquisition; many images are seriously lack of clarity.

## 2. Types of Blurred Images

In view of different forming reasons, blurred images can be divided into different types.

### 2.1 Abnormal Exposure Blurred Images

Abnormal exposure includes underexposure and overexposure. Underexposure means, in the process of image recording, due to the inaccurate estimation of the brightness of the object, the brightness of light on the photosensitive material is insufficient. Examples include, too small apertures, too fast shutter speed, and photos taken at night.[1] The overall image is obviously dark; the contrast of details is low. The image does not have rich information level.

When a photo is taken with a too large aperture or too long exposure time, or under strong light irradiation, the film or photosensitive device will receive too much light, resulting in the excessive exposure of the image. Overexposure will cause the loss of image details, the overflow of the highlight part, and the loss of other color information of the image. The whole image is obviously bright and white; the high light part annihilates details, which is difficult to repair in post production. The accuracy of image exposure can be measured by the histogram.

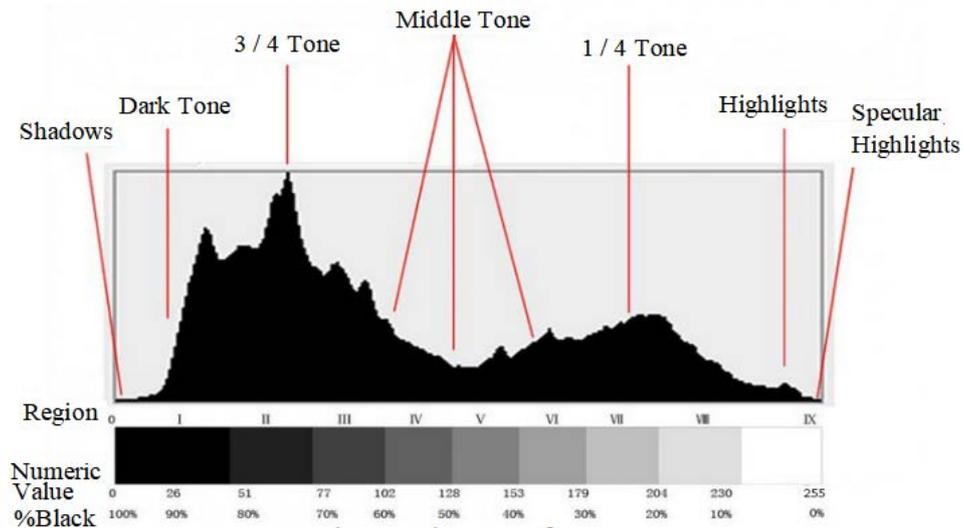


Fig.1 Histogram of Exposure

If the histogram is only on the right side, the whole image is dark and may be under exposed; otherwise, the whole image is bright and may be overexposed.

In the histogram, inaccurate exposure is reflected through less peak values; the horizontal axis almost runs through both sides of the histogram. In images, the contrast between light and dark is not obvious or too obvious, which causes the obliterated or blurred information contained in the image.

## 2.2 Noise Interference Images

In digital images, the noise mainly comes from the process of image acquisition or transmission. In the process of image acquisition by imaging sensor, environmental conditions and sensor components can cause noise. For example, when the CCD camera obtains image, the illumination level and the sensor temperature are main factors affecting the noise in the resulting image. In the process of image transmission, due to the interference in the transmission channel, the image clarity is reduced. For example, the image transmitted by the radio network may produce noise due to illumination or other atmospheric factors.

## 2.3 Scene Interference Blurred Images

In bad weather, scene images obtained by the image recording equipment have poor contrast and colors, which seriously affects the analysis and understanding of the image. In reality, foggy days have the most interference, since effect of particles in the atmosphere changes the surface light of objects visually. Particles and light interact in two ways: scattering and absorption. Scattering means, particles radiate received energy in different directions; absorption means particles convert radiation energy into other forms of energy. These effects of particles in the atmosphere lead to the change of light, resulting in the decrease of the brightness and contrast of the acquired image; the multi-directional scattering can cause the decrease of image resolution. In the case of rain and fog, the concentration of vapor and aerosol particles increases greatly. The multi-directional scattering of large particles is the main reason for the decrease of image contrast and resolution.[2]

## 2.4 Motion Blurred Images

Motion blur is caused by the relative motion between the recording device and the object, which results in linear blur in the resulting image. It is represented by the displacement of pixels in the digital image. The image degradation caused by motion is very common. In real life, the setting of various parameters of the monitoring system is fixed; motion blur is inevitable when installing on unstable equipment or recording moving objects. It brings difficulties to the later analysis.

