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Automation in Gear Shifting Mechanism

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Abstract: For the vehicle to move forward the engine has to be connected to driving wheels so as to propel the vehicle. The engine rotates at relatively high speeds, while the wheels are required to turn at slower speeds. The torque requirements of the vehicle vary as per the prevailing conditions of load, terrain etc. Gear box provides different gear ratios between the engine and the driving wheels, to suit the varying road conditions such as when climbing hills, traversing rough road or sandy road or pulling a load. The required gear shift for providing varying torque requirements can be obtained either manually or automatically. Automatic gear shifting mechanism is a concept implementing an embedded control system for actuating the gears automatically without human intervention. The automation is achieved by using a microcontroller and suitable sensor and actuator hardware. Whenever the speed of the vehicle increases or decreases beyond a pre-defined set of values, the microcontroller based control system actuates the clutch as well as the gear and helps maintain a steady operation of the automobile.

I. INTRODUCTION

A manual transmission, also known as a manual gearbox, stick shift, *n*-speed manual (where *n* is its number of forward gear ratios), standard, MT, or in colloquial U.S. English, a stick (for vehicles with hand-lever shifters), is a type of transmission used in motor vehicle applications. It uses a driver-operated clutch engaged and disengaged by a foot pedal (automobile) or hand lever (motorcycle), for regulating torque transfer from the engine to the transmission; and a gear selector operated by hand (automobile) or by foot (motorcycle).A conventional 5-speed manual transmission is often the standard equipment in a base-model car, while more expensive manual vehicles are usually equipped with a 6-speed transmission instead; other options include automatic transmissions such as atraditional automatic (hydraulic planetary) transmission (often a manumatic), a semi-automatic transmission, or a continuously variable transmission (CVT). The number of forward gear ratios is often expressed for automatic transmissions as well (e.g., 9-speed automatic).

Manual transmissions often feature a driver-operated clutch and a movable gear stick. Most automobile manual transmissions allow the driver to select any forward gear ratio("gear") at any time, but some, such as those commonly mounted on motorcycles and some types of racing cars, only allow the driver to select the next-higher or next-lower gear. This type of transmission is sometimes called a sequential manual transmission.

In a manual transmission, the flywheel is attached to the engine's crankshaft and spins along with it. The clutch disk is in between the pressure plate and the flywheel, and is held against the flywheel under pressure from the pressure plate. When the engine is running and the clutch is engaged (i.e., clutch pedal up), the flywheel spins the clutch plate and hence the transmission. As the clutch pedal is depressed, the throw out bearing is activated, which causes the pressure plate to stop applying pressure to the clutch disk. This makes the clutch plate stop receiving power from the engine, so that the gear can be shifted without damaging the transmission. When the clutch pedal is released, the throw out bearing is deactivated, and the clutch disk is again held against the flywheel, allowing it to start receiving power from the engine.

Manual transmissions are characterized by gear ratios that are selectable by locking selected gear pairs to

the output shaft inside the transmission. Conversely, most automatic transmissions feature epicyclic (planetary) gearing controlled by brake bands and/or clutch packs to select gear ratio. Automatic transmissions that allow the driver to manually select the current gear are called manumatics. A manual-style transmission operated by computer is often called an *automated* transmission rather than an *automatic*, even though no distinction between the two terms need be made.

