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June 17, 2025

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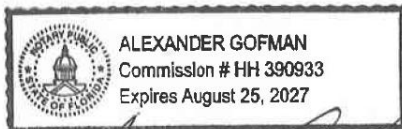
I further certify under penalty of perjury that translation of the aforementioned patent document:

[JP2007-25559A_English.pdf]

from the Japanese language into the English language is accurate and correct to the best of my knowledge and proficiency.

Timothy W. Hallett

Professional Translator


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(54) [Title of Invention] Focal position detection method and apparatus

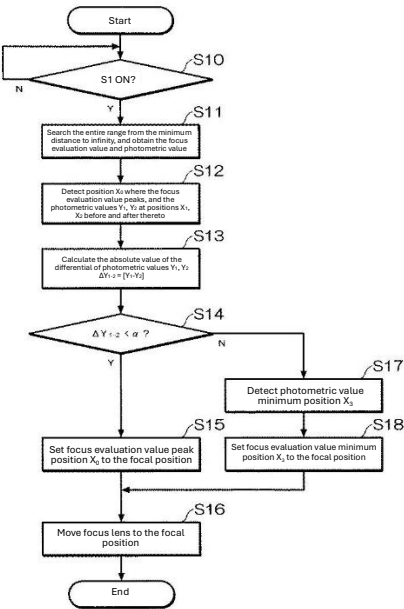
(57) [Abstract]

[Problem to be Solved] To accurately detect focal position even in cases where a high luminance point light source exists, such as during nighttime photography.

[Solution Means] The focus evaluation values and photometric values are obtained in the entire field from the minimum distance to infinity, the position X_0 where the focus evaluation value peaks is detected, and the photometric values Y_1 , Y_2 of the positions X_1 , X_2 before and after thereto are obtained. The differential ΔY_{1-2} of the obtained photometric values Y_1 , Y_2 is calculated, and the calculated differential ΔY_{1-2} is compared with an allowed value α . If the differential ΔY_{1-2} is less than the allowed value α , the position X_0 where the focus evaluation value peaks is treated as the focal position, and if the differential ΔY_{1-2} is equal to or greater than the allowed value α , the position X_3 where the photometric value is minimum is detected and that position X_3 is treated as the focal position.

[Selected Figure] Figure 6

[Field of Patent Claims]



[Claim 1]

A focal position detection method characterized by the focus evaluation values and photometric values being obtained in the entire field from the minimum distance to infinity, the position X_0 where the focus evaluation value peaks being detected, the obtained photometric values Y_1 , Y_2 of the positions X_1 , X_2 before and after thereto being obtained, the differential ΔY_{1-2} of the obtained photometric values Y_1 , Y_2 being calculated, and the calculated differential ΔY_{1-2} compared with an allowed value α , and if the differential ΔY_{1-2} is less than the allowed value α , the position X_0 where the focus evaluation value peaks being treated as the focal position, and if the differential ΔY_{1-2} is equal to or greater than the allowed value α , the position X_3 where the photometric value is minimum is detected and that position X_3 where the photometric value is minimum being treated as the focal position.

[Claim 2]

A focal position detection method characterized by the focus evaluation values and photometric values being obtained in the entire field from the minimum distance to infinity, the position X_0 where the focus evaluation value peaks being detected, the photometric values Y_1 , Y_2 of the positions X_1 , X_2 before and after thereto being obtained, the differential ΔY_{1-2} of the obtained photometric values Y_1 , Y_2 being calculated, and the calculated differential ΔY_{1-2} compared with an allowed value α , and if the differential ΔY_{1-2} is less than the allowed value α , the position X_0 where the focus evaluation value peaks being treated as the focal position, and if the differential ΔY_{1-2} is equal to or greater than the allowed value α , the position X_3 where the photometric value is minimum being detected, the photometric values Y_4 , Y_5 of the positions X_4 , X_5 of the position X_3 where the photometric value is minimum being obtained, the differential ΔY_{4-5} of the obtained photometric values Y_4 , Y_5 being calculated, and the calculated differential ΔY_{4-5} compared with the allowed value β and if differential ΔY_{4-5} is less than the allowed value β , the position X_3 where the photometric value is minimum being treated as the focal position, and if differential ΔY_{4-5} is greater than the allowed value β then the pan focal position being treated as the focal position.

[Claim 3]

A focal position detection method characterized by the focus evaluation values and photometric values being obtained in the entire field from the minimum distance to infinity, the position X_0 where the focus evaluation value peaks being detected, the photometric values Y_1 , Y_2 of the positions X_1 , X_2 before and after thereto being obtained, the differential ΔY_{1-2} of the obtained photometric values Y_1 , Y_2 being calculated, and the calculated differential ΔY_{1-2} compared with an allowed value α , and if the differential ΔY_{1-2} is less than the allowed value α , the focus evaluation value peak position X_0 being treated as the focal position, and if the differential ΔY_{1-2} is equal to or greater than the allowed value α , the position X_3 where the photometric value is minimum being detected, and the position X_6 where the focus evaluation value peaks adjacent to the position X_3 being detected, and the position X_6 where the focus evaluation value peaks being treated as the focal position.

[Claim 4]

A focal position detection method as written of in Claim 3 characterized by, if there is no position where the focus evaluation value peaks adjacent to the position X_3 where the photometric value is minimum, the pan focal position being treated as the focal position.

[Claim 5]

A focal position detection method characterized by a focal position detection method wherein a focus area is divided into multiple areas, the focus evaluation values for the entire range from the minimum distance to infinity are obtained for each area, and the focal positions detected based on the focus evaluation value information for each area are obtained, wherein the focus evaluation values and photometric values for the entire range from the minimum distance to infinity are obtained for each area, the maximum and minimum photometric values are detected in each area, the differential of the maximum and minimum photometric values are calculated in each area, and calculating the focal position by excluding the focus evaluation values for areas where the calculated differential is equal to or greater than an allowed value.

[Claim 6]

A focal position detection method characterized by a focal position detection method wherein a focus area is divided into multiple areas, the focus evaluation values for the entire range from the minimum distance to infinity are obtained for each area, and the focal positions detected based on the focus evaluation value information for each area are obtained, and wherein the focus evaluation values for the entire range from the minimum distance to infinity are obtained for each area, the positions where the focus evaluation values peak are detected in each area, and the deviation amount positions where the focus evaluation values peak are calculated for each of the areas, and calculating the focal position by excluding the focus evaluation values for areas where the deviation amount is equal to or greater than an allowed value.

[Claim 7]

A focal position detection apparatus characterized by being equipped with a focus evaluation value obtaining means that obtains the focus evaluation values in the entire field from the minimum distance to infinity, and a photometric value obtaining means that obtains the photometric values in the entire field from the minimum distance to infinity, and a peak position detection means that detects the position X_0 where the focus evaluation value peaks, and a minimum position detection means that detects a position X_3 where the photometric value is minimum, and a differential operation means that obtains the photometric values Y_1, Y_2 of the positions X_1, X_2 before and after the position X_0 where the focus evaluation value peaks, and calculates the differential ΔY_{1-2} thereof, and a focal position setting means that compares the differential ΔY_{1-2} with an allowed value α , and if the differential ΔY_{1-2} is less than the allowed value α , sets the focal position to the position X_0 where the focus evaluation value peaks, and if the differential ΔY_{1-2} is equal to or greater than the allowed value α , sets the focal position to the position X_3 where the photometric value is minimum.

[Claim 8]

A focal position detection apparatus characterized by being equipped with a focus evaluation value obtaining means that obtains the focus evaluation values in the entire field from the minimum distance to infinity, and a photometric value obtaining means that obtains the photometric values in the entire field from the minimum distance to infinity, and a peak position detection means that detects the position X_0 where the focus evaluation value peaks, and a primary differential operation means that obtains the photometric values Y_1, Y_2 of the positions X_1, X_2 before and after position X_0 where the focus evaluation value peaks, and calculates the differential ΔY_{1-2} thereof, and a minimum position detection means that detects a position X_3 where the photometric value is minimum, and a secondary differential operation means that obtains the photometric values Y_4, Y_5 of the positions X_4, X_5 before and after position X_3 where the photometric value is minimum, and a focal position setting means that, that compares the differential ΔY_{1-2} with an allowed value α , and if the differential ΔY_{1-2} is less than an allowed value α , sets the focal position to the position X_0 where the focus evaluation value peaks, and if the differential ΔY_{1-2} is equal to or greater than the allowed value α , further compares the differential ΔY_{4-5} with an allowed value β , and if the differential ΔY_{4-5} is less than the allowed value β , sets the focal position to the position X_3 where the photometric value is minimum, and if the differential ΔY_{4-5} is equal to or greater than the allowed value β , sets the focal position to the pan focal position.

[Claim 9]

A focal position detection apparatus characterized by being equipped with a focus evaluation value obtaining means that obtains the focus evaluation values in the entire field from the minimum distance to infinity, and a photometric value obtaining means that obtains the photometric values in the entire field from the minimum distance to infinity, and a primary peak position detection means that detects the position X_0 where the focus evaluation value peaks, and a primary differential operation means that the photometric values Y_4, Y_5 of positions X_1, X_2 before and after the position X_0 where the focus evaluation value peaks, and calculates the differential ΔY_{1-2} thereof, and a minimum position detection means that detects a position X_3 where the photometric value is minimum, and a secondary peak position detection means that detects the position X_6 where the focus evaluation value peaks adjacent to the position X_3 where the photometric value is minimum, and a focal position setting means that compares the

differential ΔY_{1-2} with an allowed value α , and if the differential ΔY_{1-2} is less than the allowed value α , sets the focal position to the position X_0 where the focus evaluation value peaks, and if the differential ΔY_{1-2} is equal to or greater than the allowed value α , sets the focal position to the position X_6 where the focus evaluation value peaks adjacent to the position X_3 where the photometric value is minimum.

[Claim 10]

A focal position detection apparatus as written of in Claim 9 characterized by said focal position setting means, if there is no position where the focus evaluation peaks adjacent to the position X_3 where the photometric value is minimum, sets the focal position to the pan focal position.

[Claim 11]

A focal position detection apparatus characterized by being equipped with a focus evaluation value obtaining means that obtains the focus evaluation values in the entire field from the minimum distance to infinity in individual areas of a focus area that has been multiply divided, and a photometric value obtaining means that obtains the photometric values in the entire field from the minimum distance to infinity in said individual areas, and a detection means that detects the maximum value and minimum value of the photometric values in said individual areas, and an operation means that calculates the differential of the maximum value and minimum value of the photometric values in said individual areas, and an extraction means that extracts the areas where the differential calculated in said operation means is equal to or above an allowed value, and a focal position detection means that detects the focal position based on focus evaluation value information outside of the area extracted in said extraction means.

[Claim 12]

A focal position detection apparatus characterized by being equipped with a focus evaluation value obtaining means that obtains the focus evaluation values in the entire field from the minimum distance to infinity in individual areas of a focus area that has been multiply divided, and a photometric value obtaining means that obtains the photometric values in the entire field from the minimum distance to infinity in said individual areas, and a detection means that detects the position where the focus evaluation value peaks in said individual areas, and an operation means that calculates the deviation amount of the positions where the focus evaluation values peak for said individual areas, and an extraction means that extracts the areas where the deviation amount in said operation means is equal to or above an allowed value, and a focal position detection means that detects the focal position based on focus evaluation value information outside of the area extracted in said extraction means.

[Detailed Description of Invention]

[Technical Field of the Invention]

[0001]

This invention pertains to a focal position detection method and apparatus, and specifically relates to a focal position detection method and apparatus that detects the focal position by using imaging signals obtained from imaging elements.

[Prior Art]

[0002]

The so-called "contrast detection method" is known as focal position detection method for digital cameras. The contrast detection method obtains a focus evaluation value by extracting a high frequency component of imaging signals obtained from imaging elements, detects the position at which the focus evaluation value peaks, and treats this as the focal position (for example, Patent Citations 1, 2).

[0003]

In this contrast detection method, there is a drawback in that accurate detection is not possible when a high luminance point light source exists, such as then photographing at night, and the like. When this performs focal position detection at normally suitable exposure level, the signal output of the point light source component is saturated, causing the high frequency component to not change even if the position of the focus lens changes.

[0004]

Thus, in Patent Citation 3, it is proposed that if the focal position cannot be detected by detecting a focal position at a suitable exposure level, focal position detection is performed by detecting the focal position after reducing the exposure amount greater than the suitable exposure, thereby avoiding saturation of the imaging signal due to a point light source.

[Patent Citation 1] [Laid-open Patent 2000-13666 Report](#)

[Patent Citation 2] [Laid-open Patent 21995-287162 Report](#)

[Patent Citation 3] [Laid-open Patent 2002-196220 Report](#)

[Overview of Invention]

[Problems to be Solved by the Invention]

[0005]

However, In the method of Patent Citation 3, there is a defect in that it is necessary to perform the focal position detection operation multiple times, and detection of the focal position takes time.

[0006]

The purpose of this invention is to, in light of such issues, provide a focal position detection method and apparatus capable of accurately detecting focal position even in cases where a high luminance point light source exists, such as during nighttime photography.

