

A Review on Design and Fabrication of Robotic Arm

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Abstract:

This review sheds light on various aspects of robotic arms after reviewing several successful research articles on search engine. Today, robot arm are used throughout industries to lessen human blunders and boom the efficiency, productivity, and accuracy of ongoing operations. One of the maximum vital blessings of introducing robot arm in industries is that it may function beneathneath crucial situations consisting of excessive temperature, excessive pressure, in which human beings are liable to working. Since a manipulator belongs to a bendy automation mode, it may be without problems up to date and modified. We consulted some experimentally tested studies papers to study the exclusive styles of controllers used and the exclusive methodologies utilized by exclusive authors to determine the order of magnitude. The freedom of the controller is used to choose an item and area it in a particular position. So, the expertise received after referencing these types of articles will assist in designing the robotic arm.

Keywords- Robotic Arm, Pick and Place Arm, Automation.

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1. INTRODUCTION:

1.1 What is Robotic Arm?

A robotic arm, is also called as an industrial robot, is often described as a "mechanical" arm. It is a device that functions like a human arm, with several joints that move along an axis or can rotate in certain directions. In fact, a few robot hands are anthropomorphized and try and mimic the precise actions of a human arm. In maximum cases, they're programmable and used to carry out unique tasks, maximum normally for manufacturing, manufacturing, and business applications. They may be small gadgets that carry out

complicated and certain tasks, small sufficient to be held with one hand; or so big that their span is big sufficient to assemble a whole building. Original robotic guns are designed to assist in mass manufacturing factories, maximum households in cars. They have additionally been applied to limit the hazard of damage for employees and carry out monotonous tasks, to launch people specializing in extra complicated manufacturing. These first robotic hands are specifically used to adopt easy and repeated welding missions. When the era grows, mainly era imaginative and prescient and robotic sensors, the function of robotic guns changes. This article offers a short evaluate of robotic guns in

manufacturing. All designs of robotic hands were created the usage of company paintings software. All designs include exceptional elements together with base, body, hands, forearms, and quit hose heads. To offer movement ratio amongst those elements, servo motor is used. Each a part of the layout isn't always the same. To offer a proportional movement amongst those elements, Servomotor is used. Each a part of the layout has a exceptional size. For this layout, DC servo motor can be the ideal preference over stress and pneumatic actuators because of much less electricity requirement and mild weight. The suitable variety of electrical automobiles in business robots calls for numerous elements to don't forget arm control, position, angular and linear movement. The meeting of the automated arm layout has to be prepared to do the job. There are 3 exceptional degrees for adjusting the robotic arm, together with perception, observation, and execution. The sensor offers facts approximately the hyperlinks and its finishing outcomes with the robotic arm, before, this statistics is ready for the controller and growing affordable motor symptoms and symptoms exactly. Large wide variety of robots we use are specifically managed with the aid of using electric powered automobiles. Accurate robotic hyperlinks have to be managed, may be carried out to apply servo motor. The servo motor is adjusted with the aid of using pulse width modulation statistics (PWM) supplied with the aid of using the automated controller to stimulate robot arm hyperlinks. The servo automobiles are geared up to create sufficient torque to transport a short detail from the closing location. By the way, servo motor is often utilized in cutting-edge mechanical era as an elite alternative for stepper motor. Due to its unique movement,

it makes the robotic arm extra reliable. At first, all of the layout and layout levels from robotic to operator are carried out. Then all of the segments are assembled, presenting proportional movement among the segments the usage of a rotary hyperlink through a servo motor. Finally, drawings are generated to create sketches of the portions in more than one configuration.

1.2 Types of robotic Arm:

- **Cartesian robot / Gantry robot:** Mainly Used for Pick and putting job, sealing material application, assembly operations, machine handling and arc fastening. it's a mechanism with arms with 3 prismatic joints, the axes of that coincide with a mathematician dispatcher.
- **Collaborative robot / Cobot:** Cobot applications distinction with ancient industrial artificial intelligence applications wherever the mechanism is isolated from human contact. Cobot safety will be supported light-weight construction, rounded edges and inherent limits on speed and force, or sensors and computer code that guarantee safe behavior.
- **Cylindrical robot:** used for assembly operations, machine manipulation, spot fastening and die casting machine operations. it's a mechanism whose axis forms a cylindrical reference.
- **Spherical Robot / Polar Robot:** Used for machine handling, spot fastening, die casting, abrasive machines, gas fastening and arc fastening. it's a mechanism whose axes type a co-ordinate system.

