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Micro Controller Assisted Variable Steering Ratio and Solution of Pulling of Car

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Abstract— At present most of the automobiles have immotile steering ratio for steering mechanisms. Steering ratio refers to the ratio between the turn of the steering wheel and the turn of the wheels. But the perception of this system does not change with uncertain road and vigorous condition of automobile. Thus, there is a need to differ the steering ratio of automobile depending upon the conditions in which it is being driven. This Paper enlightens a novel way for obtaining Variable Steering Ratio using Micro-Controller through which we can expeditiously change the steering ratio of its vehicle to adjust to the condition at the will of operator. Lastly the paper also suggest a completely new method for rectifying the problem of Pulling of Car.
Keywords— Variable Steering ratio, Micro-Controller, Arduino UNO, PID, Pulling of Car

I. INTRODUCTION

A. Variable steering ratio

It can be accomplished by using some specific gears and microprocessors to change the velocity ratio between steering wheel and steering shaft i.e. shaft interconnected to rack and pinion mechanism. This is done by using high precision gears and faster response microprocessor. When driving at lower speeds - such as in city traffic, when parking or on winding mountain roads, Variable Steering increases the size of the steering angle. The front wheels respond immediately to small movements of the steering wheel, enabling the driver to maneuver through tight spaces without needing to make multiple multiple turns of the steering wheel. Parking is easier and agility enhanced. At medium speeds, steering is also easier. And to ensure smoothness at higher speeds, as of around 120 to 140 km/h (depending on the model) Variable Steering Ratio becomes more indirect.

Variable Steering Ratio therefore reduces the amount of change in the steering angle for every movement of the steering wheel. This gives the driver the advantage of more precise steering at higher speeds, and ensures great stability and more comfort.

B. Pulling of Car

A steady pull is a situation when you're simply attempting to drive straight forward but your car is tending to gradually turns either to the right or left. This is troublesome because it requires you to compensate, and consequently it means something is amiss with your vehicle.

II. LITERATURE REVIEW

A. Constant Mesh Gear Box

R. S Jaden, S K Choudhary [1] presents a variable steering ratio mechanism by using steering mechanism from Tata-Nano and constant mesh type gears from Bajaj-Super. Gear housing using wood was created by them and gear shifting arrangement was incorporated

B. Using an Electric Power Steering System

Roy McCann [2] presents a novel approach in this paper by investigating a method for improving vehicle stability by incorporating feedback from a yaw rate sensor into an electric power steering system. Presently, vehicle stability enhancement techniques are an extension of antilock braking systems in facilate the driver during vehicle manoeuvres.

C. Manually operated gear shifting catcher

Devanjan Mishra [3] urbanized a manually operated gear box with an integral catcher which is placed in the steering shaft for this case in between steering wheel and pinion of rack. According to the author, the main purpose of the gear box is to alter the steering ratio of the vehicle between two settings one for higher ratio and one for lower.

D. Engine Control Unit (ECU) Assisted Power Steering

Mayur A. Ghodeswar, Meghsham D. GiteIn[4] presents a fresh approach in this Paper. Herein the Straight-Line Type Assist

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Characteristic Is analyzed hypothetically. Then A Whole Vehicle vigorous Model Used to Study the Straight-Line Type Assist Is trait Built with Adams/Car and Validated with DCF (Driver Control Files) Mode Of Adams/Car. Based On the Whole Vehicle Dynamic Model

E. Using Vehicle Body Slip Angle.

Takahiko Yoshino, Hiromichi Nozaki[5] recommends a variable steering gear system using body slip angle feedback for the intention of improved manoeuvrability and stability in the vital cornering range and upwards, in surplus of the critical limit, and into the counter steer range by applying linear-variable control to the steering ratio from a body slip angle of 5.1˚. This result is seen both in double lane changes, such as in hazard avoidance, and in J-turns with long drifting.

III. MOTIVATION

The Idea for this project was born after going through an article published in The Times of India, Sept 05, 2015. In this report some of the shocking statistics revealed that in India about 90% of accidents occur due to Overtaking. Also one another shocking Statistics revealed that this accident due to overtaking is not only prevalent to Naive drivers but it are also much pronounced in case of experienced drivers.

