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Article Title: IoT Based EV Battery Parameters Monitoring System

IoT Based EV Battery Parameters Monitoring System

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ABSTRACT

Nowadays fuel prices are rising, electric vehicles (EV) are growing in popularity. A number of automakers are looking for alternative fuel sources as a result of these situations. The environment may gain from the use of electrical energy sources since there is less pollution. EV also provides excellent environmental and energy saving advantages. It is obvious that a battery is the only source of electricity for an electric car. The performance of electric car batteries is tracked through Internet of Things (IoT). This study suggests an IoT based method for tracking EV battery characteristics. Electric car batteries have a monitoring and control system that measures their voltage, current and temperature. The sensors, microprocessor, Wi-Fi module and batteries are the components of this system. It is built using the affordable ATMEGA 328 microcontroller (Arduino UNO). The battery data is delivered through Wi-Fi connectivity to the blynk application when the microcontroller receives data on voltage, current and temperature. It is suggested that the parameters of the vehicle be monitored immediately using a Blynk app.

Keywords: Internet of Things (IoT), Arduino, Battery Monitoring, EV battery, Wi-Fi module

1 Introduction

Electric vehicles (EVs) have a significant impact on development of sustainable transportation. The EV charging procedure exemplifies the information and communication technology (ICT) field's quick development. Vehicle to sensor, vehicle to vehicle and vehicle to internet regimes are now feasible thanks to the assistance of wireless communication between EVs. EVs now have a limited market penetration due to charging process restrictions, such as the length of the charging time and the accessibility of charging stations [1]. To provide a more potent centralised control technique for the IoT that focuses on EV unpredictability and is based on real-time network efficiency [2] and addresses the four objectives of neutral current, voltage unbalance, node voltage and energy loss to limit network imbalance. Two advantages of the method are quick convergence and little communication. As a result of the central agent, there is only a partial dispersal of strategy, which could result in single point failure. The simulation outcomes also verify the usefulness of the suggested algorithm. The proposed integrated scheduling technique performs better than the individual scheduling solutions [3]. The problem is reduced to an analytical relationship between the terminal state and a few parameters, which has the advantage of allowing for speedy calculations. One issue is that slope changes and speed limits frequently not coincide and the grade of the slope is the same prior to and following the speed limit change [4]. It is required to collect and process EV parameters using sensors and devices in order to create the optimum charging plan for each EV and maximise the profit for stakeholders while taking user preferences and grid requirements into account. A suitable system architecture can make use of cloud services and IoT concepts for inter-device communications [5]. The effectiveness of the suggested wheel slip control techniques are not significantly impacted by vehicle mass or driving resistance, which explains why the strategy is appropriate for transporting vehicles in an aeroplane. Through simulation using the one wheel model, this benefit is demonstrated. HIL simulations shown how highly practical it is to execute the suggested technique on actual cars. The drawback is that it is difficult to calculate velocity when all four wheels are being driven [6]. A central controller regulates the rate of EV charging or discharging or disconnects EVs in order to accomplish the desired aim, depending on the network's limits. Although the network's constraints and performance are well maintained, concerns regarding the increasingly intricate, complex communication infrastructures and rising data processing costs arise as the number of EV participants rises [7]. The benefits of torque vectoring in an autonomous electric car, whether it is integrated into the route tracking controller or used independently of the steering controller for path tracking. Path tracking controllers benefit from attaining the fastest entry speed thanks to road previewing data and a shared reference path. The car's performance has increased. The drawbacks of integrated solutions include a fact that they frequently result in a wide range of behaviour when systems operate at different friction coefficients [8]. Torque vectoring has improved passing speed and improved tracking precision as its two key advantages. The errors include forgetting to expressly limit the vehicle's yaw rate and sideslip angle in order to achieve yaw stability [9] as well as forgetting to record reference yaw rate and sideslip angle with reference path. The advantages include increased lateral stability of vehicle. Reducing number of fatalities caused by auto accidents. The communication network's bandwidth restriction causes considerable network-induced time delays within the system. The proposed control system surpasses the original optimal LQR controller approaches in addressing network induced time delays in simulation and Hardware in a Loop (HIL) investigations [10].

An IoT based method for tracking the parameters of EV batteries is suggested in this paper. The Arduino the microcontroller, a pack of batteries, a relay that controls a load, a node MCU and sensors for temperature, current and voltage comprise the system. The method suggested

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for this system determines a real time reading of the battery's voltage, current and temperature. Wi-Fi module and a microcontroller based system are utilised to monitor these battery metrics. The voltage sensor is used to continuously check battery voltage, while the current sensor tracks the amount of current flowing to the load.

