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A Review Paper on Lithium-Ion Battery Pack Design For EVs

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Abstract: ***Unique Electric vehicles are most well known nowadays. EV's are the best vehicles for transportation. Electrical vehicles industry going to blast in India. It will happen on the grounds that India is a home all things considered dirtied urban areas on the planet additionally EV energy wises multiple times more energy productivity when contrasted with ICE vehicle and it has multiple times less parts. The Battery System, which is the core of EVs, comprises of cells, Battery Modules and Battery Packs that are acknowledged by joining battery modules. With the quick improvement of Lithium-Ion Battery Technologies in the electric vehicles (Ev's) industry, The lifetime of the battery cell increments significantly. For changing over the ICE vehicles into Electrical vehicle its fundamental to make the battery pack for that vehicle. For building or fostering the Battery pack we need to think about such countless things.***

Keywords: Li-Ion Battery cells, Battery Pack Structural design, Thermal Design, Cooling System, Battery Management System (BMS), Safety Majors.

I. INTRODUCTION

Fuel vehicles bring about a lot of carbon dioxide outflow, which prompts some genuine outcome on climate. To keep away from this issues, as of late, the public authority of UK, France, Germany, Netherland and different nations are produce the EV the majority of which are from 2025 to 2040 individually one significant boundary of EVs is driving reach per charge, which are near energy thickness and weight proportion, to the entire vehicle. The Li-Ion Batteries weight it make more serious with other battery frameworks. Lithium-Ion battery has numerous other huge elements. Like the high single cell voltage of 4V and higher limit.

A battery pack is set of quite a few indistinguishable batteries or individual battery cells. They may be sorted out in a series, equal or a combination of both to convey the ideal voltage, limit, or power thickness. Part of battery packs incorporate the singular batteries or cells, and the interconnects which give electrical inductivity between them. Battery-powered battery packs frequently contain a temperature sensor, Battery Management System(BMS), Cooling framework..

In Battery pack we should need to consider their Power and voltage for giving the dc voltage to drive the engines and the other vehicle gear's. For significant distance voyaging we really want the powerful battery pack, for planning the powerful battery pack we utilized the battery-powered lithium particles.

By associating the many number of lithium particle batteries in series and equal the high voltage and high power battery pack is created. Battery pack Structural plan is made for help the battery pack. After the pack of li-particle cells is built we need to plan the warm plan for controlling the temperature of the battery pack. Up to now numerous warm administration frameworks are intended for the Heat Dissipation, here we will involve the fluid cooling framework for the lithium particle battery pack. The primary piece of the battery pack is Battery Management System(BMS), which is the core of the battery pack. It deals with the battery packs Charging and Discharging, Cell Balancing, SOC and SOH Estimation, Voltage Measurement, Current Measurement, Temperature Measurement. BMS has its own calculations to do the all estimations and controlling the battery pack. The significant truth is the security of the battery pack, Batteries can possibly be risky in the event that they are not painstakingly planned or on the other hand assuming they are mishandled.

II. COMPONENTS OF THE BATTERY PACK FOR EV'S

1) Cells (Different from factors & chemistry types).
2) BMS (Electronics to manage the battery)
3) Connection system (Connector, pigtail, wires)

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A. Lithium-Ion Batteries

For EV's various Li-Ion batteries are available in the Market, that we can use with our requirement.
The Li-Ion batteries are the most usable batteries comparing the Lead-Acid batteries.

B. Types Of Li-Ion Batteries

1) Lithium Cobalt Oxide(LiCoO2)
2) Lithium Manganese Oxide(LiMgO2)
3) Lithium Iron Phosphate
4) Lithium Nickel Manganese Cobalt Oxide
5) Lithium Nickel Cobalt Aluminum Oxide

With our consideration and the requirement we used the Lithium Iron Phosphate(LiFePO4) Prismatic Batteries for battery pack design.
LiFePO4 has the more cycle life than Lithium ion polymer batteries, therefore the durability is greater. LiFePO4 are less degradation and long life because their greater cycle life. Due to the chemistry of this battery its harmless to the Environment, so we can use EV's. LiFePO4 has the most safest lithium chemistry. This batteries has excellent efficiency and performance, Charge efficiency is great and it will reach full charge in just 2 hours or less. LiFePO4 batteries are totally light-weight and small in size.



