Application of Siemens S7-200 PLC in the Cable Dynamic Monitoring System

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Abstract. In the study, Cableway Monitoring System which monitories cableway running state by Siemens S7-200 series PLC, is connected to PC .The PC is developed by VC Language .The article describes the principle of Dynamic Monitoring System and the program's software architecture. Test showed that the system is simple in structure, and has good real-time performance.

Keywords: Speed measurement, PLC, Barcode scanner, Communication

Introduction

The cable dynamic monitoring system mainly carry out real-time monitoring on the section of the suspended cable, making use of hardware requirements ;acquires the signals of the scanning, sharpshooting and exiting region and so on. It can dynamically display the number ,the snapshot picture ,the height above the ground., the distance between upper or lower region, the retractable times of the rope grip and total driving distances of suspended cable of the current cable.

In this monitoring systerm, we used the Siemens S7-200 series PLC(CPU226) as the controller, through the organic integration with the upper computer developed by VC Language, realize real-time monitoring on the running conditions of the cable.

Hardware Component of the System and Structure of Control System

A. Hardware Requirement. In accordance with the specific requirements of monitoring, this system is composed of S7-226 CPU, barcode scanner, speed sensor, two proximity switches and one precision PC camera.

Siemens S7-226 CPU was used as the core of the controlling system, being that can meet the demands of monitoring system,it costs relatively low, stable performance and strong anti-interference ability, procedures to facilitate the preparation of debugging. Because adverse working environment, we made use of the industrial barcode scanner whose model was 3800g,it scans the distance range, high resolution, scanning speed and good stability. The speed sensor whose model was LM18-3005NAYT was used as testing the rev of synchronous wheel of the cable. The PRL18-5DN proximity switches were used as Digital inputs of PLC. Precision PC camera was used as snapshot picture of the suspended cable.

B. Structure of Control System. As suspended cable running, firstly, barcode scanner scanned the number of the suspended cable and sent to the PLC by RS-485 communication interface 0,at he same time, PLC collect the pulse signals which are used detecting speed through synchronous wheel.; howere, after the door of suspended cable is closed, the triggering and snapshot proximity switches sends the snapshot signals to PLC, at the same time, the upper computer reads the video stream of PC Camera from Video Blaster, and save in the data-base as the snapshot pictures of suspended cable. When suspended cable exits region, it triggers proximity switches, and sends the

signal of exiting region to PLC; Then PLC deals with the various collected signal and uploads PC com1 through RS485 communication interface 1 of PLC, to achieve the communication between PC and PLC.

From com 1,PC receives the number of the suspended cable, snapshot signals, pulse signals and exiting signals from PLC, then writes relevant dynamic data of the suspended cable in the data-base one by one and shoeing on the PC. The realization diagram of the system is shown in Fig. 1.
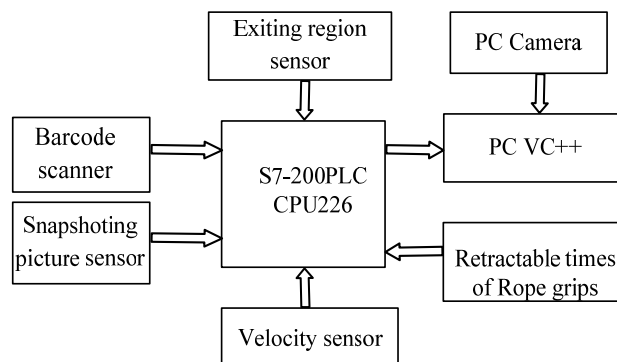

Fig. 1 realization diagram of the systerm

Function of Control Systems

Siemens S7-200 series PLC is Siemens' main product to resolve the small and medium-sized automation for users; it has fast operation, complete functions, reliable performance and flexibly combination characteristics; and it is applied extensively in the small and medium-sized automation in the world. CPU226 has command processing short period, floating point, forward backward counter, hardware and timer interruption control,2 roads RS-485 communication port, internal data and information being saved in the mothball lithium cell, and so on. As the following, we focus on introducing Application of CPU226 PLC in the cable dynamic monitoring system.

A. Bidirectional High Speed Counter Signal Detection.

The module CPU226 of S7-200PLC has multiple high-speed count input ports, being flexibly designed, to achieve detection of the multiple One-way and bi-directional counter signal. In the cable dynamic monitoring system, the application of high-speed counter makes positive inversion detection of the cable.

