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BATTERY MANAGEMENT SYSTEM WITH CHARGE MONITOR AND FIRE PROTECTION FOR ELECTRICAL DRIVE

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Abstract:The majority of automobile manufacturers currently create electrical vehicles for both two- and four- wheelers. Thus battery becomes essential component and improving methods for calculating a vehicle's charge capacity. It is required to create and develop an efficient Battery management system so that they should not be over charged or deeply discharged. Electric vehicle an accurate state of charge estimation to reduce the risk of damage, extend their longevity, and safeguard the electronics they power. This project suggests a real-time Battery Monitoring System(BMS) employing the method for State of charge(Soc) and displaying the vital parameters. The suggested BMS is implemented on a hardware platform using the Arduino environment, the proper sensing technology, a central processor, and interface devices.

1.Introduction

As the price of petrol rises, electric vehicles (EVs) are growing in popularity. This situation has prompted numerous automakers to search for other sources of petrol energy. Because they generate less pollution, using electrical energy sources can benefit the environment. EVs offer significant advantages for protecting the environment and maximising energy efficiency. Frequently, electric vehicles use rechargeable lithium-ion batteries. Compared to lead acid, it is smaller. In fact, it produces power consistently and has a 6−10 times longer energy life cycle than a lead–acid battery. The longevity of a lithium-ion battery can be decreased by some factors, including severe draining and overcharging. The size and shape of the battery and the body of the vehicle, on the other hand, frequently result in a limited operating range for electric vehicles (EVs). Currently, worries regarding the security of battery technology are severely restricting the adoption of EVs. For instance, overcharging a battery can lead to a significant drop in battery life as well as a severe safety risk like a fire. Therefore, in order to prevent the aforementioned issues, EVs must have a battery monitoring system that can inform the user of the battery state.

The previous battery monitoring system did nothing more than track and detect the battery's condition while alternating the user via the vehicle's battery indicator. This technique can notify both the manufacturer and the user about the battery status during the construction of the notification system. This may be regarded as one of the maintenance support services. A method the fabricator might employ. This study suggests constructing and implementing a battery monitoring system using an embedded system in light of the aforementioned issues.

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Despite the fact that they have not yet been fully implemented in EVs and HEVs, complex and sophisticated BMS are currently available in portable devices like laptops and mobile phones. A automobile battery has hundreds of times more cells than a battery for a portable electronic device, which explains why. The car battery is also made to be a strong, long-lasting energy source. To put it another way, EV and HEV batteries must deliver a significant amount of voltage and current. In light of this, BMSs for EVs are much more complex than those for portable devices.The fig 1 shows the Architecture of BMS is given below

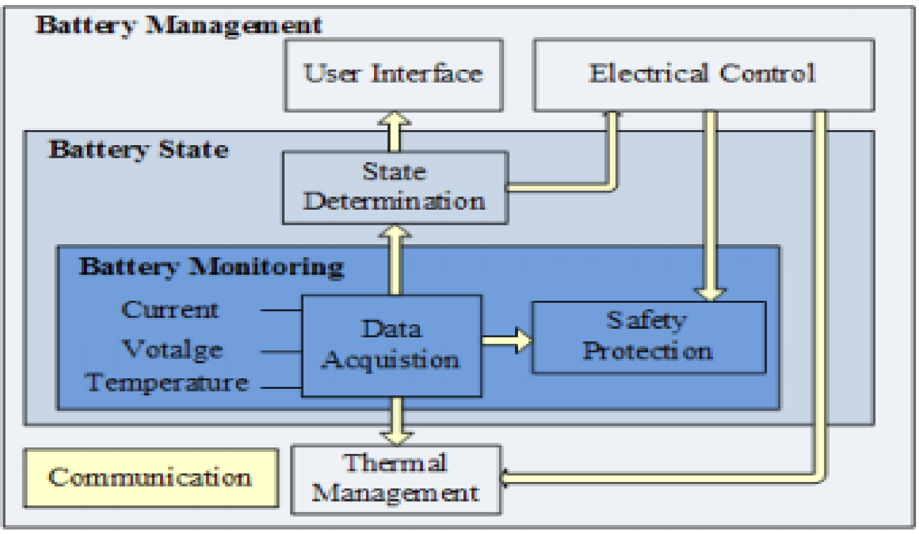

Fig. 1: Architecture of BMS

from the viewpoint of hardware organisation, three alternative topologies have been developed in bms, including centralised, distributed, and modular systems. However, bms operations are equivalent in any situation. A hierarchical structure for maintaining, monitoring, and managing battery health was presented by Meissner and Richter. Various BMS operations are categorized by money. The battery pack is equipped with numerous sensors that collect information about the monitoring layer. Real-time data collection is performed to maintain system safety and assess battery health. Charge times, discharge strategies, cell balancing, and cell-to-cell thermal management are determined by the battery state, which is also sent to the user interface.

