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Design and Analysis of Four Wheel Drive Electric Vehicle

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Abstract: ***Due to the increase in the cost of fuels and pollution, alternative to conventional internal combustion engine powered vehicles is needed. As electric vehicles are environment friendly, they are considered green transportation. In an electric vehicle various components like motor, battery, controllers are used. While designing an electric vehicle, the first and foremost component to be selected is an electric motor which replaces the Internal Combustion engines of conventional vehicles. Therefore, electric motor used in an electric vehicle must produce appropriate power and other characteristics that are required for traction purpose. The important task is to select an appropriate rating of motor based on the load to be carried. This paper describes the procedure for proper selection of rating of electric motor with an example of DC motor for an electric car. Vehicle dynamics is considered for selecting the proper electric motor that would provide required power and torque for traction. To achieve all traction characteristics in compact size, a proper selection of motor rating should be done based on the load.***

I. INTRODUCTION

Electric Vehicles (also known as electric cars or Plug-in electric vehicles) are connected, fun, and practical. They reduce pollution and are even very cheap to use and maintain when compared to Conventional I.C Engine Vehicles. Using electricity as fuel has a few merits which are not available in Conventional I.C Engine vehicles. We know that electric motors react quickly and instantaneously, Electric Vehicles have instant high torque and are quite responsive. They are also digitally connected with the option to control charging from a smartphone app. Just like a Mobile Phone, you can plug in your EV when you get home and have it ready for you to use the next morning. By charging often, you may never need to go to a Petrol bunk again! The infrastructure for electric vehicles charging in India has not been fully developed yet. Few initiatives have been taken to set up community charging stations, as in the case of Plugin India facilitated charging stations. Electric Vehicles can also reduce the emissions that contribute to climate change and smog, improving public health and reducing ecological damage.These emissions can be minimized by Charging your EV on renewable energy such as solar or wind. The above are the few main reasons behind this project. We know that, in India, 60% of the goods and cargo are transported by road. Electric vehicles on road include Trains, Buses, Cars, Autos and Bikes. Very few industries like BHEL, Visakhapatnam Steel Plant designed and developed cargo vehicles for their own use. Our project will be available for a common man to commence Cargo Transportation within the city. Our project consists of a BLDC motor fitted to a 4-speed Sequentialgearbox which is connected to the rear axle of the vehicle. A Li-ion battery supplies the electric power to run the BLDC motor through a 60V Controller Hub. This controller hub acts as an operating Centre. The accelerator is connected to the controller itself. The Li-ion Battery is charged using a 10Amps Charger

A. Electric Vehicle

All-electric vehicles, also referred to as battery electric vehicles (BEVs), have an electric motor instead of an internal combustion engine. The vehicle uses a large traction battery pack to power the electric motor and must be plugged in to a wall outlet or charging equipment, also called electric vehicle supply equipment (EVSE). Because it runs on electricity, the vehicle emits no exhaust from a tailpipe and does not contain the typical liquid fuel components, such as a fuel pump, fuel line, or fuel tank. Learn more about electric vehicles

B. Problem Definition

The problem definition for a four-wheel drive electric vehicle project will depend on the specific goals and objectives of the project. However, some common problem areas that could be addressed in such a project include:

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1) *Range limitations:* Electric vehicles typically have limited driving range on a single charge compared to gasoline-powered vehicles, which can be a barrier to adoption for some drivers. A four-wheel drive electric vehicle project could focus on improving battery technology, reducing vehicle weight, or increasing charging infrastructure to address range limitations.
2) *Cost:* Electric vehicles are often more expensive than their gasoline-powered counterparts, which can make them less accessible to some consumers. A four-wheel drive electric vehicle project could focus on reducing costs through improved manufacturing processes, increased production volumes, or innovative financing models.
3) *Charging Infrastructure:* The availability and accessibility of charging infrastructure is a key factor in the adoption of electric vehicles. A four-wheel drive electric vehicle project could focus on increasing the number and variety of charging stations, improving charging speeds, or developing new charging technologies to make EVs more convenient for drivers.

