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# IOT Based Battery Monitoring System for Electric Vechiles

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**ABSTRACT:** One of the most vital and expensive components of electric vehicles is the battery. Of course, the battery is the only source of electricity for an electric vehicle. However, the vehicle's power supply eventually declines, resulting in decreased performance. For battery manufacturers, this is a major concern. In this paper, it is proposed to use IoT approaches to monitor and display the battery performance. Here, the various battery metrics, including voltage, current, and temperature, are tracked, observed, and shown. This alerts the user to prevent the battery from being overcharged or deeply discharged. With the use of various sensors, observation can be carried out. Data on voltage, current, and temperature are sent to a microcontroller unit, which subsequently transmits battery data via the cloud for display. Real-time data of voltage, current, and temperature may be displayed by the monitoring system, and the data can be seen on an Android smartphone and a computer at the same time. As a result, we might be able to improve the battery's efficiency and lifespan. The user interface and results presentation are the two main components of the proposed IoT -based battery monitoring system. According to test results, the system is able to recognize weakened battery performance and notifies the user for further action.

**KEYWORDS:** IOT, Cloud, Microcontroller, Battery, Electric, Vehicle.

## I. INTRODUCTION

### Introduction to Internet of Things (IoT)

IoT stands for Internet of Things. It refers to the interconnectedness of physical devices, such as appliances and vehicles, that are embedded with software, sensors, and connectivity which enables these objects to connect and exchange data. This technology allows for the collection and sharing of data from a vast network of devices, creating opportunities for more efficient and automated systems.

**Internet of Things (IoT)** is the networking of physical objects that contain electronics embedded within their architecture in order to communicate and sense interactions among each other or with respect to the external environment. In the upcoming years, IoT-based technology will offer advanced levels of services and practically change the way people lead their daily lives. Advancements in medicine, power, gene therapies, agriculture, smart cities, and smart homes are just a few of the categorical examples where IoT is strongly established.

IoT is a system of interrelated things, computing devices, mechanical and digital machines, objects, animals, or people that are provided with unique identifiers. And the ability to transfer the data over a network requiring human-to-human or human-to-computer interaction.

