C12 Image Correction and Enhancement With the Apparatus for Actual Measurement of Image Degradation Properties in Security Cameras

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After attending this presentation, attendees will better understand the method to measure actual image degradation properties in security cameras as well as better enhanced and/or corrected images that can be obtained using the measured properties.

This presentation will impact the forensic science community by providing information about methods and an apparatus for measuring degradation properties in security cameras. The experimental results showed better images by using the measured actual properties in comparison with modeling methods. This information will be useful for forensic image analysts.

Videos or images that are recorded by security cameras can be objective evidence leading to criminal investigations; however, in some cases, the recorded images cannot be effectively utilized due to insufficient image quality. Thus, image processing, such as image enhancement or image correction, is expected under the circumstances. In the image processing procedure, some types of functions or parameters describing image degradation characteristics in cameras are required; for example, Point Spread Function (PFS) is used for image deblurring.[1] The Gaussian function is commonly used as an approximate model for PSF; however, the optimal deblurred image cannot be obtained with the Gaussian PSF because there is a difference between the actual PSF of a camera lens and the Gaussian function. Therefore, another approach for image enhancement/correction method is proposed in this presentation, which uses actual measured image degradation properties in security cameras.

An apparatus to measure the image degradation properties in security cameras was developed. The apparatus consists of an industrial high brightness Liquid Crystal Display (LCD) panel (19 inches, 1500cd/cm^2), three-joint flexible arm, a single board computer (Raspberry Pi 2 model B), a wireless control circuit, a small stand on casters, and a battery. The total weight was approximately 28kg. After putting the apparatus into place in view of a security camera, a series of basic graphics, such as dots, lines, color patches, and digits, were displayed on the LCD panel by the single computer board. During that time, the images of the LCD panel are recorded by the security camera. Because the recorded images of the basic graphics were distorted according to the degradation properties of the security camera, the degradation properties were obtained by analyzing the recorded images. This is the principle of the proposed method and the following are expected: (1) image deblurring using the measured PSF; (2) geometric correction of lens distortion; and, (3) measurement of color characteristics of the camera and color correction. Furthermore, the apparatus can be used for identification of digits/characters on a car license plate image and scale estimation of objects in images.

Experiments were performed using a security camera (Victor VN-H137B) in terms of 1, 2, and 3 as mentioned above. By displaying dot patterns, the PSF was successfully measured. When the Wiener deblurring filter was adopted to a blurred image taken by the camera, the restored image with the measured PSF was clearer than those with the Gaussian PSF or the circular PSF. By displaying a lattice pattern, the property of the geometric lens distortion was successfully measured. A corrected image was synthesized with the measured lens distortion data. Furthermore, the composed non-linear chromatic transfer characteristics of the camera and the recording device were successfully measured by displaying 861 color patches.

Reference(s):

1. John C. Russ (2006). *The Image Processing Handbook, Fifth Edition*. Boca Raton: CRC Press, 2006: 382-385.

Security Camera, Image Enhancement, Camera Properties