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A RESEARCH ON CRITICAL COMPONENTS OF ELECTRIC VEHICLE AND THE IMPACT OF CIRCUIT FAILURE

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ABSTRACT

It is expected that this means of transportation would soon be replaced by vehicles powered by combustion engines. Preamplifier and power stage amplifiers govern the flow of power from the battery to the motor, with numerous sensors monitoring the system's functioning, in a motorspeed controller. In addition to the basic EV components, each features a number of technologies that are presently in use or that might be significant in the future. Electric vehicles (EVs) can have a substantial influence on the environment, the electricity grid, and other connected areas. Electric vehicles might pose a serious threat to the stability of the current power grid, but with adequate management and coordination EVs could be a key contributor to the successful implementation of the smart grid idea. The battery pack's 300 V direct current powers the controller in this vehicle. As a result, the motor is supplied with a maximum 240 Vthree-phase alternating current. The batteries' massive transistors allow them to swiftly turn onand off the voltage. The connection from the accelerator pedal connects to two potentiometers when you press the pedal. Using potentiometers, the controller is able to determine how muchpower to supply the motor. As a result, the primary objective of this article is to examine all ofthe relevant data on electric vehicle layouts and electrical machines as well as charging and optimization methods.

Keywords: Circuit, components, electric, vehicle, battery, power, voltage, current, electricity grid

INTRODUCTION

You can learn a lot about magnets, electromagnets, and electricity in general if you understand how a motor works. Learn how electric motors work in this paper. The electric motor is at the very core of any electric vehicle. One of the most efficient mechanical devices on the globe is an electric motor. Electric motors produce no harmful emissions, unlike internal combustion engines. An electric motor is made up of three moving elements. Electric motors outlive internal combustion engines every day of the week, even if they have three sections. There aretwo rotors and two end bearings in this machine. Just one of the many reasons for the growing acceptance of electric vehicles and the push to encourage individuals to make their own. Regardless of whether you hire someone to create your EV or build it yourself, your EV will save the globe. Because of the intrinsic qualities of its electric motor, a high-performance, fun-to-drive EV will provide years of low-maintenance driving at a little expense.

This paper goal is to help you choose the best electric motor for your EV conversion or construction, and to point you in the right direction. Electric motor basics and useful equationsare covered in this paper in order to achieve these goals. You will also learn about the varioustypes of electric motors and their advantages and disadvantages for EVs, as well as the best electric motor for your EV conversion or build today and its characteristics. Finally, you will learn about which specific electrical engine to closely monitor and research for future EV conversions or builds. Inherently, electric motors are powerful. There are very few traction motors that do not provide near-peak torque at a speed of zero revolutions per minute. Becauseof this, electric traction motors have powered our subways and diesel-electric trains for so long.There is no need to wait for the internal combustion engine to reach its peak torque rpm range,as there is with an electric motor.

Torque is at your disposal in an instant by just running electricity through it. There is nothing wrong with the electric motor itself if an EV's performance is sluggish. As a rule, you may expect to obtain 90% or more of the electrical energy you put into an electric motor in the formof mechanical torque. This level of efficiency is unmatched by any other mechanical device. Electromagnetism is the driving force behind an electric motor. Magnets are the driving forcebehind a motor's motion. For those of you who have ever played with magnets, you've alreadyfigured out the underlying principle: Likes are repelled and dislikes are attracted. This means that if you have two bar magnets designated "north" and "south," the north end of one magnetwill attract the south end of the other. While one magnet's north end will attract the other's

north end, the opposite is true for the other (and similarly, south will repel south). To begin with, the strength of an electric motor might be a shock to the system because of its efficiency(no pun intended). On one board, the central BMS manages the tasks of data collecting, computation and security monitoring as well as control and communication. There is only onecircuit board that receives all of the measurements. Because of the high speed of inter-board communication, a centralised BMS is able to assure the coordinated collection of metrics. It is also possible to acquire the current sensor signals directly without using the CAN connection. The centralised BMS, on the other hand, has the following drawbacks: In order to accommodate a high number of battery cells, the design of connections and wire harnesses has to be sophisticated. Even more difficult to prevent short circuit and overcurrent in different portions of the battery system.

