

[Document Name] Abstract

[Abstract]

[Problem] To generate a composite image obtained by superimposing two images using a simple system.

[Resolution Means] Acquiring a focal length of a main lens, setting an adjustment magnification based on the acquired focal length of the main lens and a focal length of a sub-lens so that a partial image GSp, cropped from a predetermined position K of a sub-image GS, and a main image GM are the same size, generating a finder image GF obtained by superimposing the partial image GSp on the center of the main image GM accompanied by adjustment of the size of the partial image GSp using the set adjustment magnification, and displaying the generated finder image GF. It is thus possible to generate the finder image GF obtained by superimposing two images using a simple system and without adopting a complex mechanism.

[Selected Drawing] FIG. 7

[Document Name] Specification

[Title of Invention] DIGITAL CAMERA AND METHOD OF MANUFACTURING THE SAME

[Technical Field]

[0001]

The present invention relates to a digital camera and a method of manufacturing the same, and more specifically relates to a digital camera capable of manual focusing and changing a focal length of a main lens, and a method of manufacturing the same.

[Background Art]

[0002]

Conventionally, a camera provided with a so-called double image coincidence-type rangefinder has been proposed as a camera of this type, which is composed of a finder optical system including a semi-transparent mirror, and a rangefinder optical system that rotates in conjunction with a manual focus operation of a photography lens using the principle of triangulation (for example, see Patent Literature 1). This kind of camera uses as a finder image an image obtained by superimposing through the semi-transparent mirror a rangefinder image input from the rangefinder optical system onto a finder image input from the finder optical system.

[Citation List]

[Patent Literature]

[0003]

[Patent Literature 1] JP 2002-122907 A

[Summary of Invention]

[Problem to Be Solved by the Invention]

[0004]

In the camera described above, the rangefinder optical system needs to be rotated with high precision in conjunction with the manual focus operation, and therefore, a complex mechanism is required. This type of mechanism requires high precision for the manufacturing tolerances of each component constituting the mechanism and for assembling to the camera, and the adjustment work during assembly also takes time.

[0005]

A primary object of the present invention is to provide a digital camera that generates a composite image obtained by superimposing two images using a simple system, and a method of manufacturing the same.

[Means for Solving the Problem]

[0006]

The digital camera and method of manufacturing the same of the present invention have adopted the following means in order to achieve the primary object described above.

[0007]

The digital camera of the present invention is outlined as:

a digital camera capable of manual focusing and changing a focal length of a main lens, wherein the digital camera is provided with:

image display means for displaying an image;

main imaging means for generating a main image by photoelectrically converting a representation of a subject obtained through the main lens;

sub-imaging means for generating a sub-image by photoelectrically converting a representation of a subject obtained through a sub-lens;

focal length acquisition means for acquiring a focal length of the main lens;

magnification setting means for setting a magnification of an image based on the acquired focal length of the main lens;

composite image generating means for generating a composite image obtained by superimposing the main image and the sub-image accompanied by magnification processing of at least one image of the main image and the sub-image at the set magnification; and

display control means for controlling the display means so as to display the generated composite image.

[0008]

The digital camera of the present invention acquires the focal length of the main lens, sets the magnification of the image based on the acquired focal length of the main lens, generates a composite image obtained by superimposing the main image and the sub-image accompanied by magnification processing of at least one image of the main image and the sub-image at the set magnification, and controls the display means so as to display the generated composite image. It is thus possible to generate a composite image obtained by superimposing a main image and a sub-image using a simple system. Note that the focal length of the main lens may be changed by replacing the main lens with one having a different focal length, or by using a zoom lens having a variable focal length.

[0009]

Furthermore, in the digital camera of the present invention, the magnification setting means may be means for setting a magnification so that the representation of the subject in the main image and the representation of the subject in the sub-image are substantially the same size. If configured in this manner, this allows easy comparison of the two images. In the digital camera of the present invention in this aspect, a pan focus lens may be attached as the sub-lens. If configured in this manner, the focal length of the sub-lens is fixed, and therefore the magnification of the image may be set using simple processing based on the focal length of the main lens. Furthermore, the digital camera of the present invention in this aspect, provided with a correction mode capable of correcting a predetermined magnification rule for setting a magnification of an image accompanied by checking for a deviation in size in the composite image when the focal length of the main lens is set to a predetermined focal length, may be further provided with instruction receiving means for receiving an instruction to change the set magnification so that the deviation in size in the composite image becomes equal to or smaller than a predetermined level in the correction mode; and correction means for correcting the magnification rule by using the received degree of change to the magnification as a degree of correction at the predetermined focal length in the correction mode. If configured in this manner, it is possible for a user to correct the magnification rule using simple processing. Note that "equal to or smaller than a predetermined level" includes a state in which a deviation in size is a predetermined amount or less, or a state in which the user has visually confirmed that there is no deviation in size.

[0010]

Moreover, the digital camera of the present invention is provided with degree of operation acquisition means for acquiring a degree of operation of manual focus, wherein the composite image generating means may be means for generating, as the composite image, an image obtained by setting a cropping position at which an image is partially cropped from the sub-image, and cropping the partial image according to the set cropping position and superimposing it onto a predetermined position of the main image, based on the acquired degree of operation and a predetermined cropping rule, so that the more the subject is manually focused on, the smaller the positional deviation of the superimposed portion in the composite image. If configured in this manner, it is possible to confirm whether the subject is in focus or not by checking the positional deviation of the superimposed portion of the composite image. In the digital camera of the present invention in this aspect, the composite image generating means may be means for using, as the predetermined cropping rule, a rule predetermined by the principle of triangulation based on an interval between the main lens and the sub-lens and a distance to the subject derived from the acquired degree of operation.

[0011]

The method of manufacturing the digital camera of the present invention is outlined as:

a method of manufacturing a digital camera capable of manual focusing and changing a focal length of a main lens, wherein the method of manufacturing a digital camera is provided

with:

(a) an assembly step of assembling image display means for displaying an image; main imaging means for generating a main image by photoelectrically converting a representation of a subject obtained through the main lens; sub-imaging means for generating a sub-image by photoelectrically converting a representation of a subject obtained through a sub-lens; focal length acquisition means for acquiring a focal length of the main lens; magnification setting means for setting a magnification of an image based on the acquired focal length of the main lens so that the representation of the subject in the main image and the representation of the subject in the sub-image are substantially the same size; composite image generating means for generating a composite image obtained by superimposing the main image and the sub-image accompanied by magnification processing of at least one image of the main image and the sub-image at the set magnification; display control means for controlling the display means so as to display the generated composite image; and storage means for storing various data;

(b) a preparation step of changing the focal length of the main lens to a predetermined focal length;

(c) an adjustment step of causing the composite image generating means to generate the composite image, and when a deviation in size of the generated composite image is confirmed, performing an adjustment of the set magnification so that the deviation becomes equal to or smaller than a predetermined level; and

(d) a registration step of generating a magnification rule that associates the predetermined focal length with the magnification based on the magnification that is set when the deviation is equal to or smaller than a predetermined level, and registering the generated magnification rule in the storage means.

[0012]

According to the method of manufacturing the digital camera of the present invention, each component is assembled, the focal length of the main lens is changed to a predetermined focal length, the composite image generating means is made to generate a composite image, and when a deviation in size of the generated composite image is confirmed, an adjustment of the set magnification is performed so that the deviation becomes equal to or smaller than a predetermined level, and a magnification rule that associates the predetermined focal length with the magnification is generated based on the magnification that is set when the deviation is equal to or smaller than a predetermined level, and the generated magnification rule is registered in the storage means. This makes it possible to register a magnification rule after resolving a deviation in magnification accompanying individual differences in the digital camera due to an assembly error in each component or the like.

[Brief Description of Drawings]

[0013]

[FIG. 1] A configuration diagram illustrating an outline of the configuration of a digital camera 10.

[FIG. 2] A perspective view of the digital camera 10.

[FIG. 3] A rear view of the digital camera 10.

[FIG. 4] An explanatory diagram illustrating the concept of a method of generating a cropping rule Rk.

[FIG. 5] An explanatory diagram illustrating one example of a cropping position K in a sub-image GS.

[FIG. 6] An explanatory diagram illustrating the concept of a method of generating a magnification rule Rb.

[FIG. 7] A flowchart illustrating one example of a finder image display processing routine.

[FIG. 8] An explanatory diagram illustrating a situation wherein a finder image GF is generated.

[FIG. 9] An explanatory diagram illustrating the relationship between a deviation in the

finder image GF and focusing.

[FIG. 10] A flowchart illustrating one example of a correction processing routine.

[FIG. 11] An explanatory diagram illustrating one example of a finder GF' when adjustment is in progress.

[FIG. 12] An explanatory diagram illustrating one example of a step of manufacturing the digital camera 10.

[Embodiment of the Invention]

[0014]

Next, an embodiment of the present invention will be described based on drawings. FIG. 1 is a configuration diagram illustrating an outline of the configuration of a digital camera 10, which is one embodiment of the present invention, FIG. 2 is a perspective view of the digital camera 10, and FIG. 3 is a rear view of the digital camera 10.

[0015]

The digital camera 10 of the present embodiment is provided with a main body 12; a main electronic imaging unit 20 for photoelectronically converting a representation of a subject and outputting a digital signal; a sub electronic imaging unit 40 for photoelectronically converting a representation of a subject and outputting a digital signal for generating a finder image; an image processing unit 70 for generating image data or an image file by inputting the signal output from the main electronic imaging unit 20 or the sub electronic imaging unit 40 and applying predetermined image processing; a display control unit 80 for causing an electronic view finder (EVF) 82 or an LCD monitor 84 to display image data input from the image processing unit 70; an operation switch group 90 having various switches operated by a user; a memory card 60 capable of saving an image file generated by the image processing unit 70; and a main controller 30 for controlling the entire device.

