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Design of the Power Online Monitoring System Based on LabVIEW

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Abstract: In this paper, for the production system of Handan steel plant, it designs a power line monitoring system using LabVIEW as a platform, its functions includes: data collection, data storage and analysis, trend analysis, fault diagnosis. In the design, it is full use of the LabVIEW graphical programming quick, convenient advantages, combining DQmax powerful features and DataSocket, to complete remote monitoring and fault diagnosis of production system in steel plant. It is a great significance in steel product that to accelerate the speed of access the production information and improve the utilization rate of energy, and optimize the process of production. *Copyright © 2013 IFSA.*

Keywords: Data acquisition, On-line monitoring, LabVIEW, Signal analysis.

1. Introduction

After field research, Handan Iron and Steel plant production system currently has five units (CCPP units, 15# units, 3# units, 6# units, TRT units), the units are more wide geographical distribution, now exist following questions:

1) With geographical distribution comparison broad and Handan Iron and Steel plant production points so much, the control system needs to be connected with a heavy workload;

2) It has long relied on manual pickup, manual meter reading statistics, is less access to production information, the transmission speed is slow, long processing cycle, energy waste problem is not conducive to the discovery of hidden dangers, and it will result in the production fluctuations.

3) For production process complex, each factory workshop fully coordinated with each other without contradiction is getting worse. In order to solve the above problems, the design of the system main equipment of the unit critical data (displacement, vibration, and poor rose, pressure, temperature and other real-time data) is collected and stored in the system database. It can immediately make a warning before a fault occurs. After the fault the engineering and technical personnel can call facilitate historical data to determine the cause of the malfunction. The structure diagram of C/S communication is shown as in Fig. 1.

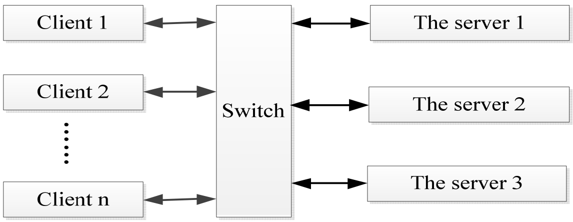

Fig. 1. The diagram of the data acquisition.

2. Server Design

According to plant requirements, a remote monitoring system is establish, in which the main task of the server is data acquisition, data storage, data dissemination, and communication with the client to accept client requests. Fig 2 shows the main interface of the server signal acquisition.

2.1. Data Acquisition

Shown in Fig. 3, the measurement signal from the sensor after signal conditioning is transferred to the computer by DAQ card [1]; finally the programs written in the LabVIEW extracts the data [2]. The signals to be acquired include the vibration signals, the displacement signals, the temperature signals, the flow rate signals and the pressure signals and the differential expansion signals. According to the types of these signals, corresponding collect tasks are created, and the relationship between the actual measurement points and channels of acquisition tasks, collection frequency, the number of acquisition samples and other information stored in the database. The information can be added and changed according to actual demands in server. Fig. 4 shows the interface adding and changing the information collection tasks.

2.2. Data Storage

According to the frequency of collection, the collected data is stored .High frequency signals such as vibration and displacement are not conducive to long-term storage for so much data. So characteristic values (mean, max, minimum) in unit time are calculated by pretreatment, then pre-set alarm thresholds compare with eigenvalues, if the characteristic value exceeds the alarm threshold, raw data and eigenvalues will be saved. Eigenvalues used for trend analysis, the raw data for fault diagnosis.

