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Telesurgical Bionic Arm

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ABSTRACT- *Relocation of patients from rural healthcare to multi-speciality hospitals during medical emergencies has increased the mortality rate to 17% in INDIA alone and medical errors due to inexperience on the particular case and false diagnosis has cost 250,000 lives last year in INDIA and 440,000 in USA and is expected to increase as high as 760,000. Surgical robots such as Da Vinci, Zeus and the Cardio-arm are able to perform various complex surgeries with ease, minimum invasion and high accuracy because of their precise controlled mechanism and technology. But these robots are extremely costly because of their sophisticated software and circuitries. This makes it unaffordable for various doctors and simple surgeries. This project deals with the design and development of a master-slave bionic hand with real time control that mimics the motion performed by the master, which is precise and cost-effective and aids surgeries performed in rural areas during trauma.*

Keywords *-Bionics, Healthcare, Real time control, PCA9685 16 channel 12 bit servo PWM driver, ESP8266 Wi-Fi module, Arduino mega*

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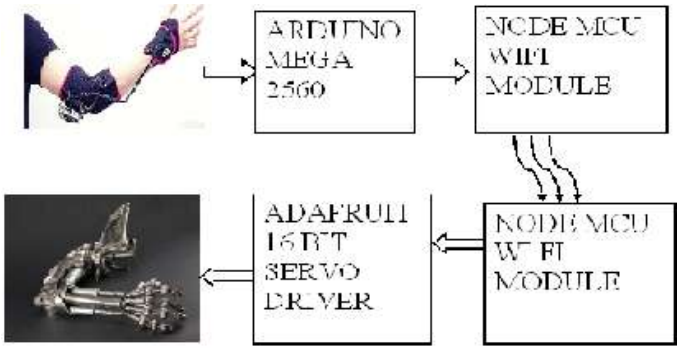
I. INTRODUCTION

Telesurgery is an emerging surgical system that utilizes wireless networking and robotic technology to connect surgeons and patients who are distantly located from one another.It also called tele-robotics, combines the advantages of robotic surgery that include magnified view, augmented reality and improved ergonomics and dexterity, and provision of surgical care in remote areas and difficult to reach locations like spacecraft and ships. Cost, availability and legislations to address legal and ethical issues remain to be addressed. Surgical robot systems have been developed from the first functional telesurgery system-ZEUS-to the da Vinci Surgical System, which is currently the only commercially available surgical robotic system. Used mainly for "on-site" surgery, these robots assist the surgeon visually, with better precision and less invasiveness to patients. The Da Vinci Surgical System has also been combined to form a Dual Da Vinci system which allows two surgeons to work together on a patient at the same time. The system gives the surgeons the ability to control different arms, switch command of arms at any point and communicate through headsets during the operation.

Rapid development of technology has allowed remote surgery rooms to become highly specialized. At the Advanced Surgical Technology Centre at Mt. Sinai Hospital in Toronto, Canada, the surgical room responds to the surgeon's voice commands in order to control a variety of equipment at the surgical site, including the lighting in the operating room, the position of the operating table and the surgical tools themselves. With continuing advances in communication technologies, the availability of greater bandwidth and more powerful computers, the ease and cost effectiveness of deploying remote surgery units is likely to increase rapidly.

The possibility of being able to project the knowledge and the physical skill of a surgeon over long distances has many attractions. There is considerable research underway in the subject. The armed forces have an obvious interest since the combination of telepresence, teleoperation, and telerobotics can potentially save the lives of battle casualties by providing them with prompt attention in mobile operating theatres.

