

# FOUR MODE STEERING SYSTEM FOR A FOUR WHEEL VEHICLE

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## ABSTRACT

*The most conventional and general steering arrangement is to turn the front wheels using a hand-operated steering wheel which is positioned in front of the driver. The four wheel four mode steering system is a modification for the present steering which is used for the improvement of easiness for vehicle handling.*

*The four wheel four mode steering system assists driver by controlling the steering angle of vehicle's four wheels as the requirement of driver, for making the parking and handling at congested areas easier. For meeting the application the rear wheels steer in the opposite direction or in the same direction of the front wheels, allowing reduced turning radius or sliding of vehicle to sideways; also steering each wheel in opposite direction to rotate the vehicle about its position. We are able to transmit the motion that is given on steering wheel to the rear wheels and able to control like front wheels as our requirements, which is the basic idea of our project four wheel four mode.*

*In convertible four wheel steering with four mode operation four steering modes can be changed as needed which assists in parking at heavy traffic conditions, when negotiating areas where short turning radius is needed, when rotation of the vehicle about its position (360 degree rotation) and in off road Driving.*

**Key words:-** *Four mode steering, Parallel parking, Reduced turning radius.*

## 1. INTRODUCTION

In 21<sup>st</sup> century vehicle is the basic need of human being for transportation. The new technologies were developed for the comfort and efficient working of the vehicle. In this project we are designing and fabricating a four mode steering system for a four wheel vehicle. This system helps in easy and efficient controlling of the vehicle..

Steering is the term applied to the collection of components, linkages, etc. which will allow a vessel (ship, boat) or vehicle (car, motorcycle, and bicycle) to follow the desired course. An exception is the case of rail transport by which rail tracks combined together with railroad switches provide the steering function. The most conventional steering arrangement is to turn the front wheels using a hand-operated steering wheel which is positioned in front of the driver, via the steering column, which may contain universal joints, to allow it to deviate somewhat from a straight line. Other arrangements are sometimes found on different types of vehicles, for example, a tiller or rear-wheel steering. Tracked vehicles such as bulldozers and tanks usually employ differential steering that is, the tracks are made to move at different speeds or even in opposite directions, using clutches and brakes, to bring about a change of course or direction.

Modern cars mostly use rack and pinion steering mechanisms, in which steering wheel turns the pinion gear; the pinion moves the rack, which is a linear gear that meshes with the pinion, this mechanism converting circular motion into linear motion along with transverse axis of the car. In two wheel steering system the front wheels are turned using a hand operated steering wheel which is positioned ahead of the driver. The common problem regarding two wheel steering system includes problem in at public place, mall, parking, traffic etc. The rack and pinion design has

the advantages of a large degree of feedback and direct steering "feel". A disadvantage is that it is not adjustable, so that when it does wear and develop lash, the only cure is replacement.

## 2. LITERATURE REVIEW

**2.1.THREE MODE STEERING SYSTEM FOR LIGHT WEIGHT AUTOMOBILE VEHICLES – IJSRET 2016 – S. Riyaz Haja Mohideen** - This paper consist of a three mode steering system for light weight automobiles. The three modes are normal mode, reduced turning radius mode and sliding mode. In conventional four wheelers system has only one steering arrangement only to turn the front. To turn the car in short radius and in off road conditions we have to take the car in reverse. This is due to unavailability of steering control of rear wheels following problem may occur. In convertible four wheel steering with three mode steering can be changed as needed which assists in parking at heavy traffic conditions, when negotiating areas where short turning radius is needed and in off road driving.

### a)Parallel Parking

With increasing number of vehicles on road it becomes more difficult for drivers to park the vehicles. With limited space available the time taken to park the vehicles is limited. With normal steering mode it is highly unlikely to achieve the task. This task becomes easy and quick by using the sliding mode, in which both front and rear wheels turns in the same direction.



