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Development of Power train in Electric Vehicles.

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Abstract - *Electric vehicles (EV) are the future of not just transportation, but also of our world. But could there ever be a more severe sort of congestion for electric vehicles? These automobiles are connected to a low voltage charging station. These automobiles don't produce any pollutants. But what if you own an electric car that is charged by solar power or household electricity? What if you could power your house and garage with this charge? You won't have to worry about the effects of gasoline exporters anymore. Drivers of electric cars must thus plan for lengthy journeys and camping. A family's carbon footprint and power costs will both be reduced by a home-built electric vehicle. Electric cars have a huge amount of promise in the future. The charging station is the logical place for these cars to start. However, this is simply the first stage in a prospective trip that may involve charging cities, houses, banks, and other industrial sectors. Therefore, the potential for electric cars is enormous. Since the mid-1980s, research facilities like NASA have been developing the technology for electric cars. In a few years, current technology will undoubtedly be far more advanced. Some predict that soon we'll see self-sustaining electric cars that gather energy through their surroundings. These cars can even run on alternate energy sources like wind and will demand extremely minimal maintenance. Hence, the research paper briefs about the wide development of the electric vehicles.*

Key Words: Battery, battery management system, PMSM

1. INTRODUCTION

When designing the architecture for EV it is mandatory to use modeling and simulation tools, with specific consideration of electric powertrain, including battery, power electronics, electric motors, sensors, and control system.

In ICE engine power production is not uniform because reciprocating components causes mechanical loss hence engine is not self-started to resolve this issue other components are added in the architecture that resulting in the engine becoming heavy as the other hand in Electric vehicle architecture consists of a motor which is self-started and can easily control by the input current. They produce uniform power and speed at the output because of this reason motor is lighter than ICE.

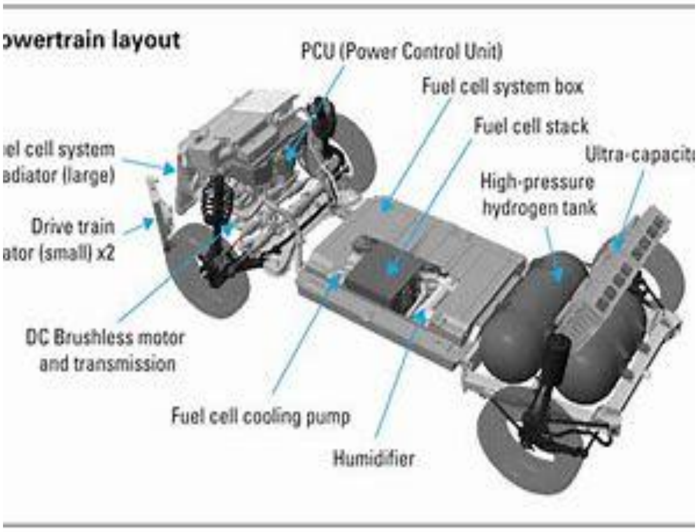

Chart-1:EV power train layout

1.1.ELECTRIC MOTOR

Electric motors provide torque to the vehicle by utilizing electromagnetic fields, energy supplied by the battery, and the torque is controlled by varying the current flow.

The traction engines for the EV's powertrain are two 12kW PMSMs. To drive the PMSMs, two 2-level three-phase inverters are created in the lab. IGBT 300 A modules are used in the development of these inverters. The power modules are driven and isolated using an SKHI 22BR gate driver circuit. A control board based on the TMS320F28335 DSP module, which includes quick arithmetic functions and floating point operators, is built and utilised to process the control strategy of the two PMSMs in order to control them. A sin/cos encoder determines the location of the PMSMs.

1.2.BATTERY PACK

The traction engines for the EV's powertrain are two 12kW PMSMs. To drive the PMSMs, two 2-level three-phase inverters are created in the lab. IGBT 300 A modules are used in the development of these inverters. The power modules are driven and isolated using an SKHI 22BR gate driver circuit. A control board based on the TMS320F28335 DSP module, which includes quick arithmetic functions and floating point operators, is built and utilised to process the control strategy of the two PMSMs in order to control them.

In high power design, thermal management is a significant problem, especially for automotive applications. It may be crucial to include air or fluid cooling ducts, pumps, fans, and heat exchangers for functioning at high temperatures or heaters for working in low-temperature conditions as part of the battery architecture. The cells' layout should make it easier to keep an eye on heat streams inside the pack.

1.3.BATTERY MANAGEMENT SYSTEM

A battery pack in an electric vehicle is made up of many modules of cells, each of which is made up of individual cells. The fact that each cell in each module can be charged and drained at a different pace makes it challenging to control the performance of a battery pack. Additionally, because to variations in temperature, health, and charge, each cell has a unique operating state. Therefore, it is necessary to monitor each battery cell separately to ensure efficient and secure functioning.

