A medical scope and method providing increased ease of use that includes a power-assisted steering mechanism, single-finger controls, and a detachable controller that can be placed distally, near an auxiliary working channel port for increased control when the scope is not fully inserted into a patient.
POWER-ASSISTED MEDICAL SCOPE

RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Application Serial No. 61/960,214 filed September 12, 2013 entitled Endoscope Control System, and to U.S. Provisional Application Serial No. 61/960,438 filed September 18, 2013 entitled Endoscope Control System, both of which are hereby incorporated herein by reference in their entireties.

FIELD OF THE INVENTION

[0002] The present invention pertains to an endoscope having power-assisted steering controls allowing greater ease of use.

BACKGROUND OF THE INVENTION

[0003] For many years, various versions of endoscopes all rely on a very similar manual navigation approach. Almost universally, the scope is advanced with the physician’s right hand, while his left hand holds the very proximal end of the device and manipulates any steering mechanism and actuates ancillary functions such as suction, flush and image capture. The current designs require two hands for manipulation and do not allow a user change the configuration in order to switch hands.

[0004] Though there have been developmental attempts at making scope manipulation more automatic, these efforts are all incorporated within the advent of robotic systems over the past decade. Unfortunately, to date these systems are very complex, and though technically advanced, there is robust debate over whether they offer procedural improvement given their complexity and cost.

OBJECTS AND SUMMARY OF THE INVENTION

[0005] The invention addresses the aforementioned concerns by providing a scope control system that can be advanced and controlled using a single hand.
One aspect of the invention is a scope system that incorporates servo-motors to facilitate single-handed operation.

Another aspect of the invention provides a scope system that may be controlled by a right hand or a left hand without requiring reconfiguration.

Another aspect of the invention incorporates steering controls that will not fatigue the user's hand.

Another aspect of the invention provides a scope system that provides physically easier steering while still providing direct manual control and feedback.

Another aspect of the invention provides a power-assisted steering scope system that is cost-effective.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects, features and advantages of which embodiments of the invention are capable of will be apparent and elucidated from the following description of embodiments of the present invention, reference being made to the accompanying drawings, in which

Figure 1 is a plan view of an embodiment of a scope of the invention;

Figure 2 is a perspective view of a controller of the invention being inserted into an optional sleeve of the invention;

Figure 3 is a plan view of a controller inserted into a sleeve and attached to a scope body of the invention;

Figure 4 is a perspective view of an embodiment of a controller of the invention;

Figure 5 is a plan view of an embodiment of a scope of the invention;

Figure 6 is a perspective view of an embodiment of a scope body of the invention;
[0018] Figure 7 is a perspective view of an embodiment of a scope body of the invention;

[0019] Figure 8a is an elevation of a controller of the invention attached to a scope body;

[0020] Figure 8b is a front view of the controller of Figure 8a;

[0021] Figure 9 is an elevation of a closeable auxiliary port of the invention;

[0022] Figure 10 is a plan view of the closeable auxiliary port of Figure 9;

[0023] Figure 11 is a plan view of a closeable auxiliary port of the invention;

[0024] Figure 12 is a cutaway view of an embodiment of an actuator of the invention; and,

[0025] Figure 13 is a cutaway view of an embodiment of an actuator of the invention.

DESCRIPTION OF EMBODIMENTS

[0026] Specific embodiments of the invention will now be described with reference to the accompanying drawings. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. The terminology used in the detailed description of the embodiments illustrated in the accompanying drawings is not intended to be limiting of the invention. In the drawings, like numbers refer to like elements.

[0027] Figure 1 shows one embodiment of a scope 100 of the invention. The scope 100 generally includes a scope body 102, scope head 101, interface conduit 103, and tool access port, 104. Attached to the scope head 101 is a servo control box 105. The servo control box 105 may include a stand 106, useable to hold the scope 100 in a desired orientation when not being held by an operator. For example, the stand 106 may be stationed on the floor or attached to the patient bed. Positioning and mounting is dependent on the size of the scope 100, and facilitating easy access to the tool port 104.
Within the servo control box, 105, actuators are connected to the steering control wires within the scope, 100, via the interface, 107. In one preferred embodiment, these actuators are DC stepper motors, which enable absolute positioning when properly calibrated. The details of the control box 105 is described in more detail below, making reference to Figures 12 and 13.