- **SCARA robot:** used for job selecting and putting, sealing material application, assembly operations and machine handling. This mechanism has 2 parallel rotating joints to make sure a one-plane match.
- **Articulated Robot:** Used for assembly, die-casting, stamping, gas fastening, arc fastening and painting operations. it's a mechanism with arms with a minimum of 3 rotating joints.
- **Parallel Robot:** One use is that the mobile platform that controls the cockpit flight simulation. it's a mechanism whose arms have competitive prismatic or rotary joints.
- **Anthropomorphic robot:** it's formed sort of a human hand, has freelance fingers and thumbs.

is managed through Programmable Logic Controller (PLC).

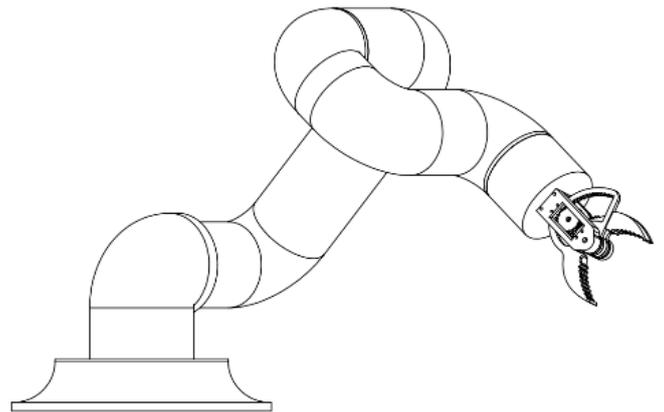


Fig. 1. 2-D model of Robotic Arm

2. DESIGNING OF ROBOTIC ARM:

To design and fabricate a pick and Place Robotic Arm System with the assist of a Arduino. this device affords an automated solution for commercial enterprise requirements for determine and vicinity operation. Robotic determine and vicinity automation accelerate the approach of selecting factors up and setting them in new location, growing manufacturing rate. at some point of this task, we will be inclined to vicinity unit developing with whole version of determine and vicinity robot arm. the approach variables that vicinity unit to be managed at some point of this task vicinity unit motion of arm, function of arm, etc. The task consists of creating a version. the complete approach

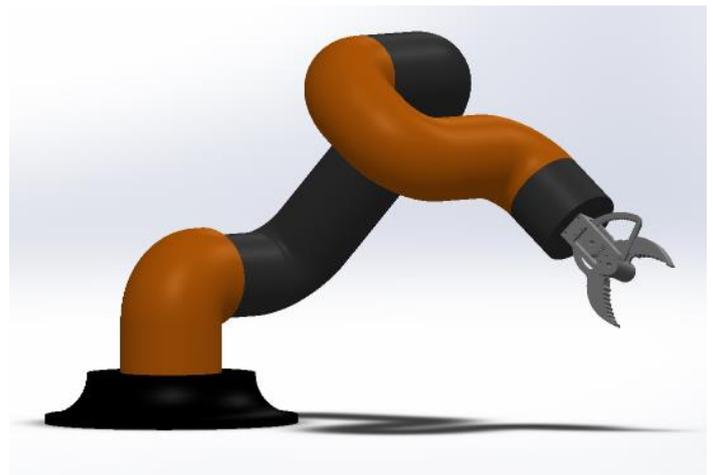
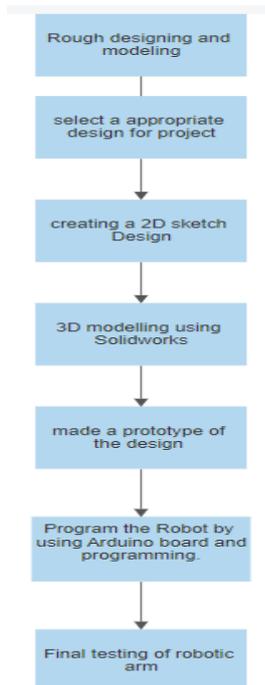


