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FINAL YEAR PROJECT II REPORT

DEVELOPMENT OF ELECTRIC SCOOTER

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SUPERVISOR DECLARATION

"I hereby declare that I have read through this report entitle "Development Of Electric Scooter" and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Power Electronics and Drives)

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DEVELOPMENT OF ELECTRIC SCOOTER

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STUDENT DECLARATION

I declare that this report entitle “Development Of Electric Scooter” is the result of my own research except as cited in the references. The report has not been accepted any degree and is not concurrently submitted in candidature of any other degree.

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ABSTRACT

The use of electric scooter is gaining attention among our community especially in large/urban areas. An electric scooter is originally inspired from a wheelchair, which is created to ease people to move from one place to another. It can be a stand scooter or seated scooter. However, this project is implemented by using a stand scooter and transformed into an electric scooter. This scooter is very simple to operate since it is a battery operated vehicle. Before this, we can see the use of electric scooter is limited only for child, but nowadays, statistic or the number of electric scooters has been increased and it is proven that it has been used by adults especially in a big city and it is widely used for a recreation in the evening. Basically this type of vehicle will used DC motor since it is directly connected to the battery as a supply, and the power will be transfer to rear wheel by sprocket and chain as its drive train. Each part of the scooter will be created and then will be fabricated together. Several parts being in refinement process to make sure it can be joining very well. At the end of the project, the model tested by several person and their comment then being record. This model can work properly after all work has been done.

ABSTRAK

Penggunaan skuter elektrik semakin mendapat perhatian di kalangan masyarakat kita terutamanya di kawasan-kawasan bandar. Skuter elektrik pada asalnya diilhamkan dari kerusi roda, yang dicipta untuk memudahkan orang ramai untuk bergerak dari satu tempat ke tempat lain. Skuter ini sama ada skuter berdiri atau skuter duduk. Walau bagaimanapun, projek ini dilaksanakan dengan menggunakan skuter berdiri dan akan diubah menjadi sebuah skuter elektrik. Skuter ini sangat mudah untuk beroperasi kerana ia cuma beroperasi menggunakan bateri. Sebelum ini, kita dapat melihat penggunaan skuter elektrik adalah terhad hanya untuk kanak-kanak, tetapi pada masa kini, statistik atau jumlah skuter elektrik telah meningkat dan ia membuktikan bahawa ia telah digunakan oleh orang dewasa terutama di bandar besar dan juga digunakan secara meluas untuk rekreasi pada waktu petang. Umumnya, skuter elektrik menggunakan DC motor kerana ia beroperasi secara langsung dengan bateri sebagai sumber kuasa, dan kuasa akan dipindahkan ke roda belakang dengan gegancu dan rantai. Bahagian-bahagian penting dalam skuter seterusnya dipasang dan pengubahsuaian dilakukan untuk membolehkan komponen dipasang dengan baik dilakukan. Diakhir projek, model skuter ini akan diuji oleh beberapa orang tertentu dan komen mereka akan direkodkan Model skuter yang dicipta akan berfungsi dengan baik setelah semua kerja selesai.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

A variety of electric scooters are emerging as an attractive alternative method of transportation that saves energy and is environmentally friendly.[1] Generally, electric scooters have been popular new mode transportation and new ride for short distance travel especially in urban areas. Electric scooter is stylish, easy to handle and its functionality attracted peoples to try and have it by their own. Basically the electric bikes is start gaining the world's popularity and capturing an increasing market share from the bicycle and auto car markets. It has been reported that the population of E-bikes in China exceeded 140 million in 2012 [2]. In the same year, about 700,000 E-bikes were sold in Western Europe, nearly half of which were in Germany [3].

A scooter is typically useful for a person who has a low stamina or maybe has a complications regarding to their leg during walking for a long distance[4]. Basically, scooters can be divided into two types. The first design of scooter is kick scooters and after a few development, electric scooters exists. However, this kick scooters require a rider to push the scooter with a foot. Similarly different with electric scooter, it does not require a rider to use leg strength to resist, but it requires a power from batteries and electric motors. This is one of the special benefit of electric scooter and it becomes a key factor in attracting people's attention thus increase the sales of electric scooter in market.

There are variety of scooter design in the market with its own specifications that can be selected by the user. Foldable electric scooter is one of the most wanted scooter since it has a

small size, light and can be folded, so this scooter can be bring together anywhere. Most of the scooters are designed to be folded. Its portability is the major cause why scooters sold faster in the market. Scooters have a smaller size rather than a bicycle. Furthermore, the price of the scooter are cheaper compared motorcycle or bicycle. An electric scooter is a one-person capacity battery-operated vehicle [4]. Nowadays, the use of a scooter was is unlimited and can be ridden by all types of people regardless of age or gender. This electric scooter is obviously to ease people to move from one place to another quickly in a shorter time rather than walking.

