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MULTI NUT REMOVER

JABATAN KEJURUTERAAN MEKANIKAL

AKUAN KEASLIAN DAN HAK MILIK

TAJUK   :MULTI NUT REMOVER

SESI   :

1.Kami, **1.KANABATHY A/L VIJAYAN (08DMP18F1146)**

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Adalah pelajar tahun akhir Diploma Kejuruteraan Mekanikal, Jabatan Kejuruteraan

Mekanikal,Politeknik Sultan Salahuddin Abdul Aziz Shah, yang beralamat di

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2. Kami mengakui bahawa "Projek tersebut di atas' dan harta intelek yang ada di dalamnya adalah hasil karya/reka cipta asli kami tanpa mengambil atau meniru mana-mana harga intelek daripada pihak-pihak lain.

3. Kami bersetuju melepaskan pemilikan harta intelek 'projek tersebut' kepada 'Politeknik tersebut' bagi memenuhi keperluan untuk peanugerahan Diploma Kejuruteraan Mekanikal kepada kami. Diperbuat dan dengan sebenar-benarnya diakui

Oleh yang tersebut;

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Di hadapan saya, (ENCIK MOHD HARIZ BIN SAMAIN)   …………………………….

sebagai penyelia projek pada tarikh:

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ABSTRAK

Spanar adalah satu alat yang digunakan untuk mencengkam dan mengetatkan atau melonggarkan nat .Spanar merupakan alat yang penting untuk membaiki alatan atau kenderaan seperti motosikal dan kereta .Terdapat pelbagai jenis spanar iaitu spanar hujung terbuka, spanar bergabung, dan juga spanar gelang. Saiz spanar ditentukan melalui jarak bukaan rahang dan garis pusat gelang. Berdasarkan penelitian ,terdapat ramai individu yang mengalami masalah ketika hendak menukar tayar kenderaan terumanya individu yang tidak mempunyai pengalaman atau kemahiran yang cukup untuk menukar tayar.Untuk permudahkan proses pembukaan tayar,alat ringkas yang berdiameter lingkaran(PCD) telah dirancang.Permodelan 3D produk membantu

ABSTRACT

Tire plays a significant role in the performance of car. Removal of tire is a really a difficult task. In order to facilitate easy removal of tire a simple tool with pitch circle diameter (PCD) of 114.3mm has been designed. 3D modeling of the product help to design the product. The aim of the project is to design and developed four in one (4 in 1) motorized nut remover, the tool will help to remove all the 4 nuts simultaneously also the time required for removing nuts will be reduced. Finite simulation is carried out using ANSYS Workbench 14.0 for stress analysis. The tool designed is easy to store as well as handy as compared to previous designed available.

CONTENT

CHAPTER 1

INTRODUCTION

1.1 RESEARCH BACKGROUND

Car is not a symbol of luxurious anymore. It is a need for every family. People need car due to several reasons. Some of them are, to get to a destination, to travel conveniently, to do daily job and to move things to a greater distance. The problem occurs the most during car operation is the problem with tyre puncture . The flat tyre needed to be replaced with spare tyre. Therefore, drivers need to know basic knowledge of tyre replacement procedure if such problem occurs. In order to change the flat tyre, one requires minimal skills. Virtually every car has a tyre replacement tools such as the L-shaped nut remover and jack supplied by the manufacturer . The tool used to remove the wheel nuts should be designed for ergonomic, easy to handle and requires small space for storage. The tool is also function as wheel nuts tightener. Nonetheless, it is difficult for women and the elderly drivers due to high required torque to remove the wheel nuts. In addition, if the nuts are successfully removed, the problem to retighten the nuts will follow. If the required torque is not

applied in tightening the nuts, the nuts will lose, and this will jeopardize the driver's safety. Impact wrench used to remove wheel nuts is also consuming time in automotive maintenance industry. For these reasons, to avoid time wasting and a lot of energy used to change the tyre, a special tool is designed and fabricated to allow driver or mechanic to

remove four wheel nuts at once with little energy consumption. The design is based on standard PCD of 100 mm for most of the cars available

1.2 PROBLEM

During tyre removing Operation the person was supposed to remove individual nuts to remove the tire which has a very fatigue level.

