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Enclosed application parts are: ☒ Specification w/o Claims Number of Pages 5
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TITLE OF INVENTION:

VOICE CONTROL OF MEDICAL INSTRUMENTS AND DEVICES

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☒ No ☐ Yes

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Respectfully submitted,

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September 3, 2002

PROVISIONAL APPLICATION FOR PATENT ONLY

Title: Voice Control of Medical Instruments and Devices

Date: 9/1/02

Inventor: Mohammed N. Islam

Background

Many medical procedures use instruments that require a high level of mechanical or manual dexterity of medical professionals (MF). Due to the high level of dexterity and strain on the MF, the MF can become fatigued. Also, the high level of dexterity requires years of training and practice. Moreover, the fatigue may lead to unnecessary errors in the procedure.

As a particular example, consider the diagnostic instrument used in gastroenterology and intestinal (GI) track investigations. This instrument can be a tube that is inserted down the throat of the patient, as an example. The tube includes a visual means, such as a fiber-optic cable with a lens system at the end that sends images to a camera. The tube also has means of guiding the tube through the patient, and possibly means of collecting samples for investigation. The MF looks on a monitor and manipulates the instrument manually. One hand of the MF is used to hold the tube and guide it. The other hand is used to manipulate the manual controls. The controls can include things for the camera. For example, commands can include change or rotate view, take a snapshot, zoom in or zoom out. The controls also allow for guiding the tube. For example, commands can be to go further, bend to the right, bend to the left, etc. Also, a probe can be used to collect a sample of tissue, if desired.

All of this motion require the GI-track MF to use both hands and to stand next to the patient, sometimes in an awkward position through the entire procedure. This creates fatigue in the MF, thereby limiting the number of procedures that can be done in a day. Also, because of the dexterity required, it takes several years of training and practice to be able to conduct GI-track procedures without supervision.

Summary of the Invention

To reduce the dexterity of the MF and reduce the strain on the MF, a voice activated control or command is envisioned for medical instruments or devices. The MF speaks into a microphone, which is connected to a computer or signal processing device. The voice commands are processed by a voice recognition software, which then sends electrical commands to a motorize, robotic head on the medical instrument. The software can be trained to the MF's voice, and the commands can be customized to the MF's preferences. The robotic head has motors with the resolution typical of the manual instrument, and the head may also have manual override controls. The overall system now has the MF and medical instrument with a processor or computer in between. This intermediate stage can be used for collection and recording of data or queries before mistakes are made, as an example.

Detailed Description of the Invention

The medical instrument or device will be equipped with voice activated control. The three main parts of the hardware will be the command receiving device on the MF, the computer or processor for analyzing the commands, and the motorized or robotic head for the medical instrument. As an example, the MF has a microphone selectively placed on him to make for ease of use of the MF while minimizing the background noise. For instance, the microphone may be placed off a headset, and a directional microphone might be used to reject background noise from other directions. The microphone may have a wired or wireless connection to the computer or processor.

The computer or processor takes the microphone input and may digitize it so that it may be sent to a voice recognition software. Several commercially available voice recognition software exist, such as ViaVoice or Dragon Speech Recognition software. However, the current problem is simpler than generic speech recognition. For example, only a selected group of words can be used, since a limited command set is necessary. The MF may train the software so that it may better recognize the MF's voice. Also, the background noise can be calibrated out at the onset.

Some functions will be simpler digital operations while others can be more complicated analog operations. As a simple example, taking the camera snapshot can be a simple digital operation. On the other hand, zooming can be an analog operation. You can zoom in or zoom out (different sign), and then there can be different degrees of zoom (i.e., different magnification factors). The selection of commands should be as natural as possible for the MF. Also, the MF should be able to customize the command vocabulary, if desired.

The medical instrument or device should have a robotic or motorized head that can operate based on the computer or processor driven signals. The connection from the computer or processor to the motorized head can be wired or wireless. The motorized head's resolution (i.e., step size or angle rotation step size) should substantially replicate the accuracy of the MF and may depend on particular operations. To match the performance of the current manual instruments, the number of degrees of freedom of the voice activated instruments or devices should match the number of controls currently available on manual instruments.

Sensors can also be placed on the medical instrument for special alarms that the MF want to be alerted of. For example, there may be a special sensor for blood if the MF wants to be alerted to unexpected bleeding.

Data from the medical instrument head should be uploaded to the computer for processing through either a wired or wireless link.

It may also be desirable to allow for manual controls on the instrument head for the MF. For example, if a difficult procedure arises, the MF may want to use manual override to take over the procedure.

