

FEATURING

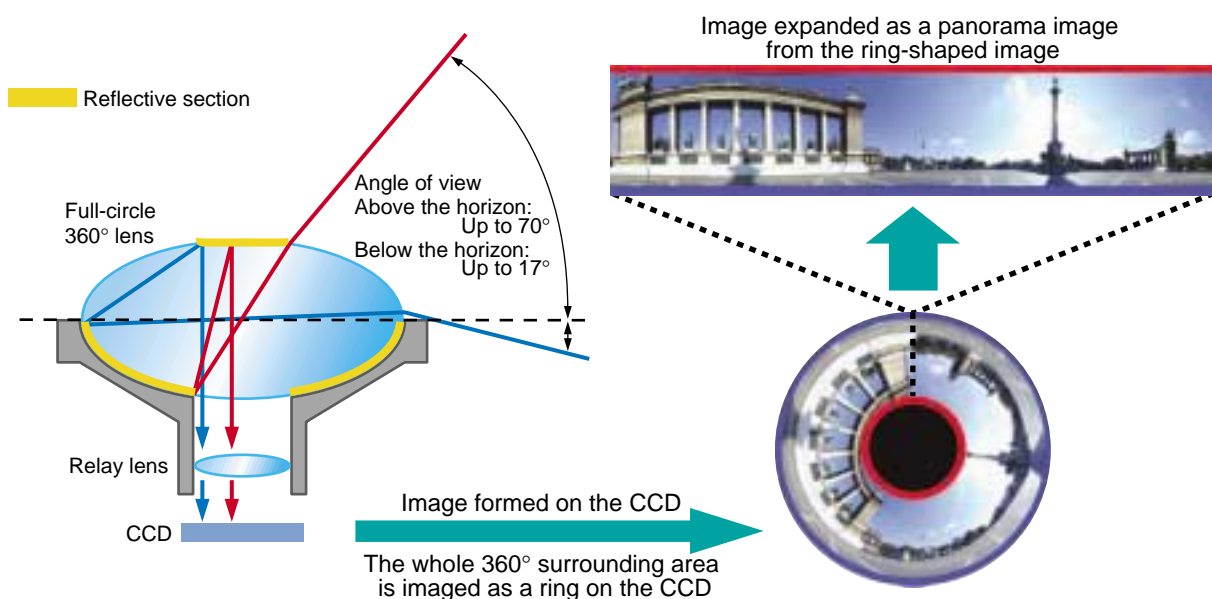
Full-Circle 360° Camera Module

Camera Module Adopts Full-Circle 360° Lens to Open New Markets

- Images a full 360 degrees in one operation
- Supports pan, tilt, and zoom without mechanism
- Focus adjustment for distance not required
- Images the whole surround area with a small convex lens

Until now, taking a 360° panorama with a normal lens has required taking multiple shots while rotating the camera slowly and then combining (“stitching”) those shots together to form the panorama. In contrast, the 360° full-circle lens allows the full 360° surroundings of the camera to be imaged at the same time with a single lens.

Sony has now developed a camera module that uses this 360° full-circle lens, and is releasing as commercial products both a camera module that uses a 380K-pixel, 30 fps CCD that outputs a ring-shaped image as a composite video signal as well as a high-resolution camera module that uses a 1.28 MP, 7.5 fps CCD with a built-in panorama expansion processing function. New functions and applications can be created by combining these devices with a variety of different products, and thus these products can contribute to the creation of new markets.



■Figure 1 Full-Circle 360° Lens Mechanism

Full-Circle Lens Overview

The mechanism that allows this full-circle 360° lens to see all of its surroundings is shown in figure 1. The image of all the surroundings is reflected twice on two reflective surfaces (formed by vapor deposition of aluminum), one in the lower part of the lens and the other at the top and the image is formed in a ring shape on the CCD. This allows everything around the lens to be imaged within a range consisting of 70° above the plane of the lens and 17° below that plane. (This is close to the area illuminated by a lighthouse. This angle was set when the lens was designed.)

This full-circle 360° lens has the following main features.

- The whole surrounding area can be imaged with a single lens.
- The area below the plane of the lens can also be imaged.

- This lens design logically results in a depth of field (the range of distances in which objects are in focus) from 0 to infinity. This means that focusing is not required.
- There are no moving structural parts, and pan, tilt, and zoom operations can be implemented in software. This makes maintenance easy, and power consumption low.
- Since images can be formed as long as just the lens section is exposed, the camera module itself can be embedded in a wall or ceiling.