So Our Intention was to remove all nuts at a time, to reduce human fatigue level.

Multi-nut opener is a device designed at developed for loosening or tightening of wheel hub nuts for

1. Tata Indigo – most common car used in India

2. And Similar PCD wheels

1.3 RESEARCH OBJECTIVE

.To create a multi nut remover , to make it more easier and easy to use.

.Reduce the energy to remove the nut

.To use easier things

1.4 Research question

This study will answer the following research question

.It is possible to create a lighter multi nut remover that are high in quality?

.what type of meterials that can be used to make multi nut remover?

1.5 Scope of research

The scopes and limits to this research are:

. this product can be operate easily

.this product can save energy

. could last for long time with a good care

1.6 Significant of research

Although, the nut remover that are currently used in Malaysia could perform well and people are using more times and enery for it. However, people can save enery and time while using the multi nut

remover.Thus, the finding of this study wil bring a lot of benefits to the people that cannot effert lot of energy.

1.7 Defination of operational terms

A wrench or spanner is a tool used to provide grip and mechanical advantage in applying torque to turn objects—usually rotary fasteners, such as nuts and bolts—or keep them from turning.

In the UK, Ireland, Australia, and New Zealand spanner is the standard term. The most common shapes are called open-ended spanner and ring spanner. The term wrench is generally used for tools that turn non-fastening devices (e.g. tap wrench and pipe wrench), or may be used for a monkey wrench—an adjustable pipe wrench.[1]

In North American English, wrench is the standard term. The most common shapes are called open-end wrench and box-end wrench. In American English, spanner refers to a specialized wrench with a series of pins or tabs around the circumference. (These pins or tabs fit into the holes or notches cut into the object to be turned). In American commerce, such a wrench may be called a spanner wrench to distinguish it from the British sense of spanner.

Higher quality wrenches are typically made from chromium-vanadium alloy tool steels and are often drop-forged. They

are frequently chrome-plated to resist corrosion and for ease of cleaning.

Hinged tools, such as pliers or tongs, are not generally considered wrenches in English, but exceptions are the plumber wrench (pipe wrench in British English) and Mole wrench (sometimes Mole grips in British English).

The word can also be used in slang to describe an unexpected obstacle, for example, "He threw a spanner in the works" (in U.S. English, "monkey wrench").

1.8 Chapter summary

In this chapter, the studies was explained about its origin of ideas and inspirations. All the objectives were made out of all the problem statements. The objective for this project along with the importance will multi nut remover that will be cheap and light causing it to be more convenient for amputees, and even the scope of this project only focusing at the easy to use . Thus, this could be used for daily routine with a really good care for a longer lifetime

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Known torque-responsive power screw drivers which are driven by electric motors or pneumatically have a relatively high speed of rotation in order to obtain a short screwing in time. Since the maximum moment of tension for the screw to be screwed requires a determined torque, the driving power of the screw driver must likewise be made high in accordance with the relatively high speed of rotation, although a high torque is required for only a short time during the tightening of the screw, unless some shock action is utilized for the purpose of producing this peak degree. The limitation of the degree of tightening of the screw is usually effected by means of ratchet couplings or striking mechanism. When screwing in expansion screws, this degree of tightening must be kept constant within very narrow, since these screws, are stressed almost to their yield point during screwing in. Torque-responsive screwing drivers

having a shock effects are useless for this purpose. The degree of tightening achieved is greatly dependent on the number of blows applied, which however cannot be kept constant because of the rapid succession of blows, while in addition the power of the individual blow is variable within wide limits because of the indeterminable reaction of work piece, screw and screwing tool on the striking operation. In addition, the shock effect causes rapid wear on the striking surface, which results in a considerable variation of the face of the blows and a relatively short life of the Torque-responsive screwdrivers having strikingmechanisms are impractical whereaccurate tensioning of a screw is necessary. It has moreover been found that, at the high speeds used, ratchet couplings also apply a powerful shock action and are therefore likewise unsuitable for tightening expansion screws.