## II. LITERATURE SURVEY

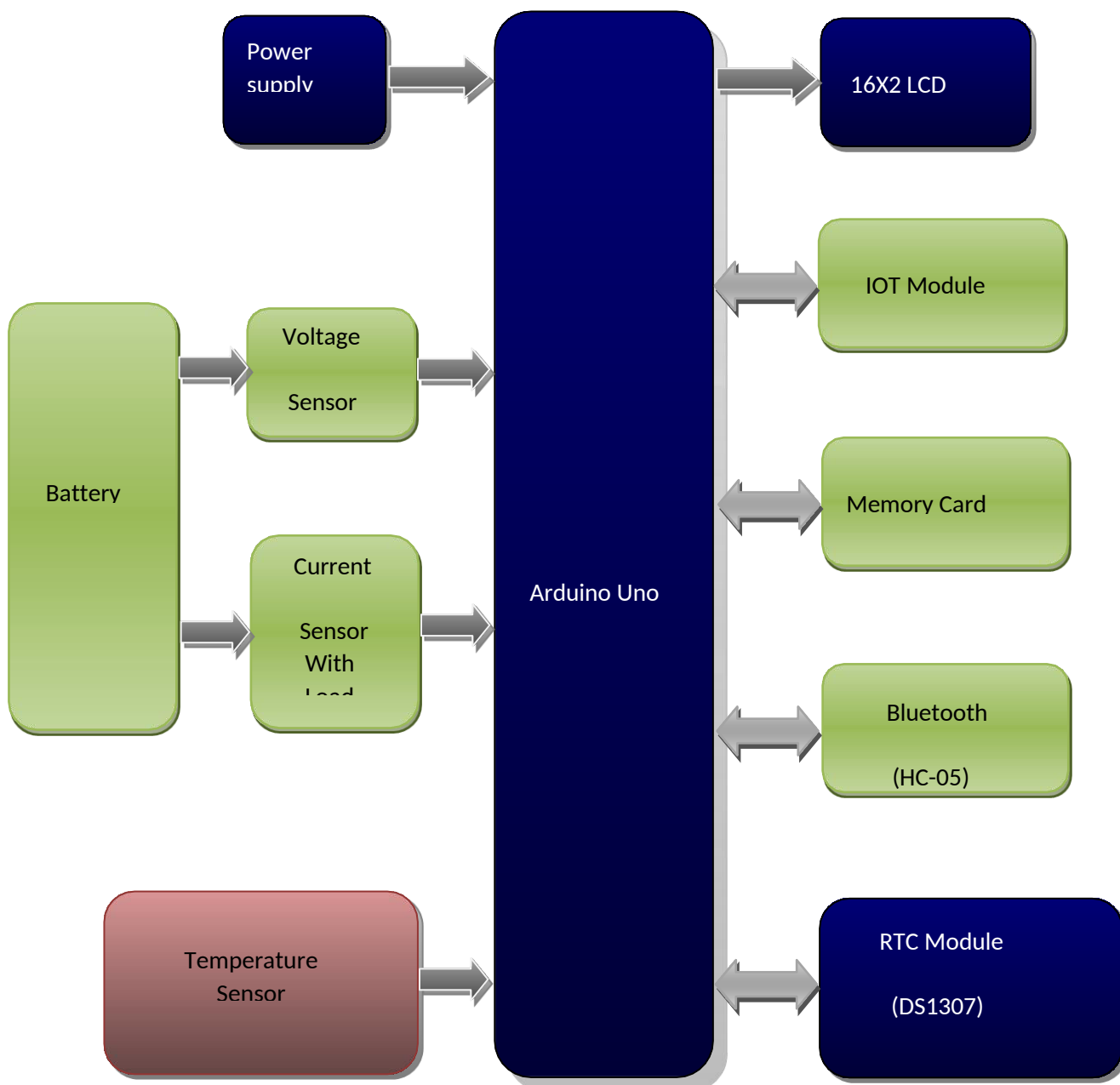
With the improvement of cell arrangements in the 1970's for expanding the absence of frequencies in the radiotelephone administrations which in go lead to presentation of AMPS (Advanced Mobile Phone System) where the transmission was simple based. This was known to be the first era in quite a while. The subsequent age depended on computerized transmission and was called with different condensing as GSM (Global System for Mobile interchanges), ERMES (European Radio Messaging System). Different Cordless phone guidelines were likewise presented during this time as it were. The third era has ascended with the unification of various advances; some of them which are prevalently



known are FPLMTS (Future Public Land Mobile Telecommunications System), UMTS (Universal Mobile Telecommunication System), and IMT-2000. The word GSM Refers to Global System for Mobile Correspondences. These days numerous individuals are demonstrating parcel important to find out about GSM related ideas. Along these lines, here we have reviewed a rundown of different GSM based ventures thoughts which are having more request and exceptionally fascinating to learn. The accompanying ventures dependent on GSM innovation we reviewed would give better thought regarding the GSM innovation for all intents and purposes.

### III. PROPOSED METHODOLOGY AND DISCUSSION

For a proposed IoT-based battery monitoring system for electric vehicles, it's important to consider advancements in technology and address potential shortcomings in existing systems.





**ARDUINO UNO:** The Arduino Uno is a microcontroller board based on the ATmega328 ([datasheet](#)). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. The Arduino UNO R3 is the perfect board to get familiar with electronics and coding. This versatile microcontroller is equipped with the well-known ATmega328P and the ATmega 16U2 Processor.

**16x2 LCD DISPLAY:** Liquid crystal display a type of display used in digital watches and many portable computers. LCD displays utilize two sheets of polarizing material with a liquid crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them. Each crystal, therefore, is like a shutter, either allowing light to pass through or blocking the light.