[Means for Solving the Issues]

[0007]

The invention pertaining to Claim 1 provides a focal position detection method characterized by the focus evaluation values and photometric values being obtained in the entire field from the minimum distance to infinity, the position X_0 where the focus evaluation value peaks being detected, the photometric values Y_1 , Y_2 of the positions X_1 , X_2 before and after thereto being obtained, the differential ΔY_{1-2} of the obtained photometric values Y_1 , Y_2 being calculated, and the calculated differential ΔY_{1-2} compared with the allowed value α , and if the differential ΔY_{1-2} is less than the allowed value α , the position X_0 where the focus evaluation value peaks being treated as the focal position, and if the differential ΔY_{1-2} is equal to or greater than the allowed value α , the position X_3 where the photometric value is minimum is detected and that position X_3 where the photometric value is minimum being treated as the focal position.

[0008]

In the invention pertaining to Claim 1, the position X_0 where the focus evaluation value peak is detected, and the photometric values Y_1 , Y_2 of the positions X_1 , X_2 before and after thereto are obtained. Then, the differential ΔY_{1-2} of the obtained photometric values Y_1 , Y_2 is calculated, and the calculated differential ΔY_{1-2} compared with the allowed value α . If the differential ΔY_{1-2} is less than the allowed value α , the focus evaluation value peak position X_0 will be treated as the focal position. On the other hand, if the differential ΔY_{1-2} is equal to or greater than the allowed value α , the position X_3 where the photometric value is minimum is detected and that position X_3 treated as the focal position. In other words, in this invention, even at the position where the peak focus evaluation value is shown, if the differential ΔY_{1-2} of the photometric values of the positions before and after thereto is equal to or greater than the allowed value α , that position X_0 is treated as a false peak due to a point light source, and the position X_3 where the photometric value is minimum is set as the true focal position. It is thereby possible to accurately detect focal position even in cases where a high luminance point light source exists.

[0009]

The invention pertaining to Claim 2 provides a focal position detection method characterized by the focus evaluation values and photometric values being obtained in the entire field from the minimum distance to infinity, the position X_0 where the focus evaluation value peaks being detected, the photometric values Y_1 , Y_2 of the positions X_1 , X_2 before and after being obtained, the differential ΔY_{1-2} of the obtained photometric values Y_1 , Y_2 being calculated, and the calculated differential ΔY_{1-2} compared with the allowed value α , and if the differential ΔY_{1-2} is less than the allowed value α , the position X_0 where the focus evaluation value peaks being treated as the focal position, and if the differential ΔY_{1-2} is equal to or greater than the allowed value α , the position X_3 where the photometric value is minimum is detected, the photometric values Y_4 , Y_5 of the positions X_4 , X_5 of the position X_3 where the photometric value is minimum being obtained, the differential ΔY_{4-5} of the obtained photometric values Y_4 , Y_5 is calculated, the calculated differential ΔY_{4-5} compared with the allowed value β and if differential ΔY_{4-5} is less than the allowed value β , the position X_3 where the photometric value is minimum being treated as the focal position, and if differential ΔY_{4-5} is greater than the allowed value β then the pan focal position being treated as the focal position.

[0010]

In the invention pertaining to Claim 2, the position X_0 where the focus evaluation value peak is detected, and the photometric values Y_1 , Y_2 of the positions X_1 , X_2 before and after are obtained. Then, the differential ΔY_{1-2} of the obtained photometric values Y_1 , Y_2 is calculated, and the calculated differential ΔY_{1-2} compared with the allowed value α . If the differential ΔY_{1-2} is less than the allowed value α , the focus evaluation value peak position X_0 will be treated as the focal position. On the other hand, if the differential ΔY_{1-2} is equal to or greater than the allowed value α , the position X_3 where the photometric value is minimum is detected, the photometric values Y_4 , Y_5 of the positions X_4 , X_5 before and after thereto are obtained, and the differential ΔY_{4-5} is calculated. Then, the calculated differential ΔY_{4-5} is compared with an allowed value β , and if the differential ΔY_{4-5} is less than the allowed value β , then the position X_3 where the photometric value is minimum is treated as the focal position, and if the differential ΔY_{4-5} is greater than the allowed value β , the pan focal position is treated as the focal position. In other words, in this invention, even at the position where the peak focus evaluation value is shown, if the differential ΔY_{1-2} of the photometric values of the positions before and after thereto is equal to or greater than the allowed value α , that position X_0 is treated as a false peak due to a point light source. Then, the position X_3 where the

photometric value is minimum is detected, and the differential ΔY_{4-5} of the photometric values of the positions before and after thereto is derived, and compared with the allowed value β , and if the differential ΔY_{4-5} is less than the allowed value β , then the position X_3 where the photometric value is minimum is set as the focal position. On the other hand, if the differential ΔY_{4-5} is equal to or greater than the allowed value β , the pan focal position is set as the focal position. It is thereby possible to accurately detect focal position even in cases where a high luminance point light source exists.

[0011]

The invention pertaining to Claim 3 provides a focal position detection method characterized by the focus evaluation values and photometric values being obtained in the entire field from the minimum distance to infinity, the position X_0 where the focus evaluation value peaks being detected, the photometric values Y_1 , Y_2 of the positions X_1 , X_2 before and after thereto being obtained, the differential ΔY_{1-2} of the obtained photometric values Y_1 , Y_2 being calculated, and the calculated differential ΔY_{1-2} compared with the allowed value α , and if the differential ΔY_{1-2} is less than the allowed value α , the focus evaluation value peak position X_0 being treated as the focal position, and if the differential ΔY_{1-2} is equal to or greater than the allowed value α , the position X_3 where the photometric value is minimum is detected, the position X_6 where the focus evaluation value peaks adjacent to the position X_3 where the photometric value is minimum being detected, and the position X_6 where the focus evaluation value peaks being treated as the focal position.

[0012]

In the invention pertaining to Claim 3, the position X_0 where the focus evaluation value peak is detected, the photometric values Y_1 , Y_2 of the positions X_1 , X_2 before and after thereto are obtained, and the differential ΔY_{1-2} of the obtained photometric values Y_1 , Y_2 is calculated. Then, the calculated differential ΔY_{1-2} is compared to an allowed value α , and if the differential ΔY_{1-2} is less than the allowed value α , the focus evaluation value peak position X_0 will be treated as the focal position. On the other hand, if the differential ΔY_{1-2} is equal to or greater than the allowed value α , the position where the position X_3 where the photometric value is minimum is detected, and the position X_6 where the focus evaluation value peaks adjacent thereto is detected and treated as the focal position. In other words, in the invention pertaining to Claim 3, even at the position where the peak focus evaluation value is shown, if the differential ΔY_{1-2} of the photometric values of the positions before and after thereto is equal to or greater than the allowed value α , that position X_0 is treated as a false peak due to a point light source. Then, the position where the position X_3 where the photometric value is minimum is detected, and the position X_6 where the adjacent focus evaluation value peaks before and after thereto is detected and treated as the focal position. It is thereby possible to accurately detect focal position even in cases where a high luminance point light source exists.

[0013]

The invention pertaining to Claim 4, in order to achieve said objective, provides a focal position detection method as written of in Claim 3 characterized by, if there is no position where the focus evaluation value peaks adjacent to the position X_3 where the photometric value is minimum, the pan focal position being treated as the focal position.

[0014]

In the invention pertaining to Claim 4, if there is no position where the focus evaluation value peaks adjacent to the position X_3 where the photometric value is minimum in the invention pertaining to Claim 3, the pan focal position is set as the focal position.

[0015]

The invention pertaining to Claim 5 provides a focal position detection method characterized by a focal position detection method wherein a focus area is divided into multiple areas, the focus evaluation values for the entire range from the minimum distance to infinity are obtained for each area, and the focal positions detected based on the focus evaluation value information for each area obtained, wherein the focus evaluation values and photometric values for the entire range from the minimum distance to infinity are obtained for each area, the maximum and minimum photometric values detected in each area, the differential of the maximum and minimum photometric values is calculated in each area, and the focal position is calculated by excluding the focus evaluation values for areas where the calculated differential is equal to or greater than an allowed value.

[0016]

In the invention pertaining to Claim 5, the focus evaluation values and photometric values for the entire area from the minimum distance to infinity are obtained for each divided area, and the maximum values and minimum values of the photometric values for each area are detected. Then, the differentials of the minimum values and maximum values is calculated, and the focal position is calculated, excluding those areas where the calculated differential is equal to or greater than the allowed value. In other words, in this invention, areas where the differential of the minimum and maximum photometric values is equal to or greater than the allowed value will be viewed as having the existence of a high luminance point light source, and detection of the focal position is performed with such areas excluded. It is thereby possible to accurately detect focal position even in cases where a high luminance point light source exists inside the focus area.

[0017]

The invention pertaining to Claim 6 provides a focal position detection method characterized by a focal position detection method wherein a focus area is divided into multiple areas, the focus evaluation values for the entire range from the

minimum distance to infinity are obtained for each area, and the focal positions detected based on the focus evaluation value information for each area are obtained, wherein the focus evaluation values for the entire range from the minimum distance to infinity are obtained for each area, the positions where the focus evaluation values peak are detected in each area, the deviation amount positions where the focus evaluation values peak are calculated for each of the areas, and calculating the focal position by excluding the focus evaluation values for areas where the deviation amount is equal to or greater than an allowed value.

[0018]

In the invention pertaining to Claim 6, the focus evaluation values for the entire area from the minimum distance to infinity are obtained for each divided area, and the peak position of the focus evaluation value in each area are detected. Then, the deviation amounts of the peak positions of each of the areas are calculated, and the focal position is detected, excluding those areas where the deviation amount is equal to or greater than an allowed value. In other words, in this invention, in areas where the deviation amount of the peak position of the focus evaluation values is equal to or greater than an allowed value will be viewed as having the existence of a high luminance point light source, and detection of the focal position is performed with such areas excluded. It is thereby possible to accurately detect focal position even in cases where a high luminance point light source exists inside the focus area.

[0019]

The invention pertaining to Claim 7 provides a focal position detection apparatus characterized by being equipped with a focus evaluation value obtaining means that obtains the focus evaluation values in the entire field from the minimum distance to infinity, and a photometric value obtaining means that obtains the photometric values in the entire field from the minimum distance to infinity, and a peak position detection means that detects the position X_0 where the focus evaluation value peaks, and a minimum position detection means that detects a position X_3 where the photometric value is minimum, and a differential operation means that obtains the photometric values Y_1, Y_2 of the positions X_1, X_2 before and after the position X_0 where the focus evaluation value peaks, and calculates the differential ΔY_{1-2} thereof, and a focal position setting means that compares the differential ΔY_{1-2} with an allowed value α , and if the differential ΔY_{1-2} is less than the allowed value α , sets the focal position to the position X_0 where the focus evaluation value peaks, and if the differential ΔY_{1-2} is equal to or greater than the allowed value α , sets the focal position to the position X_3 where the photometric value is minimum.

[0020]

According to the invention pertaining to Claim 7, the focus evaluation values for the entire range from the minimum distance to infinity is obtained by a focus evaluation value obtaining means, and the position X_0 where the focus evaluation value peak is detected by the peak position detection means. In addition, the photometric values for the entire range from the minimum distance to infinity are obtained by a photometric value obtaining means, and the position X_3 where the photometric value is minimum is detected by a minimum position detection means. Then, the differential ΔY_{1-2} of the photometric values Y_1, Y_2 of the positions X_1, X_2 before and after the position X_0 where the focus evaluation value peaks is calculated by a differential operation means. The focal position setting means compares the differential ΔY_{1-2} calculated by the differential operation means with an allowed value α , and if the differential ΔY_{1-2} is less than the allowed value α , the focal position is set to position X_0 where the focus evaluation value peaks. On the other hand, if the differential ΔY_{1-2} is equal to or greater than the allowed value α , the focal position is set to the position X_3 where the photometric value is minimum. In other words, in this invention, even at the position where the peak focus evaluation value is shown, if the differential ΔY_{1-2} of the photometric values of the positions before and after thereto is equal to or greater than the allowed value α , that position X_0 is treated as a false peak due to a point light source, and the position X_3 where the photometric value is minimum is set as the true focal position. It is thereby possible to accurately detect focal position even in cases where a high luminance point light source exists.

[0021]

The invention pertaining to Claim 8 provides a focal position detection apparatus characterized by being equipped with a focus evaluation value obtaining means that obtains the focus evaluation values in the entire field from the minimum distance to infinity, and a photometric value obtaining means that obtains the photometric values in the entire field from the minimum distance to infinity, and a peak position detection means that detects the position X_0 where the focus evaluation value peaks, and a primary differential operation means that obtains the photometric values Y_1, Y_2 of the positions X_1, X_2 before and after position X_0 where the focus evaluation value peaks, and calculates the differential ΔY_{1-2} thereof, and a minimum position detection means that detects a position X_3 where the photometric value is minimum, and a secondary differential operation means that obtains the photometric values Y_4, Y_5 of the positions X_4, X_5 before and after position X_3 where the focus evaluation value is minimum, and a focal position setting means that, that compares the differential ΔY_{1-2} with an allowed value α , and if the differential ΔY_{1-2} is less than the allowed value α , sets the focal position to the position X_0 where the focus evaluation value peaks, and if the differential ΔY_{1-2} is equal to or greater than the allowed value α , further compares the differential ΔY_{4-5} with an allowed value β , and if the differential ΔY_{4-5} is less than the allowed value β , sets the focal position to the position X_3 where the photometric value is minimum, and if the differential ΔY_{4-5} is equal to or greater than the allowed value β , sets the focal position to the pan focal position.