**Fig.2.1.1 Parallel parking.**

### b)High Speed Lane Change

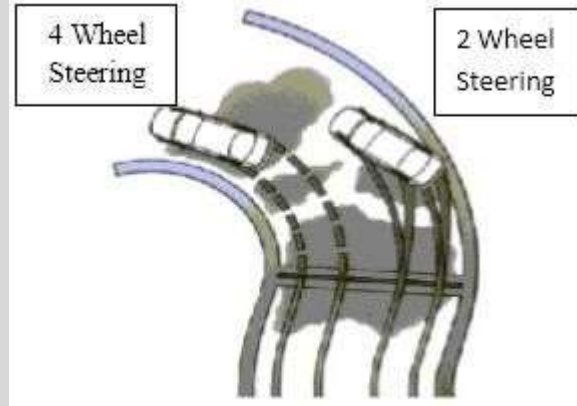
In race courts, it's highly unlikely for cars to turn the car across the lane with front wheel steering in high speed. The wheels would tend to lock resulting in skidding of car probably leading to accident. This also can be eliminated by using the sliding mode.



**Fig.2.1.2 High speed lane changing.**

### c)Short Turning Radius

Whenever it comes to short radius, cars with front wheel steering generally stumble. It's because front wheels generally will be steered properly across the short turning radius. But the rear wheel which follows it will not be steered properly. Hence special engagements are required to steer both rear and front wheels. So both the front and rear wheels are turned in opposite direction to get the reduced turning radius mode.



**Fig.2.1.3 Short turning radius comparison**

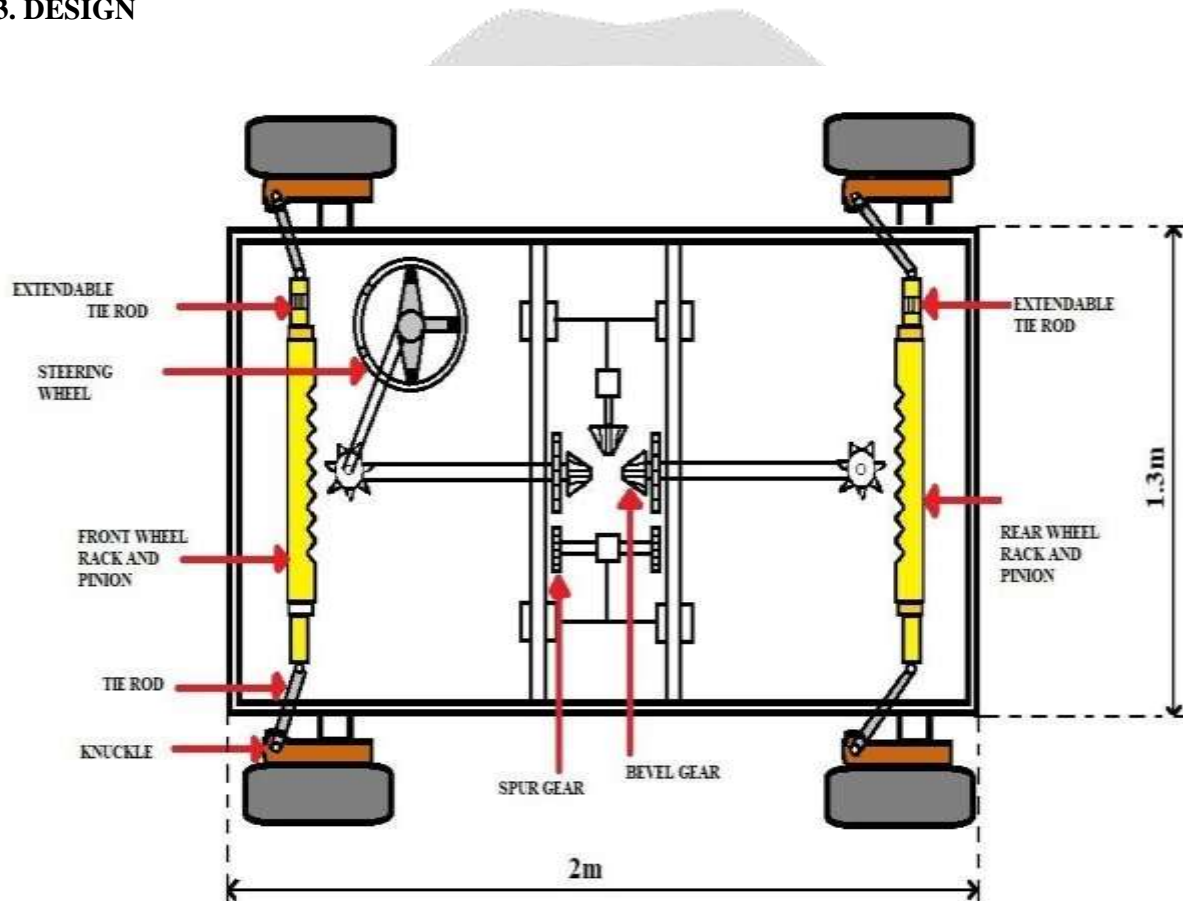
**2.2. ZERO TURN VEHICLE – IRJET 2016 – Shirsath S. V., Jadhav K. R., Patil R. V., Mohite A. V., Prof Patil .D. D.-** A vehicle containing user friendly steering mechanism and low cost has been introduced. Based on the results of analysis following conclusion are drawn. The vehicle's cornering behaviour becomes more stable. The vehicles response to steering input becomes quicker and more precise. By steering the rear wheels in the direction opposite the front wheels at low speeds, the vehicles turning circle radius is greatly reduced. This system reduce parking and turning time. We can achieve zero turn without any compromise in steer ability and handling of the vehicle. Zero turn vehicle takes the sharp turn about a vertical axis passing through its centre of gravity .For zero turn vehicle there is no need of additional space .The vehicle rotate in the circle having diameter equal to its length .The requirement of additional space is neglected. This system is used in jeep hurricane, Tata Nano pixel, JCB, lawn mower.

