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(54) **INFORMATION PROCESSING APPARATUS**

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(57) **ABSTRACT**

An information processing apparatus includes a processor configured to control the whole of the information processing apparatus, a display unit, an input unit layered on the display unit, a visible light camera configured to acquire a visible image of a subject, and a distance-measuring camera. The processor displays the visible image acquired by the visible light camera on the display unit, detects a user-specified position on the visible image specified by a user via the input unit, and confirms whether each position on the visible image is located on a near side by a predetermined value or more relative to the user-specified position on the basis of information on distance measured by the distance-measuring camera and corrects, when positions located on the near side by the predetermined value or more are present in the predetermined range, the user-specified position to a position located on nearest side out of the positions.

(A)

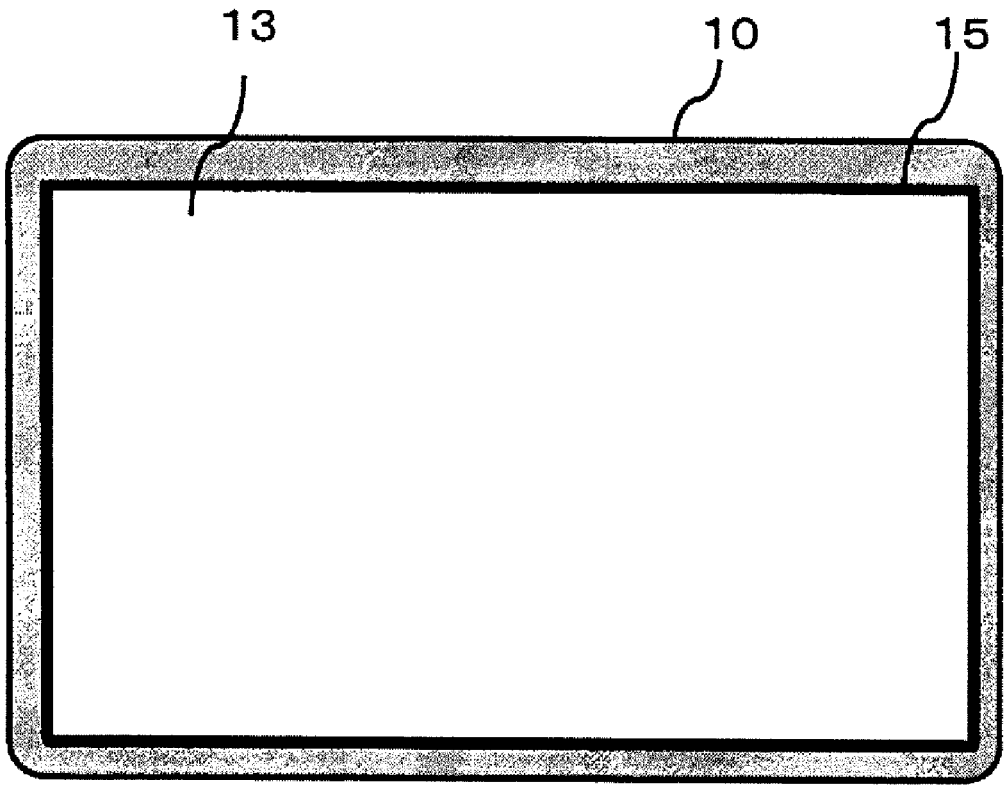


Fig.1B

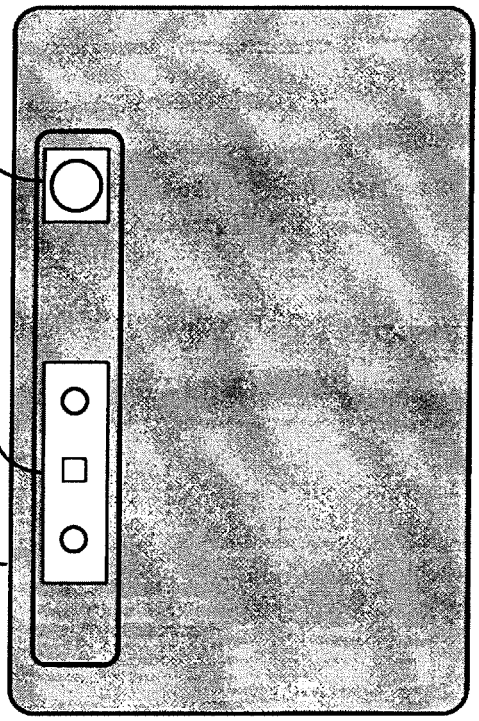
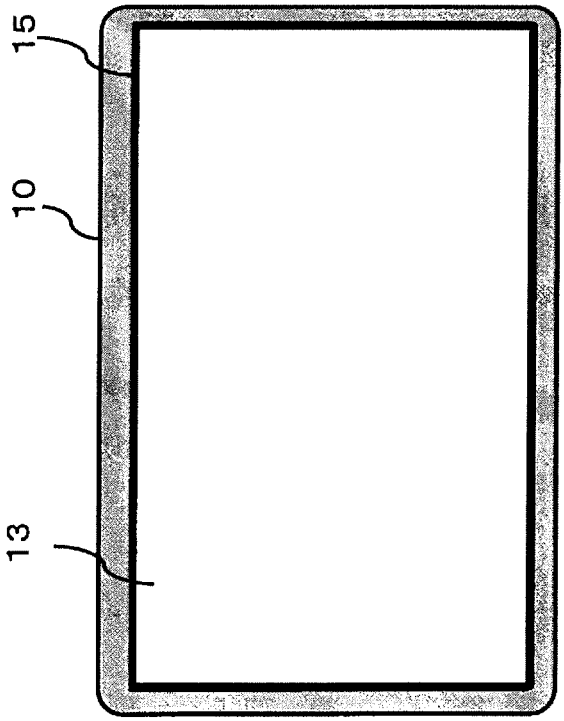