The safety and effectiveness of the batteries in Electric Vehicles (EVs) are increased by thermal monitoring while they are charging. Due to the expense, deployment complexity, and/or safety considerations, which are addressed below, no thermal sensing technologies have been able to conduct temperature sensing for battery cells in the EV up until this point.

2.Methodology :

A microcontroller is an integrated circuit containing a complete microprocessor system. Microprocessors had to be built into low-cost products, leading to the development of microcontrollers. Since microprocessors are a reasonable choice for many product implementations, when an entire microprocessor system is placed on his single chip, the yield of basic products that rely on microprocessor performance is dramatically reduced. To do. As a result, the idea of using microprocessors in low-cost items is often brought up.Typical 8-bit microprocessor systems such as the Z80 and 8085 are expensive. Both the 8085 and Z80 require additional circuitry in order to be integrated into a microprocessor system. Each element has a price. Even if the product design may just call for a straightforward system, the components are necessary to make this system a low-cost item. A single-chip microcontroller is used in a microprocessor system as a solution to this issueDue to the fact that all required components are contained on an integrated circuit, it is sometimes referred to as a microcomputer. Due to the fact that they are used to control operations, they are more commonly referred to as microcontrollers. The fig 2 shows the basic block diagram of microcontroller is given below.

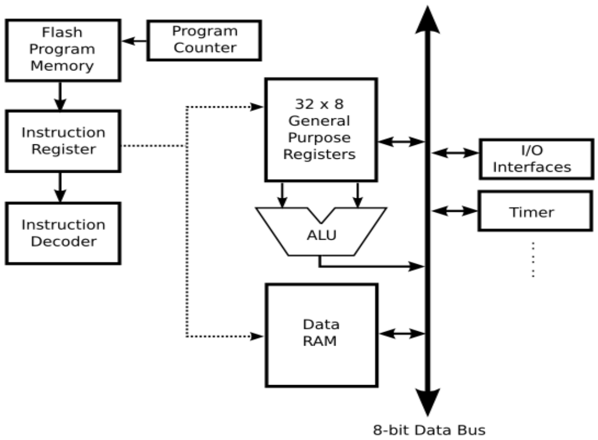

Fig. 2: Basic block of Microcontroller

The microcontroller has a full implementation of the standard MICRO PROCESSOR, ROM, RAM, I/0, CLOCK, TIMER, and SERIAL PORTS. Some other names for microcontrollers include "computers on a chip," "systems on a chip," and "single chip microprocessor systems." A microcontroller is a single-chip computer, also referred to as a computer-on-a-chip. The phrase "controller" notifies you that the gadget can direct objects, actions, or events. Micro signifies the device's diminutive size. Since a microcontroller frequently integrates with the devices it controls and the supporting circuitry it employs, it is also sometimes referred to as an embedded controller. Microcontrollers are widely used in a variety of smart products nowadays. For instance, a microcontroller is used to build the majority of personal computer keyboards. Circuitry for serial transfer, debounce, matrix decoding, and scan is completely replaced. A large variety of low-cost products, such as toys, electric drills, microwaves, VCRs, and many more consumer and commercial products, use microcontrollers.

3. Block diagram of battery management system :

This study describes how to use an embedded system to track the state of electric vehicle batteries. It is clear that the electric vehicle battery is the only source of energy.

However, the gradual reduction in power supplied to the vehicle degrades the performance of the vehicle. This is a serious problem in battery manufacturing. This study presents an idea for vehicle performance monitoring that enables direct monitoring using embedded system technology. The two main components of the proposed embedded battery monitoring system for Arduino are the monitoring device and the user interface. The system can detect low battery power, display the test results, and advise the user to take action via the LCD. The fig 3 shows block diagram of BMS is given below.

