DarkFighterX

White Paper

Imaging in the extremely low illumination

Imaging in extremely low illumination has always been a headache in the video surveillance industry. Although some cameras meet the basic requirements for city surveillance, they fail to work well when in the extremely low light environment where they have to switch to the infrared mode, leading to color data loss and black/white imaging. To provide an all-weather full-color imaging service, Hikvision has developed a technology based on the human eye bionics, the DarkFighterX.

DarkFighterX, after five years of research & development efforts dedicated by Hikvision, is able to acquire "clear, clean and full-color" video images in extremely low illumination. It extends the human vision and explores the potential of computer vision effectively. DarkFighterX also accelerates the development of the visual perception technology in complex environment, provides a new level of visibility for modern city management, and contributes to the building of the new smart city.

Why getting a true color image is so difficult?

Generally, human eyes detect visible light with wavelengths between 400 nm and 700 nm; while image sensor senses not only the visible light but also the infrared light whose wavelength range is longer than 700 nm (Figure 1).

At present, to ensure the true color of images, infrared light with wavelength exceeding 700 nm will not be acquired by the conventional camera (Figure 1). In extremely low illumination environment where there is no visible supplement light, the conventional camera has a very limited vision, producing poor imaging quality with a large amount of noises. In this case, infrared light is required to support the camera to lower the noises and get the clear image, while the true color of images cannot be guaranteed.
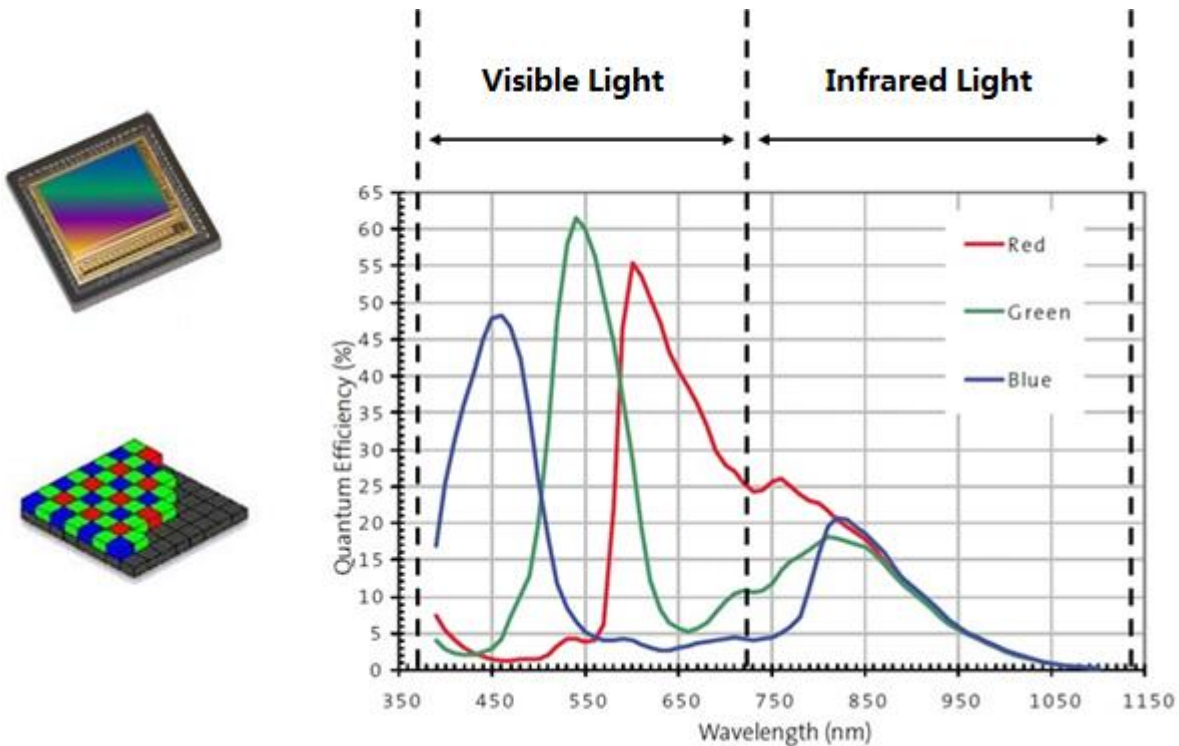
Figure 1 Visible and infrared light spectrum

