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Study on Performance monitoring system of civil engineering structure

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Abstract. Civil engineering structure as a basic part of the urban construction development, directly affects the social residents quality of life, if not in view of the concrete problems to formulate the effective solution, then it will limit our social economy steady development. In the face of the increasing probability of civil engineering structure safety accidents, how to base on the performance monitoring system of civil engineering structure components has become the main issue discussed by domestic and foreign researchers. In this paper, based on the understanding of the status quo of civil engineering structural performance monitoring research, according to the basic structure of structural performance monitoring system, in-depth discussion of practical application of damage identification methods, in order to provide effective reference for civil engineering structure monitoring and problem identification in the new era.

Keywords: Civil engineering structure; Health monitoring; Early warning system; System maintenance; Identification of problems

1. Introduction

In the field of modern architecture, social residents pay high attention to safety issues. Because the safety performance of different civil engineering structures is closely related to human life, property and health, if the building structure appears safety risks, there will be unpredictable casualties. Therefore, in the new era, social construction has strengthened the monitoring and research on the performance of civil engineering structures. Focus on combining artificial intelligence, big data, cloud architecture and other advanced technologies to build a performance monitoring system, so as to control the probability of security accidents from the basis. According to the investigation and study of the relevant departments, at present our civil engineering structure safety accident probability continues to rise, and the causes of these problems are explosion, flood, earthquake, fire and so on. [1-3]Therefore, how to guarantee the quality of civil engineering structure, strengthen the project construction monitoring, to ensure its healthy and stable operation, is the focus of attention in the construction field. As a hot topic in the field of construction engineering in the new era, structural health monitoring has been widely concerned by all walks of life. For construction engineering structures such as buildings and Bridges, because they will be affected by different external forces, especially in sudden natural disasters, such as typhoons and earthquakes, the internal structure will undergo great changes, and serious problems such as fatigue damage will occur. With the continuous improvement of the application level of social engineering, the aging problem of materials used in civil engineering structures is becoming more and more serious, which not only causes obstacles to the operation of engineering systems, but also cannot guarantee the application quality of structures. Nowadays, in order to prolong the application time of civil engineering structures, scholars from various countries propose to monitor and analyze the damage degree of structures and the region in which they are located, so as to propose effective repair and reinforcement measures. The whole process is called structural health monitoring. According to the accumulated experience of practical investigation and research, different engineering structures will be affected by technical defects, aging materials, application loads and other factors, resulting in more severe actual damage. Facing this problem, how to improve the development level of building structure monitoring in the future has become the focus of social residents' attention. Combined with the inevitable trend of the development of The Times, comprehensive monitoring and diagnosis of the application health of engineering structures, quickly

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discover the hidden safety problems, can further improve the application time of buildings, Bridges, roads, improve the effectiveness of the overall system structure, durability, safety, etc.[4]

The monitoring system of civil engineering structure should choose the construction site monitoring method and process the structure information effectively after obtaining the operating state, so as to judge and evaluate the index change problem caused by structural damage or aging. The core of the engineering structure performance monitoring system is the damage monitoring method. When abnormal conditions occur in some areas, the identification of structural damage is used for evaluation and monitoring, which can provide effective basis for the following processing work after the location and degree of damage is determined. Most of our existing Bridges and infrastructure were built in the 1950's and 60's. After years of use and transformation, the existing safety performance can not meet the needs of transportation. Under the influence of natural disaster and human factors, the damage of different degrees is produced, which will directly threaten the life and property health of social residents. Therefore, social construction and development attach great importance to the performance monitoring of civil engineering structures. By real-time monitoring and judging the structural performance of civil engineering, timely discovery of the hidden safety problems, evaluation of the application performance of the engineering structure, can further improve the efficiency of the engineering structure, to protect the health of social residents and property. In this paper, on the basis of understanding the current situation of civil engineering structure construction management in the new era, according to the basic content of structural performance monitoring system, the commonly used damage identification methods are deeply discussed, in order to provide effective basis for solving civil engineering problems.[5-6]

