

The Construction Techniques in Digital Control for Environment Monitoring of Construction Sites

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Abstract: Environmental protection is the most important index in the acceptance of green construction demonstration projects, and it also has the highest score. With the strengthening of national control, the accuracy and rigor of the data sources of various indicators in the acceptance standards have been further improved. At present, there are a variety of network platform management for the monitoring of dust, noise and sewage in green construction in the market, but there is no integrated platform to realize the comprehensive monitoring of the environment on the construction site. Moreover, the platform for simple data collection is in the majority, and there is no data analysis module. In order to save manpower and material resources and improve work efficiency, the three modules are integrated into the same platform, and the data collection is linked with the green construction management, so as to realize the digital environment monitoring on the construction site and promote the green construction information management.

Keywords: Digital control; Integrated monitoring; Environmental monitoring

1. Introduction

The construction industry is a typical industry with much industrial resources and energy consumption. It not only causes serious water pollution, affects the air quality, but also affects the sustainable development of the city process. As the strengthening of the green construction control, the acceptance requirements in the industry of demonstration projects are more stringent, especially for accuracy of the data source of the “four economies and one environmentprotections”. The construction industry should follow the pace of times, reduce and solve the problem of impact on the environment, and strengthen the information management system of green construction [1].

The most severe three impacts on the society are dust, noise and water monitoring, for now, alone on the market for green construction dust, noise. At present, there are a variety of network platform management for the monitoring of dust, noise and sewage in green construction in the market, but there is no integrated platform to realize the comprehensive monitoring of the environment on the construction site. If we can integrate the three modules, it will greatly improve the work efficiency and save manpower. In addition, monitoring alone cannot solve the fundamental problem of environmental pollution in construction projects. How to conduct real-time monitoring and take timely measures for control is still an issue we need to discuss.

2. Technical Introduction

Construction technology integrates scattered dust monitoring, construction noise detection and sewage discharge detection into the same platform for unified management. On each dust noise monitoring equipment and sewage monitoring equipment set on network transmission nodes, each node of the data are transmitted by the host data transmission, and through the WIFI AP to realize network connection, eventually to data transmission on the computer platform. People can view the environment index value on the computer and cell phone APP and see the target data line chart. At the same time, BIM model is introduced into the Internet platform for dynamic management and control, realizing the comprehensive monitoring of the construction site environment, constructing the linkage system of data statistics, analysis and treatment, and realizing the automatic warning of information. This technology can check PM2.5, PM10, temperature, wind speed, noise value, PH value and other environmental indicators through the digital environmental monitoring management platform, computer platform and handheld APP. It can be inquired/preview and downloaded.

3. Technical Features

3.1. Integrated monitoring

The scattered three modules including dust monitoring, construction noise monitoring and sewage discharge monitoring are integrated into the same platform to realize the comprehensive monitoring of the construction site

environment. The three modules are independently set pages on the platform, which can be viewed separately, and the data analysis forms can be downloaded separately. Managers can select the modules needed according to the actual situation of the project.

3.2. Automatic statistics of environmental indicators

Network transmission nodes are set on each dust noise monitoring equipment and sewage monitoring equipment. The data are transmitted by the host data transmission, and through the WIFI AP to realize network connection. Eventually the data will be transmitted to the computer platform to realize the automatic statistical analysis of data values, which includes monitoring time, real-time environment index, if it is qualified, monitoring, equipment data, etc, this can be queried/preview and downloaded on the computer platform and handheld APP [2].

3.3. Use BIM technology to implement dynamic management

This technology developed the digital control for environment monitoring platform based on BIM technology to combine the BIM model with the Internet platform for dynamic control. When the noise value and PH value beyond limit, the system will start the early warning mechanism, BIM model will highlight the location of the early warning monitoring. This can be viewed through the mobile phone APP or computer platform and the manager can timely get access to real-time monitoring of azimuth and take corresponding measures.

3.4. The spraying system realizes artificial and intelligent two-way control

When PM2.5 exceeds the limit, the spraying system will start automatically, and then the spraying system will shut down automatically after the limit is reached. Or the manager can click the "Open/close" button in the APP, or set the timing spraying duration to remotely turn on the on-site spraying equipment, so as to implement artificial and intelligent two-way control.

