Photography may be used to capture invisible images by recording infrared, ultraviolet, X-ray or others wavelengths of light either illuminating or emitted by an object. The evidence photographed may range from microscopic (or even electron microscopic) sized objects to crime scenes that may range over miles of terrain. Specialized fields of forensic photography include medicolegal, microscopic, alternative light source, spectroscopic, underwater, impression, and aerial photography. Photographers are also called upon to prepare graphical presentations and present expert testimony for court proceedings.

Increasingly, digital cameras are being used to record crime scene and evidence photographs. These cameras allow for rapid picture taking, accommodate thousands of images without changing memory chips, and allow for the immediate viewing of the images on site. Since digital images may also be deleted from the camera’s memory so easily, once taken an image should not be deleted – even if it is

---

**Figure 17.2.8.** Digital photographs may be altered to deceive audiences. The image above left appears perfectly normal but a closer analysis reveals that it has been “faked.” Analysis of the directions of the light (called “specular highlights) on the cyclists show that the two were not photographed at the same time. The direction of the light-source (given by the arrows in the picture above right) highlighting the girl’s face is inconsistent with the direction of light used to highlight her body and the other cyclists. The fire hydrant in the background shows a third light-source direction. Shrubs, grass and the curb cover hidden cyclists in the background. In addition, mismatching of adjacent pixels reveals areas where logos were removed on the girls pants and where her helmet modified by copying the man’s helmet and recoloring it. The photographs and study are reported at www.SciAm.com/jun2008. The original, unretouched photograph is shown below:
out of focus or of poor quality. Deleting images opens up the photographer to questions by the opposing counsel about why they were deleted – was it because they showed exculpatory evidence that would exonerate a defendant?

“Telltale Twinkles”
[Excerpted from Scientific American, 2008, p 66-71]

“Surrounding lights reflect in eyes to form small white dots called specular highlights. The shape, color and location of these highlights tell us quite a bit about the lighting. In 2006 a photo editor contacted me about a picture of American Idol stars that was scheduled for publication in his magazine (above). The specular highlights were quite different (below).”

“The highlight position indicates where the light source is located (above left). As the direction to the light source (yellow arrow) moves from left to right, so do the specular highlights.”

“The highlights in the American Idol picture are so inconsistent that visual inspection is enough to infer the photograph has been doctored. Many cases, however, require a mathematical analysis. To determine light position precisely requires taking into account the shape of the eye and the relative orientation between the eye, camera and light. The orientation matters because eyes are not perfect spheres: the clear covering of the iris, or cornea, protrudes, which we model in software as a sphere whose center is offset from the center of the whites of the eye, or sclera (above right).”

“Our algorithm calculates the orientation of a person’s eyes from the shape of the irises in the image. With this information and the position of the specular highlights, the program estimates the direction to the light. The image
of the American Idol cast (above; directions depicted by red dots on green spheres) was very likely composed from at least three photographs.”

As with video images, photographic images can be modified and enhanced to reveal otherwise hidden information. Dark pictures may be brightened and enhanced to reveal previously hidden information (e.g., license plates, suspect’s faces, weapons, etc.). Photographs may be digitally sharpened to help identify suspects. An entire range of computer-based enhancements are possible using simple software applications.

Photographic images may also be altered with the intent to cheat or deceive. One important role of forensic photography, therefore, is to authenticate images and expose fraudulently made pictures. Photographs using the older film-based cameras and darkroom printing techniques could be altered, but the process was typically rather difficult and relatively easy to detect. The advent of modern digital cameras and image altering software (e.g., Photoshop, etc.), however, has made it quite simple to make sophisticated altered images. While these altered images are occasionally found in artwork and commercial advertisements, they most often come into the purview of forensic experts when they are designed specifically to conceal, misdirect or defraud viewers.

**Figure 17.2.9.** An age progression photographic set of Jonelle Matthews produced by the National Center for Missing and Exploited Children (NCMEC). The left picture is an actual picture of Jonelle when she was 12 years old and the picture on the right is an age progressed image of how she might look at 37 years old (www.greeleytribune.com/article/20091220/NEWS/912209983).

**Figure 17.2.10.** Altered photograph using cloned soldiers – exact copies of some of the soldiers faced – pasted over Pres. Bush’s image in the right photograph (www.wadelaube.com/blog/world-press-photo-disqualifies-winning-photographer/).
One way to identify altered photographs is to examine the “specular highlights” in various parts of the photograph. Specular highlights are the bright spots that result from strong illumination, such as from the sun or artificial lighting, on the surface of the subject in the picture. For example, the shadows and bright spots for different objects in the picture can be analyzed from intensity, color and, most importantly, the direction of the light source, as illustrated in Figure 17.2.8. If the light sources do not match up, the photograph has likely been altered. Additionally, backgrounds can be “cloned” - exact copies of small portions of the picture pasted at other locations in the picture – and identified by finding identical “pieces” in several placed in the photograph (Figure 17.2.10). A great variety of other photographic alterations are possible and sophisticated tools have been developed to locate such deceptions.

One tool that investigators sometimes employ is age progression or regression from a known photograph. For example, if a child has been missing for years, police take a younger photograph of the child and “age” them so that people might have an idea of what they would look like today (Figure 17.2.9. Similarly, age progressed photographic renderings of suspects that have long been sought for might aid in finding them.

Clearly, photography plays a key role in any forensic investigation and, through proper case and expertise, provides invaluable information to any criminal justice system.

Figure 17.2.11. (www.sodahead.com/fan/are-you-a-window-person-or-an-aisle-person/question-1776037/?page=2&link=ibaf&q=funny+photoshop+airplane+window&imgurl=http://2.bp.blogspot.com/_l5SjYKgXgRE/TNKg6hlWQI/AAAAAAA AAJY/UdIOPfiRJES/s1600/duck-in-the-airplane-window.jpg)