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Car Parking with 90° Rotation

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Abstract: ***The automobile cars are usually designed to understeer and seldom do they oversteer. It's a main advantage in this particular era for the automobile cars to overcome these steering problems. All the people who drives usually prefers for an ease of steering and mainly in the urban cities they seek for the ease of steering as well as parking. It has become a challenging issue for modifying or bringing a change or solution for the underlying problems. Practically thinking about the solution for all the whereabouts of the current steering problems is challenging task. This was a great stimulation for us to undertake this particular project.***

In this project we have constructed the steering of wheels with 90° rotation. This is a new contemporary concept where we are developing the equipment by the arrangements with motor, chain drive, remote control, basic structure like chassis leg wheels etc., battery and control unit. The converted mechanical energy is stored in battery in the form of electrical energy.

Keywords: oversteer, motor, chain drive, chassis, leg wheels.

I. INTRODUCTION

A car can be defined as a vehicle which runs on an electric motor or an engine whose main purpose is to move people from one place to another in a short period of time. The word 'car', is derived from Latin carrus "wheeled cart''. In simple Automobile is a automotive vehicle accurately a four-wheeled vehicle designed for its main purpose of passenger transportation.

Steering is the application of nonlinear movement and control of the vehicle as per the needs of the driver or his commands (if it is an automatic driven vehicle). Currently we can see steering systems like Power Rack-and-pinion Steering, Re-circulating ball Steering, Power Steering in the production cars. From many decades there is no advancement or any major changes we could observe in the steering systems. Thus, we could expect an enormous innovation and modification in present steering systems and steering mechanisms by 2030.

Parking is nothing but resting a vehicle for a temporary period of time. Parking has become a major problem in busy areas of urban city due to the over population and more vehicles on road. There may be many developments undertaken for parking cars in apartments, malls, offices, etc., but it has taken a huge amount of one-time investment. These systems also use major space but have reduced to some extent compared to before. The innovative concept developed by us will also be much more helpful to the upcoming generation automobiles.

II. IDEA GENERATION

The main idea or genesis of our project is that the driver must be able to drive the vehicle with complete serenity and must have accurate movement in steering while parking the vehicle. Anyhow when the operator turns the wheel slightly all four wheels react to the steering input and there must be formation of slip angles for all the four wheels. There is also less clout when the wheels are turned back to a straight-ahead or the normal position. All the encountered lags are eliminated in the wheel so that the feedback is very rapid.

III. PROBLEM STATEMENT

As we are aware of the growing population as well as the increase in daily productions of the two wheelers and four wheelers, in the same manner there is increase in procuring those two wheelers and four wheelers. So, parking the vehicles has become a major issue as well as problematic in this urban city. The space equipped for parking a car is more due to the large wheelbase and turning radius of the car and the bulk size also matters. If a car has to be parked parallel to each other its very difficult due to the turning radius of the car and space consumed per car is more. Usually we come across with the frontal steering type where the driver lacks in effort to park the car. The present steering systems might have advantage in many other ways but has a major drawback in the large turning radius. The major effects of larger turning radius are that it's troublesome to park the car, requires more space and difficulty in steering. In order to beat this difficulty, we have accomplished with a better design of steering where all the wheels independently rotate using chain drive.

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IV. OBJECTIVES

The fundamental objective of our design and model is the efficiency in parking the vehicle with comfort by rotation of all the wheels independently. To improve or eradicate the existing steering mechanisms by introduction of 90-degree steering manipulation. Mentioned below are some of the other objectives of our project.