## 2.5 Defocus Blurred Images

Defocus blur is a common image blur phenomenon. In actual images of the monitoring video, the

focus may change with the camera's shooting orientation or the movement of the monitored object, resulting in the phenomenon of out of focus. At that time, the problem can only be solved by focusing again. The all-in-one machine uses automatic focusing lens; if the production is not good enough, the automatic focus may deviate and cause the phenomenon of out of focus. In criminal digital photography, defocusing is also easy to appear when using too large apertures or too slow shutter speed.

## 2.6 Low Pixel Images

The total pixel value of an image is an important indicator to measure information contained in an image. For example, in the monitoring video, if the object is far away from the recording equipment, the actual pixel of the object is often too small to be directly identified by naked eyes. It requires the super-resolution reconstruction to enlarge the image and improve its clarity.

With the rapid development of digital information technology and computer image processing technology, a large number of images appear in every corner of the society; they become an indispensable part of people's lives. For example, the real-time video monitoring system has been widely used in production, transportation, social security and other aspects. However, due to external factors and the technical conditions of the monitoring system itself, video images may not achieve the desired effect. Under the influence of these conditions, images will be degraded and blurred, which will lead to difficulties in identification, forensics, analysis and other operations. Therefore, the research and application of blurred image processing are of great significance in today's "video technology" as one of the four pillars of criminal investigation technology (criminal technology, technical investigation, network investigation, videos).

## 3. Overview of the Digital Image Processing Technology

Blurred image processing is a part of digital image processing, which aims at improving the image quality, and display and restore effective information in the blurred image.

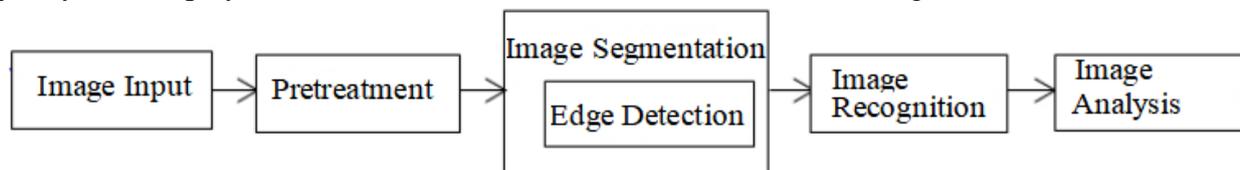


Fig.2 Flow Chart of Image Processing

With the development of digital technology, most information in reality can be expressed in the digital form. The digital image is a way to store and transmit images in the digital form. In image processing, the digital image can be defined as a two-dimensional function  $f(x, y)$ . In the function,  $x$  and  $y$  are spatial (plane) coordinates; the amplitude of  $f$  at the coordinate point  $(x, y)$  is called as the brightness or gray level of the image at that point.[3] Converting an image into digital form actually means to digitize the coordinates and amplitude. The digital image is essentially a group of ordered discrete numbers. The computer can copy and transmit the information many times without distortion.

Image processing technology in a broad sense refers to all kinds of image processing technology. At present, people are studying the digital image processing technology, that is, the computer image processing technology. Digital image processing technology means, people use the computer to operate or process image information. It appeared in the 1950s. The processing of digital images can be traced back to early 1960s. In 1964, the U.S. jet propulsion laboratory used computers to process images of the moon sent back by spaceships and achieved obvious results. Thus, the new science subject of digital image processing was born.

