Arduino-Powered Portable Motorized Car Lifter: An Intelligent Solution for Ergonomic Vehicle Lifting

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Abstract

Vehicle maintenance tasks such as tire replacement often require car-lifting tools that are physically demanding and time-consuming. Traditional manual jacks, though affordable, pose ergonomic challenges and safety risks, especially for users with limited physical strength. On the other hand, advanced automated lifting systems remain financially inaccessible to many small-scale workshops and individual users. This research aims to design and develop a smart, portable electro-hydraulic car jack system controlled by Arduino, offering a safer, faster, and user-friendly alternative. The main objective of this project is to automate the vehicle-lifting process using a motorized hydraulic jack integrated with Arduino-based control, sensors, and DC motors. The system is powered by a 12V car battery, making it suitable for both workshop and roadside use. The development follows the Agile methodology, encompassing planning, design, prototyping, testing, and user feedback phases. An ultrasonic sensor and LED indicators were used to enhance safety and provide operational feedback. Testing results demonstrate that the proposed system requires only 45 Nm of torque to lift a vehicle, compared to 70 Nm for a manual scissor jack. It also achieves a lifting height of 50 cm within 1 minute and 48 seconds, significantly faster than conventional tools. The findings confirm improved efficiency, reduced physical strain, and greater user accessibility. In conclusion, this Arduino-powered electro-hydraulic jack offers a practical and cost-effective solution for safe vehicle lifting. It is particularly advantageous for users in emergency scenarios and for workshops seeking a low-cost automation upgrade.

Keywords **:** *Arduino; Mobile jack; Automotive*

I. INTRODUCTION

Hydraulic jacks play a crucial role in lifting heavy loads, particularly in automotive repair, by utilizing hydraulic pressure. However, traditional methods involving manual labour remain prevalent among many car repairers despite being labour-intensive and time-consuming [1]. While modern car-lifting equipment such as automated lifts and advanced hydraulic systems are effective, they are often associated with high acquisition and maintenance costs, making them inaccessible to small-scale repair shops or individual vehicle owners [3].

In developing regions, where affordability is a major concern, these high costs create a significant barrier to adoption [4]. Moreover, the operational complexity of such modern systems often requires specialized training, limiting usability among general consumers. On the other hand,

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manual car jacks remain the most affordable option but demand significant physical effort to operate, posing challenges especially for elderly users or individuals with limited physical strength [2]. Prolonged usage can also cause musculoskeletal strain or injuries during frequent or heavy-duty applications [9].

Beyond cost and operational challenges, safety is another critical concern. The use of low-quality equipment or improper handling increases the risk of accidents, which can lead to vehicle damage or user injury [10]. Thus, there is a pressing need for a comprehensive solution that balances affordability, safety, and ease of use.

To address these challenges, this project proposes the development of a control motor hydraulic jack that automates the lifting process. Powered by a motor and using hydraulic principles, the proposed system aims to offer an affordable, efficient, and user-friendly solution [11].

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Automation significantly reduces manual effort, making the tool more accessible to all users, including women and the elderly. Additionally, the motorized control enhances ease of operation and eliminates the steep learning curve associated with conventional lifting systems.

This research emphasizes achieving an optimal balance between affordability and functionality, ensuring that the system remains high-quality and durable while being accessible to small repair shops and individual users. The design prioritizes safety by incorporating reliable materials and user-centric features. Furthermore, the use of the vehicle's own battery to power the system enhances portability and makes it suitable for roadside emergencies [4].

The following sections of this paper will elaborate on the conceptual design, technical development, and performance evaluation of the proposed system. Key aspects such as cost-effectiveness, safety features, and user benefits will be discussed to highlight how this innovation could redefine traditional vehicle-lifting practices.

II. LITERATURE REVIEW

Car-lifting equipment is an essential component in automotive maintenance, with a variety of designs developed to suit different user needs. Manual jacks, such as scissor and bottle jacks, are the most commonly used due to their affordability and portability. However, these jacks require considerable physical effort, making them less practical for users with limited strength, such as the elderly or women.

Hydraulic jacks, like trolley and floor jacks, offer better efficiency as they use fluid pressure to lift vehicles with minimal effort. These are widely used in workshops where their capacity to handle heavier loads proves beneficial. More advanced lifting systems such as two-post or four-post lifts provide even higher levels of performance and safety. However, their high purchase and maintenance costs often make them inaccessible to small-scale operators [3].

In addition to the cost factor, advanced systems generally require skilled operators. This training requirement increases operational complexity and reduces the systems' appeal for general consumers. Meanwhile, manual jacks, though cheaper, remain time-consuming and physically demanding to use. Regular or extended use can cause musculoskeletal discomfort, especially when applied in repeated or heavy-lifting tasks.