The main objectives of our project are –

A. Vehicles can be lined up from various angles
B. Allows for two-way traffic
C. Saving the consumption of fuel
D. Easy movement of the Vehicle
E. Prevention of external damage to the vehicle
F. Ease of parking
G. Optimize power consumption using electric drivers
H. Mechanical energy is stored in battery from the movement of the vehicle
I. Eco friendly Vehicle

V. AIM OF THE PROJECT

The project aims at developing an effective parking method which would cater the needs of the people of the urban society. So as to accomplish this we have come up with a new fabricated model and innovative design wherein the rotation of wheels is by two electric motors with greater power for turning the wheels. The rotation of the wheels occurs simultaneously without change in single degree of all the four wheels. It can be customized as per the requirement of the driver.

VI. METHODOLOGY

A. Designing of Prototype Vehicle
B. Purchasing the components required for manufacturing the machine.
C. Fabrication of the frame according to the required design for the machine.
D. Assembling the components/parts in a correct position as per the design.
E. Testing the performance of the machine.

VII. WORKING PRINCIPLE

The main component of our project is the DC motors. We are using six DC motors for the movement of the vehicle. Two motors are used for rotation of the four wheels.

Remaining four motors are used for the forward and backward movement of the wheels. All these operations are operated by a remote control where there are six buttons programmed for its operations like forward, backward, left, right, and 90° rotation of the wheels and the last one is for rotation of the wheels back to the normal direction of the vehicle. The clear indication of the movement can be observed in the remote control by the glowing led light for the respective movements of the vehicle. The additional attachment of sensors at the corners of the prototype vehicle gives a signal to the driver whether the space is enough for parking the vehicle.

The arrangements of four sprockets at the corners, connecting chain and gears have the ability to generate 90° rotation of the wheels of the vehicle.

All the four wheels rotate to the 90° from normal direction of the vehicle. Dynamo has been attached to the moving shaft which converts the mechanical energy into electrical energy. The battery gets charged when the vehicle is in movement. The converted mechanical energy is stored in battery in the form of electrical energy which can be reused again for the movement of the vehicle. There are wide varieties of batteries to choose from. Based on the amount of power required and the duration respective battery can be chosen.

The figure below depicts the arrangement of the chassis, leg, wheels, shaft, sprocket, chain and gear arrangement. The visual representation the arrangement is designed using CAD software.

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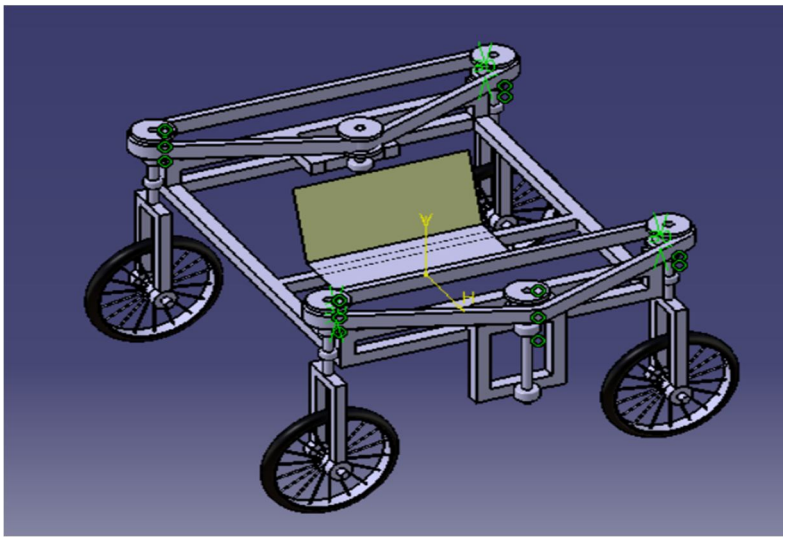
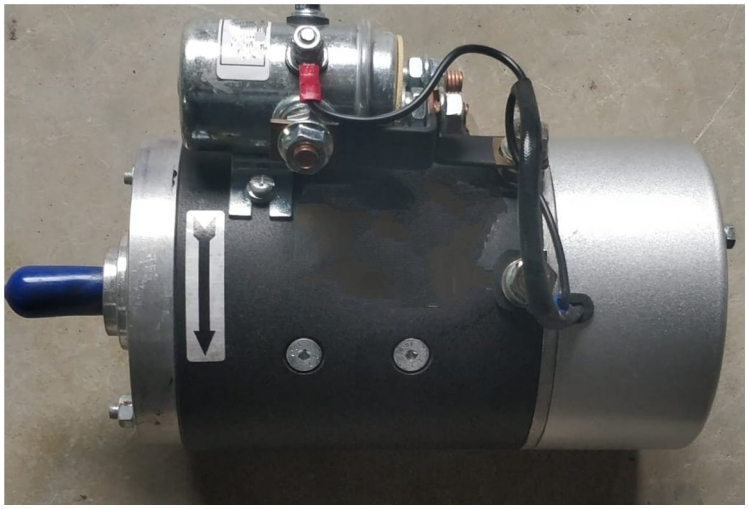


