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(54) Title: ENDOSCOPE WITH WIDE ANGLE LENS AND ADJUSTABLE VIEW

(57) Abstract: The present invention provides a system for altering the field of view of an endoscope image, comprising: at least one endoscope having a wide-angle lens in said endoscope's distal end; at least one camera located in said endoscope's proximal end, adapted to image a field of view of said endoscope image by means of said wide-angle lens; and a computer program which, when executed by data processing apparatus, is configured to select at least a portion of said field of view; wherein said portion of said field of view is selectable without physically maneuvering said endoscope or said wide-angle lens such that a virtual maneuvering of said field of view is provided.

ENDOSCOPE WITH WIDE ANGLE LENS AND ADJUSTABLE VIEW

FIELD OF THE INVENTION

The present invention generally pertains to a system and method for providing an endoscopic image, where the field of view of the image is virtually maneuverable.

BACKGROUND OF THE INVENTION

Laparoscopic surgery is becoming increasingly popular with patients because the scars are smaller and their period of recovery is shorter. Laparoscopic surgery requires special training of the surgeon or gynecologist and the theatre nursing staff. The equipment is often expensive and is not available in all hospitals. During laparoscopic surgery it is often required to shift the spatial placement of the endoscope in order to present the surgeon with the optimal view. Conventional laparoscopic surgery makes use of either human assistants that manually shift the instrumentation or alternatively robotic automated assistants (such as JP patent No. 06063003).

In laparoscopic surgery, the surgeon performs the operation through small holes using long instruments and observing the internal anatomy with an endoscope camera. The surgeon's performance is largely dependent on the camera position relative to the instruments and on a stable image shown at the monitor. In general, the surgeon needs a close-up view of the area in which he wants to work, however, there are times when an overview of a large portion of the working area, such as an overall view of the interior of the abdomen, is desirable.

U.S. Patent US6387044 discloses a laparoscope apparatus for use in laparoscopic surgery or the like comprises a cannula with an inner hollow having therein a light guide for introducing light to its tip end for illuminating the object to be observed, and an endoscope which is capable of being pulled into and out from the inner hollow of the cannula. The cannula is airtightly sealed with a transparent member at its tip end, while the endoscope has therein an image pick-up with a wide-angle lens, and the image pick-up is housed in the cannula close to the transparent member.

However, in US Patent US6387044, no means of adjusting magnification of the image is disclosed.

Korean Patent Application KR2009/012326 discloses a laparoscope and an image processing system using the same to efficiently perform a laparoscope operation by outputting an image of the inside of the abdominal cavity. The laparoscope includes a wide angle lens, an optical fiber, an inserting part, and an optical interface part. The wide angle lens is arranged at one end of the laparoscope, and is a fisheye lens. The focal distance of the wide angle lens is controllable. The optical fiber delivers incident light from the wide angle lens to the camera part, and is received in an inner space of the inserting part. The inserting part is inserted inside the abdominal cavity. The optical interface part delivers the light delivered from the optical fiber to the camera part. The camera part is a two dimensional camera or a three dimensional camera.

However, Korean Patent Application KR2009/012326 requires camera wide angle lens of adjustable focal length.

U.S. Patent Application US2011069160 discloses an imaging system and method of application, including lens designs tailored to be used with particular transformation algorithms, electronic hardware and algorithms for image transformations. Exemplary application of the system including automotive, photographic and medical endoscopic are also described. The system enables improved image view and allows customization of views by the end user even after installation of the image system hardware. In U.S. Patent Application US2011069160, mathematical algorithms are used to alter the image, so that a continuously varying distortion of the image is possible, so that desired portions of the image are magnified, but the whole of the image remains within the field of view.

However, US Patent Application US2011069160 discloses a system wherein the image is distorted, with the distortion changing continuously across the image, so that portions of the image are magnified while the entirety of the field of view is displayed.

Chinese Utility Model CN203042209 discloses a laparoscopic puncture device with an intra-cavity full-view auxiliary lens, which relates to a surgical instrument device, in particular to the laparoscopic puncture device with the intra-cavity full-view auxiliary lens for abdominal cavity minimally-invasive surgery. A main lens of a laparoscope enters into the abdominal cavity through a cannular puncture device, the puncture device is provided with an auxiliary lens which can be used for observing intra-cavity full view, and the auxiliary lens is a wide-angle lens and cold light source combination body; the auxiliary lens is arranged at the middle part of the puncture device entering into the abdominal cavity, and the auxiliary lens

is positioned at the highest position of the abdominal cavity after the abdominal cavity is subjected to air inflation; the outer ring of the puncture device is provided with a groove, the wide-angle lens and cold light source combination body of the auxiliary lens is embedded in the groove and is combined into a whole with the puncture device; and the wide angle of a wide-angle lens of the auxiliary lens is larger than or equal to 270 degrees, and the resolution ratio of the wide-angle lens of the auxiliary lens is 1-3 million pixels. By adding a cold light source and the wide-angle lens, the full-view visible function is added on the basis of the original function of the puncture device, 80 percent of the abdominal cavity can be within a visible range, motion of all instruments is within the visible range, the surgical blind area of a surgeon can be removed, and the surgery can be safer.

However, Chinese Utility Model CN203042209 requires use of at least two lenses.

It is therefore a long felt need to provide an endoscopic image, where the field of view of the image is virtually maneuverable.

SUMMARY OF THE INVENTION

It is an object of the present invention to disclose a system for providing an endoscopic image, where the image can be maneuvered virtually.

It is another object of the present invention to disclose a system for altering the field of view of an endoscope image, comprising:

a. at least one endoscope having a wide-angle lens in said endoscope's distal end;

b. at least one camera located in said endoscope's proximal end, adapted to image a field of view of said endoscope image by means of said wide-angle lens; and

c. a computer program which, when executed by data processing apparatus, is configured to select at least a portion of said field of view;

wherein said portion of said field of view is selectable without physically maneuvering said endoscope or said wide-angle lens such that a virtual maneuvering of said field of view is provided.

It is another object of the present invention to disclose the system, wherein said camera is a high-resolution camera.

It is another object of the present invention to disclose the system, additionally comprising a database.

It is another object of the present invention to disclose the system, wherein said field of view is storable in said database.