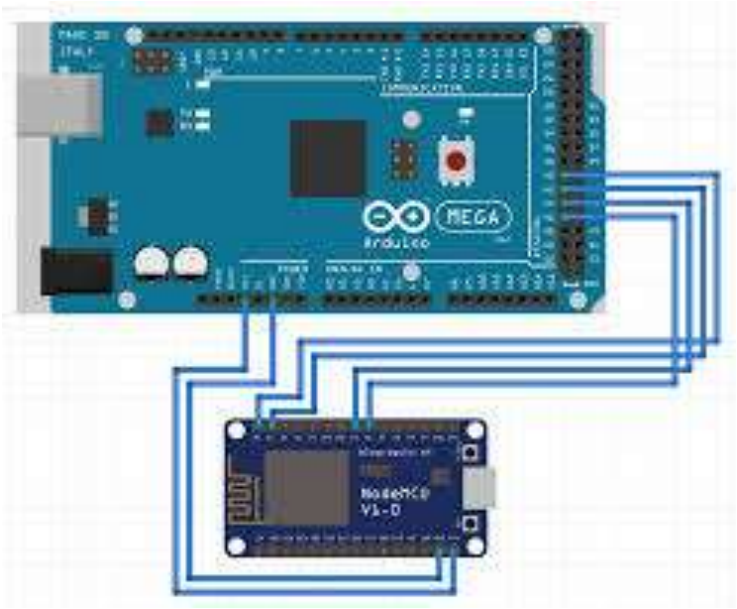
II. BLOCK DIAGRAM



III. METHODOLOGY

A. CONNECTION AT TRANSMITTING PART

- CONNECTION BETWEEN ARDUINO MEGA AND NODE MCU



NodeMCU is great for connecting cloud and arduino is great at talking with different sensors. nodemcu has only one analog pin. Arduino will take analog readings and send the readings to nodemcu over serial connection. Nodemcu will send message for every reading it receives.

Steps to create two-way communication between two ESP8266 modules using Arduino IDE

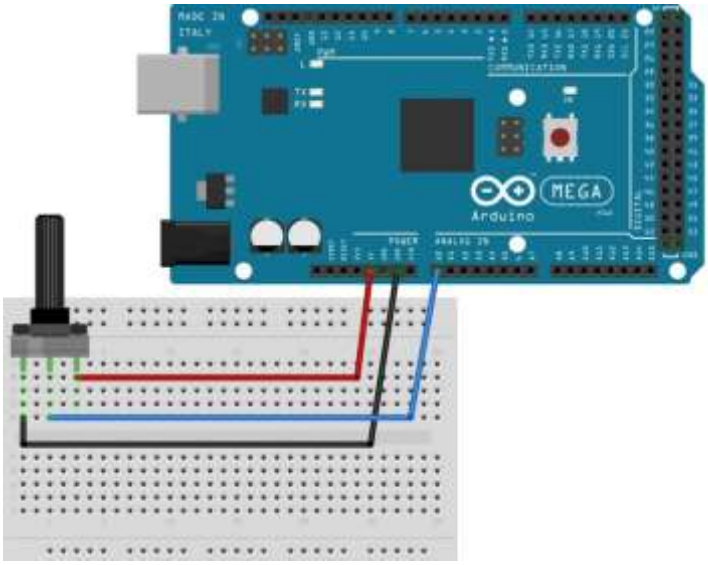
We will begin with Installing the ESP8266 support for the Arduino.

Making an ESP8266 module the access point(hotspot)

In this section, we will learn how to configure ESP8266 to run in soft access point mode so Wi-Fi stations can connect to it. The Wi-Fi network established by the soft-AP will be identified with the SSID set during configuration. The network may be protected with a password. The network may be also open if no password is set during configuration.

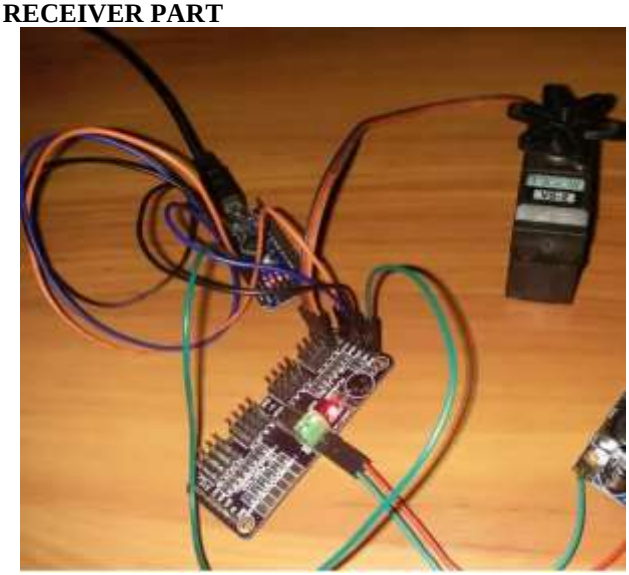
Making another ESP8266 module the station point(Wifi)

CONNECTION BETWEEN ARDUINO MEGA AND POTENTIOMETER



A potentiometer is a simple knob that provides a variable resistance, which we can read into the Arduino board as an analog value. Connecting three wires to the Arduino board. The first goes to ground from one of the outer pins of the potentiometer. The second goes from 5 volts to the other outer pin of the potentiometer. The third goes from analog input 2 to the middle pin of the potentiometer.By turning the shaft of the potentiometer, we change the amount of resistance on either side of the wiper which is connected to the center pin of the potentiometer. This changes the relative closeness of that pin to 5 volts and ground, giving us a different analog input. When the shaft is turned all the way in one direction, there are 0 volts going to the pin, and we read 0. When the shaft is turned all the way in the other direction, there are 5 volts going to the pin and we read 1023. In between, analogRead() returns a number between 0 and 1023 that is proportional to the amount of voltage being applied to the pin.

