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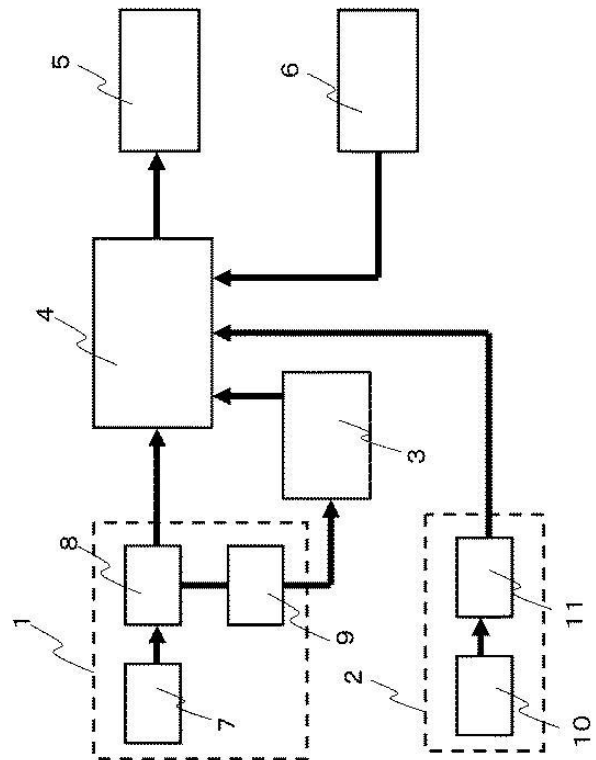
(54) [Title] Telephoto Imaging Device

(57) [Abstract]

[Problem] A conventional imaging device with a telephoto zoom function using an optical zoom lens needs, for example, a motor for moving a lens system and is therefore difficult to apply in a thin mobile terminal device. Moreover, a conventional telephoto zoom function that switches between images of an imaging device having a plurality of focal lengths according to a designated magnification has a problem where an enlarged image at a close distance is blurred.

[Solution] By having an imaging module having a wide-angle lens, an imaging module having a telephoto lens, and a measurement means for measuring a distance to a subject and compositing a wide-angle image and a telephoto image according to the distance of the subject, a mobile terminal device that is thin and has a telephoto imaging device with a telephoto magnification of a wide dynamic range can be realized.

[Selected FIG.] FIG. 1



[Claims]

[Claim 1]

An imaging device or a mobile terminal device including the imaging device, comprising: a first imaging module having a wide-angle lens system, a first imaging element, and an autofocus means; a second imaging module that has an optical axis parallel to the first imaging module and is made of a telephoto lens system focused in the distance and a second imaging element; an image control means; a display device; and a keying means; wherein

10 the image control means, when a setting magnification  $X$  set by a user via the keying means is less than a predetermined magnification  $A$ , cuts out an image corresponding to the setting magnification  $X$  from a photographic image of the first imaging element and displays this enlarged on the display device;  
further comprised is a photography-distance estimation means for estimating a photography distance  $Y$  between a photography subject and the mobile terminal device;  
the image control means, when the photography distance  $Y$  is greater than a predetermined distance  $B$  and the setting magnification  $X$  is the predetermined magnification  $A$  or greater, generates a composite image where a photographic image of the second imaging element is pasted in a substantially central portion of the photographic image of the first imaging element and composited therewith and afterward cuts out an image corresponding to the setting magnification  $X$  from the composite image and displays this enlarged on the display device; and  
20 when the photography distance  $Y$  is the predetermined distance  $B$  or less, an image corresponding to the setting magnification  $X$  is cut out from the photographic image of the first imaging element and displayed enlarged on the display device.

[Claim 2]

The imaging device or the mobile terminal device including the imaging device of claim 1, wherein the photography distance  $Y$  between the photography subject and the mobile terminal device is estimated from an output signal of the autofocus means or a control signal controlling the autofocus means.