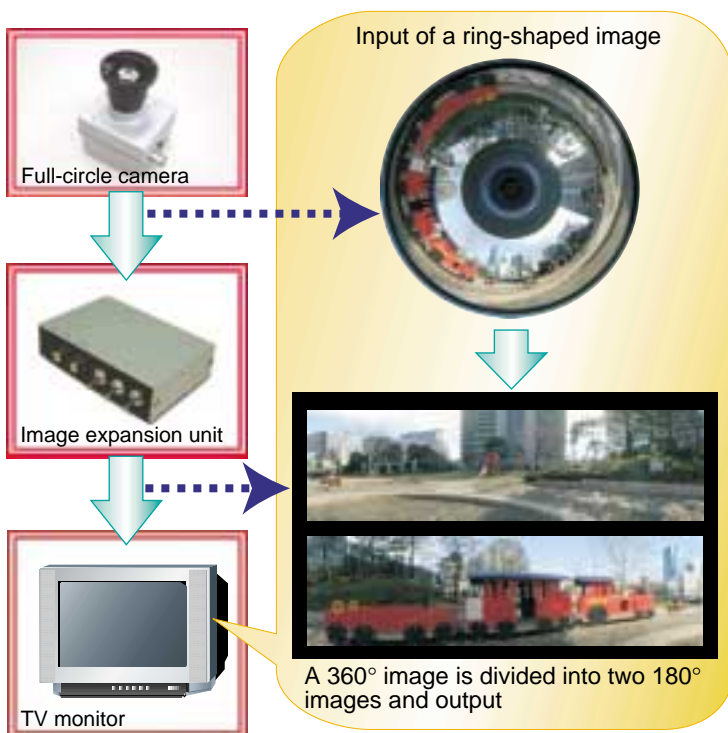
Methods for Panorama Expansion

Since the ring-shaped images taken with this full-circle 360° camera look odd when viewed directly, they must be converted to more pleasing panorama images. There are two ways to implement this panorama expansion processing: in hardware or in

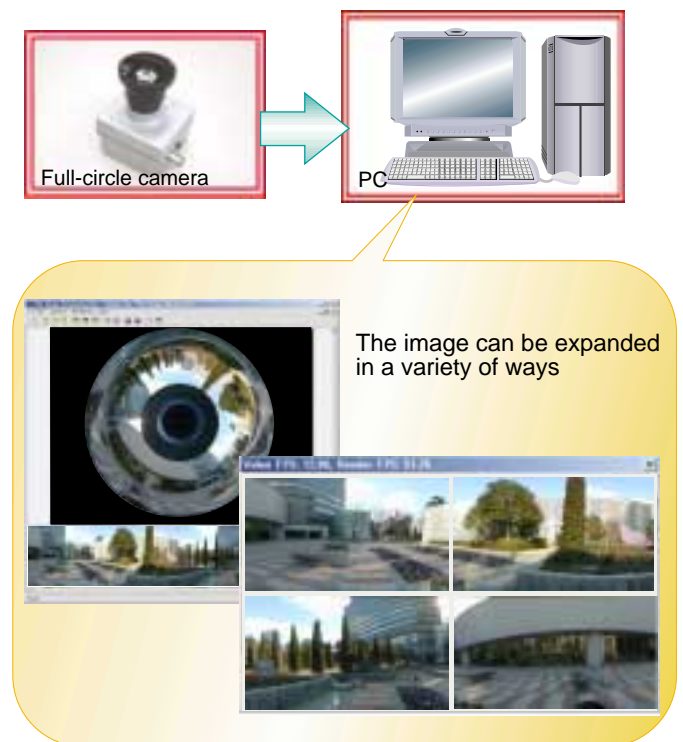
software.

Hardware-based panorama expansion uses a dedicated expansion unit that outputs expanded panorama images as a simple composite video signal without the need for a PC. (See figure 2.)

In contrast, in the software-based approach, the captured ring-shaped image is converted in software on a PC to a panorama image and then output. The software approach provides flexible processing that can support a wide range of variations, such as pan, tilt, and zoom functions. If the PC is connected to a network, only the required sections of the images can be transmitted over the network. (See figure 3.)



