Development of Intelligent Module About Integrated Multi-Channel Data Acquisition and Processing for the Bridge Structure

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Abstract: In recent years, the techniques of structural sensing and control are used to mitigate the effects of natural hazards on civil infrastructure. The objective of this study is to improve traditional structural sensing and control systems of civil engineering by applying the technologies of embedded system and wireless sensing, and puts forward a design of integrated multi-channel data acquisition and processing site management module, may realize the bridge structure detection signal and the prestressing lasso vibration testing signals of real time data collection, upload and processing, thus realize the integration and intelligent unity. This study implements the concept of smart structural system on building.

Introduction

The current design, installation and management of bridge safety monitoring system, in addition to the use of various types of sensors to detect the relative position and detection equipment, but also requires a great deal of multi-channel data acquisition module, data communications and industrial power conversion module. Due to the different monitoring system owners may also be designed for the requirements of on-line or on-site collection formula, combined with commissioning and replacement needs on-site installation, usually dependent on outsourcing way to ensure the normal operation of the system, but often purchased electrical module showing type, model complex, uneven quantity and quality problems, such as missing, which directly led to the increase in the cost of construction and after prolonged period [1,2]. Thus, with the growing number of bridge health monitoring aspects of project demand, the various types of bridge structure monitoring signal integrated management, and establish information management database and monitoring feedback system, to carry out related electrical module products really suitable for the use of the bridge structure health monitoring the development work is necessary.

Bridge Structural Health Monitoring System Integration Theory

Bridge Health Monitoring [3,4] The basic connotation that is through the bridge structure status monitoring and evaluation of the bridge warning signals trigger abnormal weather or special operating conditions critical bridge for bridge maintenance, repair and management decision-making to provide the basis and guidance. With traditional detection technologies, large-scale bridge health monitoring requires not only fast bulk of information collection and communication capabilities to the test, and strive to achieve the overall behavior of the structure of the implementation of monitoring and intelligent assessment of the state structure.

Bridge health and safety monitoring system should be designed to include the following:

1) Automatic measurement and data collection;
2) Data processing and transmission;
3) Data storage management and query applications;
4) Structural deformation dynamic real-time display;
5) Service level security alarm;

6) Structural health and safety assessment.

Each of the above unit is relatively independent but interrelated, and each having its own function, and ultimately form a real-time visibility, procedures and standardization of structural health and safety monitoring system.

Constituty of Health Monitoring System

Health monitoring system consists of field automatic measurement system, the second most remote control center systems and system components analysis center, the main functions of each system are as follows[6,7]:

1) on-site automatic measurement system;
2) Remote control center;
3) Analysis Center System.

Specifically, the monitoring system generally consists of a strain gauge, transmission lines, strain measurement, data acquisition and processing system composed. You can use embedded test strain component construction adhesive and surface strain measurement element as a monitoring point of strain monitoring sensors, data acquisition using a computer connected to the network interfaces and to achieve data acquisition, processing and remote control.

Data Transmission and Processing System

The system uses field data acquisition computer system being measured and preprocessed measurement results (as measured in terms of the results of the amendment, the main strain calculation, etc.), and finishing in accordance with the format prescribed form data file, after the adoption of the pretreated fiber optic modem The collected data to monitor communications center. Data processing functions in structural health and safety monitoring computer system consists of the following sections[8,9].

1) Data storage management and query applications;
2) the structure of the real-time dynamic display of deformed system;
3) Service Level Security Alarm System.

Development of integrated multi-channel data acquisition and processing site management module

In order to achieve bridge structural health monitoring system intelligence and integration, it is the signal acquisition and processing problems to be solved first, and therefore need to develop an integrated multi-channel data acquisition and processing site management module, which should have the following features:

1, can provide 8-16 channels for data acquisition, and by direct display button to select the signal received in the configuration of the LCD in real time;

Analog data channels can be controlled by a switch, according to the selection buttons, you can monitor traffic conditions for each channel can be cut off at any time if need be invalid or anomalous data channel to ensure the reliability of the entire data collection process.

2, can complete a simple data processing in the field, and by the configuration of the LCD real-time display;

Configuring high-performance processing chip in the module and data storage chips, can complete a simple real-time data processing and results are stored work, while necessary, through the button to select the scene displayed.

3, external provides a common data communications interfaces such as USB, RS-232, RS-485, etc., in order to facilitate networking for remote control or online debugging;

Taking into account the different requirements of on-line or on-site monitoring system - collection programs, provide data communication interfaces to meet the needs of the raw data or the results of the real-time transmission.

4, designed for dual power supply mode, and integrated industrial DC power supply.

Due to the special nature of the monitoring system, often need to provide a stable power supply for a long time, in order to solve the power supply field work inconvenience may be designed with built-in lithium battery and DC power industry to ensure the reliability of power supply modes.
Pre-developed integrated multi-channel data acquisition and processing site management module functional block diagram shown in Figure 1.