Figure:- Lithium Iron Phosphate Battery Cell

C. Connection System

For the connection of batteries in series and parallel connections the Copper strips are used for Prismatic batteries.
And wires or buses are used for connect the batteries with the battery management system.

III. BATTERY MANAGEMENT SYSTEM

Battery Management System is the control unit of the battery pack. It is likewise the specialized gadget between the battery pack and charger. It is additionally utilized for the screen the whole battery boundaries. What's more, it shows the left battery limit on the vehicles dashboard.



Figure:- Battery management system

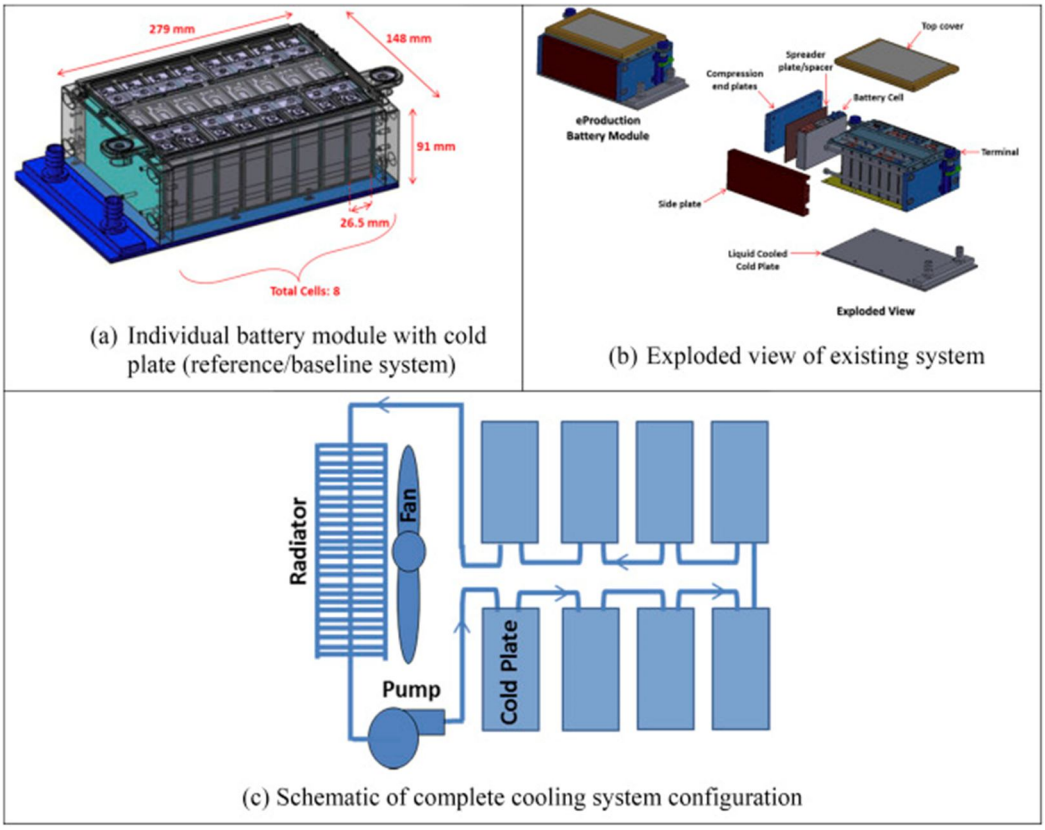
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IV. THERMAL MANAGEMENT

Thermal management is a major issue in high power design, particularly for automotive applications.

As a feature of the battery framework, it very well might be important to give air or fluid cooling ducts, pumps or fans and heat exchangers for high temperature working or heaters for operating in low-temperature environments.

The design of the cells ought to be helpful for overseeing heat streams inside the pack.



