(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
27 December 2013 (27.12.2013)

WIPO | PCT

(10) International Publication Number
WO 2013/190420 A1

(51) International Patent Classification:
G06F 19/00 (2011.01)

(21) International Application Number:
PCT/IB2013/054679

(22) International Filing Date:
7 June 2013 (07.06.2013)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/661,481 19 June 2012 (19.06.2012) US

(71) Applicant *(for all designated States except DE)*: **KONINKLIJKE PHILIPS N.V.** [NL/NL]; High Tech Campus 5, NL-5656 AE Eindhoven (NL).

(71) Applicant *(for DE only)*: **PHILIPS DEUTSCHLAND GMBH** [DE/DE]; Lübeckertordamm 5, 20099 Hamburg (DE).

(72) Inventor: **MAACK, Hanns-Ingo**; c/o High Tech Campus, Building 5, NL-5656 AE Eindhoven (NL).

(74) Agents: **STEFFEN, Thomas** et al.; High Tech Campus Building 5, NL-5656 AE Eindhoven (NL).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) Title: MEDICAL IMAGING DISPLAY ARRANGEMENT

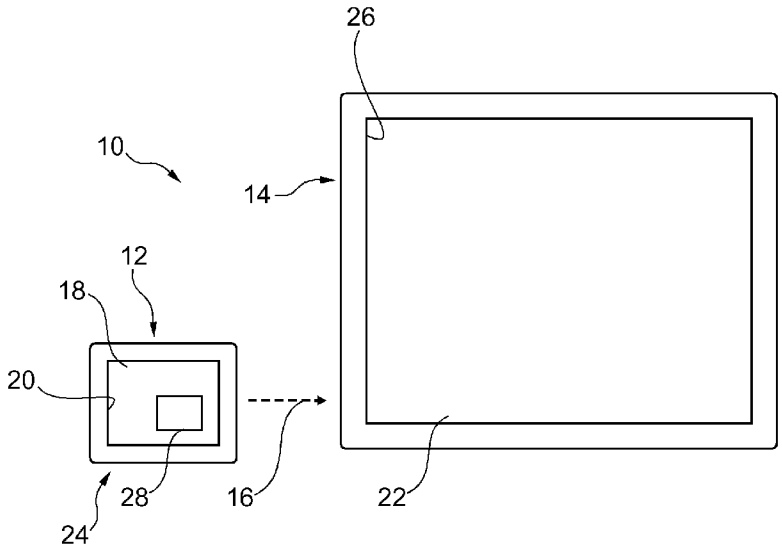


Fig. 1

(57) Abstract: The present invention relates to displaying medical images. In order to provide an improved interaction by the user for controlling the medical images shown on a display, a medical imaging display arrangement (10) is provided comprising a first display device (12), and a second display device (14). The first display device is configured to show a medical image (18) of an object in a display area (20). The second display device is configured to show a selected portion (22) of the medical image. The first display device is configured for selection of the portion to be shown on the second display device. The first display device is provided as a touch sensitive display (24) at least in the display area providing a graphical user interface for controlling the selection.

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MEDICAL IMAGING DISPLAY ARRANGEMENT

FIELD OF THE INVENTION

The present invention relates to displaying medical images, and relates in particular to a medical imaging display arrangement, a medical imaging system, a method for displaying a medical image, a computer program element and a computer readable medium.

BACKGROUND OF THE INVENTION

During medical examinations, or medical intervention procedures, for example, medical images, acquired prior or during the intervention or examination, are displayed on a large monitor. For a detailed view, an area or portion of a medical image can be selected, for example by a mouse or trackball. For a better overview, the complete image may be displayed in a portion of the monitor, whereas in a larger portion of the monitor, the detailed section is shown in an enlarged manner according to the user input via the interface such as a mouse or trackball. WO 2005/010739 A1 describes the control of the display of an image as a function of a controlling movement of the head and the eyes of an observer.

SUMMARY OF THE INVENTION

Further, to facilitate the user interaction, large size touchscreen monitors for administration tasks and also for showing the images are used. However, these monitors are rather expensive.

Thus, there may be a need to provide an improved interaction by the user for controlling the medical images shown on a display with reduced manufacturing costs.

The object of the present invention is solved by the subject-matter of the independent claims, wherein further embodiments are incorporated in the dependent claims.

It should be noted that the following described aspects of the invention apply also for the medical imaging display arrangement, the medical imaging system, the method for displaying a medical image as well as for the computer program element and the computer readable medium.

According to a first aspect of the present invention, a medical imaging display arrangement is provided, comprising a first display device and a second display device. The

first display device is configured to show a medical image of an object in a display area. The second display device is configured to show a selected portion of the medical image. The first display device is configured for selection of the portion to be shown on the second display device. The first display device is provided as a touch sensitive display at least in the display area providing a graphical user interface for controlling the selection.

By providing a touch sensitive user interface on the first display device, the user interaction for controlling the medical image being shown on the second display is facilitated. Further, by showing the selected portion on the second display device, this second display device can be adapted for presenting the selected portion in an optimized way, whereas the second display device does not need to be configured for user action, but only for showing the selected portion. In other words, the technical requirements for the second display device are reduced, thus providing financial benefits concerning the manufacturing and assembly process, despite the additional display.

For example, the first display device may be provided smaller, e.g. significantly smaller, than the second display device. The second display device may be provided as a large monitor or as a projection device for projecting the image on a respective surface, for example via a beamer.

According to an exemplary embodiment, the display area of the first display device showing the medical image is provided as a touch sensitive navigation interface for controlling the second display device.

According to an exemplary embodiment, the first display device is configured to select the portion to be shown on the second display device by a manual determination of an image portion of the medical image within the image shown on the first display device.

Thus, the user is provided with a possibility to directly select the portion that he wants to be shown on the second display directly on the image as shown on the first display device. This provides a facilitated and very intuitive way for selecting the correct portion, be a surgeon for example.

The first, i.e. smaller display device may be provided in the vicinity of the surgeon and may be provided movable for optimized handling. The surface may be cleaned easily due to the relatively small size and a continuous flat surface. The second, i.e. large display device may be provided further away such that also other staff members can see the image or image portion shown thereon. For example, the second display deice can be provided outside the range of reach by the surgeon.

According to an exemplary embodiment, a graphical indicator representing the

portion to be shown is provided superimposed on the medical image of the first display device. Size, proportion, and location of the graphical indicator can be adapted by user manual interaction by touching the display area of the first display device.

According to a further exemplary embodiment, a processing unit is provided connected to the first display device and the second display device. For example, the first display device is a user interface for entering commands for the processing unit to control the second display device.

According to an exemplary embodiment, the first display device and/or the second display device are configured to show at least two images.

For example, one image is the minimum, whereas two or more images are an option.

The first display device may be configured to shift the selected sub-image through the image, which is also referred to as "panning", for example with just one finger.

The first display device may further be configured to jump to a new position with tipping to this spot on the first display.

According to an exemplary embodiment, the second display device comprises at least two monitors and the first display device are configured for the selection of the portions to be shown on the at least two monitors.

According to a second aspect of the present invention, a medical imaging system is provided, comprising an image acquisition arrangement and a medical imaging display arrangement according to one of the above described examples. The image acquisition arrangement is provided to acquire a medical image of an object of interest. The medical imaging display arrangement is configured to show the medical image on the first display device and the selected portion of the medical image on the second display device. The selected portion is adaptable by touching the first display device.

According to an exemplary embodiment, the image acquisition arrangement is provided as an X-ray imaging arrangement, and/or as an ultrasound imaging arrangement.

According to a further example, the image acquisition arrangement is provided as an MR imaging arrangement. Even though the matrix size of MR images may be not so big, making zooming less important than in X-ray, the provision of the first display device with the second display device according provides advantages in that the surgeon can flip through images sets in an intuitive way by directly controlling the second image display device by interaction on the image of the first image display device.

