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Improved Mechanism for Converting Gear Transmission of Motorcycle from Manual to Automatic

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Abstract

This paper aims at to provide the improved mechanism for converting gear transmission of motorcycle from manual to automatic. Our proposed model of pneumatic actuated automatic gear and shift control uses a switch. The position of switch determines for automatic or manual transmission of motorbike. If the switch is in off-state, manual transmission is in play. Electronic Control Unit (ECU) receives respective signals from the sensors and it then activates pneumatic system. In Pneumatic system air pressure is build up which forces the piston to move up and down. We use double acting pneumatic cylinder in which air enters from the first port which generates pressure on one side and move the piston forward. From the other port air will move out and same process is followed for downward movement of piston. The proposed model discloses an Automatic gear shifting and actuation of clutch system by pneumatic system. No such device is available till date which can perform the said function. Normally the gear shifting and actuation of clutch are done manually, and in previous inventions the clutch is automatic and gear shifting is done manually, and they are using CVT clutch.

Keywords: Automatic Gear Shifting with Automatic Clutch in Motorcycle, Automatic Gear Shifting and Actuation of Clutch by Using Speed Sensor in Motorcycle, Changing of Gear and Clutch by Using Speed Sensors in Motorcycle

1. Introduction

Nowadays, problem of traffic jams in metro cities is increasing day by day and people who are riding on Two wheeler's specially motorcycle have to face problem of manually pressing clutch and shifting gears after every footstep. This causes unnecessary fatigue to riders affecting their ability to do other things. Also, if one of the mechanisms either clutch or gear is not synchronized with other, an abrupt sound is heard from the engine and sometimes, it leads to stopping of the motorcycle with a jerk which in some cases often results in road accidents.

For this, we can construct a mechanism to make this manual shifting automatic especially for this traffic interval and then again get back to manual transmission when traffic is running smooth. All we need is a mechanism working on compressed air to perform this shifting function instead of us smoothly with help of pneumatic cylinder and piston rod along with electrical control unit with guidance of sensors to perform this function accurately in time.

2. Solution Proposed

The proposed model discloses an improved mechanism for converting gear transmission of motorcycle from manual to automatic[1] which is easy to use for a new rider without any issue of engaging clutch and changing gear manually.

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We can have a separate clutch pedal and a gear pedal fixed adjacent to the normal existing gear pedal. The clutch pedal is given three movements upward, downward and a central position. The clutch is disengaged in both upward and downward position i.e. we can shift the gear in both positions. The clutch pedal and gear pedal move in same direction as they are fastened together and are further connected to the rod of pneumatic cylinder for its movement. The movement of the pneumatic cylinder is controlled using an Electronic Control Unit (ECU) with the help of pneumatic valve and a compressor. The whole mechanism is fixed externally without configuring any internal components of the motorcycle[2]. The mechanism automates manual gear transmission that also intends to increase its efficiency.

3. System and Architecture

3.1 Flow Chart

The flow chart of the proposed solution is shown in Figure 1 and its explanation is given below.

1. As the bike rider switch on the control using a switch mounted on handle bar, the automatic transmission activates, but, if the switch is in off state then the manual transmission is into play.
2. The speed sensor senses the speed of the motorcycle and sends the reading to the ECU and function of ECU starts.
3. If speed of the vehicles is within the predefined limits, ECU will send the signal to the compressor to get actuated and consequently the pneumatic cylinder gets functional as per the inputs from the compressor.
4. Pneumatic valve fixed in between compressor and pneumatic cylinder provides three positions of pneumatic cylinder rod viz. top, center and bottom position that correspondingly controls the movement of gear pedal and clutch pedal.
5. The pneumatic cylinder gets actuated and ultimately it moves the pneumatic cylinder rod, which pushes the gear pedal and clutch pedal as well for the simultaneous disengagement of clutch and shifting of gear as per the speed of the vehicle.

3.2 Block Diagram

The block diagram of the proposed solution is shown in Figure 2 and its schematic view is shown in Figure 3. In this, power supply gives power to both speed sensor and ECU. The speed sensor provides the appropriate readings or signals to the ECU, the ECU operates the compressor and sends singnals to the valve. The compressor sends pressurized air to the valve, the valve sends the pressurized air from the compressor to the pneumatic cylinder. The pneumatic cylinder then operates both gear pedal and clutch pedal via upward and downward motion of pneumatic cylinder piston.In the following sections each block of the block diagram is explained in detail.

