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# Design of Data Acquisition System Based on LPC2368 and PoE+ Technology

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**Abstract**. In order to overcome the cumbersome connection in the traditional data acquisition system and the additional design of the power supply system, this paper proposes and designs a large-scale distributed data acquisition and power supply system based on LPC2368 and POE technology. The data processing subsystem of the system is based on LPC2368 as the core microprocessor; the chip supports a variety of serial protocol interfaces and is widely used in the development of IoT terminals; in view of the particularity of data transmission, this paper designs a stable and reliable communication handshake protocol between the host computer and the terminal; the power subsystem adopts the PoE+ power supply mode. The network cable realizes the power supply to the data collection node. The advantage of this method is that it can realize functions such as remote power management and remote working state switch. After actual verification, the data acquisition system designed in this paper runs stably and can meet the actual engineering requirements of distributed data collection and complicated power supply requirements.

## 1. Introduction

Traditionally distributed data acquisition uses Ethernet, CAN bus or serial buses such as RS232 and RS422[1,2]. Compared with the previous centralized data collection, distributed data acquisition has the advantages of simple system connection and high reliability, but there are still problems such as cumbersome data connection, complicated power supply system and heavy data center tasks.

The rapid development of Internet technology has brought design ideas to solve these drawbacks. The Internet of Things is an important part of the new generation of information technology, which is the network that enhances user experience and interaction efficiency through intelligent sensing, recognition technology and pervasive computing to realize information exchange and communication between goods and articles[3,4]. Therefore, this paper designs a data acquisition method based on the Internet of Things to complete long-distance, long-range data collection tasks in complex systems. The scheme mainly includes the data acquisition board adopting LPC2368 microprocessor as the core, the system power supply adopts PoE+ design based on IEEE802.3at[5]; LPC2368 has multiple serial port channel interfaces, which can be applied to multiple serial communication[6]. PoE+ is an upgrade of the PoE power supply standard. In addition to increasing the maximum power limit, it also adds a power management mode, which is convenient for controlling the working state of the collection node, making the system configuration simpler, more efficient, and more convenient to maintain.

After experimental verification and actual operation, the distributed data acquisition system designed has the advantages of high reliability, low maintenance cost and simple structure.

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## 2. Overall design of the data acquisition system

The data acquisition system based on the Internet of Things can be divided into two subsystems from the functional structure. The first is the information subsystem, which mainly performs functions such as data acquisition and information control. The second is the power subsystem, which mainly provides power support for distributed nodes.

### *2.1. Information subsystem design*

The information subsystem is mainly composed of three parts. One is the data collection node, its main function is data acquisition and certain data processing functions. The second is the data interaction center, which is responsible for interacting each node information to the data processing center to complete the data. The third is the data processing center, its main function is to process the information collected by the node in real time, and perform logical operations and control. The system structure is shown in Fig.1.

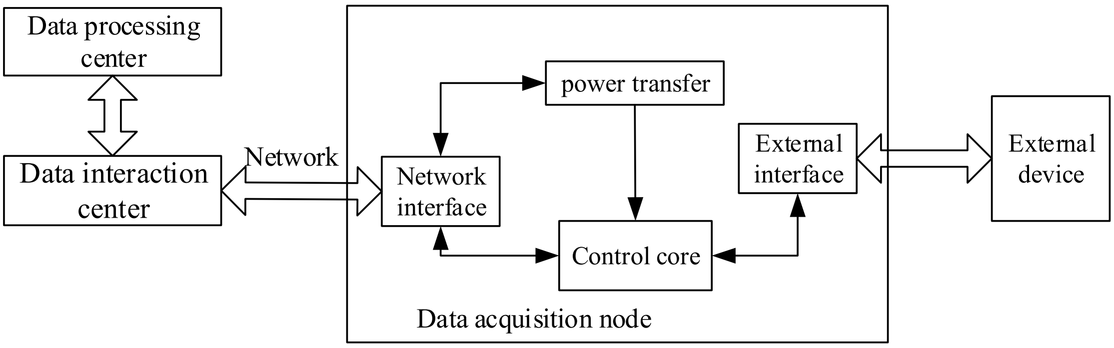


Fig.1 Information subsystem structure diagram

(1) Data acquisition node, data acquisition node is based on LPC2368 microprocessor, supports multiple types of data acquisition, including temperature and humidity sensing, photoelectric sensing and other functions, and has certain output capabilities to achieve control of external devices.

