

Fisheye Cameras in Surveillance Applications



White Paper

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Introduction

As IP surveillance moves into the mainstream to become the de facto standard for surveillance everywhere, manufacturers are devising new and better ways to enhance traditional surveillance applications. Two of the key benefits of using IP surveillance compared to traditional analog are the increase in detail & resolution and lower cost in large-scale projects. A single megapixel camera can cover an area multiple times that of a traditional analog or standard resolution IP camera.

As technology evolves in any industry, users demand better performance at lower prices. One of the newer form factors that has come into prominence in IP cameras in the last few years is the 360° camera, which enables a complete, surround view of an area. The two main methods of implementing a 360° camera are to use multiple lenses/sensors or a fisheye lens. Thus, no longer are users limited to a single, unchangeable view captured by a camera with a standard lens.

The advantage of using a fisheye lens compared to other 360° cameras on the market (which may use four separate lenses and sensors) is that not only do such cameras cost more and are more susceptible to failure due to the added hardware, but if the stitching between each view is not seamless, blind spots can occur with possible loss of information.

This white paper will outline the benefits of using fisheye cameras, including increased detail, coverage, and price savings in professional security applications.

360° Coverage with a Fisheye Lens Camera

Fisheye lenses have been introduced to the surveillance industry relatively recently. Used also in traditional photography, a fisheye lens is a wide-angle lens that captures broad, panoramic and hemispherical images with distorted appearance. Users may choose to use the distorted image for the photography of landscapes, round objects, or for artistic purposes.



Examples of images captured by a fisheye camera. The resulting image is considered an extreme form of barrel distortion.

With such photographs, users are also able to flatten or “dewarp” the image into a rectilinear or panoramic view using commercially available software applications.



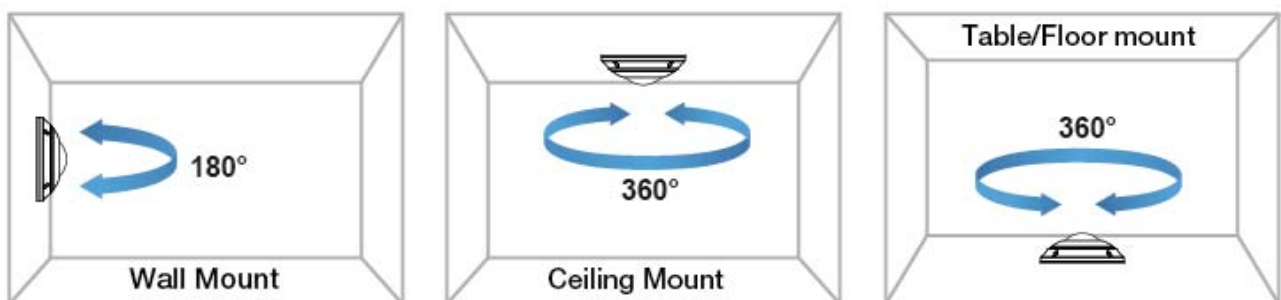
A fisheye lens creates a distorted view of a scene that, once dewarped, provides a powerful surveillance tool that can provide much more detailed coverage than a conventional lens.

Like many other traditional photography technologies that have been adapted for the surveillance industry, fisheye lenses represent a key component of the next-generation of cameras.

Applications

Equipped with a fisheye lens for 180° panoramic view (wall mount) or 360° surround view (ceiling/floor/table mount) without blind spots, a fisheye camera is able to provide an 8X wider field of view than a standard VGA camera. It is extremely suitable for monitoring open areas such as airports, shopping malls, parking lots, retail stores, offices and more.

