

DESCRIPTION

Title of Invention

DISPLAY METHOD, CONTROL DEVICE, DISPLAY DEVICE, AND PROGRAM

Technical Field

[0001]

The present invention relates to a display method, a control device, a display device, and a program.

Background Art

[0002]

Conventionally, for maintenance and management of an object such as a plant, a plurality of images (moving images) obtained by continuously imaging the object are visually recognized to confirm a time-dependent state change of the object. For example, PTL 1 describes a display device capable of displaying a state of a building after a secular change occurs by moving images. The display device generates a moving image using the post-change coloring data corresponding to the pattern or color of each region of the building after the secular change occurs when displaying a moving image representing the building after the secular change occurs.

Citation List

Patent Literature

[0003]

[PTL 1] Japanese Unexamined Patent Publication No.
2002-117416

Summary of Invention

Technical Problem

[0004]

In the case of confirming a state change of an object by a moving image, for example, in order to identify a time zone or a region where the state change is large, it is necessary to carefully keep watching a moving image to be played, that is, a plurality of continuously displayed images. In addition, even when a region or a time zone in which the state change is large can be identified in this manner, the moving image need to be played each time when the state change in the region or the time zone is to be confirmed again. In this manner, the confirmation of the state change by the moving image is labor-intensive and inefficient.

[0005]

Therefore, an object of the present invention is to provide a display method, a control device, a display

device, and a program that make it possible to easily identify a state change of an object.

Solution to Problem

[0006]

According to an aspect of the present invention, there is provided a display method for displaying a state change of an object based on a plurality of images generated by continuous imaging of the object, including: a step of extracting pixels disposed on predetermined position coordinates from each image of the plurality of images; and a step of displaying a pixel set in which the pixels are arranged according to an order of imaging of the plurality of images.

[0007]

According to this aspect, a configuration is employed in which the pixels disposed on the predetermined position coordinates are extracted from the plurality of images, and these pixels are arranged according to the order of imaging. Therefore, it is possible to easily identify a time-dependent state change of the object at the predetermined position coordinates.

[0008]

According to another aspect of the present invention, there is provided a control device that displays and

controls a state change of an object based on a plurality of images generated by continuous imaging of the object, including: a pixel set generation unit that extracts pixels disposed on predetermined position coordinates from each image of the plurality of images, and generates a pixel set in which the pixels are arranged according to an order of imaging of the plurality of images; and a display device control unit that displays the generated pixel set on a display device.

[0009]

According to still another aspect of the present invention, there is provided a display device being configured to display a pixel set in which pixels arranged on predetermined position coordinates in each image of a plurality of images generated by continuous imaging of an object are arranged according to an order of imaging of the plurality of images.

[0010]

According to still another aspect of the present invention, there is provided a program that causes a computer to execute a step of extracting pixels disposed on predetermined position coordinates from each image of the plurality of images generated by continuous imaging of an object, and a step of displaying a pixel set in which the

pixels are arranged according to an order of imaging of the plurality of images.

Advantageous Effects of Invention

[0011]

According to the present invention, it is possible to provide a display method, a control device, a display device, and a program that make it possible to easily identify a state change of an object.

Brief Description of Drawings

[0012]

Fig. 1 is a view for describing an outline of a display system 1 according to the present embodiment.

Fig. 2 is a schematic view showing an example of a functional configuration of the display system 1 according to the present embodiment.

Fig. 3 is a schematic view showing an example of a functional configuration of an image processing unit 30 according to the present embodiment.

Fig. 4 is a schematic view showing an example of a functional configuration of a display control unit 70 according to the present embodiment.

Fig. 5 is a schematic view showing an example of a state change display screen 200 displayed on a display device 90 according to the present embodiment.

Fig. 6 is an operation flow diagram showing an example of operation processing by the display system 1 according to the present embodiment.

Description of Embodiments

[0013]

Preferred embodiments of the present invention will be described in detail with reference to the attached drawings. (In each drawing, those having the same reference numerals have the same or similar configurations.)

