SMART CAR CONVERTABLE FOUR WHEELS STEERING SYSTEM WITH HIGH TORQUE D.C MOTOR

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Abstract— *We are keen to develop a system for parking of cars which would be suitable and practical for Indian society. As we know that there are already some systems which are using technology like multi floor parking system and automated parking area system. But these systems are little bit impractical in context to Indian society as these systems result in extra consumptions of money and power. So "Smart parking system for cars" would be a cheap and less expensive system for parking and simple construction as well. Nowadays, the every vehicle existed mostly still using the two wheel steering system to control the movement of the vehicle whether it is front wheel drive, rear wheel drive or all-wheel drive. Four-wheel steering is a technologically, tremendous effort on the part of automotive design engineers to provide near-neutral steering. In situations like low speed cornering, vehicle parking and driving in city conditions with heavy traffic in tight spaces, high speed lane changing would be very difficult due to vehicle's larger wheelbase and track width which brings high inertia and traction into consideration. Hence there is a requirement of a mechanism which result in less turning radius and it can be achieved by implementing four wheel steering mechanism instead of regular two wheel steering. This system finds application in off-highway vehicles such as forklifts, agricultural and construction equipment mining machinery also in Heavy Motor Vehicles. It is also useful in passenger cars. It improves handling and helps the vehicle make tighter turns. This system is used to minimize the turning radius.*

Keywords—Steering; Wheels; Steering Column; Universal Joint

1. INTRODUCTION

Four wheel steering is a method developed in automobile industry for the effective turning of the vehicle and to increase the maneuverability. In a typical front wheel steering system the rear wheels do not turn in the direction of the curve and thus curb on the efficiency of the steering. In four wheel steering the rear wheels turn with the front wheels thus increasing the efficiency of the vehicle. The direction of steering the rear wheels relative to the front wheels depends on the operating conditions. At low speed wheel movement is pronounced, so that rear wheels are steered in the opposite direction to that of front wheels. At high speed, when steering adjustments are subtle, the front wheels and the rear wheels turn in the same direction. By changing the direction of the rear wheels there is reduction in turning radius of the vehicle which is efficient in parking, low speed cornering and high speed lane change. In city driving conditions the vehicle with higher wheelbase and track width face problems of turning as the space is confined, the same problem is faced in low speed cornering. Usually customers pick the vehicle with higher wheelbase and track width for their comfort and face these problems, so to overcome this problem a concept of four wheel steering can be adopted in the vehicle. Four wheel steering reduces the turning radius of the vehicle which is effective in confined space, in this project four wheel steering is adopted for the existing vehicle and turning radius is reduced without changing the dimension of the vehicle.

2. LITERATURE SURVEY

Literature review on effect of implementing four wheel steering system on turning radius and maneuverability of a car are carried out by referring journals, books, manuals and related documents.

- The four wheel steering system model was built using ADAMS software and simulations carried out to know the turning radius and maneuverability.
- Four wheel steering physical model was built considering same stub axle for front and rear.
- CRC test was conducted to analyze maneuverability of the model.
- Turning radius comparison were made between the physical model and the ADAMS model.

3. SUMMERY

The most effective type of steering, this type has all the four wheels of the vehicle used for steering purpose. In a typical front wheel steering system the rear wheels do not turn in the direction of the curve and thus curb on the efficiency of the steering. Normally this system is not been the preferred choice due to complexity of conventional mechanical four wheel steering systems. However, a few cars like the Honda Prelude, Nissan Skyline GT-R have been available with four wheel steering systems, where the rear wheels turn by an angle to aid the front wheels in steering. However, these systems had the rear wheels steered by only 2 or 3 degrees, as their main aim was to assist the front wheels rather than steer by themselves. With advances in technology, modern four wheel steering systems boast of fully electronic steer-by-wire systems, equal steer angles for front and rear wheels, SASTECH Journal 91 Volume 12, Issue 1, April 2013 and sensors to monitor the vehicle dynamics and adjust the steer angles in real time. Although such a complex four wheel steering

model has not been created for production purposes, a number of experimental concepts with some of these technologies have been built and tested successfully. Compared with a conventional two wheel steering system, the advantages offered by a four wheel steering system include:

