REMOTE OPERATION INSTRUCTING SYSTEM, AND MOUNT TYPE DEVICE

Abstract

A mount type device includes a camera configured to photograph a work site in a wider range than a visual field of a worker; a sensor configured to obtain a visual line of the worker; and a visual line movement detector configured to detect, as visual line movement information, movement of a direction of the visual line of the worker by using the sensor information. The mount type device transmits data on the photographed image and the visual line movement information to an operation instructing apparatus via a network. An operation instructing apparatus includes a display setter configured to extract a first image having a wider range than a visual field range of the worker from the image photographed by the camera, correct the first image using the visual line movement information, and cause a display of the corrected first image; and an instruction image is generated for the worker.

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Background/Summary

FIELD
[0001] The present invention relates to a remote operation instructing system, and a mount type device.

BACKGROUND ART
[0002] A head mounted display apparatus is being introduced at work sites such as a manufacturing site and a construction site. Various kinds of information such as an instruction from an instructor (or an operator) are displayed on the head mounted display apparatus. A worker in a work site wears a head mounted display, and carries out work while viewing information from an operator.

[0003] Patent Document 1 discloses a conventional technique such as a work supporting system including a head mounted display apparatus and the like. In Patent Document 1, a worker wears a head mounted display and a camera configured to photograph the worker and his or her visual line direction. An operator generates an instruction image corresponding to an instruction from an instructor by an information processing apparatus, and causes the head mounted display for the worker to display it. The head mounted display is a semi-transmissive type, and superimposes the instruction image from the operator in a visual field of the worker.

RELATED ART DOCUMENTS
Patent Documents
[0004] Patent document 1: Japanese Patent Application
[0005] Publication No. 2013-16020

SUMMARY OF THE INVENTION
Problems to be Solved by the Invention
[0006] However, in a method of Patent Document 1, the instructor can confirm a work site only within a visual field range of the worker. For this reason, even in a case where an event to be given priority occurs in the vicinity of the visual field range, the instructor cannot grasp this, whereby there is a possibility that an instruction to the worker may be delayed. Further, an image photographed by the camera and displayed for the instructor fluctuates in response to movement of a visual line of the worker. Therefore, the instructor may feel unpleasant sickness.

[0007] The present invention has been made in view of the above points, and it is an object of the present invention to provide a remote operation instructing system and a mount type device in which an instructor does not feel unpleasant sickness.

Means for Solving the Problem
[0008] An outline of representative invention of the present invention disclosed in the present application will briefly be explained as follows. A remote operation instructing system according to the representative embodiment of the present invention includes: a mount type device to be worn by a worker; an operation instructing apparatus through which an instructor confirms a work site to output an instruction; and a network through which data are transmitted and received between the mount type device and the operation instructing apparatus.

[0009] The mount type device includes: a camera configured to photograph the work site in a wider

range than a visual field of the worker; a sensor configured to obtain a visual line of the worker as sensor information; and a visual line movement detector configured to detect, as visual line movement information, movement of a direction of the visual line of the worker by using the sensor information. The mount type device is configured to transmit data on the image photographed by the camera and the visual line movement information to the operation instructing apparatus via the network.

[0010] The operation instructing apparatus includes: a display setter configured to extract a first image having a wider range than a visual field range of the worker from the image photographed by the camera, correct the first image using the visual line movement information, and cause a display to display the corrected first image; and an instruction image generator configured to generate an instruction image for the worker. The operation instructing apparatus is configured to transmit the instruction image to the mount type device via the network.

Effects of the Invention

[0011] According to the present invention, there is provided a remote operation instructing system and a mount type device, by which an instructor does not feel unpleasant sickness.

Description

BRIEF DESCRIPTIONS OF THE DRAWINGS

[0012] FIG. **1** is a view for explaining an outline of a remote operation instructing system according to a first embodiment of the present invention;

[0013] FIG. **2** is a view for explaining one example of an operation of the remote operation instructing system according to the first embodiment of the present invention;

[0014] FIG. **3** is a block diagram illustrating one example of a configuration of a mount type device according to the first embodiment of the present invention;

[0015] FIG. **4** is a block diagram illustrating one example of a configuration of an operation instructing apparatus according to the first embodiment of the present invention;

[0016] FIG. **5** is a view illustrating one example of an image in a visual field range of a worker;

[0017] FIG. **6** is a flow diagram illustrating a detecting process of movement of a visual line of the worker;

[0018] FIG. **7** is a view for explaining another example of the operation of the remote operation instructing system according to the first embodiment of the present invention;

[0019] FIG. **8** is a view illustrating a flow related to setting of a display range in the operation instructing apparatus;

[0020] FIG. **9** is an outline drawing illustrating one example of the configuration of the mount type device;

[0021] FIG. **10** is an outline drawing illustrating another example of the configuration of the mount type device;

[0022] FIG. **11** is an outline drawing illustrating still another example of the configuration of the mount type device;

[0023] FIG. **12** is a view for explaining an outline of a remote operation instructing system according to a second embodiment of the present invention;

[0024] FIG. **13** is a view for explaining an outline of a remote operation instructing system according to a third embodiment of the present invention;

[0025] FIG. **14** is a flow diagram illustrating one example of processing of detecting a visual line of a worker in a photographing range of a facility camera; and

[0026] FIG. **15** is a view for explaining an outline of a remote operation instructing system according to a fourth embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0027] Hereinafter, embodiments of the present invention will be described with reference to the drawings.

First Embodiment

[0028] A first embodiment will be described with reference to FIG. **1** to FIG. **11**. Note that embodiments, which will be described below, are one example for realizing the present invention, and should be modified or changed appropriately depending upon a configuration of an apparatus to which the present invention is applied and various conditions. The present invention is not limited to the embodiments described below. Further, a part of each of the embodiments, which will be described later, may be combined and configured appropriately.

