ARTICLE

Image quality

AXIS COMMUNICATIONS

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Introduction

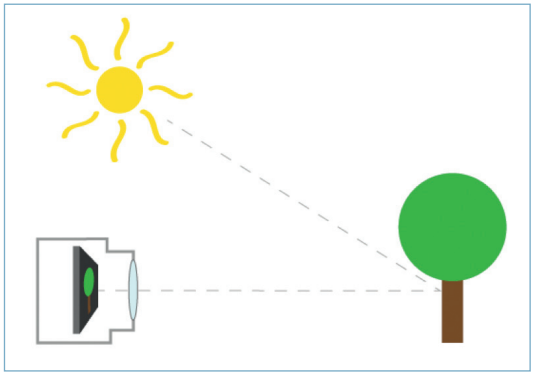
Setting up successful video surveillance requires attention to many details. The ultimate goal is to provide images of sufficient quality to support your surveillance objective – but what is image quality, and how do you adjust your camera to achieve your goal?

1. Light

The basic principle behind almost all photography is that you need light! Light emitted from a light source (such as a lamp or the sun) needs to reflect off an object and then enter the camera through the lens. Once the light rays hit the image sensor (or film strip), an image of the object can be captured.

The essence of this principle is that without light, there is no image, and poor light will result in a poor image. Anything reducing the light between the object and the sensor will impair image quality. Examples are windows that partially block light, smoked dome covers or lenses with poor optics and small apertures.

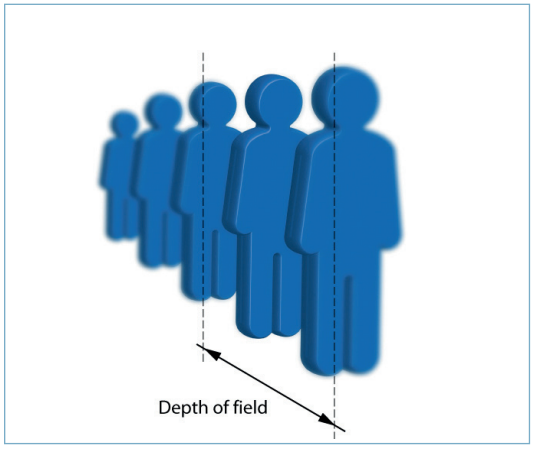
If your scene lacks light, you may have to add it. Auxiliary lamps illuminating the object can often increase image quality greatly.



In addition, consider the fact that a camera mounted and tested during daytime can give entirely different results during nighttime hours, or as seasons shift. Make sure you understand the entire range of light in your surveillance scenario, and set up your camera accordingly.

2. Basic camera settings

The opening or aperture of a lens, also known as the "iris", greatly affects the amount of light reaching the sensor. The f-number of the lens is the quotient of the focal length of the lens and the diameter of the opening. For example, a 50 mm lens with a 25 mm light opening would have an f-number of 2.0, since 50 divided by 25 equals two. The higher the f-number, the smaller the opening will be, and vice versa. A lower f-number means that more light will reach the sensor.

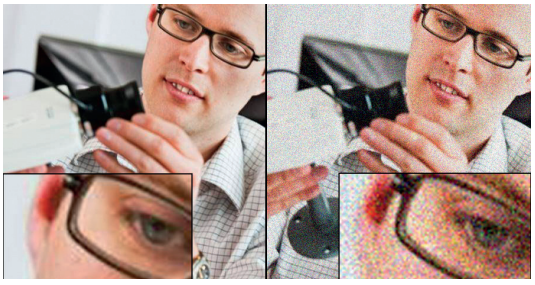


The aperture also affects the depth of field, that is, how much of the scene that can be in focus at the same time. A wide-open lens will have a very shallow depth of field. Objects slightly closer to or further from the camera than the set focus point will be out of focus. By increasing the f-number (and thereby closing the light opening), the depth of field increases, and the objects can be brought back into focus.

Another camera setting directly connected to the amount of light available in the scene is the shutter speed. The shutter speed is the amount of time that the camera takes to register an im-age, for example 1/50th of a second. With a lot of light entering the camera, faster shutter speeds are possible. As light decreases, the shutter speed slows down because the sensor needs more time to "collect" enough light to form an image. With a sufficiently low shutter speed, anything moving in the scene will appear blurred in the image, since the moving object's position changes during the capture. This is called "motion blur" (or "ghosting" in certain applications), and will have a negative effect on both image quality and usability of your video.

Many cameras employ an internal boost of the image signal; this is called gain. To enable capture in low light without sacrificing shutter speed or depth of field, the weak sensor signal is electronically amplified,

resulting in a brighter image. A side effect of this is that tiny imperfections in the capture are also amplified and are produced as image noise. This noise degrades image quality and generally increases the bandwidth needed for the video stream. Image noise increases with rising temperatures, so sometimes adding active cooling to your camera can be a remedy.

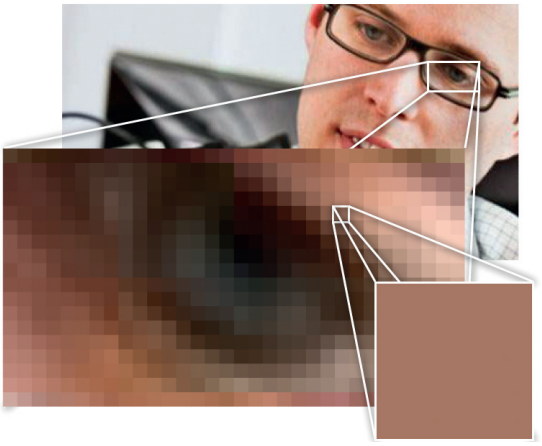


Axis cameras automatically adjust the aperture, shutter speed and gain to produce an image that is always correctly exposed. You can change a priority setting to favor either low noise or low motion blur, depending on your scene's requirements.

