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(54) MEDICAL IMAGE DISPLAY APPARATUS

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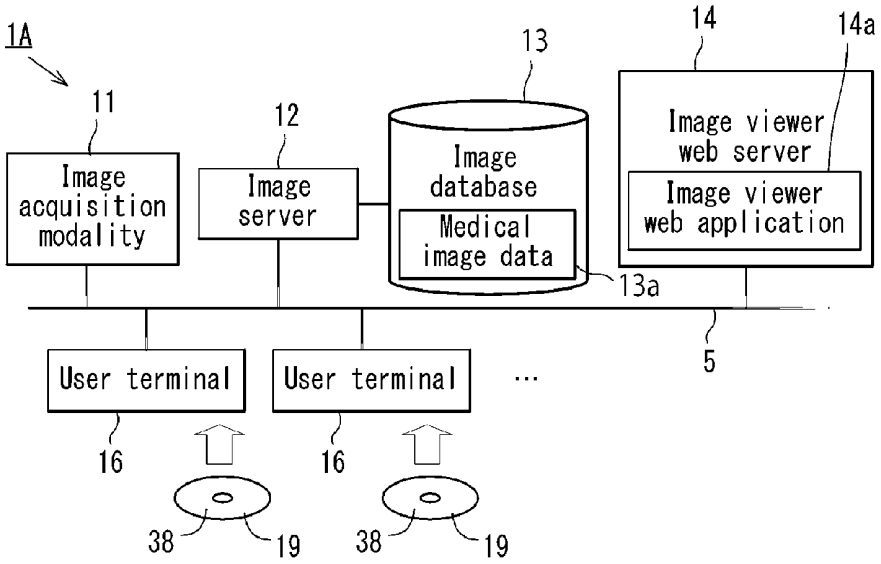
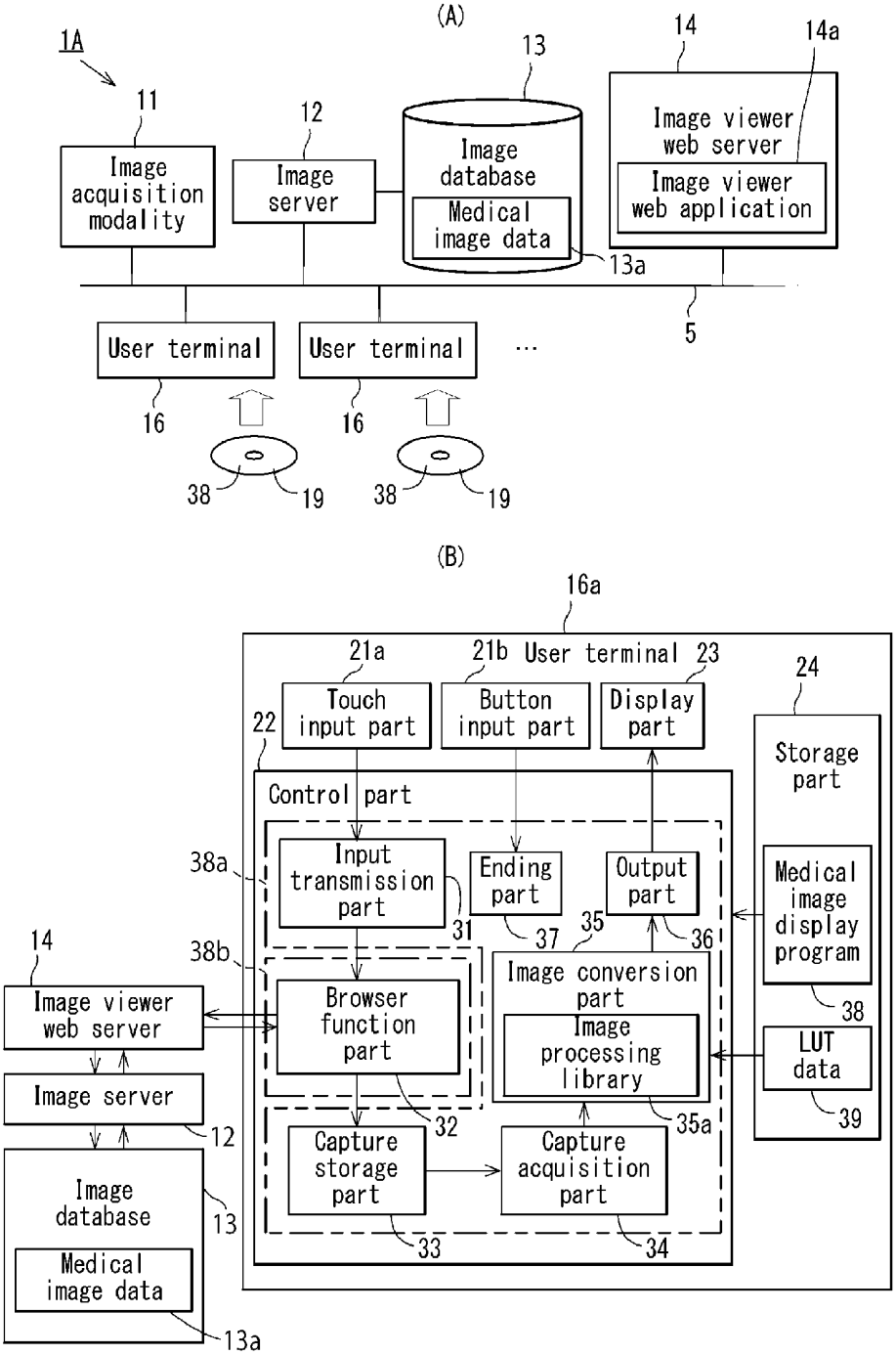
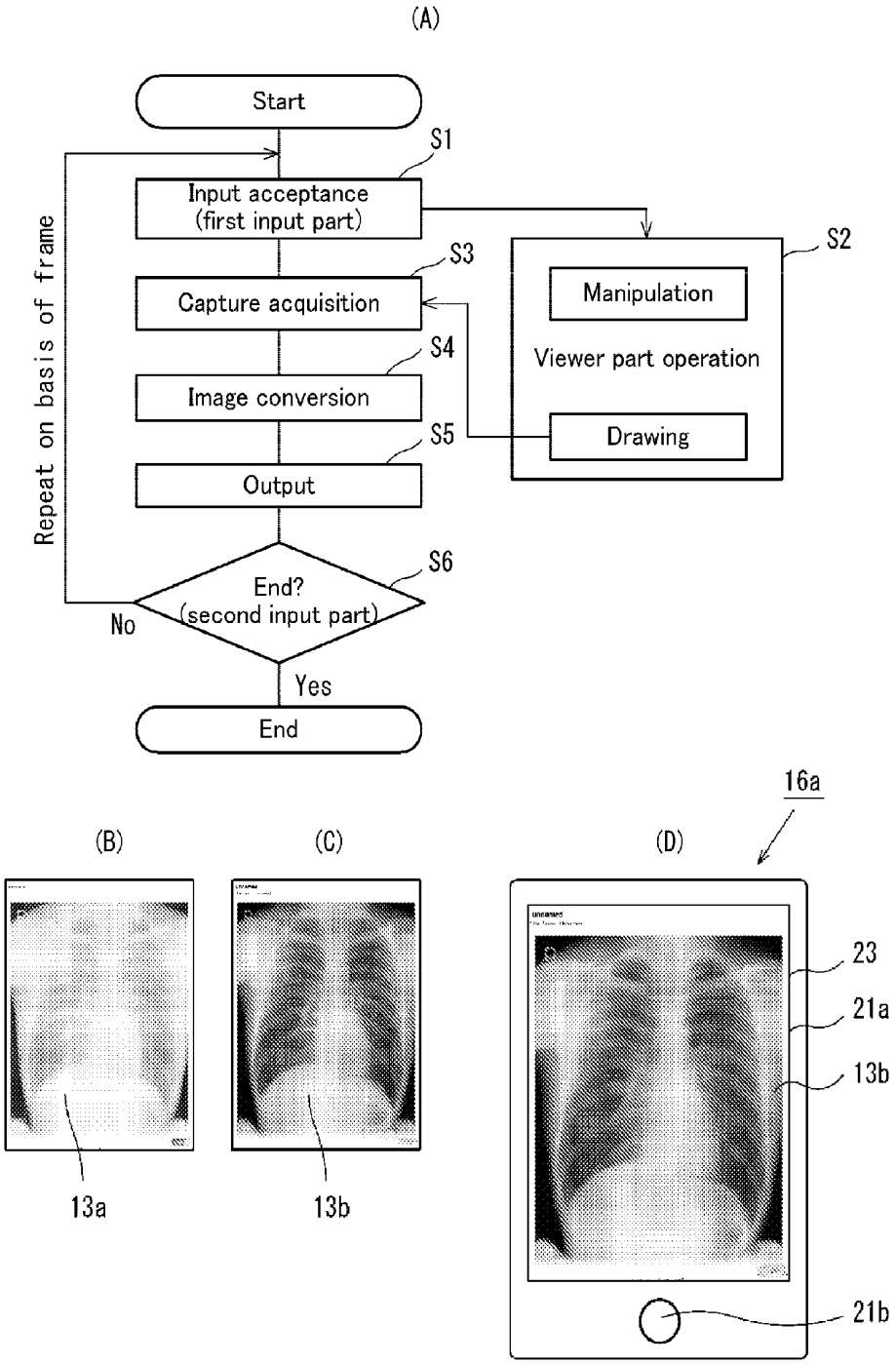
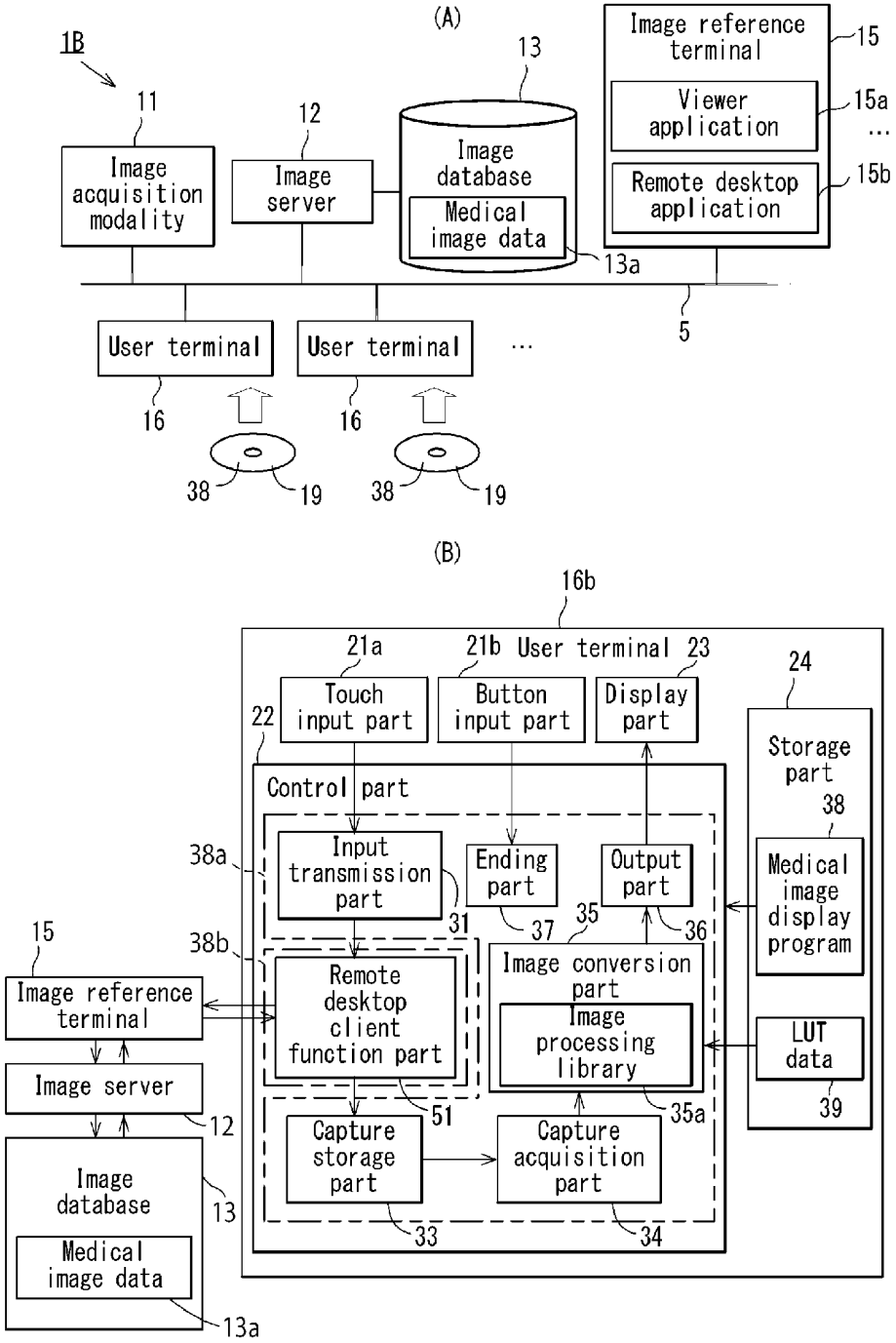
(57) ABSTRACT

