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IMAGING SUPPORT APPARATUS, IMAGING APPARATUS, IMAGING SUPPORT METHOD, AND PROGRAM

Abstract

There is provided an imaging support apparatus including a processor, and a memory in which the memory stores a first trained model, the first trained model is a trained model used for control related to imaging performed by an imaging apparatus, and the processor is configured to generate a second trained model used for the control by performing learning processing in which a first image, which is acquired by being captured by the imaging apparatus, and a set value, which is applied to the imaging apparatus in a case where the first image is acquired, are used as teacher data, and perform specific processing based on a first set value.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application is a continuation application of Ser. No. 17/954,339, filed Sep. 28, 2022, which is a continuation application of International Application No. PCT/JP2021/047377, filed Dec. 21, 2021, the disclosures of which are incorporated herein by reference in their entireties. Further, this application claims priority from Japanese Patent Application No. 2020-219153, filed Dec. 28, 2020, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND
1. Technical Field
[0002] The present invention relates to an imaging support apparatus, an imaging apparatus, an imaging support method, and a program.
2. Related Art
[0003] JP2013-207471A discloses a digital camera including an imaging unit that captures a subject image, an imaging control unit that controls imaging processing by the imaging unit by using an imaging processing set value, an image processing unit that performs image processing on image data imaged by the imaging unit by using an image processing set value, a storage unit that stores a table in which a feature amount of an imaging scene is associated with the imaging processing set value and/or the image processing set value in the past imaging processing and/or image processing, a feature amount calculation unit that calculates the feature amount of the imaging scene in the current imaging, and a set value acquisition unit that acquires the imaging processing set value and/or the image processing set value based on the feature amount of the imaging scene calculated by the feature amount calculation unit and the table stored in the storage unit. The digital camera described in JP2013-207471A further includes a learning unit that learns the feature amount of the imaging scene registered in the table and the imaging processing set value and/or the image processing set value by using a neural network, in which the set value acquisition unit acquires the imaging processing set value and/or the image processing set value based on the learning result by the learning unit.
[0004] JP2005-347985A discloses a digital camera including an imaging processing execution unit that generates image data by executing imaging processing and an execution control unit that controls the imaging processing according to a control set value of each of one or more setting items, in which the execution control unit includes a priority order determination unit that determines a priority order with respect to at least a part of a plurality of candidate set value sets among the plurality of available set value sets based on history information related to the set value set used in a plurality of times of imaging processing regarding a setting item set including at least one setting item among the setting items and a setting condition determination unit that determines a control set value set of a setting item set by using the priority order. The digital camera described in JP2005-347985A further includes a memory slot that attachably and detachably holds the memory, and the priority order determination unit acquires the history information from the memory via the memory slot and has an attachable and detachable memory history mode for determining the priority order by using the acquired history information.
[0005] JP2003-255428A discloses a camera including a count unit that counts the number of

imaging operations, when imaging is performed on the camera that is capable of performing the imaging under a plurality of predetermined imaging conditions related to at least brightness under any of imaging conditions among the plurality of the imaging conditions, for each imaging condition, a calculation unit that obtains distribution of count values based on the count values and obtains a main imaging condition range as a tendency of imaging conditions from the obtained distribution, and a control unit that defines a specific imaging condition within a main imaging condition range and other than a plurality of predetermined imaging conditions, and controls the defined specific imaging condition as the imaging condition so as to be capable of performing the imaging.

SUMMARY

[0006] One embodiment according to the present disclosed technology provides an imaging support apparatus, an imaging apparatus, an imaging support method, and a program that can contribute to the reduction of the load.

[0007] An imaging support apparatus according to a first aspect of the present invention comprises: a processor; and a memory connected to or built into the processor, wherein the memory stores a first trained model, the first trained model is a trained model used for control related to imaging performed by an imaging apparatus, and the processor is configured to generate a second trained model used for the control by performing learning processing in which a first image, which is acquired by being captured by the imaging apparatus, and a set value, which is applied to the imaging apparatus in a case where the first image is acquired, are used as teacher data, and perform specific processing based on a first set value, which is output from the first trained model in a case where a second image is input to the first trained model, and a second set value, which is output from the second trained model in a case where the second image is input to the second trained model.

[0008] In the imaging support apparatus of the first aspect according to a second aspect of the present invention, the second image is stored in the memory.

[0009] In the imaging support apparatus of the first or the second aspect according to a third aspect of the present invention, the processor is configured to generate the second trained model by performing the learning processing in a case where a condition that the number of the first images reaches a first threshold value is satisfied.

[0010] In the imaging support apparatus of the third aspect according to a fourth aspect of the present invention, the teacher data is data that includes a plurality of images, which are acquired by being captured by the imaging apparatus during a period from specific time until the condition is satisfied, and a plurality of set values, which are related to the plurality of images and applied to the imaging apparatus.

[0011] In the imaging support apparatus of the third or the fourth aspect according to a fifth aspect of the present invention, the processor is configured to perform the specific processing based on the first set value and the second set value in a case where the condition is satisfied.

[0012] In the imaging support apparatus of any one of the first to the fifth aspects according to a sixth aspect of the present invention, the processor is configured to perform the specific processing in a case where a degree of difference between the first set value and the second set value is equal to or greater than a second threshold value.

[0013] In the imaging support apparatus of any one of the first to the sixth aspects according to a seventh aspect of the present invention, the processor is configured to perform predetermined processing under a condition that the number of the first images reaches a third threshold value.

[0014] In the imaging support apparatus of any one of the first to the sixth aspects according to an eighth aspect of the present invention, the processor is configured to perform predetermined processing in a case where the number of the first images, which are acquired by performing the imaging under a first environment and used as the teacher data, is equal to or greater than a fourth threshold value and the number of the first images, which are obtained by performing the imaging

under a second environment different from the first environment and used as the teacher data, is equal to or less than a fifth threshold value.
[0015] In the imaging support apparatus of any one of the first to the eighth aspects according to a ninth aspect of the present invention, the imaging apparatus is a lens-interchangeable imaging apparatus, and the processor is configured to generate a plurality of the second trained models by performing the learning processing for each type of interchangeable lens used in the imaging related to the first image.
[0016] In the imaging support apparatus of the ninth aspect according to a tenth aspect of the present invention, the processor is configured to, in a case where the interchangeable lens is attached to the imaging apparatus, perform processing of using a second trained model generated by using an image, which is acquired by being captured by the imaging apparatus where the interchangeable lens is attached, in the learning processing as the first image among the plurality of second trained model.
[0017] In the imaging support apparatus of any one of the first to the tenth aspects according to an eleventh aspect of the present invention, the imaging apparatus includes a plurality of imaging systems, and the processor is configured to generate a plurality of the second trained models by performing the learning processing for each of the imaging systems used in the imaging related to the first image.
[0018] In the imaging support apparatus of the eleventh aspect according to a twelfth aspect of the present invention, the processor is configured to, in a case where an imaging system used in the imaging is selected from the plurality of imaging systems, perform processing of using a second trained model generated by using an image, which is acquired by being captured by the imaging apparatus using the selected imaging system, in the learning processing as the first image among the plurality of second trained model.
[0019] In the imaging support apparatus of the twelfth aspect according to a thirteenth aspect of the present invention, the processor is configured to receive an instruction of a switch of the plurality of imaging systems in a step-less manner, and continue to use the second trained model, which is assigned to the imaging system before the switch, in the imaging system after the switch, in a case where the instruction is received.
[0020] In the imaging support apparatus of the twelfth or the thirteenth aspect according to a fourteenth aspect of the present invention, the processor is configured to use a scene, which is used in a case where the first image is acquired by the imaging apparatus, and information, which is related to the selected imaging system, in the learning processing as the set values, and cause the imaging apparatus to selectively use the plurality of imaging systems at an activation timing of the imaging apparatus based on the second set value.
[0021] In the imaging support apparatus of any one of the first to the fourteenth aspects according to a fifteenth aspect of the present invention, the specific processing is processing that includes first processing of reflecting the second set value on the control.
[0022] In the imaging support apparatus of any one of the first to the fifteenth aspects according to a sixteenth aspect of the present invention, the specific processing is processing that includes second processing of storing the second trained model in a default storage device.
[0023] In the imaging support apparatus of any one of the first to the sixteenth aspects according to a seventeenth aspect of the present invention, the specific processing is processing that includes third processing of reflecting an output of a trained model, which is selected according to the instruction received by the processor among the first trained model and the second trained model, on the control.
[0024] In the imaging support apparatus of any one of the first to seventeenth aspects according to an eighteenth aspect of the present invention, the specific processing is processing that includes fourth processing of outputting first data for displaying a fourth image corresponding to an image obtained by applying a first output result, which is output from the first trained model by inputting

a third image to the first trained model, to the third image, and a sixth image corresponding to an image obtained by applying a second output result, which is output from the second trained model by inputting a fifth image to the second trained model, to the fifth image, on a first display.

[0025] In the imaging support apparatus of the eighteenth aspect according to a nineteenth aspect of the present invention, the first data includes data for displaying the fourth image and the sixth image on the first display in a distinguishable manner.

[0026] In the imaging support apparatus of the eighteenth or the nineteenth aspect according to a twentieth aspect of the present invention, the first data includes data for displaying the fourth image and first trained model specification information, which enables specification of the first trained model, on the first display in a state of being associated with each other, and for displaying the sixth image and second trained model specification information, which enables specification of the second trained model, on the first display in a state of being associated with each other.

[0027] In the imaging support apparatus of any one of the eighteenth to the twentieth aspects according to a twenty-first aspect of the present invention, the fourth processing is processing that includes processing of reflecting an output of the first trained model on the control in a case where the fourth image is selected according to the instruction received by the processor among the fourth image and the sixth image displayed on the first display, and reflecting an output of the second trained model on the control in a case where the sixth image is selected.

[0028] In the imaging support apparatus of any one of the first to the twenty-first aspects according to a twenty-second aspect of the present invention, the specific processing is processing that includes fifth processing of outputting second data for displaying time specification information, which enables specification of time when the second trained model is generated, on a second display.

[0029] In the imaging support apparatus of the twenty-second aspect according to a twenty-third aspect of the present invention, the second data includes data for displaying the time specification information on the second display in a state of being associated with a seventh image obtained in a case where an output of the second trained model is reflected.

[0030] In the imaging support apparatus of any one of the first to the twenty-third aspects according to a twenty-fourth aspect of the present invention, the specific processing is processing that includes sixth processing of associating time specification information, which enables specification of time when the second trained model is generated, with the second trained model.

[0031] In the imaging support apparatus of any one of the first to the twenty-fourth aspects according to a twenty-fifth aspect of the present invention, the specific processing is processing that includes seventh processing of reflecting an output of the second trained model on the control at a predetermined timing.

[0032] In the imaging support apparatus of the twenty-fifth aspect according to a twenty-sixth aspect of the present invention, the predetermined timing is a timing when the imaging apparatus is activated, a timing when the number of captured images acquired by being captured by the imaging apparatus is equal to or greater than a sixth threshold value, a timing when charging of the imaging apparatus is started, a timing when an operation mode of the imaging apparatus transitions from a playback mode to a setting mode, or a timing when rating is performed on the captured images in the playback mode.

[0033] In the imaging support apparatus of any one of the first to the twenty-sixth aspects according to a twenty-seventh aspect of the present invention, the specific processing is processing that includes eighth processing of, in a case where the second trained model is applied to a different apparatus that is an imaging apparatus different from the imaging apparatus, correcting at least one of data input to the second trained model or the output from the second trained model, based on characteristics of the imaging apparatus and characteristics of the different apparatus.

[0034] In the imaging support apparatus of the twenty-seventh aspect according to a twenty-eighth aspect of the present invention, image sensor information, which includes at least one of characteristic information indicating characteristics of each of different image sensors involved in the second trained model or individual difference information indicating an individual difference between the different image sensors, is appended to the second trained model, and the processor is configured to specify the characteristics of the imaging apparatus and the characteristics of the different apparatus by using the image sensor information.

[0035] In the imaging support apparatus of any one of the first to the twenty-eighth aspects according to a twenty-ninth aspect of the present invention, the specific processing is processing that includes ninth processing of outputting third data for displaying a first processed image corresponding to an image obtained by applying a third output result, which is output from the second trained model by inputting an eighth image to the second trained model, to the eighth image, and an unprocessed image obtained without applying the third output result to the eighth image, on a third display.

[0036] In the imaging support apparatus of any one of the first to the twenty-ninth aspects according to a thirtieth aspect of the present invention, the specific processing is processing that includes tenth processing of outputting fourth data for displaying a brightness adjusted image obtained by applying a fourth output result, which is output from the second trained model by inputting a ninth image to the second trained model, to the ninth image and adjusting brightness, and an unprocessed image obtained without applying the fourth output result to the ninth image, on a fourth display.

[0037] In the imaging support apparatus of any one of the first to the thirtieth aspects according to a thirty-first aspect of the present invention, first appended information, which is appended to a third processed image obtained by being captured with the output of the second trained model reflected on the control, is added to the third processed image, and the specific processing is processing that includes eleventh processing of including information, which enables specification of the second trained model, in the first appended information.

[0038] In the imaging support apparatus of any one of the first to the thirty-first aspects according to a thirty-second aspect of the present invention, second appended information, which is appended to a fourth processed image obtained by being captured with the output of the first trained model reflected on the control, is added to the fourth processed image, and the specific processing is processing that includes twelfth processing of including information, which enables specification of the first trained model, in the second appended information.

[0039] In the imaging support apparatus of any one of the first to the thirty-second aspects according to a thirty-third aspect of the present invention, the set value is at least one of a set value related to white balance used in the imaging, a set value related to exposure used in the imaging, a set value related to focus used in the imaging, a set value related to saturation used in the imaging, or a set value related to gradation used in the imaging.

[0040] An imaging support apparatus according to a thirty-fourth aspect of the present invention comprises: a processor; and a memory connected to or built into the processor, in which the memory stores a first trained model, the first trained model is a trained model used for control related to imaging performed by an imaging apparatus, and the processor is configured to generate a second trained model used for the control by performing learning processing in which a first image, which is acquired by being captured by the imaging apparatus, and a set value, which is applied to the imaging apparatus in a case where the first image is acquired, are used as teacher data, and perform specific processing based on a degree of difference between the first trained model and the second trained model.

[0041] An imaging apparatus according to a thirty-fifth aspect of the present invention comprises: a processor; a memory connected to or built into the processor; and an imaging apparatus main body, in which the memory stores a first trained model, the first trained model is a trained model used for control related to imaging performed by the imaging apparatus main body, and the processor is configured to generate a second trained model used for the control by performing learning

processing in which a first image, which is acquired by being captured by the imaging apparatus main body, and a set value, which is applied to the imaging apparatus main body in a case where the first image is acquired, are used as teacher data, and perform specific processing based on a first set value, which is output from the first trained model in a case where a second image is input to the first trained model, and a second set value, which is output from the second trained model in a case where the second image is input to the second trained model.
[0042] An imaging support method according to a thirty-sixth aspect of the present invention comprises: generating a second trained model used for control related to imaging performed by an imaging apparatus, by performing learning processing in which a first image, which is acquired by being captured by the imaging apparatus, and a set value, which is applied to the imaging apparatus in a case where the first image is acquired, are used as teacher data; and performing specific processing based on a first set value, which is output from a first trained model in a case where a second image is input to the first trained model, and a second set value, which is output from the second trained model in a case where the second image is input to the second trained model.
[0043] A program according to a thirty-seventh aspect of the present invention that causes a computer to execute a process including: generating a second trained model used for control related to imaging performed by an imaging apparatus, by performing learning processing in which a first image, which is acquired by being captured by the imaging apparatus, and a set value, which is applied to the imaging apparatus in a case where the first image is acquired, are used as teacher data; and performing specific processing based on a first set value, which is output from a first trained model in a case where a second image is input to the first trained model, and a second set value, which is output from the second trained model in a case where the second image is input to the second trained model.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0044] Exemplary embodiments of the technology of the disclosure will be described in detail based on the following figures, wherein:
[0045] FIG. **1** is a schematic configuration diagram showing an example of a configuration of an entire imaging system;
[0046] FIG. **2** is a schematic configuration diagram showing an example of hardware configurations of an optical system and an electrical system of an imaging apparatus included in the imaging system;
[0047] FIG. **3** is a schematic configuration diagram showing an example of a hardware configuration of an electrical system of an imaging support apparatus included in the imaging system;
[0048] FIG. **4** is a block diagram showing an example of main functions of a CPU included in the imaging support apparatus;
[0049] FIG. **5** is a conceptual diagram showing an example of the content of processing of a teacher data generation unit;
[0050] FIG. **6** is a conceptual diagram showing an example of the content of processing of a model generation unit in a case where a first trained model is generated;
[0051] FIG. **7** is a conceptual diagram showing an example of the content of processing of a determination unit and the model generation unit;
[0052] FIG. **8** is a conceptual diagram showing an example of the content of the processing of the model generation unit in a case where a second trained model is generated;
[0053] FIG. **9** is a conceptual diagram showing an example of the content of processing of an execution unit;

[0054] FIG. **10** is a conceptual diagram showing an example of a timing when verification is performed and a content of the verification;
[0055] FIG. **11** is a block diagram showing an example of functions included in the execution unit;
[0056] FIG. **12** is a conceptual diagram showing an example of the content of processing of a first processing execution unit;
[0057] FIG. **13** is a conceptual diagram showing an example of the content of processing of a second processing execution unit;
[0058] FIG. **14** is a conceptual diagram showing an example of the content of processing of a third processing execution unit;
[0059] FIG. **15** is a conceptual diagram showing an example of the content of processing of a fourth processing execution unit;
[0060] FIG. **16** is a screen view showing an example of an aspect of a simulation image display screen displayed on a display under the control of the CPU;
[0061] FIG. **17** is a conceptual diagram showing an example of an aspect in which a simulation image is selected from the simulation image display screen;
[0062] FIG. **18** is a conceptual diagram showing an example of the content of processing in a case where a set value, which is output from the trained model corresponding to a selected simulation image, is reflected on control related to imaging;
[0063] FIG. **19** is a conceptual diagram showing an example of the content of processing of a fifth processing execution unit;
[0064] FIG. **20** is a conceptual diagram showing an example of the content of processing of a sixth processing execution unit;
[0065] FIG. **21** is a conceptual diagram showing an example of the content of processing of a seventh processing execution unit;
[0066] FIG. **22** is a conceptual diagram showing an example of the content of processing of an eighth processing execution unit;
[0067] FIG. **23** is a conceptual diagram showing an example of the content of processing of a ninth processing execution unit;
[0068] FIG. **24** is a screen view showing an example of an aspect of the simulation image display screen displayed on the display under the control of the CPU;
[0069] FIG. **25** is a conceptual diagram showing an example of the content of processing of a tenth processing execution unit;
[0070] FIG. **26** is a screen view showing an example of an aspect of the simulation image display screen displayed on the display under the control of the CPU;
[0071] FIG. **27** is a conceptual diagram showing an example of the content of processing of an eleventh processing execution unit;
[0072] FIG. **28** is a conceptual diagram showing an example of the content of processing of a twelfth processing execution unit;
[0073] FIG. **29**A is a flowchart showing an example of a flow of imaging support processing.
[0074] FIG. **29**B is a continuation of the flowchart shown in FIG. **29**A;
[0075] FIG. **30** is a conceptual diagram showing an example of a timing when verification is performed and a content of the verification;
[0076] FIG. **31** is a block diagram showing an example of the content of the processing of the execution unit;
[0077] FIG. **32** is a block diagram showing an example of the content of processing performed by a CPU of the imaging support apparatus;
[0078] FIG. **33** is a block diagram showing an example of the content of the processing performed by the CPU of the imaging support apparatus;
[0079] FIG. **34** is a block diagram showing an example of the content of the processing performed by the CPU of the imaging support apparatus;

[0080] FIG. **35** is a block diagram showing an example of the content of the processing performed by the CPU of the imaging support apparatus;
[0081] FIG. **36** is a block diagram showing an example of the content of the processing performed by the CPU of the imaging support apparatus;
[0082] FIG. **37** is a block diagram showing an example of the content of the processing performed by the CPU of the imaging support apparatus;
[0083] FIG. **38** is a block diagram showing an example of the content of the processing performed by the CPU of the imaging support apparatus;
[0084] FIG. **39** is a schematic perspective view showing an example of a configuration of an external appearance of a smart device;
[0085] FIG. **40**A is a conceptual diagram showing an example of an aspect in which an angle of view change instruction is provided to the smart device;
[0086] FIG. **40**B is a schematic screen view showing an example of a part of a screen used in a case where a display magnification is changed;
[0087] FIG. **41** is a block diagram showing an example of the content of the processing performed by the CPU of the imaging support apparatus;
[0088] FIG. **42** is a conceptual diagram showing an example of an aspect of an angle of view change accompanied by a switch of an imaging system while the angle of view change is being performed;
[0089] FIG. **43** is a block diagram showing an example of the content of the processing performed by the CPU of the imaging support apparatus;
[0090] FIG. **44** is a conceptual diagram showing an example of the content of the processing of the model generation unit;
[0091] FIG. **45** is a block diagram showing an example of the content of the processing performed by the CPU of the imaging support apparatus;
[0092] FIG. **46** is a block diagram showing an example of the content of processing performed by a CPU of the smart device; and
[0093] FIG. **47** is a block diagram showing an example of a configuration of an imaging apparatus main body in a case where the function of the imaging support apparatus is assigned to the imaging apparatus.