[0016]

The main electronic imaging unit 20 is provided with a photography lens 21 configured as a manual focus lens and that is replaceably attached to the main body 12 through a lens mount that is not illustrated; an image sensor 22 configured as a well-known CCD image sensor that converts light input through the photography lens 21 into an electrical signal by photoelectric conversion; a focal plane shutter 23 disposed between the photography lens mechanism 21 and the image sensor 22; a driver circuit 24 for driving the image sensor 22; and an analog front end (AFE) 26 for converting the electrical signal output from the image sensor 22 into a digital signal and outputting the digital signal. The image sensor 22 is configured as a sensor having several million to tens of millions of pixels. Note that although a CCD image sensor is exemplified as the image sensor 22, a CMOS type image sensor may also be adopted.

[0017]

The photography lens 21 is provided with a lens group 21a configured by combining a convex lens and a concave lens; an aperture mechanism 21b for adjusting the amount of light; a distance ring 21c that changes the focal position when the user performs a rotation operation (focusing operation); and an extension part 21d provided on the attachment side of the photography lens 21 and formed in a spiral so that the degree of extension changes in accordance with the degree of operation (degree of rotation) of the distance ring 21c. Note that the optical axis of the photography lens 21 is parallel to a bottom surface of the main body 12. Although not illustrated in a drawing, the distance ring 21c has a distance scale displayed on its outer periphery. Furthermore, the extension part 21d abuts against a coupling ring 29 that is provided within the main body 12 so as to be displaceable in the front-rear direction. Therefore, the degree of operation of the distance ring 21c is converted into a degree of displacement of the coupling ring 29 through the degree of extension of the extension part 21d. Furthermore, the digital camera 10 is provided with a ring position sensor 29a capable of detecting the degree of displacement of the coupling ring 29. As a result, the degree of operation of the distance ring 21c is detected as a detection value of the ring

position sensor 29a. That is, a value reflecting a focus position of the main electronic imaging unit 20 (photography lens 21) is detected; hereinafter, this detected value is referred to as degree of operation So.

[0018]

The sub electronic imaging unit 40 is provided with a pan-focus type sub-lens 41 having a fixed focal length and including lens groups 41a and 41c and an aperture mechanism 41b; an image sensor 42 configured as a well-known CCD image sensor that converts light input through the sub-lens 41 into an electrical signal by photoelectric conversion; a driver circuit 44 for driving the image sensor 42; and an AFE 46 for converting the electrical signal output from the image sensor 42 into a digital signal and outputting the digital signal. Note that the optical axis of the sub electronic imaging unit 40 is parallel to the bottom surface of the main body 12. Here, the interval between the sub electronic imaging unit 40 and the main electronic imaging unit 20 is assembled so as to be positioned at a predetermined interval A in the left-right (horizontal) direction and a predetermined interval B in the up-down (vertical) direction from the main body 12. Note that in contrast to the image sensor 22 of the main electronic imaging unit 20 being configured as a sensor having several million to tens of millions of pixels, the image sensor 42 is configured as a sensor having several hundred thousand to several million pixels; for example, 2 million pixels.

[0019]

The image processing unit 70 is provided with various image processing functional blocks, although not illustrated, that execute well-known image processing in digital cameras, such as color interpolation processing or white balance processing of RGB pixels, color reproduction processing, resizing processing, gamma correction processing, image file generation processing, and the like. The image processing unit 70 inputs a digital signal output from the main electronic imaging unit 20 and executes image processing to generate a main image GM, converts the generated main image GM into an image having a predetermined format and adds photography information to generate an image file, and inputs a digital signal output from the sub electronic imaging unit 40 and executes image processing to generate a sub-image GS. Furthermore, the image processing unit 70 is provided with a crop processing unit for executing crop processing to partially crop an image from an image, a size adjustment unit for adjusting the size of the image including the cropped partial image, and a composite processing unit for executing composite processing to superimpose one image onto another, wherein a finder image GF to be displayed on the EVF 82 is generated by performing composite processing to superimpose a partial image GSp, which has been partially cropped from the sub-image GS, onto the main image GM. Note that the composite processing unit of the image processing unit 70 is capable of so-called alpha blending processing, in which a pixel value of the composite image is generated by mixing a pixel value of the lower layer image and a pixel value of the upper layer image using a coefficient α that indicates the transparency of the image to be superimposed on the upper layer relative to the lower layer image.

[0020]

The display control unit 80 displays the finder image GF generated by the image processing unit 70 on the EVF 82, and displays the main image GM generated by the image processing unit 70 or an image in an image file saved to the memory card 60 on the LCD monitor 84. Note that the display control unit 80 is capable of performing enlarged display processing to enlarge a specific portion of the finder image GF and display it on the EVF 82.

[0021]

The operation switch group 90 is composed of a shutter button 90a or a dial switch (SW) 90b, a wind-up lever 90c, a mode selection button 90d, an OK button 90e, a cancel button 90f, a JOG dial 90g, a focus selection lever 90h, or the like. The shutter button 90a is a button for receiving an instruction from the user to capture an image formed on the image sensor 22 through the photography lens 21. The dial switch 90b is a switch operated by the user to

set various setting values relating to photography, such as shutter speed and exposure value. The wind-up lever 90c is a button for, in conjunction with a winding operation, lifting and mechanically fixing a shutter curtain, which is not illustrated, of the focal plane shutter 23 from a state in which the shutter is released to a state in which the next shutter operation is possible once again. The mode selection button 90d is a button for selecting various modes. Here, the selectable modes include a setting mode for performing various settings, such as setting the brightness of the LCD monitor 84, a correction mode for correcting a magnification rule Rb, to be described later, used in the generation of the finder image GF, or the like. The OK button 90e is a button for determining various selections, and the cancel button 90f is a button for canceling a selection that has already been made. The JOG dial 90g, in conjunction with a rotation operation, moves a cursor for selecting various items displayed on the LCD monitor 84 and changes the numerical values of various settings. Furthermore, the JOG dial 90g is either in a state in which it is lifted upward or a state in which it is pressed downward; for example, when turned while in a state in which it is lifted upward, it functions as a dial for scrolling the image displayed on the LCD monitor 84 up and down, and when turned while in a state in which it is pressed downward, it functions as a dial for scrolling left and right. The focus selection lever 90h is a lever for selecting a focal length f of the attached photography lens 21. As illustrated in FIG. 2, the focus selection lever 90h is capable of selecting one of three focal lengths, f_1 , f_2 , and f_3 , and is operated by the user to the position of the corresponding focal length f when the photography lens 21 is replaced.

[0022]

The main controller 30 is configured as a microprocessor centered around a CPU 32, and is provided with a ROM 34 for storing processing programs and various tables, a RAM 36 for temporarily storing data, a flash memory 38 that allows data to be rewritten and retains the data even when the power is turned off, and an input/output port and communication port, which are not illustrated. The magnification rule Rb or a cropping rule Rk used in the generation of the finder image GF is registered on the flash memory 38. The main controller 30 is input with various operation signals from the operation switch group 90 or the degree of operation S_o from the ring position sensor 29, image files read from the memory card 60, various images from the image processing unit 70, and the like. Furthermore, the main controller 30 outputs a shutter drive signal to the focal plane shutter 23 or control signals to the driver circuits 24 and 44, image files to be written to the memory card 60, image processing commands to the image processing unit 70, display control commands to the display control unit 80, and the like.

[0023]

Here, the cropping rule Rk and the magnification rule Rb will be described. First, the cropping rule Rk will be described. The cropping rule Rk is a rule for setting a cropping position K at which a partial image is cropped from the sub-image GS in accordance with a focusing operation in order to generate the finder image GF. FIG. 4 is an explanatory diagram illustrating the concept of a method of generating the cropping rule Rk, and FIG. 5 is an explanatory diagram illustrating one example of the cropping position K in the sub-image GS. FIG. 4 illustrates a positional relationship between the main electronic imaging unit 20 and the sub electronic imaging unit 40 as viewed from above, wherein the interval between the two imaging units is the predetermined interval A as described above. Furthermore, the region indicated by the dotted line in FIG. 4 illustrates an image of the imaging region of the sub electronic imaging unit 40. As illustrated in FIG. 4, a subject (shown as a black circle in FIG. 4, and the same applies below) positioned at a distance L_1 on the optical axis of the main electronic imaging unit 20 is photographed at a position (white circle) on the imaging region at which an angle θ_1 is formed from the optical axis of the sub electronic imaging unit 40. Similarly, a subject at a distance L_2 (black triangle) is photographed at a position at which an angle θ_2 (white triangle) forms, and a subject at a distance L_3 (black square) is photographed at a position at which an angle θ_3 (white square) forms. This type of angle θ ,

distance L, and predetermined interval A have a relationship as shown in formula (1) according to the principle of triangulation, and since the predetermined interval A is a known constant, the angle θ may be found once the distance L is determined. Note that although the positional relationship as viewed from the side is not illustrated, the interval in the up-down direction between the two imaging units is the predetermined interval B as described above, and therefore, when an angle ϕ is used instead of angle θ , the relationship is as shown in formula (2), similar to formula (1). Furthermore, as illustrated in FIG. 5, when an XY coordinate system is set having the center of the sub-image GS (imaging region) as a starting point, the left-right direction in FIG. 5 as an X axis, and the up-down direction as a Y axis, the position of the subject image in the sub-image GS will be farther away from the starting point as the distance from the digital camera 10 to the subject becomes shorter, and will be closer to the starting point as the distance becomes longer, and coincides with the starting point at an infinite distance. Note that in FIG. 5, in order to match the direction with the left-right direction of the imaging region illustrated in FIG. 4, for the sake of convenience, the sub-image GS is illustrated inverted left-right from the original image. For these reasons, the subject image positioned at a distance L1 projected in a center portion of the main image GM will be projected in the sub-image GS with its center at a position K1 (X1, Y1) corresponding to the distance L1. Here, since the degree of operation of the distance ring 21c, which changes in accordance with the distance to the subject, is detected as the degree of operation So by the ring position sensor 29a, the distance L may be derived based on the degree of operation So. Therefore, the distance L may be derived from the degree of operation So, and angle θ and angle ϕ may be found from the derived distance L and formulas (1) and (2). Then, if the relationship between the angle θ and the X coordinate and the relationship between the angle ϕ and the Y coordinate are preset, the X coordinate value corresponding to the angle θ and the Y coordinate value corresponding to the angle ϕ , i.e., the cropping position K, may be derived. In the present embodiment, this type of correspondence relationship between the degree of operation So and the cropping position K is stored as the cropping rule Rk. The cropping rule Rk is stored as a relational formula between the degree of operation So and the cropping position K, and when finding the cropping position K, the cropping position K is found by performing a calculation from the degree of operation So using the relational formula. Note that the maximum values of the angles θ and ϕ are determined by the angle of view of the sub-lens 41, and the relationship between the angle θ and the X coordinate and the relationship between the angle ϕ and the Y coordinate may be set from the corresponding X and Y coordinate values.

