

INVESTIGATION OF ELECTRIC MOTORCYCLE PERFORMANCE IN UTEM
KAMPUS INDUK

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SUPERVISOR 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 award of the degree of Bachelor of Mechanical Engineering with Honours (Thermal-Fluid)”

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**This report is submitted in partial fulfilment of the requirement for the degree
of Bachelor Mechanical Engineering with Honours (Thermal-Fluid)**

**Faculty of Mechanical Engineering
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JUNE 2013

DECLARATION

“I hereby declared that the work in this report is my own except for summaries
quotation which have been duly acknowledged”

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Date : JUNE 2013

This report is dedicated to my family. Thank you for your continuous support during my vital educational years. Without their patience, understanding and most of all love, the completion of this work would not have been possible.

To my parents,

Sulaiman Bin Abdullah and Katijah Binti Abdul Rahman

My siblings

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Khairul Anuar Bin Sulaiman
Hartini Binti Sulaiman
Siti Suzana Binti Sulaiman
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ABSTRACT

Motorcycle is a vehicle that is popular among people in the world, including the people in Malaysia. Excessive fuel consumption from vehicles such as motorcycles can cause air pollution to the environment. Therefore to solve this problem then arises as an idea to create a green vehicles called "Electric Motorcycles". A study conducted to identify the electric motorcycle speed and the performance of the battery power from motorcycle. Electric motorcycle are built using the scrap motorcycle frame, a hub motor to convert from electrical energy to mechanical energy to rotate the wheel and powered by 48 volt rechargeable batteries. In order to get the result, the experiment should be run to get the actual result. Firstly the final result of velocity test that identified the maximum speed of the electric motorcycle can be produce based on the several weight of rider. The relationship between velocity of electric motorcycle and load of rider is inversely proportional because when the load is increase, the velocity of electric motorcycle is decrease. Besides that, second result is the performance of rechargeable batteries that identified the period of charging batteries and the period of the batteries got exhausted. The maximum voltage can be store is approximately 55V. The battery need 1 hour to fully charge from 45V to 55V. The lastly is the power consumption to charging the battery that also involve of monthly electrical bill. The user only can spend around RM3 to RM4 per monthly for charging the battery every day for 5 hours to move the electric motorcycle around 50km. The project objective is achieved to analyse the performance of electric motorcycle and also to determine the maximum capacity of battery for long distance travel.

ABSTRAK

Motorsikal merupakan kenderaan yang popular dikalangan rakyat di dunia termasuk juga rakyat di Malaysia. Penggunaan bahan api yang keterlaluan terhasil daripada kenderaan seperti motorsikal mengakibatkan alam sekitar mulai tercemar. Oleh yang demikian, maka bagi menyelesaikan masalah ini maka terhasil satu idea untuk mewujudkan kenderaan hijau yang mesra alam yang dipanggil “Motorsikal Elektrik”. Satu kajian dijalankan bertujuan untuk mengenalpasti halaju motorsikal elektrik, beban yang dibenarkan ke atas rangka dan prestasi kuasa bateri. Motorsikal elektrik ini dibina dengan menggunakan rangka motor terpakai, hab motor untuk menukar tenaga elektrik kepada tenaga mekanikal untuk memutar roda dan dijana oleh bateri boleh dicas semula 48 volt. Dalam usaha untuk mendapatkan hasil terakhir, eksperimen perlu dijalankan untuk mendapatkan keputusan yang sebenar. Keputusan yang pertama adalah kelajuan maksimum motorsikal elektrik yang boleh dihasilkan berdasarkan beberapa berat penunggang. Hubungan antara halaju motorsikal elektrik dan beban penunggang adalah berkadar songsang kerana apabila beban bertambah, halaju motorsikal elektrik menurun. Selain itu, hasil kedua adalah prestasi bateri boleh dicas semula yang mana tempoh mengecas semula bateri dan tempoh bateri untuk habis. Maksimum voltan yang boleh disimpan adalah 55V. Bateri memerlukan 1jam untuk mengecas semula daripada 45V kepada 55V. yang terakhir adalah penggunaan kuasa elektrik untuk mengecas semula bateri melibatkan bil elektrik bulanan. Penggunaan motorsikal elektrik hanya memerlukan pembelanjaan RM3 hingga RM4 setiap bulan untuk mengecas bateri selama 5 jam sehari untuk menggerakkan motorsikal elektrik sekitar 50km. Akhir sekali, objektif projek dicapai untuk menganalisis prestasi motorsikal elektrik dan juga untuk menentukan maksimum kapasiti bateri untuk perjalanan jarak jauh.