Fig.1A



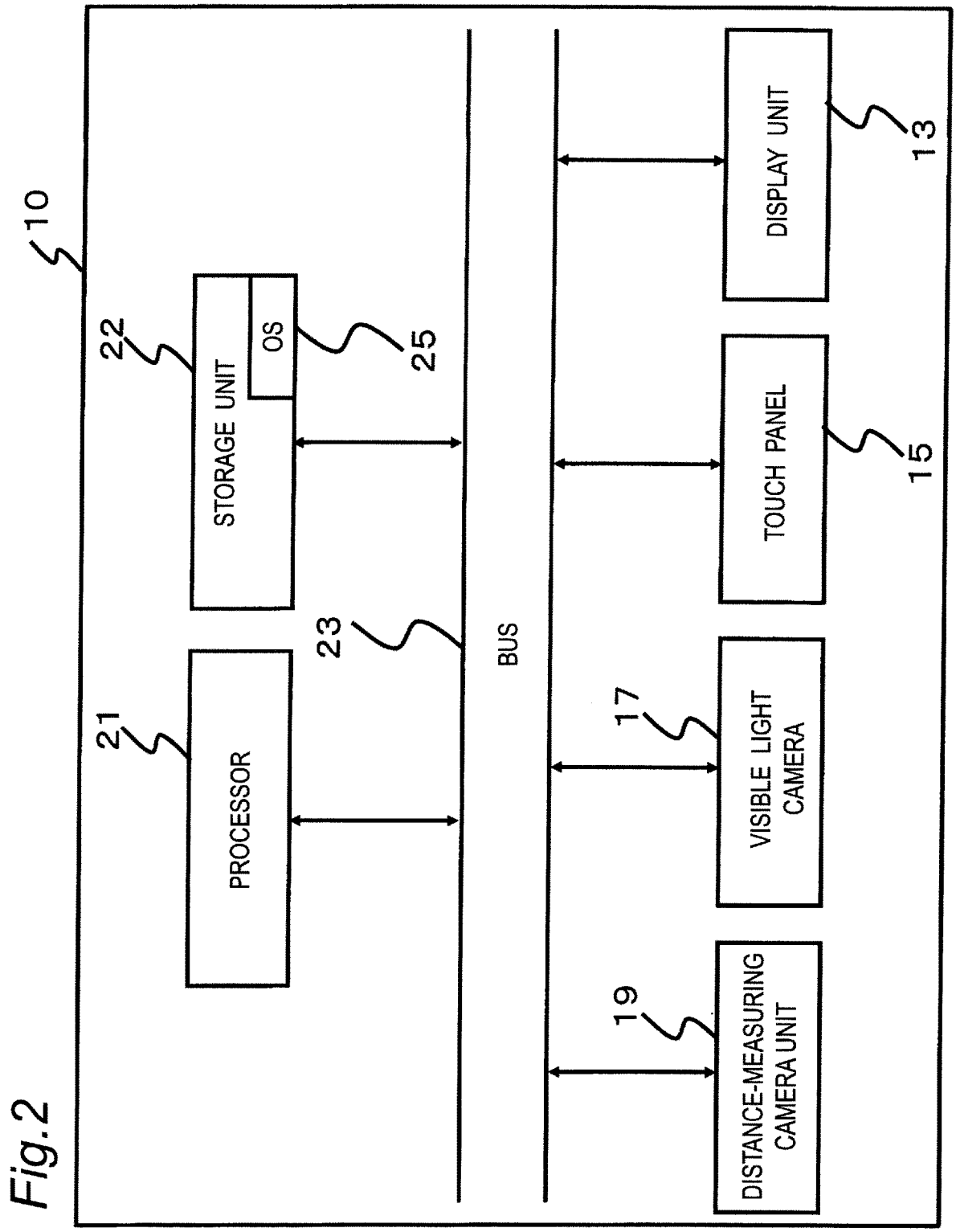

10
22
STORAGE UNIT
OS
25
21
PROCESSOR
23
BUS
DISPLAY UNIT
13
TOUCH PANEL
15
17
VISIBLE LIGHT CAMERA
19
DISTANCE-MEASURING CAMERA UNIT

