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WoS, Google Scholar et Lens

Tran, Q. A., Dang, Q. H., Le, T., Nguyen, H. T., Le, T. D.
Air Quality Monitoring and Forecasting System using IoT and Machine Learning Techniques.
6th International Conference on Green Technology and Sustainable Development (GTSD) 2022

Monitoring air pollution is of increasing concern today. People are suffering from health problems as a result of prolonged exposure to polluted environments. This project aims to develop an air quality monitoring system using machine learning with Internet of Things (IoT), an Internet server network of physical nodes. This system consists of three sections: an air pollution detection model developed in python and built using machine learning algorithms, random forest and support vector machine, a low-cost air monitoring device comprising of a hardware unit that detects different pollutants like CO, NOx, PM2.5, and an IoT Cloud, ThingSpeak, acting as a middleman for the captured data between the hardware component and the algorithm for air pollution classification. The final output displays the predicted air quality index (AQI) and provides a comparison between the two algorithms used, random forest and support vector machine, in terms of accuracy and various other statistical data. The accuracy depicted by random forest exceeds 95% and that of support vector machine is 85%.

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Gunatilaka, D., Sanbundit, P., Puengchim, S., Boontham, C.
AiRadar: A Sensing Platform for Indoor Air Quality Monitoring.
2022 19th International Joint Conference on Computer Science and Software Engineering (JCSSE)

Rapid urbanization and the expansion of industrial societies have increased air pollution, which deteriorates the health of a population and impacts global warming and climate change. Indoor air quality (IAQ) has been a topic of growing concern since people spend most of their time indoors. This drives the need for a system that can continuously monitor indoor air pollutants and consequently control indoor air quality. Therefore, this paper aims to develop an IoT-enabled system capable of measuring, aggregating, and visualizing indoor air quality. Our IAQ sensing platform collects several common air quality factors consisting of particulate matter (PM2.5 and PM10), Carbon Monoxide (CO), Volatile Organic Compound (VOC), humidity, and temperature. We implement a web application to enable access to real-time air quality data, to promptly notify users of the unhealthy environment, and to provide recommendations for air quality improvement. Additionally, we calibrate the sensors to enhance their accuracy and conduct an indoor test for system performance assessment.

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Vaheed, S., Nayak, P., Rajput, P. S., Snehit, T. U., Kiran, Y. S., Kumar, L.
Building IoT-Assisted Indoor Air Quality Pollution Monitoring System.
In: 2022 7th International Conference on Communication and Electronics Systems (ICCES).

Air pollution causes several diseases like suffocation, chronic obstructive pulmonary disease (COPD), lung cancer, throat infection, and so forth. So, there is a need to monitor indoor air quality for the safety of human life. Indoor air pollution is even more dangerous than outdoor air pollution. Even, after the COVID-19 pandemic, humans are spending most of their time in indoor houses. In addition to this, air pollution is increasing day by day due to varying climate changes. In view of this fact, this research wor has designed and developed a novel system based on the latest IoT technology that monitors indoor air quality and provides a web portal for data visualization. The proposed system consists of several gas sensors integrated on a single PCB that helps in reading seven pollutants like CO2, CO, O3, NO2, VOC, and Particulate Matter along with humidity and temperature. In our work, Raspberry Pi acts as a processor as well as the communicating node to the cloud. The experimental setup is deployed in several indoor places like closed labs, classrooms, homes, etc., where humans spend more time. Raspberry Pi is having an inbuilt wi-fi functionality and the real-time data is sent to Google Firebase with help of a Jio Fi router. After visualizing the data, Indoor Air Quality Index (IAQI) is measured and generates an alarm for the safety of humans when air standard crosses a marginal value.

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Walker, I., Less, B., Lorenzetti, D., Sohn, M., Casquero-Modrego, N.