Several mounting options are available for fisheye cameras:



Real world applications for a fisheye camera could be:

- Office spaces
- Banks
- Industrial
- Government
- Mass transit (mobile surveillance)
- Anywhere a complete overview of a scene is required

Let's examine a practical example: a single fisheye camera mounted in an office environment on a 10 foot tall ceiling can cover a 1,500 square foot room 65 feet x 25 feet in its entirety:



The images show complete coverage of the room from one end to the other. So we can predict that a 4,200 square foot room measuring 65 x 65 feet could also easily be covered using a fisheye camera. By using a regional viewing mode, users will be able to view each corner or side of the room independently:



Compare and contrast this with a standard 2-Megapixel camera. Although a 2MP camera can provide a detailed coverage, its standard lens means that the video can only be captured from one vantage point:



One can clearly see that a standard camera would be less effective in this case due to its fixed location in the corner of the room. Although it can see the far wall, objects in the floor are obscured due to the cubicle walls. In this case, a fisheye camera mounted on the ceiling in the middle of the room would provide much more comprehensive coverage.

Compared to a PTZ camera pointed at a specific area at any particular time, a fisheye camera can simultaneously monitor all four corners of a room. The viewer would be able to keep a track of suspicious objects without missing critical information.

Vendor Case Study: VIVOTEK

The FE8171V, part of the SUPREME series product line, is the first fisheye camera from VIVOTEK and has a built-in 3.1-Megapixel sensor and 1.27mm fisheye lens. Like in photography, the FE8171V will capture the image or video in a warped view, with an integrated plug-in in the Internet Explorer web browser, ST7501 or VAST Central Management Software being used to dewarp and remap the images into conventional rectilinear projection for specific viewing and analysis.

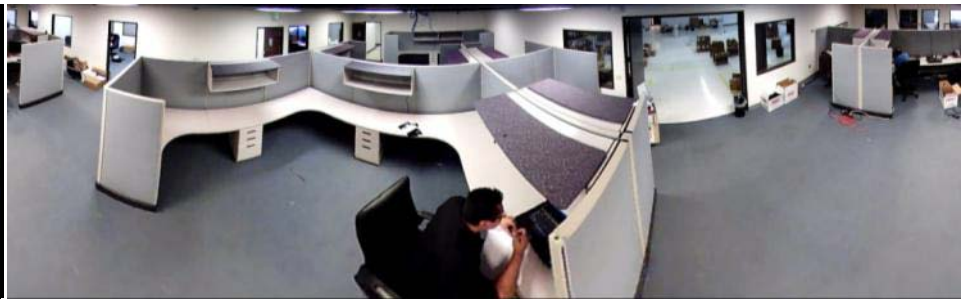
Moreover, leading third-party CMS platforms have or are planning to integrate the dewarping technology into their software, making the VIVOTEK FE8171V one of the most versatile and flexible in the industry.

Viewing modes available with the FE8171V include:

- “O” for “Original” view – This is the original, warped image captured by the camera.
- “P” for “Panoramic” view – This is the basic, panoramic view which has been dewarped. As its name suggests, the resulting image is a 180° wide view.
- “R” for “Regional” or “Rectilinear” view – This view allows for a single view, roughly equal to one quadrant of the overall image, which can undergo pan/tilt/zoom operations using the camera’s ePTZ feature.
- “2P” displays two Panoramic views. By rotating each view to opposite ends, users will see 180° on each side of the camera.
- “1P2R” allows the user two Regional views and one Panoramic view. The two Regional views can be manipulated independently, and the Panoramic view contains indicators of where each view is directed.
- “1O3R” shows the Original fisheye view and three Regional views. Indicators on the fisheye view again show where each view is pointed, facilitating ePTZ operation. This view is the equivalent of having three separate 720p HD cameras.
- “1P3R” shows a similar view to 1O3R, with the Panoramic substituted for the Original view.
- “4R” allows for manipulation of four independent Regional views. This is one of the most powerful display modes in the camera as it allows the user to view in four different directions simultaneously.
- “4R PRO” is similar to 4R mode, but automatically generates four separate Regional views. Pan/tilt operations will affect all windows simultaneously.
- “1O8R” allows for one original fisheye view and *eight independent* Regional views. This is an exclusive display mode to the FE8171V and it enables ultimate coverage and control by allowing the user to independently control each view. This mode is equivalent to having eight independent VGA cameras.



