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IOT Based Battery Management System for Electric Vehicle

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Abstract

This paper gives an overview of the implementation of a battery monitoring system on a hardware platform using appropriate sensing technology, central processor and interfacing devices. A complete wireless thermal monitoring system for electric vehicle battery charging is presented. It also includes real time battery temperature monitoring during charging for an accurate state of charge. More importantly, aged batteries will be heated up rapidly during charging; the solution is not only to build the necessary infrastructure but also to be able to correctly estimate the remaining power using an efficient battery management system.

Keywords*: - Battery monitoring system (BMS), State of charge (SOC), State of health (SOH).*

INTRODUCTION

The battery is the major component for any device as it provides power for the entire system [1]. It is essential to keep on monitoring the battery as the unusual state may lead to safety issues [2]. Due to design defects, there may be a failure of the battery; hence remotely battery monitor system is in need using wireless communication [2]. Li-ion battery is responsive to overcharge and deep discharge, which may harm the battery and condense the life. The proper battery monitoring system installed in the vehicle helps in keep track of the operating range [1].

An electronic system that manages a rechargeable battery, such as by protecting the battery from operating beyond its safe

operating area, monitoring its state, calculating secondary data, monitoring its environment, authenticating and balancing it, is a battery management system [2]. Another important function of a battery monitoring system is to extend the battery life by facing the charge capacity of the battery [3]. The performance of the battery when connected to a charge or source is based on the chemical reactions within the battery. There will be a gradual reduction in the energy storage capacity of the battery that is represented as the chemicals breakdown with period and use [3]. By charging and discharging profile control even under various load conditions, the battery depreciation process is reduced by conditioning the battery in a suitable manner. State of Charge (SOC) is the significant parameter needed to ensure stable charging and discharging. SOC is defined as the battery's current capacity expressed in terms of its rated capacity [3].

Electrification of the vehicle is the most available way of achieving safe and effective transport for sustainable development around the world [2]. This can be achieved through IoT, which refers to the networked interconnection of everyday objects, and it has a major role in the rapid development of the smart grid [1]. It is the thing that signifies the network-based interconnection of daily usage chores and helps to achieve the communication between man and machine or a machine to machine [4]. There are four features in IoT, gathering of data, bilateral communication, handling and response control. Innovations in battery technology have been the key motivation for distributed storage systems. With the recent advances in battery technology [5], the autonomy of electric vehicles has increased to well over 300kms, and it will probably continue to increase over the next few years [1].

With the increase in global warming, there is a demand for environmentally friendly clean fuel; hence there is a shift towards electric vehicles [7]. Electric vehicles are booming technology nowadays with an increase in fuel price. Therefore, these electric batteries are less harmful and can be monitored continuously to prolong the battery life [8]. Every electric vehicle has a Battery management system to monitor the properties like voltage level, current, temperature for safer handling of battery [10]. In [7], GSM can monitor and control batteries giving high-end information on voltage, state of charge and temperature.

As there is a greater demand for industrial purpose electric power and for its smooth

operation in many transportation vehicles (EVs) and uninterruptible power supply (UPS) system that is used in heavy industries and there is a necessity of monitoring the battery level using current sensor and voltage sensor [11] [9]. Thus, the necessity of monitoring the battery level using IoT based on a wireless battery monitoring system can be seen [9] [10] [8].

As there is an increasing gain of interest in the large-scale battery storage systems and management in EVs can be seen of using cloud-based battery condition monitoring [12] [10]. In [10], for the better management of EVs and better electrical characteristics, there is a networked interconnection of the smart grid, which implements the effective utility of electric power in upcoming years. In [12], a voltage sensor is used to monitor the battery level along with an Arduino microcontroller, which verifies the battery condition with the help of source code. If the battery voltage is greater than the threshold, the battery voltage level will proceed to be read. If the battery voltage is low, a notification email is sent to the administrator through the GPS module. In [12], IoT based battery monitoring system is developed where along with charging and discharging status, an alert email has been received about battery status. The main purpose of this paper is to describe the issue of overcharging and deep discharge of the battery, which shortens the life cycle of rechargeable batteries. There are limitations to electric vehicles due to safety concerns existing in the battery. For example, overcharging may cause leakage of gases or fire. A properly designed real-time battery management system is required for battery health monitoring and to ensure safety, reliability, optimal performance and cost-effectiveness [2]. Estimation of charge increases the lifespan and provides protection to the equipment they power. The use of rechargeable batteries reduces the dependency on other fuels, which in turn reduces global warming [6].

