EFFICIENCY ENERGY STORAGE, FROM KINETIC ENERGY TO ELECTRIC POTENTIAL ENERGY

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This report submitted in partial fulfilment of the requirements for the award of a Bachelor Degree in Mechanical Engineering (Automotive)

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SUPERVISORS DECLARATION

I hereby declare that I have read this report 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 (Automotive)

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DECLARATION

I hereby declare that the work in this report is my own except for summaries and quotations which have been duly acknowledged.

Signature :

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Date :

DEDICATION

To my parents, Abd Ghani Bin Ahmad, and Norshida binti Hatim who had gave me financial and moral support, and a greatest thank you to my siblings, my fellow friends, and my supervisor, Dr. Musthafah bin Mohd Tahir, for supporting me.

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ABSTRACT

The electric car is propelling by electric motor and use a battery as storage to store the electric current. The UTeM 1 car which is from conventional engine was proposed to be converted into electric vehicle. So, recharging system is important to electric vehicle in order to overcome the major problem for electric vehicle which is the batteries. However, there two system that can recharge the batteries which are alternators and regenerative braking system. The objectives is to choose one either of this system to use as recharging system and the analyses was done by using Matlab Simulink software. The regenerative braking system (RBS) was chosen. From simulation of Matlab analysis, the voltage and the current were determined. From simulation, it had shown how much the Brushless Direct Current Motor (BLDC) can regenerate back the voltage. So, the current and voltage was calculated to get how much the power can regenerate back to the BLDC motor. Hence, it shows that the BLDC motor can undergo regenerative braking process and can generate back the voltage.

ABSTRAK

Kereta elektrik digerakkan oleh motor elektrik dan menggunakan bateri sebagai simpanan untuk menyimpan arus elektrik UTeM 1 adalah kereta dari enjin konvensional telah dicadangkan untuk ditukarkan kepada kenderaan elektrik. Jadi, sistem pengisian semula elektrik adalah penting untuk kenderaan elektrik bagi mengatasi masalah utama untuk kenderaan elektrik iaitu bateri. Walau bagaimanapun, terdapat dua sistem yang boleh cas semula bateri iaitu alternator dan sistem brek regeneratif. Objektif projek ini adalah untuk memilih salah satu daripada sistem ini untuk digunakan sebagai sistem pengisian dan kemudian melakukan analisis dengan menggunakan perisian Matlab Simulink. Sistem brek regeneratif (RBS) telah dipilih. Dari simulasi analisis Matlab, voltan dan arus telah dapat ditentukan. Dari simulasi, ia telah menunjukkan berapa banyak Brusshless Motor Semasa Langsung (BLDC) boleh mengecas semula kembali voltan. Jadi, arus dan voltan telah dikira untuk mendapatkan berapa banyak kuasa yang boleh dicas semula ke BLDC motor. Oleh itu, ia menunjukkan bahawa motor BLDC boleh menjalani proses brek regeneratif dan boleh menjana kembali voltan.

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LIST OF SYMBOLS

a	Acceleration
B	Length centre gravity to the front axle
C	Length of centre gravity to the rear axle
C_d	Coefficient of drag
C_r	Coefficient of rolling resistance
d	Distance
h	Height
J_f	Moment inertia of front tyre
J_r	Moment inertia of rear tyre
K_{bf}	pressure conversion constant for front
K_{br}	pressure conversion constant for rear
L	Wheelbase length
m	mass
P_{max}	Maximum output power
R_t	Radius of tyre
t	Time
t_e	Endurance time
v	Velocity
v_{max}	Maximum velocity

LIST OF ABBREVIATION

RBS	Regenerative Braking System
GHGs	Green House Gases
BEV	Battery electric vehicle
BLDC	Brushless direct current
IGBTs	Insulated gate bipolar transistors
CVT	Continuously variable transmission
DC	Direct current
EV	Electric vehicle
FCV	Fuel cell vehicle
HEV	Hybrid electric vehicle
ICE	Internal combustion engine
COG	Centre of gravity
RPM	Revolution Per minute
PHEV	Plug-in hybrid electric vehicle
UTeM	Universiti Teknikal Malaysia Melaka

