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Design of Remote Monitoring and Evaluation System for UPS Battery Performance

Chunjie Hou, Jiabin Wang and Chun Gao

Daqing Oil Field Chemical Co., LTD, Daqing, China
hcj0302@163.com

Abstract

For the case of each unit battery status parameter of UPS is unpredictable, this paper develops a remote monitoring system, through the connection of local monitoring software and remote monitoring software, interacting database and human-computer to complete this system. Practice has proved that this system can secure stable operation and better meet the requirements of the UPS battery remote monitoring technology.

Keywords: *ups battery; remote monitoring system; system design*

1. Introduction

Mostly battery of UPS Source is VRLA, now the existing equipment monitors battery voltage and the total current, it is unable to monitor single battery parameters such as voltage, capacity, resistance, it is unable to decide charge and discharge, low capacity, failure which battery appear, after failure also cannot provide alarm information, and remind staff to change in time [1-3]. When the city network is not normal power outage or long power outage, it will cause that the battery vent discharge or not normal, we will not be able to guarantee the normal work of the UPS system, then the resulting adverse impact is enormous. Such as before the battery is depleted, the message of the city power outage do not notify the administrator, then it cannot be timely turn off all kinds of network equipment, it will lead to running the software, the system data is lost or damaged, it will affect the daily work of the normal and cause serious losses to the enterprise. Therefore, it need to implement control of UPS system for online monitoring, through the remote real-time monitor the battery's working state and degradation degree and fault alarm and other functions, so as to prolong life of UPS battery [4].

To solve this problem, this paper designs the remote monitoring software, implementing online real-time monitoring to data of battery pack, these data include voltage, current, temperature and resistance [5-7]. The software can complete on assessment which is in the remaining power and the health of the battery to ensure the stable operation of UPS batteries.

2. The Overall Structural Design of the Monitoring System

According to the need of the UPS battery cabinet features to configure a corresponding battery tester, through 485 communications and network communications, the data of UPS battery status which is monitored transmit to the local engineering stations for real-time display and monitoring, through network the engineer station software system uploads data to the database, remote monitoring platform system achieves remote battery state monitoring and alarm. The design of system structure is shown in Figure 1.

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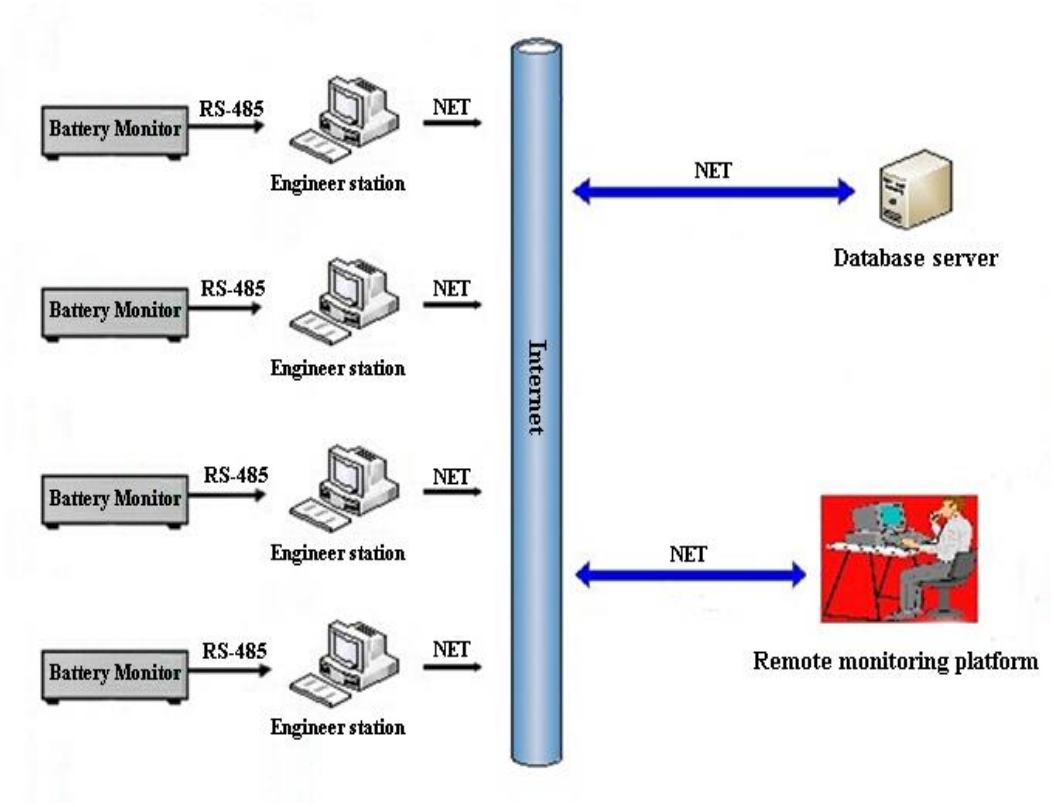

