Design & Fabrication of 360° Rotating Vehicle

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Abstract—The design and fabrication of 360 degree wheel rotation vehicle using DC motor and steering is done to reduce time to turn from one direction to other direction. Main function of this vehicle is easy to rotate the wheels of vehicle in all 360 degree angle position. Increase in population of India, society resulted in increase of vehicle on the road due to space constraints 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 areas such as, railway platform, hospital, industries and market. The purpose of this paper is to develop an alternative solution for conventional two wheel steering system. In modern era, the major 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 major disadvantage is 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 are 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. 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 greatly reduced. Zero turn vehicle system is used in jeep hurricane.

Keywords: DC Motor, Steering Motor, ARDUINO Circuit, Battery

I. INTRODUCTION

This project is about design of 360° degree wheel rotating vehicle. The difficulty that is associated with the conventional methods of steering is eliminated by employing a four wheel steering systems. In this systems, 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 radiuses. This helps in maneuvering the vehicle in tight spaces such as parking lots and within small compounds.

This wheels of vehicle moves in all directions and this design provides better comfort and also saves the time of customers. 360° 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. The DC motor is connected to wheels to run the vehicle. All four wheels at one time rotated at 360° degree using buttons in the mobile application. 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 retate 360° degree by controlling wheels directions 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 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 facilities 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 conditions without experiencing the effects of moving over it.

Zero turn vehicle as the name itself indicates the meaning that a vehicle take the turn with zero turning radius and gives circular path without leaving its vertical axis passing through the center. Zero degree turning radius 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. Today most of the vehicles use the two wheel steering system as their main steering system. The two wheel steering system has the low efficiency as compared to four wheel steering system. The four wheel steering system can be employed in some vehicles to increase their steering response, increase vehicle stability when moving at certain speed, or to decrease turning radius at low speed. Four-wheel steering is a technically, marvelous effort on the part of automotive design engineers to provide near-neutral steering. In situations like vehicle parking, low speed turning and driving in city conditions with heavy traffic in tight spaces, high speed lane changing would be very problematic because of vehicle’s larger wheelbase and track width. It gives high inertia and traction into consideration. Therefore there is need of a mechanism which result in less turning radius. This can
be achieved by using four wheel steering system instead of conventional steering.

A. Steering System

Steering mechanism is used to give the required path and achieve a perfect steering condition, the main function of the steering system is to achieve angular motion of the front wheels to negotiate a turn. For steering linkages and steering gear used which convert the rotary motion of steering wheel into angular motion of the front road wheels.

1) Functions of the Steering System

1) To control direction of motion of the vehicle
2) To give directional stability for vehicle while going straight ahead.
3) To enables straight ahead condition of the vehicle after completing a turn.
4) The road irregularities must be damped to the maximum possible extent. This should co-exist the road feel for the driver so that he can feel the road condition without experiencing the effects of moving over it.
5) To reduce tire wear and increase the life of the tire.

2) Steering Requirement

1) The steering should be very accurate and easy to handle.
2) The effort should be minimal and must not be tiresome to the driver.
3) Should provide directional stability. This implies that the vehicle should have a tendency to return to its straight ahead position after turning.

3) 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.

[Diagram of Zero Turning Radius Vehicles]

B. Analysis of Steering

1) Materials & Construction

Basic components the basic construction and main components of the Zero turn vehicle is given below:

   a) D. C Motor

   Electric motor is machine which convert electric energy into mechanical energy. Its action is based on the principle that, when a current carrying conductor is placed in a magnetic field, it experiences a mechanical force whose direction is given by Fleming’s Left Hand Rule

   b) Links

   A link is a rigid body which has two nodes which are used to attach other links. Linkages are the basic for all mechanisms. Linkages are made up of links and joints. Types of links depending upon nodes Binary link - with two nodes. Ternary link - with three nodes. Quaternary link - with four nodes a joint is used to connect two or more links, which gives some motion between the links which are connected. Joints are also called kinematic pairs.

   These can be classified in several ways:
1) By the type of contact in between the two, points line, elements or surface.
2) By the number of degrees of freedom at the joint.
3) By the type of physical closure of the joint; either force or form closed.
4) By the number of links joined.

Adapter is used to convert AC current supply to DC current supply. It can be very useful for thermal protection, overload protection etc. It can also protects from short circuit.

