

EXPLOSION-PROOF MULTISTAGE BELT TRANSPORTATION MULTI-TOUCH-SCREEN MULTI-CAN-BOARD PARALLEL LONG-DISTANCE CENTRALIZED CONTROL DEVICE

Technical field

The patent relates to a multi-touch-screen multi-CAN-board long-distance centralized control device, in particular to an explosion-proof multistage belt transportation multi-touch-screen multi-CAN-board long-distance centralized control device.

Background technology

The main mode of coal transportation in coal mine undergrounds is belt transportation. According to the actual conditions of the coal mine undergrounds, it has the characteristics of the explosion-proof multistage belt transportation. The belt transportation has a long distance, usually several hundred meters or thousands of kilometers away. Inspectors need to monitor the devices in different places in time, and there are much multistage belt transportation monitoring data, and the monitoring of multiple points is needed. The existing monitoring system is only monitored on the main console, or the monitoring of the upper computer is increased, and the monitoring of multiple points, multiple screens, and multiple data cannot be satisfied.

For monitoring of multi-screen and multi-CAN-board (i.e. CAN bus processing and data transmission circuit boards), the related papers such as: 1. "Design of Centralized Control System for Multistage Belt Transportation, Anhui University of Technology, Master's Thesis, Yang Xue, 2015.06.01" involves a upper computer and a CAN board, but the touch screen and multiple-CAN-boards are not involved. 2. The method used in "Design of Operating room Centralized control System Based on One Machine and Multi-screen Technology, Journal of Jishou University, 2012.7.25", and "Application of PLC and Human-machine Interface in Network Control, Chemical Automation and Instrumentation, 2014.3.10" is a method of connecting multiple-touch-screens in series.

The method described in "Achieve Multi-Screen Function for Delta DOP, Modern Manufacturing, 2007.7.5" and "Application of One Machine and Multi-screen Technology in Liquid Nitrate Ammonium Storage Control System, Automation and Instrumentation, 2013.7.15" is the first touch screen as the master, the PLC and other touch screens are slaves.

The disadvantages of the above methods are: 1. since a touch screen as the main screen is used as the master and PLC is used as the slave, during the communication process, the touch screen as the master continuously sends request packets to the PLC. After the PLC accepts the request, it must continue to reply to the touch screen, CPU occupancy rate of the PLC is high, most of the PLC's CPU resources consumed in the communication response process; PLC's response is given by the interrupt method, must be constantly responding the touch screen that is as the master, the query occupancy rate of the touch screen is high; PLC must use interrupt mode to respond, the programming difficult, the time-out requirements strict. 2. The data exchange between the rest of the touch screens and the PLC needs to pass through the first touch screen as a transfer station, and the data exchange on the multiple-CAN-boards (both CAN bus processing and transmission data circuit boards) also needs to pass through the first touch screen as a transfer station.

For multistage belt transportations in coal mine undergrounds, there are multiple-touch-screens and multiple-CAN-boards. Since the main function of the touch screen as a transfer station is display, the ability to process a large number of data is limited, as a result, the speed of the data transmission will be very slow and even deadlock; Similarly, the instructions and data transmitted by the PLC to each touch screen, also need to pass through the touch screen of the transfer station, the speed will be very slow or crash. The real-time and reliability of centralized control equipment are seriously affected; as result, the equipment can not be used. When the touch screen as a transfer station fails, the entire device will not be usable. Furthermore, since the touch screen is used as a transfer station, the transmission distance thereof is correspondingly increased, and the long-distance monitoring and data transmission will cause the data transmission signal to attenuate, increase the interference, and thus affect the accuracy of data transmission. The above connection method is difficult to meet the needs of coal mine safety production.

The multistage belt transportation monitoring at the coal mine undergrounds has other areas that are not sufficiently comprehensive as well as reasonable, and need to be improved. How to solve the multistage belt transportation monitoring with multiple-touch-screens and multiple-CAN-boards in coal mine undergrounds is a problem that must be solved timely in multistage belt transportations in coal mine undergrounds.

