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DESIGN AND DEVELOPMENT OF AN AUTOMATIC BICYCLE

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This report is submitted in partial fulfilment of requirement for

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Faculty of Mechanical Engineering
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“I hereby declared that this report is a result of my own except for the excerpts that been cited clearly in the reference”

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For my beloved father Mat Sari bin Hashim, my beloved mother
Maimunah binti Denak and my family.

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ABSTRACT

Bicycle is the most used transportation that became most preferred transportation in the world. The bicycles are used for many things such as recreational activities, adult fitness and many more. The purpose of the PSM project is to design and develop an automatic gear transmission for the future bicycle. In this project, the new design will be generated by using CAD software and several experiments about the gear ratio and torque will be conducted. Several literature studies about the bicycle will help on during the design development phase. In design development phase, three conceptual designs were generated and concept II is selected as the best concept by using concept scoring method. Two experiments have been conducted during this project. First experiment is to find gear ratio and gear shift sequence. In experiment 1, F1R5 gear combination is the lowest speeds gear and F2R1 is the highest speed gear. Second experiment was conducted to find the torque and pedal force require for the bicycle based on the speed. The result show the F1R5 gear combination require the lowest torque and pedal force based on speed and F2R1 gear combination require the higher torque and pedal force based on speed. For the conclusion, a new shifter for automatic gear transmission has been design and all project objectives have been achieved successfully.

ABSTRAK

Basikal adalah kenderaan yang paling banyak digunakan dan paling disukai di dunia sekarang. Basikal digunakan untuk pelbagai perkara seperti aktiviti rekreasi, kecergasaan orang dewasa dan banyak lagi. Tujuan projek PSM ini adalah untuk merekabentuk dan membangunkan transmisi gear automatik untuk basikal masa hadapan. Dalam projek ini, rekebentuk baru akan dihasilkan menggunakan perisian CAD dan beberapa eksperimen berkenaan gear ratio dan tork akan dijalankan. Beberapa kajian ilmiah tentang basikal akan membantu semasa fasa pembangunan rekabentuk. Dalam fasa pembangunan rekabentuk, tiga konsep rekebentuk telah dihasilkan dan konsep II telah dipilih sebagai konsep terbaik melalui kaedah pemarkahan konsep. Dua eksperimen telah dijalankan semasa projek ini. Eksperimen pertama berkenaan dengan gear ratio dan turutan tukaran gear. Dalam eksperimen 1, kombinasi gear F1R5 adalah gear kelajuan rendah dan kombinasi gear F2R1 adalah gear kelajuan tinggi. Eksperimen kedua pula berkenaan dengan tork dan daya pedal yang diperlukan berdasarkan kelajuan. Keputusan menunjukkan kombinasi gear F1R5 memerlukan tork dan daya pedal terendah berdasarkan kelajuan dan kombinasi gear F2R1 memerlukan tork dan daya pedal tertinggi berdasarkan kelajuan. Sebagai kesimpulan, satu penukar gear untuk transmisi gear automatik telah direkabentuk dan semua objektif projek ini telah berjaya dicapai dengan jayanya.

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LIST OF SYMBOL

μ	=	Coefficient Of Friction
f	=	Force
F	=	Force Applied On the Lever
F_f	=	Frictional Force (μf) Braking Torque
F_R	=	Radial Force Applied On the Drum
R	=	Normal Reaction on the Block
r	=	Radius of the Drum
T_B	=	Braking Torque
V	=	Instantaneous Velocity
T	=	Torque
ω	=	Angular Velocity

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CHAPTER 1

INTRODUCTION

1.1 Background

Nowadays, bicycles become the most used transportation in the world; there are about one billion bicycles in the world that is twice as many as the car, the most preferred transportation in the world. The bicycles become the means of transportation for many regions such as the capital city of Japan, Tokyo. They prefer to use the bicycle than using the car to avoid the heavy traffic on the road and the busy public transportations. A bicycle can be ridden by one or two persons at the same time according to the type of the bicycle.

