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A Comparative Study on Automatic Gear Shift in Motor-Cycle

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Abstract: Automation has been an integral part of the automotive industry with today's technology. Two-wheeler automobile vehicle also called motor-cycle is widely used all over the world. However, most often in the market, the gear mechanism used in the motor-cycle is manual. Automatic gear shifting in the motor-cycle enhances a smooth ride, but the fuel efficiency is comparatively lesser when compared to the gear featured vehicles. In this paper, various mechanisms have been reviewed that converts the conventional gear mechanism to an automatic gear mechanism. Also, manual and automatic gear mechanisms have been studied along with their comparison. This paper refers to the development of automatic gear shifting in the motor-cycle to date.

I. INTRODUCTION

Today in the metro cities the issue of road jams is rising day by day and the issue of pressing handheld clutches and changing gears after every step of the road is faced with people riding on two motorcycles in particular. The drivers who have the capacity to do other things have an unneeded exhaustion. Furthermore, if one of the functions is either not symbolised by the clutch or machinery, the engine listens suddenly and often stops the motorcycle with a jerk that sometimes leads to road accidents [1].

Some of the developments have already been made for the engine gearbox to transfer the torque from the engine shaft to the motorcycle's rear wheel. The gearbox is used under various driving conditions to adjust the torque. The gearbox increases the torque required to start and shift the motorcycle.

There is no need for high torque after starting or running the engine, so the gearbox is transmitting the optimal torque at high speed onto the rear wheel. There is a need for some effort from the motorcycle driver to operate the gearbox and adjust the equipment. The gears in a motorcycle are pushed with a foot lever.

The flywheel is also clutched between the motor and the transmission to attach and disengage the flywheel. So, it is important to take these two operations perfectly to move the motorcycle smoothly. For most new drivers, this shifting device has become a tough operation. This may also lead to injury prevention [2].

The gearbox for transmitting the torque from the driveshaft to the motorcycle rear wheel is used in every other standard motorcycle. Torque can vary according to the various driving conditions, i.e. when the vehicle starts the gearbox increases the torque needed to start the vehicle.

When the vehicle is on its way, a high torque is not required, and for this speed, it transmits the optimum torque to the rear wheel. Some other considerations, such as the footgear paddle used to drive the gear and hand clutch, for the engagement and disengagement of the flywheel, are also employed. These two operations have to be timed in a fast, smooth driving of the motorcycle. And for anyone especially new driver, this whole cycle for gear change can be so tiresome. The automatic gear shift system therefore not only eliminates injuries but also improves motor performance and fuel performance [3].

II. BASIC TERMINOLOGY

A. Sensors and Actuators

A system that senses, tracks, or otherwise reacts to physical property and records. An actuator is a machine part that controls or moves a processor device [4].

B. Servo Motor and Linear Punching Actuator

A servo engine is a rotating actuator or linear actuator that enables precise control of an angular or linear position, speed, and speed. It has a DC engine with a location feedback sensor. For precise regulation of the angular or linear position, velocity, and acceleration a linear punching actuator uses it and fro motion [4].

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C. Manual Transmission in Bikes

A hand transmission is a motor vehicle transmission type used. It is fitted with a hand-held, foot pedal or hand-held, the driver-operated seal that controls the transmission of the torque from the engine to the gearbox, and with a hand or footgear selector. Often a driver's clutch and a moveable gear pedal are used for manual transmission. The driver can pick all forward gear ratio at any time with most car manual transmissions, but others, including the ones normally attached to motorcycles and some types of racing cars, can only allow the driver to pick the next or next gear. The transmission type is often referred to as a sequential manual transmission [5].

The flywheel is mounted to the crankshaft of the engine in a hand-held transmission and rotates with it. The clutch disc is between the plate and the flywheel and is held under pressure from the plate against the flywheel. The flow wheel spins the clutch platform and thus the gear. When the engine is working and the clutch is shifted. The throw-out bearing is triggered when the clutch is depressed. This allows the pressure plate to avoid placing pressure on the clutch disc. That prevents the engine from powering the clutch plate to move the equipment without damaging the drive. If the clutch foot is released, the throw-out bearing is switched off and the flywheel is re-held so that it can start to receive power from the engine [6].