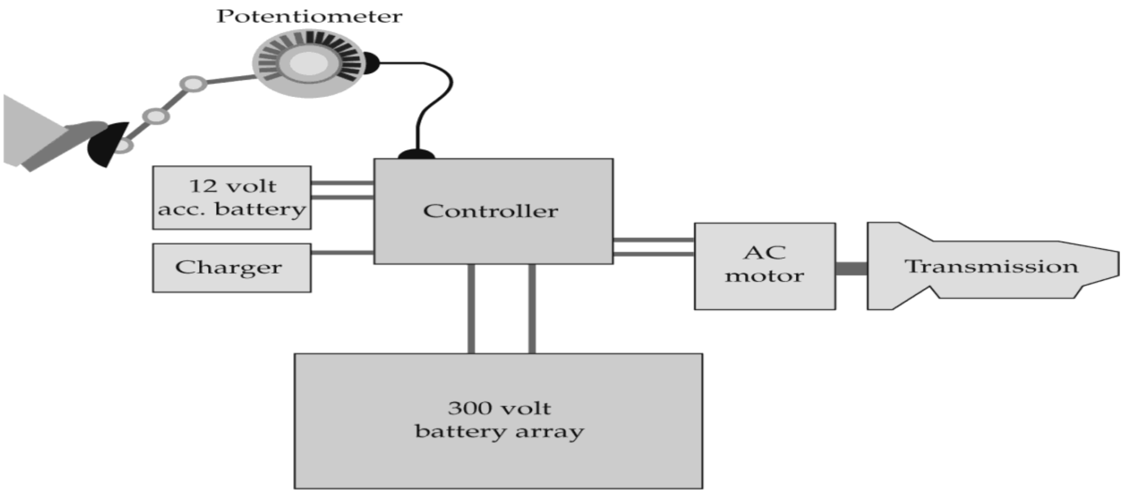

Figure 1 Controller

Managing board size and high-voltage safety is a challenge. Due to the need for adequate safety clearances between the various channels due to the high voltage safety concerns, the PCB mustbe a considerable size. A single board houses all of the components, which makes it difficult to scale and maintain. Repairing or replacing malfunctioning components can be quite complex. Cloud computing is progressively being used in BMSs for electric vehicles because of the development and use of information technology. When coupled with an on-board controller, a cloud computing system may significantly increase BMS performance. The following three aspects show its advantages: Algorithms that are both intelligent and powerfulthe battery SOX algorithms and control systems are computationally expensive. The on-board controllers in electric vehicles (EVs) don't have room for them. The BMS's computing performance may be considerably enhanced by using the cloud computing platform. High

precision in the calculations. Multiple methods can be implemented with greater precision thanks to faster processing, parallel processing, and more storage space. It's quite safe. Multiplemodels and algorithms can be performed simultaneously on the cloud. To accomplish an integrated security analysis, the system has a high level of redundancy and is straightforward to enhance features such as fault detection. We may offer a cloud computing architecture for EV BMSs based on the structure of the Internet of Vehicles. The perceptual, network, and application layers make up the bulk of this system. Temperature measurement and monitoring, heat dissipation when the battery pack temperature is too high, rapid heating to match operatingtemperatures of a battery system at low environmental temperatures, and temperature equalisation in a battery system are some of the primary functions of the thermal managementmodule. There are temperature fluctuations between cells in a battery system because of the inconsistencies in heat dissipation. As a result, the battery system's capacity and lifespan are lowered due to the cells' irregular performance.

A significant accident might occur if the battery system loses its ability to regulate its internal temperature. There are a variety of cooling methods, including air cooling, liquid cooling, andmore. It's easier to apply air cooling than other methods. Liquid cooling is more effective in ensuring that the temperature of a battery pack is evenly distributed. There are severaldrawbacks to using liquid cooling, though. Electrified circuits should be kept away from conductive liquids. This adds to the cooling system's complexity and decreases the cooling impact somewhat. Battery heating has gotten less attention than battery cooling. For the past several years, the heating plate has been offered as an alternative to the battery pack heater in most electric vehicles. Simple in design, it takes a long time to warm up the battery pack to itsdesired temperature, has an uneven distribution of heat, and wastes a lot of power.

The heating pipe has been presented as a way to speed up the heating process and ensure that the battery pack is heated evenly. A battery pack in a low-temperature environment must be warmed in order to fulfil EV applications in all-weather situations. There are both exterior andinterior types of heating available. External heating techniques can be used to warm a battery pack using air, liquid, or phase transition material. Battery packs can be preheated using AC currents, convective heat transfer methods, and mutual pulse heat transfer methods. It takes a lot of time and energy, and isn't ideal for a battery with a lot of power. Recent research suggests that nickel foil embedded in a lithium-ion battery may be heated rapidly and efficiently using an internal temperature sensor circuit. The heating schemes. For the first time, this new feature an activation terminal that may be used to control self-heating.