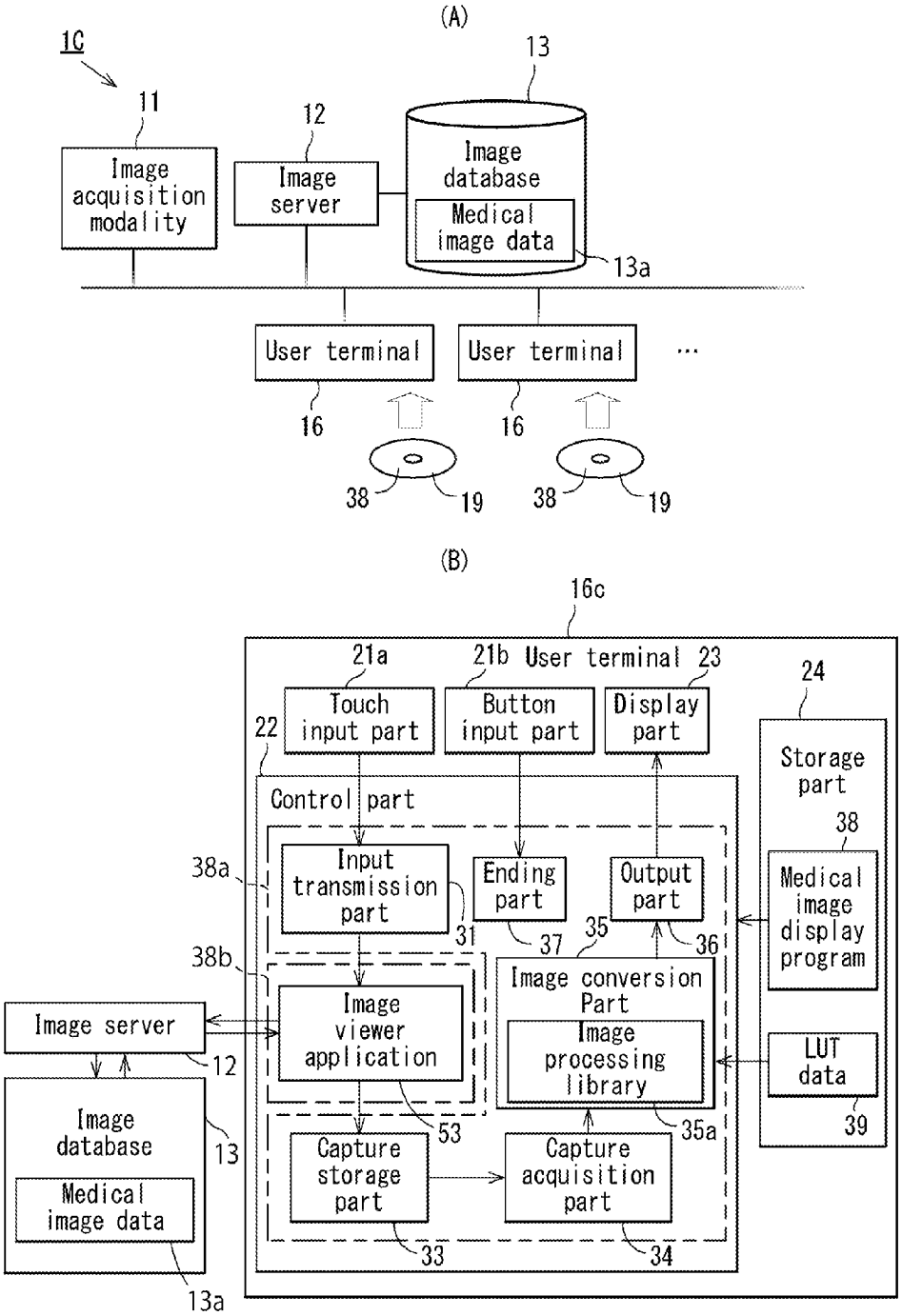
A viewer part **38***b* accesses an image viewer web server **14** by a user terminal **16**, in which a medical image display program **38** is installed, to acquire at least medical image data **13***a*, input data accepted in a touch input part **21***a* is transmitted in an input transmission part **31** and is transferred to the image viewer web server **14**, the medical image data **13***a* outputted from the image viewer web server **14** is acquired in a capture acquisition part **34**, at least a medical image data **13***a* portion is subjected to image conversion in an image conversion part **35**, and image data for display after conversion is outputted to a display part **23** by an output part **36**. Accordingly, there is provided a medical image display device that can display a medical image in proper gradation without using color management by hardware, and without performing modification corresponding to gradation correction to an individual application having a display function of the medical image.

