Integration of Wide Dynamic Range Technology in Surveillance Cameras

White Paper
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Introduction

Human vision has a very high dynamic range*, enabling us to see both in dim starlight and in bright sunshine. While it is difficult to achieve the full dynamic range experienced by humans with the imaging technology in electronic equipment such as video cameras, a number of approaches—known collectively as wide dynamic range (WDR) technology in the case of cameras—have been developed to allow more accurate representations of the range of luminance levels found in real-world environments.

* Human vision has an overall dynamic range of about 200dB, but only a portion of the full range can be perceived at any given time.

WDR applications in surveillance

WDR technology is commonly incorporated in cameras used for surveillance applications. The technology allows a camera to clearly capture detailed features even when a person or an object of interest appears in locations where there is strong back illumination, such as outdoors during the day or in front of artificial lighting at night. WDR capabilities are strongly recommended for cameras used to monitor locations where light enters from multiple directions, ensuring that at whatever angle to the camera a person or object of interest appears, sufficient detail can be captured for reliable identification. Examples of locations where difficult high-contrast lighting conditions typically prevail include building entrances, ATMs, transportation facilities, and any indoor space with windows.

Transportation

Parking Lot

Window Side

Loading Deck
Implementations of WDR technology: VIVOTEK as an example

Surveillance solutions vendor VIVOTEK has implemented comprehensive range of WDR technologies based on tone mapping and multi-frame imaging for its cameras.

WDR Enhanced

WDR Enhanced is VIVOTEK’s branding for its tone mapping technology by reducing the dynamic range of the entire image, while retaining the contrast of the image. WDR Enhanced draws on research on how the human eye and visual cortex actually perceive a scene to achieve a final result that closely mimics what people can actually see.

WDR enhancement produces superior results compared to conventional backlight compensation (BLC) because BLC relies on automatic evaluation of the brightness at the center of the field of view. If lighting levels there are too low, the brightness of the entire video frame is raised. The disadvantage of this approach is that areas in the field of view that were originally illuminated well may become overexposed.

WDR enhancement rectifies this shortcoming of BLC by adjusting the tone curve evenly based on the brightness levels in different areas of the field of view, brightening dark areas and dimming excessively illuminated areas to increase visibility throughout the field of view.
VIVOTEK also offers WDR Pro, which is based on its implementation of multi-frame imaging. WDR Pro works by simultaneously capturing two or three images of the field of view at different exposure levels. An image with a longer exposure time can capture more detail in the less illuminated areas in the field of view, though the brighter areas may be over-exposed. An image with a shorter exposure time, on the other hand, will more accurately capture the brighter areas, but may leave the less illuminated areas under-exposed.

An image signal processor then uses a sophisticated algorithm to seamlessly combine the “long” and “short” images into a single video frame that preserves detail in both darker and brighter areas of the field of view. Moreover, because the effective dynamic range of the video is expanded, contrast ratio is enhanced, further accentuating detail clarity.

**Exposure Time**

1/60 s  1/60 s

Standard Exposure Time

1/60 s  1/240 s

Long Exposure Time  Short Exposure Time

A single good-contrast frame is created by combining the two frames using an advanced image signal processor.
**WDR Pro II**

WDR Pro II is the next-generation of WDR Pro, taking the technology a step further by capturing four images at four distinct exposure levels. This advance enables cameras incorporating WDR Pro II to optimize image quality for even relatively modest differences in illumination levels. The end result is even greater detail, even more clearly rendered, over the entire field of view.

![Exposure Time Diagram]

Due to these attributes, WDR Pro is an extremely valuable technology for any surveillance environment. WDR Pro II, in particular, ensures that whatever the lighting conditions present in a monitored location, or how an object or person of interest is situated relative to the camera and light sources, a high level of detail can be clearly captured and composed for positive identification, accurate tracking, and other demanding applications.

![WDR Pro II Examples]

**Without WDR**

**With WDR Enhanced**

**With WDR Pro**

**With WDR Pro II**