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Portable Automatic Hydraulic Jack

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Abstract: The portable electro-hydraulic jack is an innovative tool designed to simplify vehicle maintenance, tire changes, and emergency repairs by combining the principles of hydraulics and electrical automation. Unlike traditional manual jacks that require extensive physical effort, this advanced device provides a fast, efficient, and user-friendly solution. As this is compact and portable, it can be easily stored in car trunks or toolboxes, making it an indispensable tool for vehicle owners, mechanics, and emergency responders. The device operates using an electrically powered motor that converts rotary motion into linear motion via a crankshaft mechanism. The automated operation, controlled by a switch or remote, eliminates the manual cranking required by traditional jacks, enhancing usability and reducing effort. This state-of-the-art electro-hydraulic jack offers a practical, robust, and efficient solution for modern vehicle maintenance, meeting the growing demand for convenience and safety automotive tools.
Keywords: Portable Hydraulic Jack, Electro-Hydraulic Automation, Vehicle Lifting Technology, Motorized Jack Design, Safety and Efficiency

I. INTRODUCTION

The portable electro-hydraulic jack is a modern innovation designed to simplify vehicle lifting for maintenance, tire changes, and emergency repairs. Unlike traditional manual jacks, which require significant physical effort and time, this tool integrates hydraulic power with electrical automation, offering a fast, efficient, and user-friendly experience.

Compact and lightweight, this jack is highly portable, making it an essential accessory for personal vehicle owners, mechanics, and emergency responders. Its design allows easy storage in a car trunk or toolbox, ensuring readiness for use during road trips or unexpected situations. The hydraulic mechanism provides the strength to lift vehicles of various sizes and weights effortlessly, while the electrical components automate the lifting process. With a simple switch or remote control, the jack can lift a vehicle quickly and safely, eliminating the need for manual cranking.

This tool is particularly useful in scenarios where speed and efficiency are critical, such as roadside emergencies. It enhances safety by providing stable and controlled lifting, reducing the risk of accidents associated with traditional jacks. Its user-friendly operation also makes it accessible to a wide range of users, regardless of their physical strength or technical expertise.

In today's fast-paced world, where convenience and reliability are key, the portable electro-hydraulic jack addresses the need for a practical, robust, and time-saving solution. Its combination of portability, power, and ease of use makes it a valuable tool for anyone who drives. Whether for routine maintenance or emergencies, this device represents a significant advancement in vehicle lifting technology, setting a new standard for safety and convenience.

II. LITERATURE SURVEY

1) Ayomikun, Ajayi (2019): Ayomikun's work focused on developing an automatic 3-ton pallet jack, emphasizing automation to reduce manual effort and enhance safety. The study compared manual and automated jacks, showing the automated version achieved a maximum displacement of 242 mm in 20 seconds, compared to 200 mm in 32 seconds for the manual jack. This highlights the potential of automated systems to improve efficiency and safety in lifting operations.
2) Wosu, David Chisom, and Richeal Chinaeche Ijeoma (2024): The authors designed an automated hydraulic jack for vehicle maintenance in Nigeria, integrating a DC motor and hydraulic system to minimize stress and injuries. The system used locally sourced materials to reduce costs, with a kinematic linkage converting motor rotation into hydraulic ram motion. Their design demonstrated user-friendly operation and cost-effectiveness, making it suitable for widespread automotive applications.
3) Nadzri, Wan Afiq Naufal Wan Ahmad, and Nolia Harudin (2023): This study developed an automatic scissor-type car jack powered by a 12V DC motor, aimed at easing tire changes for users like women and the elderly. The system included a compressor for tire inflation, enhancing its utility for roadside emergencies. The design improved safety and reduced physical strain, addressing common challenges in conventional jacking systems.

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4) Agrawal M, Thakur M G, Mahajan D, and Chahar T S (2018): The researchers explored inbuilt hydraulic jack systems for four-wheelers, converting manual hydraulic jacks into electrically powered ones using a vehicle's battery. A reciprocating linkage and handheld controller were introduced to simplify operation and enhance lifting precision. The study demonstrated that such systems could lift vehicles effortlessly, marking a trend toward integrated automotive lifting solutions.
5) Frederick R C et al. (2014): This research optimized a portable electrical hydraulic jack, analyzing its lifting force using Pascal's Law and improving its telescopic capabilities. The jack required an initial force of 5.35 kg to lift a load, with a cylinder tilt angle ranging from 11.53° to 40.83° during operation. The study emphasized safety and efficiency, proposing a modern hydraulic jack design for increased workshop productivity..

