

# Pneumatic Gear Transmission for Two Wheeler

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**Abstract—:** The present automatic transmission is fully mechanically controlled and costs very high. In this study, a gear shifting mechanism was designed and applied to make the shifting process faster and less destructible for the driver. The new device must be reliable, has a small dimensions, low construction and maintenance cost. This paper aims to improve gear shifting process using devices as a manual four speed gear box, two pneumatic double acting cylinders, Programmable Logic Controller (PLC), an electrical motor, limit switches, push buttons, bulbs, a table (holder) and power supply. According to suggested gear shifting method the control unit chooses optimum gear shifting ratio for an automobile without operating it manually (using relays). Using this method leaves to the driver the excitement of choosing the shifting moment.

**Index Terms—:** Control unit (relays) - programmable, pneumatic cylinders, Solenoid valves, gearbox, gear shifting mechanism, proximity sensor.

## I. INTRODUCTION

This invention relates to control mechanisms and more particularly to mechanisms for controlling the selection and establishment of various gear relations of automotive vehicle transmission gearing. Our Invention relates to gear shift mechanisms particularly such as are Used on automotive vehicles. It has for one of its principal objects to provide a gear shift mechanism pneumatically operated, through the instrumentality of which the various gears in the mechanism may be made operative[1].

Other objects are to provide a gear shift mechanism which is noiseless in its operation, which greatly relieves all strain on the parts with which it is connected, which has no parts easily broken or apt to get out of order, which may be operated with but slight skill on the part of the driver, which is suitable for all makes of automotive vehicles. And which can be manufactured at a relatively low cost [2].

A method of controlling a gear change of an automobile, said automobile comprising an internal combustion engine; an automatic transmission connected to an output rotation shaft of said engine so as to transmit the rotational output of said engine to drive wheels of said automobile through any selected one of a plurality of gear ratios; a load device selectively connectable to said output rotation shaft of said engine via selectively-connecting means; and means for generating a gear change control signal for selecting one of said gear ratios of said automatic

transmission in accordance with one of operational conditions of said automobile and said engine said method comprising the steps of connecting means when said gear change signal generating means generates the control signal for shifting up the gear in said automatic transmission, in such a manner that said selectively connecting means connects said load device to said output rotation shaft of said engine[3].

An automatic gear change control apparatus for an automobile, said automobile comprising an internal combustion engine; an automatic transmission connected to an output rotation shaft of said engine so as to transmit the rotational output of said engine to drive wheels of said automobile through any selected one of a plurality of gear ratios; said apparatus comprising a load device for applying a load; means for connecting said load device to said output rotation shaft of said engine and for generating a gear change control signal for selecting one of said gear ratios of said automatic transmission in accordance with one of operational conditions of said automobile and said engine; and load control means for increasing the load of said load device when said gear change signal-generating means generates the control signal for shifting up the gear in said automatic transmission[4].

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 pneumatic gear changer [4].

This study describes in detail in an understandable way to how to convert the traditional manually gear shifting mechanism by using microcontroller (control unit- relays). A method of controlling a gear change of an automobile, said automobile comprising an internal combustion engine; an automatic transmission connected to an output rotation shaft of said engine so as to transmit the rotational output of said engine to drive wheels of said automobile through any selected one of a plurality of gear ratios; a load device selectively connectable to said output rotation shaft of said engine via selectively-connecting means; and means for generating a gear change control signal for selecting one of said gear ratios of said automatic transmission in accordance

with one of operational conditions of said automobile and said engine said method comprising the steps of controlling said selectively-connecting means when said gear change signal-generating means generates the control signal for shifting up the gear in said automatic transmission, in such a manner that said selectively-connecting means connects said load device to said output rotation shaft of said engine. 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. This design helps the driver to increase his focusing on the road. Also reduces the time needed to engage the required reduction ratio, which increases the vehicles' response [5].

The designed automatic transmission is done in an auto-clutch featured bike which can be applied effectively and efficiently in a clutch featured bikes with suitable control techniques. The ultimate goal of our project is to transmit the gears without the human interference and to attain efficient, safe and easy driving in cost effective way. Microcontroller is the heart of the system which handles all the sub devices connected across it.

## II. LITERATURE SURVEY

S. Vijay Kumar, P. Nithesh Reddy was discussed about a gear shifting mechanism was designed and applied to make the shifting process faster and less destructible for the driver to improve gear shifting process using devices as: a manual four speed gear box, two pneumatic double acting cylinders, Programmable Logic Controller (PLC), an electrical motor, limit switches, push buttons, bulbs, a table (holder) and power supply. According to suggested gear\_ shifting method the control unit chooses optimum gear shifting ratio for an automobile without operating it manually (using relays). Using this method leaves to the driver the excitement of choosing the shifting moment [6].

