Chapter 17

Real-Time Carbon Emissions Monitoring in Smart Construction Using IoT and Machine Learning

Mradul Kumar Jain
https://orcid.org/0009-0003-2232-6474
Ajay Kumar Garg Engineering College, Ghaziabad, India

Updesh kumar Jaiswal
https://orcid.org/0009-0002-1572-8275
Ajay Kumar Garg Engineering College, Ghaziabad, India

Eshank Jain
Ajay Kumar Garg Engineering College, Ghaziabad, India

Jaishree Jain
Ajay Kumar Garg Engineering College, Ghaziabad, India

Anu Chaudhary
Ajay Kumar Garg Engineering College, Ghaziabad, India

Anmol Jain
Krishna Institute of Engineering and Technology, Ghaziabad, India

ABSTRACT

Research into precise real-time monitoring of carbon emissions grew stronger due to expanding worldwide environmental sustainability targets. Current carbon monitoring procedures experience problems related to inefficiency and human labor-intensity and deliver limited real-time precision. The combination of sensor networks along with cloud computing and machine learning analytics in IoT-based systems allows for automatic continuous emission tracking which needs minimal human control. The presented research develops a quantitative method for measuring system performance through response time and uptime together with energy use and sensor precision and data reliability. The system performs environmental

DOI: 10.4018/979-8-3373-2091-5.ch017

impact evaluations by measuring CO_2 concentration levels and conducting emission rate evaluations and predictive data collection processes. Results demonstrate that IoT-based monitoring achieves superior accuracy between 85% and 99% and lowers operational expenses by 10% to 50% thus constituting a better alternative to human-operated systems.

1. INTRODUCTION

The world has intensified its emphasis on reducing carbon emissions between multiple sectors because of rising concerns about climate change and environmental worsening. The construction industry produces approximately 40 percent of the total global CO_2 emissions which make up the greenhouse gas (GHG) emissions total (Jayakodi et al., 2024). Current carbon measurement methods count on manual reporting along with periodic sampling and offline testing processes proven inefficient because they require extensive personnel and remain vulnerable to human mistakes. Toxic emission control methods become inadequate and delayed responses occur because of the lack of continuous monitoring technologies.

IoT technology advancement enables automated live carbon emission tracking which has become more accurate and expandable. IoT sensor networks working together with cloud computing and edge processing and machine learning algorithms continuously measure and analyze and generate carbon emission reports (Xu et al., 2023a) with minimal human interaction. Real-time data collection remains feasible through this integration process Shahnavaz & Akhavian (2022) because it enhances analytical predictions which enables proactive management decisions regarding emissions.

Bi-directional IoT and AI collaboration creates stronger systems for detecting anomalies while additionally providing automated alerts about regulatory violations.

A research study is initiated to build an IoT system that keeps track of carbon emissions operating in smart construction sites and industrial facilities. A measurement system is proposed to evaluate core operational indicators which analyze sensor accuracy together with response speed with data transfer efficiency and energy use alongside cost performance measurements. A review of IoT monitoring systems was conducted versus traditional practices to demonstrate how automated real-time carbon footprint tracking operates despite its challenges.