Research on Intelligent Management of Engineering Construction Safety Oriented to Internet of Things + BIM

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Abstract. By integrating advanced information technologies such as BIM, Internet of things, big data and artificial intelligence algorithm, an intelligent management platform for engineering construction safety. Construction safety intelligent early warning system and intelligent management and control methods and builds an intelligent construction safety management system from the three aspects of identification warning and control, then puts forward the construction plan of the construction safety intelligent management platform, in order to provide references for the creation of smart construction site.

Keywords: Internet of Things · BIM · Engineering construction safety

1 Quotation

1.1 Internet of Things + BIM

The emergence of BIM and the rapid development of big data, artificial intelligence, cloud computing, Internet of Things, 5G and other emerging information technologies have brought vitality and vitality to the intelligent management of engineering construction safety. As an important part of the construction industrialization, prefabricated building has been paid more and more attention and become the inevitable trend of the future development of the construction industry. As the construction process of prefabricated building is divided into two parts: the off-site production process of prefabricated components and the on-site assembly construction process, the successful implementation of prefabricated building must fully coordinate the production and distribution of prefabricated components and the on-site construction activity arrangement, which makes the role of project scheduling in the smooth implementation of prefabricated building increasingly apparent, and effective scheduling scheme has become the whole process a necessary condition for the successful completion of a project. However, the process of prefabricated building construction has the characteristics of “multi space”, “non

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synchronization", "different region" and "relevance", the traditional project scheduling mode is difficult to realize the real-time interaction between physical construction system and virtual construction system. The lack of effective docking and fusion of the two system space data hinders the timely and effective. Scheduling decision-making. How to achieve intelligent project scheduling with the help of cutting-edge technology has become a major challenge.

Based on the background of the rapid development of prefabricated buildings in China, aiming at the characteristics of prefabricated building scheduling, this paper constructs an intelligent management platform of prefabricated building project scheduling based on BIM + Internet of things, and proposes an intelligent scheduling idea integrating Internet of things, big data, artificial intelligence algorithm and other advanced information technologies under the dynamic interference of multiple uncertain factors it has certain theoretical significance and practical value to improve the autonomy, intelligence and predictability of assembly construction project scheduling.

1.2 Application Status of BIM in Construction Safety

Scholars have done a lot of research on the practical application of BIM in the design, construction, operation and maintenance of prefabricated building projects, but the actual application effect is far from the expected. Because BIM is not designed to process real-time data, it is used for design, construction, maintenance tasks and interoperability in industry. The realization of these functions does not necessarily require real-time capability. Therefore, the relevant work of inputting real-time data (such as through sensors and Internet of things devices) into BIM to supplement and improve the functions of BIM is in-depth study. For example, Li et al. Reduced the schedule risk of prefabrication construction by integrating BIM and RFID technology. Ding et al. Proposed to integrate BIM model with Internet of Things devices to monitor real assets on site. Some scholars have noticed that the parametric modeling and visual simulation functions of BIM Technology are consistent with the requirements of prefabricated construction technology, which is beneficial to solve the problems of prefabricated construction project scheduling and information management. Although it has not been well applied, it has gradually formed a research trend.

2 Intelligent Identification of Construction Safety Risks

One of the important reasons leading to construction safety accidents is that the data collection and transmission of construction safety risk are not timely, and the risk identification is not intelligent enough. It is very important to form the corresponding security intelligent identification technology with the support of emerging information technology and the uniqueness of specific engineering activities.

2.1 Security Identification Technology Based on the Internet of Things

The security identification based on the Internet of Things is to collect and transmit engineering safety related data automatically in real time through the integrated application of various sensors and network facilities (wired or wireless), and carry out real-time

analysis and discrimination of safety risks by combining data analysis methods and early warning mechanisms.

This technology involves many kinds of sensors, such as temperature, humidity, pressure, gas body, light, sound, stress, strain, displacement, position, identity identification and other sensors, often used in geological environment, deep foundation pit, main structure, edge hole, dangerous gas monitoring. However, due to the complexity of the engineering environment and the large number of RFID tags identified by personnel, materials and equipment, the intelligent perception technology needs to solve the power supply, electromagnetic shielding, huge amount of communication data and other problems of the sensor. Data transmission and transmission are susceptible to the impact of the field environment, resulting in great fluctuations in its accuracy.