As the air pollution is becoming worst and the fuel's prices increase time by time, an increasing demand for non-polluting mechanized transportation has revived the interest in the use of electric vehicle especially electric scooter and automatically reduced reliance on automobiles in urban areas[2]. From financial perspective, people concern a lot about the cost to be incurred while choosing the best vehicle to be used daily. Well, the electric scooter is one of the best solution since it is low cost, environmental friendly, and easy to handle. The use of electric scooter is increasing day by day and in foreign countries, we can see these scooters present everywhere especially on city streets.

1.2 PROBLEM STATEMENT

Over past few years, the creations and development of electric vehicles, including scooters, bicycles, motorcycles, and cars are gaining more attention and the sales is forecast to be increase year by year in the market. For this project, the scope is minimized to the development of electric scooters. The use of electric scooter becomes a new mode of transportation in order to facilitate the people's movement especially in large or urban areas. Instead of that, it is such an alternative transport as a solutions for a low stamina person to move quickly and the most important thing is, it is environmental friendly. As we know, the air pollution and fuel price have come to climax and critical conditions, where it plays a major role in transportation, especially in large cities [5]. Therefore, this project is proposed to show an infinite support to a development of electric vehicles which does not emit any harmful carbon. The development of electric scooter cover on how to structured the scooter with a suitable use of battery, motor driver, switch, DC motor and analyze the limitations of scooter to carry the maximum load.

1.3 OBJECTIVE

I. To develop a kick (foot powered) scooter into an electric scooter.

II. To design the structure of electric scooter and integrate it with a specified motor.

III. To study about DC motor and its specification for electric scooter use.

1.4 SCOPE OF PROJECT

This following studies are includes in the design and development of electric scooter.

1. Literature review
2. Conceptual Design
3. Report Preparation (Proposal)
4. Materials selection
5. Design and start making a prototype.
6. Testing
7. Data analysis and record.
8. Final Report

1.5 METHODOLOGY

1) Literature review

- Do some review regarding to project's title. Searching for present model of electric scooter and analysis the differences between each type of scooter.

2) Conceptual Design

- Do some sketching of electric scooter based on what have been explain by supervisor.

3) Material Selection

- Selecting appropriate motor, battery and other part in electric scooter system.

4) Report Preparation

- Start writing proposal due to the format given.

1.6 REPORT OUTLINE

This report consists of five chapters. Chapter one is an introduction part. This chapter discuss about the project background, problem statement, objectives and lastly the scope of the project. Chapter two is about the “Literature Review”. This chapter describe about the theory of the electric vehicle and also the past research or study that have been carried out and published. This chapter also summarizes the ideas of previous electric vehicle either electric bicycle, scooter or mobility scooter that are related to this project. Next, chapter three is the “Methodology” section. This chapter is divided into two part, where the first part summarizes on how the scooter been developed into an electric scooter. While the second part is about the data analysis, which shows how the data being obtained through 3 conditions of test. The next content is in chapter 4. All the data, result and graph are included in this section. Chapter five is the “Conclusion and Recommendation”. This part will conclude the overall project and recommendation to improve the project.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The Navigant Research forecast that the worldwide sales of electric motorcycle and electric scooter will reach 6 million annually starting from 2015 to 2023, and this will total up the rapid increment of the sales is about 50 million [5]. Driven by rising fuel prices and increasingly congested city streets, more consumers are starting to turn to two-wheel vehicles, including electric motorcycles (e-motorcycles) and electric scooters (e-scooters).[6]

Scooters are classified as subclass of motorcycle. Nowadays, there are variety type of scooters we will find on city streets and park. The main parts of electric scooters are main frame, wheel, tire, brake system, battery and charger, motor, on/off switch, speed control, and one way bearing. This type of scooter is easy to operate and easy to carry anywhere since it is small and light. It can be use either for indoor or outdoor, but most people used it for outdoor / recreation activities.

Generally, there are several types of scooter operation. It is depends on how people want to use it. It may be operated by engine power, electric power or foot power. Each type of them carry their own advantage and disadvantage. However, this electric scooter are the common choice since it is light, cheaper, and easy to manufacture. It captures many eyes out there and increasingly rising sales day by day.

2.2 SCOOTER OPERATION

Generally, an electric scooter works when a motor and battery added with some connections. A switch and handbrake are mounted on the handlebar while the batteries fitted beneath your feet or maybe at the back near to the motor. Electric scooter mostly used by children during recreational time. However, the electric powered scooters also light and easy to be handle instead of low cost. This kind of bike usually use in small area and also for recreation. In order to design electric scooter motor, it is considered to have the high torque capability during low speed operations [8]. There are a few types of scooter that capture people's attention in market.

