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Remote Monitoring System of Civil Engineering Health Status Information Based on Network Communication Technology

Abdulla Hany*

Commune d'Akanda, Gabon

**corresponding author*

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Abstract: In recent years, the continuous occurrence of civil engineering safety construction accidents not only caused huge casualties and serious economic losses, but also brought a bad social impact to the national lifeline project. This paper mainly studies the remote monitoring system of civil engineering health status information based on network communication technology. Based on the problems existing in the implementation of monitoring and measurement and the characteristics of the measurement tasks in civil engineering, this paper uses network communication technology to develop a remote monitoring system for the health status of civil engineering with independent intellectual property rights. Long-term and effective monitoring and measurement. Use the public network or private network to complete the wired or wireless data transmission and control, and provide the data processing function of the database. Relying on the non-parametric method to directly analyze the dynamic characteristics of the building structure, which is conducive to the timely update of the system. Experimental data shows that the saturation and frequency values collected by this remote health monitoring and warning system are accurate and usable: the normal saturation range is 96-100%; the appropriate frequency is 65-105 times per minute. The experimental results show that the remote monitoring system of civil engineering health status based on network communication technology realizes remote control measurement and automatic analysis and processing of the measured data. The popularization of this system in the current stage of civil engineering construction can promote the development of the project in the direction of increasing safety and stability.

1. Introduction

1.1. Background and Significance

With the continuous improvement of the level of China's network communication technology and the growing material needs of the people for the living environment, people have begun to put forward a higher safety for civil construction projects, especially major construction projects with a wide range of impacts and deep impacts claim. In recent years, large-scale buildings collapsed and destroyed. According to statistics, from 2020 to 2021, there will be more than 200 accidents caused by building collapses and damages. This makes the health monitoring of building structures an urgent need for the entire society.

In the construction of large traffic engineering projects such as bridges, roads, tunnels, shafts, etc., due to the actual stress and deformation of the building, there will always be deviations from the results predicted by the mechanical model at the design stage, which makes it impossible to confirm the design. The safety and economics of the supporting structure and the rotation process are required. The supporting structure of the building usually needs to meet the requirements for the supporting structure and the rotation process in the national building safety standard on the basis of ensuring a certain cost. so it is necessary to monitor and measure the whole process of civil engineering during the construction and operation phases, and timely collect the dynamics of displacement and stress caused by stress and deformation during construction and operation Information to provide timely guidance for construction and operation [1-2].

1.2. Related Work

At present, the research on the remote monitoring system of health status information has been favored by many scholars. For example, Acheampong F recommends the use of information technology to improve patients' health and reduce healthcare costs. Through research interviewing patients and investigating patients with atrial fibrillation, through remote patient monitoring, he explored the collaborative and innovative business model between nurses and patients and the impact on healthcare delivery. He believes that remote monitoring can enhance the early detection of potential risks and the quality of clinical decisions, so that patients feel more capable and participate in their own care. The remote monitoring system consists of home ECG and Web-based services, which are provided free of charge to patients, with caregivers, patients, service providers, and governments as participants. The introduction of remote monitoring has increased the workload of nursing staff, but can achieve the convenience of timely diagnosis and decision-making. IT is the driving force for healthcare innovation, but it must be integrated into the workflow with a viable business model to realize and sustain potential benefits [3]. Although his research can facilitate medical staff, the article does not mention the relevant analysis of the correct judgment rate of the doctor after the doctor's consultation, so the paper is not authoritative. Sathya D uses wireless medical sensor networks for healthcare applications that connect a collection of biosensors to the human body or emergency care unit to monitor the patient's physiological vitality. In this work, the existing systems and their algorithms are compared to identify the best performance. In his work, he also showed a graphical comparison of the encryption time, decryption time and total calculation time of the existing system and the proposed system [4]. Gross-Schulman S found in research that heart failure (HF) is the most expensive preventable disease. With remote outpatient and timely outpatient services can significantly reduce avoidable HF hospitalization. Human abduction is a traditional method for remote monitoring. Although effective, it is costly. Automated systems can potentially provide positive clinical, financial, and satisfaction results in chronic disease monitoring. He implemented a telephone HF automatic remote monitoring system that uses deterministic decision tree logic to identify patients at risk of clinical compensationHis research focused on underserved people and proved a safe, reliable, and inexpensive method for monitoring HF patients

[5]. On the whole, many scholars have conducted in-depth research on the health status information remote monitoring system, but there are not many studies on the integration of it with network communication technology and its application in civil engineering construction. The practical research of the condition information remote monitoring system is urgent.

