

SCARA Robot for Shape Based Sorting

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Abstract: *This project focuses on the design and implementation of a SCARA (Selective Compliance Assembly Robot Arm) robot for automatic shape-based sorting. The main aim is to identify and separate objects based on their shapes such as circle, square, and triangle. The system uses sensors or a vision system to detect the shape of objects placed on a conveyor or platform. Based on the detected shape, the SCARA robot picks and places the objects into different locations. The robot provides high speed, accuracy, and repeatability in sorting operations. This project reduces manual effort and increases efficiency in industrial applications. It is useful in manufacturing, packaging, and material handling industries. The system is controlled using a microcontroller, ensuring smooth and precise operation. Overall, this project demonstrates automation and intelligent sorting using robotic technology*

Keywords: SCARA Robot, Shape-Based Sorting, Automation, Pick and Place, Sensors, Industrial Robotics, Object Detection, Microcontroller/PLC, Material Handling, Smart Manufacturing.

I. INTRODUCTION

In today's industrial environment, automation plays a very important role in improving productivity, accuracy, and efficiency. Manual sorting of objects is time-consuming, less accurate, and requires more labor. To overcome these problems, robotic systems are widely used in industries. One such robot is the SCARA (Selective Compliance Assembly Robot Arm), which is specially designed for high-speed pick-and-place operations.

This project focuses on a SCARA robot for shape-based sorting of objects such as circles, squares, and triangles. The system uses sensors or a vision system to detect the shape of objects and then controls the robot to pick and place them in their respective positions. The SCARA robot is preferred because of its simple structure, high precision, and fast operation.

The main objective of this project is to develop an efficient and automated sorting system that reduces human effort and increases accuracy. This type of system is widely used in industries like packaging, manufacturing, and assembly lines. Overall, this project demonstrates the practical application of robotics and automation in real-world industrial processes.

II. LITERATURE REVIEW

Recent advancements in robotics and automation have focused on improving industrial sorting systems using robotic arms and intelligent detection techniques. SCARA robots are widely used in industries due to their high speed, accuracy, and repeatability in pick-and-place operations.

Patil et al. [1] developed a SCARA robot for automated material handling, highlighting its efficiency in high-speed sorting applications. Their study shows that SCARA robots reduce human effort and improve production rate in manufacturing systems.

Sharma and Kulkarni [2] proposed a vision-based object sorting system using image processing techniques. The system was able to detect shapes like circle, square, and triangle, improving sorting accuracy and reducing manual errors.

Reddy et al. [3] implemented a robotic arm integrated with sensors for object detection and classification. Their work demonstrated that sensor-based systems are cost-effective and suitable for small-scale industries.



Kumar et al. [4] designed an automated pick-and-place system using a microcontroller-based SCARA robot. The system showed improved precision and flexibility in handling different types of objects.

Singh and Verma [5] explored the use of machine vision and artificial intelligence for advanced sorting applications. Their research highlights the importance of intelligent algorithms in improving detection speed and system performance.

Although many systems have been developed using SCARA robots and object detection techniques, limited work has focused specifically on combining shape-based detection with efficient robotic sorting in a simple and low-cost system. This project addresses this gap by integrating a SCARA robot with shape detection for accurate and automated sorting.

III. METHODOLOGY

System Overview

The proposed system is designed to perform automatic shape-based sorting using a SCARA robot. The system consists of a robotic arm, sensors or a vision system, a controller (microcontroller), and a working platform or conveyor. Objects of different shapes such as circles, squares, and triangles are placed on the platform.

Sensors or a camera detect the shape of each object and send this information to the controller. Based on the input, the controller processes the data and generates control signals for the SCARA robot. The robot then performs pick-and-place operations to sort objects into predefined locations.

The SCARA robot is chosen for its high speed, accuracy, and repeatability in industrial tasks. The overall system reduces manual effort, improves sorting efficiency, and ensures precise operation in real-time applications.