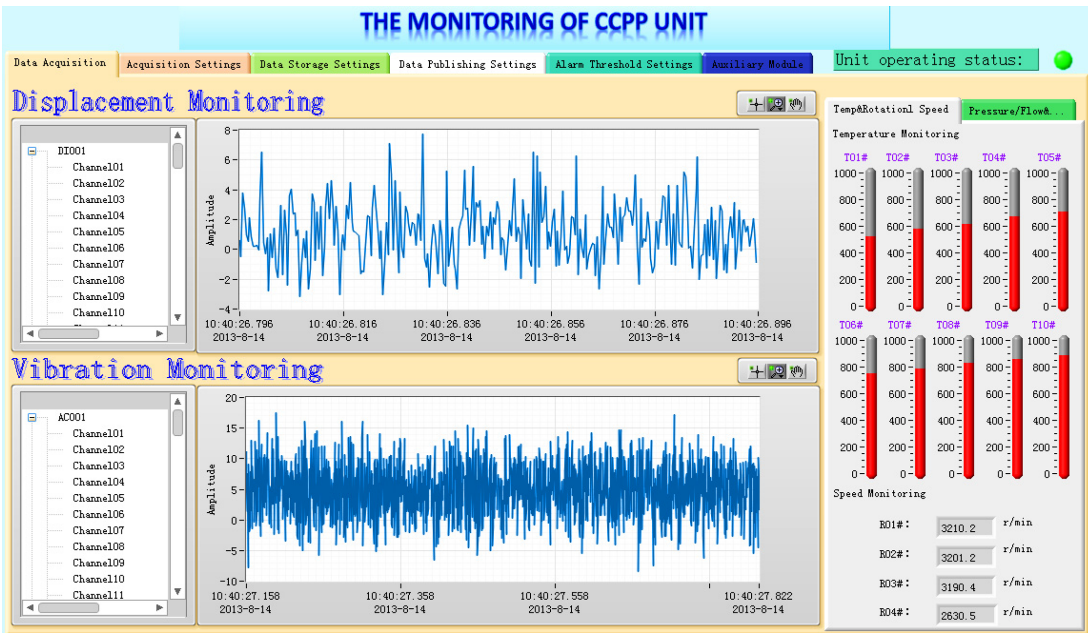

Fig. 2. The CCPP unit server's main interface.

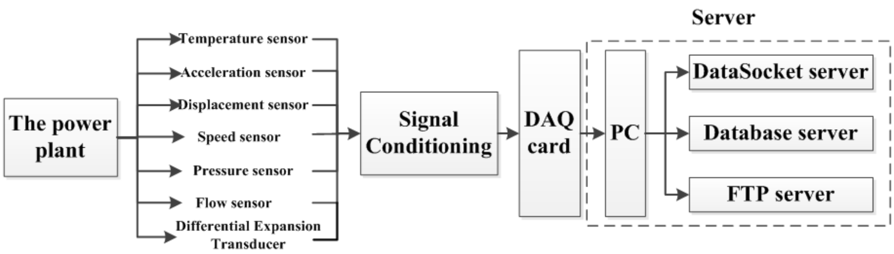

Fig. 3. A high-frequency signal acquisition task.

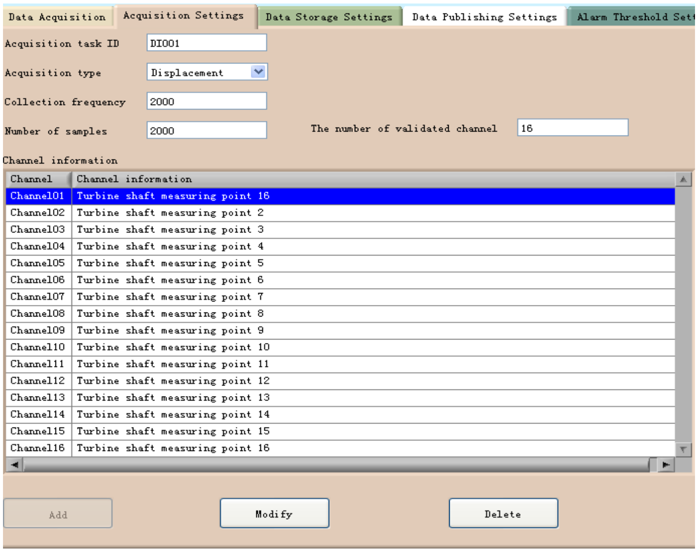

Fig. 4. Database operations.

For the low-frequency signal such as temperature signals, flow signals, pressure signals, expansion difference signals can be stored raw data which will take less room. In order to facilitate remote data access, eigenvalues use Tdms format file of Labview storage, while fault data in binary files are stored. Respectively, to establish a database for the data files, log files are stored with the data begins time, data length, data and correspondence between the actual measuring point [3].

2.3. Data Publishing

DataSocket was developed to help eliminate the complexities of hardware and software integration specifically in test and measurement applications [4]. It was also developed specifically for publishing sharing live data over a network. DataSocket allows easy data transfer over many different protocols (DSTP, OPC, HTTP, FTP, and local file access). In addition to providing an overlying interface for many protocols, DataSocket also transfers data in a self-describing format that can include strings, scalars, Booleans and waveforms. Before using this protocol, you must provide a name for the data label and attach to URL.Collection task is created for each unique URL, server, based on the URL release feature data collection task, but in order to be timely understanding of equipment operating conditions in client, the server fault data are released.

