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IoT Based Battery Monitoring System for Electric Vehicle

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Abstract: *This paper describes the application of IoT Technology for monitoring different parameters of battery of electric vehicle. Electric vehicle totally depends upon the source of energy from the battery. In this project, the idea of monitoring the performance of the vehicle using IoT techniques is proposed, so that monitoring can be done easily and directly. The objective of the project is to promote green power and to improve smartness of electric vehicle by monitoring the battery parameters such as voltage, temperature, current and charge avaibility. Also, these values displayed in cloud, which brings the concept of Internet of Things (IoT). The IoT based battery monitoring system consist of two major parts i) Monitoring device and ii) User interface. Based on experimental results, the system is capable to detect battery performance.*

Keywords: Internet of Things, Battery operated vehicle, Lithium-ion batteries.

I. INTRODUCTION

Electric vehicles becoming influential means in the field of transport day by day. As these electric vehicles are free from pollution emission, world is looking to make transportation field electrified. Nowadays, battery operated vehicle becoming popular sine the fuel prices becoming more expensive. Due to these scenarios, vehicle manufacturers looking for alternatives of energy sources other than gas. The use of electrical energy source may improve the environmental protection. Most EV s used rechargeable battery which is lithium-ion battery.

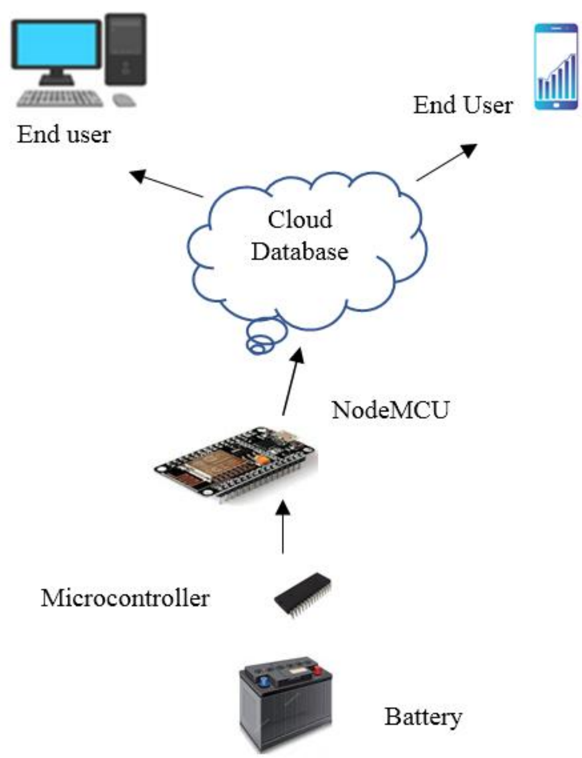

Fig.1. Proposed Work

It is smaller to be compared with lead acid battery. Lithium-ion battery life cycle can be shortened by some reasons such as overcharging and deep discharge. On the other hand, EV usually has limited range of travelling due to battery size and body structure. Now, an important reason that limit the application of EV s is the safety of existing battery technology. According to the buyers of Electric vehicle, the main problem with EV's is the limited capacity of battery and charging infrastructures availability, which leads to a variety of concerns like drivers are afraid to drive a battery powered vehicle for far distances. These issues have importance comparatively cost of battery and vehicle. Even with development of new battery batteries for electric vehicles, various concerns can limit the use of electric vehicle. In recent days, great efforts have been made to study range reduction concerns by improvising SoC in automotive battery tracking systems with low-cost microcontrollers. This project represents an easy way to represents the range in the vehicles virtual dashboard. This paper proposes a solution that makes the EV smarter by display the parameter like battery voltage, temperature, remaining charge in the mobile phone. This require a lot of sensory data to be acquired and send to the cloud. This all-sensory data is analyzed at different levels. This project is to promote green power and to improve the smartness of battery powered vehicles. IoT utilizes internet connectivity beyond traditional applications, where diverse range of devices and everyday things can be connected via the internet, making the world is at the user s finger tips. Motivating by the stated problems, in this work, the design and development of a battery monitoring system for electric vehicle using IoT technology is proposed.

