DEVELOPMENT OF BATTERY POWERED TRICYCLE

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ABSTRACT

Electrical energy is one of alternative energy used in automotive industry now days. A battery is a device consisting of one or more electrochemical cells, which store chemical energy and make it available in an electrical form and used to move loads. Usage of electrical energy in automotive field has many advantages; it can reduce pollution, more quite and cheaper. The objective of this project is to design and develop a battery powered tricycle. The common problems faced by current tricycles have been identified. Methods of Finite Element Analysis (F.E.A) have been carried out to identify the strength of material .A prototype of Battery powered tricycle is fabricated at end of the period as a fulfilment of the project. Among the fabrication processes which are involve in this project are drilling, turning, bending and welding. The design and prototype of this project will be used to commercialize soon.

ABSRAK

Pengunaan tenaga eletrik merupakan salah satu alternatif baru dalam industri automotif sekarang.Tenaga elektrik yang disimpan dalam bateri mempunyai keupayaan untuk mengerakkan beban.Pengunaan tenaga elektrik mempunyai beberapa kelebihan seperti tidak mencemarkan alam sekitar, lebih senyap dan ianya adalah percuma. Objektif projek ini adalah untuk menghasilkan sebuah trisikal yang menggunakan tenaga elektrik sepenuhnya. Projek ini cuba mengkaji masalah-masalah yang dihadapai oleh trisikal sedia ada yang mengunakan kuasa bateri. Kaedah 'Finite Analysis (F.E.A)' digunakan ke atas rekabentuk dan pengiraan dilakukan untuk membuktikan kekuatan bahan yang digunakan. Satu prototaip trisikal dihasilkan di akhir tempoh sebagai memenuhi syarat projek. Antara proses pembuatan yang terlibat di dalam melaksanakan projek ini adalah proses menebuk lubang, pembengkokan, dan kimpalan.Rekabentuk dan produk akhir daripada projek ini akan dikomersialkan kelak.

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LIST OF SYMBOLS

A	Frontal area
a	Acceleration
C	Amphour capacity
Cd	Coefficient of drag
Cr	Rolling resistance
e	2.7138
E	Fixed voltage
E	Young's Modulus
F_{ad}	Force to Overcome Wind Resistance
F_{hc}	Hill climbing force
Fla	Acceleration force
F_{te}	Tractive effort
G	Elevation change over distance traveled
G	Rigidity modulus
h	Elevation above sea level, km
I	Second moment of the area
J	Polar moment of area
L	Length
m	Total mass of the tricycle
P	Power
Pr	Power consumed in overcoming bearing and friction
Pu	Hill climbing power

R	Internal resistance
r	Wheel radius
$R\omega$	Force of the wind drag
S	Distance
T	Applied torque
Urr	Coefficient of rolling resistance
V	Different voltage
W	Work
δ	Maximum deflection
θ	Angle of twist
ρ	Density of air
v_0	The initial velocity
v_g	Ground speed in meters per second
v_r	Relative speed in air
ω	Uniform weight/length

CHAPTER 1

INTRODUCTION

1.1 Project Background

At present many exciting development in electric vehicle technology are taking place. Some of these have advanced sufficiently to be commercially available, whilst others remain for the future. The first demonstration electric vehicles were made in 1830s and commercial vehicles were available by the end of the 19th century. Today's concerns about the environment , particularly noise and exhaust emissions, coupled to new developments in batteries, fuel cells, motors and controllers may swing the balance of electric vehicles.

There are many types of electric vehicles such as railway trains, ships, aircrafts, cars, bikes, bicycles, wheel chair and many more. But in this project is focused on electrical powered tricycle which is categorized under Low Speed Vehicles (LVSs) are an environmentally friendly mode of transport for short trips. This vehicle is particularly targeted at fairly active retired people, who still want to get about to see their friends, but who do not travel so hurry and can be used inside a institution like large factories.

The objective of the project is to design and develop a concept battery powered tricycle for multipurpose use and to choose the best concept to reduce the mass expensive batteries required. Besides that, to design a tricycle with high efficiency and greater flexibility to place components in tricycle to optimize weight positioning and minimize aerodynamic drag.

1.2 Problem Statement

i. Battery powered tricycle normally expensive and required a lot of money.

ii. The mass of an electrical vehicle has critical effects on the performance, range, and cost of an electrical vehicle.

iii. Most tricycles have vibration problem due to inherent unbalance design.

1.3 Objective of the Project

The main purpose of this project is to develop a battery powered electric motor tricycle which can be used as a simple transportation and for economy reasons.

The objectives are:

i. To design and develop a battery powered electric motor tricycle speed of 20km/h.

ii. To design a tricycle which is far more stable in braking turns by reducing the centre of the gravity.

iii. To design a battery powered tricycle particularly suitable for short-distance use (1-3km).

