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Development of Battery Management System in Electric Vehicles Fire Protection and Charger Monitor

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ABSTRACT:

The Main objective of this project is to detect the any abnormal fault in the lithium-ion battery. The purpose of our research is to use ATmega328P and sensors like smoke sensor, temperature sensor to monitor the parameters like temperature, leak gases in surrounding of Lithium-ion battery of Electric vehicle. And protect it from unwanted situations occur during charging and discharging also with the help of solenoid valve, the condition of hazardous fire can be stopped. The electric vehicle uses an electric traction motor for propulsion. They can also run on power from off-board sources via a collector system, or contain batteries, solar panels, or generators that convert fuel to electricity. Electric vehicles are certainly the future of transportation, but EV technology is not yet fully developed in terms of efficiency and safety as of 2022. As the EV market expands, accidents such as EV battery fires occur one after another. So I'm trying to solve this problem using some sensors and a battery based system with an AT Mega 328 controller. This system is designed to protect the battery from a variety of fire hazards.[1]

Keywords: : Electric vehicle (EV), 12V DC motor, Temperature sensor, Atmega 328p microcontroller, Voltage Sensor,5V channel Relay, LCD display, Fan

Introduction:

Nowadays, electric vehicle (EV) is becoming popular since the fuel prices becoming more expensive. Due to these scenario, many vehicle manufacturer looking for alternatives of energy sources other than gas. The use of electrical energy sources may improve the environment since there are less pollution. In addition, EV produces great advantages in terms of energy saving and environmental protection. Most EVs used rechargeable battery which is lithium ion battery. It is smaller to be compared with lead acid. In fact, it has a constant power, and energy's life cycle is 6 to 10 times greater compared with lead acid battery. Lithium ion battery life cycle can be shortened by some reasons such as overcharging and deep discharges. On the other hand, EV usually has limited range of travelling due to battery size and body structure. Now, an important reason that limits the application of EV is the safety of existing battery technology . For example, overcharging battery not only could significantly shorten the life of the battery, but also cause a serious safety accidents such as fire .Therefore, a battery monitoring system for EV that can notify the user about battery condition is necessary to prevent the stated problems.[2] Electric vehicles (EV) are playing a key role because of its zero-emission of harmful gases and use of efficient energy. Electric vehicles are equipped by a large number of battery cells which require a effective battery management system (BMS) while they are providing necessary power. The battery installed in a electric vehicle should not only provide long lasting energy but also provide high power. Lead-acid, Lithium-ion, -metal hydride are the most commonly used traction batteries, of all these traction batteries lithium-ion is most commonly used because of its advantages and its performance. The battery capacity range for a electric vehicle is about 30 to 100 KWH or more.Battery management system (BMS) makes decisions based on the battery charging and discharging rates, state of charge estimation, state of health estimation, cell voltage, temperature, current etc.[3]

Objectives:

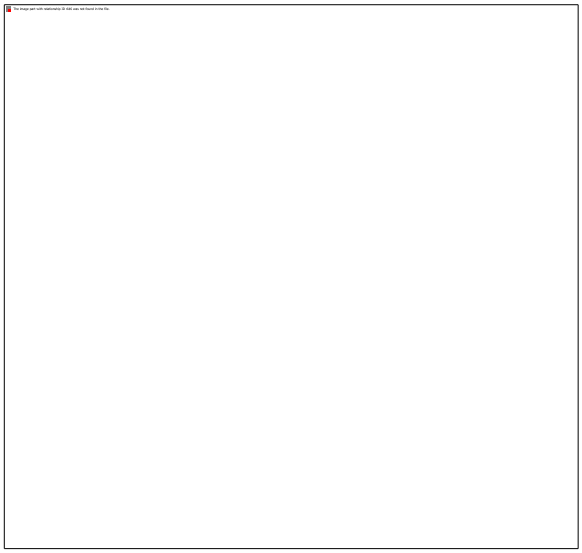
• To eliminate the use of cable in the charging process thus making it simpler and easier tocharge the battery of an electric vehicle.

• As different charging ports are available for different models it is difficult to find thespecific charging station, but WPT allows to reduce the human effort.

• Battery Monitoring System using conventional technique/ optimization technique.