2 Proposed Methodology

Many automakers are looking for alternatives to petrol. The ecology may gain from the use of electrical energy sources since there is less pollution. Furthermore, there are significant benefits to EVs in terms of energy efficiency and environmental protection. Most EVs use lithium ion batteries, which can be recharged. It is smaller compared to lead acid. It actually has a life cycle that is 6 to 10 times longer than that of a lead acid battery and offers continuous power. Overcharging and deep discharges are two factors that could reduce the lifespan of lithium ion batteries. However, the range of an EV is typically constrained.

2.1 Proposed system

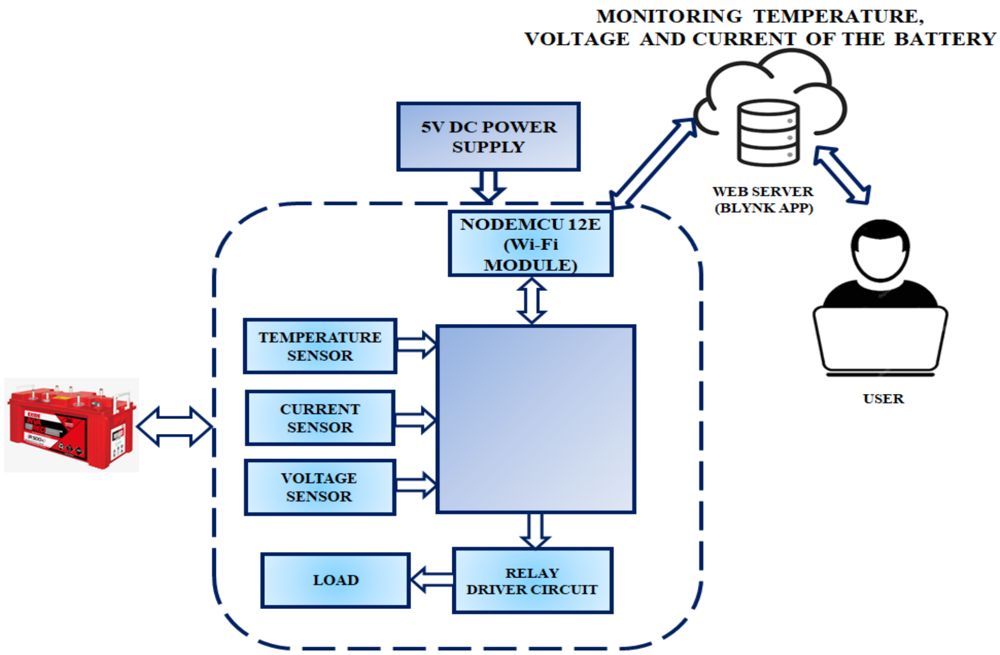

Figure 1: *Block Diagram of Proposed System*

An IoT based system for tracking EV battery characteristics is suggested in this paper. The Arduino microcontroller, a battery, a relay, a load, a node MCU and sensors for temperature, current and voltage make up the system. The method suggested for this system determines a real time reading of the battery's voltage, current and temperature. Wi-Fi module and a microcontroller based system are utilised to monitor these battery metrics. The voltage sensor is used to continuously check battery voltage, while the current sensor tracks the amount of current flowing to the load. A temperature sensor is used to calculate how hot the battery is. Microcontroller based system and Wi-Fi module are utilised to monitor these battery metrics.

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In order to charge the battery and set the time for security, the Arduino microcontroller connects to the relay. Node MCU is used to transmit the data to the IoT cloud, where it is monitored before being transmitted to the Blynk applications.

2.2 Arduino UNO

The Arduino UNO is a microcontroller MCU platform that includes a number of I/O Pins for analogue and digital operations in addition to additional capabilities including modest memory storage. The Arduino UNO MCU's main component, the ATmega328, serves as the CPU unit. A member of the Arduino line is the Arduino UNO. One USB connector on the Arduino UNO is utilised for power connections as well as uploading programming. Power connection choices include battery and main power.

2.3 NODEMCU ESP8266

The Node MCU (Node Micro Controller Unit) is built on the extremely affordable ESP8266 System on a Chip (SoC), which is also used as a platform for development of open source hardware. A WLAN 802.11 b/g/n antenna, a 32-bit microcontroller unit, a 10 bit analogue to digital converter, a TR switch, a power amplifier, a matching network PLL, regulators and power management components are all built within the device. In various operating modes, Wi-Fi technology uses the 2.4 GHz band to improve WLAN performance. This module can withstand temperatures of up to 125C. GPIO pins enable the integration of various sensors.