IV. METHODOLOGY

When driving at lower speeds - such as in city traffic, when parking or on winding mountain roads, Variable Steering Ratio increases the size of the steering angle. The front wheels respond immediately to small movements of the steering wheel, enabling the driver to maneuver through tight spaces without needing to make multiple turns of the steering wheel. Parking is easier and enhanced. At medium speeds, steering is also easier. And to ensure smoothness at higher speeds, as of around 120 to 140 km/h (depending on the model) Variable Steering Ratio becomes more indirect. Variable Steering Ratio therefore reduces the amount of change in the steering angle for every movement of the steering wheel. This gives the driver the advantage of more precise steering at higher speeds, and ensures great stability and more comfort.

Fig.1 At Low Speed

Fig.2 At High Speed

In our prototype this is achieved by using a very powerful Microcontroller named Arduino Uno. Herein we have used this microcontroller to control the motor which in turns the control the steering wheel. The process of the working is as follows: Firstly the predefined programs are been fed to the microcontroller using a laptop/computer. This programs are basically in arduino acceptable programming language (Basically developed from C programming) using the software named Arduino Surface. The first program consist mainly how much should be the steering ratio for a particular speed of the automobile.

We have used five steps for varying the same, which consist of very low speed range, low speed range, Medium speed, High Speed, Very High Speed which basically gets divided into the value of Steering Ratio varying in Five Steps. This Control of varying the speed solely rests with the driver of the auto mobile. The Driver can use any of the above steering ratios at the will of his/her own. Basically when the driver needs to run his Car at low speed or while parking the car, he needs more agility for controlling the steering wheel. Thus she/he needs more lock-to-lock steering movements. Here low steering ratio comes into play. Due to which he can easily control his car now.

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Similarly while driving at high speeds, the car control is very crucial here, since slightest movement or misalignment can steer or wander the car in completely different or you can say in the direction which the driver was not attempted to drive towards. Here the concept of high steering ratio comes into play, where the driver has now complete control over his/her car. With high steering ratio the driver will have more Lock-to-lock turning of his car due to which he now has complete control on the car. This highly increases the control of car which will definitely reduce the chances of the accident.

The solution for our next project i.e. Rectification of pulling of car, is too based on the Microcontroller Arduino plus here we are using one more electronic device named PID Controller. A vehicle with a pull problem is a vehicle that is fighting the forces of nature. Something is amiss and is causing the vehicle to follow a path other than a straight one. There are actually several different types of steering pull: a steady pull, a pull that only occurs after turning (memory steer), or a pull that only occurs under certain driving conditions such as bump steer or torque steer. An off-center steering wheel may or may not accompany a pull. Other times the pull may be more of a "drift" or steering wander to one side or the other.

This is done using the above mentioned Arduino Uno and LDR sensors. Here the sensors play the pivotal role in rectification of pulling the car problem. As we have learnt by the definition, the front wheels of the car move away against the motion of the steering wheel. Thus we have installed a pair of Light dependent resistors which will give the feedback to the PID. Now the PID will compare the actual signal with the desired signal or the angle of steering wheel and will find out the error. Now this error will be send to the main micro controller which will in turn generate an opposite movement of the steering so as to counter effect the absolute movement of the steering.

The Pictorial Representation of the problem of pulling of the Car is as shown below in Fig.3 .As it can rightly be seen in the picture that even though the steering wheel is held straight, due to this problem of problem of pulling of car, the car will still tend to steer/wander towards left or right.

Fig 3. Pulling of the Car.

This is how we are going to achieve the solution of pulling of the car problem. The main advantage of this is that the driver need not know or he/she doesn't have to worry at all the problem of gauging the pulling of car. Without the driver's knowledge this smart system will detect the problem, analyze it so as to get how much is the deviation, send signal to the main micro-controller to get the required work done i.e. automatically it will rectify the problem of pulling of car. Thus using a single micro controller both the problem has been solved i.e. obtaining variable steering ration and rectifying the problem of pulling of car.