(2) Data interaction center, in view of the data acquisition system architecture system, the data interaction center in the system is based on the PSE switch, which can realize the transmission of data information and the control of the working state of the collection node.

(3) Data processing center, the data interaction center in the system uses PC as the running carrier, receives the information transmitted by the interaction center, and outputs control information to each collection node, and the system administrator can also observe the working state and information interaction of the node through the part.

### *2.2. Power subsystem design*

PoE[8,9] is a power supply technology that provides power support to IP-based terminal equipment by adding a power supply protocol based on existing Ethernet. It has the advantages of saving power supply wiring and improving Ethernet efficiency. PoE+ technology further enhances the network power supply performance based on PoE standard. It follows the 802.3at standard, whose maximum current is 720mA, and the maximum power of the supported terminal is 30W.

The PoE system consists of two parts: a power supply device and a powered device. The power supply device serves as a power supply to the terminal through a CAT-5 cable. Generally, it is a switch with PoE function. The powered device obtains power through the Ethernet interface. This system uses MAX5941B as the core chip of the powered device. The powered device interface chip MAX5941B can complete the PoE communication task and the buck operation. The power subsystem structure is shown in Fig.2.

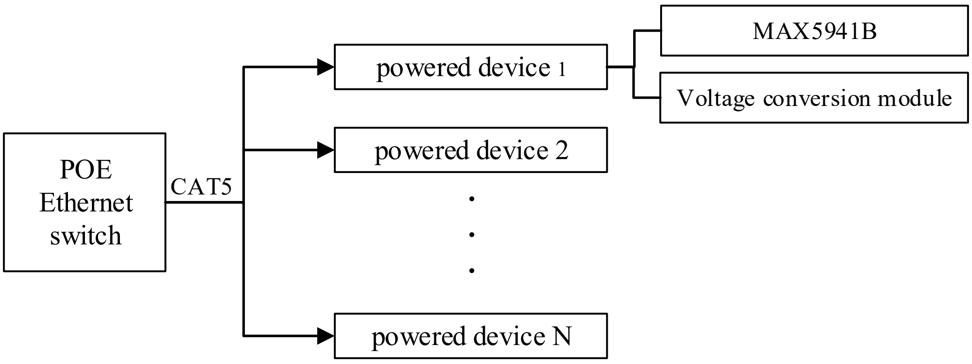

Fig.2 PoE system structure

PoE has the following requirements for the CAT5 class line used. The lines must comply with the IEEE802.3af standard[7]. The power pair must use Alternative A (pair 1, 2 and pair 3, 6) or Alternative B (pair 4, 5 and pair 7, 8). The power mode, and the PSE only provide one power mode, but the PD must meet two power supply conditions.

In view of the performance of the PoE Ethernet switch, this solution uses the Alternative A mode, that is, the signal and power supply sharing mode.

## 3. Data acquisition system implementation

The data acquisition system design consists of two components, namely the design of the information subsystem implementation and power subsystem implementation.

### *3.1. Information subsystem implementation*

The composition of the information system mainly includes three aspects, one is the selection of the core of the data acquisition node, the second is the design of the data processing center system; the third is the design of the communication protocol.

