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Takagi

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(54) **IMAGE PROCESSING APPARATUS, IMAGE PICKUP APPARATUS, IMAGE PICKUP SYSTEM, IMAGE PROCESSING METHOD, AND NON-TRANSITORY COMPUTER-READABLE STORAGE MEDIUM**

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(51) **Int. Cl.**

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H04N 5/232	(2006.01)
G06T 7/00	(2006.01)
G06T 7/20	(2006.01)

(52) **U.S. Cl.**

CPC ***H04N 5/23254*** (2013.01); ***G06T 7/0026*** (2013.01); ***G06T 7/2006*** (2013.01); *G06T 2207/10148* (2013.01)

(58) **Field of Classification Search**

CPC H04N 5/225; H04N 5/23254; H04N 5/23274; G06T 5/003; G06T 5/50
USPC 348/222.1, 47, 348, E13.074, 208.1, 348/E05.031, 208.4; 382/294
See application file for complete search history.

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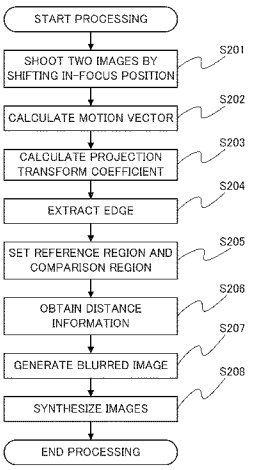
(57) **ABSTRACT**

An image processing apparatus includes a calculator configured to calculate coordinate conversion information for associating a position of a first image with a position of a second image, a region setting portion configured to set a first region in the first image and set a second region associated with the first region in the second image based on the coordinate conversion information, and an evaluation value obtaining portion configured to compare the first region with the second region to obtain an evaluation value.

16 Claims, 6 Drawing Sheets



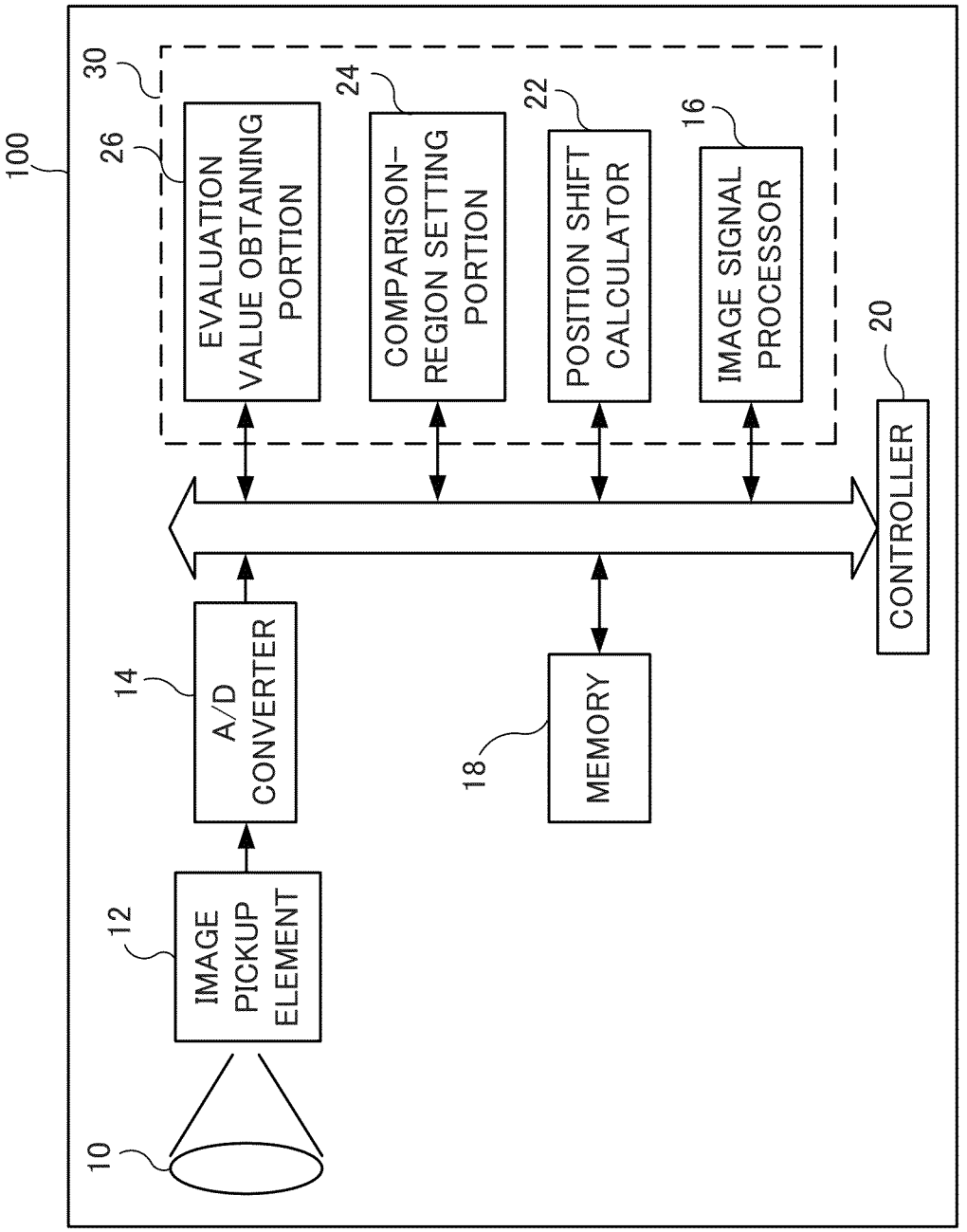

100
30
26
EVALUATION VALUE OBTAINING PORTION
24
COMPARISON-REGION SETTING PORTION
22
POSITION SHIFT CALCULATOR
16
IMAGE SIGNAL PROCESSOR
20
CONTROLLER
14
A/D CONVERTER
18
MEMORY
12
IMAGE PICKUP ELEMENT
10