2.2.1 Engine Powered Scooter

Engine powered scooter normally used a small capacity engine which is about 40 to 60 cubic centimeter (cc). It's small engine usually looks like a small super bike and can be either four stroke or two stroke engine. It can be speed up about 50 to 60 km/h. This type of scooter normally produce noise and most of them can be seen on their own club track.

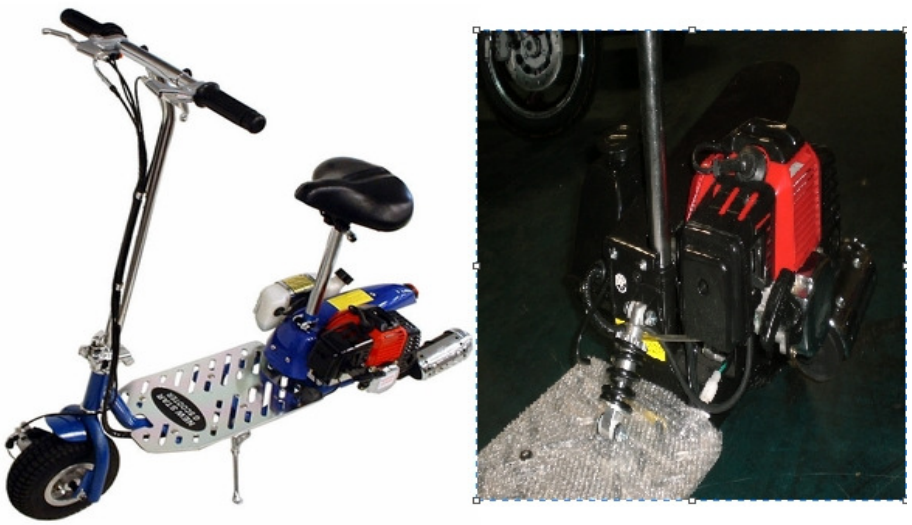


Figure 2.1: Engine Powered Scooter

2.2.2 Kick (Foot Powered Scooter)

A kick scooter can be used easily by standing on the body of scooter and pushing off the ground using foot. This kick scooter commonly have two hard small wheels, which is made up from primarily of aluminium and can be fold for convenience.However, some kick scooters that are made for children basically have 3 or 4 wheels for stability. They are made up from plastic and can not be folded.

Figure 2.2 : Kick Powered Scooter

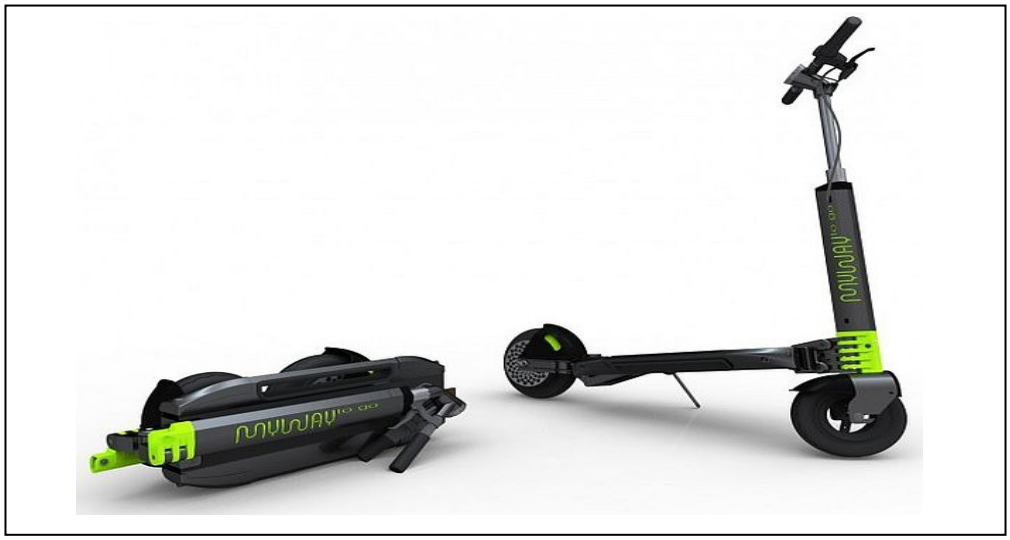
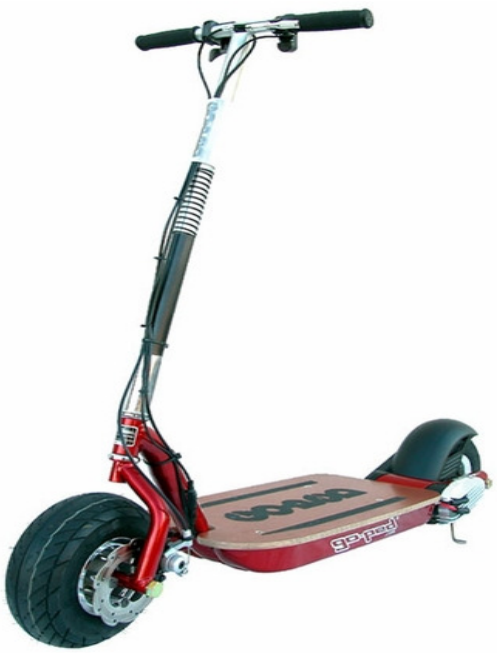