LITERATURE REVIEW

J. Ni (2018): In this study, the control-configured vehicle (CCV) approach is used to an XBWelectric vehicle in order to increase the vehicle's structural layout flexibility and performance. The CCV greatly extends the flexibility of the XBW ground vehicle's structural layout by incorporating the electric control system design into the mechanical component design. Controlled yaw (CCV) improves closed-loop stability in lateral dynamics systems under the CCV concept. As part of this study, an adaptive yaw controller that takes into account parametric uncertainty is employed. Examples of how CCV improves hardware layout flexibility include a fully-functional XBW electric car testbed. Flexible positioning of all components under CCV allows for improved wire arrangement, space savings, and ease of assembling XBW components. There are several ways in which the mechanical components and electric control systems of the CCV are interdependent and mutually beneficial.

I. Husain et al (2021): It is imperative that electric traction drive systems offer increased performance and capabilities, such as fuel efficiency (in terms of miles per gallon of gasoline equivalent), expanded range, and quick charging choices, in order to shift to electric road transportation. Higher power and more efficient electric traction drive systems are needed to improve fuel efficiency for a given battery charge as a result of increased electrification and altered mobility. Has established the technical objectives for light-duty electric cars (EVs) for2025. For passenger electric and hybrid vehicles, this article examines the latest developmentsin commercially available drivetrain systems for a variety of considerations, such as maximumspeed and torque capacity as well as heat dissipation, component cooling, power density and performance.

H. Yu (2018): In terms of both dynamic and energy economy, a 4-independent wheel drive (4-IWD) electric vehicle offers particular benefits since this configuration gives more design andcontrol flexibility. It's tough to get a 4-IWD electric car to operate at its best using traditional design and control methods. This article focuses on the optimal design and control of vehicles,with a 4-IWD electric race car attempting to reduce lap time on a specific track as a case study.Based on dynamics, a 14-DOF vehicle model is constructed that can thoroughly analyse the effects of the unsprang mass. Metric operations and parallel computing may be substantially improved with the use of a 14-DOF vehicle model that includes a reprogrammed Magic Formula tyre model and a time-efficient suspension model.

METHODOLOGY

An additional component is added to the battery: a nickel (Ni) foil 50 m thick, with two tabs on each end, which serves as an electrolyte. There is an electrical connection between the negative electrode and a tab on the board. The activation terminal, on the other hand, is used to start the battery's internal heating at a low temperature. The negative electrode is connectedto the activation terminal via a switch. Electrons will travel through the Ni foil and generate ohmic heat that quickly heats the core of the battery when the switch is flipped open. The activation procedure is complete when the switch shuts. In 20 seconds, the battery goes from -20°C to 0°C and consumes 3.8 percent of its capacity. In EV applications, this self-heating approach is more practical and promising. They are merely variants of the first three motor types, made using different building methods. The compound motor is the result of combiningthe series and shunt motors into a single unit.

First, we'll examine how the field windings are linked in the motor circuit, and then we'll examine the features of torque and speed against armature current and shaft horsepower curvesthat define the behaviour of these three motor types. These variables are significant to electricvehicle (EV) owners and will be investigated for each of the different motor types. Full-load shaft horsepower is the only way to compare equal-rated motors of various kinds. The externalresistance of the circuit to which the motor is attached affects the motor's efficiency. As a result,efficiency must be determined on a case-by-case basis. DC motor is the most widely used DCmotor for traction applications (such as pushing an EV). This motor has a diameter of 11.45 inches. It is a DC motor with a double-ended shaft that is wrapped in series. Which has been intended to make the procedure easier.

