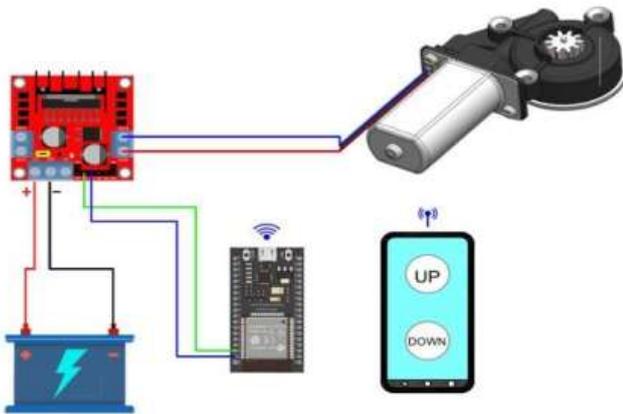


Development of Mobile Base Screw Jack System for Vehicle Lifting

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Abstract - Vehicle tire replacement using a conventional manual screw jack requires significant physical effort and time, which can be difficult for elderly people, women, and physically challenged individuals. To address this issue, this project presents the development of a mobile-controlled scissor screw jack system for vehicle lifting. The manual scissor jack is converted into an electrically operated system using a DC motor, motor driver, and ESP32 microcontroller. The lifting and lowering operations are controlled wirelessly through a smartphone application using Bluetooth or Wi-Fi communication. Power is supplied from the vehicle's 12V source, making the system suitable for emergency roadside use. The proposed system reduces human effort, improves safety, and decreases lifting time compared to conventional jacks. This project offers a cost-effective, user-friendly, and reliable solution for modern vehicle lifting applications.



Key Words: DC motor, chain sprocket, wireless control system, jack model, Wi-Fi communication, Adriano microcontroller

1. INTRODUCTION

In today's fast-moving world, vehicle breakdowns such as tyre punctures are common and often occur at inconvenient locations. Changing a tyre using a conventional manual screw jack requires considerable physical effort and time, making it difficult for elderly

people, women, and physically challenged individuals. Manual jacks also involve awkward postures, which may lead to fatigue or injury.

To overcome these limitations, this project focuses on the development of a mobile-controlled scissor screw jack system for vehicle lifting. The proposed system converts a traditional manual scissor jack into an electrically operated one using a DC motor, motor driver, and ESP32 microcontroller. The jack can be operated wirelessly through a smartphone application, eliminating the need for manual force.

2. LITERATURE SURVEY

Several researchers have focused on improving conventional vehicle jacks by introducing automation and electronic control to reduce human effort and enhance safety. Aarav V. Jadhav et al. developed an automated screw jack system that improved efficiency, ease of use, and reduced noise compared to manual jacks.

Balkeshwar Singh and Anil Kumar Mishra modified a traditional screw jack by integrating a DC motor, making the lifting process simpler and less physically demanding. C. Sai Kiran and J. Sruthi carried out structural analysis of a scissor jack using ANSYS to study stress distribution and deformation, ensuring safe load bearing capacity.

Arinola Bola Ajayi et al. converted a manual scissor jack into an automatic one using a 12V DC motor, achieving smoother and faster operation. Arun Kumar R. and co-authors introduced an Android app-controlled screw jack using IoT technology, demonstrating the effectiveness of wireless control in vehicle lifting applications. From the literature review, it is evident that electrically operated and mobile.

Chetan S.Dhamak, D.S.Bajaj, V.S.Aher Design and optimization of scissor jack Design and analyzing the scissor jack model for actual loads for varying models of automobile L.M.V. Sectors

3. OBJECTIVES

1. Manual screw jacks require high physical effort to operate. They can be unsafe when lifting heavy vehicles.
2. Users face difficulty in positioning and controlling them.
3. Operation is time-consuming and tiring.
4. Limited space makes usage more difficult.
5. Project aims to design a mobile-operated screw jack.
6. It will reduce human effort and fatigue.
7. It will save time during lifting tasks.
8. It minimizes lifting, tilting, and twisting forces.
9. Includes electronic control for remote operation.
10. Provides safer, easier, and more user friendly vehicle lifting.

2. MECHANICAL DESIGN METHODOLOGY

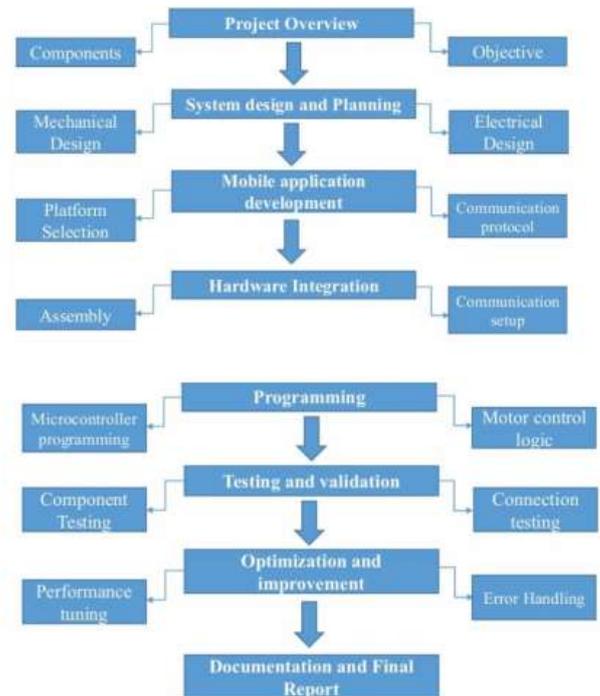
The mechanical design of the proposed mobile controlled automobile scissor screw jack is developed to ensure adequate load-carrying capacity, structural integrity, and operational safety under static and dynamic loading conditions. The design is based on classical machine design principles, considering strength, stiffness, stability, and fatigue resistance of the components.