2.4 Voltage sensor

The resistive voltage divider circuit serves as a foundation for voltage sensor module, a 0–25 DC voltage detection apparatus. It produces an analogue output voltage that is equal to the input voltage signal after being reduced by a factor of 5. This makes it possible for any microcontroller's 5V analogue pin to measure voltages up to 25V. A potential divider is used by the Voltage Sensor Module, a straightforward yet incredibly practical component, to multiply an input voltage by five. It is possible to monitor voltages that are substantially higher than those that a microcontroller can detect using its analogue input thanks to the 0-25V Voltage Sensor Module.

2.5 DTH11 Sensor

The DHT-11 Digital Temperature and Humidity Sensor is inexpensive and easy to use. It uses a thermistor and a capacitive humidity sensor to monitor the humidity in the air surrounding it, and it provides a digital signal on the data pin without the requirement for analogue inputs. Temperature and humidity are measured using the low-cost DHT11 digital sensor. A micro controller such an Arduino, Raspberry Pi, or similar can easily interface with this sensor to continuously monitor the temperature and humidity levels. There are various sensor and module options for the DHT11 humidity and temperature sensor. A pull-up resistor and a power-on LED can be used to unplug this sensor from the module. A relative humidity sensor

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is the DHT11. This sensor utilises a capacitive humidity sensor and a thermistor to monitor the ambient air. The fluctuating resistance values are calculated, decoded, and digitalized by the IC. Utilising a thermistor with a negative temperature coefficient, which causes the resistance value to drop as temperature rises, this sensor measures temperature. Semiconductor ceramics or polymers are typically employed while developing this sensor to provide it stronger resistance values even for the tiniest temperature change. The DHT11 is a tiny device that operates on 3 to 5 volts. 2.5mA is the maximum current that can be measured. The VCC, GND, Data, and a Not Connected pin are the DHT11 sensor's four pins. To facilitate communication between the CPU and sensor, a pull-up resistor of between 5k and 10k ohms is offered. The use of this sensor is widespread in technology. Weather stations that provide weather forecasts also employ these sensors. In residences where the residents are impacted by humidity, the humidity sensor is employed as a preventative strategy. For safety purposes, this sensor is utilised in workplaces, vehicles, museums, greenhouses, and companies to assess humidity levels.

2.6 Current sensor

Using the Hall Effect as its foundation, the ACS712 is a linear current sensor. This sensor allows for the measurement of both alternating current (AC) and direct current (DC). A 2.1kVRMS voltage isolator as well as a built-in low-resistance current conductor are featured. Direct sensing and indirect sensing are the two main ways that this sensor can operate. Indirect sensing is used by ACS712 current sensor. Using Ohm's law, the direct sensing technique calculates the voltage drop across a wire as current passes through it. In indirect sensing, the magnetic field is calculated by calculating the current using either Faraday's law or the Ampere law. This method uses a transformer, a Hall Effect sensor, or a fibrotic current sensor to find the magnetic field. To measure current, this IC uses a low offset Hall sensor. On the surface of IC, this sensor is located along a copper conduction path. The sensor's IP+ and IP- pins are attached to a copper strip inside the gadget. The Hall Effect sensor can recognise a magnetic field when enough current passes through copper wire. Current is measured using the voltage that the Hall Effect sensor creates in relation to the magnetic field that is sensed.

2.7 Lithium-ION Battery (LI-ON)

The most popular kind of electric vehicle battery is the Li-On battery. Due to its widespread use in portable electronics like laptops and smartphones, we may already be familiar with this battery. The battery's greater energy ratio per weight is essential for electric vehicle batteries. With the same kWh capacity, lighter batteries enable vehicles to go farther on a single charge. Additionally, this battery has a low "self-discharge" level, making it superior to all other batteries in terms of preserving its capacity to hold a full charge. For individuals interested in ecologically friendly electric cars, Li-on batteries are the best option because the majority of its parts can be recycled. The majority of lithium batteries are used by PHEVs and BEVs.

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2.8 Relay module

Electrical switches known as relays can be turned on or off to allow or prohibit the passage of electricity. Relays can be regulated using low voltages.
COM: Common Pin
NC (Normally Closed): If generally closed option is selected, the relay will be closed by default, permitting current to flow unless the relay receives a signal from relay module to open circuit and halt current flow.
NO (Normally Open): The opposite is true of arrangement that is generally open.

2.9 BLYNK app

The Internet of Things (IoT) platform Blynk, which is accessible on iOS and Android mobile devices, enables remote control of Arduino, Raspberry Pi and NodeMCU. In order to develop a graphical user interface (GUI) or human machine interface (HMI), this application gathers and supplies the relevant address on accessible widgets. The Blynk library enables direct control of Arduino or ESP32 pins from a phone without the need for programming. It is also possible to share with friends or clients, giving them access to the linked devices but not the ability to change them.

