Distributed On-line Monitoring System Based on Modem and Public Phone Net

Dandan Chen1, Qiushi Zhang2, Guiru Li3

1School of Automation Engineering, Northeast Dianli University, Jllin, 132012, China
2School of Information Engineering, Northeast Dianli University, Jllin, 132012, China
3School of Electrical Engineering, Dalian Jiaotong University, Dalian, 116028, China

Abstract

In order to solve the monitoring problem of urban sewage disposal, a distributed on-line monitoring system is proposed. By introducing dial-up communication technology based on Modem, the serial communication program can rationally solve the information transmission problem between master station and slave station. The realization of serial communication program is based on the MSComm control of C++ Builder 6.0. The software includes real-time data operation part and history data handling part, which using Microsoft SQL Server 2000 for database, and C++ Builder 6.0 for user interface. The monitoring center displays a user interface with alarm information of over-standard data and real-time curve. Practical application shows that the system has successfully accomplished the real-time data acquisition from data gather station, and stored them in the terminal database.

Keywords: distributed system; on-line monitoring; modem; public phone net; dial-up communication

1. Introduction

Water is recognized as the source of life. However, this source is in trouble and we are faced with the problem of water pollution. In recent years, with the modernization of industry and the expulsion of its population, severely-polluted sewage disposal in factories and businesses cause the serious harm to the water environment. Up to now, the disposal rate of urban sewage was less than 20% all over the country, and many cities have no municipal sewage treatment plant so far [1]. Although the number of report on industrial waste water treatment is limitless, the truth is just the reverse. In fact, a lot of difficulties are founded in operating the wastewater treatment equipments, some of the facilities even can not work normally. The so-called specified standard sewage discharge is a matter of form only [2]. In this sense, monitoring effluent discharge, make sure each site met the specified standard then give appropriate countermeasures, is found to be more and more indispensable.
Taking urban sewage disposal monitoring for an example, a long-distance data transmission technology based on Modem was applied to design a distributed on-line monitoring system. Serial communication program based on C++ Builder and dial-up Communication technology based on Modem were used to accomplish information transmission.

2. Implementations of Serial Communication Based on C++Builder

C++ Builder is a RAD (rapid application development) tool to build your enterprise applications using the C++ language and the component libraries provided by Borland. Similar to Delphi, the real power of C++ Builder is not only in the development of database but also in the development of application program [3].

Communication between a PC and a MCU, a PLC or a DSP has achieved through PC serial-port in industrial control area [4]. Unfortunately, C++ Builder itself reports no commands or components for serial communication. In spite of that, people often used ActiveX controls or the third ActiveX controls to realize the serial communication program.

There are three main implementations of serial communication program under the Borland C++ Builder 6.0 IDE (integrated developing environment).

First, use assembly language to realize the serial communication program. The advantage of this implementation is its high real-time capability. Since the efficiency of assembly language is higher than high level language. It is applicable to those applications where the high real-time capability could be more important just like serial communication. Under the Borland C++ Builder 6.0 developing environment, the assemble language could embedded into C++ language at any position. It makes the use of assemble language much easier. The disadvantage of this implementation is its poor universal property. It can only be used in Windows 9X operating systems [5]. In addition, we need to know all the details about the UART (Universal Asynchronous Receiver/Transmitter).

Second, use Windows API function to realize the serial communication. C++ Builder, have made more progress for calling the Windows API functions, and it is comparatively simple for multithreading programming. There are 26 Windows API Functions relating to the serial port communication, which used to realize the operation of open serial port, configure serial port, read / write data and close serial port respectively [6]. The use of Windows API Function can make programming much more flexible. User can create serial communication class at their will.

Third, use the MSComm control to realize the serial communication. The MSComm control has realized the data transmission and data acquisition through serial port, and makes it quite convenient to program the software of serial communication. Programmers do not need to devote more of their time to understanding complicated Windows API Function. Before programming, users must install the MSComm control on the component palette of C++ Builder IDE. Main properties be used are as follow: Commport, Settings, Portopen, Input, Output, Inputmode, Rthreshold, Sthreshold, CDHolding, InputLen.

In a word, comparing with the other two implementations, the MSComm control can be used to make programming much easier. For this reason, the system using the MSComm control to realize the serial communication functions.

3. Realization of Serial Communication Program Based on MSComm

3.1 Install method of MSComm control

The users may install components from third-party vendors on the component palette. And the user components are allowed to create. These two kinds of components are behave very naturally like the components supplied by Borland.

It is quite convenient for users to install ActiveX controls in C++ Builder. The way of install MSComm control is by selecting the Component | Import ActiveX control menu option from the IDE main menu.
Then select the Microsoft Comm Control 6.0 (Version1.1) option in a popup dialog box of import ActiveX. Finally, by click the "Install" button to complete the installation.

If there is no such option in the dialog box, click the "add" button to add mscomm32.ocx file in the Visual Studio in order to complete the installation.

C++ Builder can implement the automatic registration for ActiveX. After installation, the MSComm control will be appeared on the ActiveX Component Palette.

3.2 Mode of Handling communications in MSComm

Two mode of handling communications are provided in MSComm control. They are event driving mode and query mode. Event driving mode is a very effective approach to handling the interaction of serial port, of which to catch and deal with communications by OnComm event. Judging by essentials, query mode is also an event driving mode. This mode is more convenient under some circumstances. By using timer, query mode iterative check the property value of Commevent to query event or change after each key function of the procedure. If the port is ready to receive data, it reads the value of Input into MSComm. Therefore, this system has achieved the serial communication function based on the mode of event driving.