The lifting mechanism employs a scissor linkage actuated by a power screw, which converts rotational motion from a DC motor into linear displacement for vertical lifting. The scissor arms are subjected to axial compressive and tensile forces during operation and are designed accordingly. Mild steel is selected for the scissor arms and base frame due to its high yield strength, good machinability, weld ability, and economic feasibility.

The power screw is the critical load-bearing element and is designed to withstand axial compressive loads without failure due to crushing, shear, or buckling. A trapezoidal thread profile is adopted to provide higher load-carrying capacity, improved efficiency, and self-locking behavior, ensuring safety during load holding. The screw dimensions are determined based on maximum lifting load, allowable stresses, and a suitable factor of safety.

The nut is designed with sufficient thread engagement length to limit bearing pressure within permissible values, thereby reducing wear and increasing service life. The base platform and load saddle are designed to distribute the applied load uniformly and maintain stability during lifting operations.

A conservative factor of safety is incorporated to account for uncertainties such as load variations, material defects, and impact loads. The mechanical design ensures reliable performance, minimal vibration, and safe operation of the jack under real world automotive lifting conditions.



3. DEVELOPMENT AND MECHANISUM

This work presents the design and fabrication of an advanced screw jack system equipped with motorized and wireless control features to eliminate the drawbacks of traditional manually operated jacks. Conventional screw jacks demand

substantial physical effort, require longer operating time, and may create unsafe conditions during vehicle lifting. To overcome these limitations, the proposed design integrates a mechanical lifting arrangement with an electronic control system, resulting in a safer, more efficient, and user-oriented lifting device.

The mechanism operates on the principle of a power screw, in which rotational motion is transformed into vertical linear displacement to raise or lower loads. Instead of manual rotation, a direct current wiper motor is employed to generate sufficient torque at reduced speed, making it suitable for lifting heavy vehicles smoothly and steadily. The motion from the motor is transmitted through a chain and sprocket assembly that provides reliable power transfer, constant velocity ratio, and slip-free operation, enabling the system to handle higher loads compared with conventional belt-driven arrangements.

Wireless control is implemented using an ESP32 microcontroller with integrated Wi-Fi capability, allowing the user to operate the jack remotely through programmed commands. Switching operations are managed through relay units that permit low-power signals to regulate higher power circuits safely, while an L298N motor driver controls the motor's direction, speed, and torque output. Temporary electrical connections during testing and assembly are achieved using jumper leads, ensuring flexibility in circuit configuration.

The structural frame is constructed from mild steel angle sections joined through welding to form a rigid base capable of supporting substantial loads without deformation. The transmission shaft is selected and designed considering mechanical strength, wear resistance, machinability, and heat-treatment suitability to ensure durability and reliable performance. Standard fasteners such as bolts and nuts are used to secure all mechanical elements and maintain structural integrity.

A chain drive system is chosen due to its superior transmission efficiency, compact configuration, absence of slip, and ability to transmit motion to multiple shafts while maintaining consistent performance even under challenging operating conditions. Although proper alignment and periodic maintenance are required, its advantages make it highly suitable for heavy-duty lifting applications.

In summary, the developed motorized screw jack significantly decreases manual effort, reduces operator fatigue, shortens lifting time, and enhances overall safety. By combining mechanical design principles with modern electronic automation, the system provides a practical, economical, and innovative alternative to conventional lifting tools, demonstrating the effectiveness of integrating automation technology into traditional mechanical devices for improved functionality and convenience.

4. ELECTRICAL AND CONTROL DESIGN

The proposed mobile-controlled automobile scissor screw jack uses a 12 V DC supply from the vehicle battery, regulated for stable operation of control electronics. A DC geared motor provides the required torque at low speed, while a motor driver enables bidirectional control for lifting and lowering. An ESP32 microcontroller manages the system, receiving commands wirelessly via Bluetooth or Wi-Fi from a smartphone app and sending signals to the motor driver.

Safety is ensured through limit switches that prevent over-extension or compression, along with an emergency stop function. Overall, the design delivers reliable, safe, and user-friendly lifting with reduced human effort and accurate motor control.

5. MOBILE APP INTERFACE

An ESP32 microcontroller, facilitates Wi-Fi connectivity and interaction with the Blynk cloud. The Blink app is a IoT (Internet of Things) platform that allows users to build and control projects using microcontrollers like ESP32, ESP8266, Arduino, and Raspberry Pi via a smartphone. It provides a drag-and-drop interface to create IoT dashboards without complex coding.

6. RESULTS AND DISCUSSION

Lifting Duration: About 50 seconds to raise a 300 kg vehicle by 150 mm from the ground. Control Distance: WIFI functions effectively within a range of 10 meters. Safety Mechanisms: Includes an emergency stop button and protection against motor overload.

7. ADVANTAGES

1. Eliminates manual effort through electric motor operation.
2. Enables safe and convenient wireless control using a mobile device.
3. Operates using the vehicle's standard 12 V DC power supply.
4. Compact, portable, and cost-effective design.

8. LIMITATIONS

1. Not suitable for heavy-duty trucks without redesign
2. Limited to Bluetooth range

9. CONCLUSION

The proposed mobile-controlled automobile scissor screw jack successfully integrates mechanical, electrical, and control systems to provide a safe, efficient, and user-friendly vehicle lifting solution. The electrically actuated scissor mechanism significantly reduces manual effort and lifting time while improving operational safety. Wireless control using a microcontroller enhances user convenience and allows remote operation during emergency situations. The compact design, low power requirement, and use of standard automotive components make the system practical and cost-effective for real-world applications. The developed system demonstrates strong potential for improving roadside vehicle maintenance and automotive safety.

10. REFRANCES

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