DETAILED DESCRIPTION

[0094] Hereinafter, an example of an embodiment of an imaging support apparatus, an imaging apparatus, an imaging support method, and a program according to the present disclosed technology will be described with reference to the accompanying drawings.
[0095] First, the wording used in the following description will be described.
[0096] CPU refers to an abbreviation of a “Central Processing Unit”. GPU refers to an abbreviation of a “Graphics Processing Unit”. TPU refers to an abbreviation of a “Tensor processing unit”. NVM refers to an abbreviation of a “Non-volatile memory”. RAM refers to an abbreviation of a “Random Access Memory”. IC refers to an abbreviation of an “Integrated Circuit”. ASIC refers to an abbreviation of an “Application Specific Integrated Circuit”. PLD refers to an abbreviation of a “Programmable Logic Device”. FPGA refers to an abbreviation of a “Field-Programmable Gate Array”. SoC refers to an abbreviation of a “System-on-a-chip”. SSD refers to an abbreviation of a “Solid State Drive”. USB refers to an abbreviation of a “Universal Serial Bus”. HDD refers to an abbreviation of a “Hard Disk Drive”. EEPROM refers to an abbreviation of an “Electrically Erasable and Programmable Read Only Memory”. EL refers to an abbreviation of “Electro-Luminescence”. I/F refers to an abbreviation of an “Interface”. UI refers to an abbreviation of a “User Interface”. fps refers to an abbreviation of a “frame per second”. MF refers to an abbreviation of “Manual Focus”. AF refers to an abbreviation of “Auto Focus”. CMOS refers to an abbreviation of a “Complementary Metal Oxide Semiconductor”. CCD refers to an abbreviation of a “Charge Coupled Device”. LAN refers to an abbreviation of a “Local Area Network”. WAN

refers to an abbreviation of a “Wide Area Network”. CNN refers to an abbreviation of a “Convolutional Neural Network”. AI refers to an abbreviation of “Artificial Intelligence”. Exif refers to an abbreviation of an “exchange image file format”.

[0097] As an example shown in FIG. **1**, the imaging system **10** includes an imaging apparatus **12** and an imaging support apparatus **14**. The imaging apparatus **12** is an apparatus that images a subject. In the example shown in FIG. **1**, a lens-interchangeable digital camera is shown as an example of the imaging apparatus **12**. The imaging apparatus **12** includes an imaging apparatus main body **16** and an interchangeable lens **18**. The interchangeable lens **18** is interchangeably attached to the imaging apparatus main body **16**. The interchangeable lens **18** is provided with a focus ring **18**A. In a case where a user or the like of the imaging apparatus **12** (hereinafter, simply referred to as the “user”) manually adjusts the focus on the subject by the imaging apparatus **12**, the focus ring **18**A is operated by the user or the like.

[0098] In the present embodiment, although the lens-interchangeable digital camera is exemplified as the imaging apparatus **12**, this is only an example, and a digital camera with a fixed lens may be used or a digital camera, which is built into various electronic devices such as a smart device, a wearable terminal, a cell observation device, an ophthalmologic observation device, or a surgical microscope may be used.

[0099] An image sensor **20** is provided in the imaging apparatus main body **16**. The image sensor **20** is a CMOS image sensor. The image sensor **20** captures an imaging range including at least one subject. In a case where the interchangeable lens **18** is attached to the imaging apparatus main body **16**, subject light indicating the subject is transmitted through the interchangeable lens **18** and imaged on the image sensor **20**, and then image data indicating an image of the subject is generated by the image sensor **20**.

[0100] In the present embodiment, although the CMOS image sensor is exemplified as the image sensor **20**, the present disclosed technology is not limited to this, for example, the present disclosed technology is established even in a case where the image sensor **20** is another type of image sensor such as a CCD image sensor.

[0101] A release button **22** and a dial **24** are provided on an upper surface of the imaging apparatus main body **16**. The dial **24** is operated in a case where an operation mode of the imaging system, an operation mode of a playback system, and the like are set, and by operating the dial **24**, an imaging mode, a playback mode, and a setting mode are selectively set as the operation mode in the imaging apparatus **12**. The imaging mode is an operation mode in which the imaging is performed with respect to the imaging apparatus **12**. The playback mode is an operation mode for playing the image (for example, a still image and/or a moving image) obtained by the performance of the imaging for recording in the imaging mode. The setting mode is an operation mode in which various set values **102** (see FIG. **5**) and the like, which will be described later, are set for the imaging apparatus **12**.

[0102] The release button **22** functions as an imaging preparation instruction unit and an imaging instruction unit, and is capable of detecting a two-step pressing operation of an imaging preparation instruction state and an imaging instruction state. The imaging preparation instruction state refers to a state in which the release button **22** is pressed, for example, from a standby position to an intermediate position (half pressed position), and the imaging instruction state refers to a state in which the release button **22** is pressed to a final pressed position (fully pressed position) beyond the intermediate position. In the following, the “state of being pressed from the standby position to the half pressed position” is referred to as a “half pressed state”, and the “state of being pressed from the standby position to the full pressed position” is referred to as a “fully pressed state”. Depending on the configuration of the imaging apparatus **12**, the imaging preparation instruction state may be a state in which the user's finger is in contact with the release button **22**, and the imaging instruction state may be a state in which the operating user's finger is moved from the state of being in contact with the release button **22** to the state of being away from the release button **22**.

[0103] A touch panel display **32** and an instruction key **26** are provided on a rear surface of the imaging apparatus main body **16**.
[0104] The touch panel display **32** includes a display **28** and a touch panel **30** (see also FIG. **2**). Examples of the display **28** include an EL display (for example, an organic EL display or an inorganic EL display). The display **28** may not be an EL display but may be another type of display such as a liquid crystal display.
[0105] The display **28** displays image and/or character information and the like. The display **28** is used for imaging for a live view image, that is, for displaying a live view image obtained by performing the continuous imaging in a case where the imaging apparatus **12** is in the imaging mode. The imaging, which is performed to obtain the live view image (hereinafter, also referred to as “imaging for a live view image”), is performed according to, for example, a frame rate of 60 fps. 60 fps is only an example, and a frame rate of fewer than 60 fps may be used, or a frame rate of more than 60 fps may be used.
[0106] Here, the “live view image” refers to a moving image for display based on the image data obtained by being imaged by the image sensor **20**. The live view image is also commonly referred to as a through image.
[0107] The display **28** is also used for displaying a still image obtained by the performance of the imaging for a still image in a case where an instruction for performing the imaging for a still image is provided to the imaging apparatus **12** via the release button **22**. The display **28** is also used for displaying a playback image or the like in a case where the imaging apparatus **12** is in the playback mode. Further, the display **28** is also used for displaying a menu screen where various menus can be selected and displaying a setting screen for setting the various set values **102** (see FIG. **5**) used in control related to the imaging in a case where the imaging apparatus **12** is in the setting mode.
[0108] The touch panel **30** is a transmissive touch panel and is superimposed on a surface of a display region of the display **28**. The touch panel **30** receives the instruction from the user by detecting contact with an indicator such as a finger or a stylus pen. In the following, for convenience of explanation, the above-mentioned “fully pressed state” includes a state in which the user turns on a softkey for starting the imaging via the touch panel **30**.
[0109] In the present embodiment, although an out-cell type touch panel display in which the touch panel **30** is superimposed on the surface of the display region of the display **28** is exemplified as an example of the touch panel display **32**, this is only an example. For example, as the touch panel display **32**, an on-cell type or in-cell type touch panel display can be applied.
[0110] The instruction key **26** receives various instructions. Here, the “various instructions” refer to, for example, various instructions such as an instruction for displaying the menu screen, an instruction for selecting one or a plurality of menus, an instruction for confirming a selected content, an instruction for erasing the selected content, zooming in, zooming out, frame forwarding, and the like. Further, these instructions may be provided by the touch panel **30**.
[0111] As will be described in detail later, the imaging apparatus main body **16** is connected to the imaging support apparatus **14** via a network **34**. The network **34** is, for example, the Internet. The network **34** is not limited to the Internet and may be a WAN and/or a LAN such as an intranet. Further, in the present embodiment, the imaging support apparatus **14** is a server that provides the imaging apparatus **12** with a service in response to a request from the imaging apparatus **12**. The server may be a mainframe used on-premises together with the imaging apparatus **12** or may be an external server implemented by cloud computing. Further, the server may be an external server implemented by network computing such as fog computing, edge computing, or grid computing. Here, although a server is exemplified as an example of the imaging support apparatus **14**, this is only an example, and at least one personal computer or the like may be used as the imaging support apparatus **14** instead of the server.
[0112] As an example shown in FIG. **2**, the image sensor **20** includes photoelectric conversion elements **72**. The photoelectric conversion elements **72** have a light receiving surface **72**A. The

photoelectric conversion elements **72** are disposed in the imaging apparatus main body **16** such that the center of the light receiving surface **72**A and an optical axis OA coincide with each other (see also FIG. **1**). The photoelectric conversion elements **72** have a plurality of photosensitive pixels arranged in a matrix shape, and the light receiving surface **72**A is formed by the plurality of photosensitive pixels. The photosensitive pixel is a physical pixel having a photodiode (not shown), which photoelectrically converts the received light and outputs an electric signal according to the light receiving amount.

[0113] The interchangeable lens **18** includes an imaging lens **40**. The imaging lens **40** has an objective lens **40**A, a focus lens **40**B, a zoom lens **40**C, and a stop **40**D. The objective lens **40**A, the focus lens **40**B, the zoom lens **40**C, and the stop **40**D are disposed in the order of the objective lens **40**A, the focus lens **40**B, the zoom lens **40**C, and the stop **40**D along the optical axis OA from the subject side (object side) to the imaging apparatus main body **16** side (image side).

[0114] Further, the interchangeable lens **18** includes a control device **36**, a first actuator **37**, a second actuator **38**, and a third actuator **39**. The control device **36** controls the entire interchangeable lens **18** according to the instruction from the imaging apparatus main body **16**. The control device **36** is a device having a computer including, for example, a CPU, an NVM, a RAM, and the like. Although a computer is exemplified here, this is only an example, and a device including an ASIC, FPGA, and/or PLD may be applied. Further, as the control device **36**, for example, a device implemented by a combination of a hardware configuration and a software configuration may be used.

[0115] The first actuator **37** includes a slide mechanism for focus (not shown) and a motor for focus (not shown). The focus lens **40**B is attached to the slide mechanism for focus so as to be slidable along the optical axis OA. Further, the motor for focus is connected to the slide mechanism for focus, and the slide mechanism for focus operates by receiving the power of the motor for focus to move the focus lens **40**B along the optical axis OA.

[0116] The second actuator **38** includes a slide mechanism for zoom (not shown) and a motor for zoom (not shown). The zoom lens **40**C is attached to the slide mechanism for zoom so as to be slidable along the optical axis OA. Further, the motor for zoom is connected to the slide mechanism for zoom, and the slide mechanism for zoom operates by receiving the power of the motor for zoom to move the zoom lens **40**C along the optical axis OA.

[0117] The third actuator **39** includes a power transmission mechanism (not shown) and a motor for stop (not shown). The stop **40**D has an opening **40**D**1** and is a stop in which the size of the opening **40**D**1** is variable. The opening **40**D**1** is formed by a plurality of stop leaf blades **40**D**2**. The plurality of stop leaf blades **40**D**2** are connected to the power transmission mechanism. Further, the motor for stop is connected to the power transmission mechanism, and the power transmission mechanism transmits the power of the motor for stop to the plurality of stop leaf blades **40**D**2**. The plurality of stop leaf blades **40**D**2** receives the power that is transmitted from the power transmission mechanism and changes the size of the opening **40**D**1** by being operated. The stop **40**D adjusts the exposure by changing the size of the opening **40**D**1**.

[0118] The motor for focus, the motor for zoom, and the motor for stop are connected to the control device **36**, and the control device **36** controls each drive of the motor for focus, the motor for zoom, and the motor for stop. In the present embodiment, a stepping motor is adopted as an example of the motor for focus, the motor for zoom, and the motor for stop. Therefore, the motor for focus, the motor for zoom, and the motor for stop operate in synchronization with a pulse signal in response to a command from the control device **36**. Although an example in which the motor for focus, the motor for zoom, and the motor for stop are provided in the interchangeable lens **18** has been described here, this is only an example, and at least one of the motor for focus, the motor for zoom, or the motor for stop may be provided in the imaging apparatus main body **16**. The constituent and/or operation method of the interchangeable lens **18** can be changed as needed.

[0119] In the imaging apparatus **12**, in the case of the imaging mode, an MF mode and an AF mode

are selectively set according to the instructions provided to the imaging apparatus main body **16**. The MF mode is an operation mode for manually focusing. In the MF mode, for example, by operating the focus ring **18**A or the like by the user, the focus lens **40**B is moved along the optical axis OA with the movement amount according to the operation amount of the focus ring **18**A or the like, thereby the focus is adjusted.
[0120] In the AF mode, the imaging apparatus main body **16** calculates a focusing position according to a subject distance and adjusts the focus by moving the focus lens **40**B toward the calculated focusing position. Here, the focusing position refers to a position of the focus lens **40**B on the optical axis OA in a state of being in focus. In the following, for convenience of explanation, the control for aligning the focus lens **40**B with the focusing position is also referred to as "AF control".
[0121] The imaging apparatus main body **16** includes the image sensor **20**, a controller **44**, an image memory **46**, a UI type device **48**, an external I/F **50**, a communication I/F **52**, a photoelectric conversion element driver **54**, a mechanical shutter driver **56**, a mechanical shutter actuator **58**, a mechanical shutter **60**, and an input/output interface **70**. Further, the image sensor **20** includes the photoelectric conversion elements **72** and a signal processing circuit **74**.
[0122] The controller **44**, the image memory **46**, the UI type device **48**, the external I/F **50**, the photoelectric conversion element driver **54**, the mechanical shutter driver **56**, and the signal processing circuit **74** are connected to the input/output interface **70**. Further, the control device **36** of the interchangeable lens **18** is also connected to the input/output interface **70**.
[0123] The controller **44** includes a CPU **62**, an NVM **64**, and a RAM **66**. The CPU **62**, the NVM **64**, and the RAM **66** are connected via a bus **68**, and the bus **68** is connected to the input/output interface **70**.
[0124] In the example shown in FIG. **2**, one bus is shown as the bus **68** for convenience of illustration, but a plurality of buses may be used. The bus **68** may be a serial bus or may be a parallel bus including a data bus, an address bus, a control bus, and the like.
[0125] The NVM **64** is a non-temporary storage medium that stores various parameters and various programs. For example, the NVM **64** is an EEPROM. However, this is only an example, and an HDD and/or SSD or the like may be applied as the NVM **64** instead of or together with the EEPROM. Further, the RAM **66** temporarily stores various information and is used as a work memory.
[0126] The CPU **62** reads a necessary program from the NVM **64** and executes the read program in the RAM **66**. The CPU **62** controls the entire imaging apparatus **12** according to the program executed on the RAM **66**. In the example shown in FIG. **2**, the image memory **46**, the UI type device **48**, the external I/F **50**, the communication I/F **52**, the photoelectric conversion element driver **54**, the mechanical shutter driver **56**, and the control device **36** are controlled by the CPU **62**.
[0127] The photoelectric conversion element driver **54** is connected to the photoelectric conversion elements **72**. The photoelectric conversion element driver **54** supplies an imaging timing signal, which defines the timing of the imaging performed by the photoelectric conversion elements **72**, to the photoelectric conversion elements **72** according to an instruction from the CPU **62**. The photoelectric conversion elements **72** perform reset, exposure, and output of an electric signal according to the imaging timing signal supplied from the photoelectric conversion element driver **54**. Examples of the imaging timing signal include a vertical synchronization signal, and a horizontal synchronization signal.
[0128] In a case where the interchangeable lens **18** is attached to the imaging apparatus main body **16**, the subject light incident on the imaging lens **40** is imaged on the light receiving surface **72**A by the imaging lens **40**. Under the control of the photoelectric conversion element driver **54**, the photoelectric conversion elements **72** photoelectrically convert the subject light, which is received from the light receiving surface **72**A and output the electric signal corresponding to the amount of light of the subject light to the signal processing circuit **74** as analog image data indicating the

subject light. Specifically, the signal processing circuit **74** reads the analog image data from the photoelectric conversion elements **72** in units of one frame and for each horizontal line by using an exposure sequential reading method.

[0129] The signal processing circuit **74** generates digital image data by digitizing the analog image data. In the following, for convenience of explanation, in a case where it is not necessary to distinguish between digital image data to be internally processed in the imaging apparatus main body **16** and an image indicated by the digital image data (that is, an image that is visualized based on the digital image data and displayed on the display **28** or the like), it is referred to as a "captured image **75**".

[0130] The mechanical shutter **60** is a focal plane shutter and is disposed between the stop **40**D and the light receiving surface **72**A. The mechanical shutter **60** includes a front curtain (not shown) and a rear curtain (not shown). Each of the front curtain and the rear curtain includes a plurality of leaf blades. The front curtain is disposed closer to the subject side than the rear curtain.

[0131] The mechanical shutter actuator **58** is an actuator having a link mechanism (not shown), a solenoid for a front curtain (not shown), and a solenoid for a rear curtain (not shown). The solenoid for a front curtain is a drive source for the front curtain and is mechanically connected to the front curtain via the link mechanism. The solenoid for a rear curtain is a drive source for the rear curtain and is mechanically connected to the rear curtain via the link mechanism. The mechanical shutter driver **56** controls the mechanical shutter actuator **58** according to the instruction from the CPU **62**.

[0132] The solenoid for a front curtain generates power under the control of the mechanical shutter driver **56** and selectively performs winding up and pulling down the front curtain by applying the generated power to the front curtain. The solenoid for a rear curtain generates power under the control of the mechanical shutter driver **56** and selectively performs winding up and pulling down the rear curtain by applying the generated power to the rear curtain. In the imaging apparatus **12**, the exposure amount with respect to the photoelectric conversion elements **72** is controlled by controlling the opening and closing of the front curtain and the opening and closing of the rear curtain by the CPU **62**.

[0133] In the imaging apparatus **12**, the imaging for a live view image and the imaging for a recorded image for recording the still image and/or the moving image are performed by using the exposure sequential reading method (rolling shutter method). The image sensor **20** has an electronic shutter function, and the imaging for a live view image is implemented by achieving an electronic shutter function without operating the mechanical shutter **60** in a fully open state.

[0134] In contrast to this, the imaging accompanied by the main exposure, that is, the imaging for a still image is implemented by achieving the electronic shutter function and operating the mechanical shutter **60** so as to shift the mechanical shutter **60** from a front curtain closed state to a rear curtain closed state.

[0135] The image memory **46** stores the captured image **75** generated by the signal processing circuit **74**. That is, the signal processing circuit **74** stores the captured image **75** in the image memory **46**. The CPU **62** acquires a captured image **75** from the image memory **46** and executes various processes by using the acquired captured image **75**.

[0136] The UI type device **48** includes a display **28**, and the CPU **62** displays various information on the display **28**. Further, the UI type device **48** includes a reception device **76**. The reception device **76** includes a touch panel **30** and a hard key unit **78**. The hard key unit **78** is a plurality of hard keys including an instruction key **26** (see FIG. **1**). The CPU **62** operates according to various instructions received by using the touch panel **30**. Here, although the hard key unit **78** is included in the UI type device **48**, the present disclosed technology is not limited to this, for example, the hard key unit **78** may be connected to the external I/F **50**.

[0137] The external I/F **50** controls the exchange of various information between the imaging apparatus **12** and an apparatus existing outside the imaging apparatus **12** (hereinafter, also referred to as an "external apparatus"). Examples of the external I/F **50** include a USB interface. The external apparatus (not shown) such as a smart device, a personal computer, a server, a USB memory, a memory card, and/or a printer is directly or indirectly connected to the USB interface.

[0138] The communication I/F **52** controls the exchange of information between the CPU **62** and the imaging support apparatus **14** (see FIG. **1**) via the network **34** (see FIG. **1**). For example, the communication I/F **52** transmits information according to the request from the CPU **62** to the imaging support apparatus **14** via the network **34**. Further, the communication I/F **52** receives the information transmitted from the imaging support apparatus **14** and outputs the received information to the CPU **62** via the input/output interface **70**.