B. **CONNECTION AT RECEIVER PART**



Standard servo motor control using Arduino is extremely easy. This is because the Arduino software comes with a sample servo sketch and servo library that will run quickly

- Connect the black wire from the servo to the Gnd pin on the Arduino
- Connect the red wire from the servo to the +5V pin on the Arduino
- Connect the third wire (usually orange or yellow) from the servo to a digital pin on the Arduino

Most servos are designed to run on about 5 or 6v. Keep in mind that a lot of servos moving at the same time (particularly large powerful ones) will need a lot of current. Even micro servos will draw several hundred mA when moving. Some High-torque servos will draw more than 1A each under load.
Better not to use the Arduino 5v pin to power your servos. Electrical noise and 'brownouts' from excess current draw can cause your Arduino to act erratically, reset and/or overheat.

Applications

Remote Areas:

It promises to allow the expertise of specialised surgeons to be available to patients worldwide, especially underserved areas, without the need for patients to travel beyond their local hospital. This is particularly beneficial in situations where transfer has its own risks and time delay in transfer can be counterproductive.

Military Interest:

Providing expert surgical care to mobile military units can be made possible through telerobotics. A few surgeons with expertise in specific areas can provide care to multiple units from a distant location.

Naval and Space interest:

Providing specialised surgical care to inaccessible units in space and on ships can be brought about through utilisation of advancement in tele-robotic technology.14 Feasibility studies to operate in space have already been carried out by National Aeronautics and Space Administration (NASA) Major limitation remains the time latency due to long distances.15

Remote Surgical Training:

Surgeons present at the site of operation can get benefit from the expertise of the remote surgeon.16 various degrees of interaction are possible between remote surgeon and the surgeon on site. In its least form, tele-mentoring can be in the form of instructions only by the proctor from the remote location who is watching the real-time video of the operation being performed. On the other hand, with the help of distant robotic arms, TS can be either demonstrated or assisted. This can potentially improve surgical training in remote areas, ultimately improving surgical care

Surgical assistance

These remote-controlled robots assist surgeons with performing operations, typically minimally invasive procedures. Additional applications for these surgical-assistant robots are continually being developed, as more advanced 3DHD technology gives surgeons the spatial references needed for highly complex surgery, including more enhanced natural stereo visualization, combined with augmented reality.

Rehabilitation robot

These play a crucial role in the recovery of people with disabilities, including improved mobility, strength, coordination, and quality of life. These robots can be programmed to adapt to the condition of each patient as they recover from strokes, traumatic brain or spinal cord injuries, or neurobehavioral or neuromuscular diseases such as multiple sclerosis. Virtual reality integrated with rehabilitation robots can also improve balance, walking, and other motor functions.

IV. Result

The objective of this project was fulfilled, which was developing the Telesurgical Bionic Arm using Flex or Potentiometer controlled. From the observations made, it clearly shows the Robotic Arm movements are accurate, precise and also easy to control.

The Robotic Arm movements are currently controlled with Flex Sensors and Potentiometers. Three Flex sensors are used for providing fingers movement that is 2 flex sensors for thumb and index finger and the other one for the last 3 fingers combined. Potentiometers are accordingly placed at the elbow and shoulder joints to pick up the movement.

The movement of the Robotic Arm is made possible by using three 2.5kg/cm torque servo motors: 2 at the fingers and 1 at the wrist and using 10kg/cm torque servo motors: 2 at the elbow joint and 2 at the shoulder joint.

The arduino boards were configured to communicate which facilitated the data transfer wirelessly. The wireless function is achieved by using 2 NodeMCU WiFi in which the concept of the Master Slave technology by implementing a server and a client terminals.

We can see the fingers in the robotic arm moving as we flex the various flex sensors and we move the potentiometers in the glove.

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