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Vol. 2 Iss.4, pp. 31-37, 29th Feb, 2017
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ISSN Online : 2454-1443 © 2017, IJRMMAE
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International Journal of Research in Mechanical, Mechatronics and Automobile Engineering (IJRMMAE)

INTELLIGENT BATTERY MANAGEMENT SYSTEM FOR FUEL VEHICLES

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ABSTRACT

Sometimes the vehicles wouldn't start this is due to the battery of the vehicle, more specially either it's state of charge(SOC) or it's state of health(SOH).The challenge is to devise a user friendly application based battery management tool through which the user can get critical information about the state of charge(SOC) as well asthe state of health (SOH) along with the set of actions required to ensure a reliability of the starting is maintained.This application also helps in monitoring the temperature of the car battery. Keywords- state of charge, state of health, battery management system ,MQTT protocol.

1.INTRODUCTION

Car Battery is one of the most crucial and essential part of the car elements. The Car battery can majorly hamper your fuel economy drastically. If the car is flat then we have to spend hours to start the car .This will not only waste your time but also exert the engine and decrease the life expectancy. So it is important to monitor and manage the health of the battery. The main objective of this paper is to monitor the health level of the battery, temperature of the battery and over voltage protection through mqtt mobile application.

A battery management system is essentially the "brain" of a battery pack. It measures and reports crucial information for the operation of the battery and also protects the battery from damage in a wide range of operating conditions. Battery management system for Electric vehicles , Hybrid electric vehicles and even for monitoring and managing mobile batteries,there are proposed models and applications are used . But for Fuel cars there is no hardware modules or software applications to monitor the SOH of the battery. In this paper ,we have used hardware modules such as nodemcu, overvoltage protection circuit, dc buck converter, GSM SIM800L and the software used is Arduino 1.8.7 and the application used for monitoring the battery is linear MQTT (Message Queuing Telemetry Transport) dashboard.

2.EXISITING SYSTEM

The Battery Management for electric vehicles have various models and software applications to monitor battery level. The Battery has the great impact on the performance of electric vehicles, basically determining the driving range.
Li-ion Batteries are most widely used in the electric cars. The li-ion chemistry is the battery technology of choice due to its good energy density ,good power rating and charge/discharge efficiency in pulsed energy flow systems.
Another important function of a BMS is to extend the battery life by facing the charge

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unbalancing the issue that may arise in series-connected cells. This reduces the usable capacity of the battery because the least charged cell determines the end of discharge, even if there is still energy stored in the other cells of the battery. Due to the strict voltage limits applying to Li-ion batteries, charge unbalance cannot be self-recovered but instead worsens with time.

BATTERY INTEGRATION IN ELECTRIC VEHICLES

There are many aspects for battery integration in electrical vehicles.An example will be given to show the most relevant aspects. The example is derived from the experience gained in the E car project.The battery system uses 96 series connected Li-ion cells with 50 Ah capacity in order to reach the required voltage level of up to 400V. The cells are divided into modules of four cells. The battery pack consists of 24 modules each of them including an electronic circuit for monitoring and balancing the cells. The Battery system includes the pack management unit . Its role is to acquire data from the module

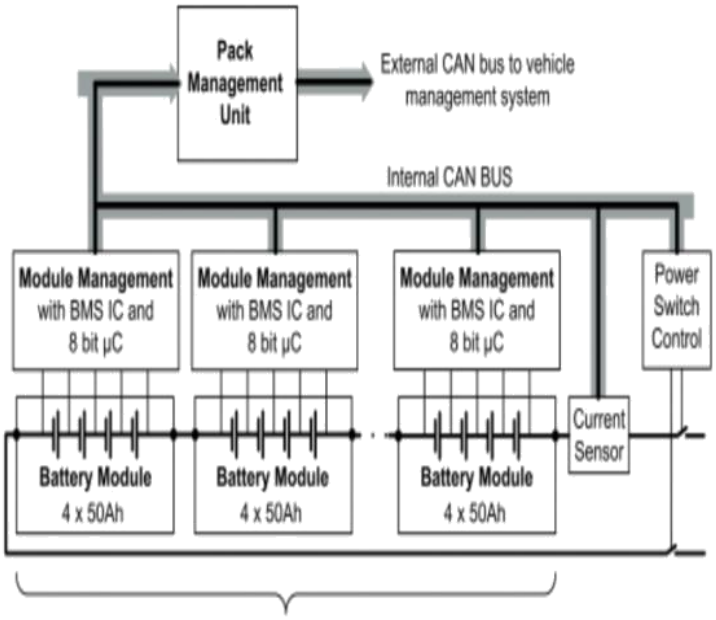

Figure 1 Battery System Overview

management units and current sensor. It calculates the battery parameters, such as state of charge , state of health and state of function, communicate with the vehicle control system , operate the power switches and control the battery cooling and heating subsystem. The Battery module management units and the pack management unit communicate via CAN bus. As the MMUs are monitoring voltages at levels upto about 400V.

