# Research of Battery Monitoring System on Vehicle

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## Abstract

Due to the relatively lack of monitoring technology for automotive batteries. Battery's life too short due to phenomenon of overcharge and overdischarge for the battery. Presenting intelligent battery monitoring system which could monitor SOC of battery and supply necessary information. Thus, this system can prevent to reduce the mounts of vehicle faults due to battery problems. It can extend life of the battery and qualities.

## Keywords

Battery, IBS, SOC.

## 1. Introduction

At present, domestic and foreign OEM vehicle battery monitoring technology is relatively lacking, and automotive engine started in addition to the need for fuel energy, battery power is also essential for energy. If the battery can not provide sufficient power, the engine will not start, and if there is nothing to do with the fuel, and this will lead to the abnormal engine stop [1]. In addition intelligent alternator also need to know the status of the battery to the battery for a reasonable charging to extend its life [2].

Remaining battery power is as important as gasoline. It monitors the operating status of the battery and calculates and displays the remaining battery charge [3]. Its core mission is to more accurately predict the dynamic use of the battery's remaining capacity. However, due to the complex nature of the battery, this prediction is very difficult, for the current widespread use of lead-acid batteries [4]. At present, SOC estimation methods include test discharge method, internal resistance method, open-circuit voltage method and Kalman filter method. It is difficult to accurately measure the coulombic efficiency, the influence of the ambient temperature and the change of the available capacity of the battery [5]. The traditional open-circuit voltage method requires the battery to stand for a long time before a stable open-circuit voltage can be obtained The Kalman filter method needs to consider complex modeling of many factors, which can only be applied to the car parking state, rather than to the dynamic SOC estimation [6]. Battery charge state estimation methods are many, but mostly for electric vehicles, the traditional fuel vehicle battery operating conditions and its very different. In addition, by the actual vehicle controller performance, automotive starter battery working conditions and manufacturing costs and other factors, the above method for real-time access to on-board battery state of charge there is a certain shortage [7,8].

Therefore, an on-line monitoring method of automobile battery based on open-circuit voltage is proposed. The on-line monitoring method does not need modeling. It only needs to collect the terminal voltage and current of the battery to monitor any car battery in real time and estimate SOC.

## 2. System Components

BCM and IBS constitute the automotive LIN network, BCM and IC constitute the automotive CAN network, as shown in Figure 1. Figure 1 shows the system structure of the system, the system is mainly composed of battery sensors (IBS), body controller (BCM), generators and instruments (IC).

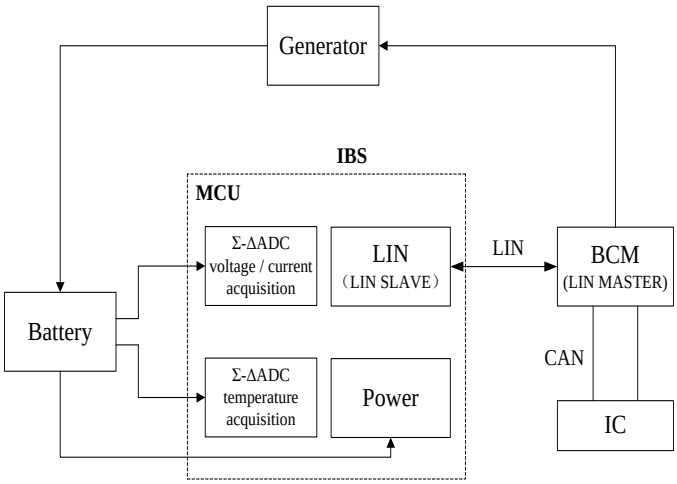


Fig.1 Battery monitoring system

The battery monitoring system uses Freescale's MM912J637 as the main control chip, the chip fully integrated battery monitoring device using the local Internet network (LIN) for communication. It includes a dual 16-bit digital-to-analog converter (ADC) that measures both battery voltage and current, as well as a separate 16-bit analog-to-digital converter for temperature measurement. The MM912J637 Smart Battery Sensor supports accurate current measurement through an external shunt resistor located on the negative side of the battery; accurate voltage measurement is supported through a series resistor located at the positive terminal of the battery. The integrated temperature sensor in combination with the battery mounting bracket allows accurate battery temperature measurement.

