



Literature Review on Design and Simulation of Industrial Robotic Arm using CAD/CAM Software

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Abstract:

Now days in this fast growing industrial age every company needs rapid manufacturing to cope up with the customer's requirements. Every industrialist cannot afford to transform his unit from manual to semi automatic or fully automatic as automation is not that cheap in India. The basic objective of my project is to develop a versatile and low cost robotic arm which can be utilized in any industry to eliminate this problem. The robotic arm so designed can be used in number of application by changing the program of controller and the structure is designed in such a way that it is capable to work under all type of conditions. The robotic arm will be used mainly in the machining processes like drilling and boring etc. CATIA offers a solution to shape design, styling, surfacing workflow and visualization to create, modify, and validate complex innovative shapes and offers the user combine the capabilities of generative sheet metal design and generative surface design.

Keywords: Robotic arm, automation, controller, machining, CATIA.

I. INTRODUCTION

A robotic arm is a type of mechanical arm, usually programmable, with functions homologous to a human arm. The most common manufacturing robot is the robotic arm. A typical robotic arm is made up of seven metal segments, joined by six joints. The computer controls the robot by rotating individual step motors connected to each joint. An industrial robotic arm is used for welding, painting, assembly, pick and place for printed circuit boards, packaging and labeling, palletizing, product inspection, and testing; all accomplished with high endurance, speed, and precision KUKA configuration for robotic arm which is cylindrical and have two parallel joints will be designed and simulated using CATIA which is latest design software for assembly and simulation of machine parts.



Figure.1. Kuka robotic arm

CATIA offers a solution to shape design, styling, surfacing workflow and visualization to create, modify, and validate

complex innovative shapes. CATIA supports multiple stages of product design whether started from scratch or from 2D sketches (blueprints). CATIA enables the creation of 3D parts, from 3D sketches, sheet metal, composites and molded forged or tooling parts up to the definition of mechanical assemblies. The software provides advanced technologies for mechanical surfacing. It provides tools to complete product definition, including functional tolerances as well as kinematics definition. It also provides a wide range of applications for tooling design, for both generic tooling and mold & die. In the case of Aerospace engineering an additional module named the aerospace sheet metal design offers the user combine the capabilities of generative sheet metal design and generative surface design.

II. LITERATURE REVIEW

This paper deals with designing a Robotic arm in the national Science Foundation Engineering Senior Design Projects for the person having some disability in arms and legs. Its name was 'Clutching and Gripping Device' developed by Arizona State University [1]. The similar Kind of project was made by the University of Massachusetts named as 'Assistive Reach Mechanism'. This device was having capacity to reach objects up to four feet from it and lifts five pounds of load. Multi-DOF Robotic Assembly for Press Shops is the another example of robotic arm. This project deals with the design, fabrication and control or monitoring of a robotic arm used for loading and unloading the metal sheets into a press. It consist of two stepper motors, out of which one control the motion of the arm and other the orientation of the wrist [2]. A robotics arm operating on Haptic technology having four degrees of freedom is unique concept on which these expert perform their research. It is designed for picking up certain object of specific weight and placing at desired location is presented in this project. The remote controller, controls the movement of robotic arm. The robotic arm is made of Polycarbonate material. The points having certain angle of rotation are fitted

with potentiometer. The microcontroller named Arduino duenlanove consist of ATemega- 328 as a processor is used to read potentiometer input signal in electrical form and convert it into digital pulse form (PWM), which drives the servomotors or the arm.[3].The new concept of designing a robotic arm with additive technology is explained in this paper. There objective was to design and built a customized, lightweight and low cost robot, capable to fulfill many industrial working tasks such as palletizing mobile telephone covers.[4]. Solid works software were used to designing and optimizing the robotic structure. Articulated robotic arm is used for handling and separating waste in waste management facility. This project focuses on thorough analysis on the design project of robotic arm for waste management application. The CAD software, Solid Works is used to model the detail design of the robotic arm, and to simulate the motion of the device.[5].This paper proposes a study on the workspace of the guiding device mechanism of a parallel topology robot is presented.

