

Design of 360 Degree Steering System

Saransh Tiwari
 BE Scholar
 OIST
 Bhopal, M.P, India
 saranshtiwari96@gmail.com

Dr. Rajeev Arya
 Professor
 TIEIT
 Bhopal, M.P, India
 rajeev.arya@trubainstitute.ac.in

Abstract- The design and fabrication of 360 degree wheel rotation vehicle using Servo motor and steering is done to reduce time to turn from one direction to other direction. This vehicle can move in all direction at a same position by used of steering, sprocket, Servo motor, bearing and chain drive. Main function of this vehicle is easy to move from one direction to other direction. Modern development and economical progression of Indian society resulted in increase of people on railway platform, increase of vehicle on the road, due to space constraints, in hospital is major problem of the country. Present study aims for development of a system to reduce the turning radius of vehicle. In this system at first vehicle is stopped and wheels are then turned in the required direction with help of steering system and DC motor. It has turning radius nearly equal to negligible of length of the vehicle itself. This vehicle used to carry the goods in various area such as, railway platform, hospital, industries and market.

Keywords: Servo motor, Steering and wheel, Easy parking, 360 Degree rotating.

1. INTRODUCTION

Modern development and economical progression of Indian society resulted in increase of cars on roads. Due to space constraints, car parking is the major problem faced in most parts of the country. Present study aims for development of a system to reduce the turning radius of a car.

The indigenously developed system consists of Ackerman steering and various mechanism with arrangement of the various kinematics links. In this system at first vehicle is stopped and wheels are then turned in the required direction with the help of steering system. It has turning radius nearly equal to negligible of the length of car itself. This system can be useful in better parking, traffic jam, back turning on narrow roads, etc.

This project is about design of 360 degree wheel rotating vehicle. This vehicle moves in all directions and this design provides better comfort and also saves the time of customers, most of the people using this vehicle to carry goods, patient etc. But most of the time, they have to face the problem like taking U turn etc. So have to design a 360 degree wheel rotating vehicle to reduce and eliminate problems in the industry and at the railway platform. Zero degree turning radius of a vehicle implies the vehicle rotating about an axis passing through the center of gravity of vehicle i.e. the vehicle turning at the same place, where it is standing. No

extra space is required to turn the vehicle. So vehicle is to be turned in the space equal to the length of the vehicle itself. In this system, steering is connected to sprocket and this sprocket is connected to sprocket of front wheel by chain drive. Steering is used to provide the direction of front wheel. The Servo motor is connected to sprocket bolt at above of frame. When power supply from battery to Servo motor then rotary motion transfer from Servo motor to the wheel. The bearings are provide below sprocket which allow to wheel rotate 360 degree about vertical axis. Then this same rotary motion is transfer to the rear wheels by sprockets and chain drive arrangement.

So as a result this arrangement of the vehicle wheels to turn 90 degrees left and 90 degree right from original position, but front wheels of this vehicle rotate 360 degree by steering, sprocket and chain drive arrangement. Without moving from the spot, i.e. the vehicle has zero turning radius. This helps in maneuvering the vehicle in tight spaces such as parking lots and within small compounds.

The various functions of the steering wheel are to control the angular motion the wheels, direction of motion of the vehicle, to provide directional stability of the vehicle while going straight ahead, to facilitate straight ahead condition of the vehicle after completing a turn, the road irregularities must be damped to the maximum possible extent. This should co-exist with the road feel for the driver so that he can feel the road condition without experiencing the effects of moving over it.

2. STEERING SYSTEM

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.

The basic aim of steering is to ensure that the wheels are pointing in the desired directions. This is typically achieved by a series of linkages, rods, pivots and gears. One of the fundamental concepts is that of caster angle - each wheel is steered with a pivot point ahead of the wheel; this makes the steering tend to be self-centering towards the direction of travel.

