ELECTRIC VEHICLES CHARGING INFRASTRUCTURE

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Abstract: Today everything becoming smart, automatic and accurate in this digital world, so we are introducing some key elements in the electrical vehicle design ,the features include Gallium Nitride based power controllers and bidirectional DC to DC converters with cooling design Effective through Naturally or by forced draft, active cell balancing system with AI based controllers are useful to monitor each and every cell intelligently, active thermal management is useful to optimize the losses in the entire system, battery cooling system with non vapor liquids are useful to cool down the motor and controllers rapidly. MOSFET driven induction motors are widely used in electrical vehicles, to get better efficiency rates Synchronous reluctance motors are best choice, fast charging Super Capacitors charge within few minutes with helps in emergency and necessary situations, charging with **Regenerative breaking System (RBS)** provides superior backup to the electric Superfast vehicles, and ultrafast chargers are useful to charge batteries in very less time periods, High C rated Batteries which provides fast charging and high current discharge capabilities are useful in challenging situations, LED head, tail lights and indicator lights helps in battery backup by consuming very less

power, door to door power stations are useful to charge vehicles in their own areas by giving little money to them, plug point connectors with copper oxide resistive technologies and waterproof rated plugs/connectors helps in the better transformation of electrical energy to the electric vehicles and finally the effective body design helps in durability and cooling aspects all these features plays a major role in handling the electric vehicle overall performance with betterment results.

Keywords: Gallium Nitride based power controllers, Bidirectional DC TO DC converters, Battery cooling system, synchronous Reluctance, super capacitors, Regenerative breaking system, High C rated Batteries, LED lights, Charging stations.

Introduction:

This paper discuss about **"ELECTRIC VEHICLES CHARGING INFRASTRUCTURE"**provides a different types of charging stations. Now, however, with more than 350 new, featureladen EV models to debut by 2025, with ranges that increasingly top 200 miles, these attributes pose less of a hurdle. Instead, if consumers purchase EVs at the expected rates in the next five to ten years, a lack of charging infrastructure could become an obstacle to EV adoption.

Gallium nitrate Based Controllers and converters:

Technology advances in electric vehicles (EV) are steadily shrinking the vehicle billof-materials cost while creating power efficiencies and new design solutions. The combination of more power-dense batteries and higher-efficiency electric motors, inverters and onboard chargers is helping to reduce vehicle mass, resulting in greater range.

For this reason, EV propulsion-system developers are bringing gallium nitride (GaN) power transistors into greater focus. GaN has the potential to replace silicon as the heart of electronic chips, to satisfy a growing need for faster, more-efficient circuits in high-power environments. GaN is capable of sustaining higher efficiency than silicon; GaN semiconductors have 1,000 times more electron mobility – they flow faster – than silicon. This, in turn, provides improved thermal-management conditions, resulting in smaller and lowercost system cooling options.

Electric vehicles (EV) use two different power systems; a high-voltage battery (200 to 450 VDC) for traction and a low-voltage (12 V) one for supplying all the electric appliances in the vehicle. Traditionally the low-voltage battery was charged from the alternator, but in today's vehicles it gets its power from the high-voltage battery pack. However. in specific electric car architectures, this low voltage battery should be ready to help recharge the highvoltage battery pack in order to provide

energy for cranking the car. This means that the on-board DC-DC converter must be bi-directional and very efficient as well as highly reliable in order to run the complex control algorithms needed to ensure an energy-efficient solution.



Bi Directional DC DC Converter

Active Cell Balancing System with AI based controllers:

Cell balancing is a technique that improves battery life by maximizing the capacity of a battery pack with multiple cells in series, ensuring that all of its energy is available for use. A cell balancer or regulator is a functionality in a battery management system that performs cell balancing often found in lithium-ion battery packs electric vehicles and ESS applications.



Typically, individual cells of a battery pack have different capacities and are at different SOC levels. Without redistribution, discharging must stop when the cell with the lowest capacity is empty, even though the other cells are still not empty. This limits the energy delivering capability of the battery pack.

Active Thermal Management:

Active thermal management relies on cooling systems that keep a battery pack at an optimal temperature. When the cells start to heat up during charge or discharge, an active thermal management system extracts heat from cells using **air or cooling plates with conventional automotive coolants or even refrigerants** to bring temperatures back down. It's not unlike how a radiator keeps temperatures in check inside an internal combustion engine.

Like any other vehicle, keeping an EV or HEV running at peak performance involves constant monitoring of its systems -- that's why electric cars, trucks, and buses have sensors and electronic controls that constantly monitor the battery condition and automatically provide appropriate cooling or heating as needed.

Battery Cooling System with Non-Vapour Liquids:

Typically, battery liquid-cooling systems rely on the familiar water ethylene glycol (WEG) mixtures used in IC engine vehicles. There are alternatives, however, including dielectric fluids for immersion cooling and even fluids containing highly thermally conductive particulates developed for computer servers.

What's more, integrated cooling systems tend to require the movement of heat between different working fluids, and of necessity incorporate heat pumps that reverse the natural hot-to-cold thermodynamic flow. Engineers must therefore make the right choices for every vehicle, in what is a field of growing complexity.

The challenges faced in engineering these systems range from maximising the overall energy efficiency, cost effectiveness, responsiveness, robustness, reliability and ease of maintenance, to more detailed considerations such as the ability to make increasingly large cold plates. In integrated systems, it is also important to ensure there is enough capacity to keep occupants and the battery comfortable, for example.

One expert in the design and manufacture of electrified powertrain components and systems points out that this can be a tough balancing act, explaining that if you simply took the peak requirement for every component in the system and added them together you would end up with an over specified and thus expensive system.

