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(54) CAMERA AND METHOD OF IMAGING

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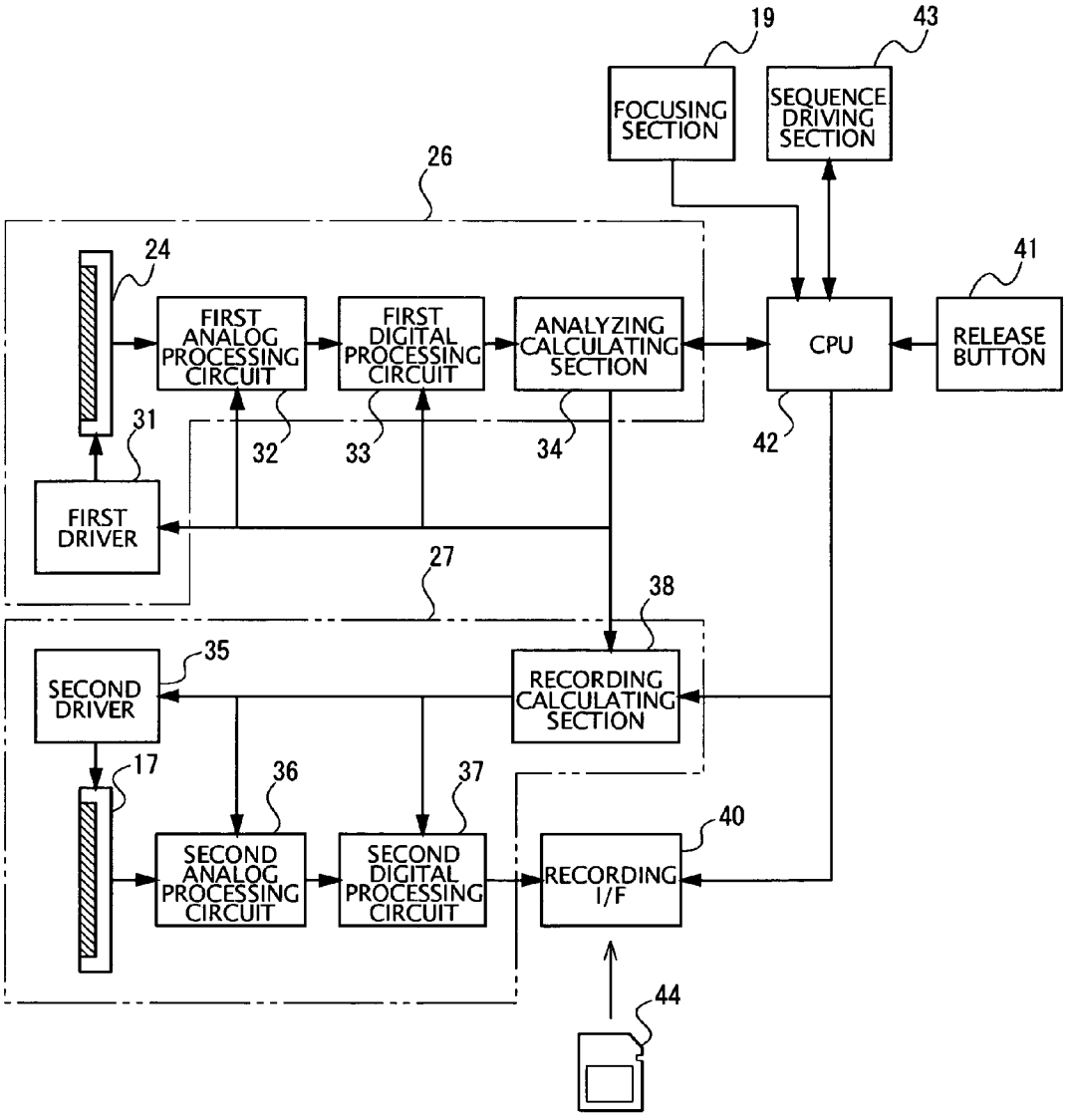
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(57) **ABSTRACT**

A camera includes a photometry section, an exposure calculating section, and a correction calculating section. The photometry section obtains photometry values at a plurality of positions of a subject. The exposure calculating section obtains an exposure value when photographing based on the photometry values. The correction calculating section obtains a correction value for correction of the exposure value based on a highest value among photometry values belonging to a predetermined range out of the plurality of photometry values obtained by the photometry section.



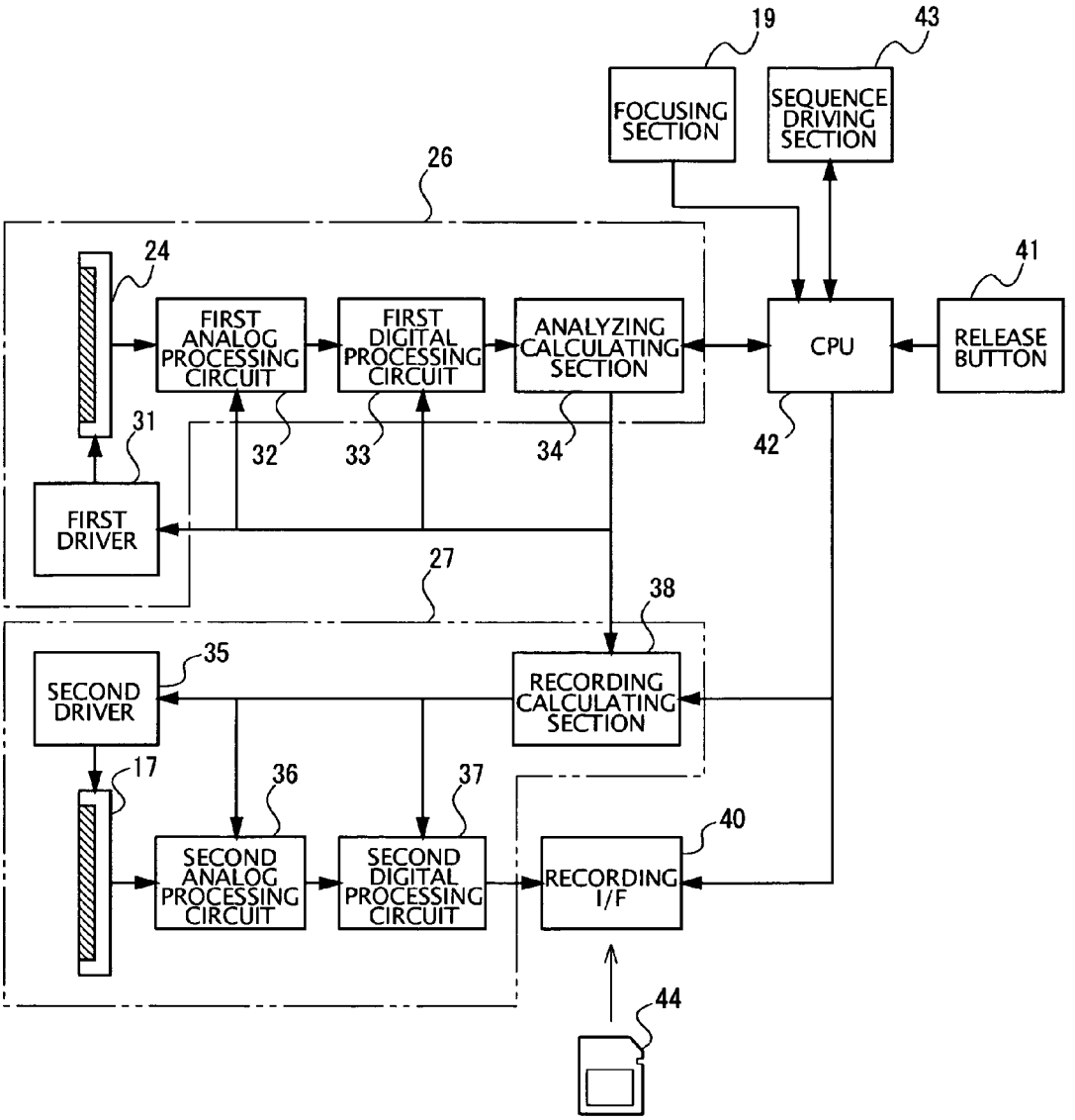

19
43
FOCUSING SECTION
SEQUENCE DRIVING SECTION
26
24
41
FIRST ANALOG PROCESSING CIRCUIT
FIRST DIGITAL PROCESSING CIRCUIT
ANALYZING CALCULATING SECTION
CPU
RELEASE BUTTON
31
32
33
34
42
FIRST DRIVER
27
38
35
SECOND DRIVER
RECORDING CALCULATING SECTION
17
36
37
40
SECOND ANALOG PROCESSING CIRCUIT
SECOND DIGITAL PROCESSING CIRCUIT
RECORDING I/F
44