Fig.2

Fig.3

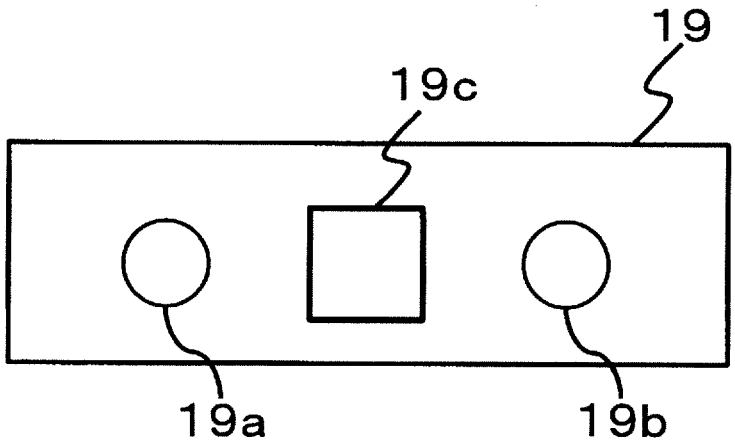
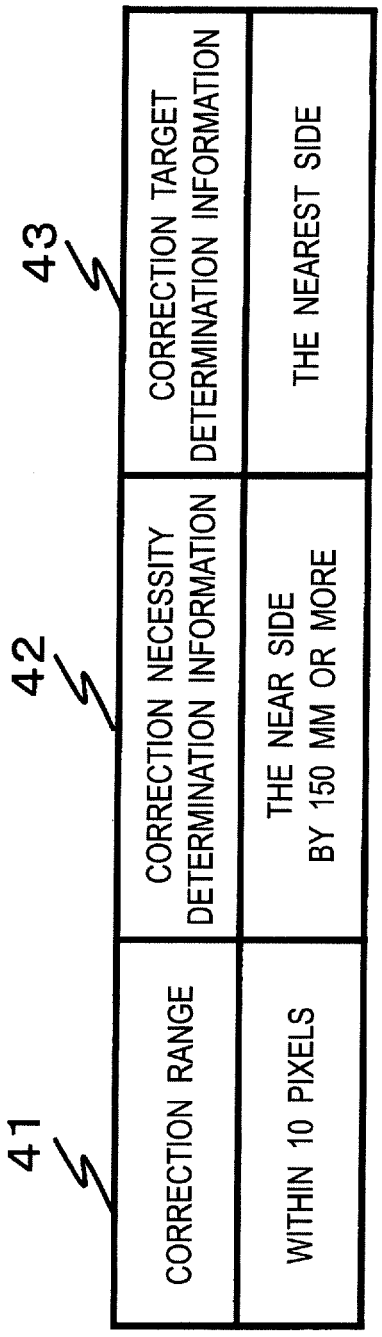


Fig.4


41
CORRECTION RANGE
WITHIN 10 PIXELS
42
CORRECTION NECESSITY DETERMINATION INFORMATION
THE NEAR SIDE BY 150 MM OR MORE
43
CORRECTION TARGET DETERMINATION INFORMATION
THE NEAREST SIDE
40