Compartmentalization and Ventilation System Impacts on Air and Contaminant Transport for a Multifamily Building.
Building Technologies & Urban Systems Division. Energy Technologies Area. Lawrence Berkeley National Laboratory 2022

The proper provision of fresh air ventilation and avoidance of cross-contamination in multi-family apartment dwellings has never been more critical than during the global COVID-19 pandemic. The airtightness of interior partitions and the design ofventilation systems in multifamily buildings determines the flows across the exterior envelope and interior partitions. These flows change the total ventilation rate for the building and individual units, and also impact the mixing of air and contaminants between apartment units or with common spaces. These flow patterns can have important implications for HVAC energy use, indoor air quality (IAQ) and occupant health and comfort. This study examined the changes in air flow and contaminant transport in multifamily buildings using a combined CONTAM/EnergyPlus modeling approach. Key parameters were systematically varied, including weather, apartment airtightness, and type of mechanical ventilation system. Simulations were performed for a four-story, mid-rise building with an enclosed common corridor. Each case was simulated for a full year with three-minute time-steps that allowed for scheduling of occupancy-related contaminant releases and operation of ventilation systems. Contaminants simulated in the analysis were PM2.5, formaldehyde and water vapor, together with CO2 as an indicator of bioeffluents and other human-activity-related pollutants. The results of this work are intended to assist codes and standards bodies (e.g., ASHRAE 62.2) in setting appropriate air tightness limits and ventilation system design guidelines for multifamily buildings.

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Han, Y., Xu, Y., Shi, S. Q., Li, J., Fang, Z.
Cuttlebone-inspired magnesium oxychloride cement reinforced by biochar as green adhesive for wood industry.
Journal of Cleaner Production, Vol. **370**, (2022)

Design of eco-friendly, non-formaldehyde and flame retardant wood adhesives is in high demand for the wood industry, which can help to alleviate environmental stress and human health concerns. Magnesium oxychloride cement (MOC) can reduce CO2 emission and increase the value-added utilization of potash industry wastes, making it an ideal alternative to hazardous formaldehyde-based adhesives. However, its practical application usually suffers from poor water resistance and the filtering effect of wood. Inspired by the porous structure of cuttlebone, a facile yet powerful strategy is presented to prepare MOC adhesive with outstanding water resistance, compressive strength and adhesive ability to wood through introducing biochar. The naturally porous structure of biochar can form a protective core-shell structure and encapsulation with hydration products to stabilize phase 5 (5Mg(OH)2·MgCl2·8H2O), avoid crack extension and mitigate the filtering effect of wood. Meanwhile, the abundant functional groups of biochar can construct multiple interactions with Mg2+, which contributes to forming an internal network with excellent cohesion strength. Compared with pristine MOC, the obtained MOC/Biochar exhibited 102.33%, 32.33% and 31.45% increases in water resistance, compressive strength and wet adhesion strength, respectively. This work provides a promising strategy in preparing eco-friendly MOC-based adhesive from agricultural and industrial by-products to reduce environmental hazards.

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Sakkas, A.
Exploring the indoor air quality requirements according to (inter-) national standards.
Institut für Architekturwissenschaften, Wien. Thèse 2022

Since people spend a large part of their lives in indoor environments like homes, offices, schools, public or private buildings and facilities, there has been a growing interest in the correlation between occupant health and building design. In recent times, several standards and guidelines –regarding architectural design- have been developed in order to facilitate a better indoor environmental quality.Indoor Environmental Quality (IEQ) could be briefly described as an indicator, which includes the elements of indoor thermal comfort, indoor acoustic comfort, Indoor Air Quality (IAQ) and visual comfort (Mahdavi et al. 2020). Strategies for addressing (IEQ) include those that protect human health, improve quality of life, and reduce stress and potential injuries. Better indoor environmental quality can enhance the lives of building occupants, increase the resale value of the building, and reduce liability for building owners (GBC 2022).Parallel with nationally and/or internationally established (IEQ) standards, there is a noticeable increase of several rating/certification systems for indoor environmental quality. This Master Thesis will focus on indoor air quality (IAQ)

requirements and standards, by reviewing the national/international standards and guidelines literature. The thesis aims to analyze the methods proposed from guidelines and standards to achieve sufficient indoor air quality (IAQ).

