Prototype Design and Research Collection

Series 1

Universiti Teknologi MARA
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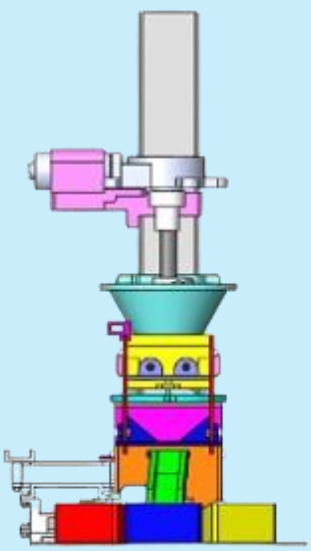

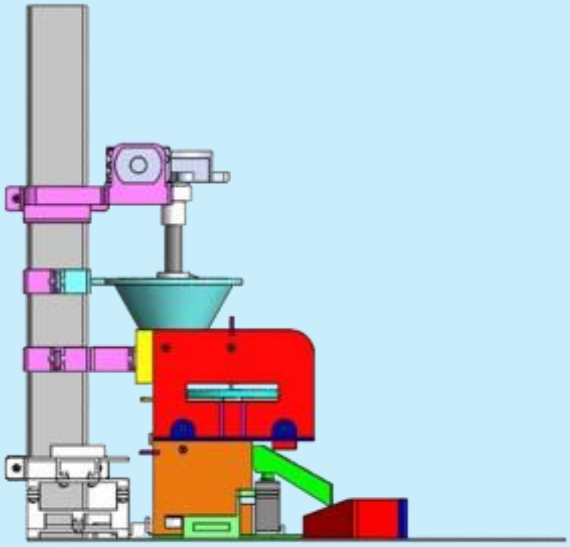

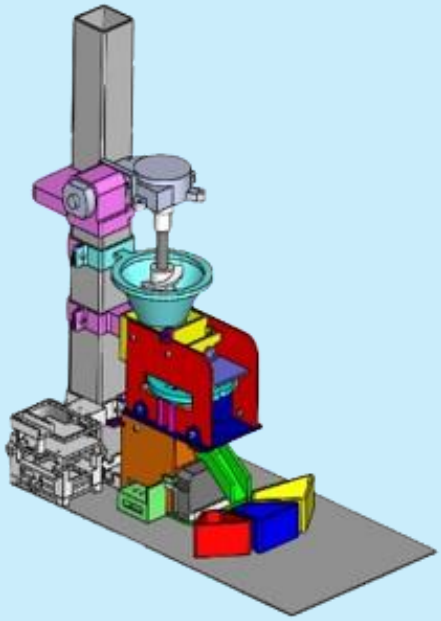

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FOREWORD

This digital book on Prototype Design and Research Collection Series 1 (PDRC Series 1), is designed as a comprehensive reference for mechanical engineering students. The designs featured in this collection undergo an extensive analysis process, incorporating both prototype development and research to ensure a thorough understanding of design principles. Each project is carefully analysed before the prototype fabrication with detailed summaries of the project description and design parameters. The design and research products presented in this series cover a wide range of tools and equipment for various applications including household, workshop and entrepreneurial purposes.

This collection aims to foster innovation by offering students valuable insights into both the technical and research aspects of product design. It is hoped that this book will inspire future engineers and designers to approach product development with a deeper understanding of the design and research processes.

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CHAPTER 15

Development and Manufacturing Fixing Holder and Gearing Mechanism for a Electrical Go-Kart

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ABSTRACT

This project focuses on designing and fabricating a go-kart motor fixing holder and gearing system to enhance stability and efficiency in electric go-karts. The development process involved conceptualizing three initial designs and refining and finalizing the most suitable concept using SolidWorks software. The fabrication phase, which spanned approximately 12 weeks, incorporated essential manufacturing processes such as cutting, drilling, welding, and bending to construct the motor fixing holder and gearing system.The motor fixing holder was fabricated using 2mm thick recycled steel plates, while the gearing system was assembled with a 3mm steel driven gear welded onto the motor shaft. A relay-based starter circuit was integrated to ensure a safe and controlled power transfer, preventing accidental motor engagement. The final prototype was successfully manufactured and assembled, demonstrating practical functionality in securing the motor and transmitting power efficiently to the wheels. The results confirm that the fabricated system meets the intended design objectives, providing a secure mounting solution and reliable gearing mechanism for the go-kart. Future improvements can be made by optimizing material selection, enhancing structural reinforcement, and refining the gearing system to improve performance, durability, and overall efficiency.