[0014]

[First Embodiment]

Fig. 1 is a view for describing an outline of a display system 1 according to the present embodiment. The display system 1 displays a state change of the object based on a plurality of images generated by continuous imaging of an object. Here, the "plurality of images" may be, for example, a "captured image" which is an image obtained by imaging an object from a predetermined fixed point position, may be a "processed image" which is an image obtained by executing predetermined processing such as semantic region division on the captured image or the

like, or may be a "differential image" which is an image of a difference between a plurality of captured images or a plurality of processed images.

[0015]

Each of the plurality of images is associated with "time information (time stamp)" according to the order of imaging such as the imaging time, and is stored in a predetermined storage unit. When the plurality of images are the captured image or the processed image described above, the time information may be the imaging time of the image. In addition, in a case where the plurality of images are the above-described differential images, the time information may be time information associated with any image, which is a base of the differential image, or may be a value calculated based on time information associated with each of the plurality of images, which is a base of the differential image (for example, an average value or a median value of a plurality of time information).

[0016]

Fig. 1 shows a rectangular parallelepiped C. Here, the rectangular parallelepiped C schematically represents a set formed by arranging a plurality of images, which are a base of a pixel set displayed by the display system 1, in the order of time information associated with each image (that is, in the order of imaging). Among the time

information associated with the plurality of images (images included in the rectangular parallelepiped C), the oldest time information is set as a start time T_s , and the newest time information (including the time information before the current time) is defined as an end time T_E . In other words, the time information associated with the plurality of images is after the start time T_s and before the end time T_E .

[0017]

In Fig. 1, three images P1, P2, and P3 of the plurality of images are explicitly drawn. The images P1, P2, and P3 are associated with time information T_1 , T_2 , and T_3 , respectively. For convenience of description, only the images P1, P2, and P3 of the plurality of images are explicitly drawn in Fig. 1, and other images are omitted, but the number of images including the plurality of images handled by the display system 1 is not limited to three and may be any number. Hereinafter, in a case where individual images such as the images P1, P2, and P3 are not particularly distinguished, each of the plurality of images may be collectively referred to as an image P.

[0018]

In Fig. 1, as an example, a plurality of images included in the rectangular parallelepiped C are represented as processed images obtained by executing

semantic region division processing for detecting a damaged region on a captured image obtained by imaging an object. Therefore, for example, as shown in Fig. 1, each of the three images P1, P2, and P3 includes damaged regions D1, D2, and D3 detected by the semantic region division processing.

[0019]

An outline of a display method of a state change of an object by the display system 1 will be described. An axis parallel to the horizontal direction of the image P is defined as an X-axis, and an axis parallel to the vertical direction of the image P is defined as a Y-axis. That is, the positions of each pixel included in the image P are identified by two position coordinates, that is, the X-coordinate and the Y-coordinate. Each pixel includes information (pixel information) indicating the magnitude of a predetermined parameter possessed by the pixel, such as brightness information and color difference information. As shown in Fig. 1, the range of the X-coordinate of the image P included in the rectangular parallelepiped C is X_1 or more and X_2 or less.

[0020]

First, the display system 1 extracts pixels disposed on "pixel extraction coordinates", which are predetermined position coordinates common to each image P, from each

image P. Here, the "pixel extraction coordinates" may be a set of at least one position coordinates identified by the X-coordinate and the Y-coordinate. In addition, the pixel extraction coordinates may be set by the user in any manner. For example, the "pixel extraction coordinates" may be one or a plurality of sets of position coordinates constituting a region having any point, line (straight line or curve), or area. In Fig. 1, as an example, the pixel extraction coordinates are set to be a straight line passing through the point $(X, Y) = (X_1, Y_1)$ and parallel to the X-axis. For example, a straight line L1 in the image P1, a straight line L2 in the image P2, and a straight line L3 in the image P3 correspond to the pixel extraction coordinates. Then, from the image P1, the pixels (pixel row) disposed on the straight line L1 which is the pixel extraction coordinates are extracted, from the image P2, the pixels (pixel row) disposed on the straight line L2 which is the pixel extraction coordinates are extracted, and from the image P3, the pixels (pixel row) disposed on the straight line L3, which is the pixel extraction coordinates, is extracted, respectively.

