Flippy Battle Tank With Zero Turning Radius

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Abstract- *The main aim of the paper is the alternative solution for the armored vehicles used in the war. By making the combination of concept of the Flippy vehicle and zero turning radius. If we only change the wheel system instead of total steering system, it is more convenient for the vehicle. In this system,the wheel positioning system was directly connected to the steering system, due to this reason steering system was more complicated. To solve this problem by new concepts of Zero Turn Vehicle with pneumatically operated system.In this system positioning of the wheel will be directly depend on the compressor. So it is easy to change position of the wheel. The vehicle can rotate at their center position at 360 degrees. And if any vehicle rotates in at 360 degrees, then it will easy to solve the problems of a battle tank*

Keywords- Flippy, Zero Turn Mechanism, Steering Wheel Configuration, Turning radius.

I. INTRODUCTION

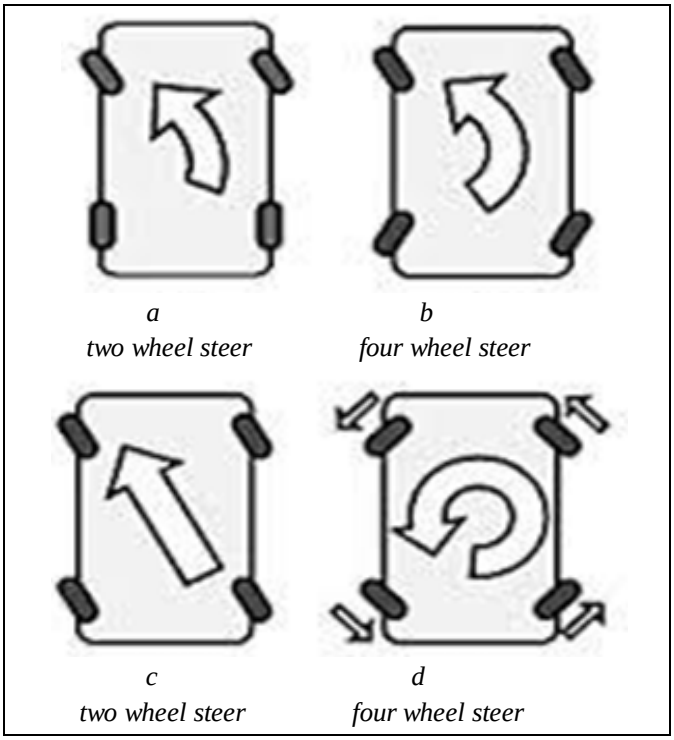
The concept of battle tank was firstly introduced in 1945-1946 by British and Russia. Today battle tanks are considered as a key component of modern armies. It requires four members' commander, driver, loader, and a gunner. During wartime battle tank require more power to turn itself. The belt should run in the opposite direction for zero turning. This battle tank requires more space and it is heavier because of metal chain belt. The vehicle is used by bomb launcher as a mini tank. But there are more possibilities of accidents with bomb launcher.[5]

With this concept a small model is created to show how the combination of Flippy vehicle and four wheel steering system work. Four wheel steering is must nowadays and is relatively a new technology that improves movement ability in cars, trucks, trailers, etc. There are some different steering systems like crab steer, zero turning system and four wheel steering system. In this turning radius is reduced by some angle. The diameter of the wheels is greater than the size of the vehicle body. So that tank can run even after it gets flipped and get ground clearance from both sides. Each wheel is powered independently by using separate motor. To steer each wheel actuator are used independently. Each wheel can turn in the opposite direction also. The concept is still used in toy cars.

II. STEERING WHEEL CONFIGURATIONS

There are four steering wheel configurations as follows.

1. Two Wheel Steer: In two wheel steering system, front wheel takes turn while the rear wheels are restricted to turn and follow the front wheels.
2. Four wheel steer: In four wheel steering system, front as well as rear wheels are turn, but in opposite direction as that of front wheel. This system is used at low speed. This enables the vehicle to turn in minimal possible space.
3. Crab steer: In crab steering system, all the wheels are turning in the same direction. This system is used at high speeds. This helps to reduce centrifugal force and prevent skidding of vehicle.
4. Zero turn steer: in zero turn steering system, the angle of wheel is so set that, the vehicle moves in a circle of zero radius. [2].



