



Fabrication of Four wheel Steering Drive Control by Bluetooth Device

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Abstract:

Four wheel systems is implemented in vehicles to achieve better performance at high speeds, reducing the turning radius of the car and to reduce the driver's steering effort. This project focuses on a mechanically feasible & innovative design involving a double acting hydraulic cylinder system. 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 turning the direction of the curve and thus curb on the efficiency of the steering. In four wheels 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

Index words: Four wheel system, Reducing the turning radius, Automobile industry and Innovative design, Steering.

I. INTRODUCTION

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 concept of four wheels 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 with the Bluetooth technology for the existing vehicle and turning radius is reduced without changing the dimension of the vehicle. Steering of a four wheeler is far as possible, arranged so that the front wheel rolls truly without the lateral slip.

The front wheel is support on the front axle so that they can swing freely. this movement is produced by gearing and linkage between the steering wheel in front of the driver and the steering knuckle or wheel. The term "steering geometry" (also known as "front-end geometry") refers to the angular Relationship between suspension and steering parts, front wheels, and the road surface. Because alignment deals with angles and affects steering, the method of describing alignment measurements is called steering geometry.

There are five steering geometry angles: Camber, Caster, Toe, Steering axis inclination, and Toe-out on turns . There is two more steering geometry angles that are not specific to each

wheel but measure the spatial relationship among all four wheels .These are Setback and Thrust angle.

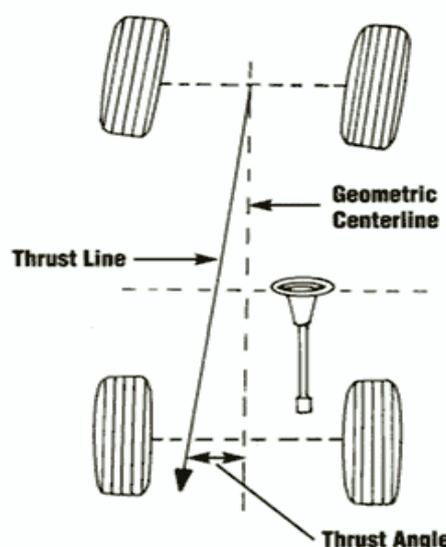


Figure.1. Steering system

All steering geometry angles can be measured in degrees. However, toe out and Setback can be measured in terms of distance and may be given in inches or mm.

II. LITERATURE SURVEY

- [1] K J yogesh, mohd rehan desai ,praveen gasthi ,(2017) made a study of Design and fabrication of four wheel steering system for low speeds.
- [2] Ansari rehan ,shoaib sayyed ,rafiuddin khan (2017) Design and synthesis of four wheel steering mechanism. It Reducing the turning radius.
- [3] mayur khangana et al, (2016) Four wheel steering –A review Its ability to drive all four wheel using a single actuator
- [4] m.pateland diptesh patel et al, (2016) Design and development of active four wheel steering system Better result for low and high speed.so it increases maneuverability, stability and decrease the turning radius

[5] aditya bochare et al, 4-wheel steering system mechanism using DPDT switch. The system assembly is easy to install and light weight and can implement in all sections of car efficiently...