[0021]

Next, the display system 1 generates a set of pixels (pixel set) in which the extracted pixels (pixel row) are arranged according to the order of imaging of each image P

from the start time T_s to the end time T_E , and displays this. Reference numeral S in Fig. 1 indicates the pixel set. The vertical direction of the pixel set S corresponds to the X-axis which is the axis of the image P in the horizontal direction, and the horizontal direction of the pixel set S corresponds to the time information (from the start time T_s to the end time T_E) associated with the image P. For example, as shown in Fig. 1, the pixel rows L1, L2, and L3 extracted from each of the images P1, P2, and P3 are shown at positions of each of the time information T1, T2, and T3 in the pixel set S. In addition, the pixel set S includes the damaged region portion S_D , which is a set of the damaged region portions of each image P.

[0022]

In this manner, the pixel set S is configured such that the pixels disposed on the predetermined position coordinates (pixel extraction coordinates) are extracted from the plurality of images, and these pixels are arranged according to the order of imaging. Therefore, it is possible to identify at a glance (by a single pixel set) a time-dependent state change of the object at predetermined position coordinates (pixel extraction coordinates).

[0023]

Fig. 2 is a schematic view showing an example of a functional configuration of the display system 1 according

to the present embodiment. The display system 1 is, for example, a system that displays a state change of the object based on a plurality of images generated by continuous imaging of an object. The display system 1 includes, for example, an imaging device control unit 10, an imaging device 20, an image processing unit 30, a real image DB 40, a predicted image generation unit 50, a predicted image DB 60, a display control unit 70, and an operation unit 80, and a display device 90. These functional units included in the display system 1 may be configured by one or a plurality of computers. Here, the computer may be, for example, an information processing device configured by a processor, a memory, or the like.

[0024]

The imaging device control unit 10 may be configured by one or a plurality of computers, and controls operations such as movement and imaging of the imaging device 20. In addition, the imaging device control unit 10 acquires an image of an object, which is generated by the imaging device 20, from the imaging device 20.

[0025]

The imaging device 20 may be configured as a camera or the like, and an image is generated by imaging an object under the control of the imaging device control unit 10. The object is not particularly limited, but may be the

whole or a part of a large-scale facility such as a furnace wall. At the time of imaging, the imaging device 20 may be fixed at a predetermined imaging position or may be held by the operator himself or herself. In addition, the imaging device 20 may be provided with movement means for moving under the control of the imaging device control unit 10 or the like, or may be moved by the movement means in order to change the imaging position. The configuration of the movement means is not particularly limited, and for example, flying means such as a drone for moving in a space in any manner or traveling means such as a slider for moving along an object may be used.

[0026]

The image processing unit 30 executes various processing on the image of the object generated by the imaging device 20 and saves the image in the real image DB 40. The configuration of the image processing unit 30 will be described later.

[0027]

The predicted image generation unit 50 generates a predicted image at each future time point based on a plurality of images stored in the real image DB 40, and stores the predicted image in the predicted image DB 60 in association with the time information (time stamp) according to the order of imaging such as a future imaging

time. For example, the predicted image may be generated by inputting a plurality of images stored in the real image DB 40 into a predetermined prediction model using an algorithm such as multiple regression analysis. The prediction model may be, for example, a trained model obtained by executing machine learning using any images such as a plurality of images stored in the real image DB 40 as training data. The type of the predicted image may be the same as the type of the image stored in the real image DB 40. Specifically, the type of the predicted image may be a captured image (an image obtained by continuously imaging an object from a predetermined fixed point position), may be an image (processed image) obtained by performing predetermined processing such as semantic region division on the captured image, or may be a differential image of the plurality of captured images or the plurality of processed images.

[0028]

The real image DB 40 stores a plurality of images generated by continuous imaging of an object in association with time information (time stamps) corresponding to the order of imaging such as imaging time. The plurality of images may be, for example, an image (captured image) obtained by continuously imaging an object from a predetermined fixed point position, may be an image (processed image) obtained by executing predetermined

processing such as semantic region division on the captured image, or may be a differential image of the plurality of captured images or the plurality of processed images.