1. Superior cornering stability.

2. Improved steering responsiveness and precision.

3. High speed straight line stability.

4. Notable improvement in rapid lane changing maneuvers.

5. Smaller turning radius and tight space maneuverability at low speed.

6. Relative wheel angles and their control.

Usually in vehicles during turning, the tires are subject to the forces of grip, momentum, and steering input when making a movement other than straight-ahead driving. These forces compete with each other during steering man oeuvres. With a front-steered vehicle, the rear end is always trying to catch up to the directional changes of the front wheels. This causes the vehicle to sway. When turning, the driver is putting into motion a complex series of forces. Each of these must be balanced against the others. The tires are subjected to road grip and slip angle. Grip holds the car's wheels to the road, and momentum moves the car straight ahead. Steering input causes the front wheels to turn. The car momentarily resists the turning motion, causing a tire slip angle to form. Once the vehicle begins to respond to the steering input, cornering forces are generated. The vehicle sways as the rear wheels attempt to keep up with the cornering forces already aerated by the front tires. This is referred to as rear-end lag because there is a time delay between steering input and vehicle reaction. When the front wheels are turned back to a straight-ahead position, the vehicle must again try to adjust by reversing the same forces developed by the turn. As the steering is turned, the vehicle body sways as the rear wheels again try to keep up with the cornering forces generated by the front wheels. The idea behind four-wheel steering is that a vehicle requires less driver input for any steering maneuver if all four wheels are steering the vehicle. As with two wheel- steer vehicles, tire grip holds the four wheels on the road.

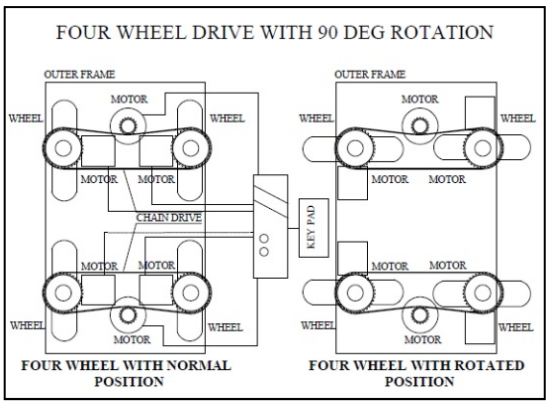
4. MATERIAL USED

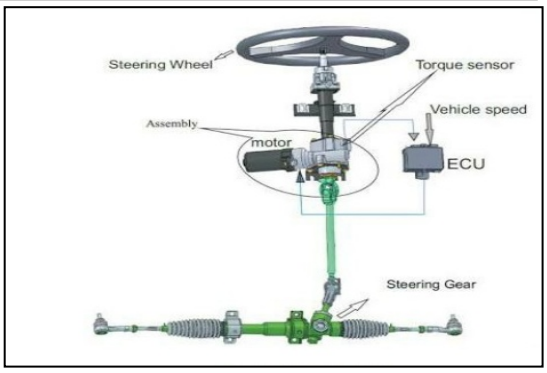
- Chassis board
- L-Clamp
- D.C. motor
- Fiber wheel
- Nut and bolts
- Mild steel pipes
- D.C. power supply
- Chain drive
- Rocker switch