Unique qualities make it stand out from the rest of the existing EV motors on the market. A Chevrolet Turbo 400 gearbox tail-shaft housing has been attached to the drive end bell of thisengine (may be ordered with or without housing). Thus, a 1.370-inch, 32-tooth involute shaft is used instead of the standard 1.125-inch, single-keyed type for the driving end shaft, which is equivalent to a Turbo 400 gearbox Tail Spline. Instead of using a gearbox, this motor was intended to be directly coupled to the driving shaft. But the maker wasn't done yet. On the driveend, the business installed double-wide bearings and grease fittings (because you now have a slip-yoke assembly). So that you may simply connect the motor to any manufacturer's drive shaft, the business opted for the industry standard 1350 universal In order to protect the motorfrom road hazards, I relocated the connections to the motor's side. A temperature snap switch

and brush wear indicators are also included in the motor. With the same fan and commutator and brushes as the motor, it has the same excellent efficiency. As an extra precaution, I even built the commutator end shaft the same diameter as that of a standard drive end. The commutator is the motor's clever portion, changing the direction of current in the windings when it reaches the minimum flux point to allow consistent spinning. A switch is what this work is all about. When the voltage is reversed, it switches the polarity. Motor rotor rotation and momentum ensure that the switching process repeats again. In order to attain a maximumspeed, the alternating magnetic poles must overcome losses (such as friction, windage, and heating). When the motor is under stress, its behaviour changes somewhat, but the increased current draw is the same. The usage of permanent magnets, but in the actual world, electromagnets (recall your toolbox nail with a few rounds of insulated copper wire wrapped around it) are more commonly utilised. However, you'll learn more about permanent-magnet motors (and how they work) later in this section.

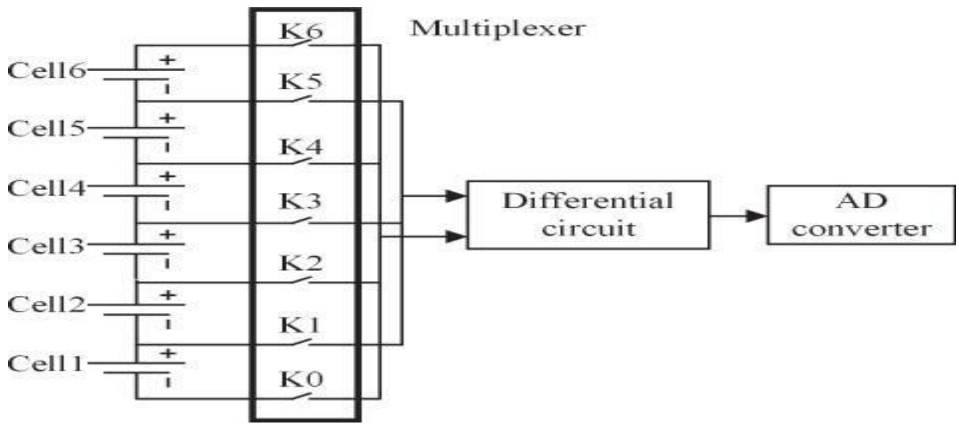

Figure 2 Differential Circuit

An electromagnet is built around a motor's poles or pole components by wrapping turns of wirearound them. As with armatures, steel has been replaced by more efficient metals in contemporary motors, resulting in a reduction in eddy current losses. A more homogeneous magnetic field is produced by curving the pole pieces around the armature. The field windings are the coils of copper wire wrapped around the poles. The type of motor is determined by howthese windings are constructed and linked. An armature with a succession of heavy-gauge wire coils attached to it is termed a series motor. A shunt motor is a coil of thin wire that is linked in parallel to the armature. Because magnets naturally attract and resist one another, this half-

turn of motion may be seen. During this half-turn of motion, the field of the electromagnet must be reversed so that the motor may continue to rotate. The electromagnet completes a half-turn of motion after the flip. By reversing the flow of electrons in the wire, you can change the magnetic field (you do that by flipping the battery over). A free-wheeling electric motor might be created by flipping the electromagnet's field at the conclusion of each half-turn of motion. A clockwise rotation of the conductor would be caused by the current flowing through it. Brushes and a commutator are added to help with rotation. This method provides a steady source of DC electricity to operate your motor. Additional coils can be added to the motor in order to boost its torque output further. Because each coil might have several windings, it is possible to have the force on each of these coils in harmony with each and every other coil if you arrange commutator segments in such a way.

Coil current flow generates torque in a motor's armature, which is typically rotatable (brushless motors tend to obscure this difference). The coils are also held in place and the flux has a low-resistance passage through it. Shaft and laminated sheet steel parts, termed the core, are commonly used to build an arm. The sides of the coils are inserted into grooves or slots on the exterior of the core, which are parallel to the shaft. This arrangement has one side under the north pole and the other side under the south pole, with neighbouring coils arranged in adjacent slots. Rather than generating a single force, each coil generates a sum of all of the forces created by the coils it connects to. Moving a wire between the poles of an elongated horseshoe-shaped magnet with its ends close together would create a magnetic field. It doesn't matter if the field is static or the wire is moving; this relationship holds. The larger the voltage, the faster you must sever the lines of flux at right angles.