It is another object of the present invention to disclose the system, wherein said computer program, when executed, can alter the apparent size of said portion of said field of view.

It is another object of the present invention to disclose the system, wherein said computer program, when executed, can show said portion of said field of view on said display.

It is another object of the present invention to disclose the system, wherein said virtual maneuvering is either continuous or discrete.

It is another object of the present invention to disclose the system, wherein said image of said at least a portion of said field of view is substantially undistorted.

It is another object of the present invention to disclose the system, wherein said computer program, when executed by said data processing apparatus, is additionally configured to perform said virtual maneuvering automatically.

It is another object of the present invention to disclose the system, wherein said automatic virtual maneuvering is performed in order to achieve a predetermined goal, said goal selected from a group consisting of: maintaining a predetermined object at the center of said portion of said field of view, maintaining a predetermined object at a predetermined apparent size; maintaining a predetermined horizon, and any combination thereof.

It is another object of the present invention to disclose the system, wherein said system additionally comprises a maneuvering mechanism for physically maneuvering said endoscope.

It is another object of the present invention to disclose the system, wherein said computer program, when executed by said data processing apparatus, is additionally configured to physically maneuver said endoscope by means of said maneuvering mechanism.

It is another object of the present invention to disclose the system, wherein said computer program, when executed by said data processing apparatus, is additionally configured to maneuver said portion of said field of view by means of a group consisting of said physical maneuvering, said virtual maneuvering and any combination thereof.

It is another object of the present invention to disclose the system, wherein said maneuvering of said field of view is commanded by means of a member of a group consisting of: moving an object, touching a prepared surface, typing on a keyboard, gesture or body movement, generating a predetermined sound and any combination thereof.

It is another object of the present invention to disclose the system, wherein said movable object is selected from a group consisting of: a joystick, a lever, a button, a slider and any combination thereof.

It is another object of the present invention to disclose the system, wherein said prepared surface is selected from a group consisting of: a touch-sensitive pad displaying commands, a display comprising a touchscreen and any combination thereof.

It is another object of the present invention to disclose the system, wherein selection of the center of said field of view is by means of touching said touchscreen.

It is another object of the present invention to disclose the system, wherein selection of zoom is selected from a group consisting of: drawing the outline of a desired image area on said display, by continuing to touch said touchscreen until zoom is complete and any combination thereof.

It is another object of the present invention to disclose the system, wherein said gestures selected from a group consisting of: hand movements, arm movements, body movements, head movements, eye movements and any combination thereof.

It is another object of the present invention to disclose the system, wherein said sound comprises at least one predetermined sound pattern.

It is another object of the present invention to disclose the system, wherein said predetermined sound patterns are selected from a group consisting of words, sounds of constant pitch, sounds of varying pitch, sounds of constant loudness, sounds of varying loudness and any combination thereof.

It is another object of the present invention to disclose a method for altering the field of view of an endoscope image, comprising steps of:

a. providing a system for altering the field of view of an endoscope image, comprising:

   i. at least one endoscope having a wide-angle lens in said endoscope's distal end;

ii. at least one camera located in said endoscope's proximal end, adapted to image a field of view of said endoscope image by means of said wide-angle lens; and

iii. a computer program which, when executed by data processing apparatus, is configured to select at least a portion of said field of view;

b. imaging said field of view of said endoscope image; and

c. selecting said at least a portion of said field of view

wherein said portion of said field of view is selectable without physically maneuvering said endoscope or said wide-angle lens such that a virtual maneuvering of said field of view is provided.

It is another object of the present invention to disclose the method, additionally comprising step of selecting said camera to be a high-resolution camera.

It is another object of the present invention to disclose the method, additionally comprising step of providing a database.

It is another object of the present invention to disclose the method, additionally comprising step of storing at least one said field of view in said database.

It is another object of the present invention to disclose the method, additionally comprising step of altering the apparent size of said portion of said field of view.

It is another object of the present invention to disclose the method, additionally comprising step of showing said portion of said field of view on said display.

It is another object of the present invention to disclose the method, additionally comprising step of performing said virtual maneuvering either continuously or discretely.

It is another object of the present invention to disclose the method, additionally comprising step of providing said image of said at least a portion of said field of view substantially undistorted.

It is another object of the present invention to disclose the method, additionally comprising step of configuring said computer program, when executed by said data processing apparatus, to perform said virtual maneuvering automatically.

It is another object of the present invention to disclose the method, additionally comprising step of performing said automatic virtual maneuvering in order to achieve a predetermined goal, said goal selected from a group consisting of: maintaining a predetermined object at the

center of said portion of said field of view, maintaining a predetermined object at a predetermined apparent size; maintaining a predetermined horizon, and any combination thereof.

It is another object of the present invention to disclose the method, additionally comprising step of providing said system with a maneuvering mechanism for physically maneuvering said endoscope.

It is another object of the present invention to disclose the method, additionally comprising step of configuring said computer program, when executed by said data processing apparatus, to physically maneuver said endoscope by means of said maneuvering mechanism.

It is another object of the present invention to disclose the method, additionally comprising step of configuring said computer program, when executed by said data processing apparatus, to maneuver said portion of said field of view by means of a group consisting of said physical maneuvering, said virtual maneuvering and any combination thereof.

It is another object of the present invention to disclose the method, additionally comprising step of commanding said maneuvering of said field of view by means of a member of a group consisting of: moving an object, touching a prepared surface, typing on a keyboard, gesture or body movement, generating a predetermined sound and any combination thereof.

It is another object of the present invention to disclose the method, additionally comprising step of selecting said movable object from a group consisting of: a joystick, a lever, a button, a slider and any combination thereof.

It is another object of the present invention to disclose the method, additionally comprising step of selecting said prepared surface from a group consisting of: a touch-sensitive pad displaying commands, a display comprising a touchscreen and any combination thereof.

It is another object of the present invention to disclose the method, additionally comprising step of selecting the center of said field of view by means of touching said touchscreen.

It is another object of the present invention to disclose the method, additionally comprising step of selecting said zoom by means of a member of a group consisting of: drawing the outline of a desired image area on said display, by continuing to touch said touchscreen until zoom is complete and any combination thereof.