[0029] FIG. **1** is a view for explaining an outline of a remote operation instructing system according to the first embodiment of the present invention. In a remote operation instructing system **100** illustrated in FIG. **1**, a worker site **102** at which a worker **2** carries out work and an instructor site **106** at which an instructor **6** carries out a work instruction to the worker **2** are connected to each other via a network **1**. In the worker site **102**, a reference numeral *a* denotes transmission/reception data that are transmitted and received between the worker site **102** and the network **1**, a reference numeral **3** denotes an operated target, a reference numeral **4** denotes a mount type device, and a reference numeral **5** denotes a photographing range to be photographed by a camera mounted on the mount type device **4**. On the other hand, in the instructor site **106**, a reference numeral **1***b* denotes transmission/reception data that are transmitted and received between the instructor site **106** and the network **1**, a reference numeral **7** denotes an operation instructing apparatus, a reference numeral **7***a* denotes a main display of the operation instructing apparatus **7**, and a reference numeral **7***b* denotes a sub display of the operation instructing apparatus **7**.

[0030] The mount type device **4** includes a display and the camera. The mount type device **4** extracts an image in a range corresponding to a visual field of the worker **2** from a photographed image photographed by the camera, and projects the extracted image on the display. Alternatively, the worker **2** views the operated target **3** through the display.

[0031] The worker **2** wears the mount type device **4**, and the camera photographs an area including the operated target **3**. Namely, the worker **2** is a wearer of the mount type device **4**. The photographing range **5** of the camera covers a range sufficiently wider than a visual field displayed on the display of the mount type device **4**. The photographed image of the camera is converted into data, and the data are transmitted to the network **1** the as transmission/reception data **1***a*. Then, the transmission/reception data **1***a* are transmitted as the transmission/reception data **1***b* from the network **1** to the operation instructing apparatus **7** in the instructor site **106**.

[0032] The operation instructing apparatus **7** is an apparatus that gives a work instruction to the worker **2** by an operation of the instructor **6**. The operation instructing apparatus **7** is configured by a personal computer or the like, which can be connected to the network **1**, for example. The operation instructing apparatus **7** extracts an image having a visual field range of the worker **2** from the photographed image of the camera, which is obtained from the transmission/reception data **1***b*, and causes the sub display **7***b* to display the extracted image. Further, the operation instructing apparatus **7** extracts an image having a wider range than the visual field range of the worker **2** from the photographed image of the camera, and causes the main display **7***a* to display the extracted image. Therefore, the operation instructing apparatus **7** provides a plurality of images having different ranges to the instructor **6**. As a result, the instructor **6** can grasp what the worker **2** is viewing, and visually recognize a state of the work site in the vicinity thereof.

[0033] When the instructor **6** inputs a work instruction for the worker **2** into the operation instructing apparatus **7**, the operation instructing apparatus **7** generates an operation instruction image (hereinafter, referred to also as an "instruction image"), and superimposes the instruction image onto the image on the sub display **7***b* to display the instruction image. This makes it possible for the instructor **6** to confirm the display content of the display of the mount type device **4** after the instruction image is received. The instruction image is transmitted as the transmission/reception

data **1***b*, and then transmitted from the network **1** to the mount type device **4** as the transmission/reception data **1***a*. The mount type device **4** uses the transmission/reception data **1***a* to cause the display to display the received instruction image. The worker **2** can confirm the instruction image by superimposing it on the operated target **3**. This improves accuracy of the work.

[0034] FIG. **2** is a view for explaining one example of an operation of the remote operation instructing system according to the first embodiment of the present invention. FIG. **2** illustrates a relationship among photographing ranges **5***a*, **5***d* of the camera **405** in the mount type device **4**, a display range **9** of the image displayed on the main display **7***a* in the operation instructing apparatus **7**, and display ranges **8***a* to **8***d* of the display in the mount type device **4**. In this regard, ad described above, each of the display ranges of the display in the mount type device **4** is equal to a display range of the sub display **7***b*.

[0035] When the center of a visual line of the worker **2** is at a point A, the photographing range of the camera **405** is an area surrounded by **5***a*, and the display range of the mount type device **4** is an area surrounded by **8***a*. The instructor **6** operates the operation instructing apparatus **7** to extract the display range **9** from the photographing range **5***a* of the camera as an area for causing the main display **7***a* to display. As a result, the instructor **6** can confirm the operated target **3** with an appropriate size and appropriate resolution. The display range **8***a* of the mount type device **4** is an area corresponding to the visual field range of the worker **2**. The worker **2** carries out the work while confirming an image in the display range **8***a* displayed on the display of the mount type device **4**. The image in the display range **8***a* is also displayed on the sub display **7***b* to share the image between the instructor **6** and the worker **2**. Further, an outer frame of the display range **8***a* is displayed on the main display **7***a*, whereby it is possible to easily confirm where the visual field of the worker is positioned in a wide range of work site.

[0036] The worker **2** may move the visual line during the work. The movement of the visual line may be inevitable in the work process, but in many cases, it is due to movement unrelated to the work process. As the visual field of the worker moves, the visual field range of the worker **2** also moves. For example, as illustrated in FIG. **2**, as the center of the visual line in turn moves from A to B, C, and D, the visual field range in turn moves from **8***a* to **8***b*, **8***c*, and **8***d*. In accordance with the movements of these, the photographing range of the camera also moves in turn. For example, in a case where the center of the visual line moves to D, the photographing range of the camera becomes **5***d*.

[0037] In the present embodiment, the display range **9** of the main display **7***a* is fixed with respect to such a movement of the direction of the visual line. The operation instructing apparatus **7** corrects an image that is extracted from the photographed image of the camera in accordance with the movement of the direction of the visual line, and sets the display range **9** of the main display **7***a*. Thus, even in a case where the visual line of the worker in turn moves A, B, C, and D, the display range **9** of the main display **7***a* is fixed. This makes it possible for the instructor **6** to view a stable image. Note that the case where the display range **9** of the main display **7***a* is fixed is illustrated herein, but the operation instructing apparatus **7** may cause the display range **9** to follow the movement of the visual line of the worker **2** so long as it is inevitable in the work process and is movement that the instructor **6** can predict. In this case, by detecting in which direction the visual line was directed within a predetermined time range and causing the display range to follow the movement of the visual line of the worker **2** slowly in accordance with the detected direction instead of causing the display range to follow all the movements thereof, it is possible to suppress sickness of the instructor **6**.

