Design of Intelligent Battery Management System

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Abstract: The battery voltage of light electric vehicles in China mainly focus on the 48V. In order to achieve wireless charging of light electric vehicles, the lead-acid battery 48V\28Ah as the design object, AT89C51 microcontroller to control the core management, construction of the battery management system of fieldbus technology and smart battery monitoring chip based on DS2438, it has the advantages of low cost, stable, reliable, has the advantages of high performance. We have shown good performance in our experimental studies. In this paper, the hardware design and software design of the battery management system are introduced in detail.

1 INTRODUCTION

In recent years, China's light electric vehicles (electric bicycles, electric Qingqi Motorcycle) in the large-scale industrialization has attracted worldwide attention. At present, the battery voltage of light electric vehicles in China are mainly concentrated in 48V.

The battery management system of electric vehicles is a set of monitoring, control and management as a whole, the battery management system should be able to monitor the battery terminal voltage, current, temperature and charge discharge when the cumulative value, to ensure that the battery life will not be reduced due to excessive overcharge and over discharge, the battery management system should also give a more accurate estimation of battery remaining power. In recent years, the battery powered portable household appliances and the use of a large number of instruments, the battery for online monitoring of the surge in demand. Abroad introduced for monitoring the battery intelligent dedicated chips, such as the United States DALLAS series chips, they have a high degree of integration, low price and strong functional advantages. Relying on its ability to develop a high performance price ratio of 48V battery management system.

In this paper, the design of 48V battery intelligent management system is composed of intelligent battery monitoring chip DS2438, MCU AT89C51, liquid crystal display L1602A and a keyboard. Specific process is as follows: 51 microcontroller a DS2438 sampling according to the command of key operation, DS2438 chip after receiving the order to monitor the real-time state of the battery and sampling, sampling results stored in the corresponding internal registers, after sampling, read by the microcontroller 51 and after processing, the results will be used as communication message display.

2 CHIP INTRODUCTION

The system uses the chip mainly has the intelligent battery monitor core DS2438 and the MCU AT89C51

2.1 Intelligent Battery Monitoring Core DS2438

DS2438 is Dallas company launched a micro chip specially used for battery detection, the chip has a unique way of single bus work, requires only one data line, realize the data input / output; chip integrated temperature sensor, A/D converter, current integrator circuit, has the function of measuring the temperature and voltage of battery current and cumulative power etc.. Measurement of

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Design of Intelligent Battery Management System

the temperature range of -55°C to 125°C temperature resolution of 0.03125 degrees. The built-in ten bit A/D converter for battery terminal voltage measurement, measurement range 0~10V, resolution is 10mV; built-in current A/D converter, current measurement of battery, the two voltage is supplied via an external resistor on the RSENS voltage drop or current transformer with a sampling rate of 36.41 times per second to the current register in the built-in accumulator; current (ICA) measurement, storage charge and discharge current cumulative value of time (cumulative ah), can be used to estimate the remaining battery power; 40 bytes of EEPROM memory built-in power does not disappear, important parameters used to record battery characteristic data; it has the advantages of small volume, powerful function and low price measurement is. A method of measuring the chip with high ratio of performance to price. Its pin as shown in Figure 1, only six valid pin ports, the hardware connection is simple.

DS2438 pin assignment is shown in Figure 1:

DQ - data input / output

Vad - Universal A/D input

Vsens+ - the input terminal of the battery current meter

Vsens- - the output terminal of the battery current meter

Vdd - power supply side (2.4V ~ 10.0V)

GND - ground

NC - no definition (Jiapeng Yan,2011)

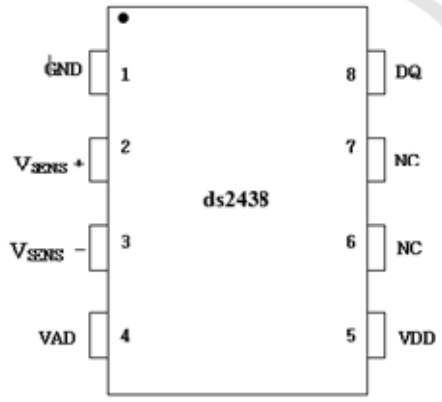

Figure 1： The leads package of the ds2438

2.2 MCU AT89C51 Brief Introduction

89C51 is a low power, low voltage, low price, high performance 8 bit microcontroller, can be flexibly applied in a variety of control areas. The on-chip Flash ROM allowed in the system or use the programmer and can be reprogrammed, cyclic endurance up to one thousand times more than. The thirtieth microcontroller AT89C51 pin ALE/PROG is the address latch enable signal end of the pin second function as the 89C51 chip Flash ROM to burn into the curing procedure when the program pulse input port, this paper uses the pin second function, so it is set to a low level; the thirty-first pin EA/ VPP is the external program memory address allows input curing / programming input voltage, when the pin is connected with the high level of CPU, Flash and ROM access on-chip implementation of internal ROM instructions in the program counter, when more than 0FFFH, will automatically turn off chip ROM to execute the program, and when the pin low level, CPU will only access off chip ROM in this paper, using the 51 compilers will program in curing the 4KB Flash in ROM, so the pin is set to high state. AT89C51 serial port and the serial communication technology, this paper use 51 MCU programming realization, its working principle is through the RS-232C interface communication standard MAX232 SCM and PC machine, 51 programmer procedures can be directly burned into the microcontroller program memory 51, its principle is shown in figure 2.(Fuzhao Zhong,2014)