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Safety issues are also central to the discourse on car-lifting tools. Manual jacks are often misused, or made from poor-quality materials, which can result in equipment failure or accidents during operation. In emergency roadside situations, where conditions may be uneven or unstable, the risks are heightened due to the absence of built-in safety mechanisms.

Although automated systems address some of these safety risks, they bring new challenges. Their size and reliance on external power make them unsuitable for portable or emergency use. On the other hand, while manual jacks are more mobile, they lack efficiency, which is crucial during time- sensitive repairs.

To overcome these limitations, modern innovations are incorporating motorized hydraulic mechanisms. These systems use electric motors to drive hydraulic pumps, eliminating the need for manual pumping. The motor supplies constant pressure, resulting in smooth, consistent lifting performance. In some designs, these systems draw power directly from the vehicle's battery [11], enhancing portability and making them ideal for roadside use.

Emerging designs now integrate smart control systems that include pressure monitoring and automated shut-off features. For example, pressure sensors can detect a sudden drop in hydraulic force and respond by adjusting the motor’s output or stopping it entirely to prevent instability [10].

One of the most significant advancements in this domain is the incorporation of Arduino-based microcontrollers. Arduino boards offer flexibility, low cost, and ease of integration with various sensors and actuators. These microcontrollers act as the “brain” of the system, managing motor speed, monitoring inputs, and executing safety protocols in real time [9].

Because Arduino is open-source and widely supported, it provides a practical platform for building intelligent systems at a relatively low cost. Its modularity allows for easy system upgrades, while wireless connectivity options enable future enhancements such as remote control or monitoring via mobile devices [13].

With the integration of sensors, automation, and programmable logic, modern car-lifting tools are evolving into smart systems. They not only improve lifting performance but also offer enhanced safety and user convenience. Such improvements are especially valuable for users who lack technical experience but still require reliable tools in emergency situations.

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In summary, the trend in car-lifting technology is shifting toward affordable, smart, and motorized systems that minimize physical effort while maximizing safety and usability. This transformation is driven by the use of motor-hydraulic combinations, microcontroller integration, and intelligent feedback systems. The development of such systems aligns with the goal of this project to provide an accessible and efficient car-lifting solution suitable for a wide range of users, including individuals and small-scale workshops.

III. RESEARCH METHODOLOGY

The development of the Portable Motorized Car Lifter utilized the Agile methodology. According to [7], [8], Agile is an ideal approach for product development as it enables more efficient and effective problem-solving. This methodology is divided into five key phases: planning, design, development, testing, and feedback, as shown in Figure 1. The iterative and flexible nature of this approach ensures that the development process can adapt to user needs and feedback at every stage.

Figure 1 Agile Methodology

The planning phase serves as the initial step in the Agile methodology, focusing on analyzing the requirements for developing the device. During this phase, key aspects such as the problem statement, proposed solutions, objectives, scope, and constraints of the device are identified. The design phase involves creating system designs, software, hardware, and prototypes to ensure the product meets its objectives. In the development phase, the Portable Motorized Car Lifter is constructed. This prototype then undergoes multiple evaluations in the testing phase, aimed at identifying and resolving errors in the Arduino circuit and the prototype itself. The final phase, feedback, gathers user input on the Portable Motorized Car Lifter. This feedback is instrumental in guiding future enhancements and improvements to the product.

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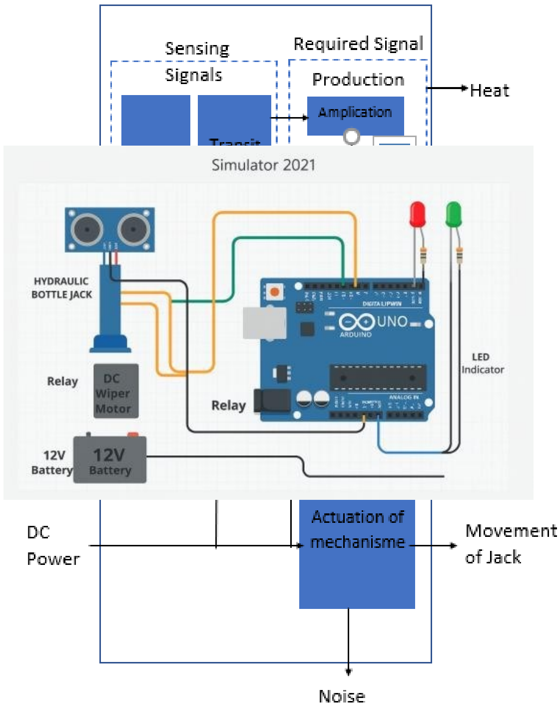
A. BLOCK DIAGRAM

The block diagram for the Portable Motorized Car Lifter outlines the system's functionality as shown in Figure 2. The ultrasonic sensor acts as the input, sending data to the Arduino circuit for processing. Once processed, the red, green, and blue LEDs serve as outputs, delivering visual feedback to the user. To ensure the accuracy of physical connections and coding, the Simulator 2021 software was utilized. This software enables testing of both coding and physical connections prior to the development of the product prototype. Figure 3 illustrates the simulator interface for this device. The use of Simulator 2021 helps to minimize the risk of damage to the hardware during prototype development.

