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Wireless Data Acquisition System Based On ARM

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Abstract:

The need of real-time data acquisition in industry control system is growing, ARM7 processor LPC2200 combined with embedded real-time operating system μc/OS-II realize the data acquisition system and remote transmission through the wireless communication and can be used in a wider field. The overall structure of the system, the software process and acquisition hardware circuit are introduced. The whole system hardware is in the small size, low power consumption, strong scalability, stable operation, convenient program maintenance and upgrade, have many channels online real-time data acquisition, processing and transmission, and other functions.

Keywords: *ARM; GPRS; data acquisition; μC/OS-II*

Introduction

In the industry, agriculture and other practical application process, it often needs to test the site equipments and environmental. We can track the equipment running state through the parameter acquisition. The ARM technology as the mainstream technology of embedded system has gradually replaced the single-chip microcomputer control technology. And data acquisition is to a powerful real-time, many parameters, high precision direction. Data storage part is to a capacity, the miniaturization, and portable direction. Data transmission is to a many of communication, remote data transmission direction. Data acquisition system based on ARM has characteristics as the high precision, high speed etc. So this paper studies data acquisition and transmission system of the high real-time requirement by μc/OS-II operating system constructing ARM7 hardware platform combined with wireless transmission.

Overall Structure Design Of System

System Framework

Hardware system is mainly composed by the data acquisition, controller, and the data transmission module. Each sensor of The data acquisition part get signal transmit to the ARM through wireless, ARM processes data and then transmits to the upper equipment such as mobile hand-held devices or PC machine through the wireless so to convenient monitoring[1]-[2]-[3]-[4]. The overall structure shown as in figure 1:

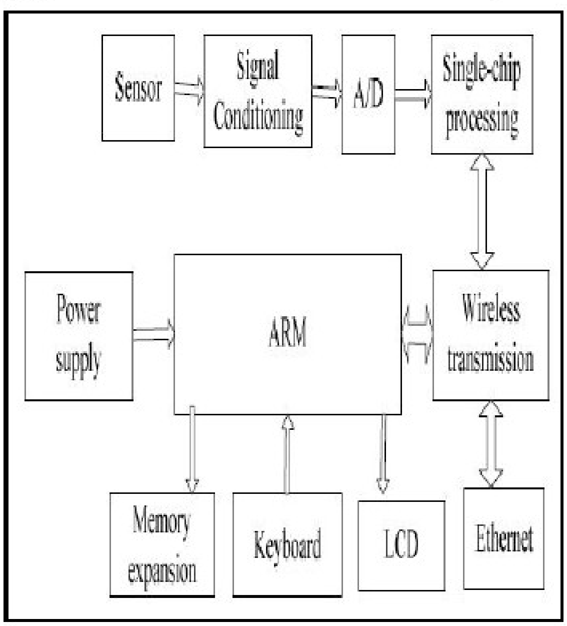

Figure 1: Framework of wireless data acquisition system based on ARM

ARM Micro Processor

The system uses processor is the production of Philips LPC2200 which based on the 32-bit ARM7TDMI CPU supporting real-time simulation and embedded tracking. The processor clock is high as 60 M / 75 M Hz, integrated high speed Flash memory, 128-bit wide memory interface and unique accelerator architecture enable the 32-bit code execution at maximum clock rate. In addition, it integrates a large number of peripherals on-chip and supports 64M memory expansion.

Memory Expansion Modules

Data monitoring terminal system needs to save collection time and collect data to front-end for remote client access from time to time. If the collection channels are many or long, it needs to save large amounts of data, and in the terminal during operation of the various alarms, historical data and measurement points need to be power-down to save. This system uses CF card as an auxiliary memory card to store large amounts of code or information. CF card is based on Flash technology, portable storage, large capacity, small size, low price. CF cards are ATA devices, using the LPC2200 GPIO port can Achieve read and write ATA timing in order to achieve the CF card read and write operations [3].

Software Design

Operating System Migration

μc/OS-II kernels are simple, stable, real-time, and can be cut, can be rewritten source code and so on. In order to improve the system of real-time capabilities, μc/OS-II can be cut a complex application into several mutually independent tasks and, based on the importance of the task to assign priority. Task scheduling entirely complete by μc/OS-II real-time kernel, including the task state management; choose the highest priority task, task execution and revocation, etc. μc/OS-II kernel is also responsible for allocation of CPU time. CPU time is always the priority assigned to interrupt the event, followed by assigned to the highest priority task of the current queue. Communication between different tasks can be through μc/OS-II provided semaphores, mailboxes, message queues, and other mechanisms to complete, most of it is the C language code, and portability. The codes associated with the ARM architecture in the μc/OS-II code file are: CPU Configuration code OS.CPU.H, OS.CPU.A, ASM and task stack initialization

OS_CPU_C. C, amend the relevant code and transplantation. Then test the post-transplant core. Write a startup program for μc/OS-II, initialize the system hardware and software environment, initialize timer and the serial port, and provide some hardware-related routines and functions to facilitate debugging to the operating system. It put the CPU control to the operating system after the CPU, board-level and program initialization is completed.

