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Signed this 11th day of May 2018.

Jeremy Coombs, VP Global Operations

ACKNOWLEDGMENT BEFORE NOTARY

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On this 11th day of May, 2018before me, the undersigned Notary Public, personally appeared Jeremy Coombs, who proved on the basis of satisfactory evidence to be the person whose name is subscribed to this Translator's Certificate of Translation and who acknowledged that he or she executed the same for the purposes stated therein.

IN WITNESS WHEREOF, I hereunto set my hand and official seal.

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(54) [Title of the Invention] Imaging Apparatus

(57) [Abstract] (Corrected)

[Object] To provide an image having high image quality and high resolution over an entire wide variable power region.

[Solving Means] An imaging apparatus includes single-focus first and second imaging optical systems LN1 and LN2 that face the same direction. A focal length of the second imaging optical system LN2 is longer than a focal length of the first imaging optical system LN1. Zooming is performed from a wide angle end to an intermediate focal length state with an electronic zoom by segmentation of an image acquired in the first imaging optical system LN1, and zooming is performed from the intermediate focal length state to a telescopic end with an electronic zoom by segmentation of an image acquired in the second imaging optical system. Thus, zooming from the wide angle end to the telescopic end is performed as a whole. Both of the first and second imaging optical systems LN1 and LN2 includes four or more lenses of first lenses of positive power and second lenses of negative power in order from an object side, the lenses nearest to the image side are negative lenses, and composite focal lengths of the first lenses and the second lenses are positive, and satisfy a conditional expression: $1.0 < fFw/fFm < 1.5$.

[Selected Drawing] FIG. 21

Specification
Title of the Invention: IMAGING APPARATUS

DETAILED DESCRIPTION OF THE INVENTION

TECHNICAL FIELD

[0001]

The present invention relates to an imaging apparatus. In particular, the present invention relates to a small-sized imaging apparatus having an electronic zoom function that can capture an image of a subject by an imaging device (for example, a solid imaging device such as a CCD (Charge Coupled Device)-type image sensor or a CMOS (Complementary Metal-Oxide Semiconductor)), and scale the image.

BACKGROUND ART

[0002]

In recent years, with improved performance and miniaturization of imaging apparatuses using a solid imaging device such as a CCD-type image sensor and a CMOS-type image sensor, mobile phones and personal digital assistants that are equipped with the imaging apparatus have been widespread. In addition, further initialization and higher performance for the imaging optical system installed in the imaging apparatus are in increasing demand. Although conventional imaging apparatuses are single focus, a zoom function has grown in demand. However, when the imaging optical system having the optical zoon function is used, the optical system itself becomes excessively large, and requires an actuator for zoom driving. As a result, the imaging apparatus becomes extremely large. Therefore, it has been difficult to install such imaging apparatus in mobile phones or personal digital assistants.

[0003]

Thus, a single-focus imaging optical system having a small entire length can be provided with an electronic zoom function (that is, pseudo zoom function by segmentation of an image). However, in the case of an electronic zoom having a large zoom ratio, disadvantageously, the number of pixels of a segmented image becomes excessively small at a telescopic end. To solve the problem, Patent Document 1 to 3 propose that a decrease in the number of pixels is prevented by installing a single-focus imaging optical system having two or more different focal lengths, and switching the electronic zoom function for each focal length. Patent Document 1 proposes a digital camera that includes a single focus lens and a zoom lens to gap the focal length with the electronic zoom. Patent Document 2 and Patent Document 3 propose an imaging apparatus that uses two or three single focus lenses to perform the electronic zoom.

CONVENTIONAL TECHNICAL DOCUMENTS

Patent Documents

[0004]

Patent Document 1: Japanese National Publication of International Patent Application No. 2008-530954

Patent Document 2: Japanese Laid-open Publication No. 2005-99265

Patent Document 3: Japanese Laid-open Publication No. 2007-306282

SUMMARY OF THE INVENTION

Problems to be Solved by the Invention

[0005]

As described in Patent Documents 1 to 3, the high variable power imaging apparatus having the large number of pixels can be realized by using a plurality of imaging optical systems to perform the electronic zoom. However, Patent Documents 1 to 3 fail to describe any specific configuration of the imaging optical system for achieving slimming-down and high image quality. The documents merely describe its concepts, and do not sufficiently demonstrate the feasibility of slimming-down.