III. LITERATURE REVIEW

Adem kader had worked on the system of zero turning radius mode in march of the year 2006. A steer-by-wire system purposes to eliminate the physical connection between the steering wheel and the wheels of a car by using electrically controlled motor to change the direction of the

wheels and to provide the feedback to driver. The combination of a steer-by-wire system can improve these systems in many ways. In particular, the handling and the safety of the cars can be enhanced significantly. Since a steer-by-wire system is easily modifiable, different drivers will be able to adjust the system to put up their styles and enhance handling.[1]

The System has two rotary encoders are responsible for angular information to a computer controller through two microcontrollers. The computer controller controls two external controllers that are required for voltage and current adjustments. The adjusted output drives the feedback actuator and the steering actuator to desired positions. Whenever there is a difference in the angles of the two motors, the system drives to bring the difference back to zero, which is the regularity and the desired configuration. The steer-by-wire system consists of two main parts. First is the steering section ,consists of the feedback actuator angle sensor ,the steering wheel, the feedback actuator . Second is the wheel section containi the wheels, the rack and pinion, a steering actuator and the pinion angle sensor

The feedback angle sensor provides the pinion angle sensor provides the feedback motor primary signal and the steering actuator with its primary input signal. The small size of the feedback motor lets the driver, rotate the steering wheel with little difficulty. When the driver starts steering, the control mechanism pushes the steering wheel back into place and this simulators the resistive force of a real steering wheel. Though, changing the proportional constant of the feedback motor can make it harder/easier for the driver to steer and allows for adjustable steering (with some drawbacks such as more vibration).[1]

Mr. B. L. Salviet all had a patent and developed a system for reducing the turning radius of a car in for International Journal of Engineering and Innovative Technology (IJEIT) in March of year 2012. The aim of this research is for development of a system to reduce the turning radius of a car. The indigenously developed system consists of screw jack, gears and mechanism with the arrangement of the various kinematics links. The developed system is electric motor driven. In this system at first car is lifted and then turned in the required direction. The mechanism is sufficiently capable in turning the car in any direction without steering and turning radius equal to the half of the length of the car. The car can be turned back in 40 second. This system is useful in parking, traffic jam, changing of punctured wheels, back turning on narrow roads etc.[2]

In order to develop the new system for car, a model of a small electric car is used. The selected model is 910 mm long, 360 mm wide and 195 mm height. Some modifications were done in the existing car by combining the screw jack, spur gears, electric motor, capacitor, etc. The power screws [6] are used to convert rotary motion into translatontion motion. For lifting and turning of the car, two methods are proposed, the mechanical system and the hydraulic system. In this model, mechanical system is developed. A screw jack (Fig. 6) was used to develop the rising mechanism for a car. At one end of the screw jack, a gear-1, which acts as the nut of the screw jack and which is free to rotate over the body of screw jack, was placed and meshed with another gear-2, which was placed on the shaft of reversible motor-2. Another end of the screw jack was attached to the frame of the car by footstep bearing.

The developed model of the car was tested in various conditions for different applications. It was lifted by 18 cm in 10 seconds, turned back in 20 seconds and lowered in 10 seconds. So in all, it required 40 seconds in lifting, turning back and lowering.[2]

Mr. Saket Bhishikaret research on the four wheel steering system for car in June year 2014 and had a patent from International. Journal of Engineering and Innovative Technology (IJEIT).The main aim of the research is to find alternative solutions for four wheel steering system by using bevel gear system. This system consists of front rack and pinion mechanism assisted by three bevel gears of which one is connected to front pinion, one is connected to steering rod in which input is given by the driver and third one will be connected to rear pinion. The Rear wheel system consists of two racks with two pinions. One of the racks will be in front of the rear wheel axis (primary rack) and the other will be behind the axis (secondary rack). Also at any point in the system, one of the rack & pinion assemblies will be engaged with the other being disengaged. Motion of pinion will be directed by an actuating pump connected to intermediate shaft which will receive input from speed sensors. The engaging & disengaging of the rack & pinion assembly will depend on the input received from the speed sensor. At lower speeds i.e. below 35kmph the pinion will be in contact with a secondary rear rack so as to keep the wheels motion out of phase while for speeds above 35kmph pinion will be in contact with front rack of rear steering system, giving in phase motion to wheels. This position of the rear pinion on the rack is controlled by a hydraulic circuit and an actuator mechanism. The angle turned by rear wheels will not be as high as that of the front wheels because the function of rear steering system is to assist the motion of front wheels and not provide its own direction. This

change of angle is obtained by changing the gear ratio of rack and pinion.[3]

Mr. S. P. Bansodeet has a patent in March year 2015 of International Journal of Emerging Technology and Advanced Engineering for working on the four wheel steering system and zero turning radius system by using the pneumatic actuators to steer the wheels. And find the alternative solution for the zero turning radius system. The system consist of four actuators to steer each wheel independently, it also consists of directional control valves and flow control valves to control the direction and the motion of the actuator. In this system each wheel consists of one actuator. The system consists of compressed air to give motion to the actuator.[4].