[0139] As an example shown in FIG. **3**, the imaging support apparatus **14** includes a computer **82** and a communication I/F **84**. The computer **82** includes a CPU **86**, a storage **88**, and a memory **90**. Here, the computer **82** is an example of a "computer" according to the present disclosed technology, the CPU **86** is an example of a "processor" according to the present disclosed technology, and the storage **88** is an example of a "memory" according to the present disclosed technology.

[0140] The CPU **86**, the storage **88**, the memory **90**, and the communication I/F **84** are connected to a bus **92**. In the example shown in FIG. **3**, one bus is shown as the bus **92** for convenience of illustration, but a plurality of buses may be used. The bus **92** may be a serial bus or may be a parallel bus including a data bus, an address bus, a control bus, and the like.

[0141] The CPU **86** controls the entire imaging support apparatus **14**. The storage **88** is a non-volatile storage device that stores various programs, various parameters, and the like. Examples of the storage **88** include a non-temporary storage medium such as an EEPROM, an SSD, and/or an HDD. The memory **90** is a memory in which information is temporarily stored and is used as a work memory by the CPU **86**. Examples of the memory **90** include a RAM.

[0142] The communication I/F **84** is connected to the communication I/F **52** of the imaging apparatus **12** via the network **34**. The communication I/F **84** controls the exchange of the information between the CPU **86** and the imaging apparatus **12**. For example, the communication I/F **84** receives the information transmitted from the imaging apparatus **12** and outputs the received information to the CPU **86**. Further, the information according to the request from the CPU **86** is transmitted to the imaging apparatus **12** via the network **34**.

[0143] The imaging support apparatus **14** includes a storage device **94** for backup. The storage device for backup **94** is an example of a "default storage device" according to the present disclosed technology. The storage device **94** for backup is a non-volatile storage device that stores a second trained model **118** (see FIG. **8**) and the like, which will be described later. Examples of the storage device **94** for backup include a non-temporary storage medium such as an EEPROM, an SSD, and/or an HDD. The storage device **94** for backup is connected to the bus **92**, and the CPU **86** stores the second trained model **118** and the like, which will be described later, in the storage device **94** for backup and reads the second trained model **118** and the like, which will be described later, from the storage device **94** for backup.

[0144] As one of the known imaging apparatuses in the related art, an imaging apparatus equipped with an automatic setting function, in which various parameters (for example, a parameter used for correction of exposure, a parameter used for AF control, a parameter used for correction of gradation, or the like) used in the control related to the imaging are set according to various conditions, is known. However, the various parameters used in this type of imaging apparatus are merely parameters determined by the manufacturer based on the manufacturer's criteria, and it is difficult to mention that the parameters reflect the preferences of each user.

[0145] Therefore, in the present embodiment, the imaging support apparatus **14** performs a machine learning on a learning model with a relationship between the set value, which is actually used in the imaging using the imaging apparatus **12**, and the captured image **75**, which is acquired by being captured by the imaging apparatus **12**, and uses the trained model to provide support for setting parameters in the imaging apparatus **12** as close to the user's preference as possible. Further,

in the imaging support apparatus **14**, processing is performed in consideration of the timing of performing processing by using a learning result. Hereinafter, a specific example will be described.
[0146] As an example shown in FIG. **4**, the storage **88** of the imaging support apparatus **14** stores an imaging support processing program **96**. The imaging support processing program **96** is an example of a "program" according to the present disclosed technology.
[0147] The CPU **86** reads the imaging support processing program **96** from the storage **88** and executes the read imaging support processing program **96** on the memory **90**. The CPU **86** performs imaging support processing according to the imaging support processing program **96** executed on the memory **90** (see also FIGS. **29**A and **29**B). The imaging support processing is implemented by operating the CPU **86** as a teacher data generation unit **86**A, a model generation unit **86**B, a determination unit **86**C, and an execution unit **86**D.
[0148] Hereinafter, an example of the content of specific processing by the teacher data generation unit **86**A, the model generation unit **86**B, the determination unit **86**C, and the execution unit **86**D will be described with reference to FIGS. **5** to **28**.
[0149] As an example shown in FIG. **5**, the teacher data generation unit **86**A generates teacher data **98**. The teacher data **98** is labeled data used in the machine learning. In the present embodiment, the teacher data **98** is used in learning processing with respect to a CNN **104** (see FIG. **6**), a replication model **116** (see FIG. **8**), the second trained model **118** (see FIG. **8**), and the like. The teacher data **98** has the captured image **75** and correction data **100**. The "trained model" according to the present disclosed technology includes a model in which additional learning is possible.
[0150] The NVM **64** of the imaging apparatus **12** (see FIG. **2**) stores parameters applied to the imaging apparatus **12**, that is, the various set values **102** applied to the control related to the imaging performed by the imaging apparatus. In the following, for convenience of explanation, the control related to the imaging performed by the imaging apparatus is also simply referred to as "control related to imaging".
[0151] Examples of the various set values **102** include a set value of white balance R (for example, a white balance gain applied to red (R)), a set value of white balance B (for example, a white balance gain applied to blue (B)), a set value used for correction of exposure, a set value used for adjustment of high color tone according to the imaging scene, a set value used for adjustment of shadow tone according to the imaging scene, a set value used for adjustment of color according to the imaging scene, and the like.
[0152] Here, the set value of white balance R and the set value of white balance B are examples of "set values related to white balance used in the imaging" according to the present disclosed technology. Further, the set value used for correction of exposure is an example of a "set value related to exposure used in the imaging" according to the present disclosed technology. Further, the set value used for adjustment of high color tone (or also referred to as "highlight tone") according to the imaging scene and the set value used for adjustment of shadow tone according to the imaging scene are examples of "set values related to gradation used in the imaging" according to the present disclosed technology. Further, the set value used for adjustment of color according to the imaging scene is an example of a "set value related to a chroma saturation used in the imaging" according to the present disclosed technology.
[0153] The teacher data generation unit **86**A acquires the captured image **75** from the image memory **46** of the imaging apparatus **12** (see FIG. **2**). Further, the teacher data generation unit **86**A acquires the various set values **102** corresponding to the acquired captured image **75**, that is, the various set values **102** applied to the control related to the imaging performed to obtain the captured image **75** from the NVM **64**. The set value **102** that is applied to the imaging apparatus **12** is a value set by the user.
[0154] The teacher data generation unit **86**A uses the various set values **102** acquired from the NVM **64**, that is, the various set values **102** applied to the imaging apparatus **12** in a case where the captured image **75** is acquired by the imaging apparatus **12** as the correction data **100**. The teacher

data generation unit **86**A generates the teacher data **98** by associating the captured image **75** acquired from the image memory **46** with the correction data **100**.

[0155] The generation of the teacher data **98** by the teacher data generation unit **86**A is performed each time the user performs one imaging, that is, each time the captured image **75** is stored in the image memory **46**. In the following, the number of images may be represented as “the number of frames” or “the number of images”.

[0156] The teacher data generation unit **86**A stores the generated teacher data **98** in the storage **88** in units of one image. A plurality of teacher data **98** are stored in the storage **88**. That is, the storage **88** stores a plurality of captured images **75** and the plurality of correction data **100** related to the plurality of captured images **75**, as the plurality of teacher data **98**.

[0157] As shown in FIG. **6** as an example, the model generation unit **86**B has the CNN **104**. The model generation unit **86**B acquires the teacher data **98** from the storage **88** and inputs the captured image **75** included in the acquired teacher data **98** to the CNN **104**. In a case where the captured image **75** is input, the CNN **104** outputs a CNN signal **104**A corresponding to the various set values **102**. The CNN signal **104**A is a signal that indicates the set value of the same items as the various set values **102**. The set value of the same items as the various set values **102** refers to, for example, the set value of white balance R, the set value of white balance B, the set value used for correction of exposure, the set value used for adjustment of high color tone according to the imaging scene, the set value used for adjustment of shadow tone according to the imaging scene, the set value used for adjustment of color according to the imaging scene, and the like.

[0158] The model generation unit **86**B calculates an error **108** between the correction data **100** that is associated with the captured image **75** input to the CNN **104** and the CNN signal **104**A. The errors **108** refer to, for example, an error of the set value of white balance R, an error of the set value of white balance B, an error of the set value used for correction of exposure, an error of the set value used for adjustment of high color tone according to the imaging scene, an error of the set value used for adjustment of shadow tone according to the imaging scene, an error of the set value used for adjustment of color according to the imaging scene, and the like.

[0159] The model generation unit **86**B calculates a plurality of adjustment values **110** that minimize the error **108**. Thereafter, the model generation unit **86**B adjusts a plurality of optimization variables in the CNN **104** by using the plurality of calculated adjustment values **110**. Here, the plurality of optimization variables in the CNN **104** refer to, for example, a plurality of bonding loads and a plurality of offset values included in the CNN **104**, and the like.

[0160] The model generation unit **86**B repeats the learning processing of inputting the captured image **75** to the CNN **104**, calculating the error **108**, calculating the plurality of adjustment values **110**, and adjusting the plurality of optimization variables in the CNN **104**, for the number of captured images **75** stored in the storage **88**. That is, the model generation unit **86**B optimizes the CNN **104** by adjusting the plurality of optimization variables in the CNN **104** by using the plurality of adjustment values **110** calculated so as to minimize the error **108** for each of the plurality of captured images **75** in the storage **88**. The model generation unit **86**B does not necessarily have to be provided inside the CPU **86** and may be provided outside the CPU **86**. That is, the learning processing is not limited to that performed by the CPU **86**, and the learning processing includes processing of causing the model generation unit **86**B, which is provided outside the CPU **86**, to perform the learning processing under the control of the CPU **86** to generate a trained model.

[0161] The model generation unit **86**B generates a first trained model **106** by optimizing the CNN **104**. That is, the CNN **104** is optimized by adjusting the plurality of optimization variables included in the CNN **104**, whereby the first trained model **106** is generated. The model generation unit **86**B stores the generated first trained model **106** in the storage **88**. As will be described in detail later, the first trained model **106** is a trained model used for the control related to the imaging. The control related to this imaging includes not only the control related to the capture of the image by the image sensor **20** (see FIGS. **1** and **2**), but also the image processing such as auto white balance, tone, and/or color for the data obtained by being imaged.

[0162] As an example shown in FIG. **7**, the storage **88** stores the first trained model **106**. Further, as described above, each time the captured image **75** is stored in the image memory **46**, the teacher data generation unit **86**A generates the teacher data **98**, and the generated teacher data **98** is stored in the storage **88**. After the first trained model **106** is stored in the storage **88**, the determination unit **86**C determines whether or not the number of captured images **75** of the teacher data **98** stored in the storage **88** has reached a first threshold value (for example, “10000”).

[0163] The first threshold value is not a fixed value but a variable value that is changed according to the number of captured images **75**. For example, at a step where the learning processing is not performed on the CNN **104**, the first threshold value is “10000”, and in a case where the number of captured images **75** reaches “10000”, a value that is counted as the number of captured images **75** is reset to “0”, and the first threshold value is set to “1000”. Thereafter, each time the number of captured images **75** reaches “1000”, the value that is counted as the number of captured images **75** is reset to “0”, and the first threshold value is set to “1000”. Here, the values “10000” and “1000” shown as the first threshold value are only examples and may be other values.

[0164] In a case where the determination unit **86**C determines that the number of the captured images **75** of the teacher data **98** stored in the storage **88** has reached the first threshold value, the model generation unit **86**B generates a replication model **116**. The replication model **116** is a learning model in which the first trained model **106** in the storage **88** is replicated. The model generation unit **86**B generates a second trained model **118**, which is a trained model used for the control related to the imaging, by performing the learning processing on the replication model **116** by using the teacher data **98** in the storage **88**. That is, the model generation unit **86**B generates the second trained model **118** by performing the learning processing on the replication model **116** by using the teacher data **98** in the storage **88** under the condition that the number of captured images **75** of the teacher data **98** stored in the storage **88** reaches the first threshold value.

[0165] As an example shown in FIG. **8**, the model generation unit **86**B acquires the teacher data **98** from the storage **88** and inputs the captured image **75** included in the acquired teacher data **98** to the replication model **116**. In a case where the captured image **75** is input, the replication model **116** outputs a CNN signal **116**A corresponding to the various set values **102**. Similar to the CNN signal **104**A, the CNN signal **116**A is a signal that indicates the set value of the same items as the various set values **102**.

[0166] The model generation unit **86**B calculates an error **120** between the correction data **100** associated with the captured image **75** input to the replication model **116** and the CNN signal **116**A. The errors **120** refer to, for example, an error of the set value of white balance R, an error of the set value of white balance B, an error the set value used for correction of exposure, an error of the set value used for adjustment of high color tone according to the imaging scene, an error of the set value used for adjustment of shadow tone according to the imaging scene, an error of the set value used for adjustment of color according to the imaging scene, and the like.

[0167] The model generation unit **86**B calculates a plurality of adjustment values **122** that minimize the error **120**. Thereafter, the model generation unit **86**B adjusts a plurality of optimization variables in the replication model **116** by using the plurality of calculated adjustment values **122**. Here, the plurality of optimization variables in the replication model **116** refer to, for example, a plurality of bonding loads and a plurality of offset values included in the replication model **116**, and the like.

[0168] The model generation unit **86**B repeats the learning processing of inputting the captured image **75** to the replication model **116**, calculating the error **120**, calculating the plurality of adjustment values **122**, and adjusting the plurality of optimization variables in the replication model **116**, for the number of captured images **75** stored in the storage **88**. That is, the model generation unit **86**B optimizes the replication model **116** by adjusting the plurality of optimization variables in the replication model **116** by using the plurality of adjustment values **122** calculated so as to minimize the error **120** for each of the plurality of captured images **75** in the storage **88**.

[0169] The model generation unit **86**B generates the second trained model **118** by optimizing the replication model **116**. That is, the replication model **116** is optimized by adjusting the plurality of optimization variables included in the replication model **116**, whereby the second trained model **118** is generated. The model generation unit **86**B stores the generated second trained model **118** in the storage **88**.

[0170] In the example shown in FIG. **8**, the teacher data **98** in the storage **88** is an example of "teacher data" according to the present disclosed technology, the captured image **75** in the storage **88** is an example of a "first image" according to the present disclosed technology, and the correction data **100** in the storage **88** is an example of a "set value" according to the present disclosed technology.

[0171] As an example shown in FIG. **9**, the storage **88** stores a standard image set **124**. The standard image set **124** has a plurality of standard images **124**A. The standard image **124**A is an example of a "second image" according to the present disclosed technology.

[0172] The plurality of standard images **124**A are images acquired by being captured by the imaging apparatus **12** in different scenes. In the example shown in FIG. **9**, as an example of the plurality of standard images **124**A, images acquired by being captured by the imaging apparatus **12** in a first scene, images acquired by being captured by the imaging apparatus **12** in a second scene, images acquired by being captured by the imaging apparatus **12** in a third scene, images acquired by being captured by the imaging apparatus **12** in a fourth scene, and images acquired by being captured by the imaging apparatus **12** in a fifth scene, are shown.

[0173] The execution unit **86**D performs specific processing under the condition that the number of captured images **75** of the teacher data **98** stored in the storage **88** reaches the first threshold value. In the present embodiment, as an example, the specific processing is performed depending on the output result of the second trained model **118** generated under the condition that the number of the captured images **75** of the teacher data **98** stored in the storage **88** reaches the first threshold value. This will be described in more detail below.

[0174] The execution unit **86**D performs the specific processing based on a first set value **106**A output from the first trained model **106** in a case where the standard image **124**A is input to the first trained model **106** and a second set value **118**A output from the second trained model **118** in a case where the standard image **124**A is input to the second trained model **118**. Specifically, first, the execution unit **86**D inputs one standard image **124**A among the plurality of standard images **124**A to the first trained model **106** and the second trained model **118**. The first trained model **106** outputs the first set value **106**A in a case where the standard image **124**A is input. The first set value **106**A is a set value of the same items as the various set values **102** (hereinafter, also referred to as "various setting items"). The second trained model **118** outputs the second set value **118**A in a case where the standard image **124**A is input. The second set value **118**A is also a set value of various setting items.

[0175] The execution unit **86**D calculates a degree of difference **125** between the first set value **106**A and the second set value **118**A. The degree of difference **125** refers to, for example, an absolute value of a difference between the first set value **106**A and the second set value **118**A. The absolute value of the difference is only an example, and the absolute value of the difference may be a ratio of the second set value **118**A to the first set value **106**A or a ratio of the first set value **106**A to the second set value **118**A or may be any value as long as the value indicates the degree of difference between the first set value **106**A and the second set value **118**A.

[0176] Further, here, as the degree of difference **125** between the first set value **106**A and the second set value **118**A, for example, an average value of the degree of difference of each of the various setting items is used. For example, the degree of difference between the first set value **106**A and the second set value **118**A is an average value of the degree of difference between the first set value **106**A and the second set value **118**A for the white balance R, the degree of difference between the first set value **106**A and the second set value **118**A for the white balance B, the degree of difference between the first set value **106**A and the second set value **118**A used for the correction of exposure, the degree of difference between the first set value **106**A and the second set value **118**A used for the adjustment of high color tone according to the imaging scene, the degree of difference between the first set value **106**A and the second set value **118**A used for adjustment of the shadow tone according to the imaging scene, the degree of difference between the first set value **106**A and the second set value **118**A used for the adjustment of color according to the imaging scene, and the like. Further, in the present embodiment, for example, scoring is performed such that each of the set values can be treated equally.

[0177] Similarly, the execution unit **86**D calculates the degree of difference **125** for the remaining standard image **124**A among the plurality of standard images **124**A. Thereafter, the execution unit **86**D determines whether or not the degree of difference **125** for all of the plurality of standard images **124**A is equal to or greater than a second threshold value. The execution unit **86**D performs the specific processing in a case where the degree of difference **125** for all of the plurality of standard images **124**A is equal to or greater than the second threshold value.

[0178] Here, an average of all the degrees of difference is calculated, but this is just an example. It is not necessary that there is a difference in each item of the above set value, for example, the specific processing may be performed in a case where there is a difference, which is equal to or greater than the second threshold value, in a certain set value. The second threshold value for the average value and the second threshold value for any one set value may be different from each other. Further, here, although an example of the embodiment in which the specific processing is executed under the condition that the degree of difference **125** for all of the plurality of standard images **124**A is equal to or greater than the second threshold value has been described, this is only an example. For example, the specific processing may be performed under the condition that the number of times that the degree of difference **125** calculated for each of the plurality of standard images **124**A is determined to be equal to or greater than the second threshold value, is equal to or greater than a default number (for example, majority, or any one frame, or the like) among the number of the plurality of standard images **124**A (in the present example, 5 images (frames) of the standard images **124**A of the first to fifth scenes). Further, for example, the specific processing may be performed under the condition that the average value of the degree of difference **125** for all of the plurality of standard images **124**A is equal to or greater than the second threshold value. Further, for example, the specific processing may be performed under the condition that the maximum value of the degree of difference **125** for all of the plurality of standard images **124**A is equal to or greater than the second threshold value. Further, for example, the specific processing may be performed under the condition that the minimum value of the degree of difference **125** for all of the plurality of standard images **124**A is equal to or greater than the second threshold value. Further, for example, the specific processing may be performed under the condition that the median value of the degree of difference **125** for all of the plurality of standard images **124**A is equal to or greater than the second threshold value.

[0179] The specific processing executed by the execution unit **86**D refers to processing that includes any of the first to twelfth processing described later. However, this is only an example, and processing that includes a plurality of processing among the first to twelfth processing may be performed by the execution unit **86**D as the specific processing.

[0180] FIG. **10** shows an example of the timing when a series of processing, which is processing of calculating the degree of difference **125** and processing of determining whether or not the degree of difference **125** is equal to or greater than the second threshold value (hereinafter, also referred to as "verification"), is performed by the execution unit **86**D.

[0181] In the example shown in FIG. **10**, until the number of captured images **75** acquired by being captured by the imaging apparatus **12** (hereinafter, also referred to as "the number of imaging frames") reaches "10000", the "standby learning" is set with respect to the CNN **104**, and the learning processing is not performed on the CNN **104**. In a case where the number of imaging frames reaches “10000”, the learning processing is performed on the CNN **104**, whereby the first trained model **106** is generated. In a case where the first trained model **106** is generated, the operation of the first trained model **106** is started. That is, inference (for example, processing of outputting the first set value **106**A from the first trained model **106** by inputting the captured image **75** or the like to the first trained model **106**) is performed on the first trained model **106**, and the imaging support apparatus **14** performs processing that uses the inference result by the first trained model **106**. Examples of the processing that uses the inference result by the first trained model **106** include processing of reflecting the first set value **106**A, which is output from the first trained model **106** in a case where the captured image **75** is input to the first trained model **106** (for example, processing of setting the first set value **106**A with respect to the imaging apparatus **12**), on the control related to the imaging. The first trained model **106** may be generated in advance by the manufacturer of the imaging apparatus **12** and stored in a memory (for example, the NVM **64**) in the camera (for example, the imaging apparatus **12**).

[0182] Further, in a case where the number of imaging frames reaches “10000”, the replication model **116** is generated. In a case where the replication model **116** is generated, the “standby learning” is set with respect to the replication model **116** until the number of imaging frames reaches “11000”, and the learning processing is not performed on the replication model **116**.

