International journal of advances in engineering and management (IJAEM)
Volume 3, issue 6 June 2021, pp: 2509-2512 www.ijaem.net ISSN: 2395-5252

Study Of Four Wheel Steering System Using Link Mechanism.

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Submitted: 10-06-2021 Revised: 20-06-2021 Accepted: 23-06-2021

ABSTRACT:- This paper deals with details of Four Wheel Steering Syteem. With the help of the Link Mechanism all the four wheels can be turned to any direction using the DC motor. The dynamic model of Four Wheel Steering system was established with the help of simulated in solidworks to check for functionality of mechanism.

Keywords— 4WS, Link Mechanism, DC motor.

I. INTRODUCTION

Four Wheel Steering is the method developed in the automobile industry to increase the maneuverability and for the effective turning of the vehicle also reduce the drivers Steering effort.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.

In situation like driving in the city conditoin with heavy traffic with less space, low speed cornering, in the vehilce parking driving is to much difficlut due to the due to larger track width and wheelbase.When both the front and back wheel steer towards the same direction, they are said to be in phase and this produces the kind of sideways movement of car at low speeds.When the front and back wheel steer in the opposite direction, this is called counter phase due to this the turn we get sharp turn.

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. However, when the driver turns the wheel slightly, all four wheels react to the steering input, causing slip angles to form at all four wheels. The entire vehicle moves in one direction rather than the rear half attempting to catch up to the front. There is also less sway when the wheels are turned ba back to straight-ahead position. Thus the vehicle respond more quickly to steering input because rear wheel lag eliminated.

II. LITERATUR REVIEW

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.

III. PROBLEM STATEMENT

Nowadays all vehicles uses two wheel steering system, but the efficiency of the two wheel steering (2WS) vehicle is proven that it is still low compared to the four wheel steering (4WS) system car. So, this project is base on how to prove that the 4WS is better than 2WS in terms of turning radius. A vehicle with higher turning radius face difficulty in parking and low speed cornering due to its higher wheelbase and track width, but the passenger prefer the vehicle to be higher wheelbase and track width as it gives good comfort while travelling. In this scenario four wheel steering will be effective as the turning radius will be decreased for the same vehicle of higher wheelbase. In this project a benchmark vehicle is considered and four wheel steering is implemented without change in dimension of the vehicle and reduction in turning radius is achieved. For achieving reduction a mechanism is built which turns the rear wheels opposite to the front wheels.

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The model can be used to have a platform for further information, research and development.

OBJECTIVE

In four-wheel steering system, two objectives are to be achieved. The first one is to develop a working model of four-wheel steering system using the Link Mechanism and second is that to learn advantages and disadvantages of the four wheel steering system.

COMPONENTS TO BE USED

- DC motor
- Couplings
- Rods
- Joints
- Mounts
- Base Frame
- Screws & Bolts

WORKING AND OPERATION OF MECHANISM

As we stated above that four-wheel will be move simultaneously by the help of the kinematics of linkage. Four-wheel steering has been applied using Ackerman steering in both axles. As in front as well as in rear. As stated by Shakir, Mahadik and Singh (2017), "According to Ackerman steering system, geometric arrangement of linkages in the steering of a vehicle designed to solve the problem of wheels on the inside and outside of a turn needing to trace out circles of different radius. The intention of Ackermann geometry is to avoid the need for tires of slip sideways when following the path around a curve" ".So, we have make both rear wheel and front wheel movable by the help of Ackerman steering system and due to that we have also connected both these by the help of link that are further connected to motor. To give the turning to the vehicle. We have used motor in terms of steering because of the compact size of the modal. For turning or as we can also say that for turning we have use a DC motor in which gear are arranged to maximum torque can be exerted over the link to move the Ackerman Mechanism. We have use L type link to play the Ackerman mechanism and we connect a simple link to the L type link to make the mechanism free to more. And because of the link arrangement we have to make the mechanism possible to give high efficiency in terms of less power.So, we have design the Mechanism first and then we implement our idea over that. We have attached one DC motor to rear axle drive to provide equal movement to both the wheel so that forward and backward motion of the vehicle can be done. We have connected all the motor and arranged switched to provide the motion and turning by the help of circuit board. We used Iron Bar to connect link mechanism to each other and wheel that we use are of plastic and motor that we used in it are DC motor. With DC motors we connect a Gear Box to provide more torque so slide movement of steering can be done. As Photo of the linkage Mechanism if given below.