[0038] FIG. **3** is a block diagram illustrating one example of a configuration of the mount type device according to the first embodiment of the present invention. In the mount type device **4** illustrated in FIG. **3**, a reference numeral **401** denotes an acceleration/gyro sensor, a reference numeral **402** denotes a visual line movement detector, a reference numeral **403** denotes a data

multiplexer/separator, a reference numeral **404** denotes a network IF (interface), a reference numeral **405** denotes a camera, a reference numeral **406** denotes a display extractor, a reference numeral **407** denotes a controller, a reference numeral **408** denotes a display (display for worker), a reference numeral **409** denotes a synthesizer, a reference numeral **410** denotes an instruction image reconstructor, a reference numeral **411** denotes a speaker, and a reference numeral **412** denotes an internal bus.

[0039] The acceleration/gyro sensor **401** is a group of sensors including an acceleration sensor, a gyro sensor, and the like. The acceleration/gyro sensor **401** uses the respective sensors to obtain the visual line of the worker **2** who wears the mount type device **4** as sensor information. The acceleration/gyro sensor **401** outputs the sensor information obtained by each of the sensors to the visual line movement detector **402**.

[0040] The visual line movement detector **402** uses the sensor information outputted from the acceleration/gyro sensor **401** to detect the movement of the visual line of the worker **2**. For example, the visual line movement detector **402** uses plural pieces of sensor information whose obtained times are different from each other to detect the movement of the visual line. The visual line movement detector **402** transmits the detected movement of the visual line to the data multiplexer/separator **403** via the internal bus **412** as visual line movement information.

[0041] The camera **405** photographs an area in a front direction of the worker **2** at a wider angle than the range in which the visual line of the worker **2** moves. A photographed image of the camera is transmitted to the display extractor **406** and the data multiplexer/separator **403**. The display extractor **406** extracts an image of the visual field range of the worker **2** from the photographed image of the camera, and transmits the extracted image to the synthesizer **409**. Note that a camera with a standard angle of view may be added to the mount type device **4** in order to obtain the image of the visual field range of the worker **2**.

[0042] The instruction image outputted from the operation instructing apparatus **7** is received by the data multiplexer/separator **403** via the network IF **404** as the transmission/reception data **1***a*, and is transmitted from the data multiplexer/separator **403** to the instruction image reconstructor **410** via the internal bus **412**. More specifically, for example, the data multiplexer/separator **403** separates data regarding the instruction image from the received transmission/reception data la, and transmits the separated data on the instruction image to the instruction image reconstructor **410**. Further, for example, the data multiplexer/separator **403** separates data regarding voice of the instructor **6** from the received transmission/reception data la, and transmits data on the voice to the speaker **411**.

[0043] The data multiplexer/separator **403** converts the photographed image of the camera into data, and transmits photographed image data to the operation instructing apparatus **7** via the network IF **404** as the transmission/reception data **1***a*. At that time, the data multiplexer/separator **403** may multiplex the visual line movement information of the worker **2** or voice data of the worker **2** with the photographed image data, and transmit data obtained by multiplexing these as the transmission/reception data **1***a*.

[0044] The instruction image reconstructor **410** reconstructs the instruction image from the received transmission/reception data **1***a*, and transmits the reconstructed instruction image to the synthesizer **409**. The synthesizer **409** synthesizes the image extracted by the display extractor **406** and the instruction image reconstructed by the instruction image reconstructor **410**; transmits the synthesized image to the display **408**; and causes the display **408** to display an image obtained by superimposing the instruction image onto the image photographed by the camera **405** (or the extracted image).

[0045] The speaker **411** converts the voice data transmitted from the data multiplexer/separator **403** into voice, and outputs the voice of the instructor **6**.

[0046] The controller **407** executes a control of each unit constituting the mount type device **4**, assignment of the internal bus, and the like, and causes the mount type device **4** to execute

respective processes. Each of the visual line movement detector **402**, the data multiplexer/separator **403**, the display extractor **406**, the synthesizer **409**, and the instruction image reconstructor **410** may be configured by hardware, or may be realized by software to be executed by the controller **407**.

[0047] FIG. **4** is a block diagram illustrating one example of a configuration of the operation instructing apparatus according to the first embodiment of the present invention. In the operation instructing apparatus **7** illustrated in FIG. **4**, a reference numeral **701** denotes a user IF, a reference numeral **702** denotes an instruction image generator, a reference numeral **703** denotes a data multiplexer/separator, a reference numeral **704** denotes a network IF, a reference numeral **705** denotes a controller, a reference numeral **7***a* denotes a main display, a reference numeral **706** denotes a display setter, a reference numeral **707** denotes a camera photographed image reconstructor, a reference numeral **7***b* denotes a sub display, a reference numeral **708** denotes a visual line range extractor/instruction image synthesizer (hereinafter, referred to as a "synthesizer"), a reference numeral **709** denotes a microphone, and a reference numeral **710** denotes an internal bus.

[0048] The user IF **701** is a functional block that receives an input from the instructor **6**. The user IF **701** is an input device such as a keyboard, operation buttons, a mouse, or a touch panel, for example. The instructor **6** carries out an input operation via the user IF **701** to cause the operation instructing apparatus **7** to execute a predetermined process via the controller **705**.

[0049] The instruction image generator **702** generates an instruction image suitable for the work process, and transmits instruction image data to the data multiplexer/separator **703**. The instruction image data are transmitted to the network **1** via the network IF **704** as the transmission/reception data **1***b*. At that time, for example, the data multiplexer/separator **703** may multiplex the instruction image data, the voice data of the instructor **6**, and the like, and transmit the multiplexed data via the network IF **704** as the transmission/reception data **1***b*.

[0050] The data multiplexer/separator **703** separates photographed image data from the transmission/reception data **1***b* received from the mount type device **4**, and transmits the photographed image data to the synthesizer **708** via the internal bus **710**. Further, the data multiplexer/separator **703** separates visual line movement information of the worker **2** from the received transmission/reception data **1***b*, and transmits the separated visual line movement information to the display setter **706**, the synthesizer **708**, and the like. Further, the data multiplexer/separator **703** may separate the voice data of the worker **2** from the received transmission/reception data **1***b*, and transmit the separated voice data to a speaker (not illustrated in the drawings).