Figure 2 Block diagram

Figure 3 Simulator interface



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B. HARDWARE AND SOFTWARE DESIGN

The core hardware components include a 12V DC gear motor, a hydraulic cylinder, relay module, pressure sensor, and an Arduino UNO microcontroller. The Arduino UNO was chosen due to its affordability, wide community support, and sufficient capabilities for basic control and monitoring tasks [5].

The system uses a DC motor to power the hydraulic pump, which provides the force required to lift a vehicle. The motor is controlled via a relay module interfaced with the Arduino. Arduino programming was carried out using the Arduino IDE, with sketches developed based on the system requirements. Programming followed structured pseudocode and modular functions for reliability and ease of debugging [6]. The hydraulic jack mechanism is mounted on a trolley frame for mobility. This design ensures that the system remains practical for both workshop and roadside environments.

Figure 4 show the final design of portable motorized car lifter. The components required for the development of the Portable Motorized Car Lifter include the Arduino UNO R4 Wi-Fi, DC Motor Wiper for pumping, Jumper Wires, and a DC Motor for the pressure valve. Additionally, 14 AWG Wire (6 meters) is used, costing, along with Iron Material and a Hydraulic Bottle Jack. The construction also involves Plain Wood and the L298N Motor Driver. Lastly, a Lever Arm is used, with no associated cost. These components collectively support the development and functionality of the system.

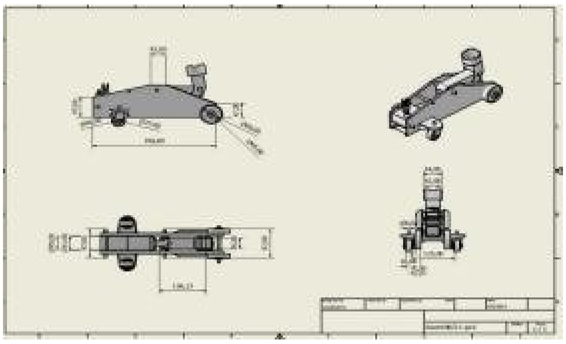

Figure 4 Final design of portable motorized car lifter

C. PRODUCT DESIGN

Figure 5 showcases the developed Portable Motorized Car Lifter, while Figure 6 illustrates the Arduino circuit integrated with an ultrasonic sensor and red, green, and blue LEDs. The circuit is securely placed inside a box to prevent direct exposure to water. The jack pumping valve is connected to an iron rod, which was crafted by grinding and welding, and is linked to a DC wiper motor to facilitate the pumping action. A second DC motor is welded to the pressure valve to automate its opening and closing every 3 seconds. Both DC motors are controlled by a control panel consisting of an Arduino UNO R4 Wi-Fi and an L298N motor driver. The control panel receives power from a 12V car battery to supply the necessary electrical current for operation.

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Figure 5 Final product in testing

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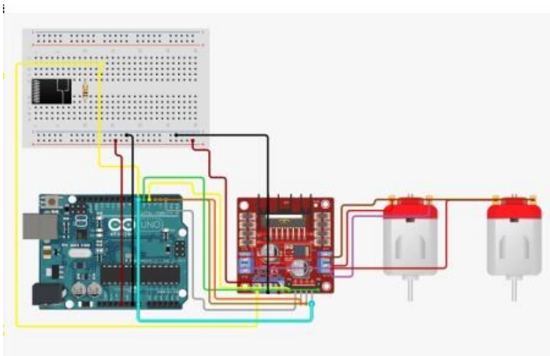

Figure 6 Integration of Arduino UNO and motor wiper

IV. DATA ANALYSIS AND TESTING

The findings indicate that the Portable Motorized Car Lifter offers superior performance compared to the scissor jack. Powered by a 12V car battery, it uses a direct current motor to operate the hydraulic pump, requiring only 45 Nm of energy significantly less than the 70 Nm required by the manually operated scissor jack. It also achieves a greater maximum height of 50 cm, compared to the scissor jack's 30 cm, and is more time-efficient, lifting the car in 1 minute and 48 seconds, which is 47 seconds faster. These results demonstrate that the Portable Motorized Car Lifter is a more efficient and user-friendly solution than the traditional scissor jack.

Table 1 summarizes the results of testing conducted in week 12 to compare the performance of a scissor jack with a Portable Motorized Car Lifter. The comparison highlights significant differences in energy consumption, maximum height, and operational efficiency between the two devices.