VIII. COMPONENTS REQUIRED

A. Permanent Magnet DC Motor



Specification of motor:

1) Weight of motor:1.3kg
2) Operating power required:12v 1 amps
3) Operating voltage: 12v
4) Operating current:1 amps
5) Motor speed:80 rpm

B. Battery

12V, 25AH Li-ion battery - Lithium Ion batteries are rechargeable and are majorly used for portable electronics and in electrical vehicles. They are also finding their popularity in the aerospace industries. It works on a basic chemical process, the negative lithium ions from the negative electrode move towards the positive electrode during discharge via an electrolyte solution and the motion is reversed on charging the battery. The positive and negative electrodes used are lithium compounds and graphite. Lithium ion batteries are known to have high energy density, low self-discharge and no memory effect. The motor requirement was 48V and 25Ah for the peak load condition. This was achieved using 4nos of 12V 25Ah batteries connected in parallel. The battery pack was placed right next to the driver seat giving it an easy access for replacing or recharging.

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C. Sprocket

A sprocket is a circular wheel ringed with teeth, that matches with its chain drive.

D. Chain Drive

A chain may be a reliable machine component, which transmits power by means of tensile forces, and is employed primarily for power transmission and conveyance systems. The function and uses of chain are almost like a belt. There are many kinds of chain. It is convenient to sort sorts of chain by either material of composition or method of construction.

E. Mild Steel Shaft, Plate & Square Blocks

Mild steel is that the most generally used steel which isn't brittle and cheap in price. Mild steel isn't readily tempered or hardened but possesses enough strength



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F. Nut & Bolts

Nut is a fastener along with a threaded hole. Nuts with its mating bolt are used if there is no necessity to weld two parts but must be joined. It is used to fasten two or more parts together.

G. Arduino Uno R3 Board with DIP ATMEGA328

We are using this microcontroller for the smart parking of the prototype vehicle for the working of the remote control in order to give the movement to the designed prototype vehicle. We are programming for the remote control as well as the infrared sensors for detection of the obstacles found during parking of the vehicle.

H. IR Sensor

The IR sensor placed at the corners of the chassis frame and connected to the Arduino R3 board. The signal produced by the sensor is been received and sent to the microcontroller. Thus, the vehicle movement stops if any obstacle found or give a signal to the driver of the vehicle. This protects the vehicle from causing damage or harm to surrounding people.

