DESCRIPTION

TITLE OF INVENTION

IMAGE PROCESSING APPARATUS, IMAGING APPARATUS, AND CONTROL METHODS THEREOF

TECHNICAL FIELD

[0001] The present invention relates to an image processing apparatus, an imaging apparatus, control methods thereof, and a program.

BACKGROUND ART

[0002] An imaging apparatus capable of capturing a plurality viewpoint images at the same time by recording light beams having passed through different pupil regions of an imaging lens is known. NPL 1 has disclosed an imaging apparatus using an image sensor in which one microlens and a plurality of divided photoelectric converters are formed in one pixel. In this image sensor, the divided photoelectric converters receive light beams having passed through different pupil partial regions of an imaging lens through one microlens, thereby implementing so-called pupil division. Accordingly, an output signal is equivalent to LF (Light Field) data containing light intensity spatial distribution information and angle distribution information, so a plurality of viewpoint images can be obtained.

[0003] NPL 1 has also disclosed a refocusing technique capable of changing the focus position (also called the in-focus position) of a captured image after imaging by generating a synthetic image formed on a virtual plane different from an imaging plane by using the obtained LF data.

CITATION LIST

NON PATENT LITERATURE

[0004]

NPL 1: Ren. Ng, and seven others, "Light Field Photography with a Hand-Held

CLAIMS

1. An image processing apparatus characterized by comprising:

obtaining means for obtaining an image signal containing intensity information and angle information of an incident light beam;

operating means for accepting a viewpoint changing operation and a focus position changing operation; and

processing means for generating, based on a plurality of viewpoint images obtained based on the image signal, a display image by changing a viewpoint in accordance with the viewpoint changing operation, and changing a focus position in accordance with the focus position changing operation.

2. The image processing apparatus according to claim 1, characterized in that in a case where the display image can be generated by changing the viewpoint in a predetermined direction based on the image signal, the operating means accepts the viewpoint changing operation along the predetermined direction.

3. The image processing apparatus according to claim 1, characterized in that in a case where the display image can be generated by changing the viewpoint in a predetermined direction based on the image signal, the operating means accepts the focus position changing operation along a direction different from the predetermined direction.

4. The image processing apparatus according to claim 2 or 3, characterized in that the operating means accepts the viewpoint changing operation, such that the change in viewpoint in the predetermined direction increases as a position moves away from a predetermined position in the predetermined direction, and the change in viewpoint increases in a direction opposite to the predetermined direction as a position moves away to an opposite side from the predetermined position along the predetermined direction.

5. The image processing apparatus according to any one of claims 2 to 4,

characterized in that a predetermined direction is a horizontal direction or a vertical direction.

6. The image processing apparatus according to claim 5, characterized in that in a case where displaying, in a vertical position, the display image whose viewpoint can be changed in a horizontal direction in a horizontal position, the operating means accepts the viewpoint changing operation in a vertical direction.

7. The image processing apparatus according to claim 6, characterized by further comprising display means for displaying a notation indicating a viewpoint changing direction in accordance with the viewpoint changing operation,

wherein the display means changes the notation in accordance with a direction in which the operating means accepts the viewpoint changing operation.

8. The image processing apparatus according to any one of claims 2 to 7, characterized in that the operation means accepts the focus position changing operation, such that the change in focus position increases as the focus position changing operation moves away from a predetermined position in an operation accepting direction.

9. The image processing apparatus according to any one of claims 1 to 8, characterized in that the operating means accepts the viewpoint changing operation and the focus position changing operation in a state in which a display image based on the image signal is displayed.

10. The image processing apparatus according to any one of claims 1 to 9, characterized in that

the operating means further accepts an operation of changing a degree of edge enhancement in the display image, and

the processing means performs edge enhancement on a focused region in the display image in accordance with the degree of edge enhancement.

11. The image processing apparatus according to any one of claims 1 to 10,

characterized in that the processing means generates the display image by changing a weight for adding the plurality of viewpoint images in accordance with the viewpoint changing operation, and adding the plurality of viewpoint images by using the weight.

12. The image processing apparatus according to any one of claims 1 to 11, characterized in that the processing means generates the display image by changing a shift amount between the plurality of viewpoint images in accordance with the focus position changing operation, and adding the plurality of viewpoint images shifted by the shift amount.

13. An imaging apparatus characterized by comprising:

an image sensor in which pixels each including a plurality of subpixels are two-dimensionally arranged, and which outputs an image signal containing intensity information and angle information of an incident light beam based on signals output from the subpixels;

operating means for accepting a viewpoint changing operation and a focus position changing operation; and

processing means for generating, based on a plurality of viewpoint images obtained based on the image signal, a display image by changing a viewpoint in accordance with the viewpoint changing operation, and changing a focus position in accordance with the focus position changing operation,

wherein in the image sensor, the plurality of subpixels are arranged in a predetermined direction in the pixel, and

in a case where the display image can be generated by changing the viewpoint in a predetermined direction based on the image signal, the operating means accepts the viewpoint changing operation along the predetermined direction.

14. The imaging apparatus according to claim 13, characterized in that in a

case where the image signal captured in a horizontal position by using the imaging apparatus is displayed as the display image in the horizontal position, the operating means accepts the viewpoint changing operation along the predetermined direction, and in a case where the image signal captured in the horizontal direction is displayed as the display image in a vertical position, the operating means accepts the viewpoint changing operation along a direction perpendicular to the predetermined direction.

15. The imaging apparatus according to claim 14, characterized by further comprising display means for displaying a notation indicating a direction in which a viewpoint is changed in accordance with the viewpoint changing operation,

wherein the display means changes the notation in accordance with a rotational angle from a vertical position or a horizontal position in which the image signal is captured.

16. A control method of an image processing apparatus, characterized by comprising:

an obtaining step of causing obtaining means to obtain an image signal containing intensity information and angle information of an incident light beam;

an operating step of causing operating means to accept a viewpoint changing operation and a focus position changing operation; and

a processing step of causing processing means to generate, based on a plurality of viewpoint images obtained based on the image signal, a display image by changing a viewpoint in accordance with the viewpoint changing operation, and changing a focus position in accordance with the focus position changing operation.

17. A control method of an imaging apparatus comprising an image sensor in which pixels each including a plurality of subpixels are two-dimensionally arranged, and which outputs an image signal containing intensity information and

angle information of an incident light beam based on signals output from the subpixels, characterized by comprising:

an obtaining step of causing obtaining means to obtain the image signal output from the image sensor;

an operating step of causing operating means to accept a viewpoint changing operation and a focus position changing operation; and

a processing step of causing processing means to generate, based on a plurality of viewpoint images obtained based on the image signal, a display image by changing a viewpoint in accordance with the viewpoint changing operation, and changing a focus position in accordance with the focus position changing operation,

wherein in the image sensor, the plurality of subpixels are arranged in a predetermined direction in the pixel, and

in the operating step, in a case where the display image can be generated by changing the viewpoint in a predetermined direction based on the image signal, the viewpoint changing operation is accepted along the predetermined direction.