2.2 Security Identification Technology Based on Machine Vision

Machine vision based security identification technology is to use image or video analysis methods or technologies to quickly and automatically process engineering safety-related images or videos and extract safety elements, and then to identify security risks. This kind of technology depends on the project site video acquisition equipment and image processing technology. Often used in worker behavior, dangerous areas, material safety testing, etc. However, this kind of technology is greatly affected by the field light, line of sight, dynamic, etc., and is also limited by the performance of algorithm and computing equipment.

2.3 Mobile Terminal Based Security Identification Technology

The security identification technology based on mobile terminal is to obtain engineering safety related data by manual means, identify and report the hidden security problems existing in the project, and then carry out the comprehensive identification of security risks. This kind of technology benefits from mobile terminal equipment and WeChat or small program. Through scanning QR code on the spot, the information transmission and processing of real data are often used for on-site inspection and identification of potential safety hazards or wind risk factors. This kind of technology is applicable to a wide range of applications, but limited by manual detection and reporting of relevant data, resulting in a narrow or incomplete data coverage.

3 Intelligent Early Warning of Construction Safety Risks

Internet of things technology is a new technology which is developing rapidly. It has great potential in intelligent management and can provide solutions for the physical information fusion of complex dynamic systems. At present, Internet of things has been tried in industry, transportation and other fields. Tao Fei et al. Elaborated the basic theory and key technology of Internet of things Workshop Information Physics fusion from four dimensions of physics, model, data and service, and put forward the criteria and application ideas of Internet of things drive.

In the construction industry, studies have shown that Internet of things is a promising solution to realize intelligent automation in the construction industry. A few scholars have applied Internet of things to the research of construction progress monitoring, construction personnel safety management, building materials monitoring and waste tracking. Due to the characteristics of both manufacturing industry and construction industry, the solution of assembly building project scheduling problem cannot simply refer to the application methods of Internet of things in workshop scheduling and satellite assembly space, but the existing research results can provide a good reference for the application of Internet of things in assembly building project scheduling.

BIM is a rich intelligent digital warehouse, which uses object-oriented method to describe the characteristics of architecture, engineering and architecture, that is, semantics, geometry and relationship. Internet of things visualization of buildings can rely on 3D CAD model extracted from BIM or customized 3D model of buildings. However, the information provided by BIM is usually limited to the level of facilities or buildings, lacking the real-time dynamic data information of personnel, materials and equipment on the project site. In the process of prefabricated building construction, the Internet of things technology can collect and transmit the information of component materials, equipment and personnel in the construction site to the information system background through RFID tag, sensing equipment, two-dimensional code, video monitoring and other sensing technologies, so as to realize the real-time information tracking of the basic information, location information and transportation status of the monitoring object. The Internet of things of buildings can use various sensor networks to create real-time views of buildings. On the basis of real-time data acquisition and monitoring, artificial intelligence algorithm and data mining technology can fuse data and mine relevant scheduling knowledge for scheduling optimization. The BIM based Internet of things prefabricated building model is shown in Fig. 1.

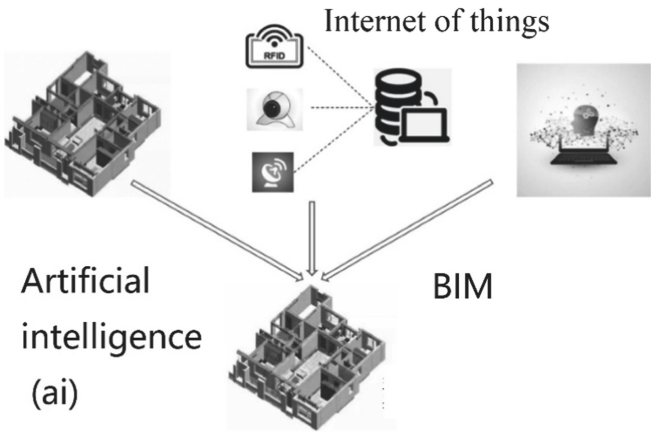

Fig. 1. The BIM based Internet of things prefabricated building model

Aiming at a series of problems in the process of prefabricated building construction, which are caused by the diversity of construction elements, uncertainty of prefabricated

component supply and multi-source of disturbance elements, real-time interaction with on-site construction system in virtual space can realize the informatization, convenience, foresight, networking, intelligence and self-management of project scheduling through simulation feedback, disturbance prediction, decision optimization and other means It's dynamic. The Internet of things model based on BIM is integrated with project scheduling. Before the implementation of the scheduling scheme, the Internet of things model of the project can be established through digital technology, and the project scheduling can be realized.