Li-ion cells are most widely used in the batteries of electric vehicles due to some important features but they have a two critical design issues – if you overcharge the cells you can damage them and cause overheating , explosion or flame so it is important to have a battery management system to provide overvoltage protection. Li-ion cells can also be damaged if they are discharged below a certain threshold ,

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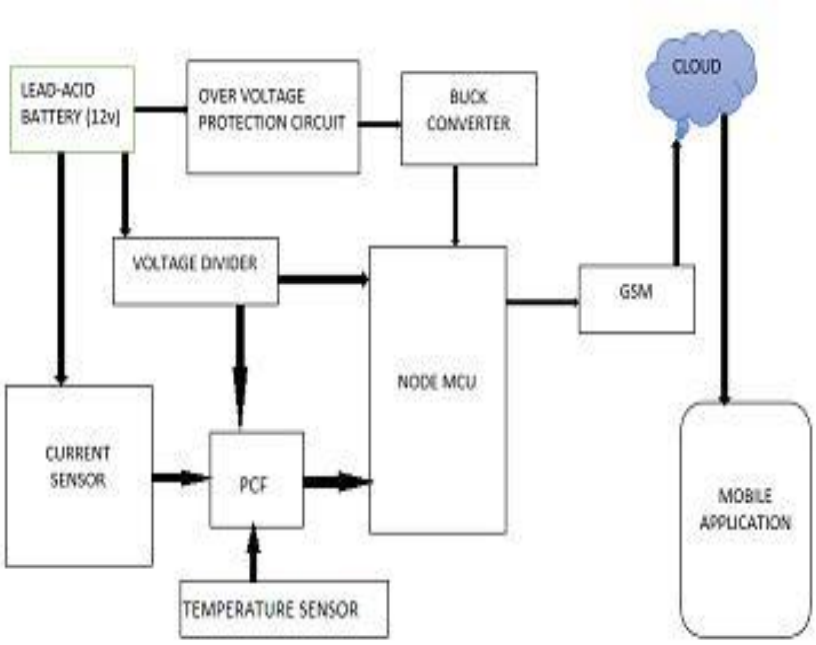
approximately 5 percent of total capacity. If the cells are discharged below 5 percent of threshold value ,the capacity can become permanently reduced.These cells are costlier to afford.

3. PROPOSED SYSTEM

In this paper, we have discussed about the monitoring and managing the car battery in the fuel cars. Lead-acid type is the most widely used types of car batteries. Primarily, these are regarded as high performance car batteries because of their affordability and ability to provide a large volume of current that is needed to start the car . Other batteries are more costly and this makes them less preferable even if they are lighter and smaller. For instance li-ion batteries are energy dense and lighter in comparison to lead- acid batteries but they do not work well in the cold weather. A lead-acid AGM battery makes the best choice,
particularly for regions that have extremely cold winters. The Main modules used are NodeMCU, overvoltage protection circuit, dc buck converter, GSM SIM800L and the software used is Arduino 1.8.7 and the application used for monitoring is linear MQTT (Message Queuing Telemetry Transport) dashboard.

BLOCK DIAGRAM

NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 wifi SoC and hardware which is based on the ESP-12 module.The firmware uses the Lua scripting language.
In this paper we are using Node MCU ESP8266 microcontroller which has a inbuilt wifi module to communicate with mobile application through cloud server . This helps the client to monitor the battery status of the fuel car using mobile application.