Keywords: Fixing Holder, Gearing System, Go-Kart

1 INTRODUCTION

A go-kart is a small, four-wheeled vehicle classified as a sports car, closed-wheeled car, open-wheeled car, or quadricycle. Go-karts come in various designs, ranging from non-motorized models to high-performance racing karts. Karting is a form of racing that utilizes these compact vehicles, with the first go-kart invented by Art Ingels in Los Angeles in 1956 [1]. An electric go-kart is a lightweight, single-seater racing vehicle powered by an electric motor instead of a traditional petrol engine. Electric motors convert electrical energy into mechanical energy, delivering power efficiently.

The safety and performance of an electric go-kart depend significantly on the type of motor and battery system used. As of 2022, electric go-karts are primarily used for recreational rental, while professional kart racing favours 2-stroke petrol engines. However, advancements in high-performance electric karts are ongoing, and competitive races using electric models are already being held. This study aims to design and fabricate a go-kart motor fixing holder and

gearing system. Specifically, the research aims to develop a motor holder that securely attaches the motor to the go-kart frame and to engineer a gearing system based on the designed prototype.

2 LITERATURE REVIEW

When selecting an engine for a go-kart, several key factors must be considered, including power output, torque characteristics, weight, fuel consumption, noise levels, emissions, and regulatory requirements. The ideal engine choice depends on the user's needs, whether for recreational driving, competitive racing, or commercial rental operations. Different gear and clutch systems also play a crucial role in optimizing performance, control, and efficiency.

The gear and clutch system selection should be based on factors such as the engine model, track layout, driver weight, and desired top speed. High-performance racing karts often require precisely tuned gearing and clutch systems to enhance acceleration and maintain speed on varying track conditions. In contrast, rental and recreational karts prioritize durability, ease of use, and safety over raw performance. Understanding these factors ensures that the go-kart operates efficiently while meeting the needs of its intended application [2].

Electric go-karts have gained significant popularity recently due to their instant torque, quiet operation, and low maintenance requirements. They are especially favoured in indoor racing facilities and environments where noise and emissions are a concern. Electric motors have fewer moving parts than traditional petrol engines, eliminating the need for oil changes, spark plug replacements, and fuel system cleaning. This results in lower maintenance costs and reduced downtime, making them a more cost-effective option in the long run [3].

Electric go-karts are more energy-efficient than their petrol-powered counterparts, as they convert a higher percentage of battery energy into motion. This improved efficiency can lower operational costs, particularly in areas with affordable electricity rates. However, one limitation of electric engines is their battery capacity, which may result in shorter runtimes. This can be a drawback for long endurance races or extended activities that require continuous operation without recharging.

3 METHODOLOGY

Fabrication is manufacturing or assembling components by combining standardized parts through various techniques such as cutting, drilling, and welding. Unlike other manufacturing methods, fabrication involves shaping raw materials into functional components through mechanical or thermal processes. This project's fabrication focuses on constructing the go-kart motor fixing holder and gearing system, as shown in Figure 1.

The fabrication of the motor fixing holder involves using 2mm thick recycled steel plates, which are measured and cut with an angle grinder. Several holes are drilled into the plates to secure the motor using bolts, nuts, and washers. Sheet metal is also measured, cut using a shearing machine, and drilled for mounting purposes. It is then bent at a 90-degree angle with a bending machine and attached to the holder. Finally, the motor's shaft is welded to the driven gear to complete the assembly (Figure 1).

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Fig. 1: Fabrication process

A 3mm steel driven gear (sprocket) is welded onto the motor shaft for the gearing system. The driving gear is pre-mounted onto the tyre shaft and secured by a team member. The shaft is then drilled to allow screws to fasten the driving gear in place, ensuring a firm and stable connection. These fabrication steps ensure the durability and functionality of the go-kart's mechanical components.