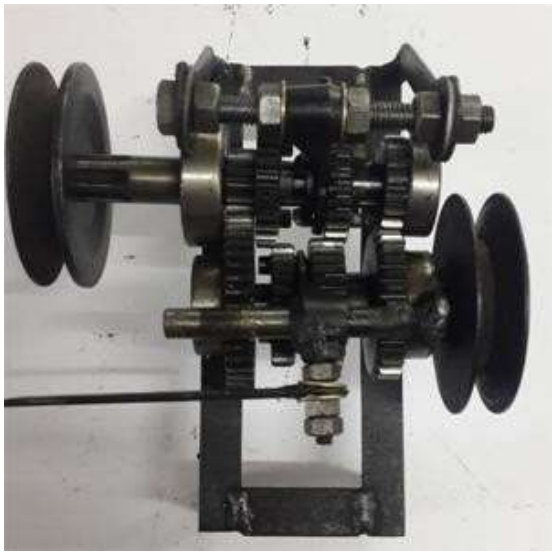


Figure 1.1: GEAR MECHANISM

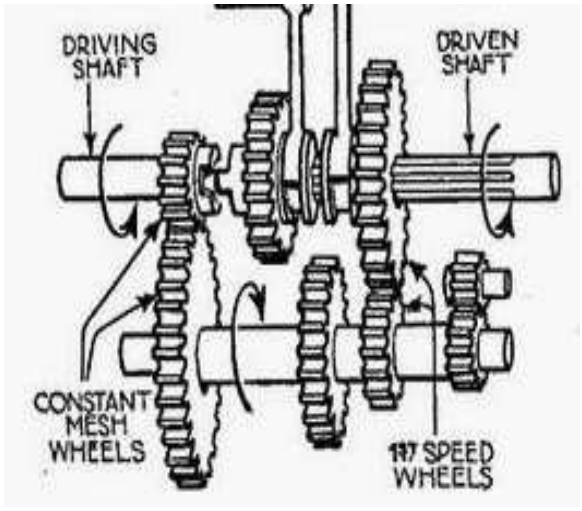


Figure 1.2: LINE DRAWING

1.1 Automatic Gear Shifting Mechanism

Automation is the use of control system to control a process replacing the human operators. Automation is now often applied primarily to reduce the human effort thereby to attain desired operation. Another major shift in automation is the increased emphasis on flexibility and convertibility in different process.

The automatic gear change mechanism is a step forward towards easing the driving operation of the automobile and at the same time efficiently controlling the transmission system thereby ensuring optimum effectiveness of the engine.

The concept of automatic gear change is applied in this work to a 4-stroke, manual transmission of four wheelers. The clutch is actuated by means of a DC Motor actuated mechanism and gear lever is actuated by means of the spring loaded solenoid actuator, both controlled by a microcontroller based circuit, programmed to read the signals from an inductive proximity sensor which senses the actual speed of the wheel. The system design and development is described in this paper with control circuit and control logics.

Concept

The automatic gear change can be ensured by continuously checking the rpm of the automobile through sensors which sends the signal to the input of Microcontroller. Whenever the speed is increased or decreased as compared to the predefined speed for a particular gear, the Microcontroller through its logic circuits sends the signals to the actuators via its output pins. The actuators apply necessary force on the clutch and then the gear pedal to cause the change of gears. This concept consists of three major systems: Sensor, Microcontroller and Actuators.

The sensor used in this system is Inductive proximity sensor. The Arduino Uno is a microcontroller board based on the ATmega328. Arduino has an 8-bit architecture. The microcontroller is the brain and controls all the actions of the system such as sensing and actuating. It selects the transmission gear as per speed of the vehicle without any human interference. The Actuators here are spring loaded Solenoid actuators and DC motor in which the output of the Microcontroller is connected. By using automatic gear change system, effective controlling by automation can be easily achieved. Moreover, the automatic gear change system not only reduces human effort but also helps in proper gear changes at the required time.

1.2 Hardware Selection Sensors

Sensors provide the windows through which microprocessor-based systems can observe their environment. They are generally used to detect the presence, absence, or motion of an object. Various sensors available are: Optical sensors, Magnetic sensors, IR sensors and Inductive proximity sensors Inductive proximity sensors operate under the electrical principle of inductance.

Upon detection of the target, the sensor‟s output is switched „ON‟.[4]

1.3 Microcontroller

A microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. The Arduino Uno has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. [3]

The reasons behind a spontaneous selection of this are mentioned below:-

• Easy to interface with its peripherals.
• Flexibility
• Availability being it as an Open Source platform
• Ease in programming
• Does not need a separate loader for a program to load and can be loaded via USB port.
• In-built Analog to Digital Convertor (ADC)

1.4 Embedded systems

Embedded systems contain processing cores that are typically either microcontrollers or digital signal processors (DSP). The key characteristic, however, is being dedicated to handle a particular task. They may require very powerful processors and extensive communication, for example air traffic control systems may usefully be viewed as embedded, even though they involve mainframe computers and dedicated regional and national networks between airports and radar sites (each of the radar probably includes one or more embedded systems of its own). Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.