Muntaser Momani (2010) was discussed about a gear shifting mechanism was designed new device must be reliable, has a small dimensions, low construction and maintenance cost. This paper aims to improve gear shifting process using devices as: a manual four speed gear box, four pneumatic double acting cylinders, four pneumatic two position five ways directional control valves, Programmable Logic Controller (PLC) LOGO unit, an electrical motor, an electrical clutch, a belt, two pulleys, limit switches, push buttons, bulbs, a table (holder) and power supply [7].

P. Alexander M.E.(2012) ) was discussed about a gear shifting mechanism was designed and applied on an auto clutch featured bike to make the gear transmission process faster and less destructible for the diver using Embedded System design. The present automatic transmission is fully mechanically controlled and costs very high and it is not suitable for small displacement engines. But the gear transmission mechanism designed makes driving easier and to achieve efficient driving. This new device must be reliable, has small dimensions, economical and low maintenance cost. [8].

P.Amuthakkannan(2015) was discussed about 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 [9].

Akshyakumar. Puttewar (2015) was discussed about The present automatic transmission is fully mechanically controlled and costs very high. In this study, a gear shifting mechanism was designed and applied on a clutch featured bike to make the gear transmission process faster and less destructible for the driver using push button System design. But the gear transmission mechanism designed makes driving easier and to achieve efficient driving [10].

D.Mangeelal (2015) was discussed about when a gear shifting-up of an automatic transmission is to be effected, the load applied by the load device is increased, or the load is connected to an output rotation shaft of the engine via a selectively-connecting device, thereby reducing the rotational speed of the output rotation shaft of the engine to a required level. In this work, two electromagnetic coils are coupled to the gear rod of the two ends. The two buttons are used to activate the electro-magnetic coil so that the gear will be shifted [11].

By review the various studies show that the pneumatic gear changer in two wheeler is not yet studied. So the aim present work of pneumatic gear changer for two wheeler is performed using sensors and pneumatic cylinder and also micro controller. 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, optimum force exerted by the cylinders to move the shifting levers.

## III. EXPERIMENTAL METHODOLOGY

### A. Gear transmission process.

A transmission is a machine that consists of a power source and a power transmission system, which provides controlled application of the power. Often the term transmission refers simply to the gear box that uses gears and gear trains to provide speed and torque conversions from a rotating power source to another device. The most common use is in motor vehicles, where the transmission adapts the output of the internal combustion engine to the drive wheels. Such engines need to operate at a relatively high rotational speed, which is inappropriate for starting, stopping, and slower travel.

The transmission reduces the higher engine speed to the slower wheel speed, increasing torque in the process. Transmissions are also used on pedal bicycles, fixed machines, and where different rotational speeds and torques are adapted.

In motor vehicles, the transmission generally is connected to the engine crankshaft via a flywheel and/or clutch and/or fluid coupling, partly because internal combustion engines

cannot run below a particular speed. The output of the transmission is transmitted via the driveshaft to one or more differentials, which drives the wheels. While a differential may also provide gear reduction, its primary purpose is to permit the wheels at either end of an axle to rotate at different speeds (essential to avoid wheel slippage on turns) as it changes the direction of rotation.

*B. Component details.*

*1) .Manual 4-Speed Gear Box*

Manual gear box is a synchronizer type with helical gears as show in Fig. 1. It has one input shaft and one output shaft. It has three shifting arms; one for first and second speeds, the second one for the third and fourth speeds, third one for the neutral as shown in (Fig.1). There are three connecting rods for each arm. Every connecting rod connects its shifting arm with a common shifting lever as shown in (Fig.2). The common arm is 80 mm length with ability of sliding and axial motions. The axial motion is 35 mm forwards and 35 mm backwards (35mm8.35mm). The sliding motion is 15 mm to the left and 15 mm to the right (15mm<sup>2</sup>15mm÷). The arm is connected from the top with the front and rear pistons rod [1-3]



Fig. 1.Gear Box Shifting Arms



Fig. 2.Gear Box Shifting Lever

*2). Relay*

A relay is an electrically operated switch. Relays are used where it is necessary to control a circuit by a low power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. The following Fig.3 shows the schematic diagram of a relay [2,5].



Fig. 3.Relays

*3). Pneumatic cylinder*

Pneumatic cylinders are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion It is also known as air cylinders.

It consists of two openings one on the top and another on its side below , when a compressed air is passes through the valve the piston present inside the pneumatic cylinder gets energized and ejects the piston head out. The pressure used in this pneumatic cylinder should be 2 bar, but due to large openings and leakage of the air from the cylinder the pressure can be increased 4-5 bar.

