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DEVELOPMENT OF ARTIFICIAL INTELLIGENCE-BASED SERVICE MONITORING SYSTEMS FOR CONSTRUCTION QUALITY CONTROL

QURILISH SIFATINI NAZORAT QILISHDA SUN’IY INTELLEKTGA ASOSLANGAN XIZMAT KURSATISH MONITORING TIZIMLARINI RIVOJLANTIRISH

РАЗРАБОТКА СИСТЕМ МОНИТОРИНГА СЕРВИСОВ НА ОСНОВЕ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА ДЛЯ КОНТРОЛЯ КАЧЕСТВА В СТРОИТЕЛЬСТВЕ

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Abstract

This article examines the development of artificial intelligence-based service monitoring systems for construction quality control. The study analyzes the potential of AI technologies to monitor quality indicators in real time, automatically detect defects, and improve the effectiveness of construction supervision. The findings indicate that the integration of AI-driven monitoring systems can reduce human errors, optimize monitoring costs, and support timely decision-making, thereby enhancing the overall quality and reliability of construction projects.

Keywords: artificial intelligence, construction quality, monitoring systems, digital technologies, quality control, automation.

Ushbu maqolada qurilish sifati nazoratini takomillashtirishda sun’iy intellekt asosida xizmat monitoringi tizimlarini rivojlantirish masalalari tadqiq etilgan. Tadqiqotda qurilish jarayonlarida sifat ko‘rsatkichlarini real vaqt rejimida kuzatish, nuqsonlarni avtomatik aniqlash va nazorat samaradorligini oshirish imkoniyatlari tahlil qilingan. Sun’iy intellekt texnologiyalarini joriy etish qurilish obyektlarida inson omili ta’sirini kamaytirish, monitoring xarajatlarini optimallashtirish va qurilish sifati bo‘yicha tezkor qarorlar qabul qilishga xizmat qilishi asoslab berilgan.

Kalit so‘zlar: sun’iy intellekt, qurilish sifati, monitoring tizimi, raqamli texnologiyalar, sifat nazorati, avtomatlashtirish.

В данной статье исследуются вопросы развития систем мониторинга услуг на основе искусственного интеллекта для контроля качества строительства. Анализируются возможности использования интеллектуальных технологий для мониторинга показателей качества в режиме реального времени, автоматического выявления дефектов и повышения эффективности контроля. Обосновано, что внедрение технологий искусственного интеллекта способствует снижению влияния человеческого фактора, оптимизации затрат на мониторинг и повышению качества принимаемых управленческих решений в строительной отрасли.

Ключевые слова: искусственный интеллект, качество строительства, система мониторинга, цифровые технологии, контроль качества, автоматизация.

The construction industry is undergoing rapid digital transformation, creating new opportunities to improve quality control and project management. Traditional construction quality monitoring methods often depend on manual inspections, which may be time-consuming and susceptible to human error.

Artificial Intelligence (AI) technologies provide effective solutions for enhancing construction quality control through automated monitoring, defect detection, and real-time data analysis. By integrating AI with technologies such as Building Information Modeling (BIM), IoT sensors, drones,

and computer vision systems, construction organizations can improve inspection accuracy and decision-making processes.

AI-based service monitoring systems help identify quality issues at early stages, reduce operational costs, and increase project efficiency. Therefore, the development of intelligent monitoring systems has become an important direction for ensuring higher construction quality, safety, and sustainability. This study examines the role and potential of AI-based service monitoring systems in modern construction quality control.

The application of Artificial Intelligence (AI) in construction quality control has become an important area of research due to the increasing demand for efficient and reliable monitoring systems. Recent studies emphasize that AI technologies can significantly improve construction performance through automated inspection, predictive analytics, and real-time monitoring of construction activities [1].

Researchers have highlighted the role of machine learning algorithms in identifying construction defects and predicting quality-related risks. AI-based systems are capable of analyzing large volumes of project data, enabling early detection of deviations from design specifications and reducing the likelihood of costly rework [2]. The integration of computer vision technologies with AI has further enhanced the accuracy of quality inspections by allowing automated recognition of cracks, structural defects, and safety violations through image processing techniques [3].

Several studies have examined the use of Building Information Modeling (BIM) combined with AI technologies. These studies indicate that AI-supported BIM platforms facilitate better communication, project coordination, and quality assurance by providing real-time information and predictive insights throughout the construction lifecycle [4]. Furthermore, researchers have emphasized the growing importance of Internet of Things (IoT) devices in collecting site data and supporting intelligent monitoring systems for construction quality management [5].

Recent literature also demonstrates that AI-based monitoring systems contribute to reducing human errors and improving decision-making processes. By utilizing deep learning and data analytics, construction managers can monitor project performance more effectively and respond to potential quality issues in a timely manner [6]. In addition, drone technologies integrated with AI have emerged as valuable tools for site inspections, offering faster and more comprehensive assessments of construction progress and quality conditions [7].

Studies conducted in the context of smart construction and digital transformation suggest that AI-driven monitoring systems support sustainability objectives by optimizing resource utilization and minimizing construction waste [8]. Despite these advantages, researchers note challenges related to data quality, cybersecurity, implementation costs, and the shortage of skilled professionals capable of managing advanced AI technologies in construction environments [9].