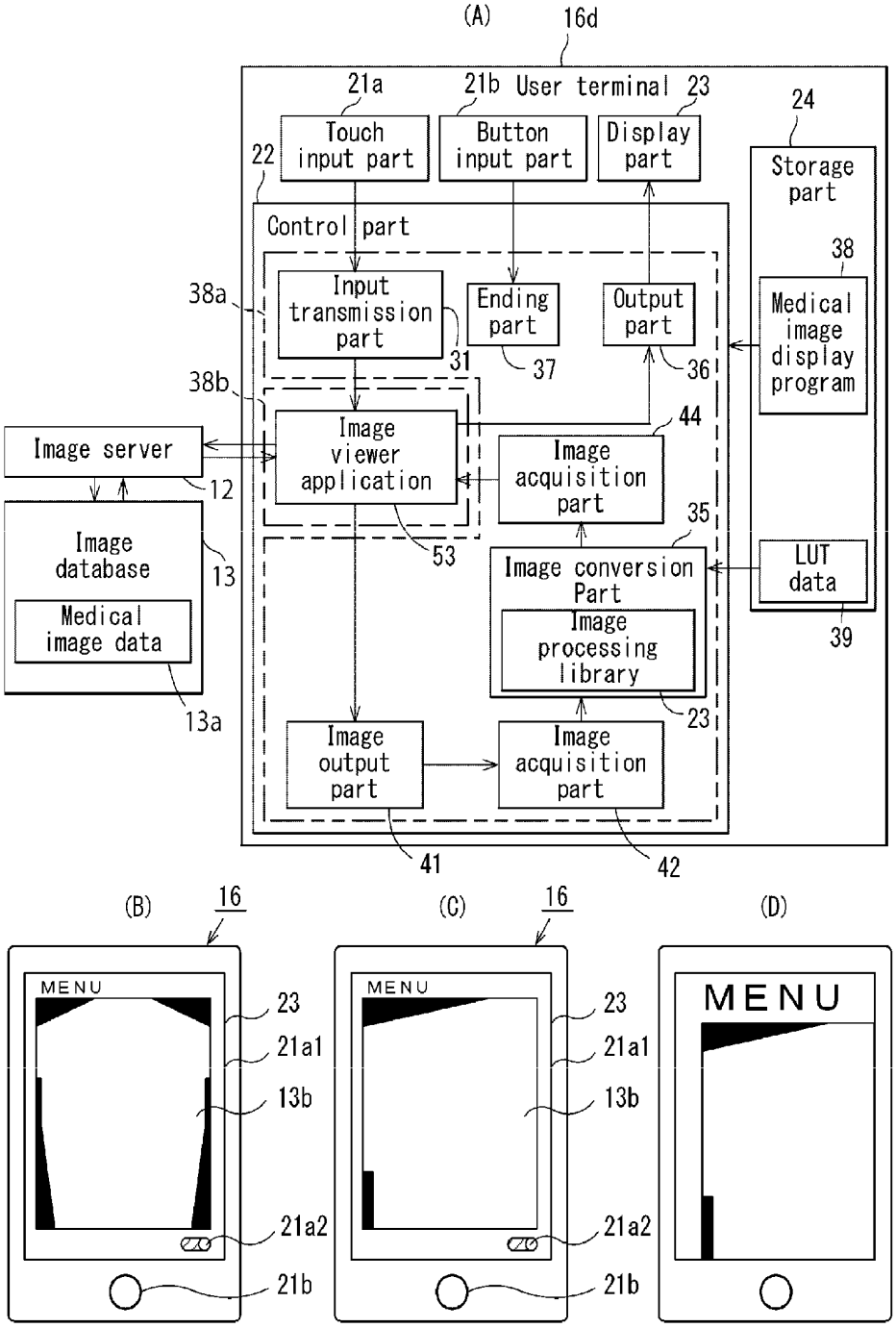



(A)
1A
11
Image acquisition modality
12
Image server
13
Image database
Medical image data
13a
14
14a
Image viewer web server
Image viewer web application
5
User terminal
User terminal
...
16
16
38
19
38
19
(B)
16a
User terminal
21a
Touch input part
21b
Button input part
23
Display part
24
Storage part
22
Control part
38a
Input transmission part
31
Ending part
37
Output part
36
35
Medical image display program
38
14
38b
Image viewer web server
Browser function part
Image conversion part
Image processing library
LUT data
39
Image server
12
32
35a
Capture storage part
Capture acquisition part
Image database
13
Medical image data
13a
33
34


(A)
Start
S1
Input acceptance
(first input part)
S2
S3
Capture acquisition
Manipulation
Viewer part operation
S4
Image conversion
S5
Drawing
Output
Repeat on basis of frame
S6
End?
(second input part)
No
Yes
End
16a
(B)
(C)
(D)
23
21a
13b
13a
13b
21b


(A)
1B
11
Image acquisition modality
12
Image server
13
Image database
Medical image data
13a
Image reference terminal
15
Viewer application
15a
Remote desktop application
15b
5
User terminal
User terminal
16
16
38
19
38
19
(B)
16b
User terminal
21a
Touch input part
21b
Button input part
23
Display part
24
Storage part
38
Medical image display program
LUT data
39
22
Control part
38a
Input transmission part
31
Ending part
37
Output part
36
35
Image conversion part
Image processing library
35a
38b
Remote desktop client function part
51
Capture storage part
33
Capture acquisition part
34
15
Image reference terminal
Image server
12
Image database
13
Medical image data
13a