To track the charge rate across the entire pack down to the cell level, a battery management system is needed. This monitoring assures secure and dependable battery operation, leading to the development of safer and more effective electric cars.

a. Centralized BMS - A centralised controller and a smart circuit are located on a single board that is used for all operations and internal communication in a centralised BMS. By having a direct link to each battery cell, the central controller manages monitoring, maintaining cell voltages, temperature, and cell balance.

Typically, battery output powers the whole board. The smart circuit board communicates both internally and externally the data that the wire harness acquired about the battery's condition and level of charge.

b. Decentralized BMS - In a decentralised BMS, the smart circuit board and cell monitoring are components of various assembly units. The two methods for implementing this type of BMS are modular and master slave. High dependability is ensured by these topologies.

The battery management system manages battery operation and ensures safety and dependability for the efficient operation of electric cars throughout an anticipated life span.

Each cell in a module experiences a varied temperature depending on its level of charge, which has an impact on the performance of the pack as a whole. The sensors are used to measure the properties of each cell's current, voltage, and temperature directly. Additionally, these measurements are utilised to assess variables like State of Charge (SoC), State of Health (SoH), energy calculation, current threshold, energy provided, and energy and power consumption. In order to maintain the battery pack's safety and extend its life, these characteristics must be continuously monitored.

Safe Operating Area (SoA) is crucial to the safe operation of a battery pack. It is referred to as the voltage, current, and temperature ranges across which it is anticipated that the device will function without suffering any self-damage. Intelligent battery management systems (BMSs) are required to protect their battery packs from external threats including overheating and improper thermal control. These circumstances might result in failure and harm. BMS makes sure the battery is running in a safe area to avoid such situations.

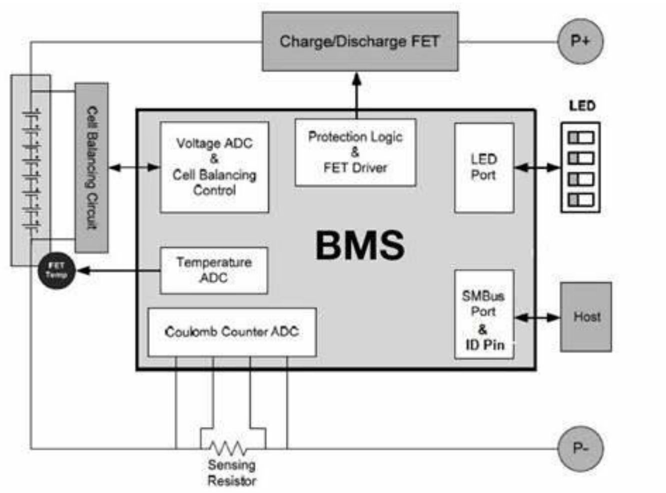

Chart-2: Battery Management System.

1.3.BATTERY CHARGING SYSTEM

Currently, there are three versions of EV chargers: Level 1, Level 2, and Level 3. Another name for Level 3 is Direct Current Fast Charging (DCFC). In Levels 1 and 2, the electric vehicle is linked to 120V or 240V AC power, and a battery charger within the vehicle transforms the AC power into the DC power required to charge the battery and regulates the charging process. Bypassing the onboard battery charger, the DCFC in DCFC converts AC power to DC and sends the DC power straight to the EV battery. This enables direct EV battery charging from the DCFC. The AC power source and the size of the onboard battery charger that is installed in the EV are typically what determine how much level 1 and level 2 charging is possible.

The rating of the DCFC equipment and the quantity of power provided by the utility or other major power sources determine how much DCFC can produce. The optimal kind of EV charging system required for the application will depend on the charge rate, the range of the EV, and the dwell time, or the length of time the EV is accessible to recharge.

Level 1

The simplest level of EV charging, this charge level involves connecting the EV into a regular 120V AC outlet using a special electrical cord with the proper connectors on either end. The battery is then charged using the EV's built-in battery charger. The maximum quantity of electricity available typically places restrictions on this sort of charging. This form of charging is typically constrained by the amount of power that the outlet can provide, typically 12-16A or less (1.44-1.92kW). Based on an EV with a 3 MPkWh rating, this means that each hour of charging will add up to 5.8 miles. A 10-hour overnight charge would only increase the battery's range by 58 miles. Only EVs with a small range can benefit from level 1 charging when their daily driving distance is minimal or when there are several days between EV usages.

Level 2

Level 2 chargers are currently available up to around 20kW and continuing our example would add 60 miles for each hour of charging at 20kW. Many Level 2 chargers are in the 7kW to 10kW range. Enough to fully recharge most EVs overnight. A long-range car or a delivery van might have a battery capacity of 100kWh and could be recharged over a little more than 10 hours by a Level 2 10kW charger taking system losses into account. Level 2 chargers are readily available and moderately priced. Higher capacity Level 2 chargers are fixed in place, but lower capacity portable ones are available. Finding a 240V receptacle to plug into can be much more challenging than a Level 1 120V receptacle though.

