Steer By Wire System

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Abstract- *The automotive industry has already implemented many advanced computer systems in an attempt to increase safety and comfort of drivers. In parallel with these advancements we see a big shift from mechanical systems to electrical systems and steer by wire system is another implementation that is very promising in terms of safety and functionality. Already, there are some commercial prototypes of such 'steer by wire' systems. Steering operated by rack and pinion mechanism is operated by using electronics circuit. The motor attached to the pinion is rotated by using motor.*

Keywords- Steer by wire, angle sensor, rack and pinion, electronic motor

I. INTRODUCTION

Steer-by-wire systems are a relatively new development compared to the traditional mechanical, hydraulic, or electric steering systems that are currently used for motor vehicles. It provides the potential benefits of enhanced vehicle performance, improved handling behavior, and fully integrated vehicle dynamic control. A steer-by-wire system aims to eliminate the physical connection between the steering wheel and the wheels of a car by using electrically controlled motors to change the direction of the wheels and to provide feedback to the driver. Today's automobiles benefit more and more from the many uses of electronic systems. The integration of a steer-by-wire system can enhance these systems in many ways. In particular, the handling and the safety of the cars can be improved significantly. Since a steer-by-wire system is easily modifiable, different drivers will be able to adjust the system to accommodate their styles and this will enhance handling.

II. LITERARURE SURVEY

[1] Er. Amitesh Kumar: The steering system acts a significant role of making car convenient to handle and enhance the vehicle stability. In the past one hundred years, the development of steering system has experienced many stages, and the Steer-by-Wire system (SBW) is the newest technology of steering system for passenger cars. But the Steer-by-Wire system has not yet accepted by public consumers and permitted by state regulations, in consideration of the reliability and safety of the system.

[2] R. Rajasekar: This paper analyzes the feasibility of improving the steering behavior in traffic situations using variable steering geometry. The design and fabrication of rack and pinion has been done by using solid works software. The objective of this paper is basically to design and manufacturing a variable rack and pinion with higher to lower ratio in order to sensitize the steering for better comfortable for Indian road condition or urban road condition. A variable-ratio steering, is a system that uses different ratios on the rack, in a steering system.

III. SYSTEM DESCRIPTION

BLOCK DIAGRAM
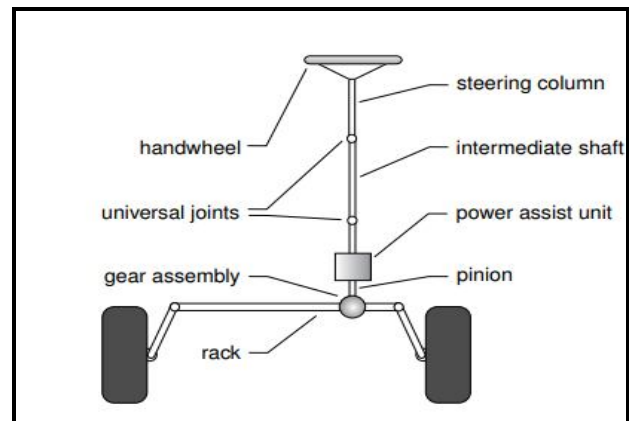
IV. WORKING & DESIGN

- The working of the system depends on the electronics system.
- Motor is used to steer the wheels with particular angle.
- Pinion is assembled to the motor in order to move rack according to the rotation of the motor shaft.
- Wheels are connected to the rack in order to prove the concept. When the shaft of the Motor is rotated with some angle it will rotate pinion .
- Rotation of the pinion is converted into linear motion.
- Wheels are connected to the rack with hinge link.
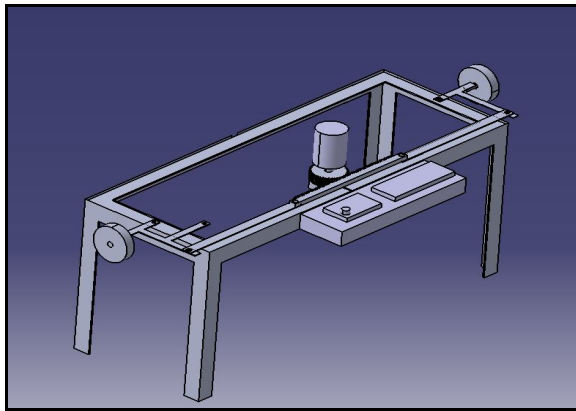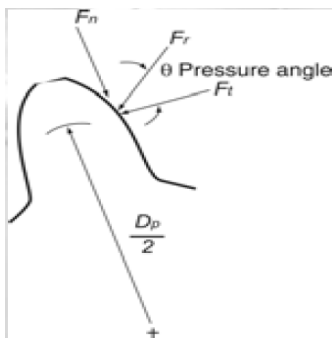- The linear motion of the rack causes rotation of wheels**.**