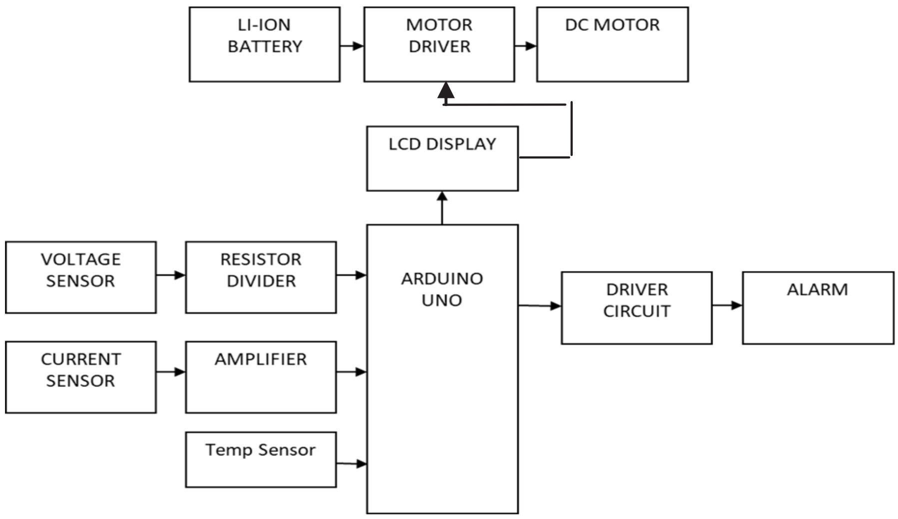

Fig. 3: Block diagram of BMS

4. Guidelines for Battery health monitoring system :

The main controller MCU of the Arduino UNO R3 is the ATmega328 microcontroller. The AVR series 8-bit ATmega328 MCU's internal register and data bus architecture is designed to support eight parallel data streams. The circuit consists of an Arduino Uno microcontroller, two sensors (MAX30100 and LM35), a 162 I2C LCD screen, and a Bluetooth module. 5V is supplied to the entire system. Connect a computer and a microcontroller (Arduino Uno) with a USB (Universal Serial Bus) connection and send commands from the computer to the microcontroller. An online circuit design tool was used to create the circuit. A design manual for the entire battery monitoring system. USB connections, Bluetooth module connections, sensor-based device connections, and other microcontroller connections are all shown. Additionally, data is received from both the mobile app and the Arduino IDE's serial monitor. The key parts of the circuit are the Arduino Uno and two sensors that can measure three different body parameters. The sensors, LCD screen, and microprocessor are all powered from the 5V power supply. To give instructions to the sensors, the microcontroller connects to the laptop using a

USB connection. A Bluetooth module is also provided to support mobile applications when reading data from the system.

ATmega328 has three types of memory:

•Flash memory: Non-volatile memory of 32 KB. Because of this, you don't need to upload your application every time you unplug the Arduino from the power source. This is used for saving programmes.
•SRAM memory: 2 KB of memory based on energy. used to store variables that applications use while they are operating.
•EEPROM memory: Non-volatile memory of 1 KB. Data that must remain accessible even after the board is turned off and back on can be stored in this way.

4.1 ACS712 Current Sensor:

Affordable options for AC or DC current sensing in commercial, industrial, and communication applications are provided by the Allegro ACS712. Utilising the technology is made simple for clients by the device packaging. Overcurrent fault protection, switching power supply, load monitoring and management, and motor control are examples of typical uses. The system consists of a precision, low-offset, linear Hall sensor circuit with a copper conductive channel close to the die surface. When rising current flows along the main copper conduction line, which is the path utilised for current sensing (from pins 1 and 2 to pins 3 and 4), the output of the device has a positive slope (>VIOUT (Q)). Low power is provided by the conductive channel's usual internal resistance, which is 1.2 m.