(A)
1C
11
Image acquisition modality
12
Image server
13
Image database
Medical image data
13a
User terminal
User terminal
...
16
16
38
19
38
19
(B)
16c
User terminal
21a
Touch input part
21b
Button input part
23
Display part
24
Storage part
22
Control part
38
Medical image display program
38a
Input transmission part
31
Ending part
37
Output part
36
35
38b
Image viewer application
53
Image conversion Part
Image processing library
35a
LUT data
39
Image server
12
Image database
13
Medical image data
13a
Capture storage part
33
Capture acquisition part
34


(A)
16d
User terminal
21a
21b
23
24
Touch input part
Button input part
Display part
Storage part
22
Control part
38
Input transmission part
Ending part
Output part
Medical image display program
38a
31
37
36
38b
44
Image server
Image viewer application
Image acquisition part
12
35
Image database
13
53
Image conversion Part
LUT data
Medical image data
Image processing library
39
13a
23
Image output part
Image acquisition part
41
42
(B)
16
(C)
16
(D)
MENU
MENU
MENU
23
21a1
13b
21a2
21b

MEDICAL IMAGE DISPLAY APPARATUS

TECHNICAL FIELD

[0001] The present invention relates to a medical image display program, a medical image display method, a medical image display device, and a medical image display system which correct gradation of a medical image to perform display with display quality in the gradation.

BACKGROUND ART

[0002] Conventionally, a terminal that displays a medical image is calibrated to GSDF (Grayscale Standard Display Function) provided in DICOM 3.0 Part 14 of the DICOM (Digital Imaging and Communications in Medicine) standard. In the case of a desktop type terminal for image reference, the calibration is performed by acquiring display gradation characteristic data of a monitor, using a luminance meter or the like and changing an LUT (Lookup Table) of the monitor in accordance with this display gradation characteristic data. This keeps quality of the medical image displayed in the terminal.

[0003] At a medical site, it is desired to share the medical image through a network system. As a method for sharing the medical image through the network system, various methods have been proposed.

[0004] For example, there has been proposed a medical network system in which an image processing server mounted with an image processing component is provided to enable a processed image to be displayed in a reference terminal (refer to Patent Document 1). In this medical network system, the reference terminal transfers image data and an image parameter to the image processing server, the image processing server performs image processing, and the reference terminal displays the processed image. This enables the image to be referred to, using only a communication function standardly mounted on a personal computer, so that the general-purpose personal computer can be used as the reference terminal in the medical network system as it is.

[0005] Moreover, there have been proposed a medical image network system and an image display method that ensure consistency in a way in which an output image is viewed (refer to Patent Document 2). In this system, a reference terminal sends display gradation characteristic data and image data of the reference terminal to an image processing device, the image processing device applies image processing such as gradation correction processing, and the image processing device sends processed image data to the reference terminal through an image server. This enables the medical image network system to display the image data in gradation that allows an image reading doctor who refers to the image to easily view the image, so that the image that facilitates diagnosis in consideration of an individual difference of the image reading doctor can be provided.

[0006] There have also been proposed an image management system and an image management method, and an image display device that compensate for changes in gradation characteristics due to aging of hardware (refer to Patent Document 3). In this system, a gradation table prescribing the gradation characteristics on a basis of a display is held in an image file server, and the optimal gradation table is automatically selected in accordance with changes in maximum luminance due to aging, so that an image can be outputted and displayed, using a gradation correction curve close to an ideal.

[0007] However, these systems have a problem that a server to hold and manage the display gradation characteristic data of the reference terminal is required, which requires tremendous costs for introduction. Therefore, there has been desired a mechanism for managing image quality and displaying an image in an optimal gradation without adding a new function to an already-introduced configuration as much as possible.

[0008] In recent years, various portable terminals such as a tablet terminal represented by an iPad (registered trademark), a smartphone, and the like have been provided. Shift to cloud computing of a medical image management device, and spread of a portable terminal at a medical site have been advanced. Thus, it is desired that a medical image is referred to in the above-described portable terminal as well.

[0009] However, the above-described portable terminal is not calibrated to GSDF, and in many cases, has no function of changing an LUT of a monitor, or is prohibited from changing the LUT. Therefore, the methods of Patent Documents 1 to 3 cannot cope with the above demands, and it has been difficult to manage the display quality of the medical image.

[0010] Here, a method of performing gradation correction by software can be considered as coping with a case where a function of performing color management is not prepared in hardware.

[0011] However, when the gradation correction is performed by software, modification for corresponding to gradation correction is required on a basis of application that displays the medical image, which poses a problem of increasing costs.

PRIOR ART DOCUMENTS

Patent Documents

[0012] Patent Document 1: Japanese Patent Laid-open Publication No. H11-239165

[0013] Patent Document 2: Japanese Patent Laid-open Publication No. 2005-131241

[0014] Patent Document 3: Japanese Patent Laid-open Publication No. 2002-306425

SUMMARY OF THE INVENTION

Problems to be Solved by the Invention

[0015] The present invention is achieved in light of the above-described problems, and an object of the present invention is to provide a medical image display program, a medical image display method, a medical image display device, and a medical image display system which enable a medical image to be displayed in proper gradation without using color management by hardware, and without performing modification corresponding to gradation correction to an individual application having a display function of the medical image.

Solutions to the Problems

[0016] A medical image display program according to the present invention causes a computer to function as a communication application part that accesses, through an electric communication line, a computer that acquires medical image data to acquire at least the medical image data, an input acceptance part that accepts manipulation input by a user, an

input data transfer part that transfers input data accepted in the input acceptance part to the communication application part, a display image data acquisition part that acquires image data for display including the medical image data outputted from the communication application part, an image conversion part that performs image conversion of at least a medical image data portion of the image data for display, and a display output part that outputs the image data for display after conversion to a display part.

Effects of the Invention

[0017] According to the present invention, it is possible to provide a medical image display program, a medical image display method, a medical image display device, and a medical image display system which enable a medical image to be displayed in proper gradation without using color management by hardware and without performing modification corresponding to gradation correction to an individual application having a display function of the medical image.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] FIGS. **1**(A) and **1**(B) are block diagrams illustrating a configuration of a medical image display system of a first embodiment.

[0019] FIGS. **2**(A) to **2**(D) are a flowchart and explanatory diagrams of a screen of a user terminal of the first embodiment.

[0020] FIGS. **3**(A) and **3**(B) are block diagrams illustrating a configuration of a medical image display system of a second embodiment.

[0021] FIGS. **4**(A) and **4**(B) are block diagrams illustrating a configuration of a medical image display system of a third embodiment.

[0022] FIGS. **5**(A) to **5**(D) are explanatory diagrams of a configuration and a screen of a medical image display system of a fourth embodiment.

EMBODIMENTS OF THE INVENTION

[0023] Hereinafter, embodiments of the present invention will be described with reference to the drawings.

First Embodiment

[0024] FIG. **1**(A) is a block diagram illustrating a system configuration of a medical image display system **1**A of a first embodiment. The medical image display system **1**A has an image acquisition modality **11**, an image server **12**, an image viewer web server **14** (an external computer), a user terminal **16** (a computer) as a medical image display device, which are connected to an electric communication line **5** such as the Internet. In the user terminal **16**, a medical image display program **38** stored in a storage medium **19** is installed. The medical image display program **38** may be installed by downloading the same from a web server on the Internet.

[0025] A configuration may be such that two or all functions (a server function, a computer function) of a computer section of the image acquisition modality **11**, the image server **12**, and the image viewer web server **14** are loaded on one server.

[0026] Hereinafter, while embodiments will be described with an example in which an iPad (registered trademark), which is one type of tablet terminal, is used as the user terminal **16**, the present invention is not limited thereto, and various terminals such as an ANDROID (registered trademark) terminal, a tablet PC, a notebook personal computer, and a desktop personal computer can be used.

