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Original Research Article

# Design of new energy vehicle fuel cell management system based on internet of things

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***Abstract:*** The rapid expansion of the new energy vehicle market has brought great opportunities to the fuel cell management system (BMS) industry. The high growth dividend of new energy vehicles has driven the explosion of the demand for battery management system, and the industry has ushered in a golden era. Efficient, safe fuel battery management system (BMS) is the key to guarantee normal operation of new energy vehicles, with the increase of number of new energy vehicles, fuel battery management system (BMS) in the future market will accelerate explosion, through the fuel battery management system (BMS) research and development, manufacture, arrangement in use and the battery data would be more competitive. Establishing a unified industry standard, improving the quality of fuel cell management system (BMS) products, and reducing production costs and prices are the key issues in the domestic fuel cell management system (BMS) field, and the increase of market concentration will help accelerate the solution of these problems. Promote the rapid and healthy development of fuel cell management system (BMS) and new energy vehicle industry. This paper proposes and "realizes" the design and use of new energy fuel cell management system (BMS) based on the Internet of Things (IOT) technology through remote control, real-time data detection, emergency solution and other aspects.

***Keywords:*** Internet of things; New energy; Remote management

## 1. Introduction

The first new energy vehicle is a new energy electric vehicle invented by Robert Davidson, a British man, in 1873 with primary battery power, which has become the earliest available and practical electric vehicle in the world. Later, in 1881, French engineer Gustav Truff built a tricycle driven by lead acid battery, which was also the world's first lead acid battery new-energy electric car. In recent years, under the background of global petrochemical exhaustion and increasingly serious environmental pollution, electric vehicles have developed vigorously with national subsidies, national policies, green environmental protection, low noise and low travel costs, and the complete industrial chain has rapidly entered the industrialization stage[1]. But in the context of the current era of big data, the development of new energy vehicles still has great space for development and the market, in the concept of "all things" the Internet and gradually after the implementation of a growing number of articles for daily use tend to be more intelligent, and in the auto industry, for now, the market of fuel battery management system (BMS) is not very complete, There is still a lot of room for the reform and development of fuel cell management system (BMS).

## 2. Value of fuel cell management systems (BMS) in the current market

The rapid expansion of the new energy vehicle market has brought great opportunities to the fuel cell management system (BMS) industry. The high growth dividend of new energy vehicles has driven the explosion of the demand for battery management system, and the industry has ushered in a golden era. Fuel cell management system (BMS), as an important link between power battery and new energy vehicle, is very important for

the good operation of vehicle system[2]. The survey results show that in 2017, the market size of new energy vehicle battery management system industry is about 3 billion yuan, and in 2020, the market size has exceeded 32 billion yuan, and due to the poor consistency of domestic batteries, fuel cell management system (BMS) role is more significant.

Efficient, safe fuel battery management system (BMS) is the key to guarantee normal operation of new energy vehicles, with the increase of number of new energy steam, fuel battery management system (BMS) in the future market will accelerate explosion, through the fuel battery management system (BMS) research and development, manufacture, arrangement in use and the battery data would be more competitive. Establishing a unified industry standard, improving the quality of fuel cell management system (BMS) products, and reducing production costs and prices are the key issues in the domestic fuel cell management system (BMS) field, and the increase of market concentration will help accelerate the solution of these problems[3]. Promote the rapid and healthy development of fuel cell management system (BMS) and new energy vehicle industry.

The discharge equations of organic hydrocarbon and lithium batteries are shown in the formula.

$$CxHyOz+(2x+y/2-z)/2O2=xCO2+y/2H2O,\ Li+MnO2+=LiMnO2 \quad (1)$$

## 3. Structure of new energy fuel cell management system (BMS) based on internet of things

Fuel cell management system (BMS) mainly analyzes and statistics the real-time state of the vehicle battery through electronic detection equipment, accurately estimates SOC, SOP, SOH, effective power balance control strategy, fault tolerance and error correction mechanism, and finds the problems of the vehicle battery based on the safety lameness model. Real-time data detection and remote control can effectively reduce the occurrence of sudden accidents in the operation of vehicles. Long-term data statistical collection is used to find and solve the problems existing in fuel cells and realize the improvement of fuel cells[4]. A set of new energy fuel cell management system based on the Internet of Things needs to be based on remote control, real-time data collection and transmission, and emergency response to ensure efficient and safe fuel cell management.

The fuel cell management system designed in this paper uses on-board computer as a medium to achieve remote control. The system mainly consists of the following parts: real-time data acquisition system, detection system, integrated network transmission interface, remote control platform, data analysis and collection platform, data feedback platform and emergency response system. At the same time, the whole system is designed with decentralized distributed architecture technology to ensure the operability, practicability, security and efficiency of the system.