[0183] In a case where the number of imaging frames reaches “11000”, the learning processing is performed on the replication model **116**, whereby the second trained model **118** is generated. In a case where the second trained model **118** is generated, the verification is performed. In the verification, each of all the standard images **124**A included in the standard image set **124** is sequentially input to the first trained model **106** and the second trained model **118**. As a result, the first set value **106**A is output from the first trained model **106**, and the second set value **118**A is output from the second trained model **118**. Thereafter, the degree of difference **125** between the first set value **106**A output from the first trained model **106** and the second set value **118**A output from the second trained model **118** is calculated, and whether or not the calculated degree of difference **125** is equal to or greater than the second threshold value is determined. Here, in a case where the degree of difference **125** is equal to or greater than the second threshold value, the processing that includes the specific processing is executed.

[0184] The processing that includes the specific processing has processing of switching from the operation of the first trained model **106** to the operation of the existing second trained model **118** (for example, the operation of the latest second trained model **118**). That is, inference (for example, processing of outputting the second set value **118**A from the existing second trained model **118** by inputting the captured image **75** or the like to the existing second trained model **118**) is performed on the existing second trained model **118**, and the imaging support apparatus **14** performs processing that uses the inference result by the existing second trained model **118**. Examples of the processing that uses the inference result by the second trained model **118** include processing of reflecting the second set value **118**A, which is output from the second trained model **118** in a case where the captured image **75** is input to the second trained model **118** (for example, processing of setting the second set value **118**A with respect to the imaging apparatus **12**), on the control related to the imaging.

[0185] On the other hand, in the verification that uses the first trained model **106** and the existing second trained model **118**, in a case where the degree of difference **125** is less than the second threshold value, the specific processing is not executed, the “standby learning” is set with respect to the second trained model **118** until the number of imaging frames reaches “12000”, and the learning processing is not performed on the second trained model **118**. Here, the existing second trained model **118** in a case where the degree of difference **125** is less than the second threshold value, that is, the latest second trained model **118** immediately before a timing of moment when the degree of difference **125** is determined to be less than the second threshold value is an example of

the “learning model” according to the present disclosed technology.
[0186] In a case where the number of imaging frames reaches “12000”, the learning processing is performed on the existing second trained model **118**, whereby a new second trained model **118** is generated. In a case where the new second trained model **118** is generated, the verification is performed. In the verification, each of all the standard images **124**A included in the standard image set **124** is sequentially input to the first trained model **106** and the new second trained model **118**. As a result, the first set value **106**A is output from the first trained model **106**, and the second set value **118**A is output from the new second trained model **118**. Thereafter, the degree of difference **125** between the first set value **106**A output from the first trained model **106** and the second set value **118**A output from the new second trained model **118** is calculated, and whether or not the calculated degree of difference **125** is equal to or greater than the second threshold value is determined. Here, in a case where the degree of difference **125** is equal to or greater than the second threshold value, the specific processing is executed. In a case where the degree of difference **125** is less than the second threshold, the specific processing is not executed, the “standby learning” is set with respect to the existing second trained model **118** until the number of imaging frames reaches “13000”, and the learning processing is not performed on the existing second trained model **118**. Thereafter, each time the number of imaging frames reaches “1000”, the same processing is performed until the condition of “the degree of difference **125**>the second threshold value” is satisfied.
[0187] In the example shown in FIG. **10**, the time when the replication model **116** is replicated, that is, the time when the number of imaging frames reaches “10000” is an example of “specific time” according to the present disclosed technology. Further, in the example shown in FIG. **10**, the time when the second trained model **118** used for verification is generated during a period when the number of imaging frames exceeds “10000” is an example of the “specific time” according to the present disclosed technology. Further, during a period when the number of imaging frames exceeds “10000”, a period from the time when the second trained model **118** used for verification is generated until the number of imaging frames reaches “1000” (that is, a period until the next verification is performed) is an example of a “period from the specific time until the condition is satisfied” according to the present disclosed technology.
[0188] In the example shown in FIG. **10**, although an example of the embodiment in which the learning processing is not performed on the CNN **104** until the number of imaging frames reaches “10000” has been described, this is only an example, and the number of imaging frames, which is used for a condition for canceling the standby learning, may be a value less than “10000” (for example, “1000”) or may be a value exceeding “10000” (for example, “100000”). Further, in the example shown in FIG. **10**, although an example of the embodiment in which the verification of the number of imaging frames is performed in units of “1000” in a case where the number of imaging frames exceeds “10000” has been described, this is only an example, and the number of imaging frames, which is used for a condition for performing the verification, may be a value less than “1000” (for example, “100”) or may be a value exceeding “1000” (for example, “10000”).
[0189] As an example shown in FIG. **11**, the execution unit **86**D includes a first processing execution unit **86**D**1**, a second processing execution unit **86**D**2**, a third processing execution unit **86**D**3**, a fourth processing execution unit **86**D**4**, a fifth processing execution unit **86**D**5**, a sixth processing execution units **86**D**6**, a seventh processing execution unit **86**D**7**, an eighth processing execution unit **86**D**8**, a ninth processing execution unit **86**D**9**, a tenth processing execution unit **86**D**10**, an eleventh processing execution unit **86**D**11**, and a twelfth processing execution unit **86**D**12**.
[0190] The first processing execution unit **86**D**1** executes first processing (see FIG. **12**). The second processing execution unit **86**D**2** executes second processing (see FIG. **13**). The third processing execution unit **86**D**3** executes third processing (see FIG. **14**). The fourth processing execution unit **86**D**4** executes fourth processing (see FIGS. **15** to **18**). The fifth processing

execution unit **86**D**5** executes fifth processing (see FIG. **19**). The sixth processing execution unit **86**D**6** executes sixth processing (see FIG. **20**). The seventh processing execution unit **86**D**7** executes seventh processing (see FIG. **21**). The eighth processing execution unit **86**D**8** executes eighth processing (see FIG. **22**). The ninth processing execution unit **86**D**9** executes ninth processing (see FIGS. **23** and **24**). The tenth processing execution unit **86**D**10** executes tenth processing (see FIGS. **25** and **26**). The eleventh processing execution unit **86**D**11** executes eleventh processing (see FIG. **27**). The twelfth processing execution unit **86**D**12** executes twelfth processing (see FIG. **28**).

[0191] As an example shown in FIG. **12**, the first processing execution unit **86**D**1** executes processing of reflecting the second set value **118**A on the control related to the imaging, as the first processing. For example, first, the first processing execution unit **86**D**1** acquires the captured image **75** from the imaging apparatus **12** and inputs the acquired captured image **75** to the second trained model **118**. The second trained model **118** outputs the second set value **118**A in a case where the captured image **75** is input. The first processing execution unit **86**D**1** transmits a first processing signal, which includes the second set value **118**A output from the second trained model **118**, to the imaging apparatus **12**. The imaging apparatus **12** receives the first processing signal transmitted from the first processing execution unit **86**D**1** and performs the imaging by using the second set value **118**A included in the received first processing signal.

[0192] In the example shown in FIG. **12**, although an example of the embodiment in which the captured image **75** is input to the second trained model **118** has been described, this is only an example, and an image other than the captured image **75** may be input to the second trained model **118**. Examples of the image other than the captured image **75** include at least one image selected by the user or the like among the plurality of standard images **124**A.

[0193] As an example shown in FIG. **13**, the second processing execution unit **86**D**2** executes processing of storing the second trained model **118** in the storage device **94** for backup, as the second processing. For example, the second processing execution unit **86**D**2** stores the latest second trained model **118** used in the verification in the storage device **94** for backup. Although the storage device **94** for backup is exemplified here as a storage destination of the second trained model **118**, the present disclosed technology is not limited to this, and the storage device of another device (for example, the imaging apparatus **12**, a server, a personal computer, or the like) existing on the network **34** may be used instead of the storage device **94** for backup.

[0194] As an example shown in FIG. **14**, the third processing execution unit **86**D**3** executes processing of reflecting the output of the trained model, among the first trained model **106** and the second trained model **118**, selected according to the received instruction on the control related to the imaging, as the third processing.

[0195] In this case, for example, any of the first trained model **106** or the second trained model **118** is selected according to the instruction provided to the imaging apparatus **12** by the user or the like. In the example shown in FIG. **14**, a model instruction screen **127** is displayed on the display **28** of the imaging apparatus **12**, and the instruction from the user or the like is received by the touch panel **30**.

[0196] A message **127**A, a softkey **127**B, and a softkey **127**C are displayed on the model instruction screen **127**. The message **127**A is a message that prompts the user to select a trained model. In the example shown in FIG. **14**, a message “Please select a trained model” is shown as an example of the message **127**A. The softkey **127**B is turned on via the touch panel **30** in a case where the first trained model **106** is selected by the user or the like. The softkey **127**C is turned on via the touch panel **30** in a case where the second trained model **118** is selected by the user or the like. In the example shown in FIG. **14**, an example of the aspect in which the softkey **127**C is turned on by the user or the like is described. In a case where the softkey **127**B or the softkey **127**C is turned on via the touch panel **30**, the imaging apparatus **12** transmits model selection information **129** to the third processing execution unit **86**D**3**. The model selection information **129** is information indicating whether any of the first trained model **106** or the second trained model **118** is selected by the user or the like (for example, information indicating whether any of the softkeys **127**B or **127**C is turned on).

[0197] The third processing execution unit **86**D**3** receives the model selection information **129** transmitted from the imaging apparatus **12** and specifies which of the first trained model **106** and the second trained model **118** is selected with reference to the received model selection information **129**. The third processing execution unit **86**D**3** inputs the captured image **75** to the specified model (hereinafter, also referred to as a "selected trained model") among the first trained model **106** and the second trained model **118**. In a case where the selected trained model is the first trained model **106**, the first trained model **106** outputs the first set value **106**A. In a case where the selected trained model is the second trained model **118**, the second trained model **118** outputs the second set value **118**A.

[0198] The third processing execution unit **86**D**3** transmits a signal, which includes the first set value **106**A output from the first trained model **106** or the second set value **118**A output from the second trained model **118**, to the imaging apparatus **12** as s third processing signal. Hereinafter, for convenience of explanation, in a case where it is not necessary to distinguish between the first set value **106**A output from the first trained model **106** and the second set value **118**A output from the second trained model **118**, the set value is called as an "output set value".

[0199] The imaging apparatus **12** receives the third processing signal transmitted from the third processing execution unit **86**D**3** and performs the imaging by using the output set value that is included in the received third processing signal.

[0200] In the example shown in FIG. **14**, although an example of the embodiment in which the captured image **75** is input to each of the first trained model **106** and the second trained model **118** has been described, this is only an example, and an image other than the captured image **75** may be input to at least one trained model among the first trained model **106** or the second trained model **118**.

[0201] As an example shown in FIG. **15**, the fourth processing execution unit **86**D**4** outputs data for displaying a simulation image **128**A, which corresponds to an image obtained by applying the first set value **106**A output from the first trained model **106** by inputting the standard image set **124** to the first trained model **106** to the standard image set **124**, and a simulation image **128**B, which is obtained by applying the second set value **118**A output from the second trained model **118** by inputting the standard image set **124** to the second trained model **118** to the standard image set **124**, on the display **28** (see FIG. **16**), as the fourth processing.

[0202] Here, the standard image set **124** is an example of a "third image" and a "fifth image" according to the present disclosed technology. That is, the "third image" and the "fifth image" may be the same image. Further, the first set value **106**A is an example of a "first output result" according to the present disclosed technology. Further, the second set value **118**A is an example of a "second output result" according to the present disclosed technology. Further, a simulation image set **126**B is an example of a "fourth image" according to the present disclosed technology. Further, the simulation image **128**B is an example of a "sixth image" according to the present disclosed technology. Further, the display **28** is an example of a "first display" according to the present disclosed technology.

[0203] In the example shown in FIG. **15**, the fourth processing execution unit **86**D**4** sequentially inputs each of all the standard images **124**A included in the standard image set **124** to the first trained model **106**. The first trained model **106** outputs the first set value **106**A each time the standard image **124**A is input. The fourth processing execution unit **86**D**4** generates a simulation image set **126**A that includes the simulation image **128**A and a use model identifier **130**A based on the output first set value **106**A and the corresponding standard image **124**A each time the first set value **106**A is output from the first trained model **106**. The simulation image set **126**A is generated for each of all the standard images **124**A included in the standard image set **124**. Here, although

each of all the standard images **124**A is sequentially input to the first trained model **106**, any one or a plurality of standard images may be used.
[0204] The simulation image **128**A is an image expected as the captured image **75** acquired by the imaging apparatus **12** in a case where the imaging is performed by using the first set value **106**A. Examples of the simulation image **128**A include an image corresponding to the standard image **124**A influenced by the first set value **106**A in a case where the imaging is performed by using the first set value **106**A, on the premise that the standard image **124**A is acquired by the imaging apparatus **12** performing the imaging.
[0205] The use model identifier **130**A, which is included in the simulation image set **126**A, is an identifier that is capable of specifying the first trained model **106**. The use model identifier **130**A is associated with the simulation image **128**A.
[0206] In the example shown in FIG. **15**, the fourth processing execution unit **86**D**4** sequentially inputs each of all the standard images **124**A included in the standard image set **124** to the second trained model **118**. The second trained model **118** outputs the second set value **118**A each time the standard image **124**A is input. The fourth processing execution unit **86**D**4** generates a simulation image set **126**B that includes the simulation image **128**B and a use model identifier **130**B based on the output second set value **118**A and the corresponding standard image **124**A each time the second set value **118**A is output from the second trained model **118**. The simulation image set **126**B is generated for each of all the standard images **124**A included in the standard image set **124**.
[0207] The simulation image **128**B is an image expected as the captured image **75** acquired by the imaging apparatus **12** in a case where the imaging is performed by using the second set value **118**A. Examples of the simulation image **128**B include an image corresponding to the standard image **124**A influenced by the second set value **118**A in a case where the imaging is performed by using the second set value **118**A, on the premise that the standard image **124**A is acquired by the imaging apparatus **12** performing the imaging.
[0208] The use model identifier **130**B, which is included in the simulation image set **126**B, is an identifier that is capable of specifying the second trained model **118**. The use model identifier **130**B is associated with the simulation image set **126**B.
[0209] In the following, for convenience of explanation, the data including the simulation image sets **126**A and **126**B is referred to as a simulation image set **126**. Further, in a case where it is not necessary to distinguish between the simulation images **128**A and **128**B, the simulation images **128**A and **128**B are referred to as simulation images **128**. Further, in a case where it is not necessary to distinguish between the use model identifiers **130**A and **130**B, the use model identifiers **130**A and **130**B are referred to as a use model identifier **130**.
[0210] The fourth processing execution unit **86**D**4** transmits the simulation image set **126** to the imaging apparatus **12**. The imaging apparatus **12** receives the simulation image set **126** transmitted from the fourth processing execution unit **86**D4. Here, the simulation image set **126** is an example of “first data” according to the present disclosed technology.
[0211] As an example shown in FIG. **16**, the CPU **62** of the imaging apparatus **12** generates a simulation image display screen **132** based on the simulation image set **126** and displays the simulation image display screen **132** on the display **28**. The simulation image **128** or the like is displayed on the simulation image display screen **132**.
[0212] The simulation image display screen **132** includes a first screen **132**A and a second screen **132**B. The CPU **62** generates the first screen **132**A based on the simulation image set **126**A and generates the second screen **132**B based on the simulation image set **126**B. In the example shown in FIG. **16**, the upper half region in the simulation image display screen **132** is the first screen **132**A, and the lower half region is the second screen **132**B.
[0213] The CPU **62** controls the display **28** such that the simulation image **128**A is displayed on the first screen **132**A and the simulation image **128**B is displayed on the second screen **132**B with reference to the use model identifier **130**. The displayed simulation images **128**A and **128**B may be

one or a plurality. As a result, the simulation image **128**A and the simulation image **128**B are displayed on the display **28** in a distinguishable manner. The use model identifier **130** is an example of “data for displaying the fourth image and the sixth image on the first display in a distinguishable manner” according to the present disclosed technology.

[0214] The CPU **62** displays the message **132**A**1** on the display **28** in a state corresponding to the simulation image **128**A based on the use model identifier **130**A included in the simulation image set **126**A. Further, the CPU **62** displays the message **132**B**1** on the display **28** in a state corresponding to the simulation image **128**B based on the use model identifier **130**B included in the simulation image set **126**B. In the example shown in FIG. **16**, the message **132**A**1** is associated with the simulation image **128**A by displaying the message **132**A**1** on the first screen **132**A, and the message **132**B**1** is associated with the simulation image **128**B by displaying the message **132**B**1** on the second screen **132**B.

[0215] The message **132**A**1** is a message that enables the specification of the first trained model **106**, and the message **132**B**1** is a message that enables the specification of the second trained model **118**. In the example shown in FIG. **16**, the message “Simulation image obtained by the first trained model” is shown as an example of the message **132**A**1**, and the message “Simulation image obtained by the second trained model” is shown as an example of the message **132**B**1**.

[0216] The content of the message **132**A**1** illustrated in FIG. **16** is only an example, and the message **132**A**1** may be a message indicating that the simulation image **128**A that is displayed on the first screen **132**A is a simulation image generated by relying on the first trained model **106**. Further, the content of the message **132**B**1** illustrated in FIG. **16** is only an example, and the message **132**B**1** may be a message indicating that the simulation image **128**B that is displayed on the second screen **132**B is a simulation image generated by relying on the second trained model **118**.

[0217] The message **132**A**1** is an example of “first trained model specification information” according to the present disclosed technology, and the message **132**B**1** is an example of “second trained model specification information” according to the present disclosed technology. Further, the use model identifier **130** is an example of “data for displaying the fourth image and the first trained model specification information that enables the specification of the first trained model on the first display in a state where being associated with each other, and for displaying the sixth image and the second trained model specification information that enables the specification of the second trained model on the first display in a state of being associated with each other” according to the present disclosed technology.

[0218] Here, although the message **132**A**1** specifies that the simulation image **128**A is an image that relies on the first trained model **106**, and the message **132**B**1** specifies that the simulation image **128**B is an image that relies on the second trained model **118**, the present disclosed technology is not limited to this. For example, color that enables the specification of the simulation image generated by the first trained model **106** may be used for an outer frame of the simulation image **128**A, and color that enables the specification of the simulation image generated by the second trained model **118** may be used for an outer frame of the simulation image **128**B. Further, a mark or the like that enables the specification of the simulation image generated by the first trained model **106** may be displayed in a state of being associated with the simulation image **128**A, and a mark or the like that enables the specification of the simulation image generated by the second trained model **118** may be displayed in a state of being associated with the simulation image **128**B.

