Voice and Gesture Controlled Robotic ARM

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Abstract— In today's world, in almost all sectors, most of the work is done by robots or robotic arm having different number of degree of freedoms (DOF's) as per the requirement. This project deals with the Design and Implementation of a "Voice and Gesture Controlled Robotic Arm". The system design is divided into 3 parts namely: Voice recognition module, Robotic Arm and Accelerometer Part (Gesture). Arm with Voice Recognition is to create a wireless voice controlled arm which can be operated through a range of 10 meters (Line of site distance) using CC2500 transmitter and receiver. It is basically an Accelerometer based system which controls a Robotic Arm wirelessly using a, small and low-cost, 3-axis (DOF's) accelerometer. The accelerometer is mounted / attached on the human hand, capturing its behavior and thus the robotic arm moves accordingly. The different motions performed by robotic arm are: PICK and PLACE / DROP, RAISING and LOWERING the objects, TRASH CLEANING, HI/HELLO etc.

Key words: Voice Recognition Module, Accelerometer Sensor, DOF, Robotic ARM

I. INTRODUCTION

A robot may define as an electro-mechanical device, which is capable of sensing its surrounding and taking its decision (command).In general, robot must be able to move (by mechanical movement), it must be able to sense (by transducer) and it should be take decision (by remote control or artificial intelligence). A robotic arm is a robot manipulator, which can perform similar functions to a human arm. Robotics arm is vital role of industrial application. Most robotics arm perform the task such as welding, trimming, picking, placing and painting etc., Moreover the biggest advantage of these arms is that it can work in hazardous areas and also in the areas which cannot be accessed by human Few variants are Keypad Controlled, Voice Control, Gesture Control, etc. However, most of the industrial robots are still programmed using the typical teaching process which is still a tedious and time-consuming task that requires technical expertise. Therefore, there is a need for new and easier ways for programming the robots. The prime aim of this project is the Robotic arm started with movement as soon as the voice commands as well as Gesture command receives by operator. If the voice is not audible then the alternative method is gesture command is used.[1]

II. SYSTEM DESIGN

A. Block Diagram Description

In this project motion of the robotic arm is control by voice as well as hand gesture .Here one manual switch that mounted on the robotic arm section, in this if we give the voice command to the robotic arm then switch is put on voice recognition mode and if we give the gesture command to the robotic arm then switch is put on gesture recognition mode manually. Here voice command is given to the voice recognition module with the help of microphone; here user can give command into the microphone. we know that output of a microphone is analog in nature, it is given to the voice recognition module(EasyVR).It have ability to process that signal and give digital output. Then that signal is given to the ARM 7 controller and from arm controller it is given to wireless transmission module (CC2500) for transmission .that command/signal is received another transreceiver present at robotic arm section. And then that command/signal is send to the ARM 7 controller. ARM 7 controller generate a signal that is send to motor drive. We know that output of ARM 7 controller is insufficient to drive the dc motor so to increase strength of that signal we use motor drive(L298). Motor drive signal given to different motor that is use to controlled the motion of the robotic arm. Similarly for gesture recognition user can wear glove, on that gesture recognition sensor (accelerometer) is mount. That command is given to the ARM controller and signal transmission is takes place wirelessly. And at the receiver that signal send to the robotic arm. Hence robotic arm give the movement according to the signal.

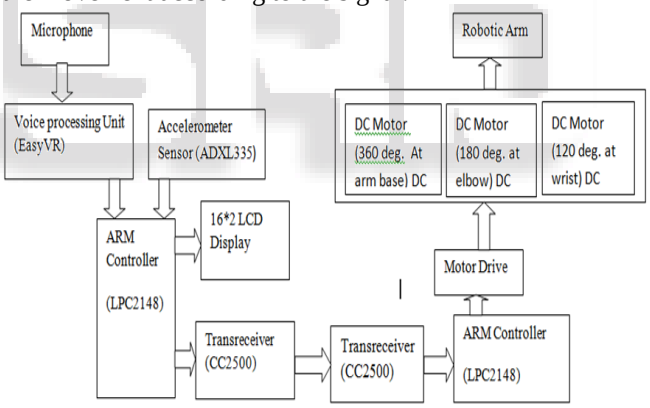

Fig. 1: Block Diagram for Voice and Gesture Controlled Robotic Arm

B. Voice Recognition Model

Speech recognition is the process of converting an acoustic signal, captured by microphone or a telephone, to a set of words. There two important part of in Speech Recognition.

- Recognize the series of sound and
- Identified the word from the sound. Converting a speech waveform into a sequence of words involves several essential steps:

1) A microphone picks up the signal of the speech to be recognized and converts it into an electrical signal. A modern speech recognition system also requires that the electrical signal be represented digitally by means of an analog-to-digital (A/D) conversion process, so that it can be processed with a digital computer or a ARM controller.
2) This speech signal is then analyzed (in the analysis

block) to produce a representation consisting of salient features of the speech. The most prevalent feature of speech is derived from its short-time spectrum, measured successively over short-time windows of length 20–30 milliseconds overlapping at intervals of 10–20 ms. each short-time spectrum is transformed into a feature vector, and the temporal sequence of such feature vectors thus forms a speech pattern.

