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ELECTRONIC POWER STEERING

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ABSTRACT

Electric Power Steering for automobiles is primarily an energy saving scheme. Steering is the term applied to the collection of components, linkages, etc. which will allow a vehicle like a car Electric power steering offers greater vehicle safety by adapting variable steering ratios to human needs, filtering drive train influences and even adjusting active steering torque in critical situations. This is the latest technology in steering system; this system is work without maintenance, and fast response comparatively mechanical steering system. This paper introduces the basic composition of the electric power steering system, and put forward the reasonable design solutions of the soft hardware and the correction methods of controller, given the main technology index of the controller. It then describes the mechanisms involved, and the nuts and bolts of the all electric power steering systems for automobiles. Actuators, sensors and controllers that make electric power steering a reality in modern automobiles are described subsequently. In addition, it can make cars even lighter and more fuel efficient when compared to those using hydraulic steering systems. The central electronic elements of today's power steering systems are modern 32-bit microcontrollers, ARM controllers (MCUs). Since power steering is a safety-critical function, it also requires new MCU elements that support the functional safety of the overall system.

KEYWORDS: EPS (Electronic Power Steering System), ECU Electronic Control Unit, Brushed DC motor, Rack and Pinion.

I. INTRODUCTION

There are three kinds of automobile steering system, for mechanical and hydraulic, and electricity powered. At present, most car use rotary valve hydraulic power steering system but parts of cars start to use electric power steering system and it has obvious effect in energy saving. It is the concept of Toyota Auto Company and jeep Auto Company. basically in heavy traffic performance of steering system need powerful working without extra efforts ,That's why we design this project or prototype of four wheel electric steering system with 90 and 360degree electric powered steering system. The current automobile electric power steering system (referred to as EPS) has significant advantage: energy-conserving and environment-protective; easy to modular design and installation; convenient in maintenance, easy to adjust and testing. In addition, some new technologies such as automatic driving, automatic parking, also require the application of EPS. The central electronic elements of today's power steering systems are modern 32-bit microcontrollers, ARM controllers (MCUs). Only high-performance MCUs can provide sufficient computing power and specialized peripherals for complex motor control functions. Since power steering is a safety-critical function and requires new MCU elements that support the functional safety of the overall system Only high-performance MCUs can provide sufficient computing power and specialized peripherals for complex motor control functions. Since power steering is a safety-critical function and requires new MCU elements that support the functional safety of the overall system.

II. MATERIALS AND METHODS

Basic principle of EPS

The automobile electric power steering system (EPS) is made up of two parts. Mechanical structure and electronic unit. The mechanical parts include the steering wheel, steering column, torsion bar, reduction gears mechanism, power steering motor, gear and rack, etc.; Electronic parts include the steering wheel torque sensor, the wheel speed sensors and electronic ECU etc. Compared with the traditional hydraulic steering system (HPS), Electric Power Steering (EPS) system adopts motor to offer the driver assistance directly and has the advantages

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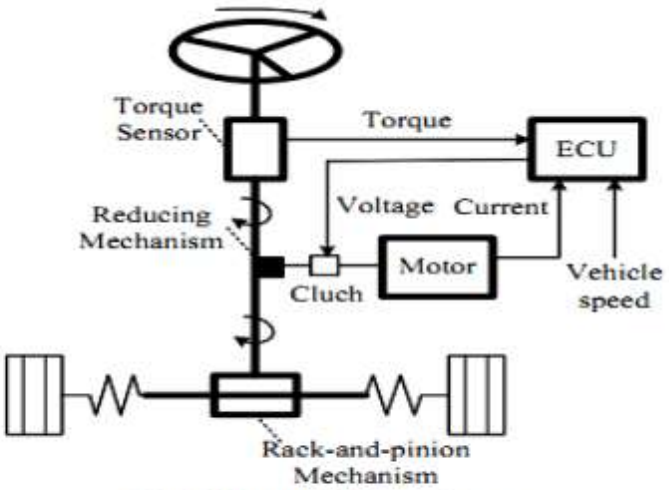
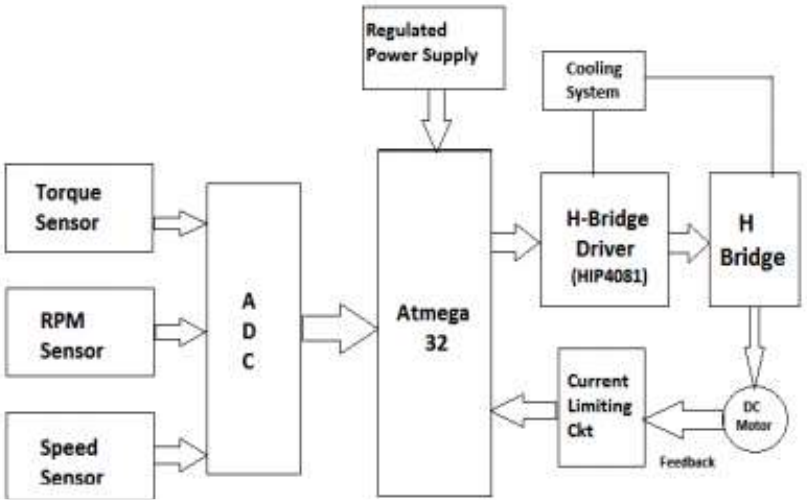
of economy, handiness, easy adjustment, less noise and waste ,oil pollution and so on the composition and working principle of EPS system.