Table 1 Performance Comparison Between Scissor Jack and Portable Motorized Car Lifter

No.	Criteria	Scissor Jack	Portable Motorized Car Lifter
1	Energy Source	Human Strength	12V DC Power Window
2	Tire Distance from Ground	3 cm	3 cm
3	Maximum Jack Height	30 cm	50 cm
4	Energy Required to Lift	70 Nm	45 Nm
5	Time to Lift Car	2 min 35 sec	1 min 48 sec

The data findings indicate that the motorized car lifter is efficient, time-saving, and offers a safer, more ergonomic, and user friendly solution for both vehicle owners and service professionals. This system enhances convenience by reducing risks associated with physical exertion and improper handling. The findings confirm that the Portable Motorized Car Lifter is a practical, cost-effective, and innovative alternative to traditional scissor jacks. With its superior performance and advanced technology, it has the potential to transform the way vehicle maintenance and tire-changing tasks are performed.

V. CONCLUSION

In conclusion, the Portable Motorized Car Lifter is a battery-powered car jack designed to make tire changes simpler, safer, and more convenient. This innovative solution is particularly useful for

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addressing unexpected car issues during long-distance travel, allowing users to lift their vehicles with ease while minimizing the risk of side injuries. Additionally, it promotes energy conservation by eliminating the need for the manual labour typically required with traditional hydraulic jacks.

The product's introduction has the potential to transform vehicle maintenance by improving accessibility for a broader range of users, including the elderly and individuals with limited physical strength. Furthermore, the system's ability to minimize physical strain reduces the risk of injury, thereby enhancing safety during vehicle servicing.

In summary, the Portable Motorized Car Lifter not only provides a practical and cost-effective alternative to traditional scissor jacks but also contributes to greater user convenience, time savings, and improved safety. This innovative solution has the potential to positively impact the

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automotive repair industry, making vehicle maintenance faster, safer, and more efficient for both vehicle owners and service professionals.

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REFERENCES

[1] P. Pandian and M. Balasubramanian, "Design and fabrication of automatic car jack system using gear motor," *Int. J. Eng. Res. Technol.*, vol. 5, no. 3, pp. 1–5, 2016.

[2] R. Sankar and K. Elangovan, "Low cost automatic car jack system using DC motor and microcontroller," *Int. J. Sci. Res. Eng. Manage.,* vol. 3, no. 7, pp. 20–25, 2019.

[3] M. Khaleel and A. Ismail, "Design and fabrication of hydraulic car jack," *Int. J. Eng. Tech*., vol. 4, no. 2, pp. 78–84, 2018.

[4] A. H. Abdalla and M. S. Ahmed, "Development of an electro-hydraulic jack powered by vehicle battery," *J. Eng. Appl. Sci., vol. 12*, no. 8, pp. 2180–2185, 2017.

[5] M. Banzi and M. Shiloh, Getting Started with Arduino, 3rd ed. Sebastopol, CA: Maker Media, 2014.

[6] S. Monk, Programming Arduino: Getting Started with Sketches, 2nd ed. New York, NY: McGraw-Hill, 2015.

[7] K. Beck and C. Andres, Extreme Programming Explained: Embrace Change, 2nd ed. Boston, MA: Addison-Wesley, 2004.

[8] M. A. Firdaus, "Agile Development Methodology," *J. Comput. Eng., vol. 10*, no. 1, pp. 15–20, 2017.

[9] A. U. Oke, T. A. Okonigene, and O. A. Olusola, "Design and implementation of a microcontroller based hydraulic car jack," *Int. J. Eng. Res. Technol*., vol. 2, no. 8, pp. 1357–1363, 2013.

[10] A. A. Adekunle and R. A. Ibrahim, "Microcontroller based intelligent jack system for automobile maintenance," *Int. J. Sci. Eng. Technol.,* vol. 6, no. 3, pp. 184–188, 2017.

[11] M. W. Ahmad, M. A. Zakaria, and A. Z. Zulkifli, "Development of an automated car jack system using Arduino," in *Proc. IEEE 8th Control and System Graduate Research Colloquium (ICSGRC)*, Shah Alam, Malaysia, 2017, pp. 56–60.

[12] A. M. Shahid and M. H. Rahman, "Arduino based smart hydraulic jack," *Int. J. Adv. Comput. Sci. Appl.,* vol. 9, no. 11, pp. 391–395, 2018.

[13] F. A. Salim and A. K. Syahrul, "Smart hydraulic jack controlled by Arduino and Bluetooth*," J. Mech. Eng. Sci., vol. 13*, no. 3, pp. 5403–5412, 2019.

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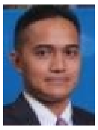
First Author: Name 	Jabatan Kejuruteraan Mekanikal, Politeknik Kuching Sarawak, KM22, Jalan Matang, Kuching, 93050, Malaysia E-mail: herman@poliku.edu.my
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