[0024]

$$\tan\theta=A/L \quad \dots(1)$$

$$\tan\phi=B/L \quad \dots(2)$$

[0025]

Next, the magnification rule Rb will be described. The magnification rule Rb is a rule for setting the magnification for the sub-image GS so that the subject projected in the sub-image GS and the main image GM will be the same size. FIG. 6 is an explanatory diagram illustrating the concept of a method of generating the magnification rule Rb. FIGS. 6(a) to (c) illustrate the main image GM, and FIG. 6(d) illustrates the sub-image GS. Note that even in FIG. 6(d), the sub-image GS is illustrated inverted left-right, similarly to FIG. 5. Here, since the main electronic imaging unit 20 and the sub electronic imaging unit 40 use the image sensor 22 and the image sensor 42 having different numbers of pixels as described above, the sizes of the main image GM and the sub-image GS are different, as illustrated in the drawing. Furthermore, the main electronic imaging unit 20 is capable of replacing the lens 21 having a different focal length f, and since the angle of view thereof also changes when the focal length f is different, the size of the subject projected in the main image GM also changes in accordance with the focal lengths f1, f2, and f3, as illustrated in FIGS. 6(a) to (c). Based on such a difference in size between the main image GM and the sub-image GS or the

relationship between the focal lengths f_1 , f_2 , and f_3 of the photography lens 21 and the focal length of the sub-lens 41, an adjustment magnification B for aligning the size of the subject image in the sub-image GS and the subject image in the main image GM is set as magnifications B_1 , B_2 , and B_3 , respectively, and the magnification rule R_b associated with each focal length f_1 , f_2 , and f_3 is generated.

[0026]

Next, the operation of the digital camera 10 of the present embodiment configured in this manner will be described. FIG. 7 is a flowchart illustrating one example of a finder image display processing routine executed by the main controller 30. This routine is executed from when a power button that is not illustrated is turned on to start a photography mode until the power button is turned off. Note that image processing, display control, or the like are actually performed mainly by the image processing unit 70 or the display control unit 80, but in the following description, no distinction is made between the two. When this routine is executed, the main controller 30 first drives the image sensor 22 of the main electronic imaging unit 20 to read out a digital signal (step S100), and also drives the image sensor 42 of the sub electronic imaging unit 40 to read out a digital signal (step S110). Next, various types of image processing are executed on the read digital signal to generate the main image GM and the sub-image GS (step S120). When the main image GM and the sub-image GS are generated, the focal length f of the currently attached photography lens 21 is input (step S130). Here, any one of the focal lengths f_1 to f_3 selected by the focus selection lever 90h is input. Then, the adjustment magnification B is set using the input focal length f with reference to the magnification rule R_b (step S140). Next, the degree of operation So of the distance ring 21c from the ring position sensor 29a is input (step S150), and the cropping position K is set using the input degree of operation So with reference to the cropping rule R_k (step S160).

[0027]

When the adjustment magnification B and cropping position K are set in this manner, the partial image GSp is cropped from a cropping region of a size based on the adjustment magnification B at a position based on the cropping position K of the sub-image GS (step S170), and size adjustment of the cropped partial image GSp is performed according to the adjustment magnification B (step S180). The adjustment magnification B is set using the focal length f with reference to the magnification rule R_b ; therefore, the size of the subject projected in the size-adjusted partial image GSp is the same as that of the subject in the main image GM . The partial image GSp , on which size adjustment has been performed in this manner, is then superimposed onto the center of the main image GM to generate the finder image GF (step S190). Generation of the finder image GF is performed by generating a pixel value of the superimposed portion using alpha blending processing that mixes a pixel value s of the partial image GSp and a pixel value m of the main image GM , based on a coefficient α that indicates the transparency of the upper sub-image GS relative to the lower main image GM . Note that the pixel value m of the main image GM is used for portions other than the superimposed portion. FIG. 8 is an explanatory diagram illustrating a situation wherein the finder image GF is generated. As illustrated, the superimposed portion of the finder image GF is generated as a double image by alpha blending processing. Note that in the superimposed portion, the partial image GSp cropped from the sub-image GS is indicated by a solid line, and the main image GM is indicated by a dotted line.

[0028]

When the finder image GF is generated in this manner, the generated finder image GF is displayed on the EVF 82 (step S200), and processing returns to step S100 and is repeated. In this manner, the adjustment magnification B is set using the focal length f of the photography lens 21 with reference to the magnification rule R_b , the cropping position K is set using the degree of operation So from the ring position sensor 29a reflecting the focus position of the main electronic imaging unit 20, with reference to the cropping rule R_k , and

the partial image GSp cropped from the set cropping position K is adjusted in size according to the adjustment magnification B and then the finder image GF superimposed onto the main image GM may be displayed. Therefore, the finder image GF may be generated where the double image of the superimposed portion changes in accordance with the focusing operation of the main electronic imaging unit 20. FIG. 9 is an explanatory diagram illustrating the relationship between a deviation in the finder image GF and focusing. In FIG. 9(b), no deviation has arisen in the superimposed portion, which means that the partial image GSp has been cropped at the correct position from the subject image in the sub-image GS, and the subject is in focus. On the other hand, in FIGS. 9(a) and (c), a deviation has arisen in the superimposed portion, which means that the partial image GSp has been cropped at a deviated position from the subject image in the sub-image GS, and the subject is out of focus. Note that in FIG. 9(a), the focus has deviated beyond the subject to the rear side, and in FIG. 9(c), the focus has deviated in front of the subject to the front side. In this manner, the user is able to adjust the focus while checking the deviation of the superimposed portion of the finder image GF. Here, since the finder image GF is obtained by mainly using the main image GM and superimposing the partial image GSp, it may be formed as an image without parallax with the main image GM. Furthermore, since the partial image GSp is superimposed on the main image GM after its size is adjusted using the focal length f of the currently attached photography lens 21, no discrepancy in size arises in the image of the superimposed portion.

[0029]

Next, the operation of the digital camera 10 when the magnification rule Rb is corrected by the user will be described. FIG. 10 is a flowchart illustrating one example of a correction processing routine executed by the main controller 30. This processing is executed when the correction mode is selected by the user operating the mode selection button 90d. Note that here, correction to the adjustment magnification B will be described on the assumption that the cropping position K is normal. When the correction processing routine is executed, the main controller 30 first places a target M at the position of reference distance L and performs the task of operating the distance ring 21c to a rotational position where its distance scale indicates the distance L; once this operation is completed, an instruction screen is displayed on the LCD monitor 84, prompting operation of the OK button 90e (step S300), and processing waits for the user to operate the OK button 90e (step S310). When the OK button 90e has been operated, the focal length f of the currently attached photography lens 21 is input (step S320). As described above, that which has been selected by the focus selection lever 90h is input. When the focal length f is input in this manner, the finder image GF is generated according to the current adjustment magnification B and cropping position K (step S340). This processing is performed in the same manner as the processing of the finder image display processing routine described above. Note that the adjustment magnification B at this time is a magnification that is set by using the input focal length f with reference to the magnification rule Rb. Then, a finder image GF' obtained by enlarging the superimposed portion of the generated finder image GF is displayed on the EVF 82 (step S350). FIG. 11 is an explanatory diagram illustrating one example of the finder image GF' in the correction mode. As illustrated, the superimposed portion is displayed enlarged and a message indicating that adjustment is in progress is displayed. Here, under normal circumstances, the finder image GF' having no deviation in size would be displayed in the superimposed portion as illustrated in FIG. 11(b). However, if the position of the main electronic imaging unit 20 or the sub electronic imaging unit 40 has deviated forward or backward due to some abnormality, a discrepancy in size may arise in the superimposed portion, as illustrated in FIG. 11(a).

[0030]

When the finder image GF' is displayed in this manner, processing waits for an adjustment operation using the JOG dial 90g (step S360) or operation of the OK button 90e (step S370) to be carried out. When the adjustment operation is carried out, it is determined whether it is

an enlargement operation or a reduction operation (step S380). For example, when the JOG dial 90g is turned to the right, it is determined to be an enlargement, and when it is turned to the left, it is determined to be a reduction. When it is determined to be an enlargement operation, a degree of change to magnification Δb of a positive value according to the degree of operation of the JOG dial 90g is set (step S390), and when it is determined to be a reduction operation, a degree of change to magnification Δb of a negative value according to the degree of operation of the JOG dial 90g is set (step S400), and the degree of change to magnification Δb is added to the current adjustment magnification B to change the adjustment magnification B (step S410).