According to a third aspect of the present invention, a method for displaying a

medical image is provided, comprising the following steps:

a) providing a medical image;

b) showing the medical image in a display area of a first display device;

c) selecting a portion of the medical image by manual user interaction comprising touching the display area; and

d) showing the selected portion on a second medical display device.

According to an exemplary embodiment, the selecting comprises adapting a graphical indicator superimposed on the medical image in the first display device.

The selected portion can thus be a portion or may also be the full image.

According to an aspect of the present invention, the medical image is provided on a first display, which is configured as a touch sensitive user interface. Thus, the user can select the image portion to be displayed in a larger scale, i.e. in a more detailed view, directly on the medical image, and the selected portion is then shown on a separate, second display. The different displays can thus be adapted and optimized to the respective function they have to fulfil. For example, the first display device can be provided as a smaller display with an improved touch sensitive surface, whereas the image quality itself of the first display device is not of primary importance, but only of secondary importance. Contrary is the case for the second display device, which may be adapted for an improved and maximized image viewing quality. Since the second display device does not need to have any touch sensitive functions, compared to a touch sensitive large screen monitor, the second display can be manufactured and provided in a much cheaper way. As a result, the surface of the second display device is kept clean, as touching on the second display it is not needed.

These and other aspects of the present invention will become apparent from and be elucidated with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

Exemplary embodiments of the invention will be described in the following with reference to the following drawings:

Fig. 1 shows an example of a medical imaging display arrangement in a schematic view;

Fig. 2 shows a further example of a medical imaging display arrangement;

Figs. 3A to 3C show a further example of a medical imaging display arrangement with different image content;

Fig. 4 shows a further example of a medical imaging display arrangement;

Fig. 5 shows a still further example of a medical imaging display arrangement;

Fig. 6 shows a medical imaging system in an overview;

Fig. 7 shows basic steps of a method for displaying a medical image; and

Figs. 8A to 8C show respective photographic illustrations of the examples of a medical imaging display arrangement according to Figs. 3A to 3C.

DETAILED DESCRIPTION OF EMBODIMENTS

Fig. 1 shows a medical imaging display arrangement 10 comprising a first display device 12 and a second display device 14. The first display device 12 is connected to the second display device 14, which is indicated with a broken line arrow 16.

The first display device 12 is configured to show a medical image 18 of an object, for example a region of interest of a patient, in a display area 20. The second display device 14 is configured to show a selected portion 22 of the medical image. The first display device 12 is configured for selection of the portion 22 to be shown on the second display device 14. The first display device 12 is provided as a touch sensitive display 24 at least in the display area 20 providing a graphical user interface for controlling the selection.

It must be noted that Fig. 1 only schematically shows a frame surrounding the respective display area 20 of the first display device 12, and a respective second frame 26 indicates the respective display area of the second display device 14. Further, a graphical indicator 28 is shown that will also be described in more detail below.

The second display device may also be a beamer arrangement projecting the image on a projection surface.

The display area 20 of the first display device 12, showing the medical image 18, is provided as a touch sensitive navigation interface for controlling the second display device 14.

The first display device 12 is configured to select the portion 22 to be shown on the second display device 14 by a manual determination of an image portion of the medical image within the image shown on the first display device 12.

For example, the graphical indicator 28, representing the portion 22 is provided superimposed on the medical image 18 of the first display device 12. However, it must be noted that the graphical indicator 28, shown as a rectangular frame as an example only, may also be provided in a different form, for example by highlighting the respective portion. Size, proportion, and location of the graphical indicator 28 can be adapted by user

manual interaction by touching the display area 20 of the first display device 12. For example, the full medical image is always shown on the first display device 12. The graphical indicator 28 can be adapted to the proportions of the second display device 14, for example 16:9.

The first display device 12 may be configured to adapt the medical image shown on the second display device by zooming, panning and the like. The selection of the portion may thus comprise zooming and panning, wherein the term "*zooming*" means to define a portion that is smaller than the full image but displayed in a more detailed view, i.e. in a larger size, often in a scale larger than 1:1, i.e. larger than "*true size*". The term "*panning*" means to define or redefine a position of the portion without changing its size but its location with respect to the object, for example a region of interest of a patient. During the interaction for selecting the portion, the medical image shown on the first display device may remain unchanged.

As shown in Fig. 2, a processing unit 30 may be provided connected to the first display device 12 and the second display device 14. It must be noted that the connection is shown in Fig. 2 by two connecting lines 32. However, it must be noted further that these only represent the connection and do not necessarily mean the provision of a wire connection. Rather, the connection can also be provided wireless.

Additionally, as an option, the processing unit 30 may also be provided with a keyboard 34 or a mouse or trackball 36.

Thus, for defining a sub-image, the first display device 12 is provided as a navigation pad, where size (zoom) and location (pan) can be selected. The keyboard and/or mouse and the like are provided for entering commands, for example with respect to a patient list or an image stamp collection and the like. The second display device 14 is provided, for example, as a high-resolution monitor where the sub-image can be displayed.

Thus, the first display device 12 is a user interface for entering commands for the processing unit to control the second display device. As indicated above, a wireless connection of the first display device 12 with the processing unit 30 may be provided.

The portion of the image is also referred to as sub-image. The second display device 14 may thus be configured to show at least two selected portions, or sub-images, of the medical image.

Figs. 3A to 3C show a further example for a setup with the first display device 12 in the foreground and the second display device 14 in the background. A medical image 38 is shown on the first display device 12. The second display device 14 also shows the

medical image 38 in an overview, for example as a default or starting point. This is shown in Fig. 3A.

Next, the user can select a portion, for example indicated by dotted frame 40 in Fig. 3B in the first display device 12, which portion is then shown on the second display device 14 in a larger scale for a detailed view. Next, the user can further identify a smaller selection, as indicated with a further dotted frame 42 in Fig. 3C, such that the respective portion is shown on the second display device 14 in an even more enlarged scale, i.e. with an even more detailed view.

As shown in Fig. 4, the first display device 12 and/or the second display device 14 are configured to show at least two images, for example a first medical image 42 in the left part of the first display device 12 and a second medical image 44 in the right half of the display area 20 of the first display device 12. Still further, the user selects the respective portion via a first graphical indicator 46 in the left half and a second graphical indicator 48 in the right half. Thus, respective selected portions can be shown on a first monitor 50 of the second display device 14 and the respective second monitor 52.

Instead of providing two separate monitors for the second display device 14, it is also possible to provide a larger screen of the second display device, as shown in Fig. 5. The display area of the second display device 14 can be divided into two parts or halves, as indicated with a dotted separator line 54.

Thus, a respective first image, such as the first image 42 of Fig. 4, and a second image such as the second image 44 of Fig. 4, can be shown on the second display device 14.

Also more than two, for example three different image areas or portions can be shown in the second display device 14.

For example, in addition to the first display device and the second display device, the latter may be provided with a number of monitors, also a further monitor may be provided that shows administrative data such as patient lists. This so-to-speak third display device may also be provided as two or more monitors or may be combined with the two other displays. Furthermore, even more image monitors may be connected.

Fig. 5 shows a further embodiment, although this not being a conditional requirement for the above mentioned figure description parts of Fig. 5. For example, the first display device 12 is provided with two separate indicators 56 in order to be able to select two different portions to be shown in a detailed view on the second display device. The respective indicators can be controlled independently from each other. It must be noted that this aspect,

i.e. providing more than one graphical indicator, is also applicable for the two monitor solution of Fig. 4.

For image viewing, for example, X-ray images are generated as pairs, for example a “PA" and a “lateral” view for chest or “CC" and “MLO” for mammography. Thus, an expansive viewing situation may have two diagnostic monitors.

It may be provided to present also two images on the two displays, such as two monitors. For example, the second display device is a 16:9 screen that may be split into two 8:9 sub-screens. For the first display, two full images can be shown next to each other, with two independent graphical indicators and thus two independent touch sensitive areas.

The first display device may be smaller than the second display device.

Administrative data can be provided on the first display device and/or on the second display device. The administrative data may include a patient list, examinations etc. Also icons to call functions (brightness, contrast, etc.) can be shown on the first display 12.