The Synchronous Reluctance Motor:

The synchronous Reluctance Motor is becoming of great interest in the recent years and represents a valid alternative for electric and hybrid vehicles due to its simple and rugged construction. The main advantage of the Synchronous reluctance motor relies on the absence of the rotor cage losses or PM losses, allowing a continuous torque higher than the torque of an Induction Motor (IM) of the same size.

The important features are:

1. The rotor is potentially less expensive than PM motors and IM ones.

2. The specific torque is acceptable and it is not affected by the rotor temperature.

In electrical vehicles to get better efficiency rates Synchronous reluctance motors are best choice. Because in synchronous motor the rotor turns at the same speed as the magnetic field. This provides high torque at low speed, making it ideal for urban driving.



Synchronous Reluctance Motor

Super Capacitor: A supercapacitor also called an ultracapacitor, is high capacity capacitor with a capacitance value much a higher than other capacitors, but with lower voltage limits, that bridges the gap between electrolytic capacitors and rechargeable batteries. It typically stores the 10 to 100 times more energy per unit mass than electrolytic capacitors, can accept and deliver charge much faster than batteries.

In electrical vehicle for charging purpose, we can use fast charging super capacitors charge within few minutes with helps in emergency and necessary situations. The super capacitor pack is used as a peak power supply providing battery lifetime improvements. Supercapacitors already exist in cars with regenerative braking systems. This is thanks to their greater power density than chemical reaction based batteries, which allows them to rapidly store and discharge electricity, handy for collecting energy generated under braking then quickly releasing it upon acceleration. In electrical vehicle charging with Regenerative breaking systems provides superior backup to the electric vehicles, superfast and ultrafast charges are useful to charge batteries in very less time periods.

High C Rated batteries:

The C rating is misleading concept where C stands for the capacity of a battery usually measured in ampere hours (Ah) indicating the amount of active material with in battery available for discharge. Ampere is the measure of a current and gives the number of coulombs per unit time, so current times time give essentially the amount of charge in coulombs stored within the battery.



In electrical vehicles high C rated batteries which provides fast charging and high current discharge capabilities are useful in challenging situations.

Electrical Vehicle Lighting Using LEDs:

Electric vehicles are very energy the inefficient conscience. Replacing incandescent lights with more efficient lights, such as light emitting diodes (LED), would conserve energy and help increase the vehicle's range. Because LEDs produce light at the needed wavelength for automotive use, less energy is consumed by the lighting fixture when compared to the white light generated by incandescent bulbs. One development is super-bright LEDs that produce light at greater efficiency. LED lights are becoming standard equipment on many vehicles and even commercial and residential lighting. The future for LED lights is very bright and will continue to grow and mature with the industry as the automobile "green technology" era unfolds. LED head,tail lights and indicator light helps in battery backup by consuming very less power.

Types of Charging Stations:

1.ElectricalVehicleSupply**Equipment**(EVSE) : It means anelement in electrical VehicleChargingInfrastructure(EVCI)thatsupplieselectrical energy for recharging the batteryof electrical vehicles.

2.Public charging station (PCS): It means an EV charging station where any eelctric vehicle can get its battery recharged.

3.Battery Charging Stations (**BCS**): It means a station where the discharged or partially discharged electric batteries for electric vehicles are electrically recharged. **4.Capacitive Charging Stations** (CCS): It means an electric vehicle charging station exclusively for the electric vehicles owned or under the control of the owner of the charging station.

5.Battery Swaping Station (BSS) : It means a station where any electric vehicle can get its discharged battery or partially charged battery replaced by a charged battery.

Electrical Vehicle Body Design:

The main concept of the EVFD approach is the development of the parametric knowledge base to facilitate performance driven design of body structure in concept design stage, including the battery sublibraries designed by vehicle power performances and the modular body frame structure sub-libraries and cross section of profile sub-libraries designed by structure performances. The layout of vehicle is firstly determined based on battery volume which calculated on the basis of power performance of EVs. And then, the body frame structures are designed by multi-load topology optimization and multi-objective parametric optimization based on the body structure performance. The feasibility and accuracy of selected EV's aluminium alloy body frame structure is suitable for designing electric vehicles.

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Conclusion:

Electric mobility (e-mobility) sector in India is categorized by the availability of Electric Vehicles (EVs) on the supply side and adoption trends on the demand side. Adequate charging infrastructure is the key prerequisite that will define the adoption trends of EVs in India. EVs carry limited onboard energy in the battery packs which need charging from time to time depending upon the battery pack, size, and capacity.

Charging systems are therefore essential for the sustainable operation of EVs. The charging requirement depends not only on the kind of vehicle (two-wheeler, threewheeler, four-wheeler, and bus) but also on the utility purpose i.e. passenger or commercial. The Government of India has set a target to electrify 70% of all commercial vehicles, 30% of private cars, 40% of buses, and 80% of two-wheeler and three-wheeler sales by 2030. This target entails simultaneous penetration of charging stations across India.

The Government of India has been supporting the EV industry through

schemes such as FAME1 and FAME2 with a major focus on charging infrastructure. The industry players too have been quite optimistic and shown an active interest in the overall EV Charging ecosystem. While EVs are being worked upon by major OEMs, an ecosystem for the development of chargers, charging stations, and other services are steadily being built.

The charging infrastructure is the backbone of electric mobility but is also one of the keys perceived barriers to EV adoption in India given its limited availability and long charging times.

India is picking up the pace in setting up the charging infra but not as much as is there in other regions like European Union (EU), USA or China. High operating cost, Discom load, and the uncertainty related to utilization rates of charging stations are holding back the charge operators from expanding their current reach.