# Automated Mobile Controlled Forklifter

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**Abstract -** Manual lifting operations have several limitations.as inefficiency, safety hazards, and human error that weremade clear by the ever-increasing demand for automation material handling systems. To replicate industrial applications, however,of forklift operations, this paper describes the design implementation of an Automated Mobile Controlled Forklifter using an ESP32 microcontroller, are real-time capable and configurable operation is made possible by the system's wireless control via a Bluetooth mobile application and a NEMA-17 stepper motor through a DRV8825 driver and turn a lead-screw based lifting mechanism for controlling the vertical position.four DC geared motors powered by an L298N motor driver allow for smooth and accurate vehicle movement.The system is powered by a 12V rechargeable battery and a 7805 voltage regulator provides controlled power to the controller. Smooth guide rods ensure that the lifting mechanism is controlled and stabilized under load. The experimental findings demonstrate reliable mobility, precise lifting performance, and stable wireless control. The proposed system offers an economical, efficient, and scalable solution for robotics research, industrial automation simulation, and educational applications.
Keywords: ESP32, Bluetooth Control, Automated Forklifter, Robotics Automation, Material Handling, and Embedded Systems.

## I INTRODUCTION

Rapid industrialization, warehouse expansion, and expanding logistics operations have all contributed to a sharp high in the order for effective material handling systems worldwide. Material handling is still done by hand in many small-scale businesses and storage facilities, which makes it labor-intensive, time-consuming, and prone to human error. These restrictions raise the possibility of workplace accidents and decrease operational effectiveness. Automated and mobile-controlled material handling systems have become crucial in addressing these issues. Because of their accuracy, dependability, and controllability, embedded systems and robotics-based automation have demonstrated notable advancements in industrial applications in recent years.

Flexible and real-time operation is made possible by wireless communication and microcontroller-based robotic platforms. Stepper motor-based mechanisms,direct current motor , and ESP32 controllers are examples of technologies that enable accurate movement and controlled lifting activities.

Applications like forklift operations that call for precise navigation and vertical load handling are a good fit for these systems. This is the development of an automated mobile controlled forklift.created with a Bluetooth-controlled ESP32 microcontroller. The system uses a lead-screw mechanism to raise the structure vertically using an L298N motor motion driver, a NEMA-17 stepper motor, and a DRV8825 stepper. The robot, which ran on a 12V battery, was tested for mobility and lifting capabilities. The dependable functioning, precise lifting control, and efficient wireless communication

## II LITERATURE REVIEW

1. "“Design and Implementation of a Bluetooth-Controlled Mobile Robot Using ESP32” by Smith et al., 2024. The authors developed a mobile robotic platform controlled via Bluetooth with an ESP32 microcontroller. They discuss the integration of DC motors and wireless command processing, highlighting efficient real-time control and low-latency communication.

2. “Embedded Systems Based Forklift Robot for Material Handling Applications” by Gupta and Verma, 2025. This study presents a compact robotic forklift for industrial simulation. It emphasizes the use of stepper motors with lead-screw mechanisms for precise lifting and demonstrates modular robot design suitable for automation learning.

3. “DC Motor and Stepper Motor Integration for Mobile Robots” by Zhao et al., 2023. The authors focus on combining DC and stepper motors to achieve coordinated motion and precise actuation. This provides awareness into motor driver selection, load handling, and movement stability.

4. “Wireless Mobile Robot Control Using ESP32 and Bluetooth Communication” by Choudhury and Das, 2024. The paper explores reliable wireless communication for mobile robots, such as error handling, command decoding, and real-time response, which is essential for mobile-controlled forklifts.

5. “Design of Lead Screw-Based Lifting Mechanisms for Miniature Robots” by Kumar and Singh, 2023. This work highlights the mechanics of lead-screw lifting, guide-rod stabilization, and load-bearing considerations. The study is particularly relevant for robotic forklifts requiring vertical motion accuracy and safety during operation.

## III PROPOSED SYSTEM

The suggested system uses wireless communication and embedded systems to implement an Automated Mobile Controlled Forklifter for material handling tasks. The system's primary goal is to use a mobile-based control interface to enable automated vehicle movement and controlled load lifting. The ESP32 microcontroller, which receives commands via Bluetooth and manages the vehicle's motion and lifting mechanism, is the central component of the system. The robot's lead-screw-based mechanism allows it to lift loads vertically and move in various directions.

A. Essential Elements

1. Control and System Architecture The forklift robot is made to be a mobile platform that can lift objects. The ESP32 receives Bluetooth commands from a mobile application and interprets them to control:

- Movement both forward and backward Turning left and right
- Raising and lowering the forklift platform
- This makes it possible to control the system in real time and with ease.

2. Lifting Mechanism and Motor Control

- The system uses an L298N motor driver to control four DC geared motors for vehicle motion and a NEMA-17 stepper motor powered by a DRV8825 driver to operate a threaded lead screw
- In order to achieve precise movement and lifting. Smooth guide rods guarantee steady, vertical motion of the forklift platform, while the stepper motor provides accurate control over lift height.

3. Software prerequisites:

- The Arduino IDE and ESP32 programming environment; the Arduino programming language and embedded C;
- Bluetooth communication libraries; and motor control libraries for DC and stepper motors Reliable communication, motor control, and system integration are made possible by these software components.

## IV SYSTEM DESIGN

A. Description of the System Architecture The "Automated Mobile Controlled Forklifter" project's system architecture is a layered, modular embedded robotics pipeline. It maintains modularity and scalability while guaranteeing efficient signal processing, motor control, lift operation, and real-time command execution.