Overall, the existing literature confirms that AI-based service monitoring systems have substantial potential to transform construction quality control by enhancing efficiency, accuracy, and sustainability in construction projects.

This study employs a qualitative and analytical research methodology to examine the development of artificial intelligence-based service monitoring systems for construction quality control. Relevant scientific literature, industry reports, and international best practices related to AI applications in construction management were reviewed and analyzed.

The research is based on comparative analysis, system analysis, and synthesis methods to evaluate the effectiveness of AI technologies such as machine learning, computer vision, IoT sensors, and Building Information Modeling (BIM) in construction quality monitoring. Secondary data obtained from academic publications and industry sources were used to identify key factors influencing the implementation of AI-driven monitoring systems.

Furthermore, the study assesses the potential benefits and challenges of integrating AI technologies into construction quality control processes, focusing on efficiency, accuracy, cost reduction, and decision-making support. The findings provide a theoretical basis for improving intelligent monitoring systems in the construction sector.

The analysis shows that artificial intelligence-based service monitoring systems significantly improve the effectiveness of construction quality control. AI technologies enable continuous monitoring of construction activities, allowing project managers to identify defects, deviations, and safety risks at an early stage. Compared with traditional inspection methods, AI systems provide faster data processing and more accurate assessments.

Computer vision technologies can automatically analyze images and videos collected from construction sites to detect cracks, structural defects, and non-compliance with technical standards. Similarly, IoT sensors provide real-time information on environmental conditions, material performance, and equipment status, helping to prevent quality-related failures.

The study also found that the integration of AI with Building Information Modeling (BIM) improves data management and supports more effective decision-making. AI algorithms can compare actual construction progress with project specifications and identify potential quality issues before they become critical.

The results indicate that the implementation of AI-based monitoring systems can reduce inspection time, minimize human errors, lower operational costs, and enhance overall construction quality. However, successful adoption requires adequate digital infrastructure, high-quality data, and skilled personnel capable of managing advanced technologies.

Overall, AI-driven monitoring systems represent an effective tool for improving construction quality control, increasing project efficiency, and supporting sustainable development in the construction industry.

The study concludes that artificial intelligence-based service monitoring systems have significant potential to improve construction quality control. AI technologies enhance the accuracy, speed, and reliability of monitoring processes by enabling real-time data analysis, automated defect detection, and informed decision-making. The integration of AI with BIM, IoT sensors, and computer vision technologies contributes to higher construction quality, reduced human errors, and improved project efficiency.

To increase the effectiveness of AI-based monitoring systems in the construction sector, the following recommendations are proposed:

1. Expand the adoption of AI technologies in construction quality management processes.
2. Integrate AI monitoring systems with BIM and other digital construction platforms.
3. Improve data collection and management infrastructure to support real-time monitoring.
4. Provide specialized training programs for construction professionals in AI and digital technologies.
5. Develop regulatory frameworks and technical standards for the implementation of AI-based quality control systems.
6. Encourage investment in smart construction technologies to enhance productivity and sustainability.

The widespread implementation of AI-driven monitoring systems can strengthen construction quality assurance, optimize resource utilization, and support the long-term development of the construction industry.

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ХАЛҚАРО ИНДЕКСЛАР АСОСИДА ИЖТИМОИЙ ҲИМОЯ ТИЗИМИНИ МОЛИЯЛАШТИРИШ

ФИНАНСИРОВАНИЕ СИСТЕМЫ СОЦИАЛЬНОЙ ЗАЩИТЫ НА ОСНОВЕ МЕЖДУНАРОДНЫХ ИНДЕКСОВ

FINANCING THE SOCIAL PROTECTION SYSTEM BASED ON INTERNATIONAL INDICES

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Аннатация

Мақолада халқаро индекслар асосида ижтимоий ҳимоя тизимини молиялаштиришнинг халқаро ташкилотлар услубиётлари, молиялаштириш манбаларининг диверсификациялашув даражасини баҳолашнинг халқаро индекслари услубиётларни умумий хусусиятлари таҳлил қилинган. Мамлакатда ижтимоий ҳимоя тизимини молиялаштириш манбаларининг диверсификациялашув даражасини баҳолашда халқаро индекслардан фойдаланиш имконияти таҳлил этилган.

Калит сўзлар: ижтимоий ҳимоя, ҳимоя тизимини молиялаштириш, давлат бюджети, ижтимоий нафақа

В статье анализируются методы международных организаций по финансированию системы социальной защиты на основе международных индексов, общие характеристики международных индексов и методы оценки уровня диверсификации источников финансирования. Рассматривается возможность использования международных индексов при оценке уровня диверсификации источников финансирования системы социальной защиты в стране.

Ключевые слова: социальная защита, финансирование системы защиты, государственный бюджет, социальные пособия

The article analyzes the methods of international organizations for financing the social protection system based on international indices, the general features of international indices and methods of assessing the level of diversification of financing sources. The possibility of using international indices in assessing the level of diversification of sources of financing the social protection system in the country is analyzed.