1.3. Innovation in this Article

The main innovations of this paper include the following aspects: (1) Assess network security status in units of network connections. During the pre-processing of network data streams, reorganize data streams in units of connections for easy analysis and processing. (2) Apply data mining and mathematical statistics to the process of network behavior extraction, for example, perform time series clustering on network data streams, and extract network behavior by the distribution of packet clusters. The research of this paper can provide a new idea for the construction of the remote monitoring system of civil engineering health status information, and also provide a novel research direction for the in-depth development of network communication technology.

2. Remote Monitoring Method of Health Status Information

2.1. Classification of Network Communication Remote Monitoring Technology

The so-called communication is the use of electronic and other technical means to achieve the effective transmission of messages from one place to another by means of electrical signals (including optical signals). When transmitting, the useful information must be transmitted without distortion and high efficiency, and at the same time, the useless information and harmful information must be suppressed during the transmission process. Useless information refers to the interference information irrelevant to the transmission task, and harmful information refers to some factors that affect the smooth progress of the transmission task. Today's communications must not only effectively transfer information, but also have storage, processing, collection and display functions.Network communication remote monitoring technology is divided into two categories: network-based communication monitoring methods, host-based communication monitoring methods [6-8]. The essential difference between the two lies in the implementation principle and implementation process. In contrast, the former has more advantages: In terms of monitoring costs, network communication monitoring prices are lower. In order to analyze and master the entire network, this method only needs to monitor the data flow of the basic nodes of the network. Security conditions and basic host monitoring methods require network data analysis of each monitored host, and the cost is relatively high [9-10]. This should not affect the normal operation of the network, and the network-based monitoring system can be distributed to independently working micro servers [11]. In addition, most of the basic monitoring system of the host through the communication function should be distributed to the protected host [12-13]. You can monitor and analyze the network security situation by minimizing the switch service. It inevitably occupies host resources, affecting the normal operation of the host [14-15]. Improve the detection effect, analyze the data transmission method of the entire network, based on network monitoring. Network data is based on the limitations of the host computer's detection method to analyze and monitor the host computer, which is more comprehensive than the network-operated electronic detector [16-17]. In general, the operating system is independent. The network-based monitoring system does not depend on a specific operating system and also has independent servers, but the monitoring system based on the main framework differs according to the main framework management system [18-19]. Analyzing various incidents and discovering that breaching the security policy is the core function of the network's abnormal communication monitoring system [20-22].

General network abnormal communication monitoring systems are divided into two categories according to misuse and abnormal state. In the error-based detection technology, we must first define the network information including specific header information and the characteristics of events that violate security policies [23-24]. The detection method mainly relies on the pattern recognition method, which is very similar to the starting method of anti-virus software. This type of system maintenance management includes a library of all known intrusion patterns. The network data stream is pre-processed in the actual detection and the corresponding mode is obtained. Then compare it with the functional pattern library to identify attacks [25-26]. If your match is considered abnormal. Then send a warning message, its advantage is that it can achieve a very low false alarm rate. It can reach around 3%. The disadvantage is that it cannot identify new intrusion patterns that do not exist in the functional database [27-28]. In addition, the larger the function database of the intrusion mode, the lower the efficiency of the system. All legal network operations can be abstracted to obtain an operational characteristics database that all legal operations of the system can explain [29-30]. In actual monitoring, through abstract comparisons, measures that deviate slightly from legal measures are regarded as intrusive measures and alarm messages are sent. The advantage of this monitoring technology is that it can theoretically identify all attack actions and new attack actions. However, due to the complexity of the network environment and the diversity of network transmission protocols, it is difficult to abstract all general actions comprehensively and accurately, so it is almost impossible to form an action function library with ideal rules.

The most common network detection products on the market are based on detection of misuse. Most detection methods use the following methods: 1) IP slice reorganization. The reconfiguration of IP fragments will reorganize and analyze sporadic IP fragments. So this is the way of data transmission. 2) The TCP stream connected to this is integrated into multiple TCP packets. This is a connection-oriented, reliable, byte stream-based transport layer communication protocol and this packet can analyze the data pre-processing method. 3) Function code control technology: Function code technology is one of the essential detection technologies of the main anti-virus software. Special codes are usually strings of binary information and usually identify unsuitable programs. If you compare special code fields, you can correctly identify the wrong Trojan horse program.

2.2. Calculation of Probability Density Function Based on Non-Parametric Method

As the deterioration of wind power bearings continues to increase, the probability density distribution of the deterioration degree of different monitoring periods will have a certain offset. Accurately describing this offset is the basis for studying the progressive change trend of the degradation of wind power bearings. From the perspective of probability statistics, the probability density function of the bearing degradation degree during the monitoring period is established based on the non-parametric method, and its confidence interval is estimated. The maximum value of the probability density function during the monitoring period is used to correspond to the degradation degree. To characterize the progressive change trend of wind power bearing degradation. There are parametric and non-parametric methods for calculating the probability density function. The measure of central tendency for parametric methods is the mean, while the nonparametric method is the median. And parametric methods only work on variables, while nonparametric methods work on both variables and properties. The non-parametric method does not need to make any prior assumptions about the distribution of variables, which is more in line with its true distribution than the parametric method. Therefore, a non-parametric kernel density estimation method is used to obtain the probability density function of the bearing deterioration degree.