Figure 1. The Design of System Structure

3. The Design of Remote Monitoring System Software

3.1. The Design of Monitoring Software of Local Engineer Station（DS）

Connecting the battery monitor and monitoring system, through 485 module communication and communication protocol of the battery tester, Software's platform uses C++ as a development language which is used to the industrial field.

Step 1, by modifying the IP address, subnet mask, default gateway, Making serial port baud rate, data bits, stop bits, parity, local port number to match MCU transfer program , so as to perform data reception and transmission [8-10].

Step 2, by passing the byte data of battery monitor, the data is converted into the data which need to be displayed. Though data display on the software of local real-time monitoring system, so engineers can monitor and transmit real-time data of battery to the database, in order to monitoring personnel can remotely monitor the data of each individual battery. The design of local real-time monitoring system is shown in Figure 2.

Figure 2. The Design of Local Real-Time Monitoring System

3.2. The Design of Remote Monitoring Software

System should ensure that the normal operation of the DS (local engineering station monitoring software for short) and WEB application system can communicate, and open specified TCP port, its operation can be divided into the following three steps.

Step 1, When WEB application start up, then establishing a TCP service.

Step 2, DS through connects with the TCP, to send receive data which receive from hardware to WEB, The connection code is as follows:

```
dataSource.username=sa
dataSource.password=snow
data.dbCreate=update
tcpservice.port=8888
```

Among the connection code, tcpservice.port is the start of the TCP listening port, through the port which DS software agrees connect to equipment and software and transmit data.

Step 3, WEB application via a communication protocol, the data is parsed into data format which WEB requires and stored in the database. The design of the remote online monitoring system is shown in Figure 3.

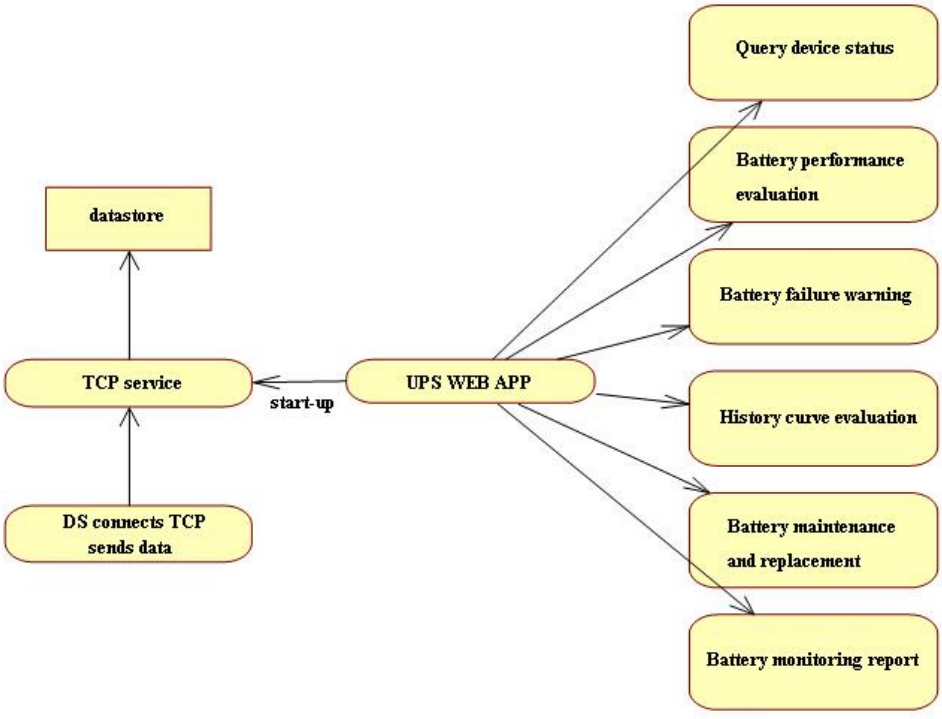

Figure 3. The Design of the Remote Online Monitoring System

3.2. Process Design

Through communicating the initialization of WEB program and DS software, completing the data transmission, so as to display the data in the remote monitoring system, the process design of remote system software is shown in Figure 4.