The virtual maneuvering of the FOV can also be performed automatically by an algorithm in order to achieve a predefined goal such as (but not limited to) centering a certain object in the

image, zooming in\out in order to maintain a certain object size, rotating the image in order to maintain a constant horizon.

The vistual maneuvering of the FOV can be combined with physical maneuvering of the laparoscope\endoscope by means of controlling the laparoscope position and orientation. The combination can be used in order to achieve more flexibility in the viewed image, such as when the laparoscope is inserted deeper in order to view beyond an occluded organ, while the FOV is virtually maneuvered in order to tilt the viewing angle.

It is another object of the present invention to disclose the method, additionally comprising step of selecting said gestures from a group consisting of: hand movements, arm movements, body movements, head movements, eye movements and any combination thereof.

It is another object of the present invention to disclose the method, additionally comprising step of selecting said sound from predetermined sound patterns.

It is another object of the present invention to disclose the method, additionally comprising step of selecting said predetermined sound patterns from a group consisting of words, sounds of constant pitch, sounds of varying pitch, sounds of constant loudness, sounds of varying loudness and any combination thereof.

BRIEF DESCRIPTION OF THE FIGURES

In order to better understand the invention and its implementation in practice, a plurality of embodiments will now be described, by way of non-limiting example only, with reference to the accompanying drawings, wherein

Fig. 1 schematically illustrates fields of view in the prior art;

Fig. 2 depicts a high-resolution camera image of an operating field in the abdomen; and,

Fig. 3-5 depict close-ups which are enlargements of portions of the image of Fig. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following description is provided, alongside all chapters of the present invention, so as to enable any person skilled in the art to make use of said invention and sets forth the best modes contemplated by the inventor of carrying out this invention. Various modifications, however, will remain apparent to those skilled in the art, since the generic principles of the

present invention have been defined specifically to provide a means and method for providing a laparoscopic or endoscopic image, which is virtually maneuverable,.

The term **'camera'** hereinafter refers to an image acquiring element. Examples of a camera include, but are not limited to, a CCD array and an electromagnetic system such as a TV camera.

The term **'endoscope tip'** hereinafter refers to the end of the endoscope that is inside the patient. The camera is attached to the other side of the endoscope, outside of the patient's abdomen.

The term **'field of view'** (FOV) hereinafter refers to the scene visible to the camera

The term **'displayed view'** hereinafter refers to the scene visible on the display.

The term **'virtual maneuvering'** hereinafter refers to maneuvering the field of view of an endoscope or laparoscope by using software to manipulate the image, such that both the center of the field of view and the extent of the field of view can be changed with or without physical movement of any portion of the endoscope or laparoscope, without physical movement of any portion of the camera and without movement of any lenses in the system.

Said **virtual maneuvering** is provided by means of an image processing means that process the image to provide change in the field of view. For example, if the image taken by the camera is an image of 270 degrees the processor can provide the user with an image of 30 degrees our of said 270 degrees. The user can then alter the field of view to another 30 degrees of said 270 degrees. All of that is done by image processing said image and not by physically maneuvering the endoscope.

The term **'physical maneuvering'** hereinafter refers to maneuvering the field of view of an endoscope or laparoscope by physically moving at least one of (a) some part of the endoscope or laparoscope, (b) some portion of the camera, or (c) one or more lenses in the system.

The term **'wide-angle lens'** hereinafter refers to any endoscope having a field of view of at least 30 degrees. Preferably, at least 60 degrees. An example of an endoscope having a wide-angle lens; is an endoscope capable of providing a 270 degrees image.

Laparoscopic surgery, also called minimally invasive surgery (MIS), is a modern surgical technique in which operations in the abdomen are performed through small incisions (usually 0.5-1.5cm) as compared to larger incisions needed in traditional surgical procedures. The key

element in laparoscopic surgery is the use of an endoscope, which is a device adapted for viewing the scene within the body, at the distal end of the endoscope. Either an imaging device is placed at the end of the endoscope, or a rod lens system or fiber optic bundle is used to direct this image to the proximal end of the endoscope. Also attached is a light source to illuminate the operative field, inserted through a 5 mm or 10 mm cannula or trocar to view the operative field.

The abdomen is usually injected with carbon dioxide gas to create a working and viewing space. The abdomen is essentially blown up like a balloon (insufflated), elevating the abdominal wall above the internal organs like a dome. Within this space, various medical procedures can be carried out.

In many cases, the endoscope cannot view the entire working space within the body, so the endoscope must be repositioned to allow the surgeon to view regions of interest within the space. However, moving the endoscope carries with it the danger of the endoscope contacting a tool and possibly moving it or, worse, contacting a portion of the body and possibly damaging it.

In many cases, the surgeon wants a close-up view of the working area; in other cases an overview is desirable and a rapid transition from close-up to overview and vice-versa is also desirable.

The device disclosed herein uses an endoscopic camera in conjunction with a wide-angle lens and software for viewing control in order to provide an endoscopic system with virtual maneuvering of the field of view, wherein both the center of the field of view (the position) and the extent of the field of view (the zoom) can be altered rapidly without need for physical movement of any part of the system. Furthermore, virtual maneuvering can be either continuous or discrete.

The advantages of virtual maneuvering (virtual zoom and virtual positioning) include:

- There is very little or no need to physically alter the position of the endoscope in order to change the viewing angle, which can be especially important in robotic systems where robotic control of the viewing angle is used rather than human control.
- Maneuvering of the endoscope is simplified – no moving parts are needed either for control of endoscope position or for control of components within the optical system.

- Change in the viewing direction can be continuous, and discrete steps are not of fixed size, unlike the fixed-size discrete steps found in systems such as the Storz-EndoCameleon™.

In the Storz-EndoCameleon, manipulation of the filed of view is carried out mechanically. **Fig. 1** illustrates the discrete, although overlapping, fields of view (**110**) possible with the Storz-EndoCameleon of the prior art.

In the device disclosed herein, the use of a wide-angle lens allows virtual maneuvering of the endoscope. A wide-angle lens such as a fish-eye lens can provide an image of a large portion, if not all, of a working area, such as the interior of the abdomen. The image provided by a wide-angle lens is typically distorted; software can be used to correct the distortion.