FIG. 1

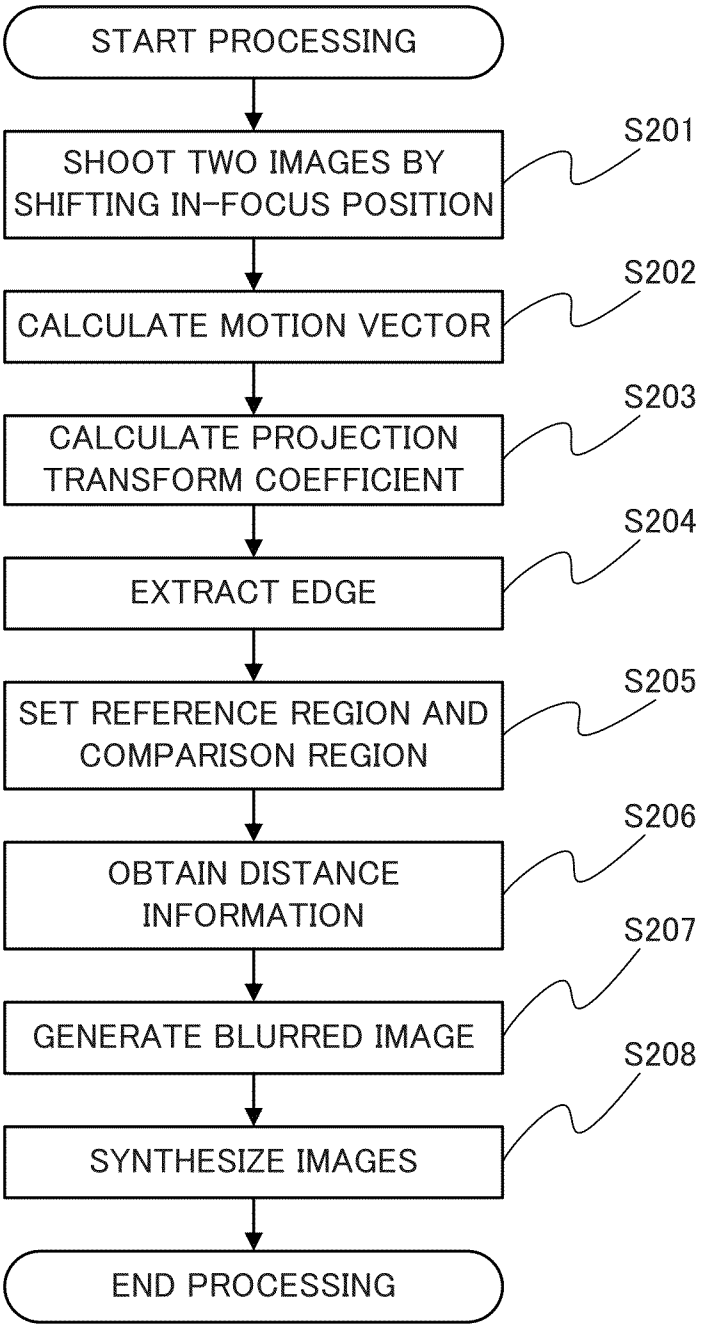

START PROCESSING
SHOOT TWO IMAGES BY SHIFTING IN-FOCUS POSITION
S201
CALCULATE MOTION VECTOR
S202
CALCULATE PROJECTION TRANSFORM COEFFICIENT
S203
EXTRACT EDGE
S204
SET REFERENCE REGION AND COMPARISON REGION
S205
OBTAIN DISTANCE INFORMATION
S206
GENERATE BLURRED IMAGE
S207
SYNTHESIZE IMAGES
S208
END PROCESSING

