Design on Automatic Rolling System for Agricultural Greenhouse-Part I

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Abstract. A CAN bus based data acquisition system design method is described in this article. Based on the theory of data acquisition and monitoring system, a high-performance, high-reliability, real-time CAN field bus is adopted, a high-performance, low-power Cortex-M3 microcontroller is used as the control core, and Visual Basic 6.0 is used to develop the upper computer. The monitoring software consists of a high-speed, real-time data acquisition system.

1. Introduction

With the development and popularization of computer technology, digital devices are increasingly replacing analog devices. In a wide range of fields such as production process control and scientific research, computer measurement and control technologies are playing an increasingly important role. However, most of the information in the external world appears in the form of continuously changing physical quantities such as temperature, pressure, displacement, speed, and so on. To send this information to a computer for processing, these continuous physical quantities must first be discretized and quantized and encoded to become digital quantities. This pCAN, the Controller Area Network[1], belongs to the industrial fieldbus category. Compared with the genrocess is data acquisition. It is the main means for the computer to obtain raw data during the process of monitoring, managing, and controlling a system.

Eral communication bus, the CAN bus data communication has outstanding reliability, real-time and flexibility. Its application range is no longer limited to the automotive industry, but to the areas of automation, aerospace, navigation, process industry, machinery industry, textile machinery, agricultural machinery, robotics, CNC machine tools, medical devices and sensors. CAN has formed an international standard and has been recognized as one of the most promising fieldbuses.

2. Whole system structure

This design scheme uses the Cortex-M3[2] as the core processor. After chip selection, the STM103 series Cortex-M3 single-chip microcomputer is selected, and the upper computer monitoring software is developed using Visual Basic 6.0. The design scheme is divided into three modules: analog-digital conversion module, serial communication module, and CAN communication module. The structure diagram is shown in Fig. 1.

(1) the analog-to-digital conversion module utilizes an integrated AD conversion module inside the microprocessor to convert the analog to data volume, and an analog input module is designed to protect the microprocessor. The on-site sensor can be used to connect the temperature and pressure of the site. , Flow and other physical quantities are converted into data quantities for the microcontroller to process.

(2) the serial communication interface module is mainly used to realize the serial communication between the processor and the host computer. The customer service PC does not have the shortcomings of the CAN bus interface to ensure that the processor can perform real-time and fast communication with the host computer.

(3) CAN communication module is to set the data acquisition system as a node on a CAN bus, through the CAN communication Letters communicate with other subsystems.

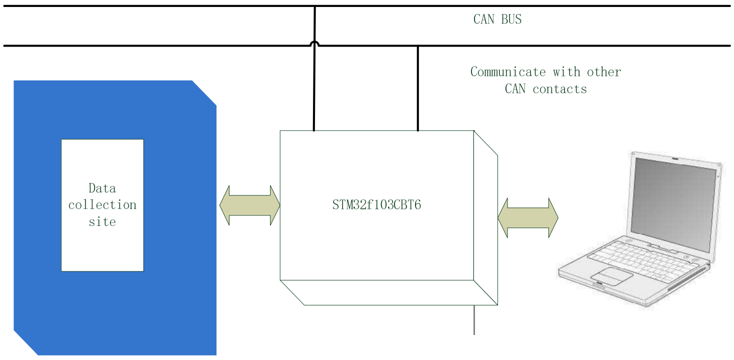

Fig. 1. Overall Design Scheme of Data Acquisition System

3. Circuit design

CAN node hardware circuit diagram is intriduced in the follow Fig. 2.

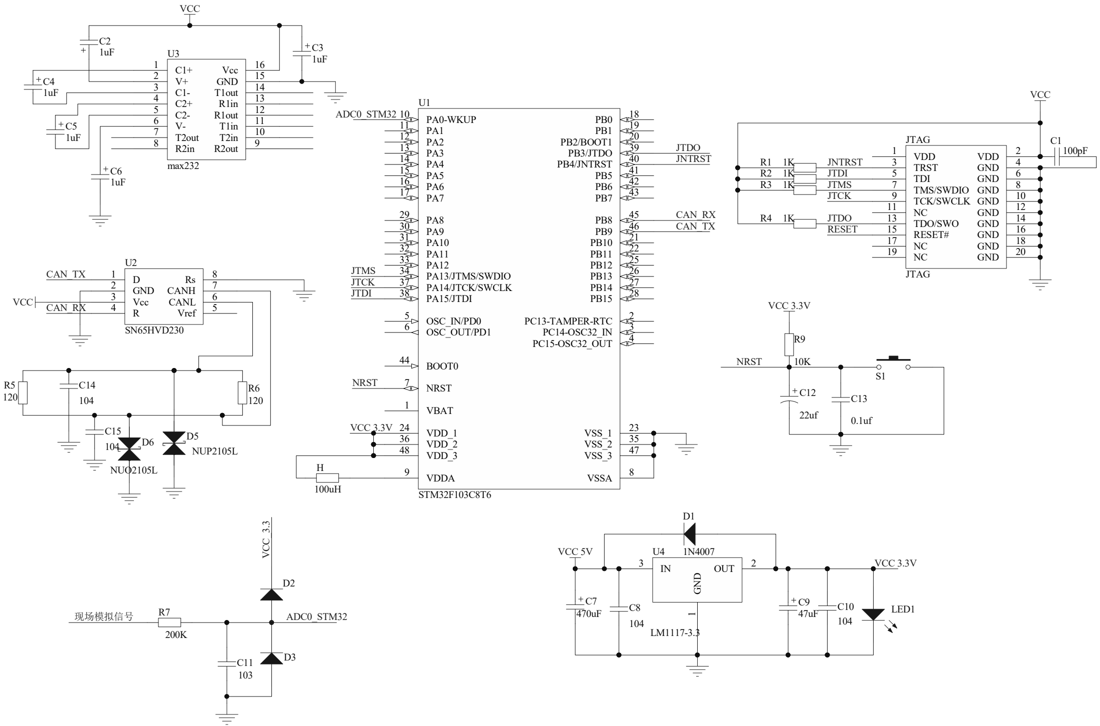

Fig. 2. CAN node hardware circuit diagram

3.1 Minimum System Design

(1) Power module

Assume that the site has already provided 5V voltage, but the voltage required by the system is 3.3V. The voltage conversion is needed. The voltage conversion chip LM1117-3.3 converts the 5V bit to 3.3V.

