Environmental Engineering and Management Journal

July 2024, Vol. 23, No. 7, 1391-1400
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu
http://doi.org/10.30638/eemj.2024.113

"Gheorghe Asachi" Technical University of Iasi, Romania

IMPLEMENTATION OF A WIRELESS SENSOR NETWORK FOR MONITORING AIR POLLUTANTS IN URBAN AND INDUSTRIAL AREAS

Mukhamad Nurkamid[1*], Firman Adi Nur Fatin[1], Anteng Widodo[2], Catur Edi Widodo[3], Jatmiko Endro Suseno[3], Budi Gunawan[4]

[1]Department of Informatics Engineering, Faculty of Engineering, Universitas Muria Kudus
[2]Department of Information System, Faculty of Engineering, Universitas Muria Kudus
[3]Department of Physics, Faculty of Science and Mathematics, Universitas Diponegoro
[4]Department of Electrical Engineering, Faculty of Engineering, Universitas Muria Kudus

Abstract

The study detailed in this paper focuses on the development and implementation of an air pollutant monitoring system using the Arduino Uno microcontroller and a wireless sensor network (WSN) to measure key pollutants, such as CO, CO_2, NH_3 (ammonia), PM2.5 (particulate matter), and NO_2, in both urban and industrial environments. The system's primary objective was to monitor air quality in real-time and analyze its potential effects on human health and the environment. The monitoring system, which uses portable and low-cost sensors, was deployed in multiple locations, with sensor nodes continuously collecting pollutant data and transmitting it wirelessly to a central database. The research methodology involved hardware and software design, implementation, system testing, and data analysis, with data being processed using Python and Jupyter Notebook.
The results demonstrated significant differences in pollutant levels between the industrial and urban areas. In industrial regions, NH3 levels were notably high due to inadequate waste management, while CO levels showed a concerning upward trend over time. In urban areas, the high density of motorized vehicles contributed to elevated levels of CO, CO_2, NH_3, NO_2, and PM2.5. These findings were supported by statistical analyses, including Pearson correlation, which revealed significant positive correlations between specific pollutants, such as between CO and CO_2, and between PM2.5 and NH_3.
This study highlights the potential of WSN and IoT-based technologies for real-time environmental monitoring, offering a practical and scalable solution to address growing concerns over air pollution in both industrial and urban settings. The data generated by the system provides valuable insights into air pollution dynamics and can support the development of targeted strategies for mitigating the negative impacts of air pollution on public health and the environment.

Key words: air pollutant, CO, CO_2, NO_2, $PM_{2.5}$, wireless sensor network

Received: January, 2023; Revised final: January, 2024; Accepted: March, 2024; Published in final edited form: July, 2024

[*] Author to whom all correspondence should be addressed: e-mail: muhammad.nurkamid@umk.ac.id