System Flowchart

After the μc/OS-II successfully transplanted to the LPC2200 ARM processor the μc/OS-II software extensions include the preparation of external device drivers, application program interface functions and tasks division three parts. The *terminal* systems there are four low-priority tasks: keyboard management tasks, data acquisition and processing tasks, communication tasks, LCD display module task. Task program flow chart as Figure 2.

The system is running, initialization operation includes the ARM chip initialization, μc/OS-II initialization, the peripherals initialization, and then the system will create the task, assign the task priorities, and start multi-task scheduling. System monitor the task, runs the highest priority task. System response to interrupts, the interrupt program obtains the CPU control to set parameters. When the interrupt service routine returns, μc/OS-II reschedule according to the situation.

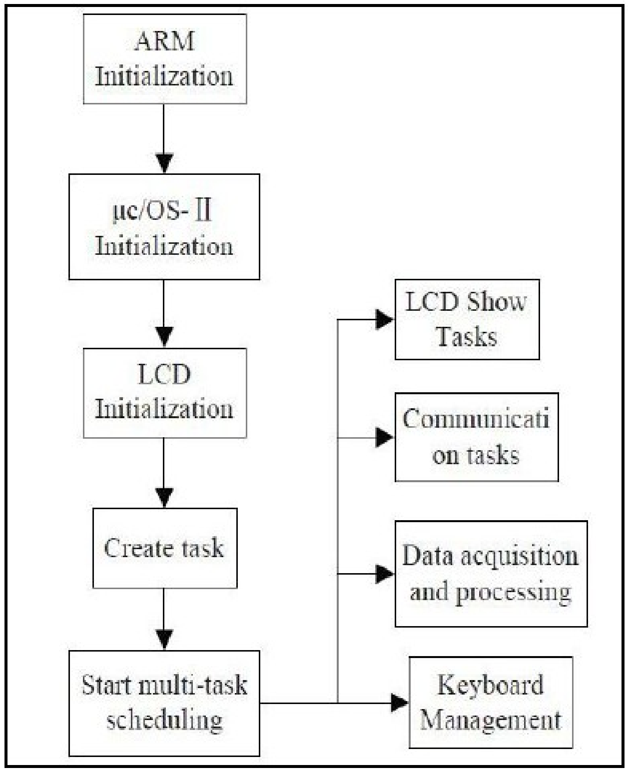

Figure 2: Task program flow chart

Wireless Communication Module

The task of wireless communication module is transmitting field data collected by wireless data to the arm processor, and transmit processed signals to the monitoring center keeping abreast with the field situation, achieve remote wireless monitoring. For real-time transmission of information, the wireless microcontroller nRF24E1 is the data collector, arm sent to the Ethernet via SIM700, reached real-time monitoring purpose.

Wireless Microcontroller

The nRF24E1 has enhanced 8051 core, the wireless transceiver nRF2401, 10-bit ADC, UART asynchronous serial port, SPI interface, PWM output, built-in CRC check. The device has 125 frequency points, achieve point to point, multipoint wireless communications, and can be used to change the frequency and frequency hopping to avoid interference. Its maximum transfer rate reach up to 1 Mbits/s, the maximum transmit power reach up to 0dBm, the indoor distance reach up to 30-40m, outdoor transmission range reach up to 100-200m at the ideal environment. Operating voltage 1.9-3.3V, operating temperature range from 40-80°C. These features of nRF24E1, making it very suitable for the system. Make the necessary initialization; nRF24E1 is in transceiver mode, waiting for the terminal to send commands; receiving the command, then data collection and delivery. ARM starts, waiting for the user, receiving a user request, after processing, and the request converse into a command wirelessly to nRF24E1, to control the collector work. Figure 3 is data acquisition circuit [5]-[6].