Manual transmissions are two fundamental forms. The type of sliding gear and the continuous mesh pattern. Nothing turns inside the transmission case with the basic and now obsolete type of glass gear, except the drive and cluster gear in neutral conditions. Apply motor power to drive the vehicle to map the gears. Figure 1 demonstrates one of the fundamental processes [7].

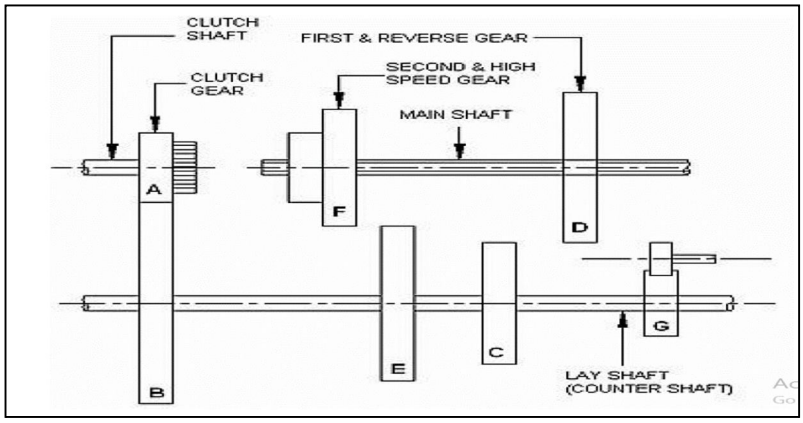

Figure 1: Sliding gear transmission

Both modern transmissions are of the form of a constant mesh, which also uses the form of sliding gear in a similar arrangement. Nevertheless, as shown in Figure 2 the main shaft gears are in constant mesh with the cluster gears. This is possible since the machinery on the principal shaft is not split into the shaft, it can be rotated. The main drive gear, the cluster gear, and all the major shaft gear will be switched always when the transmission is neutral, with a constant mesh gearbox [7].

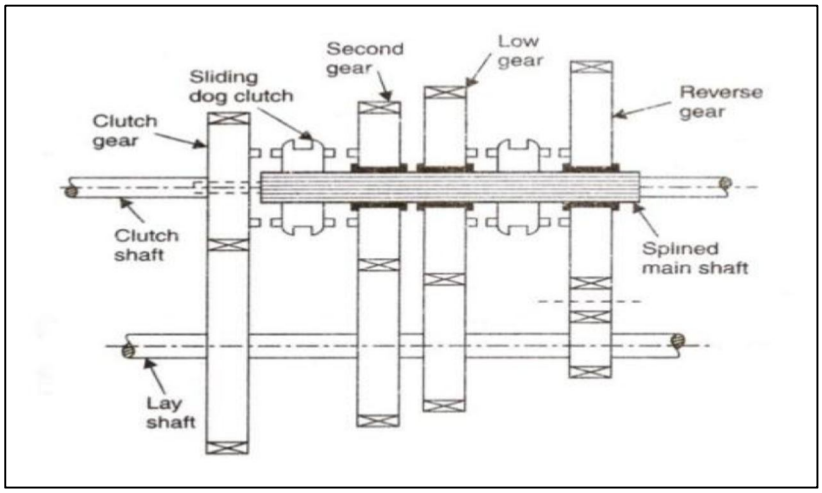

Figure 2: Constant mesh transmission

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D. Automatic Transmission of Bikes

An automatic transmission is a type of vehicle transmission that automatically modifies transmission proportions as the vehicle moves, freeing the driver from having to manually change gears. Like other vehicle transmission systems, the internal combustion engine can provide a range of speed and torque outputs needed for moving vehicles ideally suited for relatively high rotational speed. The hydraulic automatic transmission is the most common model found in cars. For heavy-duty commercial and industrial vehicles and machinery, identical but bigger systems are often used. Instead of a frozen clutch, this system uses fluid coupling and switches the gear by hydraulically locking and unlocking a planetary system. These systems have a fixed set of gears, often with a car parking pack, which locks the transmission's output shaft so that the vehicle does not roll forward or rearward. Some vehicles, for example, some chariots and lawnmowers, with small speed ranges or fixed motor speeds only use a torque converter to supply the rolling wheels with a variable gearing [8].