Summary of the invention

In order to solve the above problems, the present invention will solve the monitoring and some insufficient and reasonable places of the long-distance multistage belt transportation in the coal mine undergrounds with multiple-touch-screens and multiple-CAN-boards, the PLC's features are fully utilized in this patent, and the goal of the safe production of coal mines is realized.

The technical scheme adopted by the explosion-proof multistage belt transportation multi-touch-screen multi-CAN-board parallel long-distance centralized control device of the invention is: the explosion-proof multistage belt transportation multi-touch-screen multi-CAN-board parallel long-distance centralized control device, comprises an explosion-proof multistage belt transportation monitoring device, which is characterized by:

Also comprising PLC as main controller, multiple-touch-screens, multiple-CAN-boards; the multiple-touch-screens and multiple-CAN-boards are connected in parallel, then be connected to a serial communication port of the PLC through a RS485 serial port cable.

The PLC is a master station, multiple-touch-screens and multiple-CAN-boards are slave stations, and the data is transmitted through the MODBUS RTU SLAVE protocol.

Another serial communication port on the PLC is connected to the RS232 serial port of an upper computer through the RS485 to RS232 module. The configuration software on the upper computer has functions of setting, operation, monitoring, alarm pop-up windows, faults and operation records.

The up, down, left, right and confirm buttons on the main console are connected to the PLC inputs.

On the field control boxes at every stage, there are the touch screen, CAN board, RS485 serial connectors, self-holding or instantaneous control selection switch, sound and light signals and emergency stop button, and the up, down, left, right and confirm buttons connected to the PLC inputs.

The motor brake detection switches of the band transportation at every stage in the centralized control device are connected to the PLC inputs.

The main contact feedback detection switches of the main contactor for controlling

motor at each stage of the band transportation at each stage in the centralized control device are connected to the PLC inputs.

The signal switches of each touch screen and each CAN board in the event of a communication failure are connected to the outputs of the PLC, when a communication failure occurs, it is timely displayed on the upper computer and the touch screens.

The protection features of the brake, smoke, coal stack, sideslip, motor temperature, front roller temperature, rear roller temperature, front sideslip, middle sideslip, and rear sideslip can be set to disabling/enabling in the touch screen.

The output signals of the smoke sensor switches at every stage are connected to the PLC inputs, and the output signals of the sensor switches of the coal stacking at every stage are connected to the PLC inputs.

each emergency stop switch address, tear address, sideslip address, sideslip fault type, temperature address, front roller temperature, rear roller temperature, motor temperature, and band speed data of the multistage band transportation are collected by the CAN board, in case of failure, the fault type and fault location are displayed in each touch screen.

The output signals of the current transformer and voltage transformer of the motor of the multistage band transportation are connected to a A/D module, the current and voltage are detected by the PLC, the PLC calculates the power, and the current, voltage and power are displayed in each touch screen.

There are a CAN bus to RS485 interface on the CAN board.

The manual warning time, automatic warning time, start time of transportation bands at every stage, and delay stop time of transportation bands at every stage can be set on the touch screen.

The explosion-proof multistage belt transportation multi-touch-screen multi-CAN-board parallel long-distance centralized control device, comprises an explosion-proof multistage belt transportation monitoring device, also comprising a PLC as main controller, multiple-touch-screens, multiple-CAN-boards; the multiple-touch-screens and multiple-CAN-boards are connected in parallel, then be connected to a serial communication port of the PLC through a RS485 serial port cable.

The parallel connection method described above will minimize the connection distance between the PLC and multiple-touch-screens and multiple-CAN-boards, minimize data transmission attenuation, and minimize interference.

The PLC is a master station, multiple-touch-screens and multiple-CAN-boards are slave stations, and the data is transmitted through the MODBUS RTU SLAVE protocol.

Because the PLC is the master station, multiple-touch-screens and multiple-CAN-boards are slave stations, the MODBUS RTU SLAVE protocol is used to transmit data; the PLC is as the master device, it can initiate communication without taking up too much CPU time. The PLC directly exchanges data with multiple-touch-screens and multiple-CAN-boards without passing through a touch screen as a transfer station, ensuring the speed and reliability of data transmission. The use of the MODBUS RTU SLAVE protocol to transmit data ensures that it can be exchanged data for long-distance.

