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# FABRICATION AND PERFORMANCE ANALYSIS OF A COMPRESSED AIR VEHICLE SYSTEM

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## ABSTRACT

*This project seeks to develop and evaluate the performance of pressurized air-powered vehicles. The design yields a four-wheeled, air-powered vehicle accommodating a single occupant. The engine employs a four-vane reversible air motor with a maximum rotation speed of 3000 rpm, supplemented by an air tank with a capacity of 6 m³ at a pressure of 150 bar. Test outcomes at an operating pressure of 80 psi yield 2.74 HP. The vehicle may operate steadily and without considerable impediments. A lightweight, air-powered vehicle characterized by straightforward operation, little production and maintenance expenses, and zero exhaust emissions. Nonetheless, it has the drawback of producing a considerable noise from the air outlet; it also requires a sufficiently big and robust tube size to support high-pressure air and substantial capacity. Should these deficiencies be overcome, pressurized air-powered vehicles will emerge as a prominent mode of transportation in the future.*

***KEYWORDS***
*Air, Compressor, Car, Pressure, noise, vehicle, rpm, yield*

## I. INTRODUCTION

Vehicles powered by compressed air are less prevalent than gasoline, diesel, or electric vehicles. However, it is surprising since engine technology using compressed air has been in existence since the late 19th century. In 1872, the Mekarski air engine was used for urban transportation, including a single-stage engine [1,2]. Charles B. Hodges will be eternally recognized as the genuine progenitor of the innovative application of the powered air-car idea. He not only succeeded in developing a pressurized air drive vehicle but also effectively marketed an automobile using a pressurized air drive engine [1,2]. Following twelve years of research and development, Guy Negre successfully created a machine that has the potential to represent one of the most significant technical advancements of the century. A French mechanical engineer has successfully designed fuel-efficient, pollution-free engines for urban automobiles with compressed air technology. Motor Development International's "Air Car" has advanced the creation of a zero-emission vehicle, using a pressurized air drive engine that is safe, silent, and achieves a maximum speed of 110 km/h with a range of up to 200 km. Guy Negre is the director of research and development of Motor Development International (MDI) Car, which successfully developed the prototype Zero Emission Vehicle (ZEV) in 1994. Gasoline and diesel-fueled cars continue to dominate those operating on the roads. Approximately 70% of air pollution in metropolitan areas is attributable to car emissions [3]. Conversely, global fossil fuel supplies are depleting, rendering oil-powered cars unsustainable. Numerous efforts have been undertaken to address the issue, including the creation of fuel-efficient vehicles, electric cars, vegetable oil fuels, hybrid automobiles, and others. The advancement of fuel-efficient vehicles cannot serve as a sustainable solution, since they continue to rely on fossil fuels that will ultimately deplete. Electric automobiles provide many benefits, including greater cost-effectiveness, zero emissions, silent operation, and the potential for energy sourcing from renewable resources. However, electric vehicles possess limitations in battery charging technologies, which still need time to replenish power. This work included the development of pressurized air-driven vehicles with a mechanism designed as a four-vane reversible water motor.

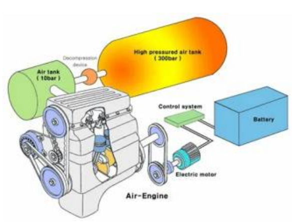


**Figure.1 Air Compressed system**

## I. LITERATURE REVIEW

The growing apprehension over environmental contamination and the exhaustion of fossil fuels has prompted experts to investigate alternate vehicle propulsion methods. Compressed air technology has emerged as a viable alternative for clean and sustainable transportation.

Srinivasa Chari et al. (2015) devised an automated pneumatic bumper and brake actuation system that enhanced vehicle safety by using compressed air to mitigate accident impact. Their study indicated that pneumatic systems might provide rapid reaction and dependable functioning in comparison to mechanical systems.

Dr. P. Poongodi and Mr. P. Dinesh Kumar (2015) investigated automated safety solutions for vehicles using pneumatic mechanics. They determined that such systems provide enhanced control, less maintenance, and superior safety performance in crises.

Jadhav N. D. et al. (2015) introduced an autonomous braking system using a pneumatic bumper, demonstrating that compressed air may efficiently function in lightweight cars for braking and impact absorption. Their research substantiated the viability of air pressure-driven energy conversion for compact vehicle applications.

Dr. Eung Soo Kim (2014) developed an automatic braking system using sensors combined with pneumatic actuators. His research demonstrated that the integration of sensors with compressed air enhanced

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precision, reaction velocity, and brake stability.