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IV. CONSTRUCTION AND WORKING

Hardware required:

D.C Motor

A DC motor is any of a class of electrical machines that convert electrical power to mechanical power. Almost all types of DC motors have some internal mechanism, either electromechanical or electronic; to periodically change the direction of current flow in part of motors .Most types produce rotary motion, a linear motor directly produces force and motion in a straight line.

DC motors were the first type widely used, since they could be powered from existing direct current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field winding. We are going to use four D.C motor.

Actuator

Actuators convert fluid power contained in the pressurized fluid to mechanical energy. They are the muscles of the system. They provide the mechanical motion to the desired part and desired actuating force. As we required motion in linear direction so we are using double acting linear actuator.

Direction control valve

Zero turn vehicle system consists of four double acting pneumatic cylinders which are actuated by Direction Control Valve. Polyurethane tubing's are used to supply compressed air from Direction Control Valve to pneumatic cylinders. Mechanical linkages are arranged between wheels and piston rod of pneumatic cylinders. Wheels are driven by side shaft D.C. motor[1]

V. CONSTRUCTION AND WORKING

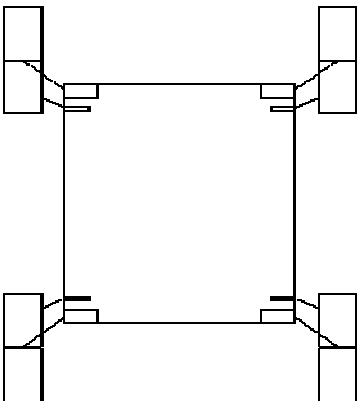

Fig. Construction diagram

Working:

Zero turn vehicle is the name itself giving the meaning that a vehicle take the sharp turn with zero turning radius and follow exact circular path without leaving its vertical axis passing through the centre. The air is pressurized in the compressor. The pressure and temperature of the air is increased and it is supplied to cylinder through directional control valves. Manually operated directional control valves are used to control the path of the pressurized air. Polyurethane hoses are used to carry the pressurized air and supply it to the directional control valve, cylinders. The pressurized air,which is supplied to the cylinder will move the piston in reciprocating motion. The piston cylinder is called as a actuator.

The piston rod is connected to the wheel through the mechanical linkages. Due to actuation or motion of the piston, mechanical linkages are also actuated and give desire motion to the wheels of the vehicle. In meanwhile the DC motors which are connected to the each wheel gives the four wheel drive to the vehicle. The DC motor can rotate in clockwise direction as well as Anticlockwise direction which are control by controller. The current is supplied to the dc motor through adapter which converts the ac supply into dc supply. When supply of compress air is start, directional control valves are manually operated to tilt the wheels to take zero turn. At that same time by means of controller dc motors are actuated and

give the drive to the vehicle so that it can take zero turn. When there is no necessity of the zero turn the lever of directional control valve is put into normal position and vehicle can move as per normal vehicle. The diameter of wheels is greater than the size of vehicle body. So that tank can run even after it get flipped and we get ground clearance from both sides. Each wheel is powered independently by using separate motor. To steer each wheel actuators are used independently. Each wheel can turn in opposite direction also. The concept is still used in toy cars only.

The body of the tank should be symmetric to the center axis of the wheels. the diameter of the wheels should be greater than the height of the body, therefore we get the equal ground clearance from the both side of the tank body when it get flipped, therefore the tank can run even it get flipped. There are four electric DC motor are provided for each wheel to make the tank four wheel drive. Therefore we can control the motion of each wheel separately, The leaf springs are used in the suspension system, it requires less height and the leaf springs more useful in the heavy load working condition. The arrangement of the driver seat is such way that the seat of the driver is pivoted on the center axis body of the tank eccentrically and it will act like pendulum. Therefore when the tank gets flipped the driver will come to the straight position.

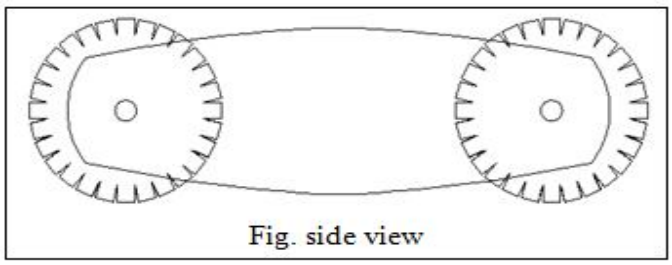

Fig. side view

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