ROBOTICS ARM MANIPULATOR WITH HAPTIC FEEDBACK

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Abstract:

Sensor plays important role in robotics. Sensors are used to determine the current state of the system. Robotic applications demand sensors with high degrees of repeatability, precision, and reliability. Flex sensor is such a device, which accomplish the above task with great degree of accuracy. The pick and place operation of the robotics arm can be efficiently controlled using micro controller programming. This designed work is an educational based concept as robotic control is an exciting and high challenge research work in recent year. The project aims to design and implement a cost-effective and an affordable prototype model of robotic hand using haptic technology. The movements of the robotic palm are controlled by moving the user's fingers using the Flex sensors and Wireless ZigBee modules. The flex sensor system gives control signals to the arm wirelessly via ZigBee module and arm mimics the movement of the flex sensor system. DC motors were used to move the fingers of the hand. A robotic arm consists of several sections connected together by linkages that help the arm to travel specifically in a designed pattern, with sensors ensuring that all movements are exactly of the similar pattern. They are endowed with several degrees-of-freedom, giving them the flexibility to move in many directions through multiple angles with utmost ease and agility.

I. INTRODUCTION

A robotic arm consists of several sections connected together by linkages that help the arm to travel specifically in a designed pattern, with sensors ensuring that all movements are exactly of the similar pattern. They are endowed with several degrees-of-freedom, giving them the flexibility to move in many directions through multiple angles with utmost ease and agility. RF modules are widely used in electronic design owing to the difficulty of designing radio circuitry. The current era of surgeries has evolved to bring forth astounding changes in the health-care system. However even

the best traditional surgeries leave behind the huge scars and increased recovery time. Haptic technology or haptics is a tactile feedback technology which makes use of a user's sense of touch for the enhancement of the remote control of machines and devices. Devices that enable manual interactions with virtual environments or tele-operated remote systems are called haptic interfaces. In general, they receive motor action commands from the human user. Tele-haptics is the science of transmitting computer generated tactile sensations over networks, between physically distant users. The movements of the robotic palm are controlled by moving the user's fingers using the Flex sensors and Wireless RF (Radio Frequency) modules. Wireless RF (Radio Frequency) module provides unprecedented range in a low-cost wireless data solution. The Minimally Invasive Robotic Surgery (MIRS) surpasses this hitch too. This is a relatively new technique that allows surgeons to operate with specially designed surgical tools through access ports requiring incisions as small as 1 cm in size. A Robot in lay man's terms is a mechanical device that has come into existence not only to make the human life simpler by replacing or replicating human activities, but to offer an excellent amount of precision and accuracy. It is defined as a programmable, multifunctional manipulator designed to move material, parts, tools or specialized devices through various programmed motions for the performance of a variety of tasks. The robot inspiring the project is a machine that senses the signals it is designed to recognize, processes the sensor information, and then uses it to carry out the assigned activity. A Robotic Arm consists of several sections connected together by linkages. It involves motors coupled with joints that are resolved by computers. Multiple degrees of freedom in robots give them the flexibility to move in many directions through multiple angles with utmost ease and agility. They circumvent human errors. This offers great accuracy reduced production time and optimum output in regards to quality as well as quantity. Some of the most advanced robotic arms have such amenities as a rotating base, pivoting shoulder, pivoting elbow, rotating wrist and gripper fingers. All of these amenities allow the robotic arm to replicate work closely resemble what a man can do only without the risk. Medical robotics is a growing field and regulatory approval has been granted for the use of robots in minimally invasive procedures. Robots are being used in performing highly delicate, accurate surgery or to allow a surgeon who is located remotely from their patient to perform a procedure using a robot controlled remotely.

II. LITERATURE SURVEY

A. Two Jaw Robotic Gripper
Two Jaw Gripers are nothing but servo operated grippers. Two jaws are controlled by a servo whose rotation angle can

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be changed to close or open the jaws. They are easy to operate, low cost & widely used by electronics hobbyists. They are generally fitted on different robotic systems for simple pick & place jobs. However these simple grippers provide no feedback to the user regarding the force of grip & object parameters like temperature, weight and boundary. Further they cannot mimic the flexibility of human hand and have limited degree of freedom (DOF).

B. Shadow Dexterous Hand
Shadow Dexterous Hand has been developed by The Shadow Robot Company. It resembles the actual human hand having the flexibility to move all joints. It has 24 joints and 20 degree of freedom. It is available in electrically actuated and pneumatically actuated versions. It can be mounted on various robotic arms and has the ability to grasp objects just like a human hand. It also includes BioTac tactile sensor which provides feedback about object parameters. However it's a very costly system and very few people can afford it. Also such a wide flexibility is not required for many simple tasks.

C. i-LIMB
i-LIMB is the world's first commercial bionic hand developed by Touch Bionics. Similar to the Shadow Dexterous Hand it has the complete flexibility of human hand. It is used in prosthetics. It has 5 individually powered fingers including a rotatable thumb. It has been developed for people without upper limbs. It has complex algorithms to auto grasp objects if the grip is loose. However this system is also expensive and complex for normal pick and place jobs.

III. SYSTEM DESIGN
1. Master Section : This section includes the flex sensors connected to the transmitting Arduino board along with the ZigBee shield and the ZigBee module.

2. ZigBee Wireless Network : It consists of the wireless communication between the ZigBee modules attached to the Transmitter and Receiver Arduino board and microcontroller board. This is the section which physically doesn't exist.
3. Slave Section : The output of the 8051 board is connected to the dc motors on the Robotic Arm enabling the corresponding motion of the arm. It includes the Receiver XBee module attached to the receiver 8051 board.