[0051] The photographed image data transmitted from the data multiplexer/separator **703** are reconstructed to photographed image by the camera photographed image reconstructor **707**. The reconstructed camera photographed image is transmitted to the display setter **706** and the synthesizer **708**.

[0052] The controller **705** executes a control of each unit constituting the operation instructing apparatus **7**, assignment of the internal bus **710**, and the like, and causes the operation instructing apparatus **7** to execute respective processes. Further, the controller **705** sets an area of the photographed image to be extracted by the display setter **706**, and transmits a setting value to the display setter **706**.

[0053] The display setter **706** extracts an image with an area to be displayed on the main display **7***a* (a first image) from the camera photographed image in accordance with the setting value transmitted from the controller **705**. At this time, the movement of the visual line is corrected for the extracted image using the visual line movement information. As explained using FIG. **2**, the display setter **706** fixes the display range **9** of the image that the main display **7***a* is caused to display even in a case where the visual line of the worker moves.

[0054] The synthesizer **708** extracts an image of the visual field range of the worker **2** (a second

image) from the photographed image, and synthesizes the image and an instruction image to cause the sub display **7***b* to display the image obtained by synthesizing these. The movement of the visual line for the image that is extracted by the synthesizer **708** may also be corrected using the visual line movement information. The microphone **709** converts the voice of the instructor **6** into voice data, and transmits the voice data to the data multiplexer/separator **703**.

[0055] Note that a display image of the sub display **7***b* may be one obtained by synthesizing a photographed image of a camera with a standard angle of view, which is added to the mount type device **4**, and the instruction image. Further, the display image generated by the synthesizer **708** may be displayed on the main display **7***a*. In this case, the sub display **7***b* may not be provided. Further, the main display **7***a* may display the image generated by the display setter **706** and the image generated by the synthesizer **708** by a picture-in-picture method, and the instructor **6** may arbitrarily switch the displays and display the images.

[0056] FIG. **5** is a view illustrating one example of an image in a visual field range of a worker. More specifically, FIG. **5** illustrates an image that is to be displayed on the display **408** of the mount type device **4** and the sub display **7***b* of the operation instructing apparatus **7**. In FIG. **5**, reference numerals **20***a* to **20***d* denote instruction images, and the instruction images **20***a* to **20***d* are synthesized and displayed on a visual field image of the worker **2**. The instruction images **20***a*, **20***c* are images for conveying the instruction content in characters, and the instruction image **20***b*, **20***d* are images for highlighting work targets. The worker **2** can easily understand the work content by viewing the instruction image.

[0057] FIG. **6** is a flow diagram illustrating a detecting process of movement of a visual line of a worker. As explained using FIG. **3**, the movement of the visual line of the worker **2** is detected using the acceleration/gyro sensor **401** and the visual line movement detector **402**. FIG. **6** illustrates a method of substituting this, that is, a flow of detecting the movement of the visual line using the photographed image in the operation instructing apparatus **7**. This makes it possible to use the mount type device **4** by which the cost is reduced by omitting the group of sensors.

[0058] When detection of movement of a visual line is started (S**1**), the operation instructing apparatus **7** respectively obtains photographed images at times Tn, Tn+1 (S**2** to S**3**). In a case where the worker **2** moves the visual line, a photographing range of a photographed image to be photographed by a camera worn by the worker **2** also moves. The operation instructing apparatus **7** evaluates how much the image at the time In+1 should be shifted on the basis of the image at the time In by executing image matching, for example (S**4**). An image shift amount and an image shift direction executed at Step S**4** become visual line movement information that indicates the movement of the visual line.

[0059] The operation instructing apparatus **7** executes filtering such as removal of abnormal values for the visual line movement information obtained at Step S**4**, and determines a visual line moving amount (S**5**). The operation instructing apparatus **7** calculates and outputs a relative coordinate value corresponding to the visual line moving amount (S**6**). By outputting the relative coordinate value, it becomes possible to output the display range **9** of operation instructing apparatus in the same display range even though the direction of the camera changes.

[0060] After the relative coordinate value at Step S**6** is outputted, the operation instructing apparatus **7** determines whether the detecting process of the movement of the visual line is continued or not (S**7**). In a case where the detecting process of the movement of the visual line is to be continued (No), the operation instructing apparatus **7** repeats the processes at Steps S**2** to S**6**. On the other hand, in a case where the detecting process of the movement of the visual line is not to be continued (Yes), the operation instructing apparatus **7** terminates the detecting process of the movement of the visual line (S**8**). Note that the flow of FIG. **6** may be executed by the controller **705**, for example, or may be executed by another component.

[0061] FIG. **7** is a view for explaining another example of an operation of the remote operation instructing system according to the first embodiment of the present invention. FIG. **7** illustrates an

operation in a case where a priority processing event occurs outside the visual field range of the worker **2**. The photographing range **5***a* of the camera **405**, the display range **9** of the main display **7***a,* and the display ranges **8***a,* **8***e* of the display **408** of the mount type device **4** are illustrated in FIG. **7**.

[0062] When the visual line of the worker **2** is positioned at a point A, an image of the display range **8***a* is displayed on the display **408**. Further, an image of the display range **9** is displayed on the main display **7***a* in the operation instructing apparatus **7**.

[0063] At this time, when a priority processing event **11** appears in the display range **8***e* outside the visual field of the worker **2**, the instructor **6** recognizes the priority processing event **11** on the screen of the main display **7***a*. Then, the instructor **6** creates an instruction image **20**, and causes the operation instructing apparatus **7** to transmit the created instruction image **20** to the mount type device **4**. The mount type device **4** separates data regarding the instruction image **20** from the received transmission/reception data **1***a,* and synthesizes the instruction image **20** to the display range **8***a* of the display **408** using the separated data.

[0064] The instruction image **20** may be any one that causes the worker **2** to direct his or her visual line toward the priority processing event **11** outside the visual field range. The instruction image **20** illustrated in FIG. **7** is an image of an arrow toward the central point E of an area including at least a part of the priority processing event **11**, and encourages the worker **2** to quickly address the priority processing event **11**.

