# Design and manufacturing of electronic power steering system and adaptive headlight system

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*Abstract*— **In the modern automobiles automation, terms like auto parking , auto driving havebeen given highest priority for safety and comfort of the customers.The aim of this work is to design and manufacture a jointless electric power steering and to remove the drawbacks of conventional steering system.This system is used to eliminate the problem of steer locking as well as reducing the effort for rotating the wheel during hill side areas which are faced in hydraulic steering system. Sensors like ultrasonic sensor and speed sensor are used. These sensors help to achieve instantaneous rotation of steering wheel and determination of speed of vehicle which are used as input to the electronic microcontroller. Using these inputs from different sensors, the microcontroller gives power to the electric motor which is connected directly to the reduction gear box. The power can be changed according to the rotation of wheel.The obtained power is used to customize steering rotation as per requirement using different input program to the Arduino-Uno used. In Adaptive headlight system the focus of the light of vehicle can be rotated according to the rotation of wheel to get more effective light while turning which will helpto minimize the accident while driving in night.**

*Keywords*— **Jointless electric power steering, adaptive headlight, reduction gear box , steer locking , Arduino UNO**

## I. Introduction

Since the first vehicles being equipped with a steering wheel, many modifications are carried out till today's state of steering systems. While for a long period of timehydraulic power steering (HPS) systems were considered the optimum solution for all vehicles but this system has some drawbacks like maintenance, steer locking, oil leakage and also the effort required for steering in hillside roads is large. To eliminate these drawbacks new system was required. So in order to fulfill those requirementuse of steering system is shifting from HPS to electronic power steering(EPS). By today, EPS systems have a wide market penetration starting from light vehiclesto the heavy passenger vehicles with high wheel loads such as SUVs. Number of road accidents occur due to insufficient and improper focus of headlights while driving in night on curved roads. In adaptive headlight system the direction of focus of headlight can be changed according to rotation of wheels, so we can get sufficient amount of light in required direction.Thus head light arrangement operably connected to the steering mechanism of the vehicle for illuminating the proposed path of travel.

## II. Modelling

### A. EPS Model

EPSsystemsfacilitateanindividualdesignofthe steering torque feedback within large boundaries but current demands go beyond this degree of freedom. In order todesign steering feedback, it is also desirable to realize a variable steeringangletransmission ratio. In fact, the first systems that were able to independently vary torque and angle transmission ratios were superimposed steering systems incorporating an additional gear set to enable the variable angle transmission ratio. It took another decade and some changes in legislation until the first real steer-by-wire system was introduced in a series-production vehicle Car safety is the avoidance of automobile accidents or the minimization of harmful effects of accidents, in particular as pertaining to human life and health. Special safety features have been built into cars for years, some for the safety of car's occupants only, and some of the safety of others. One of the choices available is Design and fabrication of steering controlled head light system.

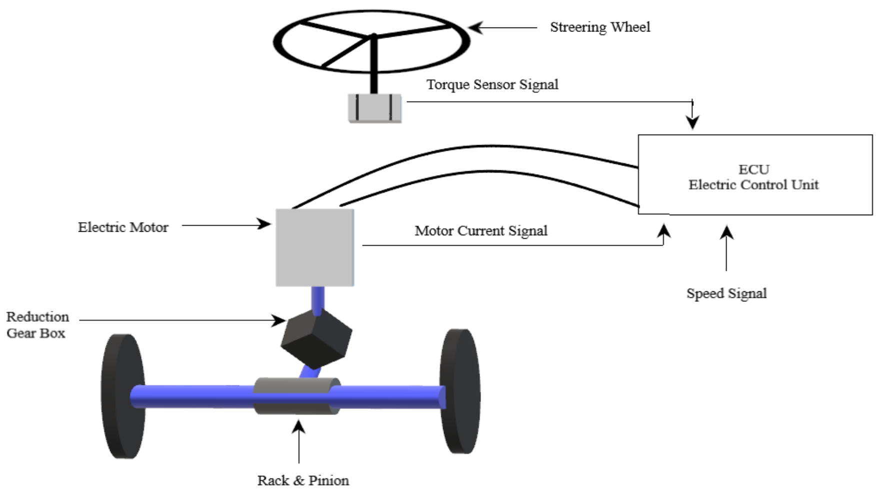


Fig. 1 steering mechanism with EPS

*B. Adaptive headlight modelling*

The device relates to a headlight arrangement for vehicles, and, more particularly, to a head light arrangement operably connected to the steering mechanism of the vehicle for illuminating the proposed path of travel including support brackets operable to support head light members thereon connectable to a frame portion of the vehicle, linkage means interconnecting the brackets for conjoint movement thereof, and means interconnecting one of the brackets to the connector rod of the vehicle whereupon the brackets and headlight members are moved in relation to the direction of vehicle travel. Still, more specifically, this device relates to a headlight arrangement operably connected to the steering and front wheel assembly of an automobile operable to maintain headlight members and front wheels pointed in the same direction at all times