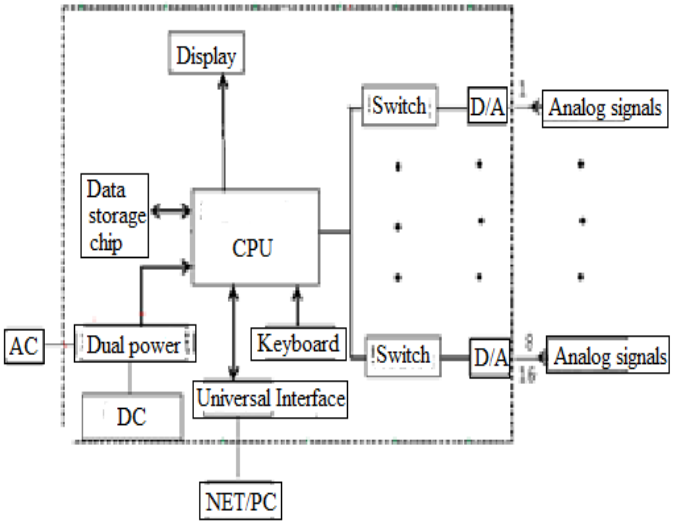

Figure 1 The site management functional block diagram

Manner function module to design the product, so we will present products are divided into four parts, one for data collection; the second is the data processing; the third is the power part, four are operating display. At present, the core of the data collection has been completed, as shown in Figure 2. If you upload the data to a PC, with Labview virtual instrument functions can be achieved, so that you can achieve the goal of intelligent and integrated. As shown in Figure 3.

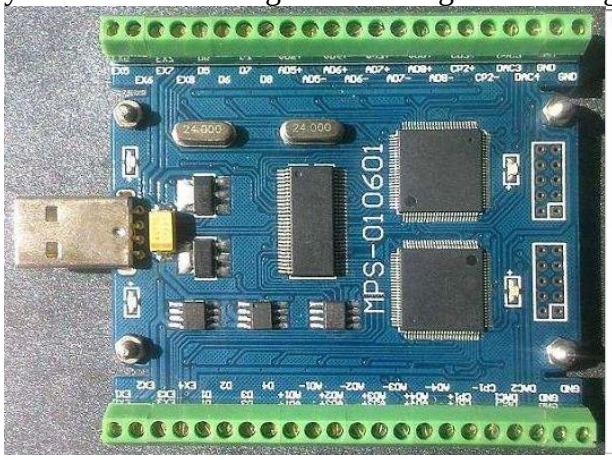

Figure 2 The data acquisition part of the board

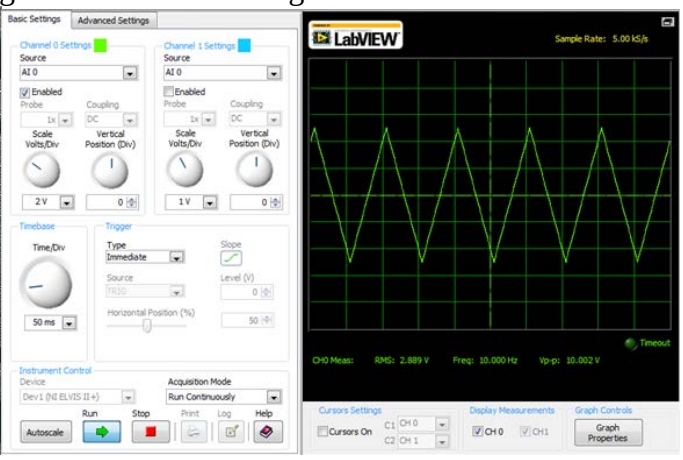

Figure 3 Virtual Instrument Panel

Field test and calibration

It can be measured using a standard 4 ~ 20mA current signal comparison test instrument, where the choice of stable performance 2000 standard load measuring instrument. The model instrument packed a signal interface, but there are 40 test channels, 40 different instruments parameters tested, supply voltage 220V AC, display refresh frequency 8Hz, communication port RS232. According to Table 1 and Table 2 compares the test results, the measurement accuracy of the designed multi-channel management module close to the standard test equipment.

Summary

The design is brought an integrated multi-channel data acquisition and processing site management module, enabling the detection signal of the bridge structure and prestressed cable vibration

detection signal in real-time collection, upload and processing, in order to achieve integrated and intelligent unity. Comparison of experimental results show that the module has a good short-term and long-term sensor performance to meet the requirements of engineering.

Table 1 Test Results Table

Load values(KN)	Shown Current value(mA)	Indication force value(KN)	Deviation(%F.S.)
0.1	4.578	4.3	0.7
400	7.189	413.8	0.7
800	9.511	818.5	0.9
1200	11.734	1216.1	0.8
1600	13.891	1592.1	-0.4
2000	16.163	1995.1	-0.2

Table 2 Integrated multi-channel acquisition module test results

Proof Load (KN)	The first measurement value(mA)	The second measurement value(mA)	The third measurement value(mA)	Average current (mA)
0.1	4.56	4.570	4.567	4.567
400	7.175	7.165	7.167	7.169
800	9.507	9.509	9.512	9.509
1200	11.691	11.699	11.704	11.699
1600	13.862	13.855	13.878	13.865
2000	16.144	16.170	16.161	16.158

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