Electronic Power Steering

Electronic Control Unit (ECU) Design

EPS ECU consists of microcontrollers, A/D converters, motor drive circuitry and regulated power supply with force cooling system.



Block Diagram of ECU

The EPS controller is designed based on motor current control method. The EPS controller consists of an interface circuit that coordinates the signals from the various sensors, an A/D converter and a PWM unit that are all built into an one-chip microprocessor, a watchdog timer (WDT) circuit that monitors the operation of this microprocessor, the motor-drive circuit that consists of power MOSFETs in an H bridge circuit driven by pulse width modulation (PWM) over a 20kHz carrier. The ECU conducts a search for data according to a table lookup method based on the signals input from each sensor and carries out a prescribed calculation using this data to obtain the assist force. In addition, trouble diagnosis for the sensors and the microprocessor is also carried out. When a problem is detected, power to the motor is interrupted, an indicator lamp illuminates, and the problem condition is memorized. Then this problem mode flashes on a display as necessary.

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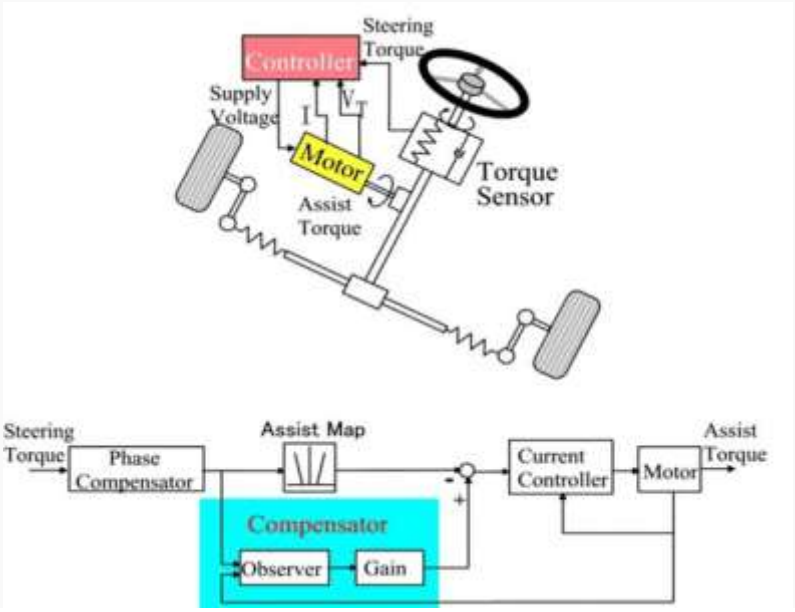
Working of EPS

