International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 06 | June -2017 www.irjet.net p-ISSN: 2395-0072

Design and Fabrication of Voice Activated Robotic Arm

Mr.S.S.Azhagu Shankar[1] Mr.Akhil Raj K V[2]

[1]*Assistant professor, Department of ME, Shree Venkateshwara Hi-Tech Engineering College, Gobi, Tamil Nadu, India.*
[2]*Student,ME Mfg Engg ,Department of ME, Shree Venkateshwara Hi-Tech Engineering College, Gobi, Tamil Nadu, India.*

Abstract - *The aim of the project is to design and fabricate the voice activated robotic arm. The voice activated robotic arm is a robotic arm that works by means of the voice recognition mechanism. The Robotic arm obeys the voice commands and it works accordingly. A suitable microcontroller must be selected in order to accomplish the task.The fabrication is done by using the arduino microcontroller incorporating the speech module. Designing will be done by using CATIA software. The project work will be beneficial to the handicapped persons, who are unable to move their hands. The voice activation is one of the advanced technologies. The fabrication is done by the incorporating a microcontroller along with a speech module. The received voice is identified and the voice signals are quantified, sampled and the discretization process take place. Hence the noise signals are rectified by the sampling process. The voice commands are processed and it is converted to text commands. The stepper motor and other devices works based on the voice signals and the text commands.*

Key Words: **CATIA, ARDUINO**

1.INTRODUCTION

The robotic arm is a prototype, similar to the human arm. It is commonly controlled by the computer programs. A robotic arm consists of links and joints which is controlled by the actuators like servo motors and gears. The arm may be the sum total of the mechanism or may be part of a more complex robot. The links of such a manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) or translational (linear) displacement. The links of the manipulator can be considered to form a kinematic chain. The terminus of the kinematic chain of the manipulator is called the end effectors and it is analogous to the human hand. The robotic arm will be having a robotic hand at the end for performing certain task according to the situations. The common task of the robotic end effector include grasping, welding ,detecting etc. In this project, the concept of voice actuation is introduced .The robotic arm works according to the voice commands. Voice comes under the field of artificial intelligence. In this project designing and fabrication of the 4 degrees of freedom robotic arm will be done.

1.1 Speech Recognition

Voice actuation is one of the artificial intelligence techniques used in the robotics. In robotics speech recognition is the transformation of the voice signals in to the text commands. The process by which the machine identifies the words is speech recognition. Speech recognition is the method by which a device or controller (or any type of arrangement) identifies the verbal words. It simply means ordering to device and it exactly recognizes the voice instruction given. Speech Recognition is an ability of computer software program or hardware mechanism to decode the human command into digitized speech that can be interpreted by the computer or hardware device. Voice recognition is commonly used to operate a device, perform commands, or to command robot to pick items or to do a certain work. There are 2 important steps in speech recognition.

1) Recognize the sound excluding the noise and
2) Identifying the words from that sound.

The speech recognition technique also depends on the parameters like the speaking mode, language and the style of speaking. In this proposed project a speech recognition hardware module will be installed to accomplish the task. The main objective of speech recognition technique is to interpret a phrase or words by using the microphone and transform it in to the text commands**.**

1.2 Robotic Arm

The robotic arm is a prototype, similar to the human arm. A robotic arm consists of links and joints which are controlled by the actuators like motors and gears. The arm may be the sum total of the mechanism or may be a part of a more complex robot. The links of such a manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) or translational (linear) displacement. The links of the manipulator can be considered to form a kinematic chain. The terminal of the kinematic chain of the manipulator is called the end effector and it is analogous to the human hand and they perform certain task according to the situations. The common task of the robotic end effector includes grasping, welding, detecting etc. In this project the concept of voice actuation and some of the basic movements using voice control is introduced. The robotic arm works according to the voice commands.