III. ACKERMANN STEERING GEOMETRY

Ackermann steering geometry is a geometric arrangement of linkages in the steering of a car or other vehicle designed to solve the problem of wheels on the inside and outside of a turn needing to trace out circles of different radii. Modern cars do not use pure Ackermann steering, partly because it ignores important dynamic and compliant effects. Some race cars use reverse Ackermann geometry to compensate for the large difference in slip angle between the inner and outer front tires while cornering at high speed. The use of such geometry helps reduce tyre temperatures during high-speed cornering but compromises performance in low speed maneuvers. The intention of Ackermann geometry is to avoid the need for tyres to slip sideways when following the path around a curve. The geometrical solution to this is for all wheels to have their axles arranged as radii of a circle with a common center point. As the rear wheels are fixed, this center point must be on a line extended from the rear axle. Intersecting the axes of the front wheels on this line as well requires that the inside front wheel is turned, when steering, through a greater angle than the outside wheel. Rather than the preceding "turntable" steering, where both front wheels turned around a common pivot, each wheel gained its own pivot, close to its own hub. A linkage between these hubs moved the two wheels together, and by careful arrangement of the linkage dimensions the Ackermann geometry could be approximated. This was achieved by making the linkage not a simple parallelogram, but by making the length of the track rod (the moving link between the hubs) shorter than that of the axle, so that the steering arms of the hubs appeared to "toe out". If the track rod is placed ahead of the axle, it should instead be longer in comparison thus preventing same "toe-out".

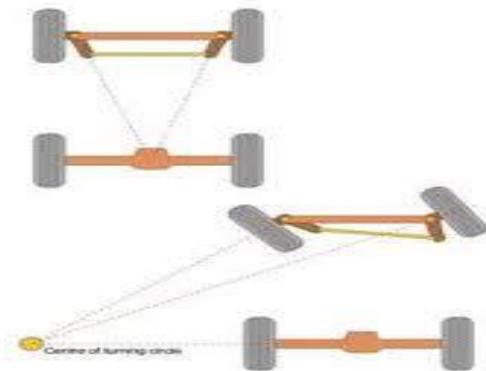


Figure.2. Toe-out

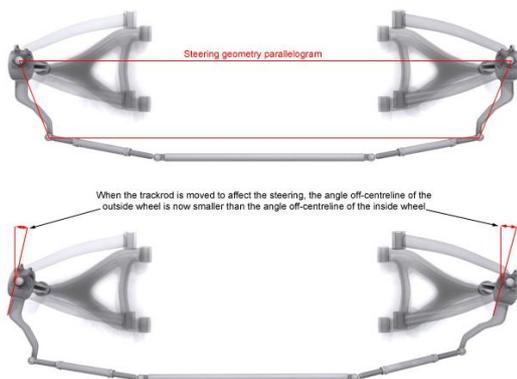


Figure.3. Ackermann Steering Geometry

IV. TURNING CIRCLES

The turning circle of a car is the diameter of the circle described by the outside wheels when turning on full lock. There is no hard and fast formula to calculate the turning circle but you can get close by using this: KING PIN AND KING PIN AXIS The imaginary axis about which the steered wheels are swiveled. In older models a solid structural component is used as a king pin and its center line is the king pin axis. In present day models the solid component is absent.

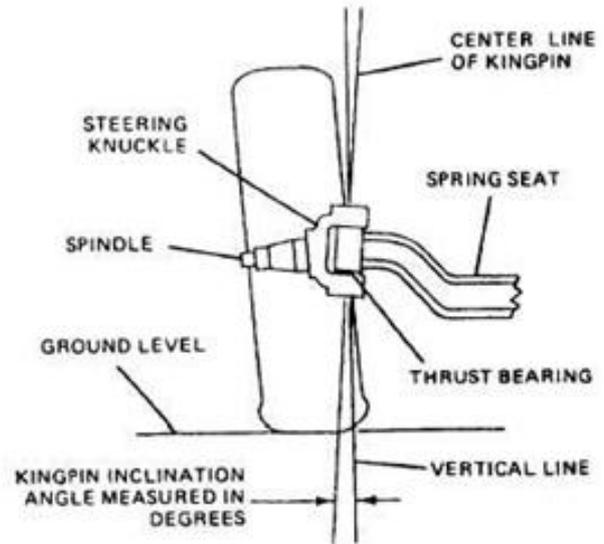
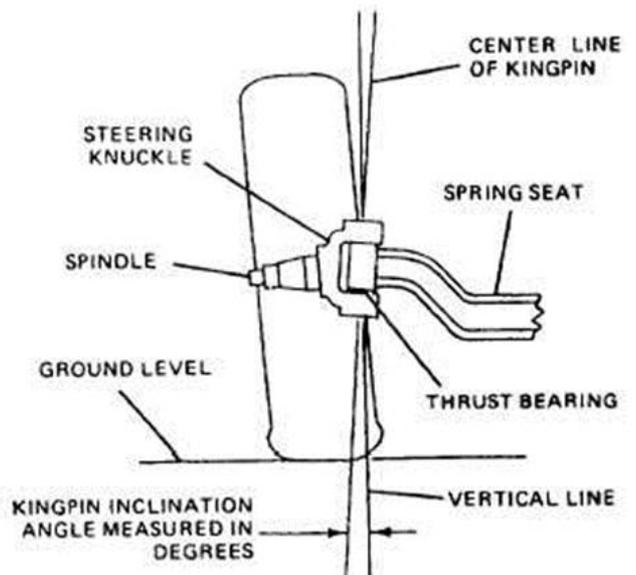