Fig.a Four Wheel Steering Link Mechanism.

In Fig. b you can check the mechanism by which steering is done. As the motor which is connected in the middle with the link moves simultaneously other link also moves from which L Type Link also moves as shown in figure b. As this L type link moves that helps to move the Ackerman Steering system that will move to turn the vehicle according to the use of driver or as per the requirement of the driver to turn the vehicle and the Ackerman steering system for that is given in the Figure c.

Figure c shows how the Wheel of this vehicle will move and this will be the system by which the wheel are tends to move. We have used DC Motor as shown in fig. a to give steering and the motor can run in clock wise direction as well as Anti clockwise direction so that the steering can be done as per the need of the driver. We can control this by the help of switches which we have connected to battery from the motor. As Opposite poles try to move motor anticlockwise and Correct poles moves the motor clockwise.

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Fig.b L type Link that moves Ackerman Steering

Fig.c Ackerman Steering Linkage System

IV. APPLICATIONS

According to Bevinkatti, Mali, Bayas, Ghadage and Anuse (2015), the application of four-wheel steering system is:

1. Parallel parking: Due to smaller turning radius the parking and un-parking of vehicle is easily performed towards the right or left side.
2. 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.
3. Slippery road surfaces: Due to the rear wheel steering operation on low friction surfaces occurs hence vehicle direction easier to control.
4. Narrow Roads: Due to rear wheel steering on narrow roads with tight bends, counter phase steering reduces the turning radius.
5. 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.

ADVANTAGES

- Superior cornering stability: The vehicle cornering behavior becomes more stable and controllable at high speed as well as on wet slippering road surfaces.
- Improved steering response and precision: The vehicle response to steering input becomes quicker and more precise throughout the vehicle enter speed range.
- High speed straight line stability: The vehicle's straight –line stability at high speed is improved. Negative effects of road irregularities and crosswinds on the vehicles stability are minimized.
- Improved rapid lane-changing maneuvers: This is stability in lane changing at high speed is improved. In high speed type operation become easier. The vehicle is less likely to go into a spin even in situations in which the driver must make a sudden and relatively large change of direction.
- Smaller turning radius: By steering the rear wheels in the duration opposite the front wheels at low speed, the vehicle's turning circle is greatly reduced. Therefore, vehicle maneuvering on narrow roads and during parking become easier.
- Controlling: Computer-controlled Quadrasteer can be switched on and off and has an effective trailer towing mode.

DISADVANTAGES

- The 4ws, due to construction of many new components, the system becomes more expensive.
- The system includes as many components (especially electronically) there is always a chance to get any of the part inactive, thus the system become in operative.

V. ACKNOWLEDGEMENT

First of all, we are grateful to THE ALMIGHTY GOD for establishing us to complete this semester. we wish to express our sincere thanks to the Principal of the SVERI's ENGINEERING COLLEGE Dr. B.P.Ronge, for providing us with all the necessary facilities. We would like to express special thanks of gratitude to Dr. S.S. Wangikar,

HOD, Department of MechanicalEngineering, for his constant encouragement. We are extremely grateful and indebted to him for his expert, sincere and valuable guidance and encouragement extended to us. We take this opportunity to record our sincere thanks to all the faculty members of the department of MECHANICAL ENGINEERING for their help and encouragement and support. Secondly, I would like to thank my teachers, parents, and friends who helped me a lot in finalizing this project within the time periods.

VI. CONCLUSION

By the analytical and experimental analysis and results we conclude that;

• Four wheel steering concept was generated

• The four wheel concept was simulated in solidworks to check for functionality of mechanism.

• Working prototype was built to check if the mechanism works or not and to find the reduction in turning radius with four wheel steering when compared to two wheel steering.

Table-1:- Calculation of Turing Radius

COMPARISON BETWEEN TURNING RADIUS	
TURNING RADIUS	FOUR WHEEL STERING
BY CALCULATION	2.50 m
BY SIMULATION	2.65 m
BY EXPERIMENTAL	2.78 m

Above table gives the comparison between the Four Wheel Steering System by calculation, simulation and by the experimental result.The components used in this project are easily available as well as reliable.The linkage mechanism is easy to install can be easily implemented.

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