Fig.1

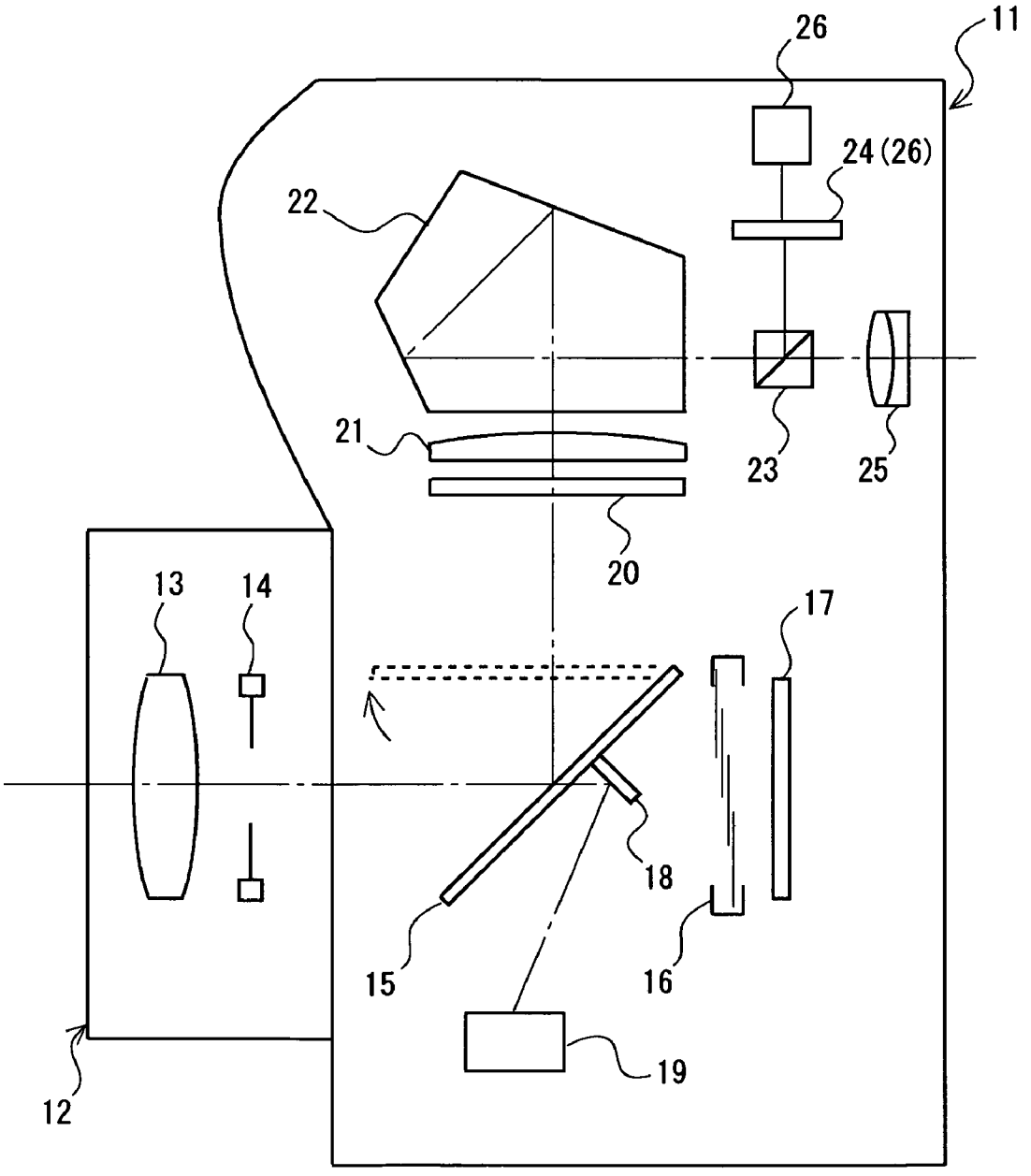


Fig.2

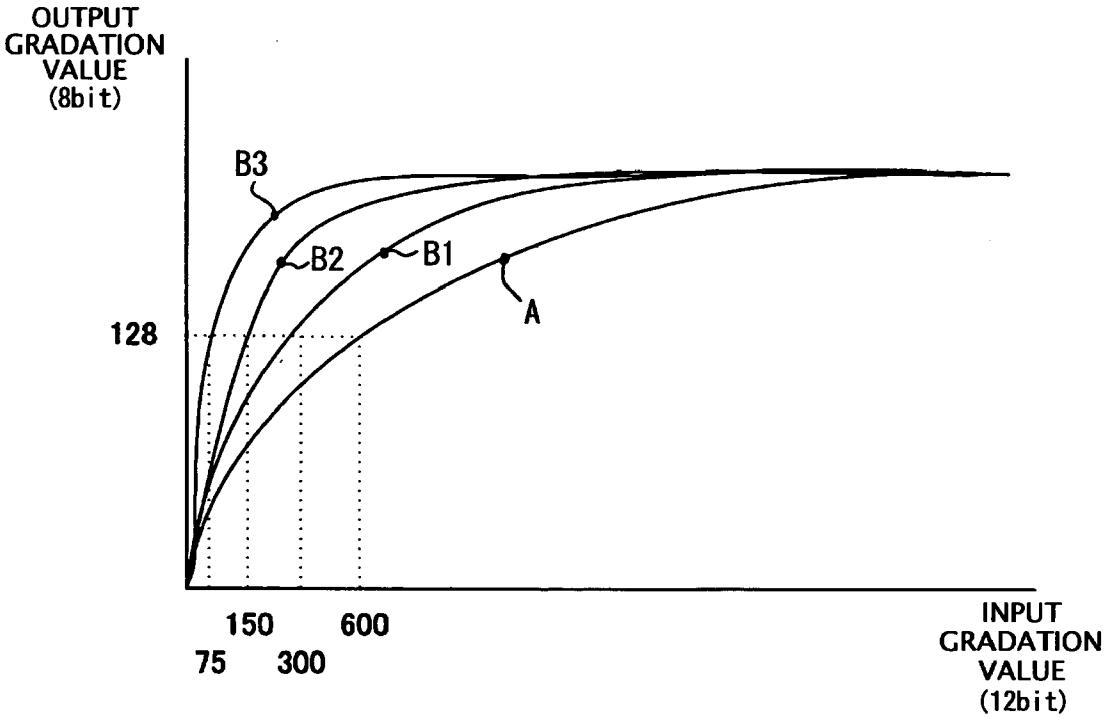

OUTPUT
GRADATION
VALUE
(8bit)
B3
B2
B1
A
128
150
600
75
300
INPUT
GRADATION
VALUE
(12bit)

Fig.3

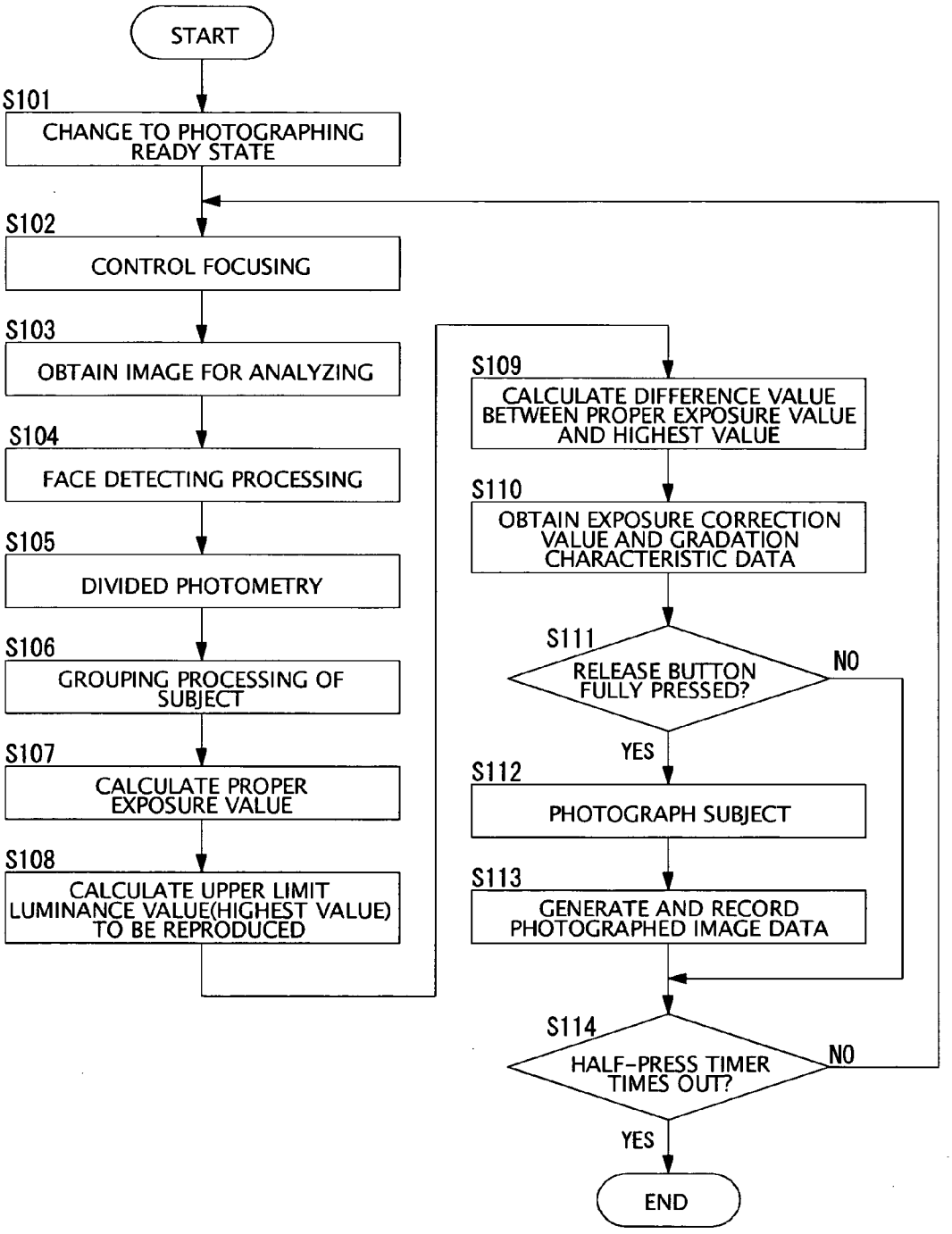

START
S101
CHANGE TO PHOTOGRAPHING READY STATE
S102
CONTROL FOCUSING
S103
OBTAIN IMAGE FOR ANALYZING
S104
FACE DETECTING PROCESSING
S105
DIVIDED PHOTOMETRY
S106
GROUPING PROCESSING OF SUBJECT
S107
CALCULATE PROPER EXPOSURE VALUE
S108
CALCULATE UPPER LIMIT LUMINANCE VALUE(HIGHEST VALUE) TO BE REPRODUCED
S109
CALCULATE DIFFERENCE VALUE BETWEEN PROPER EXPOSURE VALUE AND HIGHEST VALUE
S110
OBTAIN EXPOSURE CORRECTION VALUE AND GRADATION CHARACTERISTIC DATA
S111
RELEASE BUTTON FULLY PRESSED?
NO
YES
S112
PHOTOGRAPH SUBJECT
S113
GENERATE AND RECORD PHOTOGRAPHED IMAGE DATA
S114
HALF-PRESS TIMER TIMES OUT?
NO
YES
END