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Anastasiou, E., Vilcassim, M. J. R., Adragna, J., Gill, E., Tovar, A., Thorpe, L. E., *et al.*
Feasibility of low-cost particle sensor types in long-term indoor air pollution health studies after repeated calibration, 2019–2021.
Scientific Reports, Vol. **12** n°(1), (2022)

Previous studies have explored using calibrated low-cost particulate matter (PM) sensors, but important research gaps remain regarding long-term performance and reliability. Evaluate longitudinal performance of low-cost particle sensors by measuring sensor performance changes over 2 years of use. 51 low-cost particle sensors (Airbeam 1 N = 29; Airbeam 2 N = 22) were calibrated four times over a 2-year timeframe between 2019 and 2021. Cigarette smoke-specific calibration curves for Airbeam 1 and 2 PM sensors were created by directly comparing simultaneous 1-min readings of a Thermo Scientific Personal DataRAM PDR-1500 unit with a 2.5 µm inlet. Inter-sensor variability in calibration coefficient was high, particularly in Airbeam 1 sensors at study initiation. Calibration coefficients for both sensor types trended downwards over time to < 1 at final calibration timepoint [Airbeam 1 Mean (SD) = 0.87 (0.20); Airbeam 2 Mean (SD) = 0.96 (0.27)]. We lost more Airbeam 1 sensors (N = 27 out of 56, failure rate 48.2%) than Airbeam 2 (N = 2 out of 24, failure rate 8.3%) due to electronics, battery, or data output issues. Evidence suggests degradation over time might depend more on particle sensor type, rather than individual usage. Repeated calibrations of low-cost particle sensors may increase confidence in reported PM levels in longitudinal indoor air pollution studies.

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Zhang, Y., Hopke, P. K., Mandin, C.
History and Perspective on Indoor Air Quality Research.
In: Handbook of Indoor Air Quality. Springer Nature Singapore; 2021.

Modern indoor air science started in the 1970s. The reasons for separating the modern and old eras are: (1) building energy conservation became important due to the oil embargo in the Middle East in 1973 that had a great impact on building design and operation and in turn indoor air quality; (2) ambient air pollution became a topic of concern in many developed countries; (3) “modern diseases” were found to be associated with “modern exposure” during this period; (4) many new computational and measurement technologies such as computational fluid dynamics (CFD) and gas chromatography-mass spectrometry (GC-MS), respectively, occurred with the development of computer and the related technologies; and (5) a series of international societies and conferences related to indoor air science with worldwide impact were launched and recognized beginning in the 1970s. Modern indoor air science has been driven by two forces. One driver is the demands to fix important indoor air problems arising from a broad variety of pollutants: radon, asbestos, environmental tobacco smoke, particles (PM10, PM2.5, ultrafine particles), formaldehyde, volatile organic compounds, semi-volatile organic compounds, house dust mites, mold, bacteria, and associated health effects, e.g., sick building syndrome symptoms, asthma and allergies, Legionnaires’ disease, lung cancer, and airborne infections such as SARS and nowadays COVID-2019. The second driver is the new technologies such as CFD, big data analysis, advanced chemical analytical capability, sensing, control, and human biomarker analysis, which have contributed greatly to modern indoor air science. By understanding the influences of these two drivers on the development of indoor air science over the past decades, we can also perceive its future. In this first chapter, we summarize the history of indoor air science and outline some major challenges for the coming years.

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Othman, M. H., Azeez, M., Al-Gizzi, A.
Investigation of Air Quality in Medical Centers in Different Places in Basra Province, South of Iraq.
International Journal of Science and Management Studies (IJSMS) Vol.**5**, n° (4), (2022), pp. 225-230

To prevent nosocomial infection in patients, maintaining acceptable indoor air quality (IAQ) in medical centers (MCs) is crucial. The properties of IAQ in several medical centers were investigated in this study. The aim of this was to focus on some indoor air pollutants in different medical clinics. Models of air samples were measured inside several medical clinics in Basra province. The results of TVOC, CH2O, and PM2.5 were distributed between exceeding the standard limits and others within the standard. The results in the urban (center of Basra city) were within the legal limits for TVOC and

CH2O, but the rural areas were above the legal limits in those areas. PM2.5 were above legal limits but urban sites had the highest. Healthcare workers and patients are exposed to a variety of chemicals that vary with the activities and products used. The presence and exposure of VOCs, CH2O, and PM2.5 may lead to health effects on the patient people. Variation between rural and urban sites in pollutants concentration was clear.