The driving part of the cable running is independently rotating mechanism. The synchronous speed synchronizing wheel is on the upper or lower region, adopting rotary encoder to detect its rotary speed and rotation direction. By detection of coder double impulse signal of A and B,the bi-directional high-speed counting input channel of PLC accurately differentiate direction of operation of the cable and count signal of velocity pulse. It is supposed that Radii of synchronizing wheel to be R, synchronizing wheel generate 4 impulses per circle, signal of velocity pulse to be N in two seconds. then the running-speed of the suspended cable is:

$$n = 2\pi R * \frac{N}{4*2} m/s \tag{1}$$

Reversible running conditions of the suspended cable, high-speed counting input channel may directly reflect, positive and negative can estimate positive rotation or negative rotation.

The system uses high-speed counting 1(HSC1), namely Sensor terminal accesses are I0.6 and I0.7; opening timer interruption, timing interval is 2 seconds, the rate of speed is continually delivered by the move instruction – XMT.

B. Detection of the Number of the Suspended Cable.

In this part, bar code scanner scans and identifies the bar code fixed on the arm of the suspended cable, and send to PLC. The port RS-232 of the bar code scanner is connected with The port RS-485 of CPU226,and make sure that memory address of the number of the suspended cable being received by PLC is correctness. SMB30 and SMB130 are separately collocated communication port 0 and 1,being used as free port manipulate. The port 0 is set at agreement mode of free space, the baud rate is set at 19200 baste port 0 is connected with bar code scanner. The port 1 is set at reserved default mode, namely PPI main/passive station, whose baud rate is set at 9600bps,so that communication with PC attains.

When bar code scanner is connected with communication port 0 of PLC to communicate, because of the different communication format, the convector from RS232 to RS485 is necessary. The instruction RCV and ATCH connect interrupt event (EVNT) and interrupt routine number(INT) and initiate interrupt event, then transfer the scanning in data-base.

C. Detection of the Signal of the External Sensor.

The mode which Siemens series PLC detects input signal is optical coupling isolated current signal detection, it can isolate each factor-induced unusual electric signal on the input signal line; the detection mode of current signal effectively prevents external strong jamming from detecting normal signal.

Detection of snapshot signal of proximity switch: In this system, the port I0.0 is used as input port of detecting signal; penning interrupt 0,I0.0 triggers intermit on the increased edge, move instruction （XMT）is executed after PLC deicing, then snapshot signal is transferred to PC through the communication port 1.

Detection of exiting region switch signal of proximity switch: The port I0.1 is used as input port of exit region signal; Opening interrupt 2,I0.1 triggers intermit on the increased edge, move instruction （XMT） is executed after PLC deciding suspended cable has exited region, then exit region signal is transferred to PC through the communication port 1,so that the position and mode of the suspended cable are displayed in the monitoring picture.

Program Composition

Control programs are completed by programming software STEP7 V4.0 provided by Siemens. It is convenience to make programmers and to be set up that the programs completed can be downloaded into the controller by Programmer Line and operation condition of the programs can be monitored on the line. The terminal software is LAD language, programming is modularized and functional, so that it is to be maintained and extended. To improve the antigambling ability, many measures are used ,such as digital filter, and fault self finding., assuring the validity and reliability of the monitored operation.

This project is consist of main program initialization subroutine; bar code scanning subroutine; Cycle data processing subroutine and sub-way disruption, we have one of these examples of blocks. The main program is always running in the cycle, which the function of the initialization subroutine is initialization, set the parameters of the register; counter; the mode of PLC; The interrupt of timer and means of communication. The Fig. 2 means the flow diagram of the main program and

initialization subroutine. Through the interrupt mode collect the crane hand signal number from barcode scanner, the Fig. 3 means the bar code scanning subroutine of barcode scanner. Cycle of the implementation of data collection and subroutine collect the speed data of hanging car real-time. Upload the snapshot signal and the outbound signal through sub-way disruption to PC.
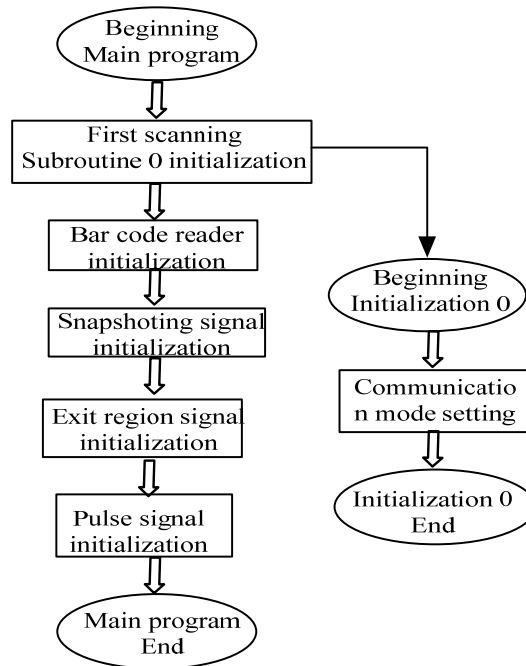