Fig. 2. 3-D design of Robotic Arm

2.1 Design Methodology:



2.2 Specification of Robotic Arm: -

Specification	Value
Degree of Freedom	5 D.O.F
Total Horizontal Reach	525 mm
Total Vertical Reach	600mm
Drives	5 servo motors
Structure	a) All the axes are Self-governing b) we can control all the axes concurrently

3. LITRATURE REVIEW:

3.1. Design and Static Analysis of Robotic Arm using Ansys by Anurag singh, Rashmi Arora, Yashpal Singh Chouhan in May 2020 [1]: In this paper, analysis and exploration is finished of the stresses and total deformation incited for a selected payload of a mechanism. A 5 degree of freedom (DOF) mechanism arm has been electing for stress and deformation analysis. the planning and model of the 5 DOF mechanism arm has been fancied by Solid works and also the whole structure analysis has been dead by ANSYS computer code. In gift world, robots square measure utilized in totally different fields particularly wherever accuracy is required. A model style development methodology utilizes the finite part analysis (FEA) for planning the robotic arm. within the past few years, the modelling, construction, and evolution of mechanism arm are terribly dynamic analysis fields everywhere the globe. during this paper, the simulation of a robotic arm is finished with the assistance of ANSYS computer code, and plenty of general aspects of a robotic arm square measure explored. the most purpose is that the evolution of a style that has the flexibility to idea the mechanism arm preciseness, underneath definite arm postures and most stress circumstances. Dissimilar nozzle weights square measure forced, and final knowledge at varied things square measure equated to find the feeble parts, thus more structure upgrading ought to be potential.

3.2. Design and analysis of a robotic arm under different loading conditions using FEA simulation By Lingala Purandhara

Sai Santosh, Neeraj Mishra, Swadhin Sri Aurobindo Mahanta, Vasanthakumar Dharmarajan, Saripella Koushik Varma, Sumit Shoor in June 2021 [2]: Robotic Arms have become a crucial part of every industry, pass packages from attachment or meeting of assorted factors to works that contain excessive precision. To alter little industries to require benefit of AI and automation, optimization of the glance through evaluation is quite essential. It conjointly reduces the fee of the products and could growth the lifestyles cycle. This observe consists of the layout and evaluation of a person`s arm type robot arm below completely exclusive loading situations exploitation Finite factor Analysis (FEA) simulation. A minimalistic method has been followed all through the layout of the robot arm. at some point of this paper, the computer-Aided Design (CAD) version of the robot arm is advanced exploitation Creo steady pc code and is exported to Ansys. From the effects of this observe, it is outstanding that fabric homes play a crucial function in numerous loading situations. Thus, optimization of favor is finished with the aid of using perceptive the effect of changing materials, the usage of Ansys Workbench. Finite factor technique (FEM) affords a obvious study of layout, optimization, failure evaluation and allows in saving fabric, time and cost.

3.3. Robust control design for a planar humanoid robot arm with high strength composite gear and experimental validation By Kang Huang, Yuanjie Xian, Shengchao Zhen, Hao Sun in June 2021 [3]: Non-linear control algorithms have been proposed to explain the

uncertainty and variable load of the robot arm. The proposed controller design is based on engineering techniques for planar humanoid robot arms with high-strength composite gears. The proposed controls consist of a PD control part and a robust control part that maintain the dynamic characteristics of the system and implement them based on errors. Theoretical analysis shows that the proposed controls can guarantee uniform finiteness and uniform limit finiteness. Using a humanoid robotic arm, experimental validation is performed on the proposed control and compared to PID control. Numerical simulations and experimental results show that the proposed controller can effectively cope with load changes and parameter uncertainties, and the robot's trajectory tracking accuracy is significantly improved by the proposed controller.