2. THEORY

Speech Recognizers (SR) can be used to facilitate communication between humans and machines. Speech-based, human-machine interaction is demonstrated in several everyday applications. SR systems have been designed for different applications, in many areas, under a

combination of restrictions, such as specific language and vocabulary, speaker dependency, noise-free environments and low talking rates, with excellent results.
Software analysis, designing and implementation are the basic steps required to develop the theoretical system. Based upon this analysis a hardware model is developed, which first recognize the voice or command and then with the help of microcontroller based embedded system, movement of motor driven robotic arm is controlled.
Complete analysis is divided into two, software and hardware for the implementation. In the first step, the designing is carried out using computer package (CATIA/ANSYS). Second step is to fabricate the hardware of the prototype of the motor driven robotic arm. After completion, the system was tested on the different loads. Durability of the system was checked for respective loads.

2.1 CATIA

The CATIA Version 5 part design application makes it possible to design precise 3 D mechanical parts with an intuitive and flexible user interface, from sketching in an assembly context to iterative detailed design. CATIA Version 5 Part Design application will enable us to accommodate design requirements for parts of various complexities, from simple to advanced.
CATIA offers a solution to shape design, styling, surfacing workflow and visualization to create, modify, and validate complex innovative shapes from industrial design to Class-A surfacing with the ICEM surfacing technologies. CATIA supports multiple stages of product design whether started from scratch or from 2D sketches. CATIA is able to read and produce STEP format files for reverse engineering and surface reuse CATIA enables the creation of 3D parts, from 3D sketches, sheet metal, composites, molded, forged or tooling parts up to the definition of mechanical assemblies. The software provides advanced technologies for mechanical surfacing & BIW. It provides tools to complete product definition, including functional tolerances as well as kinematics definition. CATIA provides a wide range of applications for tooling design, for both generic tooling and mold & die.

3.DESIGN

The design of the robotic arm such as the part drawing and the assembly drawing of the 3D model is drawn on CATIA.

3.1 Material Specification

The material for the robotic link is chosen as Aluminum (Al). There are so many materials available for the link, but why aluminum is due to following reasons:

- Low Weight.
- High Strength.
- Excellent Corrosion Resistance.
- Non Magnetic.

Table-1 : Material Specification for robotic link.

Link	Material Properties	Poisson's ratio	Young's modul	Coefficient of thermal	Density	Length
1	Aluminium	0.35	70GPa	1.17×10^{-5} per °C	2.70 g/cm^3	0.2m
2	Aluminium	0.35	70GPa	1.17×10^{-5} per °C	2.70 g/cm^3	0.15m

3.2 CATIA Modeling

Computer aided three dimensional interactive application (CATIA) is software used to create the 3d model of the components .Brief step to create the part modeling is as follows.
a) Open the CATIA software
b) Select start from the menu bar and click on engineering design< part design
c) Select the plane from the menu bar and select any plane and apply sketch.
d) Select the circle tool and line tool from the tool bar.
e) To create the dimension tool from the tool bar and give the dimension for the components.
f) To extrude the given component, click on the pad tool from the menu bar and give the correct dimension as per the requirement.
g) To cut the material from the existing component, Click on the pocket button as per the dimensional requirement.
h) Save each component and name as Part 1, 2,3,4,5.
For the Assembly of the parts
i) Click on the start menu <Engineering Design<Assembly drawing
j) Click on the existing component from the tool bar.
k) Double click on product 1 on the side of the screen and import the 5 parts.
l) To insert the components with concentricity press (ctrl + u) and click on the parts to be joined.
m) Update tool icon is pressed to assemble the parts

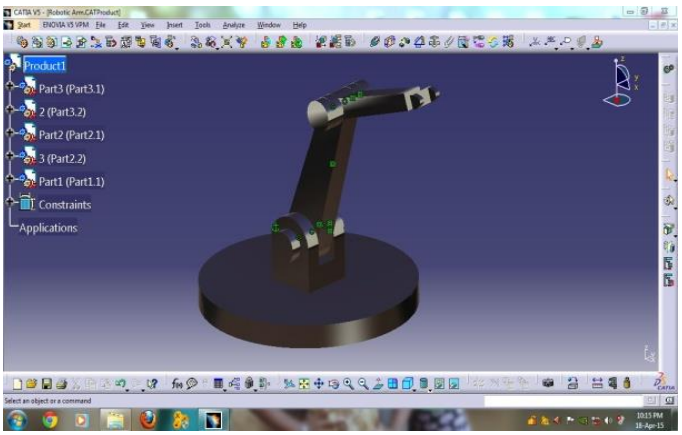

Fig-1: Assembly modeling

4.MATERIALS AND METHODS

Speech Recognition systems consist of two major parts: the speech processing and the recognition. This section describes the main issues associated with these two SR's components. Speech is a non-stationary signal and processing and is usually conducted over short-time frames where stationary can be assumed. This section introduces the basic idea behind Speech Recognition in the context of isolated word and continuous speech recognition applications.