As indicated above, and also described in relation with Fig. 4, according to a further example, the second display device 14 comprises at least two monitors, such as the first and second monitor 50, 52 and the first display device 12 is configured for selection of the portions to be shown on the at least two monitors.

The first display device may be configured to show the full image as a default, which default is provided to be changed by the user input.

Fig. 6 shows a medical imaging system 100 comprising an image acquisition arrangement 110 and a medical imaging display arrangement 112 according to one of the above-described examples. The image acquisition arrangement 110 is provided to acquire a medical image of an object of interest, for example a patient 114. The medical imaging display arrangement 112 is configured to show the medical image on the first display device and the selected portion of the medical image on the second display device, wherein the selected portion is adaptable by touching the first display device.

For example, the image acquisition arrangement is provided as an X-ray imaging arrangement, for which, as an example, Fig. 6 shows a so-called C-arm arrangement, where an X-ray source 116 and an X-ray detector 118 are provided on opposite ends of a C-arm structure 120, moveably supported by a C-arm support 122, which support 122 is suspended from a ceiling construction 124. A patient table 126 may be provided, as well as lighting equipment 128.

For the medical imaging display arrangement 112, the first display device 12 may be provided in close vicinity to the patient table 126, and the second display device 14

may be provided in the vicinity, for example suspended from the ceiling construction. Furthermore, Fig. 6 also shows a processing unit with user input devices and monitors, together with keyboard, mouse, and the like.

It must be noted that the X-ray imaging arrangement is shown as a C-arm type as an example only. Of course, other X-ray imaging arrangements are also provided, such as a CT system, or a fixed X-ray arrangement. The X-ray imaging arrangement may be provided as a Radiography or Mammography system.

Instead of an X-ray imaging arrangement, the medical imaging system 100 may also be provided as an ultrasound imaging arrangement (not further shown).

Fig. 7 shows a method 200 for displaying a medical image, comprising the following steps: In a first step 210, a medical image is provided. In a second step 212, the medical image is shown in a display area of the first display device 12. In a third step 214, a portion of the medical image is selected by manual user interaction comprising touching the display area. In a fourth step 216, the selected portion is shown on a second medical display device 14.

The first step 210 is also referred to as step a), the second step 212 as step b), the third step 214 as step c), and the fourth step 216 as step d).

According to a further example (not shown), the selecting comprises adapting a graphical indicator superimposed on the medical image on the first display device.

Figs. 8A to 8C show photographic illustrations of the respective line drawings of Figs. 3A to 3C. Since the same reference numbers are used, it is refrained from repeating a respective description concerning Figs. 8A to C.

According to an example, an off-the-shelf HDTV monitor can be used, for example with a large size of 24 inches or the like. The first display device can be provided as a small touchscreen allowing intuitive control of the image size of 7 to 10 inches. For example, the full image (for example fit to screen) is always visible on the navigation image display.

The graphical indicator may be provided, for example, as a coloured rectangle symbolizing the selected region for display “in large”. Thus, an improved workflow for the reading of images at a diagnostic workstation is provided.

It is easier to navigate through an image with large magnification factors, as the full image is always visible below.

According to a further example, the administration of the system, such as display patient list, examinations, showing image icons etc., can take place on the first display device 12 or on the second display device 14. As indicated above, this may also be

provided on one or more additional monitors, for example, when the navigation screen, i.e. the first display device is added to a high-end viewing system to provide additional user control features as described above and also depicted further below, for example to make it more comfortable.

For example, in a display mode, the large monitor in form of the second display device 14 shows only the sub-image, or portion, or two sub-images, or two portions. The navigation display, i.e. the first display device, shows the full image and additionally may show some soft keys that can be selected by touch. For example, one of these soft keys can be the function for improved image scaling. As an example, some further functions may be provided to be activated or controlled by touching the first display device, such as switching on and off functions like noise filter, sharpening, display of additional information etc.. Further, buttons (plus or minus buttons, sliders) to modify image brightness and contrast may be provided on the first display device. Still further, functions to generate an overlay with text and arrows to the image may be provided. Another function to be provided may be to measure the length or the area of an object in the image. Further, buttons for pre-defined scaling such as sub-image sizes leading to 100% scale, 50% scale; 200% scale etc. may be provided.

For example, the user can use a two-finger gesture to define the size of the sub-image on the first display device. As an example, the indicator may be adapted to a shape of the second display device, i.e. 16:9 format. Further, the user can also pan through the image on the first display device 12 with a one-finger gesture.

In another exemplary embodiment of the present invention, a computer program or a computer program element is provided that is characterized by being adapted to execute the method steps of the method according to one of the preceding embodiments, on an appropriate system.

The computer program element might therefore be stored on a computer unit, which might also be part of an embodiment of the present invention. This computing unit may be adapted to perform or induce a performing of the steps of the method described above. Moreover, it may be adapted to operate the components of the above-described apparatus. The computing unit can be adapted to operate automatically and/or to execute the orders of a user. A computer program may be loaded into a working memory of a data processor. The data processor may thus be equipped to carry out the method of the invention.

This exemplary embodiment of the invention covers both, a computer program that right from the beginning uses the invention and a computer program that by means of an

up-date turns an existing program into a program that uses the invention.

Further on, the computer program element might be able to provide all necessary steps to fulfil the procedure of an exemplary embodiment of the method as described above.

According to a further exemplary embodiment of the present invention, a computer readable medium, such as a CD-ROM, is presented wherein the computer readable medium has a computer program element stored on it which computer program element is described by the preceding section.

A computer program may be stored and/or distributed on a suitable medium, such as an optical storage medium or a solid-state medium supplied together with or as part of other hardware, but may also be distributed in other forms, such as via the internet or other wired or wireless telecommunication systems.

However, the computer program may also be presented over a network like the World Wide Web and can be downloaded into the working memory of a data processor from such a network. According to a further exemplary embodiment of the present invention, a medium for making a computer program element available for downloading is provided, which computer program element is arranged to perform a method according to one of the previously described embodiments of the invention.

It has to be noted that embodiments of the invention are described with reference to different subject matters. In particular, some embodiments are described with reference to method type claims whereas other embodiments are described with reference to the device type claims. However, a person skilled in the art will gather from the above and the following description that, unless otherwise notified, in addition to any combination of features belonging to one type of subject matter also any combination between features relating to different subject matters is considered to be disclosed with this application. However, all features can be combined providing synergetic effects that are more than the simple summation of the features.

While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive. The invention is not limited to the disclosed embodiments. Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing a claimed invention, from a study of the drawings, the disclosure, and the dependent claims.

In the claims, the word “comprising” does not exclude other elements or steps,

and the indefinite article "a" or "an" does not exclude a plurality. A single processor or other unit may fulfil the functions of several items re-cited in the claims. The mere fact that certain measures are re-cited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

CLAIMS:

1. A medical imaging display arrangement (10), comprising:

- a first display device (12); and
- a second display device (14);

wherein the first display device is configured to show a medical image (18) of an object in a display area (20);

wherein the second display device is configured to show a selected portion (22) of the medical image;

wherein the first display device is configured for selection of the portion to be shown on the second display device; and

wherein the first display device is provided as a touch sensitive display (24) at least in the display area providing a graphical user interface for controlling the selection.

2. Medical imaging display arrangement according to claim 1, wherein the display area of the first display device showing the medical image is provided as a touch sensitive navigation interface for controlling the second display device.

3. Medical imaging display arrangement according to claim 1 or 2, wherein the first display device is configured to select the portion to be shown on the second display device by a manual determination of an image portion of the medical image within the image shown on the first display device.

4. Medical imaging display arrangement according to claim 1, 2 or 3, wherein a graphical indicator (28) representing the portion to be shown is provided superimposed on the medical image of the first display device; and

wherein size, proportion, and location of the graphical indicator can be adapted by user manual interaction by touching the display area of the first display device.

5. Medical imaging display arrangement according to claim 1, 2, 3, or 4, wherein a processing unit (30) is provided connected to the first display device and the second display device.