FIG. 2

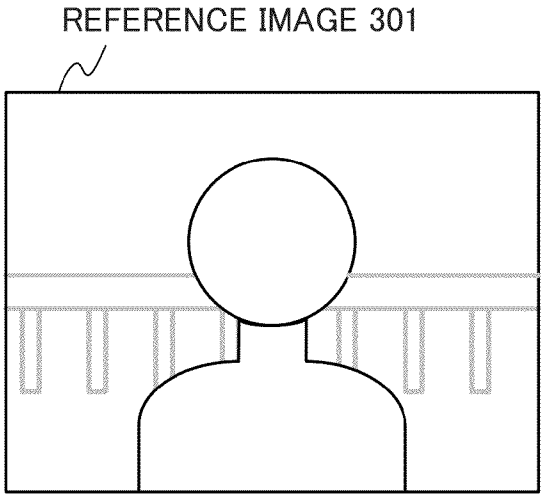


FIG. 3A

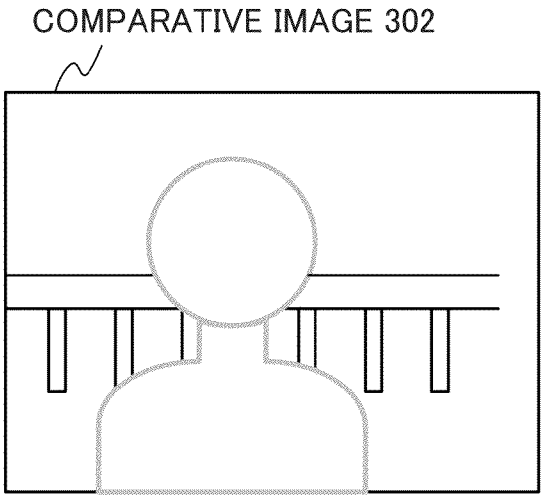


FIG. 3B

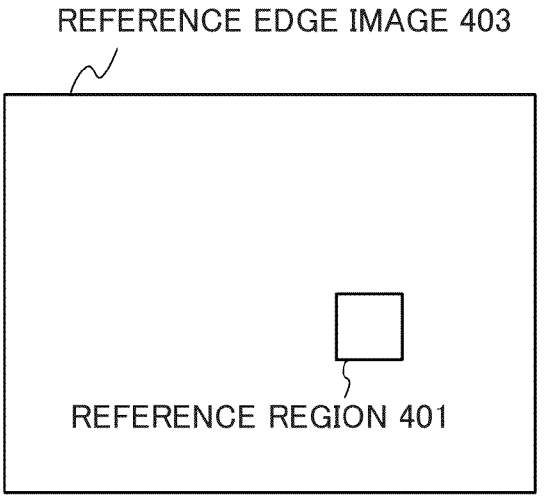


FIG. 4A

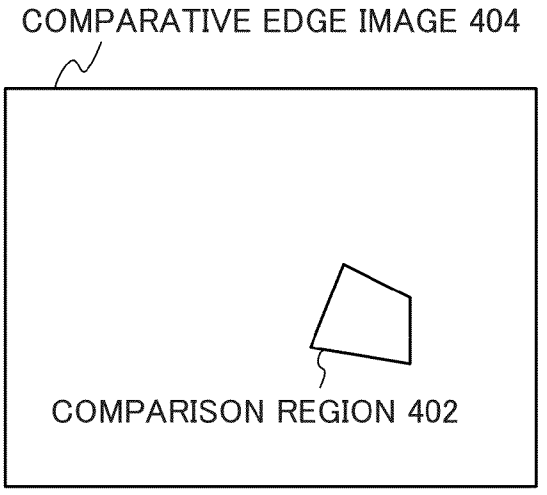


FIG. 4B

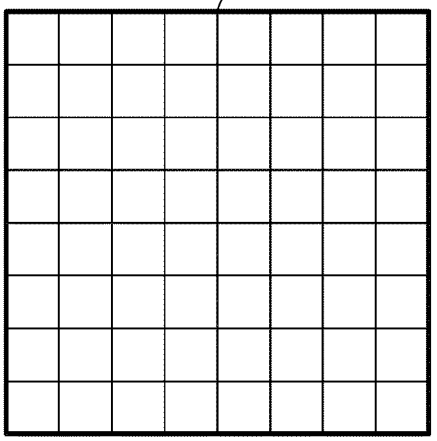


FIG. 5A

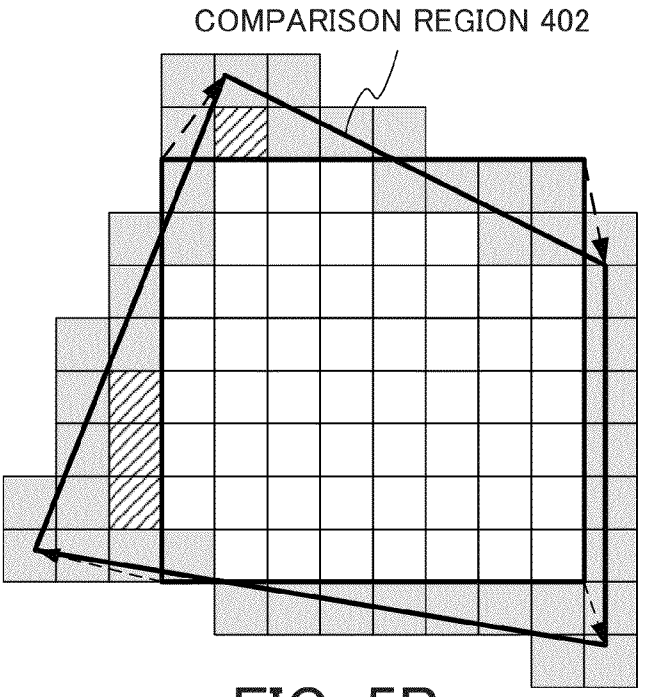


FIG. 5B

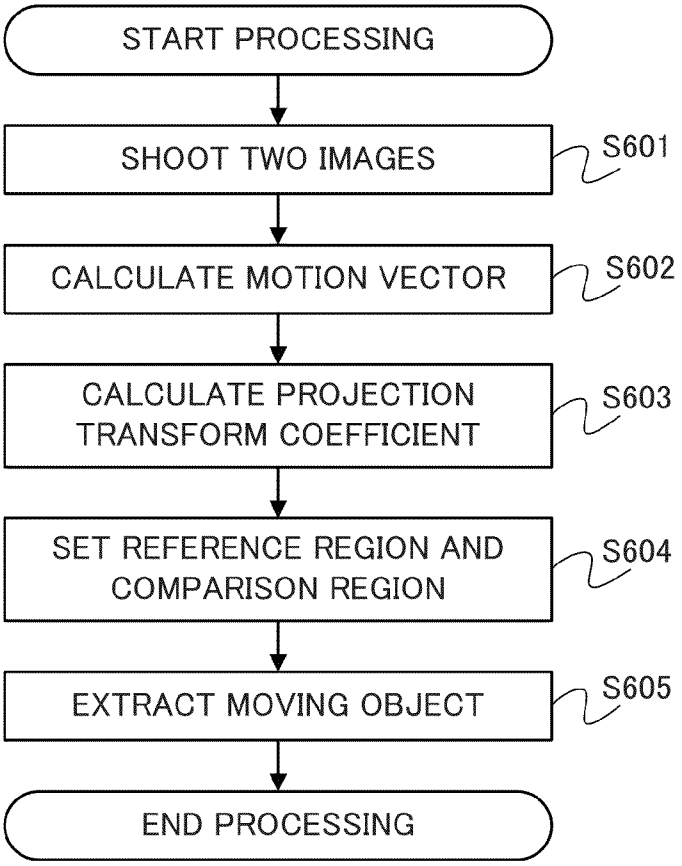


FIG. 6

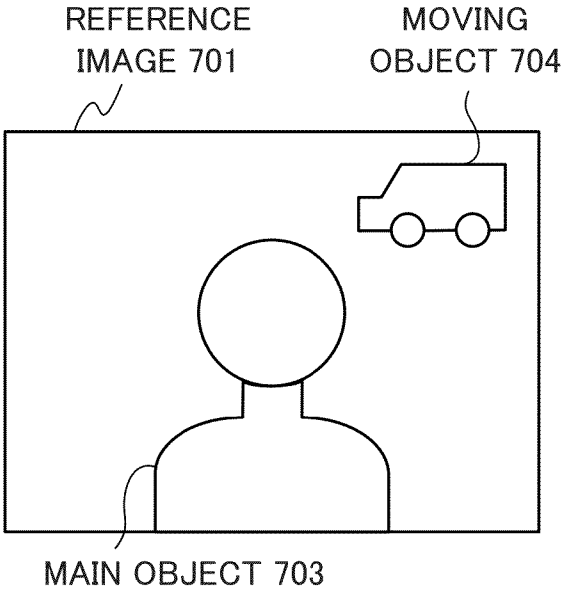


FIG. 7A

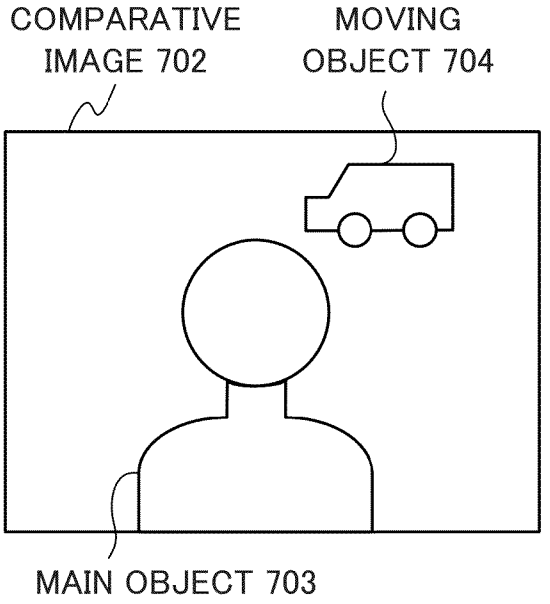


FIG. 7B

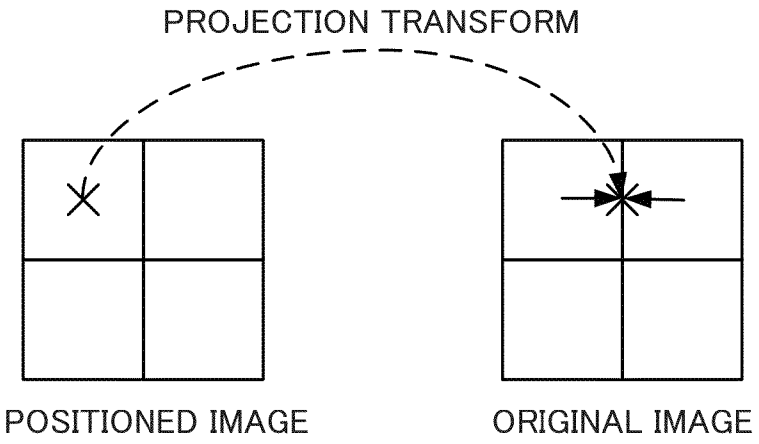


FIG. 8

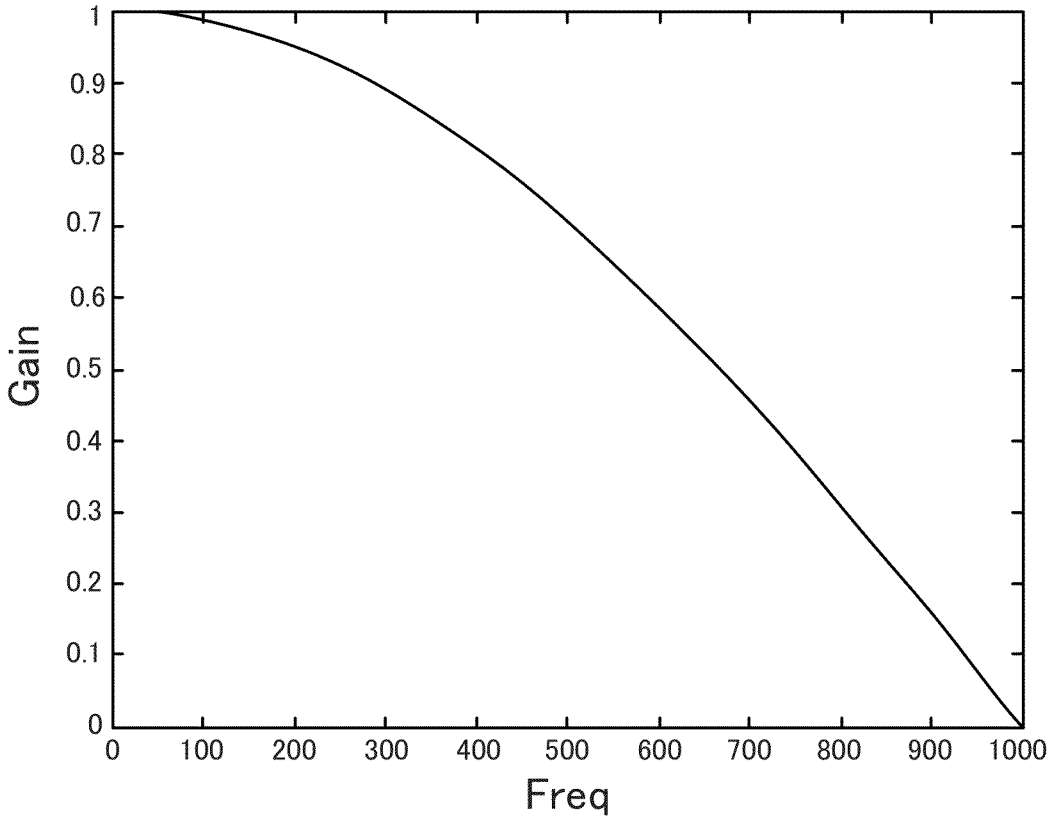

Gain
Freq
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
100
200
300
400
500
600
700
800
900
1000

FIG. 9

IMAGE PROCESSING APPARATUS, IMAGE PICKUP APPARATUS, IMAGE PICKUP SYSTEM, IMAGE PROCESSING METHOD, AND NON-TRANSITORY COMPUTER-READABLE STORAGE MEDIUM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an image processing apparatus which obtains an evaluation value for each region from two images.

2. Description of the Related Art

In the related art, an evaluation value is obtained from two images involving position shift in such a manner as to calculate the position shift of one image using the other image as a reference image and to generate pixel values by interpolating pixel values of a corresponding position from surroundings to compare with each other for each region. Japanese Patent No. 4760973 discloses, in order to extract an object during a handheld capturing, an image processing method of capturing two images of an image with an object of an extraction target and a background image without the object to perform a positioning and then extracting the object based on differential information (an evaluation between pixels.