Fig.4

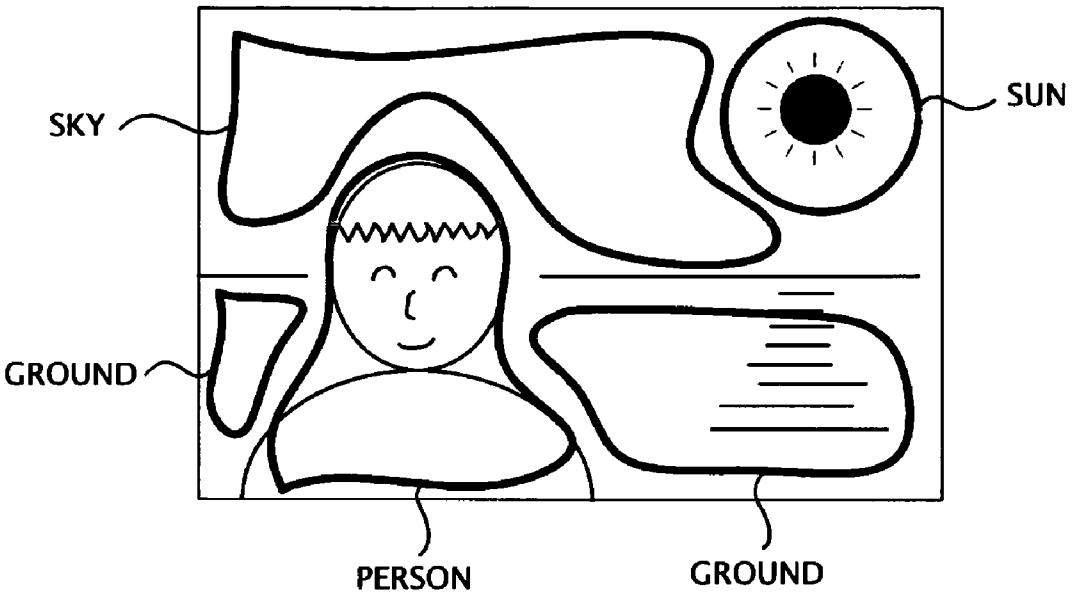

SKY
SUN
GROUND
PERSON
GROUND

Fig.5

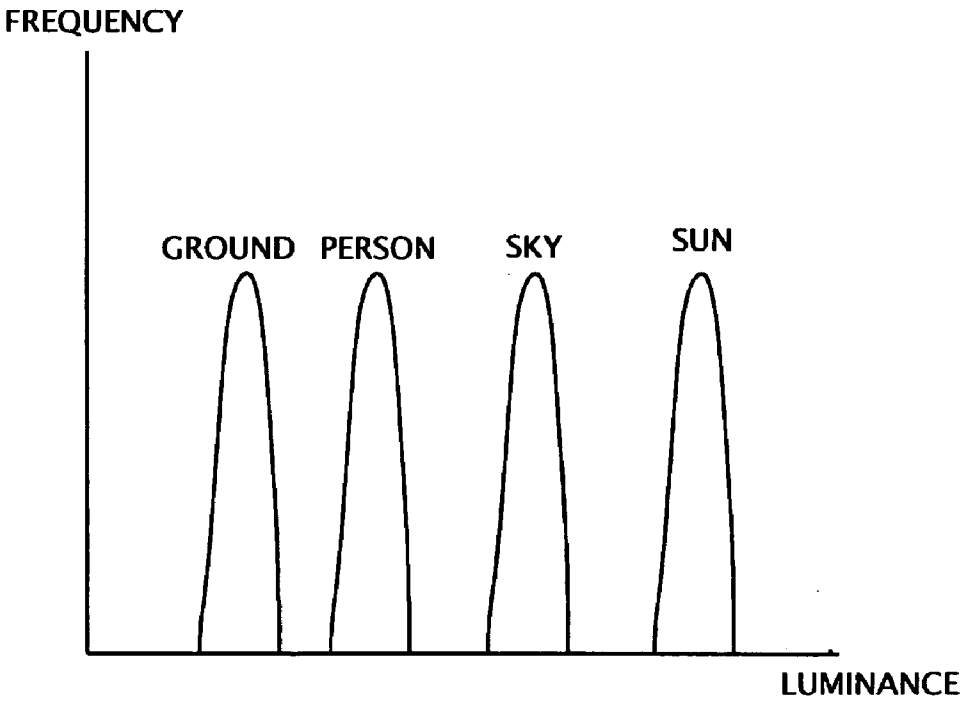

FREQUENCY
GROUND
PERSON
SKY
SUN
LUMINANCE

Fig.6

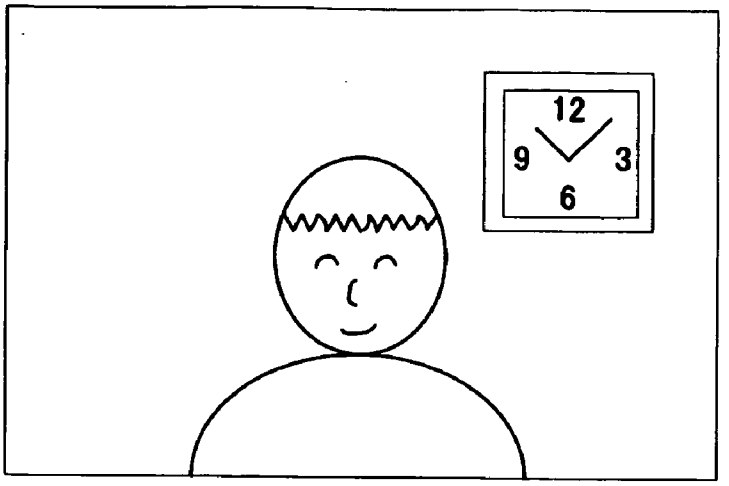


Fig.7

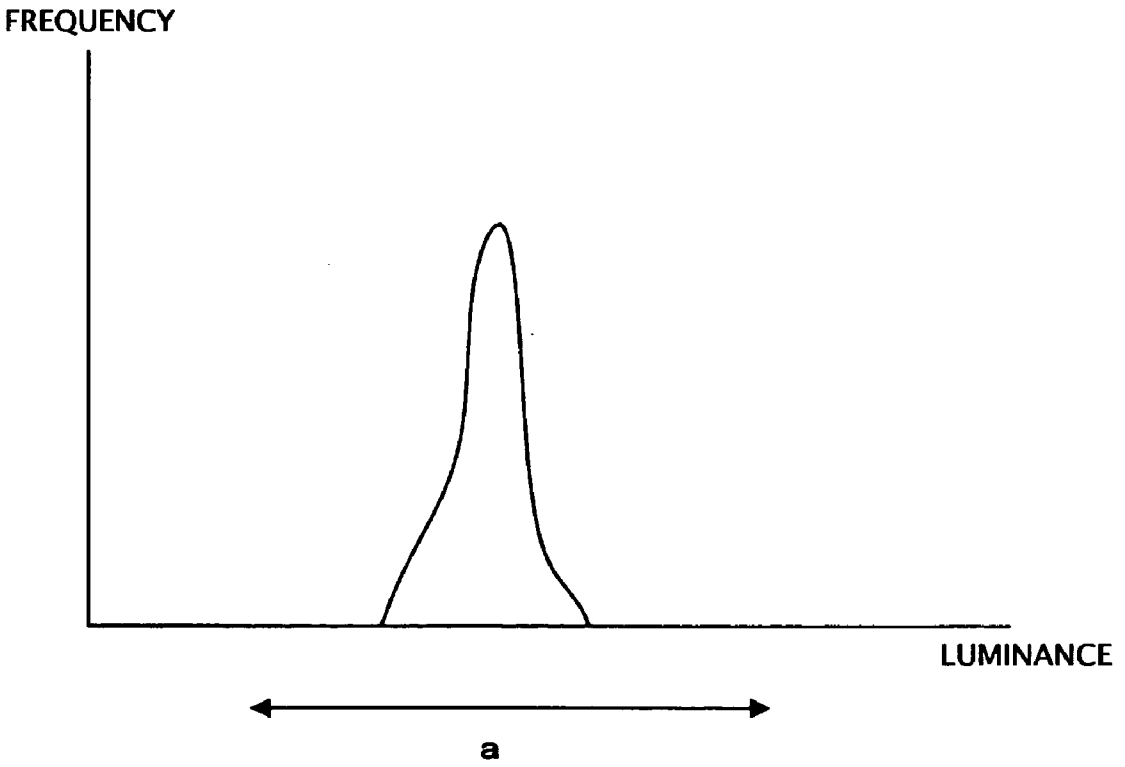


Fig.8

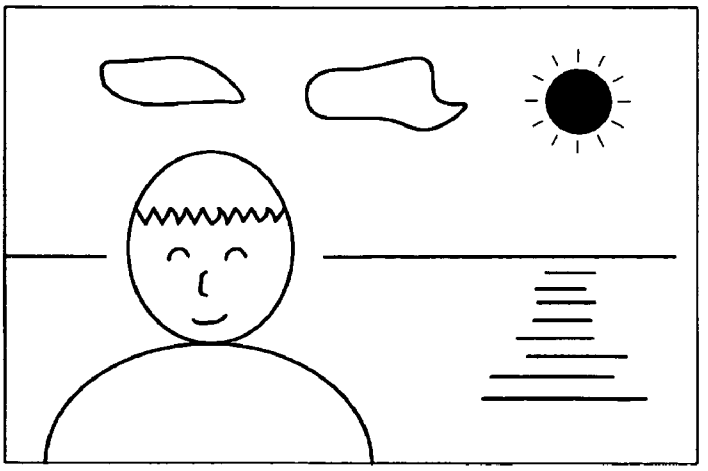


Fig.9

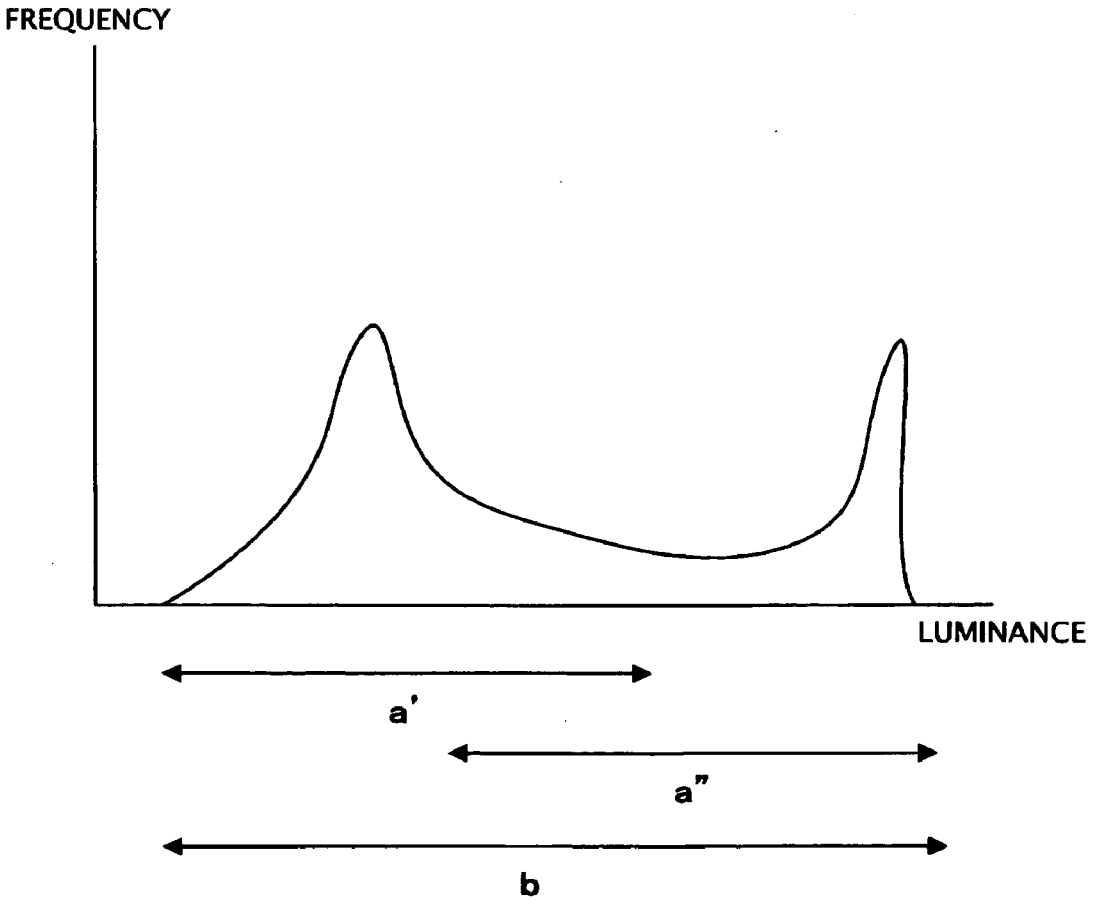


Fig.10

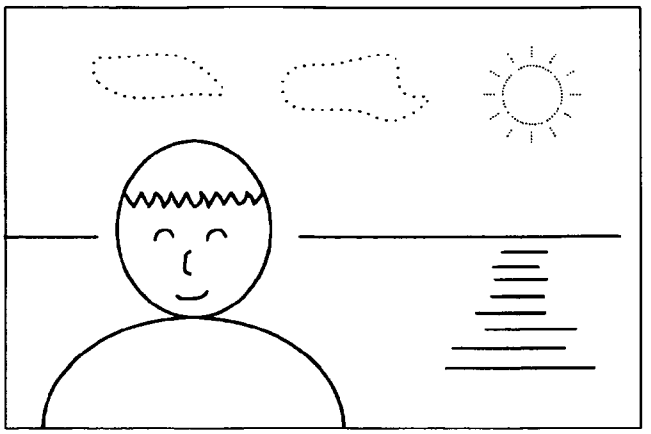


Fig.11

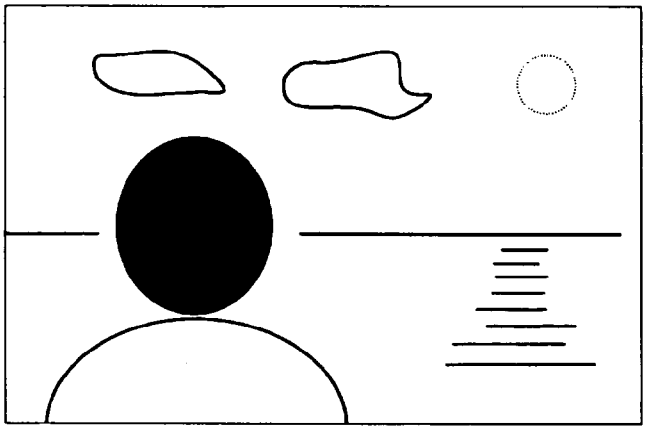


Fig.12

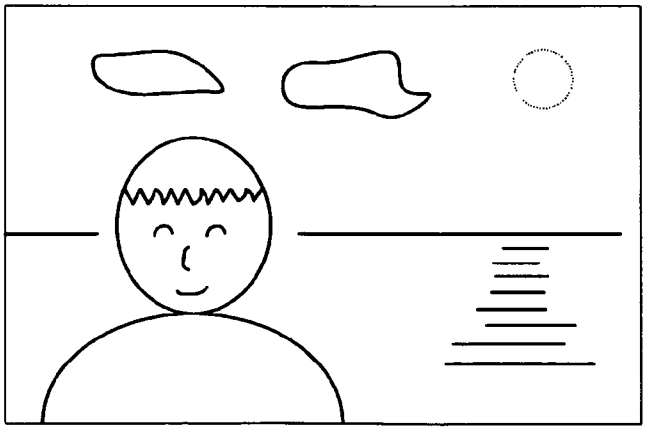