The steering linkages connecting the steering box and the wheels usually conform to a variation of Ackermann steering geometry, to account for the fact that in a turn, the inner wheel is actually travelling a path of smaller radius than the outer wheel, so that the degree of toe suitable for driving in a straight path is not suitable for turns. The angle the wheels make with the vertical plane also influences steering dynamics as do the tires. Many modern cars use rack and pinion steering mechanisms, where the steering wheel turns the pinion gear; the pinion moves the rack, which is a linear gear that meshes with the pinion, converting circular motion into linear motion along the transverse axis of the car (side to side motion). This motion applies steering torque to the swivel pin ball joints that replaced previously used kingpins of the stub axle of the steered wheels via tie rods and a short lever arm called the steering arm. 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.

3. TURNING VEHICLE

The advanced new technology has led to various modifications in the automobile sector. Out of these, zero degree turning radius which is being analyzed in various vehicles e.g. hurricane jeep, JCB, Nano Pixel etc [1]. The turning circle of a vehicle is the diameter described by the outside wheels when turning on full lock. There is no hard and fast formula to calculate the turning circle but it can be calculated using this; Turning circle radius= $(\text{track}/2) + (\text{wheelbase}/\sin(\text{average steer angle}))$ [2]. Zero degree turning radius of a vehicle implies the vehicle rotating about an axis passing through the center of gravity of vehicle i.e. the vehicle turning at the same place, where it is standing. No extra space is required to turn the vehicle. So vehicle can be turned in the space equal to the length of the vehicle itself. This technology exists in heavy earth movers like excavator which consists of two parts i.e. the upper part cabin and lower part crawler chain. The upper part of excavator can rotate about its center, so that the direction of cabin can be changed without changing direction of lower part.

Conventional steering mechanism involves either the use of Ackerman or Davis steering systems. The disadvantage associated with these systems is the minimum turning radius that is possible for the steering action. This difficulty that is associated with the conventional methods of steering is eliminated by employing a four wheel steering system.

In this system, the wheels connected to the front axles are turned opposite to each other, and so are the wheels connected to the rear axle. The wheels on the left half vehicle rotate in one direction and the ones on the right half of the vehicle rotate in the opposite direction. This arrangement of the wheels enables the vehicle to turn 360 degrees, without moving from the spot, i.e. the vehicle has zero turning radius.

This helps in maneuvering the vehicle in tight spaces such as parking lots and within small compounds. The various functions of the steering wheel are, to control the angular motion of the wheels; direction of motion of the vehicle, to provide directional stability of the vehicle while going straight ahead, to facilitate straight ahead condition of the vehicle after completing a turn, the road irregularities must be damped to the maximum possible extent.

This should co-exist with the road feel for the driver so that he can feel the road condition without experiencing the effects of moving over it. Automobile giants in India like Tata, Maruti, Hyundai, Honda, Ford, Mahindra and Mahindra etc. are manufacturing more than 3 million vehicles per year [3].

4. PROBLEM FACED

The main problem associated in city areas is traffic. This condition is very time consuming and also sometimes it is difficult to come out in the emergency situations for example of hospital or fire safety conditions. Here Fig. 1 shows the traffic at the area considered. Sometimes it is difficult to park a vehicle in condition when two car parked one to another spaced between them. Thus this condition also consumes times for the life style. Also there may be chance of sudden brakeage and chance of accident and damage for the vehicle.



Fig. 1: Problem at Parking

5. Literature Review

The idea of 360 degree wheel rotation load carry vehicle is analyzed from:

Jaishnu Moudgil, et al. [1], presented a 360 degree rotating car to overcome the problem of parking space. This car has zero degree turning radius of a vehicle implies the vehicle rotating about an axis passing through the center of gravity of vehicle i.e. the vehicle turning at the same place, where it is standing. No extra space is required to turn the vehicle. So vehicle is to be turned in the space equal to the length of the vehicle itself. In this presentation, so got idea of 360 degree wheel rotation vehicle and have plane to make 360 degree wheel rotation load carry vehicle, this vehicle is to be used in different area like industries, hospital, railway platform, etc.

Sudip kachhia [2], presented a 360 degree rotating vehicle to overcome the problem of parking space. This project is about design of 360 degree rotating car to move in all direction. This design provides better comfort and also saves the time of customers, that's why it is also the reliable for the customer. As it is also battery operated car thus no fuel is required. Hence it is economical to the environment. This also reduces the cost of the car, and also got idea to use battery to operate this vehicle.

