

# ANDROID BASED PICK AND PLACE ROBOTIC ARM VEHICLE

Srinivasan K, Thri shanth S, Thameswer U, Lingesh M\*, ELANGO VAN K

Department of Computing Technologies SRM Institute of Science and Technology Chennai, India  
Department of Engineering Multimedia University Chennai, India

**Abstract :-** This project presents the design and implementation of an Android based pick and place robotic arm vehicle aimed at improving automation in industrial and hazardous workspaces. The system consists of a robotic arm with four degrees of freedom mounted on a mobile platform that allows accurate object manipulation and controlled movement. A Raspberry Pi is used as the central controller to operate motor drivers, servos, and sensors while receiving commands from a custom Android application. Communication between the app and the Raspberry Pi is achieved wirelessly through Bluetooth or WiFi, which enables real-time control and monitoring. An optional camera module is included to support image processing and object recognition, giving the robot the ability to identify and sort objects with minimal human input. This addition enhances the system's adaptability to more complex tasks. The use of open-source hardware and software ensures that the solution remains cost-effective, scalable, and accessible for small and medium enterprises. During testing, the robot successfully picked and placed items weighing up to 500 grams and responded effectively to user instructions sent through the app. The Android interface provided a smooth user experience with intuitive controls. The system performed reliably on flat surfaces but encountered minor difficulties on uneven terrain and showed limited gripper flexibility when handling irregularly shaped objects. This project highlights the potential of integrating mobile technology with robotics to reduce manual labor, increase precision, and improve operational safety in various fields. The modular build and open design allow for easy future upgrades, including artificial intelligence-based object recognition, adaptive gripping mechanisms, and enhanced navigation over different types of surfaces. The outcome of this project demonstrates a practical and efficient approach to developing robotic systems using widely available components and modern mobile interfaces.

**Keywords -** Android application, pick and place robot, Raspberry Pi

## I. INTRODUCTION

The rapid evolution of automation in various industries has paved the way for robots to perform tasks that were once labor-intensive or hazardous to human workers. One such task is the pick-and-place operation, which is essential in fields like manufacturing, logistics, and material handling. To address these needs, the development of an Android-controlled robotic arm vehicle is proposed, combining mobility and precision in a single integrated system. This vehicle is designed to automate the process of picking up and placing objects with high accuracy, reducing the need for human labor while enhancing operational efficiency.

The robotic arm is mounted on a mobile chassis, providing flexibility in navigation across different environments, including those that are difficult or unsafe for humans to access. The system is controlled remotely through an Android application, offering users the ability to monitor and direct the vehicle's actions in real-time. At its core, the system uses a Raspberry Pi microcontroller to manage the robotic arm's movements and sensory feedback, enabling the vehicle to execute tasks autonomously or under manual guidance.

In addition to basic functionality, the system offers the potential for expanded capabilities through the integration of a camera module. This addition allows the robotic arm to identify and sort objects, further streamlining operations in environments where tasks require greater complexity, such as assembly lines or

hazardous areas. The design leverages open-source hardware and software making it an affordable yet effective solution for industries looking to adopt automation without the significant costs typically associated with advanced robotic systems.

This project aims to explore the potential of using readily available technologies to create flexible, efficient, and cost-effective robotic solutions, demonstrating the increasing role of robotics in modern industrial applications.

A voice-controlled mobile robot has been designed to assist wheelchair users in picking and placing objects. It features an extendable arm capable of handling items at two different levels and uses simple voice commands for navigation. A Raspberry Pi 2 manages its operations, including a 5-DOF servo motor arm, while a webcam provides live video streaming through a mobile app for user monitoring. The robot can effectively pick and place objects up to a height of 23.5 cm, offering practical support for individuals with limited mobility.