Pins	Description
1	Ground
2	Vcc
3	Contrast Voltage
4	"R/S" _Instruction/Register Select
5	"R/W" _Read/Write LCD Registers
6	"E" Clock
7 - 14	Data I/O Pins

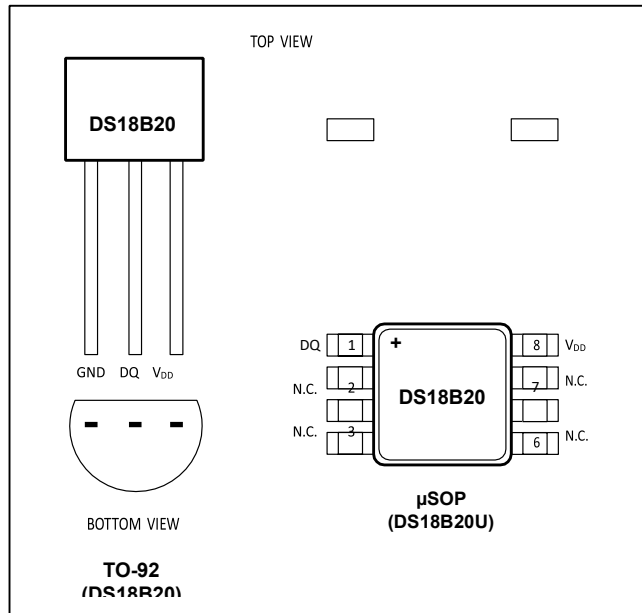
**IoT MODULE:** ESP32 is created by Espressif Systems with a series of SoC (System on a Chip) and modules which are low cost with low power consumption. This new ESP32 is the successor to the well-known ESP8266 (became very popular with its inbuilt WiFi). ESP32 not only has Built in WiFi but also has Bluetooth and Bluetooth Low Energy. In other words we can define ESP32 as "ESP8266 on Steroids". ESP32 chip ESP32-D0WDQ6 is based on a Tensilica Xtensa LX6 dual core microprocessor with an operating frequency of up to 240 MHz.

**TEMPERATURE SENSOR(DS18B20)**

The DS18B20 digital thermometer provides 9-bit to 12-bit Celsius temperature measurements and has an alarm function with nonvolatile user-programmable upper and lower trigger points. The DS18B20 communicates over a 1-Wire bus that by definition requires only one data line (and ground) for communication with a central microprocessor. In addition, the DS18B20 can derive power directly from the data line ("parasite power"), eliminating the need for an external power supply. Each DS18B20 has a unique 64-bit serial code, which allows multiple DS18B20s to function on the same 1-Wire bus. Thus, it is simple to use one microprocessor to control many DS18B20s distributed over a large area. Applications that can benefit from this feature include HVAC environmental controls, temperature monitoring systems inside buildings, equipment, or machinery, and process monitoring and control systems.



### Pin Configurations



**SD CARD:**The module (Micro SD Card Adapter) is a Micro SD card reader module for reading and writing through the file system and the SPI interface driver, SCM system can be completed within a file Micro SD card support Micro SD Card, Micro SDHC card (high speed card)

Level conversion circuit board that can interface level is 5V or 3.3V

Power supply is 4.5V ~ 5.5V, 3.3V voltage regulator circuit board

Communications interface is a standard SPI interface

4 M2 screws positioning holes for easy installation

**Control Interface:** A total of six pins (GND, VCC, MISO, MOSI, SCK, CS), GND to ground, VCC is the power supply, MISO, MOSI, SCK for SPI bus, CS is the chip select signal pin; 3.3V regulator circuit: LDO regulator output 3.3V for level conversion chip, MicroSD card supply;

**Level conversion circuit:** Micro SD card to signal the direction of converts 3.3V, Micro SD card interface to control the direction of the MISO signal is also converted to 3.3V, general AVR microcontroller systems can read the signal;

Micro SD card connector: self bomb deck, easy card insertion.

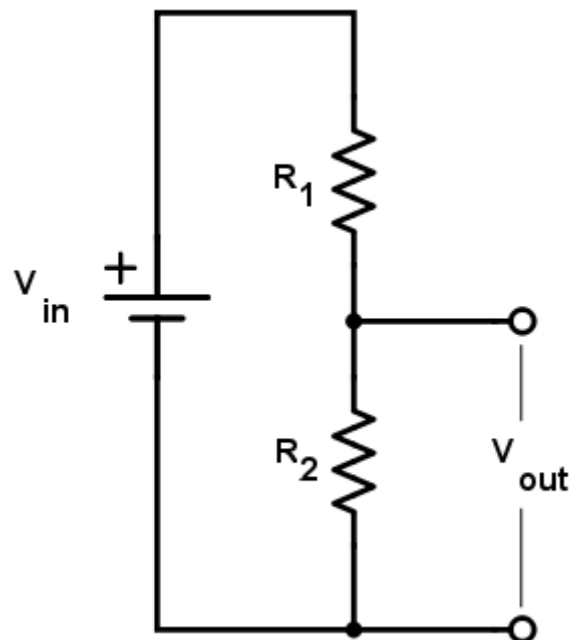
Positioning holes: 4 M2 screws positioning holes with a diameter of 2.2mm, so the module is easy to install positioning, to achieve inter-module combination.



