DESIGN AND ANALYSIS PERSONAL ELECTRIC VEHICLE FOR UTEM

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"I hereby declare that the work in this report is my own work except for summaries and quotations that I have mentioned its sources."

Signature: ……

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Date: 22 April 2011

To my beloved parents,

Mr. Jamal Bin Hj Ali and Mrs. Junaina Binti Hj Soyan

My siblings

And also

To all my trusted friends

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ABSTRACT

Due to the need for green technologies, Universiti Teknikal Malaysia Melaka (UTeM) requires an electric vehicle that is not dependent on the fossil fuel sources and at the same time can reduce the impact of the environment pollution. In addition, to large university requires students and staffs move from one place to another with the aid of the motoring vehicle. This will require more time and energy for those who had to walk around campus. In the case, an eco-design mobility that can help the movement from one place to another place in faster and save energy should be created. The main objective of this project are to design and fabricate UTeM`s first personal electric vehicle and conduct dynamic analysis using ADAMs software. The purpose of this full report is to provide a clear presentation of the electric vehicle design and analysis of the personal electric vehicle. The project scope are including research conducting and studies on vehicle design, to do sketching, 3D drawing and other design process of the PEV, to conduct dynamic analysis using ADAMs software and finally to fabricate the electric vehicle. The methodology for this PSM 1 project includes research for electric vehicle design, sketching and designing process, and finally engineering drawing (drafting) for the PEV design. The result of the project describes about the personal electric`s vehicle criteria, the electric vehicle design and analysis result of PEV. As the result, this PEV is battery electric vehicle type; designed with four wheels, combining front-half body and rear-half body to allow articulated steering system to rotate the vehicle body when cornering and have a single seat for an operator.

ABSTRAK

Atas dasar keperluan untuk teknologi hijau. Universiti Teknikal Malaysia Melaka (UTeM) memerlukan sebuah kenderaan elektrik yang tidak bergantung pada sumber bahan api fosil dan pada masa yang sama boleh mengurangkan kesan pencemaran alam sekitar. Selain daripada itu, bagi sebuah university besar memerlukan pelajar dan kakitangan bergerak dari satu tempat ke tempat lain dengan bantuan bagi mereka yang harus berjalan di sekitar kampus. Dalam kes ini, sebuah mobiliti eko-desain yang dapat membantu pergerakan dari satu tempat ke tempat lain dengan lebih cepat dan menjimatkan tenaga harus dicipta. Objektif utama projek ini adalah untuk merekabentuk kereta dan melakukan analisis untuk kenderaan elektrik peribadi (PEV) pertama UTeM. Laporan lengkap ini adalah bertujuan memberikan persembahan yang jelas tentang rekabentuk kenderaan dan analisis berdinamik bagi kenderaan elektrik. Skop projek ini meliputi penyelidikan dan kajian yang dijalankan pada rekabentuk kenderaan elektrik peribadi (PEV), melakukan analisis berdinamik dengan menggunakan ADAMs software dan akhirnya membuat kenderaan elektrik peribadi. Metodolgi untuk projek PSM 1 ini meliputi kajian untuk merekabentuk kenderaan elektrik, membuat analisis dan proses analisis, dan lukisan kejuruteraan (draf) untuk rekabentuk kenderaan elektrik peribadi. Keputusan dari projek ini meliputi penjelasan tentang criteria kenderaan elektrik peribadi dan analisis mengenai kenderaan elektrik. Sebagai keputusan, kenderaan elektrik peribadi ini adalah jenis kenderaan elektrik berbateri, direkabentuk dengan empat roda, menggabungkan separuh badan hadapan dan separuh badan belakang semasa mengambil selekoh dan mempunyai satu tempat duduk bagi pemandu.

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LIST OF ABBREVIATIONS

ACAR	=	ADAMS/car
AMS	=	Auto Motor Sport
CAD	=	Computer Aided Design
CARB	=	California Air Resources Board
CG	=	Center of gravity
CV	=	Conventional vehicle
DAEs	=	Differential And Algebraic Equations
EV	=	Electric Vehicle
FEA	=	Finite Element Analysis
H	=	Height
ICE	=	Internal Combustion Engine
ISO	=	International Standards Organization
L	=	Half-tread
Li-Ion	=	Lithium-ion
Ni-MH	=	Nickel Metal-Hydride
PC	=	Polymer composites
PEV	=	Personalized Electric Vehicle
UTeM	=	Universiti Teknikal Malaysia Melaka

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CHAPTER 1

INTRODUCTION

1.1 Overview

Electric vehicle (EV) enabled by high-efficiency electric motors and controllers and powered by alternative energy sources provide the means for a clean, efficient, and environmentally friendly urban transportation system. Electric vehicles have no emission, having the potential to curb the pollution problem in an efficient way (Husain, 2003). EVs were designed to do whatever was wanted in the past and can be designed and refined to do whatever is needed in the future (Leitman and Brant, 2009).

