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# Haptic Robotic Arm (Wireless)

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**Abstract -** The current generation robot have been used in fields isolated from the human society. Their application is limited because of they cannot manipulation and interaction with humans. In order to represent the robotic technology with human-machine interaction and wireless communication allows interactivity in real-time with virtual objects so it is necessary to develop some the other technology that makes the maximum use of robot to help people perform their work in an efficient way in their daily life. The main objective of the work is to design and develop a Controller that is used to move the robotic arm using wireless system by recognizing hand motion that is controlled by flex sensor & tilt sensor for virtual environment & human-machine interaction. This research has applications in many areas, including critical surgery, rehabilitation, simulation and training, exploration of hazardous, manufacturing, enabling technologies, design, mobile computing, and education, without risking human life or limb.

***Key Words:*** *Haptics, human-machine interaction system, robotic arm control, robot, transceiver module.*

**INTRODUCTION-** Robotics is a science which deals with designing, modeling, controlling and robots' uses in various field. Nowadays robots play an important role in everyday life of human being and take over their daily routine procedures. After a long research it is found that, robots were not only using as simple action performer but as a machine that have diverse and many purposes and usages. Mainly paper focuses on implement & design a controller which is control by using a human arm motion by means of haptics technology & that will control the motions of robotic arm.[1] Haptics is the science of recreates the sense of by applying force or motion and control for interaction with virtual or physical applications. The word haptic, had taken from the Greek word haptikos, which means pertaining to the sense of touch or contact. [2] To create virtual environment haptic is used in engineering systems. It incorporate tactile feedback technology which that measure the sense of touch by applying motions, vibrations or forces by the user.

Haptics can be divided into three areas:

- Human haptics –it is the study of human sensing and its control through touch & motions.
- Machine haptics – it is designed, constructed, and the use of machines to replace human interference.
- Computer haptics – it is to develop an algorithms and software associated with generating the touch and motin of virtual objects.

The main idea is to create electric signals through the sensors on the haptic device which work as transducers and converts hand motions into electrical signals. These hand movements will control the motion of the robotic arm. The research is done for developing the principles to realize advanced robotic and human-machine systems capable of haptic interaction. The work is divided into two modules namely, Haptics glove (Transmitter) & Robot side (Receiver).

### 1.1 Haptics Glove Side:

This device fits over the user's entire hand like an exoskeleton has potentiometers on finger, wrist the motion of the finger & wrist change in resistance with hand movement. Flex sensor attached to the finger & tilt sensor attached to the wrist.

### 1.2 Robotic Arm:

A robotic manipulator is a device capable of moving in different directions (base, elbow, shoulders, yaw, roll, pitch directions) elative to base and controlled by Haptics, The motion is given to the robotic arm through a D.C motor mounted within it. One of the most important terms to understand is degree of freedom (DOF). Each degree of freedom can be seen like joint on the arm, a place where it can bend or rotate or translate.

## 2. DESIGN OF THE ROBOTIC ARM

The Robotic Arm is designed using the Microcontroller 8051. C-embedded program is burn into the microcontroller. This works on the principle of interfacing flex sensor, tilt sensor, and dc motor. This is done using Arduino Board. The flex sensor, tilt sensor is fitted with hand gloves and the dc motors are attached to the body of the robotic arm. The flex sensor, & tilt sensor converts the mechanical motion of hand into electrical motion. When we the motion to the hand the flex sensor, & tilt sensor produce the electrical pulses, which are read able for the arduino board. The board process the signals received from the flex sensor & tilt sensor furthermore convert them into required digital pulses that are then send to the dc motors. This dc motors will respond as per the pulses and the moment of the arm occurs. In brief, the micro controller interfaces all these components mentioned above.

## COMPONENTS:

### 2.1 Flex Sensors

Flex sensors are analog resistors. The main work of this resister it acts as variable analog voltage divider. Flex sensor are made up of carbon resistive elements with thin flexible substrate. When this thin flexible substrate is bent, the flex sensor produces a resistance output is depend on the bend radius. As the bend radius smaller, higher will be the resistance value.