A high resolution camera, preferably at least 4096X3072 pixels, can provide sufficient detail for virtual maneuvering; 4D maneuvering including zoom can be implemented in software, minimizing the need to physically move the endoscope. A typical image taken with a high-resolution camera is shown in **Fig. 2**; the image shows the detail provided by large number of pixels in the image from such a camera. It is the large number of pixels that enables zooming, since the image will remain clear and detailed even when a small portion of it is zoomed to fill the whole display. In **Fig. 2**, locations are shown for the centers of the enlarged images of **Fig 3** (**210**), **Fig. 4** (**220**) and **Fig. 5** (**230**).

Fig. 3 shows (**210**) an enlarged view of a portion of the image of **Fig. 2**, centered halfway between the tools. The enlarged image includes approximately 10% of the area of the original picture but details, such as the tools (**215**), remain clear. Again, said image is provided merely by image processing said image. Not by physically maneuvering (or zooming) the endoscope.

Fig. 4 shows (**220**) an enlarged view of a portion of the image of **Fig. 2**, centered on the lobe at the top right of the image of **Fig. 2**. The enlarged image includes approximately 10% of the area of the original picture but details, such as the blood vessels (**225**), remain clear. Again, said image is provided merely by image processing said image. Not by physically maneuvering (or zooming) the endoscope.

Fig. 5 shows (**230**) an enlarged view of a portion of the image of **Fig. 2**, centered on the lobe at the top right of the image of **Fig. 2**. The enlarged image includes approximately 10% of the area of the original picture, but details such as the blood vessels (**235**) remain clear. Again,

said image is provided merely by image processing said image. Not by physically maneuvering (or zooming) the endoscope.

In the device of the present invention, software is used to correct any distortion of the image caused by the lensing system, to virtually move the image to a display a selected portion of the field of view (position the image) and to virtually alter the size of the display view, the viewed portion of the field of view (zoom the image).

In preferred embodiments of the device of the present invention, both virtual maneuvering and physical maneuvering are enabled so that maneuvering from one display view to another display view can include virtual maneuvering, physical maneuvering, or both physical and virtual maneuvering.

In preferred embodiments, the physical and virtual movements comprising the maneuvering are under software control. A surgeon or other user directs the system to maneuver the display view; the software then controls the physical and virtual movements needed to accomplish the desired maneuver. Physical maneuvering of the laparoscope or endoscope is accomplished by controlling the laparoscope's position and orientation. Combined virtual and physical maneuvering can be used to achieve more flexibility in the viewed image, such as, for non-limiting example, inserted the laparoscope deeper into the operating region in order to view beyond an occluded organ, while virtually maneuvering display view in order to tilt the viewing angle.

Virtual maneuvering of the display view can also be performed automatically by an algorithm in order to achieve a predefined goal such as (but not limited to) centering a certain object in the image, zooming in or out in order to maintain a certain object size, rotating the image in order to maintain a constant horizon and any combination thereof. For non-limiting example, a surgeon can instruct the system to retain a specified tool in the center of the display image. If the surgeon moves the tool towards himself (and away from the operating site) and to the right, the display view will automatically zoom outward (shrinking the apparent size of the operating site) and will track to the right (moving the operating site to the left in the display view).

The surgeon can control maneuvering in an accustomed manner, whether it be by moving an object, by touching a prepared surface, by typing on a keyboard, by gesture or body movement, or by sound.

For non-limiting example, the moved object can be a joystick, a lever, a button or a slider.

For non-limiting example, the prepared surface can be a touch-sensitive pad with commands on it, or the display can comprise a touchscreen and the surgeon can touch the location in the image which will form the center of the field of view, and can zoom by drawing the outline of the desired image area on the display, or by holding his finger on the screen until zoom is completed. Any combination of the above can also be used.

For non-limiting example, the gestures can comprise hand movements, arm movements, body movements, head movements, eye movements, and any combination thereof.

For non-limiting example, the sound can comprise words, predetermined sound patterns such as sounds of predetermined pitch, and any combination thereof.

For non-limiting example, if the surgeon commands a movement of the center of the field of view in a given direction, the surgeon will see the center of the field of view moving in that direction, although neither the endoscope nor the camera nor the lenses nor any of the camera optics will have physically moved. Similarly, a command to zoom in on the center of the field of view will cause the image to zoom, enlarging the image of the center of the field of view while reducing the portion of the image which is shown. Again, there will have been no physical movement of the endoscope, of any lens, of the camera, or of any component of the camera optics.

In preferred embodiments, discrete alteration of the field of view is also enabled. Again, although there is virtual movement – the image on the display changes - no physical movement is involved; there was no physical movement of the endoscope, the camera, the lenses or any part of the camera optics.

In embodiments with discrete alteration of the field of view, for non-limiting example, a user may wish to have an overview of the situation, by switching from a close-up of the area on which he is working to view of a large portion of the interior of the abdomen. This can be desirable, for non-limiting example, if the surgeon suspects that there may be bleeding and wishes to find the source of the bleeding in order to stop it.

In some variants of embodiments with discrete alteration of the field of view, switching is from (and back to) the current position and zoom, with switching to (and from) a single, predetermined, overview position, with a single, predetermined zoom and position. Preferably, this single, predetermined zoom and position includes in the image virtually all of a working area such as, but not limited to, the interior of the abdomen.

In other variants of embodiments with discrete alteration of the field of view, the surgeon can select desired overview positions and zooms, selected overview positions and zooms being stored in a database. As a non-limiting example, at the beginning of an operation, the surgeon can examine the image and create overviews by selecting desired positions, and, for each desired position, adjusting the zoom, then storing the resulting position and zoom in the database. During the operation, when a desired overview is selected, the image "jumps" so as to display an image with that overview's position and zoom. The surgeon can then either jump back to the previous close-up view, or jump to another overview.

