NOVATEUR PUBLICATIONS
JournalNX- A Multidisciplinary Peer Reviewed Journal
ISSN No: 2581 - 4230
VOLUME 11, ISSUE 4, April – 2025

FABRICATION OF MOBILE ROBOTIC ARM

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Abstract:
The fabrication of a mobile robotic arm focuses on developing a cost-effective, portable, and energy-independent solution for lifting and transporting heavy loads, particularly cylindrical objects such as pipes or concrete components. This project aims to address the limitations of traditional cranes, including high costs, energy dependency, and bulkiness, which often make them unsuitable for small-scale industries, workshops, and remote construction sites. The mobile robotic arm is designed with a robust frame, an adjustable mechanical gripping mechanism, and a manually operated lifting system that ensures safety and operational efficiency without relying on external power sources.
Mobility is achieved through the use of heavy-duty wheels, allowing the crane to operate effectively across diverse environments and uneven terrains. The system's simple construction and easy operation make it a practical tool for reducing manual labor, minimizing workplace injuries, and enhancing overall productivity. The project encompasses detailed design conceptualization, careful material selection, fabrication processes, and rigorous performance testing to ensure durability, stability, and load-handling capacity. The final fabricated machine offers a sustainable and reliable alternative to conventional lifting equipment, catering to the needs of small-scale industries and construction sites, while promoting safer and more efficient material handling practices.

Literature Survey

Many researchers and designers have developed robotic arms and material handling systems to improve efficiency and reduce human effort, particularly in industrial and construction environments. Conventional robotic arms typically rely on electrical, hydraulic, or pneumatic systems combined with sensors and automation controls. However, simpler and more cost-effective manually operated systems have also gained attention, especially for small-scale applications where high-tech solutions may not be practical or economically viable.

Mechanical linkages and scissor mechanisms are widely used in lifting and gripping devices due to their simplicity, mechanical strength, and ability to amplify input force. Studies on scissor lifts and mechanical grippers have demonstrated their effectiveness in lifting and transporting objects with minimal manual effort through strategically arranged levers and linkages. Previous works, such as manually operated trolleys, pipe lifters, and block-handling devices, show that integrating mechanical arms with mobile platforms significantly enhances versatility and operational mobility. These systems reduce direct human contact with heavy loads, thereby increasing safety and convenience on job sites. Building on these principles, this project aims to fabricate a mobile robotic arm using only mechanical linkages and levers—eliminating the need for sensors or automation—while still delivering efficient material handling capabilities for medium-weight objects in construction and workshop environments.

Problem Statement

In construction sites, workshops, and small industries, manual handling of heavy and awkward objects like ricks, pipes, and blocks poses safety risks, increases physical strain, and reduces efficiency. Existing robotic and material handling systems are often expensive, sensor-dependent and unsuitable for small-scale or outdoor use. There is a need for a simple, cost-effective, manually operated mobile robotic arm that can safely lift and transport objects without relying on sensors or complex systems.

Introduction

In industries and construction sites, the handling and transportation of heavy or awkwardly shaped objects such as concrete blocks, pipes, and bricks are common but physically demanding tasks. To improve safety, efficiency, and reduce human effort, various lifting and handling devices have been developed. While most modern robotic arms rely on complex electrical, hydraulic, or sensor-based systems, there remains a demand for simpler, affordable, and manually operated solutions for small-scale or outdoor applications.

This project focuses on the fabrication of a mobile robotic arm that operates without sensors, using mechanical linkages, levers, and a scissor-type gripper mounted on a mobile wheeled frame.Thesystemallowsuserstomanuallygrip,lift,andtransportobjectswithease,makingithighly suitableforworkshops,warehouses,andsmallconstructionsites.Thesimplicity,lowcost,andeaseof operation make this device an effective alternative for material handling in environments where powered or automated systems are impractical.

Construction working

The mobile robotic arm consists of a wheeled frame integrated with a vertical support column that holds a mechanical scissor-type gripper. The gripper is designed using a system of mechanical linkages and levers that enable smooth opening and closing of its jaws through purely mechanical motion. For mobility, the system features two rubber wheels attached to the base frame, allowing easy manual movement across flat surfaces.

In operation, the user manually pushes or pulls the robotic arm to the desired location using the wheeled base. A hand-operated lever or pedal, positioned conveniently for the user, actuates the mechanical linkage system. This motion is transferred to the scissor-type gripper, causing the jaws to open or close. This mechanism enables the user to grip or release objects such as blocks or pipes. Notably, the system

operates entirely through mechanical motion transfer, without the use of sensors, motors, or any electronic components.

Figno.1:-Assembly of mobile robotic arm

Advantage and Disadvantage

Advantages:

- Simple and low-cost construction – Ideal for small-scale industries and budget-conscious users.
- No need for sensors, motors, or electrical power – Makes the system energy-independent and maintenance-friendly.
- Easy to operate and maintain – Requires minimal training and has fewer failure points.
- Portable and suitable for various indoor and outdoor sites – Designed for mobility and versatility on job sites.
- Reduces human effort and risk of injury – Minimizes direct contact with heavy loads, enhancing safety.
- Environmentally friendly – Operates entirely through manual mechanisms without any energy consumption.

Disadvantages:

- Limited to medium-weight objects – Not suitable for very heavy or industrial-scale lifting tasks.
- Requires continuous manual effort – Can cause fatigue during prolonged use.
- Less precise compared to automated robotic arms – Manual control limits fine manipulation.
- Limited working range and height – Physical design constraints may restrict its applications.
- Slower operation compared to powered systems – Not ideal for time-sensitive or high-volume handling.

Conclusion

The fabrication of a mobile robotic arm utilizing mechanical linkages, levers, and a scissor-type gripper has been successfully accomplished. The resulting device offers a simple, cost-effective, and energy-independent solution for manual material handling, particularly suited to construction sites, workshops, and small-scale industries. By eliminating the need for sensors, motors, or electronic systems, the design ensures ease of operation, minimal maintenance, and enhanced portability.

While the system has limitations in terms of load capacity and precision compared to automated solutions, it effectively reduces manual labor and enhances workplace safety for medium-weight object handling. This project validates the practicality and efficiency of purely mechanical systems in real-world applications, especially where high-tech automation may not be feasible or economically viable. It opens avenues for further improvements and adaptations in low-resource environments.

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