



Research Article

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### A new system of temperature acquisition based on ARM

Shuangyou Wang\*<sup>1</sup>, Cheng Feng<sup>1</sup> and Yongqiang Zhang<sup>2</sup>

<sup>1</sup>Software School, Handan College, No.560, Xueyuan Road, Handan, China

<sup>2</sup>College of Information Engineering, Handan College, No.560, Xueyuan Road, Handan, China

#### ABSTRACT

It gives a new type of multi-channel temperature acquisition system that is equipped with Samsung S3C2440 and combined the Can bus communications technology. This system implements the acquisition, management and displaying printing of the multi-channel temperature data on the industry site. According to the control information, it collects multi-channel temperature, then passes the temperature signal to total controller by the Can bus. The hardware and program flow is also presented. Experiments shows, this system has the advantage of collection temperature precise, high reliability, and communication distance. So it can be widely used in various industrial controls.

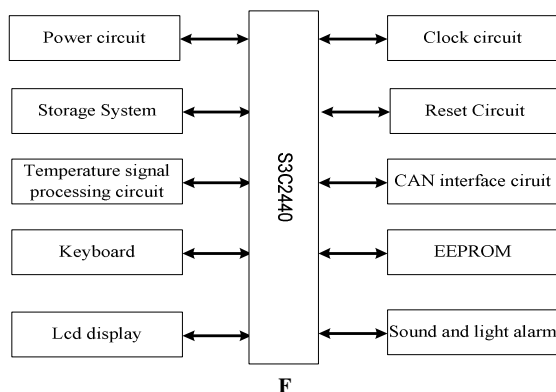
**Keywords:** Temperature date; S3C2440; Can bus; OS

#### INTRODUCTION

Currently the can bus is widely used in the field of industrial control. But there are few sensor types with the can bus interfaces, also, the price is very expensive. So with the can bus interface design of data acquisition system is a very important practical significance[8]. Based on the ARM processor and the can bus interface controller, I design CAN simultaneously external temperature signal and 8 CAN be temperature signal to the can bus communication forms of multiple remote temperature acquisition system. Experiments show that this system has important application value in various industrial occasions.

#### THE HARDWARE COMPOSITION AND PRINCIPLE

Multiple temperature acquisition system structure is shown in figure 1 in which EEPROM uses the 24C04 IIC bus interface chip that can direct links with S3C2440 in order to keep control of the information received. Below is an important part of introduction.



ig.1 The structure of hardware system

### 1. Microprocessor

This system microprocessor uses the Samsung S3C2440 microprocessor, combined with power circuit, clocking circuit and reset circuit; storage systems compose micro control system. Reset circuit choosing a monitoring system reset IMP811S chip can provide an efficient power monitoring function, ensure the normal working system. S3C2440 microprocessor is 16/32-bit ISC kernel ARM920T processor. On the basis it expanded a full range of common peripheral interface unit can provide cost-effective embedded solutions.

To reduce total system cost, the S3C2440 X includes the following components separate 16KB Instruction and 16KBData Cache, MMU to handle virtual memory management, LCD Controller (STN & TFT), NAND Flash Boot Loader, System Manager (chip select logic and SDRAM Controller), 3-ch UART, 4-ch DMA, 4-ch Timers with PWM, RTC, 8-ch 10-bit ADC and Touch Screen Interface, four channels DMA controller,117 general I/O port, two channel SPI interface, 1 multi-channel host I2C bus controller, 1 channel I2S bus controller, USB Host Device, SD Host &Multi-Media Card Interface and PLL for clock generation. The S3C2440 X was developed using an ARM920T core, 0.18um CMOS standard cells and a memory complier. Its low-power, simple, elegant and fully static design is particularly suitable for cost- and power-sensitive applications. It adopts a new bus architecture called Advanced Microcontroller Bus Architecture (AMBA). The S3C2440 X offers outstanding features with its CPU core, a 16/32-bit ARM920T RISC processor designed by Advanced RISC Machines, Ltd. The ARM920T implements MMU, AMBA BUS, and Harvard cache architecture with separate 16KB instruction and 16KB data caches, each with an 8-word line length [1].