Figure 2.3 : Compact Foldable Kick Scooter

2.2.3 Electric Motor Scooter

Electric motor scooter come in hundred of models, sizes and designs. Basically, almost all of electric motor scooter use DC motor to operate since they are powered by batteries. This type of scooter are environmentally friendly to move around and regularly can travel farther than the 1 mile of kick scooter. It is much easier and faster to move from one place to another. There are many types of electric scooter which comes with their own specification.

Table 2.1 : Electric Scooter of The Year

NAME OF PRODUCT (ELECTRIC SCOOTER)	DESCRIPTION
 Figure 2.4 : GoPed ESR 750 [8]	Recently voted as "Scooter Of The Year" by Electric Scooter World. I. Motor : 24V Brush DC Motor II. Max.Speed : 20 mph III. Max.Load : 113.4kg IV. Battery Extended Range : Up to 10 miles (16.0934km)

2.3 ELECTRIC SCOOTER COMPONENT

2.3.1 Battery

Battery is a major supplier of electricity to the electrical system scooters. It is an electrical device that converts chemical energy into electricity. [10] Without battery, electric scooter will not work. Batteries are divided into two types which are rechargeable batteries and disposable batteries (which is can not be charge). Electric scooters usually use rechargeable batteries because these batteries more durable and economical. Its advantage is it can deliver high electrical current for starting an engine. However, it runs down quickly and need to be charge about 1 hour and 20 minutes. For this electric scooter, two batteries will be used and connected in series to produce larger input supply which is equal to 24V.

The types of rechargeable batteries are:

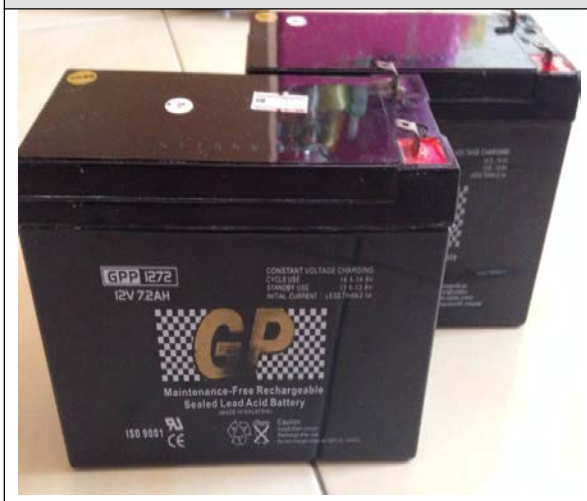
I. Seal Lead Acid Battery (SLA)
II. Nickel Cadmium Battery (NiCd)
III. Nickel Metal Hydride Battery (NiMH)
IV. Lithium-ion Battery
V. Lithium-ion Polymer

There are three main considerations in choosing battery:

I. Cost
II. Performance for a given application, and
III. Environmental friendly.

Seal Lead Acid Battery (SLA) is used for this electric scooter. The model of the battery is GPP1272. SLA is the most economical for larger power applications where weight is of little concern.

Table 2.2 : Specifications of Battery

Battery	Specifications Of Battery
 Figure 2.5 : SLA Rechargeable Battery (GPP1272) [10]	Type : Lead Acid Voltage : 12V Capacity : 7.2Ah Size : 15cm(L) x 6.5cm(W) x 9.3cm(H)

2.3.2 Motor Driver (MD30C)

There are many ways on how to control the speed of the motor. For instance, we can use arduino, potentiometer, microcontroller or other else. For this electric scooter, 30A DC Motor Driver has been used. MD30C is designed to drive medium to high power brushed DC Motor with current capacity up to 80A peak and 30A continuously. Besides that, MD30C also incorporates some user friendly features such as reverse polarity protection and onboard PWM generator which allow it to operate without a host controller. The motor can be simply controlled with the onboard switches and speed potentiometer. External switches and potentiometer can be used.