

ECCENTRIC CAM OPERATED SEMI AUTOMATIC GEAR SHIFTING SYSTEM FOR TWO WHEELER

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ABSTRACT

In this study, a gear shifting mechanism was designed and applied to make the shifting process faster and less destructible for the driver. The main objective of this concept is used to apply the gear by using automation system in automobile vehicles. This is the new innovative model mainly used to control the vehicle. Here, we are concentrating to design the automatic gear changing mechanism in two wheeler vehicles by using the electronic devices. This is very useful for the gear changing mechanism in automobile vehicles. By using this we can easily control the vehicle and improve the performance of the vehicle also we can avoid the wear and tear of the gear. Here, we are using eccentric cam to change the gears for two wheelers. By using this eccentric cam operation, we can eliminate the more disadvantages in gear changing system. By using this system, we can reduce space of locating gear box, gear damage, bleeding of pneumatic and hydraulic energy flow tubes, less noisy operation, less cost and doesn't require frequent maintenance.

Keywords: Eccentric Cam with follower, Microcontroller (MC), AC and DC motor, push buttons.

1. INTRODUCTION

At present due to the extended difficulties in manual operations, the technology has shifted from manual to automatic; few of them include ABS system, active steering system etc., in order to increase passenger safety and comfort. Increasing demands on performance, quality and cost are the main challenge for today's automotive industry. In an environment where movement, component and every assembly operation must be immediately and automatically recorded, checked and documented for maximum efficiency. One of the automatic applications includes Eccentric cam operated gear changer. This study describes in detail in an understandable way to how to convert the traditional manually gear shifting mechanism into automatic system by using microcontroller (Control Unit- Relays).

A method of controlling a gear change of an automobile is an automatic transmission connected to an output rotation shaft of engine so as to transmit the rotational output of engine to drive wheels of automobile through any selected one of a plurality of gear ratios. Our system are mainly made by the reference, how to change the gears by pneumatic and its demerits (S.Vijay et al, 2014), knowing about exact working of micro controller interface with dc motor (Suroor et al, 2013), controlling of speed of dc motor with help of microcontroller (Shinde et al, 2014), understanding kinematic design of automatic gear transmission (Long-Chang et al, 2008), gear shifting with help of PLC controller (Muntaser et al, 2010).

A load device selectively connectable to output rotation shaft of engine (lay shaft) and where the gears in the main shaft are changed by the eccentric cam which is connected to the DC motor

which had a attachment of worm and worm gears, the gears are changed by the controller of microcontroller, when the up button in the control unit is pressed and the relay connected to the dc motor rotate the eccentric cam is turned by some angle , the cam connected to the lever in the main shaft is moved by connecting rod connected to the cam is done by control unit, continuous changing are done by the same and it is reduced by down button by the activation of reverse relays.

2. OBJECTIVE

The main objective of this system is to minimize the human errors in operating the gears with the help of automatic technology. Other objectives include optimum gear ratios, reducing wear and tear of the gears, shifting the gear effectively, optimum performance of the gear box, efficient shifting in gears, minimum constructions, less space is required and doesn't required frequent maintenance.

3. MODEL COMPONENTS

3.1 Manual 3 speed gear box:

Manual gear box is a sliding mesh type with spur gears. It has one input shaft and one output shaft. It has three speed gears, three gears on the input shaft and three gears on the output shaft, the output shaft has connected with guide bush on its outside circumference to slide the gears on the output shaft, it is moved by lever linked by connecting rod (follower) attached with eccentric cam which is rotated by 12v dc motor with 10rpm.



Fig. 1: Manual 3 speed gear box

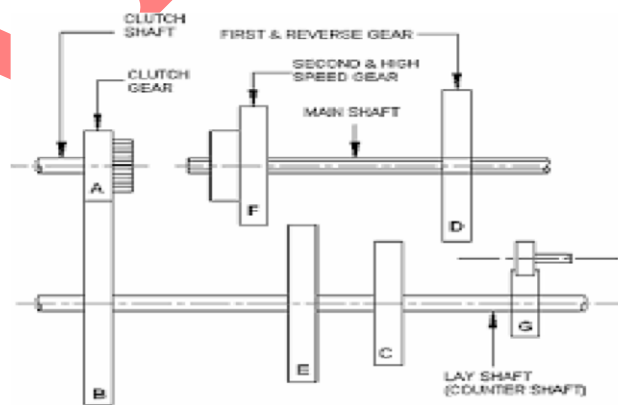


Fig. 2: sliding mesh gear box

3.2 Eccentric cam with connecting rod (i.e., follower):

Eccentric cam is a one type of cam which is connected to the follower (it is a connecting rod to the lever), it will help in movement of gears in the output shaft, the linear movement of the follower is converted into rotatory movement of the eccentric cam or vice versa.

Here, the center of the cam is connected to the shaft from dc motor and the follower is fixed to the eccentric cam plate at some certain distance from the center.