For the time series g(1), g(2),...,g(N) within the degradation degree period of the wind power bearing, the expression of the probability density function of the degradation degree g is:

$$f(g)=\frac{1}{hN}\sum_{i=1}^{N}k\left(\frac{g-g(i)}{h}\right) \quad (1)$$

In the formula, K is the kernel function. In this paper, the Gaussian kernel function is taken; h is the broadband coefficient; N is the number of samples in the monitoring period.

According to formula (1), the probability density function of the bearing deterioration degree during the monitoring period can be calculated. For the degree of degradation g, given the significance level $\alpha(0<\alpha<1)$ and satisfying the cumulative probability $P_c(g_{\min}<g<g_{\max})=1-\alpha$, the interval [gmin, gmax] is called the bilateral confidence interval of g, and 1-α represents the confidence that the interval contains the true value.

It should be pointed out that the calculation of the probability density function is closely related to the sample data volume N in the monitoring period, and the value is determined by mathematical statistical methods. Because the length of the monitoring cycle cannot be compared with the operating life of the bearing, the calculation process of the relative deterioration degree of the bearing in each cycle can be regarded as a stable random process. At any time, it is independent of each other, and the relative deterioration degree g of the bearing satisfies:

$$\left\{\begin{array}{l} E(g)\equiv\mu, D(g)\equiv\sigma^2 \\ E(\bar{g})\equiv\mu, D(\bar{g})\equiv\dfrac{\sigma^2}{N} \end{array}\right\} \quad (2)$$

In the formula, μ is the relative degradation degree, g is the expected value; σ is the standard deviation; E and D are expressed as the expected and variance respectively; g is the time series g(1), g(2),...,g(N) The mean of the sum. According to Chebyshev's inequality, for a given confidence level 1-α, as long as the number N of data points in a cycle is satisfied. Among them, λ is the range where the data deviates from the mean, and α represents the significance level, generally 0.05. In the process of determining the parameter value, σ is set to the maximum value of the standard deviation of g historical data, and λ is set to 3 times the standard deviation of g historical data according to the Gaussian distribution. Operational data analysis shows that N ⩾ 1000 can meet the needs of deterioration statistical analysis.

2.3. Choice of Objective Function

It can be seen from the relevant content that the dynamic characteristics of the structure based on direct analysis of network communication technology are: structural frequency, long gauge strain mode, etc.; the structural dynamic response can be obtained indirectly: displacement mode and its derivation (modal flexibility, etc.). The several objective functions that can be constructed are as follows:

(1) Natural frequency of structure

$$f_1(x)=\sum_{j=1}^{n} a_j\left(\frac{\omega_{aj}-\omega_{tj}}{\omega_{tj}}\right)^2 \tag{3}$$

(2) Modal confidence criteria for structural displacement modes (Figure 1)

$$f_2(x)=\sum_{j=1}^{n} a_j\left(\frac{1-\sqrt{MAC(\phi_a,\phi_t)}_j}{MAC(\phi_a,\phi_t)_j}\right)^2 \tag{4}$$

