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Design of Arduino driven gearbox

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ABSTRACT

In this project, we aim at developing an easy gear shifting mechanism for transmission which will make motor car rider's gear shifting very easy. It is everyone's personal wish for the effortless functioning of the automobile irrespective of the torque for pickup of the vehicle the human is using, yet the most important structure that every engineer works on is the gear shifting mechanism and looking after the effortless and desired ride on the car. Some simple mechanism is arranged with the pmdc motor and cross slider which will help us to change the gear as per the desired torque. In this gear shifting mechanism, gear shifting is done with the help of two cross slides. During this mechanism, the gear is operated by a servo motor which is controlled by the module feed in the Arduino Uno.

Keywords— *Gear shifting mechanism, Cross slide, Servo motors, Automotive industry, Gearbox, Arduino UNO*

1. INTRODUCTION

With the advent of automated gear transmission system ease of access to vehicles has increased over the last 20 years. Generally, in 2 wheelers, gear is shifted manually with the help of lever but this technique is not suitable for handicapped people and also non-handicapped people can get a maximum comfort level while driving. So we are in the process of making it more friendly and convenient to use. This can be achieved using motors and some mechanism to operate the lever shaft.

Nowadays, manual transmission or sequential type is a type of transmission used on cars, where gears are selected in order, and direct access to specific gears is not possible. The use of the old school method allows the driver to shift the lever of the gear to the desired position. The condition to shift to a new gear is the engagement of the clutch preceding the change of gear. This causes the torque transfer to cease totally. The old school method of shifting gear manually requires appropriate knowledge of clutch, timing, and speed by the driver. Only after proper knowledge, the manual transmission of gear is done smoothly [1].

So this project is to transfer motion through Arduino driven gearbox to reduce human labor, change gear ratios as the vehicle moves, freeing the driver from having to shift gears manually and to achieve efficient driving which reduces human efforts and fear while driving and easy driving [2]. Manual transmission of gears gives the privilege to the driver to shift from gear to gear at his own will by positioning the lever at the exact location. A clutch must be disengaged before the new gear is selected, to disengage the running engine from the transmission, which is very confusing and risky at times. After the study of the complications in manual transmission, a gearbox was designed using the hydraulic, as well as the pneumatic systems, in which the change of gear levels could be done with the help of buttons or electronic switch. The hydraulic and pneumatic systems use actuators that require a compressor. This system is much better than manual gear transmission but this concept is not implemented yet in reality because the weight of this system is more than usual also it has got drawbacks of space availability. The button-operated gear shifting system is much advanced than hydraulic and pneumatic system. It uses electromagnetic actuators to shift the gear. This system does not need compressor as needed in hydraulic system. But the electromagnetic actuator is not easily available. Also, the torque generated is difficult to control to advance this concept fully automated was invented. In this system, the various components like speed sensors and gear sensors are used [3].

2. DEFINITION OF THE PROBLEM

- Conservation of fuel is the major problem regarding any automobile invention or development.
- Generally in cars, gear is shifted manually with the help of lever but this technique is not suitable for handicapped people and also non-handicapped people can get a maximum comfort level while driving.
- The confusion to shift the gear to the desired level at the situation of emergency while driving. The technicality behind this emergency is to shift to the required reduction ratio between gears in a gearbox.

3. LITERATURE REVIEW

This paper is about Design and fabrication of a semi-automatic gear. In-car races or in events of Go-Kart shifting of gear forms the basis of pick up and speed of the car the driver drives. The accolades of the race can be decided by a difference of mere

milliseconds. Automatic gear shifting gives the driver the leverage to focus on driving and steering than to focus on shifting of gears at such events. The driver can experience the privilege of effortless driving and give more focus to other aspects of driving than gear shifting. The need for a study in the pneumatic system arose after the difficulties faced by the driver in situations of heavy traffic. To bring the car or vehicle in motion from a stationary position the driver has to release clutch each and every time. New drivers and learners have a tough time grasping this technique. So to make this easy for such drivers the study on automatic gear shifting is justified [4]. To provide the comfort that the driver needs in such situations, cars with AMT systems are used. Many major companies in the world such as Suzuki, Ferrari, and Volkswagen provide this system in their vehicles. But in situations where there is a need to change the gears frequently these pneumatic and hydraulic gear shifting mechanism falls short in providing adequate amount of torque to the vehicle. To overcome this situation the electromagnetic gear transmission system is used. It is considered to be superior to the hydraulic and pneumatic system [5].