Takahiro Wada (2013) proposed a deceleration control technique for collision avoidance predicated on driver perception risk, indicating that the amalgamation of intelligent control with pneumatic systems might markedly improve vehicle safety and automation.

The examined literature indicates that compressed air systems may significantly contribute to the advancement of future automobile technology. They have a straight forward design, are economically viable, and are ecologically sustainable. This project aims to build an air-powered vehicle that functions without fuel combustion, resulting in zero emissions and lower running costs, thereby providing a sustainable alternative to traditional automobiles.

## II. METHODOLOGY

Pneumatic braking system of a sophisticated electronically regulated car braking system. This model will facilitate the development and assessment of control techniques, including a 'antilock braking system' (ABS) and enhanced agility via individual wheel braking. Significant advancements have occurred in contemporary car braking systems in recent years. For instance, electronically controlled Anti-lock Braking Systems (ABS) for emergency braking, electronically controlled hydraulically operated individual brake-by-ultrasonic (BBW) systems for passenger vehicles, and electronically controlled pneumatically actuated systems for commercial trucks. The recent years' work will serve as the foundation for a system design approach to be executed. The innovation of the proposed research program will focus on the design and assessment of control systems for attaining individual wheel motion control enabled by BBW. In the BBW system, the brake pedal is disconnected from the hydraulic system and replaced with a 'brake pedal simulator'. The simulator generates an electrical signal for the electronic control system

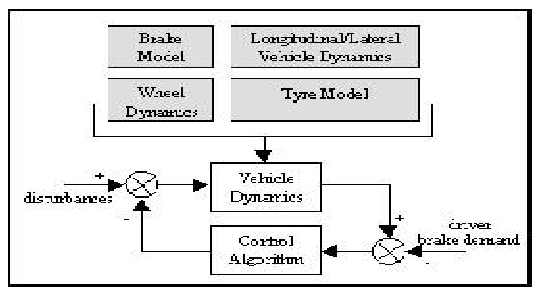


**Figure 2 Vehicle Dynamics Components**

## III. EXPERIMENTAL SETUP

The prototype has a lightweight three-wheeled structure driven by a four-vane reversible air motor. A compressed air tank with a capacity of 6 $m^3$ and a pressure of up to 150 bar served as the energy source. The system included a 12V DC compressor, a 5/2 pneumatic valve, a relay control unit, and an AT mega 328 microcontroller for the regulation of air flow and switching functions. The control system was included with an LCD display to observe the system status during operation. Recent research has bolstered the advancement of compressed air

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vehicles and pneumatic brake systems. R. Senthil Kumar et al. (2016) developed a compressed air engine for lightweight transportation systems, demonstrating that pneumatic propulsion may substantially decrease fuel reliance and environmental pollutants. Their research highlighted the significance of effective air storage and pressure management in enhancing vehicle performance.

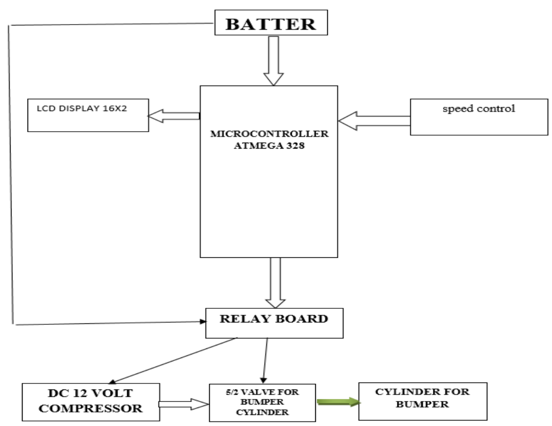
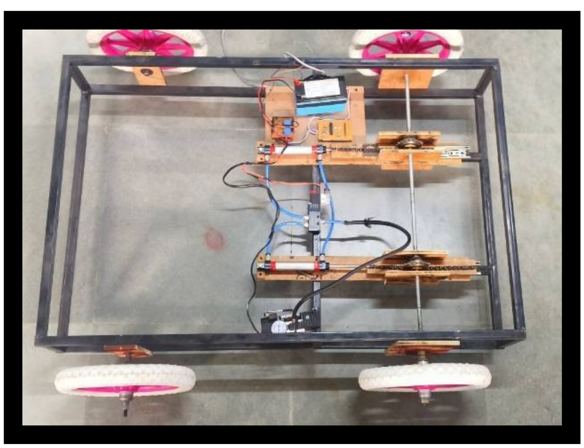
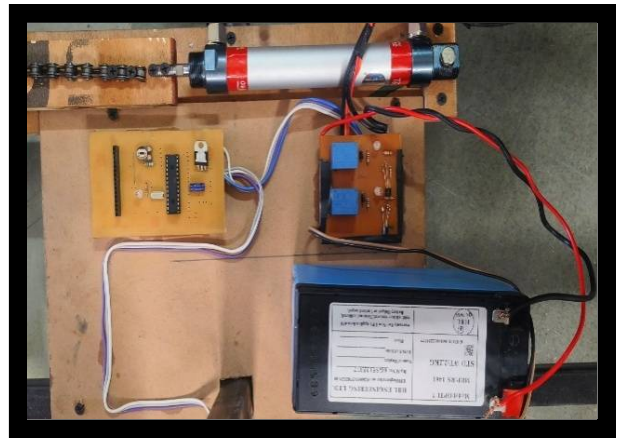