III. LIST OF MATERIALS

Sl.

no

Name of the

parts

2.2 Type of meterial

1 Gears Mild steel 5

2 Shafts Mild steel 5

3 Bearings Mild steel 10

4 Nut bits steel 4

5 stand Cast iron 1

6 wheel Rubber &

aluminium

1

7 Metal plates Iron 2

8 Bolts Cast iron 4

9 Hand

operated lever

Iron 1

Dimensions of the components:

Gears:

Diameter of the pinion (Dp) = 54mm

Number of teeth's on pinion (Tp) =22

Diameter of the gear (DG) =64 mm

Number of teeth's on gear (TG) =24

Bearings:

Type of Bearing = Ball bearing

Bore diameter = 16mm

Diameter of the bearing =40mm

Shaft:

Shaft type =solid shaft

Diameter of the shaft =16mm

Length of the shaft = 150mm

Metal plates:

Shape of the plate = Square

Size of the plate =300*300mm

Thickness of the plate=10mm

Wheel:

Pitch circle of the wheel = 112mm

Nut to nut distance = 80mm

Nut size =19mm

Height of the stand = 170 mm

Length of the stand = 300mm

Width of the stand =150 mm

2.3 multi nut remover

The torque wrench or spanners are the instrument, which are widely used to remove the nuts from the bolts. Torque wrench helps in setting torque required. The nut remover is most widely used in automobile area. Removing a wheel and replacing with other one requires wrench or spanner. This spanner can be used to remove or tighten the nuts from bolts of the wheel. But this spanner can remove only one nut at a time. In case of emergency like puncture of ambulance tyre, it will be time consuming to remove nuts one by

one. In those cases, Multi Nut Remover will be more useful. The torque, which is needed to apply to remove one nut, can be used to remove all nuts using Gear arrangement. This will reduce time consumed in replacing the wheel.

Multi nut remover

2.2.2.1

☂ Simple in estimate

☂ Less weight

☂ Low control utilization

☂ Can be worked effortlessly

Disadvantages:

It is hard to expel if rust is shaped since it requires a high torque to evacuate nut.

APPLICATIONS

It is appropriate in car workshops.

2.3 CHAPTER'S SUMMARY

As to conclude this chapter, literature review is important to showcase all the studies of materials and methods to enhance the knowledge on this project. Every thesis and others projects that are related to this bio-friendly polymer composite prosthetic leg is really helpful especially for us to understand it fully.

After a lot of materials and methods were discussed and researches were done, the materials that are the most compatible for our project is thermoset. Due to its characters and advantages, meanwhile the methods that we decided to carry on is hands layup method. This is because of its low cost benefits and great for beginner's process.

CHAPTER 3

METHODOLODY

3.1 INTRODUCTION

What is methodology? A methodology is a plan-of-attack, especially when that plan-of-attack is used repeatedly. This might be obvious, but the word methodology is related to the word method. In fact, a methodology is a system of methods followed consistently. Scientists, for example, use various methodologies as they perform experiments. It might seem like the world is nothing but chaos and disorder. But actually, sometimes there is a method to this madness. And sometimes there's a methodology.

In this chapter, there will be a lot of information about the process and journey through out the making of our final project. There will be flow chart showing the process of us making the whole project. This flow chart will explain the processes we took. Next, is the Gantt Chart, which will show the actual and planning throughout all the 13 weeks of our final year project journey. However, in this chapter, we also will show 3 methods we researched to carry our final year project. Although, these 3 methods have its own pros and cons and it will be explained individually by the teammates.