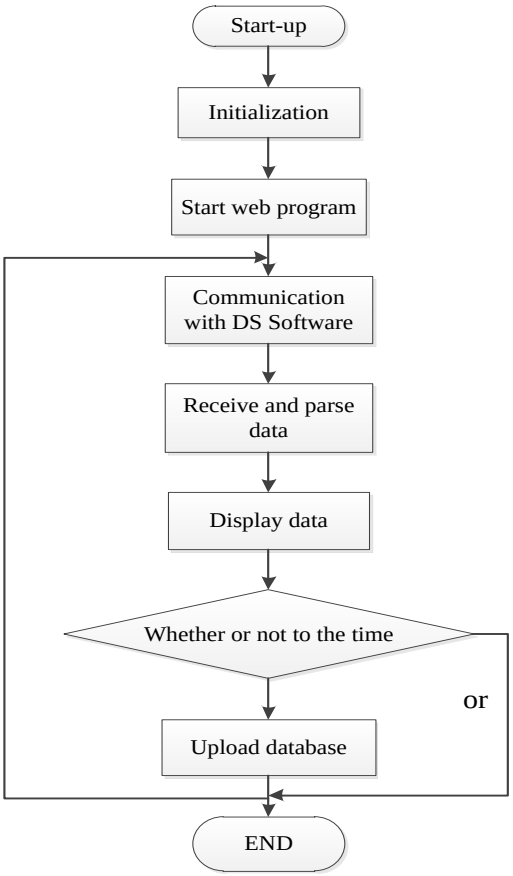

Figure 4. The Process Design of Remote System Software

4. Design and Implementation of Battery Performance Evaluation algorithm

4.1. Method for Evaluating Battery Performance

Due to measure the battery performance is mainly SOC and SOH, SOC characterizes number of the current a charge cycle battery power remaining or length of remaining running time. Accurate SOC estimation can balance the difference between the monomer battery, optimizing the strategy of charging and discharging, to prevent overheating and prevent overcharge and over discharge. Relative to the new battery, SOC characterizes the battery capacity that stores electric energy and energy. It is a quantitative description of the state of battery performance indicators. With the charging and discharging, SOH shows a downward trend. At the present time, the research ideas of SOH is from the battery aging mechanism of angle, which describes the battery capacity attenuation and impedance increase; from the experimental point of view, describing the relationship between battery capacity attenuation and impedance increases [11-14].
So this system uses the real time data voltage U and the resistance R which transmit over though DS software. Through the related formulas are calculated, finally, the SOC and SOH values are displayed to the remote monitoring interface, in order to monitor the personnel can monitor the battery state [15-16].

4.2. Design of SOC and SOH Prediction Algorithm for Battery

Selection of SOC estimation method:

$$SOC = \frac{U_{now} - U_{min}}{U_{max} - U_{min}} \times 100\% \quad (1)$$

In the formula, U_{min} is single battery minimum voltage, U_{max} is single battery highest voltage, U_{now} is current battery voltage.

Selection of SOH estimation method: The aging process of the battery is often accompanied by changes in the internal resistance of the battery, so you can to estimate the health status of the battery through the battery internal resistance, the battery internal resistance indicates that the battery SOH [17].

$$SOH = \frac{R_{now} - R_{new}}{R_{old} - R_{new}} \times 100\% \quad (2)$$

In the formula, R_{new} is the new battery internal resistance, R_{old} is aging resistance of the battery completely, R_{now} is the current battery internal resistance.

Implementation-dependent code is shown n Figure 5.

```
g_CurrentBatData[m_nArkID].BatteryData[k].dwSOC = (g_CurrentBatData[m_nArkID].BatteryData[k].Voltage
    -g_nSVoltageMin[m_nDeviceID])*100/(double)(g_nSVoltageMax[m_nDeviceID]-g_nSVoltageMin[m_nDeviceID]);

g_CurrentBatData[m_nArkID].BatteryData[k].dwSOH = (g_CurrentBatData[m_nArkID].BatteryData[k].Resistance
   -g_nSResistanceNew[m_nDeviceID])*100/(double)(g_nSResistanceOld[m_nDeviceID]-g_nSResistanceNew[m_nDeviceID]);
```

Figure 5. Implementation-Dependent Code

4.3. Monitoring System Data Curve Analysis

Through the real-time data make curve simulation analysis, The single battery number 1-10 for example, respectively, simulating the voltage of single battery and the SOC curve, the resistance of single battery and the SOH curve, as is shown in Figure 6 and Figure 7.