K. Lohith, et al. [3], presented a four wheel steering system for a car. 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 with the use of DC motor to turn left and right. In this presentation, the use of DC motor is to rotate the wheels 90 degree left and 90 degree right from original position.

Er. Amitesh Kumar, et al. [4], presented zero turn four wheel steering system, the various functions of the steering wheel are, to control the angular motion the wheels, direction of motion of the vehicle, to provide directional stability of the vehicle while going straight ahead, to facilitate straight ahead condition of the vehicle after completing a turn, the road irregularities must be damped to the maximum possible extent. This project the use of steering is to rotate front wheels.

Mr. Sharad P. Mali, et al. [5], presented zero turn four wheel mechanism, in this project people have used DC motor and wheel to vehicle rotate 360 degree at a same position. So in this project, the idea is to arrange of DC motor and wheel.

6. METHODOLOGY

Design of 360 degree wheel rotation vehicle adopted to easily move in required direction. This vehicle is mainly consist of

Servo motor, Gear, Wheel, Wheel motor, Gear assembly, Wheel supporting rod. The basic arrangement of the 360 degree wheel rotation vehicle is as shown in Fig. 2.

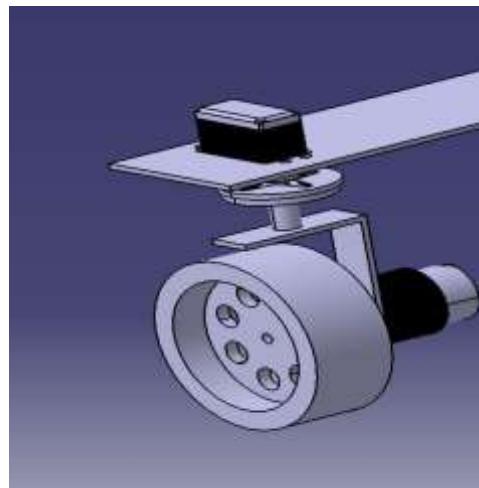


Fig. 2: 360 degree rotating wheel

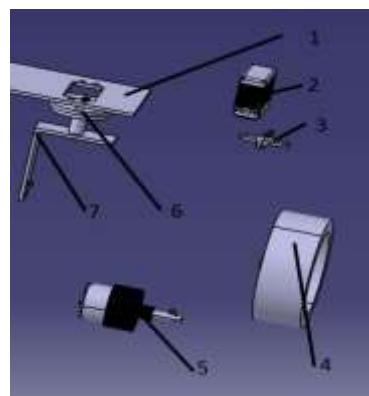


Fig. 3: Detailed View

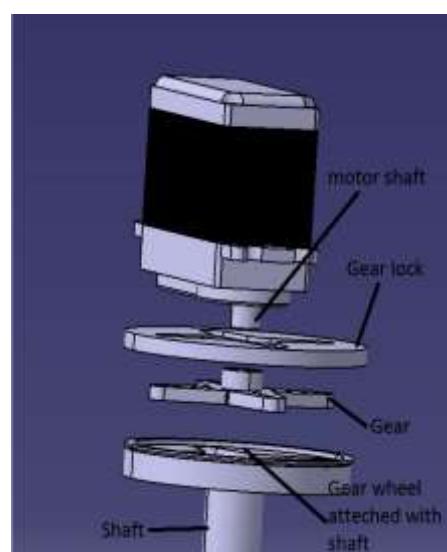


Fig. 4: Gear Assembly

Main gear is inter in in gear wheel, routed gear lock and complete this gear assembling process

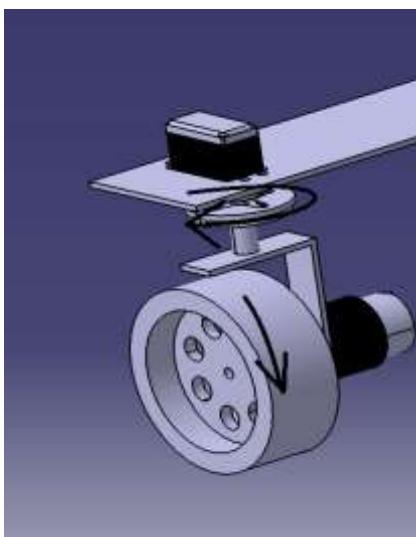


Fig 5: Wheel Mechanism

Wheel motor rotate the wheel the robot can move and servo motor is use to rotate this wheel in 360 degree direction.