[0031]

When the adjustment magnification B is changed in this manner, processing returns to step S340 and is repeated, and adjustment operations from the user are repeatedly accepted until no discrepancy in size is identified in the finder image GF.' Then, when it is determined in step S370 that the OK button 90e has been operated, a confirmation message inquiring as to whether to correct the magnification rule Rb using the current adjustment magnification B is displayed on the EVF 82 (step S430), and processing waits for a button operation to be performed (step S440). When the cancel button 90f is operated in step S440, processing returns to step S340 again and is repeated. On the other hand, when the OK button 90e is operated in step S440, a degree of change to magnification ΔB (cumulative value of the degree of change to magnification Δb) is used as the degree of correction in the input focal length f to correct the magnification rule Rk (step S450), and this routine is terminated. For example, a case where the input focal length f is focal length f2 will be considered for correcting magnification rule Rk. In this case, first, the degree of change to magnification ΔB is added to an adjustment magnification B2 of the focal length f2 as the degree of correction. Furthermore, the degree of change to magnification ΔB is added to an adjustment magnification B1 of the focal length f1 as the degree of correction, the degree in accordance with a ratio between the adjustment magnification B2 and the adjustment magnification B1. Note that the same also applies to an adjustment magnification B3 of the focal length f3. This makes it possible for the user to correct the magnification rule Rb using a simple method. Note that the degree of change to magnification ΔB may be acquired for each of a plurality of focal lengths, and the magnification rule Rk may be corrected based thereon.

[0032]

Here, the magnification rule Rb at the time of shipment of the digital camera 10 is registered during the step of manufacturing the digital camera 10, reflecting the individual differences of the digital camera 10. The following will be explained in conjunction with the method of manufacturing the digital camera 10. FIG. 12 is an explanatory diagram illustrating one example of a step of manufacturing the digital camera 10. The step of manufacturing the digital camera 10 begins with assembling each component into the main body 12 (step S500). In this assembly step, the main electronic imaging unit 20 or the sub electronic imaging unit 40, the image processing unit 70, the display control unit 80, the EVF 82, the LCD monitor 84, the operation switch group 90, the main controller 30, and the like are assembled in the main body 12. At this time, in the flash memory 38, a default adjustment magnification for each focal length is registered as the magnification rule Rb, and furthermore, the cropping rule Rk that has already been generated is registered. When the digital camera 10 is assembled in this manner, preparations are made for generating the magnification rule Rb (step S510). In the preparation step, a power button, which is not illustrated, of the digital camera 10 is turned on and the digital camera 10 is fixed to a tripod or the like, the target M is placed at a position separated by the predetermined distance L away from the fixed digital camera 10, the focus selection lever 90h is operated to set to the focal length f (here, focal length f1) of the currently attached photography lens 21, and a rotation operation is performed so that the distance scale marked on the distance ring 21c is at a rotational position indicating the distance L. Furthermore, at this time, when the power button is turned on, the digital

camera 10 executes the finder image display processing routine described above. Therefore, the finder image GF generated according to a cropping position k and the default adjustment magnification corresponding to the focal length f1 is displayed on the EVF 82.

[0033]

When the finder image GF is displayed in this manner, a deviation in size of the superimposed portion of the displayed finder image GF is confirmed (step S520). At this time, due to individual differences in the digital camera 10, a slight deviation may arise in the superimposed portion. Note that individual differences in the digital camera 10 arise due to manufacturing errors or assembly errors of the components, such as the main electronic imaging unit 20 or the sub electronic imaging unit 40, the characteristics of the image sensors 22, 42, or the like. Then, when a discrepancy in size is confirmed in the confirmation step, the magnification adjustment is performed until the discrepancy can no longer be confirmed (step S530). The magnification adjustment is performed in the same manner as adjustment processing of the correction processing routine in FIG. 10. When the deviation in size can no longer be confirmed, the magnification rule Rb is generated using the degree of adjustment at the focal length f1 and is registered in the flash memory 38 (step S540). Generation of the magnification rule Rb is performed by adding the degree of adjustment at the focal length f1 in accordance with the ratio to the adjustment magnification at each focal length, similar to correction of the magnification rule Rb in the correction processing routine of FIG. 10. This makes it possible to eliminate deviations in size associated with individual differences arising from assembly errors of the digital camera 10 or the like, and generate and register a highly accurate magnification rule Rb.

[0034]

Here, the correspondence relationship between the constituent elements of the present embodiment and the constituent elements of the present invention will be clarified. The EVF 82 in the present embodiment corresponds to the "image display means" of the present invention, the main electronic imaging unit 20 corresponds to the "main imaging means," the sub electronic imaging unit 40 corresponds to the "sub-imaging means," the focus selection lever 90h corresponds to the "focal length acquisition means," the main controller 30 corresponds to the "magnification setting means," the main controller 30 and the image processing unit 70 correspond to the "composite image generation means," and the display control unit 80 corresponds to the "display control means." Furthermore, the JOG dial 90g corresponds to the "instruction receiving means," and the main controller 30 corresponds to the "correction means."

[0035]

According to the digital camera 10 of the present embodiment described above in detail, the focal length f of the currently attached photography lens 21 is acquired, the adjustment magnification B is set by using the acquired focal length f with reference to the magnification rule Rb, the partial image GSp cropped from a predetermined position of the sub-image GS undergoes size adjustment according to the set adjustment magnification B to the same size as the main image GM, and then the finder image GF is generated by superimposing the partial image GSp onto the main image GM, and the generated finder image GF is displayed on the EVF 82 so that a finder image obtained by superimposing two images may be generated using a simple system and without adopting a complex mechanism.

[0036]

Furthermore, since the magnification rule Rb is corrected in accordance with the degree of change to magnification set by an operation by the user in the correction mode, it is possible for the user to correct the magnification rule Rb. Furthermore, since the finder image GF' in the correction mode is an enlarged display of the superimposed portion, it is easy to check for a deviation in size and correction of the magnification rule Rb may be carried out smoothly. Moreover, since the degree of operation So for manual focus is acquired and the cropping position K of the partial image GSp is set with reference to the cropping rule Rk, it

is possible to confirm whether it is in focus or not by checking the positional deviation of the superimposed portion.

[0037]

Note that it goes without saying that the present invention is not limited in any way to the embodiment described above, and may be embodied in various forms as long as they fall within the technical scope of the present invention.

[0038]

In the embodiment described above, although the finder image GF is displayed on the EVF 82, the present invention is not limited to this, and it may be displayed on the image display monitor 84.

[0039]

In the embodiment described above, although the degree of correction with respect to one focal length is reflected in each focal length, the present invention is not limited to this, and the result of adjusting the adjustment magnification B for each focal length may be reflected in each.

[0040]

In the embodiment described above, although the partial image GSp is cropped from the sub-image GS and size adjustment is performed on the partial image GSp, the present invention is not limited to this; first, size adjustment may be performed on the sub-image GS, and then the partial image GSp may be cropped. Furthermore, size adjustment is not limited to that performed on the sub-image GS, but may be performed on the main image GM.

[0041]

In the embodiment described above, although a case where the sub-image GS is smaller in size than the main image GM has been illustrated, the present invention is not limited to this; the sub-image GS and the main image GM may be the same size, or the sub-image GS may be larger in size than the main image GM. Note that although the partial image GSp cropped from the sub-image GS is combined with the main image GM, the sub-image GS may be combined in its original form.

[0042]

In the embodiment described above, although the focal length f of the photography lens 21 is selected from three focal lengths f_1 to f_3 by the focus selection lever 90h, the present invention is not limited to this; the focal length f may be selected from four or more focal lengths. Alternatively, the user may input the focal length value, or the focal length may be acquired from the photography lens 21 without going through the user, using electrical communication means or the like. Furthermore, the photography lens 21 may be a zoom lens, and when a zoom lens is attached, it is desirable to input the focal length at that time by electrical communication means or the like and set the adjustment magnification B. When a zoom lens is attached, the magnification rule R_b should be changed continuously; the magnification rule R_b is stored as a relational formula, and when finding the magnification, it is desirable to perform a calculation using that relational formula to find the adjustment magnification B.

[0043]

In the embodiment described above, although the degree of rotation of the distance ring 21c is detected through the coupling ring 29, the degree of rotation may be detected by directly detecting the rotation angle of the distance ring 21c.

[0044]

In the embodiment described above, although the magnification rule R_b is a rule that associates the focal length f with the magnification, it may be a rule that associates the focal length f with the distance to the subject acquired from the ring position sensor 29a and the magnification. This makes it possible to align the size of the subject image captured in the partial image GSp and the size of the subject image captured in the main image GM, even if the size of the subject captured in the main image GM depends on the distance to the subject.

[0045]

In the embodiment described above, although the finder image GF is generated by simply superimposing the partial image GSp on the main image GM using alpha blending processing, the finder image GF may also be generated after changing the color of at least one of the partial image GSp and the main image GM and by superimposing using alpha blending processing. In this case, the image of the superimposed portion of the main image GM or the partial image GSp may be made monochrome, amber, or the like. This makes it easy to distinguish between the image of the superimposed portion of the main image GM and the partial image GSp.

[0046]

In the embodiment described above, although the cropping position K or the cropping region are determined without taking into consideration the rotation around the optical axis in the main electronic imaging unit 20 or the sub electronic imaging unit 40, the cropping position K and the cropping region may reflect the rotation around the optical axis in the main electronic imaging unit 20 or the sub electronic imaging unit 40, so that when the subject is in focus, a deviation in the rotational direction of the superimposed portion may not arise. In this case, it is preferable that the cropping rule Rk includes information corresponding to rotation.

[0047]

In the embodiment described above, although an adjustment made when generating or when correcting the magnification rule Rb is based on the manual operation of the JOG dial 90g by an operator or user, the present invention is not limited to this; adjustment may be performed automatically.

