UNIQUE BMS IN EV

A NEW method of Battery Management System in Electric Vehicles using Embedded system and Programming on Lithium-ion cells

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Abstract - As we know in the present world, the technologies are so wide that they make man's work easier. As we see everywhere, the present technology impacts the world in making things simpler.
Embedded system is evolved in all the sectors also in all the fields, but it is not so efficient yet in EV (electrical vehicle) industry especially in developing countries.
In Developing countries like INDIA, there is still old and single way of Battery Management System exists which affects the EV" Ref[4]" one or the other way, for example if the using BMS is of thermos BMS then it will not be useful when it comes to current and voltage problem.
This NEW METHOD OF BMS helps in every problem and every category issues exists so it mainly focuses on all factors responsible for the abnormalities of the EV.
The purpose1of this researchzpaper is to provideaa detailed description of the new and best BMS method and its features. This paper will discuss the embedded systems and programming development process, including the technologies used and the challenges faced during development. Additionally, the paper will highlight the benefits of using this this system, comparing the old and other systems and explore the potential for future improvements.

Keywords— BMS (battery management system), Electric vehicles, time and processes, improved version, new method (using candle wax)

1.INTRODUCTION

Usually, the important terms and components we used are like Lithium-ion batteries, which are mostly used in electricavehicles because they have a high energy1density, which allows for a longer driving range on a single charge, and they are also more efficient and environmentally friendly compared to traditional gasoline engines.

The Battery Management System (BMS) in electric vehicles, which examines and controls the state of charge, voltage, temperature, and health of the lithium-ion cells, frequently uses an embedded system for efficient and reliable operation. The embedded system may involve sensors, micro-controllers, communication interfaces, and algorithms that ensure the optimal performance and safety of the battery pack.

The BMS persistently monitors the battery's state of charge, temperature, and voltage, among other parameters, and makes confident that the battery operates within safe limits. It also accomplishes the charging and discharging process to optimize the battery's performance and avoid overcharging or over-discharging.
In addition to its safety and performance features, the BMS also looks after data on the battery's state of condition and usage. This data can be used to foresee when the battery requires to be replaced and to optimize the battery's performance over its lifespan.
This paper proposes a Very unique method that using Candle wax, the process of handling temperature and sensors, cooling process.
This paper objects provide comprehensive descriptions of this method process and its jobs. This document discusses the development process of BMS, containing the technologies and programming used and the encounters of development each detail will be established in TFT display.
Furthermore, the paperzcenters on theygains of utilizing unique BMS structure and discovers the promise for imminent upgrades.
The document is segregated into several fragments, opening with a summary of the technology and its features. Afterwards, a description of the reasons(survey), architecture and the technology used to develop, and an evaluation of the advantages of using BMS in Electric vehicle, including improvement of user effectiveness and convenience.

2. Existing Works/Old systems

In recent years, numerous works occurred in which they were use full for moment and helped in any one way and stayed as a concern for other resolutions.

Like,

- **Circuit breakers**:
  - helps to prevent damage *"Ref[1]"* to components and reduce the risk of a short circuit or explosion
  - It must reset in manual way.
- **Thermal management system**
  - Helps avoid battery explosions by adjusting the temperature of the battery.
  - Its only use-full in *"Ref[2]"* explosions and heat damage
  - Cannot use-their entirety during the short circuit.
- **Battery disconnects switches.**
  - engineered to quickly cut off the electrical power to foil beyond damage.
  - It takes vast space.
  - It is a lengthy process.
- **Ground fault interrupters**
  - notice and interrupt electrical circuits when a ground fault is sensed.
  - Beneficial only in Ground and electrical faults
- **Battery management system** [Old Method]
  - A well-designed BMS can detect and prevent shorting events by controlling the battery voltage current. *"Ref[3]"*
  - Development is large, and it demands more components.

Total Drawbacks of the **other existing approaches**:

1. The present system is a manual.

2. Long methods.

3. maintenance is complicated.

4. Effective only in a certain way.

3. Proposed Work

Our proposed system called Unique BMS, and it works on EV's to ensure the performance of the battery in EV's in a best way and monitoring the conditions around and in the battery like short circuit, overheating, low voltage, etc and based on that alerting and managing the conditions and resulting in effective performance, the system is created with Embedded systems and Arduino technologies.

