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Discussion on Intelligent Building Construction Integrated System Based on BIM and IoT

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ABSTRACT. *In recent years, with the development of construction informatization, Building Information Modeling (BIM) and Internet of Things (IoT) technologies have been widely regarded by the construction industry. The integration of BIM and IoT involves the fusion and analysis of multiple data types in construction. This article analyzes and summarizes the application characteristics of BIM and IoT, combined with China's "Assessment standard for green building" (GB/T 50378-2019), examines the relevant clauses in the green construction specification that can be supported by the integration of BIM and IoT, and finally discusses the feasibility of applying BIM and IoT integration to intelligent construction. This paper proposes an ontology-based BIM and IoT integrated system framework.*

KEYWORDS: *Intelligent construction, Iot, Bim*

1. Introduction

Building Information Modelling (BIM) technology was first developed in the United States, and the idea for it originated in 1975 with Chuck Eastma's design of BIM technology content. In 2002, the American Construction Industry Association first proposed the concept of Building Information Modelling. At present, developed nations have formulated relevant national BIM technical standards, and the penetration rate of BIM technology has reached 60% to 70%.

Internet of Things (IoT) originated during the Second World War. Because of its own unique technical advantages, it has achieved rapid development and has been applied rapidly and widely in many fields abroad. As a strong promoter of IoT technology, the United States has created the highly influential EPC Global Standard System. They stipulated that from January 2005 onwards, RFID tag technology, an IoT technology, will be used as the identification method for all military supplies.

Wang Chao from the Harbin Institute of Technology (2015) expanded IFC and created a structural health-monitoring information model based on the IFC standard, wrote the corresponding IFC read-write program, and integrated IFC files with

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structural monitoring data. And, based on Revit for secondary development, Chao developed a set of monitoring information visualization program, which has functions of detection points, automatic monitoring, information query, and others, all of which realize data interaction, monitoring information sharing, and the BIM model[1].

2. Feasibility Analysis of the Application of Bim and Iot Integration in Intelligent Building Construction

Based on existing documents, the provisions in the "Code for Green Construction of Construction Engineering" are as follows: conduct basic regulations, construction preparations, construction sites, foundation and foundation works, main structural works, decoration works, insulation and waterproofing works, electrical and mechanical installation works, and demolition. The integration of BIM and IoT technology can play a role in the following aspects of intelligent building construction:

2.1 The Management of Building Materials

Combining BIM and IoT can establish building materials and/or detailed structural models of components in the BIM model, which in turn can simulate the job site and aid in meeting the requirements of scientific material transportation, placement and storage [3]. For example: Attach the RFID tag to the material after the construction material is produced; then, after the purchase, the detailed information of the material can be transmitted to the BIM system and saved after the RFID reader scans it, and the construction unit will be able to implement efficient management of a large number of complex building materials.

2.2 Prefabricated Buildings

Prefabricated components can not only shorten the construction period, but also save costs; and, they can reduce construction waste and sewage emissions, noise pollution, and dust emissions. However, prefabricated buildings have certain difficulties in the promotion and application of life-cycle management. One problem is that there are numerous types of prefabricated components that are related to the construction process; thus, the information is relatively scattered. The second problem is that the information of each component is not easily timely in the collecting and archiving process, which means the information of all participants is difficult to share so the construction progress and management of the entire project will be more challenging. Furthermore, there are circumstances in which a component is unqualified and lost. Combining BIM and IoT technology and applying them to the life-cycle management of prefabricated buildings can solve these problems. The sensors or RFID tags used in the data collection layer of IoT have their own unique codes that can ensure the accuracy of the information of each component. This is especially true for RFID tags, which have strong

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anti-interference ability.[2]

2.3 Intelligent Construction Monitoring Field

The safety and health of construction workers have gained more importance and attention in the construction industry over time. The intelligent monitoring technology of construction projects, such as GPS, infrared, camera and other technologies, is also improving day by day; this improves the work efficiency of manual monitoring of the scene to a certain level. The advantages of parameterization, visualization, and sharing of BIM technology can make up for these shortcomings. If the integration technology based on BIM and IoT is applied to the field of intelligent monitoring, traditional monitoring methods in construction sites will become a thing of the past.