**2.3. FOUR WHEEL THREE MODE STEERIG SYSTEM – IRJET 2018 – Rithvik M S, Hari Vignesh B, Kavin S K, Yazharasu A. -** The most conventional and general steering arrangement is to turn the front wheels using a hand–operated steering wheel which is positioned in front of the driver. The four wheel three mode steering system is a modification for the present steering which is used for the improvement of easiness for vehicle handling. In convertible four wheel steering with three mode operation three steering modes can be changed as needed which

assists in parking at heavy traffic conditions, when negotiating areas where short turning radius is needed and in off road Driving

**2.4. STUDY OF FOUR WHEEL STEERING SYSTEM TO REDUCE TURNING RADIUS AND INCREASE STABILITY – ICARI 2014 – Arun Singh, Abhishek Kumar , Rajiv Chaudhary, R. C. Singh** -Four wheel steering is a relatively new technology, that imposes maneuverability in cars, trucks and trailers. The aim of 4WS system is a better stability during overtaking manoeuvres, reduction of vehicle oscillation around its vertical axis, reduced sensibility to lateral wind, neutral behaviour during cornering, etc., i.e. improvement of active safety. 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.

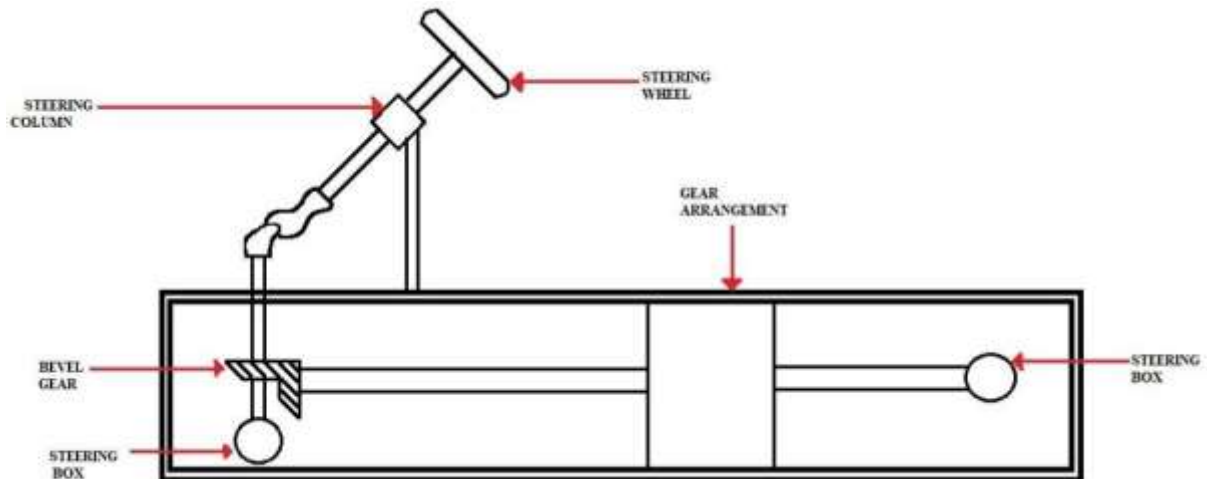
### 3. DESIGN



**Fig.3.1 Top view of layout**

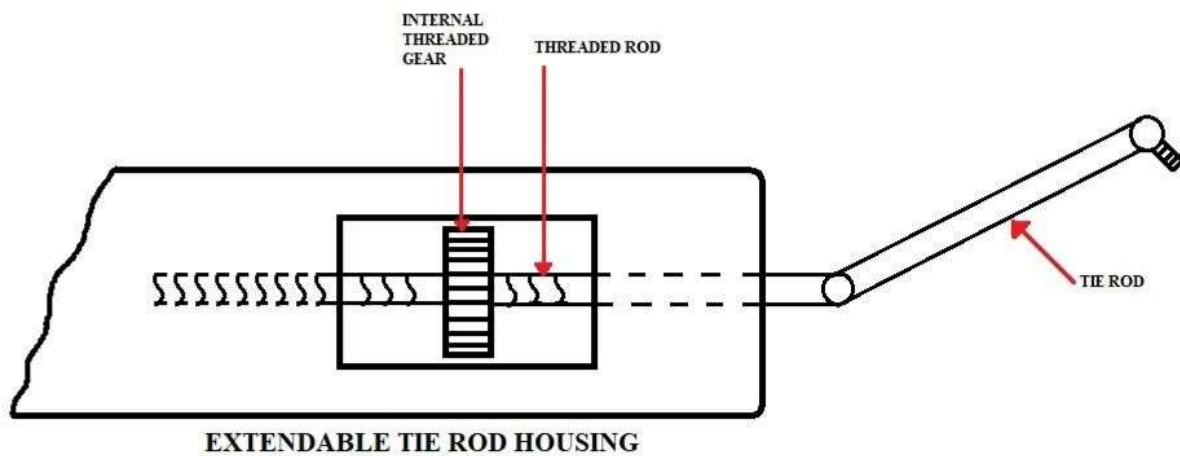
For obtaining the steering at both the front wheels and rear wheels two set of steering gear box is used, each for both front wheels and rear wheels. Both the steering boxes are linked through a set of gear arrangements as shown in fig.3.1. Each of the steering modes are obtained by engaging and disengaging these gear arrangements.

On the right side of each steering boxes, the normal tie rods are replaced by the extendable tie rods. The extendable tie rods can be extended or shortened by the user. The extendable tie rods are used to obtain the fourth mode that is the zero turn mode or the  $360^{\circ}$  rotation.