V. CAD MODEL

Based on above, we have devised a very compact prototype depicting the crust of our project. It basically consist a 50 x 50 cm Aluminium frame which rightly supports the whole assembly. Above it we have our heart of the project i.e. the Micro-controller Arduino Uno. Connecting it there are many peripheral devices such as PID Controller, A stepper motor, LDR Sensors, 12V DC motor and last but not the least the connecting wires and various peripheral devices and components.

Below are the view of CAD model which we have prepared on the CATIA® software.

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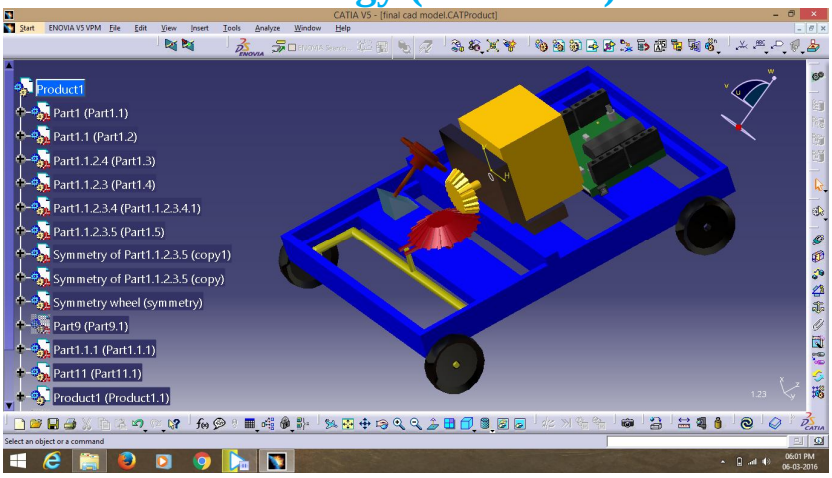

Fig. 4 Representation of CAD Model.

VI. RESULTS AND VALIDIFICATION

In order to verify our study and research on whatever we have done till now, the result and validification was carried out in two ways. Firstly manual testing was conducted by us on our prototype, and we have found the following observation table (Table No. 1) and it was found to be in sync with our final aim of the project

Speed [Physical]	Speed [Statistics]	Steering Wheel Angle	Wheels Turning Angle
Very Low/Parking	0 – 60	1	1
Low	60 – 120	1	2
Medium	120 – 180	1	4
High	➢ 180	1	6

Table No. 1: Results Table.

After manual verification the results were also verified by the software named CarSim. **CarSim** is a commercial software that gives the performance of automobiles in accordance to driver controls (steering, throttle, brakes, clutch, and shifting) in any selected environment (road geometry, coefficients of friction, wind). CarSim is produced and distributed by an American company, Mechanical Simulation Corporation.

The software is used by over 31 automotive production units over 60 suppliers, and over 400 research institutes and universities. The math models simulate physical tests to allow engineers to view results that are similar to test results, but which can be obtained repeatedly, safely, and much quicker than is possible with physical testing. The simulation models are often used to evaluate vehicle designs that have not yet been built. Results are visualized via animation, plotted for analysis, or exported to other software for analysis using the same methods that are applied to substantial test data.

On this software various plot was plotted versus independent quantities such as speed, steering ratio, Yaw rate, torque etc. Some of the various plot has been depicted in the figures (Fig. 5, 6, 7, 8) as shown below.

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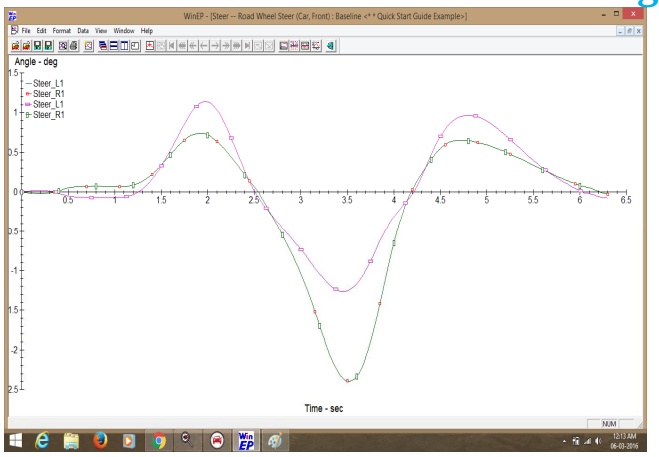