[0022]

According to the invention pertaining to Claim 8, the focus evaluation value for the entire range from the minimum distance to infinity is obtained by a focus evaluation value obtaining means, and the position X_0 where the focus evaluation value peak is detected by the peak position detection means. In addition, the photometric values for the entire range from the minimum distance to infinity are obtained by a photometric value obtaining means, and the position X_3 where the photometric value is minimum is detected by a minimum position detection means. Then, the differential ΔY_{1-2} of the photometric values Y_1, Y_2 of the positions X_1, X_2 before and after the position X_0 where the focus evaluation value peaks is calculated by a primary differential operation means, and the differential ΔY_{4-5} of the photometric values Y_4, Y_5 of the positions X_4, X_5 before and after the position X_3 where the focus evaluation value is minimum is calculated by a secondary differential operation means. A focal position setting means compares the differential ΔY_{1-2} detected by the primary differential operation means, and if ΔY_{1-2} is less than an allowed value α , the focal position is set to position X_0 where the focus evaluation value peaks. On the other hand, if the differential ΔY_{1-2} detected by the primary differential operation means is equal to or greater than the allowed value α , it will further compare the differential ΔY_{4-5} detected by the secondary differential operation means with an allowed value β , and if the differential ΔY_{4-5} is less than the allowed value β , then the focal position is set to position X_3 where the photometric value is minimum. In addition, if the differential ΔY_{4-5} is equal to or greater than the allowed value β , the focal position is set to the pan focal position. It is thereby possible to accurately detect focal position even in cases where a high luminance point light source exists.

[0023]

The invention pertaining to Claim 9, in order to achieve the aforementioned purpose, provides a focal position detection apparatus characterized by being equipped with a focus evaluation value obtaining means that obtains the focus evaluation value in the entire field from the minimum distance to infinity, and a photometric value obtaining means that obtains the photometric values in the entire field from the minimum distance to infinity, and a primary peak position detection means that detects the position X_0 where the focus evaluation value peaks, and a primary differential operation means that calculates the differential ΔY_{1-2} of the photometric values Y_4, Y_5 of positions X_1, X_2 before and after the position X_0 where the focus evaluation value peaks, and a minimum position detection means that detects a position X_3 where the photometric value is minimum, and a secondary peak position detection means that detects the position X_6 where the focus evaluation value peaks adjacent to the position X_3 where the photometric value is minimum, and a focal position setting means that compares the differential ΔY_{1-2} with an allowed value α , and if the differential ΔY_{1-2} is less than the allowed value α , sets the focal position to the position X_0 where the focus evaluation value peaks, and if the differential ΔY_{1-2} is equal to or greater than the allowed value α , sets the focal position to the position X_6 where the focus evaluation value peaks adjacent to the position X_3 where the photometric value is minimum.

[0024]

According to the invention pertaining to Claim 9, the focus evaluation values for the entire range from the minimum distance to infinity is obtained by a focus evaluation value obtaining means. In addition, the position X_0 where the focus evaluation value peak is detected by a primary peak position detection means, and the position X_6 where the focus evaluation value peaks adjacent to the position X_3 where the photometric value is minimum is detected by a secondary peak position detection means. In addition, the photometric values for the entire range from the minimum distance to infinity are obtained by a photometric value obtaining means, and the position X_3 where the photometric value is minimum is detected by a minimum position detection means. Then, the differential ΔY_{1-2} of the photometric values Y_1, Y_2 of the positions X_1, X_2 before and after the position X_0 where the focus evaluation value peaks is calculated by a differential operation means. A focal position setting means compares the differential ΔY_{1-2} detected by the differential operation means with an allowed value α , and if ΔY_{1-2} is less than the allowed value α , the focal position is set to position X_0 where the focus evaluation value peaks. On the other hand, if the differential ΔY_{1-2} is equal to or greater than the allowed value α , the focal position is set to the position X_6 where the focus evaluation value peaks adjacent to the position X_3 where the photometric value is minimum that was detected by the secondary peak position detection means. It is thereby possible to accurately detect focal position even in cases where a high luminance point light source exists.

[0025]

The invention pertaining to Claim 10, in order to achieve said objective, provides a focal position detection apparatus as written of in Claim 9 characterized by the aforementioned focal position setting means setting the focal position to the pan focal position if there is no position where the focus evaluation value peaks adjacent to the position X_3 where the photometric value is minimum.

[0026]

In the invention pertaining to Claim 10, if there is no focus evaluation value peak position adjacent to the position X_3 where the photometric value is minimum in the invention pertaining to Claim 9, the pan focal position is set as the focal position.

[0027]

The invention pertaining to Claim 11, in order to achieve said objective, provides a focal position detection apparatus characterized by being equipped with a focus evaluation value obtaining means that obtains the focus evaluation values in the entire field from the minimum distance to infinity in individual areas of a focus area that has been multiply divided, and

a photometric value obtaining means that obtains the photometric values in the entire field from the minimum distance to infinity in said individual areas, and a detection means that detects the maximum value and minimum value of the photometric values in said individual areas, and an operation means that calculates the differential of the maximum value and minimum value of the photometric values in said individual areas, and an extraction means that extracts the areas where the differential calculated in said operation means is equal to or above an allowed value, and a focal position detection means that detects the focal position based on focus evaluation value information outside of the area extracted in said extraction means.

[0028]

According to the invention pertaining to Claim 11, the focus evaluation values for the entire range from the minimum distance to infinity is obtained for each area by a focus evaluation value obtaining means, and the photometric values for the entire range from the minimum distance to infinity are obtained for each area by a photometric value obtaining means. In addition, the minimum and maximum photometric values in each area are detected by a detection means, and the differentials of the minimums and maximums are calculated by an operation means. Then, the areas where the differentials are equal to or greater than the allowed value are extracted by an extraction means, and the focal positions detected by a focal position detection means based on the focus evaluation value information outside of the extracted areas. It is thereby possible to accurately detect focal position even in cases where a high luminance point light source exists inside the focus area.

[0029]

The invention pertaining to Claim 12, in order to achieve said objective, provides a focal position detection apparatus characterized by being equipped with a focus evaluation value obtaining means that obtains the focus evaluation values in the entire field from the minimum distance to infinity in individual areas of a focus area that has been multiply divided, and a photometric value obtaining means that obtains the photometric values in the entire field from the minimum distance to infinity in said individual areas, and a detection means that detects the position where the focus evaluation value peaks in said individual areas, and an operation means that calculates the deviation amount of the positions where the focus evaluation values peak for said individual areas, and an extraction means that extracts the areas where the deviation amount in said operation means is equal to or above an allowed value, and a focal position detection means that detects the focal position based on focus evaluation value information outside of the area extracted in said extraction means.

[0030]

According to the invention pertaining to Claim 12, in each area, the focus evaluation values for the entire range from the minimum distance to infinity is obtained by a focus evaluation value obtaining means, and the photometric values for the entire range from the minimum distance to infinity are obtained by a photometric value obtaining means. In addition, the position where the focus evaluation value peaks in each area is detected by a detection means, and the deviation amounts of the positions where the focus evaluation value peaks in each of the detected areas are calculated by an operation means. Then, the areas where the deviation amounts are equal to or greater than the allowed value are extracted by an extraction means, and the focal positions detected by a focal position detection means based on the focus evaluation value information outside of the extracted areas. It is thereby possible to accurately detect focal position even in cases where a high luminance point light source exists inside the focus area.

[Effect of Invention]

[0031]

According to the focal position detection method and apparatus pertaining to this invention, it is possible to accurately detect the focal position even in cases where a high luminance point light source exists, such as when shooting at night.

[Preferred Embodiments of the Invention]

[0032]

The following describes in detail the preferred embodiments of the focal position detection method and apparatus pertaining to this invention with reference to the appended figures.

[0033]

Figure 1 is a block diagram showing the electrical constitution of a digital camera of a digital camera system where this invention is applied. As shown in the same figure, a digital camera 10 of this embodiment is composed of an imaging optical system 12, an imaging element 14, a timing generator (TG) 16, an analog signal processing unit 18, and A/D converter 20, an image input controller 22, a digital signal processing unit 24, an encoder 28, an image display part 30, a compression/decompression processing unit 32, a media controller 34, memory media 36, an AE detector 38, an AF detector 40, a CPU 42, a ROM 44, a RAM 46, a flash ROM 48, and an operation unit 50 and the like.

[0034]

The overall operation of the digital camera 10 is systematically controlled by the CPU 42, and the CPU 42 controls the components of the digital camera 10 according to a set program based upon inputs from the operation unit 50.

[0035]

The operation unit 50 includes operation buttons such as a power switch, a shutter button, and a zoom button, and the like, and outputs signals corresponding to the operation buttons to the CPU 42. Moreover, the shutter button is composed of a so-called two-stage switch with a half-press and full-press, with a half-press operating AE (Automatic Exposure) and AF (Auto Focus), and a full-press executing image recording.

[0036]

The ROM 44 stores the data necessary for the various controls of the program flowchart, and the like, in addition to the program executed by the CPU 42. The CPU 42 deploys the program stored in the ROM 44 to the RAM 46, and executes the various processes while using the RAM 46 as the working memory. In addition, the flash ROM 48 stores various types of setting information and the like pertaining to the operation of the digital camera 10 such as user setting information and the like.

[0037]

The imaging optical system 12 includes a zoom lens 12z, a focus lens 12f, and a iris (for example, an iris iris) 12, and these are driven and operated by a respective zoom motor 60z, focus motor 60f, and iris motor 60i. In other words, the zoom lens 12z is driven by a zoom motor 60z, moving it back and forth on the imaging optical axis, thereby changing the focal point distance. In addition, the focus lens 12f is driven by a zoom motor 60f, moving it back and forth on the imaging optical axis, thereby changing the image location. In addition, the iris 12i is driven by an iris motor 60i, changing the stage of the aperture volume, and changing the aperture volume. The CPU 42 controls the driving of the zoom motor 60z, focus motor 60f, and iris motor 60i via a zoom motor driver 62z, a focus motor driver 62f, and an iris motor driver 62i, and controls the operation of the zoom lens 12z, the focus lens 12f, and the iris 12i.

[0038]

The imaging element 14 is composed of a camera CCD with a predetermined color filter array (for example, a Bayer array). The light incident to the light receiving surface of the imaging element via the optical imaging system 12 is varied by the signal charge of an amount according to the incident light volume through photo diodes arranged on the light receiving surface. Then, the signal charge accumulated in the photo diodes is read out according to a timing signal applied from the timing generator (TG) 16, and sequentially output from the imaging element 14 as a voltage signal (image signal).

[0039]

The analog signal processing unit 18 includes a sampling hold circuit, a color separation circuit, a gain adjustment circuit and the like, and performs correlated double sampling (CDS) processing of the image signals sequentially output from the imaging element 14 as well as color separation processing into the RGB color signals, and adjustment of the signal levels of the color signals (pre-white balance processing).

[0040]

The A/D converter 20 converts the analog image signals output from the analog signal processing unit 18 to digital image signals.

[0041]

The image input controller 22 is stored in a buffer memory of a set capacity, and performs single-frame accumulation of image signals output from the A/D converter and stores these to the RAM 46.

[0042]

The digital signal processing unit 24 includes a synchronization circuit, a gamma correction circuit, a contour correction circuit, and a luminance/color difference signal generation circuit, and the like, processes the image signal stored in the RAM 46 according to instructions from CPU 42, and generates a YUV signal composed of a luminance signal and a color difference signal.

[0043]

If through-the-lens images are displayed by the image display unit 30, the images will be successively imaged by the imaging element 14, and the image signals obtained will be successively processed by the digital signal processing unit 24 and YUV signals generated. The generated YUV signals are applied to the encoder 28 via the RAM 46, converted to a signal form for display, and output to the image display unit 30. The through image is thereby displayed by the image display unit 30.

[0044]

When recording an image, the image is imaged by the imaging element 14 in accordance with the imaging instruction from the operation unit 50, and the image signals obtained are processed, and the YUV signals generated. The generated YUV signals are applied to the compression/decompression processing unit 32, and made to a set compressed image data (for example, JPEG), whereupon it is stored in the memory media 36 via the media controller 34.

[0045]

The compressed image data stored in the memory media 36 is read out from the memory media 36 according to reproduction instructions, and made into uncompressed YUV signals by the compression/decompression processing unit, whereupon it is output to the image display unit 30 via the encoder 28. The image recorded in the memory media 36 is thereby reproduced and displayed in the image display unit 30.

[0046]

The AE detection unit 38 calculates the physical volume necessary for AE control based on the image signals obtained from the imaging element 14 in accordance with the instructions from the CPU 42. In other words, for example, the AE detection unit 38 divides a single screen into multiple areas (for example, 16×16) relative to an image signal for a single frame acquired via the analog signal processing unit 18, the A/D converter 20, and the image input controller 22, and calculates the integrated value of the RGB image signals for each divided area. The CPU 42, obtains the integrated value calculated by the AE detection unit 38, detects the brightness of the photographed subject, and calculates the photometric value (EV value). Then, the exposure (sensitivity, iris, shutter speed) during imaging is set based on the derived EV value.

