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Portable surgery master station for robotic telesurgery

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Abstract: Technology is revolutionizing the medical field with the creation of robotic devices and complex imaging. Though these developments have made operations much less invasive, robotic systems have their own disadvantages that prevent them from replacing surgeons. Minimally invasive surgery is a broad concept encompassing many common procedures that existed prior to the introduction of robots, such as laparoscopic cholecystectomy or gall bladder excisions. It refers to general procedures that avoid long cuts by entering the body through small (usually about 1cm) entry incisions, through which surgeons use long-handled instruments to operate on tissue within the body. Such operations are guided by viewing equipment (i.e. endoscope) and, therefore, do not necessarily need the use of a robot. However, it is not incorrect to say that computer-assisted and robotic surgeries are categories under minimally invasive surgery.

Keywords: robotic arm system, microcontroller chip, zigbee technology.

1. INTRODUCTION

In the coming decades, we may see robots that have artificial intelligence. Some, like Honda's ASIMO robot, will resemble the human form. They may eventually become self-aware and conscious, and be able to do anything that a human can. When we talk about robots doing the tasks of humans, we often talk about the future, but robotic surgery is already a reality. Doctors around the world are using sophisticated robots to perform surgical procedures on patients.

Not all surgical robots are equal. There are three different kinds of robotic surgery systems: supervisory-controlled systems, TELE-SURGICAL systems and shared-control systems.

The main difference between each system is how involved a human surgeon must be when performing a surgical procedure. On one end of the spectrum, robots perform surgical techniques without the direct intervention of a surgeon. On the other end, doctors perform surgery with the assistance of a robot, but the doctor is doing most of the work.

While robotic surgery systems are still relatively uncommon, several hospitals around the world have bought robotic surgical systems. These systems have the potential to improve the safety and effectiveness of surgeries. But the systems also have some drawbacks. It's still a relatively young science and it's very expensive. Some hospitals may be holding back on adopting the technology.

2. ROBOTIC ARM SYSTEM

It consists of two primary components:

- A viewing and control console
- A surgical arm unit that includes two or three arms, depending on the model

In using da Vinci for surgery, a human surgeon makes three or four incisions (depending on the number of arms the model has) -- no larger than the diameter of a pencil -- in the patient's abdomen, which allows the surgeons to insert three or four stainless-steel rods.
The robotic arms hold the rods in place. One of the rods has two endoscopic cameras inside it that provide a stereoscopic image, while the other rods have surgical instruments that are able to dissect and suture the tissue. Unlike in conventional surgery, the doctor does not touch these surgical instruments directly.

Sitting at the control console a few feet from the operating table, the surgeon looks into a viewfinder to examine the 3-D images being sent by the camera inside the patient. The images show the surgical site and the two or three surgical instruments mounted on the tips of the surgical rods. The surgeon uses joystick-like controls located underneath the screen to manipulate the surgical instruments. Each time the surgeon moves one of the joysticks, a computer sends an electronic signal to one of the instruments, which moves in sync with the movements of the surgeon's hands. Working together, surgeon and robot can perform complete surgical procedures without the need for large incisions. Once the surgery is complete, the surgeons remove the rods from the patient's body and close the incisions.

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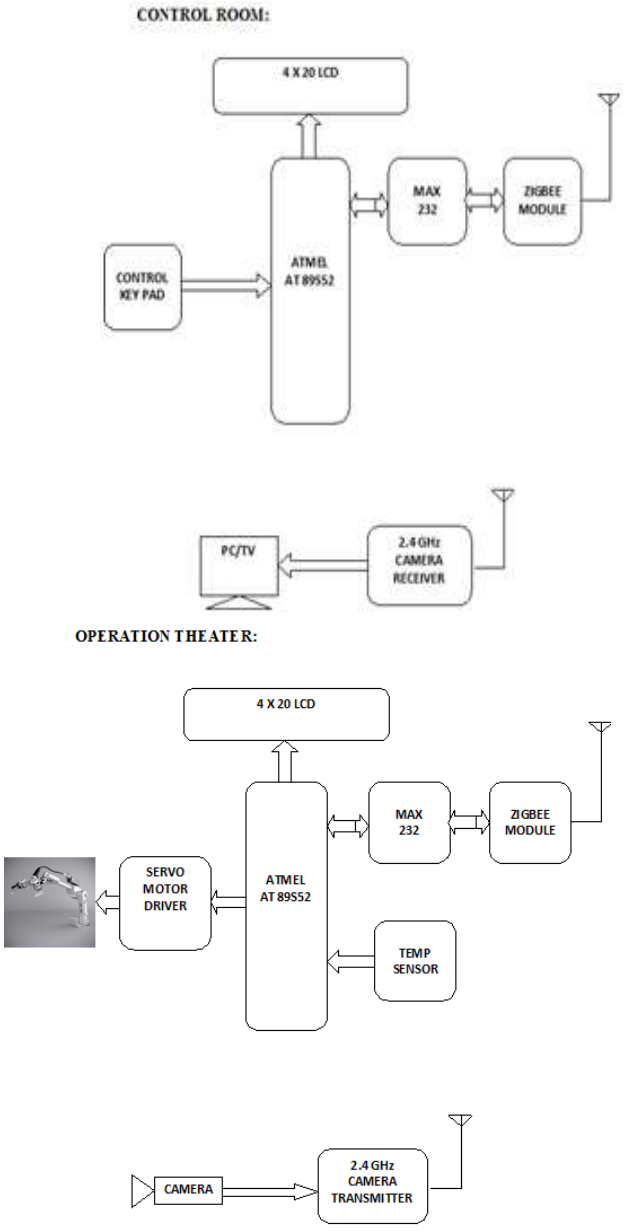
3. BLOCK DIAGRAM OF THE SYSTEM



This system is a remote controlled Robotic arm system for surgery. The remote control media used is the regular Zigbee RF module. The system installed at the operation theater along with wireless camera, and receiver is placed at control room.

The module provides bi-directional half-duplex communication through Zigbee module. Half Duplex communication means it can either transmit or receive data at a time but not both at same time. When user press controller switch for particular arm movement, microcontroller will generates CODE and transmits serially through MAX 232 serial port driver IC, which converts microcontroller TTL to RS232 voltage level of the Zigbee. It transmits the data serially at the frequency of 2.4 GHz & range about 30Mtrs.

In receiver side, output of Zigbee is connected microcontroller through MAX232 serial port driver; microcontroller will compares the data which is stored in ROM memory. If data matched, it will send the PWM signal to servo motor, which is connected to robotic arm. LCD is used for displaying patient temperature. Here LM35 temperature Sensor used. The output of LM35 is 10mv is equals to1 degree Celsius, if the temperature rises above set point, microcontroller will send a signal to control room for alerting.

The system uses 3 terminal voltage regulators, which provide the required +5V.Power is derived initially from standard 12V AC/DC adapter or 12V_500ma Transformer. This is fed to bridge rectifier, the output of which is then filtered using 1000µf electrolytic capacitor and fed to voltage regulator. +5V output powers the microcontroller and other logic circuitry.

4. APPLICATIONS

- Training and Education.
- Surgical Planning.
- Image Guidance.
- Tele-surgery.

5. CONCLUSION

About 98% efficiency of system response is designed prototype. Because of the ZigBee technology used, low data rate (<250kbps) applications are implemented for long distances (Up to 1 km). By taking corrective actions on robotic arm error will be reduced to zero. This work can be further improved by providing features like acceleration, braking (speed control) and steering (direction control). The robot can provided with an optical eye to detect any barrier in its way. This information can be fed back to the user who can accordingly control the robot.

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