



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

TITLE OF THESIS

Design and fabricate portable electric grass cutter

This report is submitted in accordance with the requirement of the University Technical Malaysia Melaka (UTEM) for the Bachelor of Mechanical Engineering Technology (Automotive) with Honours.

By

MURALLITAREN A/L SASEE

B071510848

940905086807

FACULTY OF ENGINEERING TECHNOLOGY

2018

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: Design And Fabricate Electric Grass Cutter

Sesi Pengajian: 2019

Saya **MURALLITAREN A/L SASEE** mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (X)

SULIT*

Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972.

- TERHAD* Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan.
- TIDAK TERHAD

Yang benar,

Disahkan oleh penyelia:

.....
MURALLITAREN A/L SASEE

Alamat Tetap:
Blok 12-4-4, Lengkok Mahsuri,
11950 Bayan Baru, Pulau Pinang.
Tarikh: 5 DEC 2018

.....
MR. MUHAMMAD NUR BIN
OTHMAN

Cop Rasmi Penyelia

Tarikh:

*Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I hereby, declared this report entitled Design And Fabricate Electric Grass Cutter is the results of my own research except as cited in references.

Signature:

Author : MURALLITAREN A/L SASEE

Date: 5 DEC 2018

APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of UNIVERSITI TEKNIKAL MALAYSIA MELAKA (UTEM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (automotive) with Honours. The member of the supervisory is as follow:

Signature:

Supervisor : MR. MUHAMMAD NUR BIN OTHMAN

ABSTRAK

Pemotong rumput konvensional juga dikenali sebagai pemotong rumput tangan yang dipegang secara rawak digunakan secara meluas di Malaysia untuk tujuan berkebun dan kerja-kerja landskap. Terdapat beberapa kes dan keburukan pemotong rumput konvensional meskipun pemotong rumput elektrik moden dalam situasi yang berbeza. Tujuan projek ini adalah untuk mengkaji dan merekabentuk pemotong rumput elektrik mudah alih yang memenuhi keperluan pelanggan semasa. Pemotong rumput mudah alih direka bentuk dan dibangunkan dalam projek ini adalah untuk mengatasi kelemahan pemotong rumput yang sedia ada. Prototaip ini dilakukan menggunakan bateri boleh dicas semula sebagai bekalan kuasa untuk mesin pemotong rumput. Selain itu, reka bentuk konseptual dan reka bentuk yang telah dimuktamadkan telah dibuat menggunakan perisian CAD sebelum meneruskan proses pemilihan bahan. Di samping itu, beberapa bahan telah dibandingkan dengan elemen yang berbeza untuk menentukan bahan produk yang berkesan untuk setiap bahagian prototaip. Projek itu kemudiannya telah diuji dan hasilnya direkodkan. Selain itu, analisis juga dilakukan dengan membandingkan beberapa parameter dari pemotong rumput konvensional, elektrik moden, dan prototaip ini. Oleh itu, dengan mencipta pemotong rumput elektrik mudah alih ini terbukti menjadi sangat membantu dalam isi rumah seiring dengan skop projek untuk menggunakan prototaip ini dalam sebahagian kecil kawasan berkebun.

ABSTRACT

A conventional grass cutter also known as petrol-hand held grass trimmer is widely used in Malaysia for gardening purposes and landscaping work. There is some cases and downside of the conventional grass cutter even the modern electric grass cutter in different situation. The purpose of this project is to study and design a portable electric grass cutter which meets the current customer requirements. A portable grass cutter is designed and developed in this project to overcome the downside of the previous grass trimmers. This prototype is done using a rechargeable battery as the power supply for the grass cutter machine. Moreover, the conceptual design and the finalized design were made using CAD software before proceed to the material selection process. In addition, some material was compared in different element in order to determine the effective product material for the each parts of the prototype. The project is then been tested and the result was recorded. Besides, a minor analysis also been done by comparing some parameters from the conventional grass cutter, modern electric, and this prototype. Hence, by developed this portable electric grass cutter it is proven to be a great help in household as the scope to utilize this prototype in a small portion of gardening area.