6. Medical imaging display arrangement according to claim 5, wherein the first display device is a user interface for entering commands for the processing unit to control the second display device.

7. Medical imaging display arrangement according to claim 5 or 6, wherein a wireless connection of the first display device with the processing unit is provided.

8. Medical imaging display arrangement according to one of the preceding claims, wherein the first display device and/or the second display device are configured to show at least two images.

9. Medical imaging display arrangement according to one of the preceding claims, wherein the second display device comprises at least two monitors (50, 52); and

wherein the first display device is configured for selection of the portions to be shown on the at least two monitors.

10. A medical imaging system (100), comprising:

- an image acquisition arrangement (110); and
- a medical imaging display arrangement (112) according to one of the preceding claims;

wherein the image acquisition arrangement is provided to acquire a medical image of an object of interest; and

wherein the medical imaging display arrangement is configured to show the medical image on the first display device and the selected portion of the medical image on the second display device, wherein the selected portion is adaptable by touching the first display device.

11. Medical imaging system according to claim 10, wherein the image acquisition arrangement is provided as:

i) an X-ray imaging arrangement; and/or

ii) an ultrasound imaging arrangement.

12. A method (200) for displaying a medical image, comprising the following steps:

a) providing (210) a medical image;

b) showing (212) the medical image in a display area of a first medical display device;

c) selecting (214) a portion of the medical image by manual user action comprising touching the display area; and

d) showing (216) the selected portion on a second medical display device.

13. Method according to claim 12, wherein the selecting comprises adapting a graphical indicator superimposed on the medical image in the first display device.

14. A computer program element for controlling an apparatus according to one of the claims 1 to 11, which, when being executed by a processing unit, is adapted to perform the method steps of one of the claims 12 to 13.