Nowadays, there are many functions of engineering structure health monitoring, but it is embodied in the following points: First, wind resistance performance. In the monitoring system, users can deeply understand the characteristics of the wind field according to the provided functions, and determine the stability of the overall structure in the natural wind field. Second, seismic performance. In the system, the spatial and temporal changes of ground motion in different sites are understood, the interaction of soil structure is analyzed, deformation, acceleration, structural strain and other problems are accurately monitored, and the restoring force model of buildings and Bridges is constructed, so as to provide reference for the seismic resistance of structures. Third, overall behavior. Comprehensively understand the nonlinear characteristics of various structures under the movement of wall, ground and strong wind, and identify the influence of environmental factors, structure, load, etc., so as to provide effective basis for monitoring the health status of Bridges; Fourth, the structure of the local. Monitor and understand the bridge or building boundary, steel beam weld, joint conditions and other problems, further explore the local damage, vibration absorption phenomenon; Fifth, durability. Systematically monitor and understand the durability of the structure, focusing on the remaining time of the structure, fatigue phenomenon, corrosion problems, etc. Sixth, the fundamental question. It is necessary to comprehensively monitor the basic data of system operation and pay attention to comparative analysis based on accumulated experience.[7-9]

2. Methods

2.1 Functional requirements

Nowadays, there are many functions of engineering structure health monitoring, but they are embodied in the following points: first, wind resistance. In the monitoring system, the user can deeply understand the characteristics of the wind field, and clarify the stability of the overall structure in the natural wind field; second, the seismic performance. In the system to understand the spatial and temporal changes of ground movement in different sites, analyze the interaction of soil structure, accurately monitor deformation, acceleration, structural strain and other problems, build buildings, bridge and other resilience models, to provide reference for structural seismic; third, the overall behavior. Fully understand the nonlinear characteristics of various structures under wall,

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ground and strong wind movement, and clarify the influence of environmental factors, structure and load, etc., so as to provide an effective basis for monitoring the health state of the bridge; fourth, local structure. Monitor and understand the boundary of the bridge or building, steel beam weld, connection conditions and other problems, and further explore the local damage, vibration and shock absorption and other phenomena; fifth, durability. System monitoring to understand the durability of the structure, focusing on the remaining time, fatigue phenomenon, corrosion problems, etc.; sixth, the basic problem. The basic data of the operation of the system should be comprehensively monitored, and the comparative analysis should be combined with practical accumulated experience.

2.2 Function Design

Combined with the analysis of the performance monitoring system as shown in the following figure, practical function design involves the following points:

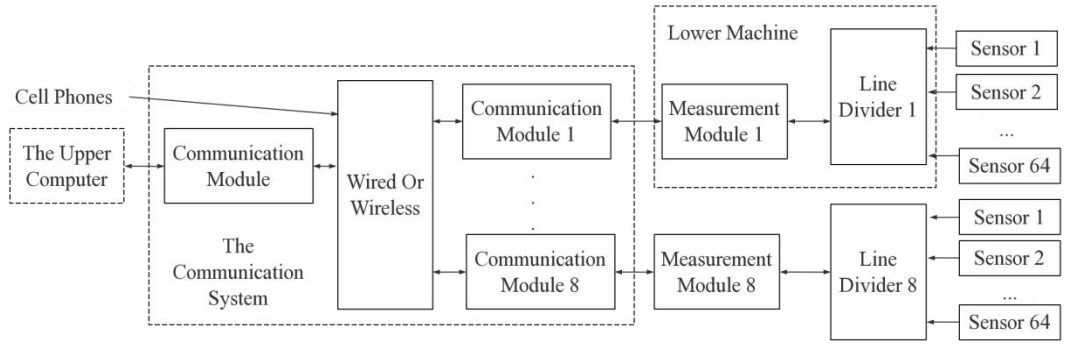

Figure 1. Structure diagram of performance monitoring system

First, the sensing system. In order to obtain the data of civil engineering structure construction, the construction unit should use all kinds of sensor equipment, the monitoring data will be directly converted into voltage or current signals, and then transmitted to the control center. In general, when collecting voltage signals, the signal strength is weak, so it is necessary to use amplifier device for strengthening processing, in order to improve the signal energy. In the sensor system, it includes thermometer, relic, accelerator and many other contents;[10-12]

Second, data collection and processing. The system is designed to receive signals sent after changes in sensors and amplifiers and record them using analog quantities. In addition, digital quantities can also be recorded after analog-to-digital conversion. In order to ensure that the system can achieve the performance monitoring target, the data should be transferred to the background data processing center to facilitate the system users to process the application data resources;

Third, data analysis and damage assessment systems. This system design will initially process the acquired data, the results are presented in the terminal interface, and then add the data to the database management system. The damage assessment and analysis of civil engineering structures according to various data models can provide effective basis for subsequent solutions and early warning analysis. At the same time, all kinds of data are organized together for scientific protection. On the basis of preserving important information, the redundant information in the system is reduced as far as possible, which can further show the application value of performance parameters.[11-14]

Fourth, early warning system. Combined with the analysis of the system structure shown in Figure 2 below, it can be seen that it is necessary to focus on the evaluation of the above mentioned damage conditions, to clarify the working status of the overall system operation. When the status parameters exceed the set value, the system will automatically alarm and remind the staff to maintain the civil engineering structure.

