

Real Time Analysis System for Automobile Emission Based on Serial Communication

Zhaowen QIU¹, Xiaohong PENG²

¹Key laboratory of Automotive Transportation Safety of Ministry of Communications, Chang'an University, Xi'an 710064, China

²Department of Automobile, Shaanxi College of Communication Technology, Xi'an 710021, Shanxi, China

E-mail: qzw@chd.edu.cn; xiaohongpengcau@163.com

Abstract: By the serial communication technology and object-oriented programming technique with visual programming language VC++, the paper develops the real time analysis system for automobile exhaust on the basis of the original equipments made by AVL Company. It can be realized to analyze, show graphical chart and save real-time measuring data with the developed system. The analysis system can record and process concentration of exhaust gas pollutant in various test modes. Further more, the developed system is useful for experiment study on automobile exhaust characteristics.

Keywords: vehicle exhaust; serial communication; VC++; real time analysis

1 Introduction

Presently, the Chinese national emission test regulations for light-duty vehicles ordain that the automobile's exhaust quantity per kilometer is obtained by measuring diluted sample and air collected in the bags, combining with air temperature, humidity, diluted flow volume and traveling distance, etc^[1]. However, there is a question with the above method; it is difficult to found out the reasons when the total exhaust quantity exceeds the criterion's limit^[2]. Moreover, as the advanced automobile exhaust test system abroad is introduced, it is not indispensable to buy the whole set. Some software can be developed in virtue of exclusively self-retained technology and is more adapt to practices. So, this paper develops the real time analysis system for automobile emission based on visual programming language VC++, with some devices in existence.

2 System Hardware

Automobile exhaust gas concentration is measured in a special box CEBII, in which there are four equipments used to measure, NO_x, HC, CO/CO₂ and O₂. CEB-II includes three parts, that is, an industrial controlling computer, a suit of analysis module and temperature controlling unit for sampling. The industrial controlling computer obligates the serial ports to expand for second study which takes charge of detecting data from various instruments. The paper uses the serial communication channels to realize graphical chart and saving data of Real time data for automobile exhaust gas pollutant in various test modes.

Data transmission between host computer and analysis modules is via AK Instruction^[3], together RS232 serial communication protocol, baud rate 9600 bit/s, non parity bit, 8 data bit, 1stop bit. Due to the

transmission is in short distance, the simplest three-line manner is used, that is, the sending ports (TXD), the receiving pots (TXD) and the grounding (GND) in the serial ports of analysis module should connect with each other. The system frame is shown in figure 1.

3 Sending Instruction for Data Acquisition Directive (AKON)

In the real time data acquisition software of host computer, the sending acquisition instruction to the serial ports of CEBII computer is 'AKON'. When the industrial controlling computer receives the acquisition directive, it returns data cluster of sampling, which includes various bag gases or real time sampling concentration (CO/CO₂, NO_x and THC). Parsing the returning data cluster is a difficult problem in developing the real time analysis system. The Data Acquisition Directive type is shown in table 1.

4 Connecting Hardware

Because between host computer and analysis modules the Data transmission is by RS232 serial communication protocol, the host's communication parameters must be set with the corresponding analysis modules.

5 Realization Method Concretely

The key points during programming the software are the following, firstly which is the realizations of data change between the dialogs windows, secondly is data saving applying large array, thirdly is graphical chart and fourthly is text saving for detecting data.

Three steps could be operated on the serial ports. First step is initialization, second step is sending AK instruction and receiving data cluster, the last step is shut down the serial port.

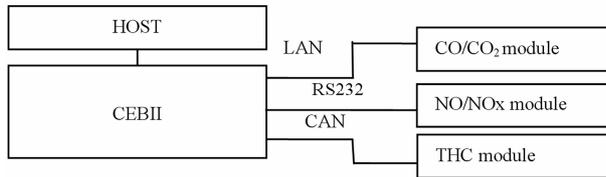


Figure 1. System frame of hardware

Table 1. Data Acquisition Directive type

Byte	Function	Explanation	Comment
0	STX	Start of Text	0x02
1	Don't Care		0x20
2~5	Function Code	Four Function Code	"AKON"
6	Space	Field Separator	
7/8	Kn	Channel Indicator	"K0"
*9	space	Field Separator	
*10/11	Block Check Sum	Xor Sum of Above	"72"
9/*12	ETX	End of Text	0x03

5.1 Initialization of Serial Ports^[4]

When the serial ports are initialized, the following set should be finished, including communication ports attribute ('Commport'), communication protocol ('HandShaking'), transmission baud rate (Settings), opening communication ports, that is, the value of 'PorOpen' is TURE.

5.2 Sending Request AK Command (AKON) and Parsing Data Cluster

As actualizing the function of sending request AK directive, the program set a clock by the function 'SetTime ()', here the clock's time long is 1 s. when the time is over, the system will automatically product the message 'WM_TIMER', in which the sending request AK directive is set. So, the program can time sending detecting data directive.