Fig. 5 CARSIM Plot 1

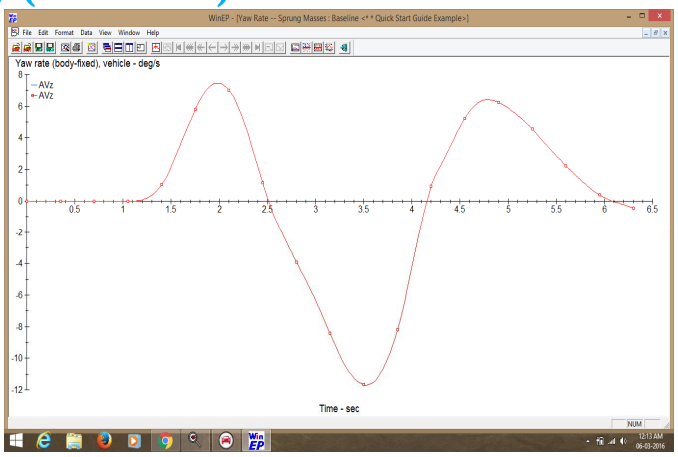

Fig. 6 CARSIM Plot 2

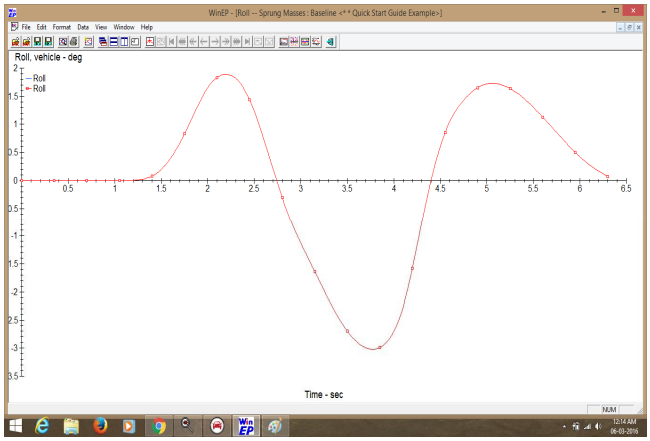

Fig. 7 CARSIM Plot 3

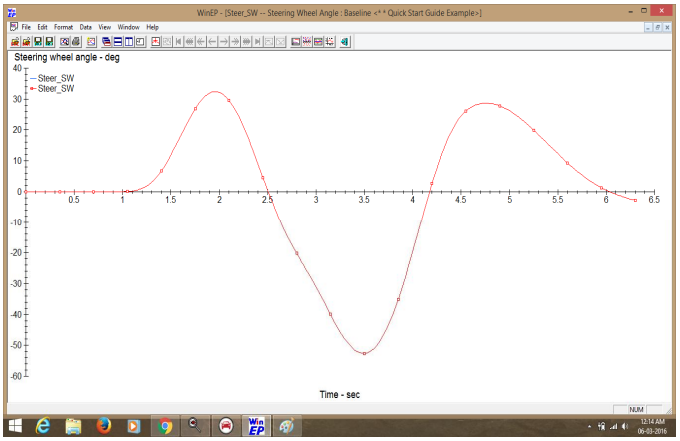

Fig. 8 CARSIM Plot 4

VII. CONCLUSIONS

When driving at lower speeds, Variable Steering increases the size of the steering angle. The front wheels respond immediately to small movements of the steering wheel, enabling the driver to maneuver through tight spaces without needing to make multiple turns of the steering wheel.

When driving at higher speeds, Variable Steering therefore reduces the amount of change in the steering angle for every movement of the steering wheel. This gives the driver the advantage of more precise steering at higher speeds, and ensures great stability and more comfort.