III. METHODOLOGY OVERVIEW

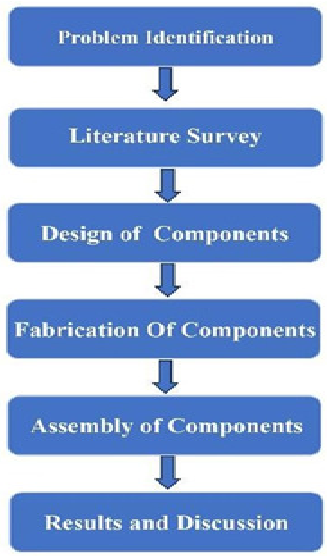

Fig 1. Flowchart of Methodology

The work began with problem identification, where the need for a portable and efficient lifting solution was recognized, and the limitations of traditional hydraulic jacks were acknowledged. A literature survey was then conducted to research existing electric hydraulic jack designs and technologies, analyzing their working principles, advantages, and limitations. The design of components followed, where the electric motor and hydraulic system components were designed using CAD software, optimizing for weight, size, and performance. The designed components were then fabricated using appropriate manufacturing processes, and assembled integrating the electrical and hydraulic systems, and control system. Finally, the electric motorized hydraulic jack was tested for performance, efficiency, and safety, with results showing improved lifting capacity, speed, and power consumption. The work demonstrated a successful design and development of an electric motorized hydraulic jack, with potential applications in various industries.

A. Block Diagram

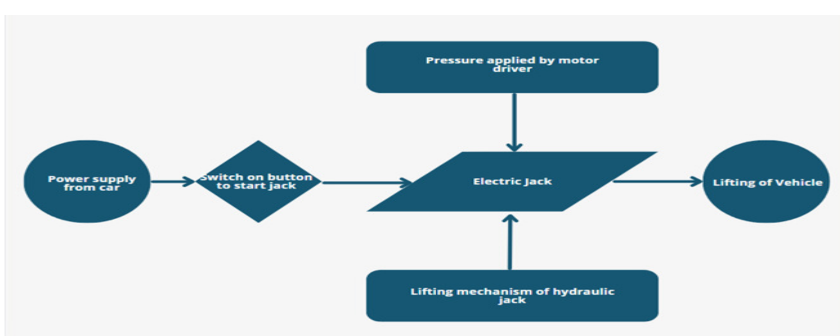

Fig 2. Block diagram

The design and development of the portable electro-hydraulic jack involve a systematic approach combining electrical automation and hydraulic principles to achieve efficient and effortless vehicle lifting.

1) Design and Component Selection: The process begins with identifying key components such as the hydraulic cylinder, electric motor, power supply, control switch, and structural frame. A compact and lightweight design is prioritized to ensure portability without compromising performance.
2) Hydraulic System Integration: A hydraulic mechanism is central to the lifting process. A hydraulic cylinder is connected to a pump that applies pressure to hydraulic fluid, generating the force needed to lift the vehicle. Calculations are performed to ensure the system can handle a wide range of vehicle weights effectively and safely.
3) Electrical Automation: An electric motor powers the hydraulic pump, automating the process. A user-friendly control system, such as a switch or remote control, is integrated to enable operation with minimal effort. Safety features like overload protection and emergency shut- off mechanisms are added.
4) Prototyping and Testing: The assembled prototype undergoes rigorous testing to assess load capacity, lifting speed, operational stability, and safety. Adjustments are made based on test results to optimize performance and reliability.

B. *Flowchart*

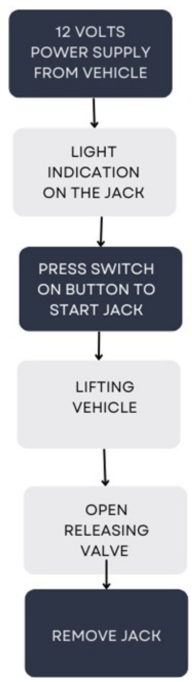

Fig 3. Flowchart

The flowchart (Fig 3) explains the working steps of the portable automatic hydraulic jack in a simple and clear manner. It starts when the user turns on the power supply. The 12V battery activates the DC motor, which then runs the hydraulic pump. This pump builds pressure and lifts the vehicle through the hydraulic cylinder. A limit switch monitors the lift height and stops the motor when the maximum level is reached. To lower the vehicle, the user presses a separate button. This activates a valve that releases pressure, allowing the jack to come down slowly. The system then stops automatically, completing the process.