3.3 A control unit:

A control unit (CU) handles all processor control signals. It directs all input and output flow, fetches code for instructions from micro programs and directs other units and models by providing control and timing signals. A control unit is used to control the movement of an eccentric cam with help of worm and worm gear dc motor, it mainly comprises of microcontroller, Liquid Crystal Display, relays, transistors, rectifier, capacitor, voltage regulator, resistor, variable resistor, push button. Etc.,

3.4 Microcontroller:

A microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications. Here, we are PIC 16f877A microcontroller family is also known as microcomputer or MCU. This is an integrated circuit that part of an embedded system which contains 200 nanosecond instruction execution and only 35 single word instruction make it more powerful yet easy-to-program.

3.5 Liquid Crystal Display:

Liquid crystal display, a type of display used in digital watches and many portable computers. LCD displays utilize two sheets of polarizing material with a liquid crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them. Each crystal, therefore, is like a shutter, either allowing light to pass through or blocking the light. Here we use view the stage of controlling gear timing distance.

3.6 Transistor:

A transistor is a semiconductor device used to amplify and switch electronic signals and electrical power. It is composed of semiconductor material with at least three terminals for connection to an external circuit.

3.7 Relays:

A relay is an electrically operated switch, which is necessary to control a circuit with low power signal (with electro isolation between control and controlled circuits) or several circuits are controlled by one signal.

3.8 Rectifier:

Rectifier is an electric component or device, which is used to convert AC current into DC motor, here it convert the alternating or irregular signal into the constant direct current into the circuit.

3.9 Capacitor:

A capacitor (originally known as a condenser) is a passive two-terminal electrical component used to store energy electrostatically in an electric field. The forms of practical capacitors vary widely, but all contain at least two electrical conductors (plates) separated by a dielectric (i.e. insulator).

3.10 Voltage regulator:

It is used to regulate the constant voltage. The input-output differential at which the voltage regulator will no longer maintain regulation is the dropout voltage.

3.11 Resistor:

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. Resistors act to reduce current flow, and, at the same time, act to lower voltage levels within circuits.

3.12 Variable resistor:

A variable resistor is a device that is used to change the resistance according to our needs in an electronic circuit. It can be used as a three terminal as well as a two terminal device. Mostly they are used as a three terminal device.

3.13 Push button:

A push-button (also spelled pushbutton) or simply button is a simple switch mechanism for controlling some aspect of a machine or a process.

3.14 Power supply:

The power supply which is incorporated in the system is Lead- acid battery (12V) with 12.6 Amps. Rechargeable lead acid batteries are the same type used in automobiles. As with your car battery, how you use this battery has a significant impact on its lifespan. For example, if you forget to turn off your car's lights and drain the battery, a jump start might work a few times.

3.15 Pulley:

A pulley is a wheel on an axle or shaft that is designed to support movement and change of direction of a cable or belt along its circumference. Pulleys are used in a variety of ways to lift loads, apply forces, and to transmit power. Here we are using two pulleys (small & large), small having 1 inch diameter and large pulley having 10 inch diameter, we are using here to transmit the power from 1440rpm into 440 rpm.

3.16 Belt:

It is made in rubber and it is used to connect two pulleys, Here we are connected the small pulley and large pulley and we used A type V belt with 35 inch length.

3.17 AC motor:

It is a single phase induction motor with small load, Because it has but a single alternating current source, a single-phase motor can only produce an alternating field: one that pulls first in one

direction, then in the opposite as the polarity of the field switches, it is a 230volt and 1025hp with 1440 rpm, Here it is used as a input speed.

3.18 DC motor:

Here, we are using 12volt dc motor it rotates at a speed of 60rpm,it converts electrical energy into mechanical energy, it is connected with worm and worm gear, the motor shaft is connected to the worm shaft its rotates the worm wheel and then the worm wheel is directly connected to the eccentric cam

Worm & worm wheel gear ratio:

Motor gives a speed of 360rpm the worm & worm wheel converts into 60rpm by the gear ratio of

$$N_1/N_2 = T_1/T_2$$

$$360/N_2 = 60/10 = \underline{N_2 = 60 \text{ rpm}}$$

Where,

N_1 = Speed of the dc motor,

N_2 = Final speed of the worm wheel.

T_1 = Total no of the teeth in worm wheel,

T_2 = Total no of the teeth in worm shaft.

3.19 Bearings:

Bearing is a part which is used to roll or turns the shaft and it is hold the gears and here we used ball bearings, two ball bearing is used here small & large bearings to support the gears in the gear box.

4. CONSTRUCTION DETAILS

The three gears are in the gear box is made as a manual gear box, the eccentric cam is connected to the dc motor, the dc motor shaft are attached the worm and worm gear, the speed of the dc motor is 360rpm is reduced into 60rpm by the worm and worm gear and then the 60rpm is reduced by 10rpm with help of spur gear, here worm wheel is connected to the small spur gear with 8 teeth is meshed with larger gear with 42 teeth. An eccentric cam with connecting rod (follower) is fixed to the gear box with help of lever to the guide bush of the shifting gear shaft (main shaft). The every shifting motion of the gear is achieved by the control unit is connected to the dc motor, every shifting signal send to the dc motor and to the eccentric cam is done by microcontroller and then the control unit needs 12v is taken from 12v battery. The input speed to the counter shaft is given by ac motor with speed of 1440rpm is reduced into 144rpm by the pulley reduction ratio.