3. Advanced camera settings

All digital images are made up of small picture elements, called "pixels". A pixel is a point in the image with a specific color and intensity. The total amount of pixels in an image is referred to as "resolution". 1920x1080 means there are 1,920 columns and 1,080 rows (2,073,600 pixels total) of pixels forming the image. Another term for this specific resolution would be 2 megapixels, since there are roughly 2 million pixels in the image.

With higher resolution, the camera can capture finer details in the scene, but since the value of each pixel needs to be stored and transferred in a video stream, the bandwidth requirement increases as well.



1 pixel

Depending on your operational requirements, you should adjust the captured resolution to provide sufficient image detail without exceeding your available bandwidth.

Visible light is composed of a wavelength spectrum where different wavelengths are perceived as different colors. Sunlight consists of almost the entire spectrum and is generally considered as white.

Other light sources may have a bias toward higher or lower wavelengths in the emitted light, causing the "white" to be slightly red-tinted or blue-tinted. When reflected off objects, this tint will transfer to the image, causing an unnatural appearance.

The wavelength bias of a light source is called "color temperature" and is measured in degrees Kelvin. If the camera knows the color temperature of the incoming light, it can adjust the image to keep white

objects white – a process called "white balancing". Many cameras try to determine automatically the color temperature and set the white balance accordingly. You can also set the white balance to a fixed color temperature depending on the light fixtures in the scene, for example fluorescent lamps or tungsten bulbs. If your image is unnaturally red or blue, check your white balance settings!

4. Image enhancements

Fluorescent lighting is very common in stores, warehouses and office environments. Because of the way fluorescent lighting works, the light output is not consistent; the lamp turns on and off at a rapid pace, but to the human eye the result appears as a steady flow of light. At certain shutter speeds, however, this flickering light will create an undesirable effect in images of the scene. Enabling the "flicker-free" option in your camera will allow the camera to adjust its shutter speed to avoid the flickering effect. Depending on where you are in the world, the AC power frequency will be either 50Hz or 60Hz, and you must also set this value in the camera to get proper results from the "flicker-free" setting.

The camera adjusts the shutter speed and aperture according to available light to produce a balanced exposure. In some scenes, there may be a few objects with a much higher brightness than average, such as a flashlight or a window on a sunny day. These overly bright areas may "trick" the camera into lowering its exposure settings, thereby making most parts of the image too dark.

By enabling the backlight compensation setting, the camera will ignore any isolated bright areas and keep the exposure at a suitable level for the darker parts of the scene.

The difference between the darkest and brightest parts of a scene is called dynamic range. If the dynamic range is wider than the sensor of the camera can capture, the dark parts will be rendered as all black, and the bright parts will be all white.

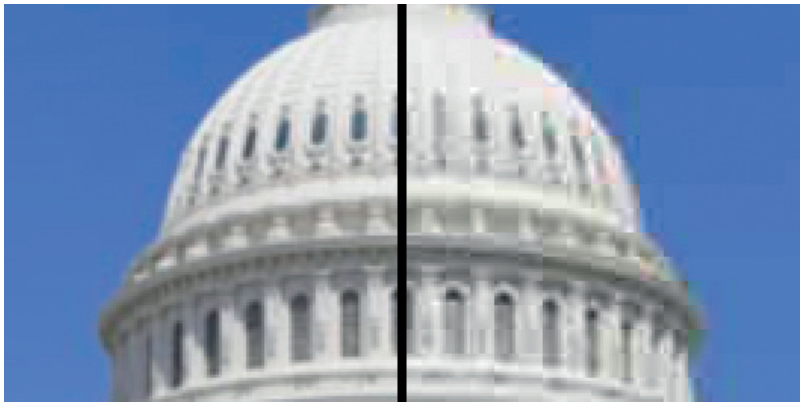
For some cameras, you can enable a Wide Dynamic Range mode (WDR), so that the camera uses various techniques to try to extend its range. Make sure you try this setting if there are very dark and very bright areas in your scene.

If possible, try to place and frame your cameras to avoid extreme variations in scene brightness.

5. Other factors

Digital video can be compressed to decrease the bandwidth it requires from the network for streaming and to save storage space. Compression entails applying a complex mathematical algorithm to the numerical values that make up the video stream. The output is considerably smaller than if not compressed, but the video stream must be expanded by a reversing algorithm before it can be viewed.

Most algorithms or codecs (an abbreviation for compressor/decompressor) decrease the amount of streamed data in part by discarding information of little significance. During decompression, this missing data is restored by approximation, making the end result slightly different than the original recording. This is called "lossy" compression since it decreases image fidelity. For low compression ratios, the human eye will fail to notice the loss, but with higher compression (low bandwidth), image quality deteriorates with noticeable artifacts in the image.



Different scenes compress with varying results. A busy scene with a lot of motion will be more difficult to compress, resulting in a higher bandwidth requirement or an increase in image artifacts. You will need to tweak your compression settings until you find an acceptable trade-off between size and quality.

Choosing the right camera and lens for the job will have the greatest effect on image quality, but you can also do a lot by mounting and setting up your camera properly.

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About Axis Communications

As the market leader in network video, Axis is leading the way to a safer, smarter, more secure world – driving the shift from analog to digital video surveillance. Offering network video solutions for professional installations, Axis' products and solutions are based on an innovative, open technology platform.

Axis has more than 1,400 dedicated employees in 40 locations around the world and cooperates with partners covering 179 countries. Founded in 1984, Axis is a Sweden-based IT company listed on NASDAQ OMX Stockholm under the ticker AXIS. For more information about Axis, please visit our website www.axis.com.

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