

Pneumatic Pick and Place Arm

¹S. N. Yadav, ² S.V. Joshi, ³ A. N. Bhoj, ⁴P. S. Koli, ⁵P. S. Barage

¹H.O.D., ^{2,3,4,5}Diploma Engineering Students

Department of Mechanical Engineering,
Ashokrao Mane Polytechnic, Vathar, Kolhapur, Maharashtra, India.

Abstract: A pneumatic pick and place arm is a mechanical system used for automated material handling in industries. This paper presents the design and development of a pneumatic pick and place arm operated using compressed air. The system uses pneumatic cylinders, directional control valves, and a gripper mechanism to perform operations such as picking, lifting and placing objects. The mechanism converts pneumatic energy into mechanical motion to achieve precise movement. The developed model is cost-effective, easy to operate and suitable for small-scale industrial automation and educational applications.

Index Terms - Pneumatic System, Pick and Place Arm, Automation, Pneumatic Cylinder, Industrial Robotics

I. INTRODUCTION

Automation plays an important role in modern manufacturing industries. Industries require machines capable of performing repetitive tasks efficiently with minimum human effort. Pick and place operations are commonly used in assembly lines, packaging units and material handling systems. A pneumatic pick and place arm is a robotic device that uses compressed air to generate motion. Pneumatic actuators convert air pressure into mechanical movement, enabling the arm to grip and move objects from one position to another. Pneumatic systems are widely used because they are simple, cost-effective, safe and easy to maintain. This project focuses on the design and fabrication of a pneumatic pick and place arm capable of performing basic material handling operations.

II. PROBLEM DEFINITION

In many industries, material handling tasks are still performed manually. This leads to several problems such as:

- High human effort
- Reduced productivity
- Inconsistent operation
- Increased chances of accidents
- Time-consuming handling process

To overcome these issues, an automated pneumatic pick and place arm is developed that can perform repetitive tasks efficiently and safely.

III. OBJECTIVES

- To design and develop a pneumatic pick-and-place arm capable of replicating basic human arm movements.
- To achieve precise and repeatable motion using simple and cost-effective pneumatic components.
- To control the speed and force of the arm for safe and efficient material handling.
- To reduce human effort, fatigue, and errors in industrial operations.
- To improve productivity and consistency in tasks such as material handling, sorting and assembly.

IV. METHODOLOGY

4.1 Design and Planning

Study of pneumatic systems and preparation of design layout using CAD tools.

4.2 Material Selection

- Mild steel for base frame
- Pneumatic cylinders
- Directional control valves

- Air compressor
- Gripper mechanism

4.3 Fabrication

- Cutting and welding of base frame
- Mounting pneumatic cylinders
- Assembly of arm structure

4.4 System Integration

- Pneumatic tubing connections
- Installation of valves and control system
- Alignment of mechanical components

4.5 Testing

- Functional testing of arm movement
- Checking gripping performance
- Observing cycle time and stability

V. Project Model

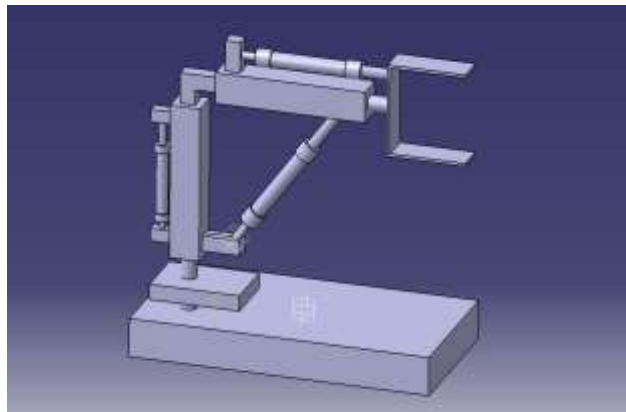


Fig. 5.1 CATIA Design



Fig. 5.2 Project Model

VI. WORKING PRINCIPLE:

1. The air compressor generates compressed air.
2. The FRL unit filters and regulates the air pressure.
3. Directional control valves control the flow of air.
4. Pneumatic cylinders extend and retract to move the arm.
5. The gripper mechanism grips the object.
6. The arm transfers the object to another location.
7. The gripper releases the object at the required position.

VII.RESULTS AND DISCUSSION

The fabricated pneumatic pick and place arm was tested successfully and produced the following results:

- Smooth and reliable arm movement
- Efficient gripping mechanism
- Reduced manual effort
- Simple and easy operation
- Stable and lightweight structure

Advantages

- Low-cost automation
- Fast response time
- Easy maintenance
- Safe operation

Limitations

- Limited load capacity
- Requires compressed air supply
- Limited precision compared to advanced robotic systems

VIII.APPLICATIONS

- Industrial material handling
- Assembly line operations
- Packaging industries
- Sorting systems
- Educational robotics laboratories

IX.CONCLUSION

The pneumatic pick and place arm was successfully designed and fabricated. The system effectively performs material handling tasks using compressed air actuators. The project demonstrates the practical application of pneumatic technology in automation. The developed system is simple, economical and suitable for small-scale industrial and educational purposes. Future improvements may include PLC control, sensor integration and automated sequencing for improved efficiency.

X.REFERENCES

- [1] Parkhi, R. (2017). Utilization of Pneumatic Actuator. International Journal of Advance Research and Innovative Ideas in Education (IJARIE), Vol. 3, Issue 6.
- [2] Walker, J., Zidek, T., Harbel, C., et al. (2020). Soft Robotics: A Review of Recent Developments of Pneumatic Soft Actuators. Actuators, 9(1): 3. MDPI.
- [3] Özçelik, Z., & Karaca, M. M. (2024). Design and Kinematic Analysis of Spherical Robot Arm and Pneumatic Driven Gripper. International Journal of Advanced Natural Sciences and Engineering Researches, 8(8), 159–180.
- [4] V. K. Banga, Jasjit Kaur, R. Kumar, Y. Singh (2011). Modelling and Simulation of Robotic Arm Movement using Soft Computing”, International Journal of Mechanical and Mechatronics Engineering, Vol:5
- [5] Rajgure S.D et al [2018]. A Review on Design and Development of Pick and Place Robotic Arm”, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) 2018 pp. 74

Copyright & License:

© Authors retain the copyright of this article. This work is published under the Creative Commons Attribution 4.0 International License (CC BY 4.0), permitting unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.