Pick-and-place tasks are a significant part of industrial robotics, but challenges with comparability and reproducibility of results have slowed progress in the field. To address this, a benchmarking framework is proposed, focusing on a common logistics task: picking fruits and vegetables from a container and placing them into an order bin. The framework includes a reproducible setup, a publicly accessible set of objects, and clear guidelines for designing scenarios of varying complexity. It has been used to evaluate the performance of four robotic system variants with different end-effectors, providing a practical approach to assess and improve manipulation systems.

This paper presents a bin pick-and-place system for factory and warehouse automation using a 6-DOF robot manipulator integrated with the Robot Operating System (ROS). The system combines an object perception module utilizing an RGB-D camera and YOLOv4 for object detection and pose estimation with a pick-and-place module that controls the manipulator and custom vacuum tools. A CAD-based pose estimation method and a collision

avoidance algorithm ensure precise and safe operations. Ten ROS nodes were developed to simplify implementation and replication. The system's effectiveness was validated through four experiments involving two task types and two object types, demonstrating reliable performance.

This study explores optimizing spring arrangements in a 3-degree-of-freedom robotic arm to reduce electrical energy consumption during pick-and-place tasks. By incorporating elastic elements, specifically Parallel Elastic Actuation (PEA) on joints 2 and 3, and rigid actuation on joint 1, the system achieves significant energy efficiency. Simulations and experiments confirm this configuration reduces root mean square (RMS) torque by 43% and peak torque by 44% on joint 2, and by 15% and 21% on joint 3, compared to a setup without springs. This approach highlights the potential of elastic actuation to enhance robotic arm efficiency while maintaining performance.

This article addresses optimizing task sequences for a dual-arm robotic manipulator in footwear production. The robot identifies randomly positioned shoe pieces on a tray and places them into a mould for processing. A decision tree model is developed to recognize patterns and determine the optimal pick-up sequence, reducing picking and decision-making time. The solution is trained and validated using two shoe models and successfully applied in a real production setting. The study highlights the advantages of decision trees in task planning for complex environments with multiple trajectories and potential arm collisions, showcasing their effectiveness in sequencing and scheduling robotic tasks.

This project involves designing and building a Cartesian robot to automate object handling in industrial environments. Mounted on a shelf for autonomous warehouse systems, the robot features a PLC-based control system to coordinate stepper motors and communicate with other systems. Its mechanical design includes a Cartesian structure with linear axes driven by threaded rods, while the electronics incorporate NEMA 23 stepper motors, controllers, sensors, and an HMI interface. The Siemens PLC processes sensor inputs and controls

the robots movements The robot enhances efficiency and precision reduces production time and minimizes errors Integration with warehouse management and artificial vision technologies further improves performance

This work introduces a novel approach to multifingered grasp planning using deep neural networks (DNNs) A voxel-based 3D convolutional neural network (CNN) is trained to predict the probability of successful grasps based on an objects visual information and grasp configuration Grasp planning is then framed as finding the configuration that maximizes this probability Additionally a mixture-density network (MDN) learns a prior over grasp configurations conditioned on the objects representation which enhances inference compared to object-agnostic or uniform priors This is the first method to plan high-quality multifingered grasps in configuration space using a DNN without external planners demonstrating superior performance in real-world robotic experiments

The paper introduces a novel robot with omnidirectional movement designed to excel in confined industrial spaces Specially tailored for pick-and-place tasks the robot underwent a complete development process including planning design fabrication and programming Its advanced mobility and adaptability mark significant progress in industrial robotics particularly in environments where traditional robots face limitations The study also explores potential enhancements and broader applications of the technology highlighting its promise for improving efficiency and versatility in various industrial settings

This work addresses the challenges of robotic pick-and-place tasks in cluttered environments where robots must carefully coordinate grasp and placement decisions for success Unlike prior methods this approach leverages advanced learning-based techniques for multifingered grasp planning A modular algorithm is proposed to plan grasps for novel objects using state-of-the-art classifiers and partial viewpoint cloud data The framework incorporates various cost functions for different placement tasks Experiments with a physical robot

in cluttered scenes demonstrate that this joint pick-and-place method outperforms traditional sequential approaches achieving higher success rates and better placement configurations highlighting its effectiveness in complex manipulation scenarios