Drifting or pulling can be temporarily avoided by employing PI Controllers & Micro Controller till it is rectified by a Car Mechanic.

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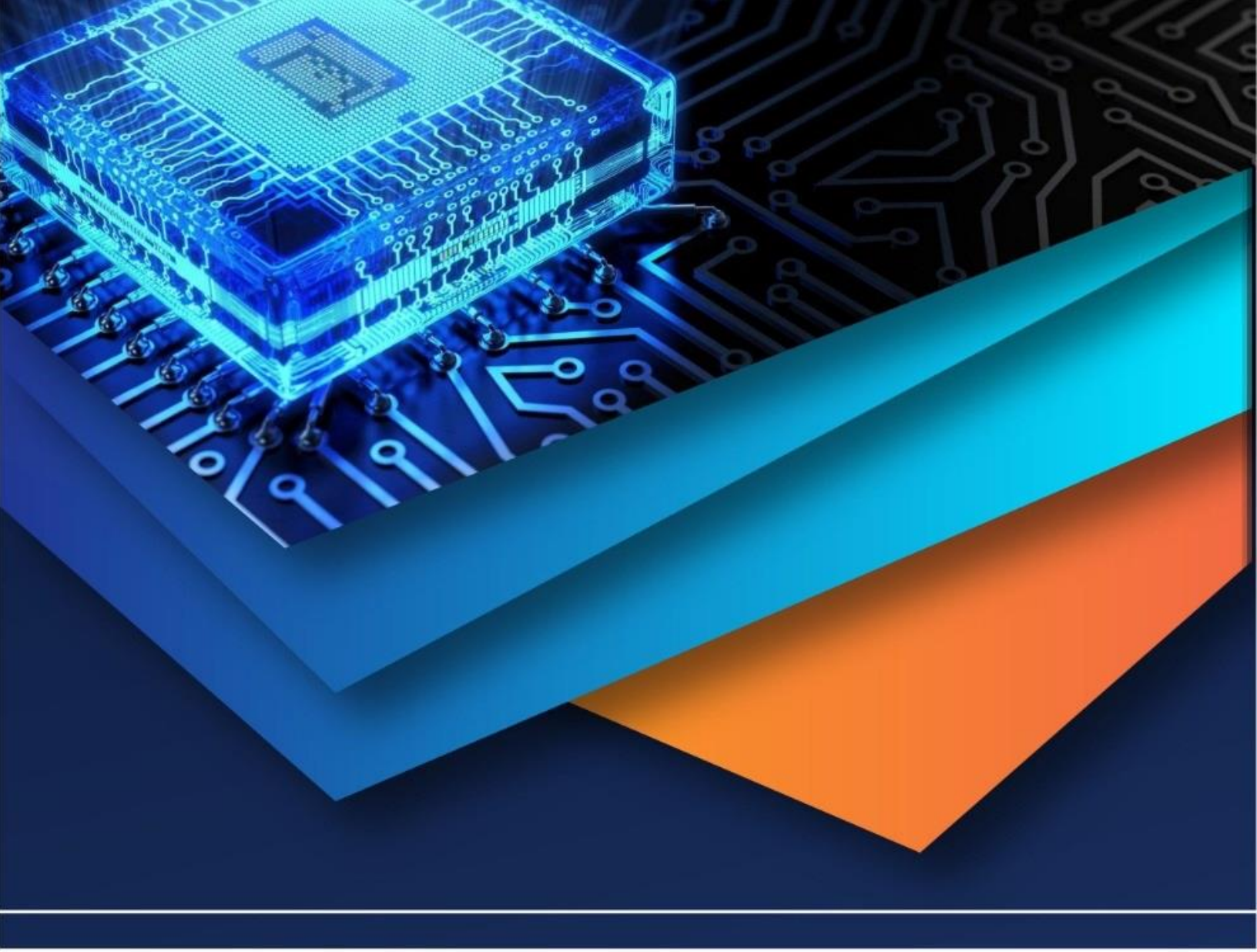

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