2.4 Chapter Summary

The combination of information technology and high technology is used in the development of intelligent construction. This chapter takes the “Code for Green Construction of Construction Engineering” (GB/T50905-2014) as the object to conduct a feasibility analysis of the integration of BIM and IoT in intelligent construction and summarizes the application fields of the integration of BIM and IoT in intelligent building construction.

3. Demand Analysis and Functions of Intelligent Building Construction System

3.1 Demand Analysis

More and more buildings have begun to build remote monitoring platforms to realize real-time monitoring of building quality. However, because different types of buildings have different structures, distinct sensor network deployment methods and data processing methods are required to obtain the final building quality results. However, the current general applications are for a single building monitoring system, which creates the problem of very high monitoring costs and high system application limitations. The principle of intelligent building construction is to analyze building status by obtaining various index data that affect building construction status. The principle mainly includes three aspects:

(1)Building data collection and transmission

Building related data collection is the first step in building monitoring. There are mainly two methods, manual information collection and sensor information collection. In the case of sensor information collection, the inspectors deploy various sensors throughout several parts of the building, which allows them to acquire building-related data that they can upload to a server. The content of data collection is always related to aspects of building maintenance, such as stress, deformation,

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displacement, energy consumption, settlement, and so on. [3]

(2) Data analysis and processing

The data analysis and processing module is the further processing of building related data collected in the early stage. There are many ways to analyze and process data, including simple formula calculations, data fusion, obfuscated algorithms, and others. Through data analysis and processing, the status of the building can be obtained.

(3) Display and processing of construction safety analysis results

According to the analysis and processing of the collected data in the previous link, the status of the building can be obtained and visualized. Depending on the different conditions of the building, different treatment measures need to be taken. When the building analysis results are safe, no measures are required; when the building analysis results display potential safety hazards, maintenance measures need to be taken to address the specific types of hazards. After this, the maintenance measures undergo an evaluation to determine building safety results and the treatment effect.

3.2 Functions of Intelligent Building Construction Management

In the context of the current social environment where building management is receiving more and more attention and concern, it is very necessary to achieve continuous safety monitoring during the life-cycle of buildings. The intelligent construction management of buildings should realize digital selection of materials, intelligent material tracking and virtual construction.

(1)Digital selection of materials

The progress information is integrated in the BIM model, and the system automatically generates the bill of materials and component codes required for the next construction stage according to the schedule plan and the existing construction schedule, which in turn then selects material suppliers and generates a variety of procurement plans. Project managers can select plans from several options and conditions, so as to save labor and improve the efficiency of material production.

(2)Intelligent material tracking

After the production of the prefabricated components is completed, the prefabrication plant needs to complete the pasting of the corresponding electronic tags on the components. The components are identified by fixed RFID readers or handheld RFID readers before shipment, warehouse, and installation, and are uploaded to the server for tracking. Managers can query the current status of components in real time through the client.

(3)Virtual construction

The next step is using 3D modeling software to establish a construction equipment model, set up related construction processes, employ BIM technology to

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simulate construction in advance, conduct repeated simulations and deliberations on the most difficult construction plans, formulate practical technical plans, optimize the construction organization design, reduce Rework, create the most effective construction period, and finally improve work efficiency. Through IoT technology, the key data information during the construction process is collected in real time and synchronized to the management platform. This helps realize the effective control of the quality of key processes and the value of key parameters.

4. Conclusion

The construction of smart cities and the development and application of new information technology are both frontier research fields that the international community is increasingly attaching more importance to. This article takes intelligent building construction as the starting point, analyzes and defines the feasibility of the combination of BIM and IOT technology, and systematically proposes the functions of the intelligent building health information service management system, which opens up a practical way for the construction of smart cities.

Future research directions for intelligent construction systems include the consideration of the implementation of scientific organization and management methods for intelligent construction systems; the popularization, promotion, and construction of software and hardware equipment suitable for China's intelligent construction systems; and finally, further research on the development of IOT and BIM from the field of intelligent buildings to that of smart cities.

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