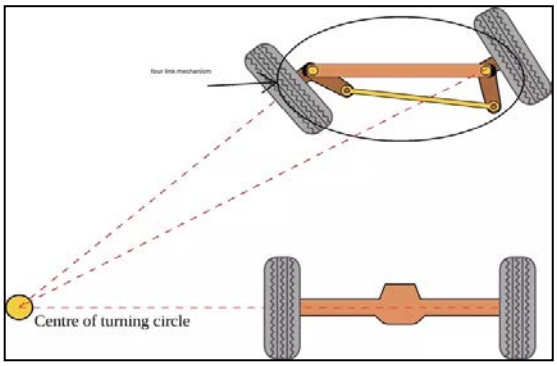
5. WORKING PROCESS

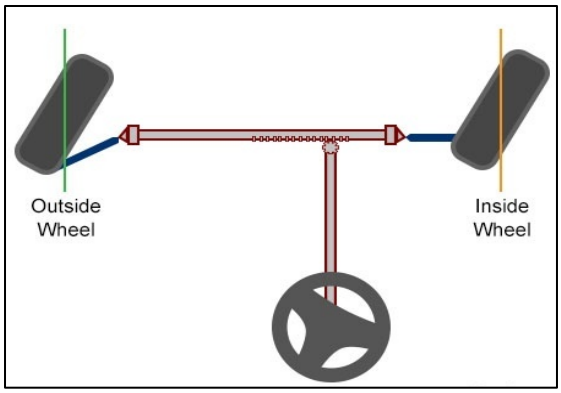
In this project battery provides the power supply to the control unit. The equipment contains totally six motors, two motors are coupled with the vehicle's left and right wheels of the front side, the next two motors are connected to the vehicle's left and right side of the back side. The four motors are used to run the vehicle. Another two motors are connected to rotate the vehicle wheel 90 degree by the chain drive arrangements. The keypad in the control unit has six keys they are left, right, forward, reverse, park left, and park right. We press the left key in the keypad the vehicle turns left side in a required angle, we press the right key in the keypad the vehicle turns at right side in a required angle, similarly the forward and reverse motion of the vehicle are controlled by the forward and reverse key in the keypad. We want to park the vehicle in left side by press the park left key then the motor connected in the chain drive is turns the wheel left side 90 degree automatically, then the vehicle is parked in the left side, this process is same as right side. Using this we can easily park the vehicle in various areas.

6. BLOCK DIAGRAM









7. ADVANTAGES

- Superior cornering stability.
- Improved steering responsiveness and precision.
- High speed straight line stability.
- Notable improvement in rapid lane changing man oeuvres.
- Smaller turning radius and tight space maneuverability at low speed.

8. DISADVANTAGES

Following are the places and positions where there are chances of failure of rear wheel steering system:

- Car while turning at speed of 50kmph suddenly reduces its speed to 30kmph there is transition from in-phase to out-phase steering. Since the car is turning there is also possibility of pinion stuck between two racks inside casing. Then for that instance car will become two wheel steering but this will not have any effect on front wheels and thus will not cause any damage or accident.
- Pump and Sensors should be checked regularly to avoid its failure.

9. APPLICATIONS

- Parallel parking: Due to smaller turning radius the parking and un parking of vehicle is easily performed towards the right or left side.
- High speed lane changing: In this is less steering sensitive this does require a lot of concentration from driver since he has to judge the space and vehicles behind them.
- Slippery road surfaces: Due to the rear wheel steering operation on low friction surfaces occurs hence vehicle direction easier to control.
- Narrow Roads: Due to rear wheel steering on narrow roads with tight bends, counter phase steering reduces the turning radius.
- U-Turns: By minimizing the vehicle's turning radius and counter phase steering of rear wheels enables U-Turns to be performed on narrow roads.

10. FUTURE SCOPE

Having studied how 4WS has an effect on the vehicle's stability and driver maneuverability, we now look at what the future will present us with. The successful implementation of 4 Wheel Steering using mechanical linkages & single actuator will result in the development of a vehicle with maximum driver maneuverability, uncompressed static stability, front and rear tracking, vehicular stability at high speed lane changing, smaller turning radius and improved parking assistance. Furthermore, the following system does not limit itself to the benchmark used in this project, but can be implemented over a wide range of automobiles, typically from hatchbacks to trucks. This coupled with an overhead cost just shy of Rs. 15,000 provides one of the most economical steering systems for improved maneuverability and drivers‟ ease of access. With concepts such as "ZERO TURN" drive as used in „Tata Pixel‟ and "360o Turning" used in „Jeep Hurricane‟, when added to this system, it will further improve maneuverability and driver's ease of access.

11. CONCLUSION

As per the focus of the project we have created an innovative 4 wheel active steering mechanism which is feasible to manufacture, easy to install and highly efficient in achieving in-phase and counter-phase rear steering with respect to the front wheels using DRRC. This system assists in high speed lane changing and better cornering. It combats the problems faced in sharp turning. It reduces the turning circle radius of the car and gives better maneuverability and control while driving at high speeds, thus attaining neutral steering. Moreover components used in this system are easy to manufacture, material used is feasible, reliable and easily available in market. The system assembly is easy to install and light in weight and can be implemented in all sections of cars efficiently.

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