

# **Design and Fabrication of a Robotic arm for Material Handling**



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## Abstract

The commercial robots are expensive for use in the educational institutions. Further the operation of them will not leave room for experimentation which is necessary in an educational institution. Further a large number of components that can be used for building a robot are readily available in the market. Hence this project has been taken up to allow us to build a working robot using as many of the off the shelf components to provide the necessary flexibility. This would make it a low cost robot with enough flexibility for the students to experiment the various functions of the robot.

The mechanical component of the manipulator is built with three axes, one rotary and two linear. This configuration is most common to be used as a material handling device for machine tools. The rotary axis is achieved by making use of a pneumatic rotary table and one linear axis is by means of a pneumatic cylinder. The second linear axis in the Z-direction is achieved by the use of an AC servomotor with a ball screw and linear motion elements to provide for accurate positioning capability.

The gripper has been designed for cylindrical components, since this robot is conceived as a material handling unit for a CNC turning centre. All the necessary design calculations have been done and the finite element analysis was carried out for the main structure.

The control of the robot is one of the crucial elements. A PC is used as a controller. The motion control is carried with the help of a motion control card DC2-PC100. This has the ability to control 2 servo and 2 stepper motors in addition to other digital and analogue controls. The control program is developed with the necessary functioning.

## Table of contents

Acknowledgements	
Abstract	
Chapter 1	
Introduction	1
Chapter 2	
Robots an introduction	5
Chapter 3	
Robot control concepts	14
Chapter 4	
Robot manipulator design	18
Chapter 5	
Robot controller design	26
Chapter 6	
Robot assembly	51
Chapter 7	
Conclusions & Suggestions for future work	60
Bibliography	62

Robot is an automatically controlled material handling unit that is widely used in the manufacturing industry. It is generally used for high volume production and better quality. Implementation of robot technology with integration of automatic system can contribute to increasing of productivity of the company and enhances the profitability of the company.

The word 'robot' first appeared in 1921 in the Czech playwright Karel Capek's play 'Rossum's Universal Robots'. The word is linked to Czech words *Robota* (meaning work) and *Robotnik* (meaning slave). *Computer Aided Manufactures International* of USA describes the meaning of robot as *a device that performs functions ordinarily ascribed to human beings, or operates with what appears to be almost human intelligence*. Another definition from Robot Institute of America is *...a programmable multi function manipulator designed to move and manipulate material, parts, tools or specialized devices through variable programmed motions for the performance of a variety of specified tasks*.

ISO defines a robot as: *A robot is an automatically controlled, reprogrammable, multipurpose, manipulative machine with several reprogrammable axes, which in either fixed in place or mobile for use in industrial automation application*.

Webster dictionary defines a robot as: *An automatic apparatus or device that performs functions ordinarily ascribed to human or operates with what appears to be almost human intelligence*.

There are a number of successful examples of robot applications such as:

- Robots perform more than 98% of the spot welding on Ford's Taurus and Sable cars in U.S.A.
- A robot drills 550 holes in the vertical tail fins of a F-16 fighter in 3 hours at General Dynamics compared to 24 man hours when the job was done manually.
- Robots insert disk drives into personal computers and snap keys onto electronic typewriter keyboards.

## **Robot Applications**

True to the above definitions of robot as an automatic machine, industrial robots are observed to perform the following tasks (shown in the ascending order of technological complexity) in manufacturing.

a) Parts Handling: this may involve tasks like

Recognizing, sorting/separating the parts  
Picking and placing the parts at desired locations  
Palletizing and Depalletizing  
Loading and Unloading the parts on required machines

b) Parts Processing: this may involve operations like