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JOHOR INNOVATION INVENTION COMPETITION AND SYMPOSIUM 2023



"Innovation Inspires a Society
to be Critical and Creative"

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**AHMAD KHUDZAIRI KHALID
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Preface

In the name of Allah, the Almighty who gives us the enlightenment, the truth, the knowledge and with regards to Prophet Muhammad (peace be upon him) for guiding us to the straight path. We thank to Allah for giving us guidance and strength to write this e-book.

This e-book compiles the extended abstracts that submitted to Johor Innovation Invention Competition and Symposium 2023 (JII CaS2023), where JII CaS2023 is a virtual platform for all creative minds to share and present their invention and innovation. The extended abstracts are divided into two categories, which are Category A (Higher Educational Student/ Any Recognized Institutional Students in Malaysia) and Category B (Primary/ Secondary School Students / Special Education School Students in Johor). Each abstract gives a brief background on the innovation or project.

We hope that this e-book will help the readers to get to know the innovation done by the students from both categories and get some ideas to develop future innovation products.



SIMULTINUT

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ABSTRACT

Changing a punctured tyre is a frequent issue for car owners and usually involves loosening the wheel's lug nuts and jacking up the car—a process that can be both tiring and time-consuming. This project aims to simplify this task by introducing SimultiNut, a four-way lug nut remover designed to facilitate the tyre replacement process. SimultiNut attaches to the slightly loosened lug nuts and employs a gear-based mechanism to rotate them simultaneously, making them easier to remove. Made from durable materials like steel alloy and mild steel, the product is intended for both individual car owners as an addition to emergency car kits and for use in automotive workshops. SimultiNut offers a time- and effort-saving alternative to the limited range of single-lug nut wrenches currently available on the market.

Keywords: tyre replacement, lug nuts remover, SimultiNut, automotive

1.0 INTRODUCTION

Cars are a vital part of everyday life for many Malaysians, serving as the main form of transportation for both short and long trips. Because of this, regular upkeep is crucial for making sure the car remains safe and reliable over time. This maintenance covers a range of parts, from the engine and transmission to the air conditioning and tires. While issues like engine or transmission failures require expert repair, simpler problems like a flat tire can usually be fixed by car owners themselves if they know the basic steps. To help with this, car manufacturers often include basic tools like L-wrenches, T-wrenches, and jacks in the car for on-the-spot tyre changes.

The task of changing a tyre quickly and easily comes with its own set of challenges. The initial step of loosening the lug nuts can be hard work and time-consuming when using standard tools like T-wrenches or L-wrenches. This is even more of a hurdle for people who might not have the strength to turn the wrench with enough force. This is where SimultiNut comes in. This specially designed 4-way lug nut remover can loosen all four lug nuts at the same time, making the whole process faster and easier. The main aim of this new tool is to make changing a tyre simpler and quicker for as many people as possible, no matter their level of physical strength or know-how in car repairs.

2.0 OBJECTIVE

The primary goals of this project are twofold: first, to design and develop a 4-way lug nut remover known as SimultiNut; and second, to simplify the tyre-changing process for both car owners and mechanics. The product is engineered from the ground up using readily available materials and involves various stages of design and fabrication.

3.0 DESCRIPTION OF INNOVATION/METHODOLOGY

The methodology for developing SimultiNut is fully outlined in Figure 1. The motivation for creating SimultiNut comes from the common issue of flat tyres, which affects many car owners. Given the technical challenges and the need for a practical solution, this project is well-suited for final-year projects and innovation contests.



Figure 1: SimultiNut methodological flow

Preliminary studies focus on studying existing tools for manual tyre changing, such as lug nut wrenches, spider wrenches, and T-wrenches. Information gathered from these tools is used to set performance standards for SimultiNut. The design targets vehicles with a four-lug nut wheel configuration, commonly found in smaller to mid-sized cars like the Perodua Myvi and Perodua Bezza. A gear mechanism is incorporated into the design, allowing for the simultaneous rotation of all four lug nuts with a single hand movement, as shown in Figure 2. This feature significantly improves both the speed and ease of the tyre-changing process.

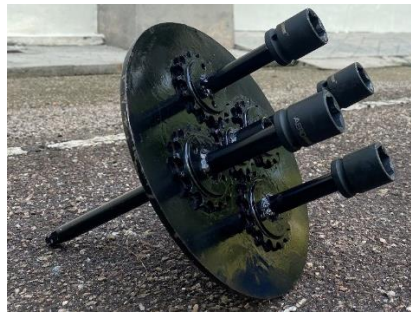


Figure 2: SimultiNut working prototype

The assembly of SimultiNut is carried out manually in an in-house setting, using key components such as circular steel plates, shafts, and gear sprockets. The manufacturing process includes various steps, including computer-aided design (CAD) and computer-based analysis, precise measurements, CNC machining, welding, assembly, and surface coating. After the manufacturing phase, the finished product is tested on an actual wheel rim to evaluate its effectiveness and make any needed minor adjustments.

In terms of usage, the process for SimultiNut is similar to that of traditional wrenches. Initially, the lug nuts are loosened manually before SimultiNut is attached to them. After it is mounted, rotational force is applied to the main shaft, which activates the connected gear sprockets, allowing all lug nuts to turn at the same time. This design significantly reduces the time needed to change a tyre compared to using conventional wrenches.

4.0 ADVANTAGE/IMPACT/RESULTS/NOVELTY

SimultiNut represents a major step forward in tyre-changing tools, specifically designed to loosen four lug nuts at the same time, a notable improvement over traditional single-nut wrenches. This new feature speeds up the tyre-changing process, cutting down both the time and effort needed from the person using it. The tool's portable design makes it easy to transport and store.

Keeping ergonomic factors in mind, SimultiNut is built for easy use by a single person, eliminating the need for extra help and lessening the chance of fatigue or discomfort. This focus on user-friendly design was driven by the current market's lack of tools, where most available tools can only handle one lug nut at a time, presenting a clear opportunity for improvement.

The making of SimultiNut follows a carefully planned set of manufacturing steps aimed at using materials and labour efficiently while producing as little waste as possible. This organised approach not only makes the production process more efficient but also aligns with sustainable practices. As for ongoing care, the tool is designed to be low-maintenance; a simple, regular application of lubricant to the gears is all that's needed to keep it working well. This user-friendly maintenance feature not only prolongs the life of the product but also lessens its long-term environmental impact.

5.0 CONCLUSION

In conclusion, SimultiNut has successfully met its design goals by enabling the simultaneous loosening of four lug nuts through a single-handed turn of the main shaft. This feature significantly simplifies the task of changing a tyre, reducing both the time and effort usually required for this process. It offers a more efficient method compared to traditional wrenches, which can only handle one lug nut at a time.

Targeted at specific users, SimultiNut proves to be a useful tool for a range of people involved in car maintenance, from individual car owners to professional repair shops and vehicle testing labs. In these various settings, SimultiNut can serve as a key part of emergency tyre-changing kits, providing a quicker and less labour-intensive solution.

By incorporating these features, SimultiNut not only achieves its initial design objectives but also addresses broader issues of efficiency and user friendliness in the field of automotive maintenance. As such, it represents a significant step forward in the larger landscape of car repair and maintenance tools.