However, as disclosed in Japanese Patent No. 4760973, in a case of comparing the image obtained by applying a pixel interpolation and the image to be a positioning reference on which the pixel interpolation is not performed with each other for each region, accuracy of the evaluation value is deteriorated by the change in frequency characteristics of the pixel due to the pixel interpolation.

BRIEF SUMMARY OF THE INVENTION

The present invention provides an image processing apparatus, an image pickup apparatus, an image pickup system, an image processing method, and a non-transitory computer-readable storage medium capable of obtaining a highly-accurate evaluation value from a plurality of pixels containing a position shift.

An image processing apparatus as one aspect of the present invention includes a calculator configured to calculate coordinate conversion information for associating a position of a first image with a position of a second image, a region setting portion configured to set a first region in the first image and set a second region associated with the first region in the second image based on the coordinate conversion information, and an evaluation value obtaining portion configured to compare the first region with the second region to obtain an evaluation value.

An image pickup apparatus as another aspect of the present invention includes an image pickup element configured to perform photoelectric conversion of an object image to obtain a first image and a second image and the image processing apparatus.

An image pickup system as another aspect of the present invention includes an image pickup optical system and the image pickup apparatus configured to obtain the object image via the image pickup optical system.

An image processing method as another aspect of the present invention includes the steps of calculating coordinate conversion information for associating a position of a first image with a position of a second image, setting a first region in the first image and setting a second region associated with the first region in the second image based on the coordinate conversion information, and comparing the first region with the second region to obtain an evaluation value.

A non-transitory computer-readable storage medium as another aspect of the present invention stores an image processing program for causing an image processing apparatus to execute the steps of calculating coordinate conversion information for associating a position of a first image with a position of a second image, setting a first region in the first image and setting a second region associated with the first region in the second image based on the coordinate conversion information, and comparing the first region with the second region to obtain an evaluation value.

Further features and aspects of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of an image pickup apparatus including an image processing apparatus in each of embodiments.

FIG. **2** is a flowchart of an image processing method in Embodiment 1.

FIGS. **3**A and **3**B illustrate an example of a reference image and a comparative image, respectively, in Embodiment 1.

FIGS. **4**A and **4**B illustrate an example of a reference edge image (a reference region) and a comparative edge image (a comparison region), respectively, in Embodiment 1.

FIGS. **5**A and **5**B are enlarged diagrams of the reference region and the comparison region, respectively, in Embodiment 1.

FIG. **6** is a flowchart of an image processing method in Embodiment 2.

FIGS. **7**A and **7**B illustrate an example of a reference image and a comparative image, respectively, in Embodiment 2.

FIG. **8** is a diagram of a positioning by a pixel interpolation.

FIG. **9** is a diagram illustrating a change of frequency characteristics by the pixel interpolation.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Exemplary embodiments of the present invention will, be described below with reference to the accompanied drawings. In each of the drawings, the same elements will be denoted by the same reference numerals and the duplicate descriptions thereof will be omitted.

First of all, referring to FIG. **1**, a configuration of an image pickup apparatus including an image processing apparatus in the present embodiment will be described. FIG. **1** is a block diagram of an image pickup apparatus **100**. The image pickup apparatus **100** compares two images (a plurality of images) containing a position shift captured by changing an in-focus position for each region and obtains an evaluation value to obtain distance information for each region.

In the image pickup apparatus **100**, an image pickup lens **10** (an image pickup optical system) optically forms a shot image on an image pickup element **12**. The image pickup element **12** performs a photoelectric conversion for the shot image (an object image) to convert the shot imago into an electric signal (an analog signal). The image pickup element **12** is configured to include a plurality of color filters. An A/D converter **14** converts an analog signal output from the image pickup element **12** into a digital signal. In addition, the image pickup apparatus **100** in the present embodiment is integrally configured with the image pickup lens **10** (the image pickup optical system) and an image pickup apparatus body, but the

image pickup apparatus **100** is not limited to this. The embodiment can also be applied to an image pickup system that is configured by an image pickup apparatus body and an image pickup optical system (a lens apparatus) removably mounted on the image pickup apparatus body.

An image signal processor **16** performs various types of image signal processing such as a synchronization processing, a white balance processing, a gamma processing, or an NR processing on image data (an image signal) obtained by taking an image. The image signal processor **16** develops the image data after the processing and stores the developed image data in a memory **18**. The memory **18** is a volatile memory (a storage portion) that stores temporarily the image data obtained by taking an image. A controller **20** controls data flow among the A/D converter **14**, the memory **18**, the image signal processor **16**, a position shift calculator **22**, a comparison-region setting portion **24**, and an evaluation value obtaining portion **26**.

The position shift calculator **22** (a calculator) calculates a position shift between two images (a first image and a second image) obtained by the image pickup element **12** to calculate coordinate conversion information for associating positions of two images with each other. The comparison-region setting portion **24** (a region setting portion) sets a reference region (a first region) with respect to a reference image (a first image) which is one of the two images and sets a comparison region (a second region) with respect to a comparative image (a second image) which is the other of the two images. The comparison region is determined based on the coordinate conversion information calculated by the position shift calculator **22**.

The evaluation value obtaining portion **26** compares the reference region (the first region) which is set with respect to the reference image, and the comparison region (the second region) which is set with respect to the comparative image, to obtain the evaluation value. In the present embodiment, the evaluation value obtaining portion **26** performs an edge extraction for each region of the reference region and the comparison region. Then, the evaluation value obtaining portion **26** obtains the evaluation value, by comparing values obtained by integrating absolute values of edge amplitudes for each pixel within these two regions. In the present embodiment, the image processing apparatus **30** is configured to include the image signal processor **16**, the position shift calculator **22**, the comparison-region setting portion **24**, and the evaluation value obtaining portion **26**.