The architecture clearly and systematically combines all of the main elements, including input command acquisition, signal processing, motor control, lift actuation, movement coordination, and output feedback.

Summary of Data Flow: Bluetooth Communication → ESP32 Processing → Motor Driver Control → DC/Stepper Motor Actuation → Forklift Operation → Feedback/Stop

System Workflow Summary:

A layered architecture is used in the implementation of the Automated Mobile Controlled Forklifter. The steps of the workflow are as follows:

1. Input order :
Bluetooth is used by a mobile to transmit orders. The user can order the robot to higher or lower the ground, turn left or right, move forward or backward, and more. These real-time orders are the ground input for the system and are explained by the ESP32 microcontroller.

2. Signal Processing :
The ESP32 takes and explains the Bluetooth orders. There are series of motor works coupled with each order. Safety points are checked, such as limited lifting height or preventing motor over weight, to smooth and controlled operation.

3. Control Logic Execution:
Based on the given orders, the ESP32 gives control signals for the DRV8825 stepper driver (which controls the forklift lift) and the L298N motor driver (which controls vehicle motion). The logic allows for accurate adjusting of lifting and movement actions.

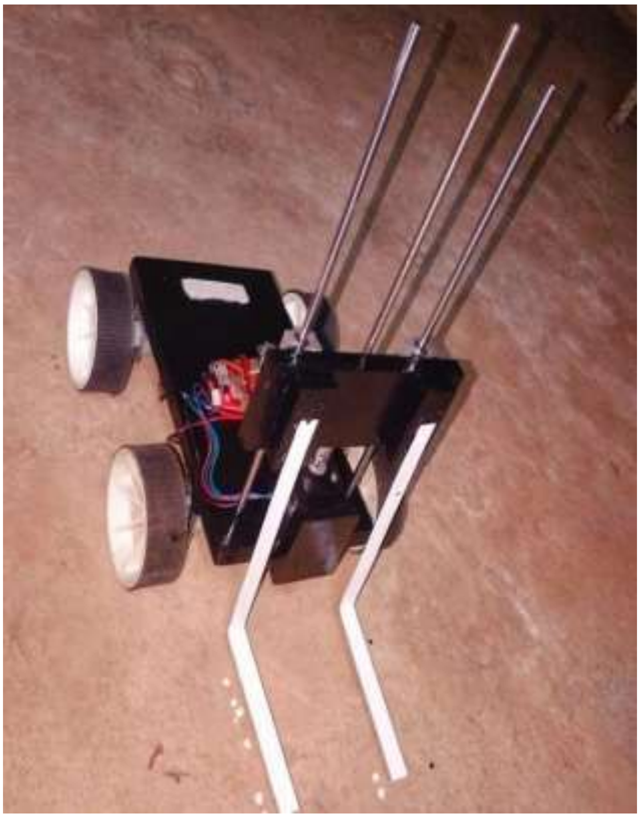
4. Motor actuation:
• The NEMA-17 stepper motor gives the lead-screw-based forklift ground for vertical lifting;
• The L298N driver initiates the DC geared motors to provide directional motion. Accurate lift positioning is made possible by the stepper motor, and the ground is stabilized to maintain vertical motion by smooth guide rods.

5. Module for Lift and Movement Coordination:
To resultant vehicle motion with forklift operations, the system continuously observes motor outputs. As the robot moves, the ground can be high or lowered, giving accurate and safe material handling.

6. Output and Feedback Module:
Through the mobile app, the output asks user feedback. It checks the robot is currently moving, turning, lifting, or stopping. Because the system is dependable and user-friendly control, it can be used for industrial simulation, prototype automation, or educational purposes.

## V RESULTS AND DISCUSSION

During testing, the DC motors generated smooth forward, backward, and turning movements, while the stepper motor precisely controlled the forklift platform's vertical motion. The system responded swiftly to real-time Bluetooth commands from the mobile application, demonstrating reliable wireless communication and command execution. The lead-screw-based lift mechanism generated precise and consistent vertical movement with the aid of smooth guide rods. The stepper motor's precise control over lift height allowed the platform to consistently reach specific positions with minimal error.



The other L298N-driven DC motors also worked well.

directional control, enabling the robot to move effectively

corners and small areas. The robot could lift and carried moderate loads without becoming unstable unduly severe vibration, as tested against different load weights. The mobile app would confirm this that the orders were carried out, including stopping right away when directed, being safe to operate.

Overall, the findings show the system to be accurate, dependable, and industrial automation simulations, and is featured educational demonstrations. The Automated Mobile Controlled The forklift could be useful for material handling in the real time works that needs accurate motor control or stable lifting and wireless command responsiveness..

## CONCLUSION

The project needs an ESP32 microcontroller and Bluetooth technology in mobile control to get an Automated Mobile Controlled Forklifter that shows industrial material handling. The system couples a NEMA-17 stepper motor with a lead screw works that gives vertical lifting using four DC-geared motors for motion. To give accurate and real time operation, lifting procedures, motor control measure, and order working were used. The vehicle moves easily, the ground of the lift is accurately positioned It receives orders and data connectionless experimental results.

This gives an incapable stepper-based lift under low weight and the need of Direct current motors mobility provide still, constant work. All components in this project shows how low cost embedded Systems and robotics techniques can be used to automate material handling, lower human labor, improve operational safety and offer a ground for industrial and educational automation simulations.

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