3.5. Green environment protection, save manpower and material resources

By integrated environmental monitoring platform, this technology can carry out real-time monitoring of three environmental indicators, namely dust, construction noise and sewage discharge, and realize the comprehensive control of intelligent, integrated and dynamic environmental indicators on the construction site to meet the requirements of green construction development. In the past, the three modules required at least three people to

coordinate all the data. This system only requires one manager to coordinate the project, which saves a lot of manpower and material resources.

4. Construction Process and Operation Points

4.1. Construction process flow

The construction process flow chart is shown in Figure 1.

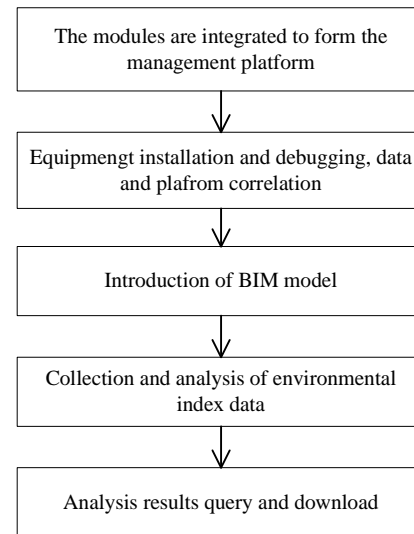


Figure 1. Construction process flow chart

4.2. Operation points

4.2.1. Construction preparation

Platform development by summing up years of green construction management experience, the investigation to the market demand for the construction site and the environment monitoring methods, our researchers put forward the solutions and development requirements for the environment monitoring problems in construction sites to software developers. The software assessor evaluate the requirements and determine the optimal solution, which will involve the environmental monitoring of various modules, formation of environmental monitoring management platform, the implement of the platform development work. The digital integrated environmental monitoring system for construction sites mainly includes dust monitoring, noise monitoring and sewage discharge monitoring. The system structure diagram is shown in Figure 2.

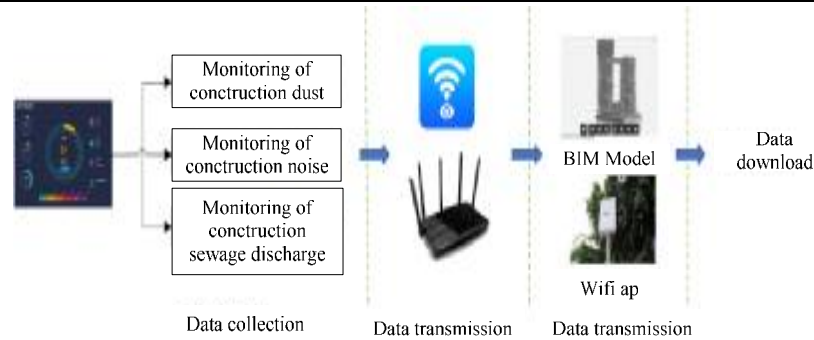


Figure 2. Construction site digital integrated environmental monitoring system structure

Equipment installation and layout planning at this stage, we will formulate the implementation plan, determine the location of dust, noise and sewage discharge monitoring points, determine the pipeline route of the automatic spraying system, determine the number of each equipment. And we will also set the equipment layout points in the BIM model. Dust monitoring and control points are generally arranged at the gate of the construction site, temporary roads of the construction site and other places prone to dust and vehicle access. Noise monitoring points are generally arranged in the field office area, living area and surrounding residential areas, and sewage monitoring points are generally arranged at the outlet of the three-level sedimentation tank [3].

Equipment procurement and installation the supplier of dust noise, construction sewage and spraying system will be determined through bidding, and the connecting equipment such as WIFI AP, transformer, intelligent water meter, guide way three-phase multi-functional power meter, signal transmitter and data transmission host will be purchased at the same time. According to the planning scheme, dust noise detector, sewage discharge detector and sprinkler system shall be installed at the equipment setting point. The drainage ditch and sedimentation tank shall be set reasonably. The water of sedimentation tank shall be extracted by water pump for flushing vehicles on the road, dust control and so on, and water resources shall be reused.