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CHAPTER 1

INTRODUCTION

1.1 PROJECT INTRODUCTION

The subject of Final Year Project (PSM), BMCU 4972 and BMCU 4984 had been compulsory to the student in order to fulfil the requirement for the award of degree. The students will supervised by a lecturer during doing the research. At the end of semester, the students had to carry out a presentation about the project that had been done. The students must show the findings and result of the project.

The title for my final project is efficient energy storage from kinetic energy to electric potential energy. Basically, the efficient energy storage from kinetic energy to electric potential energy means that how the energy was recaptures back and used the energy again. So, when this system was used, it can make the car can be drive a little a bit longer. Usually, for conventional car the alternator was used as the component to restore back energy meanwhile for hybrid or electric car the regenerative braking system which the motor act as generator was used. So, there are two ways in order to restore back the energy either by using regenerative braking system (generator) or by using the alternator.

1.2 BACKGROUND

The energy storage is one of the most important in electric vehicle. Nowadays, the pollution had increases and become more serious problem which led to global warming and green house effect. So, the electric car was one of the solutions in order to reduce the pollution. The Universiti Teknikal Malaysia Melaka (UTeM) had produced one conventional car named UTeM 1. However, UTeM 1 was used conventional engine. So, in order to reduce the pollutions and the development of the green technology the UTeM 1 car had been proposed to convert to electric car. The Figure 1.1 shows the UTeM 1 car. However, the problem is how to recharging the battery, since battery is one of the major problem in development of electric vehicle. There are two type of battery charging which are online charging and offline charging. The online charging means the battery was charge during the car was driven while the offline charging means the battery was charge outside the car which is plug in. There are two components in order to recharge the battery by regenerative braking or using the alternators. The principle of regenerative braking and alternators is same which is recuperate the energy by converting the kinetics energy to electric potential energy. From previous thesis shows the alternators had higher efficiency compared to the regenerative braking (Cheong, 2012). However, the experiment was test on bicycle.

Figure 1.1: UTeM 1

1.3 PROBLEM STATEMENT

At the 21th century, the automotive industry has post a great challenge in order to reduce the vehicle fuel consumption and emission, these is due to the shortage of fuel resources and worsen air pollution problem. However, the electric car is one of the ways to reduce these problems because it produces zero emission. The electric vehicle also had the major problem which is batteries. So, the recharging system was invented in order to charge the batteries. There are two ways to recharge the batteries by using regenerative braking system or alternators. So, the problem is to choose which one is suitable in electric vehicle which in this project used UTeM 1 as an electric vehicle.

The other problem is the efficiency of recharging batteries. The efficiency of recharging system is important because it can determine how long the car can be driven. The other important of efficiency recharging system, it can be used for other component like lamps of the car and signal of the car.

1.4 OBJECTIVES

- To design the regenerative braking system for UTeM 1.

1.5 SCOPE

1. Choose the suitable recharging system for UteM 1 by compare regenerative braking and alternator.
2. Design the regenerative braking system that suitable for UTeM 1 by using Matlab Simulink software.
3. Analyses the regenerative braking system for UTeM 1 by using Matlab Simulink software.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION OF ELECTRIC VEHICLE

Nowadays, the earth facing three major environmental problems which are global warming, desired energy independence and the need for healthy air. So, the electric car is one of the ways to reduce these problems. Actually, the electric car was popular between the late 19th century and early 20th century where electricity was preferred as automobile propulsion. This is because it provides comfort and ease operation compared to the gasoline cars at that time. However, the advances in internal combustion technology had led to decline in the use of electric propulsion. The development of electric starter especially had led to electric propulsion being ignored. The development of internal combustion such as the greater range of gasoline cars can travel, quicker refuelling times and the development in petroleum infrastructure. The declined of electric propulsion also support by mass production of gasoline vehicle such as Ford Motor Company, which reduces prices of gasoline cars to less than half that equivalent electric cars. However, in recent years people more concerns over the environmental impact of gasoline cars (wikipedia, 2012).