GSM SIM800L

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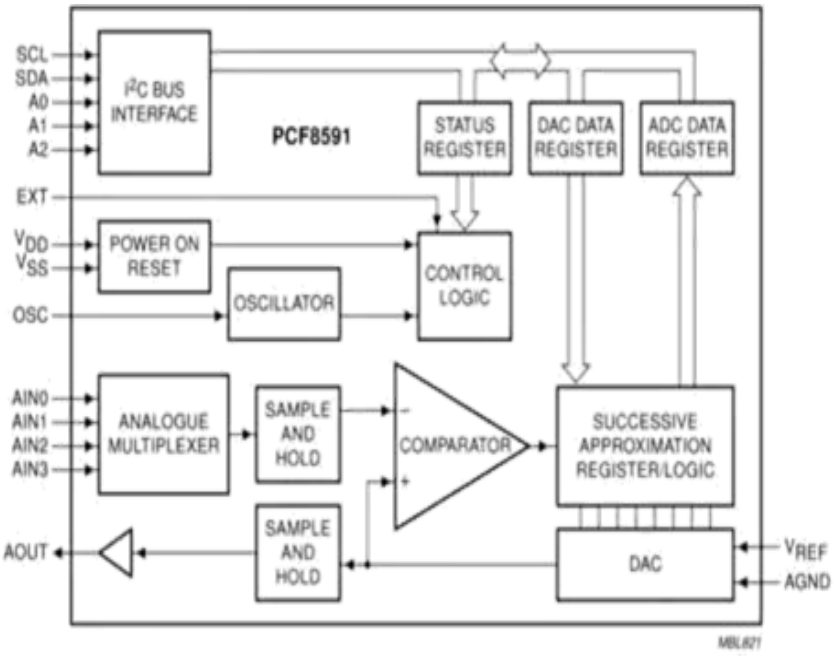
The SIM800L module supports quad-band GSM/GPRS network ,available for GPRS and SMS message data remote transmission .The SIM800L communicates with microcontroller via UART port. It also has built –in level translation, so it can work with microcontroller of higher voltage than 2.8V default . Besides the board also supports GPS technique which is called mobile positioning and gets position by mobile network .This featurecan also be used as a tracker module .`

PCF8591



The PCF8591 is a single-chip, single-supply low-power 8-bit CMOS data acquisition device with four analog inputs, one analog output and a serial I²C-bus interface. Three address pins A0, A1 and A2 are used for programming the hardware address, allowing the use of up to eight devices connected to the I²C-bus without additional hardware. Address, control and data to and from the device are transferred serially via the two-line bidirectional I²C-bus.

The functions of the device include analog input multiplexing, on-chip track , 8-bit analog-to-digital conversion and an 8-bit digital-to-analog conversion. The maximum conversion rate is given by the maximum speed of the I²C-bus.

LM35

The LM35 is one kind of commonly used temperature sensor that can be used to measure temperature with an electrical output comparative to the temperature (in °C). It can measure the temperature more accurately when compared with a thermistor. This sensor generates a high output voltage than thermocouples and may not need that the output voltage is amplified. The LM35 has an output voltage that is proportional to the Celsius temperature. The scale factor is 0.01V/°C.The LM35

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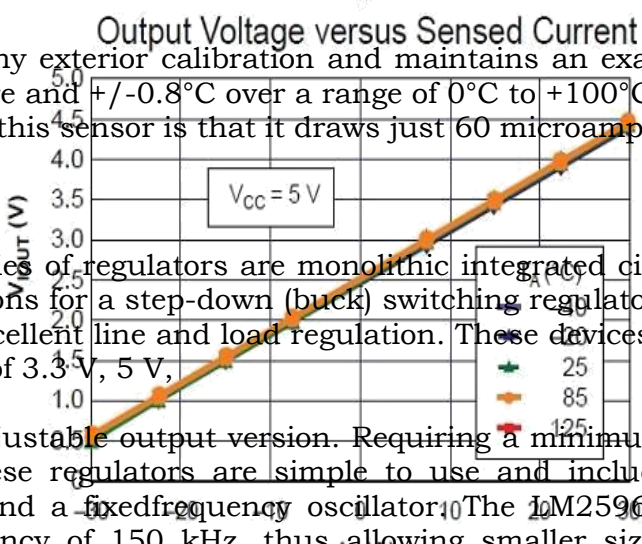


does not need any exterior calibration and maintains an exactness of +/-0.4°C at room temperature and +/-0.8°C over a range of 0°C to +100°C.One more significant characteristic of this sensor is that it draws just 60 microamps from its supply.