Electric vehicles are probably the simplest form of self propelled mechanical transportation. In its most basic form, the drive train of an electric vehicle consists of a battery attached to an off and on switch which is attached to an electric motor. The electric motor drives the wheels. Most electric vehicles have a more elaborate method to control the amount of electricity going to the motor as well as a system of gears to drive the wheels in a most efficient manner. Electric vehicles (EVs) use energy from a storage device, such a battery, flywheel, or ultra capacitor; consequently, EVs produce no tailpipe emissions, thereby meeting the zero tailpipe emissions requirements mandated by some states. In addition to providing a solution to urban air-quality problems, EVs would provide an alternative to conventional vehicles (CVs), which are powered by internal combustion (IC) engines, for certain personal transportation missions. EV

technology, however, is at an early stage of development. Low production volumes and labor-intensive manufacturing processes make the costs of its components high.

In addition to the above, electric vehicles differ from conventional vehicles in several respects. The EV`s power train does not idle when the vehicle is stopped in traffic, and very little waste heat is available for passenger compartment heating. Electric vehicles differ from conventional vehicles in several respects. The EV`s power train does not idle when the vehicle is stopped in traffic, and very little waste heat is available for passenger compartment heating (Larminie and Lowry, 2003).

There are many types of electric vehicles that used today, but this project is focused on the battery electric vehicle type. Deeply, the thesis points to design and analysis the personal electric vehicle. To design an electric vehicle, we should know what the major parts are in an electric vehicle. The battery electric vehicles has the propulsion system that contains electric battery, electric motor and controller, which combined with the body and chassis (Leitman and Brant, 2009).

Before anyone sits down to design and analysis anything, including an electric vehicle they should write specification outlining precisely what they want to achieve (Larminie and Lowry, 2003). For example, is the vehicle required high speed motorway driving, or is it simply for delivering people about town at low speeds? This fact alone will lead to great differences in the shape of the vehicle. The designing process is requires work flows, such as starting with ideas brainstorming, researching, sketching, 3D software drawing, software prototyping and so on before the design is able to fabricated.

1.2 Problem Statement

Now a day, global warming is one of currently urgent problem to the people. Moreover, the scientists believe that global warming was forming by human, which mean there is more than 90% of human responsibility. It has been an irrefutable fact to melt globally and warmly. Our earth wants heat than the past 2,000. If the situation worsens continuously, at the end of this century, the earth temperature will rise to highest over the past 2 million years. There are heap of reason to cause global warming and one of it is carbon dioxide void by car. So the environment-friendly petrol private car will be the main trend of the society.

For environment, electric car could reduce and void carbon dioxide emission. The electric vehicle does not pollute the atmosphere and produce zero pollution in the environment compared with conventional vehicles. Electric vehicle is also environmentally friendly as it only uses a battery to generate power instead of petrol. It could embellish the environment when the quantities of use electric car increased. In addition, electric vehicle also green technology that suitable for world today whereas nowadays world have many pollution from many sources.

For many people, the prices of petrol are very expensive. Due to high price of fuels, daily usage of passenger car needs to be control. Instead, most of people believe that electricity car won't decreases people's drive passion because people believe that electricity car isn't that interesting as petrol car during driving such as speed and control.

Most electric vehicle design is small in size and contains only one people. From this situation, we can discuss and explain that this car is more comfortable and easy to be driven everywhere because of its small size. Due to the need for green technologies, Universiti Teknikal Malaysia Melaka (UTeM) requires an electric vehicle that is not dependent on the fossil fuel sources and at the same time can reduce the impact of the environmental pollution. In addition, a wide area university requires students and staffs move from one place to another with aid of the motoring vehicle. This will require more

time and energy to those who had walked. In the case, eco-design mobility that can help the movement from one place to another place in faster and save energy should be created.