15. A computer readable medium having stored the program element of claim 14.

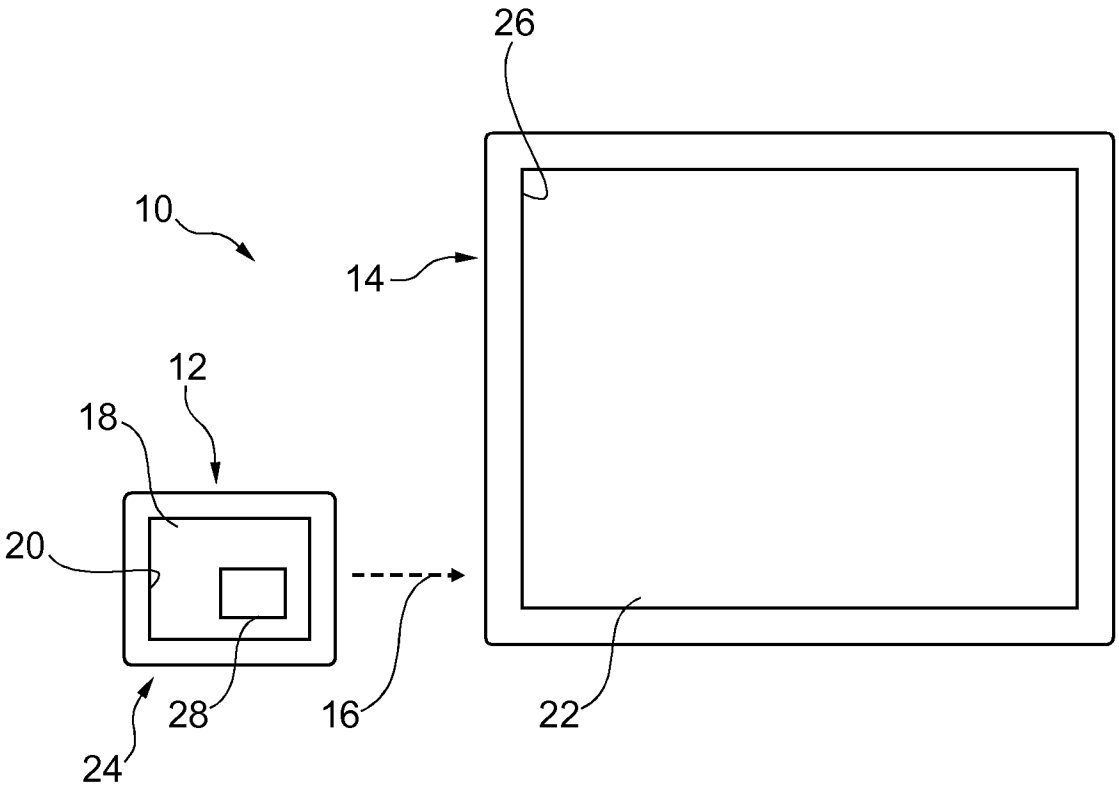


Fig. 1

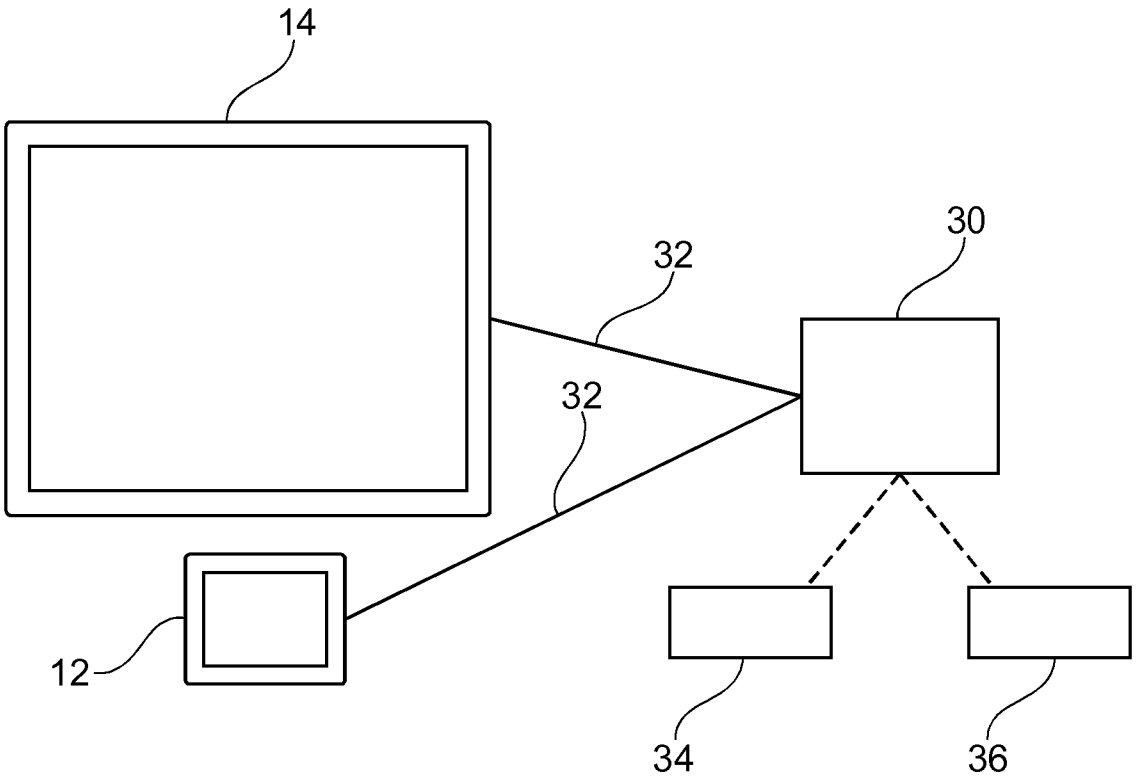


Fig. 2

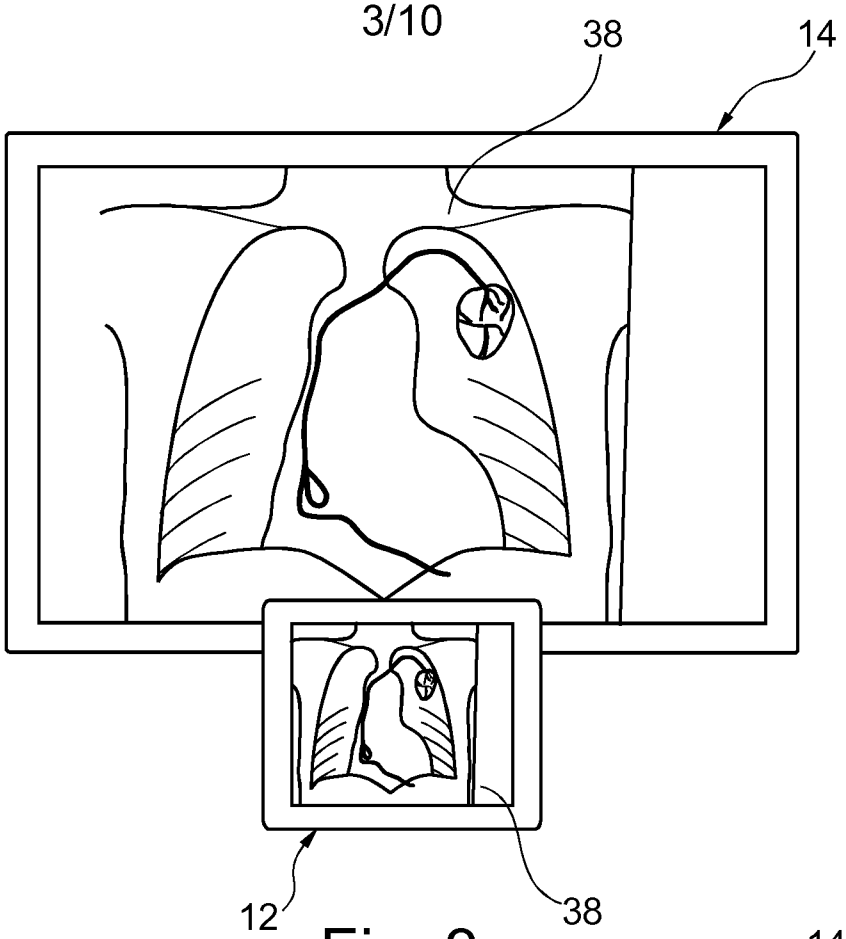


Fig. 3a

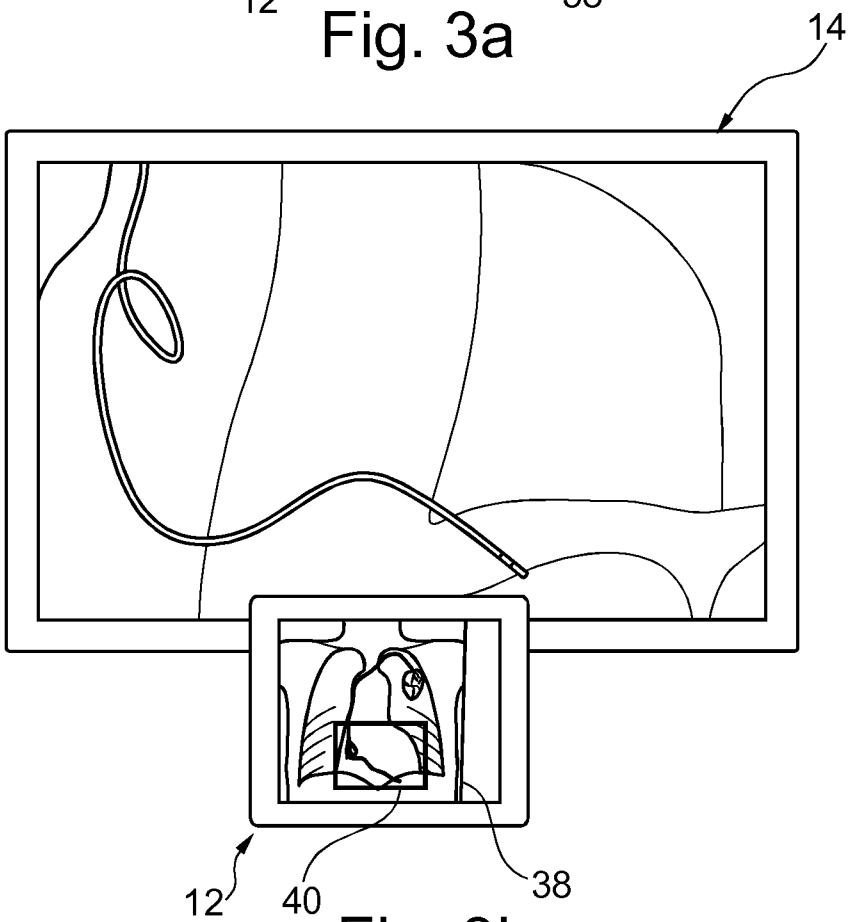


Fig. 3b

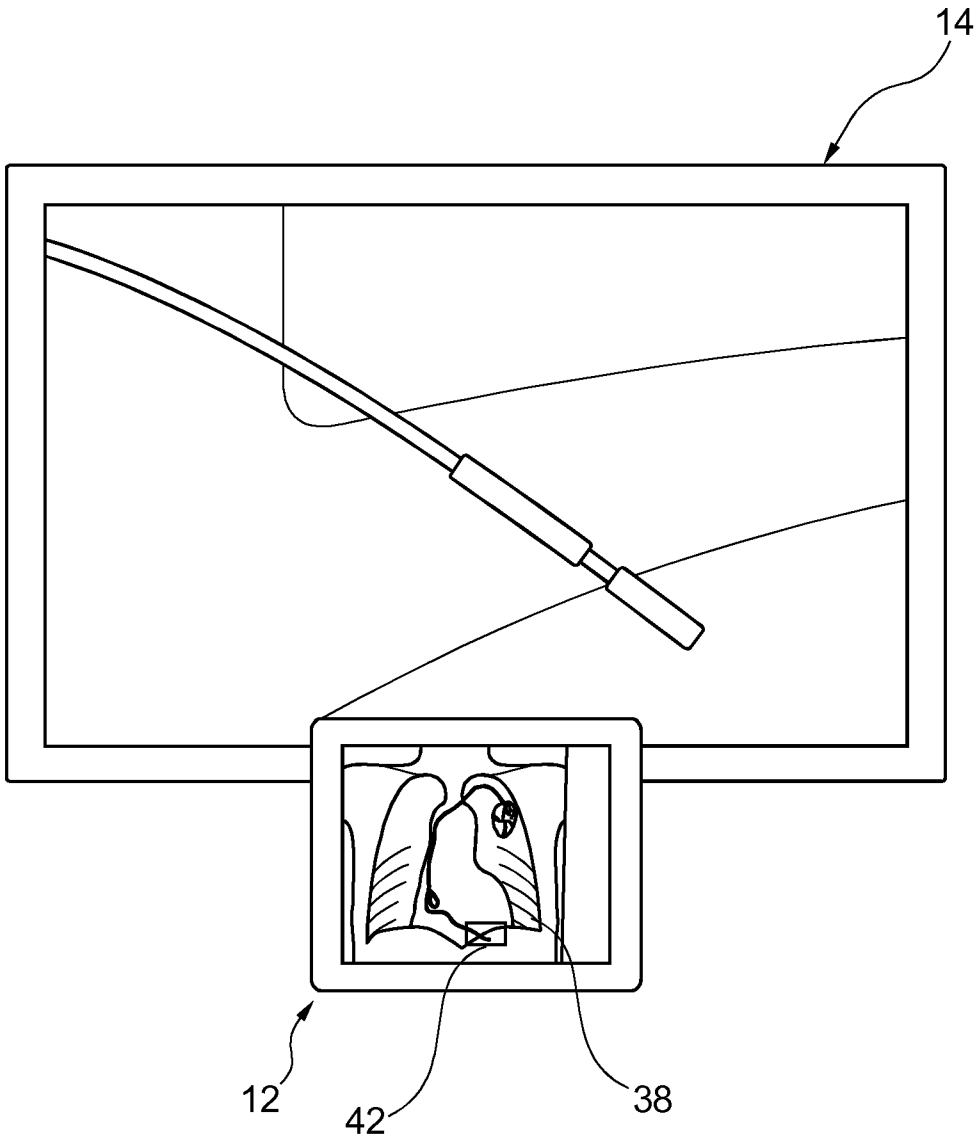


Fig. 3c

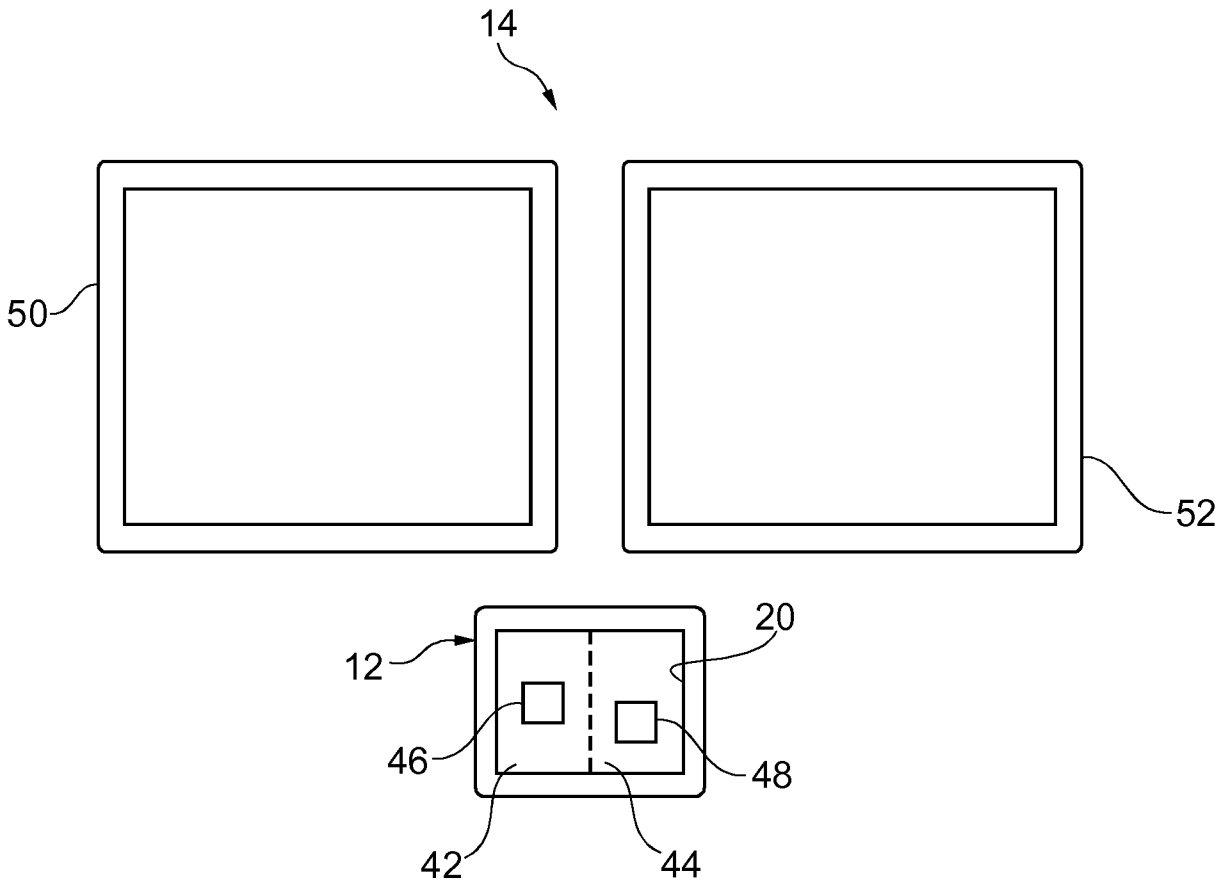


Fig. 4

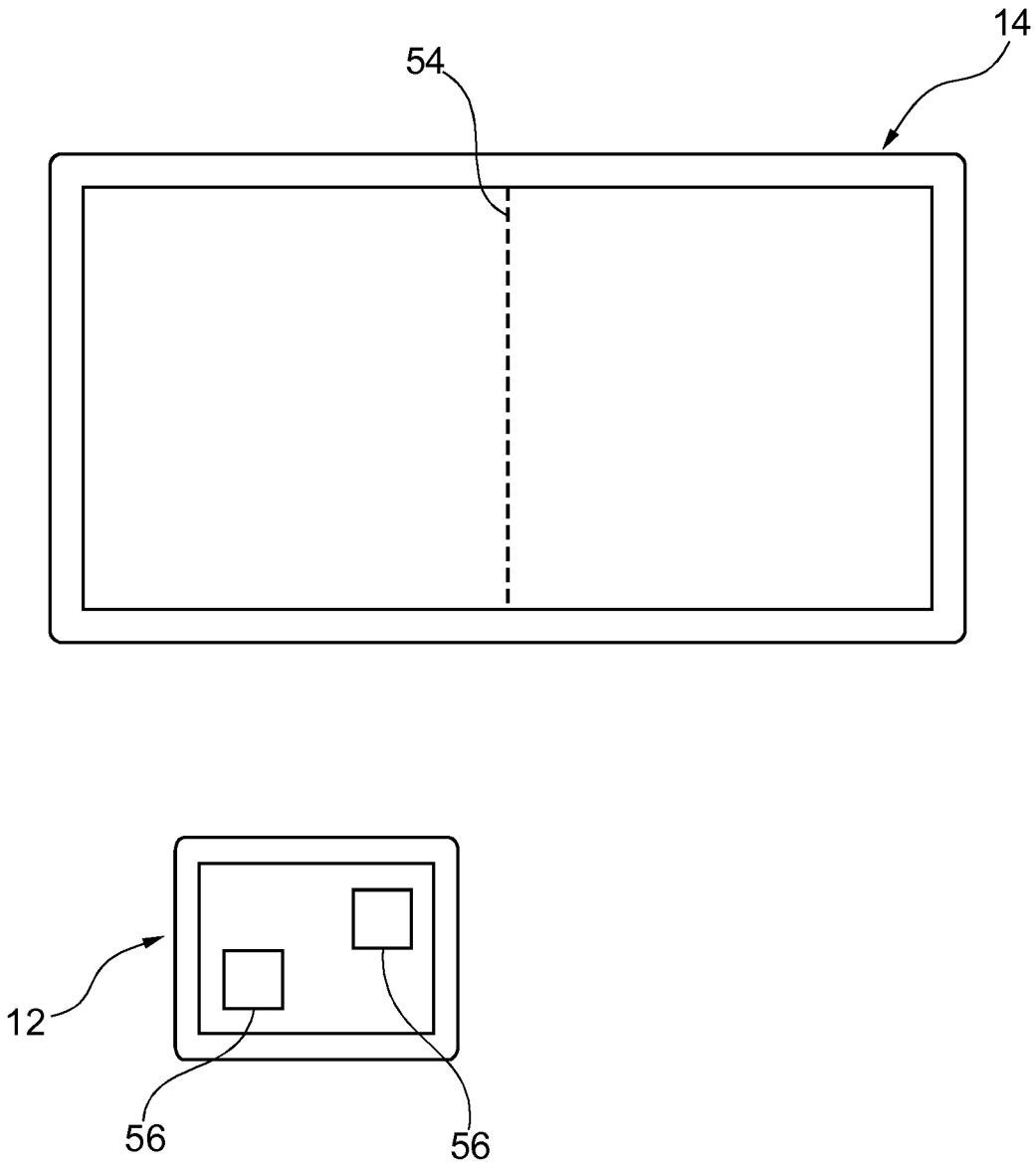


Fig. 5

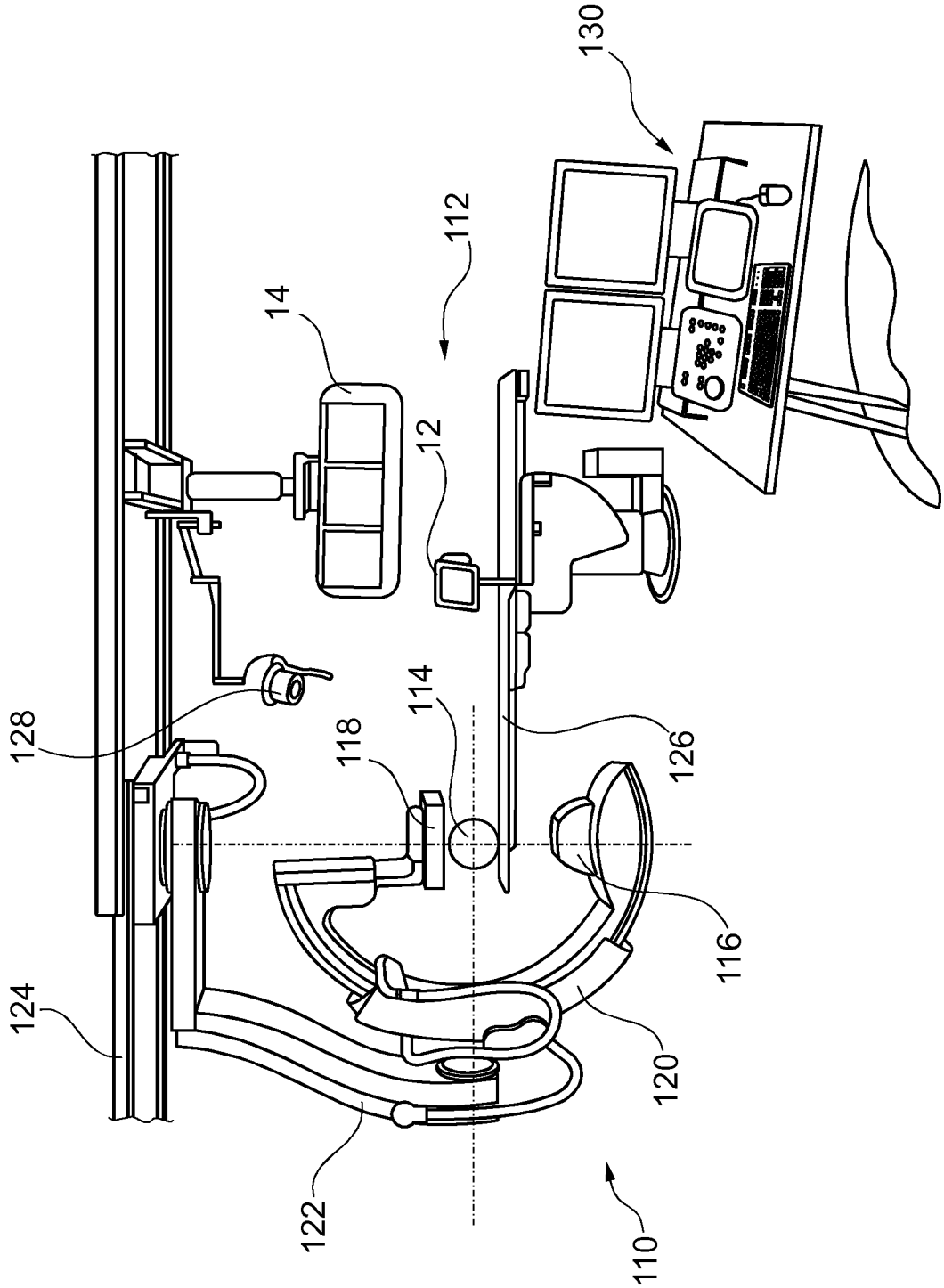


Fig. 6

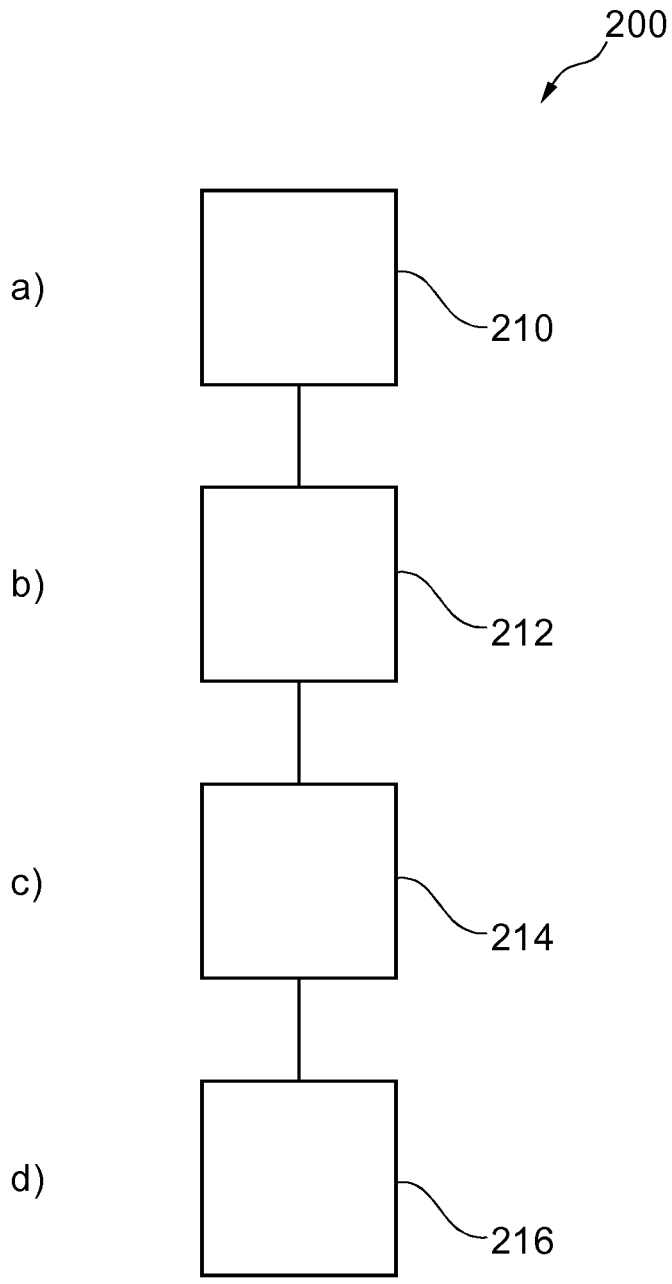


Fig. 7

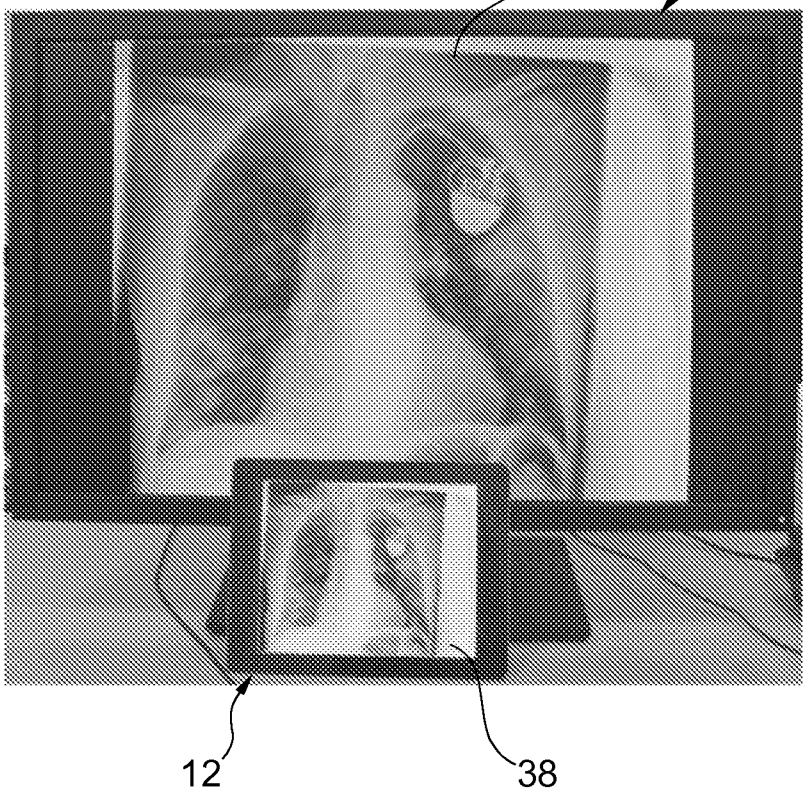


Fig. 8a

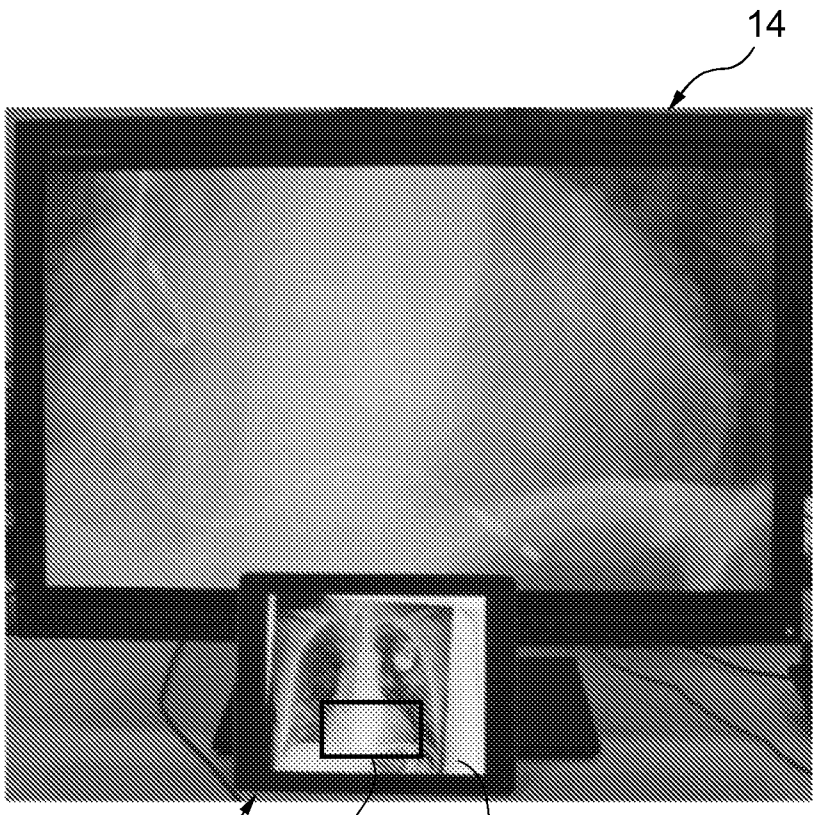


Fig. 8b

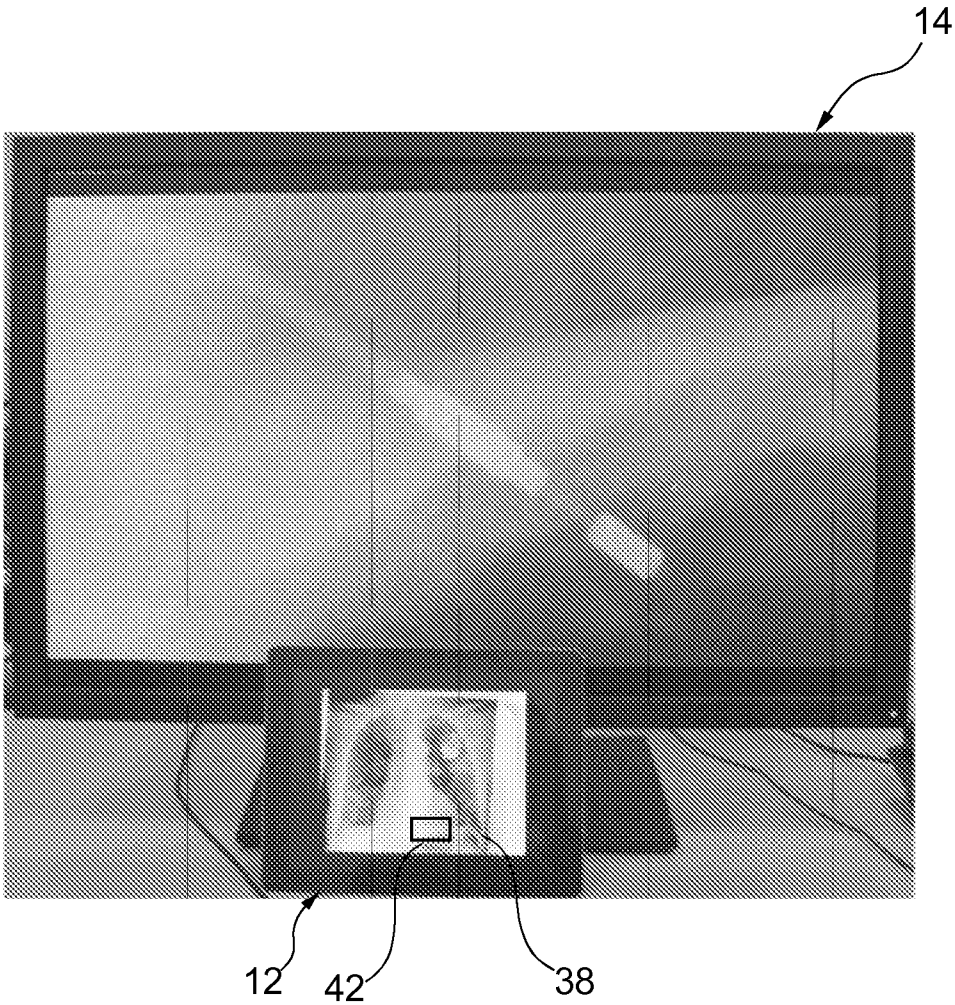


Fig. 8c