In these software programs, the data type of VARIANT, BYTE and CString is introduced. Some of these programs are following characters:

```
void SHOW::OnCommCebMscomm()
{ VARIANT variant_inp;
  COleSafeArray safearray_inp;
  LONG len,k;
  BYTE rxdata[2048];
  CString strtemp,temp;
  temp.Empty();
  char Temp[80];
  if(m_ceb_comm.GetCommEvent()==2)
```

```
{ variant_inp=m_ceb_comm.GetInput();
  safearray_inp=variant_inp;
  len=safearray_inp.GetOneDimSize();
  for(k=0;k<len;k++)
  safearray_inp.GetElement(&k,rxdata+k);
  for(k=0;k<len;k++)
  { BYTE bt=*(char*)(rxdata+k);
  Temp[k]=bt;
  strtemp.Format("%c",bt);
  temp+=strtemp;
  m_strRXData+=strtemp; }}
.....
CString temp1;
temp1=temp.Left(6);
CString temp2;
temp2.Empty();
UpdateData(FALSE);
}
```

5.3 Closing the Serial Port

```
m_ceb_comm.SetPortOpen(FALSE);
```

5.4 Showing Graphical Chart

The graphical chart can not only show the single automobile exhaust gas, but also can show others which concentration changes with the variable time. For example the graphical chart of 'CO' is shown by the following codes:

```
void CCEBView::OnDraw(CDC* pDC)
{ CString sc;
  CRect rect;
  CFont fnBig;
  fnBig.CreatePointFont(260,"Arial",pDC);
  CFont* pOldFont=pDC->SelectObject(&fnBig);
  pDC->SetMapMode(MM_LOMETRIC);
  GetClientRect(&rect);
  pDC->SetViewportOrg(rect.right/2,rect.bottom/2);
  pDC->SetTextColor(RGB(255,0,0));
  pDC->SetBkMode(TRANSPARENT);
  SHOW a_dlg; int j;
  if(ti==0)
  Rectangle0(pDC,-2000,2000,2000,-
```

```

2000,RGB(192,192,192));
    CString data; data="CO";
    pDC->TextOut(-1500,1050,data,strlen(data));
    pDC->TextOut(1000,1050,data,strlen(data));
    for(j=1;j<ai;j++){
        data.Format("%f",m_CO [j]);
    pDC->TextOut(-1500,1050-
j*50,data,strlen(data)); } }
    if(ti==1){
        Rectangle0(pDC,-2000,2000,2000,-
2000,RGB(255,255,255));
        for(j=1;j<ai-1;j++){
            Line0(pDC,-1500+j*2,int(m_CO[j]*10),-
1500+(j+1)*2,int(m_COL[j+1]*10),3,RGB(255,0,0)); }

```

5.5 Text Saving for Detecting Data

In order to analyzing the automobile emission characteristic, the real time detecting data can be saved in text during various driving condition. In case of the exhaust pollutant 'CO', the realizing codes are following program files.

```

void CCEBView::OnCOSAVE()
{
    CString Sc;
    int i = 0;
    for (i=0; i<ai; i++)
    { CString strTemp;
        strTemp.Format("%5.2f", m_CO[i]);
        Sc += strTemp;
        if (Sc != ai - 1)
            Sc += " "; }

```

```

CStdioFile
file("d:\\DATA_CO.txt",CFile::modeWrite);
    file.WriteString(Sc);
    file.Close();
    MessageBox("CO 数据已保存! ");
}

```

6 Conclusions

The real time analysis software for automobile emission has been put into operation in automobile exhaust emission analysis laboratory of Chang'an University. The system can realize real time data analysis, graphical chart and text saving for detecting data. The application practices show that this software gives a powerful hand to scientific researcher and prosthesis greatly the original equipment. This paper offers some references for the independent development of Chinese similar products.

References

- [1] Limits and measurement methods for emissions from light-duty vehicles (III), GB18352.3-2005.
- [2] Wang Chunjun, Lu Qingchun, Nie Shengfang, Deng zhiwei. Development on Host computer system of light-duty vehicle exhaust test. Automobile Technology, 1999.12: 19-22.
- [3] Qiu Zhaowen, Peng Xiaohong, Li Xiaoxia, Wang Shengchang. Data communication realization between microcomputer and AVL exhaust test equipments. Computer and Communications, 2004.4: 97-99.
- [4] Li Xianyong. Engineering and Practice based on Visual C++ with Serial Communication, Post & Telecom Press, 2002.5, the First Edition: 64-65.
- [5] Jin zhenhua, Lu qingchun. Application of Object-Oriented Software Development Methods in the development of vehicle exhausts test system. Application of Electronic Technique, 2001.4: 45-47.
- [6] Mark Nelson, Serial Communication Manual. China Water-Power Press, 2000.9, the First Edition: 4-15.