CLAIMS:

1. A system for altering the field of view of an endoscope image, comprising:
   a. at least one endoscope having a wide-angle lens in said endoscope's distal end;
   b. at least one camera located in said endoscope's proximal end, adapted to image a field of view of said endoscope image by means of said wide-angle lens; and
   c. a computer program which, when executed by data processing apparatus, is configured to select at least a portion of said field of view;

   wherein said portion of said field of view is selectable without physically maneuvering said endoscope or said wide-angle lens such that a virtual maneuvering of said field of view is provided.
2. The system of claim 1, wherein said camera is a high-resolution camera.
3. The system of claim 1, additionally comprising a database.
4. The system of claim 3, wherein at least one said portion of said field of view is storable in said database.
5. The system of claim 1, wherein said computer program, when executed, can alter the apparent size of said portion of said field of view.
6. The system of claim 1, wherein said computer program, when executed, can show said portion of said field of view on said display.
7. The system of claim 1, wherein said virtual maneuvering is either continuous or discrete.
8. The system of claim 1, wherein said image of said at least a portion of said field of view is substantially undistorted.
9. The system of claim 1, wherein said computer program, when executed by said data processing apparatus, is additionally configured to perform said virtual maneuvering automatically.
10. The system of claim 9, wherein said automatic virtual maneuvering is performed in order to achieve a predetermined goal, said goal selected from a group consisting of: maintaining a predetermined object at the center of said portion of said field of view, maintaining a predetermined object at a predetermined apparent size; maintaining a predetermined horizon, and any combination thereof.
11. The system of claim 1, wherein said system additionally comprises a maneuvering mechanism for physically maneuvering said endoscope.

12. The system of claim 11, wherein said computer program, when executed by said data processing apparatus, is additionally configured to physically maneuver said endoscope by means of said maneuvering mechanism.
13. The system of claim 11, wherein said computer program, when executed by said data processing apparatus, is additionally configured to maneuver said portion of said field of view by means of a group consisting of said physical maneuvering, said virtual maneuvering and any combination thereof.
14. The system of claim 1, wherein said maneuvering of said field of view is commanded by means of a member of a group consisting of: moving an object, touching a prepared surface, typing on a keyboard, gesture or body movement, generating a predetermined sound and any combination thereof.
15. The system of claim 14, wherein said movable object is selected from a group consisting of: a joystick, a lever, a button, a slider and any combination thereof.
16. The system of claim 14, wherein said prepared surface is selected from a group consisting of: a touch-sensitive pad displaying commands, a display comprising a touchscreen and any combination thereof.
17. The system of claim 16, wherein selection of the center of said field of view is by means of touching said touchscreen.
18. The system of claim 16, wherein selection of zoom is selected from a group consisting of: drawing the outline of a desired image area on said display, by continuing to touch said touchscreen until zoom is complete and any combination thereof.
19. The system of claim 14, wherein said gestures selected from a group consisting of: hand movements, arm movements, body movements, head movements, eye movements and any combination thereof.
20. The system of claim 14, wherein said sound comprises at least one predetermined sound pattern.
21. The system of claim 20, wherein said predetermined sound patterns are selected from a group consisting of words, sounds of constant pitch, sounds of varying pitch, sounds of constant loudness, sounds of varying loudness and any combination thereof.
22. A method for altering the field of view of an endoscope image, comprising steps of:
    a. providing a system for altering the field of view of an endoscope image, comprising:
        i. at least one endoscope having a wide-angle lens in said endoscope's distal end;

ii. at least one camera located in said endoscope's proximal end, adapted to image a field of view of said endoscope image by means of said wide-angle lens; and

iii. a computer program which, when executed by data processing apparatus, is configured to select at least a portion of said field of view;

b. imaging said field of view of said endoscope; and

c. selecting said at least a portion of said field of view

thereby selecting said portion of said field of view without physically maneuvering said endoscope or said wide-angle lens such that a virtual maneuvering of said field of view is provided.

23. The method of claim 22, additionally comprising step of selecting said camera to be a high-resolution camera.

24. The method of claim 22, additionally comprising step of providing a database.

25. The method of claim 24, additionally comprising step of storing at least one said portion of said field of view in said database.

26. The method of claim 22, additionally comprising step of altering the apparent size of said portion of said field of view.

27. The method of claim 22, additionally comprising step of showing said portion of said field of view on said display.

28. The method of claim 22, additionally comprising step of performing said virtual maneuvering either continuously or discretely.

29. The method of claim 22, additionally comprising step of providing said image of said at least a portion of said field of view substantially undistorted.

30. The method of claim 22, additionally comprising step of configuring said computer program, when executed by said data processing apparatus, to perform said virtual maneuvering automatically.

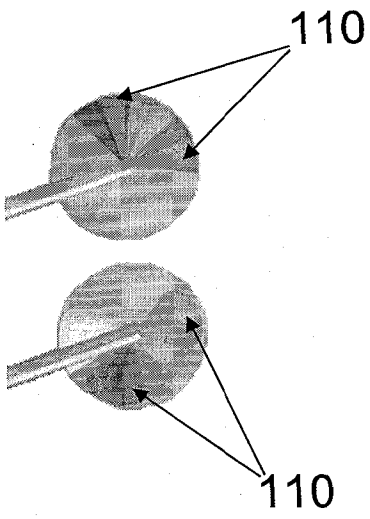
31. The method of claim 30, additionally comprising step of performing said automatic virtual maneuvering in order to achieve a predetermined goal, said goal selected from a group consisting of: maintaining a predetermined object at the center of said portion of said field of view, maintaining a predetermined object at a predetermined apparent size; maintaining a predetermined horizon, and any combination thereof.

32. The method of claim 22, additionally comprising step of providing said system with a maneuvering mechanism for physically maneuvering said endoscope.

33. The method of claim 32, additionally comprising step of configuring said computer

program, when executed by said data processing apparatus, to physically maneuver said endoscope by means of said maneuvering mechanism.