[0027] The image acquisition modality **11** is a device to acquire, as digital data, a medical image obtained by photographing a human body, such as CT (Computed Tomography), MRI (Magnetic Resonance Imaging), CR (Computed Radiography), an FPD (Flat Panel Detector), an ultrasonic diagnostic device, PET (Positron Emission Tomography), and SPECT (Single Photon Emission Computed Tomography). The image acquisition modality **11** has a signal acquisition part that acquires a signal in accordance with a type of a method, a medical image data creation part that creates medical image data from the acquired signal, and a data sending part that sends the created medical image data to the image server **12**.

[0028] The image server **12** receives the medical image data from the image acquisition modality **11** and stores the same in an image database **13**. The image server **12** has a storage part that stores data of the image database **13** and the like and a program, an input part such as a mouse, a keyboard, or a touch panel that accepts manipulation input, a display part that performs display, a communication part that communicates through the electric communication line **5**, and a control part that controls these components.

[0029] The image database **13** stores a plurality of pieces of medical image data **13***a*. Incidental data in accordance with the DICOM standard is attached to this medical image data **13***a*. The incidental data includes patient data such as a patient name and a patient ID, photographing-related data such as a photographing date, a photographing ID, a photographing region, a photographing condition (a posture, a photographing direction, and the like), and a photographing device, and image-related data such as a pixel number, the number of bits, a designated output size, a reading pixel size, and a maximum density (Dmax) of the medical image.

[0030] The image viewer web server **14** functions as a web server, and loads an image viewer web application **14***a* (an external application) expressed in an HTML or the like. The image viewer web server **14** performs operation by the image viewer web application **14***a* in accordance with a request of data for manipulation received from a web browser of the user terminal **16**, and sends the medical image data **13***a* stored in the image database **13** of the image server **12** in a form of an image file or the like together with text data expressed by a language such as the HTML (Hyper Text Markup Language) as output data so that the medical image data **13***a* can be browsed. The image file can be in a form of, for example, a substitute JPEG (Joint Photographic Experts Group). The image viewer web server **14** has a storage part that stores data and a program, an input part such as a mouse, a keyboard, or a touch panel that accepts manipulation input, a display part that performs display, a communication part that communicates through the electric communication line **5**, and a control part that controls these components.

[0031] The user terminal **16** accesses the image viewer web server **14** to acquire the medical image data **13***a*, and subjects this medical image data **13***a* to image conversion and displays the resultant. The user terminal **16** has a storage part that stores data and a program, and an input part such as a mouse, keyboard or a touch panel that accepts manipulation input, a display part that performs display, a communication part that communicates through the electric communication line **5**, and a control part that controls these components.

[0032] FIG. **1**(B) is a block diagram illustrating a hardware configuration and functional blocks of a user terminal **16***a* when the medical image is displayed by a web-based viewer application, as one example of the user terminal **16**.

[0033] The user terminal **16***a* includes a touch input part **21***a* by a touch panel (an input acceptance part), a button input part **21***b* by a pressing button used as a home button, a control part **22** configured by a CPU, a ROM, and a RAM, a display part **23** by a high-definition liquid crystal display, and a storage part **24** by a flash memory. The touch input part **21***a* and the button input part **21***b* are input devices, and the display part **23** is a display device.

[0034] The control part **22** executes a medical image display program **38** stored as an application in the storage part **24** to function as an input/output processing part **38***a* and a viewer part **38***b* (a communication application part).

[0035] The input/output processing part **38***a* has an input transmission part **31** as an input data transfer part, a capture storage part **33** as a temporary storage part, a capture acquisition part **34** as a display image data acquisition part, an image conversion part **35**, an output part **36**, and an ending part **37**. This input/output processing part **38***a* performs control of input and output by the touch input part **21***a* and the display part **23**, which are hardware, delivery of data to the viewer part **38***b*, image conversion, and end processing by input of the button input part **21***b*.

[0036] The input transmission part **31** delivers an input signal inputted from the touch input part **21***a* to a browser function part **32** of the viewer part **38***b*. This input signal is an input signal by touch coordinates, touch start, touch movement, touch end, or the like. This input signal is delivered to the browser function part **32** as it is, by which the browser function part **32** can operate similarly to a single operation of the browser function part **32** where the input/output processing part **38***a* does not exist.

[0037] Moreover, in this manner, the input transmission part **31** transmits the input signal (an input event such as a touch event), which can prevent the medical image display program **38** from performing operation in accordance with the input operation in the touch input part **21***a*. Particularly, for example, when manipulation of enlarged display by separating two fingers on a touch panel, or reduced display by moving two fingers close to each other is performed, a screen of the medical image display program **38** (a transparent screen by the medical image display program **38**) is neither displayed in an enlarged manner nor in a reduced manner, but an image displayed in the viewer part **38***b* is displayed in an enlarged manner or in a reduced manner. That is, operation is performed in which an image portion displayed by the viewer part **38***b* is displayed in an enlarged manner or in a reduced manner behind the transparent screen by the medical image display program **38**, and a menu portion displayed by the viewer part **38***b* is neither displayed in an enlarged manner nor in a reduced manner. Thereby, input manipulation of the viewer part **38***b* can be performed so that a situation is prevented that enlargement/reduction is performed without changing a display range and a resolution of the image displayed in the viewer part **38***b*, and that the image itself displayed in the viewer part **38***b* is enlarged/reduced.

[0038] The capture storage part **33** is configured, for example, by a RAM to temporarily store a captured image outputted from the browser function part **32**. Thereby, image data for display outputted from the browser function part **32** is not directly displayed in the display part **23**, but processing such as the image conversion by the input/output processing part **38***a* can be performed to display the resultant in the display part **23**.

[0039] The capture acquisition part **34** acquires the image data for display temporarily stored in the capture storage part **33**. This allows the image data for display to be subjected to the processing such as the image conversion in the image conversion part **35**.

[0040] The image conversion part **35** performs the image conversion to at least the medical image data **13***a* of the image data for display acquired from the capture acquisition part **34**. At this time, the image conversion part **35** utilizes an image processing library **35***a* loaded on the user terminal **16***a*. For this image processing library **35***a*, for example, vImage of Accelerate. framework of iOS SDK is used. This can realize processing at a higher speed than that in processing of image conversion in the control part **22** as it is.

[0041] The output part **36** outputs, to the display part **23**, image data for display after the image conversion outputted from the image conversion part **35**. The output part **36** performs this output by passing the designated image (an image captured every frame) to UIImage View, which is an image display component that manages the image display on the screen. This allows the display part **23** to display the image data for display after the image conversion. This enables a user to check the image in proper gradation.

[0042] Upon receiving end input in the button input part **21***b*, the ending part **37** performs end processing. At this time, the control part **22** desirably performs the end processing properly, for example, the control part **22** returns to the home screen in a state where the medical image display program **38** under execution remains activated and expanded on the memory behind, the control part **22** completely ends and erases the medical image display program **38** from the memory to return to the home screen, or the like. This enables the user to activate another application in the user terminal **16***a* after the end of the medical image display program **38** and use the user terminal **16***a* for another purpose.

[0043] The viewer part **38***b* has the browser function part **32**. The viewer part **38***b* receives the manipulation input through the input/output processing part **38***a*, and accesses the image viewer web server **14** and acquires the medical image data **13***a* to perform capture output to the capture storage part **33**.