Physically, embedded systems range from portable devices such as digital watches

and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure.

II. LITERATURE REVIEW

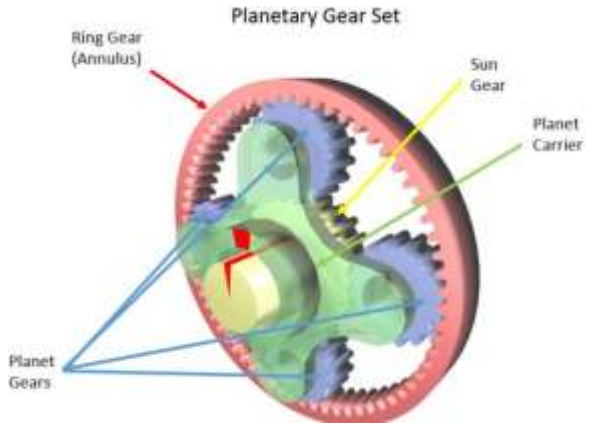
[1] A semi-automatic electric gear shifting apparatus for use in shifting gears in gear boxes of motorcycles and the like gear boxes wherein gears are shifted by rotating a spindle operably connected to a ratchet type gear shifting means. The said gear shifting apparatus comprises a lever arm connected at one end thereof to said spindle and connected at its other end to a toe pedal means. An actuating rod is operatively connected to said toe pedal, and the rod is reciprocated to move said lever arm and thus said spindle by a solenoid which is actuated selectively by a pair of push button switches mounted on the handle bar of the motorcycle.

[2] A shifting arrangement of an automatic transmision of a motor vehicle has a selector lever which can be pivoted in two shifting paths. In the first shifting path of the selector lever, various operating positions and automatically shifting gears of the transmission may be selected via a transmitting device. The selector lever can be changed over into a second shifting path in which, by a one-time pivoting of the selector lever from a center position, an upshifting or return shifting may take place by one gear respectively.

[3] The present automatic transmission is fully mechanically controlled and costs little 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. This experiment aims to improve the gear shifting process with a suitable control mechanism to implement in clutch featured bikes. According to the suggested gear shifting method, the microcontroller selects the transmission gear as per the speed of the vehicle without any human interference

III. METHODOLOGY

Now here we calculate the range of speed of gear box output power and range of all minimum and maximum rpm of the gear box shaft in every gear mashing condition… If we consider the speed for first gear is 0km /h to 20km/h for second 20km/h to 30km/h for third 30km/h to 45km/h and for greater than 45km/h take for the gear mashing. Here, we have the range in term of speed in km/h now converting the vehicle speed in rpm for that use the equation , as given below. N=V*60/3.14 D; Where , N=speed in rpm V=speed in m/s D=tire diameter in m Take, D=0.80 meter tire diameter. Thus by using this equation we can find the our speedometer speed km/h can convert in revolution per minute(rpm).



The torque converter is also in charge of driving the transmission fluid pump. The fluid pressure is what activates clutches and brakes in the planetary gear set. The pump is often a geroter type pump (a gear pump) meaning that a rotor spins in a pump housing and as it spins, it "meshes" with the housing. This "meshing" creates chambers that change in volume. When the volume increases, a vacuum is created- this is the pump inlet. When the volume decreases, the fluid is compressed or pumped by the meshing of the gears- this is the pump exit. A hydraulic control unit sends hydraulic signals to change gears (via band brakes and clutches) and to lock the torque converter.

IV. CONCLUSION

After achieving the desired gear shifting technology, we ever able to get a smooth ride in all city conditions. We have found that there is an improvement in the fuel efficiency. This gear shifting technology has improvised the auto-clutch featured bike into automatic transmission vehicle. The complete gear changing mechanism has been controlled by the acceleration of the bike. The vehicle can be used in manual mode by switching off the power supply to the electrical components. A switch has been provided for this optional mode. The programmed embedded 'C' codes, in the microcontroller, were optimized and were the key source for changing gears in city limits as well as highways

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