### 2. Temperature signal processing circuits

Temperature detection uses PY100 platinum resistance sensor. Because of the characteristic of PT100 resistance with temperature changes, we can collect temperature signal, then converts the signals collected to voltage signal. Last A/D inside the S3C2440 converts voltage signal into digital signals. Temperature signals processing includes constant-current source voltage circuit, amplifier circuit, it is shown as in figure 2.

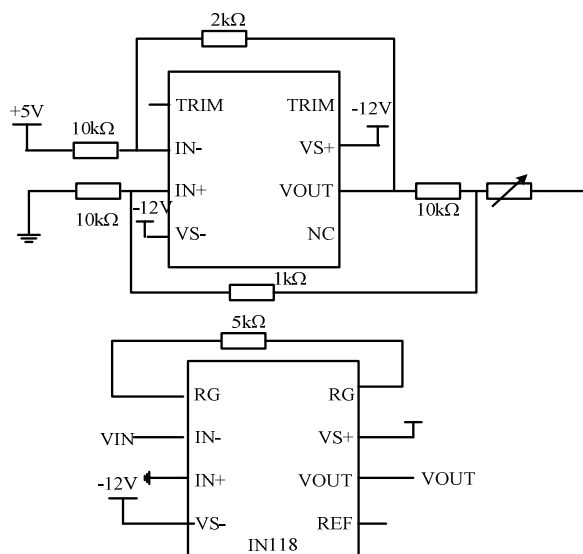
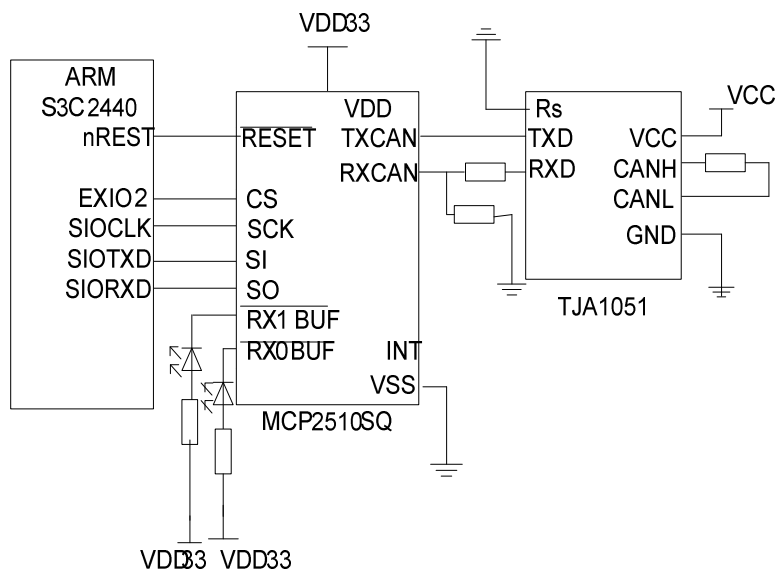


Fig.2 The schematic temperature detection

In Figure 2, OP07 amplifier with five resistors constant-current source for power supply, 16pt100, 16pt100 Voltage VIN + is smaller, So the precision op-amp IN118 amplification into A/D converter, can effectively improve the accuracy of measurement.

### 3. The can communication circuit

In order to transmit the fault information arc to upper monitor computer, System USES a CAN bus communications technology [3]. The real-time data acquisition arc S3C2440 fault information, including time, etc; The PC is preserved arc information in order to monitoring and query conveniently. Because S3C2440 itself without the can bus controller, so the system selects controller for MCP2510, adopts chip TJA1051 extended the Can bus interface. Because of the ARM chips will not automatically generate address latch signal ALE, So in the design of hardware circuit, Increased by CPLD technology needed to decode logic to get ALE. With the PC communications S3C2440 CAN interface circuit fig.03 shows[5]. With the PC communications S3C2440 CAN interface circuit figure 3 shows. The communication and computer S3C2440 CAN interface circuit is shown as figure.3.

