4th World Conference on Mechanical Engineering

Berlin, Germany 13 -15 March 2025

AirSTAQE: Design of a Sensor-triggered Sequestration Engine for Environmental Air Purification

Benjamin O. Ezurike[1*], Stephen A. Ajah[2], Udora N. Nwawelu[3]

[1,2] Department of Mechatronics Engineering, Alex Ekwueme Federal University, Ndufu-Alike.
[3]Department of Electronic Engineering, University of Nigeria, Nsukka.

Abstract

This paper presents a novel sensor-based air quality purifier, "Airborne Sensor-based Total Air Quality Enhancement" (AirSTAQE), designed to address carbon monoxide (CO) pollution in urban environments. Conventional air quality monitoring systems often struggle to integrate realtime monitoring and effective purification for CO, a toxic gas primarily emitted from vehicles that poses acute health risks. The proposed AirSTAQE system combines advanced CO detection using artificial sequestration with efficient air purification techniques. Additionally, it integrates alternative energy sources to extend operational longevity. The system utilizes a state-of-the-art gas sensor (MQ-7) along with temperature and humidity sensors to comprehensively measure CO levels, environmental temperature, and humidity. Notably, AirSTAQE demonstrates swift responsiveness by triggering purification when CO concentrations exceed hazardous levels (≥4.00 ppm), ensuring low latency and proactive mitigation at the edge layer. Experimental validation underscores the system's effectiveness, achieving an impressive 97.5% efficiency in removing CO. It reduces trapped CO from an initial inflow concentration of 4.00 ppm to an outflow concentration of 0.1 ppm post-purification. This study signifies a substantial advancement in air quality enhancement, offering a comprehensive solution to the pressing issue of CO pollution in urban areas. By synergizing cutting-edge sensor technologies, innovative CO detection mechanisms, and efficient purification processes, AirSTAQE sets a new standard for combating air pollution and safeguarding public health.

Keywords: Air Quality; Carbon Monoxide; Edge computing; IoT-Sensor Node; Monitoring