A "steering sensor" is located on the input shaft where it enters the gearbox housing. The steering sensor is actually two sensors in one: a "torque sensor" that converts steering torque input and its direction into voltage signals, and a "rotation sensor" that converts the rotation speed and direction into voltage signals. An "interface" circuit that shares the same housing converts the signals from the torque sensor and rotation sensor into signals the control electronics can process. Inputs from the steering sensor are digested by a microprocessor control unit that also monitors input from the vehicle's speed sensor. The sensor inputs are then compared to determine how much power assist is required according to a preprogrammed "force map" in the control unit's memory. The control unit then sends out the appropriate command to the "power unit" which then supplies the electric motor with current. The motor pushes the rack to the right or left depending on which way the voltage flows (reversing the current reverses the direction the motor spins). Increasing the current to the motor increases the amount of power assist. The system has three operating modes: a "normal" control mode in which left or right power assist is provided in response to input from the steering torque and rotation sensor's inputs; a "return" control mode which is used to assist steering return after completing a turn and a "damper" control mode that changes with vehicle speed to improve road feel and dampen kickback. If the steering wheel is turned and held in the full-lock position and steering assist reaches a maximum, the control unit reduces current to the electric motor to prevent an overload situation that might damage the motor. The control unit is also designed to protect the motor against voltage surges from a faulty alternator or charging problem. The electronic steering control unit is capable of self-diagnosing faults by monitoring the system's inputs and outputs, and the driving current of the electric motor. If a problem occurs, the control unit turns the system off by actuating a fail-safe relay in the power unit. This eliminates all power assist, causing the system to revert back to manual steering. A dash EPS warning light is also illuminated to alert the driver.



Working of EPS

III. RESULTS AND DISCUSSION

The results show that the EPS controller designed is stable and credible, and can meet the requirements of steering performance. The demands for faster speed, higher quality, and reduced power requirements in vehicles are continually increasing. In order to respond to these demands, research and development is under way on the application of electronic control with the aim of further improving functions and performance. Features that are being proposed include the introduction of intelligent control strategy and the application of power steering, which responds to the driving environment by varying the assist amount in accordance to fit the sensitivities of human operators.

Formulae:

1] Effort level control

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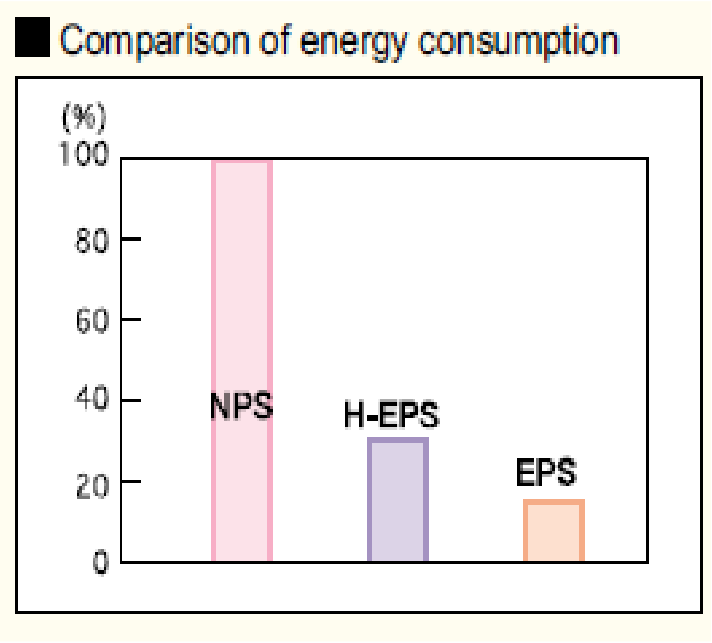
During any 120 degree interval of phase current *I*, the instantaneous power (P) being converted from electrical to mechanical is

$P = \omega T e = 2EI$
$T e$ = *Electromagnetic torque*
E = *Induced EMF per phase.*
$E = 2NphBgLr\omega$, *per phase induced emf*
Nph = Number of winding turns per phase
Bg = Rotor magnetic field density
L = Length of the rotor
r = Internal radius of rotor

2] Effort level control

Using the above expression the electromagnetic torque is given by,
$T e = 4NphBgLrI = K\varphi I$
Where,
K = Torque constant
φ = *Flux per pole pair*

Tables:



IV. CONCLUSION

EPS has got upper hand compared to Hydraulic power steering because.

- Reduced driver fatigue.
- Enhances dependability and safety.
- Compact, modular design and flexible tuning capability.
- Helps improve fuel economy by reducing the pressure the pump has to work against during straight-ahead highway speed driving.
- Accommodates most vehicle platforms.
- Reduced steering system operating temperature.
- Lower noise under all driving conditions

V. ACKNOWLEDGEMENTS

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