Design and fabrication of Steering System for Easy Parking with android application

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Abstract: This paper aims to operate the vehicle steering with the help of android phone which reduces the man effort. Main view is to improve the technology used in the world now a days. This clubs both automobile and electrical control system. Different electrical circuit are been designed for the motherboard control unit. This is project test has been done with the help of the car steering kit and the prototype of the same has been used. Here mainly operation of the steering will be done with the help of the android phone which will have a controlling app in it. The paring operation between the phone and control board is set through Bluetooth. This operation work within the Bluetooth range.

Literature Review

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.[1]

In addition, the steer-by-wire system can realize active intervention control, which can improve the vehicle handling stability, and bring more development space for the design of steering characteristics [2] .

The front steering angle of SBW system is mainly controlled by the steering angle motor, which can make it obtain more direct and accurate control[3]-[4].

Meanwhile, because of the influence of the vehicle structure on the transmission characteristics, the vehicle system has the hysteresis and nonlinearity in itself. When driving in the complex environment, the vehicle is expected to not only have a real-time and accurate operation according to the intention of the driver, but also can automatically revert to the safe state in case of danger[5]-[6]. Therefore, it is necessary to control the front steering angle reasonably.

At present, research on the control of the front steering angle mainly focus on improving the vehicle handling stability[7]-[12]. However, they neither have a comprehensive analysis of the control effects under different road test, nor consider the driver factors in the whole closed loop system. Therefore, it is unable to analyze the influence of the SBW system on the vehicle dynamic characteristics comprehensively.

The SBW system controller is divided into the steering wheel motor control and the front wheel motor control. The purpose of the steering wheel control is to improve the driver's steering feel by generating reactive torque. The purpose of the front wheel motor control is to steer the front wheel angle appropriately for improving the vehicle's maneuverability and stability. The proposed SBW control system. where the driver torque applied to the steering wheel is considered as the input, and the front wheel angle is defined as the output. The system is composed of two loops: upper loop, which mainly consists of steering wheel

and torque feedback motor, and lower loop, which mainly consists of front wheel and a driving motor. To achieve the bilateral control performance, these two loops are controlled by two PID controllers(proportional–integral–derivative), respectively[8].

The basic purpose of the steering wheel motor control is to generate reactive torque like a real commercial vehicle when the driver steers[9]. Furthermore, it makes the steering wheel easy to steer at low speed or when parking the vehicle and to make steering wheel tight at high speed for improving the driver's steering feel by adjusting reactive torque. It is relied on the variable steering ratio. PID control method is used to control the steering wheel reactive torque motor in this thesis

In the mechanical vehicle, the gear ratio was fixed; therefore, the steering characteristic of the vehicle can be nonlinear varying with the changes of the velocity and lateral acceleration in the vehicle. For the control of the vehicle following by the driver's desired trajectory, the driver must adjust constantly the steering wheel to ensure to control the steering of the vehicle, thus, these extra controls are actually increasing the burden for the drivers. [10]

For control of the front wheel, the signal from the HILINK board is very important because there is no mechanical linkage between the steering wheel and the front wheel like there is in a conventional steering system. [11] To control the front wheel motor, the PID control method is also used.

The PID controllers will be designed to reduce the tracking errors. The controller gains are adjusted according to the simulation results referring to the Ziegler-Nicholas rules. As for different velocities the gear-ratio will be different. To account for this variation, several PID controllers will designed for several typical velocities such as 20km/h, 5km/h, 60km/h, 70km/h, 80km/h, and for other velocities, the PID controllers will be scheduled by interpolating the relevant controller gains. [13]

The simulation model is built by Matlab/Simulink the variable gear-ratio in the SBW system is included. The torque map is also considered in this simulation. The torque relates to the angle of front wheel (or considered as the steering wheel angle) and the velocity of the vehicle. The relationship between the steering wheel angle and the steering torque was shown. The variable gear-ratio and the torque map both rely on the vehicle velocity and front wheel angle. The simulation is done by providing a defined steer torque to the steering wheel. The constraints on the inputs and outputs are considered, which are defined as the constraints of the steering wheel angle at the low speed according to the variable gear-ratio. [14] In this paper, the constraint of the steering wheel angle is set to 365.5 degrees because the maximum of the front wheel angle is about 40 degrees.