34. The method of claim 32, additionally comprising step of configuring said computer program, when executed by said data processing apparatus, to maneuver said portion of said field of view by means of a group consisting of said physical maneuvering, said virtual maneuvering and any combination thereof.
35. The method of claim 22, additionally comprising step of commanding said maneuvering of said field of view by means of a member of a group consisting of: moving an object, touching a prepared surface, typing on a keyboard, gesture or body movement, generating a predetermined sound and any combination thereof.
36. The method of claim 35, additionally comprising step of selecting said movable object from a group consisting of: a joystick, a lever, a button, a slider and any combination thereof.
37. The method of claim 35, additionally comprising step of selecting said prepared surface from a group consisting of: a touch-sensitive pad displaying commands, a display comprising a touchscreen and any combination thereof.
38. The method of claim 37, additionally comprising step of selecting the center of said field of view by means of touching said touchscreen.
39. The method of claim 35, additionally comprising step of selecting said zoom by means of a member of a group consisting of: drawing the outline of a desired image area on said display, by continuing to touch said touchscreen until zoom is complete and any combination thereof.
40. The method of claim 35, additionally comprising step of selecting said gestures from a group consisting of: hand movements, arm movements, body movements, head movements, eye movements and any combination thereof.
41. The method of claim 35, additionally comprising step of selecting said sound from predetermined sound patterns.
42. The method of claim 41, additionally comprising step of selecting said predetermined sound patterns from a group consisting of words, sounds of constant pitch, sounds of varying pitch, sounds of constant loudness, sounds of varying loudness and any combination thereof.