## II. WORKING OF THE PROJECT

An Android-based pick-and-place robotic arm vehicle is a highly efficient and user-friendly system designed to automate tasks like lifting and relocating objects The operation begins with the user interacting with an Android application which serves as a control interface Through the app users can specify the object to be picked up and its target location These instructions are transmitted wirelessly to the robotic vehicle using communication methods like Bluetooth or Wi-Fi Once the commands are received they are processed by a central controller such as a Raspberry Pi or Arduino which acts as the system's decision-making hub This controller converts the input into precise actions for the robotic arm and vehicle

The robotic vehicle then moves towards the designated area guided by wheels and supported by sensors that help it navigate Upon arriving at the target the robotic arm engages its detection mechanism which can involve cameras ultrasonic or infrared sensors to locate the object The arm equipped with a gripper carefully aligns itself and securely grasps the object Special care is taken to ensure the object is handled safely ensuring no damage occurs

Once the object is picked the vehicle carries it to the specified location as per the users instructions At the destination the arm carefully releases the object placing it in the desired position After completing the task the system provides feedback to the user via the Android app confirming the successful completion of the operation and allowing for new commands if necessary

This system exemplifies the seamless collaboration between human control automated processing and mechanical functionality The Android based pick and place robotic arm vehicle finds applications in diverse fields such as logistics manufacturing and home automation By automating repetitive tasks with high accuracy it reduces human effort and

improves operational efficiency demonstrating the potential of modern robotics in solving practical problems

### III. FLOW CHART

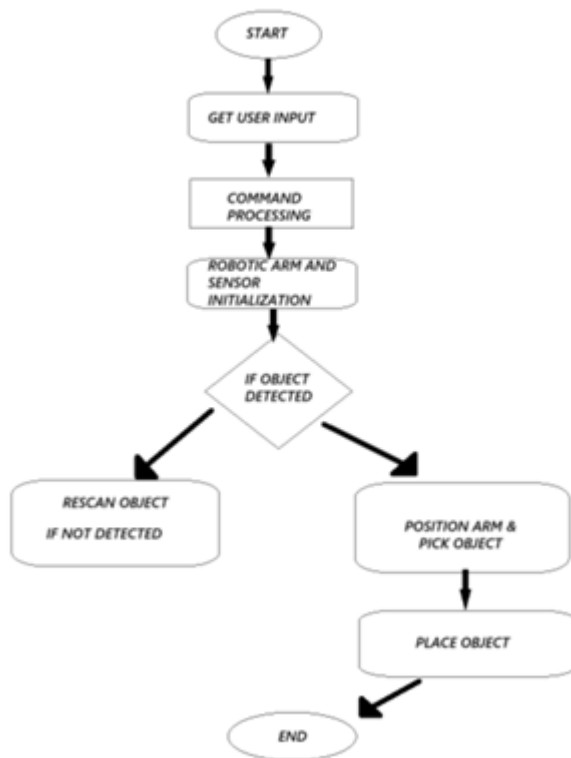


Figure 1. Flow chart of the process

**This flowchart represents a structured process for detecting picking and placing an object using a robotic system**

**Start:** The process begins here, initializing the workflow

**Get User Input:** The system waits for user instructions which might include selecting an object or defining a task

**Command Processing:** The received input is processed determining how the robotic system should operate

**Robot Arm and Sensor Initialization:** The system activates the robotic arm and sensors preparing for object detection

**Object Detection:** A decision point where the system checks for an object using its sensors

If an object is not detected the system triggers a Rescan Object step to try again If an object is detected the robotic arm moves to the next step

