JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Design and implementation of pneumatic pick and place robotic arm with specific position

1. Rushikesh G Sadavarte
2. Vivek A Ghate
3. Ashish J Ghodke
4. Shyam M Tathe

Department of Mechanical Engineering
Smt. Kashibai Navale College of Engineering, Vadgaon bk, Pune 411041.

Abstract- In recent years the industry and daily routine works are found to be more attracted and implemented through automation via Robots. The pick and place robot are one of the technologies in manufacturing Industries which is designed to perform pick and place operations. The system is so designed that it eliminates the human invention to get more precise work. There are many fields in which human intervention is difficult but the process under consideration has to be operated and controlled this leads to the area in which robots find their applications. Literature suggests that the pick and place robots are designed, implemented in various fields such as in bottle filling Industry, packing industry, used in surveillance to detect and destroy the bombs etc. The project deals with implementing a pick and place robot using Robo-Arduino for any pick and place functions. The pick and place robot so implemented is controlled using RF signal. The chassis is supported for the displacement of robotic arm by four Omni wheels. The robotic arm implemented has two degrees of freedom. Many other features such as line follower, wall hugger obstacles avoider, metal detector etc. Can be added to this robot for versatility of usage.

Index Terms- *Poppet valve, Composite Materials, CATIA, ANSYS.*

1. INTRODUCTION

Mechanical is the branch of engineering science & Technology related to machinery, and their design, manufacture, application, and structural disposition. Robotics is related to electronics, mechanics, and software. Robotics research today is focused on developing systems that exhibit modularity, flexibility, redundancy, fault-tolerance, a general and extensible software environment and seamless connectivity to other machines, some researchers focus on completely automating a manufacturing process or a task, by providing sensor-based intelligence to the mechanical arm, while others try to solidify the analytical foundations on which many of the basic concepts in robotics are built.

In this highly developing society time and man power are critical constrains for completion of task in large scales. The automation is playing important role to save human efforts in most of the regular and frequently carried works. One of the major and most commonly performed works is picking and placing of jobs from source to destination.

Present day industry is increasingly turning towards computer-based automation mainly due to the need for increased productivity and delivery of end products with uniform quality. The inflexibility and generally high cost of hard- automation systems, which have been used for automated manufacturing tasks in the past, have led to a broad-based interest in the use of mechanical arm capable of performing a variety of manufacturing functions in a flexible environment and at lower costs. The use of Industrial mechanical arm characterizes some of contemporary trends in automation of the manufacturing process. However, present day industrial mechanical arm also exhibits a monolithic mechanical structure and closed-system software architecture. They are concentrated on simple repetitive tasks, which tend not to require high precision.

The pick and place mechanical arm is a human controlled based system that detects the object, picks that object from source location and places at desired location. For detection of object, human detect presence of object and move machine accordingly.

2. IDENTIFY, RESEARCH AND COLLECT IDEA

Articulated - This robot design features rotary joints and can range from simple two joint structures to 10 or more joints. The arm is connected to the base with a twisting joint. The links in the arm are connected by rotary joints. Each joint is called an axis and provides an additional degree of freedom, or range of motion. Industrial robots commonly have four or six axes.

Fig.2.1 Articulated Robotic Arm

Cartesian - These are also called rectilinear or gantry robots. Cartesian robots have three linear joints that use the Cartesian coordinate system (X, Y, and Z). They also may have an attached wrist to allow for rotational movement. The three prismatic joints deliver a linear motion along the axis.

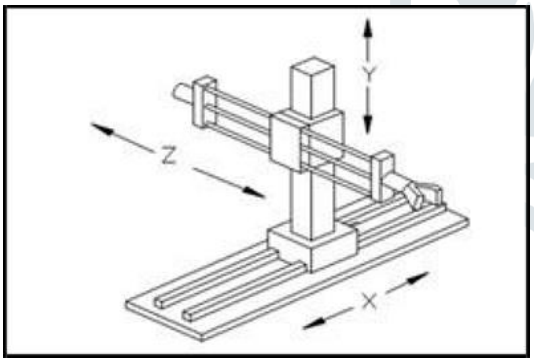

Fig.2.2 Cartesian Robotic Arm

Cylindrical - The robot has at least one rotary joint at the base and at least one prismatic joint to connect the links. The rotary joint uses a rotational motion along the joint axis, while the prismatic joint moves in a linear motion. Cylindrical robots operate within a cylindrical-shaped work envelope.

