

A Monitoring Data Acquisition System for Substation Using ARM And 3G

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Keywords: ARM; Substation; S3C6410; μ C/OS-II

Abstract. The electricity data collection system of the transformer substation's switch cubicle was proposed, which was based on the technology ARM. Realized the real-time monitoring of substation's switch cubicle. Using S3C6410 as the processor, and designing signal conditioning circuit and AD conversion circuit. Using 3G internet to transfer the collected data. At the same time, the program flow of the μ C/OS-II operation system were build. And the system was tested in some smelters. The results of the test and the transmission experiments show that, with high stability the system was good at transferring data in real-time, so it is worthy to be extended.

Introduction

About intelligent substation construction, in China, State Grid Corp built unified strong smart grid in the 2009 ~ 2020. Intelligent substation is the important base and support of strong smart grid equipment, device information digitization, functional integration, compact structure, state maintenance are the development direction of substation. Smart substation is the development direction of the next generation of substation, is the physical basis and requirements for the construction of smart grid. In order to realize the goal of smart grid, intelligent substation is of great significance to research and construction[1,2]. Therefore, monitoring of substation operation parameters is helpful for power supply departments to know the operation and the user substation of the electricity, make the smart grid more strong. Aiming at the development demand of smart grid, design a technology based on ARM and 3G technology in substation switch cubicle electric energy data acquisition terminal, and the related tests.

System Overview

The system is mainly divided into three parts, as shown in Fig.1 are collection terminal, 3G network and Data Center PC based on ARM. Collection terminal based on ARM is responsible for collection and preprocessing of substation cubicle electricity information, Using 3G transmission network sends data to the data center PC. Data center complete the analysis of the data, the final results are shown in graphical and report forms, and according to the need to store the data. In this article research and design the substation switch cubicle electric energy data collection terminal and the 3G transmission network, construction of the ARM11 data collection terminal control unit based on 16/32 S3C6410 processor produced by Samsung Corp, with 3G transmission network of low cost, low power consumption and stable transmission to transmit the data collected by monitoring terminal.

Substation switch cubicle electrical energy data collection terminal is the core of this design. The data collection terminal comprises the design of potential transformer (PT) / current transformer (CT), signal conditioning, signal acquisition (AD), ARM, the structure is shown in Fig.2. Work process is as follows: the signal of voltage (current) transformer first enter the signal conditioning circuit, after filtering, amplification sent to AD, after analog-to-digital conversion, the digital signal enter into the ARM, after a simple preprocessing, the collected data through the 3G module transmit to remote [3].

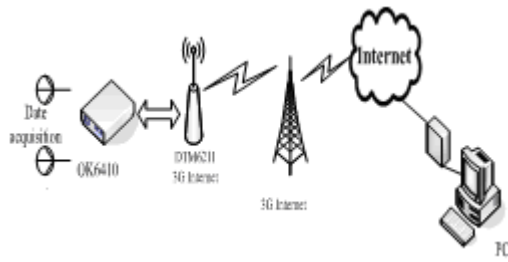


Fig.1 The system structure

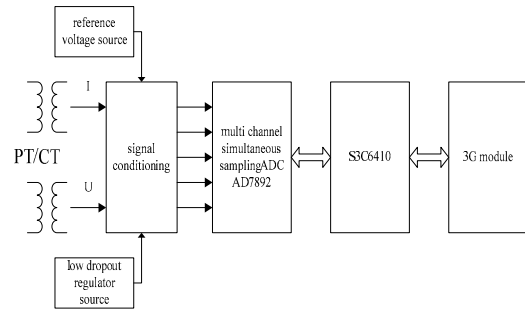


Fig.2 The structure diagram of terminal data collection

The Main Module Design

ARM center control module. Center control module uses OK6410 development board, OK6410 development board uses samsung's latest ARM11 processor S3C6410. OK6410 development board hardware resources are rich, has system management of the Camera interface, 24 bit true color TFT - LCD controller, power supply, ect, 4 channel UART, 32 channel DMA, 4 channel timer, general I/O port, IIS, IIC bus interface, USB Host (12 Mbps), USB OTG (480 Mbps), 3 channel SD/MMCHost controller and clock generation PLL. Using 90nm COMS technology, low power consumption, concise, elegant and full static design make S3C6410 very suitable for the application of cost and power consumption. Fig. 3 is ARM center control module.