Fig.13

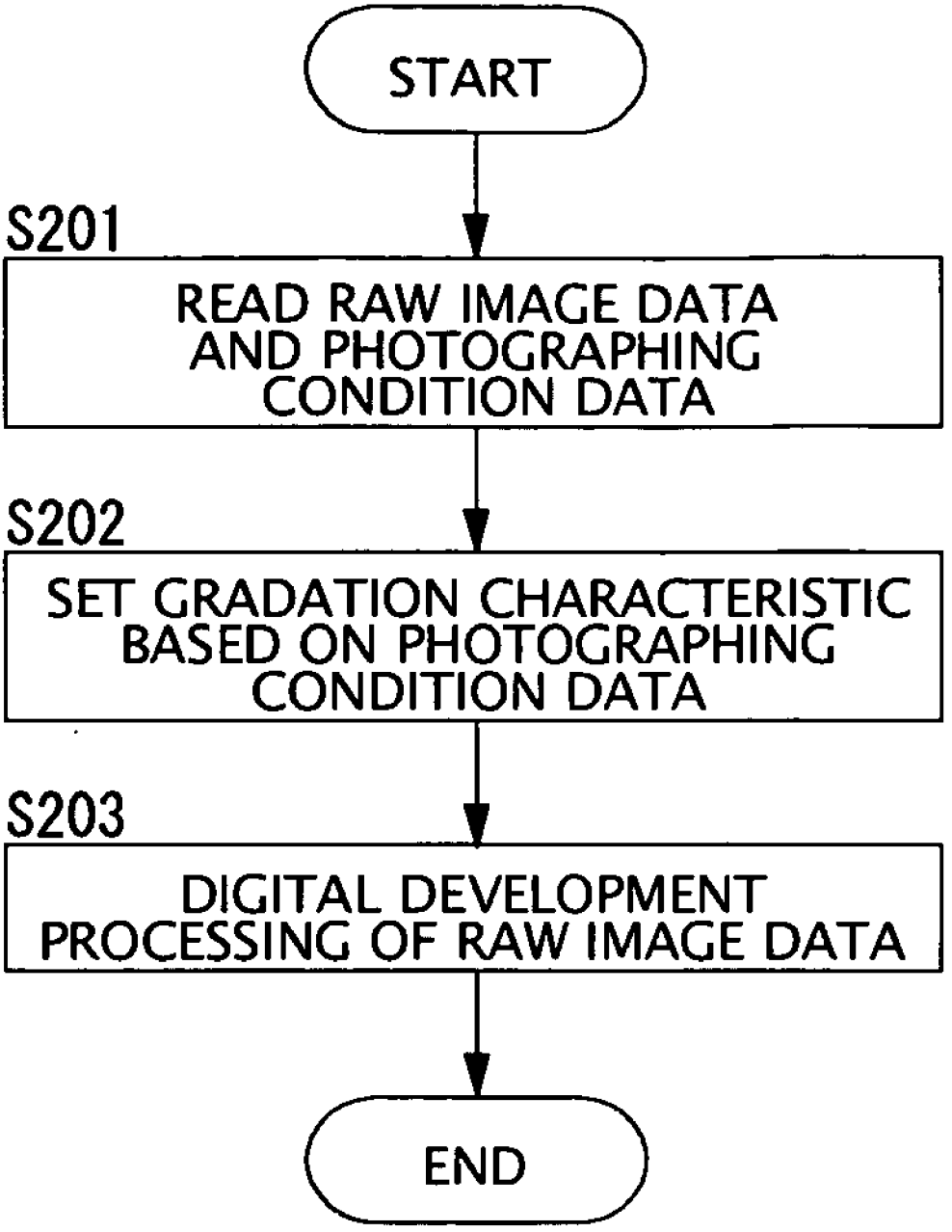

START
S201
READ RAW IMAGE DATA AND PHOTOGRAPHING CONDITION DATA
S202
SET GRADATION CHARACTERISTIC BASED ON PHOTOGRAPHING CONDITION DATA
S203
DIGITAL DEVELOPMENT PROCESSING OF RAW IMAGE DATA
END

Fig.14

CAMERA AND METHOD OF IMAGING

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2006-036243, filed on Feb. 14, 2006, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a camera for photographing a subject image and a method of imaging related to the camera.