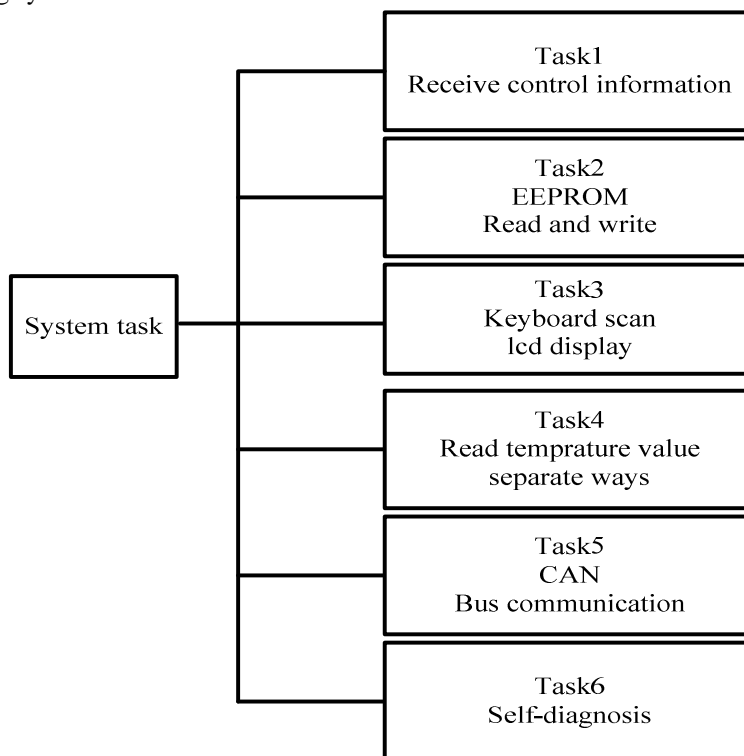


**Fig.3 Schematic for interference of S3C2440 and TMCP2510**

TJA1051 chip is CAN2.0A agreement bus controller, it can satisfy all that CAN communications protocol request. TJA1051 chip is the can bus transceiver, It is interface between the controller and physical bus, It can provide for sending and receiving the differential bus, fully compatible ISO11898 standard.

**SYSTEM SOFTWARE DESIGN**

In multiple temperature acquisition system, S3C2440 finished the function receiving control information, temperature detection, input parameters and display, temperature data etc. The system includes main program, software program, multiplexing man-machine interface temperature acquisition, the can bus control, EEPROM and functional modules. Because the software is relatively complicated, so actual programming embedded with  $\mu$ C/OS-II real-time operating system.



**Fig.4 The structure of software system.**

**1.  $\mu$ C/OS-II real-time operating system**

$\mu$ C/OS-II[4] real-time operating system is the real source of the public. The real-time kernel by hand, Supports

up 56 user tasks, stability and high reliability, and transplantation is convenient, memory is small.  $\mu C /OS - II$  real-time operating system of each task to assign a different priority, Priority is expressed with digital . The smaller the digital means the higher priority. In this system, for the importance of each task we assigned the priority as table 1 shown.

## 2. Main program

Main program completes S3C2440 GPIO initialization, operating system initialization, creates task and starts operation system.

## 3. CAN bus control

The can controller must first initialized, Mainly used to realize CAN work parameter setting [4], Including the hardware that CAN, set boundaries of CAN, setting CAN alarm the can bus baud rate, set interrupt mode of work CAN acceptance filter, the controller CAN work mode, etc.

In writing CAN send a function, one must pay attention , because after starting order of sending data, The CAN controller will send the data within the buffer, then the state of that data frames is whether sent successful or not will be returned.. So if the function has been waiting for data sending, The microprocessor performance will decline, So in order to avoid this kind of circumstance, This function should be back immediately after starting sending. If you want to get success sending events, you should cooperate with interrupting or by the method of querying the TCS status bit.

## CONCLUSION

The design of multi-channel temperature acquisition system has advantages of low cost, fast response, high reliability, long distance communication etc. For signal processing we can modify procedures for flexible change, also can replace sensor and detect signal circuit to realize detecting the other. In addition, the control core of the design uses S3C2440 which provides a wealth of internal equipment reduces the external devices of design and makes the design more conveniently and concisely for consumer. And we remain a lot of interface to extern the other external equipment such as video camera that can take the photo of the acquisition system at some time. Because S3C2440 owns eight to 10 road, the A/D converter, If multi-channel analog switches added, It can also detection external up to 64 road analogue, therefor it has strong scalability, suit for industrial control signal acquisition and remote transmission.

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