Wheels are the end link of the vehicle which give direct output of the system. They are move on a ground having rubber coating to outer side of the wheel for gripping. It carries whole weight of the vehicle.

II. LITERATURE REVIEW

A. JaishnuMoodily [1]
The idea of 360* degree wheel rotation load carry vehicle is analysed from; 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 centre 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 is to be used in different area like industries, hospitals, railway platform, etc.

B. Sudip kachhia [2]
Sudip presented a 360* degree rotating vehicle to overcome the problem of parking space. The 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.

C. K. Lohith [3]
Lohith 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 speeds 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.

D. Shirathsachin [4]
In these pneumatic systems is used to turn each wheel. If one wheel’s drive is in forward direction, then other opposite wheel direction is in reverse direction.

E. Bansode S. P., Gaikwad A. A. [5]
Bansode & Gaikwad presented a model which works on pneumatic based method. They suggested instead of charging whole steering systems if wheel systems is becomes more convenient to do a 360 turn

III. PROBLEM STATEMENT
A vehicle with higher turning radius face difficulty in parking and low speed cornering due to its higher wheel base and track width, but the passenger prefer the vehicle to be higher wheelbase and track width as it gives good comfort while traveling. In this scenario four wheel steering will be effective as the turning radius will be decreased for the same vehicle of higher wheel base.

To build a 360* degree rotating vehicle which will be capable of reducing turning radius of vehicle to minimum as possible allowing it to suit for crowded, narrow area which frequency face problems of traffic and parking

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. 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. shows the problem associated in parking at certain situation

IV. OBJECTIVE OF PROPOSED SYSTEM

1) Providing an alternative to conventional archerman’s steering mechanism.
2) Reducing turning radius of vehicle.
3) Providing vehicles ability to turn more quickly through narrow and crowded roads.
4) Allowing vehicle to park in transverse direction.
5) Avoiding vehicle skidding under quick turning at high speed.

V. METHODOLOGY
A. Determining the Dimensions of Vehicle Frame
   1) Basic Frame
   The hollow square pipes of material of mild steel are selected for the frame. The pipes are cut into required size by cutting machine. The end of the pipes cut into 45 degree to form rectangular frame. After cutting, the end of the square pipes is grinded so that it became smooth and convenient for welding. The square pipes are welded together to form a rectangular basic frame.
B. Selection of Wheels to Drive the Vehicle

1) Wheel

![Wheel](Image)

Robot Wheel 10cm Dia. x 4cm Width for your robot are easy to mount, durable and cheap. These wheels have a 6mm hole for a shaft with the screw for fitting making it very easy to mount on motors. Screw provided to tight wheel with motor shaft.

2) Diameter

10 CM Width of wheel: 4 CM Shaft bore: 6 MM

C. Selection of Drive Motor for Vehicle

These motors are simple DC Motors featuring gears for the shaft for obtaining the optimal performance characteristics. They are known as Center Shaft DC Geared Motors because their shaft extends through the center of their gear box assembly.

These standard size DC Motors are very easy to use. Also, you don’t have to spend a lot of money to control motors with an Arduino or compatible board. The L298N H-bridge module with onboard voltage regulator motor driver can be used with this motor that has a voltage of between 5 and 35V DC.

This DC Motor – 100RPM – 12Volts can be used in all-terrain robots and a variety of robotic applications. These motors have a 3 mm threaded drill hole in the middle of the shaft thus making it simple to connect it to the wheels or any other mechanical assembly.

Nutm and threads on the shaft to easily connect and internally threaded shaft for easily connecting it to the wheels.

These DC Geared motors with robust metal/Plastic gearbox for heavy-duty applications, available in the wide RPM range (Check the list below) and ideally suited for robotics and industrial applications.

![Drive Motor](Image)

D. Selection of Steering Mechanism and Steering Motors

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1) Features

1) It comes with Good Quality Gears.
2) The metal gears have better wear and tear properties.
3) Gearbox is sealed and lubricated with lithium grease and requires no maintenance.
4) Although motor gives 100 RPM at 12V, motor runs smoothly from 4V to 12V and gives the wide range of RPM, and torque.
5) The shaft has a hole for better coupling.
6) The shaft has a hole for better coupling.
7) Operating Voltage (V): 12
8) Rated Torque (kg-cm): 2.9
9) Stall Torque (kg-cm): 11.4
E. Selection of Microcontroller to Control Forward, Reverse & different Steering Movements.