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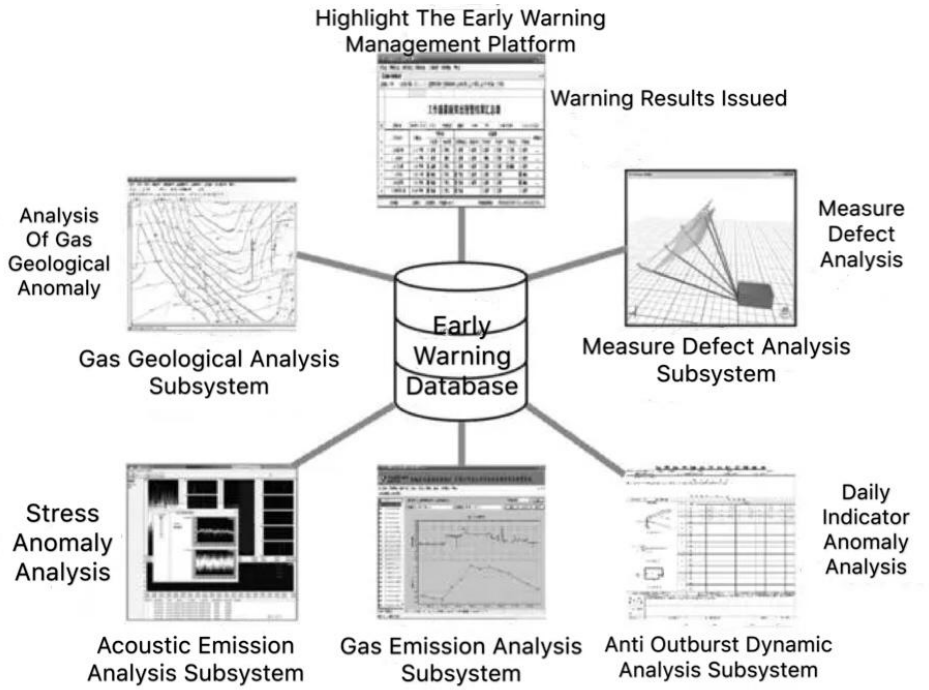

Figure 2. Structure diagram of early warning system

Fifth, system maintenance. Combined with the system maintenance structure diagram shown in Figure 3 below, it can be seen that daily monitoring data should be backed up and deleted, and application permissions within the system should be scientifically allocated to ensure that management personnel can play an important role in maintenance.