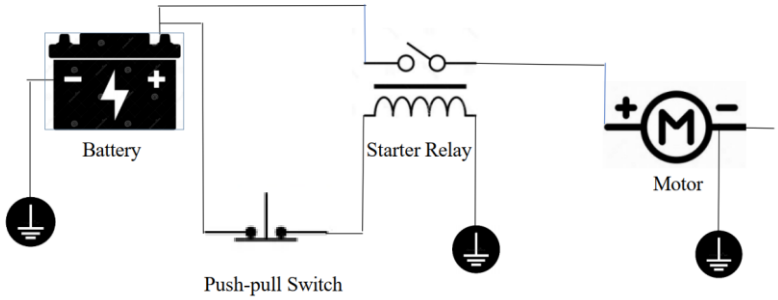

Fig. 2: Electrical circuit for the motor

A starter circuit as in Figure 2 used to initiate engine operation in this go-kart motor fixing holder and gearing system. The motor provides the initial torque required to crank the engine, after which the engine takes over. A relay system is incorporated to ensure safe operation, allowing the starter motor to function only when the push-pull switch is engaged, preventing accidental activation.

When the push-pull switch is activated, current from the battery is permitted to flow through the relay's coil. This energizes the coil, generating a magnetic field that closes the relay contacts. As a result, a direct high-current path is established between the battery and the motor, supplying the necessary power to start the motor.

Once the push-pull switch is released, the circuit is broken, de-energizing the relay and cutting off power to the motor. This ensures that the starter motor operates only when needed, enhancing safety and efficiency in the go-kart's starting mechanism.

4 RESULTS AND DISCUSSION

Figure 3 presents the final prototype of the go-kart motor fixing holder and gearing system, which has been successfully manufactured. The fabrication process took 12 weeks, during which several challenges had to be addressed and resolved.

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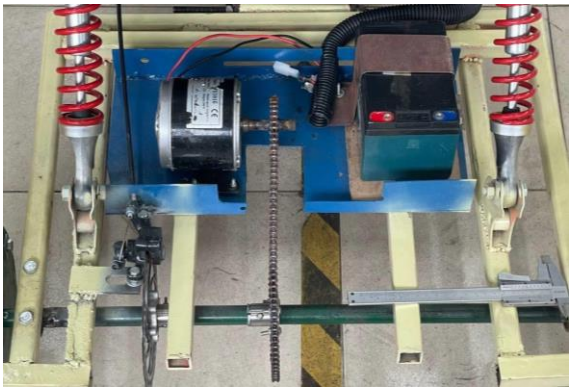

Fig. 3: Final prototype

After overcoming these issues, all components were carefully assembled, ensuring the system functions as intended. The final prototype operates effectively, meeting the design objectives and performance requirements of the go-kart's motor fixing holder and gearing system. Table 4.1 outlines the manual operation required to use the go-kart motor fixing holder and gearing system, emphasizing the importance of following these steps to prevent accidents. The process begins with switching on the power lock using a key. Once the power is activated, all necessary switches must be turned on to ensure the system is ready for operation.

Next, the pedal, which contains a push-pull button switch, is pressed to control the speed of the go-kart. As the pedal is engaged, the motor begins to rotate with the driven gear welded to it. This movement transfers power through the chain to the driving gear, which drives the tyres. As a result, the go-kart moves forward smoothly. By carefully following these steps, users can operate the go-kart efficiently, ensuring safety and optimal performance.

5 CONCLUSIONS

In this project, a go-kart motor fixing holder and gearing system was designed by initially developing three design concepts, which were then evaluated to select the most suitable one. The final design was created using SolidWorks software and underwent several modifications before fabrication. The entire fabrication process took approximately 12 weeks to complete. The primary objective of this research was to fabricate a go-kart motor fixing holder and gearing system based on the design and analysis conducted during Final Year Project 1. This involved ensuring that the system met the required performance and functionality standards. Several recommendations should be considered to further enhance the effectiveness and usability of the go-kart motor fixing holder and gearing system. Material selection, structural reinforcement, and system efficiency improvements can help maximize its potential and ensure better durability and performance.

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