Another serial communication port on the PLC is connected to the RS232 serial port of an upper computer through the RS485 to RS232 module; the configuration software on the upper computer has functions of setting, operation, monitoring, alarm pop-up windows, faults and operation records.

Using another serial port of the PLC to realize the connection with the upper computer, it can perform various operations and data processing on the centralized control device on the upper computer.

The up, down, left, right and confirm buttons on the main console are connected to the PLC inputs.

Because the touch screen can not been directly used in the coal mine in accordance with the explosion-proof requirements, the up and down button s on the main console can now be used to select the desired button content of the touch screen, and the left and right button s can change different parameters, and the confirm button can be confirmed.

On the field control boxes at every stage, there are the touch screen, CAN board, RS485 serial connectors, self-holding or instantaneous control selection switch, sound and light signals and emergency stop button, and the up, down, left, right and confirm buttons are connected to the PLC inputs.

Through field control boxes at every stage, manual control the belt transportation of the

current stage, the touch screen, CAN board of this level can be connected in parallel through the serial port connector. When manually controlling the belt transportation, self-holding or instantaneous control can be selected. Also due to the touch screen can not been directly used in the coal mine in accordance with the explosion-proof requirements, the up and down buttons on the main console can now be used to select the desired button content of the touch screen, and the left and right buttons can change different parameters, and the confirm button can be confirmed.

The motor brake detection switches of the band transportation at every stage in the centralized control device are connected to the PLC inputs.

The centralized control device is equipped with a motor brake detection switch of the belt transportation at every stage, which is used to detect whether the brake is opened before the start of the motor to prevent the motor from burning at starting the motor in the event that the brake is not opened.

The main contact feedback detection switches of the main contactor for controlling motor at each stage of the band transportation at each stage in the centralized control device are connected to the PLC inputs.

The centralized control device is equipped with the main contact feedback detection switch of the main contactor for controlling motor at each stage of the belt transportations at every stage. If the main contact of the main contactor is not disconnected properly and the adhesion phenomenon occurs, the PLC can timely power off the control circuit to prevent equipment and personnel serious accidents.

The signal switches of each touch screen and each CAN board in the event of a communication failure are connected to the outputs of the PLC, when a communication failure occurs, it is timely displayed on the upper computer and the touch screens.

As the master station, the PLC periodically issues instructions to check whether the response data returned by each slave is correct, so that various faults appearing on each touch screen and each CAN board can be found in time, and can be displayed in the upper computer and the touch screen in time when a communication fault occurs.

The protection features of the brake, smoke, coal stack, sideslip, motor temperature, front roller temperature, rear roller temperature, front sideslip, middle sideslip, and rear

sideslip can be set to disabling/enabling in the touch screen.

Due to the large number of sensors used in the centralized control device, in order to prevent the failure of individual sensors from affecting the production of the entire production line, the individual sensors may be temporarily shielded in the fault monitoring setting to release the protection function so as to prevent the influence of the entire produce.

The output signals of the smoke sensor switches at every stage are connected to the PLC inputs, and the output signals of the sensor switches of the coal stacking at every stage are connected to the PLC inputs.

The smoke sensor at every stage automatically determines the stage of smoke data. Once the warning value is exceeded, the switch signal will be output to the PLC input. The PLC will then start the sprinkler and display the type of fault and the specific fault location in each touch screen.

The coal stack sensor at every stage automatically determines the stage of coal stack data. Once the warning value is exceeded, the switch signal will be output to the PLC input. The PLC will then issue a fault signal and display the type of fault and the specific fault location in each touch screen.

Each emergency stop switch address, tear address, sideslip address, sideslip fault type, temperature address, front roller temperature, rear roller temperature, motor temperature, and band speed data of the multistage band transportation are collected by the CAN board, in case of failure, the fault type and fault location are displayed in each touch screen.