IV. HARDWARE DESCRIPTION

A. *Hydraulic Jack With 3-ton Capacity Specifications*

1) *Hydraulic Pump:*

- Piston: A cylindrical component that converts mechanical energy (pump handle movement) into hydraulic pressure.
- Cylinder: A hollow cylinder that houses the piston and contains the hydraulic fluid.
- Check Valve: Prevents backflow of hydraulic fluid, ensuring one-way flow.
- Release Valve: Controls the release of hydraulic pressure, allowing the jack to lower.

2) Hydraulic Ram:
- Piston Rod: A solid, cylindrical rod that extends from the hydraulic cylinder.
- Piston: A cylindrical component that seals the hydraulic fluid within the cylinder.
- Cylinder: A hollow cylinder that houses the piston and piston rod.

3) Base Plate:
- A sturdy, flat platform that provides stability and distributes the load.

4) Saddle Plate:
- A movable platform on top of the hydraulic ram that supports the load.

Additional Specifications:
Capacity: 3 tons (6,000 lbs.)
Lift range: Minimum height -19 cm(190mm) Maximum height -35cm (350mm)
Material: High-strength steel for durability and safety. Operation: Hydraulic mechanism for smooth and easy lifting. Weight: Generally, 5-7 kg for added stability.
Applications: Ideal for larger vehicles (SUVs, vans, light trucks). General-purpose industrial or construction use.

B. 12V Permanent Magnet DC Motor
A 12v permanent magnet dc motor is a crucial component in automotive systems, responsible for the smooth and efficient operation.

Fig 4. Permanent Magnet Dc Motor

Specifications:
1) Voltage Rating: Nominal Voltage: 12V DC
2) Current Rating:
   - No-Load Current: Around 0.3A to 0.5A when the motor is running without load
   - Full-Load Current: Typically, 1A to 3A when the motor is running load
3) Speed (RPM):
   - No-Load Speed: 40 to 60 RPM (rotations per minute)
   - Speed at Full Load: Speed usually 30 to 40 RPM under load
4) Power Output: Usually between 15W to 50W.
5) Torque: Typically, in the range of 0.3 Nm to 1 Nm under normal operation.
6) Efficiency: Typically, around 60% to 75% for wiper motors.
7) Size:
   - Diameter: Typically, between 4 cm (40 mm) to 8 cm (80 mm).
   - Length: Typically, between 6 cm (60 mm) to 12 cm (120 mm), depending on the motor's design.
   - Weight: Typically, between 0.5 kg to 1 kg.

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V. MATHEMATICAL CALCULATIONS AND FABRICATION

A. Calculations

Total weight of the car: 1400 kg (1kg=9.81N) Weight on a single wheel: 3433.5 N
Lifting time: 30 seconds
Lifting height: 250 mm = 0.25 m
Motor specifications: Torque: 11.9 Nm, RPM: 120
Step 1: Calculate the required lifting velocity
Velocity=Distance/Time=0.25 m/30 s=0.00833 m/s
Step 2: Calculate the required power to lift the wheel
The power required to lift the wheel is given by:
Power lifting=Force × Velocity=3433.5 N×0.00833 m/s=28.59 W
Step 3: Calculate the power output of the motor
Motor power is calculated as:
Angular Velocity $\omega=2\pi\times$RPM*60 = 2π*120 *60 =4π rad/s≈12.57 rad/s
Then the motor power is:
Power of motor=Torque × Angular Velocity=11.9 Nm×12.57 rad/s=149.8 W
Step 4: Comparison of power required to lift the wheel: 28.59W
Motor power: 149.8 W

B. Fabrication

Step 1: Fabrication of Frame: Initially we have made sketch of the frame which the hydraulic jack and the wiper motor will be mounted on Base frame. As the base frame is in the rectangular shape and they joined by the welding process.
Step 2: Mounting of Hydraulic jack: As after the installation of the frame, the hydraulic jack has been mounted on the frame at the one end. The hydraulic jack has been mounted on the frame permanently by the process of welding.

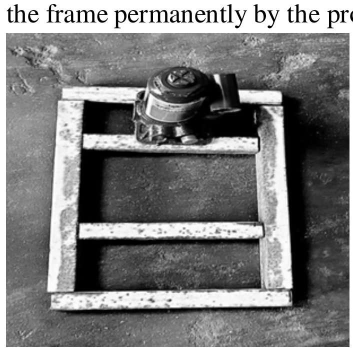

Fig 5. Top View of Mounting

Step3: Mounting of Wiper motor: In this step the wiper motor is mounted on the base frame and 20 mm from the hydraulic jack. As the motor is placed between the two bolts which the one end has been welded with the base frame and other end is free at distance 60mm.
As when the motor placed between the bolt the C clamp is inserted at which the contain of hole and tighten clamp with the help of the 11mm nut. The C clamp used for the purpose to hold the motor tightly without moving from its position.