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LIST OF SYMBOLS

mAH	Milliamp-hours
AH	Ampere-hours
N	Speed
v	Velocity
V	Voltage
T	Temperature
X	Distance
CC	Cubic Centimeter

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LIST OF ABBREVIATION

BLDC	Brushless Direct Current
SLA	Sealed Lead-acid
RAM	Rechargeable alkaline-manganese
NiCad	Nickle- cadium
NiMH	Nickle-metal hydride
Li-ion	Lithium-ion
PCB	Protection circuit module

CHAPTER I

INTRODUCTION

1.1 INTRODUCTION

Motorcycle is a vehicle with the characteristics of being mobile, quick, convenient, economical and easy to park. It is the best suited for short range transport. Taiwan is densely populated, the motorcycle has become a pretty popular means of transport. In recent years, along with fast expansion and rapid industrial development, the number of motorcycles has increase dramatically. The pollutants such as carbon monoxide (CO) and hydrocarbon (HC) can produce by motorcycle account for approximately 10% of the total annual amount of pollution emissions in world. Therefore, to reduce pollution emission from motorcycle to improve the quality of the environment has become a critical issue that cannot longer be ignored. From the issue the electric motorcycle is a solution (Chou, J. R. et. al.,2004).

Electric motorcycles are considered a new technical green product and a potential industry for many countries. Conventional transportation or vehicle technologies usually involve the use of fossil fuels for the vehicle. It can produce more pollution to the environment because it can produce carbon dioxide. Rising fuel price are cause mainstream awareness and interest in alternative transportation technology. From the problems, many automobile industries in the world today are working hard to develop more sustainable vehicles in order to combat fuel cost and at the same time also to save the environmental effect when used alternative source as a fuel source. There are many types of sustainable vehicle like car, bus, lorry and

motorcycle. It can generate using the alternative fuel such as plug-in hybrid, battery or electric and hydrogen.

In Asia, motorcycle is one of the most popular vehicles due to the pattern of economic development and geographic environment. Two-wheel motor vehicle which includes motorcycle, motor bikes, motor scooter, moped and motorized-rickshaws represent over 50% of the vehicle fleet in many Asian countries as shown in Figure 1.1 below (Collela, W.G.,2000). Based on the Figure 1.1 Malaysia also include the top five popularity used the motorcycle.