The sensors of the emergency stop rope switch, tear, sideslip address, sideslip fault type, temperature and speed of every stage of belt transportation are connected to various CAN boards. The signals and data of the above sensors will be collected by the CAN board and transmit them to the PLC. The above signals will be processed and compared the warning values by the PLC. Once an emergency stop, tear, sideslip or temperature and speed exceed the warning value, the centralized control device will stop and the PLC will output the signal to each touch screen, and the corresponding fault types and fault locations are displayed in each touch screen.

The output signals of the current transformer and voltage transformer of the motor of the multistage band transportation are connected to a A/D module, the current and voltage are detected by the PLC, the PLC calculates the power, and the current, voltage and power are displayed in each touch screen.

The current and voltage inputted from the A/D module are detected by the PLC, and calculates the power of each motor, and the current, voltage, and power values will be displayed on each touch screen.

There are a CAN bus to RS485 interface on the CAN board.

The CAN board converts the CAN bus into an RS485 interface and connects to the PLC via the RS485 interface.

The manual warning time, automatic warning time, start time of transportation bands at every stage, and delay stop time of transportation bands at every stage can be set on the touch screen.

According to the actual needs of different transportations, different manual warning time, automatic warning time, three-stage conveyor belt start time, second-stage conveyor belt start time, first-stage conveyor belt start time, two-stage conveyor belt delayed stop time, the three-stage conveyor belt delay stop time, four- stage conveyor belt delay time, and other parameters can be set in the parameter settings.

The beneficial effects of the present invention are: an explosion-proof multistage belt transportation multi-touch-screen multi-CAN-board parallel long-distance centralized control device, it can realize the function of multi-touch-screen, multi-CAN-board long-distance monitoring. It is suitable for multi-data processing, fast data transmission, low signal attenuation and strong anti-interference ability. The protection function that the motor holding brake and the main contactor contact are not disconnected in time. The communication failure occurred at every slave can be discovered in time. With the protection function of the brake, smoke, coal stack, sideslip, motor temperature, front roller temperature, rear roller temperature, front sideslip, middle sideslip, rear sideslip, and the disable/enable can be set in the touch screen; the current, voltage, and power can be displayed in the each touch screen; the functions are complete, and the performance is reliable.

Brief Description of the Drawings

The following further describes the present invention with reference to the accompanying drawings and the embodiment.

FIG. 1 is the main console drawing of the input expansion module of the explosion-proof multistage belt transportation multi-touch-screen multi-CAN-board parallel long-distance centralized control device.

FIG. 2 is the drawing of the field control box at every stage of the explosion-proof multistage belt transportation multi-touch-screen multi-CAN-board parallel long-distance centralized control device.

FIG. 3 is the PLC wiring drawing of the explosion-proof multistage belt transportation multi-touch-screen multi-CAN-board parallel long-distance centralized control device.

FIG. 4 is the wiring drawing of the input/output expansion module of the explosion-proof multistage belt transportation multi-touch-screen multi-CAN-board parallel long-distance centralized control device.

FIG. 5 is the wiring drawing of the input expansion module of the explosion-proof multistage belt transportation multi-touch-screen multi-CAN-board parallel long-distance centralized control device.

FIG. 6 is the wiring drawing of the analog/digital conversion expansion module of the explosion-proof multistage belt transportation multi-touch-screen multi-CAN-board parallel long-distance centralized control device.

FIG. 7 is the wiring drawing of the Ethernet communication extension module of the explosion-proof multistage belt transportation multi-touch-screen multi-CAN-board parallel long-distance centralized control device.

FIG. 8 is the main interface of the touch screen monitoring system of the explosion-proof multistage belt transportation multi-touch-screen multi-CAN-board parallel long-distance centralized control device.

FIG. 9 is the time setting interface of the explosion-proof multistage belt transportation multi-touch-screen multi-CAN-board parallel long-distance centralized control device.

FIG. 10 is the fault inquiry interface of the explosion-proof multistage belt transportation multi-touch-screen multi-CAN-board parallel long-distance centralized control device.

FIG. 11 is the fault monitoring settings interface of the explosion-proof multistage belt transportation multi-touch-screen multi-CAN-board parallel long-distance centralized control device.

