INFLUENCE OF GEAR SHIFTING PATTERN ON VEHICLE PERFORMANCE

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DECLARATION

"I hereby declare that this report is the result of my own work except for quotes as cited in the references."

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APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in terms of scope and quality for the award of the degree Bachelor of Mechanical Engineering (Automotive) with Honors.

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ABSTRACT

Transmission is a crucial component to deliver power and torque from engine to wheel. For this study about shifting pattern to determine proper gear ratio depending on vehicle speed and driven power demand. It is carried out totally using mathematical model without any experimental work. New shift pattern are introduced and test it using the simulation. The study on the effect on vehicle performance is focused on the top speed of vehicle. The simulation gives result that need to be analyze and comparison are made to know the effect on the vehicle performance. The results show that the transmission shifting pattern greatly affects on vehicle performance. Hopefully this study can be as a reference to automotive research in producing better product for automobile industry.

ABSTRAK

Transmisi adalah komponen yang penting untuk menjana kuasa dan tork daripada enjin ke roda. Untuk kajian ini tentang mengubahkan corak penukaran gear untuk menentukan nisbah gear yang betul, bergantung kepada kelajuan kenderaan dan pemacu yang digerakkan oleh kuasa. Ia dijalankan sepenuhnya menggunakan model matematik tanpa sebarang kerja eksperimen. Corak penukaran gear baru diperkenalkan dan diuji menggunakan simulasi. Kajian kesan ke atas prestasi kenderaan memfokuskan kepada kelajuan kenderaan. Simulasi memberikan hasil yang perlu dianalisis dan perbandingan adalah untuk mengetahui kesan ke atas prestasi kenderaan. Keputusan menunjukkan bahawa corak penukaran sangat memberi kesan kepada prestasi kenderaan. Diharap kajian ini dapat dijadikan petunjuk pengkaji di bidang automotif untuk menghasilkan produk yg terbaik di dalam sektor kenderaan.

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LIST OF SYMBOL

F	$=$	Applied force on body
m	$=$	Mass
a	$=$	Acceleration on bodies
v_f	$=$	Final velocity
v_i	$=$	Initial Velocity
xv	$=$	Change of velocity
t	$=$	Time
C_d	$=$	Drag coefficient
A_f	$=$	Frontal area of object
v	$=$	Relative velocity of object
P_{air}	$=$	Air density
F_{Ro}	$=$	Rolling resistance
F_{Ae}	$=$	Aerodynamic resistance
β	$=$	Gradient of the hill being climbed (degree)

CHAPTER 1

INTRODUCTION

1.1   Background

History of transmission

Transmission is a part in automobile to provide speed and torque conversion that affect by rotating gear. During the normal operation, power is transfer by the engine through the engine clutch direct to the input shaft of the transmission and apply its power to wheels. The gearing parts in transmission helps can increase the torque from lower to higher speed. Without the gears system in transmission, vehicle will having insufficient torque that in lower speed and having difficulties to moving a car in initial start [1].

In transmission history, manual transmissions is the earliest model use in car created by Louis Rene Panhard for first modern manual transmission development. In 1894, development of manual transmission start with three speed transmission with the basic design to test on the road its function and effectives for vehicle part. Then, Louis Rene Panhard works has been improved design by auto maker Louis Renault by keeping transmission basic design by previous work but make some change by adding the differential axle for the rear wheel. Louise Renault also change part a drive shaft with the drive chain that work more efficient in transmission and reduce the loss power in operation. This can cause vehicle increase speed compare to previous transmission [2]
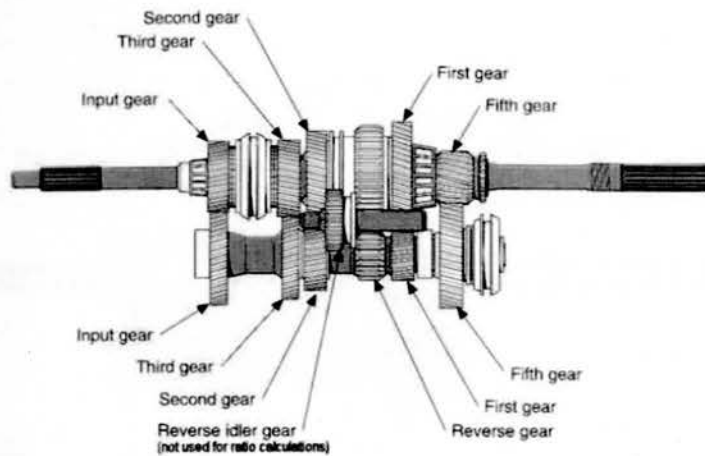
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Figure 1.1.1: Interior view of a five speed overdrive transmission [1]