3. Client Service Design

Equipment condition monitoring and fault diagnosis system is to run on the device or the basic mechanical structure without removing the case of quantitative determination of the state of the equipment, through to the measured signal processing and analysis, combined with the diagnostic object historical conditions, to quantitatively identify the machinery and equipment and parts, components, real-time status, predict mechanical anomalies and future state, and the fault location, cause analysis and judgment, and promptly identify the necessary measures and the most appropriate repair time. It facilitates the implementation of modern enterprise management, maintenance work to overcome the "excess servicing" and "lack of maintenance" phenomenon, so as to achieve equipment life cycle, to achieve the most economical cost and OEE highest goal. It is Divided into the following sections: System Settings module, real-time signal data display module, signal monitoring and analysis module, fault diagnosis module only, recalling the accident module, equipment operation and trend statistics module [5].

3.1. System Settings Module

The module features are: sensor calibration settings, key equipment of the plant temperature, voltage, vibration and displacement sensor settings [5]. When using this module, the client generates SQL statements, and communicates via TCP sends it to the server, the server to operate the database, has reached the remote to change the system parameters purposes.

3.2. Immediate Signal Display Module

Instant signal data acquisition module is for on-site real-time signal acquisition, transmission, storage, real-time display and real-time status data analysis. According retrieval, the users can select according to the actual needs of the units to be monitored, Download the acquisition task URLs and the alarm signal URLs from the server communicate via TCP, and then in this URL access to data released by DataSocket server [6].

These data also show, through observation equipment acquisition signal diagram measuring point in time, the users can easily understand the operational status of equipment, the alarm signal can easily let the staff know in time [7]. Fig. 5 shows signal monitoring module's interface of the client.

3.3. Signal Monitoring Analysis Module

Signal detection analysis module is applied to field data analysis and processing, in order to provide data support for intelligent fault diagnosis module and field staff's Judgment [8]. Function: signal time-domain waveform analysis: using different equipment to obtain the characteristics of signals in time domain diagram, auto-correlation, cross-correlation, probability density, time-domain envelope, and for time domain analysis. Signal frequency domain analysis: the analysis of equipment acquisition signal such as amplitude spectrum, phase spectrum, cross-power spectrum, envelope spectrum and cestrum. Signal three-dimensional spectrum analysis: using the three-dimensional spectrum observed the rotor's dynamic response process under its many frequency components. Analysis of the signal amplitude: Signal acquisition, including the mean, maximum, minimum, rms value and kurtosis, etc. Signal trend graph: historical data for the use of statements (day\month\year), observing whether there is a significant change in trend on the magnitude of the equipment's key parameters and then predict the possible failure of a position. Signal monitoring and analysis including timely signal analysis and fault data analysis, timely signal analysis is to obtain timely analysis of the eigenvalues (Fig 6), failure data analysis is obtained by searching the database, through the file protocol of DataSocket to download fault data. After filtering, these signals are made time domain analysis to determine the cause of the accident.