**Fig.3.2 Side view of layout**

The driver controls the steering radius through the steering wheel. The motion of steering wheel is transmitted through steering column to the front steering box. The rotary motion of steering wheel is converted to transverse motion by the steering box and transmitted to the steering knuckle through tie rods. The motion from the steering wheel is transmitted to the gear arrangement by two bevel gears as shown in the fig.3.2. Then the motion is further transmitted to the rear steering box by engaging different set of gears depending on the mode required.



**Fig.3.3 Extendable tie rod**

Extendable tie rod is a special type of tie rod constructed for the purpose of lengthening and shortening the tie rod by the user's desire. For the purpose of this project we are fabricating the extendable tie rod by ourselves for the achieving the requirements.

The extendable tie rod is a body which consist of a screw rod, an internal threaded gear and a tie rod attached to the screw rod. The lengthening and shortening of the tie rod is achieved through the movement of the screw rod. The rotation of the internal threaded gear makes the screw rod to move inside and outside of the body. The internal threaded gear is rotated by another spur gear meshed to it and can be rotated with a rotating lever.

For real application DC motor can is used in the place of the lever.

## 4. WORKING: FOUR MODES

### 4.1. Normal Mode

- In this mode only the front wheels are turned, that is the steering system in a normal vehicle.
- This mode is achieved when all the gears are disengaged.
- The steering of wheels is achieved by a rack and pinion mechanism.
- This is the default mode of this steering system.

### 4.2. Reduced Radius Turning Mode

- This mode helps to turn the vehicle in a reduced radius compared to the normal steering system.
- In this mode both the front and rear wheels turn in the opposite direction.
- This mode is achieved by engaging the spur gears with the help of the lever.
- The spur gears rotate the shafts of both the front and rear steering system in the same direction.

### 4.3. Sliding Mode

- This mode helps to change the track at high speeds and for parallel parking.
- In this mode both the front and rear wheels turn in the same direction.
- This mode is achieved by engaging the bevel gears with the help of the lever.
- The bevel gear rotates the shafts of both the front and rear steering system in the opposite direction.

### 4.4. Zero Turn Mode

- This mode helps to steer the vehicle in a zero degree radius, that is the vehicle rotates within its position.
- In this mode the front side of the front wheels turns inwards and the front side of the rear wheels turns outwards.
- This mode is achieved by steering the wheels to the right side after setting the reduced turning mode, then extend the tie rod at the rear wheel and shorten the tie rod at the front wheels

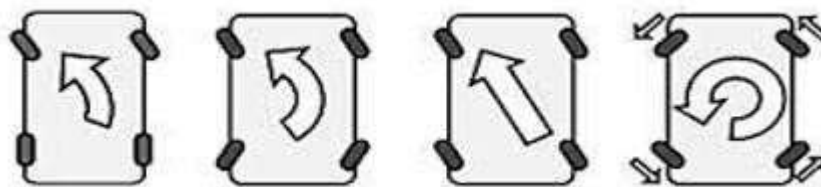


Fig. 4.4 Four modes of steering.

## 5. CONCLUSION AND FUTURE SCOPE

Four wheel steering is a relatively new technology, that imposes maneuverability in cars, trucks and trailers. In standard two wheels steering vehicles, the rear set of wheels are always directed forward therefore and do not play an

active role in controlling the steering in four wheel steering system the rear wheel can turn left and right to keep the driving controls as simple as possible.

The aim of 4WS system is a better stability during overtaking manoeuvres, reduction of vehicle oscillation around its vertical axis, reduced sensibility to lateral wind, neutral behaviour during cornering. Etc., i.e. Improvement of active safety.

The concepts involved in our project is entirely different that a single unit is used to various purposes, which is not developed by any of other team members. The project carried out by us made an impressive task in the field of automobile industries. It is very usefully for driver while driving the vehicle. This project has also reduced the cost involved in the concern. Project has been designed to perform the entire requirement task which has also been provided. By doing this project we gained the knowledge of various mechanism, drives, fabrication with welding and how it can be effectively used to control the steering for light motor vehicle.

## 6. REFERENCE

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