



Design and Fabrication of Electric Unicycle

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ABSTRACT

The increasing demand for compact and eco-friendly transportation has driven the development of the electric unicycle (e-unicycle), a single-wheeled electric vehicle gaining popularity for short-distance travel. This mini-project explores the e-unicycle's potential as a sustainable and efficient mode of transportation. The e-unicycle's design typically features an electric motor, balancing mechanisms, and foot platforms for rider control, offering clean and quiet operation compared to traditional gasoline-powered vehicles. Riders control the e-unicycle by leaning forward or backward, making it ideal for short to medium-distance commutes, recreation, and exercise. The compact size of e-unicycles reduces parking space requirements and facilitates navigation in congested areas. This project addresses the learning curve for riding an e-unicycle, along with benefits such as portability and potential for recreational use. Additionally, it explores the integration of battery management systems to optimize energy efficiency. Overall, this abstract highlight the e-unicycle as an emerging transportation option with eco-friendly qualities and unique maneuverability, making it a promising solution for short-distance commuting.

Keywords: Eco-friendly transportation, Single-wheeled electric vehicle, Electric motor, Battery management systems, Compact size, short distance commuting, Quiet operation, Portability.

1 Introduction

Urban transportation is undergoing a change in thinking driven by rapid technological advancements, growing environmental concerns, and changing lifestyle preferences. Traditional modes of transport, while effective, have contributed significantly to urban congestion, air pollution, and reliance on non-renewable energy sources. Amidst this scenario, personal electric vehicles (PEVs) are emerging as viable alternatives, offering eco-friendly, efficient, and convenient solutions for urban commuters. The electric unicycle, a single-wheeled, self-balancing personal transporter, stands out among PEVs due to its compact size, agility, and ease of use. This innovative vehicle leverages advancements in gyroscopic



technology, battery efficiency, and electric motor design, making it a promising candidate for addressing modern urban transportation challenges. This project aims to introduce an innovative electric unicycle, specially designed to transport humans over shorter distances. The prototype's affordability is a key consideration, aiming to make the technology accessible at a low cost. Utilizing modelling and designing software such as CATIA V5 and SolidWorks, the construction of the electric unicycle prototype features a low-cost yet robust design. Driven by motors, the unicycle incorporates a motor controller that enhances movement according to the pressure applied on the throttle, improving both efficiency and safety. Battery technology has also seen significant improvements, with modern lithium-ion batteries offering higher energy densities, faster charging times, and longer lifespans. This progress ensures that electric unicycles can cover substantial distances on a single charge, making them practical for daily commuting. Electric motors used in unicycles have become more powerful and efficient, providing sufficient torque to handle various terrains while maintaining energy efficiency. One of the primary motivations behind the development of electric unicycles is the reduction of urban pollution. Conventional vehicles emit a substantial amount of greenhouse gases and other pollutants, contributing to climate change and deteriorating air quality. In contrast, electric unicycles produce zero emissions, offering a clean and sustainable mode of transportation.

2 Recent Works

Junjie Shen et al [2020] this paper explores an innovative unicycle robot design that integrates an active omnidirectional wheel to enhance maneuverability and stability. The research highlights the challenges of balancing and controlling a unicycle robot, particularly addressing the need for precise control algorithms and robust hardware. Shen's design allows for dynamic and smooth transitions between different movement modes, significantly improving the robot's agility. The study provides valuable insights into the potential applications of unicycle robots in various fields, emphasizing the importance of advanced control systems and novel mechanical designs for improving performance.

Designing and Prototype Building of Self-Balancing 'Electric Uni-wheeler' (EUW) - Devang Kachhadiya et al [2020] this paper explores various design methodologies and stabilization techniques for single-wheeled robots. It delves into the principles of gyroscopic stabilization, control system architectures, and sensor integration essential for maintaining balance. The review also examines existing prototypes and their performance metrics, highlighting the innovations and challenges encountered in developing a reliable and efficient uni-wheeler. The study aims to enhance understanding and improve the design of self-balancing electric vehicles. A Tanveer Saleh et al [2004] this paper examines various stabilization techniques, focusing on gyroscopic mechanisms and control algorithms. It explores sensor technologies, including gyroscopes and accelerometers that provide real-time feedback for balance control. The review also discusses previous prototypes, their design considerations, and performance evaluations. Emphasis is placed on improving stability, manoeuvrability, and robustness in different



environments, aiming to advance the development of efficient and reliable single-wheeled robotic systems.

Suliana AB Ghani et al [2016] this paper investigates various control methods and sensor integration for maintaining balance. It examines the use of Arduino microcontrollers for real-time processing and feedback from gyroscopes and accelerometers. The review discusses the design and implementation of control algorithms, such as PID control, to achieve stability. Additionally, it highlights previous work on similar unicycle systems, emphasizing improvements in responsiveness, robustness, and ease of implementation for practical applications.

Batteries Lenin Sánchez et al [2021] this paper explores advancements in battery technology and its application in unicycles. It examines the design and construction challenges of integrating flow batteries, which offer high energy density and long cycle life. The review also covers stabilization techniques and control algorithms necessary for balancing. Previous prototypes and their performance are analysed, highlighting innovations in battery management and energy efficiency for improved unicycle functionality.