The parameters such as SOC, temperature, voltage and current are collected and transmitted to the bus controller (BCM) through LIN bus. The BCM will send the information to the CAN bus. To the instrument controller (IC), the information to prompt the information displayed on the instrument; the other BCM through the collection of information to the battery after the judge whether the battery charge to control the working state of the generator.

## 3. Software Flow

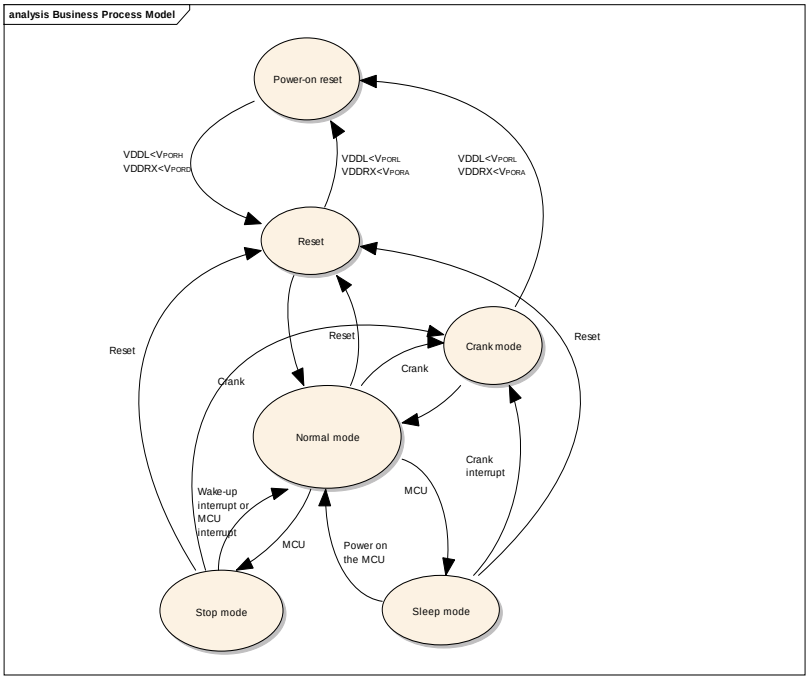


Fig. 2 Software flow chart

### 3.1 SOC Calculation

Since the open-circuit voltage has a good linear relationship with the OCV, according to the superposition theorem, the current and voltage are collected from the battery terminal. Assuming that the voltage collected in a very short time is linearly related to the SOC, the battery terminal voltage Can be broken down into:

$$v(t) = v_{zi}(t) + v_{zs}(t) \tag{1}$$

$$= v_{zi}(t) + h(t) * i(t) \tag{2}$$

Which is a zero input response, the terminal voltage is not open-circuit discharge current is zero-state response, the terminal voltage is zero, the discharge current as input.