• The main function of Battery Management System (BMS) is to ensure that the battery isprotected and any operation out of its safety limit is prevented.[4]

Diagram Block diagram of EV BMS with charger monitor and fire protection



Components used:

Power supply Circuit

Power supply could be a relation to a source of electric power. a tool or system that supplies electrical or other kinds of energy to an output load or group of loads . during this project, a +5 V DC regulated power supply comes from the facility supply unit designed and implemented. The Figure shows the circuit diagram designed to urge the +5 V DC regulated power supply for the project. A rectifier could be a device that has two or more diodes arranged in order that load current flows within the same direction during each half cycle of the ac supply.

Step Down Transformer

When AC is applied to the ability transformer's first winding, it can be stepped down or up depending on the amount of DC required. In our circuit, a 230v/12-0-12v transformer is used to execute the step-down operation, converting 230 V AC to 12 V AC across the coil. The transformer is positive at the top and negative at the bottom. The transformer used in the project has a 0.5 A rating. It provides isolation between the facility source and electronic circuitries by scaling down the AC voltage.

Rectifier Unit

One half-cycle at a time, the operation of this circuit is clearly understood. Consider the primary half-cycle, which has positive (+) on top and negative (-) on bottomvoltage polarity. Only the top diode is conducting at this time; the bottom diode is obstructing current, so the load only sees the principal 1/2 of the wave, which is positive on top and negative on bottom. During this half-cycle, only the upper 1/2 of the transformer's secondary coil transmits current, as shown in Figure.

Rectifier With Full-Wave Center-TAP

During the positive half-cycle of input, the top half secondary conducts, delivering the positive half-cycle to the load. The AC polarity reverses on the next half-cycle. The opposite diode, and therefore the transformer's coil's partner, now carry current, while the components of the circuit that carried current during the previous half-cycle now remain idle.

Filtering Unit

The rectifier unit is always followed by a filter circuit, which is commonly a capacitor acting as a surge arrester. This capacitor, also known as a bypassing capacitor or a decoupling capacitor, is used to 'short' the ripple with a frequency of 120Hz to ground as well as to leave the DC frequency to look at the output.

Regulators of Voltage

Voltage regulators are essential components of any power supply unit. A regulator's primary function is to assist the rectifier and filter circuit in maintaining a constant DC voltage for the device. Because of variations in the load or fluctuations in the AC liner voltage, power supplies without regulators have an inherent challenge of correcting DC voltage values. The voltage is frequently maintained within a specific tolerable area of the specified output when a regulator is attached to the DC output. The IC7805 is used to provide a+5v DC regulated supply in this project.

ArduinoUNO: The Arduino Uno has a set of analogue and digital pins that serve as input and output points for connecting the board to external components. Inboard, there are a total of fourteen I/O pins, six of which are analogue input pins. The board contains a USB port that can be used to connect to a power supply.

LCD Display The 162 LCD gets its name from the fact that it contains 16 columns and 2 rows. There are many different combinations available, such as 81, 82, 102, 161, and so on, but the 162 LCD is the most popular. As a result, it will have a total of (162=32) 32 characters, with each character consisting of 588 Pixel Dots.

Relay Coil

Relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof.

Current Sensor

A current sensor is a device that detects and converts current to an easily measurable output voltage, which is proportional to the current through the measured path. There are a wide variety of sensors, and each sensor is suitable for a specific current range and environmental condition.

Arduino IDE

Arduino IDE (Integrated Development Environment) is programming prototype which can let the user to draft various

kind of programs and load them into the Arduino microcontroller. We can also be programmed by using other IDEs too, like Eclipse. Arduino IDE is more versatile. This Arduino IDE needs no special drivers or additional components. This is available for Windows, Linux and Mac. Cross compiler compiles for a different target platform than the one being programmed.[5]

Working of the project:

The system makes use of a li ion Battery, Battery charging and monitors system, Push Buttons, LCD Display, voltage sensor, and temperature sensor to develop this system. The system monitors as well as protects an EV battery at all times. We here develop the system as per a 3S li ion battery. The system we design will not only monitor the battery and charge it safely but also protect it to avoid accidents from occurring. The system when turned on uses its charging and monitoring circuitry that allows user to safety charge the 3S battery. While charging the voltage sensor is used to check voltage and limit the flow of current too to the battery using charging circuitry. The LCD display also displays the current voltage level of battery. As soon as the battery is fully charged, the system cuts off the supply and displays Battery fully charged on LCD Display. When connected to a load the current sensor keeps track of current drawn from battery and displays the parameter on LCD Display. The temperature sensor is used to monitor temperature of battery while charging as well as discharging. If the battery temperature is observed to deviate from standard values, the system automatically cuts off input as well as output supply and displays the temperature as well as a buzzer alert on the LCD display. Thus the system allows for a smart and efficient battery charging as well as protection system.