[Claim 3]

30 The imaging device or the mobile terminal device including the imaging device of claim 1, wherein a relationship between a pixel density  $N1$  of the first imaging element, a pixel density  $N2$  of the second imaging element, and a telephoto magnification  $C$  of the second imaging element relative to the first imaging element satisfies the following condition:

$N1 < N2 \cdot C^2$  [Claim 4]

The imaging device or the mobile terminal device including the imaging device of claim 3, wherein a size of the second imaging element is smaller than the first imaging element.

[Claim 5]

The imaging device or the mobile terminal device including the imaging device of claim 1, further comprising: one or more mirrors or prisms that change an optical path of the telephoto lens system of the second image module by 90 degrees.

[Detailed Description of Invention]

40 [Technical Field]

[0001]

The present invention relates to a mobile phone or mobile terminal device that includes an imaging device.

[Background Art]

[0002]

50 Digital cameras and imaging devices (cameras) of mobile terminal devices such as mobile phones are becoming more highly functional, and there is also a rising demand for a telephoto zoom function. Conventional imaging devices with telephoto zooming have an optical zoom lens having a multi-group lens system made of a plurality of lenses and an imaging element (CCD) and can change a magnification by mechanically moving a relative position of the lens system using a motor or the like. Because a multi-group lens has a large size in an optical-axis direction, among methods proposed for shortening its length include utilizing a prism (for example, patent literature 1).

Furthermore, by switching between or compositing images of a plurality of optical systems and a plurality of imaging elements joined to these optical systems, a wide dynamic range of enlargement magnification from wide-angle to telephoto can be realized (for example, patent literatures 2, 3).

Furthermore, because an auto-adjusting optical zoom lens needs motor driving and the like, it is difficult to reduce in size. As such, there is a method of realizing a small camera with telephoto zooming by combining a camera having a plurality of focal lengths and electronic (digital) zooming (for example, patent literature 4).

[Citation List]

[Patent Literature]

[0003]

[Patent Literature 1] JP 3570253 B2

[Patent Literature 2] JP 4068869 B2

10 [Patent Literature 3] JP 2005-101874 A

[Patent Literature 4] JP H2-179078 A

[Summary of Invention]

[Problem to be Solved by Invention]

[0004]

To realize a telephoto function, a lens with a long focal length or a telephoto lens system is necessary, and a distance of a certain extent is necessary between a lens on an outermost side and an imaging element.

[0005]

Meanwhile, to realize a wide angle, a lens diameter relative to a distance between the imaging element and a lens in an endmost portion needs to be increased using a lens of a short focal length.

20 [0006]

A conventional optical zoom lens is a structure that lines up a plurality of lens systems—two to four groups—vertically to realize the above telephoto and wide-angle by one optical system; a length of a camera in an optical-axis direction and a horizontal width of the camera are large, making size reduction difficult. Application is particularly difficult in mobile terminal devices, which require thinness.

[0007]

Patent literatures 2, 3, 4 above realize a zoom function by using a plurality of imaging modules made of a plurality of lenses with different focal lengths—that is, lenses of different fixed magnifications. Images of the imaging modules are switched between according to each magnification set by a user.

[0008]

30 For example, in a configuration of two modules of an imaging module with a wide-angle lens and an imaging module with a telephoto lens, when a subject is at a short distance, an image of the imaging module of the wide-angle lens, which has a short focal length, is switched to, and when the subject is at a long distance, an image of the imaging module with the telephoto lens is switched to. Small changes in magnification are realized by electronic zooming, which changes a cutout region from a photographic image. This renders a multi-group lens and motor necessary for optical zooming unnecessary.

[0009]

However, a zooming method with the two imaging modules of the fixed magnifications above has the following problems.