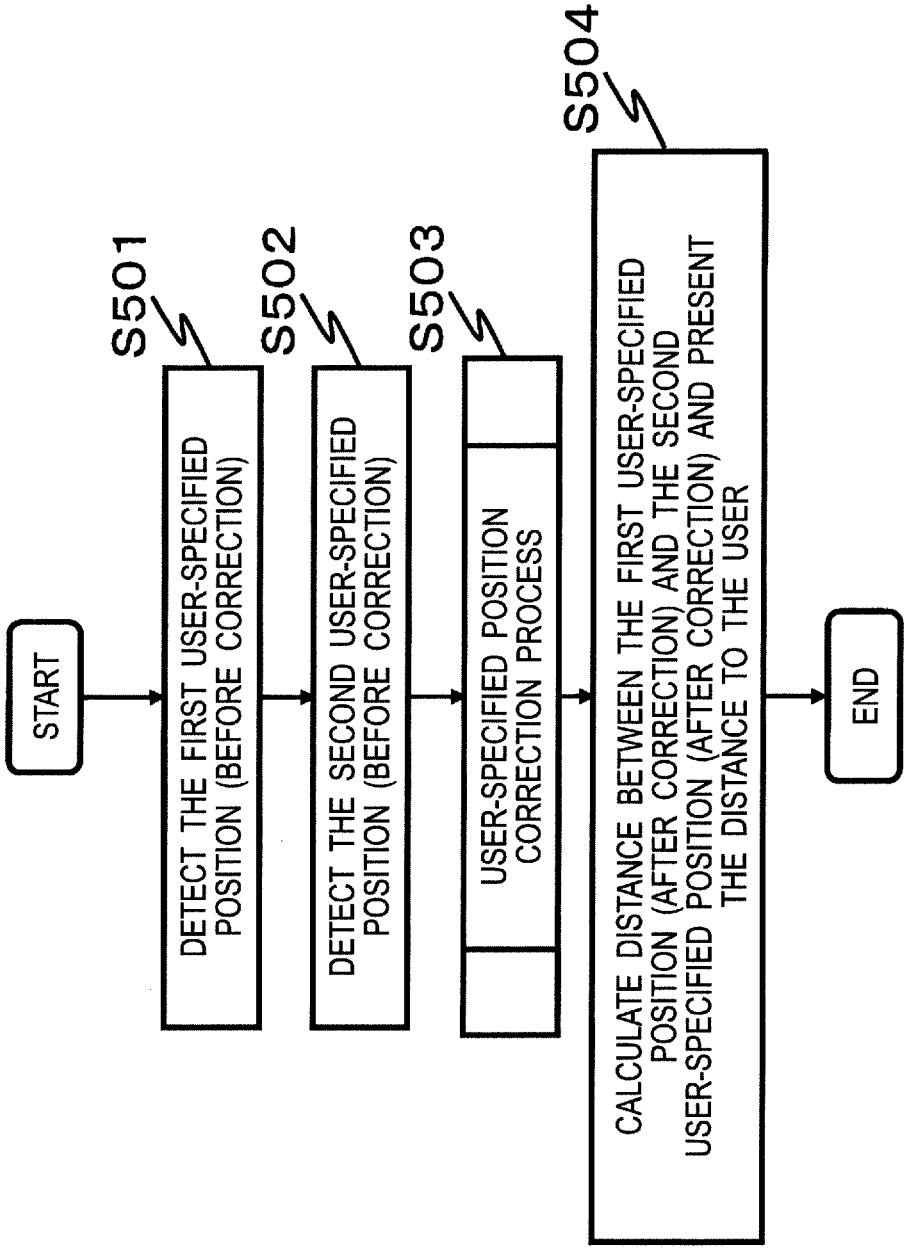

START
S501
DETECT THE FIRST USER-SPECIFIED POSITION (BEFORE CORRECTION)
S502
DETECT THE SECOND USER-SPECIFIED POSITION (BEFORE CORRECTION)
S503
USER-SPECIFIED POSITION CORRECTION PROCESS
S504
CALCULATE DISTANCE BETWEEN THE FIRST USER-SPECIFIED POSITION (AFTER CORRECTION) AND THE SECOND USER-SPECIFIED POSITION (AFTER CORRECTION) AND PRESENT THE DISTANCE TO THE USER
END