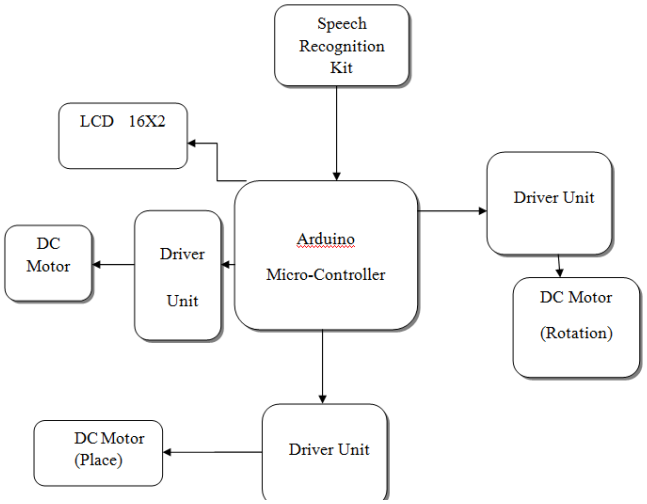

Fig-2 : Block Diagram of the Hardware.

4.1 Arduino Microcontroller

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards, in that it does not use the FTDI USB-to-serial driver chip.

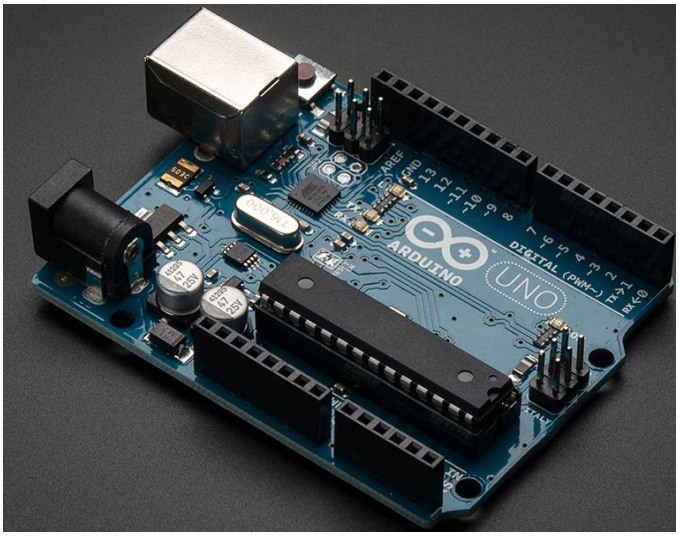

Fig-3 : Arduino microcontroller board

4.2 LCD Display Unit

A liquid crystal display (LCD) is an electro-optical amplitude modulator realized as a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. It is often utilized in battery-powered electronic devices because it uses very small amounts of electric power. The LCDs have a parallel interface, meaning that the microcontroller has to manipulate several interface pins at once to control the display.

Fig-4 : LCD Display

4.3 DC Motor and Driver unit

A driver is an electrical circuit or other electronic component used to control another circuit or component, such as a high-power transistor, liquid crystal display (LCD), and numerous others. They are usually used to regulate current flowing through a circuit or are used to control the other factors such as other components, some devices in the

circuit. The term is often used, for example, for a specialized integrated circuit that controls high-power switches in switched-mode power converters. An amplifier can also be considered a driver for loudspeakers, or a constant voltage circuit that keeps an attached component operating within a broad range of input voltages.

