Obstacle Detection System with Stereo Cameras for Level Crossings

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Some level crossings in Japan are installed with an obstacle detection system to prevent collision between trains and large-size automobiles captured on the track. In the aged society of Japan, however, aged people often run into trouble on level crossings in recent years. As barrier-free design prevails, more and more wheelchair users have chances to pass level crossings and are potentially involved in level crossing accidents.

The level crossing obstacle detection system that uses stereo cameras detects pedestrians and wheelchairs that cannot be detected by the conventional systems of the photoelectric (optical beam), ultrasonic, and loop coil types (Fig. 1).

Since this system uses TV cameras, it can record the images of the detected obstacle. If the memory is enlarged, it will be able to record the behaviors of the obstacle before and after it is detected, which will be transmitted to the train dispatching center, stations, and train drivers in the future.

The stereo cameras (Figs. 2 and 3) apply the principle of triangulation (Fig. 4), calculate the parallax between camera images, and convert it into a distance over the entire screen to determine the three-dimensional profile of the object. The level crossing surface is roughly two-dimensional in almost all cases. Therefore, the system detects three-dimensional objects that have entered the level crossing area as an obstacle (Fig. 5).

This system is now subjected to a long-term test on a revenue service line. Under normal weather conditions, there are only limited cases where the system fails to detect the object that is passing the level crossing, or erroneously detects direct sunlight or automobile headlights as an obstacle. The detection logic is now being improved to eliminate such failures.

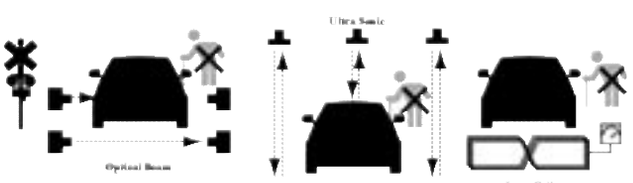

Figure 1. Conventional obstacle detection systems for level crossings: (a) Optical beam method, (b) Ultra sonic method, (c) Loop coil method.

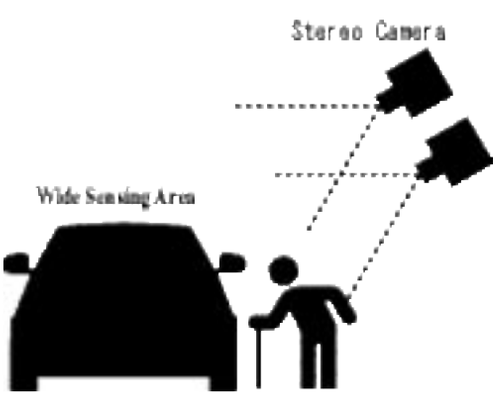

Figure 2. Stereo camera method.

Figure 3. Appearance of stereo camera unit.

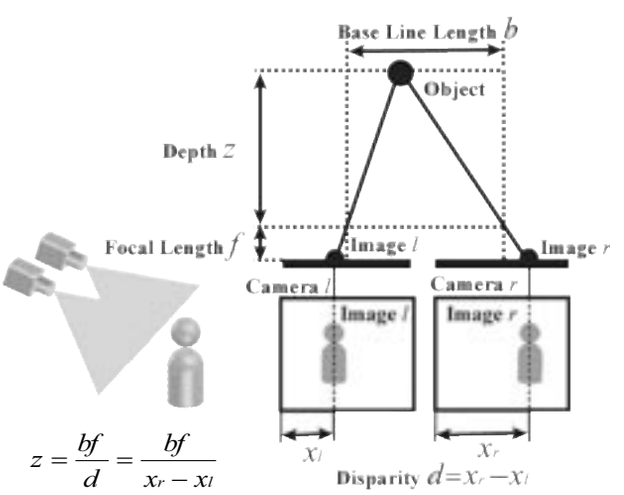

Figure 4. Principle of stereo camera.

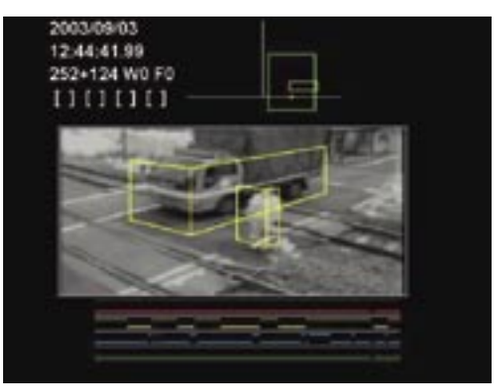

Figure 5. Example of detected obstacle.