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Battery Health Monitoring System Based on the Arduino Uno

Prof. Abhinandan. A. Patil[1], Mr. Aryan. M. Rajput[2], Miss. Namrata. C. Patankar[3], Miss. Mayuri. L. Patankar[4], Mr. Abhishek. S. Awati[5]

[1]Professor, DKTE's YCP, Ichalkaranji.
[2,3,4,5]Student, DKTE's YCP, Ichalkaranji.

ABSTRACT
As people become more aware of global warming, the need for clean fuel and energy is increasing, and as a result, there is a steady trend toward electric automobiles and hybrid electric vehicles. The DEPTH OF DISCHARGE (DOD), temperature, and charging algorithm all have an impact on battery performance. Using the ARDUINO, this study seeks to offer a measurement of the battery's voltage and current level. Lead-acid batteries are capable of powering a wide range of applications. They're simple to find, affordable, and deliver a lot of power to anything they're connected to. Unfortunately, if the charge is not monitored, the battery will ultimately run out of power. current and voltage of battery is required in extra to finding the charge of the battery. The approximate charge of the battery may be determined based on the battery's output voltage. This project summarizes a number of studies on battery health monitoring systems. Electric Vehicles are increasing popularity in the modern world and the technology related to it is also getting advanced as it is one of the most researched topics. Electric vehicles are eco-friendly and helps reduce air & noise pollution. As we can observe that overheating is a big issue with EVs. So, to resolve it there isa need to research and develop a system that can be used to control EV battery temperature. using the DHT-11 sensor we are design the model which will cool the battery when the battery the is above the exceeding the value to be decided using the Arduino and cooling fan.

Keyword: Electrical `vehicle, DC motor, Monitoring System, Charging-Discharging System, Thermal Control.

1. INTRODUCTION

Now a days battery Powered Vehicles are gaining popularity, this is mainly because of its environment friendly nature. These vehicles are called Electric Vehicle (EV). A lot of research is being done in Electric vehicle to make them reality and safe to be used in real world situations. A very important part and also called heart of an electrical vehicle is Battery Management System (BMS). Battery Management System is the central unit used to monitor different aspects of battery that is being used in electric vehicle or any electric system like State Of Charge (SOC), Temperature, Voltage and Current ranting and many more. This project is based on monitoring temperature of electric vehicle and implementing corrective measures to maintain battery

temperature.

Battery Thermal Management System (BTMS) is a subunit of battery management system that is used to monitor and maintain temperature of batteries so that life of batteries can be improves and reduce risk of burning of battery and overheating of system that can damage EVs and can put humanlife in danger BTSM is being researched thoroughly and we have come a long way but still there is a lot to achieve in this field. Battery thermal management system can regulate the temperature of battery system either by using air as coolant or cooling liquid as coolant. Method using cooling liquid is more efficient and can be used to cool or heat the battery if it is required considering environment in which system is being used. In this project we have tried to design a battery thermal management system, which will analyze battery temperature and environment condition to give input cooling and heating system installed that will be maintaining battery temperature. The above-mentioned design has 2 been simulated and a simple hardware have also made that mimics the above-mentioned mechanism in small scale.

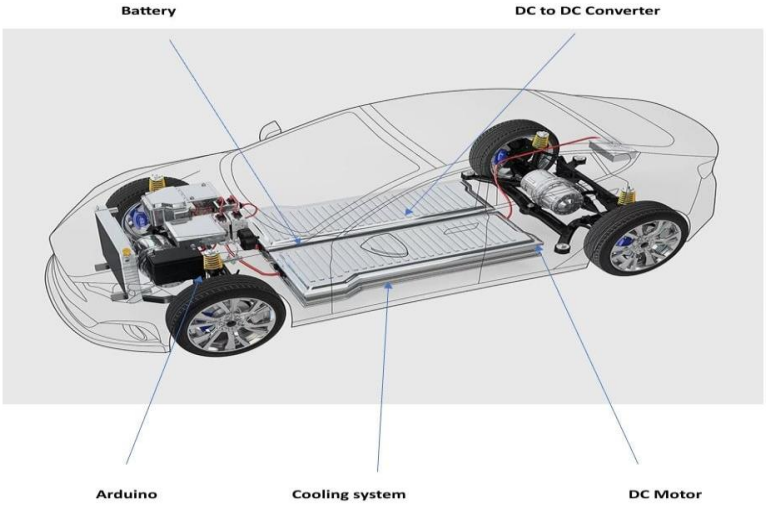

Fig.no.1 – Structure of Battery Health Monitoring System in EV.