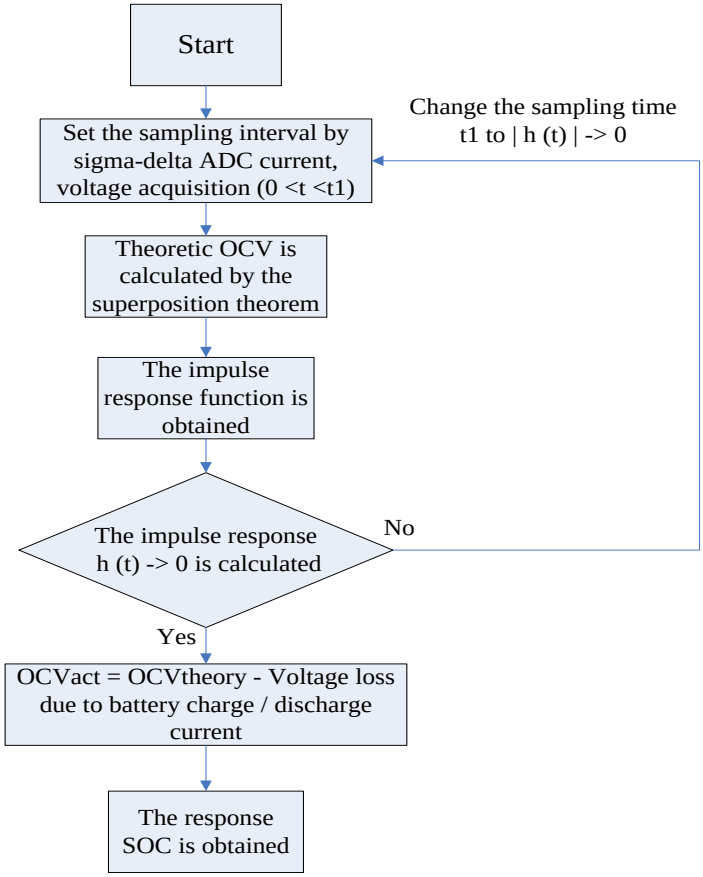


Fig.3 Method of battery monitoring system

### 3.2 Execution and Analysis

In this paper, there is no specific circuit model, for any new battery does not need to pretreatment, only need to know the type of battery SOC and OCV corresponding relationship can be used. In addition, the stability of the data analysis, the use of Σ-ΔADC analog-digital conversion technology, which integrates precision measurement channel on-chip buffer, programmable gain amplifier, 16-bit Σ-Δ modulator and digital filter to 12V car battery The system accurately measures current, voltage, and temperature variables. In addition, for the robustness analysis of the algorithm, since the minimum value obtained by the superposition theorem for each sampling interval is still the smallest value in the next sampling interval, the error will not be accumulated.

$$OCV_{act} = OCV_{theory} - \int_{t-t_e}^{t_w} i(\tau)h(t-\tau)d\tau \tag{3}$$

## 4. Testing and Verification

In order to understand the characteristics of the battery, the new lead-acid battery discharge test, in the laboratory environment, 25 ℃ environment; the battery idle 24 hours after the measurement of a stable open circuit voltage; 0.05C discharge current discharge; Until the SOC reaches 0%. Using the algorithm in this paper, the SOC is estimated and compared with the real SOC value to judge the reasonableness of SOC estimation method and achieve the purpose of real-time online monitoring.

The real-time on-line monitoring capability of the battery monitoring system is verified by simulating the BCM node and IC node in the CAN-LIN network. When the remaining battery capacity (SOC) reaches 90%, BCM through the LIN bus to get the information and control messages sent BCMmsg, the control signal BCMclt_alternator cleared to close the generator, to stop the battery charge, as shown in Figure 4 .