PROPOSED SYSTEM OVERVIEW

The module consists of a voltage monitoring system, live location tracking, temperature monitoring system, fire detector, ultrasonic sensor and data reading system. All these systems are interconnected and accessed using IoT technology. All the real-time data can be accessed through the BLYNK application. In order to develop the working module, Node MCU, L293D motor driver, ultrasonic sensor, fire sensor GPS, buzzer and battery are used.

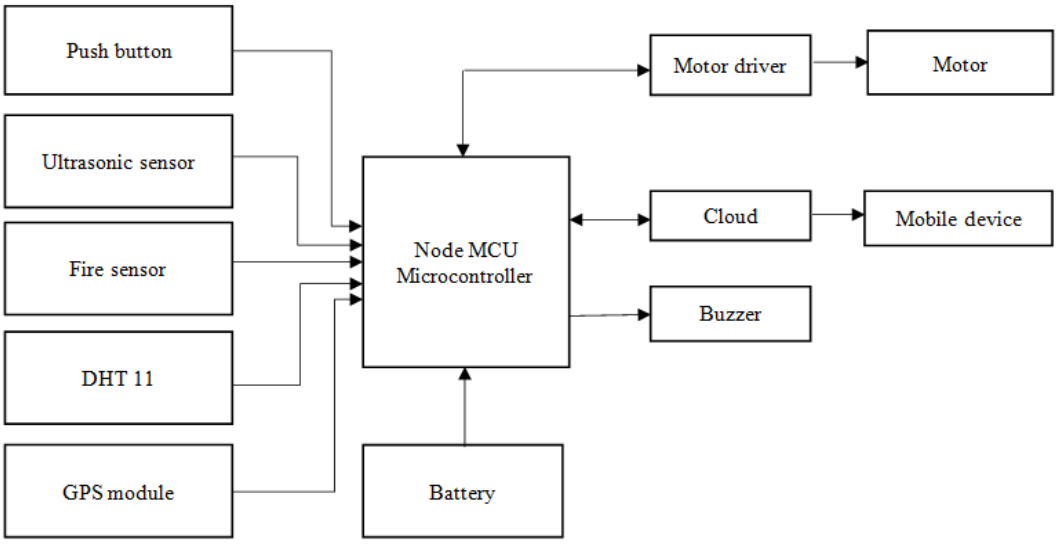

Figure 1

Node MCU is hardware and development board focused on open source Lua, specially intended for IoT based implementations. It's a microcontroller that is connected to other parts of the device to control the actions and gives digital output for the analog input taken. L293 motor driver is used to drive motor using which speed and direction control is possible. This driver is advantageous in automatic thermal shutdown. The whole module has its supply from the battery. The module has ultrasonic sensor for distance measurement and sensing objects by transmitting an ultrasonic waves. By knowing the speed and time, distance can be calculated. DHT11 is a composite temperature and humidity sensor which gives a digital output of temperature and humidity. The GPS module is used for map reading; it checks the location on earth and gives output data by analyzing the form of longitude and latitude of the position. The fire sensor detects the smoke and infrared radiation in the surrounding environment and gives the alarms as an indication of fire.

WORKING PRINCIPLE

The battery's power is degraded by overcharging as well as deep discharging, thereby reducing its existence. The battery control device decides at the time of charging how much current can go in safely and communicates the same to the charger. The battery management device can communicate with the motor controller during the discharge of the battery to prevent cell voltages from reaching too low. The microcontroller reads the sensor value, and standardizes it into sensible data and it will be sent through a wireless medium. The battery management system uses the data points obtained, such as

temperature, voltage, current, to estimate the battery's charge status and health status. State of Charge (SOC) refers to the energy remaining in the battery, which specifies how far the car can go before it needs to be recharged. The state of health (SOH) tests the battery's present condition relative to its original capacity and demonstrates the suitability of the battery. In order to ensure the smooth operation of the engine, the control units in the battery transmit the required data concerning the battery parameters to the motor controller. The voltage sensor will be monitoring the battery performance and sends the data to the user in the form of digital value. In the same way, both temperature and fire sensor data too can be displayed. If there is any change in the values beyond the limit, then the buzzer gives an alarm as a notification to the user. The location will be shown in the form of a map on the mobile device for easier identification. The GPS tracking system is based on the global navigation satellite system network. This network involves a number of satellites that use microwave signals sent to GPS devices to provide position information. A GPS tracking system can thus provide real-time data.

CONCLUSION

The paper addressed the design and implementation of an IoT-based electrical vehicle battery monitoring system to ensure that the battery output can be tracked online. The purpose is to demonstrate that the concept of the idea can be realized. Device architecture consists of the development of hardware for the Battery Monitoring Unit and the application-based Battery Control User Interface. The device is capable of displaying details such as the battery condition and the GPS system to identify and show the coordinates on the application.

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