[Description of Reference Numerals]

[0048]

10 Digital camera, 12 main body, 20 main electronic imaging unit, 21 photography lens, 21a lens group, 21b aperture mechanism, 21c distance ring, 21d extension part, 22 image sensor, 23 focal plane shutter, 24 driver circuit, 26 analog front end (AFE), 29 coupling ring, 29a ring position sensor, 30 main controller, 32 CPU, 34 ROM, 36 RAM, 38 flash memory, 40 sub electronic imaging unit, 41 sub-lens, 41a and 41c lens group, 41b aperture mechanism, 42 image sensor, 44 driver circuit, 46 analog front end (AFE), 60 memory card, 70 image processing unit, 80 display control unit, 82 EVF, 84 LCD monitor, 90 operation switch group, 90a shutter button, 90b dial switch (dial SW), 90c wind-up lever, 90d mode selection button, 90e OK button, 90f cancel button, 90g JOG dial, 90h focus selection lever, GF and GF' finder image, GM main image, GS sub-image, GSp partial image, M target, A and B predetermined interval.

[Document Name] Scope of Patent Claims

[Claim 1]

A digital camera capable of manual focusing and changing a focal length of a main lens, wherein the digital camera comprises:

image display means for displaying an image;

main imaging means for generating a main image by photoelectrically converting a representation of a subject obtained through the main lens;

sub-imaging means for generating a sub-image by photoelectrically converting a representation of a subject obtained through a sub-lens;

focal length acquisition means for acquiring a focal length of the main lens;

magnification setting means for setting a magnification of an image based on the acquired focal length of the main lens;

composite image generating means for generating a composite image obtained by superimposing the main image and the sub-image accompanied by magnification processing of at least one image of the main image and the sub-image at the set magnification; and

display control means for controlling the display means so as to display the generated composite image.

[Claim 2]

The digital camera according to claim 1, wherein the magnification setting means is means for setting a magnification so that the representation of the subject in the main image and the representation of the subject in the sub-image are substantially the same size.

[Claim 3]

The digital camera according to claim 2, wherein a pan focus lens is attached as the sub-lens.

[Claim 4]

The digital camera according to claim 3, comprising a correction mode capable of correcting a predetermined magnification rule for setting a magnification of an image accompanied by checking for a deviation in size in the composite image when the focal length of the main lens is set to a predetermined focal length, further comprises:

instruction receiving means for receiving an instruction to change the set magnification so that the deviation in size in the composite image becomes equal to or smaller than a predetermined level in the correction mode; and

correction means for correcting the magnification rule by using the received degree of change to the magnification as a degree of correction at the predetermined focal length in the correction mode.

[Claim 5]

The digital camera according to any one of claims 1 to 4, further comprising degree of operation acquisition means for acquiring a degree of operation of manual focus, wherein

the composite image generating means is means for generating, as the composite image, an image obtained by setting a cropping position at which an image is partially cropped from the sub-image, and cropping the partial image according to the set cropping position and superimposing it onto a predetermined position of the main image, based on the acquired degree of operation and a predetermined cropping rule, so that the more the subject is manually focused on, the smaller the positional deviation of the superimposed portion in the composite image.

[Claim 6]

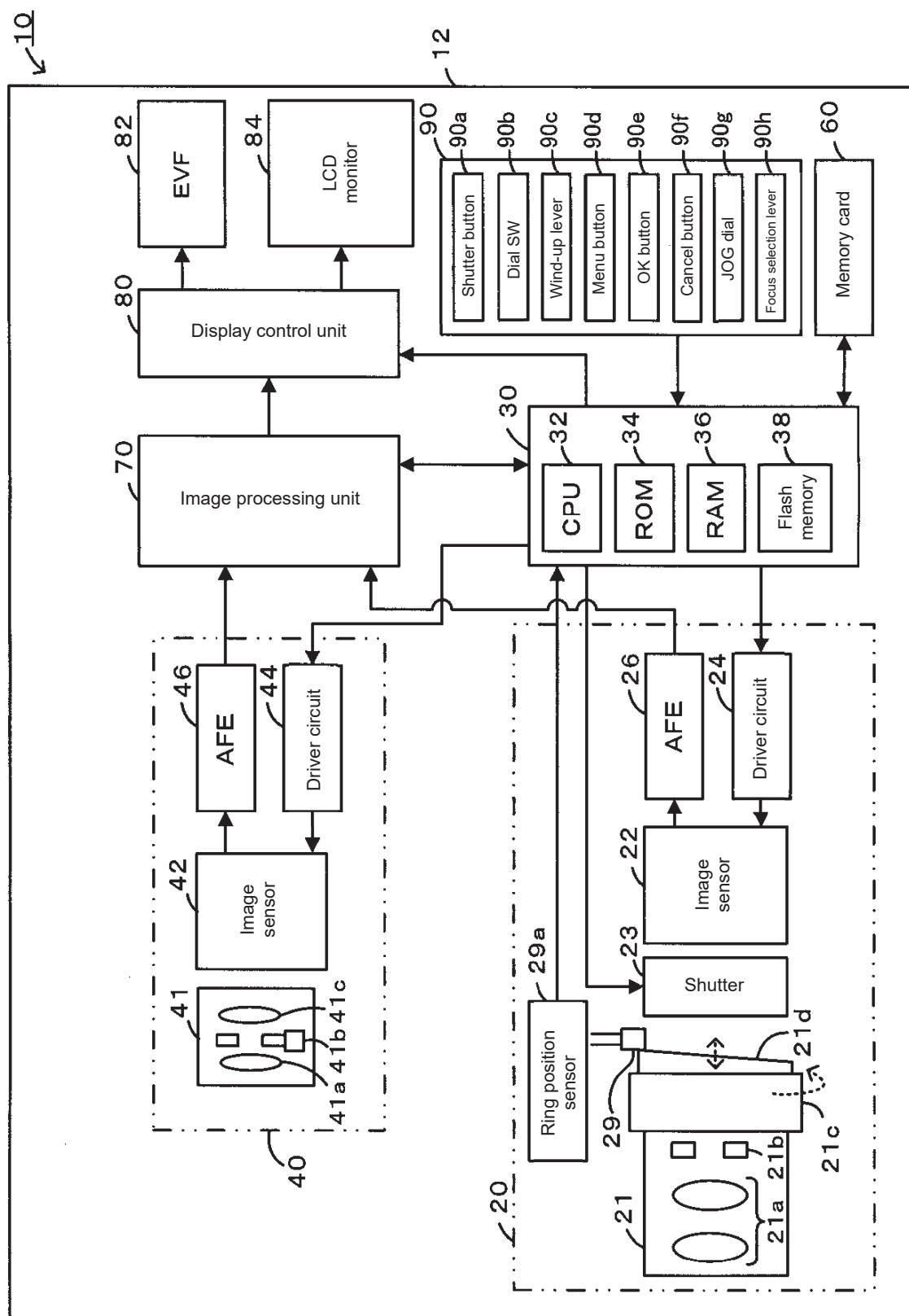
The digital camera according to claim 5, wherein the composite image generating means is means for using, as the predetermined cropping rule, a rule predetermined by the principle of triangulation based on an interval between the main lens and the sub-lens and a distance to the subject derived from the acquired degree of operation.

[Claim 7]

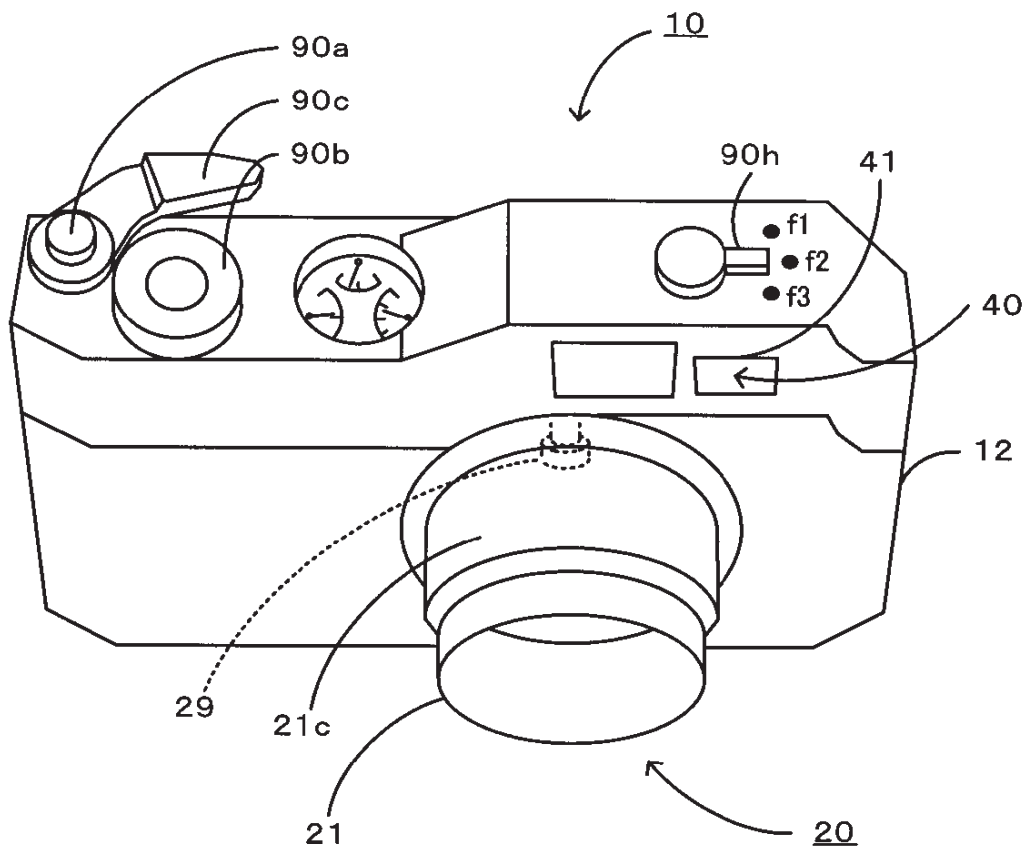
A method of manufacturing a digital camera capable of manual focusing and changing a

focal length of a main lens, wherein the method of manufacturing a digital camera comprises:

