

# FAKE PHOTOS

HANY FARID



THE MIT PRESS ESSENTIAL KNOWLEDGE SERIES



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**The MIT Press Essential Knowledge Series**

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HANY FARID

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## SERIES FOREWORD

The MIT Press Essential Knowledge series offers accessible, concise, beautifully produced pocket-size books on topics of current interest. Written by leading thinkers, the books in this series deliver expert overviews of subjects that range from the cultural and the historical to the scientific and the technical.

In today's era of instant information gratification, we have ready access to opinions, rationalizations, and superficial descriptions. Much harder to come by is the foundational knowledge that informs a principled understanding of the world. Essential Knowledge books fill that need. Synthesizing specialized subject matter for nonspecialists and engaging critical topics through fundamentals, each of these compact volumes offers readers a point of access to complex ideas.

*Bruce Tidor*

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**Chapter 1**

1. EXIF: Exchangeable Image File Format; XMP: Extensible Metadata Platform; IPTC-IIM: International Press Telecommunications Council—Information Interchange Model.
2. The image thumbnail is a small version of the full resolution that is used to provide a quick preview of an image.
3. Consider the world points  $(\Delta, Z)$  and  $(X+\Delta, Z)$ . These world points project to  $f\Delta/Z$  and  $f(X+\Delta)/Z$ . The length of the segment between these points is:  $f(X+\Delta)/Z - f\Delta/Z = (fX/Z + f\Delta/Z) - f\Delta/Z = fX/Z$ , which is independent of the horizontal displacement  $\Delta$ .
4. Be careful to distinguish between the focal length and the 35 mm equivalent focal length, both of which may be reported in the image metadata. The 35 mm equivalent focal length corresponds to the focal length assuming a 35 mm sensor size. This allows for a consistent comparison of focal lengths across cameras of different sensor sizes, but it should not be used in the calculation of distance. Some digital cameras provide both an optical and digital zoom capability. Digital zoom will not be reflected in the focal length but will affect length measurements made in the image. The image-based measurements should therefore be divided by the amount of digital zoom. Like the focal length, the digital zoom will (should?) be recorded in the image metadata.

**Chapter 2**

1. There are three basic variants of the JPEG file format: (1) the JPEG Interchange Format (JIF); (2) the JPEG File Interchange Format (JFIF); and (3) the JPEG/EXIF format. The JIF format is the full-featured version, which is rarely used because of the difficulty associated with building a fully compliant encoder and decoder. The more common JFIF and JPEG/EXIF are simpler subsets of the JIF format.
2. Ignoring overlapping regions and the edges of the image, there are 1,000,000 choose 2, equal to  $(1,000,000 \times 999,998)/2 = 500,000,000,000$  possible pairings of pixels, each of which may be the center of a pair of cloned regions.
3. The Warren Commission report states that at the time of his arrest, Oswald gave his weight as 63.5 kg (140 lbs) but on other occasions he gave weights

of both 63.5 kg and 68 kg (150 lbs). The New Orleans police records of his arrest show a weight of 61.7 kg (136 lbs), and the autopsy report indicates an estimated weight of 68 kg. Given the conflicting weights, I'll assume a weight of 64.4 kg (142 lbs), the average of the various reported weights.

### Chapter 3

1. The round down (or *floor*) of a number  $c$  is the largest integer less than or equal to  $c$ . For example  $\text{floor}(2.1) = 2$ ,  $\text{floor}(2.5) = 2$ , and  $\text{floor}(2.9) = 2$ .
2. Spatial frequency is analogous to sound frequency. A high frequency sound has many rapid changes in air pressure per second, while a low frequency sound has fewer. Similarly, a high frequency visual pattern has many abrupt changes in luminance across space while a low frequency visual pattern has fewer.
3. Long wavelength light appears red and orange, medium wavelength light appears yellow and green, and short wavelength light appears blue and violet.
4. The ISO governs the sensitivity of the sensor (see Exposure). In low light conditions, a high ISO is used to make the sensor more sensitive to small amounts of light.
5. Hao-Yu Wu, Michael Rubinstein, Eugene Shih, John Guttag, Frédo Durand, and William Freeman, "Eulerian video magnification for revealing subtle changes in the world," *ACM Transactions on Graphics* 31, no. 4 (July 1, 2012): 1–8.

### Chapter 5

1. Long wavelength light appears red and orange, medium wavelength light appears yellow and green, and short wavelength light appears blue and violet.
2. By way of example, quantizing 12.5 by 3 yields 4; quantizing 8.9 by 5 yields 1; and quantizing 3.2 by 7 yields 0.
3. Although we can return the DCT value to its original scale by multiplying by the quantization value, there is no way of recovering the original non-integer value, which is lost after conversion to an integer. This is why JPEG compression is "lossy."