A Portable Embedded Data Acquisition and Communication System

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ABSTRACT

The data acquisition equipment is very useful and popular equipment in agriculture and the other fields. This paper introduces the design of a portable data acquisition and communication system used in cropland. It collect signals of various analog and digital sensors, GPS space and time data, saving data by USB interface and transmission through WCDMA or Bluetooth. The key technology of the system is the use of embedded microprocessor (ARM), Linux Operating system and WCDMA wireless communication. This paper mainly analyzed the basic principle, hardware interface and software flow chart of this system.

Keywords: ARM, Data Acquisition, Device Driver, Embedded System, Linux, WCDMA

1. INTRODUCTION

Precision Agriculture is modern agricultural production, which is also the quintessence of environment protection and continuous farming (Wang, 2009). Precision agriculture is based on information collection, transmission, storage and analysis. With the development of technology, there are more and more new information technologies applied in agriculture domain. Many companies produce all kinds of equipments including advance technology (Mei, 2008). They can use either in tractor or by hand. However, these products are very expensive and the operating-interfaces are usually designed in foreign language. So they do not suit Chinese. In our country, the research of "precision Agriculture" is in the beginning stage now. The future of its technology relies on the getting of actual and effective data. Due to the characteristic of low-power, low-cost and high-performance, it has been applied popularly in the embedded systems today (Wang, 2009; Mei, 2008). By comparing with products alike inside and outside, we find that embedded systems based on ARM microprocessor have many advantages, such as portable, easy-using, flexible, cheaper etc.

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Considering the actual demand of data acquisition in cropland, a portable data acquisition and communication system is designed based on the ARM (Zhou, 2010; Berger, 2010). It obtains the information from various sensors (Temperature/Humidity/attribute/diseases/insect pests) and GPS signal, analyses and processes the data, then stores them in the storage device or packs with TCP/IP protocol and transmits them to the data control center through WCDMA or Bluetooth. This paper will describe the design progress of this system.

2. DESIGN

2.1. Hardware

The system takes Samsung’s S3C series core board based on an ARM920T core as hardware developing platform. The S3C series includes the following components: 64MB SDRAM and 16MB Data 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, I/O Ports, 4 DMA channels 8-ch 10-bit ADC and Touch Screen Interface, IIC-BUS Interface, USB Host, USB Device, Multi-Media Card Interface. It has the advantage of high capability and low-power, supporting many Embedded Operating Systems.

It can acquire four-route analog signals, four-route digital signals and GPS signal in real time. Then it displays on LCD. At the same time, it can store the data into flash disk in time, or send out by WCDMA/Bluetooth networks.

Figure 1 indicates the sketch map of the hardware in this data acquisition and communication system. The whole system can be divided into four parts according to its functions.

1. Data Acquisition: This part includes three modules: analog signal acquisition module, digital signal acquisition module and GPS signal acquisition module.
   a. Analog Sensor: The system has 4 analog channels. It is designed to receive the standard voltage (0-5V) and current (4-20mA). The analog signals can be changed into digital signals.
   b. Digital Sensor/GPS Signal: The system receives 4 digital signals. According to the necessary, three more digital interfaces are expanded by chip.
   c. GPS Module: The GPS signal is acquired by OEM board synchronously. There is a standard format for GPS language statement -- NMEA-0183 standard (Zhang, 2002). We adopt the GGA language statement. What provided by GGA is the orientation information of GPS, includes the longitude, the latitude, the height, HDOP.

Figure 1. The sketch map of hardware
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