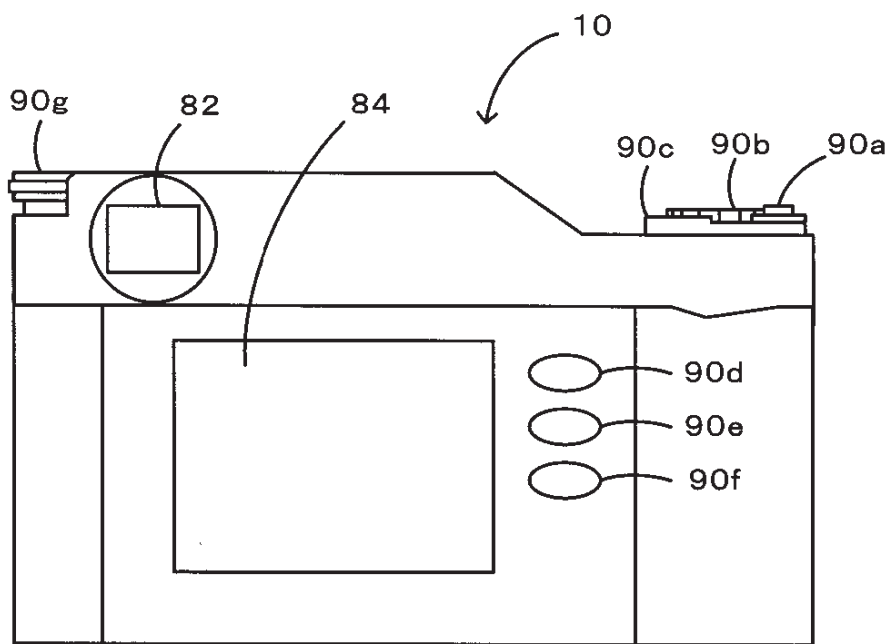
- (a) an assembly step of assembling image display means for displaying an image; main imaging means for generating a main image by photoelectrically converting a representation of a subject obtained through the main lens; sub-imaging means for generating a sub-image by photoelectrically converting a representation of a subject obtained through a sub-lens; focal length acquisition means for acquiring a focal length of the main lens; magnification setting means for setting a magnification of an image based on the acquired focal length of the main lens so that the representation of the subject in the main image and the representation of the subject in the sub-image are substantially the same size; composite image generating means for generating a composite image obtained by superimposing the main image and the sub-image accompanied by magnification processing of at least one image of the main image and the sub-image at the set magnification; display control means for controlling the display means so as to display the generated composite image; and storage means for storing various data;
- (b) a preparation step of changing the focal length of the main lens to a predetermined focal length;
- (c) an adjustment step of causing the composite image generating means to generate the composite image, and when a deviation in size of the generated composite image is confirmed, performing an adjustment of the set magnification so that the deviation becomes equal to or smaller than a predetermined level; and
- (d) a registration step of generating a magnification rule that associates the predetermined focal length with the magnification based on the magnification that is set when the deviation is equal to or smaller than a predetermined level, and registering the generated magnification rule in the storage means.



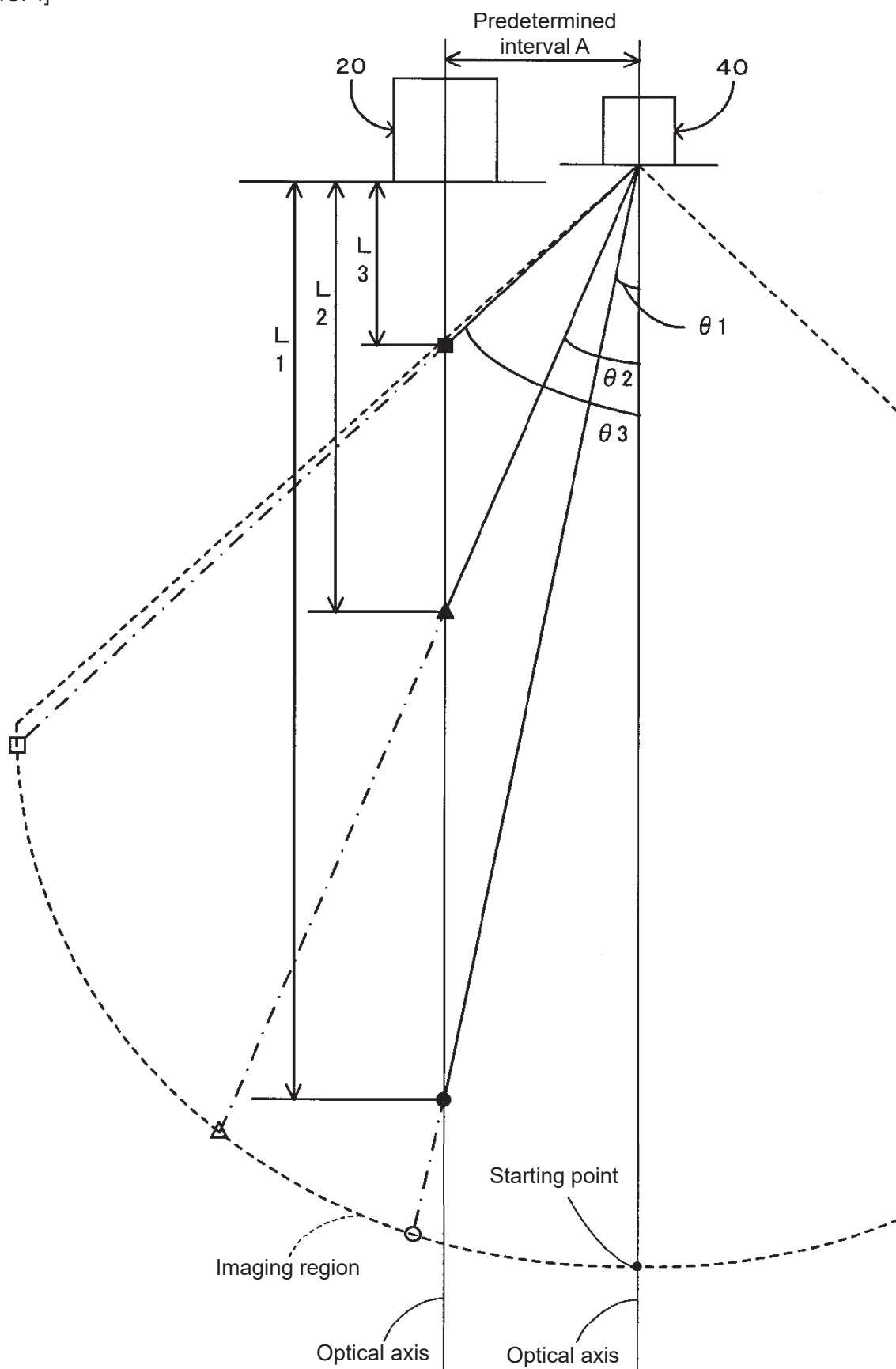
[FIG. 2]



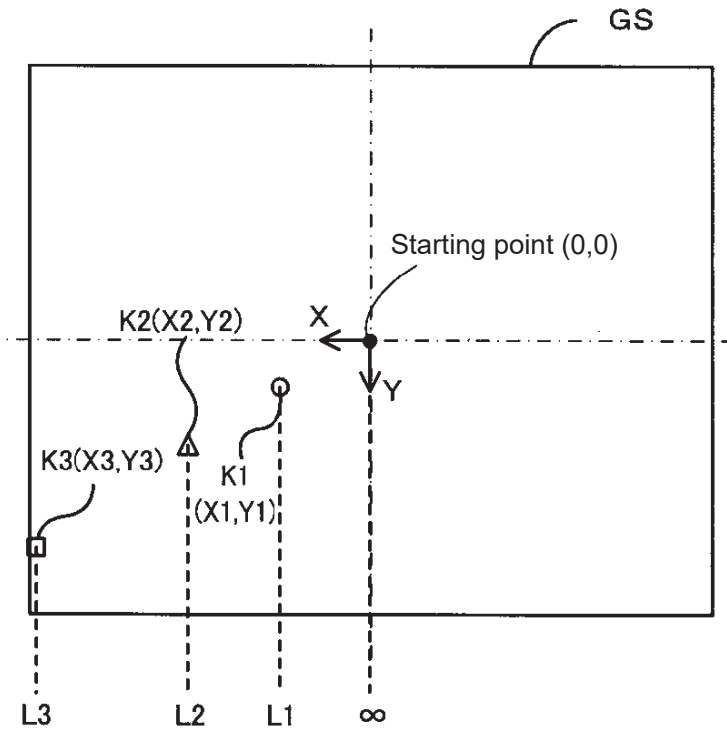
[FIG. 3]