Generally we prefer pneumatic cylinder than fluid cylinder as pneumatic cylinder has no fluid drippings and it will not affect he surroundings. As with the categorization pneumatic cylinders can be divided into two types.

- Single acting cylinder
- Double acting cylinder

*a) Single acting cylinder:*

Single-acting cylinders (Fig. 4) use the pressure imparted by compressed air to create a driving force in one direction and a spring to return to the "home" position. More often than not, this type of cylinder has limited extension due to the space the compressed spring takes up.



Fig. 4: Single acting cylinder

*b) Double acting cylinder:*

Double-acting cylinders (Fig. 5) use the force of air to move in both extract and retract strokes. They have two ports to allow air in, one for outstroke and one for in stroke. Stroke length for this design is not limited; however, the piston rod is

more vulnerable to buckling and bending. Additional calculations should be performed as well



Fig. 5. Double acting cylinder

#### 4). Microcontroller

A microcontroller (sometimes abbreviated  $\mu\text{C}$ ,  $\text{uC}$  or  $\text{MCU}$ ) 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. In this document the type of microcontroller incorporated is AT89C52. AT89C52 is an 8-bit microcontroller and belongs to Atmel's 8051 family. AT89C52 has 8KB of Flash programmable and erasable read only memory (PEROM) and 256 bytes of RAM. AT89C52 has an endurance of 1000 Write/Erase cycles which means that it can be erased and programmed to a maximum of 1000 times. The Fig. 6 shows the schematic diagram of AT89C52 [6].



Fig. 6: Microcontroller

The following Fig. 7 shows the pin diagram for AT89C52:

#### 5). Proximity Sensor

A proximity sensor (Fig.8) can detect metal targets approaching the sensor, a proximity sensor is a type of sensor which detects the presence of nearby objects called target without any physical contact.

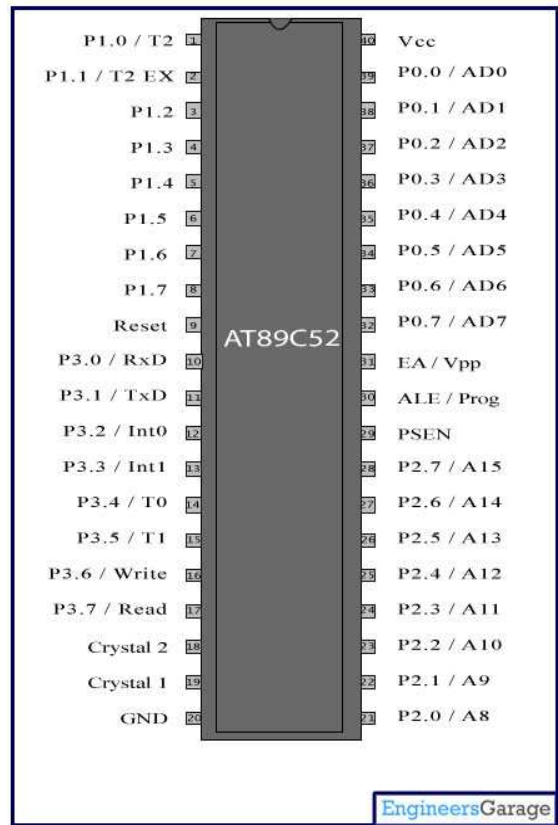


Fig. 7: AT89C52 pin diagram



Fig. 8. Proximity Sensor

Depending on the type of technology used proximity sensor emits an electromagnetic or electrostatic field, or a beam of electromagnetic radiation (infrared, for instance), and looks for changes in the field or return signal when target comes closer to the face of sensor. A proximity sensor is used in many applications such as in mobile phones and for level sensing. In I phone proximity sensor is used to deactivate the touch screen when the phone comes near to the face [7].

#### 6). Directional Control Valve

The directional control valves (DCVs) are shown in Fig.9 it used to control the direction of the compressed air passing to the cylinders. They are compounded in one common input connected to the air pressure source and two common exhaust ports that opened to ambient [8-12].

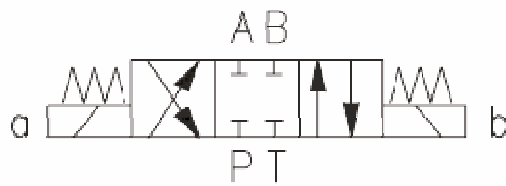


Fig. 9. Directional Control Valve

7). *Electric Motor*

In any electric motor (Fig. 10), operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. As you are well aware of from playing with magnets as a kid, opposite (North and South) polarities attract, while like polarities (North and North, South and South) repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion [13-16].