4.2.2. Linkage between the platform and intelligent devices

In construction site, the professionals set and test the data sensors and WIFI AP. through the date is transferred by GPRS, wireless router, which can realize real-time intelligent environment monitoring data collection. The network transmission nodes are set on each dust noise monitoring equipment and sewage monitoring equipment. Each node of the data is transmitted by the host data

transmission, and through the WIFI AP to realize network connection and the real-time data transmission of environmental monitoring equipment to data integration management platform. The real time data statistics and analysis and the linkage of the implementation platform with the equipment will be realized.

4.2.3. Monitoring of environmental index data

This technology integrates scattered dust monitoring, construction noise monitoring and sewage discharge monitoring into the same platform, realizing the comprehensive detection of all environmental indicators on the construction site and intelligent statistics of all data. The linkage between the equipment and platform is realized. By setting the limit of indicators, the monitoring data which is over the limit will be automatically included in the unqualified number. Automatic summary statistics to the qualified and unqualified number, using the pie chart shows that to view on the percentage of number of days per month to meet the requirements and the environmental indicators of high.

Dust monitoring and automatic spraying we can choose today, yesterday, the latest week, last month as the monitoring period, and view environmental indicators, such as PM2.5, PM10, temperature, wind speed, noise value and PH value on the computer platform and handheld APP to view the data index data line chart. The dust monitoring equipment real-time location will be highlighted in the platform of BIM model. When PM2.5 exceeds the limit, the spraying system will start automatically, and then the system will shut down automatically after it drops to the limit. Or the manager can click the "Open/close" button in the APP, or set the timing spraying duration to remotely start the on-site spraying equipment. The spraying water amount, total spraying times, total water consumption, total water saving value and saving rate will be calculated automatically and displayed on the platform.

Noise monitoring when the noise value and PH value exceed the limit value, the system will start the warning

mechanism, the BIM model will highlight the location of the warning monitoring point, the management personnel can check through the mobile APP or computer platform, timely obtain the real-time orientation of the monitoring point and take corresponding measures.

Monitoring of sewage discharge at the construction site a three-stage sedimentation tank is set up at the sewage outlet. A sewage discharge detector is installed at the outlet of the sedimentation tank to collect sewage information in real time and automatically count the indicators of sewage. The sewage data include: PH value, insoluble matter, sulfate, oxide, sulfide and other data. Different limit values are set the excess value is included in the data table to monitor the sewage data.

4.2.4. Automatic statistics and analysis of data

Managers can select different devices in each environmental indicator, and then select the time period of data they need to view the data analysis results and real-time data of each indicator. The data of a certain period of a certain device can be exported in the form of Excel on the platform for automatic statistical analysis of data values of various indicators, including monitoring time, real-time environment index value, whether it is qualified, monitoring point/device data information, and can be inquired/previewed and downloaded.

4.2.5. Query and download of achievements

After the end of the project, the equipment will be dismantled step by step. After the equipment is dismantled, the dust noise monitoring equipment, automatic spray dust removal equipment, sewage monitoring equipment and other equipment will be transported to the next project for reuse, saving the project cost.

5. Application Examples

5.1. Project overview

The total construction area of building 1, building 2 and building 7 (including the basement) of Jinyue Business

Center covers an area of 149,105 m², including a 158.2m, a 103.3m main building and a commercial podium(including two basement floors).

5.2. Implementation effect

This project used this technology to integrate the environmental protection indexes (dispersed dust monitoring, construction noise monitoring and sewage discharge monitoring) for the first time and manage them systematically. By real-time monitoring the environmental protection indexes in green construction in digital ways, this project built the data statistics and analysis of the linkage of the governance system and realized the automatic early warning information and the adaptive control. The BIM model is introduced into the Internet platform for dynamic management and control to realize real-time evaluation of three environmental protection indicators, reduce management costs. With high efficiency, strong operability, by reducing the impact of building construction on the environment at the source, this is an innovative management and control method for green construction environment detection under the integration of BIM technology [4, 5].

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