Zaiquan Sheng et al [1996] this paper explores theoretical and practical approaches to balance and manoeuvrability. It investigates various control algorithms, including linear and nonlinear control strategies, for maintaining stability. The review also examines sensor technologies like gyroscopes and accelerometers that provide critical feedback for real-time adjustments. Additionally, it analyzes previous unicycle prototypes and their performance in dynamic environments. The study aims to improve understanding of unicycle dynamics and enhance the design of control systems for better stability and responsiveness.

Pang-Chia Chen et al [2012] this paper examines control systems for maintaining longitudinal stability, emphasizing sensor fusion techniques involving gyroscopes and accelerometers. The review discusses previous hybrid power unicycle prototypes, analysing their performance and control strategies. The study aims to optimize energy efficiency and enhance rider experience by improving the balance and responsiveness of the unicycle through advanced control mechanisms.



3 Proposed Work Explanation

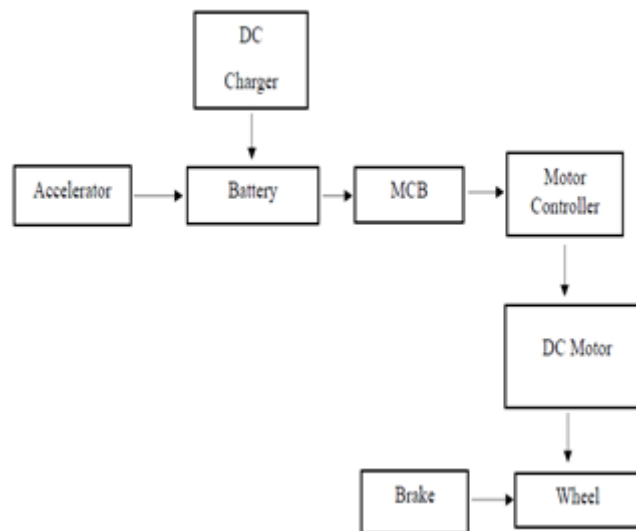


Figure 1: Proposed block diagram

An electric unicycle manual controls to maintain balance and direction while the rider uses manual inputs, such as handlebars or foot pedals, to indicate balance adjustments and direction changes. The control system processes this information and adjusts the motor speed accordingly. Powered by a battery, the motor drives the wheel, ensuring smooth operation. This setup allows the rider to maneuver the unicycle by shifting their position and using manual controls, providing intuitive control and stability.

4 Results and Discussion

The Electric Unicycle is a simple, compact, and effective solution for addressing transportation challenges in urban areas. It stands out for its eco-friendly nature, as it operates solely on battery power, which significantly helps in reducing air pollution. This personal transportation device offers a convenient and efficient way to navigate through crowded city streets, reducing the dependence on traditional fuel-powered vehicles. One of the key advantages of the electric unicycle is its compact size, making it easy to carry and store when not in use. It can be a great alternative to bicycles, scooters, and cars for short commutes, providing a quick and hassle-free means of getting from one place to another. With advancements in battery technology, modern electric unicycles offer impressive range and speed, ensuring that users can travel considerable distances on a single charge. The portability and ease of use make electric unicycles particularly suitable for transportation, it reduces the dependence on public transport, and it is a sustainable way to cover short distances. In summary, the electric unicycle represents a modern, green solution to urban transportation problems. Its reliance on battery power helps in controlling air pollution, while its compact design makes it a practical and appealing choice for urban residents seeking an efficient, eco-friendly mode of transport.



4.1 Preparation of Figures and Tables

Unicycle Design – Front View

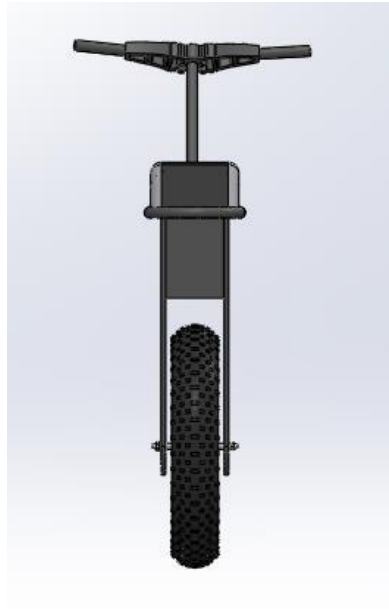


Figure 2: *3D Design – Front View*

Unicycle – 3D Design



Figure 3: *3D Design*



5 Conclusions

Gyroscopes can be installed to ensure automatic stability without human effort using sensors and actuators. Retractable handlebars can be installed to use the EUC as a trolley or something like a goods carrier. Incorporate advanced AI algorithms to improve navigation, obstacle avoidance, and route optimization. This would enable the EUC to operate in complex environments with minimal human intervention. Integration of solar panels to the EUC for sustainable and eco-friendly energy consumption, extending its operational range without the need for frequent recharging. Improvement of load capacity of the EUC to make it suitable for a wider range of applications, including delivery services and heavy goods transportation. Improvements to enhance user comfort, such as adjustable seats and shock absorbers.

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