[0044] The browser function part **32** accepts an input signal by image reference manipulation received from the input transmission part **31** in an input signal acceptance part whose illustration is omitted, and accesses the image viewer web server **14** in accordance with this input signal to send data for manipulation, which is manipulation to find the medical image data **13***a*. The browser function part **32** receives the medical image data **13***a* as output data of the image server **12** by a function provided by the image viewer web server **14**, the medical image data **13***a* being managed in the image database **13** by the image server **12**. At this time, the medical image data **13***a* is sent to the browser function part **32** together with text data expressed by a language such as the HTML. The browser function part **32** creates the image data for display such as RGB image data for displaying on the screen from the text data including the received medical image data **13***a*, and performs capture output of this image data for display to the capture storage part **33** by an output part for display whose illustration is omitted.

[0045] The storage part **24** stores various programs and data such as the installed medical image display program **38** and LUT data **39**.

[0046] The LUT data **39** is a lookup table for GSDF conversion which is created beforehand for the user terminal **16***a*. This lookup table for GSDF conversion can be created by measuring display gradation characteristic information of the user terminal **16***a* with a proper calibration tool (e.g., Medical QA web Mobile by BALCO or the like).

[0047] FIG. **2**(A) is a flowchart of operation performed by the control part **22** of the user terminal **16** in accordance with the medical image display program **38**. Here, an example of the user terminal **16***a* will be described.

[0048] When manipulation of the user activates and starts the medical image display program **38** shown in FIG. **1**(B), the control part **22** accepts the input manipulation in touch input part **21***a* (step S**1**). At this time, the input/output processing part **38***a* functions, and the input/output processing part **38***a* transmits the input data (first input data) inputted in the touch input part **21***a* by the input transmission part **31**, to transfer the same to the viewer part **38***b*.

[0049] When the input data is transmitted by the input transmission part **31** and is transferred to the viewer part **38***b*, the viewer part **38***b* performs the operation (step S**2**). In this embodiment, the browser function part **32** operates as the viewer part **38***b*, the image reference manipulation by the image viewer web application **14***a* of the image viewer web server **14** is performed, the medical image data **13***a* of the image database **13** and the text data are received through the image server **12**, and the image data for display is created and drawn from this text data and the medical image data **13***a*. This drawing is performed so that the image is captured in the capture storage part **33** (the memory) although a general browser draws the image onto a screen of a display device.

[0050] The control part **22** acquires the image data for display captured by the capture acquisition part **34** (step S**3**).

[0051] The control part **22** performs the image conversion of the image data for display by the image conversion part **35** (step S**4**), and the image data after the image conversion is outputted to the display part **23** by the output part **36** (step S**5**).

[0052] The control part **22** repeats steps S**1** to S**6** in each frame until the end input by the button input part **21***b* (step S**6**: No), and if the end input (second input data) is performed by the button input part **21***b* (step S**6**: Yes), the control part **22** ends the medical image display program **38** to return the screen to the home screen of an OS (or to a desktop screen).

[0053] By the above-described configuration and operation, the user terminal **16***a* that activates the medical image display program **38** can display the medical image data **13***a* as medical image data after conversion **13***b*, which is converted to proper gradation as shown in an image explanatory diagram of FIG. **2**(C). If the image conversion were not performed on the medical image data **13***a*, the gradation would be displayed improperly, as shown in an image explanatory diagram of FIG. **2**(B). As shown in an external appearance front diagram of FIG. **2**(D), by activating the medical image display program **38** in the user terminal **16***a* to manipulate the web browser by the touch input in the touch input part **21***a*, the user can check, in the display part **23**, the medical image data after conversion **13***b* with the gradation converted to the proper gradation. At the end, the user can manipulate the button input part **21***b* different from the touch input part **21***a* to end the processing.

[0054] Since the medical image display program **38** exerts the same function as a general web browser, it can be operated without modifying a web-based viewer application provided in the image viewer web server **14**. In the medical image display program **38**, the medical image data **13***a* is converted to the medical image data after conversion **13***b*, which is corrected to the GSDF gradation, and the medical image data can be checked in unified gradation with good accuracy by any viewer application. That is, by using the medical image display program **38**, a plurality of types of applications that operate on a basis of HTML on the image viewer web server **14** can be arbitrarily operated in the user terminal **16***a*, and for the medical image data **13***a* provided regardless of the applications, the medical image data after conversion **13***b*, which is corrected to the proper GSDF gradation, can be displayed.

[0055] Thus, since the modification on a basis of the application is not required, even by an application newly installed in the image viewer web server **14**, the user terminal **16***a* can activate the medical image display program **38** to instantly display the medical image data after conversion **13***b*, which is corrected to the proper GSDF gradation.

[0056] Moreover, since the medical image display program **38** allows the input manipulation to the touch input part **21***a* to be transmitted, maneuverability of the application such as the image viewer web application **14***a* provided in the image viewer web server **14** can be maintained.

[0057] Moreover, the user terminal **16***a* that activates the medical image display program **38** performs a series of processing from the transmission of the input manipulation in the touch input part **21***a* (step S**1**) to the image display after the image conversion (step S**5**) in each frame. This enables the user to manipulate the user terminal **16***a* with stress-free comfortable response and check the medical image data after conversion **13***b*. Moreover, the use of the image processing library **35***a* enables the user terminal **16***a* to realize the high-speed processing.

[0058] Moreover, the user terminal **16***a* allows the user to use the medical image display device that the user usually uses as it is, and performs the GSDF display with display quality managed without impairing convenience.

[0059] Moreover, since as to the user terminal **16***a*, the display quality management can be performed without adding a new function to the system, management costs of the image display quality can be greatly reduced.

[0060] While in the above-described embodiment, the whole display screen displayed by the image viewer web application **14***a* is an object of the GSDF conversion, a configuration may be employed in which only the medical image displayed by the image viewer web application **14***a* is subjected to the GSDF conversion. In this case, the image conversion part **35** may subject, to the GSDF conversion, only the image data of the data that the browser function part **32** acquired from the image viewer web server **14**. This enables the user terminal **16***a* to display only a medical image portion in the gradation after the GSDF conversion without changing colors of portions other than the medical image (other portions) such as a menu portion.

[0061] In this manner, the user terminal **16***a* holds the LUT data **39** as the display gradation characteristic information on the user terminal **16***a* side, and can perform, in accordance with the display gradation characteristic information, the gradation correction for the image sent from the image server **12** having no gradation correction function, or an interface in

which the image is displayed, or the whole screen on which the foregoing is displayed without the gradation being corrected.

[0062] Moreover, the user terminal **16***a* may have a configuration in which the image acquired from the image viewer web server **14** by a bookmarklet or the like using JAVA (registered trademark) Script is converted by the image conversion part **35**.

Second Embodiment

[0063] FIG. **3**(A) is a block diagram illustrating a system configuration of a medical image display system **1**B of a second embodiment. The medical image display system **1**B has an image acquisition modality **11**, an image server **12**, a plurality of image reference terminals **15** (external computers), and a plurality of user terminals **16** (computers), which are connected to an electric communication line **5**.

[0064] The image reference terminals **15** each have a storage part that stores a program and data, an input part such as a mouse, a keyboard, or a touch panel that accepts manipulation input, a display part that performs display, a communication part that communicates through the electric communication line **5**, and a control part that controls these components. As to the image reference terminal **15**, a viewer application **15***a* and a remote desktop application **15***b* (an external application) are installed in the storage part. The remote desktop application **15***b* receives data for manipulation to find medical image data **13***a* from a client (the user terminal **16**) who is remotely logged-in, and performs operation of the viewer application **15***a* in accordance with this data for manipulation. The remote desktop application **15***b* sends output including the medical image data **13***a* from the viewer application **15***a* to the client as output data. The user terminals **16** correspond to the image reference terminals **15** in one-to-one relation. Thus, the same number of image reference terminals **15** as that of the user terminals **16** that refer to the image are desirably provided.

[0065] Since the image acquisition modality **11**, the image server **12**, and the user terminal **16** are the same as those in the first embodiment, the same reference numerals will be given to the same components, and detailed description thereof will be omitted.