Fig.5

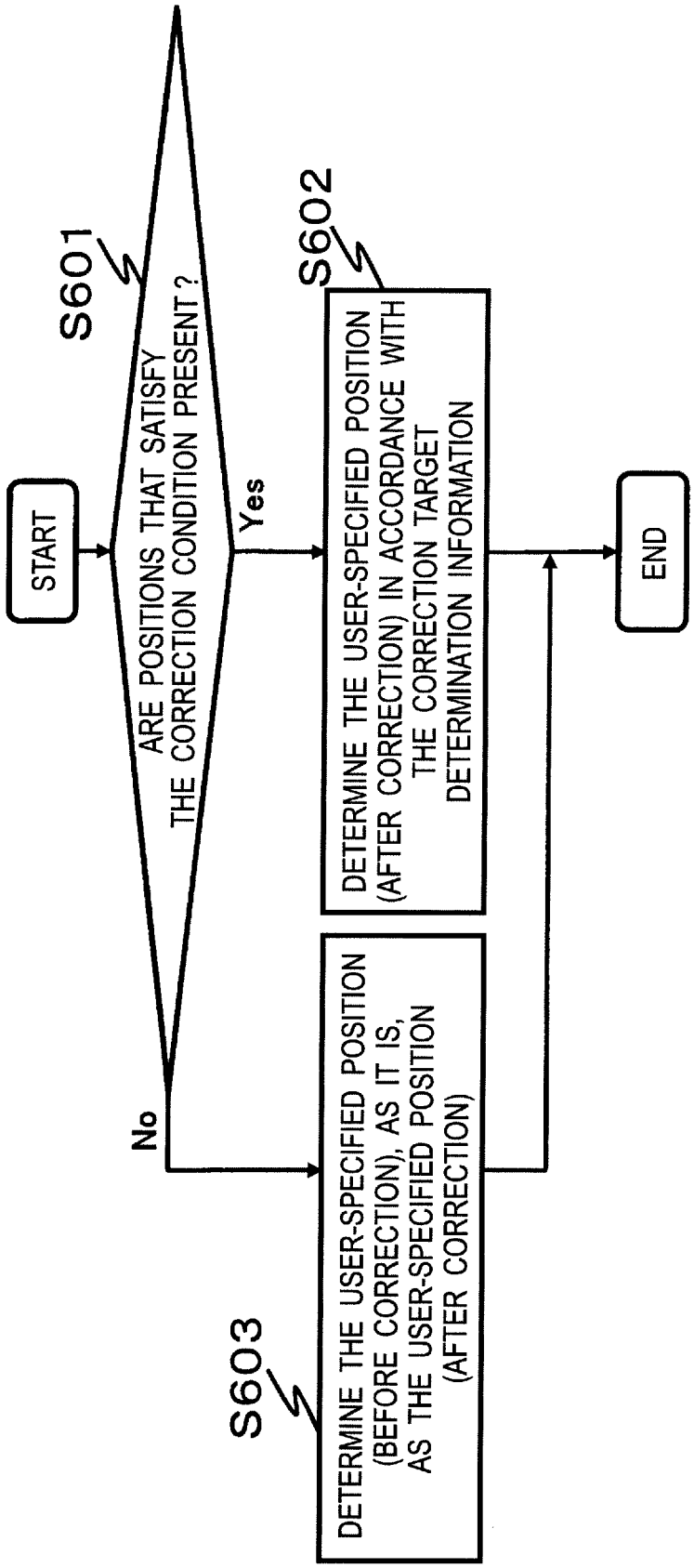

START
S601
ARE POSITIONS THAT SATISFY THE CORRECTION CONDITION PRESENT ?
Yes
No
S602
DETERMINE THE USER-SPECIFIED POSITION (AFTER CORRECTION) IN ACCORDANCE WITH THE CORRECTION TARGET DETERMINATION INFORMATION
S603
DETERMINE THE USER-SPECIFIED POSITION (BEFORE CORRECTION), AS IT IS, AS THE USER-SPECIFIED POSITION (AFTER CORRECTION)
END

Fig.6

INFORMATION PROCESSING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This is a continuation application of International Application No. PCT/JP2018/036076, with an international filing date of Sep. 27, 2018, which claims priority of JP 2017-187810 filed on Sep. 28, 2017, the content of which is incorporated herein by reference.

BACKGROUND

Technical Field

[0002] The present disclosure relates to an information processing apparatus having a function of measuring a spatial distance.

Related Art

[0003] JP 2013-156925 A discloses an electronic apparatus including a touch panel configured to correct a deviation between a touch position corresponding to a user's intension and a touch detection position.

SUMMARY

[0004] The present disclosure provides an information processing apparatus that allows a user to accurately specify a desired measurement position.

[0005] An information processing apparatus according to the present disclosure includes a processor configured to control the whole of the information processing apparatus, a display unit, an input unit layered on the display unit, a visible light camera configured to acquire a visible image of a subject, and a distance-measuring camera configured to measure distance to each object in the subject. The processor displays the visible image acquired by the visible light camera on the display unit, detects a user-specified position on the visible image specified by a user via the input unit, and confirms whether each position on the visible image within a predetermined range from the user-specified position detected on the visible image is located on a near side by a predetermined value or more relative to the user-specified position on the basis of information on distance measured by the distance-measuring camera and corrects, when positions located on the near side by the predetermined value or more are present in the predetermined range, the user-specified position to a position located on a nearest side out of the positions.

[0006] The information processing apparatus according to the present disclosure allows a user to accurately specify a desired measurement position.