[0047]

The AF detection unit 40 calculates the physical volume necessary for AF control based on the image signals obtained from the imaging element 14 in accordance with the instructions from the CPU 42. In the digital camera 10 of this embodiment, AF control is performed according to the image contrast, and the AF detection unit 40 calculates the focus evaluation value representing the sharpness of the image from image signal that was input. The AF detection unit 40, as shown in Figure 2, is primarily composed of a high pass filter 70, an absolute value processing unit 72, a focus area extraction unit 74, and an integration unit 76. The high pass filter 70 performs processing that passes only the high frequency component of the G signal from the RGB image signal acquired via the image input controller 22. The absolute value processing unit 72 perform processing that obtains the absolute value of the output signal from the high pass filter 70, and the focus area extraction unit 74 performs cutout processing of the signals inside the preset focus area. The integration unit 76 integrated the absolute value data in the focus area, and outputs the integrated value (focus evaluation value) obtained to the CPU 42. The CPU 42 moves the focus lens 12f, obtains the focus evaluation value from the AF detection unit at multiple detection points, and detects the focal position based on the obtained focus evaluation value. Then, the focus motor 60f is driven via the focus motor driver 62f, so that the focus lens 12f is moved to the derived focal position.

[0048]

The processing operations during imaging in a digital camera 10 of an embodiment such as the aforementioned constitution shall be as follows.

[0049]

First, when the shutter button is half-depressed, an S1 ON signal is output to the CPU 42 from the operation unit 50. The CPU 42 performs AE and AF control in response to this S1 ON signal from the operation unit 50.

[0050]

In other words, as AE control, an image for AE is imaged by the imaging element 14, and applied to the AE detection unit 38 via the analog signal processing unit 18, the A/D converter 20, and the image input controller 22. The AE detection unit 38 calculates the integrated value from the image signal input, and outputs it to the CPU 42. The CPU 42, detects the brightness of the photographed subject from the integrated value obtained

from the AE detection unit 38, detects the brightness of the photographed subject, and calculates the EV value. Then, the exposure is set based on the calculated EV value.

[0051]

In addition, as AF control, an image for AF is imaged by the imaging element 14 while moving the focus lens 12f, and applied to the AF detection unit 40 via the analog signal processing unit 18, the A/D converter 20, and the image input controller 22. The AF detection unit 40 calculates the focus evaluation value from the image signal input, and outputs it to the CPU 42. The CPU 42 detects the focal position based on the focus evaluation value obtained from the AF detection unit 40, and controls the driving of the focus motor 60f via the focus motor driver 62f, so that the focus lens 12f is moved to the detected focal position. Moreover, the focal position detection method during such AF control is described in detail later.

[0052]

When the shutter button is subsequently fully depressed, an S2 ON signal is input to the CPU 42 from the operation unit 50. The CPU 42 performs image imaging and recording processing in response to this S2 ON signal from the operation unit 50. In other words, an image for recording is imaged by the imaging element 14, imported to the RAM 46 via the analog signal processing unit 18, the A/D converter 20, and the image input controller 22, and applied to the digital signal processing unit 24. The digital signal processing unit 24 performs the desired signal processing on the input image signals, and creates the YUV signals. The generated YUV signals undergo compression processing/compression/decompression processing unit 32, and recorded to the memory media 36 via the media controller 34.

[0053]

The image is imaged by the above series of processes, and the imaged image is recorded in the memory media 36. The image recorded in the memory media 36 is read out from the memory media 36 according to reproduction instructions input from the operation unit 50, and then decompressed by the compression/decompression processing unit 32, whereupon it is output to the image display 30 via the encoder 28, and made into uncompressed YUV signals by the compression/decompression processing unit 32, whereupon it is output to the image display unit 30 via the encoder 28. The image recorded in the memory media 36 is thereby reproduced and displayed in the image display unit 30.

[0054]

Next, we will describe the focal position detection methods in the digital camera 10 of this embodiment.

[0055]

- The 1st Method

In the 1st method, the focus evaluation values and photometric values are obtained in the entire field from the minimum distance to infinity, the position X_0 where the focus evaluation value peak is detected, and the photometric values Y_1, Y_2 of the positions X_1, X_2 before and after thereto are obtained. Then, the differential ΔY_{1-2} of the obtained photometric values Y_1, Y_2 is calculated, and the calculated differential ΔY_{1-2} compared with the allowed value α . If the calculated differential ΔY_{1-2} is less than an allowed value α , the focus evaluation value peak position X_0 will be set as the focal position. On the other hand, if the calculated differential ΔY_{1-2} is equal to or greater than the allowed value α , the position X_3 where the photometric value is minimum is detected and that position X_3 set as the focal position.

[0056]

Figure 3 is a figure showing the change of the focus evaluation value (Fig. (a) of same) and the photometric value (Fig. (b) of same) from the minimum distance to infinity in a case where a high luminance point light source does not exist in the focus area.

[0057]

As shown in the same figure, if a high-luminance point light source does not exist in the focus area, the focus lens will be moved from the minimum distance to infinity and the focus evaluation value will be obtained, whereupon the focus evaluation value will generally vary on a peak-shaped curve. Then, the peak position X_0 of the curve will be treated as the focal position. The photometric values before and after this focal position X_0 largely do not change.

[0058]

Figure 4 is a figure showing the change of the focus evaluation value (Fig. (a) of same), the photometric value (Fig. (b) of same), the intensity of the point light source (Fig. (c) of same), and the signal level intensity (Fig. (d)

of same) from the minimum distance to infinity in a case where a high luminance point light source exists in the focus area.

[0059]

As shown in the same figure, generally, when a high-luminance point light source exists in the focus area, the focus lens will be moved from the minimum distance to infinity and the focus evaluation value peak will be obtained, whereupon a peak-shaped curve will generally appear in two locations. This is because a virtual peak is generated by the presence of the point light source. In other words, when a high luminance point light source exists in the focus area, an area will be generated where the image signal output is saturated by the part with the point light source. Then, a peak will be generated at the true focal position even in the range where the image signal output is not saturated in tandem with the virtual peak being generated in the area saturated by the image signal output. As a result, the curve appears in two locations.

[0060]

Here, when observing the variation in photometric value, the photometric value variations are greater adjacent to the virtual peak, whereas at the peak positions that show the true focal position (peak position in the range where the image signal output is not saturated), and the photometric values become minimal, and the photometric values adjacent thereto do not vary for the most part. This is due to the intensity of the light source varying according to the focal position, and at the position of the virtual peak, the intensity of the point light source varies greatly, and the photometric value also varies greatly.

[0061]

Therefore, the position at which the focus evaluation value peak is detected, and if the change in the photometric values near the peak position thereof is examined, it is possible to judge whether the or not the detected peak position is a virtual peak. Then, if the detected peak position is a virtual peak, if the position at which the photometric value is minimum is treated as the focal position, it is possible to accurately perform focal position matching even if a high luminance point light source exists in the focus area.

[0062]

Here, in the 2st method, as shown in Figure 5, the focus evaluation values and photometric values are obtained in the entire field from the minimum distance to infinity, the position X_0 where the focus evaluation value peak is detected, the photometric values Y_1 , Y_2 of the positions X_1 , X_2 before and after thereto are obtained, the differential ΔY_{1-2} of the obtained photometric values Y_1 , Y_2 is calculated, the calculated differential ΔY_{1-2} is compared with the allowed value α , and if the differential ΔY_{1-2} is less than an allowed value α , the focus evaluation value peak position X_0 is set as the focal position. On the other hand, if the calculated differential ΔY_{1-2} is equal to or greater than the allowed value α , the position X_3 where the photometric value is minimum is detected and that position X_3 set as the focal position.

[0063]

Figure 6 is a flowchart showing the processing procedure for focal position matching according to the 1st method.

[0064]

Per the above, after AF control has been performed by half-pressing of the shutter button, the CPU 42 first detects the half-pressing of the shutter button. In other words, the presence of an S1 ON signal input from the operation unit 50 is determined (Step S10).

[0065]

When an S1 ON signal is input, the CPU 42 obtains the focus evaluation values and photometric values in the full range from the minimum distance to infinity (step S11). The information of the obtained focus evaluation values and photometric values in the full range from the minimum distance to infinity is stored in the RAM 46.

[0066]

Next, the position X_0 where the obtained focus evaluation value peak is detected based on the focus evaluation value and photometric values obtained, and the photometric values Y_1 , Y_2 at the positions X_1 , X_2 (the position separated by a set distance Δx on the minimum distance side from the position at which the focus evaluation value peaks is treated as X_1 , and the position separated by a set distance Δx on the infinity side is treated as X_2) before and after the position X_0 at which the focus evaluation value peak is detected.

[0067]

At this time, the CPU 42 stores the information of the focus evaluation values and photometric values from the minimum distance to infinity obtained from the photometry and distance measurement results in the RAM 46, and detects the position X_0 at which the focus evaluation value peaks, the photometric value Y_0 at the position X_0 where the focus evaluation value peaks, the photometric values Y_1 , Y_2 at the positions X_1 , X_2 before and after the position X_0 at which the focus evaluation value peaks, and the position X_3 where the photometric value is minimum.

[0068]

Next, it calculates the differential (absolute value) ΔY_{1-2} ($\Delta Y_{1-2} = |Y_1 - Y_2|$) of the photometric values Y_1 , Y_2 at the positions X_1 , X_2 before and after the position X_0 where the detected focus evaluation value peaks (Step S13). Then, the calculated differential ΔY_{1-2} is compared with an allowed value α , and a determination is made whether the differential ΔY_{1-2} is less than the allowed value α (Step S14).

[0069]

Furthermore, this allowed value α is set by deriving an optimal value determined by experiment and simulation, and the like, and stored in advance in the ROM 44. The CPU 42 reads out the allowed value α stored in the ROM 44, and compares it with the differential ΔY_{1-2} .

[0070]

If, as a result of the determination of Step 14, the differential ΔY_{1-2} is determined to be less than an allowed value α , the CPU 42 will determine the position X_0 where the focus evaluation value peaks to be the focal position, and will set this position X_0 as the focal position (Step S15). Then, the focus lens is moved to the focal position (Step S16).

[0071]

On the other hand, if the differential ΔY_{1-2} is determined to be equal to or greater than the allowed value α in the determination of Step S14, the CPU 42 will determine the position X_0 where the focus evaluation value peaks to be a virtual peak, and will detect the position X_3 where the photometric value is minimum (Step S17). The focal position will be set to the position X_3 where the photometric value is minimum (Step S18). Then, the focus lens is moved to the focal position (Step S16).

[0072]

In other words, even for the position at which the focus evaluation value peaks, as described above, a large variation of the photometric values before and after is treated as a high luminance point light source existing within the focus area and a virtual peak having been generated due to this point light source, and therefore such cases are determined as the location X_0 where the focus evaluation value peaks not being the focal position. On the other hand, because variation in the photometric value before and after largely disappears at the true focal position, if a virtual peak occurs, the position at which the photometric value is minimum is determined to be the focal position, and the focus lens will be moved to that position.

[0073]

Because, as described above, in the 1st method, because the focal position matching is performed based on a determination of whether the position at which the focus evaluation value peaks is a virtual peak, it is possible to accurately perform focal position matching, even in cases where a high luminance point light source exists within the focus area.

[0074]

Moreover, in this example, although the position X_3 where the photometric value is minimum is initially detected when the differential ΔY_{1-2} is equal to or greater than the allowed value α , the position X_3 where the photometric value is minimum may also be detected at the same time that the position at which the focus evaluation value peaks is detected (Step S12).

[0075]

In addition, regarding the positions X_1 , X_2 at which the photometric values Y_1 , Y_2 are detected, it is desirable that an optimum position (optimum range from the position X_0 where the focus evaluation value peaks) be derived and set by experimentation and simulation and the like.

[0076]

- The 2nd Method

Although in the aforementioned 1st method, the position X_3 at which the photometric value is minimum is set as the focal position when the peak position X_0 at which the focus evaluation value peaks is a virtual peak, in the 2nd method the position X_3 at which the photometric value is minimum is detected when the peak position X_0 at which the focus evaluation value peaks is a virtual peak, the variation of the photometric values adjoining thereto are examined, and if the photometric values are largely free of variation, then the position X_3 at which the photometric value is minimum is set as the focal position. On the other hand, if the variation is great, then a preset pan focal position is set as the focal position.

[0077]

Specifically, as shown in Figure 7, the position X_3 where the minimum photometric value is detected, the photometric values Y_4 , Y_5 of the positions X_4 , X_5 before and after thereto are obtained, and the differential (absolute value) ΔY_{4-5} ($\Delta Y_{4-5} = |Y_4 - Y_5|$) is calculated. Then, the calculated differential ΔY_{4-5} is compared with an allowed value β , and a determination is made whether the differential ΔY_{4-5} is less than the allowed value β . If the differential ΔY_{4-5} is

less than the allowed value β , then the position X_3 where the photometric value is minimum is set as the focal position, and if the differential ΔY_{4-5} is equal to or greater than the allowed value β , then the preset pan focal position is set as the focal position.

[0078]

Figure 8 is a flowchart showing the processing procedure for focal position matching according to the 2nd method. Moreover, processes identical to the 1st method have the same numbers assigned.

[0079]

First, the CPU 42 detects the half-pressing of the shutter button. In other words, the presence of an S1 ON signal input is determined (Step S10).