C. *Working Of The System*

When the throttle is energized which means the potentiometer in the throttle gets input and provides the signal to the controller as in how much power it is supposed to deliver. There are two potentiometers in the throttle if one fails the other keeps operating. The controller computes the value of the accelerator from the potentiometers and then delivers power accordingly, from the batteries to the motor. The motor asses the power from the speed controller for transmitting that power into wheels. If accelerator is pressured then the controller delivers the battery voltage to the motor with respect to its value after the input from rider. If the accelerator is depressurized, the controller deliver voltage to the motor with respect to the input.

II. MANUFACTURING PROCESS

Manufacturing processes are the steps through which raw materials are transformed into a final product. The manufacturing process begins with the creation of the materials from which the design is made. These materials are then modified through manufacturing processes to become the required part. Manufacturing processes can include treating (such as heat treating or coating), machining, or reshaping the material. The manufacturing process also includes tests and checks for quality assurance during or after the manufacturing, and planning the production process prior to manufacturing.

A. *Metal Cutting*

Metal cutting or machining is the process of by removing unwanted material from a block of metal in the form of chips. Cutting processes work by causing fracture of the material that is processed. Usually, the portion that is fractured away is in small sized pieces, called chips. Common cutting processes include sawing, shaping (or planning), broaching, drilling, grinding, turning and milling. Although the actual machines, tools and processes for cutting look very different from each other, the basic mechanism for the fracture can be understood by just a simple model called for orthogonal cutting.

III. COMPONENTS OF AN FOUR WHEEL DRIVE ELECTRIC VEHICLE

A. Electric Motor
B. Battery
C. Steering
D. Wheel
E. Bearing
F. Rack And Pinion
G. Spur Gear
H. Battery charger

IV. WORKING PRINCIPLE

A. *Working*

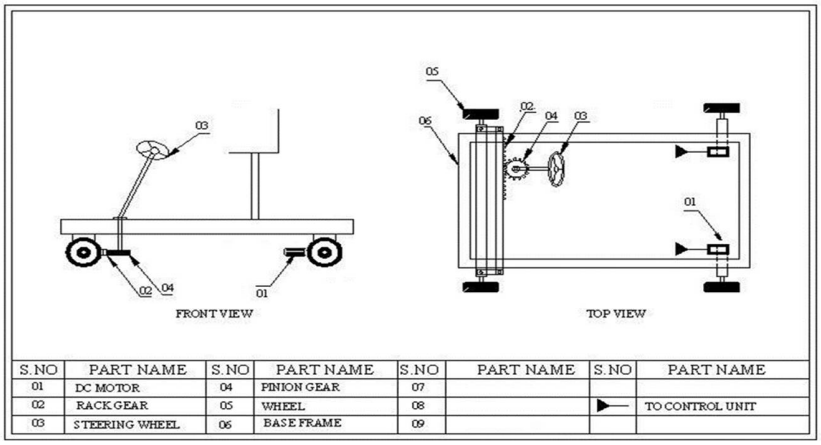
The vehicle model has totally a steering handle in which is connected to the rack and pinion in front side of the vehicle. The wheel shaft is connected with arrangement of DC motor. Battery is used to run the vehicle. Battery is connected to the DC motor.The motor connected to the wheel shaft runs the vehicle. Shock absorber is attached to the front shaft which gives more flexibility to the vehicle. Switch controls the vehicle within range of the speed. Battery and DC motor are joined to the frame of vehicle rigidly. No need of cooling device for the vehicle. This vehicle causes no pollution.

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Basically, electric vehicle is necessary for saving fossil fuel. The figure shows the simple construction of electric vehicle. It consists of battery, motor controller, motor which is connected to the transmission system. Here, battery is the energy source which is charged by taking electric current from the grid (In Solar power electric vehicle, Battery is charged with the use of solar pv panel which is attached on the roof of the vehicle). These batteries are rechargeable.