[0065] FIG. **8** is a view illustrating a flow related to setting of a display range in the operation instructing apparatus. In the flow illustrated in FIG. **8**, an image of a visual line range of the worker **2** always exists within a display range of the main display **7***a* in the operation instructing apparatus **7**, and the display range of the main display **7***a* falls within the photographing range of the camera **405**.

[0066] When the processes illustrated in FIG. **8** are started (S**10**), as a condition 1, a possibility that a display area of the mount type device **4**, that is, a part of an image to be displayed on the sub display **7***b* protrudes toward the outside of the display range of the main display **7***a* is evaluated (S**11**). In a case where it is determined at Step S**11** that there is no possibility that the part of the image to be displayed on the sub display **7***b* protrudes toward the outside of the display range of the main display **7***a* (No), a process at Step S**12** is executed. At Step S**12**, as a condition 2, a possibility that a part of the display range of the main display **7***a* protrudes toward the outside of the photographing range of the camera **405** is evaluated.

[0067] In a case where it is determined that there is the possibility that the part of the image to be displayed on the sub display **7***b* protrudes toward the outside of the display range of the main display **7***a* (S**11**, Yes), or in a case where it is determined that there is the possibility that the part of the display range of the main display **7***a* protrudes toward the outside of the photographing range of the camera **405** (S**12**, Yes), it means that a relationship among the photographing range of the camera **405**, the display range of the main display **7***a,* and the display range of the display **408** in the mount type device **4** is not in an appropriate state.

[0068] In this case, resetting of the display ranges is executed (S**13**). For example, the display range of the main display **7***a* is adjusted so that the center of the display range of the main display **7***a* and the center of the visual line of the worker **2** coincide with each other. Since the center of the visual line of the worker **2** and the center of the photographing range of the camera **405** coincide with each other, the centers of the photographing range of the camera **405**, the display range of the main display **7***a,* and the display range of the display **408** coincide with each other, a relationship of "(the photographing range of the camera) >(the display range of the main display **7***a*) >(the display range of the display **408**)" is secured. Note that the mark ">" indicates that there is an inclusion relationship. However, if the display range of the main display **7***a* is reset immediately by following the movement of the visual line, the display range moves when the worker **2** moves his or her the head or moves the visual line. Therefore, the instructor may feel unpleasant sickness. For that

reason, resetting of the display range may be executed slowly with respect to the movement of the visual line, or may be executed by calculating an average moving amount for a certain period of time or longer.

[0069] On the other hand, in a case where it is determined at Step S**12** that there is no possibility that the part of the display range of the main display **7***a* protrudes toward the outside of the photographing range of the camera **405** (No), the process at Step S**11** is executed again.

[0070] At Step S**14**, it is determined whether reset processing for the display range is to be terminated or not. In a case where it is determined that the reset processing for the display range is to be continued (No), the processes at Step S**11** to S**13** are executed again. On the other hand, in a case where it is determined that the reset processing for the display range is to be terminated (Yes), the reset processing for the display range is terminated (S**15**).

[0071] FIG. **9** is an outline drawing illustrating one example of a configuration of the mount type device. In FIG. **9**, a reference numeral **42** denotes a camera/sensor unit, a reference numeral **43** denotes a control unit, reference numerals **411***a*, **411***b* denote speakers, and reference numerals **45***a*, **45***b*, **45***c* denote holders.

[0072] The holder **45***a* is in contact with the crown, the holder **45***b* is in contact with the occipital region and the left and right temporal regions, and the glasses-shaped holder **45***c* is in contact with the nose. The holders **45***a* to **45***c* allow the mount type device **4** to be attached to the head of the worker **2**.

[0073] The camera/sensor unit **42** is a unit that includes the acceleration/gyro sensor **401** and the camera **405**, for example. The camera/sensor unit **42** is configured to photograph the front of the worker **2**, and measure movement of the head of the worker **2** to obtain sensor information regarding the movement of the visual line. Alternatively, the camera/sensor unit **42** may detect the direction of the visual line directly from an angle of the pupil by a tracking technique for detecting a direction of a visual line.

[0074] As illustrated in FIG. **9**, the camera/sensor unit **42** may be provided on the holder **45***a* for the crown, or may be provided at any other place.

[0075] The speakers **411***a*, **411***b* are provided at portions on the holder **45***b* near the respective ears of the worker **2**. The display **408** is disposed in front of the worker **2**, and the worker **2** views an image displayed on the display **408** through the glasses-shaped holder **45***c*.

[0076] The control unit **43** is a unit that includes the visual line movement detector **402**, the data multiplexer/separator **403**, the network IF **404**, the display extractor **406**, the controller **407**, the synthesizer **409**, the instruction image reconstructor **410**, and the like, which are illustrated in FIG. **3**, for example. Note that the display **408** and the control unit **43** may be configured integrally. In this case, a smartphone may be used, for example.

[0077] FIG. **10** is an outline drawing illustrating another example of the configuration of the mount type device. In FIG. **10**, the same reference numerals as those in FIG. **9** are respectively assigned to the same components as those in FIG. **9**. In FIG. **10**, a projector-type display composed of a projector **46***a* and a screen **408***a* is provided in place of the display **408**.

[0078] The screen **408***a* is configured by a transmissive screen, for example. In this case, the worker **2** can confirm an actual scene of his or her visual field range through the screen. An image projected on the screen **408***a* by the projector **46***a* is the instruction image from the operation instructing apparatus **7**, for example. The worker **2** can view the visual field image and the instruction image by synthesizing them on the screen **408***a*. For this reason, the synthesizer **409** may not be provided in the configuration illustrated in FIG. **10**.

[0079] FIG. **11** is an outline drawing illustrating still another example of the configuration of the mount type device. In FIG. **11**, the same reference numerals as those in FIG. **9** are also assigned to the same components as those in FIG. **9**, respectively. In FIG. **11**, 3D cameras **47***a*, **47***b* are provided. Further, in FIG. **11**, a 3D display **408***b* is provided in place of the display **408**. Further, a holder with shutter **48***b* is provided in place of the holder **45***c*.