Generally, image processing means to improve the visual requirements of the image by improving its quality. From the perspective of information processing, the input is the low-quality image, and the output is the improved image. It includes a series of operations carried out by computers and other

electronic equipment. Commonly used digital image processing methods include image enhancement, image restoration, image super-resolution restoration, and so on. The function of the software system used in this paper mainly includes three kinds of image processing technologies: the image enhancement technology, the image restoration technology and the image super-resolution technology.

### **3.1 Image Enhancement Technology**

When acquiring the source image, due to noises, scene interference, incorrect exposure and other conditions, the image quality may be degraded and blurred, and the image information can not be observed. Therefore, the image quality should be improved before analyzing relevant information. Image enhancement does not relate to the reason of image quality degradation; it selectively highlights important details and weakens unnecessary features. The purpose of image enhancement is to improve the visual effect of the image, so as to improve the clarity of the image and the adaptability of the process, and make it convenient for people and computers to analyze and understand.

The image enhancement includes following processing links: improving contrasts, edge enhancement, increasing brightness, improving color effects, improving fine levels, and so on.

The main purpose of image enhancement is to improve the subjective effect of image viewing, improve the clarity of the image itself, and make the image be conducive to computer processing. For example, the sharpening processing can highlight the edge contour of the image; the protruding edge line can be traced by computer programming, which is convenient for the extraction and analysis of various details.

### **3.2 Blur Image Restoration Technology**

In the process of image formation, transmission and recording, due to the influence of many factors, the image quality may be reduced. Typical performances include image blur and distortion. The reduction of image quality is called as “degradation” in image restoration. The same as image enhancement, image restoration also needs to improve the image quality, but the difference is that, image enhancement is carried out based on the subjective needs of human beings. It does not need to consider the causes of image degradation or establish the restoration model. However, image restoration should consider the reasons of image degradation and establish corresponding mathematical models according to the information of the degraded image. In order to restore the original image, the degraded image is reconstructed or restored along the inverse process of image reduction.

There are many reasons of image degradation, such as the aberration of the optical system itself, the diffraction of the imaging system, relative motion between the camera and the object, scattering of the light source or ray, and so on. Image blur is a typical phenomenon of image degradation caused by these reasons. Deblurring is a basic problem of image restoration. Image restoration is considered as an estimation process; it means to estimate the ideal image field according to the observed or measured image fields. In order to find out the mathematical model of image degradation, the mathematical process of object imaging should be found out first. Therefore, the imaging system is usually regarded as a linear system to describe the process and properties of the imaging system.

There are many factors causing the image degradation and blur; therefore, the methods and techniques of image restoration are also different. According to different reasons, the image blur can be divided into digital blur and physical blur. The digital blur means, in the process of transforming optical images into digital images, continuous values become discrete values, resulting in the reduction of image resolution. The brightness difference of the real optical image is more than 100 million to 1, which is also the ratio of continuous color changes; the brightness difference of the digitized image is 255 to 1. Therefore, the image will lose some clarity after conversion. For the video recording equipment, no matter how high the resolution is, it can only sample fixed grid pixels, rather than represent all colors of the object. On the other hand, the image can be blurred in the process of encoding, decoding and transmission. When the fixed grid pixels of the image are too dense and the pixels are small enough, the hue will become continuous in human eyes. It is the principle that human

eyes can clearly observe the image. The physical blur images are caused by physical factors, such as the defocus blur, the motion blur, the low resolution blur and so on.

In practice, the motion blur and the defocus blur are commonly seen. In general, due to the short exposure time, the relative motion between the recording equipment and the scene forms the motion blur, and the degree of blur is equal in the same image. The defocusing blur means the object can not be clearly imaged on the focal plane due to the lack of focus. In addition, the aberration of the optical system, atmospheric turbulence and random noises of the environment can also lead to the image blur.

#### **4. Summary**

The research and application of blurred image processing in “video technology” is of great significance to the detection of cases. The processing of blurred images is a big problem in criminal image processing, but these blurred images often contain important information. If we can get required information from images after processing, it is bound to provide clues for the detection of cases. Therefore, the study has high research values.

#### **Acknowledgement**

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