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**DESIGN OF ADJUSTABLE WHEEL NUT REMOVER**

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**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

## **SUPERVISOR'S DECLARATION**

“I hereby declare that I have read this thesis and in my opinion this report is sufficient in term of scope and quality for the ‘Final Year Project’ as required.”

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Date: 30<sup>th</sup> of June 2015

**DESIGN OF ADJUSTABLE WHEEL NUT REMOVER**

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**This report is submitted in fulfilment of the requirements for the degree of Bachelor of  
Mechanical Engineering (Automotive)**

**Faculty of Mechanical Engineering**

**Universiti Teknikal Malaysia Melaka**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**June 2015**

## DECLARATION

“I hereby declare that the project is based on my original work except for quotations and citations which have been duly acknowledged.”

Signature: .....

Author: MOHD TAUFIK BIN TAIB

Date: 30<sup>th</sup> of June 2015

Special for

Beloved mother and father

Wan Faizah binti Mohammad Yusoff

Mokhtar bin Abdullah

Beloved partner

Su'amira binti Ibrahim

Beloved siblings

Supervisors

Relatives and friends

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## ABSTRAK

Industri automotif dunia kini sedang membangun dengan pesat. Kenderaan pada hari ini memainkan peranan penting dalam kehidupan seharian terutamanya kepada yang bekerja. Sebagai seorang pengguna kereta, masa adalah amat penting dalam perjalanan. Namun, kadangkala perkara yang tidak diingini berlaku mengganggu jadual perjalanan pengguna. Menyedari keadaan ini, pihak pengeluar telah membekalkan peralatan untuk membaiki kerosakan-kerosakan kecil. Salah satu daripadanya kerosakan-kerosakan kecil yang sering berlaku adalah tayar pancit. Namun, peralatan-peralatan yang dibekalkan memerlukan banyak tenaga dan memakan masa yang lama untuk dikendalikan. Oleh itu, satu peralatan khas telah dicipta untuk mempercepatkan proses membuka tayar. Peralatan ini membolehkan keempat-empat nut tayar dibuka dalam satu masa yang sama. Namun, produk ini memiliki satu kelemahan iaitu hanya boleh digunakan untuk satu saiz PCD. Menyedari tentang hal ini, kajian ini telah dibuat untuk mereka satu lagi produk untuk menyelesaikan masalah ini. Semasa kajian ini dibuat, saiz PCD diantara 100mm hingga 114mm telah digunakan. Produk ini telah direka menggunakan perisian CATIA untuk memudahkan analisis-analisis data dibuat. Manakala untuk proses fabrikasi, proses kimpalan Tungsten Arka Gas (TIG) telah digunakan untuk mencantumkan komponen-komponen produk. Untuk tujuan komersial pula, antara kereta-kereta yang boleh menggunakan produk ini pada masa akan datang adalah Proton Wira, Nissan Almera, Honda Civic dan Mitsubishi Lancer.

## ABSTRACT

Nowadays, the automotive industry is developing rapidly. Vehicle today have played an important role in everyday life. As the driver, time is important in the journey. However, sometimes things go wrong and interrupt the travel plan. Aware of this situation, the manufacturer has supplied equipment to repair minor damages. One of these minor damages that often occurs is a flat tire. However, the equipment supplied requires a lot of energy and take time to manage. Therefore, a special device is designed to reduce human effort and time-consuming during the tire exchange process. This equipment allows all four tires nut to be opened in the same time. However, this product has a weakness which is it can only be to one-size-PCD. So overcome the problem, the study has been made. During this study, PCD sizes between 100mm to 114mm is used as the reference. This product has been designed using CATIA software to evaluate the analysis of data easily. While for fabrication, Gas Tungsten Arc (TIG) welding is used to combine the components of the product. This product has a bright commercial future as a lot of cars with these PCD sizes have been manufactured. Among the cars that can use this product in the future is the Proton Wira, Honda Civic, Nissan Almera, and Mitsubishi Lancer.



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**LIST OF SYMBOLS**

$P$	=	Pitch diameter
$M_G$	=	Gear ratio
$N_G$	=	Number of teeth of driver gear
$N_P$	=	Number of teeth of driven gear
$F$	=	Force
$r$	=	Length of L-shaped wrench's arm

## LIST OF ABBREVIATIONS

CATIA	=	Computer Aided Three-Dimensional Application
FYP	=	Final Year Project
PSM	=	Projek Sarjana Muda
TIG	=	Gas Tungsten Arc
PCD	=	Pitch Circle Diameter

## CHAPTER 1

### INTRODUCTION

As the standard of living in Malaysia has increased, most of the families have at least one vehicle, typically, a car, to move easily and quickly. As we all know, tire puncture is the most common problem happen in the car. With the increment of the number of cars on the road, the number of car's problem due to tire failure has increased. In order to overcome this problem, the car is provided with a set of special tools, usually L-shaped nuts remover and jack for instance spare tire replacement.