3.4. Review on Design and Development of Robotic Arm Generation-1 by Vaibhav Pawar, Sneha Bire, Shubham More, Komal More, Reshma Mule in March 2018 [4]: This paper introduces the design of robot arm Simulates the movement of a human hand to grasp object. The robot arm is a robot arm controlled by Arduino. Therefore, it can be implemented in an analyzable robot Perform material handling in dangerous locations. Uh When examining these torque characteristics, consider the model Simulates the typical lifting of a humanoid robot arm Use the robot arm to transfer tasks. Most of the current robot's hands are not complete Cannot be used as it replaces the function of the hand Environment intended for human

use hand. This paper concludes with some possible things Application of 4 degrees of freedom robot arm mechanism based on the type of end effector attached to the robot arm.

3.5. Review on design and development of intelligent robotic arm By Netra Barai, Swati Manekar in October 2015 [5]: Industrial automation requires a large number of machines to perform the same number of actions repeatedly. The main difficulties in designing such a system are complex programming and constant operating speed. Therefore, this can be overcome by designing and developing a robot arm that operates in real time. An industrial robot arm based on experience-based response learning technology. Based on the neurofuzzy approach, various techniques have previously been developed to record actions and convert them into engineering motion code and vice versa. This type of robot arm has a variety of uses in industrial automation, such as opening and closing bottlenecks, cleaning specific surfaces, and selecting and placing specific objects. To achieve such a smart robot arm, we can develop an algorithm that records the action when the user performs it during the "learning" phase, just as when the user performs the action for the first time. The robot runs. You can use a prototype vehicle arm to demonstrate and develop a system that controls a robot according to a sequence of recorded motion codes. You can install additional filters to add effects.

3.6. Modelling and Simulation of 5 DOF Educational Robot By Mohammed Abu Qassem, Iyad Abuhadrous, Hatem Elaydi in June 2010 [6]: In this

student's work, I created virtual software to control a manipulator consisting of 5d.o.f. This software is used for educational purposes and to educate people about how robotic arms work. Among them is 5d.o.f. A robot arm consisting of servo motors for the functioning of joints and end actuators. This paper also described the simulation results performed on the robot arm. The results show that we used map generation motion to communicate between the controller and the robot arm. As a result, the time resolution for accurate arm positioning was $1\mu s$, and a DC motor controller was used to produce very smooth motion.

3.7. DEVELOPMENT OF A ROBOT ARM: A REVIEW By Ibrahim Suleiman, Engr Salam, Yamajin Tanimu in January 2018 [7]: Global competition in the market requires continuous automation and modernization of production processes, especially in the automotive industry, so the use of robots in the world continues to increase year by year. Robots are also used for medical, security and even social purposes. This paper outlines the basic requirements required to develop a robot arm. We reviewed the published literature and briefly listed the important definitions and analyses of the mechanical structure of robot manipulators, their modelling, design, and control. This technique requires mathematical modelling and simulation of debt, which was briefly explained in this review paper.

3.8. A review of application industrial robotic design by Haider Abbas F. Almurib, Haidar F. Al-Qrimli, Nandha

Kumar Thulasiraman in January 2012 [8]: Robotics is at a barren technical stage that pushes the usual technical limits. Understanding robot problems and their applications requires knowledge of electrical engineering, mechanical engineering, industrial engineering, and mathematics. New technological areas such as manufacturing engineering are emerging to address the complexity of robotics and factory automation. This paper describes some of the world's industrial robot arms and shows the mechanism and components of robot arms. One of the sections presents a general classification of robotics to give you a better understanding of robotics, including: B. Actuator type, scope, and control method. The design aspects of building a robot arm are shown. B. Mobility, connectivity, redundancy, and frequency. Describes the characteristics of the hybrid robot arm structure and why it is necessary to use the hybrid structure.

3.9. Literature Review on Design and Simulation of Industrial Robotic Arm using CAD/CAM Software by Munish Baboria Munish Kaith in 2018 [9]: Today, in today's fast-paced industrial era, every company needs to produce quickly to keep up with customer requirements. Every industrialist cannot afford to upgrade their manual equipment to semi-automatic or fully automatic because automation is not so cheap in India. The basic goal of my project is to develop an inexpensive and versatile robotic arm that can be used in any industry to eliminate this problem. Such designed robotic arm can be used in many applications by modifying the control program and

designed structure in such a way that it can work in all kinds of conditions. The robot arm will mainly be used in machining processes like drilling and boring etc. CATIA provides shape, style, surface, and visualization workflow design solutions for creating, modifying, and validating complex creative shapes, and provides users with capabilities of Sheet Metal Design and Generated Surface Design.

