Chapter 16
Understanding the Core Componenets of Electric Vehicles

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ABSTRACT

This chapter explores the complex anatomy of electric vehicles (EVs) and explores the essential components of these innovative machines. The chapter provides readers with a comprehensive overview of the basic elements of an electric vehicle and illuminates the unique characteristics and functions that distinguish electric motors from traditional internal combustion engines (ICE). The chapter explores the role of the electric motor as the heart of the vehicle, converting electrical energy into mechanical motion with remarkable efficiency and precision. It discusses the different types of electric motors commonly used in electric vehicles, from asynchronous motors to permanent magnet synchronous motors, and explains their advantages and limitations. The chapter also introduces the critical role of the battery, which supplies the electric motor and auxiliary systems.

UNDERSTANDING THE CORE COMPONENTS OF ELECTRIC VEHICLES

Overview of Electric Vehicles

Electric Vehicles (EVs) are vehicles that are powered either partially or entirely by a battery, which is typically charged by plugging directly into a power source (Un-Noor et al., 2017). The heightened awareness of dwindling fossil fuel reserves

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and increasing regulatory demands to curb pollution have significantly spurred the development of Electric Vehicles. Nevertheless, despite their substantial benefits, the adoption and uptake of electric vehicles have been limited thus far.

Types of Electric Vehicles

Battery Electric Vehicles (BEVs): These vehicles are fully electric, powered by rechargeable batteries instead of petroleum-based or alternative fuel internal combustion engines. They store electricity in high-capacity battery packs located within the vehicle, using this power to operate the electric motor, drive the wheels, and power all onboard systems and electronics. They require an external electricity source for charging and offer varying ranges per charge. Importantly, they produce zero CO2 emissions and do not emit any harmful elements.

Plug-in Hybrid Electric Vehicles (PHEVs): These vehicles are powered by both an internal combustion engine and an electric motor, typically operating in all-electric mode (or charge-depleting mode). They feature a high-capacity battery pack located inside the vehicle, which stores electricity to power the electric motor. Meanwhile, a petroleum-based or alternative fuel powers the internal combustion engine. They offer an electric range typically from 10 to 60+ miles. Some types of these vehicles are also referred to as extended-range electric vehicles (EREVs). These vehicles offer the option to recharge the battery through both regenerative braking and by plugging into an external source of electrical power. Regenerative braking involves capturing energy normally lost during braking using the electric motor as a generator, which stores the captured energy in the battery. They generally emit lower CO2 emissions compared to traditional Hybrid Electric Vehicles (HEVs). There are two main configurations based on the type of power transmission: parallel and series.

Hybrid Electric Vehicles (HEVs): These vehicles are powered by an internal combustion engine along with multiple electric motors. They typically start using the electric motor, with the petroleum-based or alternative fuel engine engaging as load or speed increases. They generate electric charge through regenerative braking to recharge the battery and do not have the capability to plug into external sources for charging. They can travel about 1 to 2 miles before the petroleum-based or alternative fuel engine activates. Hybrid Electric Vehicles (HEVs) generally have higher CO2 emissions compared to other types of electric vehicles. They come in two main configurations based on battery capacity and the power of the electric motor: Mild hybrids and Full hybrids.

Fuel Cell Electric Vehicles (FCEV): These vehicles utilize a propulsion system like Hybrid Electric Vehicles (HEVs), where energy stored as hydrogen is converted to electricity by a fuel cell. They are fueled with pure hydrogen gas stored in a tank

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