[0066] FIG. **3**(B) is a block diagram illustrating a hardware configuration and functional blocks of a user terminal **16***b* when the image reference terminal **15** is remotely controlled to manipulate the viewer application **15***a*, by which the medical image is displayed, as one example of the user terminal **16**.

[0067] The user terminal **16***b* includes a touch input part **21***a*, a button input part **21***b*, a control part **22**, a display part **23**, and a storage part **24** by a flash memory. The control part **22** executes a medical image display program **38** stored in the storage part **24** as an application, and functions as an input/output processing part **38***a* and a viewer part **38***b*.

[0068] The viewer part **38***b* has a remote desktop client function part **51** that functions as a remote desktop client for remotely using a viewer application for desktop. The viewer part **38***b* receives the manipulation input through the input/output processing part **38***a* and accesses the image reference terminal **15** to remotely control the image reference terminal **15**. The remotely-controlled image reference terminal **15** accesses the image server **12** to acquire the medical image data **13***a* of an image database **13**, and sends the medical image data **13***a* to the viewer part **38***b* (the remote desktop client function part **51**). The viewer part **38***b* performs capture output of the acquired medical image data **13***a* to a capture storage part **33**.

[0069] The remote desktop client function part **51** accepts an input signal by image reference manipulation received from the input transmission part **31** in an input signal acceptance part, which is not illustrated, and accesses the image reference terminal **15** in accordance with this input signal to remotely control the image reference terminal **15**. That is, when the remote desktop client function part **51** sends the input signal received through the input transmission part **31** to the image reference terminal **15**, the image reference terminal **15** performs operation corresponding to the received input signal to display the medical image data **13***a* on a screen of the image reference terminal **15**, and send screen data after the operation to the remote desktop client function part **51**. The remote desktop client function part **51** creates image data for display such as RGB image data for performing screen display on the display part **23** from the image data including the received medical image data **13***a*, and performs capture output of the image data for display to the capture storage part **33** by an output part for display, which is not illustrated.

[0070] Accordingly, the remote desktop client function part **51** displays, in the display part **23** of the user terminal **16***b*, the same screen as the screen displayed in the display part of the image reference terminal **15**, and transfers the input signal inputted to the screen in the touch input part **21***a* to the image reference terminal **15**, to operate the image reference terminal **15** for the screen display as if the user directly operated the image reference terminal **15**.

[0071] Since configurations and operation other than those of the viewer part **38***b* are the same as those of the first embodiment, the same reference numerals will be given to the same components, and detailed description thereof will be omitted.

[0072] The user terminal **16***b* configured as described above performs the same operation as the operation described in the first embodiment with reference to FIG. **2**(A) except that the content of step **2** is different.

[0073] In step S2, when the user terminal **16***b* transmits the input data by the input transmission part **31** and transfers the input data to the viewer part **38***b*, the viewer part **38***b* performs operation (step S2). The remote desktop client function part **51** that operates as the viewer part **38***b* remotely logs in to the image reference terminal **15** to remotely control the image reference terminal **15**. Thereafter, all information displayed on a desktop of the image reference terminal **15** is subjected to image conversion by an image conversion part **35** and is then displayed almost as it is in the display part **23** of the user terminal **16***b*. The remotely-controlled image reference terminal **15** receives data of the screen including the medical image data **13***a* of the image database **13** through the image server **12** and creates the image data for display from this data of the screen. The remote desktop client function part **51** draws the image data for display acquired from the image reference terminal **15** so as to capture the same in the capture storage part **33** (the memory). Since the other operation is the same as that of the first embodiment, detailed description thereof will be omitted.

[0074] By the above-described configuration and operation, in the medical image display system **1**B, the viewer application **15***a* for browsing the medical image data **13***a* is executed on the image reference terminal **15**, which is a different terminal from the user terminal **16***b* used by the user

such as a virtual desk top. The user terminal **16***b* is connected to this image reference terminal **15** through the remote desktop client function part **51**, so that the remote desktop, or only the image can be corrected to the GSDF gradation to be displayed. Accordingly, the user can manipulate the user terminal **16***b* to browse the medical image data **13***a* with the image quality and in the gradation proper for diagnosis. In this manner, the medical image display system **1**B can bring about the same effects as those in the first embodiment.

[0075] Moreover, since the application that can be activated in the image reference terminal **15** need not be a web-based application, various applications can be used.

[0076] While in the second embodiment, the whole display screen displayed by the remote desktop client function part **51** is an object of the GSDF conversion, a configuration may be employed in which only the medical image displayed in the remote desktop client function part **51** is subjected to the GSDF conversion. In this case, only the image data of the data that the remote desktop client function part **51** acquires from the image reference terminal **15** may be subjected to the GSDF conversion in the image conversion part **35**. This allows only the medical image portion to be displayed in gradation after the GSDF conversion without changing colors of portions other than the medical image such as a menu portion.

[0077] Moreover, the user terminals **16***a*, **16***b* of the first and second embodiments each have a mechanism of performing filtering for LUT conversion and uniformity correction for the GSDF display in a platform of the web browser, the remote desktop client, or the like. This enables drawing with managed display quality to be utilized in the formerly-used medical image display device.

Third Embodiment

[0078] FIG. **4**(A) is a block diagram illustrating a system configuration of a medical image display system **1**C of a third embodiment. The medical image display system **1**C has an image acquisition modality **11**, an image server **12**, and a plurality of user terminals **16**, which are connected to an electric communication line **5**.

[0079] Since the image acquisition modality **11**, the image server **12**, and the user terminal **16** are the same as those of the first embodiment, the same reference numerals will be given to the same components, and detailed description thereof will be omitted.

[0080] FIG. **4**(B) is a block diagram illustrating a hardware configuration and functional blocks of a user terminal **16***c* when a medical image is displayed by an image viewer application **53**, as one example of the user terminal **16**.

[0081] The user terminal **16***c* includes a touch input part **21***a*, a button input part **21***b*, a control part **22**, a display part **23**, and a storage part **24** by a flash memory. The control part **22** executes a medical image display program **38** stored in the storage part **24** as an application, and functions as an input/output processing part **38***a* and a viewer part **38***b*.

[0082] The viewer part **38***b* has the image viewer application **53**. The image viewer application **53** receives manipulation input through the input/output processing part **38***a*, and accesses the image server **12** to acquire medical image data and perform capture output to a capture storage part **33**.

[0083] The image viewer application **53** accesses the image server **12** in accordance with an input signal by image reference manipulation received from an input transmission part **31** to receive the medical image data **13***a* managed in an image database **13**. The image viewer application **53** creates image data for display such as RGB image data including data of a text and a button to be displayed in the image viewer application **53** as well as the received medical image data **13***a*, and performs capture output of this image data for display **13***a* to a capture storage part **33**.

[0084] Since configurations and operation other than those of the viewer part **38***b* are the same as those of the first embodiment, the same reference numerals will be given to the same components and detailed description thereof will be omitted.

[0085] The user terminal **16***c* configured as described above performs the same operation as the operation described in the first embodiment with reference to FIG. **2**(A) except that the content of step **2** is different.

[0086] In step S**2**, when the user terminal **16***c* transmits the input data by the input transmission part **31** and transfers the input data to the viewer part **38***b*, the viewer part **38***b* performs operation (step S**2**). The image viewer application **53** operating as the viewer part **38***b* acquires the required medical image data **13***a* from the image server **12**. The image viewer application **53** creates the image data for display in which the medical image data **13***a* is displayed together with a menu screen and the like provided by itself, and draws the image data for display so as to capture the image in the capture storage part **33** (the memory). Since other operation is the same as that of the first embodiment, detailed description thereof will be omitted.