[0010]

40 Each imaging module needs a focus adjustment function for focusing the lens on a range of subjects, from a subject at a close distance to a subject at a long distance. While small in comparison to a lens movement amount necessary to change a magnification in optical zooming, focus adjustment needs to move the focus lens by a motor, an actuator, or the like, which becomes a factor in increasing a size of an optical lens system.

[0011]

Note that when there is no focus adjustment function, two or more imaging modules adjusted to focus on subjects at different distances need to be used. Images of many imaging modules need to be switched between in small increments according to the distance to the subject, making size reduction difficult.

Moreover, an image becomes blurry when there is no imaging module that matches the distance to the subject.

50 [0012]

Telephoto imaging modules with a long focal length are often designed so an image quality improves when the subject is far as opposed to near. That is, a telephoto imaging module with a long focal length is less sharp at close distances compared to a wide-angle imaging module whose focal length is short.

[0013]

Therefore, when the user sets a high magnification, a switch is made from the wide-angle imaging module to the telephoto imaging module. However, at this time, if the subject is close, the image quality degrades due to the image being from the telephoto imaging module.

[0014]

In particular, making a magnification of the telephoto lens too large degrades the close-distance image even more. As such, the telephoto imaging module needs to have a small telephoto magnification so even if the subject is at a close distance, focus adjustment is performed so the image quality is not degraded. Because of this, a zoom function with a large telephoto magnification cannot be realized.

[0015]

10 Furthermore, increasing the magnification of the telephoto lens lengthens the telephoto imaging module and increases a movement amount of the focal length, thereby prohibiting size reduction. Therefore, the telephoto magnification cannot be increased.

[0016]

When the subject is at a close distance, a change in the distance from the subject causes a change in center positions of the image of the wide-angle imaging module and the image of the telephoto imaging module. As such, as described in patent literature 3 for example, center-position correction according to the distance is necessary.

[Solution to Problem]

[0017]

20 Next, means for solving the above problem is described.

[0018]

A mobile terminal device of the present invention is an imaging device, having: a first imaging module having a wide-angle lens system, a first imaging element, and an autofocus means; a second imaging module that has an optical axis parallel to the first imaging module and is made of a telephoto lens system focused in the distance and a second imaging element; an image control means; a display device; and a keying means; wherein when a setting magnification X set by a user via the keying means is less than a predetermined magnification A, an image corresponding to the setting magnification X is cut out from a photographic image of the first imaging element and displayed enlarged on the display device; further had is a photography-distance estimation means for estimating a photography distance Y between a photography subject and the mobile terminal device; when the photography distance Y is greater than a predetermined distance B and the setting magnification X is greater than the predetermined magnification A, a composite image where a photographic image of the second imaging element is pasted in a substantially central portion of the photographic image of the first imaging element and composited therewith is generated, and afterward, an image corresponding to the setting magnification X is cut out from the composite image and displayed enlarged on the display device; and when the photography distance Y is the predetermined distance B or less, an image corresponding to the setting magnification X is cut out from the photographic image of the first imaging element and displayed enlarged on the display device.

30

[0019]

40 Furthermore, in the mobile terminal device of the present invention, the photography distance Y between the photography subject and the mobile terminal device is estimated from an output signal of the autofocus means or a control signal controlling the autofocus means.

[Advantageous Effects of Invention]

[0020]

According to the present invention, an imaging device for a mobile terminal device that is thin and has a large telephoto magnification can be realized without the need for an optical zoom lens or a focus adjustment function of a telephoto lens.

[Brief Description of Drawings]

[0021]

50 [FIG. 1] A block configuration view of a mobile terminal device of embodiment 1 of the present invention.

[FIG. 2] A structural view of a first imaging module of embodiment 1 of the present invention.

[FIG. 3] A structural view of a second imaging module of embodiment 1 of the present invention.

[FIG. 4] A sectional view of an imaging device of the mobile terminal device of embodiment 1 of the present invention.

[FIG. 5] A diagram illustrating an enlarged-image generation method of embodiment 1 of the present invention.

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