The gear ratio is defined as the ratio of steering wheel rotation to steer angle at the road wheel. Normally these range from 15 or 20 to 2 on passenger cars. A steady-state control strategy for ideal gear ratio was introduced to keep the steering gain of the vehicle as a constant and make the characteristic of the SBW vehicle independent of the speed and steering angle. A stability control algorithm was proposed to correct the steering angle dynamically based on the vehicle state feedback. The results of the simulation and the test in a driving simulator showed that the introduced strategy does keep the vehicle steering gain constant to reduce the driver burden, allowing the unskilled driver to drive the vehicle easily and effectively. [11] The proposed stability control algorithm based on the vehicle state feedback improves safety and stability of the SBW vehicle.

In the process of driving, keep the steering gain does not change while the steering wheel changes, in other words, it would keep the linear relationship between the angle of steering wheel and the yaw rate with the different velocity and lateral acceleration. [15] This would reduce the operations of the drivers to keep the

vehicle steering along the desired route. It is an easier job for the drivers operating a vehicle because the less steering compensate was needed. In the same time, variable steering ratio used in SBW system could improve the safety and stability of the vehicle, which would be suitable for more different kinds of people to control the vehicles, especially for the non-professional drivers or young lady to control the dynamics of automotive.

The mechanical connection between the steering wheel and front wheels of automotive steer-by-wire system (SBW) has been cancelled, which gets rid of the limitation of traditional steering system completely. Thus, it can design the force and displacement transmission characteristics freely, and resolve the contradiction between the portability and steering feel of the steering system [16].

Aim of project

In this project firstly we will be going to discuss about the main back ground what this project mainly meant to design.

Here will be studying about various components which are been used and there specifications parameters and there capacity as per given specific values. So in order to do the kit a “Electronic steering system” has been used. This is used because its more efficient compared to other steering system

A specific circuit is designed to operate the “Electronic steering system” and program for the same has been designed to operate the DC motor present in steering system whether it should rotate either clock or anticlock as per the required conditions of the driver.

Description of Automobile component.

Steering:

The steering linkages connecting the steering box and the wheels usually conforms to a variation of Ackermann steering geometry, to account for the fact that in a turn, the inner wheel is actually travelling a path of smaller radius than the outer wheel, so that the degree of toe suitable for driving in a straight path is not suitable for turns. The angle the wheels make with the vertical plane also influences steering dynamics (see camber angle) as do the tires.

FIG: 2

Steps to Convert AC to DC Converter and How it Works

Power Supply Circuit

Electrical power supply became as a basic need in our day-to-day life, the power we are availing is 230V 50Hz AC supply. But, by using power electronics converter circuits this power can be converted into the required and range. These converters are power electronics circuits which are further classified as step-down & step-up converters, voltage stabilizer circuit, AC to DC, DC to DC, DC to AC converter circuits and so on. Most of the microcontrollers which we frequently use in designing electronics projects require a 5V DC supply, this 5V DC can be obtained from available 230V AC supply by using AC to DC converter in the power supply circuit.

Power Supply Circuit

In general, we can observe a circuitry from which the mains power supply is taken and this circuit is used to control the power delivering to the load. Hence, this circuit can be called as a power supply circuit and there are various types of power supply circuits such as switched mode power supply, variable power supply, DC regulated power supply, etc., which are classified based on various criteria.