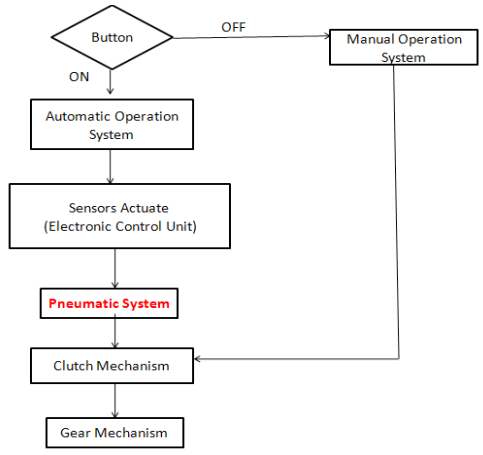


Figure 1. Flow Chart of proposed solution.

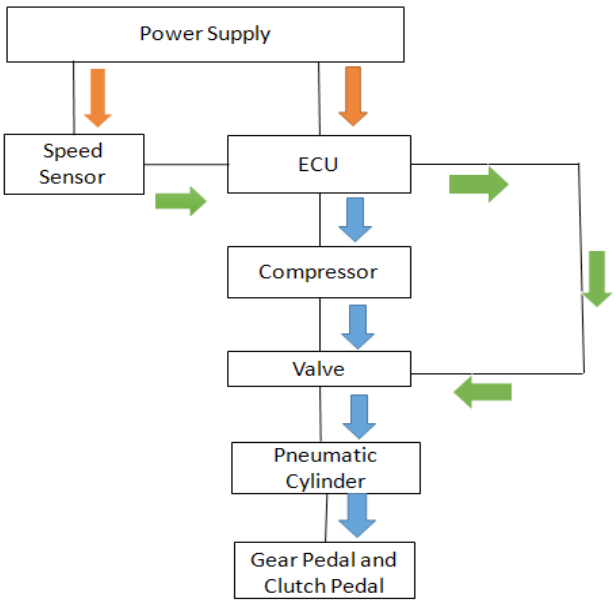


Figure 2. Block diagram of proposed solution.

3.2.1 Power Supply

For power supply, two 12 volt batteries are used as shown in Figure 4. 24V DC is used for valve relay actuation, 12V

DC is used for compressor, 5V DC is used for MCU and sensors.

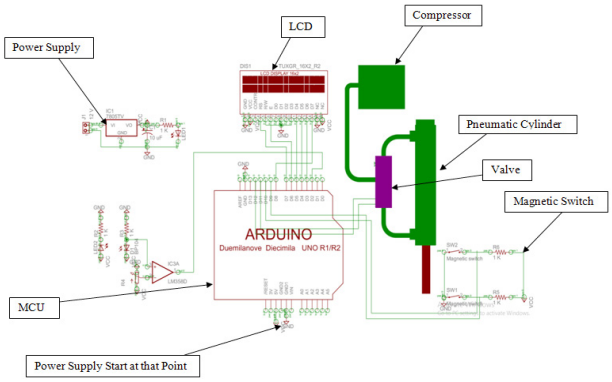


Figure 3. Schematic diagram.

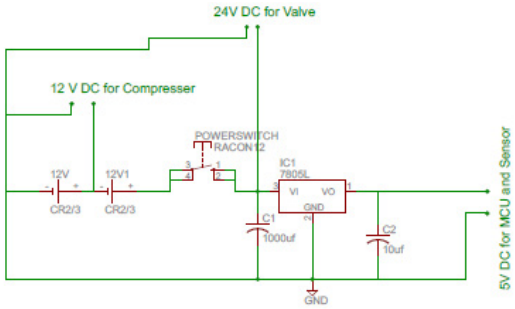


Figure 4. Power supply.

3.2.2 Speed Sensor

A speed sensor[8] is used to measure the speed of the motorcycle. This is fixed on the rim of the rear wheel. The sensor senses the speed of the rotating wheel[3]. Its actual view and schematic view is shown in Figure 5.

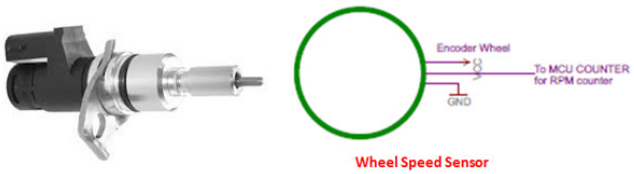


Figure 5. Speed sensor.