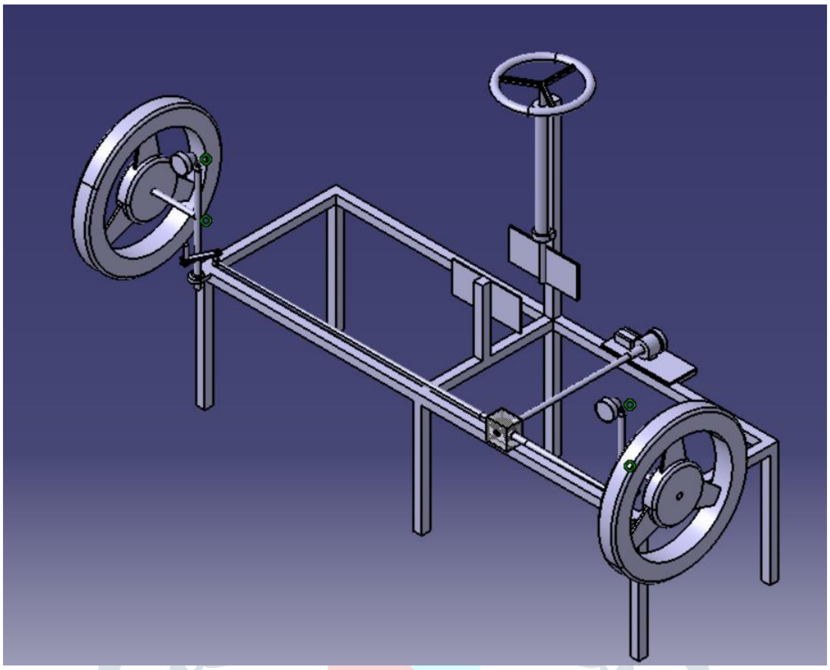

Fig. 2 EPS &Adaptive Headlight system

## III. Control Unit

Arduino is used to control the steering ratio of the vehicle according to the program provided as the input. Inputs are taken from speed sensor connected to wheels , torque sensor connected to steering wheel and ultrasonic sensor.Using these outputs from sensor arduino controls the steering ratio. The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It 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. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode. Revision 3 of the board has the following new features:

## IV. Design

*A. Shaft*

$F = m x g = 490.5$ N
$P = F x V = 49.50$ Watt
$T = P x 60 / (2\pi n) = 9.36 \times 10^3$ N-mm
$D = [(MR x 16) / (\pi x \tau)]1/3 = 15$ mm

*B. Motor*

$\tau = (P \times 60) / 2\pi N = 5.294$ N-mm$^2$

$\tau = (\pi \times F_d \times d^3)/16$

Therefore , d= 6 mm

*C. Welded joints*

$P = 0.707 \times S \times L \times F_t$
Therefore, $F_t = 6.73536$ N/mm$^2$

## V. SPECIFICATIONS

| Sr no | Components | Specifications |
|---|---|---|
| 1 | Frame | 1300 x 410 x 330 mm |
| 2 | Steering Shaft | D = 15 mm |
| 3 | Ultrasonic sensor (hc-sr04) | VCC =5 v |
| 4 | D C motor | 12 v , P = 18 watt , N = 30 rpm |
| 5 | Control unit | Arduino UNO ATmega 328P |

## VI. LITERATURE REVIEW

*A. Hao Chen , YaliYang , Ruoping Zhang*

Electric Power Steering is a full electric system, which reduces the amount of steering effort by directly applying the output from an electric motor to the steering system. This research aims at developing EPS boost curve embody into the assist characteristics, improving steer portability and stability. A model for the EPS system has been established, including full vehicle mechanical system ,EPS mechanical system, and EPS electric control system. Based on this model, a straight line boost curve was designed and evaluated in this environment to improve the performance of EPS system. Results showed that EPS system with the designed boost curve reduced reacting time and overshoot value, thus ensure the dynamic reaction and stability.

*B. FAN Chang-sheng , GUO Yan-ling*

The automobile electric steering system is a servo control system. According to the performance requirements of cars steering system, make the relevant control strategy of the electric power steering system and through the design of related software and hardware to realize this control strategy and it can control each link of the automobile steering process. In order to verify the feasibility of the control strategy, comparison experiments are carried out on a vehicle equipped with the developed EPS and the imported EPS, respectively. The results indicate that the developed EPS has similar performance with the imported one. The developed EPS not only works smoothly, but also has proper steering performance, thus can be equipped on passenger cars. The power effect is remarkable and hand feeling is good. At current, we are completing the program and debugging of the fault diagnosis.

*C. Vivan Govender , Steffen Müller*

The purpose of the controller is to ensure accurate and robust following of desired trajectories of front steering angle as well as to deliver a smooth steering wheel movement. Firstly the steering model shows how all nonlinearities for the elastic elements, frictions and gear ratio are considered.Thereafter open loop behaviour of the model is examined to determine system resonances. Next a controller synthesis using a Linear Quadratic Integrator controller as well as pole placement is developed. The performance of these controllers is presented in simulation. These results show good tracking performance from the two approaches presented and supports the use of a state space controller design approach in dealing with the various requirement of steering angle control for autonomous driving.

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