[0004] 2. Description of the Related Art

[0005] Conventionally, there are publicly known electronic cameras, which have a photographing mode capable of photographing with a wider dynamic range than in a regular photographing mode for the purpose of appropriately photographing a scene having a large difference in luminance in a photographic screen (refer to Japanese Unexamined Patent Application Publication No. 2001-78067).

[0006] However, with such a conventional electronic camera, when imaging with a wide dynamic range, the user needs to perform a switching operation to a predetermined photographing mode. Therefore, there is a possibility to miss a photo opportunity by performing such operation. Further, a relatively inexperienced user may not be able to determine whether to widen the dynamic range or not and may hence photograph a scene having a large difference in luminance with a narrow dynamic range, and then an image output of a high-luminance part saturates to be a photographing failure with high possibility. In this aspect, such conventional electronic cameras have a room for improvement.

SUMMARY OF THE INVENTION

[0007] The present invention is for solving the above-described problems. An object of the present invention is to provide a camera and a method of imaging capable of appropriately photographing a scene having a large difference in luminance.

[0008] Hereinafter, the present invention will be explained.

[0009] A camera according to a first aspect of the present invention includes a photometry section, an exposure calculating section, and a correction calculating section. The photometry section obtains photometry values at a plurality of positions of a subject. The exposure calculating section obtains an exposure value when photographing based on the photometry values. The correction calculating section obtains a correction value for correction of the exposure value based on a highest value among photometry values belonging to a predetermined range out of the plurality of photometry values obtained by the photometry section.

[0010] In the above-described camera of the first aspect, it is preferable that the highest value is a highest value among photometry values equal to or smaller than a predetermined value out of the plurality of photometry values.

[0011] In the above-described camera of the first aspect, it is preferable that the correction value is a value for correction of the exposure value to an under side.

[0012] In the above-described camera of the first aspect, it is preferable that the correction calculating section obtains the correction value based on a difference between the exposure value obtained in the exposure calculating section and the highest value. Further, it is more preferable that the correction calculating section obtains a correction value for correction of the exposure value to a more under side as the difference is larger.

[0013] In the above-described camera of the first aspect, it is preferable that the exposure calculating section detects a facial part of a person as the subject, and obtains the exposure value based on a photometry value corresponding to the facial part out of the plurality of photometry values obtained in the photometry section.

[0014] A camera according to a second aspect of the present invention includes a photometry section, an exposure calculating section, a correction calculating section, an imaging section, and a control section. The photometry section obtains photometry values at a plurality of positions of a subject. The exposure calculating section obtains an exposure value when photographing based on the photometry values. The correction calculating section obtains a correction value for correction of the exposure value based on a second highest photometry value excluding a highest value out of the plurality of photometry values obtained by the photometry section. The imaging section images an image of the subject. The control section controls an exposure when photographing in the imaging section based on the correction value and the exposure value.

[0015] It is preferable that the above-described camera of the second aspect further includes an image processing section which performs gradation conversion processing on an output from the imaging section. It is preferable that the image processing section changes a gradation characteristic in the gradation conversion processing based on a difference between the exposure value obtained in the exposure calculating section and the highest value. Further, it is more preferable that the image processing section uses a gradation characteristic in which an output gradation value changes more largely as the difference is larger in an area having a small gradation value.

[0016] In the above-described camera of the second aspect, it is preferable that the correction calculating section obtains a correction value for correction of the exposure value to a more under side as the difference is larger.

[0017] A method of imaging according to a third aspect of the present invention includes the steps of: obtaining photometry values at a plurality of positions of a subject; obtaining an exposure value when photographing based on the photometry values; obtaining a correction value for correction of the exposure value based on a highest value among photometry values belonging to a predetermined range out of the plurality of photometry values; and controlling an exposure based on the correction value and imaging an image of the subject.

[0018] In the above-described method of imaging of the third aspect, it is preferable that the highest value is a highest value among photometry values equal to or smaller than a predetermined value out of the plurality of photometry values.

[0019] In the above-described method of imaging of the third aspect, it is preferable that the correction value is a value for correction of the exposure value to an under side.

[0020] In the above-described method of imaging of the third aspect, it is preferable that in the step of obtaining the exposure value, a facial part of a person as the subject is

detected, and the exposure value is obtained based on a photometry value corresponding to the facial part out of the plurality of photometry values.

[0021] It is preferable that the above-described method of imaging of the third aspect further includes the step of performing gradation conversion processing on an image obtained in the step of imaging the image of the subject. It is preferable that in the step of performing the gradation conversion processing, a gradation characteristic in the gradation conversion processing is changed based on a difference between the exposure value and the highest value. Further, it is more preferable that in the step of performing the gradation conversion processing, a gradation characteristic in which an output gradation value changes more largely as the difference is larger in an area having a small gradation value is used. Moreover, it is preferable that in the step of obtaining the correction value, a correction value for correction of the exposure value to a more under side as the difference is larger is obtained.

[0022] A method of imaging according to a fourth aspect of the present invention includes the steps of: obtaining photometry values at a plurality of positions of a subject; obtaining an exposure value when photographing based on the photometry values; obtaining a correction value for correction of the exposure value based on a difference between the exposure value and a second highest photometry value excluding a highest value out of the plurality of photometry values; and controlling an exposure based on the correction value and imaging an image of the subject.

[0023] In the above-described method of imaging of the fourth aspect, it is preferable that in the step of obtaining the correction value, a correction value for correction of the exposure value to a more under side as the difference is larger is obtained.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The nature, principle, and utility of the invention will become more apparent from the following detailed description when read in conjunction with the accompanying drawings in which like parts are designated by identical reference numbers, in which:

[0025] FIG. **1** is a block diagram showing a configuration of an electronic camera of an embodiment;

[0026] FIG. **2** is a schematic view showing a photographing mechanism of the electronic camera of this embodiment;

[0027] FIG. **3** is a graph showing an example of gradation characteristic data of this embodiment;

[0028] FIG. **4** is a flowchart showing a photographing operation of the electronic camera of this embodiment;

[0029] FIG. **5** is a schematic view showing an example of a state that subjects in a photographic screen are grouped;

[0030] FIG. **6** is a graph of histograms showing a distribution of average luminance values of the respective groups in FIG. **5**;

[0031] FIG. **7** is a view showing a scene (indoor photographing) in which the difference in luminance is relatively small in the photographic screen;

[0032] FIG. **8** is a view showing a luminance histogram of the scene in FIG. **7**;

[0033] FIG. **9** is a view showing a scene (photographing against light under fine weather) having a large difference in luminance in the photographic screen;

[0034] FIG. **10** is a view showing a luminance histogram of the scene in FIG. **9**;

[0035] FIG. **11** is a view showing an example of an image photographing the scene in FIG. **9**;

[0036] FIG. **12** is a view showing an example of an image photographing the scene in FIG. **9**;

[0037] FIG. **13** is a view showing a photographed image of photographing the scene in FIG. **9** based on the exposure correction value in which a gradation characteristic is changed; and

[0038] FIG. **14** is a flowchart showing the operation of the electronic camera when RAW image data is subjected to digital development processing.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0039] Hereinafter, an embodiment of the present invention will be described using the drawings.

[0040] FIG. **1** is a block diagram showing the structure of an electronic camera of this embodiment. FIG. **2** is a schematic view showing a photographing mechanism of the electronic camera of this embodiment. Note that in this embodiment an example of a single lens reflex type electronic camera system with a replaceable lens is explained.

[0041] First, with reference to FIG. **2**, the imaging mechanism of the electronic camera will be explained. The electronic camera of this embodiment has a camera body **11** and a lens unit **12** accommodating an imaging optical system.

[0042] Here, the camera body **11** and the lens unit **12** are provided with a pair of mounts (not-shown) in male/female relationship respectively. The lens unit **12** is connected in a replaceable manner to the camera body **11** by coupling the mounts with a bayonet mechanism or the like. Also, the mounts are each provided with an electric contact. When the camera body **11** and the lens unit **12** are connected, an electrical connection of the both is established by the electric contacts in contact with each other.

[0043] The lens unit **12** has a focusing lens **13** for adjusting a focusing position and an aperture **14**. The focusing lens **13** is constructed to be movable in an optical axis direction by a not-shown motor. The aperture **14** adjusts an amount of incident light to the camera body **11** by opening/closing a diaphragm blade. Note that operations of the focusing lens **13** and the aperture **14** are controlled by a not-shown lens microcomputer accommodated in the lens unit **12**.

[0044] The camera body **11** has a main mirror **15**, a mechanical shutter **16**, a recording-purpose image pickup device **17**, a sub-mirror **18**, a focusing section **19**, and a viewfinder optical system. The mail mirror **15**, the mechanical shutter **16** and the recording-purpose image pickup device **17** are arranged along the optical axis of the imaging optical system. The sub-mirror **18** is arranged behind the main mirror **15**. Further, the viewfinder optical system is arranged on an upper side of the camera body **11**, which allows observation of an image made by the optical flux of a subject reflected by the main mirror **15**. Furthermore, the focusing section **19** is arranged on a lower side of the camera body **11**, which is constructed to perform focusing by detecting the optical flux of the subject which is transmitted through the main mirror **15** and reflected by the sub-mirror **18**.