■Figure 2 Hardware-Based Image Expansion



■Figure 3 Software-Based Image Expansion

A Variety of Sample Applications

Several ways of using the full-circle 360° camera module come to mind: in sensor and home monitoring applications, in image storage, and in communication applications.

1. Sensor applications

When used as a sensor, ring-shaped images from the full-circle 360° camera module would be captured periodically by the PC and moving objects could be detected from those images. This would allow, for example, intruders to be detected.

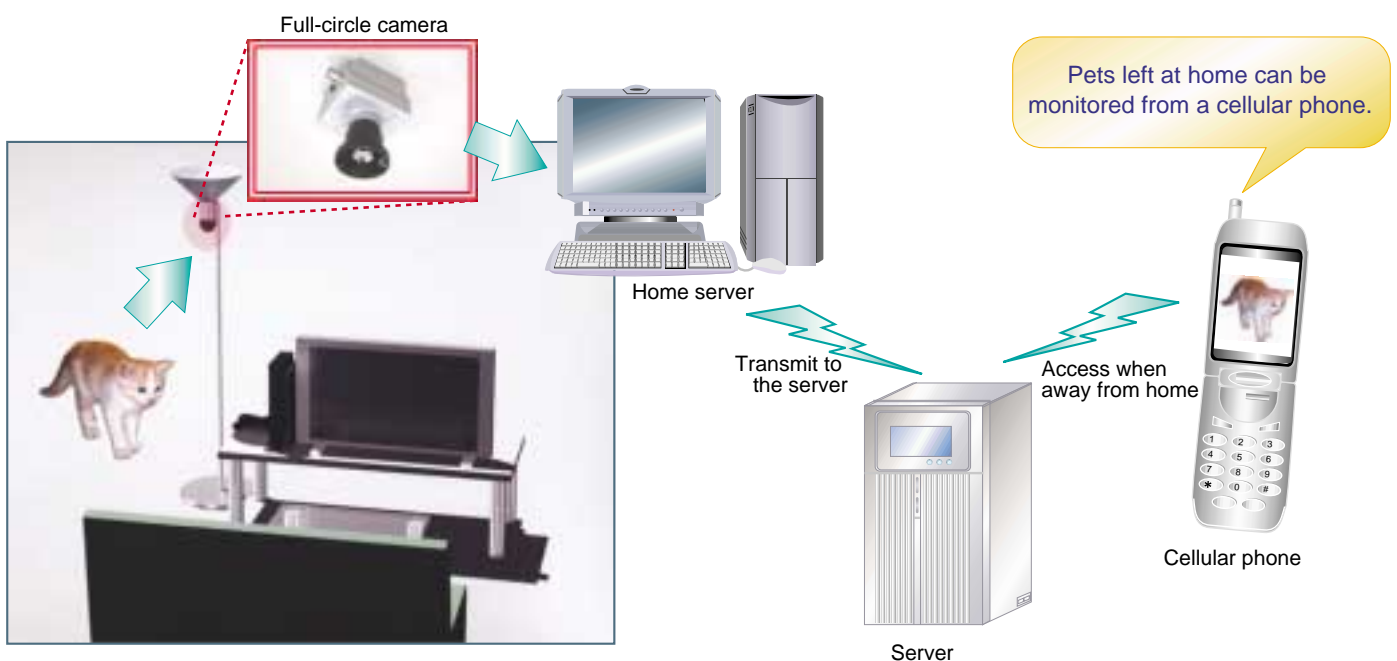
2. Home monitoring applications

This module could be used as the surveillance camera in a home monitoring system. Here, the camera images the conditions in the vicinity around the camera and that information is transmitted first to the home server and then out over the Internet. This system would allow users to access it with their cellular phones when away from home and observe conditions in the house. This system could be developed further, for example, to use moving object detection to detect suspicious intruders when you are away from home and immediately send an image of that intruder to your cellular phone. This could also be used to check on how your pets are doing when you are out. (See figure 4.)

This system would also be appropriate for remote monitoring in factories and for parking lot monitoring systems.

3. Image storage applications

One example of an image storage system application would be an electronic meeting recording system. This system is now desired when doctors explain their diagnoses to patients and when lawyers meet with clients. In these scenes, use of the full-circle 360° camera module would allow the system not only to record the audio, but also to record at the same time all the surrounding conditions, such as who was there and what they were looking at.