In addition to the conventional hydraulic automated transmissions, other automated transmissions are also available, such as Figure 3. This is free of the driver being required to shift gears manually, if, for example, the driver had to roll the engine by the machine of the transmission. Often, conventional auto transmissions differ greatly from those of semiautomatics and CVTs in internal service, despite the superficial resemblance to other transmissions. In comparison, a CVT uses a belt or other torque transmission mechanism to allow an "infinite" number of gear ratios rather than a set number of gear ratios. A semiautomatic maintains a seal-like an electrically hydraulic transmission but controls the clutch. Some semi-automatic and CVT automated transmissions also can adjust the gear manually, often via paddle shifters [9].

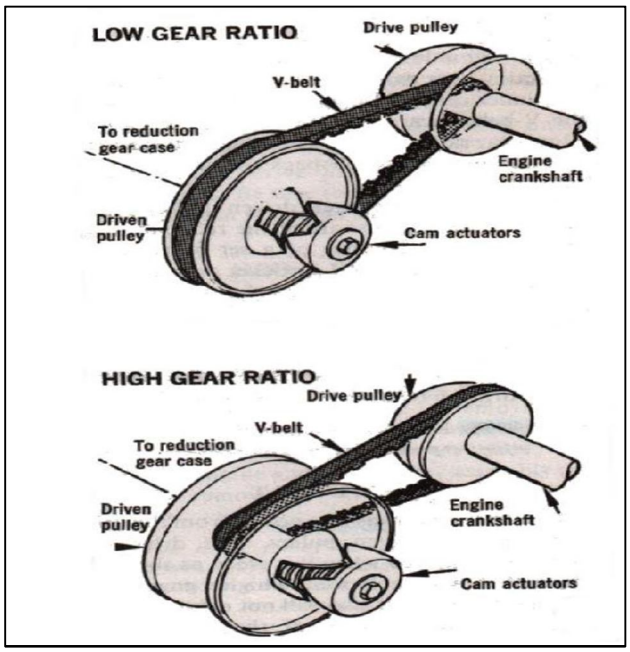

Figure 3: Constant Variable Transmission Low and High Gear Ratio

III. LITERATURE REVIEW

Mr. Amar Gupta et al. gives a concept of a hall effect sensor to measure the speed of the motorcycle. This sensor works according to the principle of the Hall effect. In the hall effect when the magnetic field is applied in the direction perpendicular to that of the flow of current then the EMF is induced in a conductor. For the Punching of gear, they used linear actuators. For moving and controlling a mechanism or system linearly the actuators are used. They have used two linear actuators one for upshifting and another one for downshifting. There is one 6 V servo motor also used for the clutch wire to make the gear shifting smoothly [10].

Vishnu P R et al. improved the gear shifting process by using the two pneumatic double acting cylinders as the punching mechanism. The basic use of a pneumatic cylinder is the power of compressed gas to produce the force in a reciprocating linear motion. And it is also called as air cylinders. They have used two air cylinders one of them for up and another one for the down. Also in this research paper, the relays were used to provide the positive/negative signal to the pneumatic double-acting cylinder. That signals to relay are provided by the control unit of the model. They have used an Atmel IC AT89C52 as a controlling unit. Also, they used the proximity sensor to sense the speed of the motorcycle [11].

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Gianluca Lucente et al. states that the automated transmission is a clutch-less or pedal-less manual transmission system which uses electronic sensors, processors, and actuators (hydraulic or electromechanical) to do clutch actuation and gear shifts as per the command of the user. An automated Transmission system uses a conventional manual transmission, actuators, and control unit to automate the entire process.

Their system consists of mainly three sections i.e sensors, processors, and Actuators [12].