Among those 3 methods are vacuum, injection moulding and hands layup. Most common way of making prosthetic leg is by using the method of vacuuming. This method has a lot advantages and disadvantages. Hence, in this chapter we will discuss about these 3 methods and which one we chosen.

3.2 METERIAL SELECTION CRERERIA

The materials used for the design of the various machine components are based on the type of force that will be acting on them, expected work or function, the environmental conditions in which they will function, useful physical and mechanical properties, cost and availability in the local market or the environment. illustrates the working procedures adopted in fabricating the developed machine.

.Material Selection and Considerations
.Design of Component Parts
.Design Calculations and Analysis
.Detailed Design Drawings
.Fabrication Process
.Principles of operation of the Machine
.Performance Evaluation

working procedure consists of the material selection and consideration, design of component parts, design calculations and analysis, detailed design drawings, fabrication process, principles of operation of the machine and performance evaluation

Design of the component parts The gear housing accommodates the gear system used for the work and it is supported by the pillar guide. The gear housing was designed, and the area was determined based on the length (L) and breadth of the plate (B), Eq. (1) Where: Ag - the area of the gear housing, L - the length of the plate, and B - the breadth of the plate. The device was designed for 114.3 PCD (centre distance between the driving and driven gears is 57.15 mm). The driver (gear) and the driven (pinion) was designed and the torque required for removal of one (1) nut is 80 Nm. Spur gears were selected due to ease in design and manufacturing. Apart from this,

the velocity ratio (V.R) in spur gear is constant. Keeping the above factors in mind and using medium carbon steel grade for the gear and pinion and the design calculation were performed. The pitch diameter (Dp) was designed based on the number of pinion teeth (Np) and diametral pitch (Pd), Eq. Where: Dp - the pitch diameter, Np - the number of pinion teeth, and Pd - the diametral pitch. Table 1 summarizes the properties and parameters of the material used for the design of the gears (medium carbon steel i.e. EN 8).

Properties and parameters for the gear design S/N Design Properties Parameters 1 Ultimate tensile strength (δu) 550 N/mm2 2 Yield strength (δy) 280 N/mm2 3 Young modulus (E)   200 GPa 4 Poisson ratio   0.3 5 Brinel hardness 255 HB 6 Pitch circle diameter (PCD) 114.3 mm (for car tyre) 7 Torgue required to remove nuts (T) 480 Nm 8 Average force by human (F) 500 N 9 Pressure angle (Ø) 20° 10 Number of teeth of the driven gear (NG) 15 11 Number of teeth of the driver gear (NP)   10 The ultimate tensile strength, yield strength, young's modulus, poisson ratio and other properties and parameters are carefully selected before the gear designs for effective performance. The pitch diameter, together with the number of pinion teeth (Np) was then used to determine the circular pitch (P), Eq. (3). (π = constant =3.142)   (3) Where: P - the circular pitch, Dp - the pitch diameter, and Np - the number of pinion teeth. The gear ratio (G.R) and velocity ratio (V.R) was designed using Eq. (4-5). (4) (5) Where: G.R - the gear ratio, NG - the number of teeth of the driven gear, NP - the number of teeth of the pinion, V.R - the velocity ratio. The radial force applied and the tangential force was determined using Eq. (6-7).   (6 (7) Where: Fr - the radial force applied, Ft - the tangential force applied, and   - the pressure angle. The stress at the base of the involute profile (δt) was designed using Eq. (8) Geometry factor for spur gear (J) was designed using Eq. (9) Where: J - the geometry factor for spur gear, δt - the stress, Pd - the diametral pitch, and F - the face width. Using the speed of the pinion gear (assume humans can turn the

pinion gear at the rate of 30 rpm) (N) and the torque applied to remove the nuts (T), the power transmitted by the pinion gear (Pp) was designed, using (10) The torque transmitted by the driven gear (Tg) is therefore designed using the dear ratio (G.R), Eq.   (11) Where: Pp - the power transmitted by the pinion gear, N - the speed of the pinion gear, T - the torque applied and Tg - the torque transmitted by the driven gear.