[0080]

When an S1 ON signal is input, the CPU 42 obtains the focus evaluation values and photometric values in the full range from the minimum distance to infinity (step S11). Then, the position X_0 at which the focus evaluation value peaks is detected, and the photometric values Y_1, Y_2 at the positions X_1, X_2 before and after are detected (Step S12).

[0081]

Next, it calculates the differential (absolute value) ΔY_{1-2} ($\Delta Y_{1-2} = |Y_1 - Y_2|$) of the photometric values Y_1, Y_2 at the positions X_1, X_2 before and after the position X_0 where the calculated focus evaluation value peaks are calculated Y_1, Y_2 (Step S13). Then, the calculated differential ΔY_{1-2} is compared with an allowed value α , and a determination is made whether the differential ΔY_{1-2} is less than the allowed value α (Step S14).

[0082]

If, as a result of this determination, the differential ΔY_{1-2} is determined to be less than the allowed value α , the CPU 42 will determine the position X_0 where the focus evaluation value peaks to be the focal position, and will set this position X_0 as the focal position (Step S15). Then, the focus lens is moved to the focal position (Step S16).

[0083]

On the other hand, if the differential ΔY_{1-2} is determined to be equal to or greater than the allowed value α in the determination of Step S14, the CPU 42 will determine the position X_0 where the focus evaluation value peaks to be a virtual peak. Then, the position X_3 where the focus evaluation value peak is minimum is detected, and the photometric values Y_4, Y_5 at the positions X_4, X_5 (the position separated by a set distance Δx on the minimum distance side from the position X_3 at which the photometric value is minimum is treated as X_4 and the position separated by a set distance Δx on the infinity side is treated as X_5) before and after are detected (Step S21).

[0084]

The CPU 42 calculates the differential (absolute value) ΔY_{4-5} ($\Delta Y_{4-5} = |Y_4 - Y_5|$) of the detected photometric values Y_4, Y_5 , compares the calculated differential ΔY_{4-5} with an allowed value β and determines whether the differential ΔY_{4-5} is less than the allowed value β .

[0085]

Furthermore, this allowed value β is set by deriving an optimal value determined by experiment and simulation, and the like and stored in advance in the ROM 44, in the same manner as the allowed value α . The CPU 42 reads out the allowed value β stored in the ROM 44, and compares it with the differential ΔY_{4-5} .

[0086]

If, as a result of this determination, the differential ΔY_{4-5} is less than the allowed value β , the position X_3 where the photometric value is minimum is set as the focal position (Step S24). On the other hand, if the differential ΔY_{4-5} is equal to or greater than the allowed value β , the preset pan focal position is set as the focal position (Step S25). Then, the focus lens is moved to the set focal position (Step S16).

[0087]

Per the above, in the 2nd method the position X_3 at which the photometric value is minimum is detected when the peak position at which the focus evaluation value peaks is a virtual peak, the variation of the photometric values adjoining thereto are examined, and if the photometric values are largely free of variation, then the position X_3 at which the photometric value is minimum is set as the focal position., and if the variation is great, then the preset pan focal position is set as the focal position, and so it is possible to perform more accurate focal position matching.

[0088]

Moreover, in this example, although the position X_3 where the photometric value is minimum is initially detected when the differential ΔY_{1-2} is equal to or greater than the allowed value α , the position X_3 where the photometric value is minimum as well as the photometric values Y_4, Y_5 at the positions X_4, X_5 before and after may also be detected in the same step (Step S12) as when the position at which the focus evaluation value peaks is detected.

[0089]

In addition, although the allowed value α and allowed value β are set separately, allowed value α and allowed value β may be the same value.

[0090]

- The 3rd Method

Although in the aforementioned 1st method, the position at which the is minimum is set as the focal position when the peak position X_0 at which the focus evaluation value peaks is a virtual peak, in the 3rd method, as shown in Figure 9, the position X_3 where the photometric value is minimum is detected when the peak position X_0 at which the focus evaluation value peaks is a virtual peak, the position X_6 where the focus evaluation value peaks adjacent thereto is detected, and that position is set as the focal position.

[0091]

Figure 10 is a flowchart showing the processing procedure for focal position matching according to the 3rd method. Moreover, processes identical to the 1st method have the same numbers assigned.

[0092]

First, the CPU 42 detects the half-pressing of the shutter button. In other words, the presence of an S1 ON signal input is determined (Step S10).

[0093]

When an S1 ON signal is input, the CPU 42 obtains the focus evaluation values and photometric values in the full range from the minimum distance to infinity (step S11). Then, the position X_0 at which the focus evaluation value peaks is detected, and the photometric values Y_1, Y_2 at the positions X_1, X_2 before and after are detected (Step S12).

[0094]

Next, it calculates the differential (absolute value) ΔY_{1-2} ($\Delta Y_{1-2} = |Y_1 - Y_2|$) of the photometric values Y_1, Y_2 at the positions X_1, X_2 before and after the position X_0 where the calculated focus evaluation value peaks are calculated Y_1, Y_2 (Step S13), and compares the calculated differential ΔY_{1-2} with an allowed value α . Then, it determines whether the calculated differential ΔY_{1-2} is equal to or greater than the allowed value α (Step S14).

[0095]

If, as a result of this determination, the differential ΔY_{1-2} is determined to be less than the allowed value α , the CPU 42 will determine the position X_0 where the focus evaluation value peaks to be the focal position, and will set this position X_0 as the focal position (Step S15). Then, the focus lens is moved to the focal position (Step S16).

[0096]

On the other hand, if the differential ΔY_{1-2} is determined to be equal to or greater than the allowed value α in the determination of Step S14, the CPU 42 will determine the position X_0 where the focus evaluation value peaks to be a virtual peak. Then, the position X_3 where the photometric value is minimum is detected, and the position X_6 where the adjacent focus evaluation value peaks before and after thereto is detected (Step S31).

[0097]

Here, the search range of the focus evaluation value is assumed to be set in a narrow range separated by a minute distance Δd , before and after, from the position X_3 where the photometric value is minimum, and the position X_6 where the focus evaluation value peaks is detected within this range.

[0098]

From the results of this search, the CPU 42 determines the presence of the position X_6 where the focus evaluation value peaks (Step S32). Then, if it is determined that there is a position X_6 where the focus evaluation value peaks, the CPU sets the position X_6 where the focus evaluation value peaks as the focal position (Step S33). On the other hand, if, it is determined that there is no position X_6 where the focus evaluation value peaks, a preset pan focal position is set as the focal position (Step S34). Then, the focus lens is moved to the set focal position (Step S16).

[0099]

As per the above, in the 3rd method, because the position X_3 at which the photometric value is minimum is detected when the peak position X_0 at which the focus evaluation value peaks is a virtual peak, the position X_6 where the focus evaluation value peaks adjacent thereto is detected, and the detected position X_6 is set as the focal position, it is possible to perform more accurate focal position matching.

[0100]

Moreover, in this example, although the position X_3 where the photometric value is minimum is initially detected when the differential ΔY_{1-2} is equal to or greater than the allowed value α , the position X_6 where the photometric value peaks may be detected at the same time that the position at which the focus evaluation value peaks is detected (Step S12) and the position X_6 where the focus evaluation value peaks adjacent thereto may also be detected.

[0101]

In addition, the position X_6 where the focus evaluation value peaks may be detected based on the initially obtained focus evaluation value information of the entire area, or the detection processing may be re-executed for the focus evaluation value adjacent to the position where the photometric value is minimum (moving the focus lens to adjacent to the position where the photometric value is minimum, and obtaining the focus evaluation value), and the peak position X_6 detected based on the information of the focus evaluation value obtained.

[0102]

- The 4th Method

In the 4th method, the focus area is divided into multiple areas, the focus evaluation values and photometric values for the entire area from the minimum distance to infinity are obtained for each divided area, and the maximum values and minimum values of the photometric values for each area are detected. Then, the differentials of the minimum values and maximum values is calculated, and the focal position is calculated, excluding those areas where the calculated differential is equal to or greater than the allowed value. In other words, in this invention, areas where the differential of the minimum and maximum photometric values is equal to or greater than the allowed value will be viewed as having the existence of a high luminance point light source, and detection of the focal position is performed with such areas excluded.

[0103]

For example, as shown in Figure 11, a focus area is set in the center of a screen, and the inside of this focus area is divided by a cross into quadrants. The divided areas are treated as areas A, B, C, and D, and the existence of a high luminance point light source is assumed in area B.

[0104]

For each of the areas A, B, C, and D, when a focus evaluation value is obtained for the entire area from the minimum distance to infinity, the focus evaluation value for each area will vary, for example as shown in Figure 12. In this case, a virtual peak occurs in area B with the point light source.

[0105]

In addition, when the focus evaluation values for each of the four areas A, B, C, and D are averaged, the focus evaluation value will change as shown in Figure 13(a). In this case, due to area B being included, there will be a virtual peak effect in area B, and a virtual peak will also occur in the averaged focus evaluation value. Then, when the focus evaluation value detection is performed based on the averaged focus evaluation value, the virtual peak will be viewed as the focal position, and an out-of-focus photograph will be taken.

[0106]

On the other hand, when the focus evaluation values for the remaining three areas A, C, and D with area B excluded are averaged, the focus evaluation value will change as shown in Figure (b) of same. In this case, because there will be no virtual peak effect from the point light source, it will be possible to treat where the focus evaluation value peaks as the focal position.

[0107]

Therefore, if the focal position is detected based on the focus evaluation values of each of the divided areas, it is necessary to perform detection excluding the area that includes the point light source.

[0108]

Here, for each of the areas A, B, C, and D, when a photometric value is obtained for the entire area from the minimum distance to infinity, the photometric value for each area will vary, for example as shown in Figure 14. In other words, the photometric value varies greatly in area B where there is a high luminance point light source. This is due to the intensity of the point light source varying according to the change of the focal position, and this result is due to the photometric value greatly varying as well.

[0109]

Therefore, the photometric values for the entire area from the minimum distance to infinity are obtained for each area, and if this change is examined, it can be determined whether each area includes a point light source.

[0110]

Here, in the 4th method, the photometric values for the entire area from the minimum distance to infinity are obtained for each divided area, the maximum values and minimum values of the photometric values for each area are detected, the differentials thereof derived, and the focal position detected by excluding the areas where the derived differential is equal to or greater than an allowed value. It is thereby possible to accurately detect the focal position even in cases free of the effect of a point light source.

[0111]

Figure 15 is a flowchart showing the processing procedure for focal position matching according to the 4th method.

[0112]

First, the CPU 42 detects the half-pressing of the shutter button. In other words, the presence of an S1 ON signal input is determined (Step S40).

[0113]

When an S1 ON signal is input, the CPU 42 obtains the focus evaluation values and photometric values in the full range from the minimum distance to infinity for each area A, B, C, and D (step S41). The information of the obtained focus evaluation values and photometric values for each of the areas A, B, C, and D is stored in the RAM 46.

[0114]

Next, the CPU 42 detects the photometric value maximums A_{MAX} , B_{MAX} , C_{MAX} , and D_{MAX} and minimums A_{MIN} , B_{MIN} , C_{MIN} , and D_{MIN} based on the obtained photometric value information for each of the areas A, B, C, and D (Step S42). Then, it calculates the differentials (absolute values) $|A_{MAX}-A_{MIN}|$, $|B_{MAX}-B_{MIN}|$, $|C_{MAX}-C_{MIN}|$, and $|D_{MAX}-D_{MIN}|$ of the obtained photometric value maximums A_{MAX} , B_{MAX} , C_{MAX} , and D_{MAX} and minimums A_{MIN} , B_{MIN} , C_{MIN} , and D_{MIN} in each of the areas A, B, C, and D (Step S43).

[0115]

Next, the CPU 42 Compares the differential $|A_{MAX}-A_{MIN}|$ of the photometric value maximum A_{MAX} and minimum A_{MIN} in area A with a standard allowed value γ , and determines whether the differential $|A_{MAX}-A_{MIN}|$ is less than the allowed value γ (Step S43).

[0116]

Furthermore, this allowed value γ is set by deriving an optimal value determined by experiment and simulation, and the like and stored in advance in the ROM 44. The CPU 42 reads out the allowed value γ stored in the ROM 44, and compares it with the differential $|A_{MAX}-A_{MIN}|$.

[0117]

If, as a result of this determination, it is determined that the differential $|A_{MAX}-A_{MIN}|$ is equal to or greater than the allowed value γ , the CPU 42 will exclude the area A from the subsequently-performed focal position detection (Step S44). In other words, focal position detection is performed without using the focus evaluation value information of area A.

[0118]

On the other hand, if it is determined that the differential $|A_{MAX}-A_{MIN}|$ is less than the allowed value γ , the CPU 42 next compares the differential $|B_{MAX}-B_{MIN}|$ of the photometric value maximum B_{MAX} and minimum B_{MIN} in area B with a standard allowed value γ , and determines whether the differential $|B_{MAX}-B_{MIN}|$ is less than the allowed value γ (Step S45).

[0119]

If, as a result of this determination, it is determined that the differential $|B_{MAX}-B_{MIN}|$ is equal to or greater than the allowed value γ , the CPU 42 will exclude the area B from the subsequently-performed focal position detection (Step S46).