[0219] As an example shown in FIG. **17**, in a state where the simulation image display screen **132** is displayed on the display **28**, in a case where any of the simulation images **128** in the simulation image display screen **132** is selected by the user or the like via the touch panel **30**, the CPU **62** transmits selected image specification information **134**, which enables the specification of which simulation image **128** is selected, to the imaging support apparatus **14**. The fourth processing execution unit **86**D**4** of the imaging support apparatus **14** receives the selected image specification

information **134** transmitted from the imaging apparatus **12**.
[0220] As an example shown in FIG. **18**, the fourth processing execution unit **86**D**4** executes processing of reflecting the output of the first trained model **106** on the control related to the imaging in a case where the simulation image **128**A is selected among the plurality of simulation images **128** displayed on the display **28** and executes processing of reflecting the output of the second trained model **118** on the control related to the imaging in a case where the simulation image **128**B is selected, as one of the processing included in the fourth processing.
[0221] In this case, for example, the fourth processing execution unit **86**D**4** specifies which simulation image **128**, among the plurality of simulation images **128**, is selected by the user or the like with reference to the selected image specification information **134**. The fourth processing execution unit **86**D**4** inputs the standard image **124**A used for generating the specified simulation image **128**, to the trained model used for generating the specified simulation image **128**. The trained model used for generating the simulation image **128** is the first trained model **106** or the second trained model **118**. The first trained model **106** outputs the first set value **106**A in a case where the standard image **124**A is input to the first trained model **106**, and the second trained model **118** outputs the second set value **118**A in a case where the standard image **124**A is input to the second trained model **118**.
[0222] The fourth processing execution unit **86**D**4** transmits a signal that includes the output set value to the imaging apparatus **12** as a fourth processing signal. The imaging apparatus **12** receives the fourth processing signal transmitted from the fourth processing execution unit **86**D**4** and performs the imaging by using the output set value included in the received fourth processing signal.
[0223] As an example shown in FIG. **19**, the fifth processing execution unit **86**D**5** executes processing of outputting data for displaying time specification information **136** that enables the specification of the time when the second trained model **118** is generated on the display **28**, as the fifth processing. A plurality of time specification information **136** may be displayed on the display **28** without displaying images. For example, information on a plurality of dates specified by the plurality of time specification information **136** is listed and displayed on the display **28**. The user may also be able to select the trained model to be used by selecting the displayed dates.
[0224] In this case, for example, the fifth processing execution unit **86**D**5** determines whether or not the second trained model **118** is generated by the model generation unit **86**B (see FIG. **8**). The fifth processing execution unit **86**D**5** acquires the time specification information **136** in a case where the second trained model **118** is generated by the model generation unit **86**B. For example, the time specification information **136** is acquired from a clock (for example, a real-time clock). The fifth processing execution unit **86**D**5** acquires the latest second set value **118**A. Examples of the latest second set value **118**A include the second set value **118**A used for calculating the degree of difference **125** in a case where the condition of “the degree of difference **125**>=the second threshold value” is satisfied.
[0225] The fifth processing execution unit **86**D**5** generates the second set value reflected image **138**. The second set value reflected image **138** is an image obtained by reflecting the output of the second trained model **118**, that is, the latest second set value **118**A on the standard image **124**A. That is, the second set value reflected image **138** is generated based on the latest second set value **118**A and the standard image **124**A in the same manner as the simulation image **128** (FIG. **15**) is generated by the fourth processing execution unit **86**D**4**.
[0226] The fifth processing execution unit **86**D**5** associates the time specification information **136** with the second set value reflected image **138**. Thereafter, the fifth processing execution unit **86**D**5** transmits the second set value reflected image **138** associated with the time specification information **136** to the imaging apparatus **12**. The imaging apparatus **12** receives the second set value reflected image **138** associated with the time specification information **136**. In the imaging apparatus **12**, under the control of the CPU **62**, the second set value reflected image **138** and the

time (for example, the time when the second trained model **118** is generated) that is specified from the time specification information **136** are displayed side by side on the display **28**.
[0227] The time specification information **136** and the second set value reflected image **138** are “second data” according to the present disclosed technology. Further, the time specification information **136** and the second set value reflected image **138** are an example of “data for displaying the time specification information on the second display in a state corresponding to the seventh image obtained in a case where the output of the second trained model is reflected” according to the present disclosed technology. Further, the second set value reflected image **138** is an example of the “seventh image” according to the present disclosed technology.
[0228] As an example shown in FIG. **20**, the sixth processing execution unit **86**D**6** executes processing of associating the time specification information **136** with the second trained model **118**, as the sixth processing. In this case, for example, the sixth processing execution unit **86**D**6** acquires the time specification information **136** in a case where the second trained model **118** is generated by the model generation unit **86**B. The sixth processing execution unit **86**D**6** stores the acquired time specification information **136** in the storage **88** in association with the second trained model **118** in the storage **88**. In the example shown in FIG. **20**, although the second trained model **118** and the time specification information **136** are stored in the storage **88** in a state of being associated with each other, the present disclosed technology is not limited to this, and the storage device **94** for backup may be used in a state in which the second trained model **118** and the time specification information **136** are associated with each other.
[0229] Further, the CPU **86** of the imaging support apparatus **14** may perform the learning processing on a replication trained model by treating the existing second trained model **118** (in the example shown in FIG. **20**, the second trained model **118** that is stored in the storage **88**) in the same manner as the first trained model **106** and by treating the replication trained model, which is a trained model that replicates the existing second trained model **118**, in the same manner as the replication model **116**.
[0230] In this case, the CPU **86** generates a third trained model by performing the learning processing on the replication trained model and associates the generated third trained model with the time specification information **136**, similarly to the second trained model **118**. Thereafter, the CPU **86** stores the third trained model and the time specification information **136** in the storage **88** in a state of being associated with each other. By repeating the same processing as the third trained model is generated by performing the learning processing on the second trained model **118**, a plurality of operable trained models are accumulated in the storage **88** in a state of being associated with the time specification information **136**. That is, in a case where N is a natural number of 3 or more, N or more trained models are accumulated in the storage **88** in a state of being associated with the time specification information **136**. N or more trained models may be accumulated in the storage device **94** for backup in a state of being associated with the time specification information **136**.
[0231] As an example shown in FIG. **21**, the seventh processing execution unit **86**D**7** executes processing of reflecting the output of the second trained model **118** on the control related to the imaging at a predetermined timing, as the seventh processing.
[0232] In this case, for example, the seventh processing execution unit **86**D**7** stores the latest second set value **118**A, which is output from the second trained model **118**, in the storage **88**. Examples of the latest second set value **118**A include the second set value **118**A used in the latest verification. The seventh processing execution unit **86**D**7** determines whether or not the predetermined timing has arrived after the latest second set value **118**A is stored in the storage **88**. Examples of the predetermined timing include timing when the imaging apparatus **12** is activated, timing when the number of captured images **75**, which are acquired by being captured by the imaging apparatus **12**, (as an example, the number of captured images **75** acquired by being captured by the imaging apparatus **12** after the latest second set value **118**A is stored in the storage

88) becomes equal to or greater than a sixth threshold value (for example, “10000”), timing when the operation mode of the imaging apparatus **12** transitions from the playback mode to the setting mode, and timing when rating (for example, evaluation by the user or the like for the image quality of the captured image **75**) is performed on the captured images **75** in the playback mode.

[0233] The seventh processing execution unit **86**D**7** acquires the second set value **118**A from the storage **88** in a case where the predetermined timing has arrived and reflects the acquired second set value **118**A on the control related to the imaging. In this case, for example, the seventh processing execution unit **86**D**7** transmits a signal that includes the second set value **118**A acquired from the storage **88** to the imaging apparatus **12** as a seventh processing signal. The imaging apparatus **12** receives the seventh processing signal transmitted from the seventh processing execution unit **86**D**7** and performs the imaging by using the second set value **118**A included in the received seventh processing signal.

[0234] As an example shown in FIG. **22**, the eighth processing execution unit **86**D**8** executes processing of, in a case where the second trained model **118** is applied to a different apparatus **140** that is an imaging apparatus different from the imaging apparatus **12**, correcting at least one of the data input to the second trained model **118** or the output from the second trained model **118**, based on the characteristics of the imaging apparatus **12** and the characteristics of the different apparatus **140**, as the eighth processing.

[0235] In the example shown in FIG. **22**, the storage **88** stores the second trained model **118** and image sensor information **142**. The image sensor information **142** is information related to a plurality of image sensors. The image sensor information **142** is appended to the second trained model **118** and has characteristic information **142**A and individual difference information **142**B.

[0236] The characteristic information **142**A is information indicating the characteristics of each of the different image sensors involved in the second trained model **118**. Examples of the different image sensor involved in the second trained model **118** include the image sensor **20** of the imaging apparatus **12** (that is, the imaging apparatus **12** in which the output of the second trained model **118** is reflected at a current timing) to which the second trained model **118** is applied at a current timing, and the image sensor mounted on a new target to which the second trained model **118** is applied. In the example shown in FIG. **22**, the image sensor mounted on the new target to which the second trained model **118** is applied is an image sensor **140**A mounted on the different apparatus **140**.

[0237] The individual difference information **142**B is information indicating individual differences between different image sensors involved in the second trained model **118**. Examples of the individual difference include a difference between the sensitivity of each RGB pixel of one image sensor (for example, image sensor **20**) and the sensitivity of each RGB pixel of the other image sensor (for example, an image sensor mounted on the different apparatus **140**), a difference between the ISO sensitivity of one image sensor and the ISO sensitivity of the other image sensor, a difference between the speed of the electronic shutter of one image sensor and the speed of the electronic shutter of the other second image sensor, and/or the like.

[0238] The eighth processing execution unit **86**D**8** acquires, from the different apparatus **140**, the different apparatus information **144** including the information that enables the specification of the image sensor **140**A as the information indicating the characteristics of the different apparatus **140**. The eighth processing execution unit **86**D**8** specifies the characteristics (for example, characteristics that can be specified from the image sensor information **142**) of the imaging apparatus **12** and the characteristics (for example, characteristics that can be specified from the image sensor information **142**) of the different apparatus **140** by using the different apparatus information **144** and the image sensor information **142**. For example, the eighth processing execution unit **86**D**8** acquires at least one of the characteristic information **142**A related to the image sensor **140**A specified from the different apparatus information **144** or the individual difference information **142**B related to the image sensor **140**A specified from the different apparatus information **144**, and specifies the characteristics of the imaging apparatus **12** and the characteristics of the different apparatus **140** by using at least one of the characteristic information **142**A or the individual difference information **142**B.

[0239] Since the second trained model **118** is a model obtained in a case where the learning processing is performed by using the plurality of captured images **75**, which are acquired by being captured by the imaging apparatus **12**, and the correction data **100**, the characteristics of the imaging apparatus **12** is reflected in the second set value **118**A in a case where the model is applied to the different apparatus **140** as it is. Therefore, the eighth processing execution unit **86**D**8** corrects the standard image set **124** used for inputting the second trained model **118** and the second set value **118**A output from the second trained model **118** based on the characteristics of the imaging apparatus **12** and the characteristics of the different apparatus **140**.

[0240] In this case, for example, the eighth processing execution unit **86**D**8** derives the content of the correction to be performed on the standard image set **124** and corrects the standard image set **124** according to the content of the derived correction by using a first table (not shown) or a first calculation expression (not shown) in which a difference between the characteristics of the imaging apparatus **12** and the characteristics of the different apparatus **140**, and the content of the correction to be performed on the standard image set **124** are associated with each other.

[0241] The eighth processing execution unit **86**D**8** inputs the corrected standard image set **124** to the second trained model **118**. The second trained model **118** outputs the second set value **118**A in a case where the corrected standard image set **124** is input. The eighth processing execution unit **86**D**8** derives the content of the correction to be performed on the second set value **118**A output from the second trained model **118** and corrects the second set value **118**A according to the content of the derived correction by using a second table (not shown) or a second calculation expression (not shown) in which a difference between the characteristics of the imaging apparatus **12** and the characteristics of the different apparatus **140**, and the content of the correction to be performed on the second set value **118**A are associated with each other.

[0242] The eighth processing execution unit **86**D**8** reflects the corrected second set value **118**A on the control related to the imaging. In this case, for example, the eighth processing execution unit **86**D**8** transmits a signal that includes the corrected second set value **118**A to the imaging apparatus **12** as an eighth processing signal. The imaging apparatus **12** receives the eighth processing signal transmitted from the eighth processing execution unit **86**D**8** and performs the imaging by using the corrected second set value **118**A included in the received eighth processing signal.

[0243] Here, although the correction is performed for both the standard image set **124** and the second set value **118**A, the present disclosed technology is not limited to this, and the correction may be performed only on one of the standard image set **124** or the second set value **118**A. Further, although an example of the embodiment in which the standard image set **124** is input to the second trained model **118** is provided here, the present disclosed technology is not limited to this, and at least one standard image **124**A or at least one captured image **75** may be input to the second trained model **118**. Further, in the same manner as the correction for the standard image set **124**, the eighth processing execution unit **86**D**8** may correct the captured image **75**, which is obtained by being captured by the imaging apparatus **12**, based on the characteristics of the imaging apparatus **12** and the characteristics of the different apparatus **140**. Further, here, although the information that includes both the characteristic information **142**A and the individual difference information **142**B is exemplified as the image sensor information **142**, the present disclosed technology is not limited to this, and the image sensor information **142** may be information that includes only one of the characteristic information **142**A or the individual difference information **142**B.

[0244] As an example shown in FIG. **23**, the ninth processing execution unit **86**D**9** executes processing of outputting the simulation image set **126**B as data for displaying the above-mentioned simulation image **128**B and an unprocessed image **146**A on the display **28** (see FIG. **24**), as the ninth processing. The unprocessed image **146**A is an image (for example, an image corresponding to the standard image **124**A included in the standard image set **124**) obtained without applying the second set value **118**A, which is output from the second trained model **118** by inputting the standard image **124**A included in the standard image set **124** to the second trained model **118**, to the standard image **124**A. In other words, the unprocessed image **146**A is an image obtained in a case where only the image processing that does not use the output result of the trained model is reflected.

[0245] In the example shown in FIG. **23**, the standard image **124**A is an example of an "eighth image" according to the present disclosed technology. Further, the second set value **118**A is an example of a "third output result" according to the present disclosed technology. Further, the simulation image **128**B is an example of a "first processed image" according to the present disclosed technology. Further, the unprocessed image **146**A is an example of an "unprocessed image" according to the present disclosed technology. Further, the simulation image set **126** and an unprocessed image set **146** are examples of "third data" according to the present disclosed technology.

[0246] The ninth processing execution unit **86**D**9** generates the simulation image set **126**B in the same manner as the processing performed by the fourth processing execution unit **86**D**4** shown in FIG. **15** and transmits the generated simulation image set **126**B to the imaging apparatus **12**. Further, the ninth processing execution unit **86**D**9** transmits the standard image set **124** used for the input to the second trained model **118** to the imaging apparatus **12** as the unprocessed image set **146**. The imaging apparatus **12** receives the simulation image set **126**B and the unprocessed image set **146** transmitted from the ninth processing execution unit **86**D**9**.

[0247] As an example shown in FIG. **24**, the CPU **62** of the imaging apparatus **12** generates a simulation image display screen **148** based on the simulation image set **126**B and the unprocessed image set **146**, and displays the simulation image display screen **148** on the display **28**. The simulation image **128**B, the unprocessed image **146**A, and the like are displayed on the simulation image display screen **148**.

[0248] The simulation image display screen **148** includes a first screen **148**A and a second screen **148**B. The CPU **62** generates the first screen **148**A based on the unprocessed image set **146** and generates the second screen **148**B based on the simulation image set **126**B. In the example shown in FIG. **24**, the upper half region in the simulation image display screen **148** is the first screen **148**A, and the lower half region is the second screen **148**B.

[0249] The CPU **62** controls the display **28** such that the unprocessed image **146**A is displayed on the first screen **148**A and the simulation image **128**B is displayed on the second screen **148**B. As a result, the unprocessed image **146**A and the simulation image **128**B are displayed on the display **28** in a distinguishable manner.

[0250] The CPU **62** displays a message **148**A**1** on the display **28** in a state corresponding to the unprocessed image **146**A. Further, the CPU **62** displays a message **148**B**1** on the display **28** in a state corresponding to the simulation image **128**B. In the example shown in FIG. **24**, the message **148**A**1** is associated with the unprocessed image **146**A by displaying the message **148**A**1** on the first screen **148**A, and the message **148**B**1** is associated with the simulation image **128**B by displaying the message **148**B**1** on the second screen **148**B.

[0251] The message **148**A**1** is a message that enables the specification of the unprocessed image **146**A, and the message **148**B**1** is a message that enables the specification of the second trained model **118**. In the example shown in FIG. **24**, the message "Unprocessed image" is shown as an example of the message **148**A**1**, and the message "Simulation image obtained by the second trained model" is shown as an example of the message **148**B**1**.

[0252] The content of the message **148**A**1** illustrated in FIG. **24** is only an example, and the message **148**A**1** may be a message indicating that the unprocessed image **146**A that is displayed on the first screen **148**A is not an image generated by relying on the trained model. Further, the content of the message **148**B**1** illustrated in FIG. **24** is only an example, and the message **148**B**1** may be a message indicating that the simulation image **128**B that is displayed on the second screen **148**B is a simulation image generated by relying on the second trained model **118**.

[0253] Here, although the message **148**A**1** specifies that the unprocessed image **146**A is not an image that relies on the trained model, and the message **148**B**1** specifies that the simulation image **128**B is an image that relies on the second trained model **118**, the present disclosed technology is not limited to this. For example, color that enables the specification of the fact that the unprocessed image **146**A is not an image generated by relying on the trained model may be used for an outer frame of the unprocessed image **146**A, and color that enables the specification of the simulation image generated by the second trained model **118** may be used for an outer frame of the simulation image **128**B. Further, a mark or the like that enables the specification of the fact that the unprocessed image **146**A is not an image generated by relying on the trained model may be displayed in a state of being associated with the unprocessed image **146**A, and a mark or the like that enables the specification of the simulation image generated by the second trained model **118** may be displayed in a state of being associated with the simulation image **128**B.

[0254] In the examples shown in FIGS. **23** and **24**, although an example of the embodiment in which the unprocessed image **146**A is the standard image **124**A, and the simulation image **128**B is an image, which is generated based on the second set value **118**A output from the second trained model **118** in a case where the standard image **124**A is input to the second trained model **118**, has been described, the present disclosed technology is not limited to this. For example, the captured image **75** may be used instead of the unprocessed image **146**A, and an image generated based on the second set value **118**A output from the second trained model **118** in a case where the captured image **75** is input to the second trained model **118** may be used instead of the simulation image **128**B.

[0255] As an example shown in FIG. **25**, the tenth processing execution unit **86**D**10** executes processing of outputting data for displaying the above-mentioned unprocessed image **146**A and a brightness adjusted image **150**A obtained by adjusting the brightness of the simulation image **128**B based on the second set value **118**A output from the second trained model **118** on the display **28** (see FIG. **26**), as the tenth processing.

[0256] In the example shown in FIG. **25**, the unprocessed image **146**A is an example of a "ninth image" according to the present disclosed technology. Further, the second set value **118**A is an example of a "fourth output result" according to the present disclosed technology. Further, the brightness adjusted image **150**A is an example of a "second processed image" according to the present disclosed technology. Further, the unprocessed image **146**A and a brightness adjusted image set **150** are examples of "fourth data" according to the present disclosed technology.

[0257] The tenth processing execution unit **86**D**10** generates the simulation image set **126**B based on the second set value **118**A and further generates the brightness adjusted image set **150** in which the brightness of the simulation image **128**B is adjusted based on the second set value **118**A in the same manner as the processing performed by the fourth processing execution unit **86**D**4** shown in FIG. **15**. The brightness adjusted image set **150** includes a brightness adjusted image **150**A and a use model identifier **150**B. The tenth processing execution unit **86**D**10** generates the brightness adjusted image **150**A by adjusting the brightness of the simulation image **128**B included in the simulation image set **126**B. The tenth processing execution unit **86**D**10** associates the use model identifier **150**B with the brightness adjusted image **150**A. The use model identifier **150**B is an identifier corresponding to the use model identifier **130**B associated with the simulation image **128**B before the brightness is adjusted (for example, an identifier obtained by replicating the use model identifier **130**B).

[0258] The tenth processing execution unit **86**D**10** transmits the unprocessed image **146**A and the brightness adjusted image set **150** to the imaging apparatus **12**. The imaging apparatus **12** receives the unprocessed image **146**A and the brightness adjusted image set **150** transmitted from the tenth processing execution unit **86**D**10**.

[0259] As an example shown in FIG. **26**, the CPU **62** of the imaging apparatus **12** generates a simulation image display screen **152** based on the unprocessed image **146**A and the brightness adjusted image set **150**, and displays the simulation image display screen **152** on the display **28**. The unprocessed image **146**A, the brightness adjusted image **150**A, and the like are displayed on the simulation image display screen **152**.

[0260] The simulation image display screen **152** includes a first screen **152**A and a second screen **152**B. The CPU **62** generates the first screen **152**A based on the unprocessed image **146**A and generates the second screen **152**B based on the brightness adjusted image set **150**. In the example shown in FIG. **26**, the upper half region in the simulation image display screen **152** is the first screen **152**A, and the lower half region is the second screen **152**B.

[0261] The CPU **62** controls the display **28** such that the unprocessed image **146**A is displayed on the first screen **152**A and the brightness adjusted image **150**A is displayed on the second screen **152**B. As a result, the unprocessed image **146**A and the brightness adjusted image **150**A are displayed on the display **28** in a distinguishable manner.

[0262] The CPU **62** displays a message **152**A**1** on the display **28** in a state corresponding to the unprocessed image **146**A. Further, the CPU **62** displays the message **152**B**1** on the display **28** in a state corresponding to the brightness adjusted image **150**A. In the example shown in FIG. **26**, the message **152**A**1** is associated with the unprocessed image **146**A by displaying the message **152**A**1** on the first screen **152**A, and the message **152**B**1** is associated with the brightness adjusted image **150**A by displaying the message **152**B**1** on the second screen **152**B.

[0263] The message **152**A**1** is a message that enables the specification of the unprocessed image **146**A, and the message **152**B**1** is a message that enables the specification of the fact that the brightness adjustment is performed on the simulation image **128**B. In the example shown in FIG. **26**, the message “Unprocessed image” is shown as an example of the message **152**A**1**, and the message “Image obtained by performing the brightness adjustment on the simulation image obtained by the second trained model” is shown as an example of the message **152**B**1**.

[0264] The content of the message **152**A**1** illustrated in FIG. **26** is only an example, and the message **152**A**1** may be a message indicating that the unprocessed image **146**A that is displayed on the first screen **152**A is an image obtained in a case where the processing that relies on the trained model is not performed. Further, the content of the message **152**B**1** illustrated in FIG. **26** is only an example, and the message **152**B**1** may be a message that enables the specification of the fact that the brightness adjusted image **150**A that is displayed on the second screen **152**B is an image obtained in a case where the brightness adjustment is performed based on the output of the second trained model **118**.