The permissible bending stress (δb) for the gears is given in Eq. (12) [4] based on the ultimate tensile strength of the gear material
(12) Where: - the permissible bending stress, and - the ultimate tensile strength of the gear material. To design the effective loading on the gear teeth (Feff), the combined shock and fatigue factor (Ka = 1.25), load distribution factor (Km = 1.2), tangential force applied (Ft = 469.85N) and the dynamic factor (Kv) were considered using Eq. (13). Feff =   (13) Where: Feff - the effective loading on the gear teeth, Ka - the combined shock and fatigue factor, Km - the load distribution factor, and Ft - tangential force applied, and Kv - the dynamic factor. The beam strength (Fb) was designed based on the Lewis form factor (Y), face width (F), permissible bending stress (δb) and module (m), using Eq. (b (14) The available factor of safety (FOS) is then determined by the beam strength (Fb) and the effective loading on the gear teeth (Feff), using Eq. (15) Where: Fb - the beam strength, m - the module, F - the face width, Y - the Lewis form factor, b is the permissible bending stress, FOS - the factor of safety. The design is safe if the available factor of safety is more than 1.5 and not safe if it is less than 1.5. The available factor of safety obtained is 2.42 which is higher than that of the required factor of safety, hence the design of the gear pair is safe. For shaft design, in actual practices, the shafts are subjected to shock and fatigue loading. Hence, in design of the shaft, the shock and fatigue factor are accounted by

using the factor knows as combine shock and fatigue factors. Putting into consideration the speed (N) and the ultimate tensile strength (Su), the power transmitted by the input shaft to the pinion gear (Pi) and the output shaft (Po) are determined using the input torque (Ti) and the output torque (To) respectively. The diameter of the input shaft (D) and the output shaft (d) are then determined. Theoretical efficiency of the machine (ηT) is then calculated (ratio of output and input power).

3.3 IV. DESIGN AND CALCULATIONS

All engineering activities necessarily begin with

some ideas with high or low innovative content,

translated into definite plans for their realization in

the form of products. This is the essence of design

engineering. The ultimate success depends on a

thorough consideration of how the product will be

made and used as well as on the attention to detail

paid by the design engineering. This is applicable

equally for a minor redesign of a existing product

or for a most innovative one. The project model is

designed in UNIGRAPHICS. That is also called as

NX software. It is CAD/ CAM based software

3.4 BUDGET CALCULATION

NO	METERIALS/EQUIPMENT	AMOUNT	PRICE
1	SKRU AND NUT	5 UNITS	RM20
2	METAL PLATE	1 UNIT	RM10
3	BEARING	5UNITS	RM15
4	WELDING	.	RM30
5	SPANNER	2UNITS	RM10
6.	WASER	5UNITS	RM5
		TOTAL	RM90

3.5 PROJECT ACTIVITY

project Activity weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Briefing and Project Planning	🟩													
	🟥													
Project Design		🟩												
		🟥												
Material Selection			🟩											
			🟥											
Materials Purchase				🟩										
				🟥										
Method Selection					🟩									
					🟥									
Fabrication						🟩	🟩	🟩						
						🟥	🟥	🟥						
Test Run									🟩					
									🟥					
Analysis Data										🟩				
										🟥				
Report Writing											🟩			
											🟥			
Video and Slide making												🟩		
												🟥		
PITEX preparations													🟩	
													🟥	
PITEX presentation														🟩
														🟥

3.6 SUMMARY

As a conclusion, the methods implemented in this project are very crucial and important to complete the project. Thus, as stated in the interview, this project is agreed and accepted by ENCIK HARIZ . The materials used in the project will create a light and very strong multi nut remover and cheap, hence this project is very convenient to the amputees . However, this method will affect the result totally if one of the method is change.