ACKNOWLEDGEMENT

First of all, I would like to thank and gratitude to god for the blessings in completing this final year project successfully. I am also thankful and would like to express my sincere appreciation to my supervisor, Mr Muhammad Nur Bin Othman for his continuous encouragement and invaluable guidance in making this report. Constant moral support and tips from him is so appreciated and without that it would be difficult for me to complete this project. In addition, his guidance is so helpful which makes me to understand and develop this project until the completion of this report. I would also thank to my family member and friends who are always there for me in giving ideas and suggestions while completing this research. Last but not least, a deep thanks to everyone who is involved in the completion of my final directly or indirectly. All the supports and the efforts are appreciated.

TABLE OF CONTENTS

Contents

TABLE OF CONTENTS	ix
LIST OF TABLES	xii
LIST OF FIGURES	xiii
CHAPTER 1 INTRODUCTION	1
1.1 Introduction	1
1.2 Problem Statement	2
1.3 Objective	4
1.4 Scope	4
CHAPTER 2 LITERATURE REVIEW	5
2.1 Introduction	5
2.2 Grass Cutter	6
2.3 Effect of Vibration on Human's Health.	7
2.4 Dc Motor	9
2.4.1 Permanent Magnet Dc Motor	10
2.4.2 Series Dc Motor	11
2.4.3 Shunt Dc Motor	13
2.5 Rechargeable Battery	14
2.5.1 Lead Acid	16
2.5.2 Lithium Ion	17
2.5.3 Nickel-Cadmium (NICD)	18
2.5.4 Nickel Metal Hydride (NIMH)	19
2.6 Materials	20
2.6.1 Aluminium	20
2.6.2 PVC (Polyvinyl Chloride)	22
2.7 2 Stroke Engine	24
CHAPTER 3 METHODOLOGY	29
3.1 Introduction	29
3.2 Project Workflow	30

3.3	Gantt Chart	32
3.4	Problem Statement	33
3.5	Literature review	33
3.6	Project Requirement	34
3.7	Conceptual Design	35
3.8	Final Project Design	36
3.9	Material Selection	38
3.10	Tools And Equipment	41
3.10.1	Hand grinding machine	41
3.10.2	Measuring tape	42
3.10.3	Screw driver	43
3.10.4	Plier	44
3.10.5	Spanner set	45
3.10.6	Drilling machine	46
3.11	Fabrication	47
3.12	Testing	47
3.13	Preliminary result	48
CHAPTER 4	RESULT AND DISCUSSION	50
4.1	Introduction	50
4.2	Cost of the project:	51
4.3	Project cost	52
4.4	Product design specification	52
4.5	Material selection	55
4.5.1	Material selection for the main body:	55
4.5.2	Material selection for power supply:	56
4.5.3	Material selection for motor:	58
4.6	Fabrication process	59
4.7	Prototype	63
4.7.1	Prototype testing	64
4.7.2	Result of the project:	65
4.7.3	Prototype result	66
4.7.4	Comparison of the prototype	68
4.8	Analysis	69
4.8.1	Graphs:	71

CHAPTER 5	CONCLUSION	73
REFERENCES		75
Appendix		79-80

LIST OF TABLES

Table 3.3 Gantt chart	32
Table 3.6-1 List Of Requirement Needed	34
Table 3.9 Material Selection	40
Table 3.13-1 Weight Comparison	49
Table 4.2 Cost of project	51
Table 4.4 Product design specification	54
Table 4.5-1 Material selection for main body	55
Table 4.5-2 Material selection for power supply	56
Table 4.5-3 Material selection for motor	58
Table 4.7-2 Result of project	65
Table 4.7-4 Comparison of Prototypes	68