[0080] The 3D camera **47***a* is provided on the holder **45***b* at a right side of the worker **2**. The 3D camera **47***b* is provided on the holder **45***b* at a left side of the worker **2**. The 3D cameras **47***a*, **47***b* respectively photograph images having a parallax in a right-and-left direction each other, and output the photographed images to the 3D display **408***b*. For example, the 3D display **408***b* alternately displays the photographed images of the 3D cameras **47***a*, **47***b* in a time-division manner.

[0081] The holder with shutter **48***b* has a liquid crystal shutter, for example. The holder with shutter **48***b* repeats ON/OFF of the shutter in accordance with the right and left photographed images displayed on the 3D display **408***b*. More specifically, the holder with shutter **48***b* controls the shutter so that the 3D display **408***b* can be viewed by a right eye when the right image of the 3D camera **47***a* is displayed, and controls the shutter so that a left eye can view the 3D display **408***b* when the left image of the 3D camera **47***b* is displayed. The control of the shutter allows the worker **2** to view the 3D image.

[0082] According to the configuration illustrated in FIG. **11**, the worker **2** can view the foreground thereof as a 3D image, and also obtain depth information of the image. For example, when the 3D image (the photographed images of the 3D cameras **47***a*, **47***b*) is transmitted to the operation instructing apparatus **7**, the instructor **6** can create a 3D instruction image in consideration of the depth of a work target. If the depth information on such an image is fed back to the worker **2**, the accuracy of the work is improved.

[0083] Further, the 3D display may be provided in the operation instructing apparatus **7** as the sub display **7***b* in correspondence with the configuration illustrated in FIG. **11**. In this case, a 3D image of the 3D camera is supplied to the synthesizer **708** in place of the photographed images of the cameras.

<Main Effects by the Present Embodiment>

[0084] According to the present embodiment, an image having a wider range than the visual line range of the worker **2** is displayed on the main display **7***a*. According to this configuration, even though the visual line of the worker **2** moves, the influence on the image displayed on the main display **7***a* is suppressed. Therefore, the instructor **6** does not feel unpleasant sickness.

[0085] Further, according to the present embodiment, the instructor **6** can create the instruction image while viewing the image of the visual field range of the worker, which is displayed on the sub display **7***b*. Further, the instruction image is superimposed and displayed on the display **408** in the mount type device **4**. According to this configuration, the instructor **6** can accurately carry out an instruction to the worker **2** while viewing the wide range of the work site.

[0086] Further, according to the present embodiment, the controller **705** sets an area of the photographed image that is to be extracted. According to this configuration, it becomes possible to appropriately change the area of the image displayed on the main display **7***a* in consideration of a usage situation thereof. Further, according to the present embodiment, even in a case where the visual line of the worker **2** moves, the area of the photographed image displayed on the main display **7***a* is fixed. According to this configuration, the photographed image displayed to the instructor **6** does not fluctuate in response to the movement of the visual line of the worker **2**. As a result, the instructor **6** is less likely to feel unpleasant sickness.

[0087] Further, according to the present embodiment, in a case where the priority processing event **11** occurs outside the visual field range of the worker **2**, the instructor **6** generates the instruction image to cause the worker **2** to direct his or her visual line toward the priority processing event **11**. According to this configuration, the worker **2** can direct his or her visual line toward the priority processing event **11**, and address the priority processing event **11** quickly.

Second Embodiment

[0088] Next, a second embodiment will be described. Note that hereinafter, explanation for the portions that overlap with the embodiment described above will be omitted in principle. FIG. **12** is a view for explaining an outline of a remote operation instructing system according to the second

embodiment of the present invention. In FIG. **12**, a working robot **12** is used in place of a worker **2**. An instructor **6** carries out a remote operation for the working robot **12** to carry out work. An operation head **13** is attached to a tip of the working robot **12**. Positioning for the working robot **12** is carried out, and the working robot **12** carries out predetermined work for the operated target **3** using the operation head **13**.

[0089] A mount type device **4***a* is installed at a position where the entire working range of the operation head **13** can be viewed. The mount type device **4***a* is configured so that a display **408** is omitted from a mount type device **4**. The mount type device **4***a* includes a wide-angle camera, and transmits, to an operation instructing apparatus **7**, photographed image data on a photographed image of a work site, which is photographed by the camera, and movement information of the working robot. Of course, the installation position of the mount type device **4***a* is not limited to this position.

[0090] An image extracted from the received photographed image is displayed on a main display **7***a* or a sub display **7***b* of the operation instructing apparatus **7**. At this time, a display setter **706** executes correction for the image extracted from the photographed image (a third image) by using the movement information of the working robot **12**.

[0091] The instructor **6** generates an instruction of positioning for the working robot **12** or a work instruction for the operation head **13** while viewing the displayed image. More specifically, in the present embodiment, the instruction **702** image generator illustrated in FIG. **4** serves as a work instruction generator, and the work instruction generator generates a work instruction on the basis of an input operation by the instructor **6**. By transmitting the generated work instruction or the like, a remote operation for the working robot **12** is carried out.

[0092] Note that the photographed image may be transmitted from the mount type device **4***a* to the operation instructing apparatus **7**, or may be transmitted via the working robot **12**. Further, the work instruction may be transmitted to the working robot **12** via the mount type device **4***a*, or may be transmitted directly to the working robot **12**.

[0093] According to the present embodiment, it becomes possible to use the working robot in the remote operation instructing system.

Third Embodiment

[0094] Next, a third embodiment will be described. FIG. **13** is a view for explaining an outline of a remote operation instructing system according to the third embodiment of the present invention. FIG. **13** illustrates only a worker site including a work site. The worker site is facility in a limited area such as a warehouse or a hospital, for example. A facility camera **14** for monitoring a state of the facility is installed in the worker site. The facility camera **14** may be provided newly for the remote operation instructing system. For example, a camera installed for another purpose, such as a security camera, may be used as the facility camera **14**. The facility camera **14** photographs the inside of the facility at a wide angle to obtain a photographed image having a photographing range **15**. The facility camera **14** has a network function, and transmits the photographed image to an operation instructing apparatus **7** via a network **1** as transmission/reception data **1***c*.

[0095] The worker **2** wears a mount type device **4** that has a camera **405** with a standard angle of view, for example. The camera **405** generates a photographed image having a photographing range **16**, and transmits photographed image data to the operation instructing apparatus **7** as transmission/reception data **1***a*.