[0006]

The present invention is devised in consideration of such problem, and its object is to provide a high-performance thin and small-sized imaging apparatus capable of acquiring an image of high quality and high resolution over an entire wide variable power region.

MEANS FOR SOLVING THE PROBLEMS

[0007]

To attain the above-mentioned object, an imaging apparatus from a first aspect of the invention includes single-focus first and second imaging optical systems that face the same direction, a focal length of the second imaging optical system is longer than a focal length of the first imaging optical system, zooming is performed from a wide angle end to an intermediate focal length state with an electronic zoom by segmentation of an image acquired in the first imaging optical system, zooming is performed from the intermediate focal length state to a telescopic end with an electronic zoom by segmentation of an image acquired in the second imaging optical system, and zooming from the wide angle end to the telescopic end is performed as a whole. Both of the first and second imaging optical systems includes four or more lenses of first lenses of positive power and second lenses of negative power in order from the object side, the lenses nearest to the image side are negative lenses, and composite focal lengths of the first lenses and the second lenses are positive, and satisfy a conditional expression (1).

$$1.0 < fFw/fFm < 1.5 \quad \text{... (1)}$$

wherein,

fFw: Composite focal lengths of the first lenses and the second lenses in the first imaging optical system, and

fFm: Composite focal lengths of the first lenses and the second lenses in the second imaging optical system.

[0008]

The imaging apparatus from a second aspect of the invention is characterized by that, in the first aspect of the invention, following conditional expression (2A) and (2B) are satisfied.

$$fFw/fw > 1 \quad \text{... (2A)}$$
$$fFm/fm < 1 \quad \text{... (2B)}$$

wherein,

fw: Focal length of the entire first imaging optical system, and

fm: Focal length of the entire second imaging optical system.

[0009]

The imaging apparatus from a third aspect of the invention is characterized by that, in the first or second aspect of the invention, a following conditional expression (3) is satisfied.

$$-0.6 < fXw/fXm < 0.5 \ldots (3)$$

wherein,

fXw: Focal length of the second lens from the image side in the first imaging optical system, and

fXm: Focal length of the second lens from the image side in the second imaging optical system.

[0010]

The imaging apparatus from a fourth aspect of the invention is characterized by that, in any one of the first to third aspect of the invention, a following conditional expression (4) is satisfied.

$$94 > 2\omega w > 72 \ldots (4)$$

wherein,

2ωw: Entire viewing angle [deg] of the first imaging optical system.

[0011]

The imaging apparatus from a fifth aspect of the invention is characterized by that, in any one of the first to fourth aspect of the invention, the first imaging optical system includes four lenses of a first lens of positive power, a second lens of negative power, a third lens of positive power, and a four lens of negative power in order from the object side, and the second imaging optical system includes four lenses of a first lens of positive power, a second lens of negative power, a third lens of negative power, and a four lens of negative power in order from the object side.

[0012]

The imaging apparatus from a sixth aspect of the invention is characterized by that, in any one of the first to fourth aspect of the invention, the first imaging optical system includes five lenses of a first lens of positive power, a second lens of negative power, a third lens of positive power, a fourth lens of positive power, and a fifth lens of negative power in order from the object side, and the second imaging optical system includes five lenses of a first lens of positive power, a second lens of negative power, a third lens of positive power, a four lens of negative power, and a fifth lens of negative power in order from the object side.

[0013]

The imaging apparatus from a seventh aspect of the invention is characterized by that, in any one of the first to sixth aspect of the invention, a following conditional expression (5) is satisfied.

$$0.6 < FNOw/FNOm < 1.3 \ldots (5)$$

wherein,

FNOw: F-number of the first imaging optical system, and

FNOm: F-number of the second imaging optical system.

[0014]

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