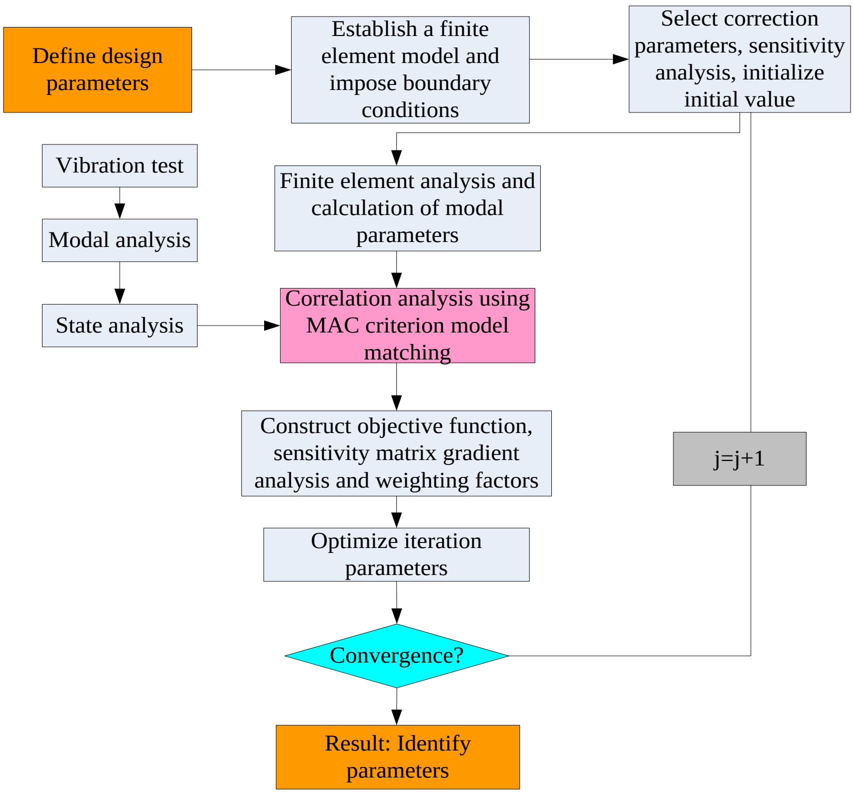

Figure 1. The general process of finite element model modification

(3) Modal confidence criteria for long-gauge strain modes of structures

$$f_3(x)=\sum_{j=1}^{n} a_j\left(\frac{1-\sqrt{MAC(\delta_a,\delta_t)}_j}{MAC(\delta_a,\delta_t)_j}\right)^2 \tag{5}$$

(4) Euclidean norm of long-gauge strain mode of structure

$$f_4(x)=\sum_{j=1}^{n} a_j \frac{\left\|\delta_{aj}-\delta_{tj}\right\|}{\left\|\delta_{tj}\right\|} \quad (6)$$

(5) Modal flexibility

$$f_5(x)=\sum_{j=1}^{n} a_j \left\| \sum_{j=1}^{n} \frac{1}{\omega_j^2} \phi_{aj} \phi_{aj}^T - \sum_{j=1}^{n} \frac{1}{\omega_j^2} \phi_{tj} \phi_{tj}^T \right\| \quad (7)$$

(6) Strain energy

$$f_6(x)=\sum_{j=1}^{n} a_j \left(\frac{\phi_{aj}^T K \phi_{aj} - \phi_{tj}^T K \phi_{tj}}{\phi_{tj}^T K \phi_{tj}} \right)^2 \quad (8)$$

In practical applications, the objective function can use one or a combination of the above functions, such as

$$f_7(x)= f_1(x)+ f_2(x)=\sum_{j=1}^{n} a_j \left(\frac{\omega_{aj}-\omega_{tj}}{\omega_{tj}} \right)^2 + \sum_{j=1}^{n} \gamma_j \left(\frac{1-\sqrt{MAC(\phi_a,\phi_t)_j}}{MAC(\phi_a,\phi_t)} \right)^2 \quad (9)$$

Where ω_{aj}, ω_{tj} are the analysis value and measured value of the jth natural frequency of the structure respectively, ϕ_{aj} and ϕ_{tj} are the analysis value and measured value of the jth displacement mode of the structure, MAC is the modal confidence criterion, δ_{aj} and δ_{tj} are respectively The analysis value and measured value of the jth long-gauge strain mode of the structure, K is the structural stiffness matrix, and a_j and γ_j are the weighting factors.

3. Design of Remote Monitoring System for Health Status Information

3.1. System Functional Requirements

The health status information remote monitoring system mainly implements the following functions:

(1) Monitor the working voltage data of each monitor in real time, and display and process on the monitor host screen, and can store the data of each workstation for later query, analysis, printing, there can be two kinds of digital tube display and chart display the way.

(2) The communication port can be selected and changed according to the actual situation of the user and the interface is reserved for future upgrades. The communication method uses Ethernet, which can save resources and investment through the hospital LAN network, and can ensure the stability of the collection and transmission. The communication distance can theoretically be arbitrarily far.

(3) When the system detects abnormal data, there is no recognition result to communicate through the serial port and GPRS/GSM module, automatically send a short message to the set number for alarm, and can add and delete alarm calls at any time.

(4) The monitoring software can be used to access the monitor and set related parameters. The monitoring management software can determine whether the voltage monitor on the monitored node is in working condition. The name and network address of the monitored node can be changed by the user. The structure of the remote monitoring system for health status information is shown in Figure 2.