[0265] Here, although the message **152**A**1** specifies that the unprocessed image **146**A is an image that does not rely on the second trained model **118**, and the message **152**B**1** specifies that the brightness adjusted image **150**A is an image obtained in a case where the brightness adjustment is performed based on the output of the second trained model **118** with respect to the simulation image **128**B, the present disclosed technology is not limited to this. For example, color that enables the specification of the fact that the unprocessed image **146**A is an image that does not rely on the second trained model **118** may be used for an outer frame of the unprocessed image **146**A, and color that enables the specification of the fact that the brightness adjusted image **150**A is an image obtained in a case where the brightness adjustment is performed based on the output of the second trained model **118** may be used for an outer frame of the brightness adjusted image **150**A.

[0266] Further, a mark or the like that enables the specification of the fact that the unprocessed image **146**A is an image that does not rely on the second trained model **118** may be displayed in a state of being associated with the unprocessed image **146**A, and a mark or the like that enables the specification of the fact that the brightness adjusted image **150**A is an image obtained in a case where the brightness adjustment is performed based on the output of the second trained model **118** may be displayed in a state of being associated with the brightness adjusted image **150**A.

[0267] In the examples shown in FIGS. **25** and **26**, although an example of the embodiment in which the brightness adjusted image **150**A is an image generated based on the second set value **118**A output from the second trained model **118** in a case where the standard image **124**A is input to the second trained model **118** has been described, the present disclosed technology is not limited to this. For example, an image generated based on the second set value **118**A output from the second trained model **118** in a case where the captured image **75** is input to the second trained model **118** may be used instead of the standard image **124**A.

[0268] As an example shown in FIG. **27**, the eleventh processing execution unit **86**D**11** inputs the standard image **124**A included in the standard image set **124** to the second trained model **118**. The second trained model **118** outputs the second set value **118**A in a case where the standard image **124**A is input.

[0269] The eleventh processing execution unit **86**D**11** reflects the second set value **118**A on the control related to the imaging in the same manner as the processing performed by the first processing execution unit **86**D**1** shown in FIG. **12**, the processing performed by the third processing execution unit **86**D**3** shown in FIG. **14**, the processing performed by the seventh processing execution unit **86**D**7** shown in FIG. **21**, and the processing performed by the eighth processing execution unit **86**D**8** shown in FIG. **22**. As described above, the captured image **75**, which is acquired by being captured by the imaging apparatus **12** in a state where the second set value **118**A is reflected on the control related to the imaging, is stored in the image memory **46**. In the example shown in FIG. **27**, the captured image **75** stored in the image memory **46** is an example of a “third processed image” according to the present disclosed technology.

[0270] The CPU **62** of the imaging apparatus **12** acquires the captured image **75** from the image memory **46** and adds appended information **154**, which is appended to the captured image **75**, to the acquired captured image **75**. The appended information **154** includes, for example, the second set value **118**A used in the imaging to obtain the captured image **75**, the information indicating the characteristics of the imaging apparatus **12**, the imaging condition, the imaging date and time, and the like. Examples of the appended information **154** include Exif information. In the example shown in FIG. **27**, the appended information **154** is an example of “first appended information” according to the present disclosed technology.

[0271] The CPU **62** of the imaging apparatus **12** transmits the captured image **75** to which the appended information **154** is added to the eleventh processing execution unit **86**D**11**. The eleventh processing execution unit **86**D**11** receives the captured image **75** transmitted from the CPU **62** of the imaging apparatus **12**. The eleventh processing execution unit **86**D**11** executes processing of including the above-mentioned use model identifier **130**B in the appended information **154** added to the received captured image **75**, as the eleventh processing.

[0272] In the example shown in FIG. **27**, although an example of the embodiment in which the standard image **124**A is input to the second trained model **118** has been described, this is only an example, and the captured image **75** may be input to the second trained model **118**.

[0273] As an example shown in FIG. **28**, the twelfth processing execution unit **86**D**12** inputs the standard image **124**A included in the standard image set **124** to the first trained model **106**. The first trained model **106** outputs the first set value **106**A in a case where the standard image **124**A is input.

[0274] The twelfth processing execution unit **86**D**12** reflects the first set value **106**A on the control related to the imaging in the same manner as the processing performed by the first processing execution unit **86**D**1** shown in FIG. **12**, the processing performed by the third processing execution unit **86**D**3** shown in FIG. **14**, the processing performed by the seventh processing execution unit **86**D**7** shown in FIG. **21**, the processing performed by the eighth processing execution unit **86**D**8** shown in FIG. **22**, and the processing performed by the eleventh processing execution unit **86**D**11** shown in FIG. **27**. As described above, the captured image **75**, which is acquired by being captured by the imaging apparatus **12** in a state where the first set value **106**A is reflected on the control related to the imaging, is stored in the image memory **46**. In the example shown in FIG. **28**, the captured image **75** stored in the image memory **46** is an example of a "fourth processed image" according to the present disclosed technology.

[0275] The CPU **62** of the imaging apparatus **12** acquires the captured image **75** from the image memory **46** and adds appended information **154**, which is appended to the captured image **75**, to the acquired captured image **75**. The appended information **154** includes, for example, the first set value **106**A used in the imaging to obtain the captured image **75**, the information indicating the characteristics of the imaging apparatus **12**, the imaging condition, the imaging date and time, and the like. Examples of the appended information **154** include Exif information. In the example shown in FIG. **28**, the appended information **154** is an example of "second appended information" according to the present disclosed technology.

[0276] The CPU **62** of the imaging apparatus **12** transmits the captured image **75** to which the appended information **154** is added to the twelfth processing execution unit **86**D**12**. The twelfth processing execution unit **86**D**12** receives the captured image **75** transmitted from the CPU **62** of the imaging apparatus **12**. The twelfth processing execution unit **86**D**12** executes processing of including the above-mentioned use model identifier **130**A in the appended information **154** added to the received captured image **75**, as the twelfth processing.

[0277] Next, the operation of the imaging system **10** will be described with reference to FIGS. **29**A and **29**B.

[0278] FIGS. **29**A and **29**B show an example of a flow of the imaging support processing performed by the CPU **86** of the imaging support apparatus **14**. The flow of the imaging support processing shown in FIGS. **29**A and **29**B is an example of an "imaging support method" according to the present disclosed technology.

[0279] In the imaging support processing shown in FIG. **29**A, first, in step ST**100**, the teacher data generation unit **86**A determines whether or not the captured image **75** is stored in the image memory **46** of the imaging apparatus **12**. In step ST**100**, in a case where the captured image **75** is not stored in the image memory **46** of the imaging apparatus **12**, the determination is set as negative, and the determination in step ST**100** is performed again. In step ST**100**, in a case where the captured image **75** is stored in the image memory **46** of the imaging apparatus **12**, the determination is set as positive, and the imaging support processing shifts to step ST**102**.

[0280] In step ST**102**, the teacher data generation unit **86**A acquires the captured image **75** from the image memory **46**. After the processing in step ST**102** is executed, the imaging support processing shifts to step ST**104**.

[0281] In step ST**104**, the teacher data generation unit **86**A acquires various set values **102** from the NVM **64** of the imaging apparatus **12**. After the processing in step ST**104** is executed, the imaging support processing shifts to step ST**106**.

[0282] In step ST**106**, the teacher data generation unit **86**A generates teacher data **98** based on the captured image **75** acquired in step ST**102** and various set values **102** acquired in step ST**104**, and stores the generated teacher data **98** in the storage **88**. After the processing in step ST**106** is executed, the imaging support processing shifts to step ST**108**.

[0283] In step ST**108**, the determination unit **86**C determines whether or not a first learning processing execution timing, which is the timing for executing the learning processing for the CNN **104**, has arrived. Examples of the first learning processing execution timing include the timing when the number of imaging frames reaches the first threshold value (for example, "10000").

[0284] In step ST**108**, in a case where the first learning processing execution timing has not arrived, the determination is set as negative, and the imaging support processing shifts to step ST**100**. In a case where the first learning processing execution timing has arrived in step ST**108**, the determination is set as positive, and the imaging support processing shifts to step ST**110**.

[0285] In step ST**110**, the model generation unit **86**B generates the first trained model **106** by performing the learning processing on the CNN **104** by using the teacher data **98** stored in the storage **88**. After the processing in step ST**110** is executed, the imaging support processing shifts to step ST**112**.

[0286] In step ST**112**, the determination unit **86**C determines whether or not the number of imaging frames has reached the first threshold value. In step ST**112**, in a case where the number of imaging frames has not reached the first threshold value, the determination is set as negative, and the determination in step ST**112** is performed again. In step ST**112**, in a case where the number of imaging frames has reached the first threshold value, the determination is set as positive, and the imaging support processing shifts to step ST**114**.

[0287] In step ST**114**, the model generation unit **86**B generates the replication model **116** from the first trained model **106** generated in step ST**110**. After the processing in step ST**114** is executed, the imaging support processing shifts to step ST**116**.

[0288] In step ST**116**, the teacher data generation unit **86**A determines whether or not the captured image **75** is stored in the image memory **46** of the imaging apparatus **12**. In step ST**116**, in a case where the captured image **75** is not stored in the image memory **46** of the imaging apparatus **12**, the determination is set as negative, and the determination in step ST**116** is performed again. In step ST**116**, in a case where the captured image **75** is stored in the image memory **46** of the imaging apparatus **12**, the determination is set as positive, and the imaging support processing shifts to step ST**118**.

[0289] In step ST**118**, the teacher data generation unit **86**A acquires the captured image **75** from the image memory **46**. After the processing in step ST**118** is executed, the imaging support processing shifts to step ST**120**.

[0290] In step ST**120**, the teacher data generation unit **86**A acquires various set values **102** from the NVM **64** of the imaging apparatus **12**. After the processing in step ST**120** is executed, the imaging support processing shifts to step ST**122**.

[0291] In step ST**122**, the teacher data generation unit **86**A generates teacher data **98** based on the captured image **75** acquired in step ST**118** and various set values **102** acquired in step ST**120**, and stores the generated teacher data **98** in the storage **88**. After the processing in step ST**122** is executed, the imaging support processing shifts to step ST**124**.

[0292] In step ST**124**, the determination unit **86**C determines whether or not a second learning processing execution timing, which is a timing for executing the learning processing for the replication model **116** generated in step ST**114**, has arrived. Examples of the second learning processing execution timing include the timing when the number of imaging frames reaches the first threshold value (for example, “1000”).

[0293] In step ST**124**, in a case where the second learning processing execution timing has not arrived, the determination is set as negative, and the imaging support processing shifts to step ST**116**. In step ST**124**, in a case where the second learning processing execution timing has arrived, the determination is set as positive, and the imaging support processing shifts to step ST**126** shown in FIG. **29**B.

[0294] In step ST**126** shown in FIG. **29**B, by using the teacher data **98** (as an example, the teacher data **98** obtained by repeating the processing in steps ST**116** to ST**124**) stored in the storage **88**, the model generation unit **86**B generates the second trained model **118** by performing the learning processing on the latest model (for example, the replication model **116** in a case where the first positive determination is made in step ST**124**, and the existing second trained model **118** in a case where the second and subsequent positive determination are made in step ST**124**, (that is, the latest trained model **118**)). After the processing in step ST**126** is executed, the imaging support processing shifts to step ST**128**.

[0295] In step ST**128**, the execution unit **86**D acquires the standard image set **124** from the storage **88**. After the processing in step ST**128** is executed, the imaging support processing shifts to step ST**130**.

[0296] In step ST**130**, the execution unit **86**D inputs the standard image set **124** acquired in step

ST**128** to the first trained model **106** and the second trained model **118**. After the processing in step ST**130** is executed, the imaging support processing shifts to step ST**132**.

[0297] In step ST**132**, the execution unit **86**D acquires the first set value **106**A output from the first trained model **106** and the second set value **118**A output from the second trained model **118**. After the processing in step ST**132** is executed, the imaging support processing shifts to step ST**134**.

[0298] In step ST**134**, the execution unit **86**D calculates the degree of difference **125** between the first set value **106**A and the second set value **118**A acquired in step ST**132**. After the processing in step ST**134** is executed, the imaging support processing shifts to step ST**136**.

[0299] In step ST**136**, the execution unit **86**D determines whether or not the degree of difference **125**, which is calculated in step ST**134**, is equal to or greater than the second threshold value.

[0300] In step ST**136**, in a case where the degree of difference **125**, which is calculated in step ST**134**, is less than the second threshold value, the determination is set as negative, and the imaging support processing shifts to step ST**116** shown in FIG. **29**A. In step ST**136**, in a case where the degree of difference **125**, which is calculated in step ST**134**, is equal to or greater than the second threshold value, the determination is set as positive, and the imaging support processing shifts to step ST**138**.

[0301] In step ST**138**, the execution unit **86**D executes the specific processing. After the processing in step ST**138** is executed, the imaging support processing is ended.

[0302] As described above, in the imaging support apparatus **14**, the first trained model **106** is stored in the storage **88**, and the first trained model **106** is used for the control related to the imaging. Further, in the imaging support apparatus **14**, the various set values **102**, which are applied to the imaging apparatus **12** in a case where the captured image **75** is acquired, are defined as the correction data **100**, and the learning processing, in which the captured image **75** and the correction data **100** are used as the teacher data **98**, is performed on the learning model, thereby the second trained model **118** that is used for the control related to the imaging is generated. Thereafter, the specific processing is performed based on the first set value **106**A output from the first trained model **106** in a case where the standard image set **124** is input to the first trained model **106** and the second set value **118**A output from the second trained model **118** in a case where the standard image set **124** is input to the second trained model **118**. Therefore, the present configuration can contribute to reducing the load on the CPU **86** and/or the user as compared with the case where only the processing irrelevant to the degree of difference between the first trained model **106** and the second trained model **118** is performed.

[0303] In the imaging support apparatus **14**, the standard image set **124** is stored in the storage **88**. Therefore, according to the present configuration, the processing of inputting the standard image set **124** to the first trained model **106** and the second trained model **118** can be easily implemented as compared with the case where the image that is input to the first trained model **106** and the second trained model **118** is not stored in the memory such as the storage **88**.

[0304] In the imaging support apparatus **14**, the second trained model **118** is generated by performing the learning processing in a case where the condition that the number of imaging frames reaches the first threshold value is satisfied. Therefore, according to the present configuration, the load on the learning processing can be reduced as compared with the case where the learning processing is constantly performed.

[0305] In the imaging support apparatus **14**, the plurality of captured images **75** acquired by being captured by the imaging apparatus **12** during the period from the time (for example, the time when the replication model **116** is generated) when the latest learning model to be the target of the learning processing is obtained to the time when the condition that the number of imaging frames reaches the first threshold value is satisfied, and the various set values, which are related to the plurality of captured images **75** and applied to the imaging apparatus **12**, are used as the teacher data **98**. Therefore, according to the present configuration, the load on the CPU **86** required for the learning processing can be reduced as compared with the case where the learning processing, in which the single captured image **75** and the single set value are used as the teacher data, is performed each time the imaging is performed.

[0306] In the imaging support apparatus **14**, the specific processing is performed in a case where the condition that the number of imaging frames reaches the first threshold value is satisfied. Therefore, according to the present configuration, the load on the CPU **86** can be reduced as compared with the case where the specific processing is constantly performed.

[0307] In the imaging support apparatus **14**, the specific processing is performed in a case where the degree of difference **125** between the first set value **106**A and the second set value **118**A is equal to or greater than the second threshold value. Therefore, according to the present configuration, the load on the CPU **86** can be reduced as compared with the case where the specific processing is constantly performed regardless of the degree of difference **125** between the first set value **106**A and the second set value **118**A.

[0308] In the imaging support apparatus **14**, as the first processing included in the specific processing, processing of reflecting the second set value **118**A on the control related to the imaging is performed. Therefore, according to the present configuration, the control related to the imaging can be made closer to the control intended by the user or the like, as compared with the case where only the first trained model **106** is constantly used for the control related to the imaging.

[0309] In the imaging support apparatus **14**, as the second processing included in the specific processing, processing of storing the second trained model **118** in the storage device **94** for backup is performed. Therefore, according to the present configuration, the same second trained model **118** can be used repeatedly.

[0310] In the imaging support apparatus **14**, as the third processing included in the specific processing, processing of reflecting the output of the trained model, among the first trained model **106** and the second trained model **118**, selected according to the received instruction by the third processing execution unit **86**D**3** on the control related to the imaging. Therefore, according to the present configuration, the output from the trained model, among the first trained model **106** and the second trained model **118**, corresponding to the preference of the user or the like can be reflected on the control related to the imaging.

[0311] In the imaging support apparatus **14**, as the fourth processing included in the specific processing, data for displaying the simulation image **128**A, which corresponds to an image obtained by applying the first set value **106**A output from the first trained model **106** by inputting the standard image set **124** to the first trained model **106** to the standard image set **124**, and a simulation image **128**B, which is obtained by applying the second set value **118**A output from the second trained model **118** by inputting the standard image set **124** to the second trained model **118** to the standard image set **124**, on the display **28** is transmitted to the imaging apparatus **12**. Therefore, according to the present configuration, it is possible for the user or the like to visually recognize a difference between the output of the first trained model **106** and the output of the second trained model **118**.

[0312] In the imaging support apparatus **14**, the simulation image **128**A, which corresponds to an image obtained by applying the first set value **106**A output from the first trained model **106** by inputting the standard image set **124** to the first trained model **106** to the standard image set **124**, and a simulation image **128**B, which is obtained by applying the second set value **118**A output from the second trained model **118** by inputting the standard image set **124** to the second trained model **118** to the standard image set **124**, are displayed on the display **28** in a distinguishable manner. Therefore, according to the present configuration, the user or the like can easily perceive a difference between the simulation image **128**A and the simulation image **128**B as compared with the case where the simulation image **128**A and the simulation image **128**B are displayed on the display **28** in an indistinguishable state.

[0313] In the imaging support apparatus **14**, the simulation image **128**A and the message **132**A**1** are displayed on the first screen **132**A in a state of being associated with each other, and the simulation image **128**B and the message **132**B**1** are displayed on the second screen **132**B in a state of being associated with each other. Therefore, according to the present configuration, the user or the like can easily perceive that the simulation image **128**A is an image obtained by using the first trained model **106**, and the simulation image **128**B is an image obtained by using the second trained model **118**.

[0314] In the imaging support apparatus **14**, as the fourth processing included in the specific processing, data for displaying the simulation image **128**A, which corresponds to an image obtained by applying the first set value **106**A output from the first trained model **106** by inputting the standard image set **124** to the first trained model **106** to the standard image set **124**, and a simulation image **128**B, which is obtained by applying the second set value **118**A output from the second trained model **118** by inputting the standard image set **124** to the second trained model **118** to the standard image set **124**, on the display **28** is transmitted to the imaging apparatus **12**. Therefore, according to the present configuration, the output of the trained model, among the first trained model **106** and the second trained model **118**, that is intended by the user or the like can be easily reflected on the control related to the imaging as compared with the case where the output of the trained model, which is randomly selected from the first trained model **106** and the second trained model **118**, is reflected on the control related to the imaging.

[0315] In the imaging support apparatus **14**, as the fifth processing included in the specific processing, data for displaying the time specification information **136** that enables the specification of the time when the second trained model **118** is generated on the display **28** is transmitted to the imaging apparatus **12**. Therefore, according to the present configuration, the user or the like can perceive the time when the second trained model **118** is generated.

[0316] In the imaging support apparatus **14**, the second set value reflected image **138**, in which the output of the second trained model **118** is reflected, and the time specification information **136** are displayed on the display **28** in a state of being associated with each other. Therefore, according to the present configuration, the user or the like can perceive a correspondence relationship between the time when the second trained model **118** is generated and the image obtained in a case where the output of the second trained model **118** is reflected.

[0317] In the imaging support apparatus **14**, as the sixth processing included in the specific processing, processing of associating the time specification information **136** with the second trained model **118** is performed. Therefore, according to the present configuration, the user or the like can perceive a correspondence relationship between the time when the second trained model **118** is generated and the second trained model **118**.

[0318] In the imaging support apparatus **14**, as the seventh processing included in the specific processing, processing of reflecting the output of the second trained model **118** on the control related to the imaging is performed at the predetermined timing. Therefore, according to the present configuration, for example, the trained model can be updated at a timing convenient for the user as compared with the case where the trained model is updated at the timing in a case where a significant difference is determined.