1.1 Measurement of Basic Parameters of Batteries

Measurement of Voltage and Current

The voltage of the battery will not offer the charging voltage of the battery when it is charging in any way. The chargin g voltage does not have to be the same as the voltage recorded across the battery.A dead battery that isn't attached to an ything can have a voltage of around 12.5 volts.To measure the charging voltage, we'll need some circuitry, or we can us e any voltage detector module to measure thevoltage across the battery terminals.We could easily measure the voltage with the help of the Microcontroller Atmega328p and measure the output with a simple voltage divider network, by putti ng correct values of resistance, regulating it, and then using signal conditioning mechanism, which is nothing more than using an analogue to digital converter. We can measure the current produced by the battery by connecting it to a known value of load resistance. The circuit diagram for measuring the voltage of the battery is shown in the diagram below:

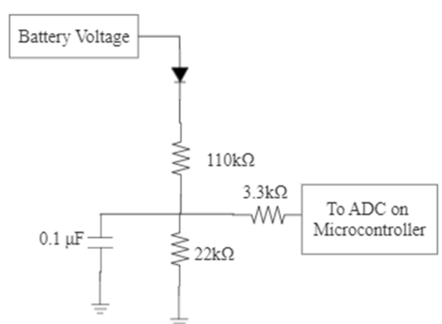

Fig.2. Circuit Diagram to Measure Voltage

The Hall Effect Current Sensor Module, model ACS712, is used to measure current. The current flowing from the battery can be determined using the Hall Effect concept, which uses the voltage created when electric and magnetic fields cross. Again, we may provide to the Microcontroller and acquire the output in usable form by using the analogue to digital converter and properly managing the input voltage. If V0 is the ADC's output, we can compute the current delivered by the battery at that voltage and load using the current sensor's sensitivity. The ACS712's maximum current sensitivity is 185 mV/A, and the current is given by:

I = (V0 (2 Resolution Bits)/2) / 0.185 Amperes (1)

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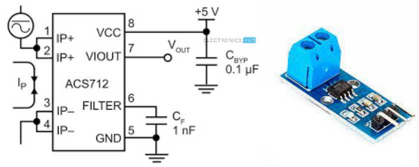

Fig.3.Current Sensor

1.2 Measurement of Temperature

The temperature of the battery is an important characteristic because it determines the battery's present status. If the battery is at room temperature, it has a resistance of 10 kilo ohms. This is connected is high; it is a clear sign of the battery's instability; it represents the battery's behaviour under abnormal circumstances. The thermistor will be used to measure the temperature. A thermistor is a device whose resistance changes as temperature changes. A negative temperature coefficient thermistor is employed in this experiment, which exhibits with series resistance in a voltage divider network, and the change in resistance is mapped with the change in voltage between the two resistance, which is equivalent to temperature.

This is fed into the Microcontroller's Analog to Digital converter, and the temperature of the battery is calculated using the Steinhart-Hart equation.

The Steinhart-Hart formula is as follows:

$$T \text{ (in K)} = 1 / (A + B * \ln (R) + C * [\ln (R)]^3). \quad (2)$$

where A, B, and C are Steinhart's Coefficients, which vary depending on the type of thermistor employed, and R is the resistance of the thermistor. This temperature information is gathered and sent to the cloud.


Fig.4.Thermistor

1.3 Sending Data to Cloud

NodeMCU ESP8266 microcontroller with Wi-Fi module

NodeMCU is an open source IoT platform that uses the ESP8266 Wi-Fi SoC and the ESP-12 module for hardware. It refers to firmware rather than a development kit that gives users access to the ESP8266's GPIOs and is commonly utilised in IoT applications. It gives you access to the module's GPIO (General Purpose Input/Output), which can be either an input pin or an output pin, and whose behaviour can be modified while it's operating.

