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Stressless Gear Using Embedded System Technology

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Abstract

Today's world need cars to be more automated. Automation not only focuses on the ease of use but also on the technology applied. Automatic cars, to an extent, have features such as automatic gear system, comprising of auto mode (discussed in later sections), which changes in accordance to the speed of the car being accelerated. Initially, semi-automated vehicles such as formula cars, Volvo buses having more than 5+1 gears were designed by using a Transfer Case Control Unit (TCCU). The disadvantage in using TCCU is that, cars designed for the road traffic cannot withstand the speed of traction. So, the idea is to propose an embedded gear over the steering instead of gear rods. The controls of a gear can be directly embedded over the steering for the ease of operation of the driver. This paper explain how a gear system in a car can be installed in a power steering.

Keywords: Microcontroller; switch; gear transmission; motor.

1. Construction

1.1. Steering gear control

The gear control, as said previously, is embedded in the steering is shown in figure 2. It has six metal contacts from which one can beselected using a sliding contact in order to provide a current flow into the port of the microcontroller. These metal contacts are provided with a power supply of +5V to enhance the current flow through it. When the switch is closed, the microcontroller interprets that a particular signal is applied in accordance to the gear applied.

2.2 Speedometer input

As a car already has a speedometer to indicate the speed at which it runs, it is very much easier to track it's speed. In theproposed system, speed tracking is essential to indicate the driver that he is crossing the allowable speed for the current gear. This

indication is done using analarm. The speed limit and the input speed are compared using the microcontroller. Alternatively, a crankshaft sensor can also feed the input to the MCU by identifying the speed at which the crankshaft rotates.

2.3 Clutch and Brake inputs

The clutch/brake inputsare fed to the microcontroller in order to bring the gear position to neutral. This is achieved using pressure sensors installed at the clutch and break sites.

2.4 Microcontroller

8051 is a basic microcontroller (MCU) which is a stand-alone, high performance embedded system. It is intended for the use in sophisticated real time applications, such as instrumentation, industrial control, automobilesand computer peripherals. It provides extra features like interrupts, bit addressability, and an enhanced set of instructions which make the chip very powerful and cost effective. It is an 8-bit microcontroller, with a 64KB of data memory and 64KB of program memory.

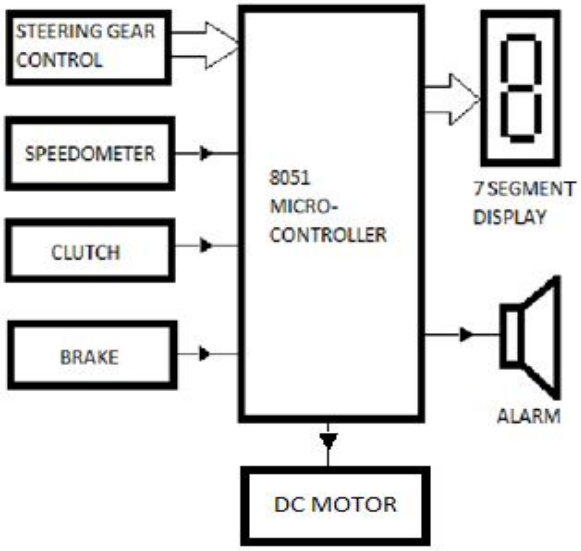

Fig. 1: Block diagram of the stress-less gear system.

2.5 DC Motor

A dc motor is designed with a stator and a rotor. As the name suggests, the stator is a fixed magnet made of coils, produce the main flux and the rotor is a rotating armature winding that produces deflection and rotates according to the polarity given. The proposed idea uses three dc motors controlled by the MCU through interface circuitry. The manual gear rod engages the dog clutch into the desired gear plate on the main shaft to drive the vehicle. There are three separate dog clutches to handle the gears {1, 2}, {3, 4}, {5, R} gears respectively. The idea that, a rod linking the dog clutch with the manual gear rod balls can handle two gear plates, is replaced by the dc motor to

handle this operation mechanically and automatically. Each motor can be provided a polarity inversion to make it rotate in the reverse direction. This helps in pushing the dog clutch in both forward and reverse directions. Similarly, this concept applies to the other two motors. Adopting the motor for moving the dog clutch mechanically forward and backward needs a separate gear module.

2.6 Front end switches

The switches are placed over the steering for the driver to operate directly and reduce the burden of using a lever in applyinga gear mechanically. It is simply a link that has two conductors on the either ends that is closed circuited when the switch is placed onto the switch in which either of the conductors is provided with a supply of +5V, as in figure 3.