[0029]

When the plurality of images are the captured image or the processed image described above, the time information associated with each image may be the imaging time of the image. In addition, in a case where the plurality of images are the above-described differential images, the time information associated with each image may be time information associated with any image, which is a base of the differential image, or may be a value calculated based on time information associated with each of the plurality of images, which is a base of the differential image (for example, an average value or a median value of a plurality of time information).

[0030]

The display control unit 70 is an example of a control device, and generates various display data based on an image stored in the real image DB 40 and/or the predicted image DB 60 and supplies the display data to the display device 90 to display various screens. The configuration of the display control unit 70 will be described later.

[0031]

The operation unit 80 may be any device as long as the operation (click, tap, swipe, pinch, drag, drop, and the like) can be performed by a user, and may be, for example, a touch pad, a keyboard, a button, a mouse, or the like. When the operation unit 80 is operated by the user, the operation unit 80 generates a signal corresponding to the operation and supplies the signal to the display control unit 70.

[0032]

The display device 90 may be any device as long as it is possible to display a video, an image, or the like, and is, for example, a liquid crystal display, an organic electro-luminescence (EL) display, or the like. The display device 90 displays various screens based on the display data supplied from the display control unit 70.

[0033]

Fig. 3 is a schematic view showing an example of a functional configuration of the image processing unit 30 according to the present embodiment. The image processing unit 30 includes, for example, a normalization processing unit 31, a processing unit 32, a differential image generation unit 33, and an image synthesis unit 34. The image processing unit 30 uses at least one of the normalization processing unit 31, the processing unit 32, the differential image generation unit 33, and the image

synthesis unit 34 to execute various processing on the image of the object generated by the imaging device 20 or the image saved in the real image DB 40, and save the generated image in the real image DB 40.

[0034]

For example, the normalization processing unit 31 executes a predetermined normalization processing on an image supplied from the imaging device 20. The predetermined normalization processing may be executed, for example, by obtaining an average value of the brightness value/color difference value of the captured image, and by performing correction such that the brightness value/color difference value of each captured image data is approximately the same based on the obtained average value.

[0035]

For example, the processing unit 32 executes a predetermined processing on the normalized image. The type of the processing is not particularly limited, and may be, for example, a semantic region division processing. In the semantic region division processing, a feature quantity is extracted from an image and then divided into a preset region such as a damaged region based on the feature quantity.

[0036]

In addition to the semantic region division processing, the processing unit 32 may execute any processing, for example, histogram conversion, monochrome image conversion, binarization, morphology conversion, noise removal, edge enhancement, enlargement/reduction, filter processing, affine conversion, linear conversion, center of gravity measurement, area measurement, circularity measurement, spindle angle measurement, moment feature calculation, huff conversion, target identification, pattern recognition, or template matching.

[0037]

The differential image generation unit 33 generates a differential image between a plurality of images having consecutive imaging times (consecutive time stamps). The plurality of images, which are the base of the differential image may be an image obtained by executing the normalization processing by the normalization processing unit 31, or may be an image obtained by executing the processing (semantic region division processing or the like) by the processing unit 32.

[0038]

The image synthesis unit 34 synthesizes a plurality of images. For example, a plurality of images captured at the same time (having the same time stamp) are bonded together

based on the position information of each image, thereby generating an image captured in a wide range.

[0039]

Fig. 4 is a schematic view showing an example of a functional configuration of the display control unit 70 according to the present embodiment. The display control unit 70 includes, for example, a storage unit 71, an image extraction unit 72, a pixel set generation unit 73, a setting change unit 74, a pixel extraction coordinate determination unit 75, a display device control unit 76, and a save unit 77.

[0040]

The storage unit 71 is composed of a ROM, a RAM, or the like, and stores various programs such as a driver program, an operating system program, and an application program, and various data. Various programs stored in the storage unit 71 may be installed in the storage unit 71 from a computer-readable portable recording medium such as a CD-ROM or a DVD-ROM using a known setup program or the like. The storage unit 71 stores, for example, a program for causing the display control unit 70 to realize the image extraction unit 72, the pixel set generation unit 73, the setting change unit 74, the pixel extraction coordinate determination unit 75, the display device control unit 76, and the save unit 77. In addition, the storage unit 71 may

store, for example, an image (real image and/or predicted image) extracted from the image extraction unit 72.