### 2.2 Tilt Sensor

A type of transducer, tilt sensor aids gives information about the vertical as well as horizontal inclination. In construction there is a cavity and a conductive free mass inside it, such as a blob of mercury or rolling ball. In cavity one end has two conductive elements like poles. When the motion is given to the tilt sensor so that that end is downwards, the mass rolls onto the poles and shorts them, which act as a switch.

### 2.3 MICRO CONTROLLER (8051)

A microcontroller is a small computer on a single integrated circuit containing a memory, processor core, and programmable input/output peripherals. 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

### 2.4 RF Module

The CC2500 is a low cost true single chip 2.4GHz transceiver is designed for very low power wireless transmission. [5] In this signal is send or transmitted with the help of RF module. It carries frequency of 2.4GHz. For long distance wireless transmission the data received at Din pins of cc2500 from TXD (PD1) pins of microcontroller is modulated by ASK technique. Without using antenna the normal transmitting range of the transmitter is 25 to 30m (radius). For higher distance transmission an antenna should be connected. Hence this modulated data is send to receiver (robotic arm).

### 2.5 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 belo 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.

### 2.6 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.

### 2.7 Robotic Arm

We have implemented robotic arm in our robot. The arm is able to pick any light weight item. the arm will do other movement given in table below as command given by microcontroller programming. We can operate arm from user haptics glove. when we move wrist up and down then robot will move up and down respectively and so on. Microcontroller will perform These functions ,

motor driver IC and PMDC motor.

## 3. Mechanical Assembly

In this there are two different mechanical assemblie on which the device can move There is an base assembly to move the device in forward, backward.
There is another one axis assembly to open and close the jaws of the object lifter as to move the jaws up and down to lift up the object.

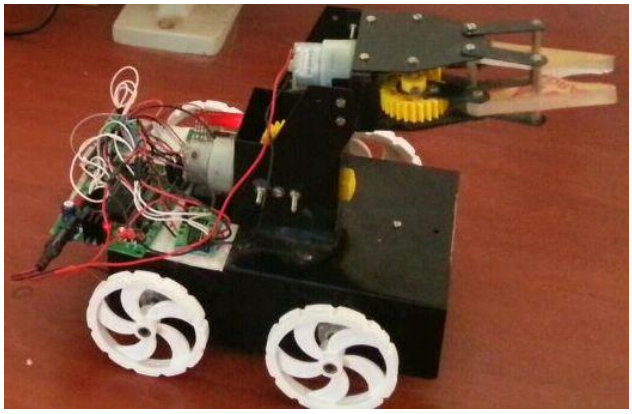

**Fig 3** Robot manipulator

## 4.RESULT

Hardware of this work was successfully executed under due guidance of our in-charge and showed successful results. The results obtained from working of this work have shown that the work performance is quite reliable and efficient.

The robot movement is checked and controlled by a haptics glove wear by user that transmits data to the transceiver module attached to the robot.
We operated Robotics arm from user haptics glove and action given below:

| HAND ACTION | ROBOT ACTION |
|---|---|
| Wrist will move upwards | Robotic arm will move upwards |
| Wrist will move downwards | Robotic arm will move downwards |
| Opening the Hand | Opening the Gripper |
| Closing the Hand | Closing the Gripper |
| Wrist will move left | Robot will move in forward direction |
| Wrist will move right | Robot will move in backward direction |

**Table 3** Operation Table

### 4.1 Range: 15 to 20 meters

| DEVICE | ANGLE |
|---|---|
| TILT SENSOR | 0◦ TO 60◦ |
| FLEX SENSOR | 0◦ TO 30◦ |

**Table 4** Angle of bend & tilt table

## 5.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 theyhave a limited workspace .[4]

## 6. CONCLUSIONS

With the help of flex sensor and tilt sensor it is possible to introduce direct human interference into the industrial world. The robot which is used to pick & place the objects in required places performs significantly. The haptic glove designed can be operated within the range of 15 to 20 metres which can be increased with the use of other modules for transmission of signals. Such device gives a direct interaction with the work without involving in it. This eliminates the disadvantages of remote controller efficiently. Human are tired for hard work such as assembly line, material handling etc. this device does all those things it mainly reduces the manual work, the haptic glove with flex sensor and the tilt sensor is designed at low cost as well as high efficient one.

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