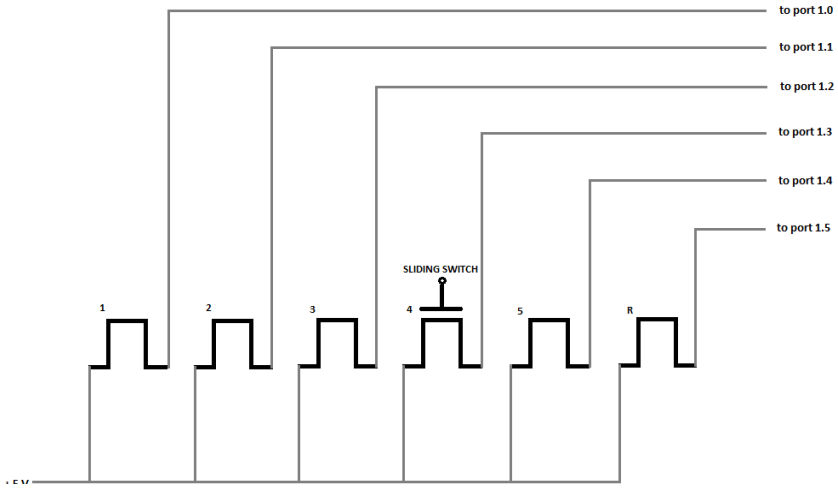

Fig. 3: Internal connections of switches in the steering.

2. Basic Operation

All the above said constructional elements are integrated and synchronized using the microcontroller. All the inputs are fed to the controller as electrical pulses, as shown in figure1, where they are processed based on an assembly language program. The inputs are digital, and hence, there is no need of digitizing. The programming part is discussed in the next section**.**

3. Concept Involved

3.1 Gear transmission:

	00	01	11	10
0	000(0)	001(1)	011(3)	010(2)
1	100(4)	101(5)	111(R)	-

Fig. 3: Digital values for the corresponding gears.

```
0->1    000-001  1 BIT CHANGE
1->0    001-000  1 BIT CHANGE
1->2    001-010  2 BIT CHANGE
2->1    010-001  2 BIT CHANGE
2->3    010-011  1 BIT CHANGE
3->4    011-100  3 BIT CHANGE
4->3    100-011  3 BIT CHANGE
4->5    100-101  1 BIT CHANGE
5->4    101-100  1 BIT CHANGE
-----------------------------------------
2->0    010-000  1 BIT CHANGE
3->0    011-000  2 BIT CHANGE
4->0    100-000  1 BIT CHANGE
5->0    100-000  1 BIT CHANGE
```

4. Operation

The driver, who intends to change the gear, pushes the switch to its corresponding position which shorts the +5V supply to the connection provided to the port of the microcontroller. As per the algorithm, the corresponding gear position is transmitted to the microcontroller. This in turn is displayed in the display unit. When the speed needs to be increased, the relative gear must also be changed, which is to be manually operated. This is made available to the driver by giving an alarm which alerts the driver to change to the next gear. The overall operation is controlled by the microcontroller, that is already been programmed.

The programming follows the given algorithm. Initially, after ignition, the driver puts the vehicle in first gear. The microcontroller senses the current speed and the gear position and then slowly instructs the driver to move to the next gear through the alarm. Under normal running conditions, the controller continuously senses the break input, accelerator input and the clutch input. In case, if the driver forces the vehicle to reduce from a higher speed, there is a need to bring the gear to neutral. This is also achieved by the microcontroller's program.

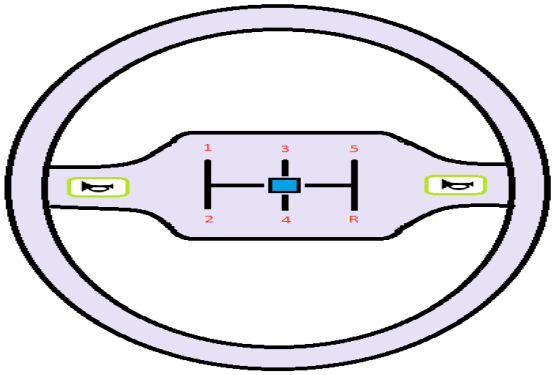

Fig. 2: Front end appearance of the gear system.

5. Algorithm

1. Initial State - 000(Gear in Neutral)
2. Applying Fisrt Gear -State Changes To 001
3. Sense the Speed from KMPH

i) Generate alert when the Speed Range and Gear State Goes Different

ii) Display the Current Gear State After Update

4. If the Vehicle is in high SPEED and if sudden brake is applied the gear state should reach Neutral position once the SPEED Reduces to Minimum Range.
5. Repeat from step2.

6. Conclusion

The implemented gear system over the steering appears as in the fig 2. The proposed system is more advantageous over the existing manual gear system. The cost of installation and design is very less and affordable. Also, the application of embedded system into an automobile, makes it reliable and efficient.

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