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Design and Fabrication of Four-Wheel Steering Mechanism

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ABSTRACT:- This research provides when a vehicle is in a congested or narrow area, a better-turning response from the vehicle is expected, or may want the vehicle to move without much movement. There is a need to find an alternative mechanism for easy steering turning of the vehicles. This project proposes the design & fabrication of “FOUR-WHEEL STEERING MECHANISM” and the proposed project is used for the movement of rear wheels helpful to reduce turning radius, more precisely controlled, especially during cornering, parking, or while traveling in narrow areas. This project proposes validation through experimentation.

Our work aims to make all four wheels movable simultaneously using a linkage mechanism. We use the Ackermann steering mechanism at both the front and rear wheels for steering the vehicle.

KEYWORDS:Steering, CATIA, Linkage mechanism, Ackermann steering Mechanism, Four- wheel drive

I. INTRODUCTION

Four-wheel steering is a method developed in the automobile industry for the effective turning of the vehicle and to increase maneuverability. In a typical front-wheel steering system, the rear wheels do not turn in the direction of the curve and thus curb 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 the rear wheels are steered in the opposite direction to that of the 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 the 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 a higher wheel base and track width face problems of turning as the space is confined, the same problem is faced in low-speed cornering. Usually, customers pick vehicles with higher wheel base and track width for their comfort and face these problems, so to overcome this problem the concept of four-wheel steering can be adopted in the vehicle.

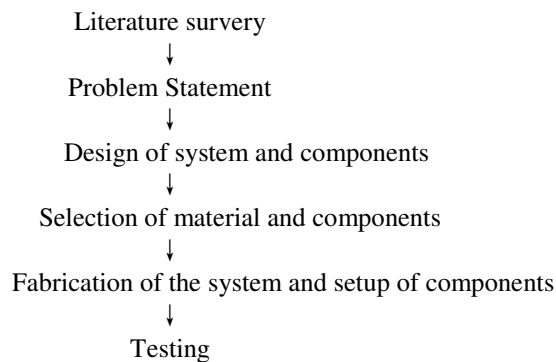


II. RELATED WORK

PROBLEM DEFINITION:-

Nowadays all vehicles use a two-wheel steering system, but the efficiency of the two-wheel steering vehicle is proven that it is still low compared to the four-wheel steering system car. So, this project is based on how to prove that four-wheel steering is better than two-wheel steering in terms of turning radius. Four-wheel steering is a serious effort on the part of automotive design engineers to provide near-neutral steering. Also in situations like low-speed cornering, vehicle parking, and driving in city conditions with heavy traffic in tight spaces, driving would be very difficult due to vehicles larger wheelbase and track width. Hence there is a requirement of a mechanism that results in less turning radius and it can be achieved by implementing a four-wheel steering mechanism instead of regular two-wheel steering.

III. METHODOLOGY



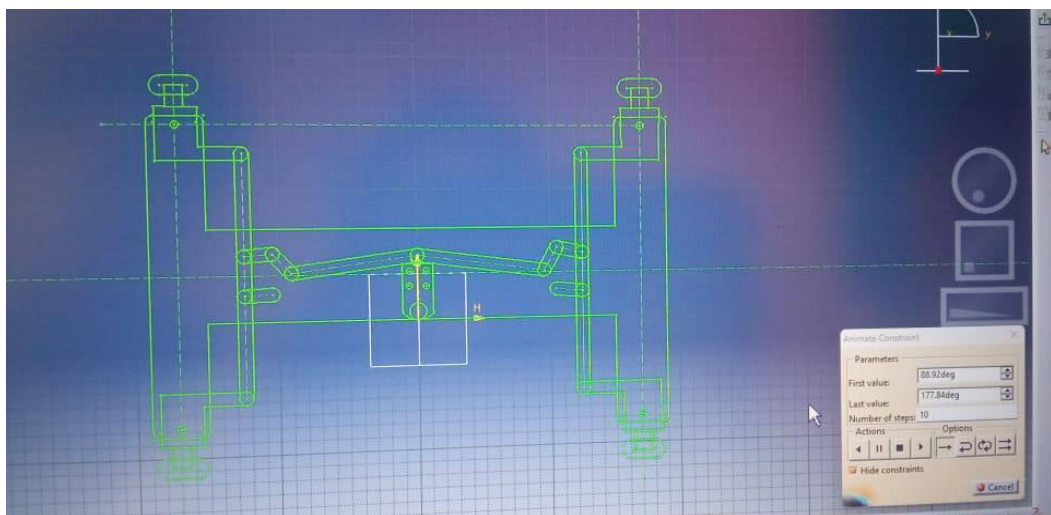
III. DESIGN OF SYSTEM AND COMPONENTS

WORKING PRINCIPLE:-

This project makes use of a linkage mechanism, where the front wheel and back wheels are connected to each other with the help of a link in such a way that both the front wheel and the back wheels turn simultaneously. These links are connected to the motor which will make the wheels turn.