LIST OF FIGURES

Figure 2.3-1 Hand Arm Vibration Syndrome, HAVS	8
Figure 2.4-1 Dc Motor	9
Figure 2.4-2 Permanent Magnet Circuit	10
Figure 2.4-3 Series Type Dc Motor Connection	11
Figure 2.4-4 Equivalent Circuit of Series Dc Motor	12
Figure 2.4-5 Shunt Excited Dc Motor Connection	13
Figure 2.5-1 Type of Rechargeable Batteries	14
Figure 2.6-1 Type of Aluminium Grade and Its Properties	21
Figure 2.6-2 PVC Pipe	22
Figure 2.7-1 2 Stroke Engine Operation	25
Figure 2.7-2 Comparison of each scavenging type of 2 stroke engine	28
Figure 3.3 Project Workflow	31
Figure 3.7-1 Conceptual Design	35
Figure 3.8-1 Final Project Design	36
Figure 3.8-2 Top View	37
Figure 3.8-3 3D View	37
Figure 3.10-1 Hand Grinding Machine	41
Figure 3.10-2 Measuring Tape	42
Figure 3.10-3 Screw Driver	43

Figure 3.10-4 Plier	444
Figure 3.10-5 Spanner Set	45
Figure 3.10-6 Drilling Machine	46
Figure 3.13-1 12V Lead Acid Battery	48
Figure 4.7 Finalized Assembled of Portable Grass Cutter Prototype	63
Figure 4.7-1 Testing of Portable Electric Grass Cutter	64
Figure 4.7-1(i) Process of Grass Trimmer	65
Figure 4.8-1 Type of Grass Cutter vs. Weight	71
Figure 4.8-2 Type of Grass Cutter vs. Area Covered	71
Figure 4.8-3 Type of Grass Cutter vs. Size	72
Figure 4.8-4 Type of Grass Cutter vs. Cost	72

CHAPTER 1

INTRODUCTION

1.1 Introduction

A conventional grass cutter also known as petrol-hand held grass trimmer is widely used in Malaysia for gardening purposes and landscaping work. The mechanism contains of petrol engine, handle shaft and grass cutter uses metal blade or nylon. To meet the requirements in completing bachelor in mechanical engineering technology (automotive) with honours this project is carried out. This project is a proposed model of portable electric grass cutter using rechargeable battery as the power source. In addition, this is an innovative idea inspired from the conventional grass cutter. Upon completion of this project, it will be of great help in the household since it will be made portable and light weight. Nowadays conventional grass cutter has many disadvantages and it is one of the reasons for choosing this project. Hence, a new design of grass cutter is been built in order to maximize the advantages and eliminate the downside of the conventional grass cutter. The design with various functions such as portable, light weight, and also using a rechargeable battery as the power supply is made.

1.2 Problem Statement

Although conventional grass cutter and also modern electric powered grass trimmer is used broadly in industries and households nowadays, there are some disadvantages or downside of this equipment. Studies show that there are some major problems and issues that have to be considered and come out with solutions. Firstly, one of the main issues with the conventional grass cutter that have been used in industries is its noise pollution. Studies and many researchers proved that the sound pollution is from the loud engine and there was also air pollution due to the combustion in the engine. Since the conventional grass cutter is using engine as well, maintenance such as changing the engine oil and 2-stroke oil is needed. Thus, it requires users to spend some cost to keep the grass cutter well maintained and last for long term. In addition, weight of the conventional grass cutter is also one of its downside. It makes the users to get tired easily while they using it for a long term. Moreover, fuel consumption is another issue that been encountered. The engine in conventional grass cutter uses fuel as its main element to power the engine and it's stated as a disadvantage due to rising in fuel price nowadays. Other than that, size of the conventional grass cutter is an obstacle because of its shaft's dimension that is quite long and difficult to bring along in vehicle. A research done by (Azmir, Ghazali, Yahya, Ali, & Song, 2015) also state that extend hand arm vibration presentation of conventional grass cutter machine can affect normal circulation as well as nervous and musculoskeletal systems, and cause an alternate hand disorder side effect called HAVS, also known as hand arm vibration syndrome. Besides, the modern electric grass trimmer also has its downside that had to be considered. One of the disadvantages is the main body or the shaft is not as longer as the conventional grass cutter. This cause the grass trimmer cant been swung while trimming the lawn as the conventional grass cutter. A small portion of area is

trimmed due the grass trimmer can't be swing while trimming the grass; makes the duration more long to cover up all the areas. Other than that, another downside of the modern electric powered grass trimmer is its battery capacity to run the machine. The smaller capacity of battery that provided not eventually makes the grass trimmer runs for longer duration. Finally, modern electric powered grass cutter also not stretchable or portable. Thus, it's hard to bring along in a compact car for any case.