Fig 6. Clamp Mounted

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Step 4: Fabrication of Crank Linkage and jack handle: It involves creating a mechanism that converts rotational motion into linear motion to lift heavy loads using hydraulic power. This machine basically works on the principle of Single Slider Crank Mechanism which is the heart of this machine. In this, link 1 is fixed which is connected to motor and link 2 which is a crank is rotating about fixed link 1 and converts this rotary motion into the reciprocating motion of slider (corresponds to the link 4) by means of connecting rod which corresponds to the link 3 a jack handle (mild steel pipe). This is the inversion of single slider crank which is obtained by fixing link.

Fig 7. Crank Linkage

Step 5: Lifting floor: The "lifting floor" specification of a hydraulic jack denotes the maximum vertical distance from the ground or base surface to which it can elevate a load. This measurement is pivotal in determining the jack's practical utility, ensuring it can reach the necessary height for lifting tasks. It correlates closely with the jack's stroke length, which dictates the vertical travel capability of its hydraulic piston or ram within the cylinder. This specification varies with the jack's load capacity, with higher capacity models typically capable of lifting heavier loads o greater heights. Crucially, the lifting floor specification guides the selection of a suitable jack for specific applications, ensuring safety, stability, and operational effectiveness at the desired lifting heights.

VI. RESULTS AND DISCUSSION

A. *Result of the Hydraulic Jack*

A normal Hydraulic jack is typically used to lift heavy objects such as vehicles. When we operate a scissor jack by rotating the lead screw, its force on the floor of scissor jack causing to lift the vehicle. This, allowing the jack to lift the object placed on top of it. The result of using a jack is that it can lift heavy loads with relatively little effort from the user, as compared to a mechanical jack or manual lifting. Hydraulic jacks commonly found in vehicles are designed to lift loads ranging from 1 ton to 2 tons, though this can vary depending on the specific model and intended use. The height to which a scissor jack can lift a vehicle depends on its design and the number of sections in the Hydraulic mechanism. Generally, they can lift vehicles anywhere from around 300 mm to 350mm off the ground. The time required to lift a vehicle with a Hydraulic jack can vary based on the weight of the vehicle and the effort put into turning the jack handle. Typically, it can take a few minutes to achieve the desired height, especially if the jack is operated manually. The Hydraulic mechanism extends as the handle is turned, lifting the vehicle.

Fig 8. Motorized Hydraulic jack

B. Comparison of results

The result of using a motorized hydraulic jack is efficient and relatively effortless lifting of heavy loads, enhanced by motorized operation and the robust lifting power of hydraulic systems. These jacks are favored for their convenience, speed operations, and versatility in various automotive, industrial, and emergency situations. Their combination of motorized power and hydraulic efficiency makes them a preferred choice in various professional and personal settings where reliable lifting solutions are essential. Motorized hydraulic jacks are available in a range of lifting capacities depending on their intended use. Common capacities can vary from 1 ton for lighter applications (such as small vehicles) to 20 tons for light motor vehicles. Heights typically range from around 350mm to 450mm or more, depending on the specific model and application.

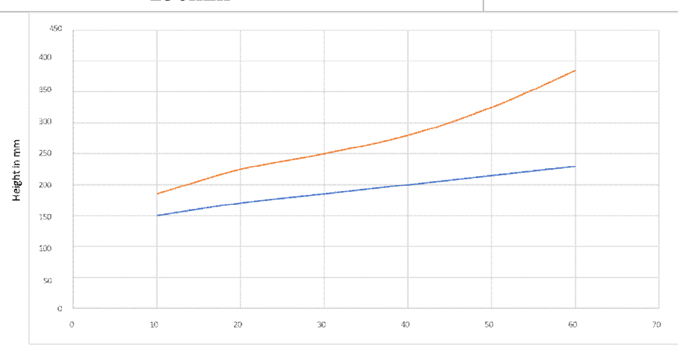
TABLE I. RESULTS OF NORMAL HYDRAULIC JACK AND MOTORIZED HYDRAULIC JACK

Sl. No	Factors	Convention Hydraulic Jack	Motorized Hydraulic Jack
01	Maximum Lift Height	300-350mm	385-450mm
02	Time Required	2 Mins	45 secs (LMVs)
03	Lifting Capacity	1.5 Tons	3 Tons

As we conducted an experiment on Hyundai Santro car consisting of weight of approximately 995 kg.