Prior Art

Fig. 1

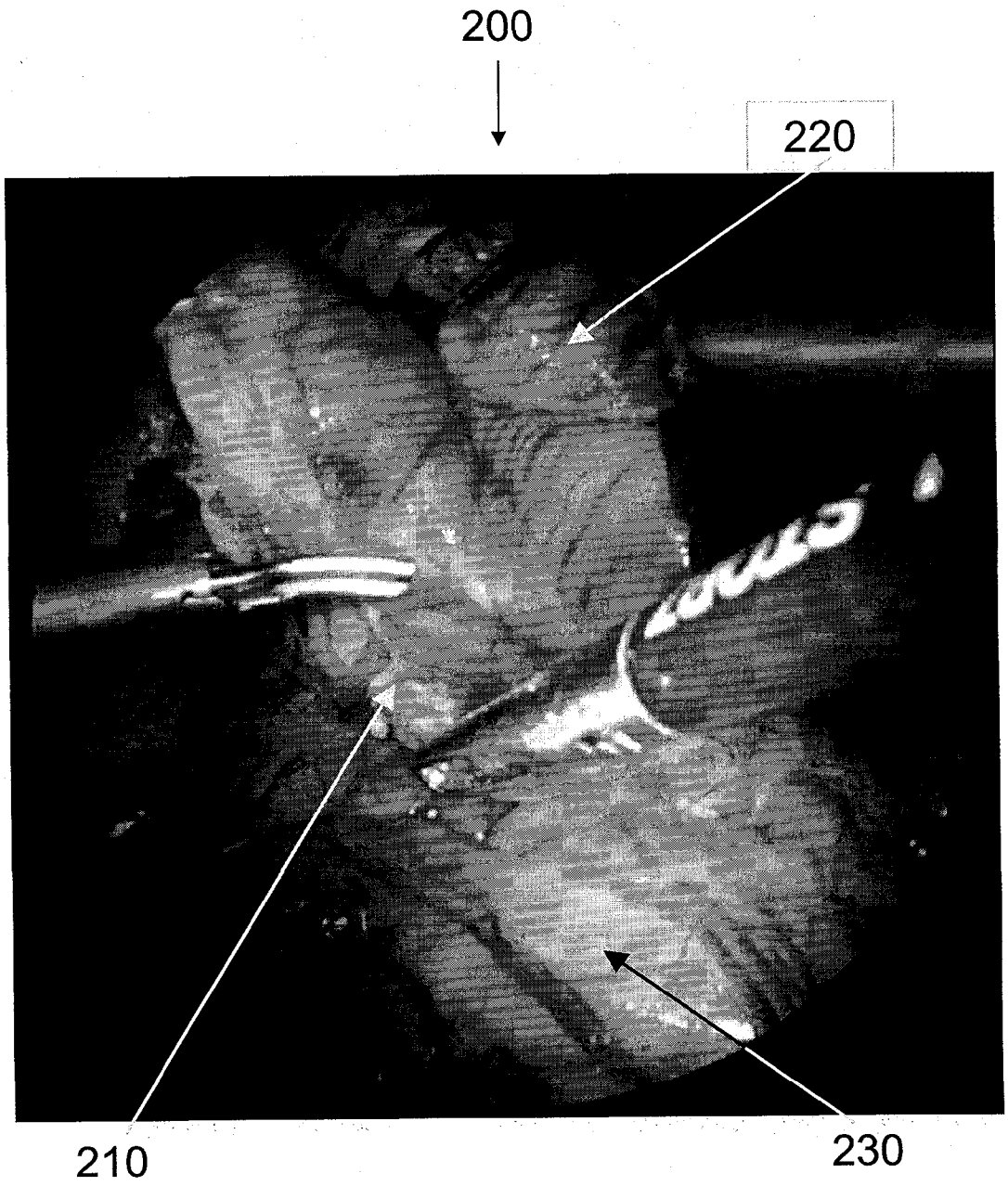


Fig. 2

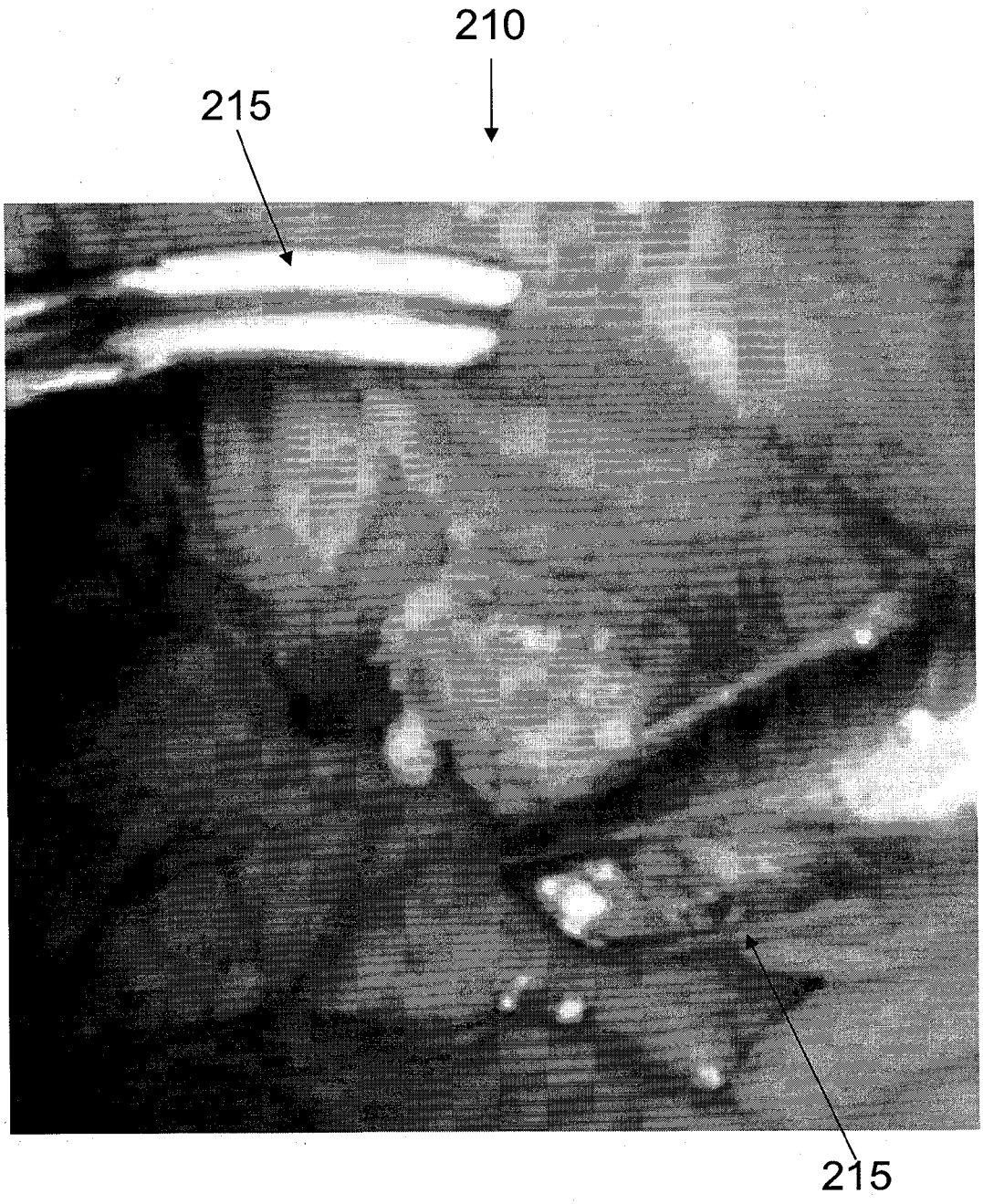


Fig. 3

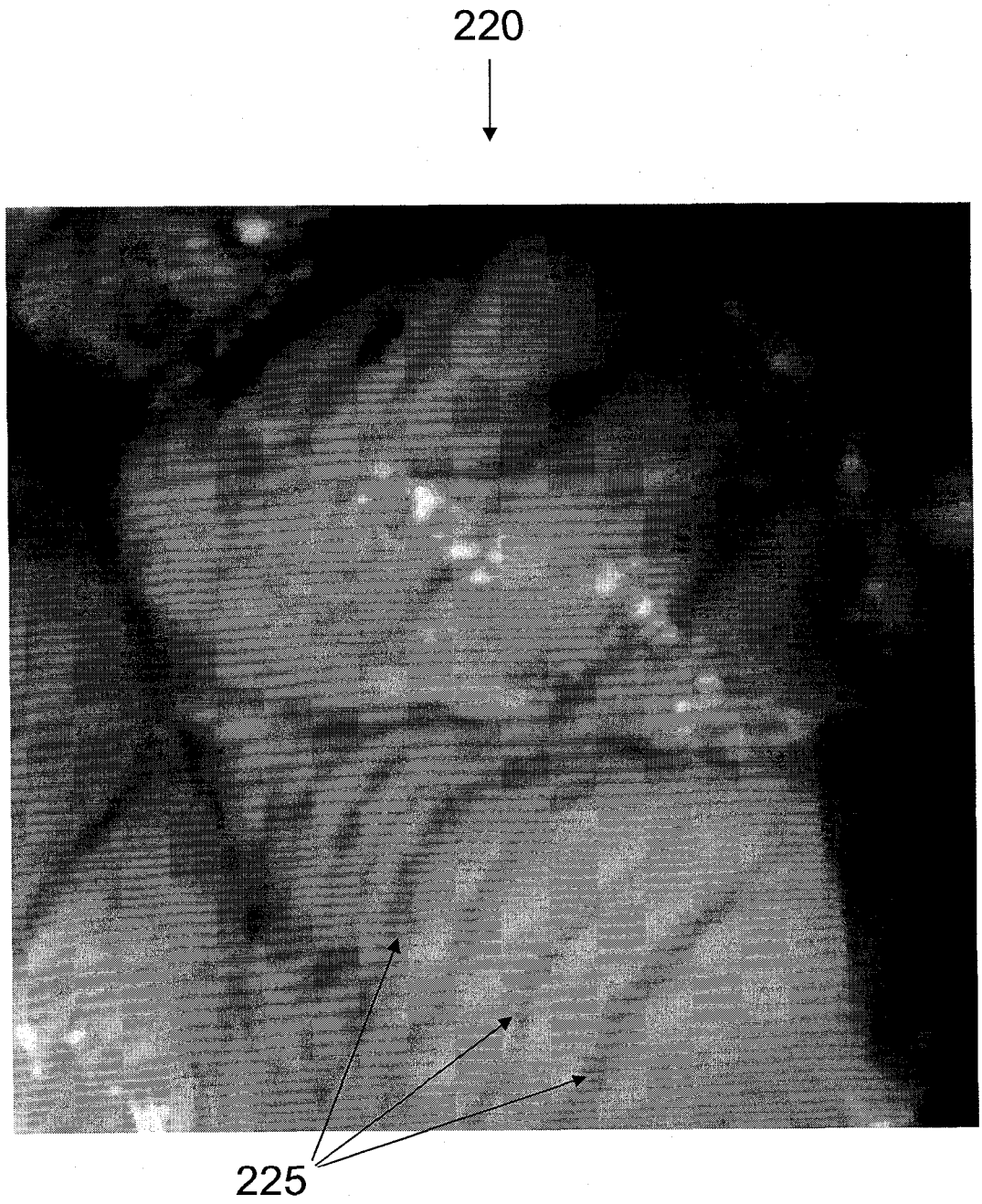


Fig. 4

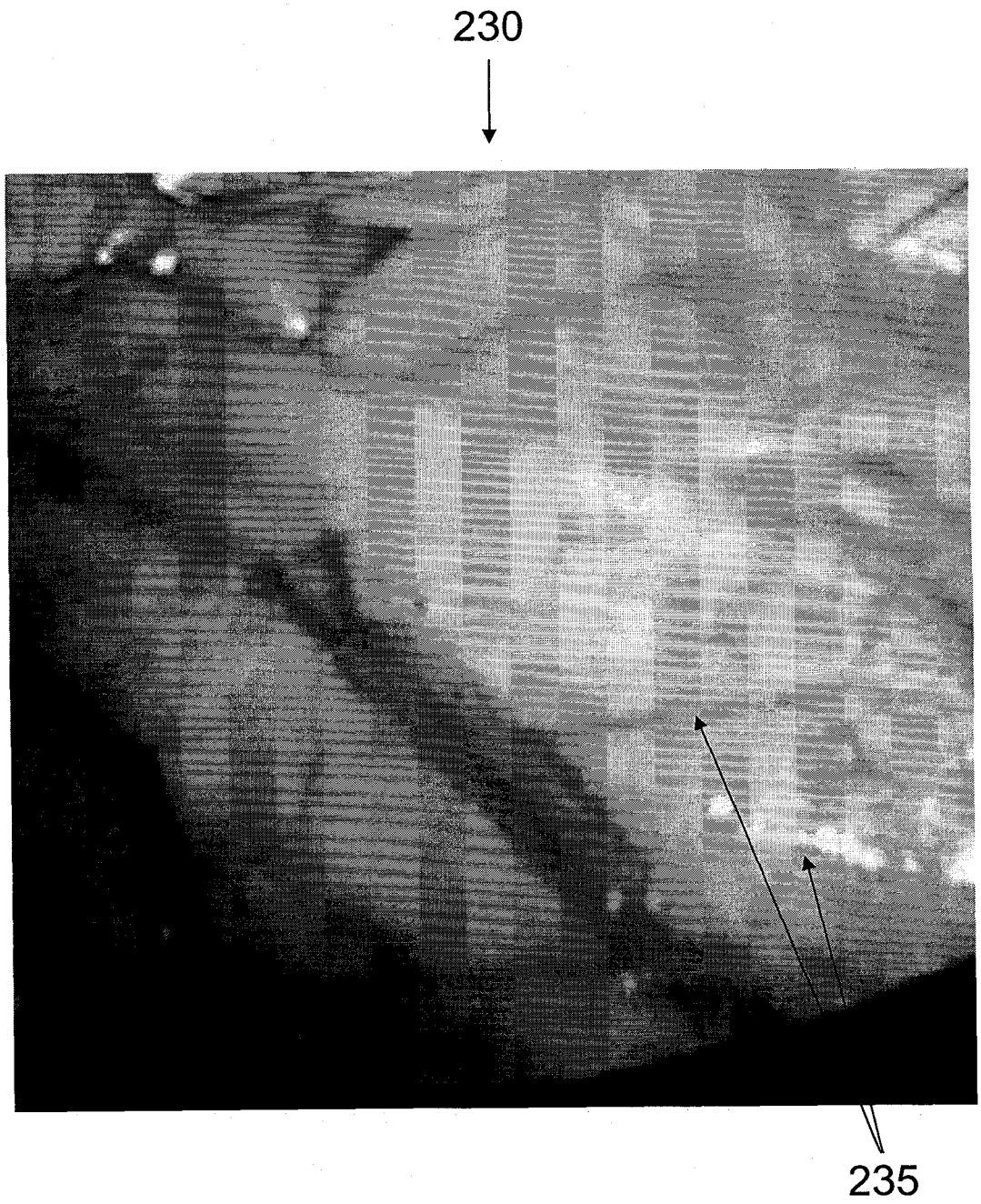


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IL15/50345

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61B 1/04; G02B 23/24 (2015.01)
CPC - A61B 1/04; H04N 5/2259
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)
IPC(8): A61B 1/04; G02B 23/24 (2015.01)
CPC: A61B 1/04; H04N 5/2259; USPC: 348/39, 65, E5.03

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)
PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data); Google; Google Scholar; EBSCO; PubMed/Medline; Search terms used: endoscope, "wide angle lens", camera, processor, computer, zoom, gesture, joystick, "touch screen"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US 5313306 A (KUBAN, DP et al.) May 17, 1994; abstract; figures 2, 3, 6; column 1, lines 13-18, 21-27; column 2, lines 3-9, 19-23, 55-57, 60-67; column 3, lines 1-11, 23-24; column 4, lines 65-66; column 5, lines 