Figure 2 depicts an embodiment of a control device 200 of the invention. The control device is used to operate the actuators described above. The control device generally includes a head 201 and tail 204. The head 201 houses includes user input controls, such as, by way of non-limiting example, a switch 202 that directs the steering actuators described above. An x-y switch is depicted but switch 202 may also be a roller ball, touch pad, membrane switch, joystick, or other control. The head 201 may include other input controls as well. Non-limiting examples of other functions include irrigation, suction, and imaging, to name a few. These controls are depicted by buttons 203. Manipulation of the user input controls causes a signal to be sent to the servo control box, preferably wirelessly but alternatively physically. The control device 200 is preferably sealed to allow use of cold sterilants currently used for endoscopic devices.

The control device tail 204 acts as a handle. Optionally, as shown in Figure 2, a wipe 205 is provided with a sleeve or pocket 206 sized to accommodate the tail 204. Wipe 205 may be simple cotton gauze and is preferably disposable, or may be made of cloth and be washable. It is common to use disposable gauze to hold a slippery scope for control purposes and wipe 205 allows the user to handle the scope in a manner s/he is accustomed to, while simplifying the steering aspect of scope use.

Figure 3 shows a typical configuration for the utilization of the control device 200, with the tail 204 inserted into the pocket 206 of the wipe 205. In this depiction, the wipe is wrapped around at least a portion of the scope. In this manner, the wipe 205 is used in a typical fashion to aid manual control of the scope forward and backward, while keeping all other functional controls within easy access.

Figure 4 depicts an example of a control device 200 having true-position sliding switches 206 rather than an x-y switch. Additionally provided is a contoured base 207 shaped to ride on the scope body 102. The contoured base 207 may also
include a non-slip coating 208 that increases friction between the control device 200 and the scope body 102 to make manipulations easier. The coating 208 may obviate the need for the gauze wipe 205.

[0033] Figure 5 illustrates an embodiment of a scope 120 in which a control box 300 is integrated into the scope head rather than attached to it. In this configuration, all functional capabilities of the scope can be activated from the control device 200 (Figure 2). The scope head/control box 300 includes all servos, electric valves and mechanical actuators (not shown). Like scope 100 of Figure 1, scope 120 includes a scope body 102, an optional stand 106, and an interface conduit 103 that interconnects to all supply elements utilized by the scope, e.g. water, vacuum, imaging.

[0034] One aspect of the invention, shown in Figure 6, is a scope body 102 featuring a plurality of access ports 108 along a section thereof. Access ports 108 lead to a tool lumen 111, best shown in Figure 7. The access ports 108 may be instead of, or in addition to, tool access port 104 of the scope. Access ports 108 provide alternative, more distal entrances to the tool lumen 111, thus increasing tool controllability when the scope body is partially withdrawn from the patient. Increase tool controllability is achieved due to the shortened effective length of the tool lumen 111 when using the more distal access ports 108. As shown in Figure 7, access ports 108 may alternatively take the form of an access slot 109.

[0035] Turning now to Figures 8a and b, it is envisioned that the control device 200 may include a feature 307 that allows the device 200 to be attached to the scope body 102. The feature 307 includes an internal lumen that communicates with tool lumen 111, when the feature 307 is attached to an access port 108 or slot 109. Feature 307 thus allows a physician a more distal control station for operating the control device and any tools s/he may be using in the event that the scope is partially withdrawn from the patient.

[0036] Also shown in Figures 8a-b is that the access ports 108 may be optionally angled toward the distal end of the scope body 102. This design allows simplification of the scope configuration, allowing for a single, straight segment as depicted in Figures 5 and 6. The cumbersome right angle of heavy cabling is no longer needed as all the
servo controls described earlier can be incorporated into the primary control box currently used with all scopes.

[0037] One aspect of the invention also shown in Figures 8-b is that more than one tool lumen 111 may be provided. Multiple tool lumens may allow the passage of multiple devices. Another reason would be to ensure the easiest access for insertion of a tool, such as a biopsy tool, by keeping at least some of the access ports, 108, in the event that the scope is twisted during the procedure.