[0045] The main mirror **15** is pivotally supported rotatably by a not-shown rotary shaft, and can be switched between an observation state and a retracted state. The main mirror **15** in the observational state is obliquely arranged on a front side of the mechanical shutter **16** and the recording-purpose

image pickup device **17**. The main mirror **15** in this observation state reflects an optical flux passed through the imaging optical system upward and leads the optical flux to the viewfinder optical system. Further, a center portion of the main mirror **15** is a half mirror. Then, a part of flux transmitted through the main mirror **15** is refracted downward by the sub-mirror **18** and lead to the focusing section **19**. Note that the focusing section **19** detects an amount of image displacement of a subject image divided by a not-shown separator lens.

[0046] On the other hand, the main mirror **15** in the retracted state is flipped upward together with the sub-mirror **18** and is at a position out of an imaging optical path. When the main mirror **15** is in the retracted state, the optical flux passing through the imaging optical system is lead to the mechanical shutter **16** and the recording-purpose image pickup device **17**.

[0047] The finder optical system has a diffusing screen (focus plate) **20**, a condensing lens **21**, a pentagonal prism **22**, a beam splitter **23**, an analyzing-purpose image pickup device **24**, and an eyepiece lens **25**. The diffusing screen **20** is positioned on an upper side of the main mirror **15**, and focuses the optical flux reflected by the main mirror **15** in the observation state once. The optical flux focused on the diffusing screen **20** passes through the condensing lens **21** and the pentagonal prism **22** and is lead from an exit plane at an angle of 90° with an incident plane of the pentagonal prism **22** to the beam splitter **23**. The beam splitter **23** divides the incident flux into two directions. One flux passing through the beam splitter **23** is lead to the analyzing-purpose image pickup device **24** via a not-shown secondary focusing lens, and is processed by the analyzing processing circuit **26** as will be described later. Further, the other optical flux passing through the beam splitter **23** reaches the user's eye via the eyepiece lens **25**.

[0048] Next, a circuit configuration of the electronic camera will be described with reference to FIG. **1**. The camera body **11** has the analyzing processing circuit **26**, a recording processing circuit **27**, a recording I/F **40**, a release button **41**, a CPU **42**, and a sequence driving section **43**.

[0049] The analyzing processing circuit **26** has the analyzing-purpose image pickup device **24**, a first driver **31**, a first analog processing circuit **32**, a first digital processing circuit **33**, and an analyzing calculating section **34**.

[0050] The analyzing-purpose image pickup device **24** is a sensor for analyzing the condition of a subject inside the photographic screen. The analyzing-purpose image pickup device **24** has a light-receiving surface in which light-receiving elements are arranged two-dimensionally. Then, the analyzing-purpose image pickup device **24** photoelectrically converts a subject image passing through the viewfinder optical system and being focused on the light-receiving surface to generate an analog image signal. An output signal of the analyzing-purpose image pickup device **24** is inputted to the first analog processing circuit **32**.

[0051] As an example, the analyzing-purpose image pickup device **24** of this embodiment has approximately 320×200 number of pixel, and a front plane of the light-receiving surface is constituted of an image pickup device on which a color filter array according to a publicly known Bayer arrangement is arranged. Note that the analyzing-purpose image pickup device **24** may either be of sequential charge transfer method (CCD or the like) or XY address method (CMOS or the like).

[0052] The first driver **31** supplies a timing pulse to the analyzing-purpose image pickup device **24** in response to an instruction from the analyzing calculating section **34** and controls various operations (storing and reading out of a signal charge, discharging of unnecessary charges) of the analyzing-purpose image pickup device **24**.

[0053] The first analog processing circuit **32** is an analog front-end circuit having a CDS circuit, a gain circuit, an A/D converting circuit, and so forth. The CDS circuit reduces noise components in output of the analyzing-purpose image pickup device **24** by correlated double sampling. The gain circuit amplifies and outputs the gain of an input signal. The A/D converting circuit A/D converts an output signal of the analyzing-purpose image-pickup device **24**. Note that in FIG. **1**, respective circuits of the first analog processing circuit **32** are omitted.

[0054] The first digital processing circuit **33** executes various image processing such as color interpolation processing on an output signal of the first analog processing circuit **32**.

[0055] The analyzing calculating section **34** controls respective sections of the analyzing processing circuit and performs various calculation processing for analyzing the condition of a subject inside the photographic screen. For example, the analyzing calculating section **34** executes a publicly known exposure calculation based on an output of the first digital processing circuit **33**. Further, the analyzing calculating section **34** also executes a face detecting processing which will be described later based on an output of the first digital processing circuit **33**.

[0056] Here, the analyzing calculating section **34** of this embodiment particularly performs the following processing.

[0057] (1) The analyzing calculating section **34** calculates an exposure correction value for correcting a proper exposure value based on a difference value between the proper exposure value for the photographic screen and an upper limit luminance value (highest value) in a predetermined luminance range to be reproduced in a scene in the photographic screen. This exposure correction value corrects the proper exposure value to an under side according to the difference value.

[0058] (2) The analyzing calculating section **34** determines a proper gradation characteristic for gradation conversion processing of a photographed image based on the difference value in (1). For example, the analyzing calculating section **34** selects gradation characteristic data according to the difference value from a plurality of gradation characteristic data, which are prepared in a memory (not shown) or the like in advance. Respective gradation characteristic data show curves representing different correspondences of an input gradation value and an output gradation value respectively.

[0059] An example of the gradation characteristic data in this embodiment is shown in FIG. **3**. A curve A in FIG. **3** shows a standard gradation characteristic corresponding to the proper exposure value. Further, curves B**1**, B**2**, B**3** show gradation characteristics which the analyzing calculating section **34** selects depending on a difference value from the proper exposure value. With FIG. **3**, a case that the input gradation is 12 bits (0 to 4095), the output gradation is 8 bits (0 to 256) will be explained.

[0060] On the curves B**1**, B**2**, B**3** shown in FIG. **3**, the output gradation value changes largely in an area where the input gradation value is smaller as compared to the curve A.

For example, the input gradation value by which the output gradation value becomes a standard output value (for example, 128 by 8 bits) is 600 on the curve A, whereas it is 300 on the curve B1, 150 on the curve B2, and 75 on the curve B3. Thus, on the curves B1, B2, B3, black saturation does not occur easily in the photographed image when the input gradation value is small. Note that the output gradation value is not increased when the input characteristic value is large, so that white saturation does not occur either. In other words, by the gradation characteristic data of the curves B1, B2, B3, the photographed image can be recorded with a wider dynamic range compared to the standard gradation characteristic data (curve A).

[0061] Returning to FIG. **1**, the recording processing circuit **27** has the recording-purpose image pickup device **17**, a second driver **35**, a second analog processing circuit **36**, a second digital processing circuit **37**, and a recording calculating section **38**. Note that in the recording processing circuit **27**, part of explanation of ones having the same functions as those in the configuration of the analyzing processing circuit **26** is omitted.

[0062] The recording-purpose image pickup device **17** is a sensor for photographing a subject in the photographic screen to generate photographed image data. This recording-purpose image pickup device **17** photoelectrically converts a subject image passing through the imaging optical system and being focused on the light-receiving surface to generate an analog image signal. In this embodiment, an image pickup device having the same structure as the analyzing-purpose image pickup device **24** is used for the recording-purpose image pickup device **17**. As a matter of course, the recording-purpose image pickup device **17** and the analyzing-purpose image pickup device **24** may be image pickup devices having different structures respectively.

[0063] The second driver **35** supplies a timing pulse to the recording-purpose image pickup device **17** in response to an instruction from the recording calculating section **38** and controls various operations of the recording-purpose image pickup device **17**.

[0064] The second analog processing circuit **36** has a CDS circuit, a gain circuit, an A/D converting circuit, and so forth. Here, in the gain circuit of the second analog processing circuit **36**, adjustment is performed on imaging sensitivity which corresponds to ISO sensitivity in response to an instruction from the recording calculating section **38**. Further, in this embodiment, the gradation of a digital image signal outputted from the A/D converting circuit is set to 12 bits.

[0065] The second digital processing circuit **37** executes various image processing (defective pixel correction, color interpolation, gradation conversion processing, white balance adjustment, edge enhancement) on the output signal from the second analog processing circuit **36** to generate photographed image data. Particularly, the second digital processing circuit **37** of this embodiment executes gradation conversion processing, which changes an image signal with an input gradation of 12 bits to an image signal with an output gradation of 8 bits, based on the gradation characteristic instructed by the recording calculating section **38**. Further, the second digital processing circuit **37** executes compression/decompression processing of photographed image data, and the like.

[0066] The recording calculating section **38** executes various controls of the recording processing circuit, and sets parameters for image processing. Note that in this embodiment, when photographing is performed with exposure based on the aforementioned exposure correction value, the recording calculating section **38** sets parameters for the gradation characteristic in response to an instruction from the analyzing calculating section **34**.

[0067] Further, the recording calculating section **38** generates a header file in which additional data such as photographing condition are recorded in a predetermined format. Note that this header file is associated with corresponding photographed image data to constitute one data file.

[0068] In the recording I/F **40**, a connector for connecting a recording medium **44** is formed. Then the recording I/F **40** executes writing/reading of photographed image data to/from the recording medium **44** connected to the connector. The recording medium **44** is constituted of a card type recording medium or the like, which includes a semiconductor memory. Note that in FIG. **1** a card type recording medium is shown as an example of the recording medium **44**.

[0069] The release button **41** receives from the user an instruction input to start an exposure operation.