(1) Data collection node

The LPC2368 is an ARM-based microcontroller featuring an internal frequency of 72MHz with 512KB of on-chip flash program memory and two AHB systems for simultaneous operation of Ethernet DMA[8], USB DMA and on-chip Flash execution. Advanced vector interrupt controller supporting up to 32 vectored interrupts; chip with 10-bit A/D converter and 4 general-purpose timers, each with 2 capture input pins and up to 4 comparison output pin; a PWM/timer module that supports three-phase motor control; to enhance system stability, the chip has a watchdog timer that is clocked by the internal RC oscillator, RTC oscillator, or APB clock.

Different from other ARM controllers, the LPC2368 is equipped with a rich serial interface to facilitate interface design. The chip includes a 10/100 Ethernet MAC, USB 2.0 full-speed interface, 4 UARTs, 2 CAN channels, 1 SPI interface, 2 synchronous serial ports, 3 way of I2C interfaces, 1way of I2S interface and MiniBus. The types of communication that can be supported include Ethernet, CAN, RS232 and other common serial communication, which greatly simplifies the programming of related applications.

(2) Data processing center

The data processing center is developed by VC, and the information communication with the data collection node is realized by the MSComm control. The main program flow is shown in Fig.3.

(3) communication protocol

In view of the fact that the data collection node has two states of non-networking and networking, the collection node should have the function of interacting with the data processing center information and displaying the output under the network working state, and should have output lock and establish with the data processing center in the non-networked working state. Therefore, the design communication protocol is shown below.

First, the data collection node sends the collected external device information to the data processing center. Secondly, the data processing center performs the parity check of the information according to the received device information terminator. If it is correct, it returns "over" information; otherwise, returns "error" information; After the data collection node receives the information returned by the data processing center, if it is "error", the original data is continuously sent 1 to 3 times; if the received information is "over", it indicates that the information has been sent, and the communication is successfully ended; If the data collection node does not receive the information returned by the data processing center, it indicates that the communication link is interrupted, and the data collection node should continue to send data until the data processing center returns the information.

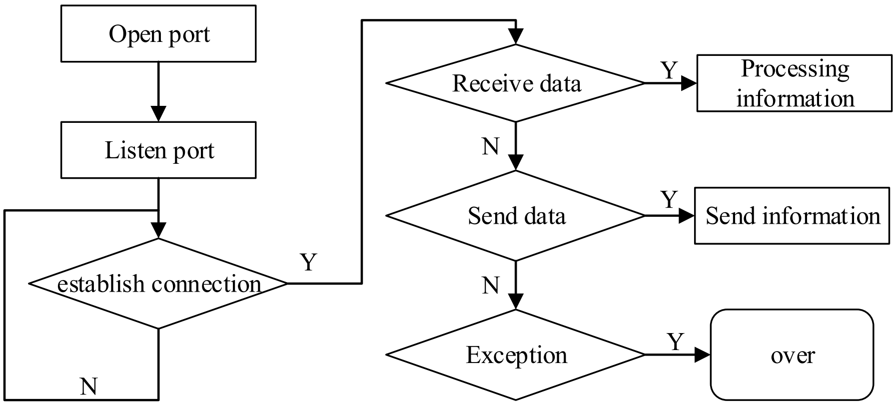


Fig.3 data processing center main function flow

### *3.2. Power Subsystem Implementation*

The design of the power subsystem includes the selection of power supply equipment and the design of the power receiving equipment, especially the selection of the PoE power supply protocol handshake chip.

(1) Power supply equipment

The switch D-Link DHS-3218MP-AC with built-in PoE function is used as the power supply device of the PoE system[9].

(2) Powered equipment

In order to meet the PoE power supply requirements, the PD side uses the Maxim MAX5941B as the core chip of the powered device[10], and implements the handshake of the PoE power supply protocol with the PSE.

The MAX5941B chip integrates the IEEE802.3at technology standard power device interface and pulse width modulation controller. In addition to supporting PoE power supply, it can also realize constant voltage and steady current function through an external power supply. It has wide voltage input capability and input voltage from 18V to 67V. The switching frequency can be up to 275KHz, and has a power working status output interface, which can feedback the PD power supply status.