**Position Arm & Pick Object:** The robotic arm moves to the correct position and picks up the detected object

**Place Object:** The robotic arm places the picked object in the designated location

**End:** The process concludes after the object is successfully placed

This structured approach ensures efficiency and accuracy in robotic operations reducing errors and enhancing automation

### IV. SCALABILITY AND ADAPTABILITY OF AN ANDROID-BASED PICK-AND-PLACE ROBOTIC ARM VEHICLE

Automation has become a game-changer across various industries and robotic systems are at the forefront of this transformation Among these an Android-based pick-and-place robotic arm vehicle stands out for its flexibility efficiency and ease of control The ability to scale and adapt such a system is critical in ensuring its long-term usability across different applications from industrial automation to logistics and even healthcare

**Scalability:** Expanding Capabilities for Broader Applications

Scalability refers to how well a system can handle increased workload or be upgraded to perform more complex tasks In the case of an Android-controlled robotic arm scalability can be achieved in several ways

**Hardware Upgrades** – The robotic arm can be enhanced with stronger actuators higher-precision sensors and better gripping mechanisms to handle heavier or more delicate objects This ensures that the system can work across industries from manufacturing to medical applications

**Software Enhancements** – Since the robot operates through an Android interface updates can be rolled out to improve efficiency add new functionalities or integrate artificial intelligence for smarter operations Machine learning algorithms can help the system learn from past tasks improving accuracy over time

**Modular Design** – A scalable robotic system benefits from a modular approach where different components such as the robotic arm vehicle base and sensors can be swapped or upgraded depending on the required task This allows for seamless integration with existing automation systems

**Adaptability:** Meeting Changing Needs and Environments

For a robotic system to be truly effective it must be adaptable to different conditions and environments Here’s how an Android-based robotic arm vehicle can achieve this

**Multi-Platform Compatibility** – By leveraging Androids ecosystem the robot can be controlled from a wide range of devices including smartphones tablets and even voice commands through virtual assistants This makes it accessible and easy to operate without requiring specialized hardware

**AI and Computer Vision Integration** – By incorporating computer vision and AI-based decision-making the robotic arm can recognize objects differentiate between materials and adjust its grip strength accordingly This is particularly useful in industries where precision is essential such as pharmaceuticals or electronics assembly

**Wireless and Remote Operations** – Since the system is Android-based it can function over Wi-Fi or Bluetooth allowing remote operation This is especially beneficial in hazardous environments where human presence is risky such as chemical plants or disaster response scenarios

**Real-World Applications and Future Potential**

The ability to scale and adapt makes Android-based robotic arm vehicles ideal for numerous real-world applications They can be used in

**Warehouses and Logistics** – Automating inventory management and package handling

**Medical and Healthcare** – Assisting in surgeries or delivering medical supplies in hospitals

**Agriculture** – Sorting and packing produce with minimal human intervention

**Disaster Relief** – Handling hazardous materials or delivering aid in dangerous areas

Looking forward advancements in 5G connectivity edge computing and AI-driven automation will

further enhance these robotic systems making them even more responsive and autonomous

## V. LITERATURE SURVEY

**"Design and Development of a Robotic Arm for Industrial Automation" – International Journal of Engineering Research and Applications (IJERA) 2015**

This study emphasizes the use of robotic arms for repetitive industrial tasks like assembly packaging and material handling It highlights how robotic arms reduce human effort improve precision and operate in hazardous environments The study used microcontrollers and servo motors for arm control laying the groundwork for automation systems like pick-and-place robots

## VI. BENEFITS OF HYBRID ALGORITHM

Consisting of the Advanced Encryption Standard (AES) and RC4 to encrypt and decrypt images can provide some important advantages This is because in terms of security the whole arrangement is first ever useful one that uses AES along with the swiftness & simplicity from RC4 It’s like this because while the American National Standards Institute standard encryption provides strong cryptographic protection against a widely known attack of adversary adding RC4 gives an extra layer of perceived security provided this has been done correctly