[0120]

On the other hand, if it is determined that the differential $|B_{MAX}-B_{MIN}|$ is less than the allowed value γ , the CPU 42 next compares the differential $|C_{MAX}-C_{MIN}|$ of the photometric value maximum C_{MAX} and minimum C_{MIN} in area C with a standard allowed value γ , and determines whether the differential $|C_{MAX}-C_{MIN}|$ is less than the allowed value γ (Step S47).

[0121]

If, as a result of this determination, it is determined that the differential $|C_{MAX}-C_{MIN}|$ is equal to or greater than the allowed value γ , the CPU 42 will exclude the area C from the subsequently-performed focal position detection (Step S48).

[0122]

On the other hand, if it is determined that the differential $|C_{MAX}-C_{MIN}|$ is less than the allowed value γ , the CPU 42 next compares the differential $|D_{MAX}-D_{MIN}|$ of the photometric value maximum D_{MAX} and minimum D_{MIN} in area D with the

standard allowed value γ , and determines whether the differential $|D_{\text{MAX}} - D_{\text{MIN}}|$ is less than the allowed value γ (Step S49).

[0123]

If, as a result of this determination, it is determined that the differential $|D_{\text{MAX}} - D_{\text{MIN}}|$ is equal to or greater than the allowed value γ , the CPU 42 will exclude the area D from the subsequently-performed focal position detection (Step S50).

[0124]

In this way the differentials of the photometric value maximums and minimums are compared for all areas A, B, C, and D, and areas where the differential is equal to or greater than the allowed value shall be excluded from the focal position detection. Then, the focal position is detected using the focus evaluation value information of the remaining non-excluded areas (Step S51). In other words, for example, if the differential $|B_{\text{MAX}} - B_{\text{MIN}}|$ of the photometric value maximum B_{MAX} and minimum B_{MIN} in area B is equal to or greater than the allowed value γ , area B shall be excluded from the focal position detection and so focal position detection will be performed based on the focus evaluation value information of the remaining areas A, C, and D. In addition, for example, if the differential of the photometric value maximum and minimum values in area B and area C is equal to or greater than the allowed value, area B and area C shall be excluded from the focal position detection and so focal position detection will be performed based on the focus evaluation value information of the remaining areas A and D.

[0125]

Here, the focal position detection averages the focus evaluation values of the remaining areas that have not been excluded, and the peak position of these averaged focus evaluation values will be detected. Then, the focus lens is moved to the focal position so derived, and focal position matching is performed (Step S52).

[0126]

In the 4th method per the above, because focal position detection is performed excluding the areas where a point light source exists, it is possible to accurately perform focal position matching even if a point light source exists in the focus area.

[0127]

Furthermore, in this example, the focal position is detected, the focus evaluation values of the remaining areas that have not been excluded are averaged, and although the peak position of the averaged focus evaluation values is detected, it is not limited thereto with regard to the method of detecting the focal position. For example, the peak position of the focus evaluation value may also be detected in each area, the peak values averaged, and focal position detected. In addition, it is also possible to move the focus area.

[0128]

In addition, in this example, although we have described an example wherein the focus area is set in the center, and the inside of the focus area is divided into quadrants, it is not particularly limited with regard to the focus area setting methods and the methods of dividing this focus area. For example, the entire screen can be treated as the focus area, and divided into 64 parts at 8×8 .

[0129]

In addition, although in this example focal position detection is performed based on the focus evaluation values of the remaining area, excluding the areas where a point light source exists, in the case that the focal position cannot be detected from the focus evaluation value information of the remaining areas, the pan focal position may be used as the focal position.

[0130]

- The 5th Method

In the 5th method, the focus area is divided into multiple areas, the focus evaluation values for the entire area from the minimum distance to infinity are obtained for each divided area, and the peak position of the focus evaluation value for each area is detected. Then, the deviation amounts of the peak positions of each of the areas are calculated, and the focal position is detected, excluding those areas where the deviation amount is equal to or greater than the allowed value. In other words, in the 5th method, areas where the deviation amount of the peak positions of the focus evaluation values is equal to or greater than the allowed value, then this will be viewed as having the existence of a high luminance point light source, and detection of the focal position is performed with such areas excluded.

[0131]

For example, as shown in Figure 16, a focus area is set in the center of a screen, and the inside of this focus area is divided into three parts. The divided areas are treated as areas A, B, and C, and the existence of a high luminance point light source is assumed in area C.

[0132]

For each of the areas A, B, and C, when a focus evaluation value is obtained for the entire area from the minimum distance to infinity, the focus evaluation value for each area will vary, for example as shown in Figure 17. In this case, a virtual peak occurs in area C with the point light source.

[0133]

In addition, when the focus evaluation values for each of the three areas A, B, and C are averaged, the focus evaluation value will change as shown in Figure 18(a). In this case, due to area C being included, there will be a virtual peak effect in area C, and a virtual peak will also occur in the averaged focus evaluation value. Then, when the focus evaluation value detection is performed based on the averaged focus evaluation value, the virtual peak will be viewed as the focal position, and an out-of-focus photograph will be taken.

[0134]

On the other hand, when the focus evaluation values for the remaining two areas A and B with area C excluded are averaged, the focus evaluation value will change as shown in Figure (b) of same. In this case, because there will be no virtual peak effect from the point light source, it will be possible to treat where the focus evaluation value peaks as the focal position.

[0135]

Therefore, if the focal position is detected based on the focus evaluation values of each of the divided areas, it is necessary to perform detection excluding the area that includes the point light source.

[0136]

Here, when the positions X_A , X_B , and X_C where the focus evaluation value peaks for each area A, B, and C are compared, as shown in Figure 19, the peak position X_C of area C with a point light source is greatly disturbed by the peak positions X_A and X_B of the other areas.

[0137]

Therefore, the positions X_A , X_B , and X_C where the focus evaluation value peaks are derived for each area A, B, and C, and their positions compared, and if a greatly disturbed area is detected, it is possible to detect an area including a point light source.

[0138]

Here, in the 5th method, the position where the focus evaluation value peaks for each divided area is detected, the deviation amount of the peak positions of each of the areas are detected, the areas containing a point light source are derived, and the focal position detected by excluding the derived areas. It is thereby possible to accurately detect the focal position even in cases free of the effect of a point light source.

[0139]

Figure 20 is a flowchart showing the processing procedure for focal position matching according to the 5th method.

[0140]

First, the CPU 42 detects the half-pressing of the shutter button. In other words, the presence of an S1 ON signal input is determined (Step S60).

[0141]

When an S1 ON signal is input, the CPU 42 obtains the focus evaluation values in the full range from the minimum distance to infinity for each area A, B, and C (step S61). The information of the obtained focus evaluation values for each of the areas A, B, and C is stored in the RAM 46.

[0142]

Next, the CPU 42 detects the positions X_A , X_B , and X_C where the focus evaluation values peak based on the obtained focus evaluation value information of each of the areas A, B, and C (Step S62). Then, the deviation amounts (absolute values) X_{AB} , X_{BC} , and X_{CA} of the detected peak position of each area A, B, and C (Step S63).

[0143]

Next, the CPU 42 compares the calculated deviation amounts X_{AB} , X_{BC} , and X_{CA} of the peak positions of each of the areas with a standard allowed value δ , and determines whether each of the deviation amounts X_{AB} , X_{BC} , and X_{CA} all satisfy the condition of being less than an allowed value δ ($X_{AB} < \delta$, and $X_{BC} < \delta$, and $X_{CA} < \delta$).

[0144]

Furthermore, this allowed value δ , is set by deriving an optimal value determined by experiment and simulation, and the like and stored in advance in the ROM 44. The CPU 42 reads out the allowed value δ stored in the ROM 44, and compares it with the deviation amounts X_{AB} , X_{BC} , and X_{CA} .

[0145]

If as a result of this determination it is determined that each of the deviation amounts X_{AB} , X_{BC} , and X_{CA} all satisfy the condition of being less than the allowed value δ , the CPU 42 determines that no high luminance point light sources exist in each area A, B, and C, and detects the focal position based on the focus evaluation value information of all the areas (Step S65).

[0146]

Here, the focal position detection averages the focus evaluation values of the remaining areas that have not been excluded, and the peak position of these averaged focus evaluation values will be detected. Then, the focus lens is moved to the focal position so derived, and focal position matching performed (Step S66).

[0147]

On the other hand, if it is determined that deviation amounts X_{AB} , X_{BC} , and X_{CA} in the above Step 64 all do not satisfy the condition of being less than the allowed value δ , the CPU42 next determines whether the condition where deviation amount X_{AB} and deviation amount X_{BC} are equal to or greater than the allowed value δ and the deviation amount X_{CA} is less than the allowed value δ ($X_{AB} \geq \delta$, and $X_{BC} \geq \delta$, and $X_{CA} < \delta$).

[0148]

If as a result of this determination it is determined that the condition of deviation amount X_{AB} and deviation amount X_{BC} being equal to or greater than the allowed value δ , and the deviation amount X_{CA} being less than the allowed value δ is satisfied, the CPU 42 will determine that a high luminance point light source exists in area B, and will exclude area B from the focal position detection (Step S68). Then, the focal position is detected based on the area excluding area B, in other words, the focus evaluation value information of areas A, B, and C (Step S65), and the focus lens is moved to the derived focal position, and focal position matching performed (Step S66).

[0149]

On the other hand, if it is determined that the condition of deviation amount X_{AB} and deviation amount X_{BC} being equal to or greater than the allowed value δ , and the deviation amount X_{CA} being less than the allowed value δ is not satisfied, the CPU42 will determine whether the condition where deviation amount X_{AB} is less than the allowed value δ and deviation amount X_{BC} and the deviation amount X_{CA} are less than the allowed value are equal to or greater than the allowed value δ ($X_{AB} < \delta$, and $X_{BC} \geq \delta$, and $X_{CA} \geq \delta$) (Step S69).

[0150]

If as a result of this determination it is determined that the condition of deviation amount X_{AB} being less than the allowed value δ and deviation amount X_{BC} and deviation amount X_{CA} being equal to or greater than the allowed value δ is satisfied, the CPU 42 will determine that a high luminance point light source exists in area C, and will exclude area C from the focal position detection (Step S70). Then, the focal position is detected based on the area excluding area C, in other words, the focus evaluation value information of areas A and B (Step S65), and the focus lens is moved to the derived focal position, and focal position matching performed (Step S66).

[0151]

On the other hand, if as a result of this determination it is determined that the condition of deviation amount X_{AB} being less than the allowed value δ and deviation amount X_{BC} and deviation amount X_{CA} being equal to or greater than the allowed value δ is not satisfied, the CPU 42 will determine that a high luminance point light source exists in area A, and will exclude area A from the focal position detection (Step S71). In other words, in this case, deviation amount X_{BC} is less than the allowed value δ and deviation amount X_{AB} and deviation amount X_{CA} are equal to or greater than the allowed value δ , and therefore the CPU 42 will determine that a high luminance point light source exists in area A, and will exclude area A from the focal position detection (Step S71). Then, the focal position is detected based on the area excluding area C, in other words, the focus evaluation value information of areas A and B (Step S65), and the focus lens is moved to the derived focal position, and focal position matching performed (Step S66).

[0152]

In the 5th method per the above, because focal position detection is performed excluding the areas where a point light source exists, it is possible to accurately perform focal position matching even if a point light source exists in the focus area.

[0153]

Furthermore, in this example, the focal position is detected, the focus evaluation values of the remaining areas that have not been excluded are averaged, and although the peak position of the averaged focus evaluation values is detected, it is not limited thereto with regard to the method of detecting the focal position. For example, the peak position of the focus evaluation value may also be detected in each area, the peak values averaged, and the focal position detected.

[0154]

In addition, in this example, although we have described an example wherein the focus area is set in the center, and the inside of the focus area is divided into three parts, it is not particularly limited with regard to the focus area setting methods and the methods of dividing this focus area. For example, the entire screen can be treated as the focus area, and divided into 64 parts at 8×8. In addition, it is also possible to move the focus area.

[0155]

In addition, although in this example focal position detection is performed based on the focus evaluation values of the remaining area, excluding the areas where a point light source exists, in the case that the focal position cannot be detected from the focus evaluation value information of the remaining areas, the pan focal position may be used as the focal position.

[0156]

As described above, according to the focal position detection method and apparatus pertaining this invention, it is possible to accurately perform focal position matching even if a high luminance point light source exists in the focus area.

[0157]

Furthermore, in the above embodiment, an example is described in which this invention is applied to a digital camera, however the application of this invention is not limited to this. If the focal position is detected with a contrast detection method, it is applicable to all imaging devices.