The complete work is categorizing into.

I. *Recognizing the requirements*: Gather information on the battery type, cell configuration, voltage, and current ratings.

II. *Proposing the BMS architecture*: Design the architecture of the BMS that contains hardware and software components.

III. *Using New method*: Using candle max with the lithium ion and aluminium configuration which helps in transfer of heat and any deviation of EV devices.

IV. *Progressing the BMS software*: Develop the BMS software using a programming language like Arduino programming.

V. *Integrate the BMS hardware*: Integrate the BMS software with the hardware components like sensors and micro-controllers.

VI. *Performing field testing*: Conduct field testing to ensure the BMS is operating correctly under various driving environments. Test the BMS to see if it gives enough protection, balancing, and performance optimization.

4. LITRETURE SURVEY

(CAUSES AND LEADS)

1. PURE EV scooter,6 May 2023,

Nizamabad district:Due to an explosion of Battery of pure EV battery of two-wheeler, one 80-year-old man was killed, and two others injured very badly.

2. OLA s1 EV scooter,8 oct 2022

PUNE : Battery overheating: If the battery pack of an EV is subjected to elevated temperatures due to overcharging, overuse, or external factors like a fire, it can result in thermal runaway.

3. Ola S1 EV,15 dec 2022

Bengaluru: Electrical short circuit: An electrical short circuit in the battery or electrical system

4. Like above incidents there are more than 150 cases in last 6 months in all type EVs like scooters and cars.

5.Architecture

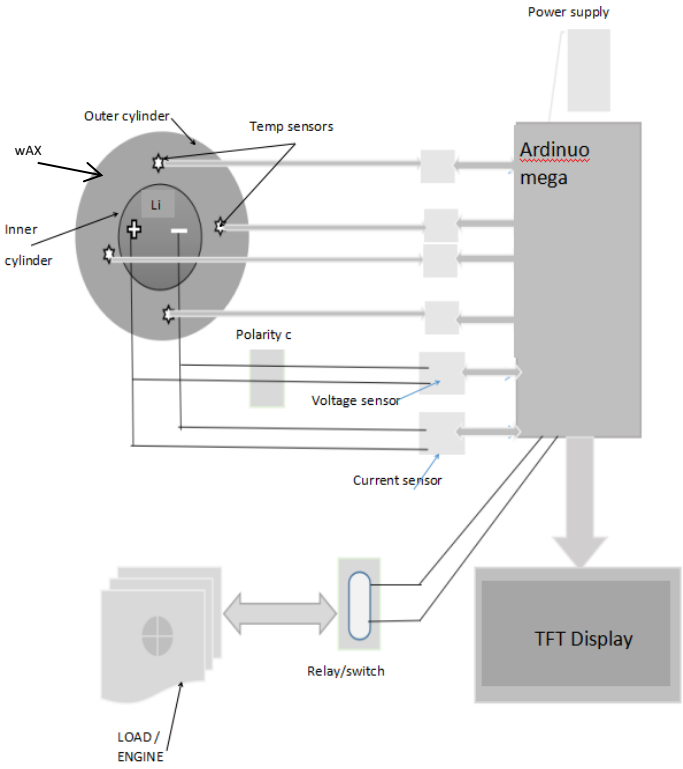

Figure 1. System Architecture

Three key components make up the recommended architecture for the Wax aluminium BMS: Li+ cells, aluminium cylinders, candle wax, temperature sensors (1 to 4), current sensors, voltage rectifiers, relays, TFT display, Arduino mega and load/engine. Each module must carry out the features.

The system is managed by the Arduino broad module. Since this must maintain the conditions and programs as inputs and delivers to other components for next acts and to TFT display to display all conditions and state of the system.

The main body of the system is Aluminium Cylinders which holds the Lithium cells inside and wax from the other side,

Since aluminium is a *good conductor* of electricity and heat so we used the aluminium for the holding and distributed purpose. there are two cylinders in which they kept inside out pattern where inner cylinder holds the lithium cell and in between the inner and the outer cylinder we filled with a wax and the arranged the sensors in a particular angle so that the temperature of each part of the body can be measured.