BRIEF DESCRIPTION OF DRAWINGS

[0007] FIGS. **1**A and **1**B are external views of an information processing apparatus according to an embodiment of the present disclosure;

[0008] FIG. **2** is a block diagram showing an internal structure of the information processing apparatus according to the embodiment of the present disclosure;

[0009] FIG. **3** is a block diagram showing an example of a structure of a distance-measuring camera unit included in the information processing apparatus according to the embodiment of the present disclosure;

[0010] FIG. **4** is a diagram showing an example of user-specified position correction information according to the embodiment of the present disclosure;

[0011] FIG. **5** is a flowchart showing operation of the information processing apparatus according to the embodiment of the present disclosure, in which the information processing apparatus calculates distance between two user-specified positions and presents the distance to a user; and

[0012] FIG. **6** is a flowchart showing operation of the information processing apparatus according to the embodiment of the present disclosure, in which the information processing apparatus corrects the user-specified position.

DETAILED DESCRIPTION

[0013] An embodiment will be described in detail below with appropriate reference to the drawings. However, a detailed description more than necessary may be omitted. For example, a detailed description of a well-known matter and a redundant description on substantially the same structure may be omitted. This is to avoid the following description being unnecessarily redundant and to help those skilled in the art to easily understand the following description.

[0014] The accompanying drawings and the following description are provided to help those skilled in the art to fully understand the present disclosure and are not intended to limit the subject matter of the claim.

Embodiment

[0015] The embodiment will be described below with reference to FIG. **1**A to FIG. **6**.

[1-1-1. Structure of Information Processing Apparatus]

[0016] FIGS. **1**A and **1**B are external views of an information processing apparatus **10** according to the embodiment of the present disclosure. FIG. **1**A is a front view of the information processing apparatus **10**, and FIG. **1**B is a rear view of the information processing apparatus **10**. The information processing apparatus **10** corresponds to a so-called tablet terminal. The information processing apparatus **10** includes a display unit **13** and a touch panel **15** on a front side of the information processing apparatus **10**. The touch panel **15** is layered on the display unit **13** and serves as an input unit. The information processing apparatus **10** includes a visible light camera **17** and a distance-measuring camera unit **19** on a rear side of the information processing apparatus **10**.

[0017] FIG. **2** is a block diagram showing an internal structure of the information processing apparatus **10**. The information processing apparatus **10** includes a processor **21**, a storage unit **22**, a bus **23**, an operating system (OS) **25**, the display unit **13**, the touch panel **15**, the visible light camera **17**, and the distance-measuring camera unit **19**.

[0018] The processor **21** runs a program to control the other components of the information processing apparatus **10**.

[0019] The storage unit **22** temporarily or permanently stores data required for processing in the information processing apparatus **10**. For example, the storage unit **22** stores the OS **25**, the program, user-specified position correction information **40** (to be described later), and the like. Examples of the storage unit **22** include a volatile memory, a non-volatile memory, a hard disk drive (HDD), and the like.

[0020] The OS **25** is software that controls the operation of the information processing apparatus **10**.

[0021] The bus **23** is a path that electric signals transmitted and received by the other components of the information processing apparatus **10** pass through. Control signals and data are transmitted and received between the components of the information processing apparatus **10** through the bus **23**.

[0022] The display unit **13** includes, for example, a liquid crystal display or an organic electro-luminescence (EL) display. The touch panel **15** (an example of a controller) is an input device that detects touch operation made with a user's finger or a stylus pen. The touch panel **15** has its control area extending over a display area of display unit **13**. The information processing apparatus **10** may further include, as a control member, a button or a slide switch physically provided on the information processing apparatus **10**, in addition to the touch panel **15**. The information processing apparatus **10** is capable of changing (reduce/enlarge) display magnification of an image in accordance with user's control (pinch-in/pinch-out control) made on the touch panel **15** to display the image on the display unit **13**.

[0023] The visible light camera **17** is an image capturing device that is sensitive to the visible light wavelength range and captures visible light reflected from a subject to produce an image (hereinafter, referred to as a "two-dimensional image").

[0024] The distance-measuring camera unit **19** is a device that measures distance to each object within a subject and produces an image containing information on the distance to each object within the subject (hereinafter, referred to as a "distance image"). The distance-measuring camera unit **19** is implemented via various known techniques such as an active stereo system and a time of flight (TOF) system. FIG. **3** is a diagram showing an example of a structure of the distance-measuring camera unit **19**. As shown in FIG. **3**, the distance-measuring camera unit **19** includes a right infrared camera **19***a*, a left infrared camera **19***b*, and an infrared projector **19***c*. The distance-measuring camera unit **19** whose structure has been exemplified in FIG. **3** is configured to cause the infrared projector **19***c* to emit infrared rays in a specific pattern and perform calculation on the basis of a difference between images acquired by the right infrared camera **19***a* and the left infrared camera **19***b* to measure distance to the object.

[0025] The processor **21** can acquire the information on distance from the information processing apparatus **10** to each position on the two-dimensional image by superimposing the two-dimensional image produced by the visible light camera **17** and the distance image produced by the distance-measuring camera unit **19**.