As in the related art, however, when an image obtained by performing a pixel interpolation and an image for which the pixel, interpolation has not been performed, which is a reference of the positioning are compared with each other for each region, the accuracy is deteriorated by the change in the frequency characteristics of the pixel due to the pixel interpolation. For example, as a result of detecting the position shift between two images, when the pixel is positioned in a state horizontally shifted by 0.5 pixels and is generated by a linear interpolation as illustrated in FIG. **8**, a low-pass filter of the frequency characteristics is applied as illustrated in FIG. **9**. For this reason, the frequency characteristics are changed only for the positioned image. Thus, the image processing method of the present embodiment obtains a highly-accurate evaluation value without interpolating the pixel. A specific embodiment of the image processing method will be described below.

Embodiment 1

First of all, referring to FIGS. **2** to **5**, an image processing method in Embodiment 1 of the present invention will be described. FIG. **2** is a flowchart of the image processing method (a method of obtaining the evaluation value) in the present embodiment. Each step of FIG. **2** is mainly performed by the image processing apparatus **30** based on a command of the controller **20**.

First of all, in step S**201**, the image pickup apparatus **100** takes two images (a first image and a second image) by shifting the in-focus position. Here, one image (for example, a first shot image) is referred to as a reference image **301** (a first image), and the other image (for example, a second shot image) is referred to as a comparative image **302** (a second image). FIGS. **3**A and **3**B illustrate an example of the two images obtained by shooting images, FIG. **3**A illustrates the reference image **301**, and FIG. **3**B illustrates the comparative image **302**. The reference image **301** is an image which is focused on the object. On the other hand, the comparative image **302** is an image which is focused on the background. In addition, in the present embodiment, since the two images are shot under a condition of holding the image pickup apparatus **100** with hand, the position shift occurs between the reference image **301** and the comparative image **302** (the two images).

Next, the position shift calculator **22** calculates a motion vector between the two images to calculate the coordinate conversion information for associating the position shift between the two images. That is, the position shift calculator **22** calculates the coordinate conversion information based on the motion vector between the reference image **301** (the first image) and the comparative image **302** (the second image).

Specifically, in step S**202**, the position shift calculator **22** divides each of the reference image **301** for the positioning and the comparative image **302** for calculating the position shift (an amount of the position shift) with respect to the reference image **301** into a plurality of regions (sub-regions), respectively. Then, the position shift calculator **22** calculates the motion vector by obtaining the position on shift amount between the reference image **301** and the comparative image **302** for each of these regions (divided regions). As a method of calculating the amount of the position shift in the present embodiment, for example a method disclosed in Japanese Patent Laid-open No. 2009-301181 is used. According to this method, a correlation value is obtained while the sub-region of the reference image **301** moves in the sub-region of the comparative image **302**, and the motion vector up to the position to be the minimum correlation value is referred to as the amount of the position shift in the sub-region. In addition, for example, the sum of absolute differences (SAD) is used as the correlation value.

Subsequently, in step S**203**, the position shift calculator **22** calculates the coordinate conversion information for associating the position shift between the two images, based on the amount of the position shift calculated for each sub-region. In the present embodiment, the coordinate conversion information is a projection transform coefficient, and the projection transform coefficient is a coefficient indicating a deformation of the object image. Further, only one projection transform coefficient may be calculated with respect to one image, or alternatively, different projection transform coefficients may be calculated for each sub-region. In the present embodiment, the projection transform coefficient is used as the coordinate conversion information, but the embodiment is not limited to this. Instead of the projection transform coefficient, other types of coordinate conversion information such as an affine transform coefficient may be calculated.

Next, in step S**204**, the image signal processor **16** performs an edge extraction processing using a band-pass filter for each of the reference image **301** and the comparative image **302** to generate a reference edge image **403** and a comparative edge

image **404**. FIG. **4**A illustrates an example of the reference edge image **403**, and FIG. **4**B illustrates an example of the comparative edge image **404**.

Next, in step S**205**, the comparison-region setting portion **24** sets the reference region **401** with respect to the reference edge image **403**. In addition, the comparison-region setting portion **24** sets the comparison region **402** with respect to the comparative edge image **404** based on the projection transform coefficient calculated in step S**203**.

A method of setting the reference region **401** and the comparison region **402** will be described below in detail. First of all, the comparison-region setting portion **24** sets the rectangular reference region **401** around a target pixel which obtains distance information in the interior of the reference edge image **403**. Subsequently, the comparison-region setting portion **24** performs the coordinate conversion for four corners (four vertexes) of the reference region **401** using the following Expressions (1) and (2) based on the projection transform coefficient calculated by the position shift calculator **22**, to set the comparison region **402** with respect to the comparative edge image **404**.

$$x'=(ax+by+c)\div(dx+ey+1) \quad (1)$$

$$y'=(fx+gy+i)\div(dx+ey+1) \quad (2)$$

In Expressions (1) and (2), coefficients a, b, c, d, e, f, and g are the projection transform coefficients calculated in step S**203**. Symbols x and y indicate an x-coordinate and a y-coordinate of one corner among four corners (four vertexes) of the reference region **401**, respectively. Symbols x' and y' indicate an x-coordinate and a y-coordinate of one corner among four corners (four vertexes) of the comparison region **402**, respectively, which are a position of one corner of the comparative, edge image **404** corresponding to one corner of the reference region **401**. The comparison-region setting portion **24** calculates positions of three corners of the comparative edge image **404** corresponding to remaining three corners of the reference region **401**, respectively, based on Expressions (1) and (2) to obtain coordinates of four corners of the comparison region **402**.

FIGS. **5**A and **5**B are enlarged diagrams of the reference region **401** and the comparison region **402**, respectively, and FIG. **5**A illustrates the reference region **401** and FIG. **5**B illustrates the comparison region **402**. Arrows of wavy lines indicated in FIG. **5**B represent that the coordinates of four corners of the reference region **401** have been converted into the positions indicated by the arrows of wavy lines according to the method described above. Thus, the comparison-region setting portion **24** sets a region, which has each vertex at points obtained with respect to each vertex of the reference region **401** using the coordinate conversion information, as the comparison region **402**.

