

Research on Intelligent Platform Construction and Pavement Management of Expressway Operation and Maintenance Based on BIM+GIS Technology

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ABSTRACT

With the advent of the information age, the traditional pavement management technology of operating expressways can no longer meet the higher requirements for the improvement of engineering quality in the information age. This paper proposes a method of integrated analysis based on BIM (building information modeling) and GIS (geographic information system), builds an intelligent platform for highway operation and maintenance, and solves the problem of data islands in highway maintenance and management.

KEYWORDS

BIM, Fusion Analysis, GIS, Highway, Pavement Gap

1. INTRODUCTION

Expressways have the characteristics of multiple points and long lines. For key point-like projects such as Bridges and tunnels, their structure is complex and the number of fine model components is huge (Di Graziano et al., 2023; Duong, 2021; Sheina et al., 2022). For lines, their length is usually measured in kilometers, requiring a very wide viewing range and complex terrain along the lines. Therefore, the operation and maintenance management of expressway requires both fine management based on the BIM model and macro-management supported by GIS. The two technologies complement each other. In the field of expressway operation and maintenance, BIM can provide complete basic data on road, bridge, and tunnel engineering consistent with the actual situation (Bracht, Melo, & Lamberts, 2021; Li, Lai, Ma, & Wang, 2021; Saman & Esmatullah, 2021), while GIS can provide more macro geospatial positioning information. It includes the geographical location information of the road, the surrounding environment information, and other spatial macro information. The integration of BIM and GIS can achieve the effect of interconnection and complementarity.

DOI: 10.4018/JCIT.332879

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Compared with the separate applications of BIM and GIS, the modeling quality, analysis accuracy, decision-making efficiency, and other aspects have been significantly improved, playing a huge role in the field of highway operation and maintenance. In addition to the ability to store, analyze, manage (Marco, Sebastian, & André, 2021; Qian et al., 2021; Vito et al., 2021), and query data and to display the panorama of external maps, GIS technology makes up for the lack of BIM computing ability in data processing. In addition, GIS technology can provide an external environment and geographic information for BIM model items, especially when it is used in BIM modeling of long-mileage roads, and GIS can provide a more comprehensive information platform. In general, BIM and GIS complement each other's strengths and are widely used in the digital management platform of road maintenance (Liu et al., 2021; Tan, Grant, Eleni, & Liu, 2021; Tang et al., 2021).

BIM combined with data analysis technology has promoted the development of road nursing management platforms and provided a new way for nursing management decision-making (Alireza, 2021; Filip et al., 2021). In the literature (Bonsang et al., 2021), the developed pavement damage analysis and evaluation program was used to analyze and evaluate the pavement damage in the model road section (Jakob & Guido, 2021), and a reasonable maintenance plan was proposed according to the severity degree (Yu et al., 2021). This research is based on the analysis of two-dimensional data and does not involve GIS technology. At present, road maintenance management platform is widely used in airport pavement management. Literature, combined with software, proposed a web-based three-dimensional (3D) model of airport pavement quality difference expression numerical twin method, which effectively improved the intelligent and intelligent level of airport pavement management system (APMS) (James et al., 2021).

This paper takes the BIM model as the base for fine management, GIS as the support for macro management, builds a highway operation and maintenance platform based on BIM+GIS technology, realizes the multidimensional visualization of the entire highway, and comprehensively uses image analysis technology to detect the pavement gap according to the pavement management requirements, thus improving the highway pavement management level.

- The innovation point is to conduct fine management based on the BIM model and macro management supported by GIS. The integrated analysis method of Building Information Modeling (BIM) and Geographic Information System (GIS) was introduced into the expressway operation system, and the three-dimensional roaming of the expressway was carried out based on BIM+GIS.
- Combined with BIM (Building Information Modeling) and GIS (Geographic Information System), the actual pavement gap was detected, which greatly improved the pavement management technology of operating expressways.

2. CONSTRUCTION OF HIGHWAY OPERATION AND MAINTENANCE PLATFORM BASED ON BIM+GIS TECHNOLOGY

This paper intends to build a highway operation and maintenance platform based on BIM+GIS technology. The overall architecture technology of the platform includes collaborative visualization of the inclined photography model and BIM model, the bidirectional query of BIM and GIS, and the dynamic association between highway operation and maintenance data and the BIM model. This section describes the data association mechanism, emphasizing that O&M service data can be automatically associated with the model through attribute matching so that service information can be viewed on the model. At the same time, you can consider talking about the business information located by the mileage value, latitude, and longitude value. The business data can be located on the BIM model through the above-mentioned bidirectional query technology of BIM and GIS. It is recommended to put one or two renderings, which can be used to display business data on the box with ten meters.

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