Figure.4. king pin and king pin axis

Instead ball joints are used. The imaginary line joining upper and lower ball joint acts as king pin axis.c.



KING-PIN INCLINATION OR STEERING AXLE INCLINATION

The angle between the vertical line and center of the king pin or steering axle, when viewed from the front of the vehicle is known as king pin inclination or steering axle inclination. The king pin inclination, in combination with caster, is used to provide directional stability in modern cars, by tending to return the wheels to the straight – ahead position after any turn.

Kingpin Angle

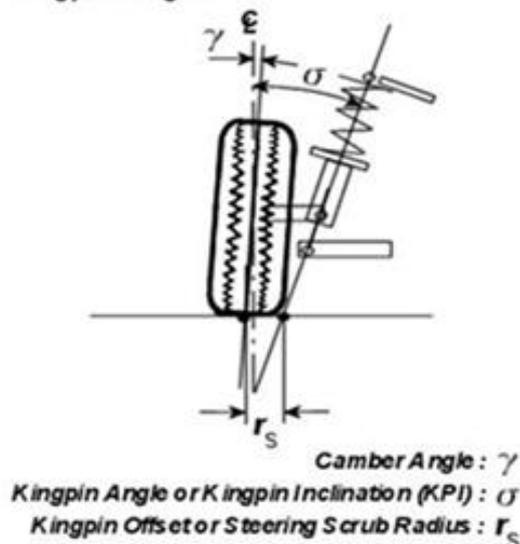


Figure.6. kingpin angle

CASTOR

In addition to being tilted inward toward the centre of the vehicle, the kingpin axis may also be tilted forward or backward from the vertical line. This tilt is known as caster. Thus the angle between the vertical line and the kingpin centre line in the plane of the wheel (when viewed from the side) is called caster angle. When the top of the king pin is backward, the caster angle is positive, and when it is forward the caster angle is negative. The caster angle in modern vehicles ranges from 2 to 8 degree. Tilt of the king pin axis from the vertical either towards the front (negative castor) or towards the rear (positive castor)

STEERING GEAR

The steering gear is a device for converting the rotary motion of the steering wheel into straight line motion of the linkage with a mechanical advantage. If the steering wheel is connected directly to the steering linkage it would require a great effort to move the front wheels. Therefore, to assist the driver, a reduction system is used having a steering ratio (the ratio between the turn of the steering wheel in degrees or handlebars and the turn of the wheels in degrees) between 10:1 to 24:1 the actual value depending upon the type and weight of the vehicle. A higher steering ratio means that you have to turn the steering wheel more, to get the wheels turning, but it will be easier to turn the steering wheel. A lower steering ratio means that you have to turn the steering wheel less, to get the wheels turning, but it will be harder to turn the steering wheel. Larger and heavier vehicles like trucks will often have a higher steering ratio, which will make the steering wheel easier to turn. In normal and lighter cars, the wheels become easier to turn, so the steering ratio doesn't have to be as high. In race cars the ratio becomes really low, because you want the vehicle to respond a lot quicker than in normal cars.