The best solution for these problems is to design and fabricate the first personal electric vehicle (PEV) for UTeM. As a summary, the problem statements for this project are:

i. The need of green technologies
ii. Efficiency
iii. Eco-design
iv. Mobility device

1.3 Objective

The objective of this study can be described as the following:

1) To conduct a feasibility study of PEV design
2) To perform dynamic analysis of PEV
3) To study the behavior and performance of the PEV

1.4 Scope And Limitation Of Project

The scopes of work of the study are as follows:

1) To conduct analysis using ADAMs software in order to determine the behavior of electric vehicle.
2) To perform full vehicle dynamic analysis.

1.5 Organization Of Final Project

The remainder of this thesis is compromised of five further chapters as summarized below.

Chapter 2: A review of literature relevant to the present study designing component of electric vehicle and analysis of electric vehicle.

Chapter 3: This chapter explains the working procedures to execute the whole project. The new methodology, proposed through the designing part of electric vehicle approach is described. This uses a CATIA software to drawing and ADAMS software to study the dynamic behavior of an electric vehicle.

Chapter 4: This section analysis and result discusses the results that have been complete.

Chapter 5: Conclusions are drawn from the overall findings of the research along with recommendations for future work.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The subject of electric vehicle simulation has generated a considerable volume of literature which includes a number of theories that have been formulated. Studies on electric vehicle simulation involve two major areas of study; which are create model in ADAMs/view and conduct dynamic analysis. The chapter begins with the introduction of electric vehicle, to give overview about the electric vehicle before go further to the vehicle simulation studies which has more explanation of information and theories. This chapter also including the literature of the simulations and finally and a summary of the existing approaches is provided together as the guideline in vehicle simulation process of the personal electric vehicle.

2.2 Historical Background of Electric Vehicle

2.2.1 The Early Years (1890-1930)

The electric vehicle is not a recent development. In fact, the electric vehicle has been around for over 100 years, and it has an interesting history of development that continues to the present. Electricity is one of the oldest automobile propulsion methods

still in use today. The history of electric vehicle is interesting. The first demonstration electric vehicles were made in the 1890s, and commercial electric vehicles were available by the end of the 19th century. The electric vehicle has now entered its third century as a commercially available product and as such it has been successful, outlasting many other technical ideas that have come and gone (Larminie and Lowny, 2003).

By the turn of the century, America was prosperous and the motor vehicle, now available in steam, electric, or gasoline versions, was becoming more popular. The years 1899 and 1900 were the high point of electric vehicles in America, as they outsold all other types of cars. Electric vehicles had many advantages over their competitors in the early 1900s. They did not have the vibration, smell, and noise associated with gasoline cars. Changing gears on gasoline cars was the most difficult part of driving, while electric vehicles did not require gear changes. While steam-powered cars also had no gear shifting, they suffered from long start-up times of up to 45 minutes on cold mornings. The steam cars had less range before needing water than an electric's range on a single charge. The only good roads of the period were in town, causing most travel to be local commuting, a perfect situation for electric vehicles, since their range was limited. The electric vehicle was the preferred choice of many because it did not require the manual effort to start, as with the hand crank on gasoline vehicles, and there was no wrestling with a gear shifter (Mike Chancey, 2009).

Figure 2.1: 1918 Detroit Model 74

(Source: Mike Chancey, (2009))

2.2.2 The Middle Years (1930-1990)

Electric vehicles had all but disappeared by 1935. The years following until the 1960s were dead years for electric vehicle development and for use as personal transportation. The 1960s and 1970s saw a need for alternative fueled vehicles to reduce the problems of exhaust emissions from internal combustion engines and to reduce the dependency on imported foreign crude oil. Many attempts to produce practical electric vehicles occurred during the years from 1960 to the present (Mike Chancey, 2009).

At the start of the 20th century electric vehicle must have locked a strong contender for future road transport. The electric vehicle was relatively reliable and started instantly, whereas internal combustion engines were at the time unreliable, smelly and needed lighting and the thermal efficiency of the engines was relatively low (Larminie and Lowry, 2003). With oil and gasoline prices again approaching their 1970s levels, everyone lost interest in electric vehicles, and the capital coffers of the smaller electric vehicle manufactures were simply not large enough to weather the storm. Even research programs were affected. From mid-1983 until the early 1990s, it was if everything having to do with electric vehicles suddenly fell into a black hole; there were no manufacturers, no books, not even many magazine articles (Leitman and Brant, 2009).

Despite the above problems there have always been for electric vehicles since the early part of the 20th century. They have certain advantages over combustion engines, mainly that they produce no exhaust emissions in their immediate environment, and secondly that they are inherently quiet. This make electric vehicle ideal for environment such as warehouses, inside buildings and on golf courses, where pollution and noise will not be tolerated (Laeminie and Lowry, 2003).