[0096] The operation instructing apparatus **7** uses the photographed image having the photographing range **15**, which is transmitted from the facility camera **14**, and the photographed image having the photographing range **16**, which is transmitted from the mount type device **4** to detect a visual line of the worker **2**, that is, a position of the photographing range **16** in the photographing range **15**.

[0097] The center of the photographing range **15** of the facility camera **14** does not almost match with the center of the photographing range **16** of the camera **405** in the mount type device **4**. For

this reason, in order to detect the position of the photographing range **16** in the photographing range **15**, it is necessary to execute processing of detecting the position of the center of the photographing range **16** in the photographing range **15** of the facility camera.

[0098] Hereinafter, the processing of detecting the visual line of the worker (that is, the photographing range **16**) will be described with reference to FIG. **14**. FIG. **14** is a flow diagram illustrating one example of the processing of detecting the visual line of the worker in the photographing range of the facility camera. Note that the processing according to FIG. **14** may be executed by a controller **705** of the operation instructing apparatus **7**, or may be executed by the other functional block.

[0099] When the processing of detecting the visual line of the worker is started (S**20**), the operation instructing apparatus **7** obtains a photographed image of the facility camera **14** (S**21**), and obtains a photographed image of the mount type device **4** (S**22**). In a case where the worker **2** moves his or her visual line, the photographing range **16** of the camera **405** in the mount type device **4** moves, but the photographing range **15** of the facility camera **14** does not move. Therefore, the operation instructing apparatus **7** executes an image matching process between the photographed image having the photographing range **16** and the photographed image having the photographing range **15** (S**23**), and detects a position of the photographing range **15** in the photographing range **16** as a visual line value indicating the visual line of the worker **2** (S**24**). For example, the center of the photographing range **16** may be detected as the visual line of the worker **2**, and a coordinate position of the center of the photographing range **16** may be detected as the visual line value.

[0100] Movement of the visual line of the worker **2** can be racked by a group of sensors mounted on the mount type device **4** (S**30**). Therefore, the operation instructing apparatus **7** uses the visual line value obtained by the calculation at Step S**24** as an initial value and sensor information obtained at Step S**30** to execute movement correction for tracking the movement of the visual line (S**25**), and outputs the visual line value (the coordinate position) of the photographing range **16** in the photographing range **15** of the visual line (S**26**).

[0101] Then, it is determined whether a visual line detecting process is to be terminated or not (S**27**). In a case where the visual line detecting process is continued (No), it is determined whether a refreshing process is to be executed or not (S**28**). In a case where it is determined that the refreshing process is to be executed (Yes), the process at Step S**21** is executed. On the other hand, in a case where it is determined that the refreshing process is not to be executed (No), the process at Step S**25** is executed. In a case where it is determined at Step S**27** that the visual line detecting process is to be terminated (No), the visual line detecting process is terminated (S**8**).

[0102] According to the present embodiment, the remote operation instructing system utilizing the facility camera **14** can be realized. In addition, it is also possible to use an existing camera as the facility camera **14**.

Fourth Embodiment

[0103] Next, a fourth embodiment will be described. FIG. **15** is a view for explaining an outline of a remote operation instructing system according to the fourth embodiment of the present invention. FIG. **15** illustrates an automobile (a mobile object) **17** provided with an automatic driving apparatus **19***a* in place of a worker. The automobile **17** includes a front camera **18***a*, a rear camera **18***b*, and side cameras **18***c,* **18***d.* The front camera **18***a*, the rear camera **18***b*, and the side cameras **18***c,* **18***d* respectively photograph corresponding areas to generate photographed images thereof. The automobile **17** is connected to a network **1** to transmit these photographed image data to the operation instructing apparatus **7** as transmission/reception data **1***d*. Note that a visual line of the automobile **17** (which corresponds to the worker) when moving forward is located in a photographing area of the front camera **18***a*. Further, the visual line of the automobile **17** (which corresponds to the worker) when moving backward may be located in a photographing area of the rear camera **18***b*.

[0104] For example, these photographed images are displayed on a display in the operation

instructing apparatus **7**. This allows an instructor **6** to observe a wide area corresponding to a work area (for example, the entire circumference of the automobile **17**) while viewing the photographed images displayed on the display.

[0105] When an emergency situation is detected, the instructor **6** transmits an emergency processing operation command, and an emergency processing apparatus **19***b* and the automatic driving apparatus **19***a* cause the automobile **17** to stop in a safe zone such as a roadside zone. The emergency processing operation command is generated by an emergency processing command unit (not illustrated in the drawings). For example, a function of the emergency processing command unit may be possessed by the instruction image generator **702** illustrated in FIG. **4**, or the emergency processing command unit may be provided separately from the instruction image generator **702**. Note that the automobile **17** is exemplified as the mobile object, but the mobile object is not limited to this.

[0106] According to the present embodiment, it is possible to apply the remote operation instructing system to the automobile **17** provided with the automatic driving apparatus **19***a*, and this makes it possible to improve safety of the automobile **17**.

[0107] In this regard, the present invention is not limited to the embodiments described above, and various modifications are contained. For example, the embodiments described above have been explained in detail for explaining the present invention clearly.

[0108] The present invention is not necessarily limited to one that includes all configurations that have been explained.

[0109] Further, a part of the configuration of one embodiment can be replaced by a configuration of the other embodiment. Further, a configuration of the other embodiment can be added to a configuration of one embodiment. Moreover, a part of the configuration of each of the embodiments can be added to the other configuration, deleted or replaced thereby. Note that each member illustrated in the drawings and a relative size thereof are simplified and idealized in order to clearly explain the present invention, and each member may have a more complex shape on implementation thereof.

[0110] Further, a part or the whole of each component may be implemented by hardware, for example, by designing an integrated circuit. Further, a microprocessor unit, a CPU, or the like may interpret and execute an operation program, each component may be implemented by software. Further, the implementation range of the software is not limited, and the hardware and the software may be used together.