Specific implementation methods

This embodiment is a four-stage belt transportation. The PLC used is a S7-200CN series CPU226 type PLC manufactured by Siemens, and has two communication ports, which are PORT0 and PORT1, respectively. The communication ports of touch screen 1, touch screen 2, touch screen 3, touch screen 4, CAN board 1, CAN board 2, CAN board 3 and CAN board 4 are connected in parallel, and are connected to the communication port PORT0 of the PLC, and PORT1 is connected to the communication port of the upper computer.

The input/output expansion module is Siemens EM223, 16DC/16REL, the input expansion module is EM221, the analog/digital conversion expansion modules EM231, 8AD, and the Ethernet communication expansion module is EM243-1, the touch screen is a MT4404T 10-inch touch screen produced by Shanghai Kinco Automation Co., Ltd.

The field control/console control knob selection switch in the control method is connected to the PLC input I0.0 and I0.1; the manual operation/automatic operation knob selection switch of the console control operation mode is connected to the PLC input I0.2, I0.3; the emergency stop button is connected to the PLC input I0.4, the reset button is connected to the PLC input I0.5.

The field start 1 button of the first stage of the belt transportation is connected to the PLC input I1.0, the field stop 1 button is connected to the PLC input I1.1, the console start 1 button is connected to the PLC input I1.2, the console stop 1 button is connected to the PLC input I1.3, the contact feedback 1 switch is connected to the PLC input I1.4, the brake 1 switch connects to the PLC input I1.5, the smoke 1 switch is connected to the PLC input I1.7, coal stack 1 switch is connected to the PLC input I2.0, the up button is connected to

the PLC input I2.2, the down button is connected to the PLC input I2.3, the left button is connected to the PLC input I2.4, the right button is connected to the PLC input I2.5, the confirm the button is connected to PLC input The end of I2.5.

The control voltage of the used intermediate relay is DC 24V. The control relay for starting the sound and light alarm is connected to the PLC output Q0.0, the intermediate relay coil of the motor 1 of the first stage belt transportation is connected to the PLC output Q0.1, the intermediate relay coil of the fault 1 is connected to the PLC output Q0.2, the intermediate relay coil of the sprinkler 1 is connected to the PLC output Q0.3.

The intermediate relay coil of the motor 2 of the second stage belt transportation is connected to the PLC output Q1.1, the intermediate relay coil of the fault 2 is connected to the PLC output Q1.2, the intermediate relay coil of the sprinkler 2 is connected to the PLC output Q1.3.

The field start 2 button of the second stage belt transportation is connected to connect to the PLC input I3.0, the field stop 2 button is connected to the PLC input I3.1 of the input/output expansion module, the console start 2 button is connected to the PLC input I3.2 of the input/output expansion module, the console stop 2 button is connected to the PLC input I3.3 of the input/output expansion module, the contact feedback 2 switch is connected to the PLC input I3.4 of the input/output expansion module, the brake 2 switch is connected to the PLC input I3.5 of the input/output expansion module, the smoke 2 switch is connected to the PLC input I3.7 of the input/output expansion module, the coal stack 2 switch is connected to the PLC input I4.0 of the input/output expansion module.

The intermediate relay coil of the motor 3 of the third stage belt transportation is connected to the PLC output Q2.1 of the input/output expansion module, the intermediate relay coil of the fault 3 is connected to the PLC output Q2.2 of the input/output expansion module, the intermediate relay coil of the sprinkler 3 is connected to the PLC output Q2.3 of the input/output expansion module.

The intermediate relay coil of the motor 4 of the fourth stage belt transportation is connected to the PLC output Q3.1 of the input/output expansion module, the intermediate relay coil of the fault 4 is connected to the PLC output Q3.2 of the input/output expansion module, the intermediate relay coil of the sprinkler 4 is connected to the PLC output Q3.3 of

the input/output expansion module.

The field start 3 button of the third stage of the belt transportation is connected to connect to the PLC input I5.0 of the input expansion module, the field stop 3 button is connected to the PLC input I5.1 of the input expansion module, the console start 3 button is connected to the PLC input I5.2 of the input expansion module, the console stop 3 button is connected to the PLC input I5.3 of the input expansion module, the contact feedback 3 switch is connected to the PLC input I5.4 of the input expansion module, the brake 3 switch is connected to the PLC input I5.5 of the input expansion module, the smoke 3 switch is connected to the PLC input I5.7 of the input expansion module.