3G communication circuit module. 3G module's main function is to send the collection data to the base station through wireless channel. Choose Leadcore Technology production DTM62113G module as the wireless network transmission module. DTM6211 support TD - SCDMA&GSM dual-mode wireless module products, it support the network between TD-SCDMA and GSM system automatic seamless switching, under the TD-SCDMA, support the uplink and downlink asymmetric data transmission ability, the data transmission rate can reach 384 kbps; Support the UART and USB communication interface, the use is more convenient and flexible; Use the assembly height 2.9 mm slim design, make it be used in smart phones and all kinds of data card, integrate H. 324 protocol stack internal, makes the realization of the function of the video phone more simple; Integrating TCP/IP protocol internal, which can be connected to the Internet conveniently, can be widely used in different industries. The hardware connection diagram is shown in Fig .4 [4,5].

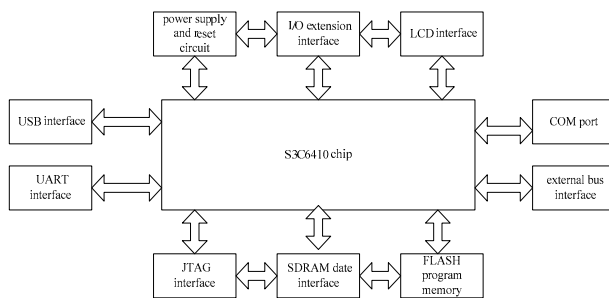


Fig.3 ARM center control module

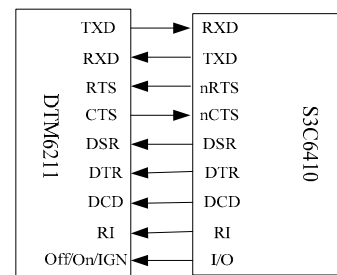


Fig.4 Diagram of hardware connection of 3G module

AD conversion circuit. In the process of A/D sampling, ensure that the speed of sampling and the accuracy of sampling. The AD conversion circuit uses a high speed, low power, 6 channel, 16 bit high speed synchronous sampling analog-to-digital converter ADS8365 by TI company. When the external clock input is 5MHz ,the highest sampling frequency is 250Kbps, the data acquisition time and transferring time is 4us, its conversion principle is the successive comparative (SAR), as its conversion rate is rapid, fully meet the requirements of the system.

Software Design

First call function SysInit () to initialize the terminal hardware, and then call function OSInit () to initialize μ C/OS - II operating system, function OSTaskCreate () is responsible for each

task's creating, and assigning task priority, all new task is set to the ready state. Function OSStart() is responsible for the system startup, start task scheduling. The main program flow chart is shown in Fig. 5[6,7]. Dial-up connection task makes monitoring terminal login to 3G network, in the process of system operation, the network state detection task test the network connection status constantly, ensure the effective transmission of data.