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2013/054679

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06F19/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2009/042630 A1 (GLOBAL DEVICE MAN [US]; HARRIS DAVID PETER [US]; CORMACK RANDALL WAYNE) 2 April 2009 (2009-04-02) the whole document	1-15
X	EP 0 994 433 A1 (FAIRFIELD IMAGING LTD [GB]) 19 April 2000 (2000-04-19) the whole document	1-15
A	US 2007/274585 A1 (ZHANG DAOXIAN H [US] ET AL) 29 November 2007 (2007-11-29) the whole document	1-15
A	EP 2 169 524 A2 (FUJIFILM CORP [JP]) 31 March 2010 (2010-03-31) the whole document	1-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 September 2013	07/10/2013

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Sanandrés Ledesma, J

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2013/054679

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2009042630 A1	02-04-2009	CN 101874402 A	27-10-2010
		EP 2201753 A1	30-06-2010
		US 2009102933 A1	23-04-2009
		WO 2009042630 A1	02-04-2009
EP 0994433 A1	19-04-2000	DE 69925084 D1	09-06-2005
		DE 69925084 T2	29-06-2006
		EP 0994433 A1	19-04-2000
US 2007274585 A1	29-11-2007	US 2007274585 A1	29-11-2007
		WO 2007139633 A2	06-12-2007
EP 2169524 A2	31-03-2010	EP 2169524 A2	31-03-2010
		JP 2010086149 A	15-04-2010
		US 2010083154 A1	01-04-2010

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2013/054679

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 4, 5, 8, 9(all partially)
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 4, 5, 8, 9(all partially)

The claims in the present application are drafted in an unclear way that does not allow to define the scope of the claimed subject matter (Article 6 PCT). According to Rule 6(4)(a) PCT, any dependent claim which refers to more than one other claim (multiple dependent claim) shall not serve as a basis for any other multiple dependent claim. Claims 4, 5, 8, 9 violate indeed this rule as they depend on combinations of previous claims. This renders obscure the claimed subject matter. These claims are considered to depend only on the corresponding independent claim.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) declaration be overcome.