The module consists of Voltage Monitoring devices, Live Location Tracking, Temperature Monitoring System, Fire Detector, Ultrasonic Sensor & Data Reading System. All these systems are interconnected and accessed using IOT Technology.

• The BMS monitors the charging and discharging of the battery, to maintain the health of the battery

. • BMS uses data points such as temperature, voltage, and current to estimate the charge of the battery.

• All the control units in the microcontroller, access the data points and send the data through a Wi-Fi module.

• The real-time data is received by the BLYNK application by the user.

• If in case, the temperature, voltage and current data points cross beyond the limit, then the user is notified by the buzzer. The system has an IOT-based electrical vehicle battery monitoring system to ensure that the battery state can be tracked online. The system consists of the development of hardware for monitoring the battery. The system is capable to show information such as battery condition, temperature, location via sensors incorporated. The smartphone application shows the remainder of the battery degradation state to the user.[6]

Role of BMS in the Performance of Electric Vehicles

The BMS provides individual control of the voltage and resistance of each cell, determines the loss of capacity due to imbalance, and ensures safe connection/disconnection of the load.

The functionality of BMS improves the operating mode and service life of EV batteries.

The BMS monitors and regulates the safety circuitry of the electric vehicle. When problematic conditions such as overvoltage or overheating are detected, the BMS alerts the user and initiates the predetermined corrective procedure. In addition to these activities, the BMS monitors electric vehicle temperature to optimize energy use and communicates with specific components and operators.Without a BMS, an electric vehicle's energy management will be

unpredictable, leaving it vulnerable to various safety hazards that could result in catastrophic failures such as a short circuit or thermal meltdown of the battery. Therefore, the BMS is vital for an electric vehicle's safety and efficient power management.[7]

Advantages:

A Battery Management System, or BMS, is a device that helps to improve the overall performance of your EV battery. Here are some benefits of having a BMS:

Enhanced Battery Performance – By monitoring and managing the charging and discharge of your battery, a BMS can help to optimize its performance. This can lead to increased range and efficiency, as well as longer battery life.

Safety – One of the most important functions of a BMS is to protect your battery from overcharging or over-discharging. This can help to prevent damage to the battery, and in some cases, fires.

Convenience – A BMS can automate many of the tasks associated with maintaining your EV battery, such as equalizing charges and balancing cells. This can save you time and hassle, and allow you to focus on enjoying your EV.[8]

Applications:

Conventional Battery Management

Generator Current Monitoring

Battery Management For Hybrid And Ev Markets

Grid Power Infrastructure

Result and Conclusion:

We convert normal vehicles into the electrical vehicle because it is pollution-free and it has a low running cost as compared to other types of vehicle. By using a battery management system, we improve the efficiency of the battery. In the battery management system, we combine 2 batteries and form a new battery for the vehicles. The advanced battery management system can significantly improve the performance of the electric vehicle. The battery management system is a critical component of electric vehicles that promotes guaranteed safety, efficiency, and reliable battery operation. Also, they provide solutions for inclination, Power, and heating problems for electric vehicles.[11]

Future Scope:

In future the electric vehicle batteries will be made less complicated and easy to charge as well as easy to use. The BMS is improving slowly and steadily which will save energy and accelerate the performance. There is a need for government support in adopting electric vehicles. The work of battery management engineers is to develop a BMS that will maintain/manage the lithium-ion batteries in the electric vehicle. The demand for electric vehicles is increasing day by day, and lithium-ion cells are utilized to power the electric vehicle motor. Soon in 2030, all petrol and diesel engine vehicles will disappear, and people will start using electric vehicles because it has lots of advantages compared to diesel and petrol engines such as no pollution, low noise, no fuel consumption, etc. And also the demand for lithium batteries will increase. But to maintain a lithium-ion battery pack in EV, battery management engineers are required to design proper BMS.[13]

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