[0041]

In addition, the storage unit 71 stores any settings related to various screens to be displayed on the display device 90. The setting items are not particularly limited, and may include, for example, the following items. ·Type of images (captured images, processed images, differential images, and the like) ·Various parameters of images (size, aspect ratio, resolution, and the like) ·Items related to time (start time T_s , end time T_E , and the like of pixel set) ·Pixel extraction coordinates (may be a set of one or a plurality of position coordinates of each point included in a point, a line (straight line or curve), a region having an area, or the like).

[0042]

The image extraction unit 72 extracts the real image and/or the predicted image, which is the base of the pixel set, from the real image DB 40 and/or the predicted image DB 60. Specifically, the image extraction unit 72 extracts an image associated with time information before the current time between the start time T_s and the end time T_E included in the setting stored in the storage unit 71, that is, a real image, from the real image DB 40. In addition, the image extraction unit 72 extracts an image associated

with time information after the current time between the start time T_s and the end time T_E stored in the storage unit 71, that is, a predicted image, from the predicted image DB 60.

[0043]

The pixel set generation unit 73 generates a pixel set based on the image extracted by the image extraction unit 72. Specifically, the pixel set generation unit 73 extracts pixels arranged on the pixel extraction coordinates included in the settings stored in the storage unit 71 in each of the images (real image and/or predicted image) extracted by the image extraction unit 72, and then generates the pixel set by arranging the extracted pixels according to the order of time information of the image.

[0044]

The setting change unit 74 changes the setting items stored in the storage unit 71 according to the operation or the like performed by the user via the operation unit 80.

[0045]

The pixel extraction coordinate determination unit 75 determines the pixel extraction coordinates by analyzing a plurality of images (real image and/or predicted image) extracted by the image extraction unit 72. The pixel extraction coordinate determination unit 75 may determine a portion of the plurality of images in which the change is

larger than other portions as the pixel extraction coordinates. Specifically, for example, a portion where the change of the damaged region identified by the semantic region division processing is equal to or greater than a threshold may be determined as the pixel extraction coordinates.

[0046]

The display device control unit 76 generates display data and supplies the display data to the display device 90, and accordingly, the display device 90 displays various screens. In particular, the display device control unit 76 displays the state change display screen on the display device 90. The state change display screen may include, for example, an image (real image and/or predicted image) extracted by the image extraction unit 72, a pixel set generated by the pixel set generation unit 73, or the like. Details of the state change display screen will be described later.

[0047]

Fig. 5 is a schematic view showing an example of a state change display screen 200 displayed on the display device 90 according to the present embodiment. As shown in the drawing, the state change display screen 200 includes, for example, an image region 210, a first pixel set region 220, a second pixel set region 230, and a save button 240.

[0048]

In the image region 210, one image associated with the selected time information is displayed from among the plurality of real images stored in the real image DB 40 or the plurality of predicted images stored in the predicted image DB 60. In Fig. 5, as an example, a processed image (real image or predicted image) obtained by executing the semantic region division processing is displayed in the image region 210. Reference numeral 210D is a damaged region identified by the semantic region division processing. In this manner, the image region 210 makes it possible to identify at a glance the actual appearance or the predicted appearance of the object corresponding to the selected time information.

[0049]

Reference numeral 212L indicates a first axis. Here, the first axis 212L is a straight line parallel to the X-axis, and is an example of pixel extraction coordinates. As shown in Fig. 5, the first axis 212L is associated with an image displayed in the image region 210, and more specifically, the first axis 212L is displayed to be superimposed on a position corresponding to the first axis 212L in the image. In the first pixel set region 220, a first pixel set, which is a pixel set composed of pixels disposed on the first axis 212L, is displayed.

