Legibility of HD-SDI zoom camera (vs. analog camera)

Most big issue in CCTV market - HD video quality

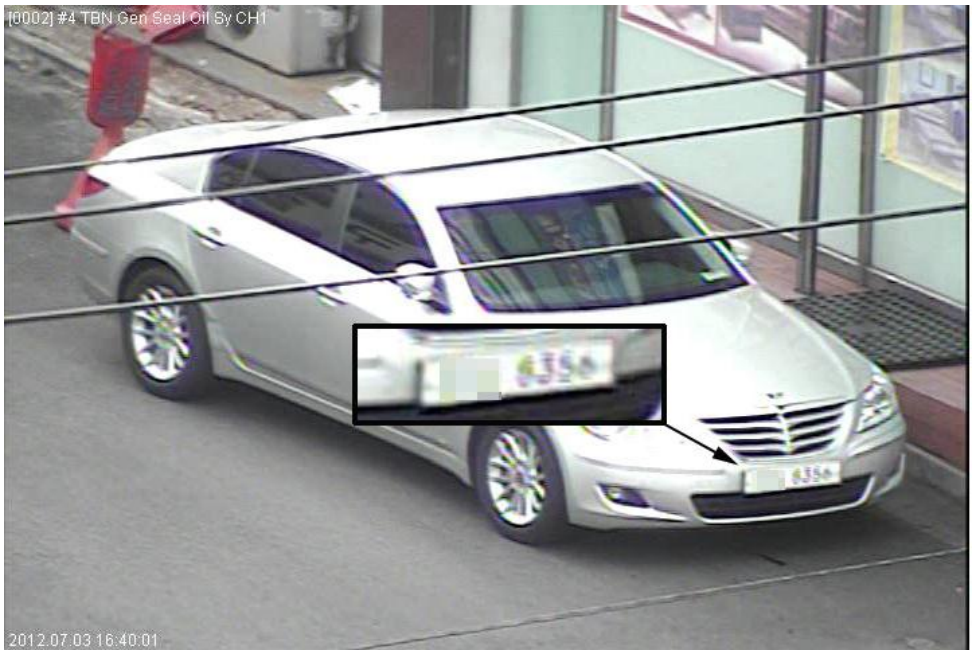
Recently, the most big issue in CCTV market must be the expansion of Full-HD(High-Definition) system. The change of resolution from the existing SD(Standard-Definition) class (720x480 in case of NTSC) to Full-HD(1920x1080, 1080p) requires the whole system change, not only the video quality enhancement of camera simply.

Because the conventional SD-CCTV(NTSC/PAL) is based on analog TV standard, it could not meet the market request for the high-resolution, clearer video image in digital era of HDTV. The first step for high resolution was started from megapixel IP camera adopting HD class image sensor, and recently HD-SDI transmission technology which have been used for digital video transmission between broadcasting equipment was grafted into CCTV market, and introduced as the name of HD-CCTV system.

Legibility difference between 35x analog zoom camera and 20x HD-CCTV zoom camera

Zoom camera is one of important product in CCTV market. 35x optical zoom modules are forming the mainstream of analog zoom products, and 20x optical zoom modules are widely used for Full-HD (1920x1080) zoom products.

Below <Pic. 1> shows an image which is taken by 35x analog zoom camera, and <Pic. 2> shows an image which is taken by 20x Full-HD zoom camera. As the the result, 20x HD-CCTV zoom camera provides more clear video image than 35x analog zoom camera, and you can easily understand that if you checked the license plate of the car. Let's check out the video quality difference more technically.



<Pic. 1> Video image from 35x analog zoom camera showing 4:3 aspect ratio

<Pic. 2> Video image from 20x Full-HD zoom camera showing 16:9 aspect ratio

Relationship between the magnification of optical lens and its legibility

To get the optical performance of lens, we may simply compare the focal-length of lenses. But, it is somewhat risky to judge the zoom performance only based on the zoom magnification which is calculated by the focal-length ratio of Tele-end and Wide-end. Several factors like resolution of lens itself and light transmittance affect the actual legibility of zoom camera.

In the following case, zoom performance of two 35x and 37x camera is almost same, but actually 35x zoom camera will show better zoom performance. In other words, the higher zoom magnification does not mean the better legibility.

Camera A : 35x optical zoom (f=3.4 ~ 119mm)
Camera B : 37x optical zoom (f=3.2 ~ 118.4mm)

Many conventional zoom camera and speeddome customers had been judged zoom performance based on focal-length at Tele-End, and zoom magnification. But, if we compare the HD-CCTV camera with conventional analog camera, we need more deep study. Because HD-CCTV camera has much higher resolution than analog camera, it is not suitable only to use lens magnification to compare the legibility between the videos.

Legibility comparison between analog camera and HD-CCTV camera based on resolution

You may consider 20x HD-CCTV camera may have lower legibility if it compared with 35x analog camera because it has lower zoom magnification, but it it not true. Because HD-CCTV camera is using 2 megapixel image sensor, it provides much greater information than analog camera which

uses 410Kpixel image sensor. Moreover, HD-CCTV is using digital video transmission method so, it prevents the drop of video quality during transmission, and it keeps relatively higher legibility. More technically, let's compare the pixel quantity between HD-CCTV camera and analog camera. NTSC video can be converted to digital video, and its maximum size is as follows.

Resolution of HD-CCTV camera : 1920 x 1080 = 2,073,600 pixels (Full-HD, 1080p)
Resolution of Analog camera : 720 x 480 = 345,600 pixels (NTSC)

Therefore, HD-CCTV's total pixel is exactly 6 times bigger than analog's one. Because $\sqrt{6} = 2.45$, it means HD-CCTV camera has same effect as using a zoom lens which has 2.45 times better performance compared to an analog camera.

Zoom performance comparison through actual cameras

If we compare the legibility among cameras through the formula of "Focal-length at Tele-end x Resolution Factor = Virtual focal-length at tele-end"

Camera 1 : Analog 35x zoom camera (410K pixels, 720 x 480)
Focal length : 3.4mm ~ 119mm
119mm x 1 = 119mm

Camera 2 : HD-CCTV 18x zoom camera (720p, 1,280 x 720)
Focal length : 4.7mm ~ 84.6mm
84.6mm x 1.63 = 137.9mm

Camera 3 : HD-CCTV 20x zoom camera (1080p, 1920 x 1080)
Focal length : 4.7mm ~ 94mm
94mm x 2.45 = 230.3mm

From the above results, camera 2 shows similar legibility to 29x analog zoom camera, and camera 3 shows similar legibility to 49x analog zoom camera. In other words, judging the zoom performance of HD-SDI and analog camera by simply their zoom magnification may bring wrong result.

Not only the merit of uncompressed original video and lossless digital transmission, the superior video quality of HD-CCTV camera provides excellent video legibility. Moreover, lens manufacturer's effort to enhance the higher magnification of HD class lens is accelerating the improvement of video legibility.