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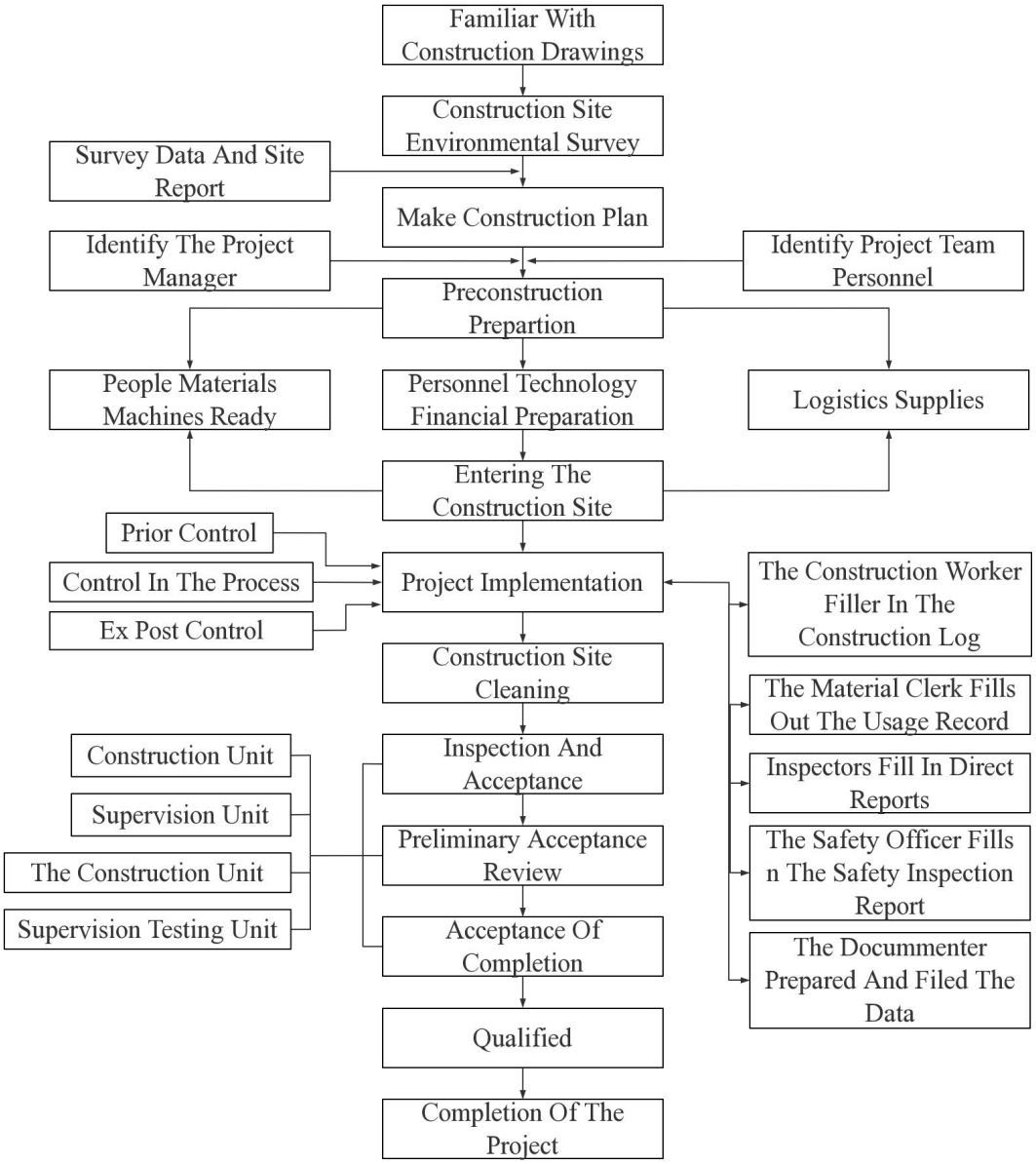

Figure 3. System maintenance structure diagram

2.3 Damage identification method

Nowadays, scholars at home and abroad have conducted in-depth research on damage identification and diagnosis methods, which are embodied in the following points: First, time domain method. This method is operated by using autoregressive sliding average, extended Kalman filter algorithm, autocorrelation function and other technologies. For example, some scholars accurately identify the damage location and specific problems of multilayer composite materials by using the model coefficient changes before and after structural damage. Second, the frequency domain method. This method includes stealing poor analysis, multispectral analysis, Fourier spectrum analysis and so on. After constructing the damage model of Qingma Bridge, some scholars used WCC and Iatm to fully show the small changes, which is more effective than traditional technology methods. Finally, the time-frequency method. The most representative of this method is the wavelet analysis, which can be divided into two forms according to the application technology, wavelet transform and wavelet packet transform. Taking the method of the change of wavelet transform coefficient before and after damage as an example, some scholars use the wavelet transform coefficient of the acceleration response of the damaged structure to compare with the wavelet transform technology under good condition, so as to accurately judge whether the civil

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engineering structure changes, identify and analyze, and whether there are cracks in the cantilever beam. Among them, the operation flow of wavelet transform is shown in Figure 4 below:[15]