[0026] Note that, in the present embodiment, the visible light camera **17** has been described as a component separate from the distance-measuring camera unit **19**, but the visible light camera **17** is not limited to such a structure and may be a part of the distance-measuring camera unit **19**. Further, for example, the right infrared camera **19***a* and/or the left infrared camera **19***b* may serve as not only an infrared camera but also a visible light camera.

[0027] Note that the components described above may form the information processing apparatus **10** as physically separate components, or alternatively, some of the components may be integrated into the information processing apparatus **10**. For example, the processor **21**, the storage unit **22**, and some or all of the functions of the other components are integrated and contained into one large scale integration (LSI).

[0028] Further, other components that are physically separate may be combined to form each of the components described above. For example, a plurality of physically different storage units may be used to form a logically single storage unit **22**.

[0029] Further, in order to decentralize the load on the processor **21**, a plurality of processors or a microcomputer contained in the storage unit **22** may perform actual processing. According to the present embodiment, components that perform these processes are generically defined as the processor **21**.

[1-1-2. Structure of User-Specified Position Correction Information]

[0030] The user-specified position correction information **40** contains information representing a condition for determination of whether to correct the user-specified position specified by the user via the touch panel **15** with respect to the two-dimensional image displayed on the display unit **13** and how the correction is made when the correction is required. FIG. **4** is a diagram showing an example of the user-specified position correction information **40**. As shown in FIG. **4**, the user-specified position correction information **40** contains correction range **41**, correction necessity determination information **42**, and correction target determination information **43**. The processor **21** confirms whether each position on the two-dimensional image within the range specified by the correction range **41** from the user-specified position satisfies the condition specified by the correction necessity determination information **42** on the basis of the information on distance measured by the distance-measuring camera unit **19** and determines, when positions that satisfy the condition are present, a correction target from the positions that satisfy the condition in accordance with the information specified by the correction target determination information **43**. In the example shown in FIG. **4**, the processor **21** confirms whether each position within a range of 10 pixels from the user-specified position on the two-dimensional image displayed on the display unit **13** is located on a near side by 150 mm or more relative to the distance from an information processing terminal **10** to the user-specified position on the basis of the information on distance measured by the distance-measuring camera unit **19** and determines, when positions located on the near side by 150 mm or more are present, a position located on a nearest side as a correction target from the positions. Hereinafter, a user-specified position before correction is referred to as "user-specified position (before correction)", and a user-specified position after correction is referred to as "user-specified position (after correction)". When no position within the range specified by the correction range **41** from the user-specified position on the two-dimensional image satisfies the condition specified by the correction necessity determination information **42**, the processor **21** determines the user-specified position (before correction), as it is, as the user-specified position (after correction).

[1-2. Operation]

[0031] The operation of the information processing apparatus **10** configured as described above will be described.

[0032] The information processing apparatus **10** according to the present embodiment has a function of displaying the two-dimensional image acquired by the visible light camera **17** on the display unit **13**, calculating the distance between two user-specified positions specified by the user via the touch panel **15** with respect to the two-dimensional image displayed on the display unit **13** on the basis of the information on distance measured by the distance-measuring camera unit **19**, and presenting the distance to the user. FIG. **5** is a flowchart showing operation of the information processing apparatus **10** according to the present embodiment, in which the information processing apparatus **10** performs the above function.

[0033] (Step S**501**) The processor **21** displays the two-dimensional image acquired by the visible light camera **17** on the display unit **13** to prompt the user to input a first user-specified position. When the user specifies a position via the touch panel **15** in response to the above, the processor **21** detects the specified position as the first user-specified position (before correction).

[0034] (Step S**502**) The processor **21** displays the two-dimensional image acquired by the visible light camera **17** on the display unit **13** to prompt the user to input a second user-specified position. When the user specifies a position via the touch panel **15** in response to the above, the processor **21** detects the specified position as the second user-specified position (before correction).

[0035] (Step S**503**) The processor **21** performs a user-specified position correction process (to be described later) on both the first user-specified position (before correction) detected in S**501** and the second user-specified position (before correction) detected in step S**502** to determine a first user-specified position (after correction) and a second user-specified position (after correction).

[0036] (Step S**504**) The processor **21** calculates distance between the first user-specified position (after correction) and the second user-specified position (after correction) determined in step S**503** on the basis of the information on distance acquired by the distance-measuring camera unit **19** and presents the distance to the user via the display unit **13**.

[0037] FIG. **6** is a flowchart showing operation of the information processing apparatus **10** according to the present embodiment, in which the information processing apparatus **10** performs the user-specified position correction process.