But sometimes, due to the difficulty in applying the required torque to remove the nuts, most of the time, the driver relies on the tow truck and available nearest mechanic to solve the problem (especially female and old driver). This will contribute to the waste of time and cost. To minimize the problem a special tool called all-wheel nut remover is designed. The existing product of all-wheel nuts function is to remove all four-nuts at the same time. But the major problem of this device is it can only fix with one pitch circle diameter (PCD).

## 1.1 Problem Statement

As we all know, the most common problem encounter by driver is tire puncture. Lots of human effort and time are needed during the tire removal process. To minimize the problem all-wheel nut remover device is designed. All-wheel nut remover is a device that helps to reduce human effort in order to remove the wheel nuts. Instead of removing the nuts one by one, this device helps to remove all nuts at the same time. This will save a lots of time during the process of tire removal. The main problem of existing product of all-wheel nut remover is, it only designed to fix with one PCD size. So, this adjustable wheel nut remover is being designed to fix with flexible PCD size within its range (114mm to 118mm).

## 1.2 Objectives

These are the objectives to be achieve throughout this project. The objectives are arranged by its priority as stated below:

- To improve function of existing product by providing more option of PCD sizes.
- To reduce the human effort during the process of tire removal. This can be achieved by removing all nuts at the same time instead of removing the nuts one by one.
- To design and fabricate a prototype of adjustable wheel nut remover. This can be achieved by applying several concepts of mechanical.

### 1.3 Research Scope

The research scope of this project is to study the existing product such as finding the minimum value of force or torque needed during the removal process. The working mechanism on how to remove the wheel nuts must also be taken into consideration in order to have better understanding and to make some improvement where possible. While, to determine the suitable material to fabricate the prototype, the structural analysis and the cost studies will be done by using software of CATIA and CES Edupack 2010. For fabrication process, welding, cutting, drilling and some other technical skills may be included in order to produce a prototype of the adjustable all-wheel nuts remover.

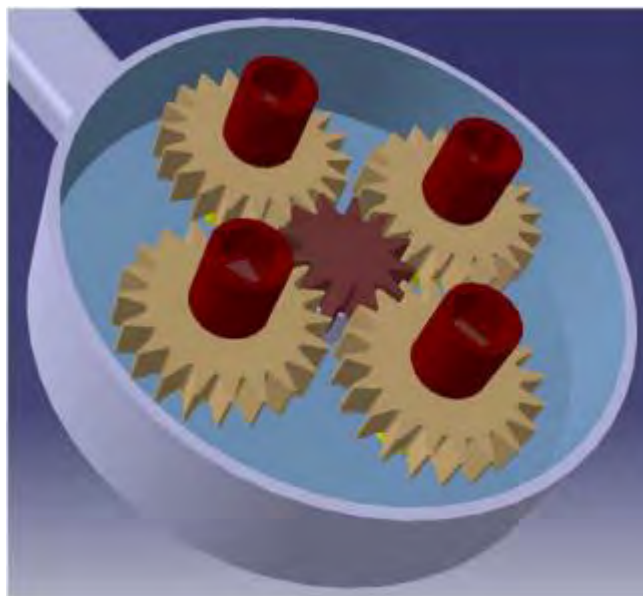
## **CHAPTER 2**

### **LITERATURE REVIEW**

In the automotive industry, the nuts remover function is to loosen and tighten the nuts of the tire. The nuts function is to hold the tire rim to axle so that it always in the tight condition. Usually the manufacturer will provide the L-shaped nut remover and jack as the basic tools in every car. The existing product of all-wheel nut remover used the gear as the primary mechanism. To move all the gears, the force only needs to be applied to the middle gear which act as the driver and usually called as the pinion.

## 2.1 The Existing Product

Some study has been done to the existing product in order to understand the concept, identify the problems that may be encountered by the existing product and to come out with a solution for the problem. Based on the study done on the existing product, it used the concept of gear mechanical as the basic mechanism. By only applying the force on the center gear (driver gear), all the driven gear will be moved by the driver gear but in the opposite direction. Further study about the conceptual design finally leads to the main problem of the product. In order to move the gears all together, all the gear teeth of the driven gear must be connected to the teeth of the driver gear. Any distance between them will cause product malfunction. These are the reason why the existing product only can fixed with one PCD size. **Figure 2.1** shows the virtual conceptual design of the existing product.



**Figure 2.1:** The conceptual design of existing all-wheel nut remover (Abdul Aziz, 2008).

## 2.2 Wrench

There are various types of wheel nut remover available in the market nowadays. Among the available wheel nut remover are impact wrench, L-shaped wrench, and socket wrench. The nuts itself also have various sizes such as 18mm, 19mm and 21mm. The shape of the head nut is hexagonal. In this project, a lot of research and study related to nut remover have been done.

### 2.2.1 Impact wrench

Impact wrench also known as impactor or pistol torque. It is a high power socket wrench which designed to produce high torque with minimum human effort, by storing the energy in the rotating mass and transmit it to external shaft. As the result, the nut will be tightened hard enough. Impact wrench basically used air, electric or hydraulic as the source of power. **Figure 2.2** shows the available impact wrench available in the market.



**Figure 2.2:** Electrical Impact wrench (DeWALT, 2013)