Nowadays, transmission involved with automatic transmission that shifting gear by itself parallel with every stage of speed. There is some improvement in transmission such as Continuously Variable Transmission, Sequential Manual Transmission and many more. For this report, we will focus on manual transmission. Manual transmission or known as manual gearbox are widely used with automatic transmission. Manual transmission is slightly different with automatic transmission because it has clutch to move its moveable stick to shifting gear. When the clutch is pressed, it's temporarily disengaged between engine and transmission. So, car can move or run even the cars standing still. Pressing clutch is necessary to allow driver to switch between gears neither shifting to next gear or reverse gear. If clutch not press properly when shifting gear, it will produce noisy sound.

There is some problem happen in this gear box that experienced by the manual car's driver. Firstly is clutch pad always stuck or slips. This happen due to worn clutch or clutch pedals needs to adjust and inspection are needed to avoid driver from a breakdown when driving. Moreover, changing fluid in transmission is important to smooth the operation and also to keep the internal components operating correctly. When changing oil fluid, when can see iron precipitate or powder also comes out when flushing oil fluid. This is because meshing or frictions between gears happen and tip of gear will be eroded.
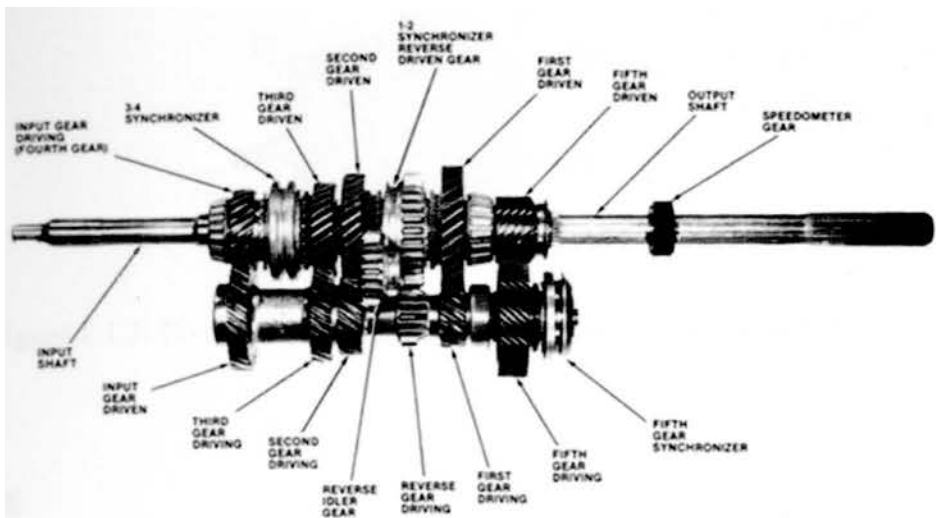
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Figure 1.1.2: Interior view of five speed overdrive transmission with
transmission features [6].

From Figure 1.2 above, its show some example of the interior view for five speed transmission, each system has their own power flow according to their gear selection. Each speed has their speed gear ratio for example 3.5:1 which means three and half full turns of the input shaft to one full turn of the output shaft. Each gear has their own gear speed ratio for selecting gear. The engagement of gears are helps by the synchronizer by locking collar into place. Its function to bring rotary shafts and gears to the same speed before shifting gears occur. [5].

First gear

For the starting gear, moves the gearshift lever into first to moving a standstill vehicle. Its turn the low gear of countershaft in the reverse direction. Then, the first/second synchronizer lock into the output shaft by moving to the rear. A typical first speed gear ratio is 3.5:1 between countershaft gear and first gears.