4.The Flex Sensors : An unflexed sensor has a nominal resistance. Flex sensor is a unique component that changes resistance when bent or flexed. As the flex sensor is bent in one direction the resistance gradually increases. The flex sensors provide with corresponding voltage change to the flex thereby providing us with an accurate replication of a natural movement.

5.DC Motor Driver :The microcontroller output is not sufficient to drive the DC motors, so current drivers are required for motor rotation. The L293D is a quad, high-current, half-H driver designed to provide bidirectional drive currents of up to 600 mA at voltages from 4.5V to 36V. It

makes it easier to drive the DC motors. The L293D consists of four drivers. Pin IN1 through IN4 and OUT1 through OUT4 are input and output pins, respectively, of driver 1 through driver 4. Drivers 1 and 2, and drivers 3 and 4 are enabled by enable pin 1 (EN1) and pin 9 (EN2), respectively. When enable input EN1 (pin 1) is high, drivers 1 and 2 are enabled and the outputs corresponding to their inputs are active. Similarly, enable input EN2 (pin 9) enables drivers 3 and 4. The L293 is an integrated circuit motor driver that can be used for simultaneous, bidirectional control of two small motors as shown fig below output current of 1.2A per channel. Moreover for protection of circuit from back EMF output diodes are included within the IC. The output supply (VCC2) has a wide range from 4.5V to 36V, which has made L293D a best choice for DC motor driver. As seen in the circuit, three pins are needed for interfacing a DC motor (A, B, Enable). As we want the o/p to be enabled completely so we have connected Enable to VCC and only 2 pins are needed from controller to make the motor work.

6.DC Gear Motor :Geared the motors that operate using gears are used because they are bidirectional with these motors you can move your robot in forward and backward direction .here 4 motors (12v,60rpm) are used to move robotic arm.using program in the microcontroller robot starts moving.

7.MICRO CONTROLLER (8051): Micro controller (8051) is one of the most popular general purpose micro controller in use today. Microcontroller consists of in the form of Ferroelectric RAM, ALU, NOR flash or OTP, ROM is also often included on chip, as well as small amount of RAM. For embedded applications microcontroller are designed, in contrast to the microprocessor used in personal computer or other general purpose applications consisting of various discrete chips.
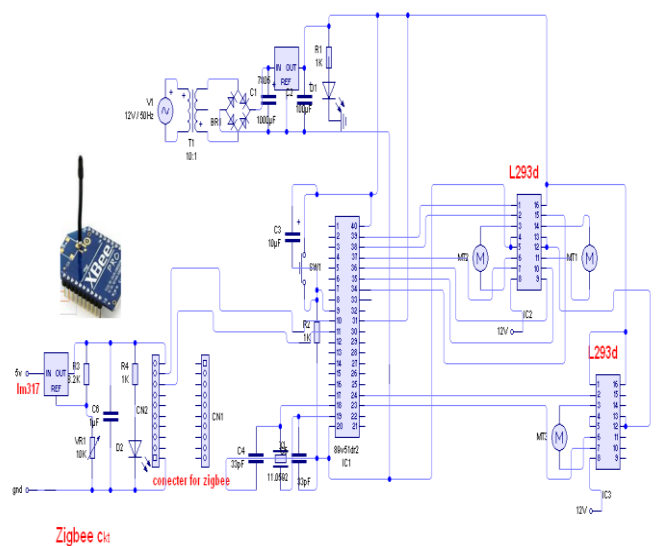
IV. CIRCUIT DIAGRAM

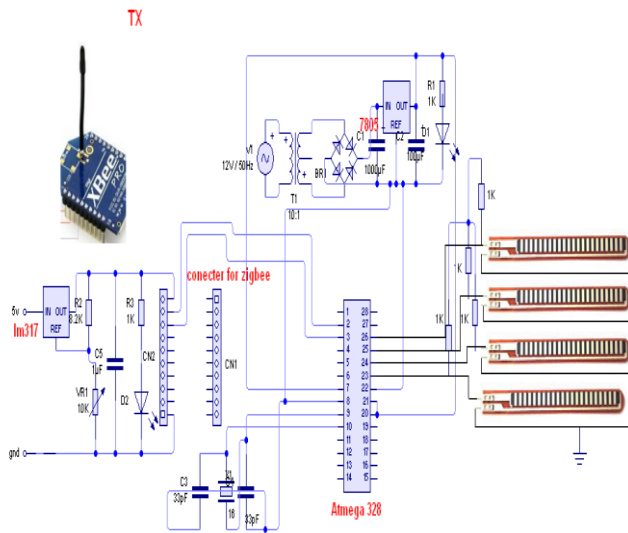Fig: Circuit diagram of transmittar section

Fig: Circuit diagram of receiver section

V. ADVANTAGES & LIMITATIONS

Advantages:

- Can be used in military areas where highly skilled doctors may not be present
- Medical robotics is a growing field and regulatory approval has been granted for the use of robots in minimally invasive procedures.
- Robotic arms are being used in performing highly delicate, accurate surgery, or to allow a surgeon who is located remotely from their patient to perform a procedure using a robotic arm, controlled remotely.
- More recently, robotic arms can be used autonomously in surgery

Limitations:

- Sensors required for operation are costlier.
- Delay is more in transmitting the signal hence response time is more
- The haptic interfaces are basically not portable and they have a limited workspace.

VI. CONCLUSION

Sensor plays an important role in robotics. Sensors are used to determine the current state of the system. Robotic applications demand sensors with high degrees of repeatability, precision, and reliability. Flex sensor is such a device, which accomplish the above task with great degree of accuracy. The pick and place operation of the robotics arm can be efficiently controlled using micro controller programming. This designed work is an educational based concept as robotic control is an exciting and high challenge research work in recent year.

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