Scientific Research

The Application of VB Language in the Ultrasonic Detection Motion Control System

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Abstract: This paper introduces an approach to realize the serial communication between PC and MCU by using VB programming language and MODBUS protocol, then applies the approach for the motion control system of the ultrasonic detection of the solder joint. It has been proved by the practice that this approach is very convenient, fast, and efficient. It can meet the functional requirements.

Keywords: serial communication, MCU, motion control, ultrasonic detection

1. Introduction

Visual Basic is an object-oriented and visual program design language which is widely used in Windows, as the tool of developing the Windows application program. The using of Visual Basic as the development tool has many features, such as simple, easy to learn, efficient, convenient and interface elegant. And now Visual Basic (hereinafter referred to briefly as VB) has been widely used by many programmers in various fields. VB not only provides a good capability of the interface design, but also plays a very important role in the serial communication. [1-3] It provides a communication control named Microsoft Communication Control (hereinafter referred to briefly as MSComm), which packages the most operations of the lower layers and many tedious processes in the serial communication. It enables the users to easily access the major properties of Windows' serial communication drivers. The whole development process of the serial communication program becomes very simple, and we can use the MSComm to complete the program development by using only a small amount of code to achieve the main function and interface design.

2. Application Background

I took part in developing of the ultrasonic detection scanning system using for the solder Joint, which is mainly composed of the two-dimensional(x or y) scanning platform, driver, Micro Controller Unit (hereinafter referred to briefly as MCU) and Personal Computer (hereinafter referred to briefly as PC). This system is not only able to control the trajectory of the probe so as to meet the requirements of scanning movement of the ultrasonic detection, but also can return the real-time coordinate datas of the probe which can be combined with the detection data of the ultrasonic detection system to synthesize the C-scan Ultrasonic detection graphics. The model of MCU is AT89S52, which is produced by Atmel company in the USA. MCU as the underlying controller, which runs the control program designed by C language, is mainly used to control the detection equipment. PC as the senior controller will be appointed to analyzing, processing, and displaying datas of the entire motion control system. It is the RS-232 serial interface that makes the communication between PC and MCU possible. The schematic of the motion control system of the ultrasonic detection is shown in the Figure 1.
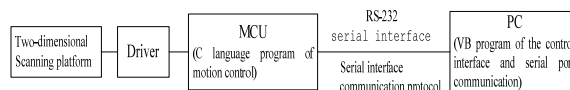

Fig.1 motion control system of the ultrasonic detection

Now, the key points of the design are as follows: how to realize the MCU control conveniently and quickly by the serial communication with MCU so as to decrease the design time and increase the efficiency; and also make the control interface designed simple, elegant, and easy to run.

To solve the problem, I use the VB language to design the control interface and the serial communication program on PC. It can control MCU through the transmission of the control commands and parameters between PC and MCU so as to control the ultrasonic detection scanning system of the solder Joint, which is achieved by VB language.

3. Serial Communication Control

The *MSComm* is the Visual Basic's customized control for the serial communication. It provides a series of standard communication properties and methods. It can be used to establish a connection between the application and the serial port. These properties are related to the configuration of ports, data transmission, the use of handshake signals and identification controls. The MSDN documentation of Visual Basic provides the syntax and some details needed when using the properties. I will not give unnecessary details here. Now, the basic

properties related to the program design are as follows.[3-5]

CommPort: Set and return the number of the port;

InBtrfferSize: Set and return the size of receiving buffer, measured in bytes;

InputLen: Set and return the number of characters which the Input function will be read into;

InputMode: Set and return the type of data from Input to Output;

OutBtrfferSize: Set and return the size of the sending buffer, measured in bytes;

PortOpen: Set and return the port status ("open" is True, "close" is False);

Rthreshold: Set and return the number of the receiving characters which is prior to triggering the comEv-Receive;

Settings: Set and return the baud rate, the number of the parity check bits, data bits, and stop bits.

4. Achievement of the Program

To realize the function of motion control of the Ultrasonic detection, the system is to let MCU control the two-dimensional scanning platform to complete the prescriptive movement according to the VB serial communication program by the transmission of the protocol between the VB program written on PC and MCU.

The communication protocols prescribe the regulateons of the transmission of the control commands and parameters, which should be commonly observed by the VB program and MCU.

4.1. Serial Communication Protocol

In the ultrasonic detection motion control system of the solder joint which I developed, the serial communication protocols between the VB program and MCU include: the serial data transmission rate is 9600 bps, one start bit, 8 data bits, one stop bit, no parity bits, and high byte fist. The frame structure is used for the transmission of data, with using MODBUS protocol, which is an industrial control protocol. By using this protocol, different controllers, and other devices can communicate. Because it is uncomplicated and completely open, the MODBUS protocol is widely used. According to the MODBUS protocol, a frame is mainly composed by the address code, function code, data area and error check code. The frame structure is shown in the Figure 2. The address code is used to distinguish different devices. The function code is used to distinguish different functions. According to the different function codes, the functions such as serial communication, restoration, free or scanning movement, motion control, reading coordinates of the probe can be set and distinguished. Data area contains the data which is needed by the different functions to perform, or the information which is sent back from the device. Error checking is achieved by using the CRC-16 checksum method.

