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Development of Protection Circuit for EV Batteries

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ABSTRACT
Transportation is the key for development of any country in the world. At present we majorly depend on the fuel driven IC engines for transportation. Fuel based vehicles causes severe pollution to the environment so we are moving towards Electric vehicles. But during these days the burning of EV's is the major setback for the transition from IC engine to Electric motor. So, in this project we designed a circuit to protect the EV battery under abnormal conditions like heating and overcurrent. In order to gain optimum battery performance, the ideal operating temperature range of the Li-ion battery should be 20-45 ℃ . The electric vehicles are powered by lithium-ion battery throughout the world. Compared with other types of fuel vehicles, lithium-ion battery electric vehicles have the great advantages of no vibration, no noise and no pollution. However, Li-ion batteries generate a vast amount of heat when they are operated, resulting in an increase in the temperature of the battery. It is not safe to operate the vehicles when the temperature of the battery is high. The protection circuit for isolating the battery is very important for the safe and reliable operation of the electric vehicle. By using the LM35 sensor and the PIC microcontroller we can detect the temperature of the batteries using relays we can break the circuit under abnormal conditions. Also, the problem of overcurrent needs to be addressed by using the shunt resistors. The purpose of shunt resistor is to measure the current flowing through the circuit. The protection circuit will detect the overcurrent and measure the temperature and if any one parameter increases the maximum value, then microcontroller will indicate the relay to close the circuit. So, with the help of this circuit, we can protect the EV batteries.
Keywords—Cylinder block, V8 engine, design, analysis

1. Introduction

At present we majorly depend on the fuel driven IC engines for transportation. Fuel based vehicles causes severe pollution to the environment so we are moving towards Electric vehicles. But during these days the burning of EV's is the major setback for the transition from IC engine to Electric motor. So, in this project we designed a circuit to protect the EV battery under abnormal conditions like heating and overcurrent. Three categories of BMS exist: centralised, distributed, and modular BMS. Each battery cell in a centralised BMS is connected to and managed by a solitary microprocessor. A distributed BMS, on the other hand, is made up of several slave modules and one master controller. Only slave modules in this topology have a direct connection to a single battery cell for the purpose of performing cell monitoring. Modular BMS is a combination of centralised and distributed BMS. A number of modules are interconnected in this topology. Each module has direct connections to many battery cells.

2. Experimental Methods or Methodology

Li-ion batteries generate a vast amount of heat when they are operated, resulting in an increase in the temperature of the battery. It is not safe to operate the vehicles when the temperature of the battery is high. The protection circuit for isolating the battery is very important for the safe and reliable

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operation of the electric vehicle. Using the microcontroller PIC16F877A we are designing a protection circuit, which detects the temperature and measures the current using NTC temperature sensor and shall effect sensor. When the value of the current and temperature reaches the maximum then relay will break the circuit and protects from the risk of getting burnt. Relay to turn off the vehicle.

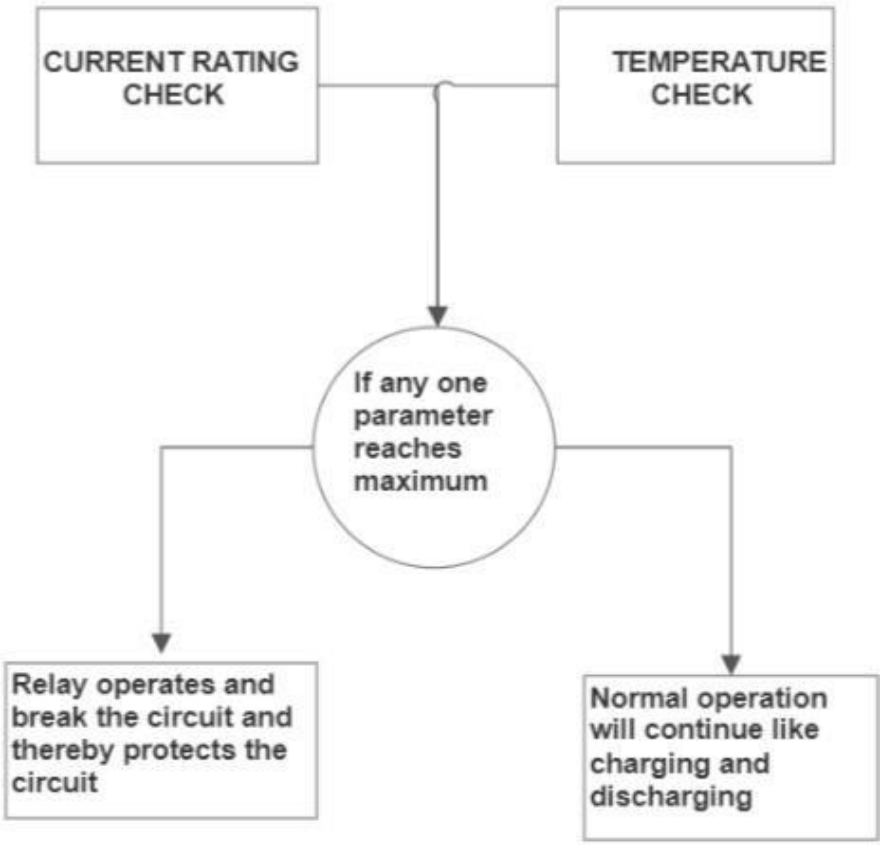

Fig 1. Flow of operation of protection circuit

Higher operating temperatures have a negative effect on battery performance as well as quick capability fading and ageing. Similar to how conductor material activity declines, the rate at which lithium-ion diffuses into the solution and, consequently, the conductor material, so does battery performance. Another important operational metric is temperature distribution, which is not uniform throughout a battery or pack. This metric can lead to chemical chemistry imbalance over time, accelerate capacity loss, and premature ageing.