Detection system: The operating status of the fuel cell is monitored by sensors installed on the fuel cell. At the same time, temperature sensors are set up in each area of the system to fully perceive the thermal field distribution of the battery system. During the charging and discharging process, the input and output current of the battery will be recorded in real time to provide an effective basis for evaluating the battery status[5, 6]. The battery management system also monitors the insulation characteristics of the battery to ensure that the high voltage of the battery is fully isolated from the car body to ensure safe operation.

Real-time data acquisition system: installed in the vehicle computer system, through the detection system of the fuel cell real-time status of the charge and discharge current of the battery, real-time temperature and the operation of the battery in emergencies or extreme weather and other information.

Integrated network transmission system: a complete network pure system is very important, the collected information will be transmitted to the control platform through the integrated network transmission system.

Data analysis and collection platform: summarize and analyze the information collected by the real-time data collection system, analyze, calculate, count and summarize the collected information through the algorithm, make the corresponding information summary table, and classify and deal with the same or individual problems existing in all kinds of trams.

Remote control platform: connected with the data analysis platform through comprehensive network transmission interface, and stored in the user's mobile phone in the form of QPP, feedback the data collected by the data analysis and collection platform to the user, so that the user can know the status of their own vehicle battery and whether there are security risks.

Data feedback platform: through the network transmission interface, the analyzed data will be fed back to the on-board computer, so that the car owner can know the running status of the vehicle fuel cell system in real time through the on-board computer or mobile phone[7].

Emergency response system: This system is used to deal with all kinds of unexpected situations encountered, such as driving or extreme weather. Separate procedures and permissions are required when relative measures are enabled.

Embedded in the on-board computer program and connect to remote control platform, data analysis, collection platform, all kinds of emergency input chip, in the process of emergency or in the driving experience extreme weather , and so on and so forth, fuel battery management system can make the corresponding counter measures (power), in order to protect the vehicles and the safety of the user.

# 4. Development and design of fuel cell management system based on internet of things

## 4.1. System development

The development of a system is based on good software and voice programs. Taking general, practical and accurate factors into consideration, the following facilities are used for programming, as shown in **Table 1**.

**Table 1.** Table of facilities.

| **operating system** | **Windows 10** | |
|---|---|---|
| development tools | MyEclipse | SQLAERVER |
| Programming language | Java | Python |
| Server software | Tomcat 7.0 | |

Tomact can provide free source code and stable performance. Java is favored by programmers for its simplicity, object-oriented, distributed, robust, security, platform independence and portability, multi-threading, and dynamic characteristics[8, 9]. Python has gradually stepped into the field of artificial intelligence in recent years. The technology mentioned in this article has a certain reference guiding role in the use of Java programming is to use the coding table and formula 2 shown in **Table 2**.

**Table 2.** Coding table.

| **header** | **filter value** | **partition** | **Commodity bar code** | **Device type and function set** |
|---|---|---|---|---|
| 8 | 3 | 3 | 44 | 40 |
| 0011<br>0110 | 100 | 101 | binary | binary |

$$8bit+3bit+3bit+44bit+30bit+6bit+34bit=128bit=16Byte \quad (2)$$

## 4.2. Distributed architecture

Distributed architecture has the advantages of strong scalability, high decoupling degree, good performance expansion and redundancy. Because the system has many parts in the actual application process, distributed architecture improves the availability of the system, and will not cause global failure because of a single point of failure. The advantage of decentralization is that the whole system has no main system but is an independent main system, which solves part of the problems of the existing fuel cell management system.

### 4.3. System operation process

To develop a new mobile phone app or web page, the app (web page) should be connected to terminals and fuel battery management system of system, the app page show the login interface, the commonly used vehicles can be binding after login, or through the on-board computer bluetooth, cable connection with vehicle binding, binding after the app to get the corresponding permissions[10]. With the obtained permissions, the system terminal will collect, analyze and process the information through the APP to the mobile phone of the car owner (voice broadcast can be set up, voice broadcast in case of abnormalities). At the same time, a reporting cycle can be set up, and the summarized information analyzed by the system can be transmitted to the user concisely. Users can know what aspects of their vehicle problems need to be addressed. Of course, not everyone will use the same car, so we can still use wireless connection to temporarily bind vehicles through WiFi and Bluetooth, and the wireless connection can greatly reduce the problems existing in using temporary vehicles in many cases.

## 5. Conclusion

Based on the brief analysis of the new energy fuel cell market, this paper briefly describes the design and development of fuel cell management system. In a distributed architecture design to the whole system, solved the general system will lead to full system for a certain component failures according to the failure problem, the system's main job is through a wireless connection to the owner of vehicle battery management, through the analysis of the underlying summary, device node management, and other operation to complete understanding of the fuel cell vehicle real-time situation, It can timely find the problems of the vehicle battery to avoid accidents caused by the failure of the vehicle battery. The system still has a lot of places to improve, the development of the basic platform and software design is not fine enough, and in the later operation design can be added to the security protection system, to prevent information leakage, stolen and tampered with by lawbreakers.

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