Fig: steer by wire mechanism design

V. CALCULATION

1. Rack & pinion:

- **In rack and pinion following parameters are used:**

f_t= transmitted force

f_n = normal force

f_r = resultant force

θ = pressure angle

Pressure angle = 20^0

- $\tan\theta = \dfrac{Fn}{Ft}$

$Fn = Ft \tan\theta$ …………………………(1)

f_t= tangential force (weight of frame)

 = 10 kg

f_t= 10 x 9.81

f_t= 98.1 N

f_n = 98.1 x $\tan 20^0$……………(2)

f_n = 35.7054 N

f_r= 104.39 N

- Power(P)= $=\dfrac{Force\ x\ displacement}{time}$ …………(3)

P= 4.905 watt

- $P = \dfrac{2\pi NT}{60}$ …………………………(4)

assuming the minimum rpm value=30

    T = 1.56 N.m.

- $T = f_t \times r$ …………………………………(5)

r = 15 mm....................(radius of pinion)

D = 30 mm

P_d = diametrical pitch

$P_d = \dfrac{T}{D}$ ……………………………………(6)

$= \dfrac{18}{30}$

P_d = 0.6 mm^{-1}

$\sigma_t = \dfrac{f_t \times P_d}{y.b}$ …………………………...(7)

$= \dfrac{98.1 \times 0.6}{30 \times 0.308}$

σ_t = 6.37 N/mm^2

$\sigma_{allow} = \dfrac{S_{ut}}{fos}$ …………………………….(8)

$= \dfrac{210}{2}$

σ_{allow}= 105 N/mm^2

So $\sigma_t << \sigma_{allow}$

So design is safe.

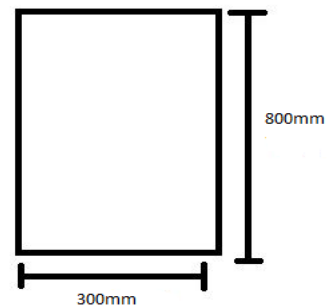- $m = \dfrac{D}{T}$ ……………………………(9)

$= \dfrac{30}{18}$

m= 1.66

Then the module of pinion = 1.66

Also The module of rack = 1.66

2. Calculation of frame

Frame design for safety , for 25*25*3 L angle mild steel channel

b = 25 mm, d= 25 mm, t = 3 mm.

Consider the maximum load on the frame to be 50 kg. Max. Bending moment = force*perpendicular distance

$= 50*9.81*150$

M = 73575 N.mm

We know,

$\dfrac{M}{I} = \dfrac{\sigma_b}{y}$

$I = \dfrac{bd^3}{12}$

I = 32552.08 mm^4

$\sigma_b = \dfrac{M.y}{I}$

$= \dfrac{73575 \times 12.5}{32552.08}$

$\sigma_b = 28.25$ **N /mm^2**

The allowable shear stress for material is

$$\sigma_{allow} = \frac{S_{yt}}{FOS}$$

S_{yt} = yield stress = 210 N/mm^2

And factor of safety = 2

So **σ_{allow}= 105 N/mm^2**

Comparing above,

$\sigma_b < \sigma_{allow}$

28.25 < 105 N/mm^2

So design is safe.

VI. CONCLUSION

- By using the steer-by-wire technology the performance of steering system can be increase and fixed the steering ratio according to the requirement.
- In this technology replace the mechanical link of steering system by electric connections, therefore it have many advantage over conventional steering system like fuel free, environment friendly, less space required, the position of steering system varying according to requirement, improve the handling at low speed .
- For increase the characteristics and features steer-by-wire of the contact less angle sensor preferred because it is reduce the mechanical losses.

VII. FUTURE SCOPE

- Fabricate and assemble the parts of steer by wire mechanism and check as per the requirement.
- Analyze the mechanism theoretically, practically and using analysis software.
- Apply the steer by wire concept on actual vehicle.

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