13-15, 19-21, 23-25, 31-34, 38-40; column 9, lines 1-7, 9-12, 29-41, 45-51, 57-64; column 10, lines 10-16; claims 1, 2, 4, 5	1, 5-10, 14-17, 22, 26-31, 35-38 ---------- 2-4, 11-13, 18-21, 23-25, 32-34, 39-42
Y	US 6192267 B1 (SCHERNINSKI, F et al.) February 20, 2001; figure 1; column 6, lines 4-5	2, 23
Y	US 7833152 B2 (CHATENEVER, D et al.) November 16, 2010; figure 8; column 10, lines 49-55	3, 4, 24, 25
Y	WO 2013/027200 A2 (M.S.T. MEDICAL SURGERY TECHNOLOGIES LTD.) February 28, 2013; page 17, 3rd paragraph; page 79, 5th paragraph; page 81, 6th paragraph; figure 1	11-13, 32-34
Y	US 2014/0066703 A1 (VANTAGE SURGICAL SYSTEMS INC.) March 6, 2014; paragraph [0052]	18, 39
Y	AU 2013/202775 A1 (ULTRADENT PRODUCTS, INC.) December 19, 2013; page 6, lines 15-16; claims 38, 40	19, 40
Y	WO 1996/009587 A1 (COMPUTER MOTION INC.) March 28, 1996; page 3, 1st paragraph	20, 21, 41, 42

☐ 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
30 June 2015 (30.06.2015)	02 SEP 2015
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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