In the present embodiment, the method of determining the comparison region **402** based on the rectangular reference region **401** is described, but the embodiment is not limited to this. For example, the reference region **401** may be set to a polygonal shape, and then the comparison region **402** may be set by performing the coordinate conversion for each vertex of the polygonal shape. Alternatively, the reference region **401** may be set to an arbitrary shape, and then the comparison region **402** may be set by performing the coordinate conversion for each pixel included in the reference region **401**. In this case, the comparison-region setting portion **24** sets a region which includes pixels obtained using the coordinate conversion information with respect to the pixels included in the reference region **401**, as the comparison region **402**.

Next, in step S**206**, the evaluation value obtaining portion **26** compares the reference region **401** with the comparison region **402** to obtain the evaluation value of the regions. Specifically, the evaluation value obtaining portion **26** obtains a difference between signal values (hereinafter, referred to as "edge integral values") each obtained by integrating an absolute value of the edge amplitude of the pixel in each region of the reference edge image **403** and the comparative edge image **404**, as an evaluation value. As will be described below, the evaluation value of the present embodiment is used to obtain the distance information of foreground or background.

As described above, the evaluation value obtaining portion **26** compares the edge integral value of the reference region **401** with the edge integral value of the comparison region **402** to obtain the evaluation value. In the embodiment, the comparison region **402** is not necessarily the rectangular shape. When the comparison region **402** has a quadrangular shape is deformed quadrangular shape) other than the rectangular shape, a target region (a target pixel) of the comparison region **402**, for which an edge integral is performed, is a pixel included fully in the comparison region **402**. For example, in the case of the comparison region **402** illustrated in FIG. **5**B, the target pixels are white pixels and diagonal-lined pixels included inside the comparison region **402**.

In addition, the number of pixels of the reference region **401**, which is taken as a target of the edge integral, is **64**, whereas the number of pixels of the comparison region **402**, which is taken as a target of the edge integral, is **59**. For this reason, in the present embodiment, it is preferred that the edge integral value is normalized in accordance with the number of the pixels which are taken as a target of the edge integral. Specifically, a value which is normalized by multiplying **64/59** by the edge integral value of the comparison region **402** is set to a final edge integral value of the comparison region **402**. Thus, the evaluation value obtaining portion **26** may normalize the evaluation value in accordance with sizes of the reference region **401** (the first region) and the comparison region **402** (the second region).

Furthermore, with respect to pixels (gray pixels) included partially inside the comparison region **402**, it is possible to add to the edge integral value by multiplying a weight (performing a weighting) depending on a fraction (a ratio) included inside the comparison region **402**. Thus, the evaluation value obtaining portion **26** may obtain the evaluation value by changing the weight for each pixel included in the comparison region **402** (the second region).

Subsequently, the evaluation value obtaining portion **26** (the controller **20**) determines (obtains) the distance information based on the obtained evaluation value. The evaluation value obtaining portion **26** compares the edge integral values for each region as described above. In a region where the edge integral value of the comparative edge image **404**, which is focused on the background, decreases with respect to the reference edge image **403**, which is focused on the foreground object, an image in the comparative edge image **404** is blurred with respect to the reference edge image **403**. Therefore, the region is determined to be the foreground. Conversely, when the edge integral value of the comparative edge image **404** increases with respect to the reference edge image **403**, the image in the comparative edge image **404** is focused with respect to the reference edge image **403**. Therefore, the region is determined to be the background. In the present embodiment, the difference between the edge integral values (the signal values) is used as the evaluation value, but the embodiment is not limited to this. A ratio of the edge integral value may also be used, or alternatively, the edge integral value for calculating the evaluation value may be used by

combining edge integral values of edges extracted by a plurality of filters having different frequency characteristics.

Next, in step S**207**, the image signal processor **16** (the controller **20**) generates a blurred image, in which an entire image is blurred, by applying a blur filter to the reference image **301**. As the blur filter, for example, a low-pass filter having the frequency characteristics passing through a low frequency region is selected.

Next, in step S**208**, the image signal processor **16** (the controller **20**) synthesizes (combines) the reference image **301** and the blurred image generated in step S**207** based on the evaluation value (the distance information) calculated in step S**206**. The reference image **301** is referenced to the foreground region which is determined as a foreground by the distance information. On the other hand, the blurred image generated in step S**207** is referenced to the background region which is determined as a background by the distance information. Then, the image signal processor **16** (the controller **20**) may synthesize the foreground and the background to generate the background-blurred image in which the object region (the foreground region) is focused and the background region is blurred.

According to the present embodiment, the shape of the comparison region is changed without having any influence on the pixel value based on the coordinate conversion coefficient for the positioning, and thus the evaluation value (the distance information) can be obtained for each region by reducing the influence of the positioning.

Embodiment 2

Next, referring to FIGS. **6**, **7**A, and **7**B, an image processing method in Embodiment 2 of the present invention will be described. The image processing apparatus **30** of the present embodiment obtains the evaluation value for each region from two shot images containing a position shift to extract a moving object region in an image. That is, the evaluation value obtaining portion **26** compares the reference region set in the reference image and the comparison region set in the comparative image with each other to obtain the evaluation value (moving object information) and to extract the moving object region. Thus, the evaluation value of the present embodiment is used to determine the moving object region.

FIG. **6** is a flowchart of the image processing method (a method of obtaining the evaluation value) in the present embodiment. Each step of FIG. **6** is mainly performed by the image processing apparatus **30** based on a command of the controller **20**. First of all, in step S**601**, the image pickup apparatus **100** captures (shoots) two images. In the embodiment, one image (for example, a first shot image) is referred to as a reference image **701**, and the other image (for example, a second shot image) is referred to as a comparative image **702**.

FIGS. **7**A and **7**E illustrate an example of two images obtained, by capturing (shooting), and FIG. **7**A illustrates the reference image **701** and FIG. **7**B illustrates the comparative image **702**. In the reference image **701** and the comparative image **702**, a main object **703** is not moving, on the other hand, a moving object **704** is moving. In addition, in the present embodiment, since the two images are shot under a condition of holding the image pickup apparatus **100** with hand, the position shift occurs between the two images.