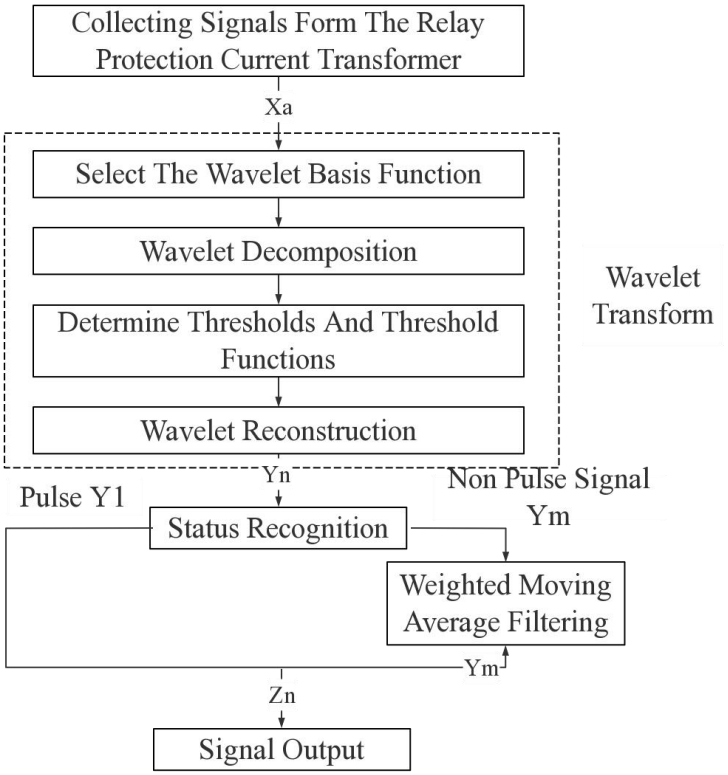

FIG. 4 Operation flow chart of wavelet transform

3. Result analysis

The remote control interface as shown in Figure 5 below is used to complete the performance monitoring and analysis, providing real-time online monitoring services for system users. From the perspective of practical application, according to the application background and design requirements of civil engineering structures in various regions, the installation of multiple strain sensors and acceleration sensors inside the structure can not only form a wireless sensor network, but also improve the level of accurate data measurement. According to the results obtained from the final measurement, the technical scheme is verified from both static and dynamic aspects, which can not only obtain the specific data of civil engineering structure, but also accurately judge the existing structural quality problems, which meets the application requirements of civil engineering structure monitoring system in the new era.

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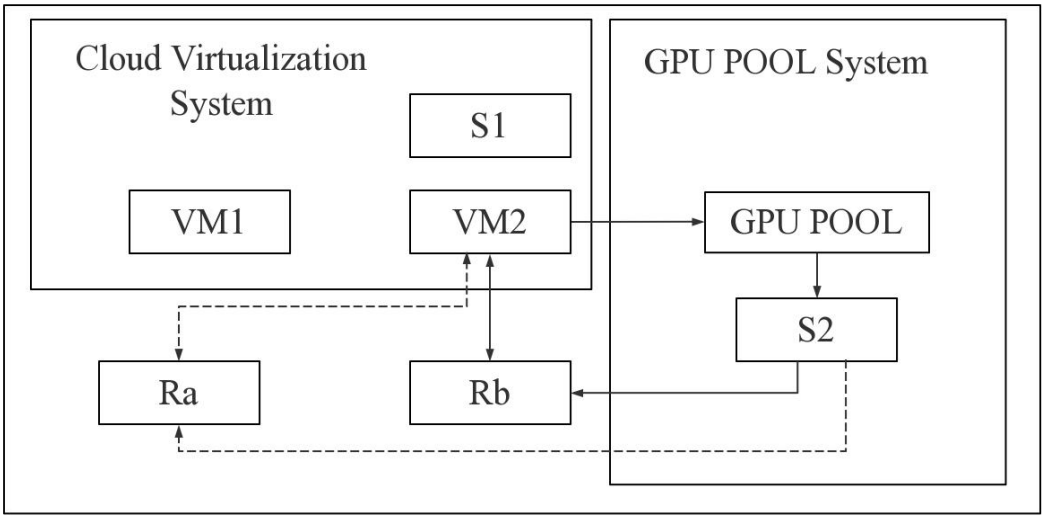

Figure 5 Remote control flow chart of the system

After understanding the concept, composition, function and other basic contents of the civil engineering structural performance monitoring system, this paper discusses the problems existing in the system application and design in combination with the practical application, such as the lack of universal and effective damage quantification index for state assessment, the obvious difference between the monitoring signal and the original signal, but the natural vibration frequency is not sensitive to local damage. This leads to the actual measurement accuracy is not high. Therefore, in the development of modern science and technology innovation, our country should strengthen the research of civil engineering structure performance monitoring system, while learning from domestic and foreign scientific research scholars' technical achievements, gradually optimize our engineering structure performance monitoring system functions, pay attention to training more outstanding technical talents, to solve the civil engineering structure performance problems.

Conclusion

In summary, according to the analysis of this paper, it is found that when constructing the performance monitoring system of civil engineering structures, the rational use of sensor principle and engineering structure monitoring principle can carry out all-round monitoring and analysis of the structural performance, help the staff to understand the health status of the engineering structure as soon as possible, and provide reference for daily warning and comprehensive maintenance. It should be noted that this monitoring system can not only be applied in the structural performance, but also explore other issues according to the technical principles, which can guarantee the application quality of civil engineering structures from the basis, and meet the needs of innovation and development in the engineering field in the new era.

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