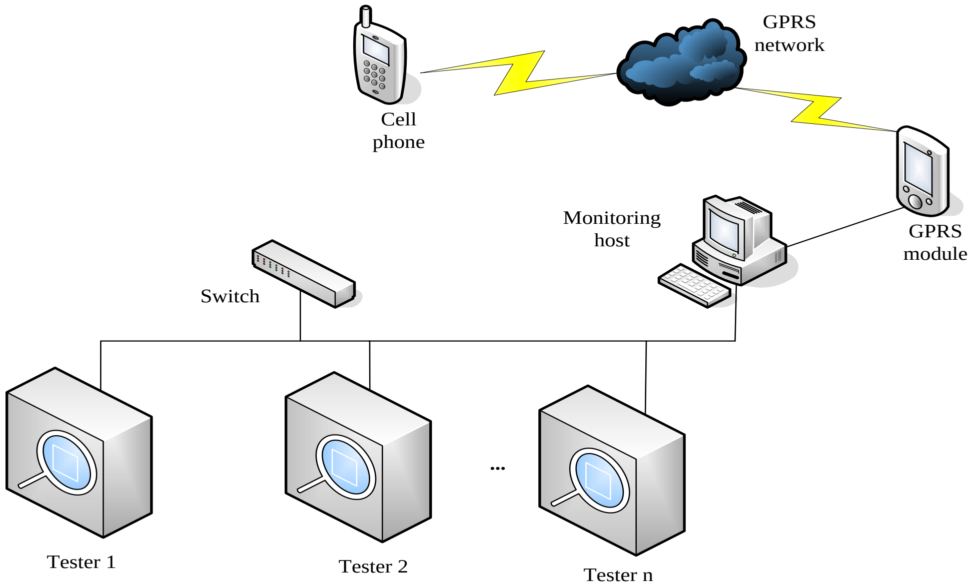

Figure 2. Schematic diagram of power supply monitoring and management

3.2. Experimental Procedure

First of all, the health status remote monitoring system can have user login settings, this setting can complete the user login system verification function. During the login process, according to the login instructions of the module, enter the database, login name and password set by the user. Then the system should also set up a real-time monitoring module, which can realize the function of real-time and complete monitoring of various variables of the building structure. According to the description of the real-time monitoring module, it mainly realizes real-time identification of wind direction, temperature, humidity, sinking, cracks, molds, forming, and vibration acceleration. The method of virtual measuring instrument is used to display relevant content intuitively and clearly. Upload real-time data to the Value property controlled by the virtual meter. The 8 indicator arrows are designed to indicate the direction and wind direction used. In addition, the function of the data report module: complete the same statistics as the data report. This module can choose the quality of the sensor and the distance of the area for query and statistics according to the amount of time. Use a multi-functional system to insert into the database, and select reasonable data to extract from it. The time domain display module is indispensable in the system: the real-time short circuit display is completed in the time domain of the main interface of the system. According to the description of the time domain display module, the health status remote monitoring system provides structural variables with strong correlation. Subsequent grouping and integration to facilitate management and comparison. (Example: If the temperature and humidity are constructed with a monitoring chart, it is easy to draw conclusions). After completing GUI graphic programming, the data collection time can be adjusted to an appropriate level. The final warning and monitoring module contains comprehensive monitoring of various variables of the building structure. Combining real-time trend graphs with preset thresholds allows data monitoring and early warning. If the preset value is less than the key value, the system will operate as usual. If the preset value exceeds the key value, a pop-up window event will occur. The early warning window pops up, displaying the early warning message. The task time to cancel the video and warning is 1 second.

3.3. Data Collection

First, the embedded gateway sends the get command to the wireless network coordinator; then after receiving the command with the wireless network coordinator, it starts to send commands to the CC2530 wireless node module with the RS232 module. The wireless node module starts data collection through the RS232 module; then RS232 The module and the strain sensor communicate through the serial port. The communication rules are as follows: send commands to the serial port: #mAy!, where # represents the start bit (0x23), m represents the number of the recording box, which is represented by 00000000; A is the data collection Command; y is the check digit, and the calculation formula of y is y=128+totalmod128, where total indicates the value added after the instruction is converted to ASCII code:! Is the end bit. The command to get the collected data is # 0000000A193!, after conversion to hexadecimal, it is 23 30 30 30 3030 30 303041C121 and then send the command through the serial port. Receive the collected data from the serial port: $tyl my2 dy3!, where S stands for the start character; t is the model number, y1 is the verification; m is the record box number, y2 is the verification; d is the collected data, y3 Verify it. In this way, the strain sensor data can be collected and transmitted back to the embedded gateway through the serial port and wireless network. Finally, after obtaining the data through the wireless module, the data is transmitted to the wireless network coordinator, and the coordinator transmits the data to the embedded gateway through the serial port.