The field start 4 button of the fourth stage of the belt transportation is connected to the PLC input I6.0 of the input expansion module, the field stop 4 button is connected to the PLC input I6.1 of the input expansion module, the console start 4 button is connected to the PLC input I6.2 of the input expansion module, the console stop 4 button is connected to the PLC input I6.3 of the input expansion module, the contact feedback 4 switch is connected to the PLC input I6.4 of the input expansion module, the brake 4 switch connects is connected to the PLC input I6.5 of the input expansion module, the smoke 4 switch is connected to the PLC input I6.7 of the input expansion module.

The coal stack 3 switch of the third stage of the belt transportation is connected to the PLC input I7.0 of the input expansion module.

The coal stack 4 switch of the fourth stage of the belt transportation is connected to the PLC input I8.0 of the input expansion module.

The other communication port PORT1 on the PLC is connected to the RS232 serial port of the upper computer through the RS485 to RS232 module.

The determine time of The PLC as master station periodically queries the slave to return data is 5 seconds.

The above description is only a specific implementation manner of the present invention, but the protection scope of the present invention is not limited thereto, and any skilled personnel in the field can easily think of the change or replacement within the technical scope disclosed by the present invention. All should be covered by the protection

scope of the present invention. Therefore, the protection scope of the present invention should be subject to the protection scope defined by the claims.

Claims

1. Explosion-proof multistage belt transportation multi-touch-screen multi-CAN-board parallel long-distance centralized control device, comprises an explosion-proof multistage belt transportation monitoring device, which is characterized by:

also comprising PLC as main controller, multiple-touch-screens, multiple-CAN-boards; the multiple-touch-screens and multiple-CAN-boards are connected in parallel, then be connected to a serial communication port of the PLC through a RS485 serial port cable;

the PLC is a master station, multiple-touch-screens and multiple-CAN-boards are slave stations, and the data is transmitted through the MODBUS RTU SLAVE protocol; another serial communication port on the PLC is connected to the RS232 serial port of an upper computer through the RS485 to RS232 module; the configuration software on the upper computer has functions of setting, operation, monitoring, alarm pop-up windows, faults and operation records;

the up, down, left, right and confirm buttons on the main console are connected to the PLC inputs;

on the field control boxes at every stage, there are the touch screen, CAN board, RS485 serial connectors, self-holding or instantaneous control selection switch, sound and light signals and emergency stop button, and the up, down, left, right and confirm buttons are connected to the PLC inputs;

the motor brake detection switches of the band transportation at every stage in the centralized control device are connected to the PLC inputs;

the main contact feedback detection switches of the main contactor for controlling motor at each stage of the band transportation at each stage in the centralized control device are connected to the PLC inputs;

the signal switches of each touch screen and each CAN board in the event of a communication failure are connected to the outputs of the PLC, when a communication failure occurs, it is timely displayed on the upper computer and the touch screens;

the protection features of the brake, smoke, coal stack, sideslip, motor temperature, front roller temperature, rear roller temperature, front sideslip, middle sideslip, and rear sideslip can be set to disabling/enabling in the touch screen;

the output signals of the smoke sensor switches at every stage are connected to the PLC inputs, and the output signals of the sensor switches of the coal stacking at every stage are connected to the PLC inputs;

each emergency stop switch address, tear address, sideslip address, sideslip fault type, temperature address, front roller temperature, rear roller temperature, motor temperature, and band speed data of the multistage band transportation are collected by the CAN board, in case of failure, the fault type and fault location are displayed in each touch screen;

the output signals of the current transformer and voltage transformer of the motor of the multistage band transportation are connected to a A/D module, the current and voltage are detected by the PLC, the PLC calculates the power, and the current, voltage and power are displayed in each touch screen;

there are a CAN bus to RS485 interface on the CAN board;

the manual warning time, automatic warning time, start time of transportation bands at every stage, and delay stop time of transportation bands at every stage can be set on the touch screen.