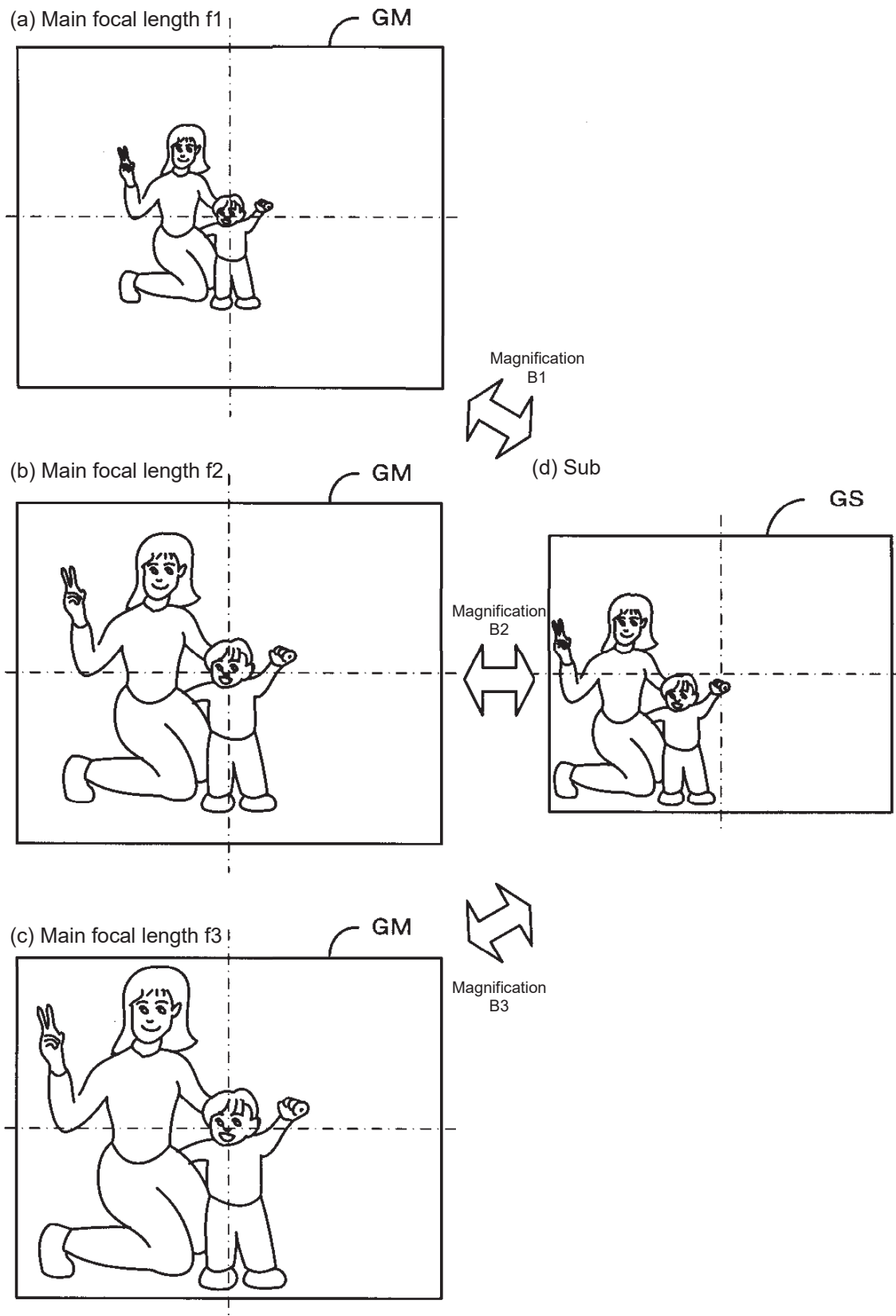
[FIG. 4]



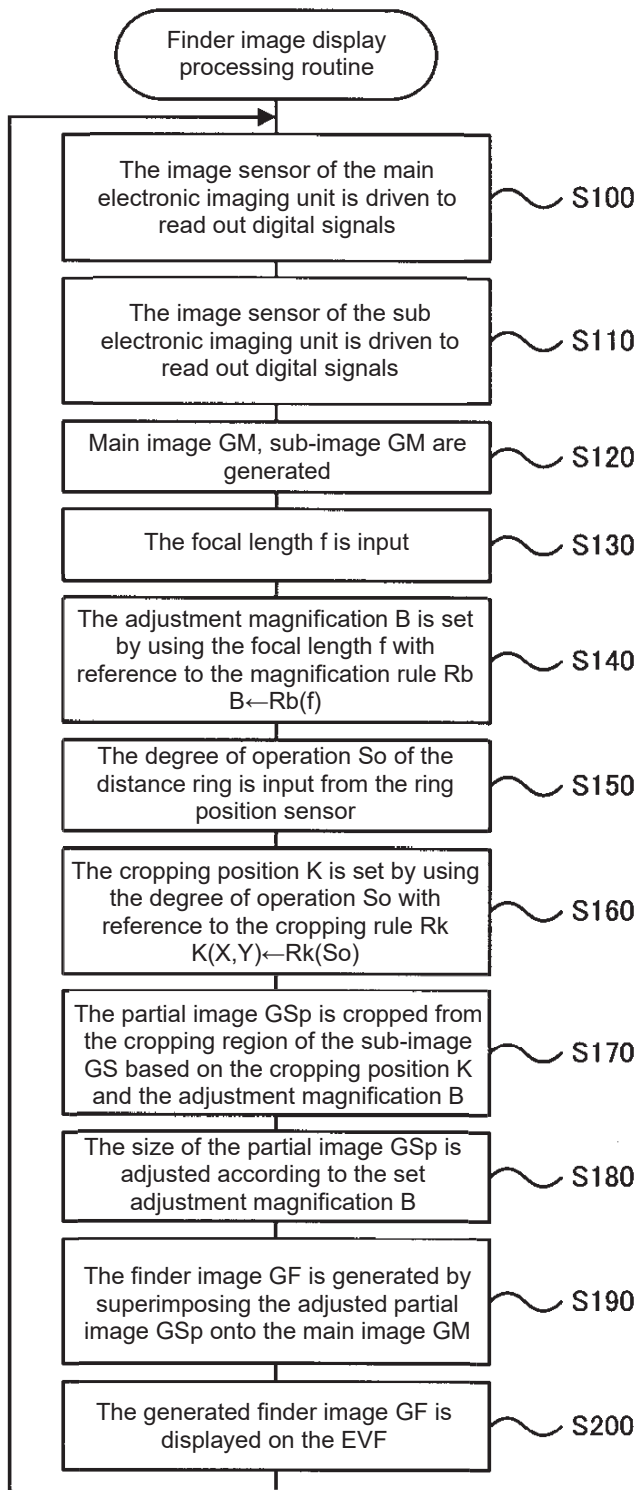
[FIG. 5]



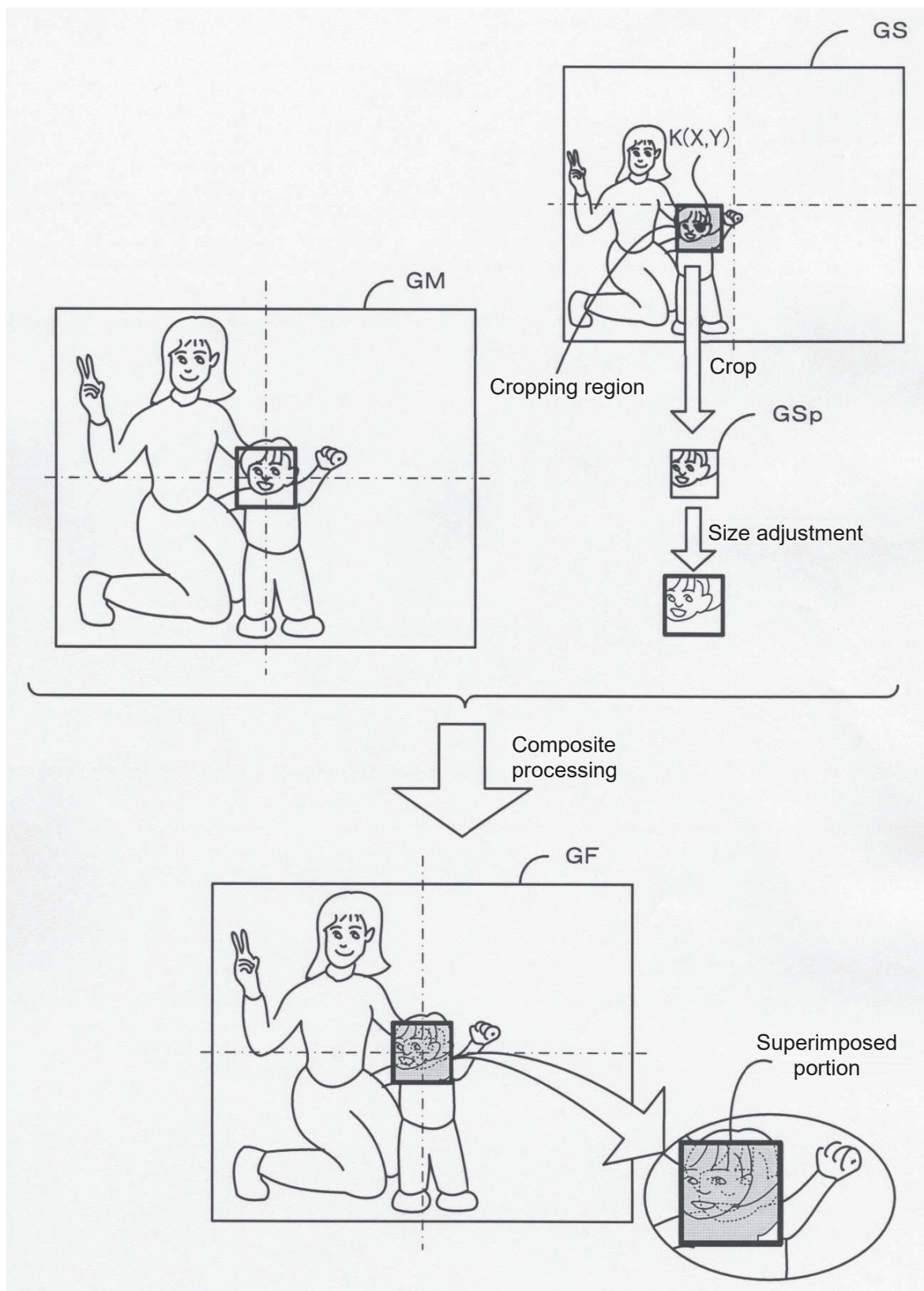
[FIG. 6]