5. WORKING PRINCIPLE

In our project, the control unit is connected to the dc motor, the control unit comprised of microcontroller, relay and LCD display and here, there are three gears, first gear is in neutral position and then the gear shifted as a first gear is achieved by the movement of the eccentric cam is done by pressing the up button, after pressing the up button the signal send to the microcontroller and then it sends to relay 1 and its send to dc motor then rotates the cam it is connected to the main shaft by lever it moves the gear to the 1st gear and then second & third gear is shifted by pressing up

button. The reversing operation can be achieved by the signal passing through the relay 2, this operation is as like same as forward operation, this operation is equivalent to all three gears.

6. CALCULATION

Theoretical and practical results are more or less same:

First gear-1 st Gear	Second gear-2 nd gear	Third gear-3 rd gear
$\frac{N_1}{N_2} = \frac{T_2}{T_1} = \frac{1144}{N_2} = \frac{88}{24} = N_2 = 40 \text{ rpm.}$	$\frac{N_3}{N_4} = \frac{T_4}{T_3} = \frac{144}{N_4} = \frac{56}{56} = N_4 = 144 \text{ rpm.}$	$\frac{N_5}{N_6} = \frac{T_6}{T_5} = \frac{144}{N_6} = \frac{24}{88} = N_6 = 528 \text{ rpm.}$

Table.1

Where,

N_2 = speed of the first gear, N_4 =speed of the second gear, N_5 =speed of the third gear.

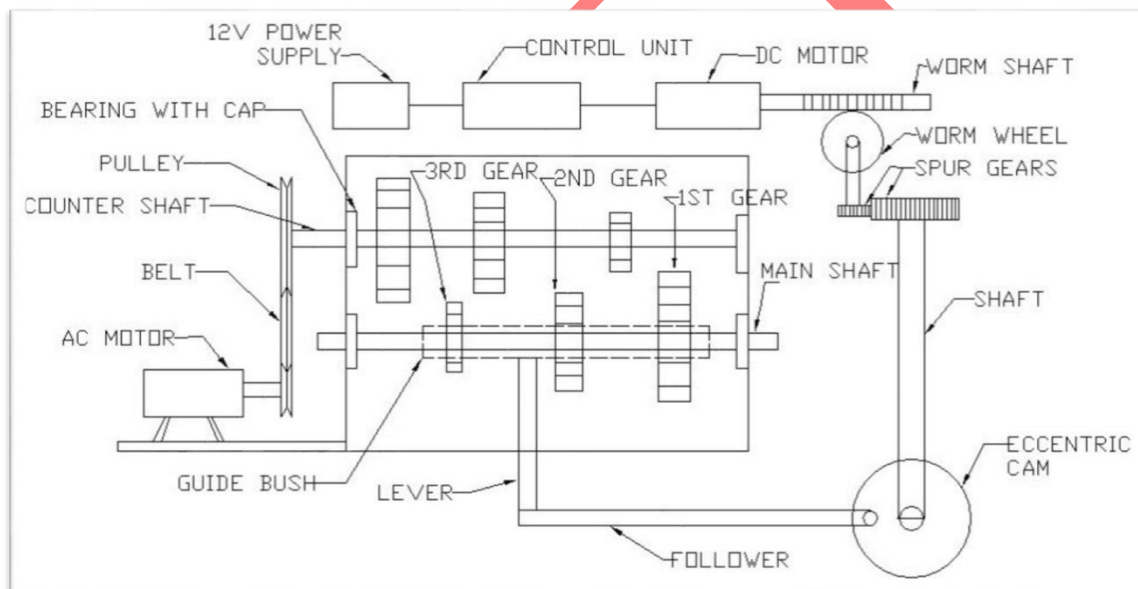


Fig. 3 Overall diagram of eccentric cam operated automatic gear shifting system.

7. CONCLUSION

The project presented has involved the development and implementation of automatic transmission for bikes. The automatic transmission can be also used in 5 and 6 speed versions by altering few changes in the program and in designing of gear box. Therefore from the above calculation, this is the final value of speed of all gears is obtained by rotating eccentric cam at an optimum angle. According to the achieved results, the suggested mechanism is realizable and workable. By using this shifting system, there will be a less wear and tear, gear damage will reduced, less noisy, doesn't require frequent lubrication, this highly efficient & speed system. The way of controlling and changing the gear is quit easier & faster. It requires less space to locating the gear box. The application of this mechanism leads to make the driving process easier, reduces the

risk of destabilizing the car and the chance of miss shifting. This design helps the driver to increase his focusing on the road. For some drivers, the gear shifting can cause some confusing at driving especially at critical situations. A crowded road on a hill or a sudden detour makes a lot of tension on the driver. One of the difficulties in this situation is to choose right reduction ratio and engaging it at the right time. Also reduces the time needed to engage the required reduction ratio, which increases the vehicles response.

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