[0050]

The first pixel set is configured such that a pixel row disposed on the first axis 212L in each image is arranged in the order of time information associated with each image. A dotted line with reference numeral 214N indicates the position of a current time T_N , and a region 220A on the left side of the dotted line 214N is composed of a pixel row extracted from a real image stored in the real image DB 40. In addition, a region 220B on the right side of the dotted line 214N is composed of a pixel row extracted from the predicted image stored in the predicted image DB 60.

[0051]

A portion of the first pixel set region 220, which is indicated by reference numeral 220D, is a portion corresponding to the damaged region 210D included in the image region 210. In this manner, it is possible to identify at a glance (using a single pixel set) a time-dependent change of an object in the first axis 212L which is a predetermined position coordinate (pixel extraction coordinate) by the first pixel set region 220.

[0052]

Reference numeral 213L indicates a second axis. Here, the second axis 213L is a straight line parallel to the Y-axis, and is an example of pixel extraction coordinates. As

shown in Fig. 5, the second axis 213L is associated with an image displayed in the image region 210, and more specifically, the second axis 213L is displayed to be superimposed on a position corresponding to the second axis 213L in the image. In the second pixel set region 230, a second pixel set, which is a pixel set composed of pixels disposed on the second axis 213L, is displayed.

[0053]

The second pixel set is configured such that a pixel row disposed on the second axis 213L in each image is arranged in the order of time information associated with each image. A region 230A on the left side of the dotted line 214N indicating the position of the current time T_N is composed of a pixel row extracted from a real image stored in the real image DB 40. In addition, a region 230B on the right side of the dotted line 214N is composed of a pixel row extracted from the predicted image stored in the predicted image DB 60.

[0054]

A portion of the second pixel set region 230, which is indicated by reference numeral 230D, is a portion corresponding to the damaged region 210D included in the image region 210. In this manner, it is possible to identify at a glance (using a single pixel set) a time-dependent change of an object in the second axis 213L which

is a predetermined position coordinate (pixel extraction coordinate) by the second pixel set region 230.

[0055]

On the left side of the image region 210, a first axis slide bar 212B elongated in the vertical direction is displayed. The first axis slide bar 212B includes a slider 212S, a user slides the slider 212S along the first axis slide bar 212B in the vertical direction by an operation of the operation unit 80, and accordingly, the position of the first axis 212L can be changed between $Y = Y_1$ and $Y = Y_2$. When the position of the first axis 212L is changed by the slide operation, the setting change unit 74 changes the setting of the first axis 212L stored in the storage unit 71. Then, the pixel set generation unit 73 displays the pixel set based on the pixel row disposed on the changed first axis 212L in the first pixel set region 220.

[0056]

On the lower side of the image region 210, a second axis slide bar 213B elongated in the horizontal direction is displayed. The second axis slide bar 213B includes a slider 213S, a user slides the slider 213S along the second axis slide bar 213B in the horizontal direction by an operation of the operation unit 80, and accordingly, the position of the second axis 213L can be changed between $X = X_1$ and $X = X_2$.

[0057]

When the position of the second axis 213L is changed by the slide operation, the setting change unit 74 changes the setting of the second axis 213L stored in the storage unit 71. Then, the pixel set generation unit 73 displays the pixel set based on the pixel row disposed on the changed second axis 213L in the second pixel set region 230.

[0058]

On the upper side of the first pixel set region 220, a time axis slide bar 214B elongated in the horizontal direction is displayed. The time axis slide bar 214B includes a slider 214S. A time axis 214L extends in the vertical direction from the slider 214S. The user slides the slider 214S in the vertical direction by an operation of the operation unit 80, and accordingly, the position of the time axis 214L can be changed between the start time T_s and the end time T_E .

[0059]

When the position of the time axis 214L is changed by the slide operation, the setting change unit 74 changes the setting (time information of the image to be displayed in the image region 210) stored in the storage unit 71. Then, the display device control unit 76 displays an image (real image or predicted image) associated with the time

information indicated by the changed time axis 214L in the image region 210.

[0060]

The user can select the save button 240 by an operation of the operation unit 80. When the save button 240 is selected, the save unit 77 saves the image displayed in the image region 210, the first pixel set displayed in the first pixel set region 220, the second pixel set displayed in the second pixel set region 230, and the like in the storage unit 71.