THE STEERING GEARS ARE ENCLOSED IN A BOX, CALLED THE STEERING GEAR BOX. THERE ARE MANY DIFFERENT DESIGNS OF STEERING GEAR BOX.

- Worm and wheel steering gear
- Worm and sector steering gear
- Cam and lever / peg steering gear
- Cam and roller or worm and roller steering gear
- Worm and nut or screw and nut steering gear

- Recirculation ball steering gear
- Rack and pinion steering gear

WORM AND WHEEL STEERING GEAR

The system consists of worm wheel which is carried in bearings in a cast iron case. The case is made in halves. The outer end of the worm wheel is fixed to a drop arm which having ball end to connect the side rod. The side rod is connected to the steering arm which is fixed to the stub axles.

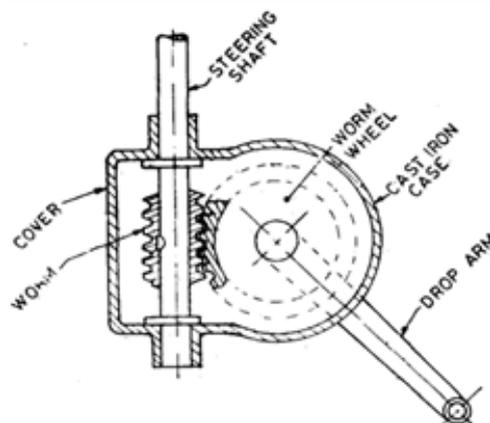


Figure.7. Worm and wheel steering gear

V. BLUETOOTH

Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength radio transmissions in the ISM band from 2400–2480 MHz) from fixed and mobile devices, creating personal area networks (PANs) with high levels of security. Created by telecom vendor Ericsson in 1994,^[2] it was originally conceived as a wireless alternative to RS-232 data cables. It can connect several devices, overcoming problems of synchronization. Bluetooth is managed by the Bluetooth Special Interest Group, which has more than 19,000 member companies in the areas of telecommunication, computing, networking, and consumer electronics.^[3] Bluetooth was standardized as **IEEE 802.15.1**, but the standard is no longer maintained. The SIG oversees the development of the specification, manages the qualification program, and protects the trademarks.^[4] To be marketed as a Bluetooth device, it must be qualified to standards defined by the SIG.^[5] A network of patents is required to implement the technology, which is licensed only for that qualifying device. The word "Bluetooth" is an anglicized version of the Scandinavian Blåtand/Blåtann, the epithet of the tenth-century king Harald I of Denmark and parts of Norway who united dissonant Danish tribes into a single kingdom. The idea of this name was proposed in 1997 by Jim Kardach who developed a system that would allow mobile phones to communicate with computers (at the time he was reading Frans Gunnar Bengtsson's historical novel *The Long Ships* about Vikings and king Harald Bluetooth).^{[6][7]} The implication is that Bluetooth does the same with communications protocols, uniting them into one universal standard.^{[8][9][10]} The Bluetooth logo is a bind rune merging the Younger Futhark runes Hagall (H) and Bjarkan (B), Harald's initials.

VI. FABRICATION OF FOUR WHEEL STEERING SYSTEM

The main objective of our project is to fabricate the Four Wheel steering, (REAR STEER MODE). This was the first

mode of four-wheel steering used in a car. Here, the rear wheels turn in a direction opposite to the front wheels so that to reduce the turning circle radius at low speeds. This would be very useful in city traffic conditions. A separate circuit was used to obtain this steering mode. The standard four-wheel steering mode, in which the front wheels steer opposite to the rear wheels, can also be utilized in this kind of four-wheel steering system to improve low-speed handling. We made modifications in the MARUTHI-800 model car to achieve four wheel steering. Maruti 800 is the largest selling car in India. It is manufactured by Maruti Udyog in India. Maruti 800 is ideal compliment to advanced lifestyles and tastes with a car fully made for the Indian roads.