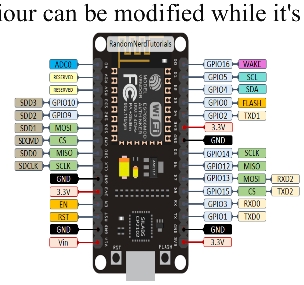
Fig. 5. GPIO notations of ESP8266

Some of the GPIO lines on the processor chip are used to interface with other SoC components, such as flash memory. There are around 11 GPIO pins left to be used for GPIO purposes. In order to communicate with a host PC from which compiled object code is downloaded, two pins of the 11 GPIO are usually designated for RX (receiver) and TX (transmitter). This module is charged, and data is sent from the host to the board via USB connection.

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Fig.6. NodeMCU ESP8266 microcontroller with Wi-Fi module

The Internet of Things is a rapidly evolving technology. When the battery monitoring system is integrated with IoT, we may access the data collected from the battery from anywhere using our mobile phone, or it can be saved in the cloud and retrieved at any time for analysis. A NodeMCU module is used to enable this feature, which collects data from the microcontroller and displays it on the Thingspeak platform. The Internet of Things (IoT) technology provides a simple but strong capability for working with many types of devices and exchanging data.IoT services are in charge of sending messages to clients who are linked to the IoT platform. ThingSpeak is an Internet of Things (IoT) platform that collects sensor data and develops IoT applications in the cloud. The ThingSpeak IoT platform includes apps that allow you to study and visualise data before taking action. The NodeMCU ESP8266 Wi-Fi module can be used to send sensor data to ThingSpeak.

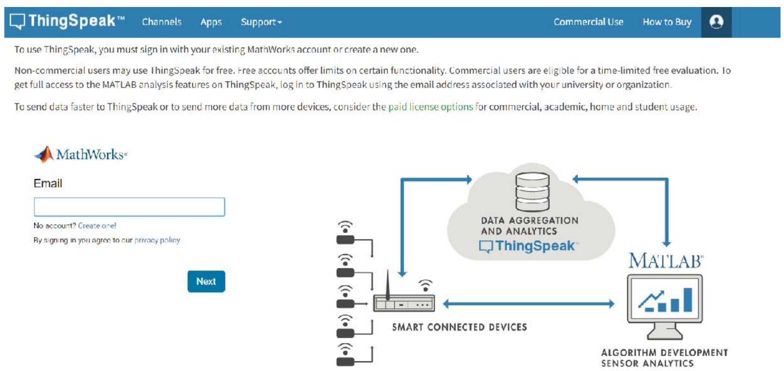

Fig.7.Thingspeak login page

Display Data on LCD

Interfacing of LCD with Microcontroller

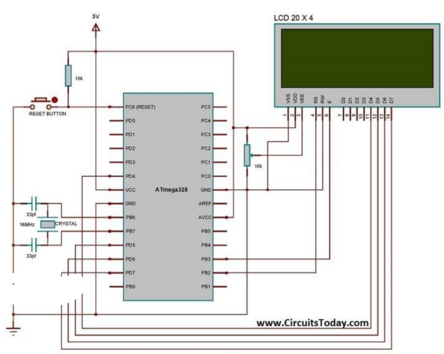

Fig.8.Interfacing LCD Module With ATmega328p

The microcontroller's ports B and D are utilised to interface with the LCD module in Figure 6. In 4-bit mode, just the D4-D7 lines, as well as the RS, R/W, and E pins, are utilised. This allows us to preserve four pins on our controller, which we can put to better use. We only need to write on the LCD module at this point. As a result, the R/W pin can be grounded as indicated in Fig.6.The total number of pins can be lowered to 6 this manner. The data bytes are split into two 4 bits and sent in the form of a nibble in 4 Bit mode. Assigning logic states to the control pins RS and E allows data to be transmitted to an LCD. To ensure the proper operation of the c, a reset circuit, oscillator circuit, and power supply must be provided.