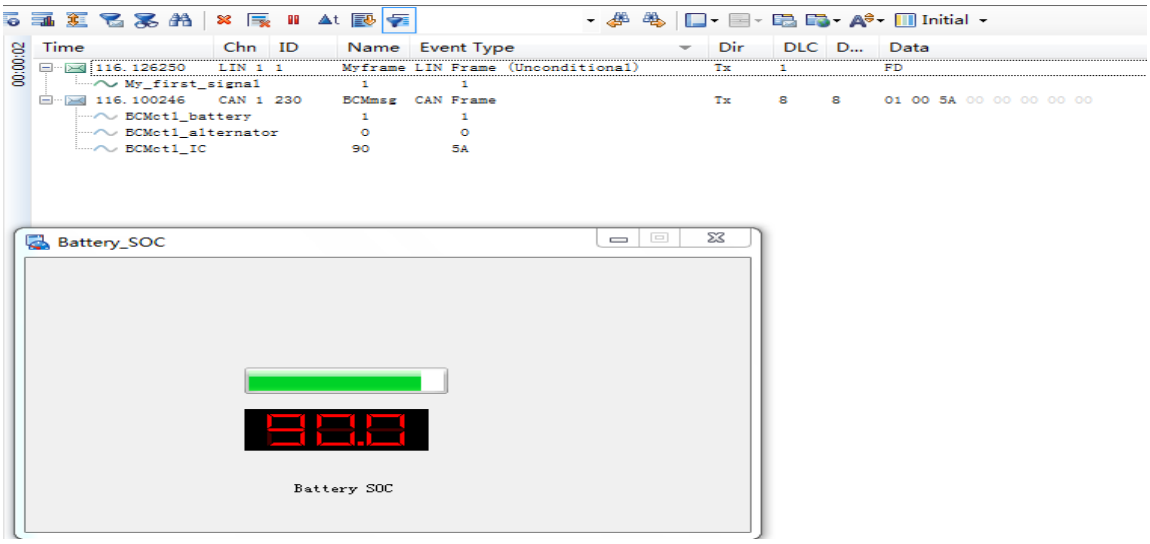


Fig.4 Online monitoring 1st

When the battery remaining capacity (SOC) reduced to 10% of the time, BCM through the LIN bus to get the information and control messages sent BCMmsg, the control signal BCMclt_alternator set, open the generator, the battery charge, as shown in Figure 5.

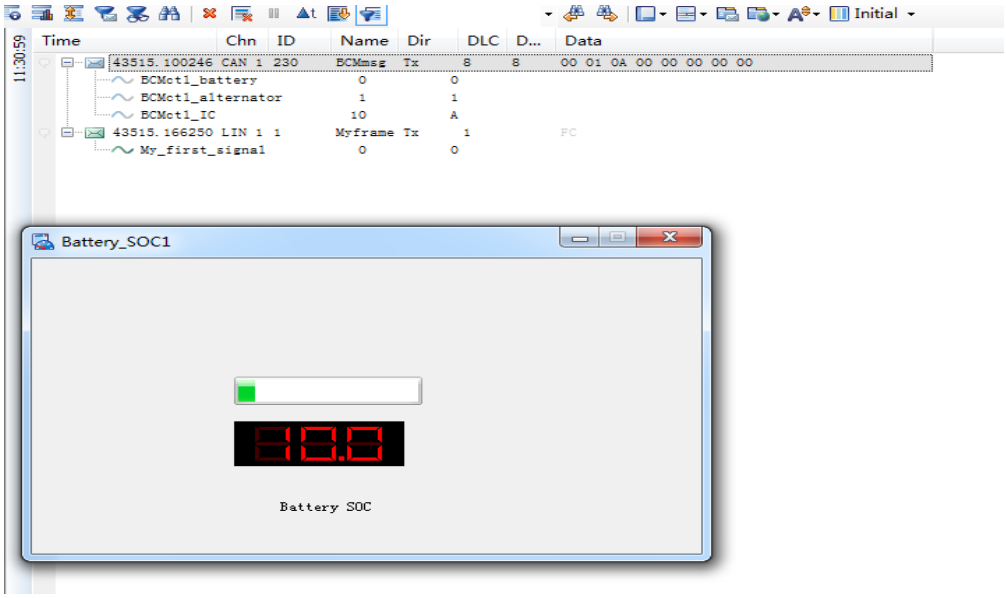


Fig.5 Online monitoring 2nd

## 5. Conclusion

Through the test, the intelligent test system can real-time monitor the battery through the calculated SOC value, and can accurately measure the SOC of the battery through the modified open-circuit voltage method to prevent the vehicle start failure caused by the battery failure, and extended the battery life.

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