UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND ANALYSIS OF ELECTRIC BICYCLE FOR DISABLE PERSON

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Mechanical Engineering Technology (Automotive Technology) (Hons.)

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirements for the degree of Bachelor Degree of Mechanical Engineering Technology (Automotive Technology) with Honours. The member of the supervisory is as follow:

…….

(Mr Muhammad Nor Bin Othman)

ABSTRAK

Basikal lebih dikenali sebagai kenderaan yang mempunyi dua roda dan penunggangnya mesti mengekalkan kestabilan pada pusat gravity supaya basikal tersebut sentiasa bergerak. Basikal digerakkan oleh kuasa otot yang mengayuh dan mengerakan salah satu roda untuk menghasilkan perggerakkan untuk membuat maju ke hadapan. Untuk basikal elektrik ia digerakkan oleh motor elektrik yang mengerakkan roda basikal. Basikal yang mempunyai dua roda adalah satu kelemahan bagi seorang yang telah kehilang kaki kerana ia adalah mustahil bagi mereka untuk mengekalkan seimbangkan basikal dan ketiadaan kaki menyukarkan keadaan mereka untuk menggerakkan basikal. Rekaan basikal yang akan di hasilkan adalah dari evolusi basikal sejak ia diperkenalkan. Keunikan basikal ini akan dilihat dari penglibatan mekanikal dan elektrik, terutama dari sudut reka bentuk. Untuk mengatasi masalah kestabilan, satu roda tambahan akan ditambah dan basikal pula akan digerakkan oleh motor elektrik. Di samping itu, basikal yang direka adalah untuk orang yang tanpa kaki dan reka bentuk basikal ini akan menekan pada keselesa untuk orang yang hilang keupaya untuk menunggang basikal seperti seorang yang normal dan perisian CATIA digunakan untuk membuat analisis kepada rekaan badan basikal. Oleh itu, dari segi ketinggian, kestabilan, keselesaan, akan dianalisis, semasa mereka bentuk ia adalah untuk memastikan bahawa, orang tiada kaki akan berasa bebas untuk menunggang dan pergi ke mana-mana sahaja yang mereka mahu. Tujuan kajian ini adalah untuk mereka bentuk dan analisis basikal elektrik untuk orang cacat yang tidak mampu untuk menaiki basikal dua roda.

ABSTRACT

Bicycle commonly known as two-wheel vehicle, the rider must maintain the vehicle centre of the gravity to keeping the bicycle upright. The bicycle is propelled by the muscle power that pedals to rotate one of the two wheels to produce power to move ahead. For the electric bicycle it propelled by the electric motor that is coupled to the wheel. Two-wheel bicycle give the disadvantage to the disable person with no leg because it is impossible for them to keep the bicycle upright and do not have leg to propel the bicycle. During the designing, the bicycle design will be created from the evolution of the bicycle since it's been introduced year by year. The uniqueness of this bicycle will be introduced from the mechanical and electrical involvement, especially from the design point of view. To overcome the stability problem one additional wheel will be added and the bicycle will be propelled by the electric motor. In addition, the bicycle is designed for the disable person without legs and the design of this bicycle will base on the comfortable for the disable person to ride this bicycle like a normal person and using CATIA software to run the analysis of the frame design. Thus, in term of height, stability, comfort, will be analyzed during the designing to make sure that, disable person will feel free to ride and go anywhere they want. The aims of this study are to design and analysis the electric bicycle base on the inability for the disable to ride on two wheel bicycles.

DEDICATIONS

Thank you for myself because never give up and always find the right path in life.
To my beloved family especially to my father
Abdul Khalid bin Bujang and to my beautiful mother Halimah binti Razali
That always support me and always be my back bone.
They always inspired me from the day I was born until what I have become today.
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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

3D	-	Three Dimension
CAD	-	Computer Aided Design
CAE	-	Computer Aided Engineering
CATIA	-	Computer Aided Three-Dimensional Interactive Application
UTeM	-	Universiti Teknikal Malaysia Melaka
MSD	-	Musculoskeletal Disorders
MS	-	Microsoft software

CHAPTER 1
INTRODUCTION

1.0 Introduction

Chapter 1 is the framework of this project includes brief introduction about the problem statement, objective and scope of this project.

1.1 Background of the Study

Bicycle is a machine that helps people moving while sitting on the seat. Amazing thing, that people can think and able to build machine that can help people reduce the usage of energy moving from one place to another place. The question is, who build the first bicycle and how do people in the past without any proper technology can make wheel and design a bicycle. There were too many stories about the inventor of the bicycle and from the story just one thing is confirm that a bicycle firstly made from wood.

The existence of the first bicycle is difficult to pinpoint. There was a story that in the tombs of Egypt and among the frescoes of Pompeii can been seen the bicycle-like forms. In history of bicycle at France, bicycle was creating from wood. Two wheels were combining with long frame that reassemble the horse (Richling, 2006).