4. System Test and Result Analysis

4.1. Frequency Analysis of Health Monitoring and Early Warning System

After the design of the health status information monitoring and early warning system, it is necessary to conduct experimental verification and related performance tests on the entire system. Therefore, we selected multiple buildings with normal frequencies and one building that will soon be scrapped, and will use this system to The equipment terminal node is fixed at its estimation point, at the same time, the terminal node and the control coordination node are placed in the Bluetooth effective transmission range for experiments, and the health monitoring data packet is sent to the control coordination node through Bluetooth, which is analyzed, processed, and displayed, And upload the health data package to the COM port of the computer through the serial port data line, and analyze the health data information again, display and save the data through the PC computer software. Figure 3 is the normal frequency signal waveform measured by the system at the PC. Compared with other images, the ripple in the frequency waveform is significantly reduced, and the Frequency waveform changes more smoothly. That is because the frequency analog front end passes After the hardware filtering, the software filtering is performed through the FIR notch filter that can run in the MCU, and the influence of the 50 Hz power frequency noise signal on the frequency waveform is suppressed. Figure 4 is the frequency signal waveform diagram obtained by the PC on the PC after the measurement by this system. Compared with the normal frequency signal waveform diagram of Figure 3, the third R wave of the frequency waveform of Figure 4 is reversed, which is the obvious frequency Signal abnormal waveform.

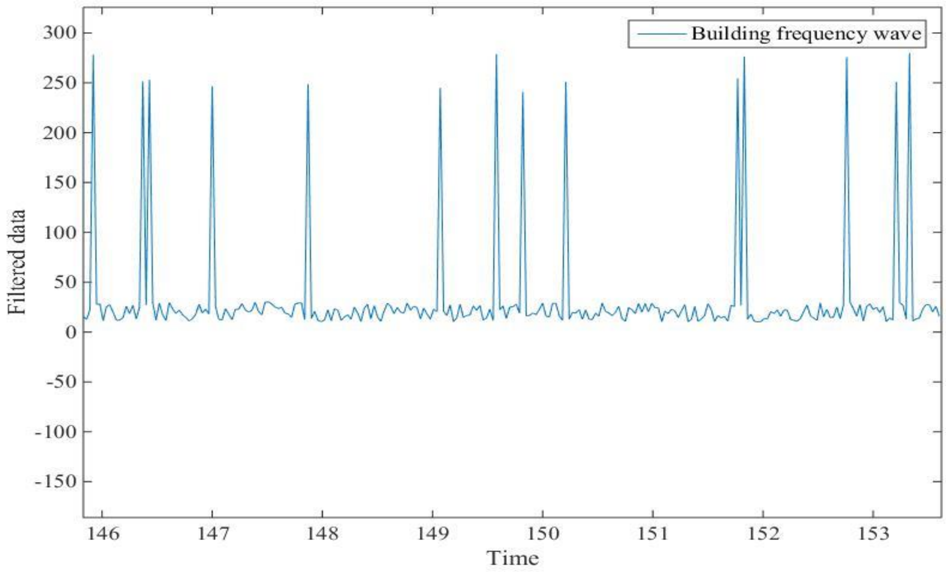

Figure 3. The normal frequency signal waveform measured by this system

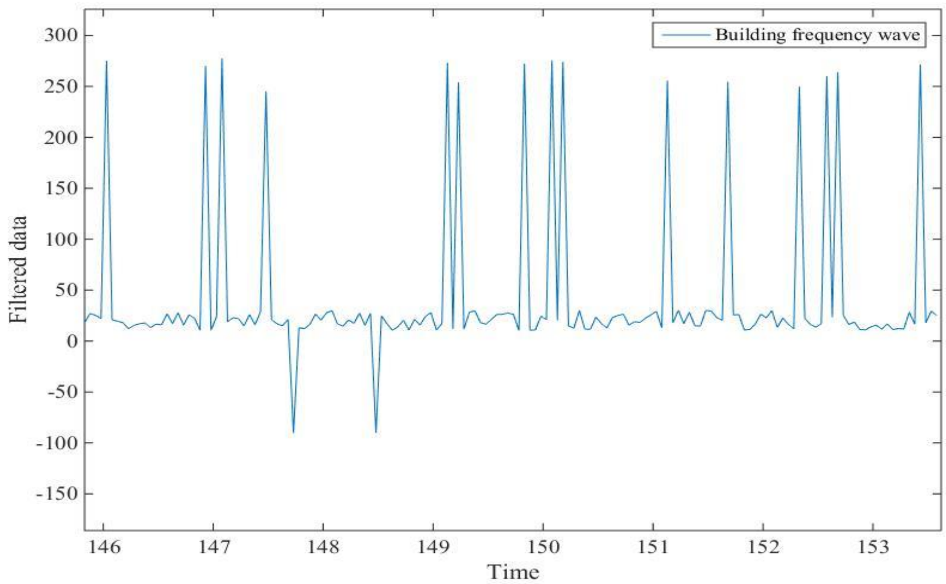

Figure 4. Abnormal waveform of frequency signal measured by this system

After being processed by the upper computer algorithm, the overall upper computer software display of the frequency of the health monitoring system is shown in Figure 4. From Figure 4 we can see that the frequency signal and pulse signal waveform are clearly visible, which overcomes noise interference and baseline The effect of drift on the signal waveform.