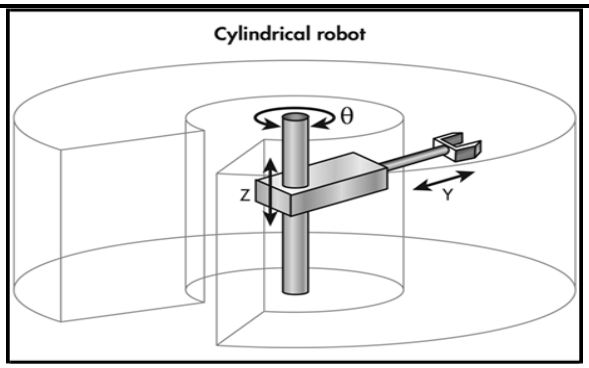

Fig.2.3 Cylindrical Robotic Arm

Polar - Also called spherical robots, in this configuration the arm is connected to the base with a twisting joint and a combination of two rotary joints and one linear joint. The axes form a polar coordinate system and create a spherical-shaped work envelope.

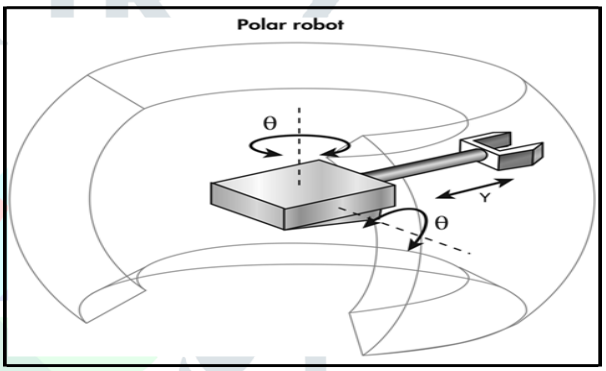

Fig.2.4 Polar Robotic Arm

SCARA - Commonly used in assembly applications, this selectively compliant arm for robotic assembly is primarily cylindrical in design. It features two parallel joints that provide compliance in one selected plane

Fig.2.5 SCARA Robotic Arm

Delta - These spider-like robots are built from jointed parallelograms connected to a common base. The parallelograms move a single EOAT in a dome-shaped work area. Heavily used in the food, pharmaceutical, and electronic industries, this robot configuration is capable of delicate, precise movement.

Fig.2.6 Delta Robotic Arm

3. LITERATURE REVIEW

S. Premkumar, K. Surya Varman, R. Balamurugan [2016]: "Design and Implementation of multi handling Pick and Place Robotic Arm" has illustrated about the collaboration between the gripper mechanism and vacuum sucker mechanism working in a single pick and place robotic arm. The research also shows that robot can be self-operational in controlling, stating with simple tasks such as gripping, sucking, lifting, placing and releasing in a single robotic arm. The operation of various arm linkages and the robotic arm has been extensively tested and the required corrective measures were taken. Hence the objective of designing and manufacturing of a pick and place robot at low cost was successful and it's been proved that running cost of the robot is also very less.

Prof. S. N. Teli, Akshay Bhalerao et.al. [2017]: "Design and Fabrication of Pneumatic Robotic Arm" had done a project which aims to Design and fabricate pneumatic arm for pick and place of cylindrical objects. The project was completed by considering effective and economic considerations. The movement of robotic arm was entirely controlled manually using flow control and direction control valves. The total weight of arm was 25 kg and it was successful in lifting of objects of at least 10 kg weight.

Santosh C, Manoj C S, et.al. [2016]: has given the detailed comparison between the Pneumatic systems and Hydraulic systems. The research mainly states the advantages of using Pneumatic systems over Hydraulic systems. It also tells that since Pneumatic systems contains lower pressure, components can be made of thinner and lighter weight materials, such as aluminum and engineered plastics, whereas hydraulic components are generally made of steel and ductile or cast iron.

Ravikumar Mourya, Amit Shelke, et.al. [2015]: have done a detailed study on design and implementing a 4-DOF Pick and place robotic arm. The main focus of his study is on 4-DOF articulated arm. Four servo motors were used in this project to perform four degree of freedom (4-DOF). The robot arm is controlled by a serial servo.

Biswas Palok, S. Anandan Shanmugam [2016]: Design and Development of a 3 axes Pneumatic Robotic Arm" has designed an articulated robotic arm using pneumatic linear actuators which carried out material handling tasks for industries where the usage of electric components can be hazardous. The design of the arm employed crank mechanism in which linear displacement from actuation was converted to angular displacement of the joint effectively. Closed loop control using a microcontroller and feedback sensors provided precise and improved control of the joint angle with high accuracy. It was also found that the force changes with the position of the articulated arm dynamically.