**Figure. 3 Block Diagram and Working of**



**System**

**Figure 4 (a) & (b) Actual setup with different view**



## V. RESULT ANALYSIS

The investigation revealed that increased air pressure directly enhances motor torque and vehicle velocity, while concurrently accelerating air consumption. The system operated effectively at 80–100 psi, achieving an ideal equilibrium between velocity and pressure application. The findings validate that compressed air may efficiently propel lightweight vehicles with no maintenance and no emissions.

Variation of Power with Pressure

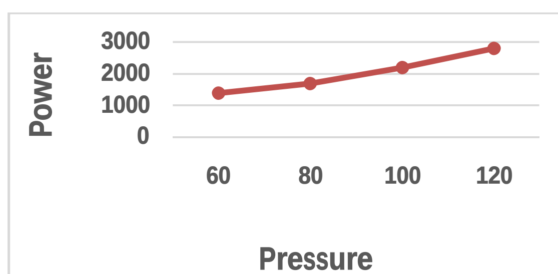



Figure 3 Variation of Power with Pressure

Variation of Speed with Pressure

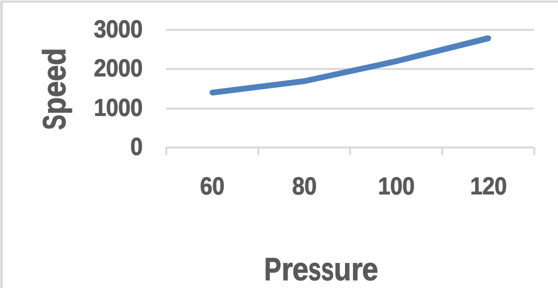



Figure 4 Variation of Speed with Pressure

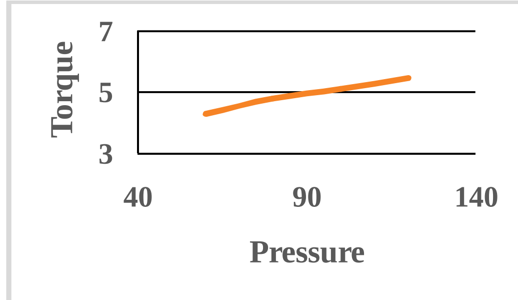



Figure 5 Variation of Torque with Pressure

Variation of Torque with Pressure

## VI. CONCLUSION

The conclusion asserts that air-powered vehicles provide a straightforward, cost-effective, and eco-friendly substitute for traditional fuel-powered automobiles. These vehicles use compressed air rather than gas or diesel, resulting in a lightweight and less intricate design. Their reduced mechanical components result in cheaper production and maintenance costs relative to conventional autos. A significant benefit is that air-powered vehicles generate no detrimental exhaust pollutants, since fuel combustion does not occur during operation. This mitigates air pollution and promotes environmental conservation.

Nonetheless, the result also underscores certain drawbacks of air-powered vehicles. A significant concern is the noise generated when compressed air is expelled via the air exit. Moreover, robust and resilient tanks and pipelines are essential for the secure storage of high-pressure air. The technique requires adequate infrastructure, including high-pressure air filling stations at around 100 bar, for extensive implementation.

Notwithstanding these constraints, air-powered vehicles has significant future promise. Should the issues with noise, storage, and infrastructure be addressed, these cars may emerge as an efficient, cost-effective, and sustainable transportation alternative for the future.

## FUTURE SCOPE

The compressed air vehicle is appropriate for environmentally sustainable and zero-emission transportation, particularly for short-distance travel at campuses, industrial facilities, airports, and municipalities. It is applicable in hazardous areas where fuel-based vehicles are dangerous, as well as for instructional and research purposes in pneumatics and alternative energy systems.

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