Secondly such hybrid algorithms improve performance by relying on lightweight stream ciphers such as RC4 for fast encryption/decryption tasks The speed can be very convenient in applications working with large image files on the fly For instance, the ability to personalize options is another benefit of this mixed approach for instance AES allows users to choose among different key sizes and modes for encrypting while RC4 may be easily optimized for security or performance only and also an overall improvement occurs in terms of security robustness where no single algorithmic weaknesses are present when AES is combined with

RC4 thereby avoiding various dangers associated with them individually



Figure 2. Expected result

## VII. METHODOLOGY

Image sensing involves capturing processing and analyzing visual information from the environment. The primary tools used in image sensing include image sensors such as CCD (Charge-Coupled Device) and CMOS (Complementary Metal-Oxide Semiconductor) sensors which convert light into electrical signals. These sensors are commonly integrated into cameras and smartphones to capture images and videos. To interpret the captured data image processing software like MATLAB, OpenCV, and TensorFlow is used for tasks such as filtering, edge detection, object recognition, and feature extraction. Infrared cameras, thermal imaging sensors, and LiDAR (Light Detection and Ranging) systems are also employed in applications like night vision, autonomous vehicles, and industrial automation. Additionally, tools like machine learning algorithms and AI models are integrated to enhance image analysis capabilities, allowing systems to detect patterns, classify objects, and make decisions. Together, these tools form a comprehensive image sensing system that is essential in fields such as robotics, healthcare, security, and environmental monitoring.

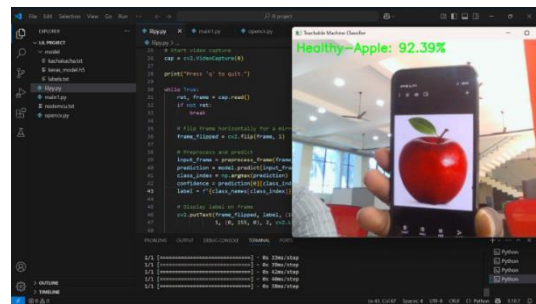


Figure 3. Image processing

## VIII. RESULT AND DISCUSSION

The results of the Android-based pick-and-place robotic arm vehicle demonstrated efficiency, adaptability, and ease of control. The system responded to commands in under a second with Bluetooth, providing faster short-range communication and Wi-Fi, enabling remote operation. The robotic arm successfully handled objects up to 500g, though gripping small or irregular items required improvements. The vehicle moved smoothly on flat surfaces but faced challenges on uneven terrain, highlighting the need for better wheel traction. Battery performance lasted 2-3 hours per charge with power-saving features enhancing efficiency. The Android interface made the system user-friendly, allowing intuitive control. However, occasional Wi-Fi latency and grip strength limitations were noted. Future enhancements could include adaptive grippers, AI-powered object recognition, and all-terrain mobility. The modular design allows for easy upgrades, making the system scalable for various industries.

Overall, the robotic arm vehicle proved to be a promising solution for automation in logistics, healthcare, and manufacturing.

## IX. CONCLUSION

The development of an Android-based pick-and-place robotic arm vehicle demonstrates the potential of integrating mobile technology with robotics for efficient automation. This project highlights how a user-friendly Android interface can be used to control a robotic arm remotely, enhancing precision and reducing human effort in various applications.

By leveraging wireless communication, such as Bluetooth or Wi-Fi the system ensures seamless control making it suitable for industrial automation hazardous material handling and warehouse management The combination of robotics and mobile technology not only improves efficiency but also paves the way for future advancements in autonomous systems

Overall this project serves as a foundation for further improvements such as AI-driven automation enhanced gripping mechanisms and increased payload capacity As technology continues to evolve such robotic solutions will play a crucial role in modernizing industries and improving productivity

## X. DECLARATIONS

Funding This research received no external funding  
Conflict of Interest The authors declare no conflict of interest

Ethical Approval Not applicable

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