Vighnesh Devgirkar, Akash Sharma, et.al. [2017]: has done a detailed study about Robotics. In their study they have mentioned that "Robotics" is interdisciplinary with mechanical in the domain and other stream similar to electrical, electronics and computer, organism the additional and necessary for the engineering robot to be flexible, well-organized and exact in process. Further they have mentioned details about the components used in making a robot and their uses. Also in addition to that they have illustrated about changing trends in automation playing important role to save human effort in most of the regular and frequently carried works

Design and Manufacturing of Low-Cost Pneumatic Pick and Place Robot" designing a robotic arm that is completely functional by pneumatic principles and thus reducing the complexity in designing, manufacturing and machining.

4. SELECTION OF MATERIALS

Material selection for robotic arm should have the following requirements:

1.Fixture is synced to welding program
2.Cost benefit analysis must be preformed
3.Strong clamping mechanism will be designed

4.Fixture must be able to adapt to weld both straight lines and circular features on the work piece.
5.Fixture must be able to adapt to weld circular features at any point on the work piece surface.
6.Design will have enough degrees of freedom to complete all weld operations.
7.Design will be compact and easily assembled
8.Fixture will have independent clamping system

5. CALCULATION FOR FORCES ACTING ON HORIZONTAL, VERTICAI & ROTARY CYLINDERS

Design of cylinders: Horizontal, vertical, rotary cylinders & arm lifting cylinder are of same design and selected from the product catalogue.
Cylinders are of double acting type. According to the applications the forward and return stroke of the piston has to be controlled with some time interval. So double- acting cylinders are preferred. This time interval cannot be achieved by single- acting cylinders.

Design of Horizontal, Vertical & Rotary Cylinders

Force to be exerted is 200N Force = pressure x area
Pressure in the cylinder = 4 x105N/m2
Area of the piston, (πd2)/4 =Force/pressure
= 200/ 400000
= 0.0005m2
Bore diameter = 0.02523m
= 25.23mm

From this we have selected 25 mm bore diameter cylinder
For forward stroke:
For 25 mm bore diameter Corresponding rod diameter =10mm Area of the piston =(πd2)/4
= (πx252)/4
=490.874 mm2
Force (modified) to be exerted = pressure x area
= 4 x105 x 490.874
= 196.34 N

For return stroke:
On the return stroke, when the pressure is applied to the reverse direction, the force on the piston due to the pressure is = P x (A-a)

Where,
P = Pressure in the cylinder (N/m2)
A = Area of the piston (m2)
a = Cross sectional area of the piston rod (m2)

Therefore
Area of the piston (A-a) = {(π x d2)/4}-{(π x d 2)/4}
= {π x 252/4}-{π x102/4}
=490.874-78.53
=412.33mm2

Force to be converted
On the reverse direction = pressure x area
= 4 x 105x412.33
= 164.932 N

For working pressure of 4 x105N/m2
Extending force = 196.34 N Retracting force = 164.932 N

Design of end effector

Force (Fa) required for holding the work piece is 180N

Let force F = force applied by the cylinder.
Fa is the force required to hold the object
Fa x 22=F x 15
Therefor F=180x22/15
=264N
Thus 264 N of force should be supplied by the pneumatic cylinder

Selection of end effector cylinder
Pressure (P) supplied by the cylinder = 4 bar
Let area of cylinder be A.
A=F/P= 264/ (4 x 105)
Therefor (πd2)/4=264/ (4 x 105)
From this we get d = 28.98mm

Since the available standard cylinder is of diameter 32 mm and stroke length 100 mm, the cylinder used for the end effectors are selected with the dimensions of 32 mm x 100 mm.

6. Design of robotic arm Using CAD

Fig.

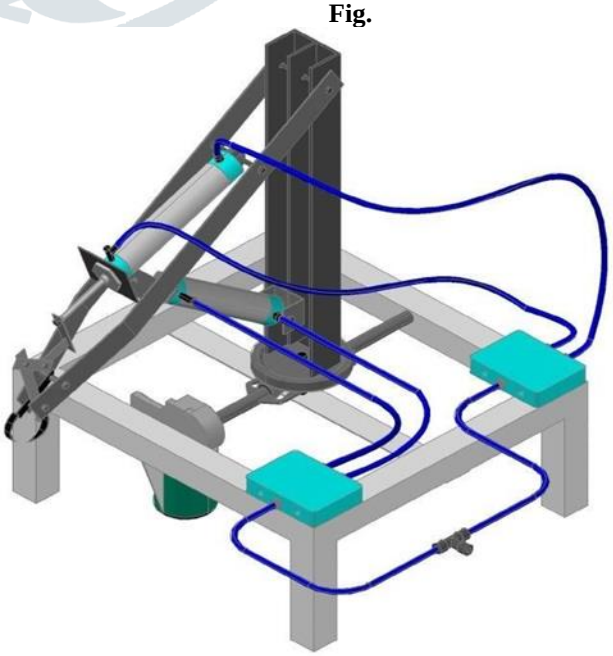

Fig.