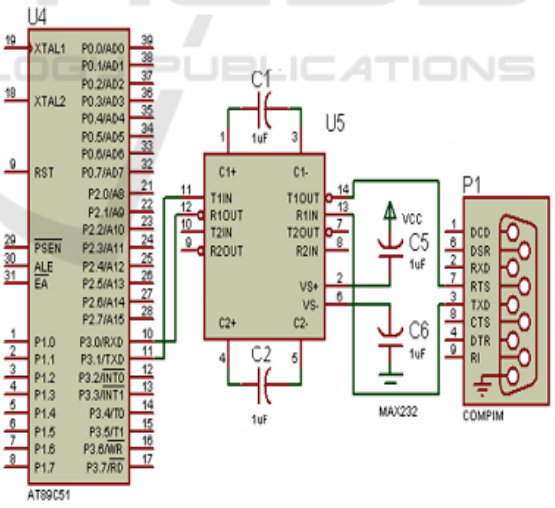

Figure 2: Schematic of 89c51's serial communication

3 HARDWARE DESIGN SCHEME

51 MCU control display is used to display status information users need to know the battery current, the keyboard is the information input way for users

347

on the battery management system, the user can control the microcontroller through the operation button enter the corresponding interrupt subroutine, the battery information collection. The sampling system will be stored in the sampling parameters in the DS2438 or 51 microcontroller with a nonvolatile E2PROM or static ROM, so the system has the function of power down protection. 51 single chip microcomputer as the control and processing core of the battery information collection subsystem, the main software of the sampling control process was completed, which obviously reduced the hardware complexity of the system.

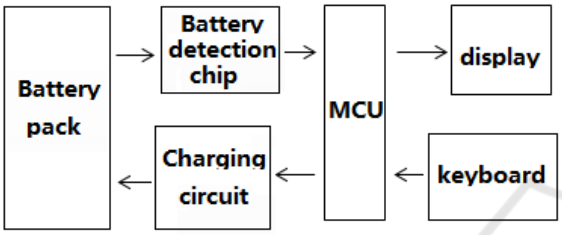

Figure 3： The structure of battery management system

Single chip using 89C51. Because the 89C51 chip has ROM 4K, without further expansion of external memory, the entire system is very simple. Single chip and DS2438 data acquisition board potential, in accordance with the communication protocol provided by DALLAS company, in the way of field bus data transmission, the following components of the system.

Voltage measuring circuit ： Using the built-in DS2438 voltage A/D converter to measure the terminal voltage of the entire set of cells. Because the voltage measurement range of 0~10V is DS2438, the terminal voltage of the battery group is 48V, so the voltage dividing circuit is used to be applied to the voltage measurement range of DS2438.

Current measuring circuit: Using the built-in DS2438 current A/D converter to measure the battery charge and discharge circuit. The sampling resistance is connected to the battery charging (discharging) electric circuit, and the charging and discharging current of the battery can be measured by measuring the resistance voltage drop of DS2438. From the current built-in accumulator (ICA) chip, automatically calculate the battery charge and discharge current cumulative value of time, when charging accumulated value is increased, and the discharge is decreasing. After proper treatment, the estimation of the remaining power of the battery can be used.(Zhou Guan,,2015)

Temperature measurement： DS2438 chip close to the battery, so as to measure the battery shell temperature, and display and LCD display.

The cumulative ah ： In order to estimate the remaining battery charge and discharge, the total is very important ah. When accumulated not by SCM but by detection chip, DS2438 has a built-in current accumulator (ICA), battery charge and discharge current measurement of the cumulative value of time, charge is accumulated, discharge is decreasing. Cumulative value through the microcontroller, in the liquid crystal display.

LCD: liquid crystal display selection is the 1602 LCD screen, the display is used to display the battery voltage, current, power consumption, the remaining power estimation, battery temperature.

The original design of the LED digital tube to display the program, but the LED digital tube display not only occupy more than SCM resources, but also to maintain the LED digital tube display requires a lot of energy consumption, to achieve the display algorithm is relatively complex. LCD liquid crystal display module and MCU connection convenient, simple operation, and LED digital tube display compared to take SCM less resources, and low energy consumption, very suitable for the controller design, the final selection of the LCD1602 display system information.