TABLE II. COMPARISON TEST RESULTS

Time in Sec	Normal Hydraulic Jack	Motorized Hydraulic Jack
10	150mm	185mm
20	170mm	225mm
30	185mm	250mm
40	200mm	280mm
50	215mm	325mm
60	230mm	385mm



Legend:
------- Hydraulic Jack
--------Motorized Hydraulic Jack

Fig 10. Comparison of Lifted height of Convention Hydraulic Jack and Hydraulic Jack with Time

While both types of jacks can effectively lift heavy loads, motorized hydraulic jacks offer enhanced features like automatic operation and precise timing control that can improve efficiency, safety, and accessibility compared to conventional manual hydraulic jacks.

VII. CONCLUSION

The portable automatic hydraulic jack was successfully designed and fabricated to simplify vehicle lifting operations. It significantly reduces manual effort by integrating an electric motor with a hydraulic mechanism.

The system is compact, efficient, and capable of lifting up to 3 tons with increased speed and safety. Testing demonstrated improved lift height and reduced time compared to conventional jacks. The motorized system proved reliable and user-friendly, especially in emergency scenarios. Overall, the work achieved its objectives of automation, portability, and enhanced lifting efficiency.

VIII. ACKNOWLEDGMENT

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REFERENCES

[1] Durvesh Rohidas More, Aditya Arun Patil, Adesh Ananta Thakare, Nishank Rajesh Vartak, Md Saqib Ansari, "Design and Fabrication of Motorized Hydraulic Jack," International Journal of Engineering Research & Technology (IJERT), Vol. 9, Issue 5, 2020, pp. 123–126.

[2] S.K. Amedorme, Y.A.K. Fiagbe, "Modification of an Existing Small Hydraulic Jack for Lifting Light Duty Vehicle," Innovative Systems Design and Engineering, Vol. 4, Issue 9, 2013, pp. 55–60.

[3] Dr. S. M. Dhomne, Amar Dhabekar, Bhavesh Waghale, Mahesh Talmale, Rushikesh Tapare, "Design and Fabrication of Motorized Hydraulic Jack," International Journal for Research in Applied Science and Engineering Technology (IJRASET), Vol. 8, Issue 6, 2020, pp. 245–248.

[4] Joshi Kandarp U, Patel Nisarg N, Soni Vatsal D, Vakil Brijesh M, "D.C. Operated Portable Vehicle Lifting Jack," International Journal of Engineering Sciences & Research Technology, Vol. 6, Issue 4, 2017, pp. 309–312.

[5] Mohan Kumar R S, Vinayagamoorthi M A, "Design and Fabrication of Automated Inbuilt Hydraulic Jack for Light Motor Vehicle," International Journal of Mechanical and Production Engineering Research and Development (IJMPERD), Vol. 10, Issue 3, 2020, pp. 10035–10042.

[6] Balkeshwar Singh, Anil Kumar Mishra, "Analysis and Fabrication of Remote-Control Lifting Jack," International Journal of Scientific Research & Engineering Trends (IJSRET), Vol. 3, Issue 2, 2017, pp. 135–139.

[7] Aadarsh Kumar, Amit Kashyap, Vinay Kumar, "Four Wheel Automatic Hydraulic Jack," International Research Journal of Engineering and Technology (IRJET), Vol. 6, Issue 5, 2019, pp. 1871–1875.

[8] Ramkumar, Rishab Jain, Premnath, Pradeesh, Samueal Hansen, "Design & Fabrication of Hydraulic Jockey for Changing Die Set In Pipe Production," International Journal of Engineering Development and Research (IJEDR), Vol. 6, Issue 2, 2018, pp. 784–788.

[9] M.M. Noor, K. Kadirgama, M.M. Rahman, M.S.M. Sani, M.R.M. Rejab, "Development of Auto Car Jack Using Internal Car Power," Journal of Applied Sciences Research, Vol. 5, Issue 11, 2009, pp. 2131–2138.

[10] [10] Akash Mali, Suraj Patil, Harshwardhan Veer, Sanket Bhagat, Mahesh Thorat, "Inbuilt Motorized Screw Jack for Vehicle," International Journal for Research in Engineering Application & Management (IJREAM), Vol. 4, Issue 3, 2018, pp. 152–156.