

Advantages Of Iris-Free Lens Design.

Abstract

For analog video cameras, auto-iris lens design is the common approach to cope with changing light levels. As a consequence, analog video cameras suffer from the drawbacks of this type of lens design. Digital video cameras that include advanced digital exposure control can eliminate the auto iris and benefit from an iris-free lens design.



Problem Domain

Video surveillance systems have to cope with scenes with often-changing light conditions. The illumination of outdoor scenes in particular can vary from bright sunlight to complete darkness. CCD sensors used in analog as well as in digital video cameras cannot handle bright sunlight. When overexposed, they tend to exhibit vertical white stripes due to bleeding. The CCD sensors can even physically deteriorate when exposed to bright sunlight for longer periods of time without protection.

Conventional Solution

Analog video cameras solve this problem by a lens design that uses a so-called „auto iris“. An auto iris is a diaphragm with electrically adjustable aperture. The aperture is formed by several motor-driven blades controlled by a signal, which in turn is derived from the analog video signal.

The use of an auto iris imposes several drawbacks:

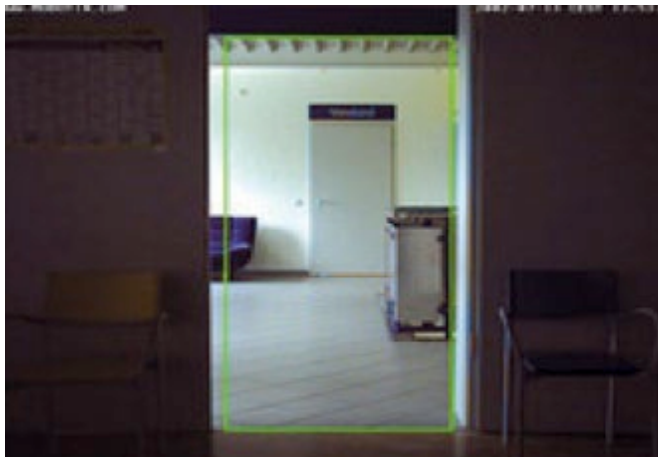
- Moving parts are prone to fail. By using a motor-driven device, reliability and robustness are adversely affected.
- Varying the aperture changes depth of field. An image might look focused at high illumination since the camera uses a low aperture and thus has a high depth of field. However, as illumination decreases, the aperture opens and depth of field decreases, leading to a larger image area that is out of focus.
- When applying the auto-iris lens design to digital video cameras, this creates even more counter-productive effects as the shape of the diaphragm influences the appearance of blurred image areas. Low-quality diaphragms with fewer blades result in unnatural out-of-focus image areas. This effect becomes more dominant as the resolution of the image sensor increases, e.g. for megapixel digital video cameras.
- Most cameras with auto iris implement a basic exposure control, averaging brightness over the total image area in order to maintain a constant level of light on the image sensor. In critical exposure situations, e.g. with backlighting, darker areas become even darker and faces cannot be recognized any more.

These drawbacks prompted an iris-free lens design.

HiRes Video Innovations

The German company MOBOTIX AG is known as the leading pioneer in network camera technology and its decentralized concept has made high-resolution video systems cost efficient.

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One exposure window (green frame) on the door itself



Two exposure windows on both sides of the door.

MOBOTIX' Approach to Iris-Free Lens Design

MOBOTIX has taken a completely different approach to solving the problem:

- MOBOTIX uses digital CMOS sensors that do not exhibit bleeding as CCD sensors do.
- In addition, the digital CMOS sensors used in MOBOTIX cameras do not need to be exposed at a constant level of light to provide a good image. Instead, exposure is controlled digitally from 1/8000th of a second to 1 second.

Since MOBOTIX cameras are using an iris-free lens design, they do not suffer from the drawbacks and limitations imposed by an auto iris, i.e. MOBOTIX cameras have no moving parts that can fail or lock in the cold.

MOBOTIX cameras implement the iris-free lens design by applying a sophisticated software-based exposure control algorithm. This algorithm relies on exposure windows that are drawn on specific areas of the image. The exposure control algorithm uses these exposure windows to maintain good exposure.

Both example images have been shot by a camera placed inside a dark room that is looking through a door into a room with sufficient illumination. Between the shots, the illumination conditions did not change. A conventional camera with auto-iris lens would darken the faces of people entering the darkened room (left image). By using two exposure windows on both sides of the door opening, the MOBOTIX camera takes a perfectly exposed picture of a person entering the room (right image).

Summary

Auto-iris lens design is a relic from analog technology. Its use involves drawbacks and even impairs high-resolution megapixel digital video cameras. By using a digital CMOS sensor combined with software-based exposure control, iris-free lens design guarantees optimal image exposure and outperforms conventional lens designs that are relying on auto-iris exposure control.



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