DCFC, Level 3, or

Without using the onboard AC battery charger, DCFC charging uses DC to charge the EV battery. A battery charging system with a substantially bigger capacity is possible at this charging level. Due to its high cost and requirement for 480V electrical supply, DCFC chargers are often only used in fleet operations or commercial fast charging stations. One EV with a 100kWh battery can be fully charged in roughly an hour using a 100kW DCFC. A 3MPkWh EV would acquire 300 miles for every hour of charging at his rate.

00 Chargers for DCFC batteries must have 480V three-phase electricity and are substantially more costly than chargers for Level 1 or 2. This mostly restricts them to installations at commercial EV chargers.

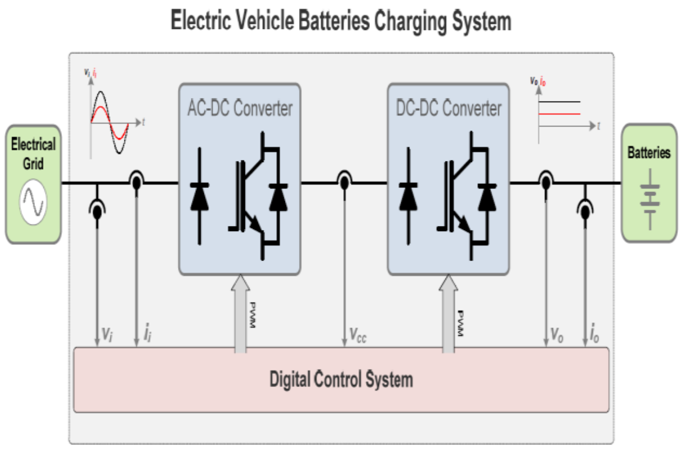

Chart-3:battery charging system

1.4 THERMAL MANAGEMENT SYSTEM

To address the issue of overheating, which damages the battery, most EV manufacturers today have resorted to the technology they were most familiar with from their ICE offerings: a water-glycol cooling system. Tubes containing the water-glycol combination snake their way through the EV's battery pack, maintaining temperatures between 20 and 32 degrees Celsius, the optimal working temperature for the batteries.

While this type of active cooling allows for quicker charging speeds and longer battery life, it does have certain drawbacks. Because the heat must travel from the battery pack through the cooling jacket to reach the coolant, it does not disperse as quickly as it might. To put it another way, while water-glycol cooling is more efficient.

The degradation-temperature connection may be expressed as an Arrhenius-type behaviour, in which the degradation rate grows exponentially with temperature:

The precise relationship is determined by the battery's unique electrochemistry and design." As a result, there is no one life model that can account for all chemistries. Although capacity increases as the working temperature rises, so does the degree of capacity fading. Low operating temperatures, on the other hand, result in poor performance. Furthermore, high or uneven temperature spikes in a system or pack drastically shorten its lifespan.

Thermoelectric coolers work by converting voltage to temperature difference. The Peltier-Seebeck effect, like the Thompson effect, is a thermoelectric effect. "The thermoelectric effect encompasses all of the mechanisms that convert heat to electricity and vice versa. Several notable studies have been conducted in recent years. In one of these systems, the cold sides of the thermoelectric coolers were linked to the heat sink, and the maximum temperature was kept below 55°C. "Cold air was pumped into the battery pack and cabin to keep them cool." Later, a heatsink-fan set was added for both cold side cooling and hot side heat dissipation.

Furthermore, thermoelectric cooling may be used in conjunction with other battery thermal management technologies, such as forced air cooling and liquid cooling.

The battery in the air conditioning system is cooled by an airflow that sweeps the battery pack. The air normally comes from outdoors, but it can also originate from the interior and extra AC units in more complicated systems. The simplicity of this technology allows for no insulation between the air and the battery, as well as less maintenance and lighter components. This method has certain disadvantages. Because of the low specific heat capacity of air, the BTMS components must take up more area.

Furthermore, particular shape for the coolant channel is required, and only a few cells may be cooled at the same time. Because of the aforementioned concerns, the airflow velocity must be raised, resulting in reduced energy efficiency.

2.CONCLUSION

In this way, we started from the basis of the electric vehicles to the advancement of the battery packs, the PSMS motor and all other sub-systems involved in the development of the Electric vehicles.

There have been advancements in the type of battery cells like the pouch cells, motors and all other subsystems. Also, motor controllers have also evolved which plays a key role in performance of the motor. Hence these systems were properly studied and examined in this paper.

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