Most electric vehicle uses lead acid battery but in new type of electric cars, use lithium ion batteries because it can store more energy than lead acid battery in same physical space. The efficiency and life span of battery is far better than other type of batteries, but it is costlier than lead acid battery. After that controller control the flow of energy from energy source to the motor. Motor transmit the power to the wheels of the vehicle by the use of transmission system

V. CAD MODEL



S.NO	PART NAME	S.NO	PART NAME	S.NO	PART NAME	S.NO	PART NAME
01	DC MOTOR	04	PINION GEAR	07			
02	RACK GEAR	05	WHEEL	08			TO CONTROL UNIT
03	STEERING WHEEL	06	BASE FRAME	09			

Fig.1. 2D Layout Model

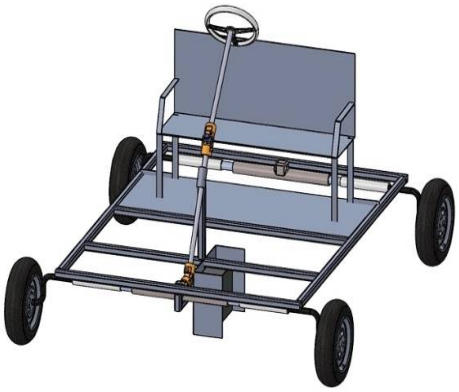


Fig.2. 3D CAD Model

VI. CONSTRUCTION OF FOUR WHEEL DRIVE ELECTRIC VEHICLE

A. Electric Motor

An electric motor is an electrical machine.that converts electrical energy into mechanical energy Most electric motors operate through the interaction between the motor's magnetic field and electric current in a wire winding to generate force in the form of torque applied on the motor's shaft. An electric generator is mechanically identical to an electric motor, but operates with a reversed flow of power, converting mechanical energy into electrical energy

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B. Motor Contorller

In most of the electric vehicle, Brushless DC motor is used which is better than brushed DC motor, permanent magnet DC motor. Brushless DC motor does not have brush and commutator, the electric vehicle which uses brushless DC motor has to use motor controller which helps to control various properties of motor to take sufficient current and voltage applied to motor. When accelerating pedal is press, this linked variable resistor type controller gives signal to the motor controller to adjust speed as per our needs. The motor controller has no power when vehicle is at rest position.

C. Battery

Electric vehicle batteries differ from starting, lighting, and ignition (SLI) batteries as they are designed to give power over sustained periods of time and are deep-cycle batteries Batteries for electric vehicles are characterized by their relatively high power- to-weight ratio, specific energy and energy density; smaller, lighter batteries are desirable because they reduce the weight of the vehicle and therefore improve its performance. Compared to liquid fuels, most current battery technologies have much lower specific energy, and this often impacts the maximum all-electric range of the vehicle

D. Rack And Pinion

A rack and pinion is a pair of gears which convert rotational motion into linear motion. The circular pinion engages teeth on a flat bar - the rack. Rotational motion applied to the pinion will cause the rack to move to the side, up to the limit of its travel. The pinion is in mesh with a rack. The circular motion of the pinion is transferred into the linear rack movement.

E. Mechanical Energy

Electric motors are mechanically very simple. Electric motors often achieve 90% energy conversion efficiency over the full range of speeds and power output and can be precisely controlled. They can also be combined with regenerative braking systems that have the ability to convert movement energy back into stored electricity. This can be used to reduce the wear on brake systems (and consequent brake pad dust) and reduce the total energy requirement of a trip. Regenerative braking is especially effective for start-and-stop city use. They can be finely controlled and provide high torque from rest, unlike internal combustion engines, and do not need multiple gears to match power curves. This removes the need for gearboxes and torque converters. Electric vehicles provide quiet and smooth operation and consequently have less noise and vibration than internal combustion engines. While this is a desirable attribute, it has also evoked concern that the absence of the usual sounds of an approaching vehicle poses a danger to blind, elderly and very young pedestrians. To mitigate this situation, automakers and individual companies are developing systems that produce warning sounds when electric vehicles are moving slowly, up to a speed when normal motion and rotation (road, suspension, electric motor, etc.) noises become audibles

VII. FABRICATION WORK



Fig.3. Fabrication Work

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VIII. CONCLUSION

Four wheel drive electric vehicles (4WD EVs) offer several advantages over their two wheel drive counterparts. Here are a few conclusions

