

AI-Powered Occupancy Detection in Smart Buildings Using IoT Environmental Sensors and LightGBM

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Abstract

This research investigates environmental IoT sensor data for real-time occupancy detection in smart buildings. We evaluated three machine learning models using the UCI occupancy detection dataset: random forest, SVM, and LightGBM on temperature, humidity, CO₂ and light intensity features. LightGBM achieved 99% accuracy with robust performance even in low-light scenarios where conventional sensors typically fail. Our findings demonstrate that CO₂ and humidity are effective proxies for metabolic activity, enabling the detection of passive occupancy such as sleeping in darkness. These results highlight the potential of lightweight, sensor-driven AI models for energy-efficient building automation and space optimisation, particularly in commercial environments.

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