In order to meet the operating voltage requirements of the components of the data acquisition node, the PD device performs the transformer processing on the 48V voltage provided by the PoE; among them, the 48V to 28V voltage conversion is realized by the power module PAH350S48-28 LAMBDA; conversion from 28V to 5V through the CS51411 chip; conversion from 5V to 3.3V through the AMS1117-3.3 chip.

## 4. Experimental verification and system operation

### *4.1. Power Subsystem*

After the PoE switch is powered on, each data collection node works normally. At the same time, the power subsystem can query the power consumption of each node in real time from the power management software provided by the PoE+ switch. After the system works normally, the power management system of the PoE+ switch is shown in Fig.4.

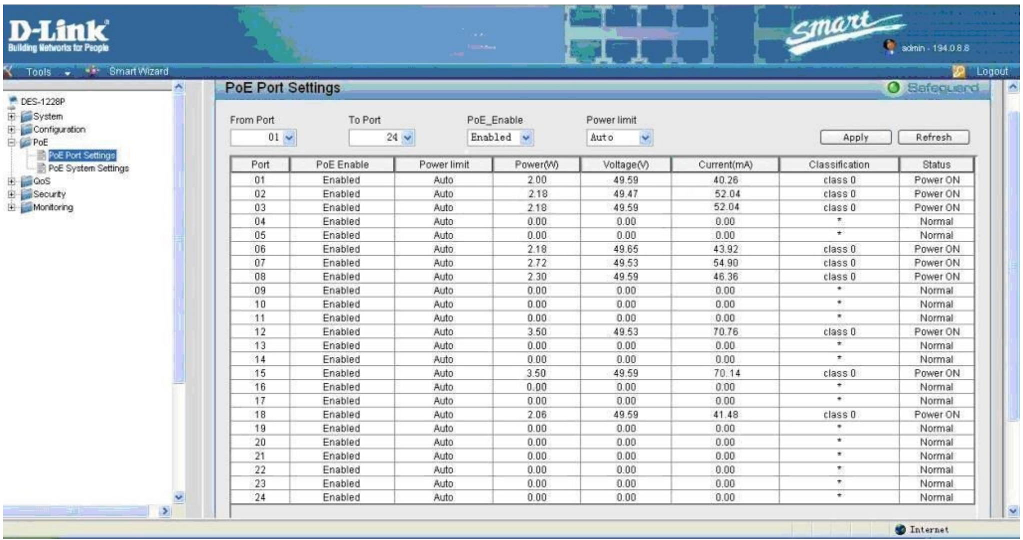


Fig.4 PSE power management interface

It can be seen from Fig.4 that the PoE+ power supply scheme designed by the system satisfies the design requirements, and the remote shutdown and restart of the data collection node can be realized through the power management interface.

## 4.2. *Information subsystem*

The test uses WD11 node (IP: 194.0.8.11) as the information subsystem test equipment, and its output signal is an LED dot matrix. The data processing center sends and receives data interface and the final device display is shown in Fig.5.