1.4 Scope of the Project

The scope of the project:

i. Review various literatures about the tricycle designs, function and its components.

ii. Learn to use various kind of software like Solidwork, and Algor.

iii. Model building using Solid work.

iv. Mathematical simulation using Matlab program.

v. Failure analysis on body structure to identify the maximum loading capability (50-70 kg) using Algor program.

vi. Analysis on motor and battery performance to choose proper motor and battery.

vii. Develop, fabricate and assemble all parts of the tricycle.

viii. Testing the final product

1.5 Example of Tricycles

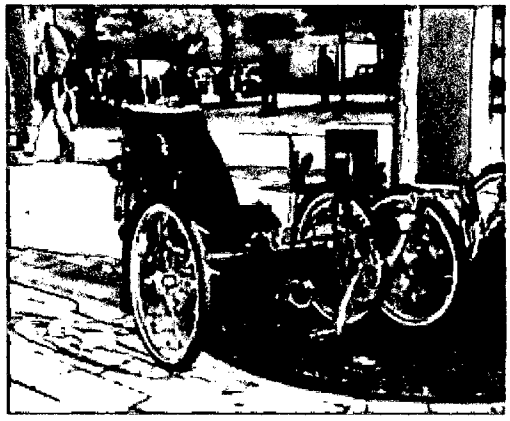

Figure 1.1: Recent recumbent trike

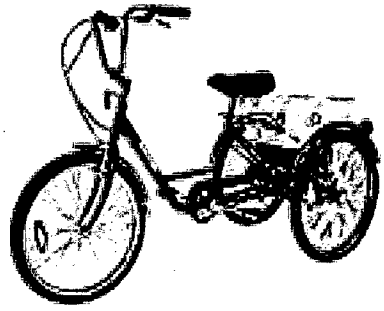

Figure 1.2: Tri-1 Tricycle

1.6 Summary

This chapter is generally about project background, problem statement, objectives of the project and scope of the project in order to achieve the objectives as mentioned.

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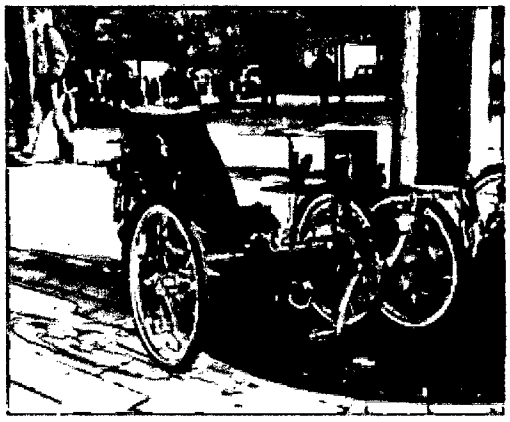

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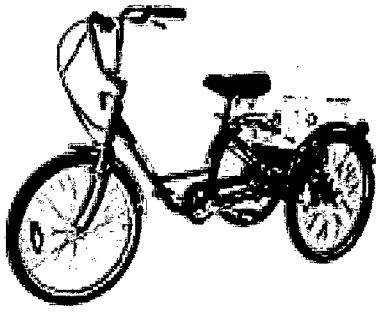

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The main purpose of this literature review is to get information about the project from the reference books, magazines, journals, technical papers and web sites. One of that was from (www.pashley.co.uk/gallery/tricycle.html), where it helps me to generate ideas on new design. In this chapter, I want to discuss all the in formations that I found from many sources.

2.2 Common Problems Faced In Current Motorized Tricycle

The common problems faced by consumers by using current motorized or battery powered tricycles can be divided into:

2.2.1 Cost

Manufacturing of battery powered tricycle normally expensive and required lot of money. This is because the components that used for produce a tricycle normally are very expensive. The components consist of electric cells, battery charger, electric motor (DC or AC), motor controller and power transmission system. If the performance is high, of course the cost will double up.

2.2.2 Weight

The mass of an electrical vehicle has critical effects on the performance, range, and cost of an electrical vehicle. If the tricycle is too heavy, the electric motor will require more power to move. So it is important to design a light, strong and rigid tricycle framework which can reduce the total weight of the tricycle. Besides that it is also important to choose a better electric motor mass and proper battery mass that can reduce the weight of tricycle, increase transmission efficiency and double the vehicle range.

2.2.3 Vibration

Most tricycles have vibration problem due to inherent unbalance design. The unbalance may be due to faulty design or poor manufacture. Naturally, a frame of tricycle designed to support heavy load like motor and battery, are also subjected to vibration. In this entire situation, the structure or components subjected to vibration can fail because of material fatigue resulting from the cyclic variation of the induced stress. Furthermore, the vibration causes more rapid wear of tricycle parts such as bearings and gears also creates excessive noise. It also causes fasteners such as nuts

and bolts to become loose. Due to vibration, its also causes some electrical parts fail to work.