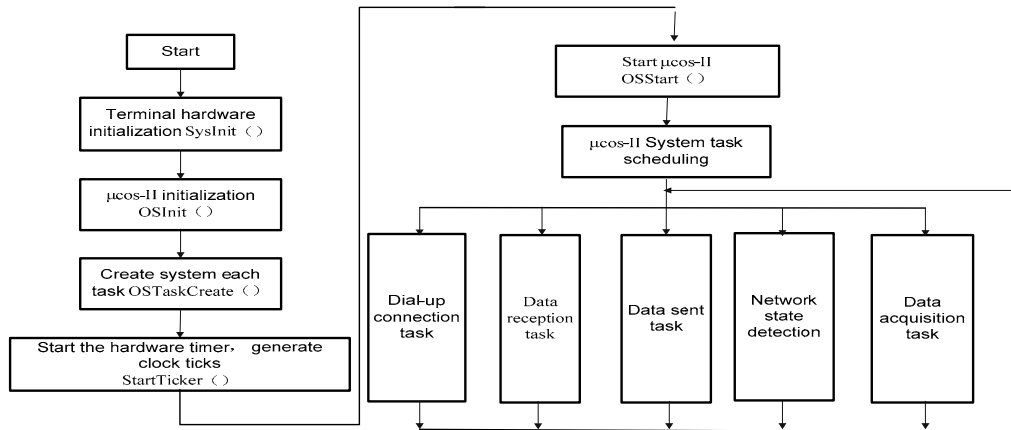


Fig.5 Control flow chat

Experimental Testing

Environmental monitoring. In order to verify the reliability of the system, specially select a smelter for testing. The smelter's 35kV general step-down substation has a power transformer of 16000kVA, 35/10kV, the substation's a 35kv line supply the whole equipment, to meet one level load power requirements, has 10kV standby power supply line to supply the main building's standby transformer power. The substation's 35kV and 10kV systems use the single bus mode, use cable to supply the plant substation, high voltage motor power by radiating, and supply two back power supply to the smelter's oxygen station 10kV distribution room.

Experimental data. In the date center PC set analysis software, use the form of reports and graphical analysis the substation switch cubicle power information monitoring data to display. Fig. 6 and Fig. 7 are parts of the information interception of the switch cubicle in the monitoring of three phase watt, voltage, power factor and voltage harmonic component report data.

According to the information displayed by image data, through the analysis, in line with changes of the smelter power consumption. Show that the system can timely monitor the substation switch cubicle in power information real-time changes. Diagram can be through the comparison of the maximum and the rated power, learn whether have reached maximum load. Combining a few figures above can we know the system reactive power impact is bigger, the power factor is lower, and when the load is small, the system has delivering conditions.

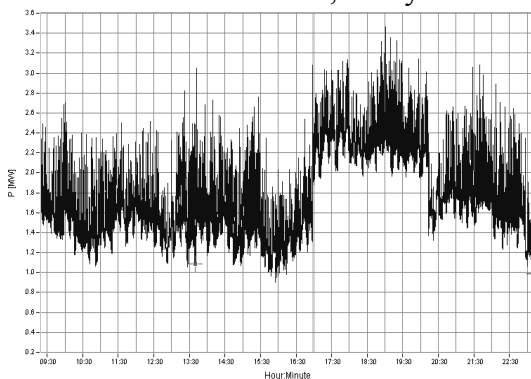


Fig.6 Three-phase active power change curves

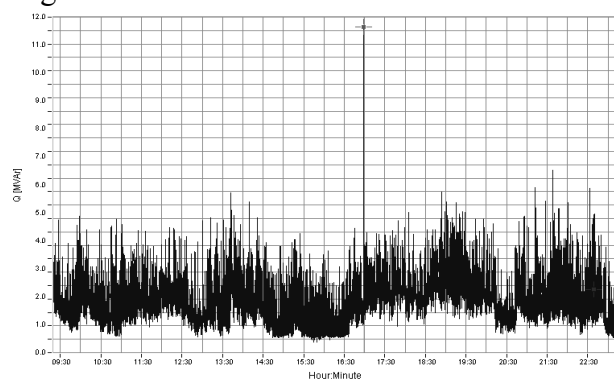


Fig.7 Three-phase reactive power change curves

Conclusion

The embedded technology is applied to the switch cubicle electricity information collection,

transfers data via 3G transmission network, designs the concrete scheme and process of software and hardware, and a transmission experiment is carried out. Test results show that the system can timely monitor the switch cubicle of electricity information, be easy to handle in time. In the transmission experiments, 3G technology can transmit the measured substation operation data accurately, shows good capability of transmission. Meet the requirements of substation monitor real-time data, realize the wireless, intelligent transformer substation monitoring, staff can grasp the running situation conveniently and make the corresponding adjustment, has the very high application value in the smart grid.

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