[0070] The CPU **42** controls the operation of the entire electronic camera system according to a predetermined sequence program. Further, the CPU **42** calculates a defocus amount by a phase difference detection method based on an output from the focusing section **19**. Note that the CPU **42** can switch the control when photographing depending on a photographing mode selected by the user.

[0071] The sequence driving section **43** drives the main mirror **15**, the mechanical shutter **16**, and so on by an instruction of the CPU **42**. Further, the sequence driving section **43** outputs information such as aperture value and defocus amount to the aforementioned lens microcomputer via the mounts.

[0072] Hereinafter, the operation of the electronic camera of this embodiment will be described with reference to a flowchart of FIG. **4**.

[0073] Step **101**: upon reception of a half-press input (operation of a first stroke) of the release button **41** by the user, the CPU **42** of the camera body **11** changes from a power saving state to a photographing ready state. Specifically, the CPU **42** starts up a sequence program for photographing, and also turns on the analyzing processing circuit **26**, the recording processing circuit **27**, the sequence driving section **43**, and so forth. Note that in S**101**, the main mirror **15** is at the position of the observation state.

[0074] Step **102**: The CPU **42** instructs the focusing section **19** to control focusing. The CPU **42** obtains an amount of image displacement in each focusing area from the focusing section **19**. Then the CPU **42** calculates a defocus amount of a focusing area selected by a predetermined algorithm (such as giving priority to a close distance or a center for example). Thereafter the lens microcomputer drives the focusing lens **13** based on the defocus amount.

[0075] Step **103**: The CPU **42** instructs the analyzing processing circuit **26** to obtain an image for analyzing the subject in the photographic screen. The analyzing calculating section **34** initializes the analyzing-purpose image pickup device **24** by discharging unnecessary charges therefrom, and thereafter drives the analyzing-purpose image pickup device **24** to obtain the image for analyzing the subject. Note that the output of the analyzing-purpose image pickup device **24** is inputted to the analyzing calculating

section **34** via the first analog processing circuit **32** and the first digital processing circuit **33**. Accordingly, the above image data is in a state of being color interpolated by the first digital processing circuit **33**.

[0076] Step **104**: The CPU **42** causes the analyzing calculating section **34** to execute face detecting processing based on the image from S**103**. Accordingly, the analyzing calculating section **34** obtains information on position and size of a face area in the photographic screen. This is because it is highly possible in general that the face of a person is the main subject, and thus by the face detecting processing, the main subject in the photographic screen can be estimated easily. Note that when several faces are detected in the face detecting processing, the analyzing calculating section **34** takes a face area on a closer side where the area of the face is largest as the main subject.

[0077] Such face detecting processing is carrier out by publicly known means. For example, the analyzing calculating section **34** can extract a face area from the aforementioned image by characteristic point extraction processing of Japanese Unexamined Patent Application Publication No. 2001-16573 or the like. Examples of the characteristic point include opposite ends of eyebrows, eyes, nose, and lips, in addition to contour points of a face, a vertex point, an end point of a jaw, and the like. Alternatively, as in the Japanese Unexamined Patent Application Publication No. H08-63597, the analyzing calculating section **34** may extract the contour of flesh color area based on color information of a subject, and may further perform matching with templates of facial parts prepared in advance to thereby detect a face.

[0078] Here, the CPU **42** may switch execution/non-execution of the face detecting processing depending on the setting of photographing mode. For example, when a photographing mode suitable for photographing a person (such as portrait photographing mode) is selected, the CPU **42** executes the face detecting processing. On the other hand, when a photographing mode not intended for photographing a person is selected, or when the position of a main subject is determined by a focusing area selected in S**102**, the CPU **42** omits the face detecting processing of S**5O4**. Further, the CPU **42** can also enable automatic focusing to a face detected in the face detecting processing. In this case, the CPU **42** can omit the aforementioned focusing operation in S**102**.

[0079] Step **105**: The analyzing calculating section **34** executes divided photometry in the photographic screen based on the image obtained in S**103** to obtain luminance values corresponding to respective pixels or groups of plural pixels of the aforementioned image respectively.

[0080] Step **106**: The analyzing calculating section **34** executes grouping processing of subjects in the photographic screen by analyzing the image obtained in S**103**. Then the analyzing calculating section **34** calculates an average luminance value for each of the grouped areas. FIG. **5** shows an example of a state that subjects in the photographic screen are grouped. Further, FIG. **6** shows histograms showing a distribution of average luminance values of the respective groups in FIG. **5**.

[0081] Such grouping processing is performed by publicly known means. Specifically, when certain adjacent pixels have approximately the same luminance values or hues as each other in the image obtained in S**103**, the analyzing calculating section **34** assumes that these pixels belong to the same subject and hence groups them. For example, the analyzing calculating section **34** executes the grouping processing by a method disclosed in Japanese Unexamined Patent Application Publication No. H04-257831, No. H04-310930, or the like. Note that the analyzing calculating section **34** may be configured to perform grouping using a result of the above-described face detecting processing.

[0082] Step **107**: The analyzing calculating section **34** obtains a proper exposure value for photographing a subject in the photographic screen by publicly known exposure calculation based on the luminance value obtained in S**105**. At this time, the analyzing calculating section **34** calculates the proper exposure value so that the average luminance value (obtained in S**106**) of the group including the aforementioned main subject becomes the standard output value of the photographed image.

[0083] Step **108**: The analyzing calculating section **34** obtains an upper limit luminance value (highest value) in a predetermined luminance range to be reproduced in a scene in the photographic screen, out of the average luminance values (obtained in S**106**) of the respective groups.

[0084] First, the analyzing calculating section **34** excludes from objects of calculation for the highest value a group showing an average luminance value larger than a predetermined value (for example, 11.3 BV). Then the analyzing calculating section **34** determines the highest one among the average luminance values of the respective groups as objects of calculation as the highest value. For example, in FIG. **5** and FIG. **6**, when the group including the sun has an average luminance value exceeding the predetermined value, the average luminance value of a group including the sky among the groups excluding the group including the sun is determined as the highest value.

[0085] Step **109**: The analyzing calculating section **34** calculates a difference value dBV between the proper exposure value (obtained in S**107**) and the highest value (obtained in S**108**)

[0086] Step **110**: The analyzing calculating section **34** obtains the exposure correction value and the gradation characteristic data based on the difference value dBV (obtained in S**109**). In this S**110**, the analyzing calculating section **34** performs judgment based on a reference value S (EV) calculated by the following equation (1). Here, respective symbols in the equation (1) are explained. A is an input gradation value corresponding to a saturation level. B is an input gradation value corresponding to the standard value of the output gradation value.

$$S=\mathrm{Log}_2(A/B) \tag{1}$$

[0087] Hereinafter, the processing in S**10** in this embodiment will be explained with a specific example. As an example, the value of A is 3600 and the value of B is 600 when the input gradation is 12 bits (0 to 4095) and the output gradation is 8 bits (0 to 255). Further, the standard value of the output gradation value corresponding to B is 128. With the above conditions, the equation (1) gives the reference value S of approximately 2.6 EV.

[0088] First, a case of the difference value dBV being smaller than 2.6 EV (dBV<2.6) will be explained. In this case, it is possible to sufficiently reproduce a subject on a high luminance side in the photographic screen even by performing photographing with the proper exposure value and applying the standard gradation characteristic data (curve A). Therefore, the analyzing calculating section **34**

sets the exposure correction value to 0 (zero). Further, the analyzing calculating section **34** selects the standard gradation characteristic data.

[0089] Next, a case of the difference value dBV being 2.6 EV or larger will be explained. In this case, the difference in luminance in the photographic screen is large, and thus the subject on the high luminance side will be saturated in the photographed image when the setting is the same as in the case of dBV being smaller than 2.6 EV. Accordingly, the analyzing calculating section **34** changes the exposure correction value and the gradation characteristic data in stages as follows according to the difference value dBV.

[0090] (1) When the difference value dBV is equal to or larger than 2.6 EV and smaller than 3.6 EV (2.6≦dBV<3.6), the analyzing calculating section **34** sets the exposure correction value to −1. Further, the analyzing calculating section **34** selects the gradation characteristic data of the curve B**1**.

[0091] (2) When the difference value dBV is equal to or larger than 3.6 EV and smaller than 4.6 EV (3.6≦dBV<4.6), the analyzing calculating section **34** sets the exposure correction value to −2. Further, the analyzing calculating section **34** selects the gradation characteristic data of the curve B**2**.

[0092] (3) When the difference value dBV is equal to or larger than 4.6 EV (4.6≦dBV), the analyzing calculating section **34** sets the exposure correction value to −3. Further, the analyzing calculating section **34** selects the gradation characteristic data of the curve B**3**.

[0093] Here, in S**110**, the reason for adjusting the exposure correction value and the gradation characteristic data will be described. FIG. **7** shows a scene (indoor photographing) in which the difference in luminance is relatively small in the photographic screen. FIG. **8** shows a luminance histogram of the scene in FIG. **7**. In the scene in FIG. **7**, the luminance in the photographic screen can be recorded even by the dynamic range (range a shown in FIG. **8**) which is realized by the standard gradation characteristic (curve A in FIG. **3**).

[0094] On the other hand, FIG. **9** shows a scene (photographing against light under fine weather) having a large difference in luminance in the photographic screen. FIG. **10** shows a luminance histogram of the scene in FIG. **9**. In the scene in FIG. **9**, the difference in luminance in the photographic screen is large, and thus the luminance in the photographic screen cannot be recorded with the same dynamic range as a in FIG. **8**.

[0095] For example, in the case where the exposure is matched to a subject having a low luminance in the above dynamic range (case of a' shown in FIG. **10**), a subject having a high luminance (such as sun, cloud, or the like) in the photographic screen over flows to cause white saturation (refer to FIG. **11**). Further, in the case where the exposure is matched to a subject having a high luminance in the above dynamic range (case of a" shown in FIG. **10**), a subject having a low luminance (person) in the photographic screen under flows to cause black saturation (refer to FIG. **12**). Accordingly, in such cases, in this embodiment, the gradation characteristics (curves B**1**, B**2**, B**3** in FIG. **3**) corresponding to b in FIG. **10** are applied.