[0061]

Fig. 6 is an operation flow diagram showing an example of operation processing by the display system 1 according to the present embodiment.

[0062]

(S301)

The image extraction unit 72 extracts an image from the real image DB 40 and/or the predicted image DB 60 based on the settings stored in the storage unit 71. The range of the time information of the extracted image may be from the start time T_s to the end time T_E included in the setting. For example, in a case where the end time T_E included in the setting is before the current time T_N , the image extraction unit 72 extracts the real image, of which the time information is from the start time T_s to the end time T_E ,

from the real image DB 40. Further, for example, in a case where the end time T_E included in the setting is later than the current time T_N , the image extraction unit 72 extracts the real image, of which the time information is from the start time T_S to the current time T_N , from the real image DB 40, and extracts the predicted image, of which the time information is from the current time T_N to the end time T_E , from the predicted image DB 60. The type of the image to be extracted may be a captured image, a processed image, a differential image, or the like, depending on the settings stored in the storage unit 71.

[0063]

(S302)

Next, the pixel extraction coordinate determination unit 75 may analyze the image according to the type of the extracted image (real image and/or predicted image) to determine the pixel extraction coordinates. For example, in a case where the extracted image is a processed image obtained by executing the semantic region division processing, the pixel extraction coordinate determination unit 75 may select an axis at which the change in the dimensionality of the damaged region is equal to or greater than a predetermined threshold.

[0064]

(S303)

The pixel set generation unit 73 extracts a pixel row arranged on the set pixel extraction coordinates, and arranges the extracted pixel row according to the order of time information of the image to generate a pixel set.

[0065]

(S304)

The display device control unit 76 displays the state change display screen 200 as shown in Fig. 5, for example, on the display device 90.

[0066]

(S305)

The setting change unit 74 determines whether or not the setting of the pixel extraction coordinates has been changed in response to an operation of the operation unit 80 by the user. For example, in the case of the example shown in Fig. 5, when the slider 212S of the first axis slide bar 212B is operated, it is determined that the setting of the first axis 212L, which is an example of the pixel extraction coordinates, has been changed, and when the slider 213S of the second axis slide bar 213B is operated, it is determined that the setting of the second axis 213L, which is an example of the pixel extraction coordinates, has been changed. In a case where it is determined that the setting of the pixel extraction

coordinates has not been changed (S305; No), the processing proceeds to step S308.

[0067]

(S306)

In a case where it is determined that the setting of the pixel extraction coordinate is changed (S305; Yes), the pixel set generation unit 73 extracts pixels disposed on the pixel extraction coordinates, of which the setting has been changed in each of the images (real image and/or predicted image) extracted by the image extraction unit 72, and then generates the pixel set by arranging the extracted pixels according to the order of time information of the image. For example, in an example shown in Fig. 5, in a case where it is determined that the setting of the first axis 212L has been changed, the pixel set generation unit 73 generates a pixel set composed of the pixels disposed on the new first axis 212L. For example, in an example shown in Fig. 5, in a case where it is determined that the setting of the second axis 213L has been changed, the pixel set generation unit 73 generates a pixel set composed of the pixels disposed on the new second axis 213L.

[0068]

(S307)

The display device control unit 76 updates the display of the pixel set region on the state change display screen

by the new pixel set generated in step S306. For example, in an example shown in Fig. 5, when the setting of the first axis 212L is changed, the display device control unit 76 displays the first pixel set generated in step S306 on the first pixel set region 220. In addition, in an example shown in Fig. 5, when the setting of the second axis 213L is changed, the display device control unit 76 displays the second pixel set generated in step S306 on the second pixel set region 230.

[0069]

(S308)

The setting change unit 74 determines whether or not the setting of the time axis has been changed in response to an operation of the operation unit 80 by the user. For example, in the case of the state change display screen 200 shown in Fig. 5, when the slider 214S of the time axis slide bar 214B is operated, it is determined that the setting of the time axis 214L has been changed. In a case where it is determined that the setting of the time axis has not been changed (S308; No), the processing proceeds to step S310.