(A) Original Mode



(B) Panoramic Mode



(C) Regional Mode



(D) 2P Mode



(E) 103R Mode



(F) 4R Mode



(G) 108R Mode

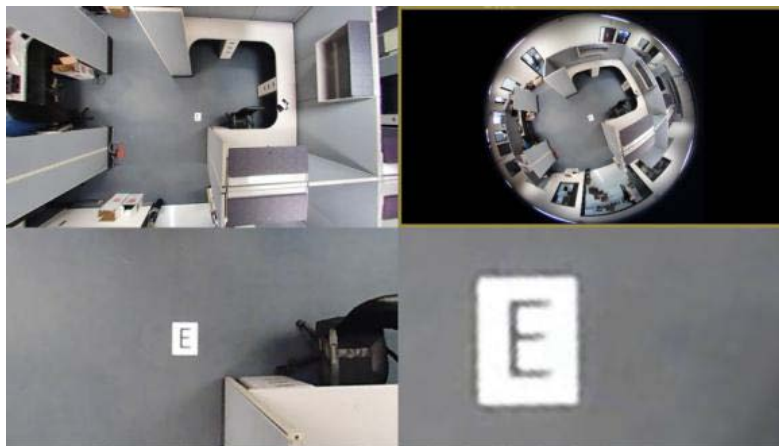
Benefits of VIVOTEK FE8171V

The main benefits in using the VIVOTEK FE8171V are its wide coverage at high resolution, excellent image quality, robust design, intuitive ePTZ control, user-friendly applications on handheld devices, industry standard encoding, cost-effective solutions, and unobtrusive appearance.

- Wide Coverage

As most users know by now, megapixel cameras provide far and away more coverage of a particular area than a standard resolution VGA camera. The FE8171V provides the detail of approximately eight standard resolution VGA cameras.

Even using the digital zoom feature, video can be zoomed in at least 4X before it starts to pixelate and objects become unidentifiable.



- Excellent Image Quality

VIVOTEK has long been known for its capability in performing superior optoelectronic integration and image quality. Among the capabilities, VIVOTEK offers to achieve high image quality through in-house image tuning of the sensor/lens/front end as well as close cooperation with lens and sensor manufacturers. The FE8171V uses the most advanced image processor to produce high quality images unsurpassed by other manufacturers.

Key advantages in image quality compared to other 360° cameras on the market include:

WDR Enhancement

FE8171V is the first 360° camera on the market to feature WDR Enhancement, making it usable in situations with glare, contrast, or backlighting.