VII. METHODOLOGY

Modification was made in the rear wheel assembly and addition of one more rack and pinion steering gear box for steering the rear wheels. Then a transfer rod is placed in between the front and rear steering gear box to transfer the motion to rear steering gear box. As the vehicle Maruti 800 is front wheel drive as shown in fig 10.1 there will be no difficulty in transferring the power from the Engine through Gear box, only a rear wheel assembly with steering gear box is required

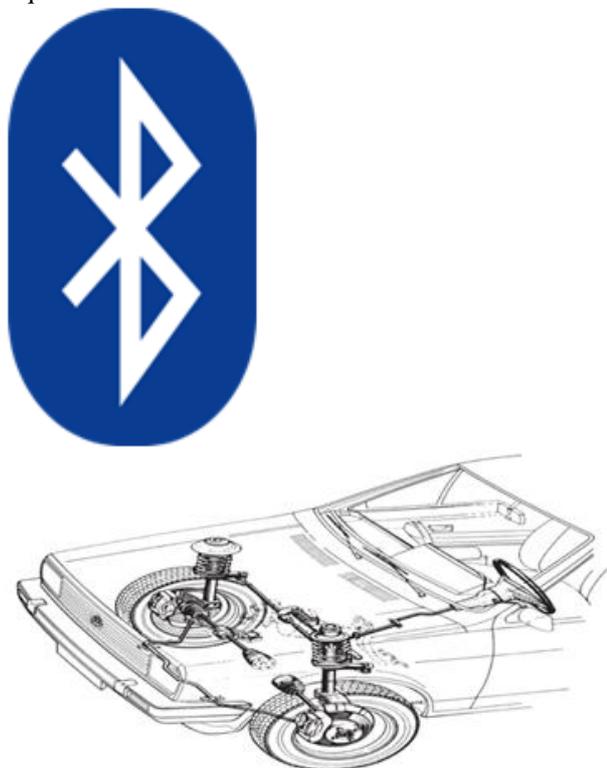


Figure 9. Methodology

VIII. THE PROJECT CONSISTS THE FOLLOWING PARTS:

- Rear Rack and pinion steering gear box
- Transfer rod.
- Bevel gear (2 no's)
- Rear wheel hub (2 no's)
- Lower Arm (2 no's)
- Support (2 no's).

IX. WORKING PRINCIPLE

When the steering is steered the power is transferred to the front rack and pinion steering gear box, and a bevel gear arrangement is made to transfer the power to the rear rack and pinion steering gear box. Bevel gear is used to transmit the

rotary motion perpendicularly, so the one bevel gear is introduced in the front steering rod. Other bevel gear is connected to the transfer rod. Two supports are used to support the transfer rod. Transfer rod is connected to the rear rack and pinion steering gear box. Rear rack and pinion steering gear box is fixed to the car body by bolts and nuts and the ends of the steering box are connected to the rear wheel hub where the tyres are mounted. As the steering is steered the rear wheels also turn by the arrangements made and the rear wheel turn in the opposite direction by the arrangements in the bevel gear it is controlled by the mobile Bluetooth technology.

X. CONCLUSIONS

An innovative feature of this steering linkage design is its ability to drive all four (or two) wheels using a single steering actuator. Its successful implementation will allow for the development of a four-wheel, steered power base with maximum maneuverability, uncompromised static stability, front- and rear-wheel tracking, and optimum obstacle climbing capability. Thus the four-wheel steering system has got cornering capability, steering response, straight-line stability, lane changing and low-speed maneuverability. Even though it is advantageous over the conventional two-wheel steering system, 4WS is complex and expensive..



Figure 10 Bevel Gear Arrangements

XI. REFERENCES

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