The LCD1602 used in the selection of the standard 16 pin (with a backlight), pin distribution as shown in Figure4, pin is described below:

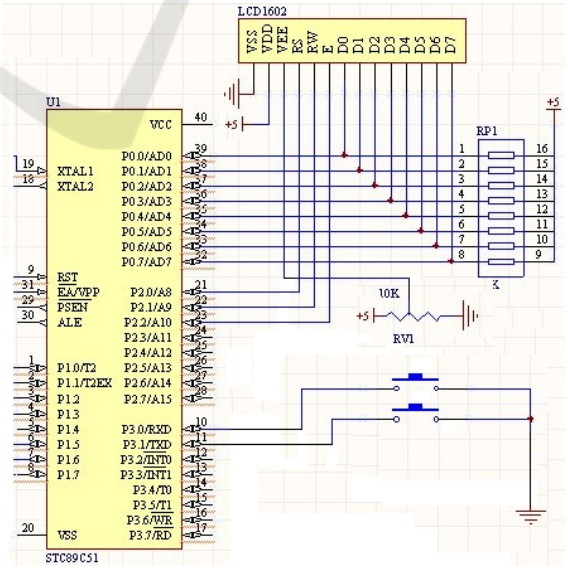

Figure 4 : Liquid crystal display circuit

348

Design of Intelligent Battery Management System

4 SOFTWARE DESIGN OF THE SYSTEM

The battery information collection subsystem designed to access the DS2438 by the use of 51 single-chip keyboard scanning and monitoring battery state parameters related to the acquisition, the specific work process is as follows: first initialize the 51 microcontroller, LCD display and smart battery monitoring chip DS2438, and then enter the keyboard scan subroutine, when scanning to press a button, determine the key No., enter the corresponding interrupt subroutine: DS2438 data acquisition subroutine calls corresponding to, after sampling, processed and displayed by the 51 microcontroller to read the collected data, and finally return to the re initialization

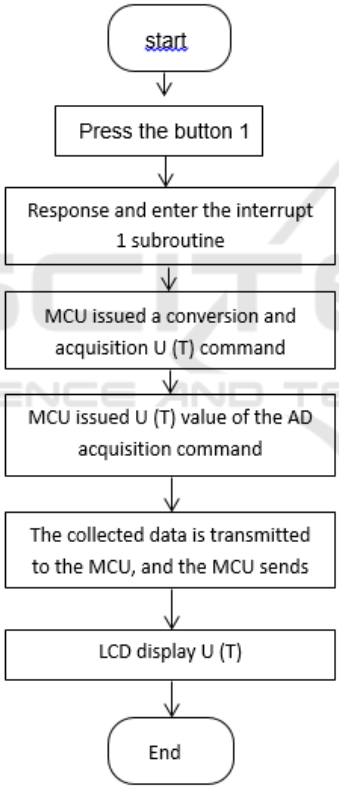

Figure 5 : The flow diagram of subprogram sampling battery Voltage

The battery information collection subsystem to monitor the battery voltage and temperature of the sampling process is as follows: firstly, 51 MCU detects a button 1 is pressed, determine the key commands by 51 DS2438 microcontroller sends control commands to collect voltage or temperature response, and enter the interrupt 1 subroutine, MCU by conversion of U (T) and U (T Collection) command, U (T) acquisition, delay U (T) transformation completed, the completion of U (T) after conversion, MCU by U (T) AD acquisition command value, collect the data to the microcontroller through a single bus, single-chip LCD display command issued, the acquisition of U (T), end.

Before the 51 MCU ready to register is read the contents of DS2438, to determine whether the DS2438 sampling end, judgment method is through the level of data line between DS2438 and 51 microcontroller, if the low level shows that the sampling is ongoing, you cannot read the data, only goes high can read the correct data. The battery information collecting subsystem monitoring of battery power supply mode and current sampling process is as follows: first by 51 MCU commands the current analog-to-digital converter DS2438, then the smart battery monitoring chip DS2438 will monitor the current sampling every 27.46ms the battery automatically flows in and out, and the results will be stored in the current register, then read by the microcontroller 51, at the same time through the S register in the current judgment to judge the state of charge and discharge of the battery, the software process is shown in figure6.

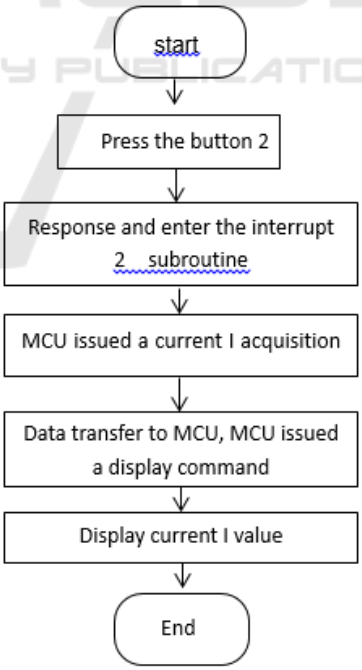

Figure 6 : The flow diagram of subprogram sampling battery current

349

5 CONCLUSIONS

This paper takes DS2438 as the battery information sampling chip, using AT8 9 C5 1 microcontroller to control the core management to build battery information collecting subsystem, and the lead-acid battery 48V for the design of hardware and software realization of battery information collection, which is characterized by powerful function and low cost, stable operation, reliable and in practical, our experimental study shows a good performance. We are willing to cooperate with the manufacturer, the technology is applied to the industrialization and industrialization.

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350