1.3 Objective

There are several objective that been aimed to achieve by designing and developing a portable electric grass cutter such as:

- To design and fabricate a portable electric grass cutter.
- To design a mechanism with light weight compared to the conventional grass cutter.
- To fabricate a portable grass cutter in low cost and flexible.
- To test the newly designed and developed grass cutter with the performance.

1.4 Scope

This research will be focused on the designing and fabricating a portable electric grass cutter. Below are the listed scopes of this project:

- Usage of the grass cutter in household.
- To utilize in small portion of gardening area.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this 21st century, the grass cutter machine has given a crucial impact among every household. The grass cutter machine is a crucial utensil for people has residents with backyard in order to keep their yard clean and tidy effortlessly. A grass cutter machine also known as a gadget using one or more circulate blades to trim the surface of grasses to an even height. Furthermore, the grass cutter has varied designed benefit, it also comes in different types and sizes, and however they serve a common function. In this specific chapter, the study emphasized about the exploration and investigation varied journals and articles for further understanding, also techniques that has been utilized by previous researchers which interconnected to the electric grass cutter. In addition, in this chapter, the study has also concisely explains and summarizes a variety of electric grass cutter and its elements (rechargeable batteries, DC motors), types of materials utilized and also the demographic that has been accumulated regarding the project. Moreover, the pros and cons of the grass cutter machines are included in the chapter as well.

2.2 Grass Cutter

The sector of home gardening has particularly been industrialized from the advancement of the personal satisfaction that the utilization of grass cutter, as a gadget for planting, began to expand relentlessly. In addition, the engine based grass cutter that came into the broadest use starting at now is outfitted with more prominent cutting power yet additionally with high revolving power in the meantime including a noteworthy plausibility of causing deadly damage on the human body including neurological harm or debilitated vision because of particles happened from woods or stones amidst process. Moreover, the engine likewise creates a considerable measure of exhaust gas happened from combustion stroke and also threat materials on the human body and environment because of deficient sifting unit for exhaust gas. In addition, such an awesome level of noise presentation may make physiological troubles the operators in the long term. In the present circumstance, it is prescribed that to consider redesigning the grass-cutting machine or should be provided earplugs or ear covers on other hand. Then again, engine-based grass cutter works just if rpm increments up to a specific level that individuals turn out to be more arranged to careless mishap when using it.(Youm et al., 2013)

2.3 Effect of Vibration on Human's Health.

The fuel hand-held grass cutter machines are generally used in Malaysia because of the maintenance of grass growth along the highways, roadside, and general landscaping work. The machine contains of petrol engine, grass cutter utilizes nylon or metal cutting edge, and handle shaft. Furthermore, the vibration energy deliver by the combustion into the worked engine have created the revolution energy to the grass cutter too. Moreover, extend hand arm vibration presentation of grass cutter machine can affect normal circulation as well as nervous and musculoskeletal systems, and cause an alternate hand disorder side effect called HAVS, also known as hand arm vibration syndrome. In any case, there is less mindfulness in these words related sicknesses especially in the cultivation facility. Accordingly, in term of the occupational safety and health study, viewpoint, for example, ergonomics and repetitive of working activities and also the vibration transmit through the hands during different work activities in which turning or percussive power devices or vibrating machines are held. These exposures have been cited as the factor of chronic nerve disease and can encounter vascular symptoms in the fingers or hands.