Advantages

- It consumes very less time to turn from one direction to other direction.
- It is more efficient compare to other type of load carry vehicle.
- This type of load carry vehicle is easily parked in any direction.
- It is less costly load carry vehicle.
- Eco friendly.
- Less noise operation.
- More efficient.

Application

- In Industries for automation of raw material like automated guided vehicle.
- In automobile sector there are so many types of vehicle are using to carry goods from one position to another position, there is space problem in the industry so this vehicle is used in automobile applications because this vehicle consumes very less space compare to other type of vehicle.
- This vehicle is used in small Industries for transportation of raw material from one position to another position.
- Modern development and economical progression of Indian society resulted in increase of vehicle in park so there are also problem. In park other vehicle are taking more space to move from one direction to other direction and 360 degree wheel rotation vehicle have capability to

move parallel direction so this vehicle is easily move from one direction to other direction in park.

- Take easily U-turn because front wheel of this vehicle are rotating freely by steering, chain drive and sprocket arrangement.
- It is used in hospitals to carry the patient from one room to another room. Because there are lots of patients those are staying in one room.

7. CONCLUSION

A prototype for the proposed approach was developed by introducing steering and servo motor to wheel rotate 360 degree. Thus it is concluded that vehicle can be allowed to guide vehicle in all direction. 360 degree of rotating automobiles and also we can guide in parallel direction. In recent time the advancement is made in automobiles. So, it has been modified in such a way that it can save time and also easily work with many problem. This can give fast response and less space is required. The developed model is recommended for inclusion in the cars in various area such as small industries, railway platforms.

REFERENCES

- [1] Jaishnu Moudgil, Shubhankar Mengi and Mudit Chopra, 360 Degree Rotating Vehicle to Overcome the Problem of Parking Space, International Journal of Research in Mechanical Engineering and Technology, 5(2), 2015, 22-25.
- [2] Sudip kachhia, Design of 360 Degree Rotating Car, International Journal of Advance Research and Innovative Ideas In Education, 2(5), 2016, 15-16.
- [3] K. Lohith, K. Lohith, Dr. S. R. Shankapal, M. H. Monish Gowda, Development of Four Wheel,Scholars Journal of Engineering and Technology,12(1), 2013, 52-53.
- [4] Er. Amitesh Kumar, Dr.Dinesh.N.Kamble, Zero Turn Four Wheel Steering System, International Journal of Scientific & Engineering Research,5(12), 2014, 22-24.
- [5] Mr. Sharad P. Mali, Mr. Sagar Jadhav, Prof. D.U.Patil, Zero Turn Four Wheel Mechanism, International Engineering Research Journal,2(2), 2016, 484-486.
- [6] Neville, A., Stanton, Marsden P.(2001), From fly-by-wire to Drive-by-wire:Safety implications of automation in Vehicles , Automotive engineering, Vol.109, No.9, Pp.102-106.
- [7] Brian T., Murray,D.,Ambrosis ,Joseph,W., Barbara J. C., System- Safety Process For By-Wire Automotive System, SAE TECHNICAL PAPER SERIES 2000-01-1056A.
- [8] Chori S., Alonso J.J., and Kroo H.M.,Two-level multifidelity design optimization studies for supersonic jets, Journal of Aircraft, Vol 46,No.776-790.
- [9] Gajanan S. Rao and Prof. R. R. Deshmukh. Art of Fatigue Analysis of Helical Compression Spring Used in Two-Wheeler Horn. International Journal of Mechanical Engineering and Technology, 4(2), 2013, pp. 196-208.
- [10] R. S. Khurmi, J. K. Gupta, "A text book of Machine Design. Eurasia Publishing house (PVT.) Ltd", First multi color edition, 2005.