[0038] Turning now to Figures 9-11 there are shown mechanisms for sealing or closing access ports 108 when they are not in use to prevent contaminating lumen(s) 111. Figures 9 and 10 show a sliding internal tube 112 that resides within lumen 111 and is slidable via thumb slide 113 from a first position to a second position. The tube 112 has a hole 115 formed therein that aligns with the port 108 when the tube 112 is in the first position, shown in Figure 9-10. When the thumb slide 113 is moved to the second position, defined by the extents of groove 114 in which the slide 113 is contained, the hole 115 is taken out of alignment with the port 108, thereby blocking communication between the port 108 and the tool lumen 111. The groove 114 may have a rubber or polymer insert that deforms itself around slide 113 to provide additional sealing.

[0039] Figure 11 shows an alternative mechanism, comprising a permanent, semi-permeable plug 116. The plug 116 is penetrable by a tool but reseals when the tool is removed. When sealed, the plug 116 is able to withstand a predictable amount of suction through the lumen 111 without allowing ambient air from being drawn into the lumen 111 through the port 108.

[0040] Figures 1 and 5 discussed servo control boxes 105 and 300, respectively. Servo control box 105 of Figure 1 interacts with the scope head 101 via an interface 107, while servo control box 300 is integrated into the scope head. Referring now to Figures 12 and 13, more detail about the servo control boxes and interface 107 will now be discussed.

[0041] Figure 12 depicts a control box 105 connected to a scope 100 via an interface 107. The interface 107 includes a first connector 400 attached to the control box 105,
and a second connector 402 attached to the scope head 101 of the scope 100. The first and second connectors 400 and 402 are constructed and arranged for easy alignment and mating. When mated, the connectors 400 and 402 align in order to bring internal components in working relationship with each other.

[0042] For example, with regard to the internal components shown in Figure 12, the first connector 400 surrounds a drive shaft 404 that extends into the control box 105 and is operably connected to a servo motor. The drive shaft 404 is slidable axially such that connection may be easily made with a corresponding secondary shaft 406 contained in the second connector 402. Interacting ends of the drive shaft 404 and secondary shaft 406 are fitted with locking components 408 and 410. Springs 412 and 414 act on the shafts 404 and 406 in order to maintain the components 408 and 410 in tight contact with each other. The constant tension effected by the components 408 and 410 and the springs 412 and 414 reduces system hysteresis.

[0043] An alternative interface 507 is shown in Figure 13. Like that of Figure 12, interface 507 includes a first connector 500 attached to the control box 105 and a second connector 502 attached to the scope head 101 of scope 100. The first and second connectors 500 and 502 are constructed and arranged for easy alignment and mating. When mated, the connectors 500 and 502 align in order to bring internal components in working relationship with each other.

[0044] For example, with regard to the internal components shown in Figure 13, the first connector 500 surrounds a first gear 504, which is driven by servo motor 506 via a belt 508. One skilled in the art will realize belt 508 may be substituted for a chain, worm drive, or other acceptable drive mechanism. Second connector 502 contains a secondary gear 510 that meshes with first gear 504 when the first connector 500 is mated with the second connector 502. The secondary gear 510 is operably attached to a control wire 512 or similar control mechanism used for controlling scope 100.

[0045] In a similar fashion is the connection between the control box and scope elements for the additional functions, such as, but not limited to, imaging, water, and suction. These functions maybe incorporated into the same connector as the power
transmission, or may be housed in a separate connector, creating a split-tail at the proximal end of the scope.

[0046] The scope, 101, has a distal, working end, 102. This is the end to be handled by the user and inserted into the patient. There is also a proximal end, 103, which serve as a service length connecting the working end to the control box, 104, via a connector, 105, or connectors.

[0047] Between the proximal and distal ends of the scope is a section, 106, which enables some rotation of the scope. Within section 106, there is a break in the continuity of the length of the torsionally-rigid scope jacket. In this section, features allow for partial rotation. This partial rotation must be at least 90 degrees in both directions, and could be as much as 160 degrees in either direction or more. A feature limiting rotation provides tactile feedback to the user that full rotation has been reached. A tough, flexible jacket covers section 106 and is hermetically attached to proximal and distal portions of the scope.

[0048] A typical diameter for an endoscope is 0.50 inches. As an example, presuming that functional elements running through the length of the scope run at halfway between the OD and center of the scope body, a feature such as an imaging conduit or actuation cable can be assumed to rotate about a 0.125 inch radius. Again, assuming a maximum rotation of + 160 degrees over a length of 12.0 inches, the strain induced on any element is approximately 0.04%, far lower than any hysteresis that may be fabricated into a device like an endoscope.