Plus, the symptoms of HAVS normally increase after a long presentation of a hand-vibrating mechanical assembly and incorporate irremediable damage, and chronic pain in the hands and arms that prompts challenges in performing daily activities and to insufficiency. There are a few announced case on the disease of HAVS in developed countries as shown in figure 2.1.(Azmir et al., 2015)

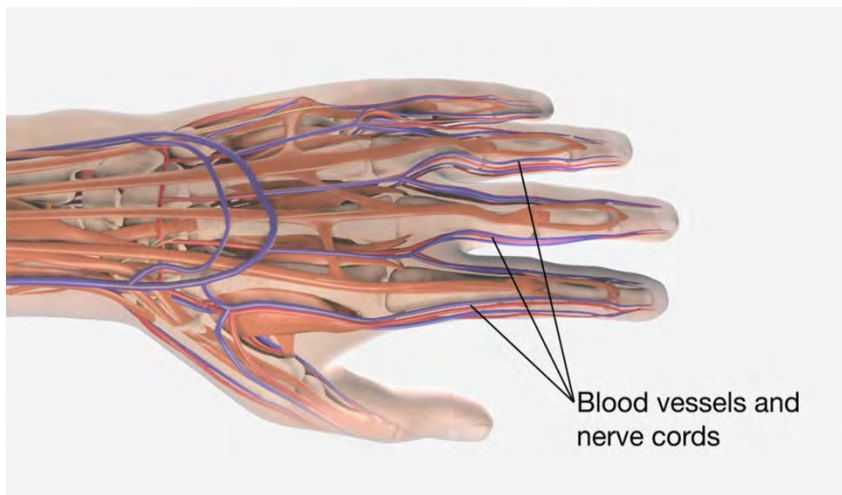


Figure 2.3-1 Hand Arm Vibration Syndrome, HAVS

2.4 Dc Motor

According to the study (Soressi, n.d.), found that DC motors as appeared as in figure 2.2.1 have been used as a piece of the past as the workhorse of modern framework to the point that the introduction of the AC motors, around twenty years back. Starting now and into the foreseeable future, the DC motors in the mechanical plants have been supplanted by all the more effective, less unpredictable AC ones and the speed control was refined by advanced framework controlled PWM inverters. In any case, sometime in the past the power gadgets, computerized control or even the analogical control was far to be displayed and the speed course, if even possible, was deputed to electromechanical gadget. This equipment has been created in such a solid course, to the point that some of them are up until now working and used for the age, i.e. in metal businesses. A particular setup, the compound DC motors were extensively used, for example for lifting and traction.



Figure 2.4-1 Dc Motor

2.4.1 Permanent Magnet Dc Motor

A research done by (Wu & Tian, 2012), found that the motor body, position sensor and electronic compensation circuit are the three noteworthy parts that created in lasting brushless DC motor. Electronic substitution circuit drives the comparative power exchanging device with the armature winding connection from the output signal of the position sensor which mirrors the position of the rotor. A jumping rotating magnetic field is generated in the stator and drives the permanent magnet rotor rotate.

Besides, in other examination by (Lad & Chudamani, 2017), the speed of DC motor can be controlled by differing the transition, connected voltage and armature resistance. As indicated by (Gowthaman, Vinodhini, Hussain, Dhinakaran, & Sabarinathan, 2017), there are a few favorable circumstances of the lasting brushless dc motor, for example, current ratio and power/weight. In addition, in spite of the fact that it delivers great speed control and awesome beginning torque, they will be utilized as a part of the low drive application since the torque is constrained.

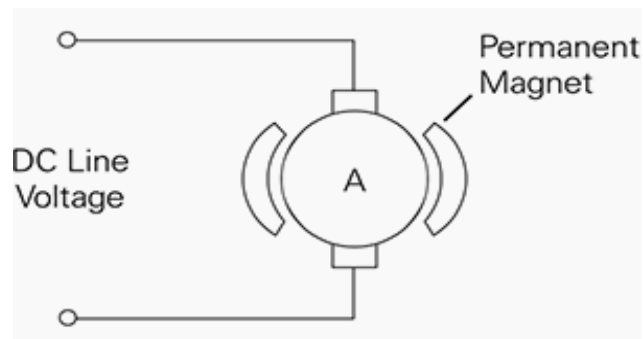


Figure 2.4-2 Permanent Magnet Circuit