**Interface Parameters:**

Items	Min	Typical	Max	Unit
Power Voltage VCC	4.5	5	5.5	V
Current	0.2	80	200	mA
Interface Electrical Potential	3.3 or 5			V
Support Card Type	Micro SD Card(<=2G), Mirco SDHC Card(<=32G)			—
Size	42X24X12			mm
Weight	5			g

**Voltage Sensor:**The two resistor voltage divider is one of the most common and useful circuits used by engineers. The primary purpose of this circuit is to scale down the input voltage to a lower value based on the ratio of the two resistors. This calculator helps determine the output voltage of the divider circuit given the input (or source) voltage and the resistor values. Take note that the output voltage in actual circuits might be different, since resistor tolerance and load resistance (where the output voltage is connected) become factors.



**Equation**

$$V_{out} = V_{in} * (R_2 / (R_1 + R_2))$$

Where:

V<sub>out</sub> = Output voltage. This is the scaled down voltage.

V<sub>in</sub> = Input voltage.

R<sub>1</sub> and R<sub>2</sub> = Resistor values.

**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. Among these sensors, a current sensing resistor is the most commonly used. It can be considered a current-to-voltage converter, where inserting a resistor into the current path, the current is converted to voltage in a linear way. The technology used by the current sensor is important because different sensors can have different characteristics for a variety of applications.

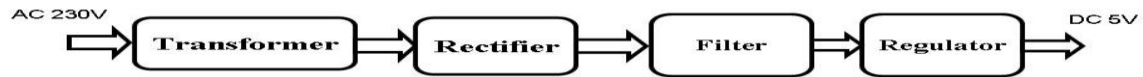
**RTC MODULE:** A real time clock, or RTC, is a digital clock with a primary function to keep accurate track of time even when a power supply is turned off or a device is placed in low power mode. RTC's are comprised of a controller, oscillator, and an embedded quartz crystal resonator. They are engineered as all-in-one devices to provide better performances than discrete components, simplify integration in new designs, and accelerate time to market.

**BLUETOOTH(HC-05):** HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup.

Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH(Adaptive Frequency Hopping Feature). It has the footprint as small as 1.

**POWER SOURCE(12v 1amp DC Battery):** Power supply is a supply of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others.