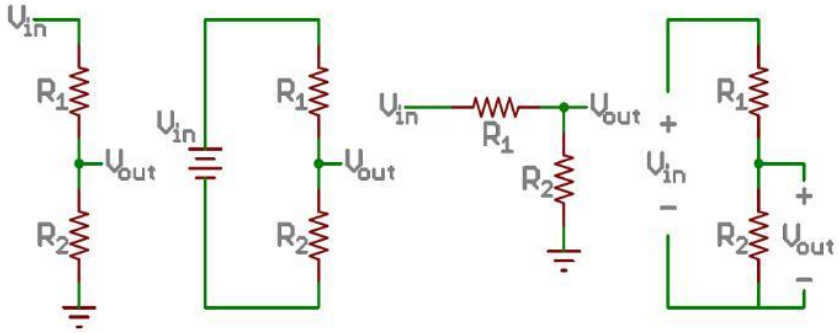
LM2596

The LM2596 series of regulators are monolithic integrated circuits that provide all the active functions for a step-down (buck) switching regulator, capable of driving a 3-A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V,

12 V, and an adjustable output version. Requiring a minimum number of external components, these regulators are simple to use and include internal frequency compensation, and a fixedfrequency oscillator.The LM2596 series operates at a switching frequency of 150 kHz, thus allowing smaller sized filter components. Available in a standard 7-pin TO-220 package with several different lead bend options, and a 7-pin TO-263 surface mount package.

VOLTAGE DIVIDER BIAS

A voltage divider is a simple circuit which turns a large voltage into a smaller one. Using just two series resistors and an input voltage, we can create an output voltage that is a fraction of the input.
We'll call the resistor closest to the input voltage (Vin) R1, and the resistor closest to ground R2. The voltage drop across R2 is called Vout, that's the divided voltage..



CURRENT SENSOR

Sensing and controlling current flow is a fundamental requirement in a wide variety of applications including, over-current protection circuits, battery chargers, switching mode power supplies, digital watt meters, programmable current sources, etc. This ACS721 current module is based on ACS712 sensor, which can accurately detect AC or DC current. The maximum AC or DC that can be detected can reach 30A, and the present current signal can be read via analog Input port of Controller.

$$V_{out} = V_{in} \cdot \frac{R_2}{R_1 + R_2}$$

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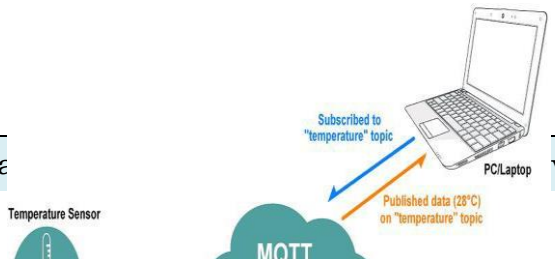
VOLTAGE PROTECTION CIRCUIT

Although modern power supplies are now very reliable, there is always a small but real chance that they can fail.Although they can fail in many ways, one particularly worrying possibility is that the series regulator element, i.e. transistor or FET may fail in such a way that it goes short circuit. If this happens a very large voltage often referred to as an over-voltage could appear on the circuitry that is being powered causing catastrophic damage to the whole equipment.By adding a little extra protection circuitry in the form of over-voltage protection, it is possible to protect against this unlikely but possibly worrying possibility.

WORKING

The Battery supplies power to the over-voltage protection circuit. This circuit limits the voltage from the supply. The output(9V) of the over-voltage protection circuit is given to the buck converter(LM2596). The LM2596 reduces the input 9V to 5V which is an appropriate supply voltage for NodeMCU and PCF . The Current sensor senses the state of charge of the battery. The Outputs from the temperature sensor(LM35), Current sensor and voltage divider bias circuit is given as input to the PCF ADC channels. These channels convert the analog input to digital values /output. The digital date from the PCF is given to NodeMCU. The MQTT(Message Queuing Telemetry Transport) software is installed in NodeMCU. The MQTT is a light weight publish and subscribe system where you can publish and receive messages as a client. This is a simple messaging protocol, designed for constrained devices with low –bandwidth .So, it's the perfect solution for internet of things applications .MQTT allows you to send commands to control output, read and publish data from sensor nodes and much more. Therefore, it makes it really easy to establish a communication between multiple devices . The
MQTT broker is primarily responsible for receiving all messages, filtering the messages, decide who is interested in them and then publishing the message to all subscribed clients. The Measured datas from the sensors is displayed on mobile application (Linear MQTT Dashboard) via NodeMCU . GSM SIM800L is connected to NodeMCU . This helps to send SMS alert to the client when the battery status is critical.



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CONCLUSION

Thus we have discussed about the battery monitoring and management for fuel vehicle via mobile application by NodeMCU using MQTT protocol. By implementing this idea we can resolve various issues such as alternator issue , improper fuel injection , engine shutoff , head light problem , improper functioning of display and many more.

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