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IX. CALCULATIONS

A. Drive Shaft Design

Shear stress of mild steel is $\tau = 200\ Mpa$

Torque produced by the motor T = $\frac{P*60000}{2*\pi*n}$

Expected speed of the vehicle is V = 20Kmph

V = 5.5m/s

Dia of wheel d = 13in = 13*2.54 = 33.02 cm

d = 0.3302 m

No of rotation of wheel = No of rotation of shaft

No of rotation of wheel n = $\frac{V}{\pi d}$

n = $\frac{5.5}{\pi*0.33}$ = 5.30 rps

n = 5.30*60 = 318rpm

T = $\frac{1.2*60000}{2*\pi*318}$ = 36.035 Nm or 36035 N mm

Dia of sprocket D =130mm

Dia of Shaft that could fit into sprocket D' = 25mm

Check for Torsional Failure

Torsion Equation is given by $\frac{T}{J} = \frac{\tau}{R}$

$$\frac{36035}{\frac{\pi}{4}25^4} = \frac{\tau}{25/2}$$

$\tau = 1.46\ Mpa$ < Allowable Stress Hence Safe

B. Chain Drive

Effort applied = 300 N

Mass of Shaft M = 2 kg

W = 9.81 N

Total breaking load on chain = 300 + 9.81 = 309.81 N

For load F = 309.81 N Selecting Chain (06 B)

All Data from Data hand book

Breaking load of simplex 06 B chain, F = 8900 N > 309.81 N

Pitch -9.5mm

Roller diameter, d1=6.5 mm

Width, b1=5.5 mm

Transverse pitch point=54.75 mm

z1=44; z2=18

approximate centre distance,

a= 600 mm for practical feasibility and may change in the fabrication.

No of links,

$$L_n = 2 * \left(\frac{a}{p}\right) + \left(\frac{z1+z2}{2}\right) + \left(\frac{z1-z2}{2\pi}\right)^2 * \left(\frac{p}{a}\right)$$

= 179.5454 = 180

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C. Sprocket

For Used chain no (06 B)

For Z=18

All Data from Data hand book

For Z=18

Pitch, P=9.5 (table no 14.1)

Width between inner plates, b1=5.5mm (table no 14.1)

Roller diameter, d1=6.5 mm (table no 14.1)

Transverse pitch point=10.25

pitch circle diameter D= p sin (180/z) =54.75 mm

Top diameter (Da)

(Da)max=D+1.25p-d1=60.5 mm

D. Energy Calculation of Power Battery Pack

According to the rated working time of the machine, we can determine the total energy of the power pack that is consumed:
WB = 1.2 *PE*T
Where,
PE = Rated power (W)
T = Rated working time (hr) WB = Total energy (KWh)
WB = 1.2*PE*T □1.2*1.2*⅔ WB = 0.96KWh.

E. Calculation Of Power Battery Capacity

The total capacity of the battery pack is determined based on the total energy consumed by the power pack:
CB = 1000 WbV
V = Rated operating voltage of the power Battery (V)
CB = total capacity of the battery (Ah)
CB =1000 WbV □1000*0.9648
CB = 20Ah
Available battery CB= 25Ah.

X. RESULTS & DISCUSSION

Based on the overall performance of the machine we can say that the project will satisfy the need of transverse parking, because of the difficulty in parking cars due to requirement of large space for each car. The machine required less turning radius and less time compared to existing system, so if we manufacture it on a large scale its cost gets significantly reduce and we hope this will satisfy the needs and benefits of the present system. So, in this way we solve the traffic problem that we come across every day in the huge population country like India.

A. Merits

1) Applicable in all electrical four-wheeler vehicles
2) Decrease in parking space for vehicles
3) High manipulation in the steering system
4) Grip and control over the vehicle are large
5) These systems are suitable for any kind of roads with some considerations
6) Comfort in parking vehicle at right ends or left ends
7) High Efficiency in turning
8) Turning radius can be reduced at small acceleration

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B. Scope of Future Work

By increasing the equipment strength and quality to its peak, we can have for lifetime usage. By providing hydraulics, gear arrangements and some minor adjustments the equipment will have its highest efficiency. The system will utilize an onboard computer to regulate and direct the turning left and right of the rear wheels. Hence, there is a high scope for this mechanism in the near future when implemented would have a major change in effect seen in the evolution of the steering mechanisms. Due to its high balance and feedback in the steering system might bring a great impact to the society in needful ways. We might expect these steering systems on road hopefully by 2030.

