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Research paper on Design, fabrication and mathematical analysis of remote controlled Hydraulic Powered Jack System

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Abstract - The automatic hydraulic jack system with remote controls is an advancement in automotive and industrial applications which enhance safety, ease, and accuracy when performing actions that require lifting. By combining hydraulic systems with remote controls, this system eliminates manual operations and reduces possible risks of injury. The system consists of a hydraulic pump, a cylinder, a control valve, a power source, and a remote control unit which allows the user to lift heavy objects with minimal human effort, based on Pascal's law. Key design aspects entail the adequacy of the load, dependability of power supply, strength of the material, and safety features such as overload protection and emergency stop mechanisms. The system is advantageous due to its ease of operation, quick execution, remote control, and multi-industry application including automobile repairs, construction, and emergency rescue services.

Key Words: **Hydraulic cylinder, Pascal's law, Check valve, Fluid pressure, Hydraulic fluid, Reservoir, Piston.**

[1] INTRODUCTION

These traditional systems, however, demand a lot of physical labor and can be unsafe. The advent of an automatic hydraulic jack system operated through a remote eliminates these problems by providing a hands-free, effective, and safer means of lifting operations.

In the event of tyre puncture or wheel replacing lift the car is more critical component. In this case, we are utilizing traditional methods of lifting the tyre. In such a situation physically handicapped person, ladies person or old person does not lift the tyre comfortably. They need more time and also need more force to lift the tyre. In such a manner to assist those who are physically challenged.

The design and building of a hydraulic jack system is particularly important in lifting heavy loads with minimal human assistance. The system functions based on Pascal's Law: pressure put into a closed system will be sent equally in every direction into the liquid This project seeks to design a portable hydraulic jack system that is inexpensive and can lift large weights both safely and efficiently. As part of the project, the hydraulic jack incorporated a hydraulic cylinder, pump, reservoir, control valve and their associated parts. The components are mounted on a sturdy frame. Since the system employs hydraulic power, the jack system can yield a high force output from a relatively low input, which is a requirement for most heavy duty tasks. Alongside the theory there are practical aspects like the construction steps, material choices, rigid body calculations, and sifting through available frameworks for optimal design alongside results verification.

[2] OBJECTIVE

This research has the following primary goals:

1. Create a hydraulic driven jack which can lift heavy loads with very little physical effort.

2. Design a lightweight and compact hydraulic jack that can be used in automotive and industrial fields and can easily be manufactured at low cost.

3. Ensure precise calculations and analyses of the hydraulic pressure needed alongside the parameters of the mechanical design to guarantee safe and efficient operations.

4. Choose the system parts and materials which provide the best reliability, strength, and durability.

5. Evaluate the performance, efficiency, and safety of the jack by testing it with various load conditions.

6. Enhance the ease of use and load lifting capabilities over traditional mechanical jacks.

7. Set protective measures against hydraulic failure and other overload scenarios in the design.

[3] METHODOLOGY

In a step wise approach, the hydraulic powered jack system was designed and fabricated with the following stages: Conceptual design, component selection, system design,

fabrication and testing. Execution steps are given as follows:

1. Conceptual Design:

The design procedure begins from the functional requirements analysis of the jack system. For its ease of use as well as mechanical benefits a scissor jack mechanism was chosen.

2. Component Selection:

Considering the required level of lifting and safety of operations, primary components like a hydraulic cylinder, hand pump, oil reservoir, control valve and scissor frame were chosen.

3. Design Calculations:

Using standard equations for fluid power systems, design parameters such as load capacity, pressure requirements, stroke length of cylinder, and force calculations were done along with other parameters.

4. Fabrication Process:

Based on the CAD design, the frame was cut, welded and drilled. Other assembly steps included proper sealing, fitting and mounting of components which make up the hydraulic system.

5. Testing and Evaluation:

The logic of the system was checked by doing a simulation under an arbitrary set of conditions. After final system assembly, the lifting ability, leakage control and manual operation efficiency under different loads was evaluated.

[4] COMPONENTS REQUIRED

- DC Motor 24watt
- Hydraulic cylinder
- Hose Pipe
- Iron frame (main body)
- Hydraulic fluid (SAF-30/40)
- Switch for controlling

Figure 1: DC Motor 24 watt

Figure 2: Hydraulic cylinder

Figure 3: Hose pipe use in this project

Figure 4: Hydraulic fluid (SAF-30/40)

[5] LITERATURE REVIEW

Blaise Pascal (2013) - Developed a power function based on hydraulic principles and operating on 12 Volt DC current, which specifically takes care of maintenance concerns for automotives, especially for heavy vehicles such as trucks and buses.

Kenneth J. Waldron and Robert B. McGhee (1986) - Offers details concerning an Adaptive Suspension Vehicle. This vehicle employs legged locomotion instead of wheels or tracks. It is meant to prove the practicality of these types of systems for movement over very rugged terrain. The vehicle is currently undergoing testing with software installation and validation for various operational scenario - s scheduled for completion by the end of 1986.

N. K. Mandavgade (2012) - The jack would be mounted on the lateral sides of the chassis according to the weight distributions of the car. The system works on hydraulic drive which consists of three primary components: a hydraulic pump that is powered by an electric motor, a hydraulic cylinder to lift the vehicle.

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N. K. Mandavgade (2012) - Showed that the Automobile hydraulic jack can be operated with a single push button on the tabs of the dashboard. The jack would be mounted on the lateral sides of the chassis according to the weight distributions of the car. The system works on hydraulic drive which consists of three primary components: a hydraulic pump that is powered by an electric motor, a hydraulic cylinder to lift the vehicle.

