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Zero Radius Turning Vehicle

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ABSTRACT

In modern era, the characteristics of the vehicle like steer ability and handling have become major aspects, conventional steering involve either the Ackerman or Davis steering system which has disadvantage that it can't take minimum radius turn. Providing zero turn steering without any compromise in steer ability and handling of the vehicle is a major concern for automakers. The main intention is to improve the zero turn steer ability of the vehicle without wheel wandering problems. The number of vehicles is continuously increasing. It causes the problem of traffic congestion, pollution (noise and air). To overcome problem like vehicle maneuvering on narrow roads and during parking this system has been proposed. Zero turn steering gives much better maneuverability and control on the vehicle. We have developed an innovative idea about four wheel steering design to implement a mechanism that can take minimum radius turn about its gravitational axis. Zero turning is done by turning drive wheels at the same rate in opposite direction. By steering the rear wheels in the direction opposite the front wheels at low speeds, the vehicles turning circle radius is reduced.

Keywords-- Steering System, Maneuverability, Turning Circle Radius

I. INTRODUCTION

The zero-radius wheel steering arrangement is best suitable when there is very less space in between the two parked vehicles of the order of nearly equal to the size of the vehicle. 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 Now day everyone has own vehicle, due to that car parking essential in the important places such as bazaar & market.

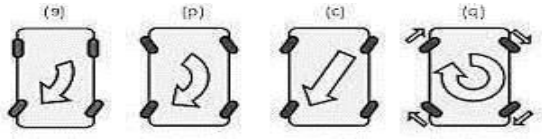

Figure 1.1: Comparison of Steering systems.

a. Ackerman Steering: Nowadays most of the vehicles use the two wheel steering mechanism as their main handling system. But the efficiency of the two wheel steering vehicle is proven to be low compared to the four wheel steering vehicles.

b. Four-wheel steering, 4WS, also called rear-wheel steering or all-wheel steering, provides a means to actively steer the rear wheels during turning man oeuvres. It should not be confused with four-wheel drive in which all four wheels of a vehicle are powered. It improves handling and helps the vehicle make tighter turns.

c. Crab steering is a special type of active four-wheel steering. It operates by steering all wheels in the same direction and at the same angle.

d. Zero turning radius vehicles: Zero turn Vehicle takes the sharp turn about a vertical axis passing through its center 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. Zero turning radius were all wheels turn in opposite direction placed at 45° angle to spin the vehicle at same axis. The requirement of additional space is neglected.

II. METHODOLOGY

The zero degree turning radius vehicle consists of frame made of mild steel, the motors are attached to the wheels. One motor at the front and other motor at the rear wheel individually. Each wheel is connected to the column individually through shaft and bearing to the main frame, were whole wheel with column rotates by DC motor simultaneously. All wheel columns is fitted with DC motor which can rotate the wheel 360º, this helps to place the wheels at different angle according to the requirements. Each wheel can turn independently. The zero turning radius were all wheels turn in opposite direction placed at 45º angle to spin the vehicle at same axis. For the vehicle movement DC motor is operated by toggle switch by ON, OFF, ON, this toggle switch reverse the current for the DC motor to rotate clock wise and anticlockwise direction intend to move the vehicle forward and backward direction. Lead acid battery is required for the dc motor to run the vehicle. The flow diagram as shown in Fig.2.1 describes the process of operation.

This vehicle provides circular path i.e. vehicle turns at the same place where it's standing. In this condition, the tie rod will shift to another end and angle of wheel is to set that the vehicle moves in circle of Zero radius.

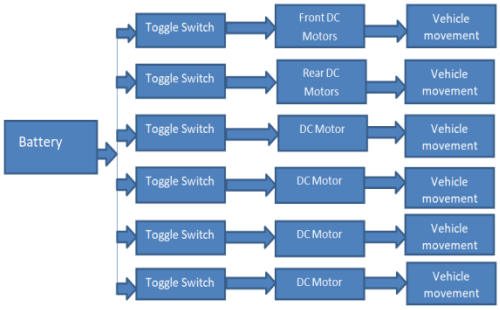

Figure 2.1: Block Diagram

The measurements of frame are as follow;
Width: 0.7 m
Length: 0.8 m
Thickness: 0.0016 m
Measurement of bearing are;
Inner diameter: 0.03 m
Outer diameter: 0.04 m
Thickness: 0.012 m
Speed of DC motor: 10 rpm
Battery capacity (lead acid): 12 V, 8 A
Total gross weight :
Weight of DC motors = 1Kg
Weight of frame = 3.5

Force = m x g
= 4.5 x 9.81
= 44.145 N

Force on each wheel = 44.145/4
= 11.03N

Torque, T= f x r
= m x g x r
= 4.5 x 9.81x 0.05
=2.207 N-m (for one motor)

For 4 motors, T= 4 x 2.207
=8.828 N-m

Speed required = Power / Torque
Power = V x I
= 12 x 8
=96 w

Speed = 96 / 8.828
= 10.8 rpm

Therefore, the speed required for carrying weight of 4.5kg is 10.8 rpm for each wheel. The assembly of the turning mechanism is shown in Fig. 2.2.

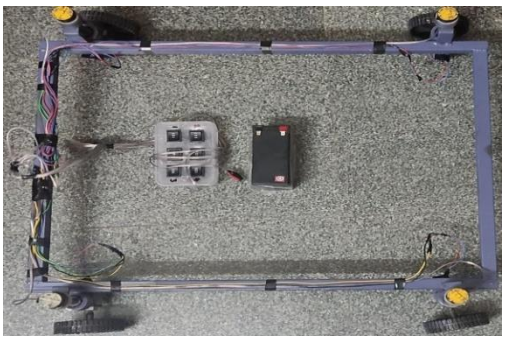

Figure 2.2: Assembly of Zero Turning Mechanism

III. RESULTS AND DISCUSSIONS

The turning of vehicle for 360 is tested and the time taken for the same for the two types, i.e. zero and normal steer of steering mechanisms is recorded and is shown in the Table 3.1.

Table 3.1 Comparison between Zero Turn and Normal Steer of Steering Mechanism

Type of Steering	Time taken for 360°(sec)
Zero turn vehicle	28
Normal steer	160

A vehicle with higher turning radius face difficulty in parking and low speed cornering due to its higher wheelbase and track width, in this scenario zero turning steering will be effective as the turning radius will be decreased for the same vehicle of higher wheelbase. As this radius of turning decreases time required for turning the vehicle and path which the vehicle covers while taking turns decrease. The zero turning vehicle is designed such a way that it can be changed from four wheel steer to two wheel steer whenever required.

IV. CONCLUSION

The maneuverability of the device is quite good and the handling is quite simple. For commercial purpose one can improve the efficiency of the device effectively by increasing the size of the device. However, The device affords plenty of scope for modifications, further improvements and operational efficiency, which should make it commercially available. If taken up for commercial production and marketed properly. It has plenty of scope if the device is made larger in size so that the capacity of carrying weight and the load is maintained properly.

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