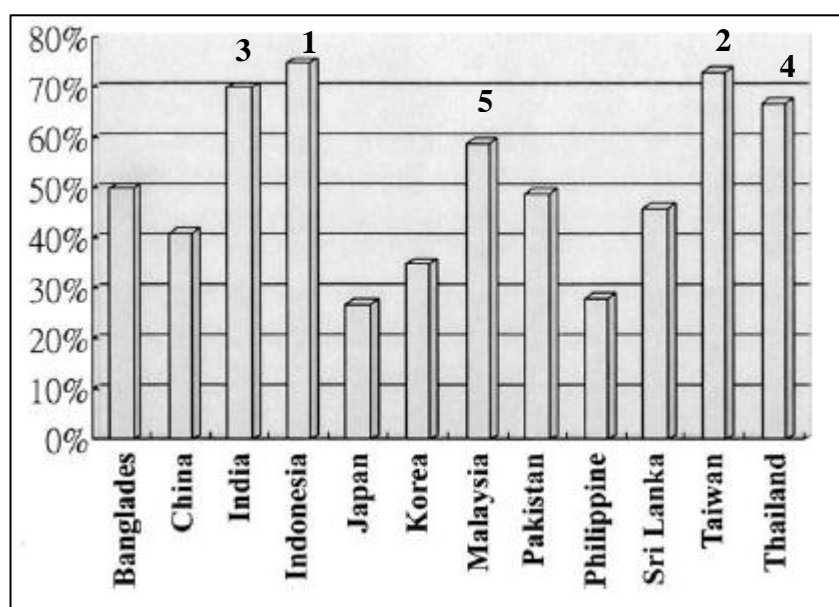


Figure 1.1: Popularity of motorcycle in Asia

Nowadays, electric motorcycle are considered a new green technology of transportation for the 21th century and also regarded as a viable niche market and a potential industry for many countries. It is because by using electric motorcycle the sound pollution can be reduced because it not exhaust from pedalling. Besides that, using electric motorcycle cost to move from one location to one location is cheaper compare it used the fossil fuel. Usually the motorcycle used only in short distance, means that between 0 km until 100 km. Based on the cost of maintenance, the electric motorcycle is higher compare to the motorcycle using fuel because the hub motor and the rechargeable battery is very expensive. But in term of lifetime the electric motorcycle is more efficient than the motorcycle using fuel.

1.2 PROBLEM STATEMENT

The increasing of fuel consumption throughout the world can be the main reason for creation of electric vehicle nowadays. This is cause by the depletion of raw petroleum oil source in the world. To counter this problem, the government have take initiative to reduce and minimize the dependence of oil source as fuel for energy by introducing renewable energy , green technology and others. Many researchers from Non-Government Organization (NGO) and university especially UTeM are developing green technology project. One of the project is electric motorcycle that can be use in the main campus area. For example :

- 1) Increasing of the fuel cost that are used by the general assistant in the UTeM main campus area during delivered letters, documents, and goods.
- 2) Motorcycle that only used fossil fuel as a power source produced carbon dioxide contribute air pollution in the UTeM main campus area.

1.3 PROJECT OBJECTIVE

The studies are to achieve this objective:-

- 1) To Identified the performance of the electric motorcycle.
- 2) To determine the maximum capacity of battery for long distance travel.

1.4 PROJECT SCOPE

This report covered:-

- 1) Test performance of the electric motorcycle such as, speed, velocity and power consumption.
- 2) Examine the relationship between capacity of battery motorcycles with the distance.

CHAPTER II

LITERATURE REVIEW

2.1 INTRODUCTION

Electric vehicle also refer to as an electric drive vehicle. Electric vehicle is not same with the hybrid electric vehicle because the electric vehicle only used single system compare hybrid electric vehicle is used two sources which is gasoline and electric. Usually the electric vehicle is created by converting the gasoline powered car. The gasoline engine will be replaced with the electric motor to turn the wheel. Electric motor can get the power from the external controller because the controller is control the power to supply to the electric motor from the rechargeable batteries. The rechargeable battery is very important device that produce electricity to supply to the system.

2.2 BACKGROUND OF ELECTRIC MOTORCYCLE

In 1860, the first electric motorcycle is already found in patents. But in 1920 the electric motorcycle was developed. An electric motorcycle is a motorcycle comprising a frame and a platform for the rider. Motorcycle designs have been created in some of the earliest forms of motorcycles and motorcycle is identified as scooters. It was created late 1894 by Hildebrand and Wolfmuller world's first production motorcycle shown in Figure 2.1 (Walker, M., 1998). This motorcycle is had a step-through frame, with its fuel tank mounted on the down tube, its parallel

two-cylinder engine mounted low on the frame and its cylinder mounted in line with the frame. It was water cooled and had a radiator built in to the top of rear fender.



Figure 2.1: First Steam Motorcycle

(Source: Walker, M., 1998)

Production of the motorcycle only built a few hundred, and the high price and technical difficulties made the venture a financial failure (Bishop, J.D.K. et al., 2011). Since 1900, after generation by generation compete to produce motorcycle from steam engine to gasoline engine and the finally today their passion to compete is to produce a green vehicle after realize the deterioration of fossil fuel to earth. In this report a green vehicle is refer the electric motorcycle.

Nowadays, in 2000 electric motorcycle have updated because have many research and development (R&D) to improve the electric motorcycle based on the design and performance. It is because nowadays the electric motorcycle also has the high cubic centimeters (CC) such as Zero S and Cowboy. The user demand of the electric motorcycle is increase from one year to another year. Usually the performance of the electric motorcycle depends on the selecting the component.