4. OBJECTIVE

- To make the gear shifting automatic.
- To make system wireless using Arduino.
- To make the system useful for physically handicapped people.
- To make the system useful for industries to reduce labor work.

5. WORKING

To improve passenger safety as well as comfort, the use of automotive technology has increased in many fields, namely, the ABS system, several safety systems and also active steering systems. The growth in these fields showed improved results in preparing a noiseless smoother gearbox. Gear shifting mechanisms can be judged on the basis of its ease to shift the gear. This aspect is very important when we focus on small cars driven by handicapped people [6].

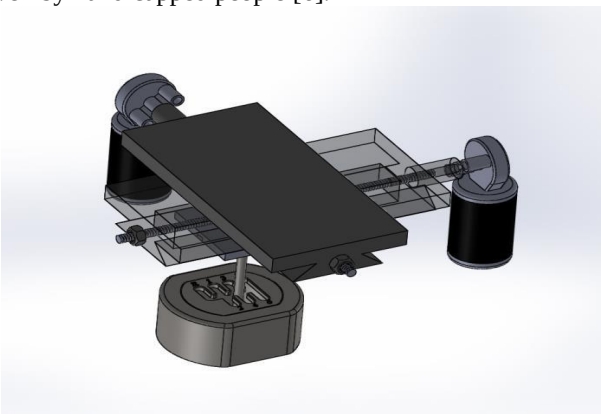

Fig. 1: Cross Slide Mechanism

The cross slide used in the lathe machine will be used here. The cross slide has the lead screw inside it. By moving the lead screw in the clockwise and anti-clockwise direction the table can be moved in a linear direction. To make the movement in a linear direction, two PMDC motors will be used to provide torque to the lead screws for the cross slide to move in X and Y direction. By using the cross slide any position in the plane will be covered. The motor will be controlled using an Arduino circuit. The whole system will be designed to work and will be controlled on Bluetooth. The android app will control the gearbox lever movement and the system will be wireless [1].

6. CIRCUIT DETAIL

The Arduino Uno used in the circuit is a type of microcontroller board which has its functions defined on the basis of ATmega328. It consists of a total of fourteen digital pins, the analog inputs. These pins are used for the input and output commands of the circuit. Out of these 14 pins 6 can be used and PWM outputs. For smooth functioning of the Arduino, it requires a 16 MHz ceramic resonator combined with a power jack, an ICSP header [7]. For connectivity, a USB cable connection and to troubleshoot a reset button is attached. Having all these components on the microcontroller board the Arduino can be directly connected to the computer with the help of a USB cable with a supply of AC or DC connection [8].

The Arduino Uno uses Atmega16U2 (Atmega8U2 up to version R2) [9]. It is regulated as a USB – to serial converter. The resistor pulls the 8U2 HWB connectivity into the ground under revision 2. This makes it much easier to achieve the DFU mode. Revision 3 is slightly different than the previous ones and has some new features. SCA and SDA pins are added in 1.0 pinout near the AREF pin. Another two pins are located near the RESET pin. The shields are allowed by the IOREF to adapt to the voltage received from the board. In the near future, the shields will be able to adapt to both, the ones that use AVR (5V) as well as the Arduino (3.3V). Revision 3 also possesses a stronger RESET circuit. 8U2 is replaced with Atmega 16U2.

The word 'UNO' is derived from the Italian language which means one. It is named to mark the opening release of Arduino 1.0. This acts as the version of the Arduino. The latest series is marked by the USB Arduino Uno boards.

Table 1: Summary of Arduino used

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

7. RELAYS

The working of the relay functions on the basic fundamentals of an electromagnet. A power supply, small size of wire and an iron material object is needed to make a working electromagnet. Till the current or power supply doesn't flow through the iron

material, it does not act as an electromagnet. Once the current starts flowing it attracts other metal materials around it, forming an electromagnet.

Understanding the concept of electromagnetic attraction a relay is formed. If we keep the material near the electromagnet and once the attraction takes place to close the contacts of the materials, it will form a relay with the help of an electromagnet.