(2) System clock module

The STM32 system clock can be driven by three different clock sources: the HSI oscillator clock, the HSE oscillator clock, and the PLL clock. The design scheme selects the HSI oscillator clock, so pins 5 and 6 of the chip should be left floating.

(3) Download debugging circuit

The STM32F10xxx uses the Cortex(TM)-M3 core, which contains hardware debug modules and supports complex debug operations. The hardware debug module allows the kernel to stop when fetching (instruction breakpoints) or accessing data (data breakpoints). When the kernel is stopped, both the internal state of the kernel and the external state of the system can be queried. After the query is complete, the kernel and peripherals can be restored and the program will continue to execute. When the STM32F10x microcontroller is connected to the debugger and starts debugging, the debugger will use the kernel's hardware debug module for debugging. Supports two debug interfaces: serial interface, JTAG debug interface

3.2 CAN transceiver

This design scheme adopts SN65HVD230 as the CAN bus transceiver, and SN65HVD230 is a 3.3V CAN transceiver manufactured by Texas Instruments. The device is suitable for serial communication with high communication speed, good anti-interference ability and high reliability CAN bus.

CAN bus can realize high reliability serial communication with its high communication speed and good anti-electromagnetic interference, so it has extremely high application value in practical application.However, with the continuous development of integrated technology, in order to save power and reduce the circuit size, the logic of some new CAN bus controllers uses LVTTL on average, which requires a bus transceiver[3] that adapts to it. TI's SN65HVD230 type circuit solves this problem very well.

SN65HVD230 is 3.3 CAN bus transceiver that Texas Instruments Company produces, it is mainly used with TMS320Lx240x series DSPs with CAN controller, this transceiver has the ability of receiving and dispatching differentially, the highest speed can reach 1Mb/s.Widely used in automotive, industrial automation, UPS control and other fields.

3.3 AD conversion circuit

The ADC conversion module of this design scheme uses the integrated ADC conversion module of STM32F103CBT6. STM32F103CBT6 is used for two 12-bit ADC converters and has 16 conversion channels. Channel A/D conversions can be performed in single, continuous, scan, or discontinuous mode. The result of the ADC can be stored left-justified or right-aligned in 16-bit data registers. The analog watchdog feature allows the application to detect if the input voltage exceeds a user-defined high/low threshold.

To avoid excessive input voltage damage to the MCU in the field, an input protection circuit is added to the ADC input pin. The circuit diagram is shown in Figure 5. R7 is used for current limiting and C11 filter. When the input voltage is higher than 3.4V, the D3 tube conducts, clamping the input voltage at 3.4V. When the input voltage is lower than -0.7V, the D4 tube conducts and clamps the input voltage at -0.7V.

4. Circuit design Software design

The CAN bus slave node needs to sample the scene data at regular intervals and then transmit it to the master node through the CAN bus. The master node then transmits the serial port communication to the PC upper computer for processing.

(1) CAN field node software design

CAN field node software module includes: system clock setting, timer module, AD module, CAN transceiver module. After the system initializes each module, it waits for the monitoring room node to send a collection command, and the frequency is set by the user. After 10 sets of data are collected by the timer, the median filter is applied and sent to the monitoring room node.

(2) CAN monitoring room node software design

CAN monitoring room node software design includes: system clock setting, serial transceiver module, CAN bus transceiver module. After each module is initialized, the program waits for the upper layer to send a name. After receiving the collection and naming, the program starts sending collection naming to each node. The AD data received from the CAN site node is forwarded to the PC, and the received command data is processed.

(3) Upper computer programming

The software development environment of the upper computer is developed with visual integrated development environment Visual Basic 6.0. The line method and BitBlt function are used to draw real-time curves on the picture space. The serial communication uses MScomm1 space for programming communication. Fig. 3. shows the on-site signal monitored by the host computer. In addition to real-time curve display, the real-time curve can be saved, and the baud rate of serial communication can be set.

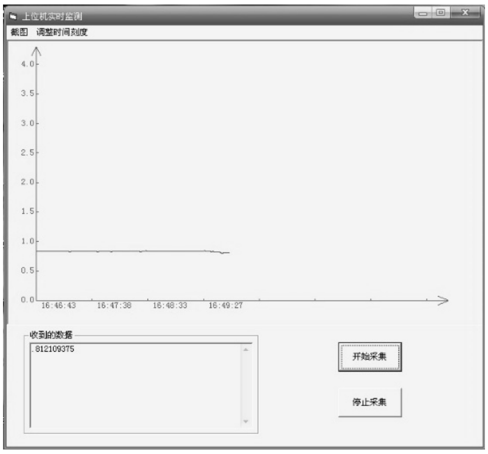

Fig. 3. upper computer interface

5. Conclusion

After debugging the above-mentioned hardware and software solutions, basic requirements can be met, data acquisition and transmission have good anti-interference, the host computer interface is friendly and easy to operate and can realize the monitoring of the scene.

References

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