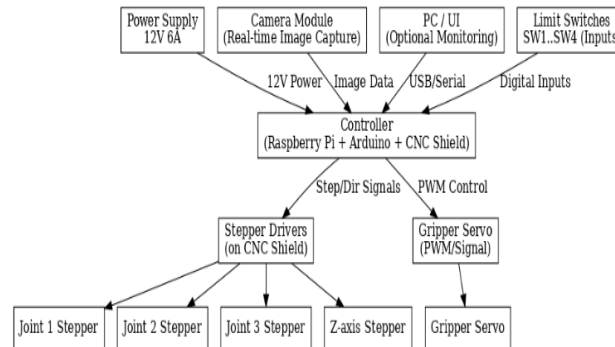


Fig. 1. Block diagram of Scara robot for shape based sorting

Functional Requirements

- The system should detect and identify different shapes of objects accurately. It includes a latching solenoid valve for efficient water flow control, using energy only during the switching process.
- The SCARA robot should perform precise pick-and-place operations.
- The controller should process sensor/vision data and control robot movement. The system monitors flow rate and total discharged volume to prevent both over- and under-irrigation.
- The system should sort objects into separate locations based on their shapes.
- The robot should operate with high speed and repeatability.
- The system should minimize human intervention and improve efficiency.
- The setup should be simple, reliable, and suitable for industrial applications.
- Safety measures should be included to avoid damage during operation.



IV. EXPERIMENTAL RESULTS

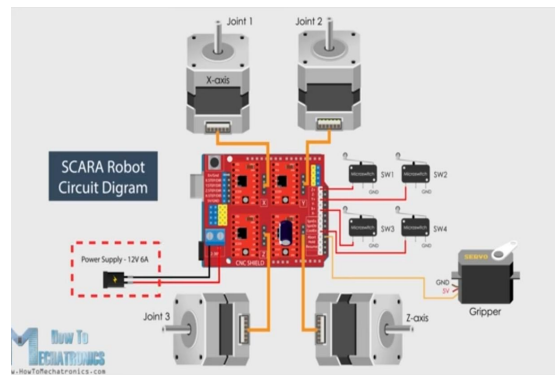


Fig. 2. Circuit Schematic of Scara robot for shape based sorting

Figure 2 shows Circuit Schematic diagram Scara robot for shape based sorting

V. CONCLUSION

This project presents the design and implementation of a SCARA robot for shape-based sorting. The system effectively reduces manual effort and increases sorting speed and accuracy. By using sensors and automated control, the robot can identify and separate objects efficiently. The project demonstrates the practical application of robotics in industrial automation. In future, the system can be improved by adding advanced vision systems and AI-based object recognition for more complex sorting tasks

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REFERENCES

- [1]. B. Siciliano, L. Sciavicco, L. Villani, and G. Oriolo, Robotics: Modelling, Planning and Control. Springer, 2009. Numbi, N. H., Mbuyu, S., & Hlahlele, T. S. (2024, January). Development of an ESP32 Smart and Safe Outdoor Plant Watering System. In *2024 32nd Southern African Universities Power Engineering Conference (SAUPEC)* (pp. 1-6). IEEE.
- [2]. J. J. Craig, Introduction to Robotics: Mechanics and Control, 3rd ed. Pearson, 2005. Mujoo, S., Sharma, A., Gaikwad, K., Madhe, S., Sista, S., & Khatape, M. (2021, August). Smart irrigation system using IoT based control valve. In *2021 Asian Conference on Innovation in Technology (ASIANCON)* (pp. 1-5). IEEE, "Industrial Robotics and Automation Standards," IEEE Publications.
- [3]. Sadik-Zada, E. R., & Jalabi, S. (2025). Powering agricultural revival: How solar-based irrigation is transforming Northeast Syria's war-torn fields. *The Electricity Journal*, 38(2), 107471.
- [4]. S. S. Raut and A. V. Kulkarni, "Shape Detection and Sorting Using Image Processing," *International Journal of Engineering Research & Technology (IJERT)*, vol. 9, no. 5, pp. 1–5, 2020. Bhanuse, V., Bhosale, S. N., Bhilare, A. M., & Bauskar, A. R. (2025, January). Smart Servo Operated Ball Valve with IoT Integration and PID Control for Precise Fluid Management. In *2025 International Conference on Intelligent and Innovative Technologies in Computing, Electrical and Electronics (IITCEE)* (pp. 1-5). IEEE.
- [5]. International Federation of Robotics, "World Robotics Report 2023." Arnaud, A., Sbarbaro, A., Calarco, N., Gak, J., Gudiño, H., Tepezila, A., ... & Miguez, M. (2024, September). Power management for a wireless solenoid irrigation valve. In *2024 IEEE 2nd Conference on AgriFood Electronics (CAFE)* (pp. 85-89). IEEE.



- [6]. M. P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, 4th ed. Pearson, 2015.
- [7]. R. S. Gaonkar and S. B. Patil, "Automation in Material Handling Systems Using Robotic Arms," International Journal of Advanced Research in Engineering and Technology (IJARET), vol. 10, no. 3, pp. 45–52, 2019