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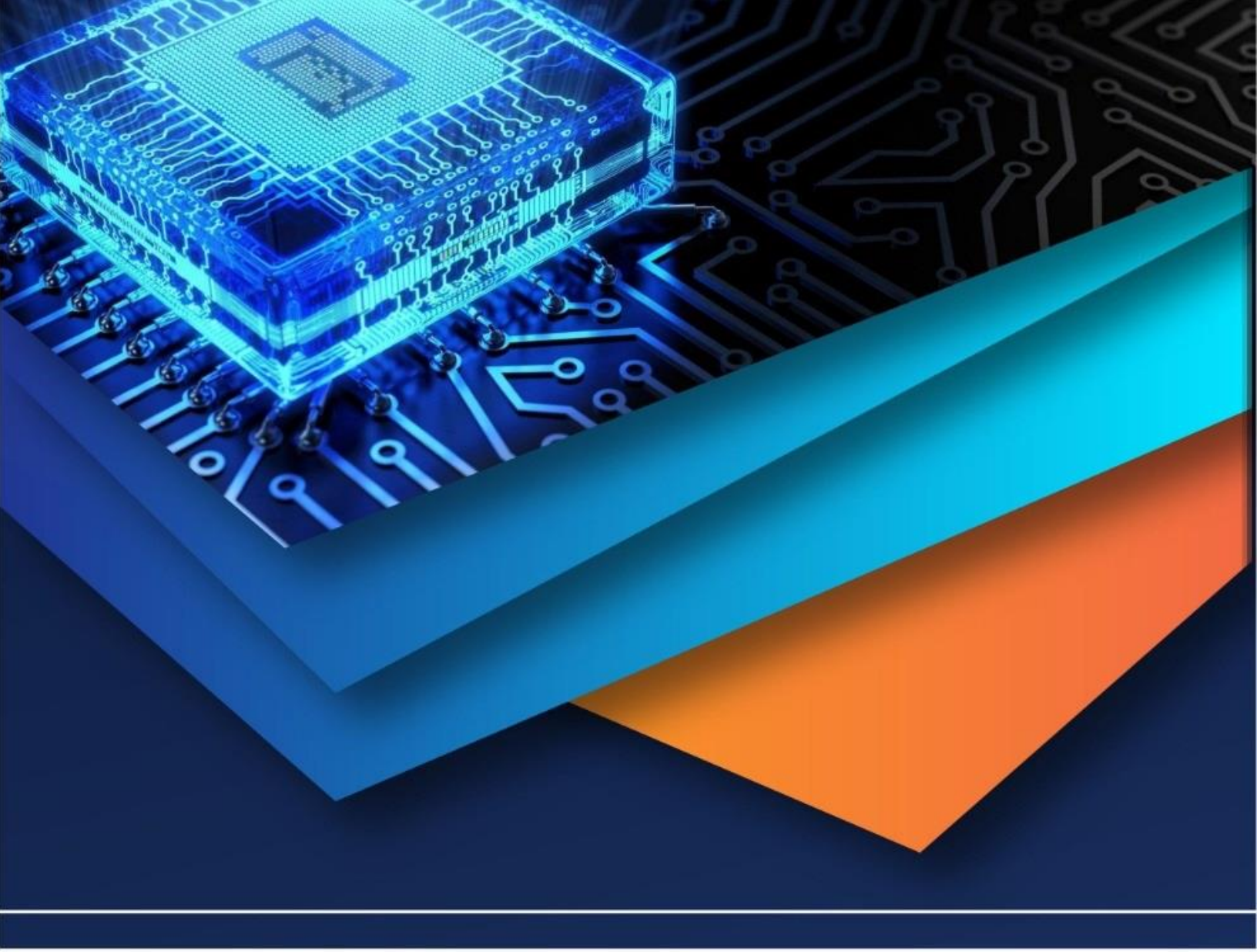

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