The DarkFighterX Technology

DarkFighterX is a breakthrough of the video imaging technologies. Based on the human eye bionics, DarkFighterX uses two sensors to simulate the rod and cone cells of the human eye, simultaneously acquiring visible and infrared light to collect the color data and brightness details respectively. DarkFighterX also adopts Hikvision SpecEX visual and thermal image fusion technology to combine the color data and brightness details of a scene, rendering true and detailed high definition full-color images in extremely low illumination.

Dual-Sensor Structure

DarkFighterX camera is equipped with the dual-sensor structure and each sensor works independently. The Cone SENSOR acquires visible light to collect the color data while the Rod SENSOR captures the infrared light to gather brightness details (Figure 2).

This unique optics structure realizes the efficient utilization of the visible and infrared light. With both visible and infrared light perceivable and the sensitivity to light greatly enhanced, DarkFighterX camera is characterized by high light sensitivity, high resolution, clear image and true color.
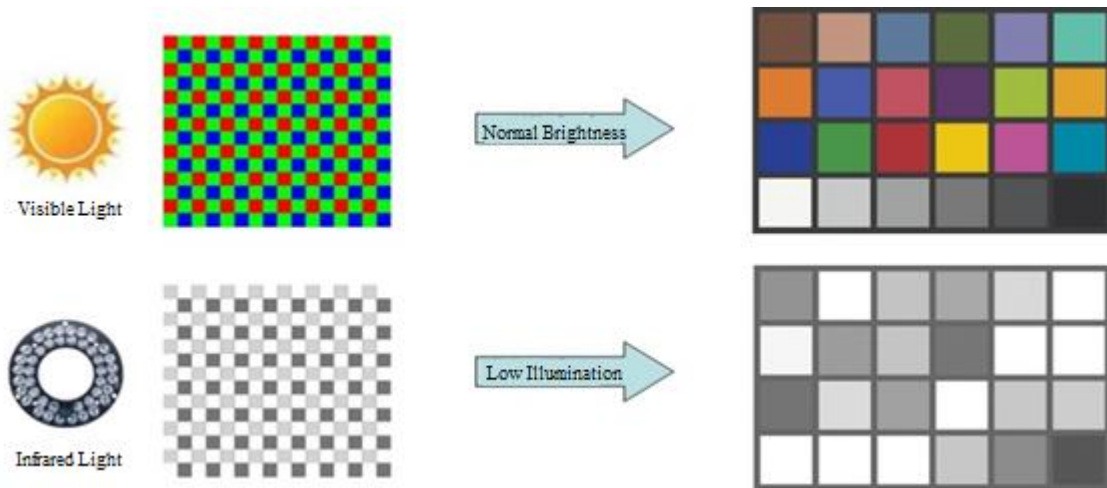
Figure 2 Cone SENSOR collecting color data and Rod SENSOR gathering brightness details