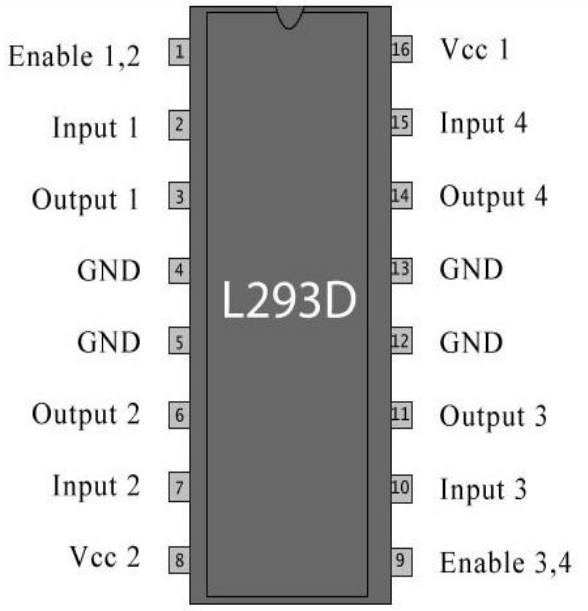

Fig-5 : Driver Unit

A DC motor in simple words is a device that converts direct current (electrical energy) in to mechanical energy. It's of vital importance for the industry today, and is equally important for engineers to look into the working principle of DC motor**.** The DC motor works on the principal that when a current carrying conductor is placed in a magnetic field, it experiences a torque and has a tendency to move. This is known as motoring action. If the direction of current in the wire is reversed, the direction of rotation also reverses. When magnetic field and electric field interact they produce a mechanical force, and base don that the working principle of dc motor is established. The direction of rotation of this motor is given by Fleming's left hand thumb rule, which states that, if the index finger, middle finger, and thumb of the left hand are extended mutually perpendicular to each other and if the index finger represents the direction of magnetic field, middle finger represents the direction of current, then the thumb indicates the direction in which force is experienced by the shaft or dc motor.

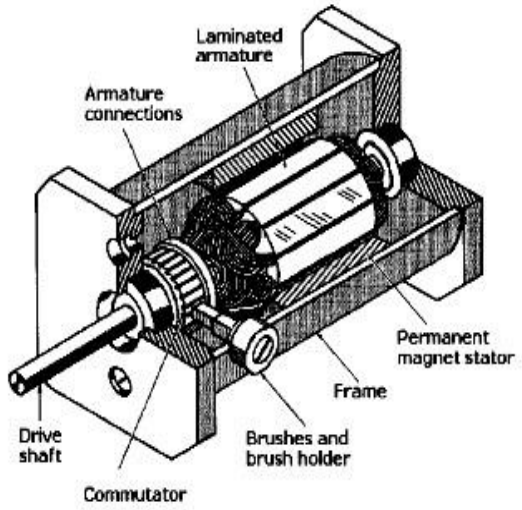

Fig-6: DC Motor

4.4 Speech recognition kit

Complete system contains three main sub systems. All sub systems are interfaces together such a way that ultimate objective can be accomplished. These sub systems are voice Recognition Module HMC 2007, microcontroller based PCB Designing and a prototype of a robotic arm designed with the help of DC motor.

Voice Recognition Module HMC 2007 was used for automatic speech recognition. This module can store up to 20 voice instruction, each word of length 1.92 sec. Voice Recognition module HMC2007 generates a specific code for each specific voice command and this code is send serially to microcontroller and then a code is written to the microcontroller to control arm movements according to given voice commands.

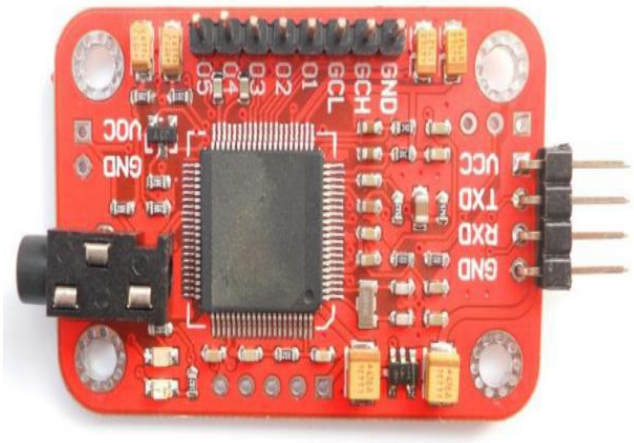

Fig-7 : Speech Recognition Unit.

