Chapter 10
Future Trends in Intelligent Construction Monitoring Technologies

Widi Aribowo
https://orcid.org/0000-0002-4059-1293
Electrical Engineering, Faculty of Vocational Studies, Universitas Negeri Surabaya, Indonesia

Sharyar Wani
https://orcid.org/0000-0001-6812-0066
Department of Computer Science, International Islamic University Malaysia, Kuala Lumpur, Malaysia

Hakem Beitollahi
Soran University, Iraq

Firas Mahmood Mustafa
https://orcid.org/0000-0002-8757-5303
Duhok Polytechnic University, Iraq

Sabat Salih Muhamad
Soran University, Iraq

Anik Vega Vitianingsih
Universitas Dr. Soetomo, Indonesia

Muhammad Dedi Irawan
https://orcid.org/0000-0001-5530-2418
Universitas Islam Negeri Sumatera Utara, Indonesia

Vita Mahardhika
Faculty of Law, Universitas Negeri Surabaya, Indonesia

Senny Luckyardi
https://orcid.org/0000-0001-9954-7433
Universitas Komputer Indonesia, Indonesia

ABSTRACT

The construction industry is undergoing a transformative shift with the integration of intelligent monitoring technologies. Advanced sensing systems, including IoT-enabled devices, drones, and wearable technologies, are increasingly employed to track project progress, detect potential hazards, and predict environmental impacts. Coupled with artificial intelligence (AI) and machine learning algorithms, these

DOI: 10.4018/979-8-3373-9245-5.ch010

technologies facilitate proactive decision-making, enhance operational efficiency, and reduce human error. This chapter explores emerging trends in intelligent construction monitoring, highlighting innovations in real-time data acquisition, predictive analytics, automated reporting, and adaptive risk management frameworks. It also examines challenges related to data integration, interoperability, cybersecurity, and ethical considerations, providing a comprehensive roadmap for researchers, practitioners, and policymakers to leverage intelligent monitoring systems for safer and more sustainable construction practices.

1. INTRODUCTION

The construction industry is witnessing a profound transformation with the integration of intelligent monitoring technologies that enhance safety, operational efficiency, environmental prediction, and risk management. Traditional construction monitoring methods, relying heavily on manual inspections and periodic assessments, are increasingly being supplemented or replaced by advanced digital systems capable of continuous real-time observation and predictive analytics (Irani & Kamal, 2014; Liu, Meng, Kong, & Zhang, 2022). These intelligent systems leverage a combination of artificial intelligence (AI), Internet of Things (IoT), wearable devices, unmanned aerial vehicles (UAVs), and cyber-physical systems to enable comprehensive monitoring of construction activities, structural health, and environmental conditions (Abdelhafidh, Fourati, Fourati, & Chouaya, 2019; Aouedi et al., 2024; Shafique, Khawaja, Sabir, Qazi, & Mustaqim, 2020).

AI has emerged as a key enabler in this domain, facilitating data-driven decision-making, predictive maintenance, and automation of complex monitoring tasks (Adebayo, Udoh, Kamudyariwa, & Osobajo, 2025; Ali, Saad, Rasheed, & Ammad, 2024; Lu, 2019). Machine learning algorithms, deep learning models, and large language models (LLMs) are increasingly applied to analyze vast amounts of construction data to detect anomalies, forecast risks, and optimize resource allocation (Mahmud et al., 2025; Sarker, 2021; Taye, 2023). Integration with building information modeling (BIM) further enhances these capabilities, enabling digital twins of construction sites that facilitate simulation, visualization, and proactive risk mitigation (Pan & Zhang, 2023; Mazzetto, 2024; Marizal & Jannah, 2026).

IoT-enabled sensing technologies, including wireless sensor networks, embedded systems, and smart devices, form the backbone of intelligent construction monitoring (Abdelhafidh et al., 2019; Preethichandra, Suntharavadivel, Kalutara, Piyathilaka, & Izhar, 2023; Sonko, Etukudoh, Ibekwe, Ilojianya, & Daudu, 2024). These devices collect real-time data on structural vibrations, material stresses, environmental parameters, and worker movements, which are then processed using AI-driven analytics