2.3 MAIN COMPONENTS

Electric motorcycle has some main component that can establish the electric vehicle. The main components are an important part to make it move with two wheels that use an electric motor to move. It is because the main part is related to each other's to make sure the electric motorcycle can move. This section describes the description of the important component that include as an electric motor scooter. An electric motorcycle consists of the battery to provide the electrical energy. Electric hub motor to drives the wheels and also the controller that regulate the energy flow to the electric hub motor.

2.3.1 Hub Motor

Hub motor is an electric motorcycle that is built in into a hub of the wheel and drives it directly. Hub motor is an electric motor that turns a wheel without the use of a transmission (Carl, V., 2009). This is same with auto transmission. This is accomplished because a hub motor is built directly into the wheel hub which is the point around which the wheel rotates. All the motor principle is to convert electrical energy to mechanical energy. Hub motor can run on electricity from a rechargeable battery.

The hub motor is steadily emerging as the standard drive method for e-bikes, scooters, solar cars, and many other light electric vehicles. With a hub motor conversion, there is no need for external mounting brackets and drive chains to support a motor and transmission (Justin, D., 2011). It is because all of this is contained inside the wheel which mounts on bike like any other wheel. There are two basic categories of hub motor like direct drive and geared.

2.3.1.1 Direct Drive Hub Motor

The direct hub motor is simple design. Direct hub drive has no internal gears or other moving parts except the actual case which rotates around the axle on sealed bearings (Carl, V., 2009). The coils are wound around an assembly that is fastened to the axle and remains stationary. The outer ring of the case has a ring of magnets that rotate in closeness to the electromagnets formed by the coils. As the coils are energized in a specific pattern by the motor controller, the magnets are attracted and repelled causing the wheel to rotate. The outer case directly drives the wheel of the bike. In direct drive motor is divide by two parts which is hub motor rotor and hub motor stator shown in Figure 2.2.

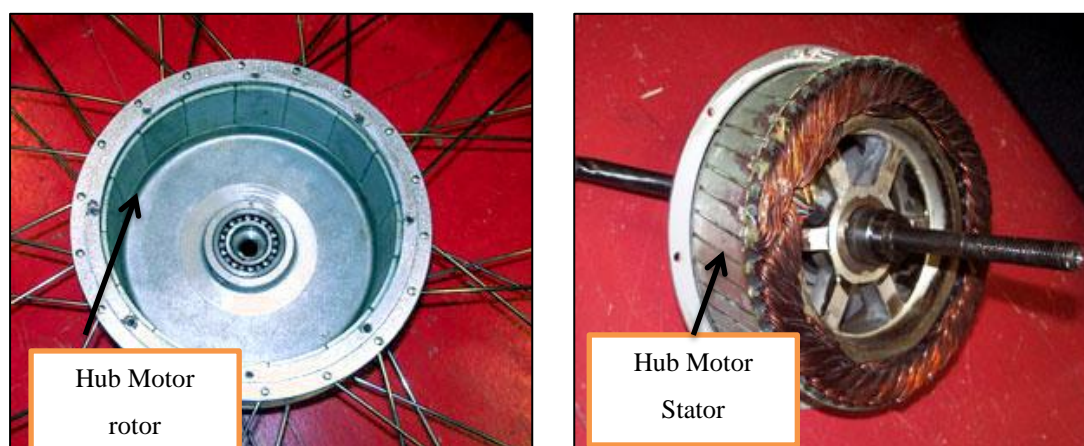


Figure 2.2: Direct hub Motor

(Source: Justin, D., 2011)

Normally these are radial-flux Brushless DC (BLDC) machines that have an array of permanent magnets on the inside surface of the hub. The stator windings are attached to the axle, and the hub is made to rotate by alternating currents through these windings. In a DC hub motor, the magnets are on the axle, and the windings are actually spinning on the inside of the hub. When the electrical potential is applied across the electrical connection, current flows through the motor. A carbon brush transmits electricity to the spinning windings via a commutator plate. The commutator rotating along with the rotor, complete the connection for each different set of winding in the stator (Justin, D., 2011).