HIKVISION

HIKVISION
Dual-Lens People Counting Technology

More lenses, greater accuracy.

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WHITE PAPER

Table of Content

1. BACKGROUND

With the rise in human resource cost and the competition becoming fiercer, government agencies, enterprises, public institutions, and self-employed workers are all transforming management mode from extensive to refined. Precise people counting data can provide the data reference for effective and accurate management and decision making. The technology can be applied to several industries, including retail and chain, real estate, transportation, public service, tourism, etc.

Superseding manual counting and IR curtain counting methods, people counting based on video analysis has become the main technology. Moreover, dual-lens people counting technology based on the binocular stereo vision has better counting data accuracy, application scene compatibility, anti-interference ability, and configuration convenience. It's a good choice for a people counting strategy.

2. KEY TECHNOLOGIES

Hikvision dual-lens people counting technology is based on the binocular stereo vision and performs people detection and tracking in 3D space, analyzes the people moving track, and finally achieves precise counting data.

The technology consists of the following three sub-technologies: binocular stereo vision, 3D people detection and tracking, and height filtering.

2.1. BINOCULAR STEREO VISION

Binocular Stereo Vision is a technology that based on the observation of the same object from two different positions. We can generate the position offset in the two images to get the 3D geometric information of the environment and the objects.

The parallax is the effect whereby the position or direction of an object appears to differ when viewed from different positions. The parallax angle is the angle between the two observing positions. The parallax range is the distance angle between the two observing positions. For the Binocular Stereo Vision, the right lens and the left lens optical axis should be parallel. As shown in Figure 1, the parallax at P point is $d = u_1 - u_2$.

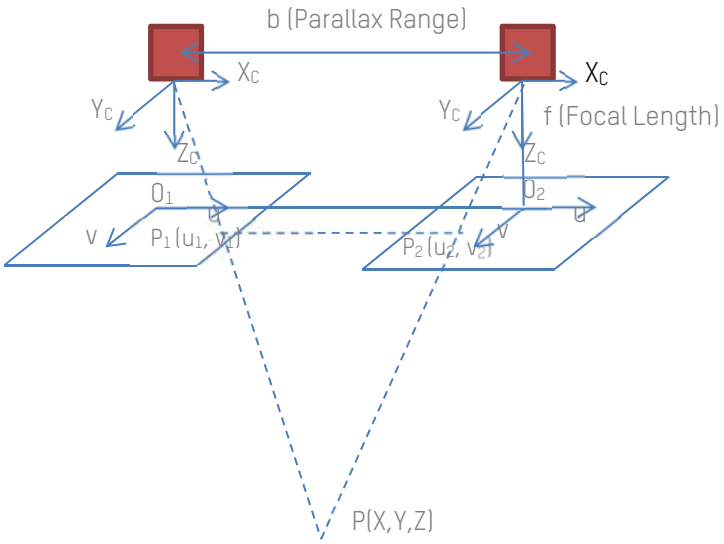

Figure 1 Diagram of Binocular Stereo Vision Theory

Then use the parallax and the below formula to get the X,Y,Z coordinates of the P point in the left lens.

$$x_c = \frac{b * u_1}{d}, \qquad y_c = \frac{b * v_1}{d}, \qquad z_c = \frac{b * f}{d}$$

In this way, the binocular stereo vision can get the 3D coordinates of all points in the image and support further people detection and tracking.

See the Figure 2 for the images from the right lens and the left lens at the same time.

Figure 2 The Images From The Right Lens And The Left Lens

See the following pictures for the parallax greyscale image and the parallax pseudo-color image.

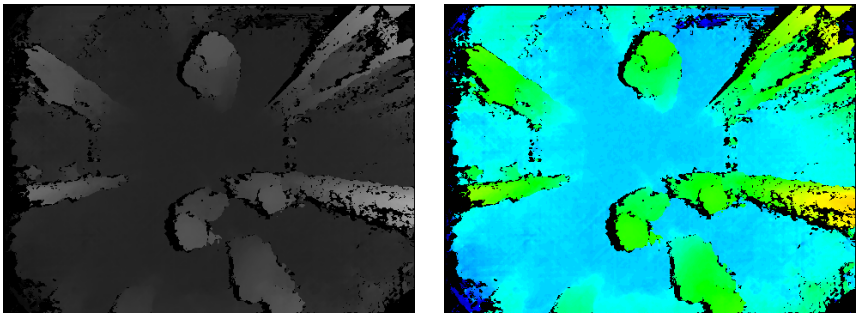

Figure 3 The Parallax Greyscale Image And The Parallax Pseudo-Color Image

See the following pictures for the image from the left lens and the corresponding top view of 3D image.