[0038] (Step S**601**) The processor **21** browses the user-specified position correction information **40** stored in the storage unit **22** to confirm whether each position on the two-dimensional image within the range specified by the correction range **41** from the user-specified position (before correction) satisfies the condition specified by the correction necessity determination information **42**. For the confirmation, the processor **21** acquires the information on distance from the information processing apparatus **10** to each position on the two-dimensional image by superimposing the two-dimensional image produced by the visible light camera **17** and the distance image produced by the distance-measuring camera unit **19**. When any position satisfies the condition, the process proceeds to step S**602**. When no position satisfies the condition, the process proceeds to step S**603**. When the user-specified position correction information **40** has the same content as shown in the example in FIG. **4**, the processor **21** confirms whether each position within 10 pixels from the user-specified position (before correction) on the two-dimensional image displayed on the display unit **13** is located on the near side by 150 mm or more relative to the distance from the information processing terminal **10** to the user-specified position (before correction).

[0039] (Step S**602**) The processor **21** determines the user-specified position (after correction) in accordance with the correction target determination information **43**. When the user-specified position correction information **40** has the same content as shown in the example in FIG. **4**, the processor **21** selects a position located on the nearest side from among the positions determined to satisfy the condition in step S**601** on the basis of the information on distance measured by the distance-measuring camera unit **19** to determine the position as the user-specified position (after correction).

[0040] (Step S**603**) The processor **21** determines the user-specified position (before correction), as it is, as the user-specified position (after correction).

[0041] As described above, the information processing apparatus **10** according to the present embodiment corrects the position specified by the user on the two-dimensional image using the information on distance to each position on the two-dimensional image. This allows the user to specify a desired position more accurately.

[0042] Note that the description has been given of the correction range **41** with a range of within a predetermined pixel ("within 10 pixels" in FIG. **4**) from the user-specified position (before correction) as an example, but the correction range **41** is not limited to such a range, and it is also possible to set a range with consideration given to, for example, not only the information on the range of within the predetermined pixel, but also information on direction from the user-specified position (before correction), the two points of the first user-specified position (before correction) and the second user-specified position (before correction), or the like. For example, it is conceivable that, for example, "a range of within a predetermined pixel from a straight line connecting the first user-specified position (before correction) and the second user-specified position (before correction)" is set.

[0043] Note that the description has been given of the correction necessity determination information **42** with a near side by a predetermined value or more ("neat side by 150 mm or more" in FIG. **4**) relative to the user-specified position (before correction) as an example, but the correction necessity determination information **42** is not limited to such a condition, and it is also possible to set, for example, "a far side by a predetermined value or more" or "having a distance of a predetermined value or more" regardless of whether it is a near side or a far side.

[0044] Note that the description has been given of the correction target determination information **43** with "nearest side" as an example, but the correction target determination information **43** is not limited to such a condition, and it is also possible to make, for example, a setting on distance from the user-specified position (before correction) or a setting with consideration given to the two points of the first user-specified position (before correction) and the second user-specified position (before correction). For example, it is conceivable that, for example, "a position closest to the user-specified position (before correction) on a straight line connecting the first user-specified position (before correction) and the second user-specified position (before correction)" is set.

[1-3. Effects and Others]

[0045] As described above, the information processing apparatus **10** according to the present disclosure has the function of measuring information on distance to each position on the two-dimensional image and correcting the position specified by the user on the two-dimensional image on the basis of the information on distance. This allows the user to specify a desired position more accurately. For example, when a scene containing a narrow subject such as a power line or an overhead line of a railway is captured, it is possible to accurately specify such a subject located at a short distance relative to a background. Further, even when a subject appears to be assimilated with the background during, for example, nighttime shooting, it is possible to accurately specify the subject located at a short distance and more accurately specify the position even under conditions where it is difficult to specify the position with image recognition.

[0046] The present disclosure is applicable to information processing apparatuses having the function of measuring a spatial distance. Specifically, the present disclosure is applicable to tablet terminals, personal computers, smartphones, wearable computers, and the like.

What is claimed is:

1. An information processing apparatus comprising:

a processor configured to control a whole of the information processing apparatus;

a display unit;

an input unit layered on the display unit;

a visible light camera configured to acquire a visible image of a subject; and

a distance-measuring camera configured to measure distance to each object in the subject, wherein

the processor

displays the visible image acquired by the visible light camera on the display unit,

detects a user-specified position on the visible image specified by a user via the input unit, and

confirms whether a position located on a near side by a predetermined distance or more relative to the user-specified position is present within a predetermined range on the visible image from the user-specified position detected on the visible image on a basis of information on distance measured by the distance-measuring camera and corrects, when positions located on the near side by the predetermined distance or more are present within the predetermined range, the user-specified position to a position located on a nearest side out of the positions.

* * * * *