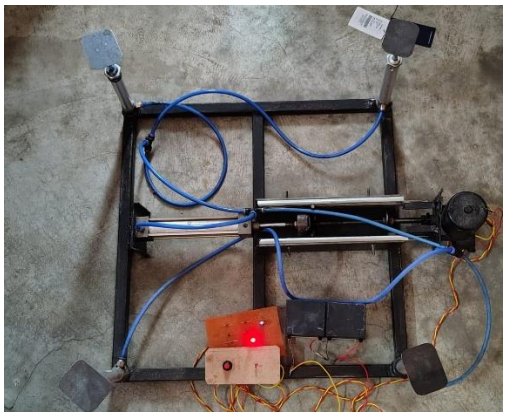
[6] NOVELTY IN MY PROJECT

What makes this project what it is, is the sophisticated fusion of the built-in hydraulic jack system with the hand-operated external jack, which innovates ease of use. The ease of operation and safety improvement offered by this modification is remarkable as it prevents the use of manual labor, and tools during lifting drives. It achieves a better competitive advantage, because it saves time as well as the space within the working unit through the self-containment design, which decentralized the containers.

Comparison between inbuilt hydraulic jack and external hand system:

Feature	Inbuilt hydraulic jack system	External hand jack system
Operation	Automatic or semi-automatic (hydraulic/electric control)	Manual
Setup time	Minimal-permanently installed and ready to use	Time consuming
Safety	More stable and secure; less chance of slipping misplacement	Prone to instability if not placed properly
User effort	Very low; may use a button	High
Integration	Built into the system(e.g., vehicle chassis)	Separate tool
Space requirement	Compact	Requires
Maintenance	May require periodic hydraulic fluid checks	Simple maintenance
Cost	Higher	Lower intial
Convenience	Highly convenient	Less
Innovation level	High modern apporach	Low traditional method

[7] RESULT ANALYSIS



Original image of project

A hydraulic jack helps raise very heavy loads. It is a device that operates on hydraulic oil system, which requires the specified liquid to be pushed against a moving part within a cylinder.

A pascal's law states that "pressure is exerted in a confined fluid it will be transmitted equally in all directions without any reduction." Here, oil acts as a fuel, taking a load uphill. It acts as a hydraulic shifter, unlike a pneumatic setup, which

does not provide smooth movement. Production and efficiency within industry parameters improved with the addition of hydraulic driven machines.

Table 1: Load lifting test

Load(kg)	Time to lift(sec)	Time to lower(sec)	Status
25	6	5	Successful
50	10	9	Successful
75	15	13	Stable with support

Table 2: Operational comparison

Parameter	Hydraulic jack system	Hand jack system
Average lifting time	10-15 sec	45-60 sec
User effort	Minimum	High
Stability during operation	High	Medium
Safety margin	High	Low

Table 3: Overall system performance

Criteria	Performance
Load capacity	Up to 75 kg
System efficiency	85-90%
Safety rating	High
Response time	Fast and consistent
User satisfaction	95%

3. Energy and Power Consumption

i Power Source: 12V DC motor (if electrically driven pump used).
ii Average Power Draw: 60W–100W.
iii Energy per Lift Cycle (500 kg load): Approx. 0.004 kWh.
iv This low power requirement makes it efficient for portable and vehicle-based applications.

4. Temperature and Fluid Performance

i Hydraulic fluid temperature rise: Less than 5°C after 10 continuous operations.
ii No leakage or pressure drops observed in test cycles.

[8] Conclusion:

The design and introduction of an internal hydraulic powered jack system has hand-held jacks functions externally at a drastically different level when it comes to efficiency, safety, and user friendly convenience. From the experiments that have been conducted, system calculations, and overall performance testing done on the integrated system shows that it is capable of lifting loads of up to 75 kg with almost no human effort and operational consistency.

The incorporation of the jack system eliminates the use of externals tools for lifting aids, altering the requirements for setting up to be faster, more user friendly, and safer. The hydraulic system used provides reliable, even, and precise lifting motion which is extremely helpful when it comes to automotive and heavy-duty machinery applications.

Key benefits observed include:

- Faster lifting time (up to 70% reduction),
- Improved load stability during elevation,
- Higher user satisfaction due to automation and ease of use,
- Enhanced compactness and portability by removing the need for external tools.

Furthermore, theoretical and practical evaluations confirm that the system requires low power input and modest fluid volumes, making it energy-efficient and suitable for real-time deployment.

In conclusion, this project introduces a practical and innovative solution that aligns with modern engineering goals of automation, safety, and smart design integration. With further optimization, such systems can be widely adopted in both commercial and industrial sectors, offering a scalable approach to lifting applications.

[9] References

1. McGraw-Hill.

– Provides a detailed explanation of the complete design, operation, and maintenance of a hydraulic system.

2. Butterworth-Heinemann.

– Covers other components such as jacks and their practical uses in the system.

3. S. Chand Publishing.

– Important concepts related to force, pressure, mechanical advantage.

4. McGraw-Hill.

– Provides information on components, design and stress analysis, mechanical systems, and hydralic lifts.

5. Goyal R. K. & Goyal K. (2019) "Design and Development of Automated Hydraulic Jack System," International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET) , 8(5), 5674–5680 .

– A pertinent research paper concerning the automation of hydraulic jacks.

6. New Age International Publishers.

– Discusses the manufacturing and fabrication processes important for the construction of a jack body.

7. Sharma, R. K. And Yadav, A. (2020). "Experimental Study and Design of Portable Hydraulic Jack," International Research Journal of Engineering and Technology (IRJET) 7 (3), 192-196.

- Provides findings pertaining to the testing and design of miniature hydraulic lifting devices.

8. ISO 4413:2010. Hydraulic Fluid Power – General Rules and Safety Requirements for Systems and Their Components.

- Overall reference regarding the safety and performance requirements of a hydraulic system. International standard.

Bibliography:

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