3.2.3 Electronic Control Unit

ECU (Figure 6) is basically a brain of an automobile[4]. It controls various functions in any machine in which it is embedded. Its schematic view is shown in Figure 6. The ECU in the proposed design controls the operation of the pneumatic assembly. The components of the ECU in the proposed design are:

- Micro Controller Unit (MCU)
- Power supply 5V DC
- Micro switches *2
- Rotary encoder
- Tachometer
- Magnetic switch

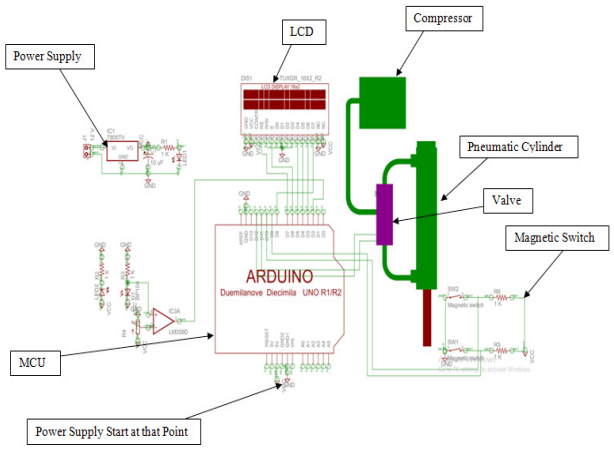


Figure 6. Electronic Control Unit (ECU).

ECU gets the supply of 5V DC. Here 2 micro switches are used one for the manual to automatic shifting and other for the actuation of the first gear. When bike starts moving, speed sensor (tachometer+rotary encoder) starts counting the speed (RPM) which is displayed on the LCD. When the speed increases, the clutch pull signal get triggered by the MCU and gear is changed. Again the controller releases the clutch slowly. The control system always monitors the RPM via tachometer i.e. whether it is increasing or decreasing and adjusts the gears automatically. The magnetic switches defined the extreme positions of the piston rod. When brakes are pressed or speed is below 5 RPM the controller automatically switches the bike to neutral and waits for the start button to be pressed again and for the system to work accordingly.

3.2.3.1 Microcontroller Unit

Arduino[9] microcontroller (Figure 7) consists of a programmable circuit board and software that run on a computer. The program is used to write and upload computer code to the circuit board.

3.2.3.2 LCD

A LCD[5] is attached at the speedometer. Its actual view and its schematic view is shown in Figure 8. The measured

value (RPM) is transmitted to the LCD which displays the speed to the operator.

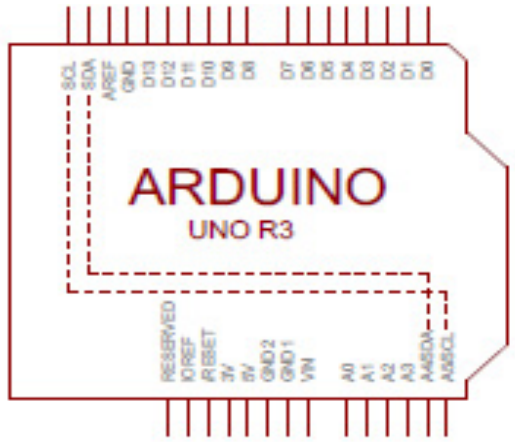


Figure 7. MCU (Microcontroller Unit).

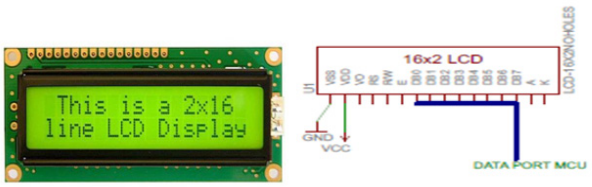


Figure 8. LCD.

3.2.4 Pneumatic System

Pneumatic system (Figure 9) contains compressor, DC valve, and pneumatic cylinder[6]. The compressor operates at 12v and valve operates at 24v DC.

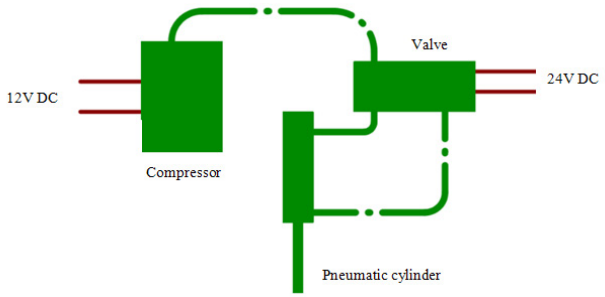


Figure 9. Pneumatic system.