Figure 4 The Image From The Left Lens And The Corresponded Top View of 3D Image

Based on the binocular stereo vision coordinates, the camera creates a model that is stereo and is updated in real time according to the images. Compared to the 2D modeling, the 3D modeling is more accurate and has better adaptability, which can be less affected by the illumination changes.

See the following figure for the 3D environment modeling diagram.

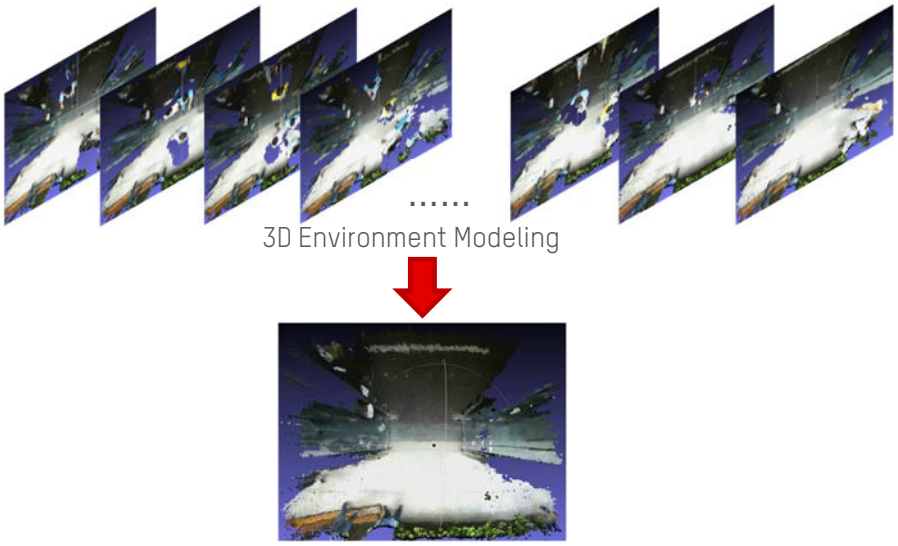

Figure 5 3D Environment Modeling Diagram

2.2. 3D PEOPLE DETECTION AND TRACKING

The technology is based on the spatial distribution features that the head is always higher than the shoulder, and thus is able to detect the head accurately so as to focus the people. The technology can easily adapt to different installation heights and simple or complicated environments.

See the following figure for the 3D people (head) detection result, the detected targets are marked with the colorful cubes.

Figure 6 3D People (Head) Detection

After focusing the target, the camera can track the target until it disappears in the image. The technology can effectively prevent the repeated count of the loitering target.

See the following figure for the moving track of the each target.

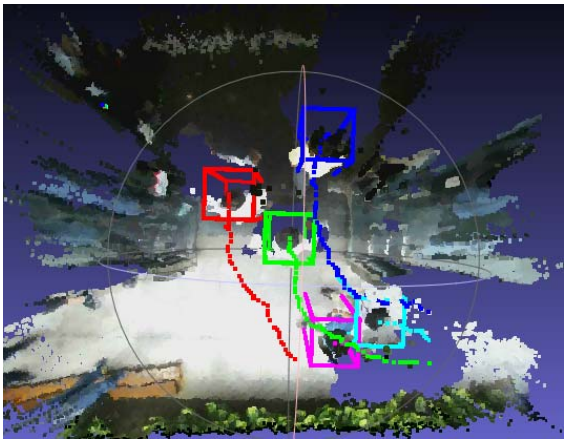

Figure 7 3D Tracking

2.3. HEIGHT FILTERING

Based on the height information in the Z-axis, the target height should be in the range of the average human height, to prevent the interference of the cart, baby carriage, etc.

3. APPLICATIONS

See the below picture for the actual output image of the dual-lens people counting camera.

Figure 8 Snapshot of the Dual-Lens People Counting Camera

The dual-lens people counting technology can be widely applied to entrance and exit of shopping malls, super markets, chain stores, stations, etc. With the help of the statistic software, the data can be generated into daily, monthly, and annual reports and provides the commercial analysis basis.

Museum

Shopping Mall

Figure 9 Application Scenes

4. SUMMARY

Hikvision dual-lens people counting technology is a self-developed technology that is mainly based on binocular stereo vision and aims at providing the people counting solution to the commercial industries. Compared to the traditional monocular people counting technology, the dual-lens people counting technology has the following advantages:

- More accurate
- Easier configuration
- Better environment adaptability
- Better anti-interference ability, such as the interferences of cloth color, hair style, shadow, carts, target loitering, etc.

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