From the other story, they were claims that in 1493, Gian Giacomo Caprotti was the earliest to sketch. In addition, Learnado da Vinci in 1493 version of a bicycle sketch was surface (Malppan & Sunny, 2015). In 1830 bicycle was first introduce but not popularized until the 1890, during industrialization, urbanization, segregation, temperance, mass consumption, and suburbanization the bicycle continued to evolve.

The symbolic nature of the bicycle developments left marks that contributed to alternation and the ways in which Americans consumed it (Turpin, 2013).

Now day, bicycle was introduced by parent since the early age as a child's toy. Regardless of when it all begin, has made huge impact of the bicycle on daily life has been phenomenal and outstanding because of the evolution and development of technology of the bicycle now day.

1.2 Bicycle Timeline

Figure 1.1 : The Celerifere

In 1791, Comte de Sicrac builds the celerifere. Purportedly was a hobby horse with two wheels instead of a rocker was call as the celerifere. A rider would straddle or power forward by running and pushing off the ground or walking with their feet and then glide on the celerifere (Turpin, 2013).

Figure 1.2 : Laufmaschine by karl Drais Von Sauerbronn

In 1817, German Baron, Karl Drais Von Sauerbronn invented a laufmaschine, means a running machine, an improved version of the celerifere with two-wheel. It had had a steer-able front wheel directing the front wheel a bit and has been name as running machine, velocipede, Draisienne and Dandy horse (Malppan & Sunny, 2015). Over the next few years, there was improvement to the cycle, however cycle was still propelled by running, an armrest and an adjustable saddle to make the rider more comfortable was made (Richling, 2006).

Figure 1.3 : The Pedal Cycle

In 1839, Kirkpatrick MacMillan invented the first 2-wheel mechanical propelled vehicle. It calls Velocipedes, with the pedals that allows rider to propel the machine and the system of driving levers with feet off the ground. The bike literally a bone shaker, which made of steel wheel, manufactured with straight angles and stiff materials. In 1863, Ernest Michaux French blacksmith designed commercial version with rotary cranks and pedals and the front wheel hub was mounted (Malppan & Sunny, 2015).

Figure 1.4 : The High-Wheeler

In 1870, James Starley British engineer come out with the idea to invented the high-wheeler or penney farthing also known as the ordinary bicycle (Richling, 2006). Penney farting is two wheel machines to be called bicycle. It powered by directly-driven axle and consisting large front wheel pivoting on a simple tubular frame and consisting of a small rear wheel with tires of a rubber and was really efficient bicycle.

It also the first metal machine (Malppan & Sunny, 2015). James Starley come with an idea to overcome the low gear ratio while retaining direct drive of the velocipede (Richling, 2006). There was no free wheel mechanical in the penny farthing because the front wheel pedal was directly attached. The rider sat so high above the centre of gravity so, the chance of falling was higher. In 1879, Henry J.Lawson comes with an idea to overcome the situation with patents a rear wheel, chain-driven safety bicycle, the Bicyclette (Malppan & Sunny, 2015).

Figure 1.5 : The Safety Bicycle

In mid-1880, common model of bicycle seen today known as the safety bicycle that have triangular frame propelled by the rear wheel, which was driven by chain with two wheel of equal circumference (Turpin, 2013). In 1885, John Kemp Staley British inventor design safer bike than the ordinary one. It consists of sprocket system and the chain by adjusting the gear ratio the speed of huge high wheeler can be attained. The drive is transferred to the non-steering rear wheel and give advantages to the driver that is provides improving speed as well as comfort. Therefore, free pedalling allows drive to safety drive the bicycle without any injury. In 1890, bicycle became very

popular among the Europe and North American because of the improvement in the safety, steering, comfort and speed (Malppan & Sunny, 2015).

In 1903, Sturmey Archer invented the internal hub gear and used it on the bicycle in the year 1930. For women there was a suitable bicycle for them know as the freedom machine and was popular among women in large number. In 1930, Tullio Campagnolo patents the quick release hub. The flat tire, spring fork, streamline excelsior was made by Schwinn and early mountain bikes frame were the Schwinn Excelsior for almost fifty year(Malppan & Sunny, 2015).

In 1934, recumbent bicycle were banned by the Union Cycliste International from all form of officially sanctioned racing. It is because of the speed of recumbent bicycle is too dangerous and in 2009, Sam Whittingham set a human powered speed record on level ground at speed of 132km0h at Battle Mountain (Malppan & Sunny, 2015).

In 1950, Tullio Campagno introduces the parallelogram derailleur which is being operated through cables and for two decades, it stands as true racing bikes. In 1990, Shimano introduced the integrated brake and gear level. The speed derailleur system were produce by Rohloff in 2000 and the 10 Co-gear cluster that allow 30 speed bicycles were introduced by Campagnolo in 2002 (Malppan & Sunny, 2015). This could lead to great efficiency and ultimately, faster speed because of the capability to allow for various gear ratios to use in different type off road condition (Turpin, 2013).