[Brief Description of the Drawings]

[0158]

[Figure 1] Block diagram showing the electrical constitution of a digital camera of a digital camera system where this invention is applied

[Figure 2] This is a block diagram showing the constitution of the AF detection unit

[Figure 3] A figure showing the change of the focus evaluation value (a) and the photometric value (b) from the minimum distance to infinity in a case where a high luminance point light source does not exist in the focus area

[Figure 4] A figure showing the change of the focus evaluation value (a), the photometric value (b), the intensity of the point light source (c), and the signal level intensity (d) from the minimum distance to infinity in a case where a high luminance point light source exists in the focus area

[Figure 5] A figure showing the change of the focus evaluation value (a) and the photometric value (b) from the minimum distance to infinity in a case where a high luminance point light source exists in the focus area

[Figure 6] A flowchart showing the processing procedure for focal position matching according to the 1st method

[Figure 7] A figure showing the change of the focus evaluation value (a) and the photometric value (b) from the minimum distance to infinity in a case where a high luminance point light source exists in the focus area

[Figure 8] A flowchart showing the processing procedure for focal position matching according to the 2nd method

[Figure 9] A figure showing the change of the focus evaluation value (a) and the photometric value (b) from the minimum distance to infinity in a case where a high luminance point light source exists in the focus area

[Figure 10] A flowchart showing the processing procedure for focal position matching according to the 3rd method

[Figure 11] Descriptive diagram of the focus area division method

[Figure 12] Figure showing the variations of the focus evaluation value of each divided area

[Figure 13] Figure showing the variations of the focus evaluation value of each divided area when all areas have been averaged (a) and then averaged excluding the area containing a point light source (b)

[Figure 14] Figure showing the variations of the photometric value of each divided area

[Figure 15] A flowchart showing the processing procedure for focal position matching according to the 4th method

[Figure 16] Descriptive diagram of the focus area division method

[Figure 17] Figure showing the variations of the focus evaluation value of each divided area

[Figure 18] Figure showing the variations of the focus evaluation value of each divided area when all areas have been averaged (a) and then averaged excluding the area containing a point light source (b)

[Figure 19] A descriptive figure of the comparison method for the peak positions of the focus evaluation value for each of the areas

[Figure 20] A flowchart showing the processing procedure for focal position matching according to the 5th method

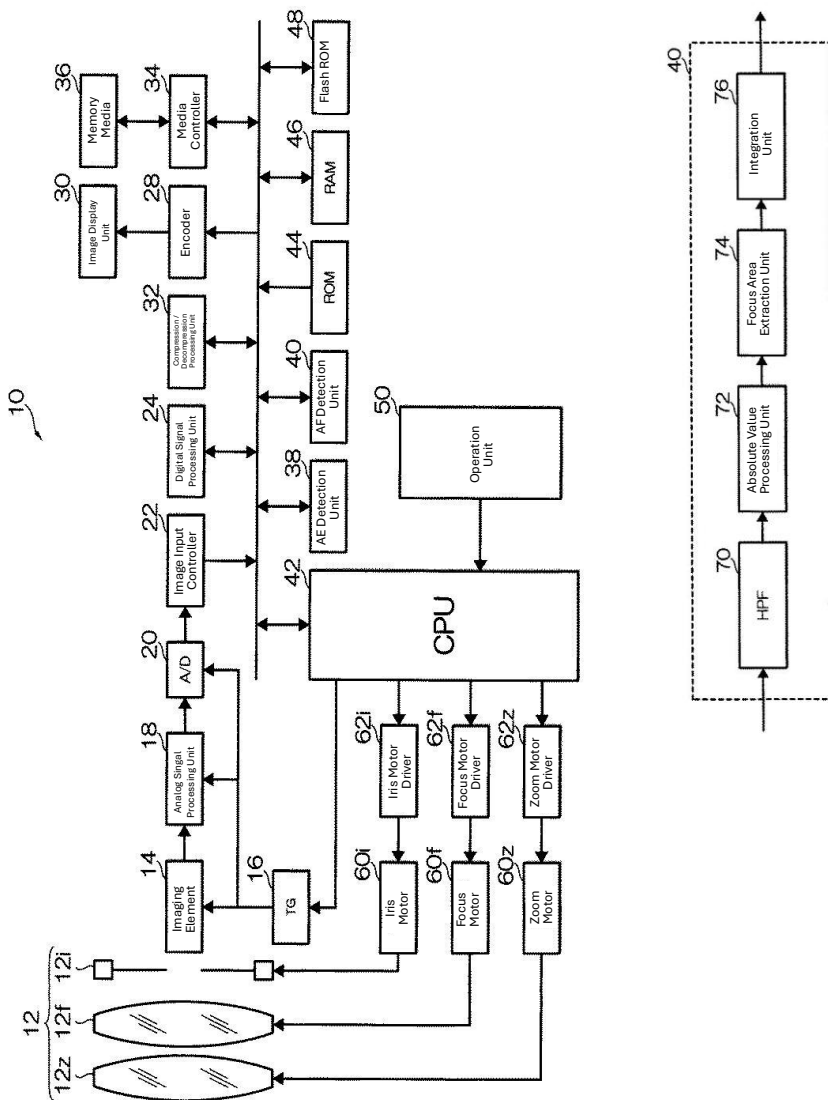
[Explanation of Symbols]

[0159]

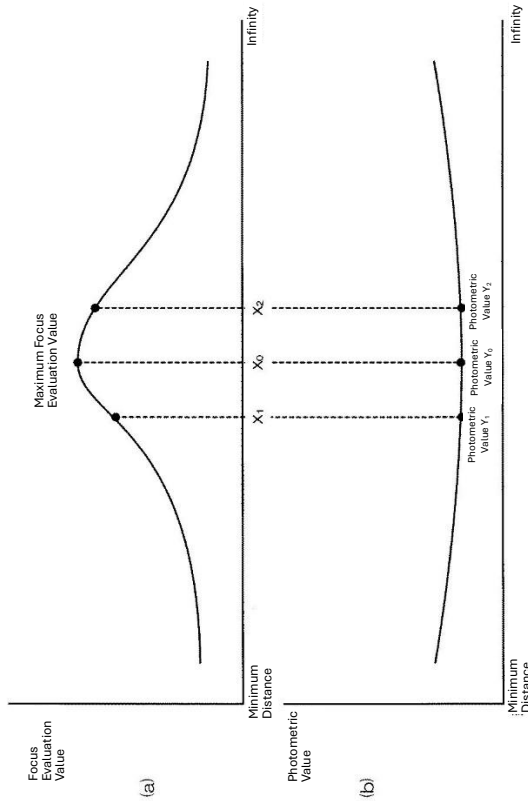
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[Figure 1]

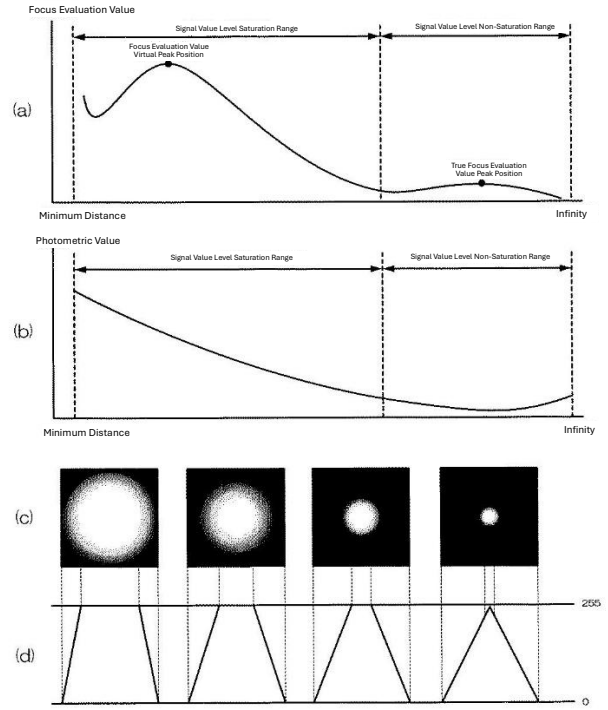
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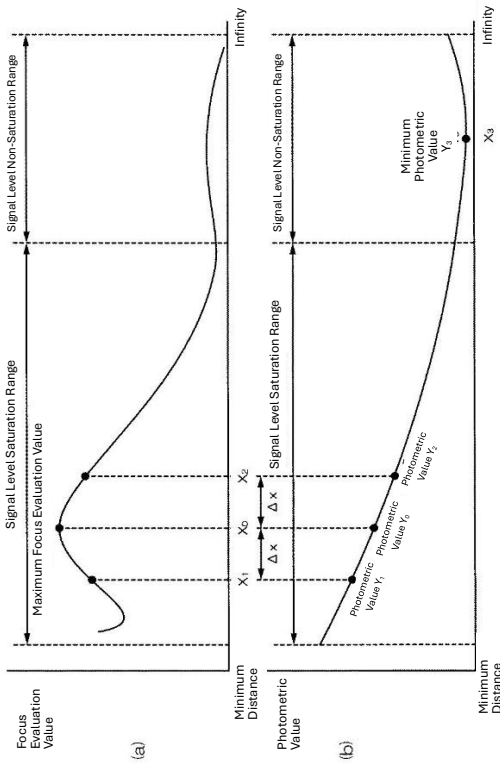
[Figure 3]



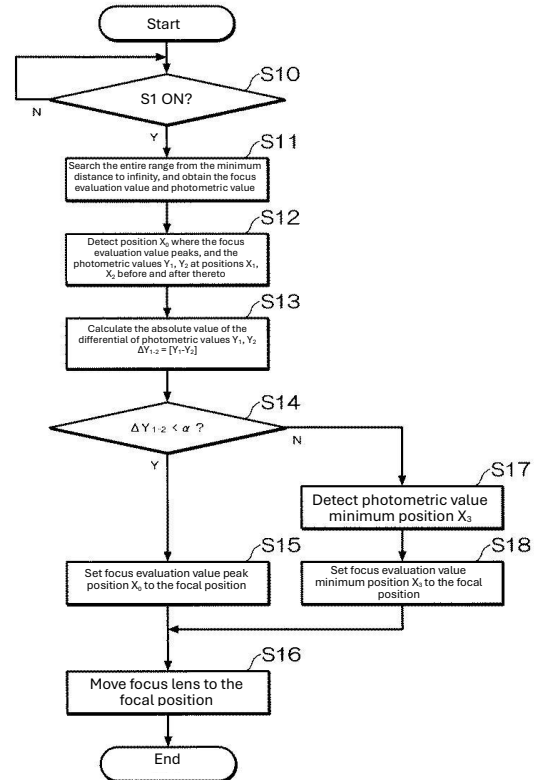
[Figure 4]



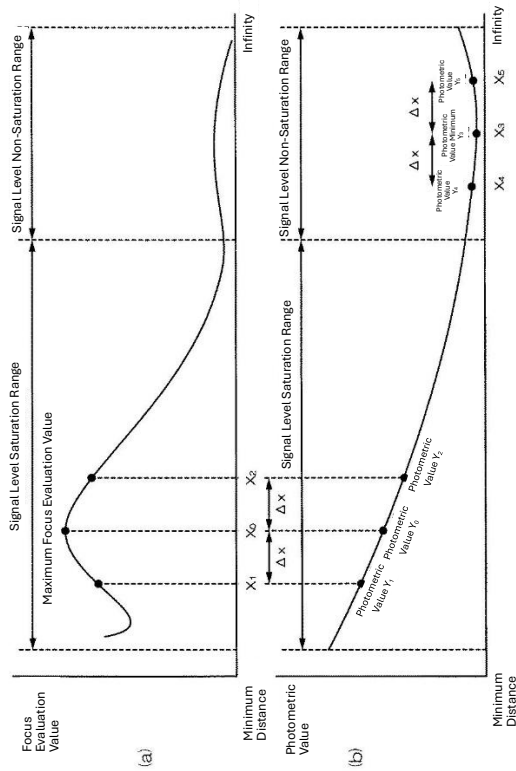
[Figure 5]



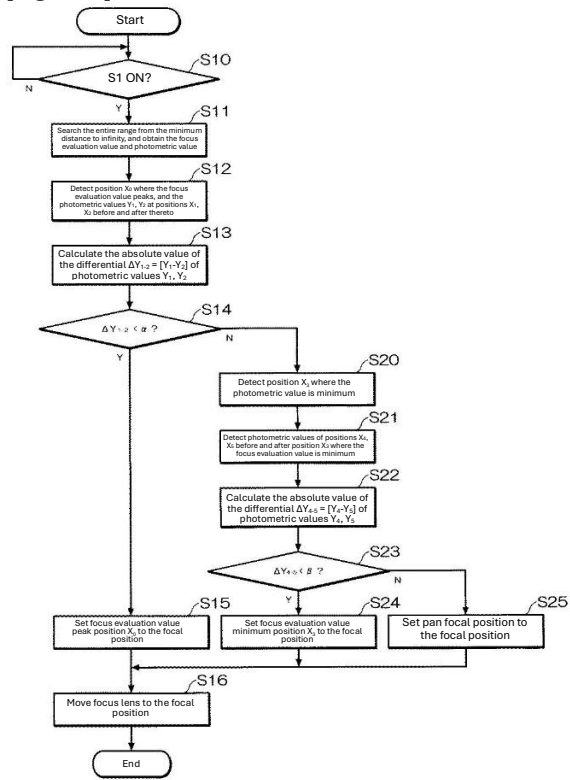
[Figure 6]



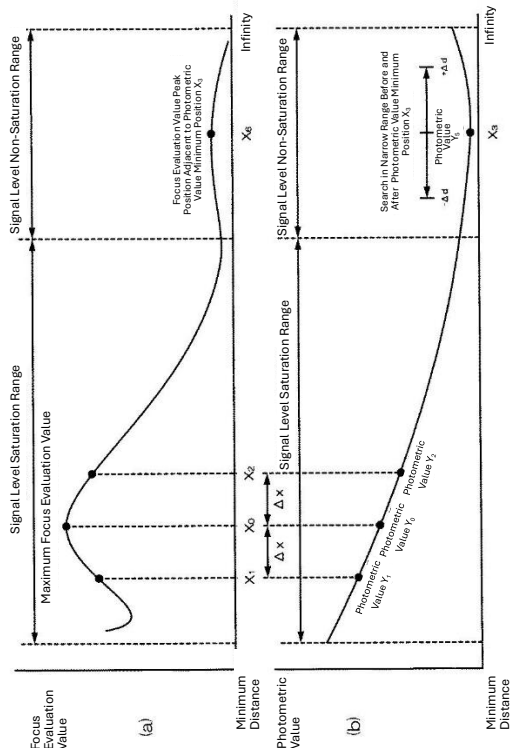
[Figure 7]