7. FUTURE SCOPE

1. Highly heat resistant poppet valve is the requirement of 'modern high speed engine'.
2. By using the molybdenum material instead of stainless steel for valve mfg. the production cost of poppet valve to becomes less.
3. In sport or racing cars there is number of engine cycles done within a minute so, there is a high temperature & pressure is generates, then they cam affects the life & performance of poppet valve.
4. By the implementation of composite materialed poppet valve design, improves the life & performance of poppet valve.
5. By giving some amount of concave shape to the bottom side of valve head, to escape the exhaust gases in combustion chamber like a 'scavenging'.

8. CONCLUSION

The effective Design and Implementation of multi handling Pick and Place Robotic Arm has been performed. The operation of various arm link age sand the robotic arm has been extensively tested and the required corrective measures were taken. Hence the objective of designing and manufacturing of a pick and place robot at low cost was successful and It's been proved that running cost of the robot is also very less. This will help to cut down labor and improve profits at very low initial investment. The proposed model is demonstrated through an application of example of real world. By considering the above advantages and also by looking at various benefits, this project can be employed in the assembly industry.

We hereby, conclude by saying that this project can be a factor for creating an impact on assembly section.

The project based on "DESIGN AND IMPLEMENTATION OF PNEUMATIC PICK & PLACE ROBOTIC ARM WITH SPECIFIC POSITION" was interesting to work on and was also gained in this project work...

This knowledge of project will definitely be helpful in our future. So we must maintain that this final year project was an essential part of our engineering education enhancing our technical knowledge and practical skill.

9. AKNOWLEDGEMENT

Acknowledgement is a sweet and short way to express gratitude. I take this opportunity heartfelt thanks to all those who have guided, supported and encouraged me to complete my research work.

Indeed, the words at my command are not adequate to convey the depth of my feeling and gratitude to my project guide Prof. V.H. Bansode, for his most valuable and inspiring guidance with his friendly nature, love and affection, for his attention and magnanimous attitude right from the first day, constant encouragement, enormous help and constructive criticism throughout the course of this investigation and preparation of this manuscript.

I am also thankful to Prof. V.H. Bansode , for counsel generous guidance and useful suggestions; special thanks are tendered to Prof. T.S. Sargar, Head of Mechanical Department.

Taken deep appreciation is being rendered to Dr. A. V. Deshpande, Principal, Smt.Kashibai Navale College of Engineering, Pune, for providing the facilities during the course of my studies.

I would like to thank the entire staff members of Mechanical Department for timely help and inspiration for completion of the dissertation.

My vocabulary fail to get words expressed for my respect and sense of gratitude to my beloved parents, colleagues and friends who always wanted my success, inspired me with their love and affections and for the sacrifice made by them to shape my career.

10.REFERENCES

1) S Premkumar, K.Surya Varman R.Balamurugan "design and implementation of multihandling pick and place robotic arm. " Volume 33, march2016.

2) Prof .S.N. Teli' Akshay Bhalerao, Sagar Ingole, Mahesh Jagdale, Kiran Kharat "design and fabrication of pneumatic robotic arm "ijert volume 8, issue, march2017.

3) Santosh C, Manoj C S, Akshy Peddarajula, Abhishek R Shetty "design and fabrication of pneumatic arm for pick and place of cylindrical objects "ijerte volume v, issue VI, June2016.

4) Ravikumar Mourya, AmitShelke, Sourabh Satpute, Sushant Kakade, Manoj Botre."Design and implementation of pick and place robotic arm "ijerte, volume 2, issue 1, April – September2015.

5) Asharaf Elfasakhany , Edurado Yanez , Karen Baylon , Ricardo Salgado "design and development of low cost robot arm four degree of freedom " ijerte , November 2011.

6) Rakesh .N, Pradeep Kumar. A, Ajay .S "design and manufacturing of low cost pneumatic pick and place robot "ijrte volume 2, issue 8, August2013.

7) Biswas Palok, S. Anandan Shanmugam [2016]: "Design and Development of a 3 axes Pneumatic Robotic Arm" volume 5, issue 9, September2016.

8) Vighnesh Devgirkar, Akash Sharma, Abhijeet Chavan, Pratik Dhobi, Bhoomika Shukla [2017]: "Design and Manufacturing of Pick & Place Robotic Arm" volume 4, issue 4, April2017.