4.2. Saturation Test 0f Building Space

In this system's test experiment on some building spaces, Fluke's Index2 space saturation simulator was first used to generate a standard detection signal with a frequency of 72 and a saturation value of 96%. Secondly, the health monitoring and warning system and force Kang PC-60NW, Kang Tai CMS-50IW, YX-301 measured the standard detection signal for eight minutes, in which the frequency value and saturation value were recorded and registered every two minutes, after four measurements and calculations within eight minutes After that, its frequency and deviation are shown in Table 1. Figure 5 is the pulse rate of four different products, the average value of the building space saturation value

Table 1. Pulse rate of 4 different products, average value of building space saturation value

Test model	Spatial saturation%	Pulse rate	Deviation
This design circuit	95.12	74.32	-0.21,0.3
Likecom PC 60NT	96.42	75.62	0.26,0.5
Yu Yue YX-301	94.86	76.12	-0.23,0.6
CONTEC OIS-501W	95.37	74.25	-0.45,0.7

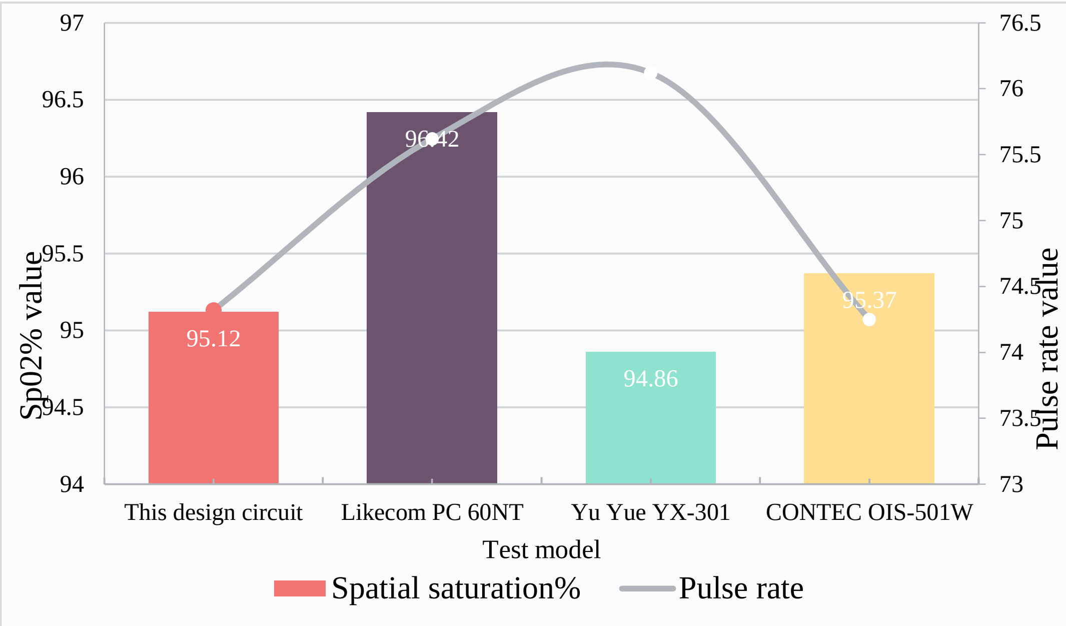

Figure 5. Pulse rate of 4 different products, average value of building space saturation value

It can be known from the above measurement results: the saturation value and frequency value collected by this remote health monitoring and early warning system are accurate and usable: normal saturation range: 96-100%; The spatial saturation of the system proposed in this paper is up to 96.42%. frequency: 65-105 times per minute.The remote health monitoring system was tested with individual modules and combined tests. First, the frequency signal detection module was tested, and the frequency waveform test results were briefly analyzed. Then the whole system was tested, and the pulse saturation and standards were tested. The calibration device and three commercial instruments were compared in terms of precision and accuracy. Secondly, the relevant algorithms were used to suppress the power frequency noise and baseline drift before and after comparison.

Then the system and two portable commercial products were accurate in physiological parameters. The comparison is made in nature, and finally the experiment on the fall warning module and warning mechanism is carried out, and the relevant results are analyzed.

4.3. Civil Engineering Analysis and Classification Decision

This study mainly clusters and classifies building frequency waves, and divides them into three basic characteristics according to the similarity of building frequency waves, namely normal, abnormal and sudden. Each category has a set of typical representative waveforms as templates. After identification of the template feature value, the identification is extracted, so that the collected data is analyzed for arrhythmia and decision-making. After the data is subjected to feature extraction, sample classification and segmentation, and then normalized, the features of each sample are mapped into the [0, 1] interval, and the vector matrix composed is analyzed by fuzzy clustering algorithm. As a result, the statistics are divided into two categories. The first category of data is divided into cases, which are used to verify the detection accuracy of the algorithm for different categories and to evaluate the detection rate of abnormal data. The second type of data is used for comparison with the first type of data. The specific results are shown in Table 2,The percentage of positive samples in the number of samples is shown in Figure 6.