DarkFighterX camera uses the supplement infrared light in extremely low illumination environment. Through a spectrometer, the visible light and infrared light enter separate image sensors, and form two images. These two images will be processed by the special image signal processing (ISP) and Hikvision image fusion algorithm, rendering an image of higher brightness and higher signal-to-noise ratio (SNR) (Figure 3).
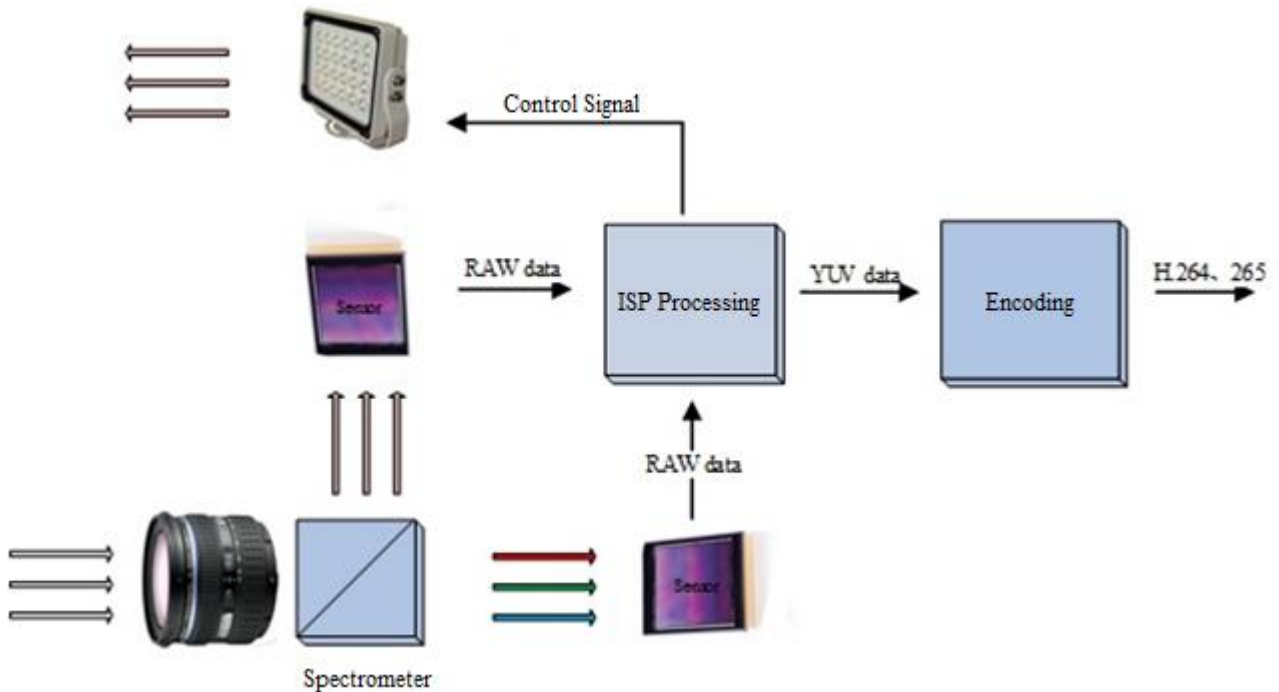

Figure 3 DarkFighterX light flow diagram

SpecEX Visual and Thermal Image Fusion

SpecEX visual and thermal image fusion is a technology based on the human eye bionics. Inspired by rods and cones of the human eye, this technology simulates the operation pattern of photopic vision and scotopic vision with two sensors. With this technology, the DarkFighterX camera simulates the photopic vision when there is sufficient daylight and only its Cone SENSOR is working; while in the low illumination environment, the camera simulates the scotopic vision, and its Rod SENSOR, responsible for brightness details perception, functions together with the Cone SENSOR. After the combination of two sensors' imaging, the DarkFighterX camera presents far better night vision than the conventional camera.

A Breaking of the Sensing Limitation

Technology advances as human beings continue to break the boundary of the human vision. DarkFighterX breaks the human eye's limitation to "detect" in darkness, extending the human vision and exploring the potential of computer vision effectively. To some extent, it expands the scope and possibility of the human vision and provides a new vision for the security and development of mankind.

Hikvision DarkFighterX technology breaks the limitation of computer vision in the dark environment. Globally released DarkFighterX products have been playing a vital role in the construction of the city visual perception system, greatly promoting visualized city management and effectively driving the development of big data based smart city.

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