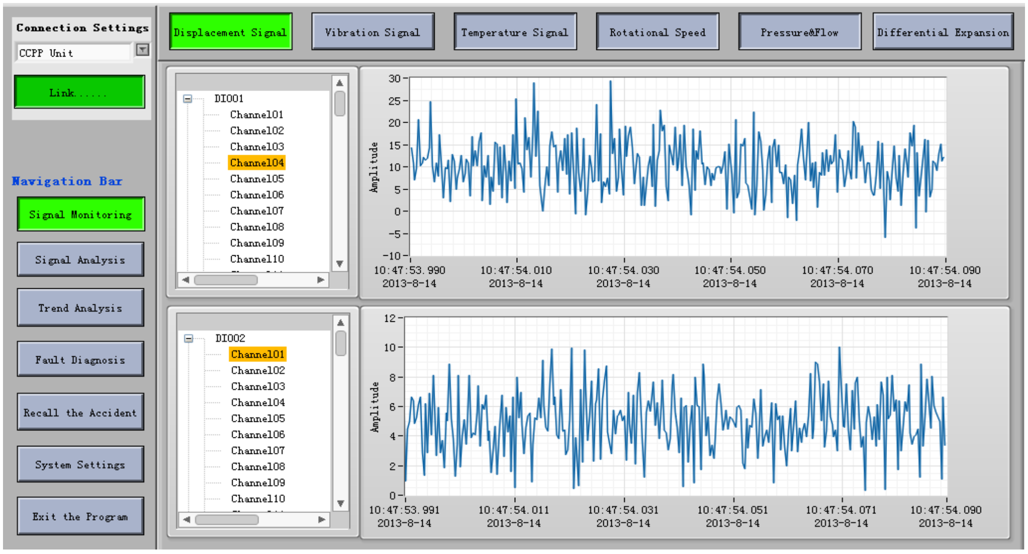

Fig. 5. Signal monitoring module's interface of the client.

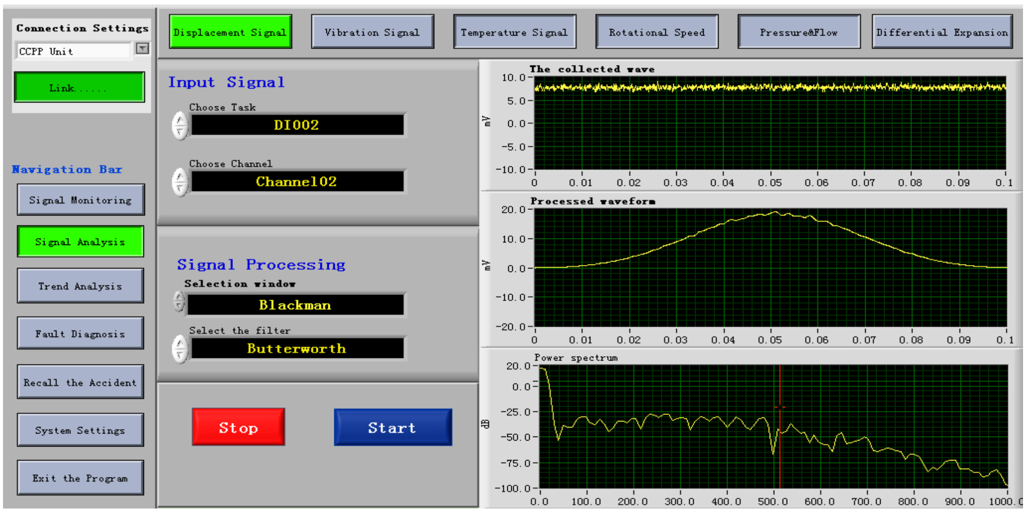

Fig. 6. Signal analysis module's interface of the client.

3.4. Fault Diagnosis Module

Data using real-time signal data acquisition module and the detection analysis module, key equipment working condition of the power plant, the failure mechanism, the cause of the failure to make judgments and to provide a reference for the engineering staff to provide troubleshooting measures. Function: failure mechanism analysis: acquisition signal analysis using fuzzy mathematical principles to judge the malfunction site conditions. The main reason for the failure: the main reason for equipment failure, the decision to provide a scientific basis for people whether the failure of the unit and take safeguard measures. Fault Analysis of the salient features: equipment failure occurs, especially scene gathering the salient features of the signal [9].

3.5. Recall the Accident Module

Recall the accident module stores the historical accident data of power plant critical equipment, and offers a variety of ways to search for the engineering staff. Function: direct inquiries can carried out through the use of workshop, equipment name, time, accidents name .etc. Providing the indirect way input keyword fuzzy query [9]. By clicking on the using name of the equipment, you can link to all historical accident records of this equipment, and view all incidents information this equipment recorded; simultaneously having the modifying permissions of the user can conduct modified operation [10].

3.6. Equipment Running Trend Statistics Module

Equipment running trend statistics module is based on historical operating data, intuitive expression of critical equipment operating trends, and to predict equipment failure. The factory may be based on the device name key equipment for the power plant equipment operation at any time trend analysis. The options trends and statistics equipment running the length includes data analysis, critical days, months, and years.

4. Conclusions

In this paper, a power plant remote monitoring system is successfully designed by using Labview graphical programming language and powerful communication capabilities of DataSocket. The data from the plant is locally stored in multiple servers, through Datasocket server publishing data, LAN Service client can communicate with the server via TCP protocol, while taking advantage of the DSTP protocol of DataSocket to accept data and the file protocol of DataSocket to download fault data, the staff can obtain and analysis the data from the plant to make remote monitoring and fault analysis come true.

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