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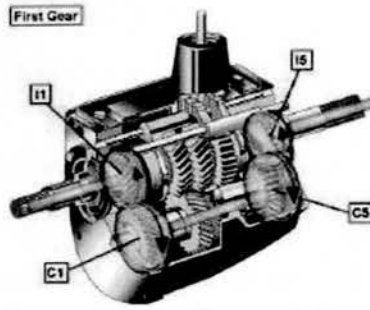
Figure 1.1.3: Five speed transmission power flow for first gear [5]

Second gear

By changing to the second gears, the countershaft moves by reverse direction and lead to the same direction of rotation for output shaft to turn same as input shaft. So, the second gear are locked to the output shaft due to the synchronizer has been to moves forward. This result of typical gear is 2.2:1 which increasing in speed for vehicle.

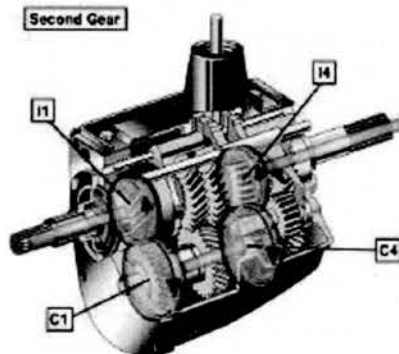Figure 1.1.4: Five speed transmission power flow for second gear

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Third gear

The power flows are likely same with the previous gear but the synchronizer has moves rear and locked at the third/fourth gear. Power flow of third gear are reaching to the third speed gear and increase in speed and having gear speed ratio of 1.5:1.
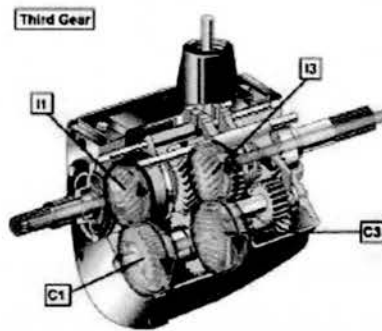

Figure 1.1.5: Five speed transmission power flow for third gear

Fourth gear

For fourth gear are called direct gear because power flow is directly from input shaft to the output together with ratio of 1:1 on moving of third/fourth synchronizer to lock the gear. Its give to maximum speed output and promote to the maximum fuel economy.
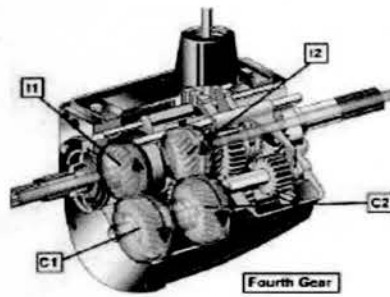
Figure 1.1.6: Five speed transmission power flow for fourth gear

Fifth gear

Fifth gear or overdrive gear is a top speed gear for overdrive increase speed. For the fifth gear, on the output shaft is already mesh with a gear. The gear ratio is 0.7:1.

Figure 1.1.7: Five speed transmission power flow for fifth gear

Reverse gear

Direction of transmission spin opposite of the engine through reverse idler gear. The output shaft and synchronizer are locked together and direct powers to the gears without affect gear ratio.

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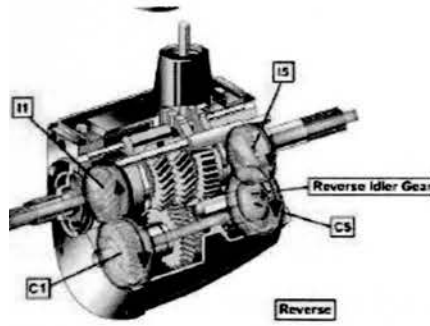
Figure 1.1.8: Five speed transmission power flow for reverse gear

1.2   Problem Statement

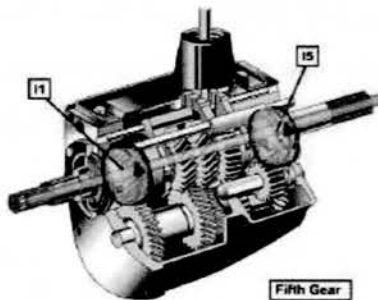All manual drivers car facing low efficiency when shifting gear due to its inconsistent with their top speed. Even though test with the same type of vehicle include their standard specification, each of the car having a different maximum top speed and also time to complete a test road. All this happen also effect by time delay when shifting gear. Some test will be conduct using software by changing their parameter without the design change. All parameter will be measure and some ideas to implement into block diagram and test with Matlab.
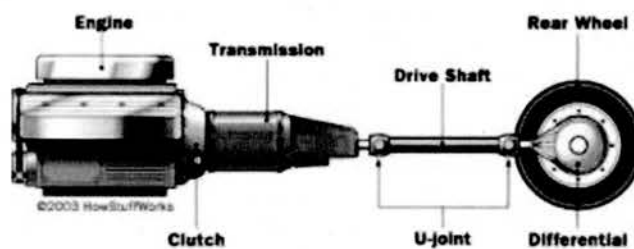
Figure 1.1.9: Basic flow of power vehicle

