

Sensor and Actuator Networks in Occupational Ergonomics: Status, Challenges, and Opportunities for Developing Economies

Adinife Patrick Azodo ¹

¹Department of Mechanical Engineering, Federal University of Agriculture, P. M. B. 2240, Abeokuta, Ogun state

Email: azodopat@gmail.com

Abstract

Wearable sensors and Wireless Sensor Networks (WSN) are advancing occupational ergonomics by enabling continuous monitoring of worker health, environmental conditions, and performance indicators. The integration of Internet of Things (IoT) technologies into industrial environments supports real-time data fusion between physiological signals and environmental parameters such as temperature, vibration, and workload intensity to form closed-loop ergonomic systems. However, high dependence on manual labor, limited monitoring infrastructure, and elevated injury risks remain critical challenges in developing economies. This paper presents a thematic review of sensor–actuator networks in occupational ergonomics, focusing on implementation barriers and emerging opportunities in resource–constrained settings. Drawing on documented applications, the review identifies a central gap: existing studies emphasize passive sensing and data acquisition, with limited integration of actuator-based systems that translate environmental and physiological data into real-time corrective or assistive interventions. This limits the development of responsive systems capable of triggering feedback actions such as haptic alerts, adaptive workload redistribution, and environmental adjustments. Integrating low-cost sensor–actuator networks with edge computing and artificial intelligence is therefore discussed as a pathway toward scalable solutions, where local processing enables real-time physical actuation in low-connectivity environments. The paper concludes by outlining future research directions to improve system reliability, affordability, and deployment of responsive sensor–actuator frameworks, contributing a structured perspective for advancing closed-loop ergonomic systems in resource-constrained environments.

Keywords: Wireless sensor networks; Wearable sensors; Occupational ergonomics; Actuator systems; Edge computing