The unique way is all about CANDLE WAX, for *holding and cooling process* because the wax in between the inner and outer aluminium cylinders will hold the temperature sensors and wax being a covalent compound which doesn't contain any positive or negatively charged ions so it will be perfectly managed in the holding process of sensors and cooling process of the Engine/load.

In this project, we are going to use LEDs under different resistance as Load or engine, in meanwhile for outer world /real purpose it is going to be a actual engine of the vehicle so that the regulation of that battery engine results.

Li+ cells: The lithium cells we are going to use has a 5V and which has a inbuilt circuit for outlying 2 wires for charging and using for the project

This paper is categorized and made as three major parts of architecture.

A. Modules of Architecture

The proposed Architecture contains three main modules which are as follows:

I. TEMPRATURE sensors:

1) Module Name: *K Type Thermocouple*

2) RANGE: 0 to 1200 Degree C

3) Purpose in this project: *"Ref[6]"* Measuring the temperature of the cells and battery and for reading the surrounding temperature.

4) Dimensions: Probe dia:1mm, length :55mm and cable length: one meter

5) Number: Four

II. Voltage and Current sensors:

1) Module Name:
Voltage Detection Sensor Module (25V)
2) RANGE: 0 to 25 volts
3) Purpose in this project: Measuring the voltages in the circuits and in the battery for measuring the min and max volt and for maintain g the proper voltage.
4) Number: 1

5) C Module Name:
Current Sensor Module WCW2700
6) RANGE: 0.0 to 5.0 amp
7) Purpose in this project: The current sensor in a BMS is used to measure and monitor the flow of electric current in the battery pack.

TFT DISPLAY:

TFT display is a small screen that uses *thin-film transistor* technology to control individual pixels and create a color display with a diagonal size of 2.4 inches or any size is required.

[7] Users and operators can view the display in a BMS for real-time information about the battery pack's status, including voltage, current, temperature, and battery charge level, as well as system faults and alerts.

B. Code conduct / software simulation:

Arduino programming is a popular method of coding for Arduino mega board and microcontrollers, which are widely used in DIY electronics and prototyping. It involves writing code in C/C++ language using the Arduino IDE, uploading it to the Arduino board, and utilizing various libraries and functions to interact with sensors, actuators, and other components.

Arduino programming allows for a wide range of applications, from simple LED blinking and sensor readings to complex projects such as home automation systems, robotics, and Embedded systems.[8]

The Arduino programming and embedded c helps in many ways and will be useful to study ,rewrite and understanding the process very well and the technical words for the measurement and conversions used in the project like *DO, CS, DOD, SOC, SOH, Vbat, Ibat, V-Is* and others and the major sensors and components like *Relays, thermocouples, temp sensors, Vol sensor, current sensors, FT display ,Arduino mega* and others for the system.

C. Methodology

The BMS constantly monitors the battery's state of charge, temperature, and voltage, among other parameters, and makes sure that the battery operates within safe limits. It also manages the charging and discharging process to optimize the battery's performance and prevent overcharging or over-

discharging. In addition to its safety and performance functions, the BMS also provides data on the battery's state of health and usage. This data can be used to predict when the battery needs to be replaced and to optimize the battery's performance over its lifetime.

- Designing the System Architecture: The first step is to design the system architecture of the BMS, which includes selecting the micro-controller, communication protocol, and sensors. The micro-controller must be powerful enough to handle the complex algorithms involved in battery management.
- Selecting the Sensors: The BMS needs to monitor several parameters such as voltage, current, temperature, and state of charge. Therefore, appropriate sensors must be selected for each of these parameters.
- Developing the Software/CODE: The next step is to develop the software for the BMS. This includes programming the microcontroller to read data from the sensors and perform calculations to manage the battery.
- The programming of a BMS typically involves several key tasks, including:

Sensor Data Acquisition: The BMS must acquire data from various sensors to monitor the battery's state of charge, voltage, temperature, and other parameters.

Battery Management: The BMS uses this data to manage the battery's charge and discharge cycles, including implementing appropriate charging and discharging protocols and ensuring the battery operates within safe limits.