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1.3 OBJECTIVE

The objectives of this project are as follows:

1. To construct a transmission model using simulation.
2. To show by Mathematical lab simulation by analysis on top speed by changing the gear pattern

1.4 Scope of Project

My project target is only limited to investigate gear shift pattern based on mathematical model simulation without an experimental work involved. Software that is going to be used is Matlab Simulink. Major parameters that influence the gear shift pattern such as speed during gear changing process needs to be discussed in details.

CHAPTER 2

LITERATURE REVIEW

2.1   Vehicle performance

Vehicle performance is the study of motion on the vehicle. Performance of a vehicle is affected by the force and moment relies on the vehicle bodies. Other than that, the surrounding medium such as gravitational forces, Earth surface, air or water and others factor can affect on the vehicle performance. For this vehicle performance, acceleration, top speed and fuel consumption on vehicle will be study through this research. A studied will be applies on the rigid bodies of a vehicle.

2.1.1   Acceleration

Acceleration in a short amount of time is to be considered for demanding for a driver to choosing a car. Acceleration is important for the driver to avoid accident. Reflex from the driver are required to control the acceleration of the car through the performance and handling. Moreover, acceleration is necessary in gaining speed in a short distance. Mostly, it is used in car racing to complete the circuit in a short time [13].

$$F = ma \qquad\qquad (1)$$

Where:

F = Applied force on body

m = Vehicle mass

a = Acceleration on bodies

From the equation above is given by the Newton's Second Law. The integration from the equation can give the velocity in time and integration can lead to the position in time. The integration result from the formula can be used in characterization for the vehicle performance.

Table 2.1.1: Previous research on acceleration on Sport Car [13]

Bibliographic Entry	Result	Standardized Result
Zitzewitz, Paul. Merril Physic Principles and Problem. New York: Glencoe, 1995: 91.	"A drag racer tries to obtain maximum acceleration over a quarter mile course. The fastest time on record for the quarter mile is 4.801 seconds. The highest final speed on record is 301.70 miles per hour."	$\sim 28 \text{ m/s}^2$
2008 Aston Martin DBS 2008. Aston Martin	"Acceleration: 0 – 100 km/h (62mph) in 4.3 seconds"	6.5 m/s^2
Wardell, Gareth. 2007 Jaguar XK Coupe Review – A Love Story. The auto Channel	"0-60 (mph): 5.9seconds"	4.5 m/s^2
2002 Ferrari Enzo Technical Specifications. Carfolio	"0-100 km/h 3.65 seconds"	7.6 m/s^2
"B" 0-60 and ¼ mile times for Factory Stock Vehicles. Albee Digital	"Bugatti 2006 Veyron 2.3 [0-60] 10.8 [1/4 mile] (C&D Jan '06)"	11.59 m/s^2

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Study on the acceleration vehicle is calculated when the car is not in motion (0 km/hour) and the time taken will be taken to reach velocity of 60 km/hour. So, test will be conduct in initial velocity of zero to achieved final velocity is 60 km/hour. Different type of vehicle will be compare through this research. To calculate the actual acceleration will use with this formula:

$$a = \frac{xv}{t} = (v_f - v_i)/t \qquad (2)$$

Where

a = acceleration

xv = Change of velocity

v_f = Final velocity

v_i = Initial Velocity

t = time

2.1.2 Top speed

Top speed is indicator for road safety and fuel consumption. For the driver, it doesn't mean for the drive to use through driving. On the road that has not speed limit, it is an advantage to know the car performance on driving. I n Malaysia, standard top speed can be drive on the road around 80 to 110 km/h through highway. From the figure show the selling car in the Belgium for the last twenty years [17]. The top speed car lead the selling at that country as the best sold model. From the figure that the top speed will affect in craterisation in buying a car. Nowadays driver are prefer to buy top speed car rather that neither standard version or top version.

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