It is also desirable that the weight and size of the medical head not be substantially larger or heavier than used in current manually controlled devices. Otherwise, the inconvenience of the use may prevent MF from using the voice-controlled device.

Such a voice activated instrument can have the added benefit of allowing for remote procedures by a MF. For example, a medical technician or assistant can insert the instrument or device into the patient, and the data can be transmitted to a remote MF. While watching the monitor or looking at the incoming data, the MF can operate the medical instrument or device remotely with or without voice commands. Moreover, it may be desirable for the MF to have a "joy-stick" to emulate the manual override functions. The commands from the joy-stick can be transmitted to the robotic or motorized head, just as in the manual control device.

With the intervention of the computer or processor between the medical instrument or device and the MF, many new possibilities arise. For example, the computer may monitor the operations and give warnings when accidents or unusual moves are anticipated. The computer control may also be use to automate some of the simpler functions, such as directing the head or going until a stop or blockage is encountered.

Finally, with the introduction of the computer between the MF and the medical instrument or device, new technologies can be exploited either at the MF's end, the device end or the computer processors themselves. Just as one example, consider some of the technologies that are being developed for the military commands that can be applicable here. Beyond just voice commands, new means of communicating with the instruments are being devised by the military. One example is a head-up display, where the images are displayed directly at the eyes of the operator rather than on a separate screen. This could either be a display near the operator's eyes or projection on the eyeballs of the operator. Another example is where the operator wears a helmet, and based on the motion of his head (which is sensed or detected), the instrument command is received. For example, rotation of the head to the right may mean that the operator wants the instrument to move to the right. However, it would be necessary in this case to make sure that inadvertent rotations of the head are not mistaken for commands. As technologies likes these are developed and made lower cost, they can possibly be adapted to the control or command of the medical instruments or devices.

Therefore, some of the benefits of the proposed medical instrument or device include:

1. MF can have at least one hand freed up, thereby reducing the fatigue and allowing for more procedures to be performed.
2. MF can monitor and control from a remote location. This would free up the MF from having to be located with the patient.
3. Data can be easily collected and uploaded to the computer, either through a wired or wireless link.
4. some of the more standard functions could be automated based on feedback from some of the sensors. This is possible because not a computer or processor has been placed between the MF and the medical instrument or device.

5. The voice commands can be customized to the voice of the MF. The software can be trained to the MF's voice, and the vocabulary of commands can also be customized to the taste of the MF.
6. Digital and analog controls are possible. The digital can be fairly straight forward, such as taking a snapshot. The analog controls can be more complicated. As an example, the analog controls can follow the concept of momentum. Keep going in a certain direction until directed otherwise. For example, when saying "go more, continue, etc.," the motion continues in the same direction.
7. The medical professional should not need as much dexterity of the hand motion. Hence, the level of training and length of training can be considerably reduced.
8. With the computer between the MF and the medical instrument or device, some errors or accidents may be avoided. This kind of operation would require the placement of sensors on the medical instrument. Based on the sensors information, the action of the MF may be checked. For example, the MF may receive a query or message such as, "are you sure that you want to...."

The broadest elements of the invention include:

- Movable medical instrument or device, possibly with sensor or a camera head that can feed images through a fiber-optic connection
- Robotic or motorized head for controlling motion of the instrument. The head is connected to the computer or processor either wired or wireless. The head receives commands from the computer or processor. In addition, the head may send to the computer either sensor data, camera data, and/or other uploaded data.
- A receiving device such as a microphone can be appropriately placed on the medical professional. The type and position of the microphone should be selected to reduce the background noise and offer ease of use and convenience for the MF.
- The receiving device such as the microphone should be connected to a computer or processor. The computer or processor should have installed a voice recognition system to translate the voice commands for the instrument or device head. In the voice recognition system, the MF can train for his voice and can customize for desired commands. Also, rather than having a complete speech recognition system, all that is required is a selected command vocabulary.
- The MF should have a visual or instrument monitor on the basis of which commands will be generated.
- Optionally, the instrument head may have a manual override system or at the console of the MF have a joy-stick for control.
- Optionally, the MF may be at a remote location, with a transmission system between the medical instrument or device and the MF.
- Since the system is no longer MF directly connected to the medical instrument or device, but rather now is computer or processor between the MF and the instrument, new possibilities arise. For example, some of the simpler steps can be automated under computer control, and checks can be made to avoid accidents.

- The intervention of the computer also allows for future upgrades based on developing technology. For example, some of the technology for the military, such as head-up displays and head position control, may later be adapted to the system.