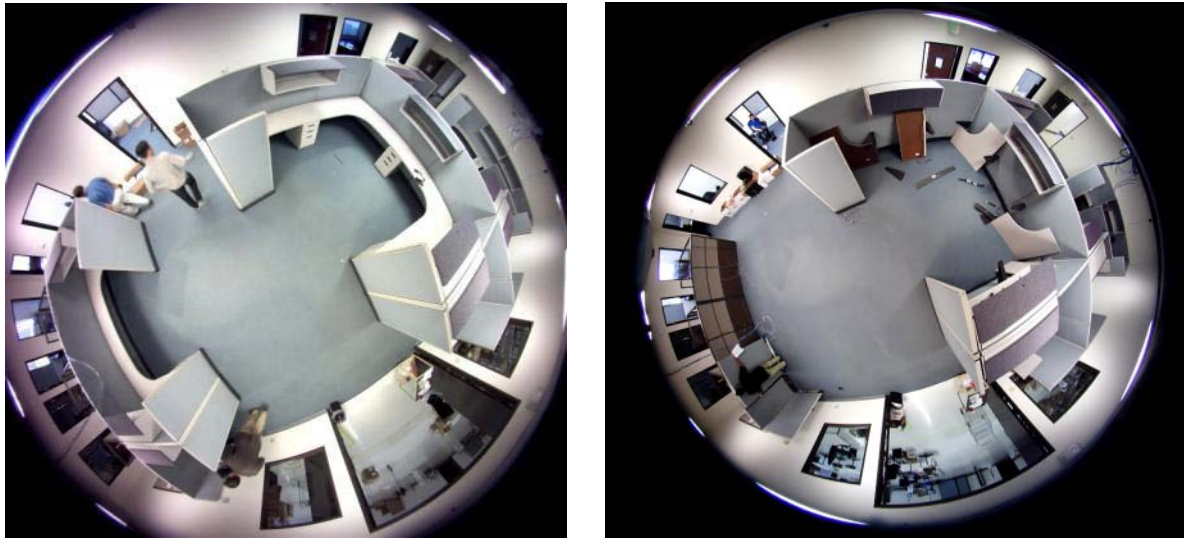
Without WDR Enhanced



With WDR Enhanced

Vignetting & Chromatic Aberration

By selecting the highest quality components and giving the user the ability to tune color profiles, a VIVOTEK fisheye camera is able to minimize the effects of vignetting and chromatic aberrations commonly found in wide angle lenses:



Competitor's fisheye camera (L) vs. VIVOTEK fisheye camera (R). The VIVOTEK camera has less vignetting and color fringing around the edge.

● Robust Design

Besides image quality, the FE8171V also retains all of the high-end features found in typical VIVOTEK cameras, including IK-10 vandalproof rating and IP66 weatherproof housing for enhanced security. With resistance to an extended temperature range of -25° C to 50° C, the FE8171V is also compliant with the EN50155 standard for electronic equipment operating in railway vehicles. It also meets the EN50155's shock and vibration requirements to provide high reliability and rugged performance during vehicle movement.



Actual image captured by the VIVOTEK FE8171V installed on the top of a car.

- Intuitive ePTZ Control

The FE8171V provides electronic pan/tilt/zoom functionality, allowing users to move to a target region in the viewing window without the need to physically manipulate the direction and position of the lens. Users can switch views and manipulate the viewing angle in a multitude of ways. In a “panoramic view” and a “regional view”, users can utilize the ultra-smooth ePTZ function to easily focus on a region of interest (ROI) using the mouse wheel or joystick.

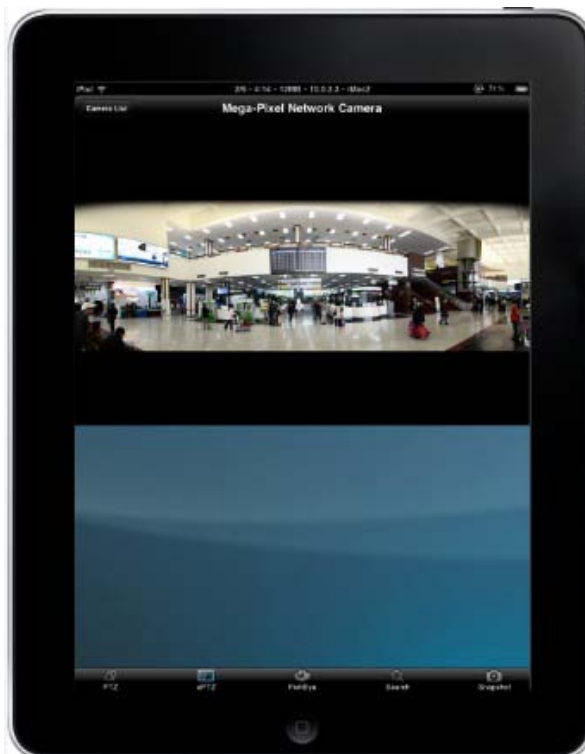
Compared to conventional mechanical PTZ, the ePTZ feature offers zero-wait operation through client-side control. In addition, with a high-end dewarping algorithm (plug-in), the ePTZ on the FE8171V responds swiftly and seamlessly to a user’s control.



ePTZ in 103R Mode

- User-friendly Applications on Handheld Devices

By connecting an FE8171V camera to a server running VIVOTEK’s VAST or ST7501 central management software, users can use the iViewer app to control ePTZ operations using the touchscreen on an iPhone or iPad. This affords an additional level of usability for integrators and end users on the go.