[0049] Although the invention has been described in terms of particular embodiments and applications, one of ordinary skill in the art, in light of this teaching, can generate additional embodiments and modifications without departing from the spirit of or exceeding the scope of the claimed invention. Accordingly, it is to be understood that the drawings and descriptions herein are proffered by way of example to facilitate comprehension of the invention and should not be construed to limit the scope thereof.
What is claimed is:

1. A power-assisted medical scope comprising:
   a steerable scope having a scope body and a hand-held scope head attached to a proximal end of the scope body;
   a powered actuator at a proximal end of the scope and operably associated with a steering device useable to bend a distal end of the scope body;
   a control device having at least one user input control, operable with a single finger, and useable to control the powered actuator;
   wherein the control device is attachable to a proximal end of the scope.

2. The power-assisted medical scope of claim 1 wherein the control device is attachable to the scope head.

3. The power-assisted medical scope of claim 2 wherein the control device is removably attached to the scope head.

4. The power-assisted medical scope of claim 1 wherein the control device is attachable to the scope body.

5. The power-assisted medical scope of claim 4 wherein the control device is removably attached to the scope body.

6. The power-assisted medical scope of claim 1 further comprising a working channel having a proximal port.

7. The power-assisted medical scope of claim 6 further comprising at least one auxiliary port leading to the working channel located on the scope body.

8. The power-assisted medical scope of claim 7 wherein the at least one auxiliary port comprises a slot.
9. The power-assisted medical scope of claim 7 wherein the at least one auxiliary port comprises a plurality of ports.

10. A power-assisted medical scope comprising:
    a steerable scope having a scope body and a hand-held scope head attached to a proximal end of the scope body;
    a powered actuator at a proximal end of the scope and operably associated with a steering device useable to bend a distal end of the scope body;
    a working channel extending through the scope body;
    at least one port leading to the working channel and located on the scope body.

11. The power-assisted medical scope of claim 10 wherein the at least one port comprises a slot.

12. The power-assisted medical scope of claim 10 wherein the at least one port comprises a plurality of ports.

13. The power-assisted medical scope of claim 10 further comprising a powered actuator at a proximal end of the scope and operably associated with a steering device useable to bend a distal end of the scope body.

14. The power-assisted medical scope of claim 13 further comprising a control device having at least one user input control, operable with a single finger, and useable to control the powered actuator.

15. The power-assisted medical scope of claim 14 wherein the control device is attachable to a proximal end of the scope.

16. The power-assisted scope of claim 15 wherein the control device is removably attachable to the scope head.

17. The power-assisted medical scope of claim 15 wherein the control device is removably attached to the scope body.
18. A method of improving the operability of a steerable medical scope comprising:
   associating a powered actuator with a steering device useable to bend a distal end of the scope;
   providing a control device attachable to a proximal end of the scope and operable with a thumb, wherein the control device includes controls that operate the powered actuator.

19. The method of claim 18 further comprising providing at least one auxiliary port along a length of a body of the scope spaced distally from a scope head of the scope leading to a working channel of the scope.

20. The method of claim 19 further comprising providing an attachment mechanism on the control device allowing the control device to be removed from the proximal end of the scope and attached proximate the auxiliary port.
INTERNATIONAL SEARCH REPORT

INTERNATIONAL APPLICATION

PCT/US2014/051552

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A61B 1/00 (2014.01)
CPC - A61B 1/018 (2014.09)

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 1/00, 1/12, 8/00 (2014.01)
CPC - 600/104, 123, 137, 145, 156, 446

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - A61B 1/018, 1/12 (2014.01) (keyword delimited)

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

Orbit, Google Patents, ProQuest
Search terms used: endoscope, steering, actuators, control, handheld, ports

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category* Citation of document, with indication, where appropriate, of the relevant passages Relevant to claim No.

Y US 4,207,873 A (KRUY) 17 June 1980 (17.06.1980) entire document 1-17, 19-20

Further documents are listed in the continuation of Box C.

* Special categories of cited documents:

A' document defining the general state of the art which is not considered to be of particular relevance
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Date of the actual completion of the international search
25 October 2014

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