Inducing a current is possible only if the circuit is fully closed. Using the right-hand rule might help you recall the relationships. It's important to keep your thumb pointing upward, your index finger pointing in the direction of the flux (from north to south), and your third finger pointing outward in the polarity of the induced voltage (the direction of the current flow) when you're doing an experiment. A force is exerted on a conductor by current flowing in a direction perpendicular to the direction of the magnetic field. In this case, the thumb on your right-hand points toward you in the direction of current flow through the conductor, your extended index finger at a right angle to it points toward flux (from the north to the south pole), and your extended third finger points downward at a right angle to the other two, indicating the direction of generated for now ready to discuss motors in further detail. An electric motor is built around an electromagnet.

EXPERIMENT RESULT

Imagine the following situation to have a better understanding of how an electric motor works: If you wrapped 100 loops of wire around a nail and connected it to a battery, you'd have a basic electromagnet. While the battery is plugged in, the nail becomes a magnet and has a north and south pole. This time, instead of using nails, you'll use a horseshoe magnet to hold your nail electromagnet in place. The basic rule of magnetism informs you what would happen if you attached a battery to the electromagnet such that the north end of the nail appeared as shown in the illustration. The electromagnet's north end would be repelled from the horseshoe magnet's north end and attracted to the horseshoe magnet's south end. The electromagnet's south end would be resisted in the same manner.

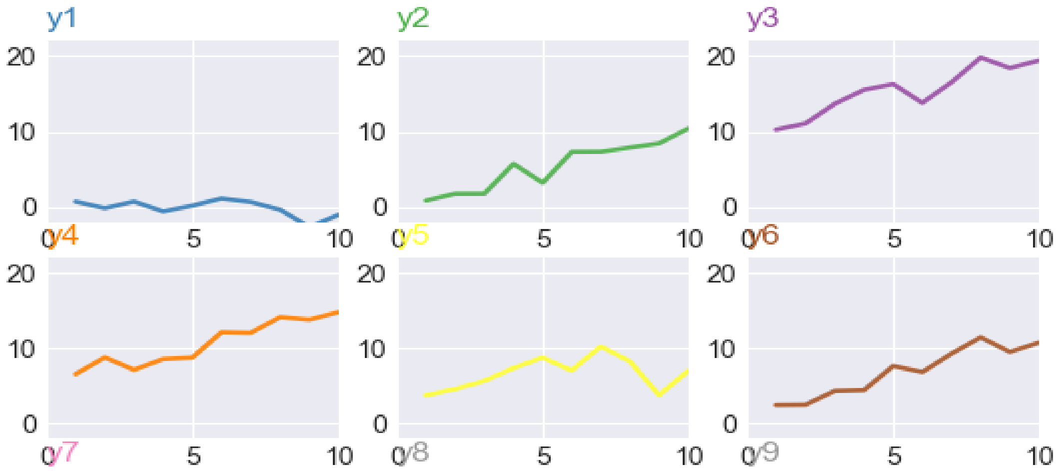

Figure 3 Performance metrics of circuit components

The nail would rotate about half a revolution before stopping. Mechanically, an electric motoris a device that turns electrical energy into motion and may be further modified to conduct useful tasks such as pulling or pushing or lifting and stirring. Magnetic and electrical qualities can be used to their fullest potential in this application. Before we go into DC motors and theirattributes. Electricity and magnetism are opposites of each other. Electromagnetism design engineers rely heavily on Maxwell's principles based on Faraday's and Ampere's previous discoveries in their everyday work. Magnetism and electricity are inseparable in nature. Unlessyou're discussing electric motors or other equipment that use both, you're more likely to focuson one or the other. An electromotive force is the proper name for voltage. In order to use a light bulb, you connect the battery's positive and negative terminals to the bulb, and it lights

up. Double the voltage by connecting two batteries in series, and the light glows brighter. If you want to know how much voltage you have, you need to know how much current you have,and how much resistance you have. In order to increase the brightness of a light bulb, you mustincrease the voltage. Instead of increasing resistance (as, for example, when you widen a bucketof water's opening), you can double the flow if the same volume of water is present (increase the current). There are two poles on the bar magnet, north and south, that you may have seen in your school science lesson. Magnetizable things can be drawn to either end of the magnet. As the polarities of two bar magnets face each other in space, they attract and repel each otherin opposite directions (north-south). An item having its own north and south poles is a compass needle. In a light and perfectly balanced design, it is able to inform you which way north is located. The Earth's magnetic north pole will be displaced if a bar magnet is placed near it. Electricity may be used to generate a magnetic field. Wrap a few twists of insulated copper wire around an iron nail from your toolbox and connect the ends to a battery. Nail becomes a bar-shaped magnet that functions like a compass.