The most common type of relay is the single pole single throw (SPST) relay. It is merely a replica of a switch that is electrically controlled. The property possessed by this relay is to control a big flow of current with the help of a small flow current. This gives us the leverage to use small diameter sized wires to transfer large amounts of current without any damage and wear and tear of the material.

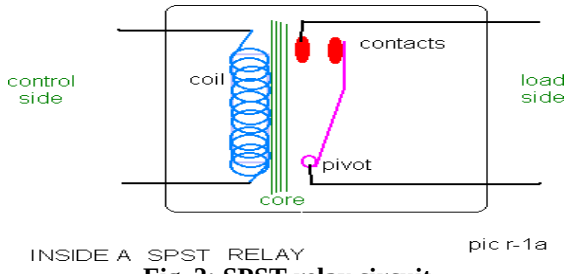

Fig. 2: SPST relay circuit

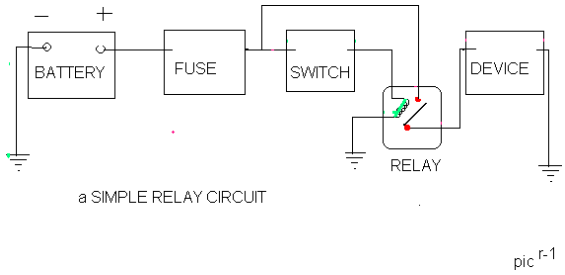

Fig. 3: Simple Relay Circuit

The diagram presented below shows the functioning of the relay circuit. With the use of a small amount of current, the coil inside the relay is powered by the control circuit (green). The battery is earthed to the ground. The current flows through the battery to the fuse which is used as protection against fluctuations. This current passes through a switch to the coil which then energizes it.

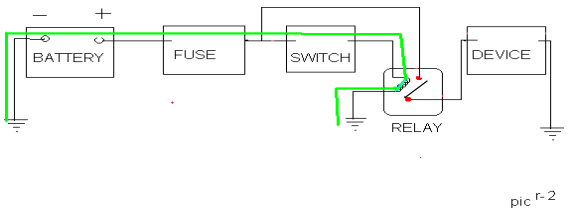

Fig. 4: Working of a Simple Relay Circuit

An electromagnet is formed after the coil is energized. This electromagnet now attracts the metal in the vicinity with contacts and closes and derives a secondary heavy path (red).

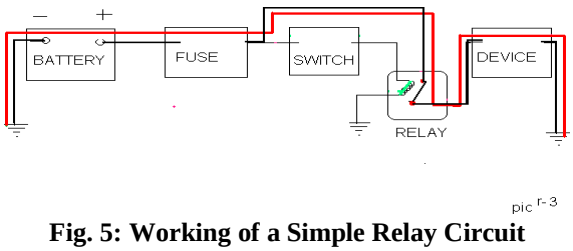

Fig. 5: Working of a Simple Relay Circuit

The electromagnet works only till the time the current flows. Once the switch is opened the current stops flowing and the metal is no more an electromagnet.

8. PARTS OF ASSEMBLY

8.1 Lead screw

The lead screw is used under the XY table. It allows the table to move in a linear direction. A total of two lead screws are used for the movement in both directions.

Fig. 6: Lead Screw

8.2 Motor

The movement of the lead screw requires power. It is supplied with the help of two PMDC motors of 20 N-m/s each. These PMDC motors regulate the movement and positioning of the lead screw which is defined by the input from the Arduino.

Fig. 7: PMDC Motor

8.3 Cross slide

The cross slide contains the lead screw and acts as a support to the motor. The cross slide defines the position of the gear lever.

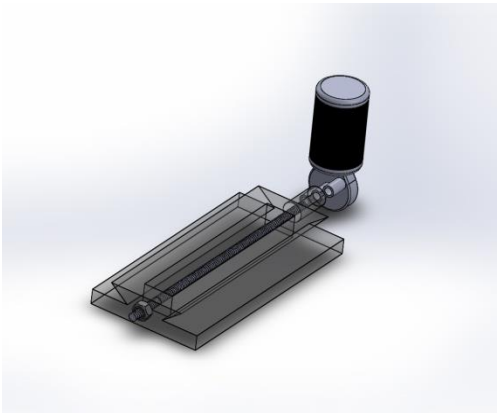

Fig. 8: Cross Slide

8.4 Table

The table holds the gear lever. The gear lever is directly connected to the gearbox. The gear shifting mechanism is done with the help of the gear lever.