[0096] Incidentally, when the gradation characteristic is changed to the curve B**1** or the like as described above, the output gradation value becomes the standard value by a smaller input gradation value. Therefore, it is possible to make the input gradation value when photographing smaller by correcting the exposure when photographing to an under side. Here, when the exposure for a scene having a large difference in luminance is corrected to the under side, also the input gradation value of a high-luminance subject becomes small naturally. Specifically, the high-luminance subject whose input gradation value reached the saturation level to cause white saturation by the exposure with the proper exposure value can be reproduced on the photographic screen by reduction of the input gradation value by setting the exposure to the under side. From the above points, in this embodiment the exposure is corrected to the under side by the exposure correction value.

[0097] FIG. **13** shows a photographed image of photographing the scene in FIG. **9** on the under side based on the exposure correction value in which the gradation characteristic is changed. In this case, being different from FIG. **11** and FIG. **12**, the person on the near side to clouds in the background are reproduced in the photographed image.

[0098] Step **111**: CPU **42** judges whether the release button **41** is fully pressed or not. When it is fully pressed (YES side), the process goes to S**112**. On the other hand, when it is not fully pressed (NO side), the process goes to S**114**.

[0099] Step **112**: CPU **42** instructs the sequence driving section **43** and the recording calculating section **38** to perform photographing. The sequence driving section **43** causes the main mirror **15** to retract from the imaging optical path. Further, the recording calculating section **38** photographs a subject image by driving the recording-purpose image pickup device **17**. During this photographing, the sequence driving section **43** and the recording calculating section **38** performs controlling of exposure based on the proper exposure value (obtained in S**107**) and the exposure correction value (obtained in S**110**).

[0100] Step **113**: The recording calculating section **38** generates photographed image data from the output of the recording-purpose image pickup device **17**. At this time, the second digital processing circuit **37** executes the gradation conversion processing based on the gradation characteristic data selected in S**110**. Then the photographed image data is recorded finally in the storage medium **44**.

[0101] Step **114**: CPU **42** judges whether a predetermined time has passed from the half-pressing of the release button **41** (a half-press timer times out) or not. When the half-press timer times out (YES side), the CPU **42** cuts off the power of the analyzing processing circuit, the recording processing circuit, the sequence driving section **43**, and so forth to return to the power-saving mode, and thus completes the photographing operation. On the other hand, when the half-press timer has not timed out (NO side), the CPU **42** returns to S**102** to repeat the above-described operation.

[0102] Further, in this embodiment, it is possible to allow the recording calculating section **38** to generate RAW image data in S**113**. When the RAW image data is generated, the second digital processing circuit **37** does not perform any kind of image processing, and thereby records digital data of every pixel in the image pickup device in a state of not being processed. Further, the recording calculating section **38** records the photographing condition data, which is needed during digital development processing, in the header file of the RAW image data. This photographing condition data includes, for example, information such as combination of the above-described proper exposure value (obtained in

S107) and the highest value (obtained in S108) or the difference value (obtained in S109).

[0103] FIG. 14 is a flowchart showing the operation of the electronic camera when the above RAW image data is subjected to digital development processing.

[0104] Step 201: The CPU 42 reads the above RAW image data from the recording medium 44 together with the photographing condition data.

[0105] Step 202: The recording calculating section 38 selects gradation characteristic data suitable for processing of the RAW image data based on the combination of the proper exposure value and the highest value or the difference value in the information of the photographing condition data. Specific contents of this processing in S202 overlap with the above-described S109 and S110, and thus detailed explanation thereof is omitted.

[0106] Step 203: The recording calculating section 38 instructs the second digital processing circuit 37 to perform digital development processing of the RAW image data. At this time, the second digital processing circuit 37 executes gradation conversion processing based on the above-described gradation characteristic data. Accordingly, photographed image data similar to the data generated in the above-described S113 can be generated.

[0107] Hereinafter, effects of this embodiment will be described.

[0108] In this embodiment, based on the difference value between the proper exposure value (obtained in S107) and the highest value (obtained in S108), the analyzing calculating section 34 automatically adjusts the exposure correction value and the gradation characteristic data (S110). Particularly, in this embodiment, white saturation of a subject on a high-luminance side does not easily occur owing to the exposure correction with the exposure correction value, and also black saturation of a subject on a low-luminance side does not easily occur since a dark subject becomes bright by gradation conversion. Therefore, according to this embodiment, a photographed image of a scene having a large difference in luminance can be reproduced with a dynamic range having an appropriate width, without requiring the user to perform any complicated operation.

ADDITIONAL MATTERS TO THE EMBODIMENT

[0109] (1) The electronic camera according to the present invention is not limited to the single lens reflex type, and may be one having a structure of a compact type digital camera which performs photometry by an image pickup device for photographing. Note that in the compact-type electronic camera, when photographing is performed in a state that a picture composition assisting frame for determining a photographing picture composition is displayed in a superimposed manner on the display screen of an electronic viewfinder, the position of a main subject may be determined based on the position of the picture composition assisting frame. Note that the analyzing processing circuit shown in the above-described embodiment can be mounted in a silver film camera as an exposure calculating device.

[0110] (2) When the RAW image data are generated in the above-described embodiment, information showing the gradation characteristic data selected in S110 may be recorded in the header file. Further, in the above-described embodiment, the digital development processing may be performed by executing an image processing program on a personal computer.

[0111] The invention is not limited to the above embodiments and various modifications may be made without departing from the spirit and scope of the invention. Any improvement may be made in part or all of the components.

What is claimed is:

1. A camera, comprising:
a photometry section which obtains photometry values at a plurality of positions of a subject;
an exposure calculating section which obtains an exposure value when photographing based on said photometry values; and
a correction calculating section which obtains a correction value for correction of said exposure value based on a highest value among photometry values belonging to a predetermined range out of said plurality of photometry values obtained by said photometry section.

2. The camera according to claim 1, wherein
said highest value is a highest value among photometry values equal to or smaller than a predetermined value out of said plurality of photometry values.

3. The camera according to claim 1, wherein
said correction value is a value for correction of said exposure value to an under side.

4. The camera according to claim 1, wherein
said correction calculating section obtains said correction value based on a difference between said exposure value obtained in said exposure calculating section and said highest value.

5. The camera according to claim 4, wherein
said correction calculating section obtains a correction value for correction of said exposure value to a more under side as said difference is larger.

6. The camera according to claim 1, wherein
said exposure calculating section detects a facial part of a person as said subject, and obtains said exposure value based on a photometry value corresponding to said facial part out of said plurality of photometry values obtained in said photometry section.

7. A camera, comprising:
a photometry section which obtains photometry values at a plurality of positions of a subject;
an exposure calculating section which obtains an exposure value when photographing based on said photometry values;
a correction calculating section which obtains a correction value for correction of said exposure value based on a second highest photometry value excluding a highest value out of said plurality of photometry values obtained by said photometry section;
an imaging section which images an image of said subject; and
a control section which controls an exposure when photographing in said imaging section based on said correction value and said exposure value.

8. The camera according to claim 7, further comprising an image processing section which performs gradation conversion processing on an output from said imaging section.

9. The camera according to claim 8, wherein
said image processing section changes a gradation characteristic in said gradation conversion processing based

on a difference between said exposure value obtained in said exposure calculating section and said highest value.

10. The camera according to claim **9**, wherein

said image processing section uses a gradation characteristic in which an output gradation value changes more largely as said difference is larger in an area having a small gradation value.

11. The camera according to claim **8**, wherein

said correction calculating section obtains a correction value for correction of said exposure value to a more under side as said difference is larger.

12. A method of imaging, comprising the steps of:

obtaining photometry values at a plurality of positions of a subject;

obtaining an exposure value when photographing based on said photometry values;

obtaining a correction value for correction of said exposure value based on a highest value among photometry values belonging to a predetermined range out of said plurality of photometry values; and

controlling an exposure based on said correction value and imaging an image of said subject.

13. The method of imaging according to claim **12**, wherein

said highest value is a highest value among photometry values equal to or smaller than a predetermined value out of said plurality of photometry values.

14. The method of imaging according to claim **12**, wherein

said correction value is a value for correction of said exposure value to an under side.

15. The method of imaging according to claim **12**, wherein

in said step of obtaining said exposure value, a facial part of a person as said subject is detected, and said exposure value is obtained based on a photometry value corresponding to said facial part out of said plurality of photometry values.

16. The method of imaging according to claim **12**, further comprising the step of performing gradation conversion processing on an image obtained in said step of imaging the image of said subject.

17. The method of imaging according to claim **16**, wherein

in said step of performing said gradation conversion processing, a gradation characteristic in said gradation conversion processing is changed based on a difference between said exposure value and said highest value.

18. The method of imaging according to claim **17**, wherein

in said step of performing said gradation conversion processing, a gradation characteristic in which an output gradation value changes more largely as said difference is larger in an area having a small gradation value is used.

19. The method of imaging according to claim **16**, wherein

in said step of obtaining said correction value, a correction value for correction of said exposure value to a more under side as said difference is larger is obtained.

20. A method of imaging, comprising the steps of:

obtaining photometry values at a plurality of positions of a subject;

obtaining an exposure value when photographing based on said photometry values;

obtaining a correction value for correction of said exposure value based on a difference between said exposure value and a second highest photometry value excluding a highest value out of said plurality of photometry values; and

controlling an exposure based on said correction value and imaging an image of said subject.

21. The method of imaging according to claim **20**, wherein

in said step of obtaining said correction value, a correction value for correction of said exposure value to a more under side as said difference is larger is obtained.

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