3 Results and Discussion

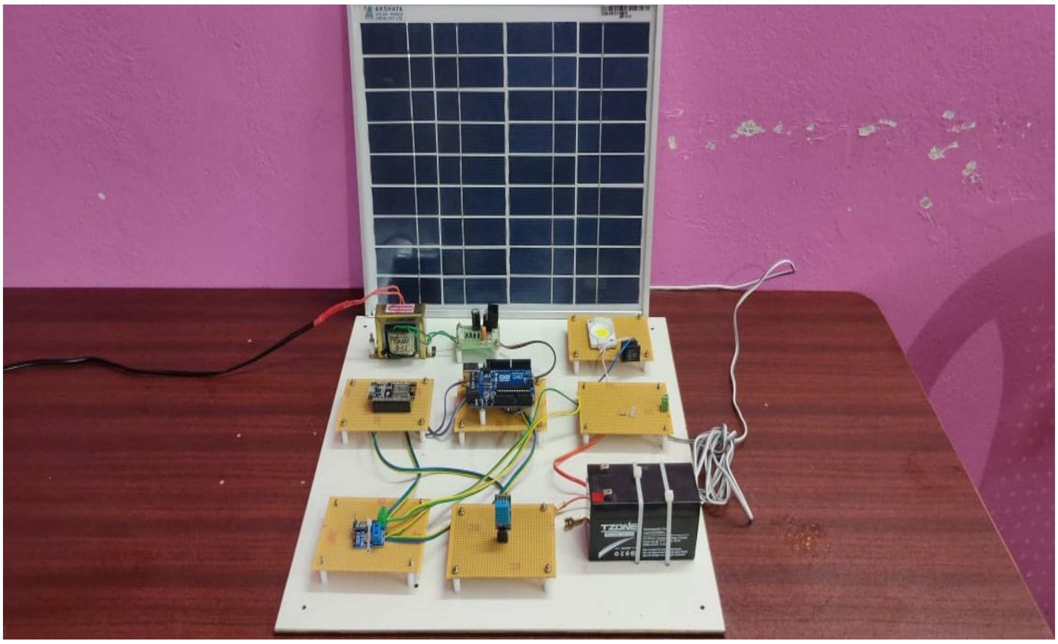

Figure 2: *Hardware setup*

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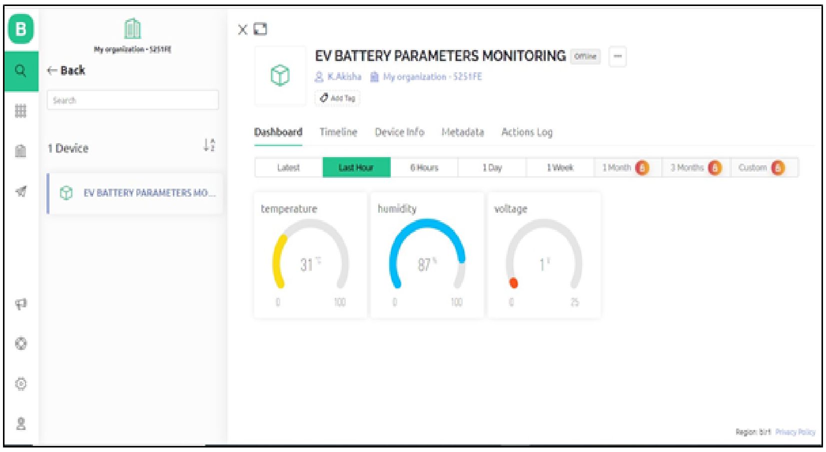

Figure 3: *Output display*

The system design was initially created in order to confirm appropriateness of the hardware components. A voltage sensor, an Arduino Uno, a NODEMCU ESP8266, a DTH11 sensor, a current sensor, a lithium-ion battery (LI-ON) and a relay module are all shown in Figure 2 as the system's components. Figure 2 depicts the real hardware layout of the suggested Internet of Things-based battery monitoring device. Figure 3 displays the output. The humidity rises to 87° and the temperature is 31°. The voltage stays at one all the time.

4 Conclusion

Reduced greenhouse gas emissions from electric vehicles would make them much more environmentally benign and help stop global warming. This is because conventional cars currently emit a lot of greenhouse gases. The battery serves as the only energy source for electric vehicles. An IoT based system for tracking EV battery characteristics is shown in this paper. The voltage sensor continuously checks the battery voltage while current sensor keeps track of how much current is being directed to the load. A temperature sensor is used to calculate the battery's heat output. The system that tracks these battery characteristics makes use of a Wi-Fi module and a microprocessor. The Arduino microcontroller is connected to the relay so that the battery can be charged while the time is set for security. The data is transferred to the IoT cloud via Node Mcu and then monitored there before being sent to the Blynk application.

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