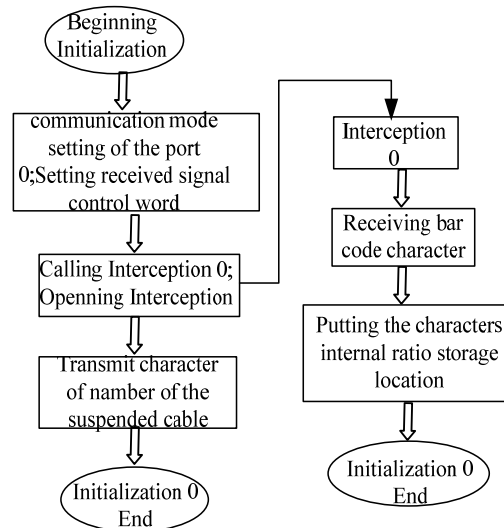
Fig. 2 Flow diagram of the main program and initialization

Fig. 3 Flow diagramof   subroutine of barcode scanne

The Cable Dynamic Monitoring System

We can see the real-time running condition which include the specific position and snapshot pictures as exiting region of every suspended cable. The Fig. 4 is main picture of the dynamic monitoring system.

After the system runs, all signals from sensors received and processed by PLC, and transferred to upper computer, according to these real-time days, real-time running condition of the cable can be dynamically showed in the computer, monitor can directly watch some information,

such as the direction and rate of the cable, distance, the retractable times of the rope grips, the distance between upper or lower region, exiting region pictures, and so on.
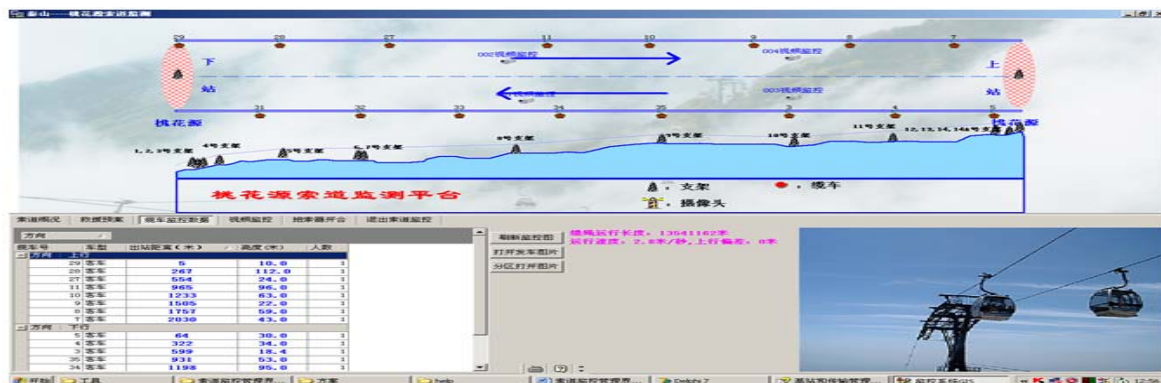

Fig. 4 Main picture of the dynamic monitoring system

Conclusions

Siemens S7-200 series PLC is higher controller in performance-price ratio. It has so many high-speed counting ports that it appropriates for detecting signals together with all kinds of sensors;

The integrated PPI communication ports in the internal of the mode CPU can execute multiple communication ways of data. By the monitoring system developed by VC Language, running condition of the cable can be remote monitored through Internet. This networking and remote monitoring system, tourism industry becoming digital step is more and more close.

Auctorial innovation point in this page is: workers could know the information of every cable in time, so that the basis is provide for exigent and accurate rescue to travellers,and it makes up for the blank of this part, and has generalizability and practical reference value.

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