3.10. A Review on Design and Development of Pick and Place Robotic Arm by Prof. S.D Rajgure, Aakash D Chougale, Ajit N Bhatkande, Suraj A Bhamare, Swaroop S Chougale in September 2020 [10]: Modelling of pneumatic robotic arm for automation in two machines, for material handling purpose.

Automation is to be done between two machines namely extrusion and belt grinding machine. This is made as per forward and inverse kinematics of robot arm motion. It is necessary to calculate the load carried by arm during its work time. It is commanded to design the pneumatic arm to pick and place the cylindrical object like steel bars. There are many types of robotic arms that operate on various power sources such as pneumatic systems, hydraulic systems, servomotors and include many basic mechanisms, it is more expensive to design a pneumatic arm, It requires several cylinders and pistons and its movement is achieved. using a compressed air supply. Robots are invented in industry to perform repetitive tasks, reduce labour costs and achieve the required quality control of the process. For pick and place operations, the basic

requirements of the base arms are high speed and reliability, and the robot gripper should be the least expensive and have a simple design. Basic operation starts with a simple task of grabbing, lifting, moving, placing, and releasing in a unique robotic arm system.

- 3.11. Design Concept and Validation of Robotic Arm Inspired by the Octopus”, M. Cianchetti, A. Arienti, m. follador in August 2011[11]: They get stimulated via way of means of the Octopus to and make an exciting version in robotics because of its excessive dexterity, variable stiffness, and really complicated behaviour. In this test they observe the important thing capabilities and styles of motion of Octopus arm and this capabilities and styles, and styles of motion are this is elongation, shortening, bending, and accomplishing etc. used for manual the motion of actuator. They finish that the idea proposed for the mechanism at the bottom of the robot arm stimulated to the Octopus muscular hydrostat wherein efficiently carried out on mock-ups and the corresponding fashions were changed and validate.
- 3.12. Design and Implementation of Pick and Place Robotic Arm by Ravikumar Mourya, Amit Shelke, Saurabh Satpute in April 2015 [12]: The main goal of the project is to design and implement a robotic arm with four degrees of freedom. They concluded that CAD tools such as Creo1.0 and Auto CAD were used to create the model for the desired operator. To determine the location and direction of the end effects, a theoretical inverse kinetic analysis was performed. Ansys software was used for FE analysis.
- 3.13. Design and Fabrication of Pneumatic Robotic Arm by Prof. S. N. Teli, Akshay Bhalerao, Sagar Ingole in March 2017 [13]: This mission objectives to layout and fabricate the pneumatic arm for select out and location of cylindrical objects. They finish that arm is managed with the aid of using manually flaw manage and route manage valve. Arm rotation and motion is carried out with the aid of using pneumatic cylinder the use of helical slot mechanism. Total arm weight is 25 kg. The version is predicted to raise at the least 10 kg weight.
- 3.14. Design and Implementation of Multi Handling Pick and Place Robotic Arm by S. Premkumar, K. Surya Varman, R. Balamurugan in March 2016 [14]: The objective of the test was to have the clamping mechanism and the vacuum mechanism operate in a single pick and place a collaborative robotic arm. These robots can perform tasks such as grasping, sucking, lifting, placing, and releasing in just one robotic arm. It will reduce cycle time, ideal time, operating cost, space consumption. It is user-friendly and effectively used in glass processing system.
- 3.15. Design and Manufacturing of a Prototype of a Lightweight Robot Arm”, S. C. Gutierrez, R. Zotovic, M. D. Navarro in June 2017 [15]: Their work goal was to create a lightweight robotic arm on a low-cost budget. They concluded that to avoid a negative effect on the total weight of the arm, a fiber-reinforced plastic material was used, and a vacuum infusion process was used for production. Local reinforcements must be included

during the construction of the arm shell. Light helical gear reducers, harmonic transmission types are used, but due to mismatch, the gear assembly must be disassembled to avoid these soft couplings.