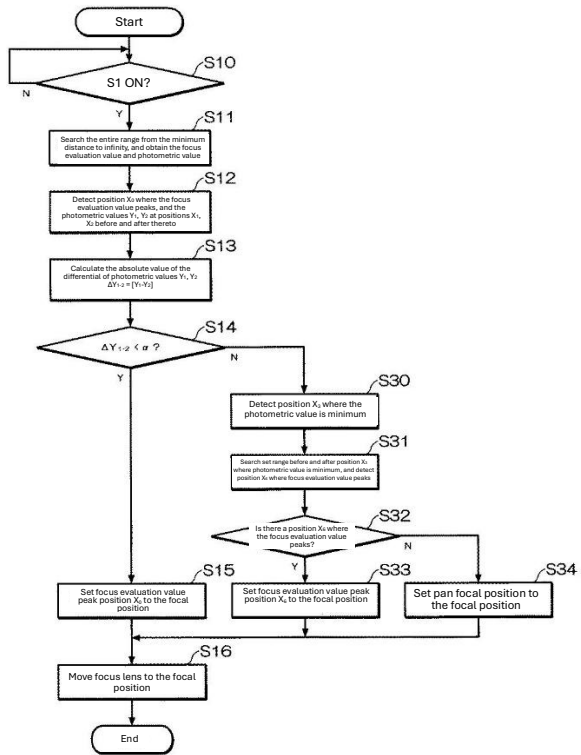
[Figure 8]



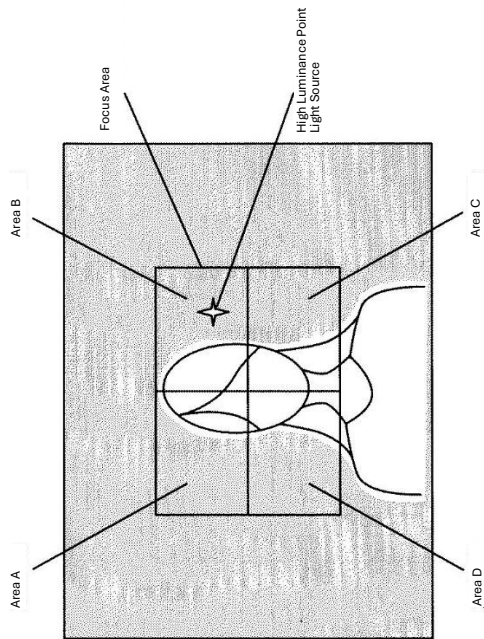
[Figure 9]



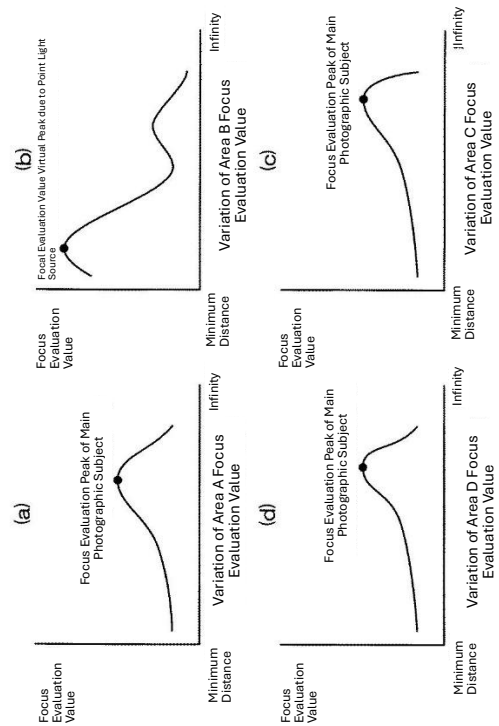
[Figure 10]



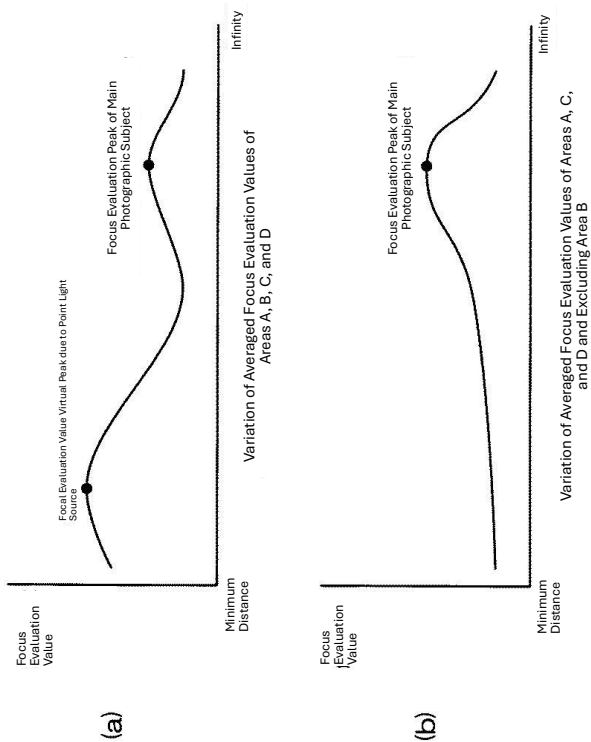
[Figure 11]



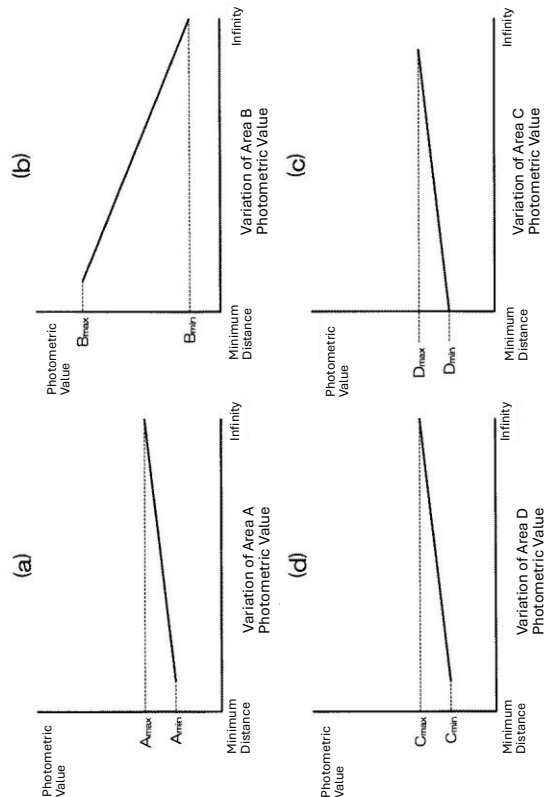
[Figure 12]



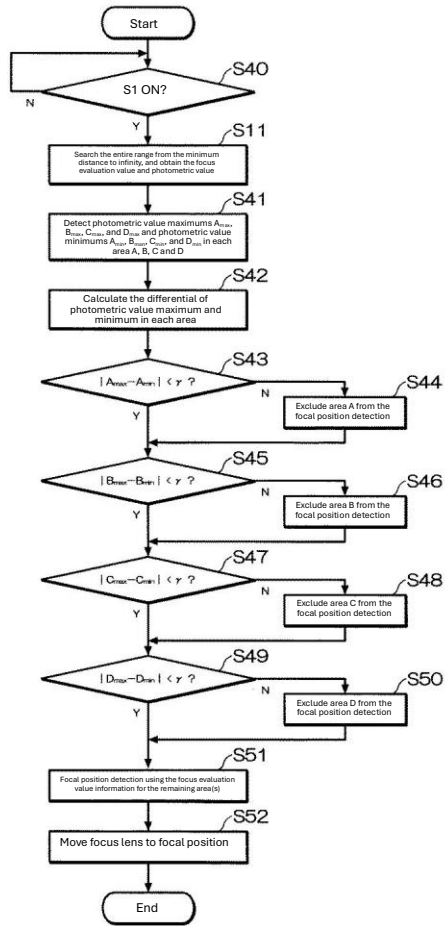
[Figure 13]



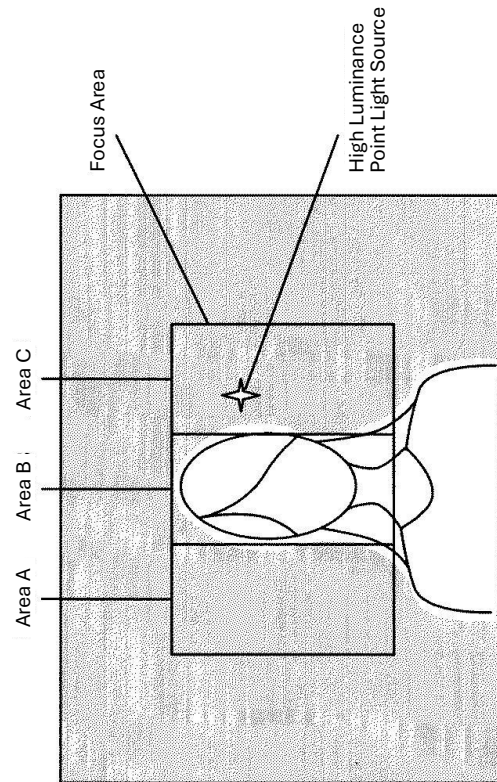
[Figure 14]



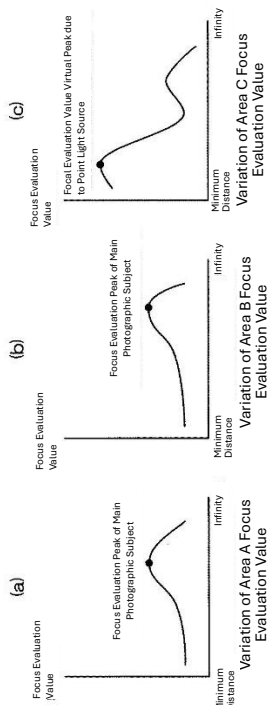
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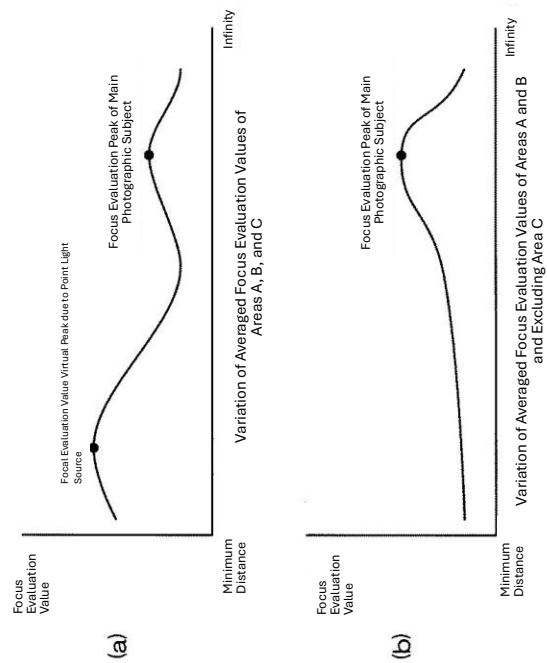
[Figure 16]



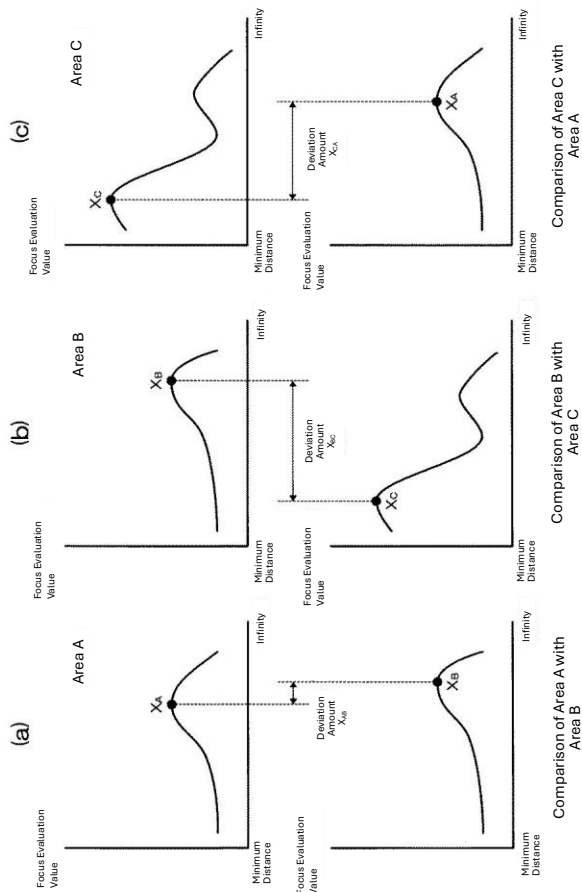
[Figure 17]



[Figure 18]



[Figure 19]



[Figure 20]