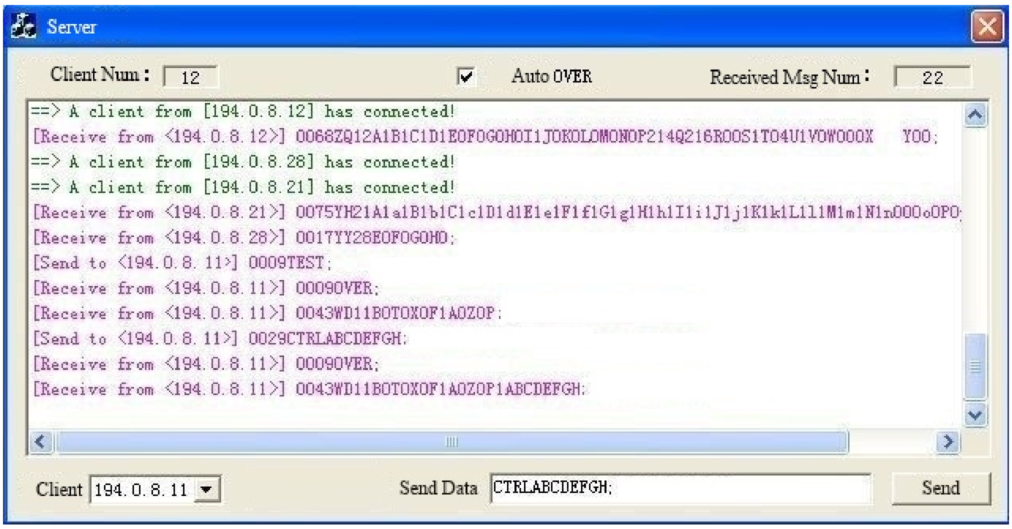


Fig.5 data acquisition software interface

After the data collection node is working, it can be properly connected to the test software and receive display control data from the data processing center. The data collection of the data acquisition node is correct and the display shows that the data is correct.

## 5. Conclusion

This paper introduces a data acquisition system based on the LPC2368 and PoE technology that can be applied to the needs of large-scale distributed systems. The information subsystem selects the LPC2368 with multiple serial interfaces as the processing core, and realizes the information interaction with the data processing center by designing a reliable network communication protocol. The system selects the PoE+ power supply scheme with higher power and higher efficiency, adopts the MAX5941B as the core chip of the power receiving section, and realizes remote power management through the PoE power supply switch. After experimental verification and system operation, the system runs reliably and stably, and is highly open, which facilitates the addition, deletion and management of various data collection nodes in large-scale distributed systems, and provides some reference for the design and implementation of other distributed data acquisition systems.

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**References**

[1] Liao Shenhai, Lou Chengzhi, Tian Hao. The Monitor and Cntrol System of Solar hot water project based on the internet of things[J]. Acta Energiae Solaris Sinica, 2016,37(7):1851-1856(in Chinese).
[2] Deng Yun, Li Chaoqing, Chen Xiaohui. Design of remote wireless monitoring system for smart home based on Internet of things[J]. Journal of Computer Applications, 2017,37(1):159-165(in Chinese).
[3] Jia Wei. Research on data acquisition and information transmission technology of Internet of Thing[J]. Modern Electronics Technique, 2016,(5): 33-37(in Chinese).
[4] Zhang Kaisheng, Tian Kaiyuan, Lv Ming, et al. Design of agricultural greenhouse environment monitoring system based on internet of things technology[J]. Journal of Xi'an University of Science and Technology, 2015,35(6): 805-811(in Chinese).
[5] Hao Qinxia. Digitalized mine heterogeneous information integration processing model based on internet of things[J]. Journal of Xi'an University of Science and Technology, 2015,35(1): 132-136(in Chinese).
[6] Tan Zhanglu, Shi Houbo, Fang Yifang. Application Research of IOT Technology in Coal Mine Visualization Management[J]. Coal Mine Machinery, 2012,33(8): 280-283(in Chinese).
[7] Zhao Fangyun, Zhang Mingfu. Ddata acquisition and dynamic monitoring node design of marine transportation environment based embedded[J]. Ship Science and Technology, 2016,38(9): 130-135(in Chinese).
[8] Xin Kai, Zhang Xiyan, Qi Shengbo,et al. STM32 based design of marine environmental data acquisition system[J]. Shandong Science, 2014,27(2): 8-12(in Chinese).
[9] Qi Shengbo, Wang Shengnan, Liu Qun. Software and Hardware Low-power Consumption of Underwater Recorder Based on STM32L[J]. Microcontrollers & Embedded Systems, 2016,16(4): 60-63(in Chinese).
[10] Mai Jun, Deng Qiaoyin, Wan Zhiping. A ZigBee wireless network temperature monitoring system based on CC2530[J]. Electronic Design Engineering, 2015,23(22):117-121(in Chinese).