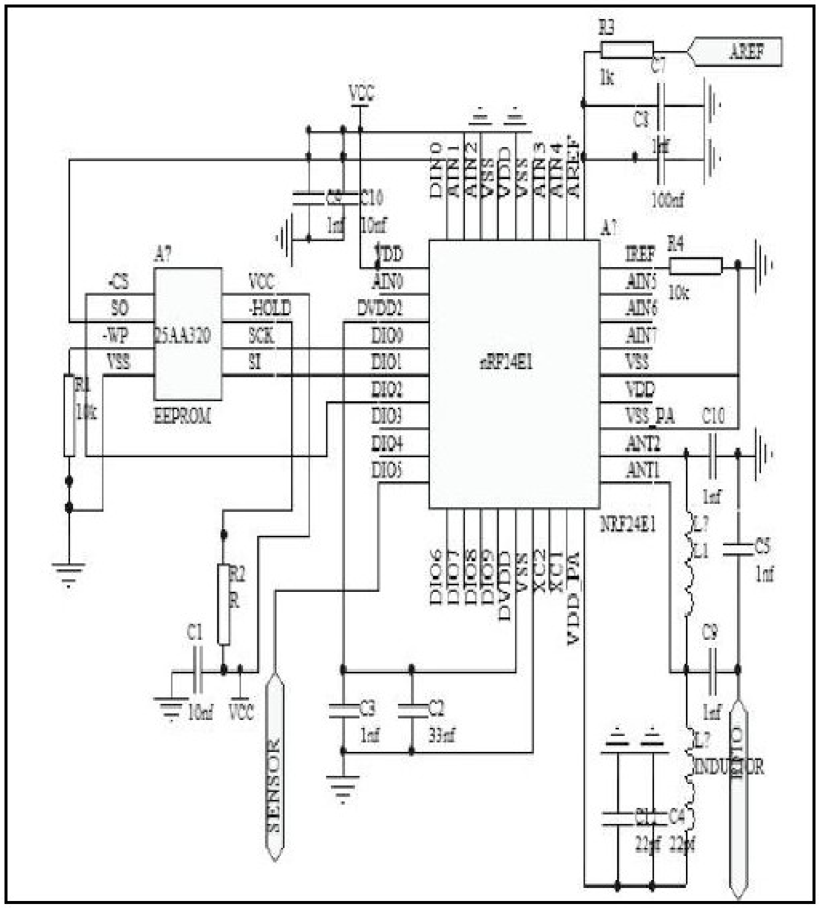

Figure 3:Data acquisition circuit

GPRS Module

GPRS module uses SIM700, SIM700 is board to board connection with an industry standard interface, and can transmit data, voice, SMS, fax, and so on. SIM700 can meet the design requirements to variety industrial applications. Embedded TCWIP protocol stack, the rate reach up to 236.8kbps, GPRS module communicate with LPC2200 through the UART interface, achieve wireless data transmission. Serial interface is from DTRO to DSRO. IGN and EMERG-RST are the startup and shutdown control: ING GPRS module receive data and GPRS module stops receiving data when input is low, INA-IND are the expansion port [4]. After power turned on, open the GPRS, connected to the service, perform the task. GPRS module task flow shown in figure 4:

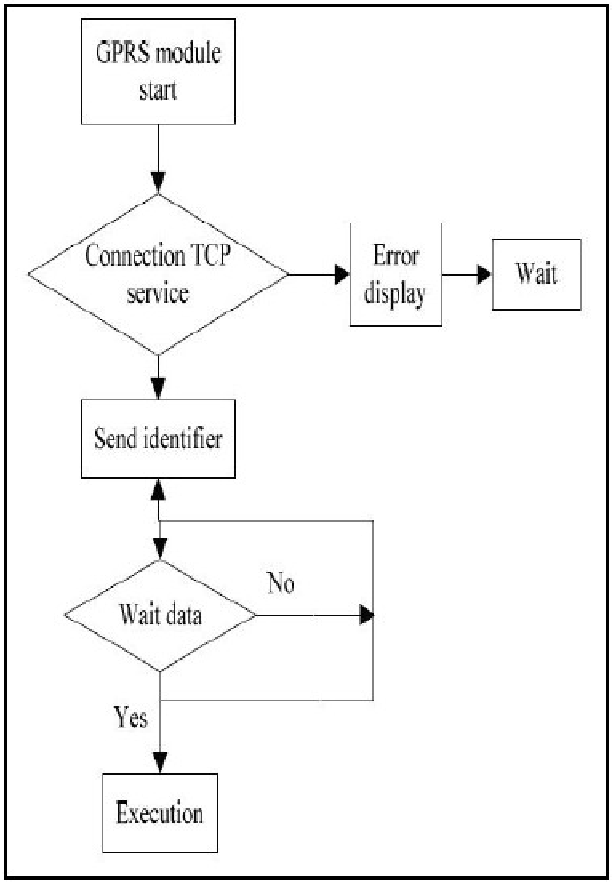

Figure 4: GPRS work flow

Conclusions

The design clearly describes the overall system architecture, and successfully completed a wireless data collection tasks to achieve the target, reflects the advantages of this system. Wireless transmission can overcome many practical difficulties, used in various industries, and compared to traditional wired monitoring, GPRS coverage's more wide area, and communications fast, accurate, low-cost, real-time, safety, and indeed provide a better choice for the data acquisition system.

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