- 3.16. Design, Actuation and Control of Anthropomorphic Robot Arm by Gabrielle J. M., Tuijthof, Just L. Herder in August 1999 [16]: Existing robots are not safe to interact with humans, especially for children, so a robotic arm with four degrees of freedom was developed. First, the joint stiffness of the arm is reduced to zero, then the arm is provided with pneumatic artificial muscles, and their stiffness can be adjusted by controlling the open-loop stiffness.
- 3.17. A Method for Reducing the Energy Consumption of Pick and Place Industrial Robots by M. Pellicciari, G. Berselli, F. Leali, A. Vergnano in April 2013 [17]: This article presents a method to reduce the total power consumption of the pick and place robot arm. First, electromechanical models of the series and parallel manipulators are generated, and then by constant time scaling, the optimal energy trajectories are calculated. We find that it's not always possible to cut down on an activity as much as possible. Energy consumption of a given operation as a function of task execution time. Future work includes improving the engine model, developing online programming algorithms.
- 3.18. Wireless Mobile Robotic Arm”, Mohd Ashiq Kamaril, Yusoff, Reza Ezuan Samin in December 2012 [18]: This paper introduces the development of wireless mobile robot arm. The

wireless PS2 controller is used to control the pick and place operation. The development of this robot is based on the Arduino Mega Platform. Analysis of the swing arm's speed, distance, and lift load is performed to know its performance. This robot will overcome problems such as placing or picking up an object far away from the user and picking up and placing a dangerous object quickly and easily.

- 3.19. Modeling Construction and Manufacture of A Lightweight Robot Arm”, H. Hagenah, W. Bohm, T. Breitsprecher in December 2013 [19]: This paper will show how modern materials such as cellular titanium and nanocrystalline aluminum can be used to build advanced and lightweight robotic arms. This article will cover defining the product specification, defining the basic design, and optimizing it through topology optimization. This optimization requires intelligent modeling that can study different initial settings and boundary conditions. Various innovative lightweight building materials and corresponding production technologies are developed and analyzed.
- 3.20. Development Of Simple Structured Pneumatic Robot Arm and Its Control Using A Low Cost Embedded Controller”, Mohd Aliff, Shujiro Dohta, Tetsuya Akagi, Hui Li in December 2012 [20]: The aim of the research is to develop lightweight actuators and applications in a flexible robotic arm. In this article, flexible altitude control of the Slavic master's degree and trajectory control of the robot arm is proposed. This robotic arm has 3DOF i.e., bends, expands and

contracts and will be applied in human wrist rehabilitation device. In this paper, the analytical model of the year with a flexible robotic arm is proposed to control the altitude of a master slave in orbital control.

3.21. Design and Structural Analysis of a Robotic Arm by Gurudu Rishank Reddy Venkata Krishna Prashanth Eranki in October 2016 [21]:

Automation is creating a revolution in today's industrial sector, as it reduces labour and production time. Our project mainly involves cutting operations, where sheet metal is picked up by hand and placed on belts for cutting, which involves an element of risk. Our challenge was to design a pick and place operator to transport the plate from the stack and place it in the cutter for feeding. We reviewed various literature, research articles and observed cutting-edge technologies used in other industries for a similar activity. After related research, we realized the design of a 3-joint robotic arm in which the base is fixed, and the remaining joints move in the vertical and horizontal directions. The end effector is also designed in such a way to lift the plate, we use suction cups where the plate is lifted with some pressure. Here we used Creo Parametric to design and Autodesk Inventor 2017 to simulate the designed model.

4. **CONCLUSION:**

Pick and place robotic arm will scale back the human efforts by automatic handing of fabric, associate degree automatic, servo controlled, freely

programmable, useful manipulator, with many areas for the handling of labor items, tools or special devices. By victimization trendy materials as cellular metal & nano crystalline metallic element, a lightweight weight robotic arm are often manufacture.

5. **REFERENCES**

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