There is one patent on semi-automatic gear shifting apparatus for use in shifting the gears in gearboxes of motorcycles and the like gearboxes wherein gears are shifted by rotating spindles and which are connected to the ratchet type gear shifting that means in the shifting apparatus consists of a lever arm, one end of the arm is connected to the spindle and the other end is connected to the toe pedal. Also, an actuating rod is connected to the toe pedal and the rod is reciprocated to move the lever and in turn the spindle. This spindle is actuated by a pair of push-button switches mounted on the handlebar [13].

In this patent, an actuator with a tachometer for the fore-aft movement of the gears is used. The gear shifting mechanism also includes a solenoid and pivotal mounting to provide movement of the actuator assembly in the second direction. Also, the invention of an automated driver system for a manual transmission vehicle includes a gear shifting mechanism under control of a microprocessor is given in this patent. The gear shifting mechanism consists of a gear shift actuator, DC Motor, Tachometer with a lead screw assembly, and also a Linear displacement transducer is used [14].

U. M. Friedrich Raff the Patent holder states that a solenoid actuated transmission shifting apparatus is should be provided for temporary and permanent installation in automobiles with convention motorcycle transmission [14].

David G. Funk mentioned that the transmission gears and clutch shifting apparatus for automatic operation of manual shift mechanism in an automotive vehicle include gear and clutch actuation mechanisms mounted on the bar of the vehicle and coupled by the cables to the control actuation mechanisms mounted off the vehicle board. The on-board gear shift actuator includes two intersecting movable slots for causing movement of the shift lever. In this invention, electrical control and actuation mechanism are mounted outside the vehicle. Relatively small gear and clutches are mounted on the vehicle, cables are used to connect these actuators [15].

P. Alexander explained that a multi-speed automatic transmission for automobiles having parallel input and output shafts includes two parallel gear sets and constant meshing gear wheels, which provide two fixed speed ratios. The first power path uses the first speed ratio which includes a first control clutch and a second control clutch. The second power path uses the second speed ratio which is higher than the first speed ratio, which includes a third control clutch. This also has a double planetary gear set, a first and second control brake.

Alternatively, either the input or output shafts are in alignment, and one of the two-speed ratios are used. This transmission features six forward speeds, a braked neutral, and a reverse drive [16].

Oliver J. Tysver et al. gives a brief introduction to the shift schedule of gears to save energy and improve fuel economy. Since there is no perfect automatic shift technology for engineering vehicles, this theory is implemented to improve the ordinary vehicle transmission. The author predicts that automatic gear transmission vehicle chooses the best shift rule based upon driver's information of manipulation. The author also claims that the rule of shift decision changes the traditional shift mechanism to intelligent shift decision [17].

A journal has provided the solution for the power loss in the manual gear transmission system. The main objective is to create a mechanism to reduce the inconvenience caused by manual gear Literature Review The shifting of gears is done automatically as well as manually. In an automatic gear shifting mechanism, the gears are shifted following the speed of the vehicle. The wheel revolutions are sensed and the signal is transferred to the microcontroller which shifts the gear according to the implemented C program [18].

Luigi Guglielmo et al. provides information, that the production of a manual transmission is reduced by fifty percent and automated manual transmission (AMT) production is increased. The AMT's are used in racing cars and modern hybrid electric vehicles [19].

Dhananjay R Patil et al. provides the use of automatic provides ease in the operation and gives a good average. Also, according to their research, the more powerful than any equivalent manual transmission. And also, it has better fuel efficiency than manual transmission.

The output they have considered around this thesis is about the main fuel efficiency and also the costings. So according to our research due to the use of the Rack and pinion concept the force required to exert on the gearbox will be less as the small torque on the rack and pinion will produce a greater force for the gear shifting. As a result, power consumption will be effective and less [20].

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IV. CONCLUSION

Automobile transmissions have progressed over the last two decades with increased speed, an increasing ratio, and better efficiencies and changing efficiency. Many types of research have been made to explore the automatic gear transmission system in the motorcycle. CVTs have also increased torque capacity and performance. CVTs will coexist in the future on the passenger vehicle market. It will dominate the market in future. There is almost an end to the growth in the speed of traditional car transmissions. The performance and costs of various automatic transmission mechanisms are therefore not accurate in the current scenario. The emphasis will continue in the future to be on the optimization, as far as performance, driving convenience, and transformation strategy and control technology is concerned, of mechanical and hydraulic transmission systems.