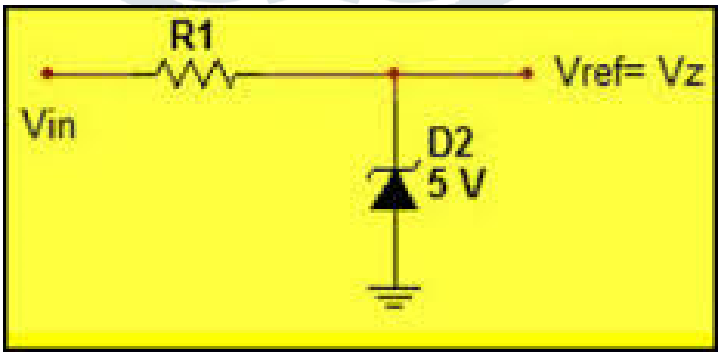


FIG: 23

BATTERY

Sealed lead acid rechargeable battery 12V 8.0Ah

Specifications

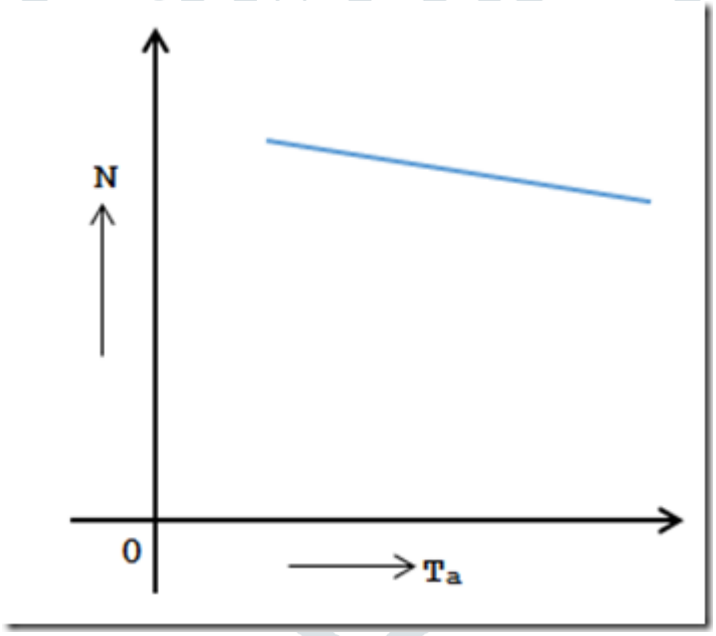
Nominal voltage: 12V

Rated capacity: 8.0Ah

Type: sealed

Usage: UPS

Life: 5 years



Where

N- Speed

T_a- torque

Specifications

Hardware features

Typical -80dBm sensitive power

Low power 1.8V Operation, 1.8 to 3.6V I/0

PIO control

UART interface with programmable baud rate

With integrated antenna

With edge connector

Software features

Default baud rate: 38400, Data bit: 8 stop bit: 1, parity: No parity, Data control: has. Supported baud rate:

9600,19200,38400,57600,115200,230400,460800.

Given a rising pulse in PIO0, device will be disconnected.

Status instruction port PIO1, low – disconnected, high – connected;

PIO10 and PIO11 can be connected to red and blue led separately. When master and slave are paired, red and blue led blinks 1time/2sec in interval, while disconnected only blue led blinks 2times/sec.

Auto-connect to the last devices on power as default.

Permit paring device to connect as default.

Auto-reconnect in 30mins when disconnected as a result of beyond the range of connection.

RESULTS AND CALCULATIONS

The required torque that is applied by motor to rotate the steering has been calculated by given rated rpm

$$T=P/w_n$$

Where

T= Torque

P= Power

w_n= mechanical speed

$$P=VI$$

V= Voltage

I= Armature current

$$P=12 \times 8$$

$$P=84 \text{ Watts}$$

$$\text{Speed (N)}=2400$$

$$w_n = \frac{2\pi N}{60}$$

$$w=258.736$$

Torque produced

$$T = \frac{84}{258.736}$$

$$T = 320 \text{ N-mm}$$

SI.NO.	Parameters	Symbol	Formula	Spur Gear	Rack
1	Module Teeth	m		3	3
2	Pressure Angle	α		30	30
3	Number of Teeth	Z		12	24
4	Coefficient of Profile Shift	X		0.6	
5	Height of Pitch Line	H			32
6	Working Pressure Angle	αw			30
7	Centre Distance	Ax	Zm/2+H+xm	51.8	51.800
8	Pitch Diameter	d	Zm	36	
9	Base Diameter	Db	dcosα	33.829	

TABLE 7.1

Rack and Pinion gear dimensions

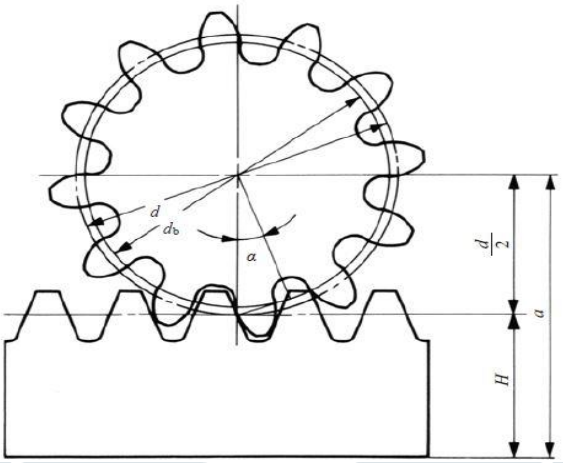


FIG: 29

CONCLUSION

Combination of both android and steering controlling gives more comfort in long drivers and it is best use full for the automobile transmission vehicles as the future is totally automatic drive.

This operation system is to use and gives more flexibility to the hands of the operator and can be operated within the Bluetooth range. Consumes less space and very efficient with 12V and 24 voltage battery power.

Modification can be done to make use for controlling acceleration, braking as they even improve comfort levels of drivers, moving the vehicle in and out of parking spaces can be done more efficiently as the driver can better view from outside.

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