3.3 Mode of receiving data in MSComm

Two mode of receiving data are provided in MSComm. They are text mode and binary mode, which accomplished by setting 0 or 1 of Input Mode property. The working mode depends on the type of receiving data.

The MSComm control must be working at binary mode, on the condition that the receiving data is not an ASCII code which is larger than 127.

The property value of Input and Output in MSComm has realized the function of receiving data and sending data respectively. They all need the class OleVariant as intermediary agent. The class OleVariant includes a union and a variate. The union consists of data members of all types, and the variate used to indicate data type which is taking effect. The receiving and sending data are stored in a certain data member of this union.

4. Dial-up Communication Technology based on Modem

4.1 Working state of Modem

Modem, as the essential part of computer network in this distributed on-line monitoring system, connecting personal computer, terminal, printer and other peripheral equipment on a host computer to realize the long-distance resources sharing.

The working state of Modem can be divided into two parts: command state and online state. And the command state is divided into off-line command state and on-line command state. Modem does not communicate with outlying equipment on the off-line command state, it just preparing for receiving command. After Modem receiving the conversion code sequence, it is turning into the on-line command state.

4.2 Communication between C++ Builder and Modem

Modem has realized the connection with PC based on RS-232. The action of modem was taking by character string instructions from the AT Command Set. The receiving instructions of modem must be putting the symbol of “AT”, which be called as AT Command Set [7].

Therefore, by sending instructions through RS-232, the control of Modem is realizable based on the MScomm control of C++ Builder.

For example, if the phone number is 123456 then put the symbol of “ATDT” which means using audio frequency. After receiving instructions of “ATDT123456”, the Modem taking action of dial-up. After hanging up the phone, Modem return the character string of “NO CARRIER”, by means of online failed. And the hang-up instruction is “ATHn”, its default value is zero.
By using this method, the connection between local Modem and long-distance Modem has accomplished through public phone net. When the both Modem has successfully connected means the both computer on the status of online. This is the so called online mode. The character string sending by serial port form the one-side computer can be showed on the receiving buffer of the other side, thus the other side can receiving character string from its own receiving buffer.

The flow of the serial communication program based on Modem is seen in Fig.1 [8].

4.3 Realization of Modem dial-up communication

The program of Modem dial-up communication can be divided into two parts: master station dial-up program and slave station dial-up program.

The following is the basic idea of dial-up program based on master station.

The Modem of master station establishes dial-up connection with each Modem in slave station one by one. After the Modem of slave station sending out a DSRHolding signal, the communication between master station and slave station is accomplished. The master station receiving data form the slave station and store them in the database of its own, then do the next dial-up communication until all the slave station dial-up communication finished.

The flow of the dial-up program based on master station is illustrated in Fig.2. And the program of sending data based on slave station is similar to the master station.

Figure1. Flow of the serial communication program based on Modem

Figure2. Flow of the master station dial-up programs
The programs of judge whether Modem is ready and set its value are as following:

```c
if (mscomm1->DSRHolding==false) // Judge whether Modem is ready
    { messagedlg('Modem does not reset correctly, please turn off the power and check out the line!',mtinformation,[mbok],0);
    }
else
    {mscomm1->OutBufferCount=0; //Set or return the receive buffer size, the default value is 1KB
     mscomm1->SThreshold=0;
     mscomm1->InputMode=0;
     mscomm1->InputLen=0;
     mscomm1->RThreshold=1; //The on Comm event occurred whenever receiving a byte
     mscomm1 ->RTSEnable=true; //Computer require Modem transmitting data
     mscomm1->DTREnable=true; //Data terminal is ready, computer can receiving and sending data
    }
```

5. **System Design**

5.1 **Hardware design**

Figure 3 shows the system structure of the on-line monitoring system, which can be divided into three modules: data acquisition module, modem dial-up communication module and terminal software control module. There into, the switch connect the line between the ask side and answer side [9]. The data acquisition module, mainly include transducer and Data Acquisition Card, has accomplished the task of data acquisition. The modem dial-up communication module plays a very important role in transmitting data. The data acquisition module takes Modem as bond, which make real-time data be transmitted to the upper computer. The terminal software control module of system is running on the monitoring and control center [10]. This system adopts PC as master computer.

![Figure 3. System structure of the on-line monitoring system](image-url)
The master computer mainly implements the functions of supervision and management. It includes: dynamic show of sewage level, real-time data acquisition and show, history data save and print, fault alarm, etc.

5.2 Software design

As with every release, C++ Builder 6.0, the object oriented programming language, is very rich with features. Best of all, users can build distributed objects in different technologies in the real RAD way.

The software consists of initialization module, real-time data module, historical data module and alarm module.

The monitoring system provides a friendly human-computer interface which was designed by C++ Builder6.0 to display real-time data, deal with historical data queries, realize dial-up testing and alarming for over-standard data, and use Microsoft SQL Server 2000 for database.

C++ Builder6.0 has powerful functions of interacting and database programming, which can implement operating database by ODBC. Therefore, the connection between terminal software and SQL Server 2000 has realized by using of ODBC Data Source.

Conclusion

This system has successfully accomplished the real-time data acquisition from data gather station by using long-distance data transmission technology based on Modem. The realization of serial communication program is based on MSComm control in C++ Builder6.0. Due to its own advantage, Modem makes the system structure easy and clear. Moreover, the high widespread rate of public phone net makes the system more popular. Based on C++ Builder6.0, the software with friendly human-computer interface and powerful communication function can be applied in monitoring urban sewage disposal. A user interface on which real-time curve can be displayed to the monitoring center.

References