Fault Detection and Diagnosis: The BMS programming should also be capable of detecting and diagnosing faults in the battery system, such as short circuits, overvoltage, undervoltage, and overcurrent situations.

- Building the Hardware: After the software is developed, the hardware components of the BMS must be assembled. This includes the microcontroller, sensors, power management circuitry, and communication interface.
- Testing and Calibration: Once the BMS is assembled, it needs to be tested and calibrated. This involves checking the accuracy of the sensors, verifying the functionality of the software, and ensuring that the BMS operates within safe limits.
- Integration with the EV: Finally, the BMS must be integrated with the EV's control system. This involves connecting the BMS to the vehicle's CAN bus and ensuring that it communicates correctly with the other systems.

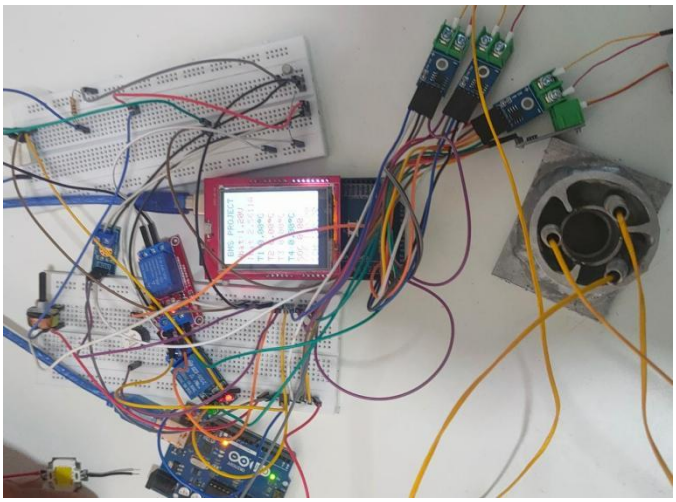

Fig -2: BMS

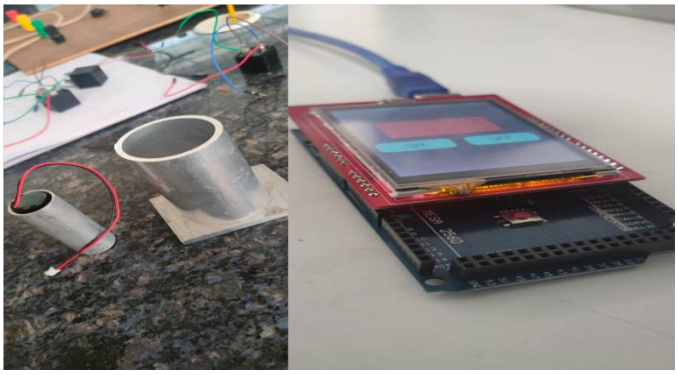

Fig-3: aluminum cells and tft

6. CONCLUSIONS

i.Safety: Oneeof the primary objectivesnof BMS isyto ensure the safety of the batterynpack and the vehicle by preventing overcharging, over-discharging, overheating, and short-circuiting of cells. It also controls battery pack for any potential fault or failure and activates an alarm or a shutdown mechanism to prevent any further damage.

ii.Early Detection of Battery Faults: The BMS can detect battery defects like overcharging, undercharging, and short circuits, allowing for early detection and correction of potential problems. This can prevent costly renovations and idle time for the vehicle.

iii.Endurance: BMS ensures the long-term health and longevity of the battery pack through balancing charge across cells and prevent any cells from being

overcharged or over-discharged. It also manages the charge and discharge rates of the battery pack to prevent damage to cells and enhance their lifespan.

iv.Performance: BMS ensures that the battery pack functions optimally by providing accurate readings of SoC and SoH of cells. It also manages the temperature of the battery pack against overheating which can alter its execution.

v.Efficiency: BMS ensures that the battery pack works efficiently by reducing energy losses during charging and discharging, and by optimizing the power flow between cells. It also controls the regenerative braking system to boost the amount of energy that can be recovered by braking.

vi.User Experience: BMS provides real-time information about the battery pack's stage, such as its charge level, range, and remaining time until the next charge. It also alerts the driver about any potential issues with the battery pack and recommends actions to be taken to prevent further injury.

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