[0070]

(S309)

The display device control unit 76 displays an image (real image or predicted image) associated with the time

information corresponding to the time axis changed in step S308 on the image region on the state change display screen. For example, in an example shown in Fig. 5, when the setting of the time axis 214L is changed, the display device control unit 76 displays an image associated with the time information corresponding to the changed time axis 214L in the image region 210.

[0071]

(S310)

Next, the save unit 77 determines whether or not the save is selected in response to an operation of the operation unit 80 by the user. For example, in the case of the state change display screen 200 shown in Fig. 5, when the save button 240 is selected, it is determined that the save is selected. In a case where the save is not selected (S310; No), the processing proceeds to step S305.

[0072]

(S311)

Next, the save unit 77 saves the image displayed in the image region 210, the first pixel set displayed in the first pixel set region 220, the second pixel set displayed in the second pixel set region 230, and the like in the storage unit 71. Then, the processing returns to step S305. After that, steps S305 to S311 are repeated until the end is selected by the user.

[0073]

The embodiments described above are for facilitating the understanding of the present invention, and are not for limiting and interpreting the present invention. Each element included in the embodiment and the disposition, material, condition, shape, and size thereof are not limited to those exemplified, and can be changed as appropriate. In addition, the configurations illustrated in different embodiments can be partially replaced or combined.

Reference Signs List

[0074]

- 1 Display system
- 10 Imaging device control unit
- 20 Imaging device
- 30 Image processing unit
- 31 Normalization processing unit
- 32 Processing unit
- 33 Differential image generation unit
- 34 Image synthesis unit
- 40 Real image DB
- 50 Predicted image generation unit
- 60 Predicted image DB
- 70 Display control unit

- 71 Storage unit
- 72 Image extraction unit
- 73 Pixel set generation unit
- 74 Setting change unit
- 75 Pixel extraction coordinate determination unit
- 76 Display device control unit
- 77 Save unit
- 80 Operation unit
- 90 Display device

CLAIMS

1. A display method for displaying a state change of an object based on a plurality of images generated by continuous imaging of the object, comprising:

a step of extracting pixels disposed on predetermined position coordinates from each image of the plurality of images; and

a step of displaying a pixel set in which the pixels are arranged according to an order of imaging of the plurality of images.

2. The display method according to claim 1, wherein the predetermined position coordinates are at least one position coordinate constituting a region having a point, a line, or an area.

3. The display method according to claim 2, wherein the predetermined position coordinates form a straight line.

4. The display method according to claim 3, wherein the straight line is parallel to any coordinate axis of each image included in the plurality of images.

5. The display method according to any one of claims 1 to 4, further comprising:

a step of determining the predetermined position coordinates based on the plurality of images.

6. The display method according to any one of claims 1 to 5, further comprising:

a step of displaying at least one image of the plurality of images.

7. The display method according to claim 6, wherein the step of displaying the at least one image includes a step of displaying the predetermined position coordinates in association with the at least one image.

8. The display method according to any one of claims 1 to 7, wherein

the plurality of images include a plurality of real images and a plurality of predicted images generated based on the plurality of real images.

9. The display method according to claim 8, further comprising:

a step of generating the plurality of predicted images based on the plurality of real images.

10. The display method according to any one of claims 1 to 9, wherein

the plurality of images are processed images obtained by executing a predetermined processing on a captured image generated by imaging the object.

11. A control device that displays and controls a state change of an object based on a plurality of images generated by continuous imaging of the object, comprising:

a pixel set generation unit that extracts pixels disposed on predetermined position coordinates from each image of the plurality of images, and generates a pixel set in which the pixels are arranged according to an order of imaging of the plurality of images; and

a display device control unit that displays the generated pixel set on a display device.

12. A display device being configured to display a pixel set in which pixels arranged on predetermined position coordinates in each image of a plurality of images generated by continuous imaging of an object are arranged according to an order of imaging of the plurality of images.

13. A program that causes a computer to execute
a step of extracting pixels disposed on predetermined
position coordinates from each image of the plurality of
images generated by continuous imaging of an object, and
a step of displaying a pixel set in which the pixels
are arranged according to an order of imaging of the
plurality of images.