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Simulation

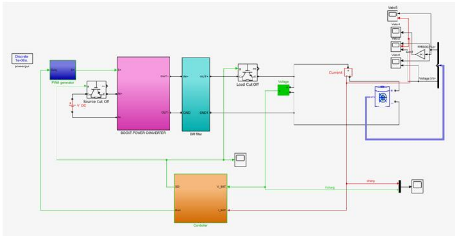

Fig. 9. Simulation Model for battery monitoring system

II. RESULTS

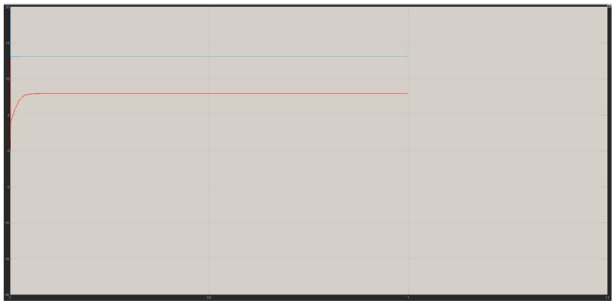

Fig.10.Output voltage and current

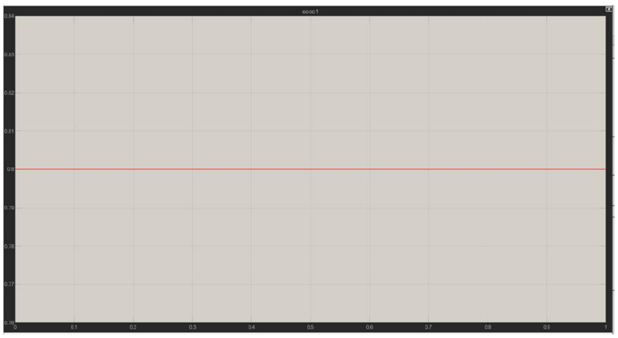

Fig.11.SOC Graph

III. HARDWARE SETUP

A voltage divider circuit and a current sensor are used to detect voltage and current, respectively, in this work's proposed battery monitoring system. The ATmega328p Microcontroller is used to process the measured voltage and current. The data is sent to the Thingspeak platform through an ESP2866 Wi-Fi module, which allows for remote monitoring. The LCD also shows parameters like voltage, current, and temperature.

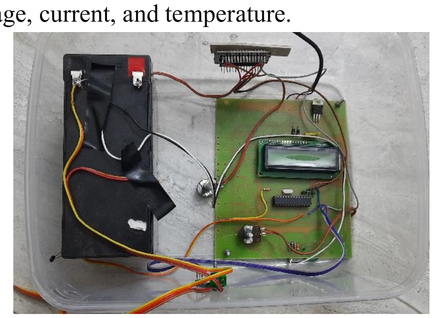

Fig.12.Hardware Setup for Battery Monitoring System

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Results

Following fig.13 showing the battery parameters such as voltage, temperature and SOC on Thingspeak platform.

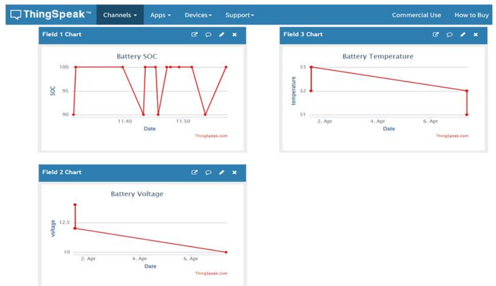

Fig.13.Battery parameters on Thingspeak platform

Following fig.14 showing the battery parameters such as voltage, current and temperature and power consumption on LCD display.

Fig.14.Battery parameters on LCD Display

IV. FUTURE SCOPE

To display this data, the aforesaid architecture can be coupled with mobile phones. With the help of the Wi-Fi module, we can transfer data to the Thingspeak platform. Even from remote regions, data can be collected and seen. This prototype might also be used to create a multi-battery monitoring system.

V. CONCLUSION

To display this data, the aforesaid architecture can be coupled with mobile phones. With the help of the Wi-Fi module, we can transfer data to the Thingspeak platform. Even from remote regions, data can be collected and seen. This prototype might also be used to create a multi-battery monitoring system. The battery's basic parameters aid in the monitoring of the battery's condition. The integration of cloud and IoT into the Battery Monitoring System will aid in data analysis. Modifications can be made to the system to improve its functions. The solution, which runs on the Thingspeak platform, can be used in smartphones to assist users keep track of their battery life.

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