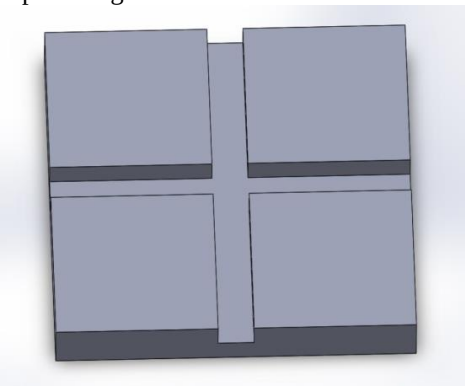

Fig. 9: Table

The different views of the entire assembly show the exact model of the automatic gear shifting mechanism. The whole system is controlled by the inputs fed into the Arduino.

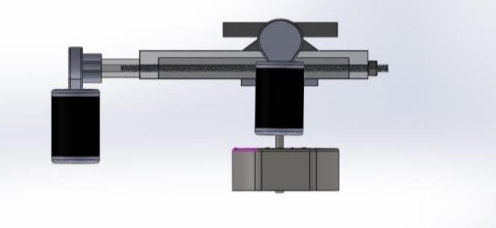

Fig. 10: Side View

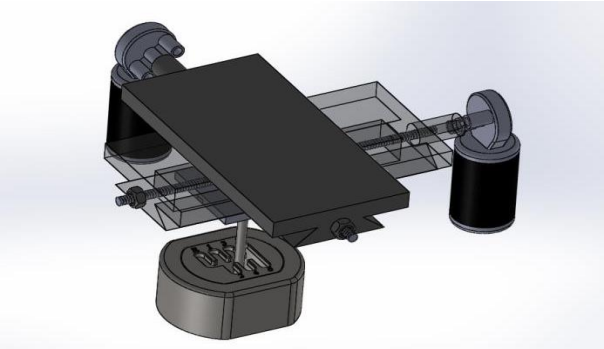

Fig. 11: Isometric View

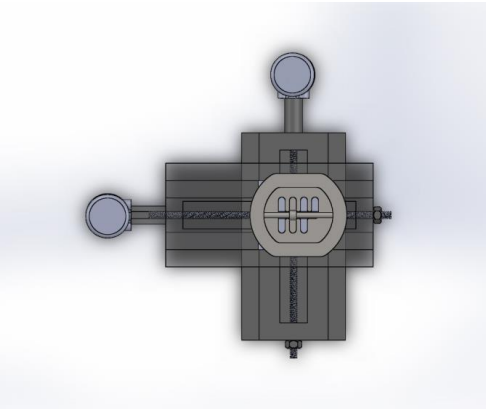

Fig. 12: Top View

9. GEARBOX

While fabricating a gearbox, the most important factor to be considered is the gear reduction ratio. Ideal gear reduction ratios for a 4-speed gearbox are as follows:

I^{st} gear = 4.2:1

II^{nd} gear = 2.56:1

III^{rd} gear = 1.52:1

Top gear = 1:1

The smallest pinion on the layshaft should have a minimum of 15 teeth to deliver the desired reduction in ratio and speed.

A pinion shaft of a standard size 20 mm diameter is used. The corresponding bolt size to M10 of 8 mm is used. The lead screw of 15 mm diameter for a 4-speed gearbox with the mentioned reduction ratio is used.

10. CONCLUSION

In this paper, we can conclude that this type of gear shifting mechanism allows the driver to have an effortless experience. The torque required by the vehicle is delivered without lag. This model which is Arduino driven is cost-effective compared to the models prepared by brand companies. The driver does not need to operate the clutch manually. This model is fuel-efficient. The chances of the driver suffering from fatigue due to driving are lowered down. The gear shifting mechanism becomes smooth and noiseless. The shocks and jerks experienced due to the release of the clutch are not experienced. This type also gives an opportunity for the physically handicapped people to experience driving and not rely on their subordinates to travel.

11. REFERENCES

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