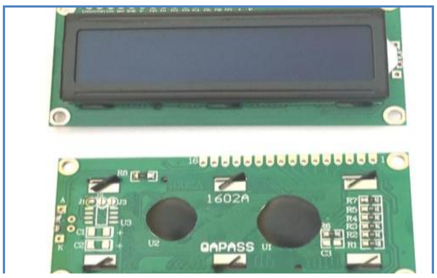

Fig. 4: LCD display

4.2 Battery :

A rechargeable battery, also known as a storage battery, is made up of a collection of one or more secondary cells. Electrochemical processes that are electrically reversible are used in rechargeable batteries. There are many different sizes and chemical compositions used in rechargeable batteries. Lead acid, nickel-cadmium (NiCd), nickel-metal hydride (NiMH), lithium, and lithium ion polymer are a few examples of secondary cell chemistries (sometimes referred to as "rechargeable batteries") that are frequently used.

4.3 Voltage divider :

.A voltage divider is a straightforward electrical circuit that uses just two resistors to efficiently split a higher voltage (Vin) into a lower voltage (Vout). The input voltage is divided by a ratio based on the values of two resistors (R1 and R2) to achieve this. Low current applications like sensor and data lines are where this circuit excels. The output voltage will change if too much current is pulled from Vout. As a result, applications that require a lot of current, like power supply, shouldn't use this.(voltageregulators are a much better choice).The fig 6 shows the voltage divider is given below

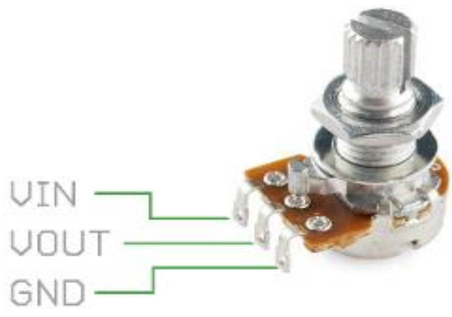

Fig.6:Voltagedivider

5. Result and discussions:

Battery aging is affected by charge and discharge cycles, atmosphere, and certain materials. Analyze the state of the battery before discharging at constant temperature and current flow. Here we present some experimental data for lithium-ion batteries at different temperatures and discharge rates. Lithium-ion is the most efficient, lightest, and most reactive type of battery. Lithium-ion batteries charge and discharge faster than conventional batteries. To prevent a chain reaction of multiple chemical reactions, lithium-ion batteries must be operated outside of their safe operating voltage range. Cells can vent and start a fire as a result of increased temperature. As a result, the battery can operate within its safe zone thanks to the battery management system or his BMS.

The fig 7 shows the Hardware implementation of our desired project is given below

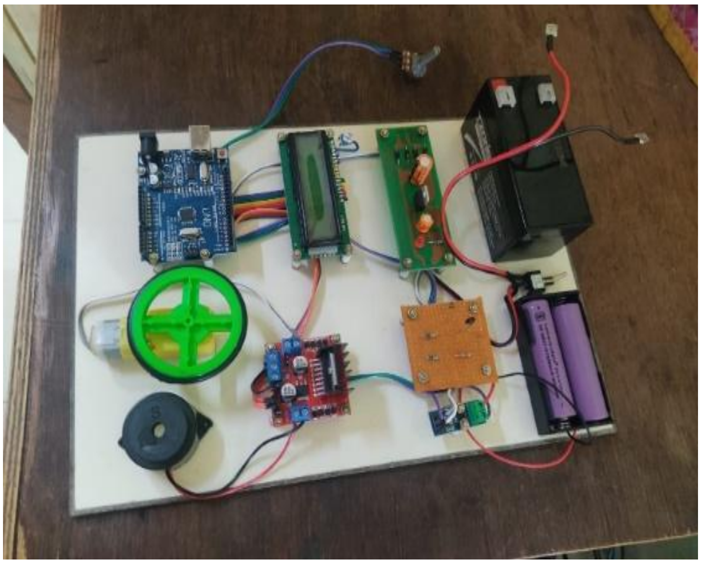

Fig. 7: Hardware implementation

The fig 8 and fig 9 shows the Results for our hardware implementation is shown below

Fig. 8: Displaying parameters

Fig. 9: Fail State of Motor condition

6. Conclusion

The development of an embedded battery monitoring system for electric vehicles was covered in this project. This will enable online monitoring of battery performance degradation. The process of system development entails creating the embedded user interface and hardware for the battery monitoring. By using sensors and LCS, the system can identify coordinates and display them in the Google Maps app, as well as display information like location, battery life, and time. By creating a smartphone application that assists users in keeping track of their battery, the system will eventually be accessible on cell phones.

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