A whole power management system IC with full integration, high-precision and high-reliability for battery pack which might monitor and defend the system is demonstrated, achieving lower application costs. The IC protects the battery from over-voltage, over-current and overtemperature once charging and discharging with 0.5 mV discrimination accuracy.

3. Components used:

PIC MICRO-CONTROLLER

A PIC microcontroller is the PIC16F877A. It uses FLASH memory technology, allowing for unlimited write-erase cycles. There are 33 input and output pins out of a total of 40 pins on it. Numerous applications with pic microcontrollers use the PIC16F877A. Applications for the PIC16F877a can be found in a plethora of gadgets. It is utilised in various industrial instruments as well as remote sensors, security and safety equipment, and home automation

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systems. It also has an EEPROM, which enables the permanent storage of some data including transmitter codes, reception frequencies, and some other relevant data. This controller is inexpensive, and using it is simple. It is adaptable and can be used in applications for microprocessors, timer functions, and other things where microcontrollers have never been utilised before.

TEMPERATURE SENSOR

The LM35 temperature sensor measures a known temperature measurement using the fundamental principles of a diode. As we all know from semiconductor physics, the voltage across a diode grows at a known rate as the temperature rises. The main benefit of the LM35 is that it is linear (10mv/°C), meaning that its output will increase by 10mv for every degree that the temperature rises. Thus, the temperature will be 22°C if the LM35's output is 220mv/0.22V. So, if the ambient temperature is 32 °C, the LM35's output will be 320 mV, or 0.32 V.

SHUNT RESISTOR

Shunt resistors, also known as current sense resistors, are instruments used to measure the flow of current. They pick up current and transform it into a measured output voltage. Typically, low-value, high-power resistors are used as current sensing resistors. They are made with low resistance to reduce power consumption and the chance of short circuits, which could harm other parts. A sensor circuit can measure the amperes given to a load in real time thanks to Ohm's Law's proportional link between voltage and current. This simple and affordable way of measuring current flow is employed to minimize the consequences of overloads or short circuits and to increase the effectiveness of electrical systems.

LCD DISPLAY

There are several uses for LCD (Liquid Crystal Display) screens, which are electrical display modules. A 16x2 LCD display is a very fundamental module that is frequently included into many different devices and circuits. With a 16x2 LCD, there are 2 lines that can each display 16 characters. Each character on this LCD is presented using a 5x7 pixel matrix. The 224 different characters and symbols that can be displayed on the 16 x 2 intelligent alphanumeric dot matrix display. The Command and Data registers on this LCD are its two registers.

POWER SUPPLY

A lithium-ion battery is a type of reversible battery that is frequently used in laptops and mobile devices. Lithium ions go from the negative conductor through a solution to the positive electrode to create electricity. An intelligent component of a battery pack responsible for sophisticated observation and administration is called a battery Management System (BMS). It controls the battery's levels of safety, performance, charge rates, and longevity. It is the brain of the battery.

RELAY

One type of electro-mechanical component that serves as a switch is called relay. In order to open or close contact switches, DC is used to energise the relay coil. A coil and two contacts, such as ordinarily open (NO) and usually closed (NC), are often found in a single channel 5V relay module (NC). This article gives a general overview of the 5V relay module and how it operates, but first we need to understand what a relay is and how its pins are configured.

3. Results and Discussion

3.1 Proteus Simulation

The outline of previous battery abuse experiments with overheating, overcharging and nail penetration all indicated the presence of dioxide within the vent-gas. At identical time, CO, H2 and VOCs were found in several batteries abuse experiments, however lacked consistency across completely different testing conditions. Considering the early presence in first emanation, sensible consistency, ability to notice cell outflow and detector feasibility, CO2 was hand-picked because the indicator for gas venting events.

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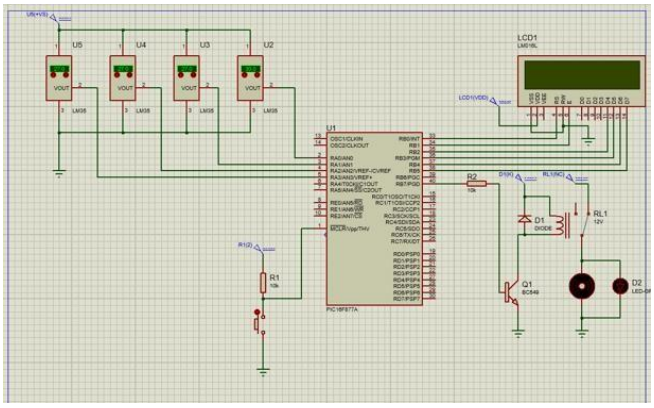

Fig. 2. Proteus simulation

CONCLUSION

The ultimate goal in creating these hardware modules is to provide a simple means of defence. We made an effort to create these hardware modules in order to meet nearly all of the platform-specific requirements, including: Flexible, user-friendly, interactive, and utilising the most recent technology. Even with this functionality, the platform still has a tone of potential, therefore work on it will go on.

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