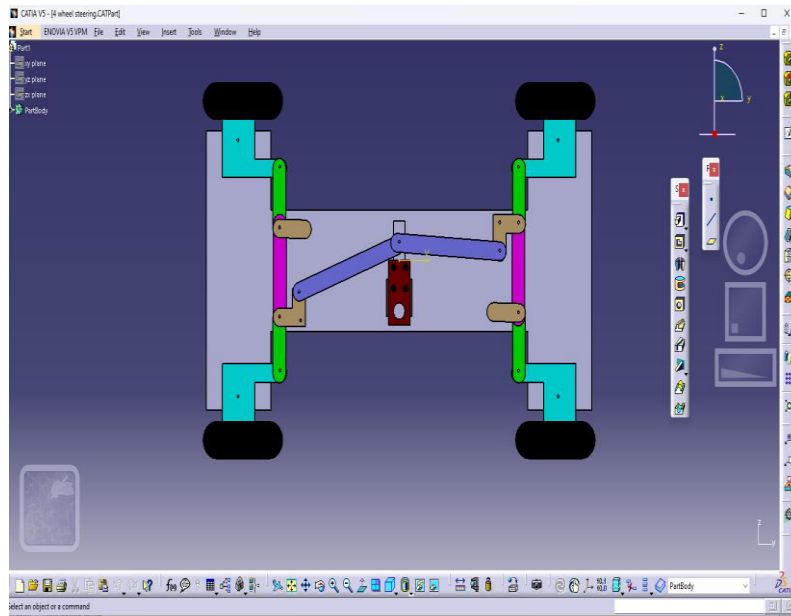
The geared motor is controlled by a 3-way switch to operate it using a battery and change direction. The mechanism involves a set of linkage joints placed in a certain way that allows for smooth mechanical motion on all wheels.

2D MODEL:-





3D MODEL:



COMPONENTS:-

Tyres:

A Tire is a ring of material that covers the rim of a wheel. Most commonly used is the rubber tire. They help a vehicle to move smoothly. In this design, we will require four rubber tires. Driving with worn out tires is very dangerous. Hence, one should take proper care about the health of his tires. It causes the tire to explode and cause serious driving issues, there are many types of tires. They come in all shapes and sizes.



Nuts and Bolts:

A nut is a fastener with a threaded hole. They are used in conjunction with a mating bolt to fasten many parts together. The two are kept together by combining their threads together. A bolt is a thread fastener type with an external male thread.



DC motor: It is a device that converts direct electrical current into useful mechanical energy. In our project, we have used a simple DC motor of 60RPM which is enough to demonstrate the working of the four wheel steering system.



Steering:

It is the assembly of various components (linkages) fastened together to allow the vehicle to pursue a desired course of path. Its primary use is to help the driver to guide the vehicle efficiently. Four wheel steering system is used to improve steering response and give less effort to the driver's hands while driving. It is also used to decrease the turning radius of the vehicle. Also, it helps in easing the high speed lane changing.

Battery:

12V, 7200mAh refers to the electrical specifications of a rechargeable battery. The voltage of the battery is 12 volts, which is the electrical potential difference between the positive and negative terminals of the battery. The capacity of the battery is 7200 milliampere-hours (mAh), which is a measure of the amount of electrical charge the battery can hold.

IV. FABRICATION OF THE SYSTEM CONSIST OF MANUFACTURING SETUP OF COMPONENTS:-

CUTTING:-

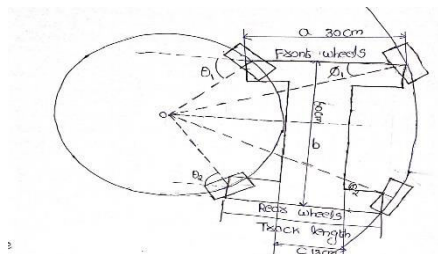




STICKING:-



CALCULATION:-



The Turning Circle Radius for Different Wheels:

$$1.R_{IF} = (b/\sin\theta_1) - ((a-c)/2)$$

Where;

IF = Inner front wheel

Let take θ value is maximum 44°

$$\begin{aligned} R_{IF} &= (60/\sin 44) - ((30-13)/2) \\ &= 86.3 - 8.5 \\ &= 77.8\text{cm} \end{aligned}$$

$$2.R_{OF} = (b/\sin\theta_1) + ((a-c)/2)$$

Where;

OF = Outer front wheel

Let θ value is maximum 30°

$$\begin{aligned} R_{OF} &= (60/\sin 30) + ((30-13)/2) \\ &= 120 + 8.5 \\ &= 128.5\text{cm} \end{aligned}$$

$$3.R_{IR} = (b/\tan\theta_2) - ((a-c)/2)$$

Where;

IR = Inner rear wheel

Let Θ value is maximum 44°

$$\begin{aligned} R_{IR} &= (60/\tan 44) - ((30-13)/2) \\ &= 62.1 - 8.5 \\ &= 53.6\text{cm} \end{aligned}$$

$$4.R_{OR} = (b/\tan \Theta_2) + ((a-c)/2)$$

Where;

OR = Outer rear wheel

Let Θ value is maximum 30°

$$\begin{aligned} R_{OR} &= (60/\tan 30) + ((30-13)/2) \\ &= 103.9 + 8.5 \\ &= 112.4\text{cm} \end{aligned}$$

6.1.1 Total turning radius:

$$\begin{aligned} R &= (R_{IF} + R_{OF} + R_{IR} + R_{OR})/4 \\ &= (77.8 + 128.5 + 53.6 + 112.4)/4 \\ &= 93.07\text{cm} \\ &\text{(OR)} \\ R &= 930.7\text{mm} \end{aligned}$$

MODELLING:-



V. EXPERIMENTAL RESULTS

The design is expected to work better than the traditional two-wheel and four-wheel steering systems. It is expected to deliver better results at low speed as well as at high-speed conditions. The traditional steering system impacts a great load on the driver's hands. But this design will aim at decreasing this effect and make the steering operation quite easy.

VI. FUTURE SCOPE

An innovative feature of this steering linkage design is its ability to drive all four Wheels using a single steering actuator. Having studied how 4WS has an effect on the vehicles stability and driver maneuverability, we now look at what the future will present us with. It's successful implementation will allow for the development of a four-wheel,



steered power base with maximum maneuverability, uncompromised static stability, and front- and rear-wheel tracking and optimum obstacle-climbing capability.

VII. CONCLUSION

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

1. Four-wheel steering concept was generated.
2. The four-wheel concept was simulated in CATIA to check for the functionality of the Mechanism.

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