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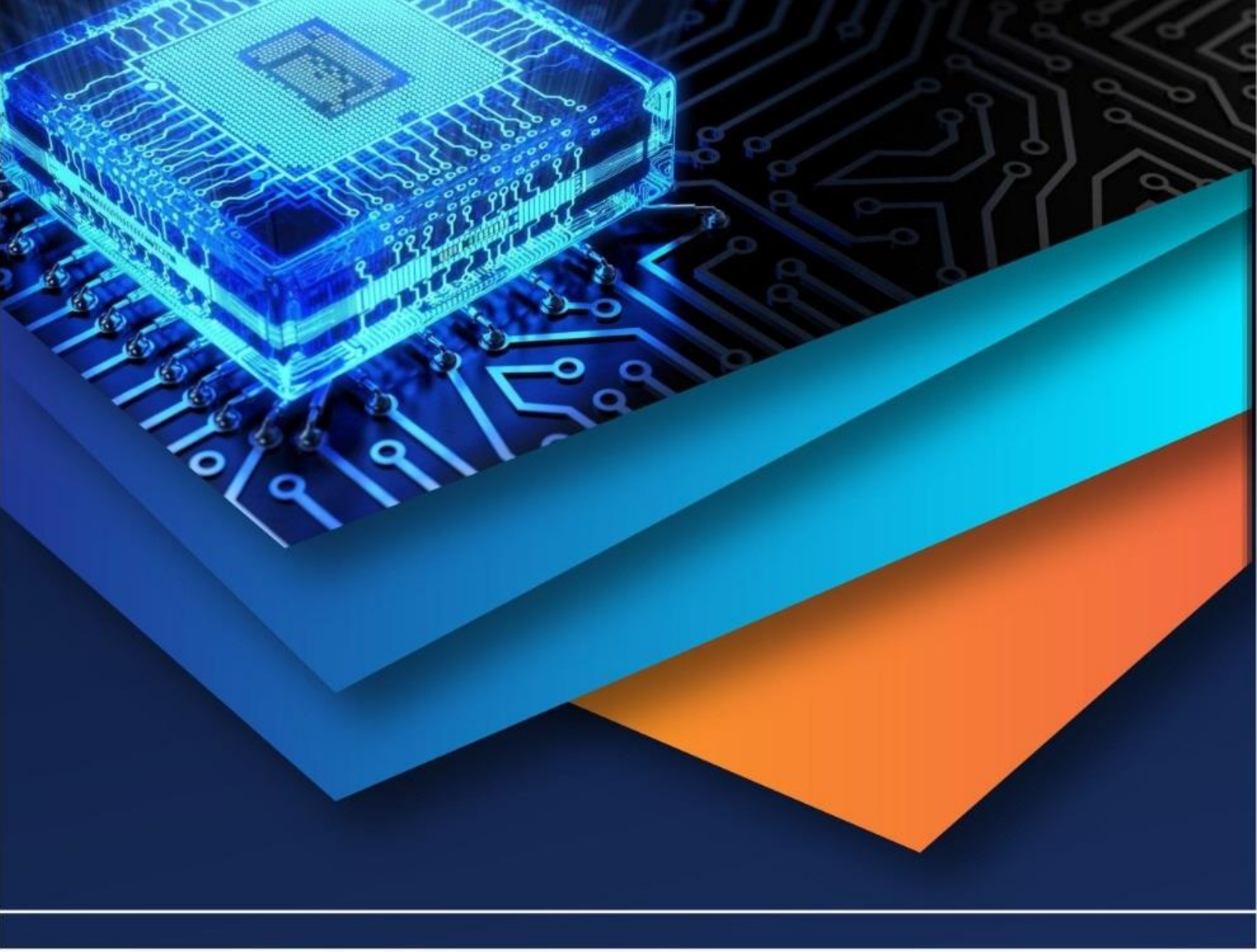

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