3) The speech pattern is then compared to a store of phoneme patterns or models through a dynamic programming process in order to generate a hypothesis (or a number of hypotheses) of the phonemic unit sequence. (A phoneme is a basic unit of speech and a phoneme model is a succinct representation of the signal that corresponds to a phoneme, usually embedded in an utterance.) A speech signal inherently has substantial variations along many dimensions.[2]

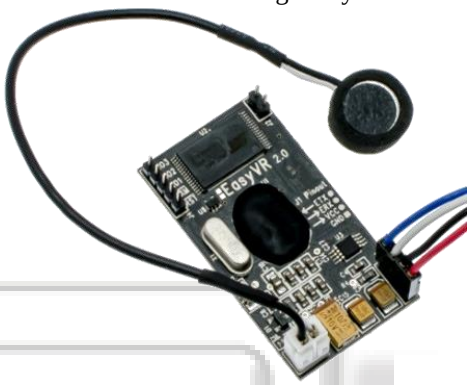

Fig. 2: Voice Recognition Module

C. Gesture Recognition

In this project we are going to control a robot wirelessly using hand gestures. This is an easy, user- friendly way to interact with robotic systems and robots. An accelerometer is used to detect the tilting position of your hand, and a ARM controller gets different analogue values and generates command signals to control the robotic arm. This concept can be implemented in a robotic arm used for welding or handling hazardous materials, such as in nuclear plants.[3]

Fig. 3: Appearance of Gesture recognition

D. Robotic Arm

The robotic arm has 2 links and 3 joints. It is mounted on the center of a table or the platform on which it is supposed to deal with the objects. The range of the arm is the total length of the two links. The length of each link can be designed as per requirement. It can be of equal or different lengths. The arm has 3 degrees of freedom. Each joint has a dc motor for the link movement.

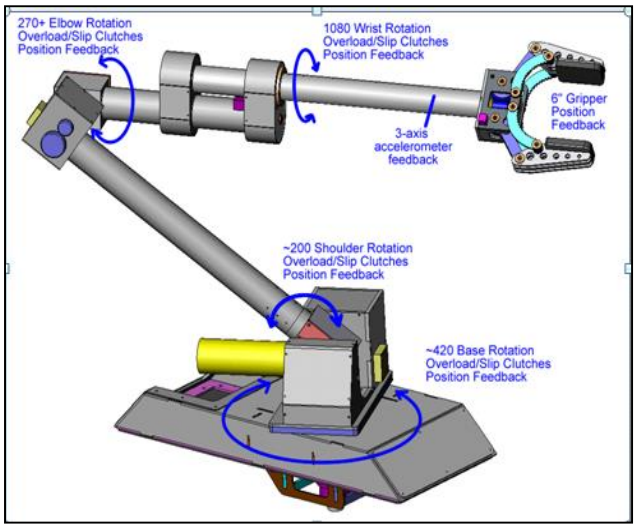

Fig. 4: Robotic Arm Structure

E. ARM 7 Controller

ARM controller is used as the hardware platform. It is the controlling unit, to which all other components (Voice recognition, Motors, Transreceiver modules etc.) are interfaced. Two such controllers are used in this project, one at the Transmitting end and one at the Receiving end.

F. DC Motor and Motor Drive

DC Motor is based on principle of to convert the electrical signal into mechanical motion. In this Project DC Motors are used to control the motion of robotic arm. This motor controller would prevent the motor from breaking or burning, and it would also prevent a short circuit from happening. Since the motors chosen for the project were small and did not need huge amounts of current to operate, the speed controller could actually have a low amp value.

G. EasyVR

EasyVR is multi-purpose speech reconition module designed to easily add versitile, robust and cost effective speech recognition capabilities to virtual to any application.The EasyVR module can br used with any host with an UART interface powered at 3.3v-5v,such as a PIC . Speech recognition is the process of converting an acoustic signal, captured by microphone or a telephone, to a set of words. There two important part of in Speech Recognition

H. Accelerometer Sensor(ADXL335)

This is a complete three-axis acceleration measurement system. ADXL335 has a minimum measurement range of ±3g. It contains a poly silicon surface micro-machined sensor and signal conditioning circuitry to implement open-loop acceleration measurement architecture. Output signals are analogue voltages that are proportional to acceleration. The accelerometer can measure the static acceleration of gravity in tilt-sensing applications as well as dynamic acceleration resulting from motion, shock or vibration. The sensor is a poly silicon-surface micro-machined structure built on top of a silicon wafer. Poly-silicon springs suspend the structure over the surface of the wafer and provide resistance against acceleration forces. Deflection of the structure is measured using a differential capacitor that consists of independent fixed plates and plates attached to the moving mass.

I. Transreceiver(CC2500)

VT-CC2500-M1is based on RF transceiver CC2500of TI Chipcon it's a small size .And Low power consumption module.CC2500 is a low-cost 2.4GHz transceiver designed for designed for very low power wireless applications. The circuit is intended forthe2400-2483.5MHz ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band. The MAX RF output power can be set as high as+1dBm, with data rate as high as 500 Kbps .The module integrated many RF functions thus you can use it conveniently and reducing your development time.

J. LCD Display

It used for user interface .It show the command given by user. The LCD displays used in these early digital watches were very different from the LEDs they replaced. While even a tiny LED display consumes a few milliwatts of power, the LCD consumes just microwatts of power. Hence, the LCDs are over 1000 times more efficient at their job than the LED

III. APPLICATION

1) Industrial control-In industries we can use this system for pick and place the small objects.
2) Medical data collection-In medical application we can use this project for providing surgery components to the doctors. We also use such a system for the surgery using gesture recognition.
3) Home Entertainment and control-By using this system we can do many household works such as cleaning, pick and place the small object etc.

IV. CONCLUSION

Voice and Gesture controlled robotic arm for picking and placing an object was studied. The robot control will be find to be user friendly. Here robotic arm recognized the voice as well as movements of human hand on which accelerometer (Gesture) is mounted and give the movement according to the command given by human being. Speech Recognition (SR) technology gives the researcher the opportunity to add Natural language (NL) communication with robot in natural and even way. The working domain of the Service Robot is in the society help the people in every day's life and so it will be controlled by the human.

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