Interface, plus material attributes, boundary conditions and load conditions, can real-time monitor the safety state of personnel and mechanical substances in the construction of the project, simulate the stress and strain state of the engineering structure in the construction, effectively prepare safety management measures, real-time maintenance and correction of safety emergency management plan. BIM technology can be used for dangerous partial projects or complex heterosexual structure installation.

Taking the dynamic database of engineering construction safety risk as the platform connotation, building the intelligent management platform of engineering construction safety based on BIM is the inevitable way to realize the linkage management of "awareness", "police" and "control" of engineering construction safety risk. The platform includes five layers: perception layer, transmission layer, data layer, algorithm layer and functional application layer, as shown in Table 1.

Table 1. Perception layer, transmission layer, data layer, algorithm layer and functional application layer

Management platform	Layer	Construction safety
Intelligent early warning	**Functional application layer**	BIM
contingency management	**Algorithm layer**	Awareness
Assistant decision	**Data layer**	Police
5G technology	**Transport layer**	Control
AI	**Conclusion layer**	Internet of things

Euclidean distance is used in KNN algorithm. The Euclidean distance between two points in two-dimensional space is calculated as follows:

$$\rho = \sqrt{(x_2 - x_1)^2 - (y_2 - y_1)^2} \tag{1}$$

The simplest and rudimentary of KNN algorithm is to calculate the distance between the prediction point and all the points, then save and sort, select the first k values to, When we expand to multi-dimensional space, the formula becomes like this:

$$d(x, y) := \sqrt{(x_1 - y_1)^2 + (x_2 - y_2)^2 + \cdots + (x_n - y_n)^2} = \sqrt{\sum_{i=1}^{n} (x_i - y_i)^2}. \tag{2}$$

Average error of KNN algorithm as shown in Fig. 2.

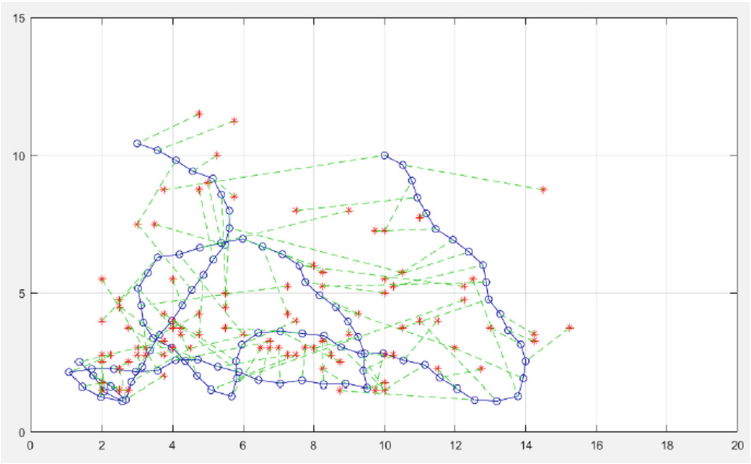

Fig. 2. Average error of KNN algorithm

4 Epilogue

Based on BIM + Internet of things technology, the automatic identification of engineering construction safety risk factors, intelligent early warning of safety accidents, efficient decision-making of safety emergency rescue management, and the establishment of a scientific and perfect engineering construction safety intelligent management system is a scientific and modern solution to the problem of frequent safety accidents. Smart compared with traditional safety management, safety management with the aid of BIM to visualization of dynamic simulation, realtime monitoring of the Internet of things, the depth of the large data analysis and auxiliary decision-making of artificial intelligence, real time control of the construction site can be realized Conditions, the dynamic analysis of safety risk factors, predict the safety trend, accurate formulate safety protection measures, effectively implement the safety management measures.

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