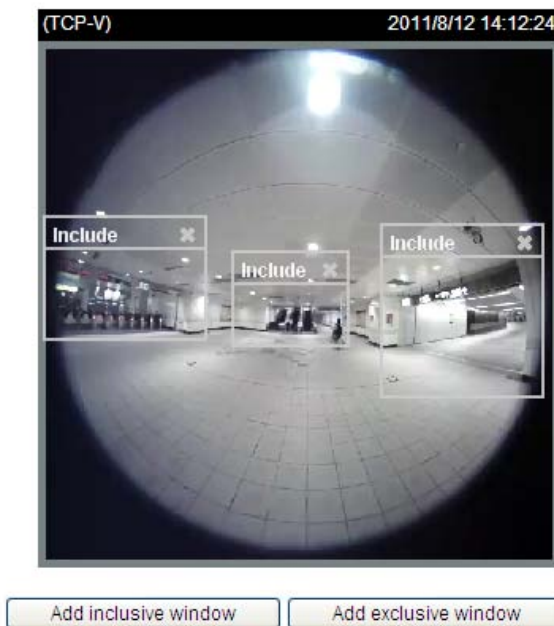
Panoramic View on iPad

- Customized Exposure

Due to the super wide angle of view of fisheye cameras, there are often unwanted light sources in the video. When applying auto exposure control, these light sources may have undesired effects, making the image darker.

With this in mind, VIVOTEK has developed the **Customized** Exposure feature. Users can choose their region of interest (ROI) and the camera will only calculate the exposure level based on the region of interest while ignoring the other regions.

For example, when viewing on a hallway with 3 exits, users might want to use **103R** as the viewing mode. In order to obtain the best image, Customized Exposure could be applied as shown in the following picture:



Or, if the viewing area includes a portion of the sky or ground, the user might choose windows that exclude these unneeded areas.



With **Customized Exposure**, users have the advantage of an extremely wide angle of view while maintaining the best video quality.

- **Standard Codec**

Flexible decoding methods ensure that even though video is recorded and stored in the original fisheye format, it can be decoded into any of the aforementioned views for analysis of an entire area. The decoding is performed by software rather than on the camera as bandwidth requirements would increase dramatically if the dewarped images were sent through a network.

Like other VIVOTEK 8000-series cameras, the FE8171V supports H.264 compression, widely regarded as the standard for video compression in the video surveillance industry today. In addition to H.264, MPEG4, and MJPEG compression, stream configurations are also selectable by the user in order to tailor performance to the viewing or recording platform. By using open standards as well as being ONVIF-compatible, the FE8171V is assured the most comprehensive third-party software support of any fisheye camera in the industry.

- **Cost-effective Solution**

Using the FE8171V also delivers significant cost savings for an installer and end user. One FE8171V camera can capture an area that would normally require 720p cameras x 3. From a TCO analysis standpoint, an end user would realize significant savings in the following areas:

Item	Qty	Cost Savings (USD)
720p Cameras	2 units	\$1,300
Cabling	450 ft	\$68
NVR/SW Licenses	3 licenses	\$640
Labor	2 hrs	\$150
Total		\$2,858

These savings reflect installation for a single room. For a large commercial building covering multiple rooms, this figure can easily be multiplied.

- **Unobtrusive Appearance**

With a stylish, compact metal housing, the FE8171V is easy to install and blends seamlessly into any location, minimizing the feeling of being under surveillance.



Conclusion

Compared to analog and standard resolution cameras, megapixel cameras already represent significant benefits in cost savings as well as resolution. A fisheye lens increases the utility of a network camera to an even greater degree by capturing more of an area with multiple views. By offering the flexibility of viewing multiple objects from the same camera, a greater freedom of choice and flexibility is realized for security installations of all sizes.



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