REFERENCE SIGNS LIST

[0111] **1** . . . network, **1***a* to **1***d* . . . transmission/reception data, **2** . . . worker, **3** . . . operated target, **4** . . . mount type device, **5**, **5***a*, **5***b*. photographing range, **6** . . . instructor, **7** . . . operation instructing apparatus, **7***a* . . . main display, **7***b* . . . sub display, **8***a* to Sephotographing range, **9** . . . display range, **401** . . . acceleration/gyro sensor, **402** . . . visual line movement detector, **403** . . . data multiplexer/separator, **404** . . . network IF, **405** . . . camera, **406** . . .

[0112] display extractor, **407** . . . controller, **408** . . . display, **409** . . . synthesizer, **410** . . . instruction image reconstructor, **411** . . . speaker, **412** . . . internal bus, **701** . . . user IF, **702** . . . instruction image generator, **703** . . . data multiplexer/separator, **704** . . . network IF, **705** . . . controller, **706** . . . display setter, **707** . . . camera photographed image reconstructor, **708** . . . visual line range extractor/instruction image synthesizer, **709** . . . microphone, **20**, **20***a* to **20***d* . . . instruction image, **11** . . . priority processing event, **42** . . . camera/sensor unit, **43** . . . control unit, **411***a*, **411***b* . . . speaker, **45***a* to **45***c* . . . holder, **46***a* . . . projector, **408***a* . . . screen, **47***a*, **47***b* . . . 3D camera, **408***b* . . . 3D display, **48***b* . . . holder with shutter, **12** . . . working robot, **13** . . . operation head, **4***a* . . . mount type device, **14** . . . facility camera, **15** . . . photographing range, **16** . . . photographing range, **17** . . . automobile, **18***a* . . . front camera, **18***b* . . . rear camera, **18***c*, **18***d* . . . side camera, **19***a* . . . automatic driving apparatus, **19***b* . . . emergency processing apparatus, **21** . . . internal bus.

Claims

1. A data transmission and reception system comprising: a first apparatus; a second apparatus; and a network through which data are transmitted and received between the first apparatus and the second apparatus, wherein the first apparatus includes: a camera configured to photograph a vicinity of the first apparatus in a wider range than a visual field of a user of the first apparatus; a sensor configured to obtain visual line information regarding a visual line of the user; a first network interface configured to transmit an image photographed by the camera and the visual line information to the second apparatus via the network, wherein the second apparatus includes: a display; a display setter configured to extract a first image having a wider range than a visual field range of the user from the image photographed by the camera, correct the first image using the visual line information, and cause the display to display the corrected first image; an image generator configured to generate a conveyance image for conveying information in characters to the user; a synthesizer configured to extract a second image having the visual field range of the user from the photographed image, and superimpose the second image and the conveyance image to cause the display to display the second image and the conveyance image; and a second network k interface configured to transmit the conveyance image to the first apparatus via the network, wherein, in a case where there is a possibility that a part of the second image does not exist within the range of the first image, the display setter adjusts the extraction of the first image from the photographed image so that the center of the adjusted first image and the center of the second image coincide each other.

2. The data transmission and reception system according to claim 1, wherein the first apparatus is attached to a head of the user.

3. The data transmission and reception system according to claim 2, wherein the second apparatus is a personal computer.

4. The data transmission and reception system according to claim 1, wherein the first apparatus includes a display for the user configured to superimpose the conveyance image onto the visual field of the user and display the conveyance image.

5. The data transmission and reception system according to wherein the second apparatus includes a controller configured to set a range for extracting the photographed image in the display setter.

6. The data transmission and reception system according to claim 1, wherein the display setter fixes an area of the first image to be displayed on the display even in a case where the visual line of the user moves.

7. The data transmission and reception system according to claim 1, wherein, in a case where a priority processing event occurs outside the visual field range of the user, the image generator is configured to generate the conveyance image to cause the user to direct the visual line toward the priority processing event, and the second apparatus transmits, to the first apparatus, the conveyance image to cause the user to direct the visual line toward the priority processing event.

8. The data transmission and reception system according to claim 1, wherein a photographing range of the camera includes an area of the first image that is extracted and displayed by the second apparatus, and the area of the first image includes an area of the second image.

9. The data transmission and reception system according to claim 1, wherein the visual line information is information which indicates movement of a direction of the visual line of the user.

10. The data transmission and reception system according to claim 1, wherein the visual line information is a coordinate which indicates a direction of the visual line of the user.

11. An information processing apparatus for transmitting and receiving data with other apparatus, comprising: a display; a network interface configured to receive, from an other apparatus, a photographed image which is photographed a vicinity of the other apparatus in a wider range than a visual field of a user of the other apparatus and visual line information regarding a visual line of the

user; a display setter configured to extract a first image having a wider range than a visual field range of the user from the photographed image, correct the first image using the visual line information, and cause the display to display the corrected first image; an image generator configured to generate a conveyance image for conveying information in characters to the user; and a synthesizer configured to extract a second image having the visual field range of the user from the photographed image, and superimpose the second image and the conveyance image to cause the display to display the second image and the conveyance image, wherein the network interface is configured to transmit the conveyance image to the other apparatus, and wherein, in a case where there is a possibility that a part of the second image does not exist within the range of the first image, the display setter adjusts the extraction of the first image from the photographed image so that the center of the adjusted first image and the center of the second image coincide each other.

12. The information processing apparatus according to claim 11, wherein the other apparatus is attached to a head of the user.

13. The information processing apparatus according to claim 12, wherein the information processing apparatus is a personal computer.

14. The information processing apparatus according to claim 11, further comprising: a controller configured to set a range for extracting the photographed image in the display setter.

15. The information processing apparatus according to claim 11, wherein the display setter fixes an area of the first image to be displayed on the display even in a case where the visual line of the user moves.

16. The information processing apparatus according to claim 11, wherein, in a case where a priority processing event occurs outside the visual field range of the user, the image generator is configured to generate the conveyance image to cause the user to direct the visual line toward the priority processing event, and the network interface transmits, to the other apparatus, the conveyance image to cause the user to direct the visual line toward the priority processing event.

17. The information processing apparatus according to claim 11, wherein the visual line information is information which indicates movement of a direction of the visual line of the user.

18. The information processing apparatus according to claim 11, wherein the visual line information is a coordinate which indicates a direction of the visual line of the user.