Design and Development of a Performance Improved Cost Effective Open-Wheel Single Seater Race Car

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Open-wheel race cars are among the most advanced and performance-oriented vehicles in motorsport, requiring an optimal balance between speed, handling, safety and cost efficiency. This study presents the design and development of a Formula-style, single-seater open-wheel race car built under student-level resource constraints, with a focus on lightweight construction, aerodynamic performance and sustainable material usage. The primary objective of this project is to demonstrate how core automotive engineering principles can be effectively applied to develop a functional race car within limited financial and manufacturing resources. The design process integrates computer-aided design (CAD), engineering simulations, material selection and hands-on fabrication. A rear-mid-mounted Suzuki F6A engine coupled with a rear-wheel-drive configuration was selected to achieve improved weight distribution, balance and efficient power delivery. The chassis was constructed using lightweight steel tubing to ensure structural rigidity while minimizing overall mass. The suspension system consists of a double wishbone setup at the front and a MacPherson strut configuration at the rear, providing stability and precise handling characteristics. Aerodynamic components, including front and rear wings and side air vents, were developed through iterative design and computational fluid dynamics (CFD) simulations to enhance downforce and airflow management. A key innovation in this project is the use of jute fiber-reinforced composite materials combined with polyester resin for body panels, offering a cost-effective and environmentally sustainable alternative to conventional carbon fiber. Comparative material analysis showed that while fiberglass exhibits superior mechanical strength, jute composites provide significant advantages in terms of weight reduction, cost efficiency and environmental impact. The vehicle was evaluated through static testing and controlled speed test runs (up to 100 km/h), which confirmed stable handling, effective braking performance and balanced system integration. The implementation of a four-wheel disc braking system and essential safety features further enhanced operational reliability. Future work will focus on comprehensive performance testing and further design optimization to prepare the vehicle for participation in Formula-style racing competitions in Sri Lanka. Overall, this project demonstrates the feasibility of developing a cost-effective, sustainable and high-performance open-wheel race car, highlighting the potential of alternative materials and innovative design approaches in modern automotive engineering.

Keywords: aerodynamics, bio-degradable materials, jute fiber composites, lightweight design, open-wheel, single-seater race car