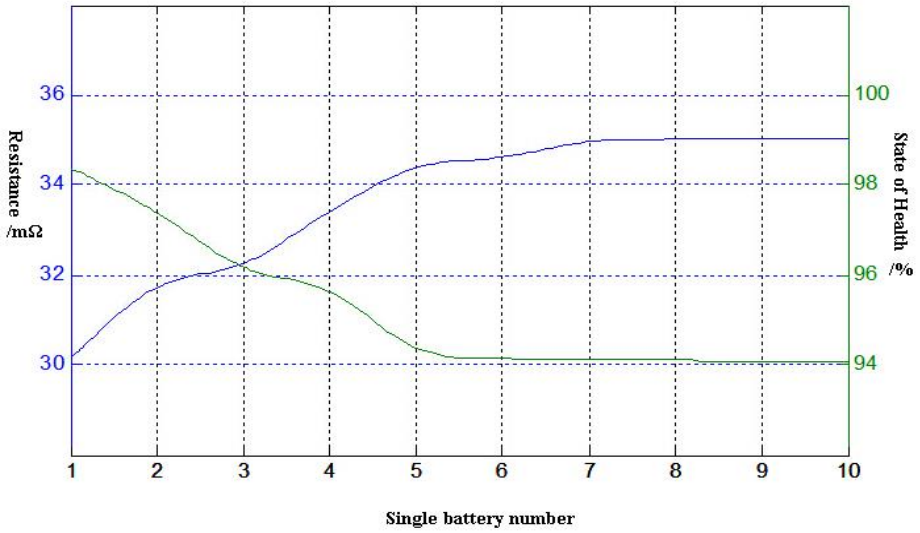

Figure 6. The Resistance and SOH Curve

As can be seen from the figure, No.1-10 individual battery's the remaining charge

SOC> 50%, the battery is in use, has been in a shallow discharge status, which is conducive to extend battery life.

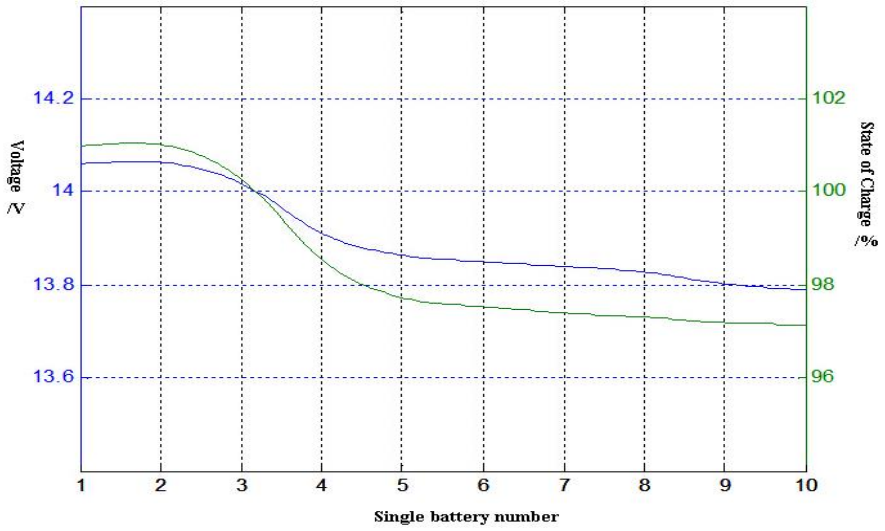

Figure 7. The Voltage and SOC Curve

According to the standard of IEEE1188-1996,SOH>80% explain that the battery is in a healthy state, the battery SOH of the health status are more than 90%,illustrating the numbers 1-10 monomer battery are in the state of health, This monitoring system can evaluate the performance of the battery with flying colors.

5. Conclusion

This system use visual studio2010 platform, via the LAN and WAN, serial and parallel communicating way of data, four monitoring and management, open communication interfaces for a variety of network resource requirements (RS232, WIFI, RS485, TCP / IP, *etc*), Achieving on-line monitoring of each battery testing equipment. And using the unified management of the database which keeps records of the whole history of monitoring data, it can timely analysis and judges the degradation degree of the battery. The parameters of the single battery voltage, internal resistance, ambient temperature and other can be judged professionally and synthetically, giving a standard which determines whether the battery is dead. It is proved by practice that the system can monitor the state parameters of the battery well.

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