УДК 811.111:005.5

Folynskov D., Folynskova E., Khomenko S.

Specific Peculiarities Use of Fisheye Panoramic Camera

Belarusian National Technical University
Minsk, Belarus

Traditional surveillance cameras capture relatively narrow fields of view, typically about 90 degrees, a quarter of a circle. When extremely wide angles need to be covered, such as the extreme left or right or in the opposite direction, would typically add more cameras. In this approach, due to their finite size, the cameras cannot be collocated. Hence, they do not share a single viewpoint and, in general, have significant parallax. To address this issue, uses a pyramidal mirror to co-locate the viewpoints of multiple cameras, thus eliminating the parallax [1]. In all cases, the use of multiple cameras requires careful geometric and photometric calibration of the cameras as well as synchronization with respect to time. Moreover, the use of multiple cameras can make the imaging system bulky and expensive. A popular dioptric solution is the use of fisheye lenses [2].

Fisheye panoramic cameras let you deploy a single camera that can "see" in a circle, typically a full 360°. This image figure 1 shows the difference in field of view between the two.

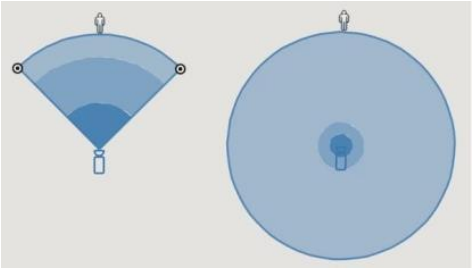

Fig. 2 – Difference in Field of View between the Typical Camera and Fisheye Panoramic Camera

However, these cameras have their own characteristics. Because of their extreme angle of view, fisheye images are distorted, typically referred to as "warped", appearing as an oval or circle. Fisheye camera streams also typically include blank space, since the full image circle does not cover the corners of the imager [3].

All the same, fisheye images are generally not used in their normal, warped state, as these images are difficult to monitor, with objects appearing upside down or sideways depending on where they are in the field of view. Instead, special software is used to "dewarp" the image, which flattens it into a more typical, usable surveillance image.

Dewarping is a critical component of fisheye panoramics since warped video, by itself, is practically useless. Dewarping is performed in one of two locations (or both):

Camera-side: Dewarping is performed in the camera, prior to streaming to the video management system (VMS).

Client-side: The full warped stream is sent to the VMS, with client software performing dewarping. The choice of where to dewarp impacts VMS integration and usability greatly.

There are several types of fisheye lenses which use different "projections" when dewarping, including stereographic, equidistant, and Panomorph.

Typical fisheye lenses use equidistant projections, which maintains an angular distance throughout the field of view, making it the most "even" type of lens. Stereographic and Panomorph lenses shift more detail to the edge of the field of view, which is typically drastically distorted [4].

Mounting fisheye panoramic cameras low and close to targets is critical. The pixel density of panoramic cameras falls quickly as the subject moves farther away from the camera, so increased distance resulting from mounting cameras higher worsens this issue.

For instance, a subject who is 1,5m away from a 6MP 360 camera will be captured at nearly 100 PPF, but the same subject at 3m will drop to only ~48 PPF. At 6m, relatively short for most typical cameras, PPF is only ~24 PPF, too low to provide much usable detail [3].

To avoid such problems, do not mount the cameras too high or use extension cords to get the camera closer. (of course, with the recognition that this may be aesthetically displeasing).

Ceiling Vs. Wall Mounting. Nearly all fisheye panoramic models may be either ceiling-mounted (looking down) or wall-mounted (looking horizontally out).

The decision of whether to mount a fisheye camera on the ceiling or wall essentially depends on where subjects are likely to move through the scene.

Wide area of interest: If objects to be observed are likely to move throughout the scene and not just near the camera, using a ceiling mount camera is likely the better option, as it may increase details of objects too far away for a wall mount camera to capture.

Narrow area of interest: If objects are likely to enter/exit through one or two locations, wall mounting a fisheye camera is likely to provide better details of subjects as they pass due to its lower angle of incidence.

Wall Mount Fisheye Camera Pros and Cons. The main

advantage of wall mount fisheye cameras is simplicity, as they generally dewarp onboard and output a panorama stream, instead of requiring more complex camera or client side dewarping integration and setup.

However, these models are generally lower resolution than typical fisheye cameras, 3-5 MP instead of 6-12 MP found in typical high end high resolution fisheye models, so may display fewer details.

In 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.

References:

1. S. Lin and R. Bajcsy. True single view point cone mirror omni-directional catadioptric system. – In ICCV, 2001. – p. 102–107.
2. K. Miyamoto. Fish eye lens. JOSA, p. 1060–1061, 1964.
3. «Fisheye Panoramic Camera Guide» [Electronic resource]. Mode of access: https://ipvm.com/reports/fisheye-guide. – Date of access: 01.03.2021.
4. U. Iwerks and S. Oaks. US Patent No. 3,118,340: Panoramic motion picture camera arrangement, 1964.