4.5 Complete Structure of the System.

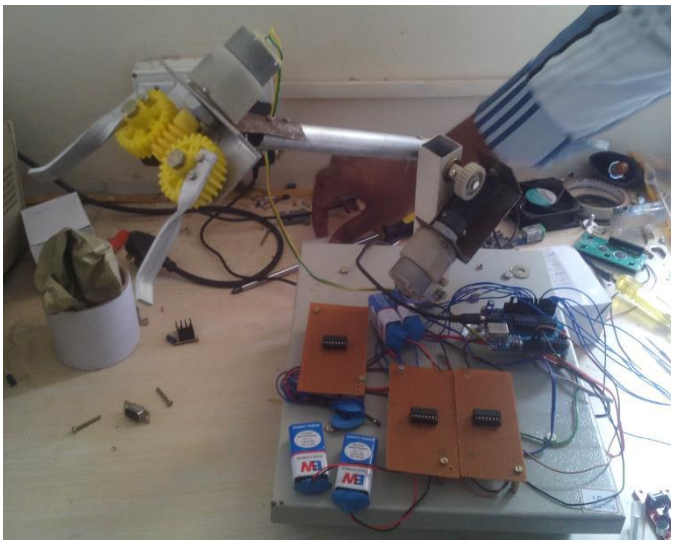

Fig-8 : Assembled Robot corresponding to Voice Actuation

5. LIMITATIONS

Speech has difficulties to be recognized by an application. Because speech is different for every speaker, May be fast slow, or varying in speed. May have high pitch, low pitch, or be whispered. Have widely-varying types of environmental noise, can occur over any number of channels. Changes depending on sequence of murmurings, May not have distinct boundaries between units (phonemes), Boundaries may be more or less distinct depending on speaker style and types of phonemes. Changes depending on the semantics of the utterance, has an unlimited number of words, has phonemes that can be modified, inserted, or deleted. Even a single noise may affect the working.

6. CONCLUSIONS AND FUTURE ASPECTS

In this project, a systematic approach to design and implement Voice Activated Robotic Arm is described. The 2 DOF robot arm is fabricated using the above mentioned components and the design is done on the computer software CATIA. The system was trained for 5 voice commands (Pick, Place, Rotate, Up, Down). According to these voice commands the movement of arm takes place. The commands were differentiable so that any kind of overlapping between the commands would not create the confusion to microcontroller, and finally the robotic arm should be capable for performing the commands as per the voice.The testing was done using the different Weights and the respective response time was calculated.

6.1 Future Aspects

In the proposed hardware five voice commands namely pick, place, rotate, up and down were implemented and same design can be extended up to 15 voice commands namely shoulder moments and finger movement (can be added to increase more accuracy). Also, some precision work can be done in the design of arm. Some time controller does not understand voice signal due to external voice interface, so a new algorithm can be developed to train voice signal to make it completely free from external noises. We can also focus on the following criteria in future,

- Changing the degrees of freedom.
- Equipping the robotic arm with vision camera.
- Selection of the suitable microcontroller as per the arm design.
- Noise rectification.

7.REFERENCES

[1] Ali Sekmen, Prathima Challa (2013). Assessment of Adaptive human-robot interactions. *Knowledge-Based systems* 42, 49-59

[2] Steven Keating, Neri Oxman. (2013).Compound fabrication: A multi functional robotic platform for a digital design and fabrication. *Robotics and computer-Integrated Manufacturing* 29,439-448.

[3] Dalibor petkovic , Mirna Issa, Nenad D Pavlovic,Lena Zentner(2013). Intelligent rotational direction control of passive robotic joint with embedded sensors. *expert system with applications*, 40, 1265-1273

[4] "Design And Implementation Of A Robotic Arm Based On Haptic Technology " A. Rama Krishna, G. Sowmya Bala, A.S.C.S. Sastry , B. Bhanu Prakash Sarma, Gokul Sai ,Vol. 2, Issue 3, May-Jun 2012 .

[5] "Voice Automated Mobile Robot "Dr. S.K Saxena International Journal of Computer Applications (0975 – 8887) Volume 16– No.2, February 2011 .