[0087] Although by the above-described configuration and operation, the user terminal **16***c* cannot use various applications that operate in the image viewer web server **14** (refer to the first embodiment) or the image reference terminal **15** (refer to the second embodiment), the image viewer application **53** can bring about similar effects to those of the first embodiment as an application loaded on the user terminal **16***c*.

Fourth Embodiment

[0088] FIG. **5**(A) is a block diagram illustrating a hardware configuration and functional blocks of a user terminal **16***d* when a medical image is displayed by an image viewer application **53**, as one example of a user terminal **16**.

[0089] The user terminal **16***d* includes an image output part **41**, an image acquisition part **42**, and an image acquisition part **44** in place of the capture storage part **33** and the capture acquisition part **34** in the third embodiment.

[0090] The image output part **41** outputs medical image data **13***a* received from an image server **12** by the image viewer application **53** to an input/output processing part **38***a*. The image acquisition part **42** in the input/output processing part **38***a* acquires the medical image data **13***a* to pass the same to an image conversion part **35**, and the image conversion part **35** performs the GSDF conversion.

[0091] The image acquisition part **44** acquires medical image data after conversion **13***b* subjected to the GSDF conversion to send the same to the image viewer application **53**.

[0092] The image viewer application **53** outputs the medical image data after conversion **13***b* through an output part **36** to a display part **23**.

[0093] Since other configurations and operation are the same as those of the third embodiment, the same reference numerals will be given to the same components, and detailed description thereof will be omitted.

[0094] The above-described configurations and operation can bring about similar effects to those of the third embodiment.

[0095] In the above-described embodiments, the button input part **21***b* may not be a button but a partial region of the touch panel. In this case, an inputtable region of the touch panel is divided into a region of a first input part and a region of a second input part, and subsequent operation may be sorted, depending on in which of the regions input is performed.

[0096] Moreover, as shown in an exterior appearance diagram of FIG. **5**(B), the touch input part **21***a* may be divided into a region of a touch input part for transmission **21***a***1** and a region of a touch input part for control **21***a***2** in the display part **23**. In this case, the touch input part for transmission **21***a***1** may be an interface to input a manipulation instruction to the viewer part **38***b* (first input data) similar to the touch input part **21***a* of the above-described embodiments, and the touch input part for control **21***a***2** may be an interface to input a manipulation instruction to the input/output processing part **38***a* (second input data). In the illustrated example, the user terminal **16** (**16***a*, **16***b*, **16***c*) switches the presence and absence of the image conversion by the image conversion part **35** by manipulation to switch ON/OFF of the touch input part for control **21***a***2**. While processing is the same as the above-described embodiments in the case where the image conversion is present, if switching to the absence of the image conversion is performed, a configuration is such that the user terminal **16** delivers the data outputted from the capture acquisition part **34** to the output part **36** as it is without passing the data through the image conversion part **35**. This allows the user terminal **16** to transmit the input manipulation of the touch input part for transmission **21***a***1**, which is a portion other than the touch input part for control **21***a***2**, and input the input manipulation to the viewer part **38***b* while switching the presence/absence of the image conversion by the image conversion part **35** by the touch input part for control **21***a***2**. Accordingly, the user terminal **16** can perform enlargement manipulation or the like of the medical image data after conversion **13***b* displayed in the display part **23** (the medical image data **13***a* if the image conversion is not performed), as shown in an exterior appearance diagram of FIG. **4**(C).

[0097] In this manner, since in the user terminal **16**, the input manipulation region to the input/output processing part **38***a* (the button input part **21***b* and the touch input part for control **21***a***2**), and the input manipulation region to the viewer part **38***b* (the touch input part **21***a* or the touch input part for transmission **21***a***1**) are divided, for example, a situation can be prevented, in which all of the display including the menu displayed by the viewer part **38***b* are enlarged as shown in a reference diagram of FIG. **5**(D) when the enlargement manipulation is performed, so that the proper input manipulation to the viewer part **38***b* is enabled.

INDUSTRIAL APPLICABILITY

[0098] The present invention can be utilized not only for a system that displays a medical image, but for various purposes in which the image is desirably calibrated and displayed in a user terminal.

DESCRIPTION OF REFERENCE SIGNS

[0099] **1**A, **1**B, **1**C: Medical image display system
[0100] **5**: Electric communication line
[0101] **13***a*: Medical image data
[0102] **16**, **16***a*, **16***b*, **16***c*, **16***d*: User terminal
[0103] **21***a*: Touch input part
[0104] **21***a***1**: Touch input part for transmission
[0105] **21***a***2**: Touch input part for control
[0106] **21***b*: Button input part
[0107] **23**: Display part
[0108] **31**: Input transmission part
[0109] **32**: Browser function part
[0110] **33**: Capture storage part
[0111] **34**: Capture acquisition part
[0112] **35**: Image conversion part
[0113] **36**: Output part
[0114] **38**: Medical image display program
[0115] **38***b*: Viewer part
[0116] **51**: Remote desktop client function part
[0117] **52**: Image viewer application

1. A medical image display program that causes a computer to function as:

a communication application part that accesses, through an electric communication line, an external computer that acquires medical image data to acquire at least the medical image data;

an input acceptance part that accepts manipulation input by a user;

an input data transfer part that transfers input data accepted in the input acceptance part to the communication application part;

a display image data acquisition part that acquires image data for display including the medical image data outputted from the communication application part;

an image conversion part that performs image conversion of at least a medical image data portion of the image data for display; and

an output part that outputs the image data for display after conversion to a display part.

2. The medical image display program according to claim **1**, wherein

the communication application part performs capture output of the image data for display to a temporary storage part, and

the display image data acquisition part acquires the image data for display from the temporary storage part.

3. The medical image display program according to claim **1**, wherein

the input data transfer part performs different processing, depending on whether the input data inputted in the input part is first input data or second input data,

when the input data is the first input data, the first input data is transmitted and transferred to the communication application part without performing operation corresponding to the first input data, and

when the input data is the second input data, operation corresponding to the second input data is performed.

4. The medical image display program according to claim **1**, wherein

the communication application part

sends, to an external application that operates in the external computer, data for manipulation to manipulate the external application, and

receives output data from the external application, the output data being a result from the external application operating corresponding to the data for manipulation.

5. The medical image display program according to claim **1**, wherein the image conversion part converts only the medical image data of the image for display, and does not convert other portions.

6. A medical image display method comprising:

accessing, through an electric communication line, an external computer that acquires medical image data to acquire at least the medical image data by a communication application part;

accepting, by an input acceptance part, manipulation input by a user;

transferring, by an input data transfer part, input data accepted in the input acceptance part to the communication application part;

acquiring, by a display image data acquisition part, image data for display including the medical image data outputted from the communication application part;

performing, by an image conversion part, image conversion of at least a medical image data portion of the image data for display; and

outputting, by an output part, the image data for display after conversion to a display part.

7. A medical image display device comprising:

a communication application part that accesses, through an electric communication line, an external computer that acquires medical image data to acquire at least the medical image data;

an input acceptance part that accepts manipulation input by a user;

an input data transfer part that transfers input data accepted in the input acceptance part to the communication application part;

a display image data acquisition part that acquires image data for display including the medical image data outputted from the communication application part;

an image conversion part that performs image conversion of at least a medical image data portion of the image data for display; and

an output part that outputs the image data for display after conversion to a display part.

8. A medical image display system comprising:

an external computer that acquires medical image data; and

a user terminal that accesses an image server through an electric communication line,

the user terminal comprising:

a communication application part that accesses the external computer through the electric communication line to acquire at least the medical image data;

an input acceptance part that accepts manipulation input by a user;

an input data transfer part that transfers input data accepted in the input acceptance part to the communication application part;

a display image data acquisition part that acquires image data for display including the medical image data outputted from the communication application part;

an image conversion part that performs image conversion of at least a medical image data portion of the image data for display; and

an output part that outputs the image data for display after conversion to a display part.

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