Next, in step S**602**, the position shift calculator **22** calculates the motion vector between the two images. Then, in step S**603**, the position shift calculator **22** calculates the coordinate conversion information (the projection transform coefficient) for associating the position shift between the two images. Steps S**602** and S**603** of the present embodiment are the same as steps S**202** and S**203** of Embodiment 1, respectively.

Next, in step S**604**, the comparison-region setting portion **24** sets the reference region **401** and the comparison region **402**. Basically, step S**604** of the present embodiment is the same as step S**205** of Embodiment 1. In the present embodiment, however, the reference region **401** and the comparison region **402** are set to the reference image **701** and the comparative image **702**, respectively.

Next, in step S**605**, the evaluation value obtaining portion **26** (the controller **20**) obtains the evaluation value of each region to extract the moving object region within the image. In the present embodiment, the evaluation value obtaining portion **26** obtains a total sum of luminance values (signal values) of the pixels inside the rectangular reference region **401** around the target pixel and the pixels inside the comparison region **402** corresponding to the reference region **401**, as the evaluation value. Then, when a difference or a ratio between the total sum of the luminance values of the reference region **401** and the comparison region **402** is a predetermined value or more, the evaluation value obtaining portion **26** determines the region as the moving object (the moving object region). In the present embodiment, the total sum of color differences, the sum of signal values of different color spaces, or the total sum of signal values of various color sections may also be compared by weighting. In addition, on, similarly to Embodiment 1, even in pixels included partially inside the comparison region **402**, it is possible to add to the total sum of signal values by performing the weighting depending on the fraction (the ratio) included inside the comparison region **402**.

According to the present embodiment, the shape of the comparison region is changed without having any influence on the pixel, value based on the coordinate conversion coefficient for the positioning, and thus the evaluation value (the total sum of luminance values) can be obtained, for each region by reducing the influence of the positioning.

Therefore, according, to each embodiment, an image processing apparatus, an image pickup apparatus, an image pickup system, and an image processing method capable of obtaining a highly-accurate evaluation value from a plurality of pixels containing a position shift can be provided. Also, according to each embodiment, a non-transitory computer-readable storage medium which stores an image processing program for causing the image processing apparatus to execute the image processing method can be provided.

As described above, although preferred embodiments are described, the present invention is not limited to these embodiments, and various changes and modifications can be made within the scope of the invention.

While she present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2012-262376, filed on Nov. 30, 2012, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. An image processing apparatus, which generates a background-blurred image from two images captured by changing an in-focus position, comprising:

a calculator configured to calculate coordinate conversion information for associating a position of a first image with a position of a second image;

a region setting portion configured to set a first region in the first image and set a second region associated with the first region in the second image based on the coordinate conversion information;

an evaluation value obtaining portion configured to compare the first region with the second region to obtain an evaluation value, and to determine whether the first region in the first image is a foreground region or a background region based on the evaluation value; and

an image generating portion configured to combine the first image and a blurred image, which is obtained by blurring the first image, based on the evaluation value and to generate the background-blurred image, wherein the image generating portion is configured to use the first image for the foreground region and use the blurred image for the background region.

2. The image processing apparatus according to claim **1**, wherein the calculator calculates the coordinate conversion information based on a motion vector between the first image and the second image.

3. The image processing apparatus according to claim **1**, wherein the coordinate conversion information is a projection transform coefficient indicating a deformation of an object image.

4. The image processing apparatus according to claim **1**, wherein the evaluation value obtaining portion obtains the evaluation value without interpolating pixels included in the first region and the second region.

5. The image processing apparatus according to claim **1**, wherein the evaluation value obtaining portion normalizes the evaluation value in accordance with sizes of the first region and the second region.

6. The image processing apparatus according to claim **1**, wherein the evaluation value obtaining portion changes a weight for each pixel included in the second region to obtain the evaluation value.

7. The image processing apparatus according to claim **1**, wherein the evaluation value obtaining portion compares edge integral values of the first region and the second region with each other to obtain the evaluation value.

8. The image processing apparatus according to claim **1**, wherein the evaluation value obtaining portion compares differences between signal values of the first region and the second region to obtain the evaluation value.

9. The image processing apparatus according to claim **1**, wherein the region setting portion sets a region, which has each vertex at points obtained using the coordinate conversion information with respect to each vertex of the first region, as the second region.

10. The image processing apparatus according to claim **1**, wherein the region setting portion sets a region, which includes a pixel obtained using the coordinate conversion information with respect to a pixel included in the first region, as the second region.

11. The image processing apparatus according to claim **1**, wherein the evaluation value is used to obtain distance information.

12. The image processing apparatus according to claim **1**, wherein the evaluation value is used to determine a moving object region.

13. An image pickup apparatus comprising:

an image pickup element configured to perform photoelectric conversion of an object image to obtain a first image and a second image; and

an image processing apparatus according to claim **1**.

14. An image pickup system comprising:

an image pickup optical system; and

an image pickup apparatus according to claim **13**, configured to obtain the object image via the image pickup optical system.

15. An image processing method for generating a background-blurred image from two images captured by changing an in-focus position comprising the steps of:

calculating coordinate conversion information for associating a position of a first image with a position of a second image;

setting a first region in the first image and setting a second region associated with the first region in the second image based on the coordinate conversion information;

comparing the first region with the second region to obtain an evaluation value;

determining whether the first region in the first image is a foreground region or a background region based on the evaluation value; and

combining the first image and a blurred image, which is obtained by blurring the first image, based on the evaluation value and generating the background-blurred image, wherein the first image is used for the foreground region and the blurred image is used for the background image.

16. A non-transitory computer-readable storage medium which stores an image processing program for causing an image processing apparatus, which generates a background-blurred image from two images captured by changing an in-focus position, to execute the steps of:

calculating coordinate conversion information for associating a position of a first image with a position of a second image;

setting a first region in the first image and setting a second region associated with the first region in the second image based on the coordinate conversion information;

comparing the first region with the second region to obtain an evaluation value;

determining whether the first region in the first image is a foreground region or a background region based on the evaluation value; and

combining the first image and a blurred image, which is obtained by blurring the first image, based on the evaluation value and generating the background-blurred image, wherein the first image is used for the foreground region and the blurred image is used for the background region.

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