■Figure 4 Full-Circle Camera Application: Home Monitoring

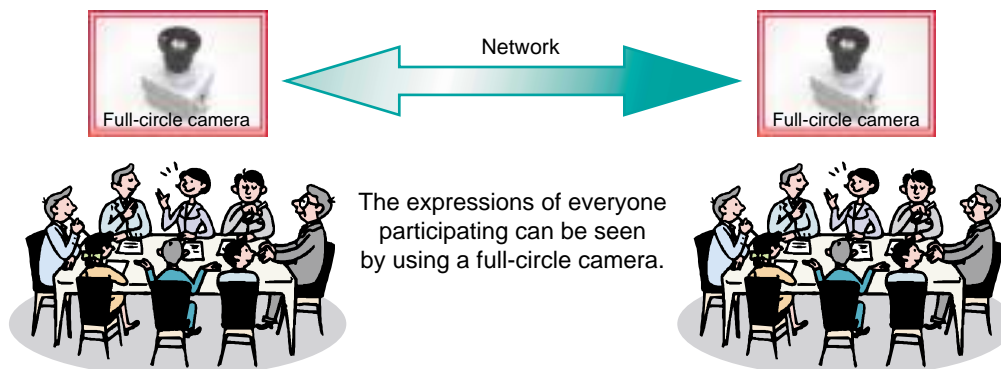
4. Communication applications

One example of a communication application would be use in a web conference system. In the current web conference system, systems in which each participant uses their own PC or terminal are the mainstream. However, if the full-circle 360° camera module were used, the system could also handle meetings with one local conference room (many participants) and the other remote conference room (many participants). (See figure 5.)

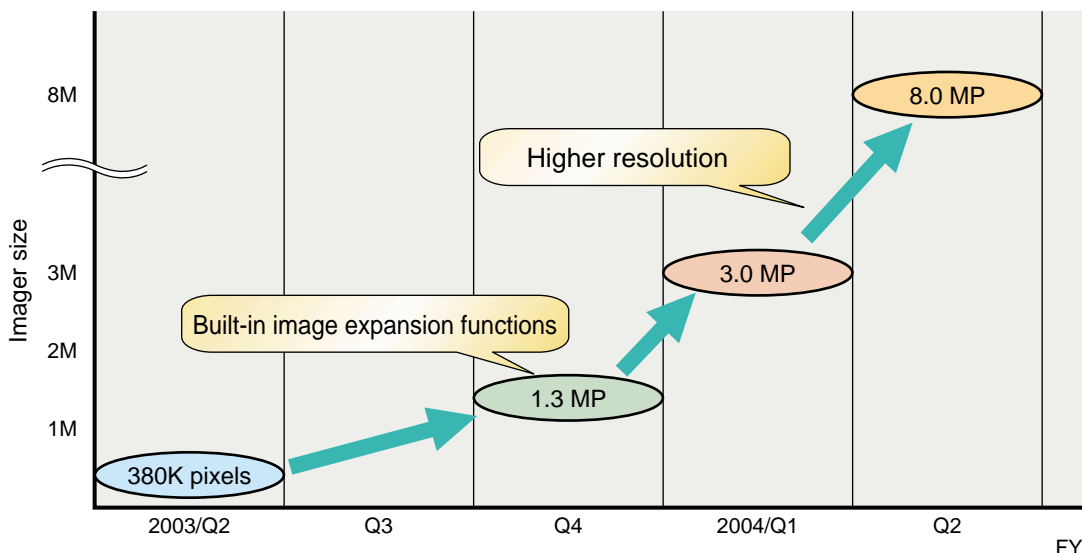
In applications such as these, the full-circle 360° camera module can provide the added value of “seeing” when combined with a variety of other products.

Future Module Developments

To respond to an ever wider range of users’ market needs, Sony is also working both to improving the image quality by increasing the CCD’s resolution and to achieving further miniaturization in the lens system. Sony is also developing, in addition to the current composite video signal module, modules which provide a digital interface for use with networks and other information equipment. Sony is committed to expanding the lineup of camera modules that use the full-circle 360° lens through these efforts. Keep you eye on Sony for the latest in full-circle 360° camera modules.



■Figure 5 Full-Circle Camera Application: Network Conference System



■Figure 6 Full-Circle Camera Roadmap