

The Influence of Camera Sensor Size on Image Characteristics

Assist. Prof. Dr. Hesham Ahmed Ahmed Marei

Assistant Professor at Department of Photography, Cinema and Television, Faculty of Applied Arts, Helwan University, Egypt

HISHAM_MAREY@a-arts.helwan.edu.eg

ABSTRACT:

The size of the camera sensor has a very important impact on the quality and quantity of details that can be obtained in the image, as the case in films, the greater the area of the image that is formed on the camera sensor, the less the effort to enlarge it to obtain the dimensions of the final image, hence the details and tones will be better in the final image, than if the original image had been formed on a smaller sensor. The size of the camera sensor also affects many characteristics of the image, including those related to the appearance of the image such as: angle of field of view, and including what relates to image quality, such as: the dynamic range. Therefore, the sensor size is considered one of the most important factors that help evaluate the quality of the performance of digital cameras. The research problem lies in how to balance the sensor size with the resolution in a way that does not conflict with the image quality, as well as calculating the angle of the field of view of the lens with the sensors of different sizes. Therefore, the research aims to study the effect of the sensor size on the image properties in terms of field of view angle, depth of field, resolution, dynamic range, sensitivity, and noise. This is in order to fully control the characteristics of the image, as well as to achieve the maximum possible use of the camera.

Keywords:

Digital Image, Sensor Size, Dynamic Range, Field of View, Crop Factor, Depth of Field.

INTRODUCTION:

In the case of traditional film shooting, the characteristics of the final image are controlled in terms of contrast, texture and color, by choosing the type of film, printing paper and chemical solutions used in the processing operations, which requires that the photographer be familiar with the chemical properties of all the materials and solutions used in photography and printing; Until he gets the results he desires in his final image. The same applied to the production of the digital image after that. Where the photographer must fundamentally understand how the camera sensor works, how it produces colors and luminance degrees, and its impact on the various characteristics of the image, in order to achieve the maximum possible effectiveness of the digital camera he uses.

In fact, the size of the camera sensor has a very important impact on the quality and quantity of details that can be obtained in the photo, cinematic or television, as the case in traditional films, the greater the area of the image that is formed on the camera sensor, the less one will have to enlarge it to get the dimensions of the final image, therefore, the details and tones will be better in the final image, than if the original image had been formed on a smaller sensor, which requires a higher enlargement ratio to get the final image. The area of the camera sensor also affects many characteristics of the digital image, including those related to the appearance of the image and the composition contents such as: angle of field of view, and depth of field.

Including what relates to image quality, such as: the dynamic range that the camera can record, and the percentage of noise in the image.

Therefore, the size of the camera sensor is considered one of the most important factors that help evaluate the quality of the performance of digital cameras, but it comes in importance before the power of resolution of the camera, as increasing the number of pixels of the camera sensor does not necessarily increase the quality of the images that it produces, but may have an effect which sometimes the opposite is true, if the sensor area is small, as increasing the number of pixels on the surface of the small sensor, it will cause the pixels to be very close to each other, thus increasing the probability of signal interference between adjacent pixels, which will increase noise in the image .

Therefore, in this research we will study the effect of the size of the digital camera sensor on the image characteristics in terms of angle of field of view, depth of field, resolution, dynamic range, sensitivity, and image noise. This is in order to fully control the characteristics of the image, as well as to achieve the maximum possible use of the camera.

PROBLEM STATEMENT

Research problems can be limited to the following points:

- The problem of compromising between the sensor size and the resolution in a way that does not conflict with the image quality.
- Problem of calculating the angle of view of the lens, as well as controlling the depth of field with the different sensor sizes.
- Problem of lack of the dynamic range of the camera with some sensors.
- The problem of choosing the appropriate sensitivity for shooting without affecting the image quality.
- The problem of increased noise in the image with some sensors.

AIMS AND OBJECTIVES

The research aims to study the effect of the size of the digital camera sensor on the image characteristics in terms of angle of field of view, depth of field, resolution, dynamic range, sensitivity, and image noise. This is in order to fully control the characteristics of the image, as well as to achieve the maximum possible use of the camera.

METHODOLOGIES

The research follows the descriptive analytical method by studying the extent to which the characteristics of the digital image are affected by the size of the camera sensor, in order to find out how to make the best use of the camera.

CONCLUSIONS

- The size of the camera sensor has a very important impact on the quality and quantity of details that can be obtained in the photo, cinematic or television, so the greater the area of the image that is formed on the camera sensor, the smaller the percentage of magnification necessary for it to obtain the dimensions of the final image, and therefore the details and color are better in the final image, than if the original image had formed on a smaller sensor.

- The higher the sensor's size, the greater the angle of the field of view of the camera to the image coming from the lens, and whenever it is necessary to use lenses with a longer focal length to obtain the field of vision required to be obtained in the image. Therefore, in cameras with the largest sensor in the size, the depth of field in the images that they produce is less than the depth of field that we get when photographing the same subjects using cameras with a smaller sensor, when using the same aperture and the shooting distance.
- **The greater the sensor size, the greater the pixel area, when the resolution is constant leading to:**
 - Increase the maximum electrical charge that the pixel can produce and collect, thereby increasing the dynamic range of the sensor, and there is no loss of detail in high-light areas or shadows in the image.
 - Increase the exposure area of the pixel to the photons of light coming from the lens, increasing the optical response of the sensor.
 - The greater the signal ratio resulting from converting photons of light into electrons, compared to other charges caused by the electrical circuits on the surface of the pixel, the less noise will be in the image.
- Digital cameras allow the selection of a specific iso speed response value for use in shooting. The camera amplifies the electrical charge produced in each pixel in proportion to the chosen iso value, but this will also amplify unwanted weak signals, increasing the percentage of noise in the image.
- The small size of the sensor results in the pixels being very close to each other, thus increasing the probability of interference in signals between adjacent pixels, which increases the noise in the image.
- Increasing the number of pixels of the camera sensor does not necessarily mean increasing the quality of the images that it produces. The more pixels there are in small size sensors, the smaller the pixel area, and therefore the lower the image quality, and the greater the possibility of defects in it, while the more the sensor size, with the same resolution, the more pure the pictures it produces. However, the only certain advantage of increasing the sensor resolution is that it gives us the ability to obtain final images with larger areas, whether printed, or displayed on any type of screen.
- The increase in the number of camera bit depth, does not mean at all an increase in the dynamic range of the camera, but it only leads to the camera will produce smoother gradations within the same range of contrast that it can translate.
- When choosing and evaluating the camera, it is very important to consider the size of the camera sensor, and not only pay attention to the number of pixels the sensor contains. This is because the effect of the camera sensor size, and the consequent increase in the area of one pixel, will be reflected in the quality and characteristics of the image in all cases, but the number of pixels that the sensor contains will increase its importance only in cases that require the final image to be displayed on very large areas, whether printed or On any type of screen.
- The focal lengths of the lenses used for imaging must be chosen according to the size of the camera sensor used, in order to obtain the angle of field of view required in the shot.

- It is preferable to use the actual optical response of the sensor (base iso), which is often the lowest iso allowed by the camera, so that the amplification of the signal is minimal, and thus the noise is not noticeable in the image, so we get the best possible quality in the image.
- It is preferable to use a camera with a large sensor size when wanting to obtain an image with a shallow depth of field, especially in cases where shooting in high light levels does not allow the use of a wide aperture. And the use of a camera with a small sensor size when wanting to obtain an image with a deep depth of field, especially in cases where filming in low levels of lighting does not allow the use of a narrow aperture.

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