The bicycle was invented more than 200 years ago by a Frenchman Baron von Drais in Mannheim, France. He actually created a walking machine that has two in-line wheels that makes it easy to get around faster than walking; propelled by his feet against the ground to move the Draisienne also known as bicycle. The Draisienne is made from wood that has two in-line wheels and steering on the front wheel.

After more than 200 years, the bicycles have been change a lot. Today, there were many type of the bicycles that are used for many purposes. The bicycles are used for recreational, children's toys, adult fitness, military and police applications, courier services and bicycles racing. The bicycles also have been used for the transportation for the students to get to school and the workers to go to workplace.

The first bicycle made is propelled by the feet. After that, in the early 1860s, the bicycles design took the new direction by adding a mechanical crank drive with pedal on the front wheel by the Frenchmen. However, the front wheel pedals design has a major problem on the control mechanism of the bicycle. Next, Englishman came out with the new design to move the bicycle that is the chain drive that propels the rear wheel. This chain drive design makes the new history of the modern bicycle because it is use in almost bicycles in the world right now.

Today, every bicycle in the world uses the gear transmissions in order to propel the bicycles. There are many type of the gear transmissions have been invented such as single-speed gear, derailleur gear, internal hub gear and many more that were used on the bicycles nowadays. These gear transmissions are the important part on the bicycle because it is used to move the bicycle. Without these gear transmissions created, the bicycles history become less interesting and the bicycle will not become the most uses transportation in the world.

1.2 Objectives of the Project

The main objectives this project are to design and develop an automatic bicycle which does not need to change the gear. The gear would change automatically based on the amount of torque required.

1.3 Scopes of the Project

The scopes of this project in order to make this project successful and fulfill the objective are:

- a. Literature review on the bicycle.
- b. Analysis on the torque required based on the bicycle speed.
- c. Design using CAD software of the system.

1.4 Problems Statement

Cycling is one of the popular recreational activities for urban populations. They are always cycling in the public park using utility bicycles that have multi-speed gear transmission. However, they are always difficulty during changing the gear during cycling that will make their ride on the park become uncomfortable. To improve comfort during cycling, the automatic bicycle with automatic gear transmission will be designed.

Bicycle with multi-speed gear transmission were the most popular bicycles among the cyclers around the world. These multi-speed bicycles use the derailleur gearing because it is convenient and easy to maintain. This factor make derailleur gear is the most use gear system among the cyclist including the professional road cyclist. However, most of the amateur cyclist do not know how and when to change the gear properly. The automatic transmission will be design based on the derailleur gear by adding the automatic gear changer.

The general objective of the bicycle project is to design a new automatic gear transmission system that would accommodate various types of cyclers. This automatic gear transmission must have durability and repetitiveness because all the cyclers have different ways or styles during cycling that could give extreme torque or pressure on the transmissions. The automatic transmission also can be use on the extreme conditions.

CHAPTER 2

LITERATURE STUDY

2.1 Introduction

This chapter describe about the general introduction of the bicycles and specifically on the type of bicycles and bicycles gear transmissions commonly used by the cyclers around the world. This chapter also includes the history of the bicycles and its bicycle evolution until now on. Explanations on the type of bicycles and the gear transmissions also have been included in this chapter. Many things need to be considered in designing some product or part before it is use by human. This chapter also used some previous researches that have been done as guidance and reference according to make and improve the new design of an automatic gear transmission for the bicycles.

Nowadays, gear transmission for bicycle generally means derailleur, although hub gear still exists. (Plas, 1995) This derailleur gear system is commonly used in much type of the bicycles such as utility bicycles, racing bicycles, mountain bicycles and also in kid bicycles. Normal derailleur gears are using manual switch on the handle of the bicycles and the cyclist must change the gear normally by hand