[0319] In the imaging support apparatus **14**, as the seventh processing included in the specific processing, processing of reflecting the output of the second trained model **118** on the control related to the imaging is performed at the timing when the imaging apparatus **12** is activated, timing when the number of captured images **75**, which are acquired by being captured by the imaging apparatus **12**, (as an example, the number of captured images **75** acquired by being captured by the imaging apparatus **12** after the latest second set value **118**A is stored in the storage **88**) becomes equal to or greater than a sixth threshold value (for example, “10000”), timing when the operation mode of the imaging apparatus **12** transitions from the playback mode to the setting mode, or timing when rating (for example, evaluation by the user or the like for the image quality of the captured image **75**) is performed on the captured images **75** in the playback mode. Therefore, according to the present configuration, for example, the trained model can be updated at a timing

convenient for the user as compared with the case where the trained model is updated at the timing in a case where a significant difference is determined.
[0320] In the imaging support apparatus **14**, as the eighth processing included in the specific processing, in a case where the second trained model **118** is applied to a different apparatus **140** that is an imaging apparatus different from the imaging apparatus **12**, processing of correcting at least one of the data input to the second trained model **118** or the output from the second trained model **118** is performed based on the characteristics of the imaging apparatus **12** and the characteristics of the different apparatus **140**. Therefore, according to the present configuration, the image quality of the image obtained by being captured by the different apparatus **140** can be easily made closer to the image quality intended by the user or the like as compared with the case where the second trained model **118** is applied to the different apparatus without considering the characteristics of the imaging apparatus **12** and the characteristics of the different apparatus **140** at all.
[0321] In the imaging support apparatus **14**, the image sensor information **142** is appended to the second trained model **118**, and the characteristic information **142**A and the individual difference information **142**B are included in the image sensor information **142**. Thereafter, the characteristics of the imaging apparatus **12** and the characteristics of the different apparatus **140** are specified based on the image sensor information **142**. Therefore, according to the present configuration, it is possible to more accurately reproduce the image quality intended by the user or the like with respect to the image obtained by being captured by the different apparatus **140** as compared with the case where the second trained model **118** is applied to the different apparatus **140** without considering the difference between the image sensor **20** used in the imaging apparatus **12** and the image sensor **140**A used in the different apparatus **140** at all.
[0322] In the imaging support apparatus **14**, as the ninth processing included in the specific processing, the simulation image **128**B obtained by applying the second set value **118**A, which is output from the second trained model **118** by inputting the standard image set **124** to the second trained model **118**, to the standard image set **124**, and the unprocessed image **146**A are displayed on the display **28**. The unprocessed image **146**A is an image (for example, an image corresponding to the standard image **124**A included in the standard image set **124**) obtained without applying the second set value **118**A, which is output from the second trained model **118** by inputting the standard image **124**A included in the standard image set **124** to the second trained model **118**, to the standard image **124**A. Therefore, according to the present configuration, the user or the like can perceive the difference between the image affected by the output of the second trained model **118** and the image not influenced by the output.
[0323] In the imaging support apparatus **14**, as the tenth processing included in the specific processing, data for displaying the brightness adjusted image **150**A obtained by applying the second set value **118**A, which is output from the second trained model **118** by inputting the standard image set **124** to the second trained model **118**, to the standard image set **124** and by adjusting the brightness, and the unprocessed image **146**A on the display **28** is transmitted to the imaging apparatus **12**. Therefore, according to the present configuration, the user or the like can perceive the difference between the unprocessed image and the image obtained in a case where the brightness of the image, which is influenced by the output of the second trained model **118**, is adjusted.
[0324] In the imaging support apparatus **14**, as the eleventh processing included in the specific processing, processing of including the use model identifier **130**B in the appended information **154** added to the captured image **75** is performed. Therefore, according to the present configuration, it is easy to specify that the image, which is obtained by being captured with the output of the second trained model **118** reflected on the control related to the imaging, is an image obtained by using the second trained model **118** as compared with the case where the image, which is obtained by being captured with the output of the second trained model **118** reflected on the control related to the

imaging, is not associated with the information that enables the specification of the second trained model **118**.

[0325] In the imaging support apparatus **14**, as the twelfth processing included in the specific processing, processing of including the use model identifier **130**A in the appended information **154** added to the captured image **75** is executed. Therefore, according to the present configuration, it is easy to specify that the image, which is obtained by being captured with the output of the first trained model **106** reflected on the control related to the imaging, is an image obtained by using the first trained model **106** as compared with the case where the image, which is obtained by being captured with the output of the first trained model **106** reflected on the control related to the imaging, is not associated with the information that enables the specification of the first trained model **106**.

[0326] In the imaging support apparatus **14**, the various set values **102** are used as the teacher data **98**. As the various set values **102**, a set value related to white balance used in the imaging, a set value related to exposure used in the imaging, a set value related to saturation used in the imaging, and a set value related to gradation used in the imaging are adopted. Therefore, according to the present configuration, as the teacher data **98**, at least one of a set value related to the white balance used in the imaging, a set value related to the exposure used in the imaging, a set value related to the saturation used in the imaging, or a set value related to the gradation used in the imaging can be easily made to closer to the set value intended by the user or the like as compared with the case of using the set value that is completely irrelevant to the set value related to the white balance used in the imaging, the set value related to the exposure used in the imaging, the set value related to the saturation used in the imaging, and the set value related to the gradation used in the imaging.

[0327] Further, a set value related to the focus used in the imaging may be used as the teacher data **98**. Examples of the set value related to the focus used in the imaging include a set value related to a focus frame used for the AF control, a set value related to an AF method being used (for example, a phase difference AF method, a contrast AF method, or the like), and/or the like. In this case, as the teacher data **98**, the set value related to the focus used in the imaging can be easily made closer to the set value intended by the user or the like as compared with the case of using a set value that is completely irrelevant to the set value related to the focus used in the imaging.

[0328] The set value **102** used as the teacher data **98** may be at least one of the set value related to the white balance used in the imaging, the set value related to the exposure used in the imaging, the set value related to the saturation used in the imaging, the set value related to the gradation used in the imaging, or the set value related to the focus used in the imaging.

[0329] In the above embodiment, although an example of the embodiment (see FIG. **10**) in which the verification is performed by inputting the standard image set **124** to the first trained model **106** and the second trained model **118** has been described, the present disclosed technology is not limited to this. For example, as shown in FIG. **30**, the verification may be performed by inputting 1000 captured images **75** to the first trained model **106** and the second trained model **118**. In this case, as an example shown in FIG. **31**, each time the captured image **75** is stored in the image memory **46** of the imaging apparatus **12**, the captured image **75** is also stored in the storage **88**. Thereafter, in a case where the number of captured images **75** stored in the storage **88** reaches 1000, the execution unit **86**D inputs the 1000 captured images **75**, which is in the storage **88**, to the first trained model **106** and the second trained model **118**. As a result, the first trained model **106** outputs the first set value **106**A corresponding to the input captured image **75**, and the second trained model **118** outputs the second set value **118**A corresponding to the input captured image **75**. The execution unit **86**D calculates the degree of difference **125** between the first set value **106**A and the second set value **118**A and determines whether or not the degree of difference **125** is equal to or greater than the second threshold value.

[0330] In this case, for example in a case where the second trained model **118** is generated by performing the learning processing by using the 1000 captured images **75**, and the 1000 captured images **75**, which are used in the learning processing for generating the second trained model **118**, are provided one by one with respect to the generated second trained model **118** and first trained model **106** as an input for the verification, the trained model that is used for the operation may be switched to the latest trained model, or the specific processing may be performed, under the condition that the number of images, for which the degree of difference **125** between the first set value **106**A and the second set value **118**A reaches the second threshold value, reaches the designated number of images (for example, 800).

[0331] Further, an example of the embodiment, in which the verification is not performed until the 1000 captured images **75** are accumulated, is only an example, and the trained model that is used for the operation may be switched to the latest trained model, or the specific processing may be performed at the step where the verification is performed each time one image is captured and the number of images, for which the degree of difference **125** between the first set value **106**A and the second set value **118**A reaches the second threshold value, reaches the designated number of images.

[0332] Here, although an example of the embodiment in which the 1000 captured images **75** are input to the first trained model **106** and the second trained model **118** has been described, this is only an example, and the number of captured images **75** of less than 1000 images (for example, 100) or the number of captured images **75** of more than 1000 images (for example, 10000) may be input to the first trained model **106** and the second trained model **118**.

[0333] In the above embodiment, although an example of the embodiment in which the specific processing is performed in a case where the degree of difference **125** is equal to or greater than the second threshold value has been described, the present disclosed technology is not limited to this. For example, as shown in FIG. **32**, the CPU **86** may perform predetermined processing under the condition that the number of images obtained by being captured within a default period reaches a third threshold value. Examples of the third threshold value include 5000 images after the replication model **116** is generated and 5000 images after the verification is performed, but the present disclosed technology is not limited to this, and a value corresponding to the number less than 5000 images may be used, or a value corresponding to the number more than 5000 images may be used. Further, a default period is, for example, one day. That is, for example, it may be determined whether or not the capturing related to 5000 or more images per day is performed. In a case where the image capturing related to the 5000 images is performed in one day, it is considered that the second trained model **118** has a larger significant difference than that of the first trained model **106**.

[0334] Examples of the predetermined processing include processing of storing the second trained model **118**, which is determined to have a significant difference between the output of the first trained model **106** and the output of the second trained model **118**, in the storage device **94** for backup and/or processing of determining that a significant difference has occurred between the output of the first trained model **106** and the output of the second trained model **118**. Here, the significant difference refers to, for example, the degree to which the tendency of the content (for example, the imaging scene) of the captured image **75**, which is used in the learning processing of the second trained model **118**, deviates from the tendency of the content of the captured image **75**, which is used in the learning processing of the first trained model **106**, by a default degree or more. Further, the significant difference refers to, for example, the degree to which the tendency of the content of the correction data **100**, which is used in the learning processing of the second trained model **118**, deviates from the tendency of the content of the correction data **100**, which is used in the learning processing of the first trained model **106**, by the default degree or more. The default degree may be a fixed value or may be a variable value that is changed according to the instruction, which is provided to the imaging support apparatus **14** by the user or the like, and/or various conditions. Although the processing is predetermined here, it does not need to be predetermined, for example, the user may be allowed to select the processing under the condition that the number of images, which are captured within the default period, reaches the third threshold value.

[0335] According to the configuration in which the predetermined processing is performed under the condition that the number of images obtained by being captured reaches the third threshold value, the load on the CPU **86** can be reduced as compared with the case where the predetermined processing is performed regardless of the number of images obtained by being captured. Further, for example, in a case where the processing of storing the second trained model **118**, which is determined to have a significant difference, in the storage device **94** for backup is performed under the condition that the number of images obtained by being captured reaches the third threshold value, only the second trained model **118**, which is considered to have a particularly large difference, can be stored in the storage device **94** for backup as compared with the case where all the second trained models **118**, which is determined to have a significant difference, are stored in the storage device **94** for backup.

[0336] Further, the CPU **86** may perform the predetermined processing in a case where the number of captured images **75**, which is acquired by performing the imaging under a first environment during the default period and used as the teacher data **98**, is equal to or greater than a fourth threshold value, and in a case where the number of captured images **75**, which is obtained by performing the imaging under a second environment different from the first environment and used as the teacher data **98**, is equal to or less than a fifth threshold value. The default period refers to, for example, one day. For example, in a case where the fourth threshold value is significantly greater than the fifth threshold value (for example, the fourth threshold value is 1000 and the fifth threshold value is 10) and the number of captured images **75** satisfies the above condition, it is considered that the captured images **75** include many images obtained by being captured under the first environment. That is, it is considered that the captured image **75**, which is the basis of the teacher data **98**, is obtained by being captured under the first environment in a biased manner. It is considered that the second trained model **118** has a larger significant difference than that of the first trained model **106** in a case where the learning is performed by using the teacher data **98** imaged under the first environment in a biased manner. Examples of this specific processing also include processing of storing the second trained model **118** in the storage device **94** for backup, processing of determining that a significant difference has occurred between the output of the first trained model **106** and the output of the second trained model **118**, and/or the like. These processing also do not need to be predetermined, for example, the user may be allowed to select these processing in a case where the number of captured images **75**, which is acquired by being captured under a first environment and used as the teacher data **98**, is equal to or greater than the fourth threshold value, and in a case where the number of captured images **75**, which is obtained by being captured under a second environment different from the first environment and used as the teacher data **98**, is equal to or less than the fifth threshold value. Further, the number of captured images **75** obtained under the second environment does not necessarily have to be used, for example, the above-mentioned predetermined processing may be performed by determining whether the ratio of the number of captured images **75**, which is acquired by being captured under the first environment with respect to the total number of captured images **75** obtained in one day, is equal to or greater than a default threshold value.

[0337] In this case, for example, as shown in FIG. **33**, the CPU **86** specifies the number of captured images **75** (hereinafter referred to as “the number of frames under the first environment”) acquired by performing the imaging under the first environment and the number of captured images **75** (hereinafter referred to as “the number of frames under the second environment”) acquired by performing the imaging under the second environment with reference to the appended information **154** of each of the captured images **75** from the 10000th image to the 11000th image, on the premise that the appended information **154** added to the captured image **75** includes information that enables the specification of the first environment and the second environment. Here, the first environment and the second environment refer to, for example, an environment specified from an imaging scene and a light source. The imaging scene refers to, for example, a person or a landscape, and the light source refers to, for example, the sun or an indoor light source.

[0338] The CPU **86** determines whether or not the condition (hereinafter, also referred to as a “determination condition”) that the number of frames under the first environment is equal to or greater than the fourth threshold value and the number of frames under the second environment is equal to or less than the fifth threshold value, is satisfied. Satisfying the determination condition means that a significant difference has occurred between the output of the first trained model **106** and the output of the second trained model **118**. Therefore, in a case where the determination condition is satisfied, the CPU **86** executes predetermined processing. The fourth threshold value and the fifth threshold value may be a fixed value or may be a variable value that is changed according to the instruction, which is provided to the imaging support apparatus **14** by the user or the like, and/or various conditions.

[0339] As described above, the CPU **86** specifies the number of frames under the first environment and the number of frames under the second environment with reference to the appended information **154** and determines whether or not the determination condition is satisfied based on the specific result. Therefore, according to the present configuration, it is possible to reduce the load on the CPU **86** from the acquisition of the captured image **75** by the CPU **86** to the time when the predetermined processing is performed as compared with the case where the captured image **75** is input to the first trained model **106** and the second trained model **118**, the first set value **106**A is output from the first trained model **106**, the second set value **118**A is output from the second trained model **118**, and the degree of difference **125** between the first set value **106**A and the second set value **118**A is calculated. Further, it is possible to store only the second trained model **118**, which is considered to have a particularly large difference, in the storage device **94** for backup by performing the processing of storing the second trained model **118**, which is determined to have a significant difference, in the storage device **94** for backup in a case where it is determined whether or not the capturing related to the image captured image **75**, which is used as the teacher data **98** under the first environment in a biased manner, is performed and the capturing related to the image captured image **75**, which is used as the teacher data **98** under the first environment in a biased manner, is performed, as compared with the case where all the second trained models **118**, which is determined to have a significant difference, are stored in the storage device **94** for backup.

[0340] In the example shown in FIG. **33**, although an example of the embodiment in which the CPU **86** specifies the number of frames under the first environment and the number of frames under the second environment with reference to the appended information **154** of the captured image **75** has been described, this is only an example, for example, as shown in FIG. **34**, the CPU **86** may specify the number of frames under the first environment and the number of frames under the second environment by performing subject recognition processing on each captured image **75**. The subject recognition processing may be an AI method subject recognition processing or a template matching method subject recognition processing.

[0341] In the above embodiment, although the fact that one type of interchangeable lens **18** is attached to the imaging apparatus main body **16** has been described as a premise, the present disclosed technology is not limited to this. For example, as shown in FIG. **35**, since the imaging apparatus **12** is a lens-interchangeable imaging apparatus, an interchangeable lens **18** of a different type is selectively attached to the imaging apparatus main body **16**. Therefore, the CPU **86** of the imaging support apparatus **14** generates a plurality of second trained models **118** by performing the learning processing on the learning model (for example, the replication model **116**, or the like) for each type of interchangeable lens **18** used in the imaging related to the captured image **75** included in the teacher data **98**. The CPU **86** stores the generated plurality of second trained models **118** in the storage **88**. Therefore, according to the present configuration, the output of the second trained model **118** suitable for the interchangeable lens **18** attached to the imaging apparatus main body **16** can be reflected on the control related to the imaging as compared with the case where the output from only one second trained model **118** is constantly reflected on the control related to the imaging regardless of the type of the interchangeable lens **18**.

[0342] Further, as an example shown in FIG. **36**, in a case where the interchangeable lens **18** is attached to the imaging apparatus main body **16**, the CPU **86** acquires the second trained model **118**, among the plurality of second trained models **118** in the storage **88**, corresponding to the interchangeable lens **18** attached to the imaging apparatus main body **16**. The second trained model **118**, which corresponds to the interchangeable lens **18** attached to the imaging apparatus main body **16**, refers to the second trained model **118** generated by using the captured image **75**, which is acquired by being captured by the imaging apparatus **12** equipped with the interchangeable lens **18**, in the learning processing as the teacher data **98**. The CPU **86** performs various processing (for example, the processing of reflecting the output of the second trained model **118** on the control related to the imaging, the learning processing with respect to the second trained model **118**, and/or the like) by using the second trained model **118** acquired from the storage **88**. Therefore, according to the present configuration, the processing can be performed by using the second trained model **118**, among the plurality of second trained models **118**, suitable for the interchangeable lens **18** as compared with the case where the processing is performed by using randomly selected one second trained model **118** among the plurality of second trained models **118**.

[0343] In the examples shown in FIGS. **35** and **36**, although an example of the embodiment in which the second trained model **118**, which corresponds to the interchangeable lens **18** attached to the imaging apparatus main body **16**, is used in a case where the interchangeable lens **18** of a different type is selectively attached to the imaging apparatus main body **16** has been described, in the same manner as above, the second trained model **118** corresponding to the selected imaging system may be used in a case where a plurality of imaging systems each having a function of imaging a subject are selectively used.

[0344] For example, as shown in FIG. **37**, in a case where the smart device **155** has the imaging systems **155**A and **155**B as the plurality of imaging systems and each of the first imaging system **155**A and the second imaging system **155**B is used in the imaging related to the captured image **75** included in the teacher data **98**, the CPU **86** of the imaging support apparatus **14** generates the plurality of second trained models **118** by performing the learning processing on the learning model (for example, the replication model **116**, or the like) for each of the first imaging system **155**A and the second imaging system **155**B. The CPU **86** stores the generated plurality of second trained models **118** in the storage **88**. Therefore, according to the present configuration, the output of the second trained model **118**, which is suitable for the imaging system to be used among the first imaging system **155**A and the second imaging system **155**B, can be reflected on the control related to the imaging performed by the imaging system to be used among the first imaging system **155**A and the second imaging system **155**B as compared with the case where the output from only one second trained model **118** is constantly reflected on the control related to the imaging performed by the first imaging system **155**A and the second imaging system **155**B of the smart device **155**. The smart device **155** is an example of the “imaging apparatus” according to the present disclosed technology, and the first imaging system **155**A and the second imaging system **155**B are examples of the “plurality of imaging systems” according to the present disclosed technology.

[0345] Further, as an example shown in FIG. **38**, in a case where an imaging system to be used in the imaging is selected from the first imaging system **155**A and the second imaging system **155**B, the CPU **86** acquires the second trained model **118**, which corresponds to the imaging system selected from the first imaging system **155**A and the second imaging system **155**B, among the plurality of second trained models **118** in the storage **88**. The second trained model **118**, which corresponds to the imaging system selected from the first imaging system **155**A and the second imaging system **155**B, refers to the second trained model **118** generated by using the captured image **75**, which is acquired by being captured by the selected imaging system from the first imaging system **155**A and the second imaging system **155**B, in the learning processing as the teacher data **98**. The CPU **86** performs various processing (for example, the processing of reflecting the output of the second trained model **118** on the control related to the imaging performed by the imaging system selected from the first imaging system **155**A and the second imaging system **155**B, the learning processing with respect to the second trained model **118**, and/or the like) by using the second trained model **118** acquired from the storage **88**. Therefore, according to the present configuration, the processing can be performed by using the second trained model **118**, which is suitable for the selected imaging system from the first imaging system **155**A and the second imaging system **155**B, among the plurality of second trained models **118**, as compared with the case where the processing is performed by using randomly selected one second trained model **118** among the plurality of second trained models **118**.

[0346] FIG. **39** shows an example of the configuration of the smart device **156** equipped with the plurality of imaging systems having a magnification changing function. As an example shown in FIG. **39**, the smart device **156** includes the first imaging system **156**A and the second imaging system **156**B. Each of the first imaging system **156**A and the second imaging system **156**B is also generally referred to as an out camera. Each of the first imaging systems **156**A and **158**B has the magnification changing function in which magnification changing ranges are different from each other. Further, as in the examples shown in FIGS. **37** and **38**, the second trained model **118** is assigned to each of the first imaging system **156**A and the second imaging system **156**B.