The Electric Vehicle (EV) was reappeared and become important again because the internal combustion engine was creating some problems. The causes of the problems are the emissions that produce from internal combustion are too high. When normal cars burn liquid fuels, such as petrol or diesel, it will produce pollution. This pollution is made up of poisonous gases (emissions) called greenhouse gases (GHGs) which can be harmful to the environment and to our health. These gases include carbon monoxide, oxides of nitrogen, carbon dioxide and methane. Carbon dioxide and greenhouse gases (GHGs) that dangerous can cause problems for our environment through processes such as the Greenhouse Effect or global warming. The green house effect can cause the earth become warm and warmer over a long period time. This is because the hot air is trapped in the earth. These are support by the higher gasoline prices, improvements in battery technology (transport.vic.gov.au, 2012). The electric vehicle (EV) is an automobile that is propelled by one electric motor or more by using the electrical energy which is stored in batteries or the other storage energy device. The function of electric motors to create strong and give electric cars instant torque while had a smooth acceleration (Sperling, 2009). The Figure 2.1 shows the schematic diagram of electric vehicle. The battery as voltage supplies the energy to the electric direct current (DC) motor to propel the car. The motor controller functions to control the voltage that needed in motor electric. The continuous variable transmission (CVT) functions as transmission to shift gear in electric vehicle.

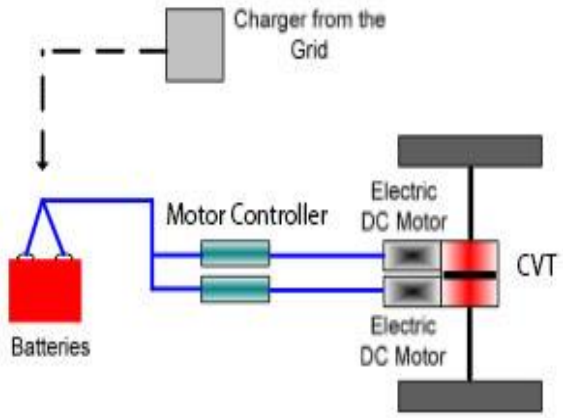

Figure 2.1: The schematic diagram of electric vehicle

2.2 TYPES OF ELECTRIC VEHICLE

The EV can divide into three types which are Battery electric vehicle (BEV), Hybrid electric vehicle (HEV) and Fuel Cell electric vehicle (FCV). BEV is a type of EV that used chemical energy stored in battery packs. BEV used electric motor and motor controls for propulsion instead of ICE. HEV is a combination of ICE propulsion system and electric propulsion system. HEV also had a better fuel economy and performance compared to the ICE. HEV also can functions as EV as well. FCV is a type of electric which use hydrogen. It uses fuel cell to produce electricity. Then, electricity will supply power to an electric motor using hydrogen and oxygen from the air. The Table 2.1 below shows the comparison between these three electric vehicles (Chan, 2007):

Table 2.1: Comparison between electric vehicles

Types of EV	Battery EV	Hybrid EV	Fuel Cell EV
Propulsion	• Electric motor drives	• Electric motor drives • Internal combustion engine	• Electric motor drives
Energy System	• Battery • Ultracapacitor	• Battery • Ultracapacitor • ICE generating unit	• Fuel cells • Need battery or ultracpacitor to enhance power density for starting
Energy source & infrastructure	• Electric grid charging facilities	• Gasoline stations • Electric grid charging facilities (for plug in hybrid)	• Hydrogen • Hydrogen production and transportation infrastructure