2. METHODOLOGY -

At a situation where large heat loads needs to be dispatched usually liquid cooling is used. Liquid cooling can achieve much better heat transfer at much lower mass flow rate. At these situation air will need high flow rate, so a liquid cooling system is a better fit for situation like these.

The main function of battery thermal management system is to maintain the temperature of battery to its normal operating temperature that is anywhere around 20 to 30 degrees Celsius. This DHT 11 sensor and batteries are readily paired with the Arduino microcontroller. Under overheating condition cooling system comes into action. When temperature is reduced to its normal condition temperature sensor again alerts Arduino and the fan stop action. A refrigeration system or a cooling system is used to reduce the temperature of battery using cooling fan.

BLOCK DIAGRAM- BATTERY HEALTH MONITORING SYSTEM

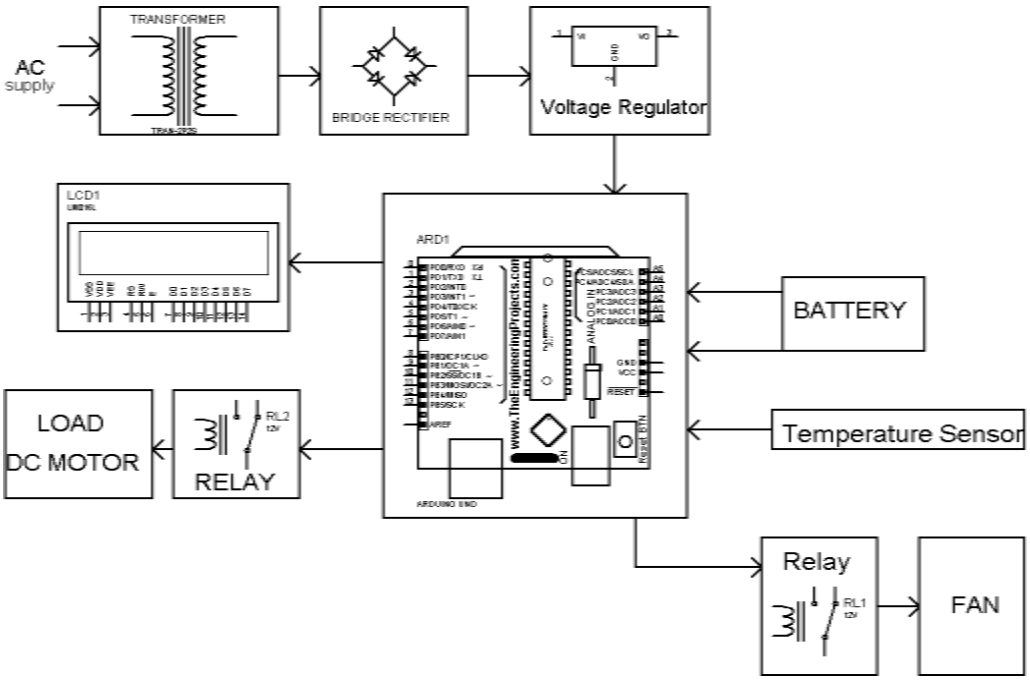

Fig.no.2 – Block Diagram for Battery Health Monitoring System.

3. WORKING

Battery thermal management system is used to maintain the thermal state of battery by using temperature sensor. The DHT-11 temperature sensor is used to detect the temperature range of the battery. The normal operation range of battery is 25℃ to 35℃. For the purpose of this project, we have taken it as 32℃ DHT 11 is connected physically to the battery and takes real time temperature reading of the battery which is then displayed on the display connected with the controller, for this purpose Arduino UNO is used as control the fan of cooling. Arduino/ATMEGA 2560, an effective energy-management system for Lead Acid Batteries is being developed. The system detects current and voltage in the circuit with a sensor, while the temperature is detects with an temperature sensor that outputs voltages proportional to the temperature measured in degrees Celsius. Arduino is used to store and handle the data generated by these sensors (microcontroller). The battery's state of charge (SOG) is an index that indicates how much charge is in the battery. The SOC is affected by a number of factors, including current, voltage, temperature, and pressure. The temperature, current, and voltage are all taken into to account while calculating the SOC in our system.

This system consists of one battery which is connected to the DC to DC converter. It converts DC into 12v DC. This DC to DC converter is connected to Arduino UNO for gives the instruction to the relay-1 which is used for the charging of the battery. If the battery is fully charged i.e. 13.85v then the charger of the battery is cut-off from the battery. If the battery is discharges below the 10v then the relay-2 is operated battery is automatically start to charging. The another system is included in this project which is thermal management system. If the battery temperature arises beyond the decided value (i.e. 40℃) then automatically cooling system (fan) is start to cooling the battery.