Address Code 8bits	Function Code 8bits	Data Area N×8bits	Error Check Code 16bits

Fig.2 frame structure of MODBUS protocol

The method of calculating CRC code is following. Step one, define a 16-bit register, and then the 16-bit register is all preset 1. Step two, the first 8-bit data XOR the lower bits of the 16-bit CRC register, and store the result in the CRC register. Step three, make the contents of the register right one bit, and fill the highest bit with 0. Then, check the lowest bit, if it is 0, repeat the step three, or if it is 1, make the CRC register data XOR the polynomial A001(1010 0000 0000 0001). Then, process the 8-bit data.

Function CrcResult(ByBal Data As Long, ByVal Genpoly As Long, ByVal CrcData As Long) As Long
  Dim TmpI As Integer
  *Data=Data*2*
  For TmpI=8 To 1 Step-1
    Data=Fix(Data / 2)
      If((Data Xor CrcData) And 1) Then
        CrcData =Fix(CrcData / 2) Xor Genpoly
    Else
        CrcData =Fix(CrcData / 2)
    End If
   Next TmpI
   CrcResult =CrcData
   End Function

All of the communication frames can be divided into two categories: frames from PC to MCU or frames from MCU to PC. These frames prescribe the content and form of the control command and the control parameters which plays an important role in controlling MCU.

It can be illustrated by the transfer of the frame of the scanning movement. First of all, the scope of the scanning, the scanning speed and some information can be transmitted to MCU through the communication frame. When MCU receives the frame, it will begin the scanning movement according to the regulations are transferred before. At the same time, MCU will send a responding frame to PC. If PC receives this frame, it will know that the scanning movement has already begun and then send a request to MCU for the coordinate datas of the probe. If MCU receives the request, the coordinates of the probe will be returned to PC until the move stops. This is a basic control process made by the transmission of the communication function frames. The transmission of the communication frames will be achieved by the serial communication in VB program.

4.2. Design of the Interface and Program

The main interface of the VB program is as Figure 3. In the main interface, there are several parts: the communication detection, the free movement, the scanning movement, origin settings, operational control and the coordinates display. Every part has each own function, so

all the program has many functions. In the free movement part, the probe can move to the prescribed position at the prescribed speed. In the scanning movement part, the scanning scope and speed can be set by the VB program and the current location can be set as the origin. And the scanning movement on the two-dimensional scanning platform can be achieved, and the position coordinates of the *X, Y* direction can be read real-time.
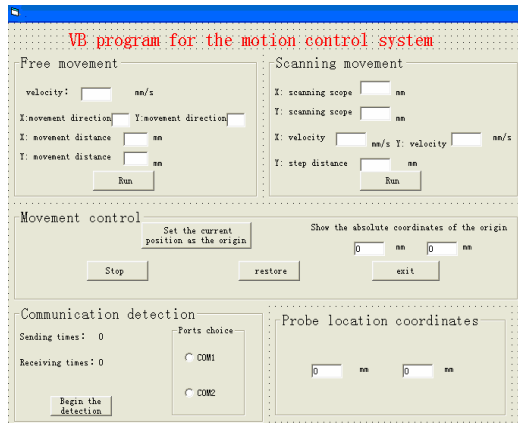

Fig.3 The main interface of the VB program

As the program I write is very long, now I only list part of the program, and it will show you how the communication protocols are transferred through the serial communication program between PC and MCU. The program of the serial communication which is used for the restoration of the probe (the probe return the initialization datas) is shown as follows:

(1)The initialization of the communication

Private Sub Form_Load()
MSComm1.Settings = "9600,n,8,1"
  'set the baud rate as 9600
MSComm1.CommPort = 1
  'set the number of the serial port as one
COM1.Value = True
  'default use the COM1 as the serial port
MSComm1.InputLen = 0
  'read the characters in the receiving buffer
MSComm1.InputMode = comInputModeText
'the data of the Input is text
    End Sub

(2)Sending and receiving the serial communication protocol

'click the restoration button to realize the manual restoration
Private Sub reset_Click()
If   MSComm1.PortOpen   =   False   Then
MSComm1.PortOpen = True   'open the serial port
MSComm1.Output = Chr(255) + Chr(3)
'send the restoration protocol (FF03) to MCU
Do
DoEvents   'receive the response of other events
Loop While (MSComm1.InBufferCount = 0)
'do the cycle until receive the data
If (MSComm1.Input <> (Chr(255) + Chr(3))) Then
  ' the receival of "FF03" means the end of restoration
MsgBox "MCU doesn't finish the restoration" + Chr$(10) + "please wait", 0, "restoration dialogue frame"
Else
MsgBox "MCU restoration is finished" + Chr$(10) + "please continue the operation", 0, " restoration dialogue frame "
End If
MSComm1.PortOpen = False   'close the serial port
End Sub

5. Acknowledgment

This paper introduces the application of the VB and MODBUS to realize the serial communication between PC and MCU in the ultrasonic detection system of the solder Joint. It is very fast and convenient proved by the practice. And the control interface is simple, elegant, and easy-to-operate.

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