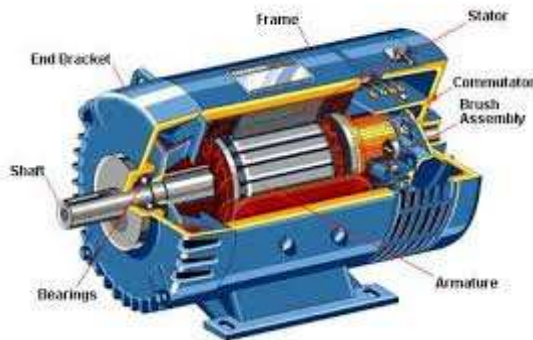


Fig. 10. Electric motor

IV. DESIGN OF PNEUMATIC GEAR CHANGER

Many technical concepts from different areas like mechanical, electric, electronic and pneumatic systems were used to project a build the gear changer for two wheeler.

A. *Block diagram*

The presented project is aimed to perform operations such as automatic gear transmission, automatic headlight control, and digital speedometer. Here the speed is the inputs to the microcontroller unit.

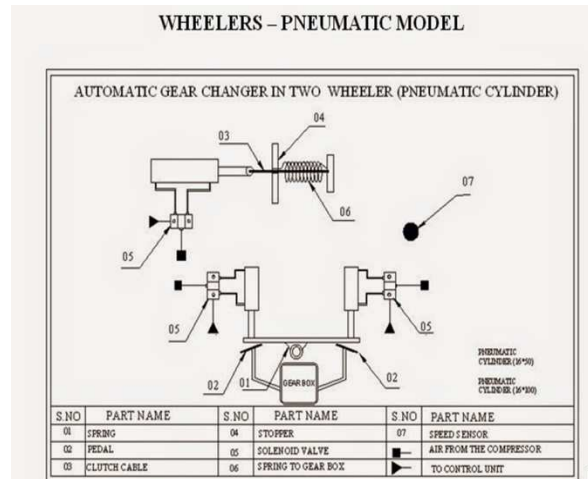


Fig. 11. Block diagram

The block diagram shows (fig.11) schematic arrangement of component which the different types of sensors and pneumatic cylinders are arranged and also connected with plc controller and microprocessor

B. *System working*

The compressor sends the pressurized air to the solenoid valves through the hoses of 6mm diameter whereas the solenoid valve acts as temporary storage of air and acts as passage. The air from the solenoid valves passes to the pneumatic cylinders which act as working medium for actuating cylinders. When air enter into the cylinders the pistons starts reciprocating that is extraction and retraction. The retraction is done manually by operating switches on the solenoid valves by closing the air inlet.

On the other hand the relays send the precise signals to the solenoid valves. The input for these relays is the speed of the wheel or vehicle which is sensed by sensor proximate to the wheel. The shifting of gear is done by altering the speeds by rotating the rotor in the speed regulating board i.e., accelerator in case of automobile. The following analysis shows the procedure for shifting of gears.

C. *Assembly of working model*

This figure 12 shows that the proto type of pneumatic gear changer for two wheeler which fabricated by using the microprocessor, pneumatic cylinders, relays and different types of sensors.

This proto type is very different in performance and working process from the other gear changers which using in two wheelers.



Fig. 12. Assembled model

#### D. Future scope of work

This project is very useful for drivers which who interested to drive two wheelers, It is very differ from gear less motor bikes which this system is very useful for rough driving and increase the performance and torque of the two wheeler. This can be also applied in feature for four wheeler and also heavy vehicles to improve the driving and avoid fear while driving

#### E. Advantages

- It requires simple maintenance cares
- The safety system for automobile.
- Checking and cleaning are easy, because of the main parts are screwed.
- Easy to Handle.
- Low cost automation Project
- Repairing is easy.
- Replacement of parts is easy.

#### V. CONCLUSION

The project presented has involved the development and implementation of automatic transmissions for bikes. The motivation of this work is to implement this idea in clutch featured bikes with a suitable clutch control. Using the simplest PLC and required hardware enables to convert the old traditional gear shifting mechanism to semi automatic one. This type of gear transmission is very different in performance and working process from the other gear changers which using in two wheelers. When a gear shifting-up of an automatic transmission is to be effected, the load applied by the load device is increased, or the load is connected to an output rotation shaft of the engine via a selectively-connecting device, thereby reducing the rotational speed of the output rotation shaft of the engine to a required level. The application of this mechanism leads to make the driving process easier, reduces the risk of destabilizing the car, the lap/stage time, and the chance of miss shifting.

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