[0347] As an example shown in FIG. **40**A, the smart device **156** includes a touch panel display **158**. The touch panel display **158** has a display **160** and a touch panel **162**, and in a case where an angle of view change instruction is provided to the touch panel **162** in a state where the captured image **164** is displayed on the display **160** as a live view image, the magnification changing function is operated and the angle of view is changed. In the example shown in FIG. **40**A, a pinch-out operation is shown as the angle of view change instruction. In a case where the pinch-out operation is performed on the touch panel **162** in a state where the captured image **164** is displayed on the display **160**, the magnification changing function is operated and the captured image **164** is enlarged in the display **160**. The method of magnification changing is not limited to this, and as an example shown in FIG. **40**B, an embodiment may be used in which the magnification is directly selected by using the softkeys **160**A, **160**B, and **160**C. In the example shown in FIG. **40**B, the softkey **160**A is a softkey that is turned on in a case where “1 time” is selected as the magnification, the softkey **160**B is a softkey that is turned on in a case where “0.5 times” is selected as the magnification, and the softkey **160**C is a softkey that is turned on in a case where “2.5 times” is selected as the magnification. The magnification illustrated here is only an example and may be another magnification. Further, the number of softkeys is not limited to three of the softkeys **160**A, **160**B, and **160**C and may be two or may be four or more.

[0348] As an example shown in FIG. **41**, the smart device **156** transmits use imaging system information **166**, which enables the specification of the imaging system being used at a current timing among the first imaging system **156**A and the second imaging system **156**B, and the captured image **164**, which is acquired by being captured by the imaging system being used at a current timing, to the imaging support apparatus **14**. The captured image **164** is classified into the captured image **164**A acquired by being captured by the first imaging system **156**A and the captured image **164**B acquired by being captured by the second imaging system **156**B.

[0349] The imaging support apparatus **14** has the second trained model **118** for the first imaging system **156**A and the second trained model **118** for the second imaging system **156**B, and the second trained model **118** for the first imaging system **156**A is a model obtained by performing the learning processing, in which the set value that is applied to the first imaging system **156**A as the teacher data, with the plurality of captured images **164**A and the image capturing for obtaining the plurality of captured images **164**A. The second trained model **118** for the second imaging system **156**B is a model obtained by performing the learning processing, in which the set value that is applied to the second imaging system **156**B as the teacher data, with the plurality of captured

images **164**B and the image capturing for obtaining the plurality of captured images **164**B.
[0350] The CPU **86** of the imaging support apparatus **14** receives the use imaging system information **166** and the captured image **164** that are transmitted from the smart device **156**. The CPU **86** inputs the received captured image **164** to the second trained model **118** corresponding to the imaging system specified from the received use imaging system information **166**. For example, in a case where the imaging system that is specified from the received use imaging system information **166** is the first imaging system **156**A, the CPU **86** inputs the captured image **164**A to the second trained model **118** for the first imaging system **156**A. Further, in a case where the imaging system that is specified from the received use imaging system information **166** is the second imaging system **156**B, the CPU **86** inputs the captured image **164**B to the second trained model **118** for the second imaging system **156**B.
[0351] The second trained model **118** for the first imaging system **156**A outputs the second set value **118**A in a case where the captured image **164**A is input. The CPU **86** reflects the second set value **118**A output from the second trained model **118** for the first imaging system **156**A on the control related to the imaging performed by the first imaging system **156**A. Further, the second trained model **118** for the second imaging system **156**B outputs the second set value **118**A in a case where the captured image **164**B is input. The CPU **86** reflects the second set value **118**A output from the second trained model **118** for the second imaging system **156**B on the control related to the imaging performed by the second imaging system **156**B.
[0352] Examples of a method of switching the imaging system, that is used in the imaging, from one of the first imaging system **156**A or the second imaging system **156**B to the other include a method of switching the imaging system each time at least one softkey (not shown), which is displayed on the display **160**, is turned on, and a method of switching the imaging system in a step-less manner in a case where a step-less instruction such as a pinch-in operation and a pinch-out operation is provided to the touch panel **162**. In the method of switching the imaging system in a step-less manner, CPU**86** changes the angle of view in a step-less manner according to the step-less instruction such as the pinch-in operation and the pinch-out operation and one of the first imaging system **156**A or the second imaging system **156**B may be switched to the other while the angle of view is being changed. That is, it is not possible to switch from one of the first imaging system **156**A or the second imaging system **156**B to the other, in a case where the angle of view is changed within a range (hereinafter, also referred to as a “overlapping magnification changing range”) in which the magnification changing range of the first imaging system **156**A and the magnification changing range of the second imaging system **156**B overlap with each other or within a range (hereinafter, also referred to as a “non-overlapping magnification changing range”) in which the magnification changing range of the first imaging system **156**A and the magnification changing range of the second imaging system **156**B do not overlap with each other, but the switching from one of the first imaging system **156**A or the second imaging system **156**B to the other is accompanied in a case where the angle of view is changed from one of the overlapping magnification changing range or the non-overlapping magnification changing range to the other.
[0353] The output of the second trained model **118** for the first imaging system **156**A is reflected on the control related to the imaging performed by the first imaging system **156**A, and the output of the second trained model **118** for the second imaging system **156**B is reflected on the control related to the imaging performed by the second imaging system **156**B. Therefore, as an example shown in FIG. **42**, in a case where the switching is performed from one of the first imaging system **156**A or the second imaging system **156**B to the other while the angle of view is being changed, hunting may occur for the captured image **164** due to the difference between the second trained model **118** for the first imaging system **156**A and the second trained model **118** for the second imaging system **156**B.
[0354] Therefore, as an example shown in FIG. **43**, the CPU **86** of the imaging support apparatus **14** receives the step-less instruction (hereinafter, referred to as an “angle of view change

instruction”) received by the touch panel **162** of the smart device **156** as an instruction to change the angle of view. Thereafter, in a case where the received angle of view change instruction is an instruction that accompanies a switch of the imaging system during the operation, the CPU **86** continues to use the second trained model **118** assigned to the imaging system before the switch, in the imaging system after the switch. As a result, even in a case where one of the first imaging system **156**A or the second imaging system **156**B is switched to the other, it is possible to avoid hunting due to the difference between the second trained models **118** at a timing not intended by the user or the like.

[0355] The smart device **156** is an example of the “imaging apparatus” according to the present disclosed technology, and the first imaging system **156**A and the second imaging system **156**B are examples of the “plurality of imaging systems” according to the present disclosed technology.

[0356] By the way, at the timing when the smart device **156** is activated (hereinafter, also referred to as an “activation timing”), in a case where the imaging system that is frequently used by the user or the like is activated among the first imaging system **156**A and the second imaging system **156**B, it is possible to start the imaging quickly without switching the imaging system.

[0357] Therefore, as an example shown in FIG. **44**, information related to the imaging system may be included in the various set values **102** used as the correction data **100**, as the set value. The information related to the imaging system refers to, for example, information related to the imaging system selected in a case where the captured image **75** is acquired by the smart device **156** (for example, information that enables the specification of the imaging system). As described above, by including the information related to the imaging system in the correction data **100**, the model generation unit **86**B is capable of making the replication model **116** learn the tendency of the imaging system that is frequently used in the smart device **156**. The replication model **116** is optimized by training the tendency of the imaging system that is frequently used in the smart device **156**, and the second trained model **118** is generated.

[0358] As an example shown in FIG. **45**, the CPU **86** inputs the captured image **164**, which is obtained by selectively captured by the first imaging system **156**A and the second imaging system **156**B of the smart device **156**, to the second trained model **118**, which is obtained by optimizing the replication model **116** by training the tendency of the imaging system that is frequently used in the smart device **156** for a certain imaging scene. The second trained model **118** outputs the second set value **118**A in a case where the captured image **164** is input. By reflecting the second set value **118**A output from the second trained model **118** on the control related to the imaging performed by the smart device **156**, the CPU **86** sets the imaging system to be used at an activation timing of the smart device **156** and causes the smart device **156** to selectively use the first imaging system **156**A and the second imaging system **156**B at the activation timing of the smart device **156**. As a result, the imaging system that is intended by the user or the like can be quickly used at the activation timing of the smart device **156** as compared with the case of using an imaging system randomly selected from the first imaging system **156**A and the second imaging system **156**B at the activation timing of the smart device **156**.

[0359] In a case where the output of the second trained model **118**, which is obtained by performing the learning processing with the information including the information related to the imaging system as the correction data **100**, is reflected on the control related to the imaging performed by the smart device **156**, as an example shown in FIG. **46**, the CPU **168** of the smart device **156** sets a position of the angle of view used at the activation timing of the smart device **156** within the overlapping magnification changing range (for example, the center of the overlapping magnification changing range) with respect to the imaging system used at the activation timing of the smart device **156** such that the imaging is started at the angle of view within the overlapping magnification changing range.

[0360] The information related to the imaging system included in the correction data **100** may be information that includes history information of the angle of view change instruction. In a case where the second trained model **118** is generated by performing the learning processing by using the teacher data **98** that includes the correction data **100** configured in this way, by reflecting the output of the second trained model **118** on the control related to the imaging performed by the smart device **156**, the CPU **168** of the smart device **156** is capable of setting the position of the angle of view to a position frequently used within the magnification changing range.

[0361] Although two imaging systems of the first imaging system **155**A and the second imaging system **155**B are exemplified in the examples shown in FIGS. **37** and **38**, and two imaging systems of the first imaging system **156**A and the second imaging system **156**B are exemplified in the example shown in FIG. **39**, the present disclosed technology is not limited to this, and three or more imaging systems may be used. Further, the devices equipped with the plurality of imaging systems need not be limited to smart devices **155** and **156**, for example, it may be an imaging apparatus (for example, a surveillance camera) that captures each of a plurality of wavelength band lights with different imaging systems.

[0362] In the above embodiment, although an example of the embodiment in which the CPU **86** performs the specific processing based on the first set value **106**A and the second set value **118**A has been described, the present disclosed technology is not limited to this. For example, the CPU **86** may perform the specific processing based on the degree of difference between the first trained model **106** and the second trained model **118**. For example, the CPU **86** performs the specific processing in a case where the degree of difference between the first trained model **106** and the second trained model **118** is equal to or greater than a default degree of difference. The default degree of difference may be a fixed value or may be a variable value that is changed according to the instruction, which is provided to the imaging support apparatus **14** by the user or the like, and/or various conditions.

[0363] Further, each of the first trained model **106** and the second trained model **118** may be a model having an input layer, a plurality of interlayers, and an output layer, and the CPU **86** may perform the specific processing based on the degree of difference of at least one layer (for example, at least one designated layer) between the first trained model **106** and the second trained model **118**. In this case, at least one layer may be, for example, the plurality of interlayers and the output layer, may be all of the plurality of interlayers, may be a part of the layer among the plurality of interlayers (for example, at least one designated layer), or may be the output layer.

[0364] In the above embodiment, although an example of the embodiment in which the imaging apparatus **12** and the imaging support apparatus **14** are separated has been described, the present disclosed technology is not limited to this, and the imaging apparatus **12** and the imaging support apparatus **14** may be integrated. In this case, for example, as shown in FIG. **47**, an imaging support processing program **96** may be stored in the NVM **64** of the imaging apparatus main body **16**, and the CPU **62** may execute the imaging support processing program **96**.

[0365] Further, as described above, in a case where the imaging apparatus **12** is to be responsible for the function of the imaging support apparatus **14**, at least one other CPU, at least one GPU, and/or at least one TPU may be used instead of the CPU **62** or together with the CPU **62**.

[0366] In the above embodiment, although an example of the embodiment in which the imaging support processing program **96** is stored in the storage **88** has been described, the present disclosed technology is not limited to this. For example, the imaging support processing program **96** may be stored in a portable non-temporary storage medium such as an SSD or a USB memory. The imaging support processing program **96** stored in the non-temporary storage medium is installed in a computer **82** of the imaging support apparatus **14**. The CPU **86** executes the imaging support processing according to the imaging support processing program **96**.

[0367] Further, the imaging support processing program **96** may be stored in the storage device such as another computer or a server device connected to the imaging support apparatus **14** via the network **34**, the imaging support processing program **96** may be downloaded in response to the request of the imaging support apparatus **14**, and the imaging support processing program **96** may be installed in the computer **82**.

[0368] It is not necessary to store all of the imaging support processing programs **96** in the storage device such as another computer or a server device connected to the imaging support apparatus **14**, or the storage **88**, and a part of the imaging support processing program **96** may be stored.

[0369] Further, although the imaging apparatus **12** shown in FIG. **2** has a built-in controller **44**, the present disclosed technology is not limited to this, for example, the controller **44** may be provided outside the imaging apparatus **12**.

[0370] In the above embodiment, although the computer **82** is exemplified, the present disclosed technology is not limited to this, and a device including an ASIC, FPGA, and/or PLD may be applied instead of the computer **82**. Further, instead of the computer **82**, a combination of a hardware configuration and a software configuration may be used.

[0371] As a hardware resource for executing the imaging support processing described in the above embodiment, the following various processors can be used. Examples of the processor include software, that is, a CPU, which is a general-purpose processor that functions as a hardware resource for executing the imaging support processing by executing a program.

[0372] Further, examples of the processor include a dedicated electric circuit, which is a processor having a circuit configuration specially designed for executing specific processing such as FPGA, PLD, or ASIC. A memory is built-in or connected to any processor, and each processor executes the imaging support processing by using the memory.

[0373] The hardware resource for executing the imaging support processing may be configured with one of these various processors or may be configured with a combination (for example, a combination of a plurality of FPGAs or a combination of a CPU and an FPGA) of two or more processors of the same type or different types. Further, the hardware resource for executing the imaging support processing may be one processor.

[0374] As an example of configuring with one processor, first, one processor is configured with a combination of one or more CPUs and software, and there is an embodiment in which this processor functions as a hardware resource for executing the imaging support processing. Secondly, as typified by SoC, there is an embodiment in which a processor that implements the functions of the entire system including a plurality of hardware resources for executing the imaging support processing with one IC chip is used. As described above, the imaging support processing is implemented by using one or more of the above-mentioned various processors as a hardware resource.

[0375] Further, as the hardware-like structure of these various processors, more specifically, an electric circuit in which circuit elements such as semiconductor elements are combined can be used. Further, the above-mentioned imaging support processing is only an example. Therefore, it goes without saying that unnecessary steps may be deleted, new steps may be added, or the processing order may be changed within a range that does not deviate from the purpose.

[0376] The contents described above and the contents shown in the illustration are detailed explanations of the parts related to the present disclosed technology and are only an example of the present disclosed technology. For example, the description related to the configuration, function, action, and effect described above is an example related to the configuration, function, action, and effect of a portion according to the present disclosed technology. Therefore, it goes without saying that unnecessary parts may be deleted, new elements may be added, or replacements may be made to the contents described above and the contents shown in the illustration, within the range that does not deviate from the purpose of the present disclosed technology. Further, in order to avoid complications and facilitate understanding of the parts of the present disclosed technology, in the contents described above and the contents shown in the illustration, the descriptions related to the common technical knowledge or the like that do not require special explanation in order to enable the implementation of the present disclosed technology are omitted.

[0377] In the present specification, “A and/or B” is synonymous with “at least one of A or B”. That

is, “A and/or B” means that it may be only A, it may be only B, or it may be a combination of A and B. Further, in the present specification, in a case where three or more matters are connected and expressed by “and/or”, the same concept as “A and/or B” is applied.
[0378] All documents, patent applications, and technical standards described in the present specification are incorporated in the present specification by reference to the same extent in a case where it is specifically and individually described that the individual documents, the patent applications, and the technical standards are incorporated by reference.

Claims

1. An imaging support apparatus comprising: a processor; and a memory connected to or built into the processor, wherein the memory stores a first trained model, the first trained model is a trained model used for control related to imaging performed by an imaging apparatus, and the processor is configured to generate a second trained model used for the control by performing learning processing in which a first image, which is acquired by being captured by the imaging apparatus, and a set value, which is applied to the imaging apparatus in a case where the first image is acquired, are used as teacher data, perform specific processing based on a first set value, which is output from the first trained model in a case where a second image is input to the first trained model, and a second set value, which is output from the second trained model in a case where the second image is input to the second trained model, and display, on a display, information related to the second trained model, and wherein the type of the first set value and the type of the second set value are the same.
2. The imaging support apparatus according to claim 1, wherein the information related to the second trained model includes time specification information that enables specification of time when the second trained model is generated.
3. The imaging support apparatus according to claim 1, wherein the information related to the second trained model includes an image in which an output of the second trained model is reflected.
4. The imaging support apparatus according to claim 1, wherein the information related to the second trained model is data for displaying, on the display, time specification information that enables specification of time when the second trained model is generated, in a state of being associated with an image in which an output of the second trained model is reflected.
5. The imaging support apparatus according to claim 1, wherein the second image is stored in the memory.
6. The imaging support apparatus according to claim 1, wherein the specific processing is processing that includes first processing of reflecting the second set value on the control.
7. The imaging support apparatus according to claim 1, wherein the specific processing is processing that includes second processing of storing the second trained model in a default storage device.
8. The imaging support apparatus according to claim 1, wherein the specific processing is processing that includes third processing of reflecting an output of a trained model, which is selected according to the instruction received by the processor among the first trained model and the second trained model, on the control.
9. The imaging support apparatus according to claim 1, wherein the specific processing is processing that includes fourth processing of outputting first data for displaying a fourth image corresponding to an image obtained by applying a first output result, which is output from the first trained model by inputting a third image to the first trained model, to the third image, and a sixth image corresponding to an image obtained by applying a second output result, which is output from the second trained model by inputting a fifth image to the second trained model, to the fifth image, on a first display.

10. The imaging support apparatus according to claim 1, wherein the set value is at least one of a set value related to white balance used in the imaging, a set value related to exposure used in the imaging, a set value related to focus used in the imaging, a set value related to saturation used in the imaging, or a set value related to gradation used in the imaging.
11. An imaging support apparatus comprising: a processor; and a memory connected to or built into the processor, wherein the memory stores a first trained model, the first trained model is a trained model used for control related to imaging performed by an imaging apparatus, and the processor is configured to generate a second trained model used for the control by performing learning processing in which a first image, which is acquired by being captured by the imaging apparatus, and a set value, which is applied to the imaging apparatus in a case where the first image is acquired, are used as teacher data, perform specific processing based on a degree of difference between the first trained model and the second trained model, and display, on a display, information related to the second trained model, and the first trained model outputs a first set value in a case in which a second image is input, the second trained model outputs a second set value in a case in which the second image is input, and the type of the first set value and the type of the second set value are the same.
12. An imaging apparatus comprising: a processor; a memory connected to or built into the processor; and an imaging apparatus main body, wherein the memory stores a first trained model, the first trained model is a trained model used for control related to imaging performed by the imaging apparatus main body, and the processor is configured to generate a second trained model used for the control by performing learning processing in which a first image, which is acquired by being captured by the imaging apparatus main body, and a set value, which is applied to the imaging apparatus main body in a case where the first image is acquired, are used as teacher data, perform specific processing based on a first set value, which is output from the first trained model in a case where a second image is input to the first trained model, and a second set value, which is output from the second trained model in a case where the second image is input to the second trained model, and display, on a display, information related to the second trained model, and wherein the type of the first set value and the type of the second set value are the same.
13. An imaging support method comprising: generating a second trained model used for control related to imaging performed by an imaging apparatus, by performing learning processing in which a first image, which is acquired by being captured by the imaging apparatus, and a set value, which is applied to the imaging apparatus in a case where the first image is acquired, are used as teacher data; performing specific processing based on a first set value, which is output from a first trained model in a case where a second image is input to the first trained model, and a second set value, which is output from the second trained model in a case where the second image is input to the second trained model; and displaying, on a display, information related to the second trained model, and wherein the type of the first set value and the type of the second set value are the same.
14. A non-transitory computer-readable storage medium storing a program executable by a computer to perform a process comprising: generating a second trained model used for control related to imaging performed by an imaging apparatus, by performing learning processing in which a first image, which is acquired by being captured by the imaging apparatus, and a set value, which is applied to the imaging apparatus in a case where the first image is acquired, are used as teacher data; performing specific processing based on a first set value, which is output from a first trained model in a case where a second image is input to the first trained model, and a second set value, which is output from the second trained model in a case where the second image is input to the second trained model; and displaying, on a display, information related to the second trained model, and wherein the type of the first set value and the type of the second set value are the same.
15. The imaging support apparatus according to claim 1, wherein: the second trained model is obtained by performing learning processing on a replication model that is obtained by replicating the first trained model, and the specific processing is performed based on a degree of difference

between the first set value and the second set value.

16. The imaging support apparatus according to claim 11, wherein the second trained model is obtained by performing learning processing on a replication model that is obtained by replicating the first trained model.

17. The imaging apparatus according to claim 12, wherein: the second trained model is obtained by performing learning processing on a replication model that is obtained by replicating the first trained model, and the specific processing is performed based on a degree of difference between the first set value and the second set value.

18. The imaging support method according to claim 13, wherein: the second trained model is obtained by performing learning processing on a replication model that is obtained by replicating the first trained model, and the specific processing is performed based on a degree of difference between the first set value and the second set value.

19. The non-transitory computer-readable storage medium according to claim 14, wherein: the second trained model is obtained by performing learning processing on a replication model that is obtained by replicating the first trained model, and the specific processing is performed based on a degree of difference between the first set value and the second set value.