(a) Individual battery module with cold plate (reference/baseline system)

(b) Exploded view of existing system

(c) Schematic of complete cooling system configuration

V. LITERATURE SURVEY

1) *YoonCheoul JEON, GunGoo LEE, TaeYong KIM, SangWon BYUN, "Development of Battery Pack design for High power Li-ion Battery pack of HEV".*

In this paper, researchers are mainly focused on the design of compact battery pack with high Cooling performance and Desired Structural Safety. Due to the installation of battery pack under the seat, the height of the battery pack is reduced and also the weight of the battery pack is minimized by the using optimization methodology with Finite Element Analysis. By through the computational fluid dynamic element (CFD) analysis, for having the uniform temperature circulation and limited pressure drop inside the pack under typical charging and releasing conditions. By employing module frames and cooling system based on numerical simulations, a prototype of battery pack was manufactured. Experiments were also carried out on this optimized prototype of the battery pack to further validate numerical simulation.

2) *Zhitao Liu, CherMing Tan, Feng Leng "A reliability based design concept for lithium-ion battery pack in electric vehicles".*

In this paper, an idea for plan in unwavering quality for Li-particle battery pack in EVs applications utilizing cells overt repetitiveness is presented, and the examination depends on the SoH of the phones in the battery pack. They compute the unwavering quality of the battery loads with various designs utilizing UGF procedure. Looking at the unwavering quality of two battery packs at various temperatures, we infer that the dependability could be improved by adding repetitive cells true to form, and the setup of the excess cells has huge impact on its unwavering quality. The proposed plan idea gives a method for choosing the best repetitive cells arrangement for good pack unwavering quality, while thinking about the complete expense through the ideal number of the excess cells.

3) *Shashank Arora, Ajay Kapoor "Mechanical design and Packaging of Battery Pack for Electrical Vehicles".*

In this paper, mechanical design elements affecting safety and reliability of EV battery packaging are discussed. Forces like mechanical vibration, impact energy and ambient temperature variations interact with the battery pack through different interfaces. These interactions need to be controlled for safe and reliable operation of battery pack. Restricting battery cell movement is found to be one of the successful strategies to achieve a higher degree of protection against all of them and mechanism that can be used for this purpose are presented. Other mechanical design solutions to increase crashworthiness and vibration isolation of the EV battery pack are also discussed. Lastly, a case study focusing on mechanical design of an eBus battery pack at Swinburne University of Technology in Australia is presented.

4) *Changhao Piao, Tao Chen, Anjian Zhou, Pingzhong Wang, Junsheng Chen "Research on Electric Vehicle Cooling System Based on Active and Passive Liquid Cooling".*

This paper proposes an active and passive liquid cooling-based EV cooling system, which is used for the battery cooling, motor, MCU, and DCDC. An movable intake grill is considered. The mathematical models for each component of the system are established by combining experimental data and component mechanism. The performance data for each component is obtained by experimental data fitting using linear interpolation. To show the proposed strategy, the reproduction tests are directed in light of the model worked by Flowmaster. The trial results show that the proposed strategy can fulfill the framework cooling prerequisite for various types of gadget. The combination of active and passive liquid cooling schemes can not only guarantee the battery operating temperature, but also save energy.

5) *Priyanka, R. Sandeep, V. Ravi, O. Shekar, "Battery Management System in Electric Vehicles".*

Here are they developing the system model for battery management in the electrical vehicles. With changing or controlling such battery parameters such as Voltage, Current, State of Charge, State of Health, State of Life, Temperature. This paper mainly focusses on the study of the Battery Management System and optimize the power performances of electric vehicles. And they give various particular situations and different strategies for upgrades and optimize the performance of the BMS in EVs.

6) *Y.Lyu, A.R.M.Siddique, S.H. Majid, M. Biglarbegian, S.A. Godsden, S. Mohmud."Electric vehicle battery thermal management system with thermoelectric cooling".*

In this paper, authors presented the use of TEC for BTMS due to low thermal efficiency, researched have been consider the few literature has been came forward reference. However studies suggest that working at above 50 degC can be harmful to the lifespan of batteries. Further studies indicate that a temperature range from 25 degC to 40 degC (a maximum 50 degC difference from this temperature range) provides the best working environments for batteries such as Lead-acid, NiMh, and Li-ion. The battery thermal behavior by natural air cooling at different voltage supplies was investigated first.

The temperature rises in volume and rate of change of increases significantly as the voltage supply increases. When heater voltage changed from 30v to 60v, the steady temperature to almost doubled. Next a study was carried out for a purposed liquid cooling and hybrid study was carried out purposed of liquid cooling and hybrid TEC-liquid-air cooling system. In one of the recent studies, researches used TEC for BTMS without any coolant where their temperature drop was 31.5 degC which is 11.5 degC less compared to the current work.