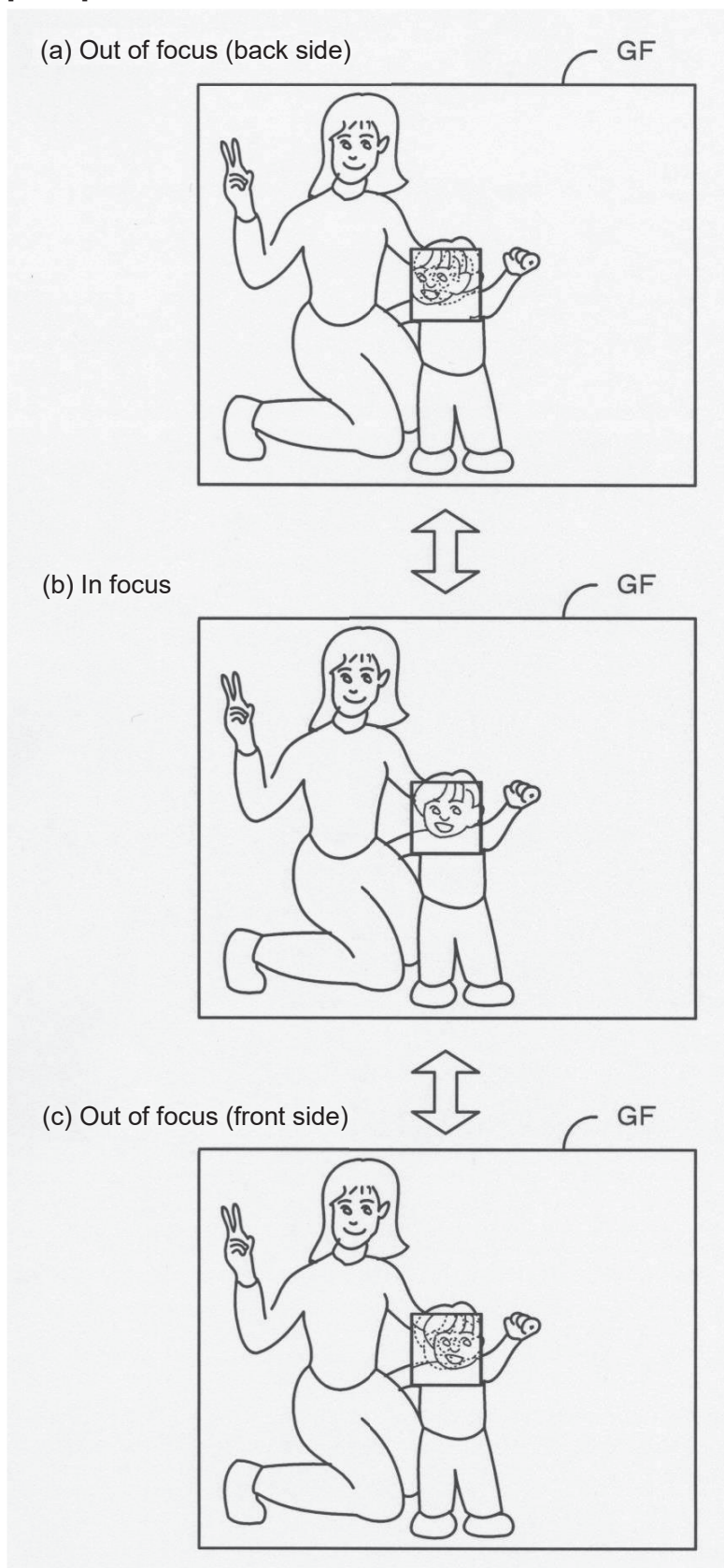
[FIG. 7]



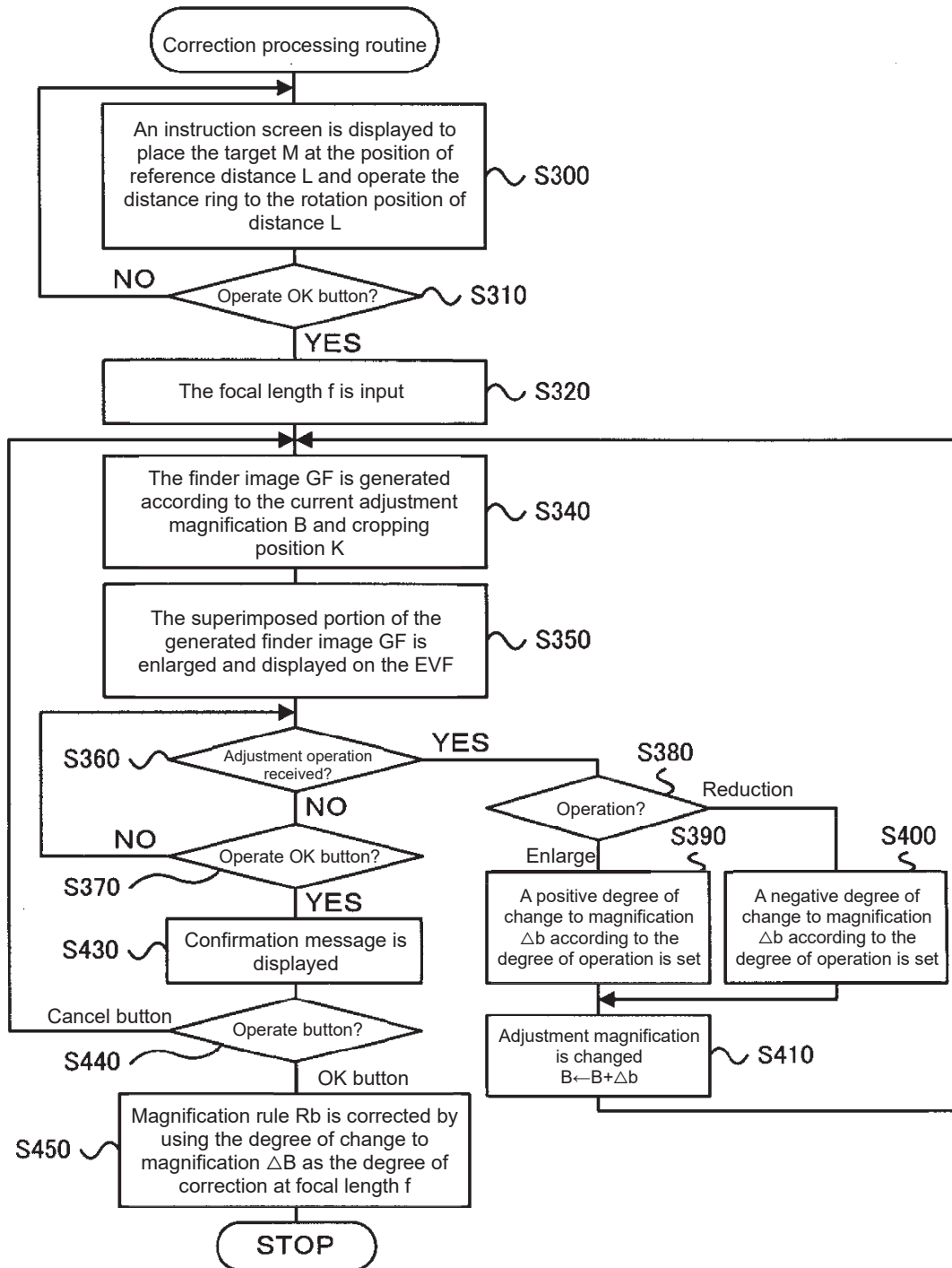
[FIG. 8]



[FIG. 9]

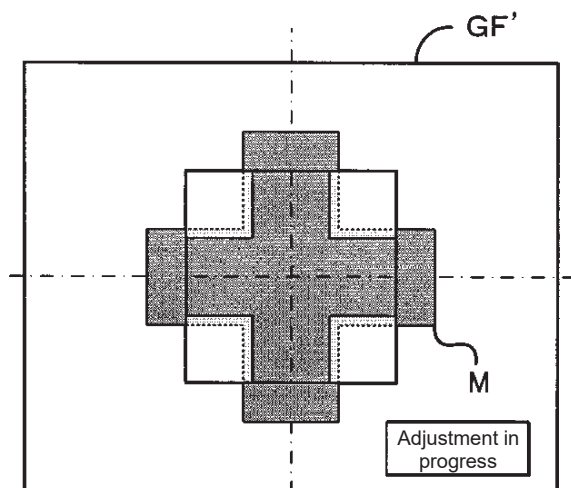


[FIG. 10]

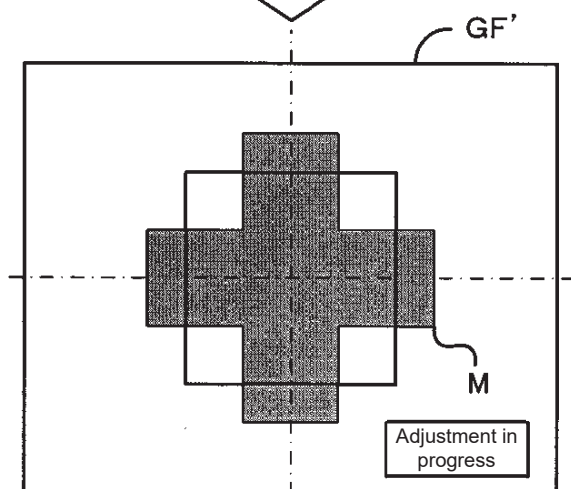


[FIG. 11]

(a)



(b)



[FIG. 12]