## Regulated Power supply



### IV. OUTPUT

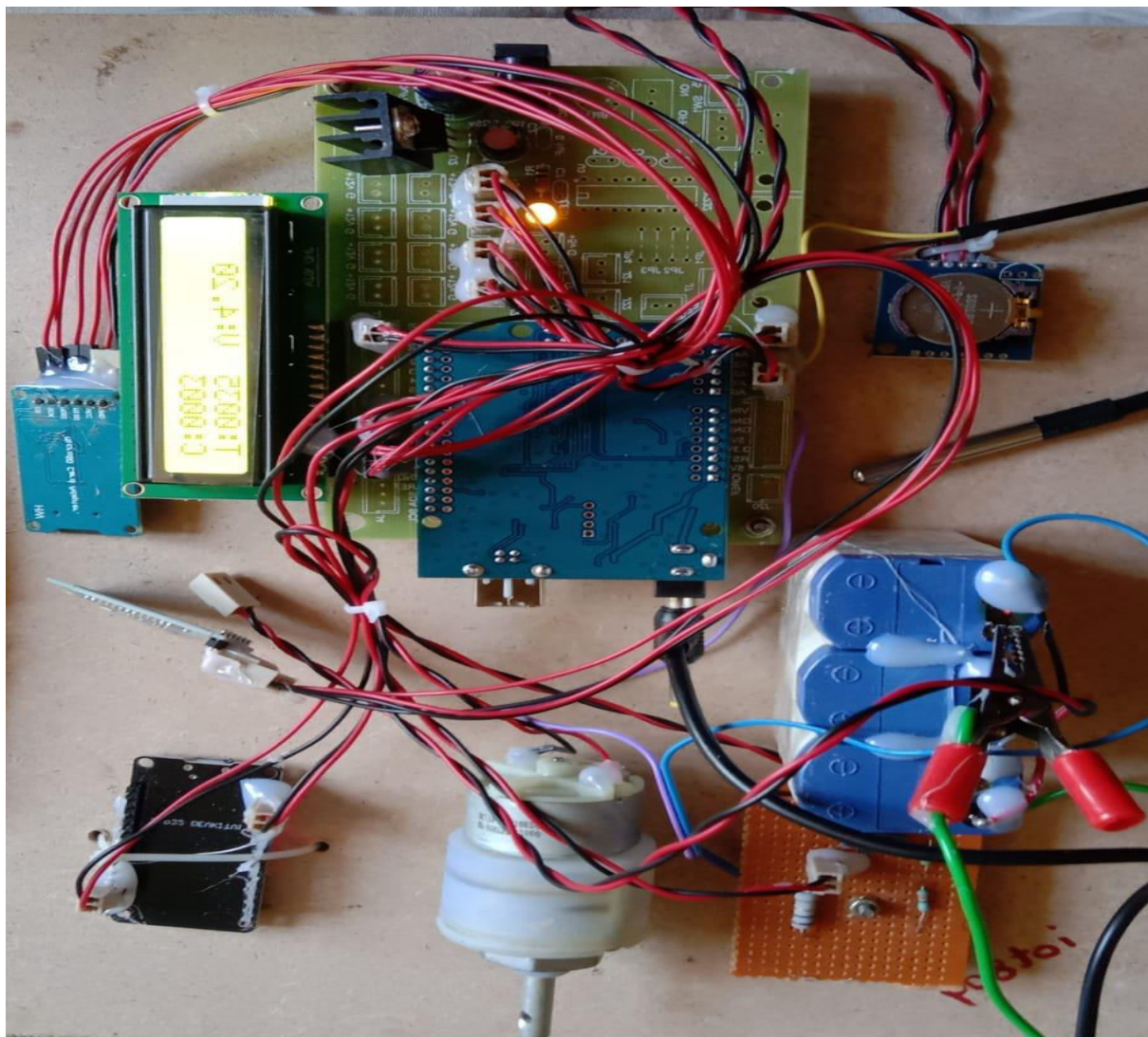


Fig:output



S.No	Temperature	Voltage	Current	Date
1	35	4	0	2024-04-23 10:11:02
2	35	4	4	2024-04-23 10:10:08
3	35	4	3	2024-04-23 10:09:15
4	35	4	0	2024-04-23 10:08:22
5	35	4	0	2024-04-23 10:07:28
6	35	4	1	2024-04-23 10:06:35
7	35	4	2	2024-04-23 10:05:41
8	36	4	4	2024-04-01 12:36:14
9	37	12	7	2024-04-01 12:35:21
10	37	0	0	2024-04-01 12:34:41
11	33	0	0	2024-04-01 08:59:16
12	32	12	5	2024-04-01 08:58:24
13	32	12	9	2024-04-01 08:57:29
14	35	0	0	2024-03-30 13:10:11
15	36	0	0	2024-03-30 13:09:17

Fig:Data stored in cloud

## V. CONCLUSION

The paper described the design and development of an IoT-based battery monitoring system for electric vehicle to ensure the battery performance degradation can be monitored online. The objective is to prove that the concept of the idea can be realized. The development of the system consists of the development of the hardware for the battery monitoring device and a web-based battery monitoring user interface. The system is capable to show information such as location, battery condition and time via internet by incorporating GPS system to detect the coordinate and display it on the Google Maps application. Further modification can be done to improve the system by adding more functions into the system. The system can be used in smartphones by developing smartphone application that can help user to monitor battery and as a battery degradation reminder. In order to enhance the internet connection, Ethernet can be used to get a better internet connection compared to GPRS.

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 Thing speak 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 Thing speak platform, can be used in smartphones to assist users keep track of their battery life.

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