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again. Arduino Uno Specification

- Microcontroller: ATmega328P
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- Input Voltage (limit): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- PWM Digital I/O Pins: 6
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB (ATmega328P) of which 0.5 KB used by bootloader
- SRAM: 2 KB (ATmega328P)
- EEPROM: 1 KB (ATmega328P)
- Clock Speed: 16 MHz
- LED_BUILTIN: 13
- Length: 68.6 mm
- Width: 58.4 mm
- Weight: 25 g

stepper motors. That makes it a great shield for any robotic project.

F. Quick Overview

1) 2 connections for 5V ‘hobby’ servos connected to the Arduino’s high-resolution dedicated timer
2) 4 H-Bridges: L293D chipset provides 0.6A per bridge (1.2A peak) with thermal shutdown protection, internal kickback protection diodes.
3) Can run motors on 4.5VDC to 25VDC.
4) Up to 4 bi-directional DC motors with individual 8-bit speed selection (so, about 0.5% resolution)
5) Up to 2 stepper motors (unipolar or bipolar) with single coil, double coil or interleaved stepping.
6) Pull down resistors keep motors disabled during power-up
7) Big terminal block connectors to easily hook up wires (18-26AWG) and power
8) 2-pin terminal block and jumper to connect external power, for separate logic/motor supplies

HC-05 6 Pin Wireless Serial Bluetooth Module is a Bluetooth module for use with any microcontroller. It uses the UART protocol to make it easy to send and receive data wirelessly. The HC-06 module is a slave only device. This means that it can connect to most phones and computers with Bluetooth but it cannot connect to another slave-only device such as keyboards and other HC-06 modules. To connect with other slave devices a master module would be necessary such as the HC-05 version which can do both master and slave

I) Applications
1) Embedded Projects.
2) Industrial Applications.
3) Computer and Portable Devices.
4) GPS receiver.

II) Features
1) Working current: matching for 30 mA, matching the communication for 8 mA
2) Dormancy current: no dormancy.
3) Used for a GPS navigation system, water, and electricity gas meter reading system.
4) With the computer and Bluetooth adapter, PDA, seamless connection equipment.
5) Bluetooth module HC-08 Master and slave Two in one module.
6) Use the CSR mainstream Bluetooth chip, Bluetooth V2.0 protocol standards.
7) Potter default rate of 9600, the user can be set up.
8) Bluetooth protocol: Bluetooth Specification v2.0+EDR
9) Speed: Asynchronous: 2.1Mbps (Max) / 160 kbps, Synchronous: 1Mbps/1Mbps.
11) Profiles: Bluetooth serial port.
12) Bluetooth protocol: Bluetooth Specification v2.0+EDR
13) Frequency: 2.4GHz ISM band.
14) Modulation: GFSK (Gaussian Frequency Shift Keying).
15) Emission power: =4dBm, Class 2.
16) Sensitivity: =-84dBm at 0.1% BER.

G. Calculation of Desired Battery to Provide Sufficient Power to All Components

![Battery](image1)

Fig 2.7: Battery Voltage 9V Capacity 120mAh Applications Ideal for usage of RC air and hobby Dimension (LxWxH) 48.5mm (2") x 26.5mm (1.05") x 16.9 mm (0.7") Weight 34g (1.2 oz)

Fabrication and assembly of all components. Wiring and connection of all electronic components. Programming microcontroller for proper operation.

![Microcontroller Assembly](image2)

Fig 2.8: Microcontroller Assembly

VI. RESULT

In this way, we will study and utilize data available for designing and building 360° degree rotation wheel vehicle which will improve turning, driving and parking experience of driver.

![360° Rotating Model](image3)

Fig 3.1: 360° Rotating Model

VII. FUTURE SCOPE

Automatic parking feature can be provided by using 360° degree rotating vehicle wheel along with sensors and camera. During parking collision of vehicle with other vehicle happens due to large space required for parking. Parking vehicles near railways stations, malls, bus stops, and offices is the most difficult task. Driving vehicle from parking yard is extremely time consuming task. 360° degree rotating wheels will allow to reduce turning radius and space consumption during turning and sensors will guide motors to park vehicles automatically and safely without need of driver.

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