VI. CONCLUSION

Hence, we have successfully go though several research papers which are been published by different manipulators for better knowledge and understanding of the development Lithium-Ion Battery Pack Design For EVs.

VII. ACKNOLEDGEMENT

This review paper was carried out "Get My Solutions Pune" under the guidance of Mr. Jaywant Mahajan.

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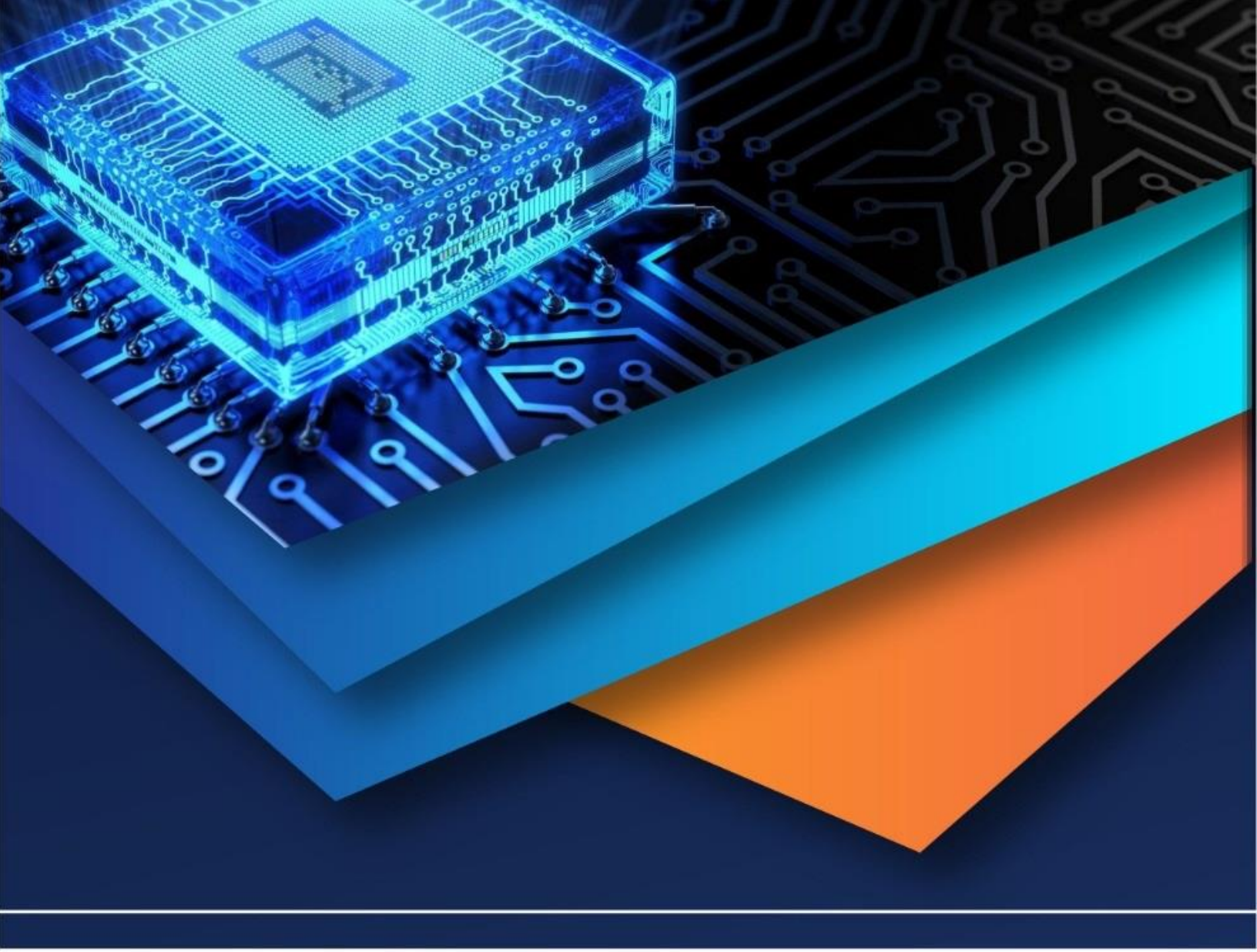
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