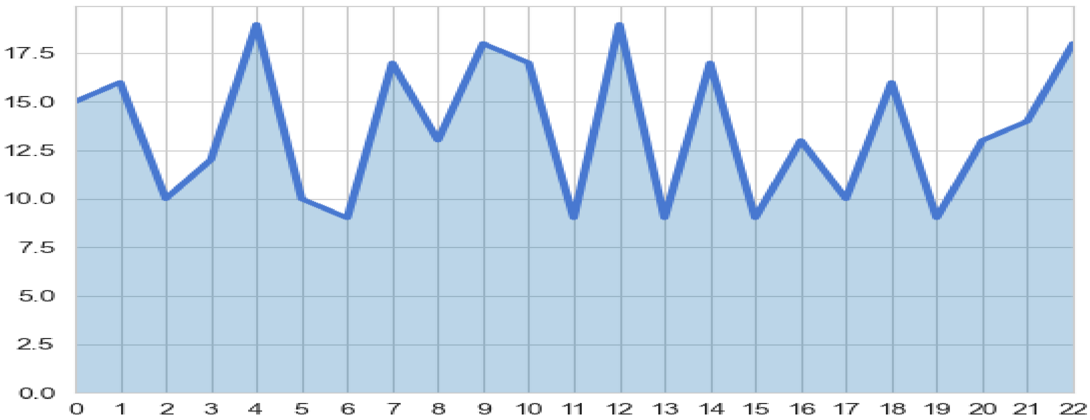

Figure 4 Circuit protection graph

Simply put, the shunt motor is superior than the induction motor because it can run at a constantspeed under a wide range of current and voltage conditions. However, as the initial current loadis reduced, the series motor will decrease its rotations per minute. Another form of motor, the compound motor, combines both parallel and series windings and is used to create higher loads(as with the series motor) and to control the resulting rotations per minute (as with the shunt motor). When a shunt motor starts to fail, it is quite hot to the touch. The issue is usually simpleto fix. In the event of a malfunction, the first thing to examine is if the armature winding has

been ruptured or whether the voltage supply has been cut off. Due to its direct connection to the voltage source, flux in the shunt motor is generally stable. The armature current has a directeffect on its torque. Torque is closely related to current in shunt motors. When starting a shuntmotor, there is no counter-EMF to limit the flow of starter current, but this is rapidly developed.This results in a lower starting torque for the shunt motor than for the series motor. Owners of electric vehicles driven by shunt motors will experience decreased acceleration as a result of this. Another essential component of any electric vehicle is the controller (EV). The controlleris to blame for the resurgence in interest in electric vehicles. Early electric vehicle fans could only dream of having a controller that plugs into the vehicle and is ready to go in minutes. The motor control electronics will continue to get smaller and more efficient in the future. Despitethe fact that the motor may only benefit from minor technological advances, future motors may be dispersed and located in the wheels themselves. When the batteries are charged, they are used to power the controller. Potentiometer (variable resistor) signals are sent to the controllervia the accelerator pedal, which connects to a pair of potentiometers (variable resistors).

CONCLUSION

This document goes into great detail about the many types, configurations, power sources, motors, power conversion, and charging systems for electric vehicles. In comparison to mechanical switches, electronic switches may be activated and deactivated more quickly and do not wear out. So quickly (thousands of times per second) are they turned on and off that themotor obtains average current instead of peak or zero. Pulse-width modulation (PWM) is a term for this (PWM). As a result of its low cost, wide availability, and stepless motor control capabilities, PWM controllers are a popular choice. The features of each section's core technology have been described. In general, AC controllers need more noise-isolation measures, although DC motors are much louder than their AC counterparts. Also highlighted is how EVs affect various industries, and how they may help create a cleaner and more efficientenergy system by partnering with smart grids and making it easier for renewable sources to be integrated. Both permanent-magnet and shunt motors may be used interchangeably in control circuit designs because of their similar properties in terms of torque, speed and reversing capability. In addition, the most recent optimization and control methods have been incorporated. It has been given a basic review of the existing EV technologies.

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