The kinematical scheme and the geometrical model of the guiding device mechanism of the parallel topology. The lengths of binary links between the platforms determine the shape and the volume of the parallel robot's workspace; different boundaries of the workspace are presented. Thus, variation of the workspace in both volume and shape is studied, depending on the binary link lengths, using for modeling and simulation Solid Works software [6]. A kinematic ally redundant manipulator is a robotic arm posses extra degree of freedom(DOF) than those required to establish an arbitrary position and orientation of the end-effector. A redundant manipulator offer several potential advantages over a non-redundant manipulator [7]. Development of versatile robotic hand just like artificial arm or humanoid robot is need of today. In this paper, Omni-directional bending mechanism called "double-screw-drive mechanism" was applied to drive a robotic hand. Robotic hand having three fingers as gripping part was built, and experimentation was carried out, in which each finger was controlled so as to track the elliptical orbit.[8]The robotic arm driven by pneumatic actuator for material handling was developed by this team. It consists of pneumatic hand and pneumatic wrist. The hand looks like human hand and able to grasp objects that have different shapes and mechanical characteristics. In this research, experimental models of the drive system of the pneumatic robot wrist have been constructed.[9].

The robot arm was designed with four degrees of freedom and do simple tasks, such as light weight material handling, which will be integrated into a mobile platform that serves as an assistant for industrial workforce. Different servo motors with variable capacities are implemented to operate various links. For controlling the robot they used **Lab view**, which performs inverse kinematic calculations and communicates the proper angles serially to microcontroller that drives the servo motors with the capability of modifying position, speed and acceleration.[10].

III. PROBLEM FORMULATION

Through various papers, it has been found that studying various parts of robotic arm is difficult and time consuming. Using 3d modeling software, a 3d model of a robotic arm can be easily created with all its geometrical parameters. Before actually creating a robotic arm the design, various

requirements and behavior of a robotic arm can be studied. It is a cost efficient method as it will enable to create error free robotic arm. This 3D robotic arm can be easily customized based on the requirements or changes provided.

IV. METHODOLOGY

KUKA configuration for robotic arm which have two parallel joints will be designed and simulated using CAD sotwares. KUKA robotic arms are commonly used in assembly operations. The robotic arm to be studied will have 5 degrees of freedom for faster and accurate and repeatable movements.

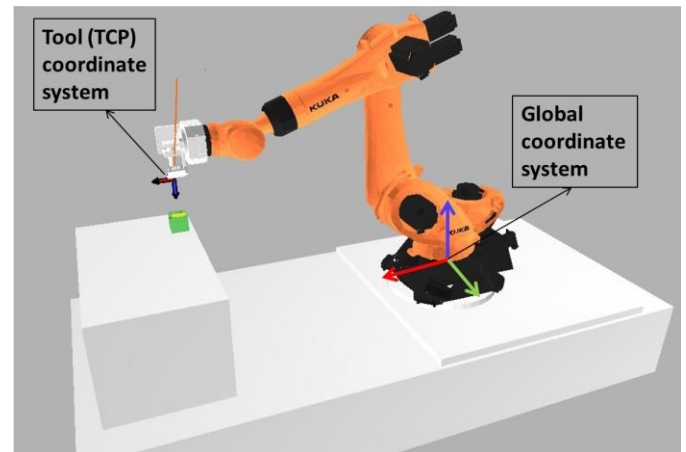


Figure.2. Kuka robotic arm model in powermill

CATIA software is used for design and simulation of robotic arm will be done on PowerMill .. It will also save time and money by avoiding restarting the design process with automatic updates. CATIA will predict the behaviour of the robotic arm across complex surfaces, taking corrective action wherever necessary.

The following approach will be used in this thesis work:

- Firstly the requirement of robotic arm will be accumulated and modeled in the form of drawing which is drafted in 2d sketch in CATIA.
- Then the detailed assembled 3D solid view will be generated in CATIA using commands and constraints conditions.
- The motion of the robotic arm and the geometry of the 3D space will be studied the various transformations as a large part of robot kinematics will be applied which are concerned with the establishment of various co-ordinate systems to represent the position and orientations of rigid objects and transformations among these coordinate systems.
- Then final model will be analyzed for getting idea about its total workspace consumption during its working in actual form.
- Finally the generated 3d model will be simulated by the aid of Power mill.

V. CONCLUSION

Development of versatile robotic hand just like artificial arm or humanoid robot is need of today. Every industrialist cannot afford to transform his unit from manual to semi automatic or fully automatic as automation is not that cheap in India. The design of robotic arm in CATIA enables 3D modeling in various angles and alignment with geometrical parameters can

be precisely checked and simulation provides prior analysis of robotic arm much before its actual working.

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