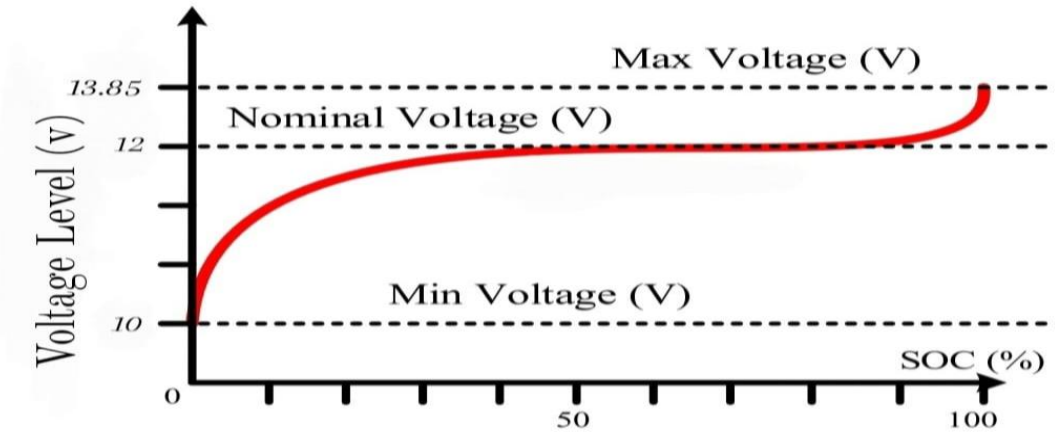

Fig.no.3 – Charging-Discharging Curve.

4. ADVANTAGES

1. **Enhanced Safety:** BMS ensures safe operation by monitoring battery conditions, preventing overcharging, overheating, and over-discharging, thereby reducing the risk of accidents.
2. **Prolonged Lifespan:** BMS helps extend battery life by managing charging/discharging rates, balancing cell voltages, and preventing conditions that could degrade the battery over time.
3. **Improved Performance:** It optimizes battery performance by regulating power flow, ensuring efficient utilization of energy, and maintaining consistent voltage levels.
4. **Fault Detection:** BMS can identify faults or abnormalities in individual cells, allowing for timely maintenance or replacement, preventing potential failures.
5. **Efficiency:** It contributes to energy efficiency by managing power flow, reducing wasted energy,and optimizing charging cycles, thus maximizing the battery's capacity utilization.

5. FUTURE SCOPES

1. The Battery health monitoring manages batteries by controlling load environment, monitoring battery state and accordingly balancing the charging. Battery management system is useful for ensuring prolonged life of batteries, preventing battery damage due to overcharging and voltage fluctuations, managing optimal state of charging for the battery and facilitating BMS interface with host application to provide real-time information regarding battery health.
2. Battery health monitoring follows three types of topologies, which are distributed, centralized and modular. Distributed Battery health monitoring has a single communication cable controller and battery; a cell board is installed at each cell number of cells and communicate with each other.
3. The report begins with an overview of the Battery health monitoring market. The global battery management system market is segmented on the basis of verticals into automotive, energy, telecom and drones.
4. The battery health monitoring system prevents from the accident battery damages.

6. CONCLUSIONS

According to proposed methodology, a battery cooling system is designed and fabricated which governs on the concept of Air cooling of batteries. Through the proposed model we can observe that the temperature of batteries increases gradually and the system used in model can reduce it effectively. So, it

can be observed that by employing this system maximum efficiency of battery can be observed and the lifetime of the battery is also improved. The construction of recharging infrastructure is required for the widespread use of electric vehicles. In it available charging terminal, management of charge system, power generating also facility of supply reinforcement. There is extra power in a specific region might occur if several electric cars are charged at the same time, it is critical to regulate power based on the conditions.

With recent improvements in battery performance for energy storage, the approaches that are employed on the night for high load provide better capacity. Creating room with a high-capacity battery for recharging an automobile necessitates a system to keep the battery in top condition and regulate power recharge and discharge. A good storage battery connecting in parallel and series combination gives required power. Combination of cells can be very accordingly it's performance, so it regulated separately. The problem in any single cell prevents the entire stored energy from being used. As a result, the implementation system that checks state of every cell in actual time while also automatically managing the stored power is necessary.

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