Table 2. Sample classification test results

Sample number	Number of positive samples	Positive sample percentage	Misjudged heart beat	False positive percentage
ABERR	1288	1.16%	6	7.1%
LBB	7682	9.92%	118	1.7%
NORMAL	55324	69.31%	376	0.3%
PVC	7152	8.31%	56	0.8%
NESC	1362	2.25%	32	9.7%
RBB	6273	7.86%	265	4.3%

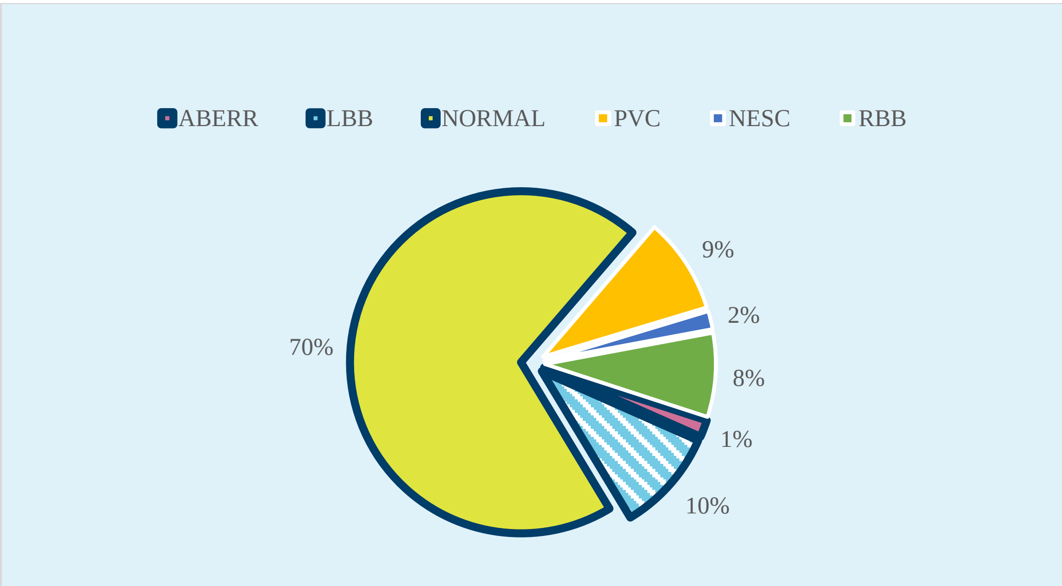

Figure 6. Percentage of positive samples in the number of samples

It can be seen from the above test results that the fuzzy clustering algorithm has a high accuracy rate, which is basically above 90%, which is relatively higher than the general algorithm. As can be seen from the sample test data of ABERR and NESC in Table 2, the detection rate of this algorithm for special low sample data also maintains a high detection rate.

5. Conclusion

This study uses wireless sensor networks to transmit data by monitoring structural information, meteorological information, and vibration information of buildings, and uses data-intensive USB serial ports through data fusion coordinators. The host server can simplify the network structure to prevent each node from sending information to the host separately. In order to realize the function of the multi-channel decoder, multi-chip components under the condition of existing integrated circuits are necessary. These components are typically unhermetically assembled on a multilayer interconnected substrate by wire bonding, tape bonding or flip chip means. Through the research of VHDL and CPLD, the current mainstream programmable technology has been adopted. In order to reduce power consumption and simplify the system, multiple programmable decoders have been developed and implemented.

In this study, a structural damage identification method was set up based on a long gauge deformation time history in moving loads. Using the theory of influence marking, the influence marking area of the long gauge is related to the damage condition within the marking area, and can correspond one-to-one. The active simulator and the actual bridge test verified this method, and at the same time, the method carried out the effects of axle weight, axle weight, speed, gauge length and moving load test errors, and showed the axis and number of moving loads. Although weight, speed and gauge length have almost no effect on this method, if the test error reaches 10%, then the method of this study still has high accuracy, and the paper will set a large amount of test data in the bridge test. An effective processing method can effectively delete a large amount of duplicate data in actual testing, and only retain characteristic data directly related to rescue performance.

Research on AT commands and SMS has developed a communication node machine that can achieve a perfect connection between a personal network and a GSM network, as well as a mobile phone remote telemetry. Programming is completed in the communication process according to the design of each module, based on the IEC104 protocol, to achieve the basic station domain function of the host terminal communication simulation software. After testing the pressure, the experiment yielded the expected results.

Although this paper uses network communication technology to conduct in-depth research on the remote monitoring system of civil engineering health status information, there are still many deficiencies, and my academic level research is also limited. Study appropriate methods and means from more angles, and continuously improve the quality of research work.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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