1.3 Problem Statement

Movement is natural habit for essence of life. All living thing move for it on interest for animal they move to attack prey, snake slide, caterpillars crawl, kangaroo hop and men walk. Of all that moving, human move the most. Human travel kilometre went to workplace and back every day (Gupta, 2015). But for the disable person moving will be a problem because with inability to walk, moving from one place to another place is quite a troublesome.

A normal person walks efficiently without taking help from other person. However, on the other hand due to some misshaped in person life at some stage of life or physically handicapped person is depend on other to perform any kind of work especially moving from one place to the other place (Iqbal Ahmed Khan Galgotias University 12, 2015). To help the disable person to move freely, electric bicycle are design so they can move without help of other person. Ability to move freely is important, for the disable person so they can interact with community and have a healthy life style.

Bicycle usually has two wheels but because of the inability to walk, additional wheel will be added so stability problem will be overcome so the bicycle will always stand still. Frame is the heart of the modern bicycle and efficiency, safety and comfort must be design to meet specific need especially for the disable (Balasubramanian, Jagannath, & Adalarasu, 2014). The normal bicycle demand one to bend forward while pedalling, this posture may increase the risk of chronic injuries such as musculoskeletal disorders (MSD) and compression neuropathies (Balasubramanian et al., 2014). To overcome these injuries, seat for disable person will be a proper seat same as the design of the chair to make sure that they can feel comfortable while seating on the bicycle.

Safety is the first priory in every machine that been build. It is to make sure that injury is prevent from the user while using the machine, especially for the disability person. The inability to walking and who cannot use the lower limbs, the seat height of the bicycle should be based on the ability of the user that using arm muscle to support at the time of sitting/standing from the bicycle (Iqbal Ahmed Khan Galgotias University 12, 2015).

Using environmentally friendly vehicle is always a solution to reduce pollution. However, the large battery pack increases the cost and at the same time decreases the attractiveness of these solutions for the user. The highly cost of the machine always bring problem to the user. To solve these cost electric bicycle and congestion problem off the 21st century mobility, a more all-around and more integrated solution has to be adopted (Corno et al., 2015). Therefore, the electric bicycle will use parts recycled from scrapped metal, steel and bicycle.

Disable person is among the special person that living in the community, every day they sleep and wakeup like normal person. However, ever thing that they do will be a limitation due to the disable. Like a normal person it is important for them to growing in a social community hanging around with friend. Not everyone can accept the disable community and not everyone care about them. It is very emotional when; everyday they work hard to continue daily life. Hard work and the spirit to continue live for the disable person is the motivation to design bicycle for community like them. It is important and responsible for a normal person to create, imagine and design the machine to help them with their life.

1.4 Project Objective

For centuries bicycles have been man's leading means of transportation. With automobile traffic congestion a world-wide problem, bicycles will be in increasing demand. This project will design the proprietary technologies makes electric bicycle an attractive commuting and recreational alternative. Thus, this project controller brings to the electric bicycle industry a higher level of performance than currently exists. Now with the introduction of the new and rare design and its proprietary of the ability to be portable machine will bring more benefit to the disability. The main objective of this project is to:

i. To design the frame of the electric bicycle for the disable person with no leg.

ii. To design the friendly user electric bicycle.

iii. To design the comfortable electric bicycle.

1.5 Scope of Project

The projects subjected to the following scope:

i. Designing the frame body by using CAD software (CATIA).

ii. Electric bicycle only for disable that do not have leg.

iii. The electric bicycle with three-wheel.

iv. Use only for weight about 70kg below.

v. Do not ride in rain condition and off road.

vi. One passenger ride only.

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

This chapter will discuss literature of the design and analysis of electric bicycle for disable person. The development of technology now day influence the development of the industry and creative design for the disable person bicycle and able to understand and know every part of the dimensions of the normal bicycle and its operation characteristic is important to ensure that the bicycle will be perfectly in good and fine condition and can be smoothly transform to disable bicycle. These will be the critical design factor while planning the bicycle (Malppan & Sunny, 2015).

2.1 Design

The single word "design" incorporates a terrible part, and that is the reason the justifiable scan for a solitary definition prompts to long verbal confrontation most definitely. There are wide definitions and particular ones both have disadvantages. It is possible that they're too broad to be in any way significant or they avoid excessively.

One definition, publicized by architect Richard Seymour amid the Design Council's Design in Business Week 2002, is 'improving things for individuals'. It underscores that plan movement is centred around and premier on human conduct and personal satisfaction, not elements like merchant inclinations.

In any case, medical attendants or street sweepers could verbalize they, moreover, 'improve things for individuals'. In the meantime, a definition focused on items or 3D acknowledge of originations excludes the work of visual architects, settlement originators and numerous different controls. There might be no outright meanings of plan that will satisfy everybody, except trying to discover one can in any