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Zigbee-based wireless smart device for enclosed space real-time air quality monitoring: Experiment, data analysis and risk assessment

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This project deals with the development of a smart real-time indoor (offices and family homes) air quality monitoring device based on Internet of Things (IoT). Environmental data from the sensor nodes are sent over the ZigBee wireless communication protocol, and after collection are subjected to careful statistical analysis for exposure risk assessment. The free XCTU platform application in interaction with the XBee modules is used to visualize real-time temporal evolution of the measured data. This portable device is composed of a microcontroller board, XBee wireless transmission modules, and some low-cost air pollutant sensors including particulate matter (PM2.5) and toxic gas (ground-level ozone O3, carbon monoxide CO, sulfur dioxide SO2, nitrogen dioxide NO2) sensors. Particular attention is paid to indoor air quality in this chapter due to the long-term occupation of confined spaces by people. The results of measurements taken from September 21 to October 22, 2020, in two different confined spaces (home and office), in the city of Yaoundé-Cameroon, gave maximum exposure rates of 13.06 µg/m3 (home) and 10.71 µg/m3 (office) for PM2.5 ; 18.65 ppm (office) and 17.72 ppm (home) for SO2; 4.97 ppm (office) and 7.49 ppm (home) for NO2; 2.42 ppm (office) and 1.30 ppm (home) for O3 and, 18.03 ppm (office) and 13.66 ppm (home) for CO. Thus, both office and home spaces gave an internal Air Quality Index (AQI) lower than 50 and an Air Quality Health Index (AQHI), less than 1. The values are low, very varied but still acceptable compared to the WHO standard values. This is due to the diversity of potential sources of pollution which are the number of inhabitants of the confined space, the gas emissions of the installed devices and the intake of outside air. From the results obtained, it emerges that in addition to its low-cost and its flexibility, the proposed device exhibits interesting performance in terms of reliability and global functionality. Keywords. Indoor Air quality; Microcontroller; Low-cost sensors; ZigBee protocol; Exposure risk assessment.

Abstract Category

Computing & 4IR

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