3.2.4.1 Compressor

The compressor (Figure 10) is connected with the battery of the bike and operates as per the programming of the ECU. The compressor supplies air to the valve which in turn leads to the actuation of the pedals connected to the pneumatic cylinder.

Figure 10. Compressor.

3.2.4.2 Valve

It is a 5 port 3 position solenoid operated DC air discharge valve (Figure 11) which supplies the air to the required port of the cylinder. An electronic relay attached to the valve is connected with the ECU which controls the positions of the valve i.e. it decides from which valve port the air is to be supplied to the cylinder.

Figure 11. 5\3 Pneumatic DC valve.

3.2.4.3 Pneumatic Cylinder

The main purpose of the pneumatic cylinder (Figure 12) is to actuate the gear as well as clutch pedal directly[7]. Air from the compressor is supplied to the cylinder via pneumatic valve.

Figure 12. Pneumatic cylinder.

As the signals from the sensor at wheel are sent to the ECU, the ECU processes the information and directs it to the compressor as well as the valve relay. The compressor sends the air to the valve while the relay in response to the command sent by the ECU, operates the valve and sends

the air to the cylinder fitted over the pedals. As the air enters the cylinder, it moves the pedals in the direction of piston rod movement and operates the transmission system (gear and clutch assembly) according to the programming of the ECU.

3.2.5 Gear Pedal

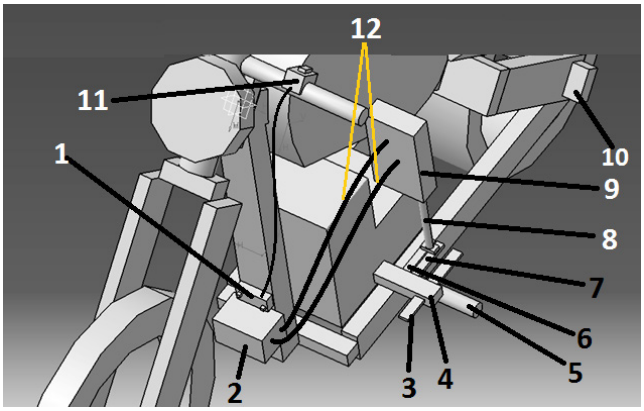
The gear pedal is attached to the pneumatic cylinder piston rod for the upward and downward position of the gear pedal. The gears will shift by upward and downward motion of gear pedal. The gear is in the neutral position only when the gear pedal is at its mean position which is done via 5 port 3 position DC valve.

3.2.6 Clutch Pedal

The clutch pedal is further connected to the clutch wire for engagement and disengagement of the clutch. The clutch pedal is provided with a two way mechanism of disengagement of clutch i.e. whether the clutch pedal is in upward position or downward position the clutch is disengaged and the mechanism is in position to shift gear. The clutch pedal disengages the clutch whenever it is pulled upward or pushed downward.

4. CAD Design of Proposed Solution

The CAD design is shown in Figure 13, in which all the components are shown by numbers.



1. Electronic control unit, 2. Compressor, 3. Manual Gear Pedal, 4. Engine Spline, 5. Footrest, 6. Automatic Gear Pedal, 7. Electronic control unit, 8. Compressor, 9. Manual Gear Pedal, 10. Engine Spline, 11. Footrest, 12. Automatic Gear Pedal

Figure 13. Bike design.

An 110cc bike is used for the proposed solution which is using sequential gear box. An On/Off switch (11) is used to actuate the automatic system of the bike. An additional pedal i.e. clutch pedal (7) is attached above the footrest (5) for the actuation of clutch. The automatic gear pedal (6) is fixed beside the manual gear pedal (3) at the engine spline (4). The clutch pedal is attached to the clip via clutch wire. As per the design the speed Sensor (10) at wheel gives signals to the ECU (1) which in turn operates the whole pneumatic system i.e. the compressor (2), valve, and pneumatic cylinder (9) via pneumatic pipes (12).Thus leading to the actuation of gear and clutch via the upward and downward motion of the pneumatic cylinder rod (8).

5. Conclusion

The proposed model is an improved mechanism to convert gear transmission of motorcycle from manual to automatic which is easy to use for a new rider without any issue of engaging clutch and changing gear manually. The model after being engaged in Automatic mode can be reverted back to manual setting whenever required thus; rider can also enjoy the ride where he has full control of his vehicle. The tiredness that rider has to face in traffic jams due to gear shifting can be greatly reduced enabling him to channelize his energy elsewhere for greater good.

This Model can be attached to any existing motorbike without disturbing any integral component thus; it does not adversely affect overall performance of the vehicle.

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