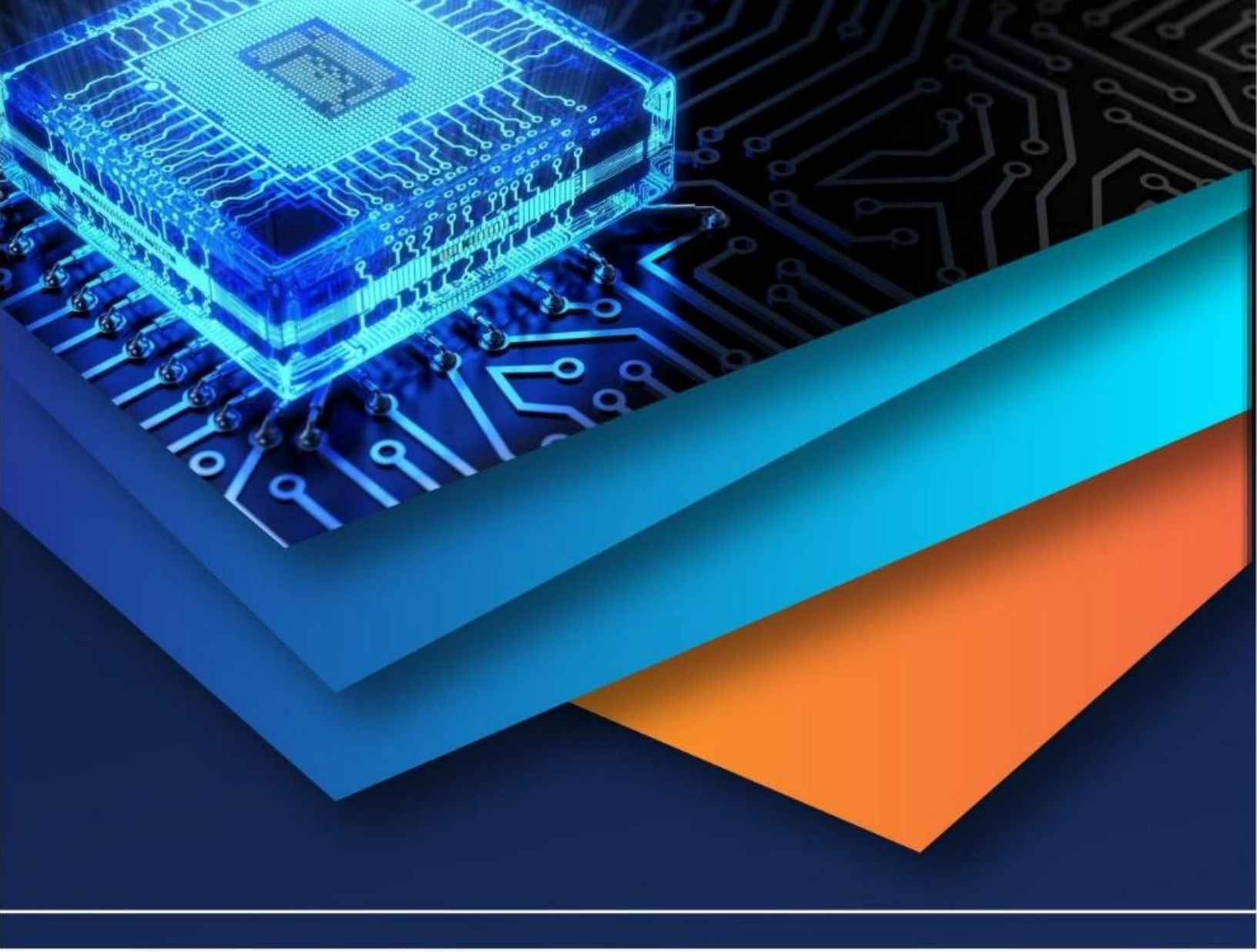
1) *Improved Traction:* 4WD EVs have better traction than 2WD EVs, which can be particularly helpful in inclement weather or off-road situations. With power going to all four wheels, 4WD EVs can distribute torque more evenly and effectively
2) *Better Handling:* 4WD EVs can provide better handling and stability, especially when cornering or taking turns at high speeds. The extra grip from the four wheels can help keep the vehicle more stable and prevent it from slipping or sliding.
3) *Increased Efficiency:* 4WD EVs can be more energy efficient than 2WD EVs, as the four-wheel drive system can distribute torque more efficiently, reducing energy waste.

Overall, 4WD EVs can be a good choice for drivers who frequently encounter difficult terrain or adverse weather conditions. However, if you don't need the extra traction and handling capabilities, a 2WD EV may be a more cost-effective option.

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