2.2.4 Stability

As well as being rigid and crash-resistant, it is clearly important that a tricycle design should also be stable. For maximum stability, wheels should be located at the vehicle extremities and the centre of gravity should be kept as low as possible. This is one area where the weight of the batteries can be beneficial, as they can be laid along the bottom of the vehicle, making it extremely stable.

2.3 How Does A Battery Powered Tricycle Works?

A motorized tricycle is a three wheeled bicycle with an attached motor used to assist with pedaling. Generally considered as a vehicle, tricycles are usually powered by electric motors or small internal combustion engines and have function as electric bicycles. Some can be propelled by the motor alone if the rider chooses not to pedal; while in others the motor will only run if the rider pedals. Electric bicycles are generally powered by rechargeable batteries. These are normally charged from the utility supply (mains), with perhaps the option of using the motor to effect regenerative braking or charging while being pedaled or rolling downhill. Electric motorized bicycles are either *power-on-demand*, where the motor is activated by a handlebar mounted throttle, or *pedelec* (from pedal electric), where the electric motor is regulated by pedaling. These may have a mechanism such as a crank sensor to detect when the user is pedaling, or a more sophisticated torque sensor. But, for this project, no pedal is used to run the tricycle and fully powered by battery and electric.

2.3.1 Important in Design Considerations

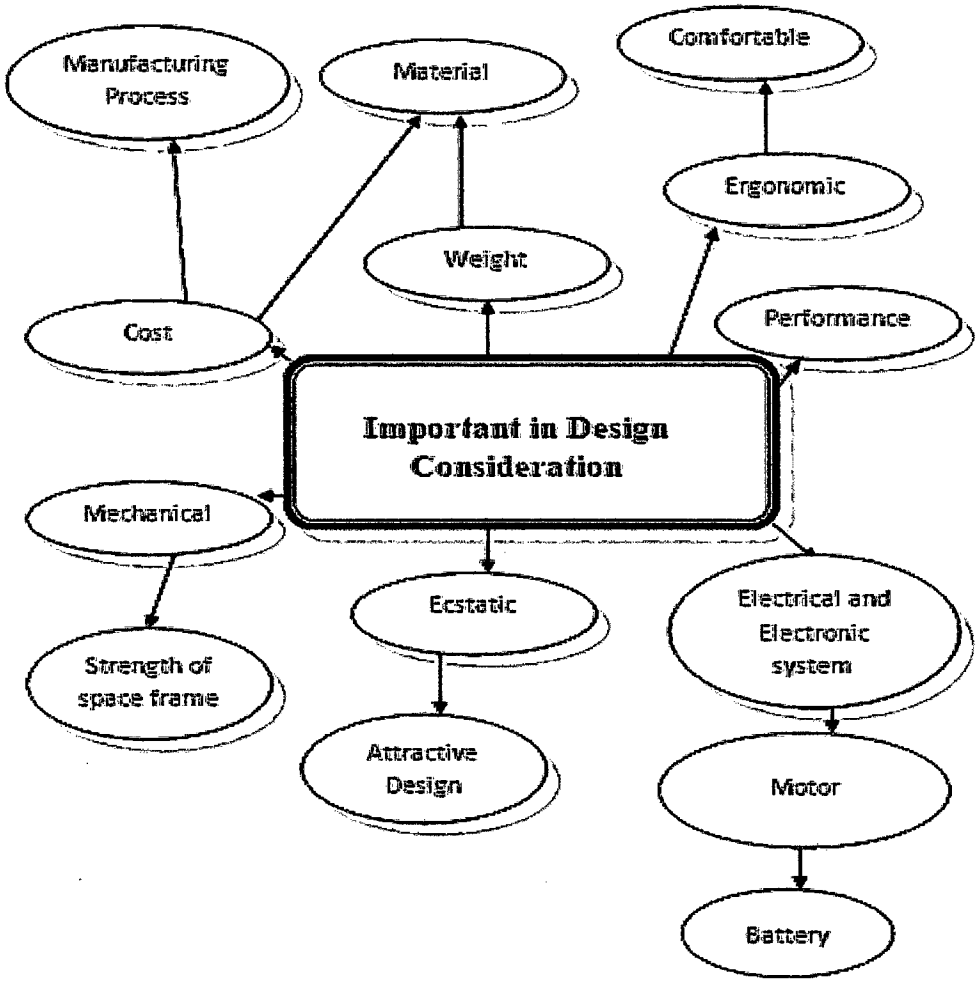

Figure 2.1: Important in designing consideration