CHAPTER 4
FINDING AND ANALYSIS

4.1 INTRODUCTION

This chapter combine data and analysis of the friendly multi nut remover and its materials calculations. This data and analysis are very important for this project to achieve the objectives and scope of the project. This data indicates the successful results of the materials testing. After getting all of this data, we analyze every single possible to make it perfect.

4.2 ADVANTAGES AND DISADVANTAGES

Every project has its own pros and cons, the pros will help the people and also the environment. However, the cons or the disadvantages must be improved or change for the future so that we could enhance the good and very efficient product that hardly to find disadvantage of the project.

Multi nut remover composite prosthetic leg has a lot of advantages to help amputees and also environment. Besides of the advantages, this project also disadvantages that we must overcome it in the future for the better good.

4.3 CHAPTER'S SUMMARY

As a conclusion for this chapter , the analysis and findings have been made. This MULTI NUT REMOVER has a lot of advantages however there are every cons to pros. Hence, the challenges are taken as a room for improvements and more developments for future generation and well as to enhance their knowledge on the project we carried out. Test run is carried out to determine both very strong and stiff. The relationship is really well shown in the grafts.

CHAPTER 5

DISCUSSION,CONCLUTION AND UPGRADE PLAN

5.1 INTRODUCTION

This chapter explains about discussion , conclusion and upgrade plan all together for the project . From the data from the test run of the project, the analysis have been done. Hence, the discussion from all the results of test run and analysis will be explain in this chapter. Then , the conclusion will be made based on the discussion and upgrade plan that have been made.

5.2 DISCUSSION

Multi nut remover is a kit invented to reduce the effort and time in replacing the wheels of the vehicle. The plurality of lug nuts can be removed at one time without the usage of an electric motor or any hydraulic and pneumatic devices. The planetary shafts are arranged exactly in the pitch circle position of the lug nuts. This method can be used to remove any number of lug nuts but the design of gear varies according to the cAn adjustable multi nut tighter or remover for car tyre (with 114.3 PCD) was developed. The need to loosen and tighten car wheel nuts with little application of force (torque) and time spent is of great importance to most car users. Operation with the existing common instruments like ratchet, socket and impact wrench is quite tedious and time consuming. This study was aimed at designing and fabricating a device that will remove and tighten four-wheel nuts of car tyre simultaneously. The design was done using Solidworks CAD software. The device was successfully fabricated, and performance evaluation was carried out. The tightening and loosening of nuts were done with ease as evident from the results obtained. From the performance evaluation of the developed machine, it took 65 seconds to loosen four nuts and 75 seconds to tighten the nuts and the loosening and tightening process were reduced by 41% and 38% respectively compared to using L shaped wrench. Ergonomics consideration was put in place in designing this device as it can be used with ease by both man and woman. The device is also easy to maintain, easy to handle and able to remove and tighten four-wheel nuts of car tyre at on certain parameters like number of lug nuts, pitch circle diameter.

5.3 CONCLUTION

An adjustable multi nut tighter or remover for car tyre (with 114.3 PCD) was developed. The design of the adjustable multi nut tighter or remover was completed, and the performance evaluation has been carried out successfully. From the results obtained during the performance evaluation, it clearly shows that the device can conveniently removes and tightens four-wheel nut of car tyre with little application of force and time spent. Hence, the machine can be operated by both men and women with ease. A detail feasibility study is however recommended to find alternative materials that are lighter in weight to further reduce the weight of the device. Also, this study should be further subjected to improvement and modification by inculcating free wheel to each of the socket wrench. This will overcome the challenges of one nut tightening faster than the rest. Provision for adjustable gear arrangement system will also make the wheel nuts to fit in perfectly into the socket wrench.

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