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Wang, H., Xiong, J., Wei, W.
Measurement methods and impact factors for the key parameters of VOC/SVOC emissions from materials in indoor and vehicular environments: A review.
Environment International, Vol. **168**, (2022)

The emissions of volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) from indoor building and vehicle cabin materials can adversely affect human health. Many mechanistic models to predict the VOC/SVOC emission characteristics have been proposed. Nowadays, the main obstacle to accurate model prediction is the availability and reliability of the physical parameters used in the model, such as the initial emittable concentration, the diffusion coefficient, the partition coefficient, and the gas-phase SVOC concentration adjacent to the material surface. The purpose of this work is to review the existing methods for measuring the key parameters of VOCs/SVOCs from materials in both indoor and vehicular environments. The pros and cons of these methods are analyzed, and the available datasets found in the literature are summarized. Some methods can determine one single key parameter, while other methods can determine two or three key parameters simultaneously. The impacts of multiple factors (temperature, relative humidity, loading ratio, and air change rate) on VOC/SVOC emission behaviors are discussed. The existing measurement methods span very large spatial and time scales: the spatial scale varies from micro to macro dimensions; and the time scale in chamber tests varies from several hours to one month for VOCs, and may even span years for SVOCs. Based on the key parameters, a pre-assessment approach for indoor and vehicular air quality is introduced in this review. The approach uses the key parameters for different material combinations to pre-assess the VOC/SVOC concentrations or human exposure levels during the design stage of buildings or vehicles, which can assist designers to select appropriate materials and achieve effective source control.

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He, Z., Ruan, X.
Research on Indoor Air Monitoring System Based on STM32.
Academic Journal of Engineering and Technology Science, Vol. **5** n°(7), (2022), pp. 46-52

Adults spend 80% of their time indoors every day, so the quality of indoor air is closely related to people's health and quality of life.In this project, an indoor environment monitoring system is designed for indoor air quality. Data interaction between the system and the indoor air monitoring system is carried out by means of wireless transmission, so as to monitor indoor PM2.5 concentration, temperature and humidity in real time through mobile phones.Realization function: For the collection of various parameters of the home environment, the collected environmental parameters will be transmitted to the main control device through the RS-485 circuit, using the RS-485 circuit to transmit data, can collect data for different positions of the indoor, aiming at faster and more accurate detection of indoor air condition.

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Lv, M., Liang, W., Yang, X., Zhang, J. J.
Simulations for Indoor Air Quality Control Planning.
In: Handbook of Indoor Air Quality. Springer Nature Singapore; 2021.

Indoor air pollution has become a broad problem due to various indoor or outdoor pollutant sources and limited ventilation. A performance-based approach, which is built upon accurate modeling and simulation of indoor air pollutant characteristics, has obvious advantages over the prescription-based method to achieve a better indoor environment. Moreover, the simulation could play a key role in actively preventing indoor air pollution from happening in the first place. In this Chapter, we introduce the working procedures of the performance-based approach including identification of purpose, model assumptions, governing equations, determination of model inputs, specification of model outputs, simulation case design, simulation running, and analysis of simulation results for indoor air quality (IAQ) design. Single-zone, multi-zone, and detailed computational fluid dynamics (CFD) models are discussed along with a brief review of example software tools available for implementing the simulation models. Discussions are focused on

modeling volatile organic compound (VOC) sources, sinks, ventilation, and their impact on the concentrations indoors. As for the public concerned SARS and SARS-CoV-2 virus, a brief discussion is provided based on the real cases.

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Zhang, J. J., Chen, W., Liu, N., Guo, B. B., Zhang, Y.
Testing and Reducing VOC Emissions from Building Materials and Furniture.
In: Handbook of Indoor Air Quality. Springer Nature Singapore; 2021.

Labeling and certification for low-emission building materials and furniture is an effective source control strategy for reducing indoor air pollution. The labeling and certification programs rely on the results from standardized environmental chamber tests to measure the emission rates of volatile organic compounds (VOCs) and assess their impact on indoor air quality (IAQ). In this chapter, we first introduce the fundamental principles, methods, and procedures of environmental chamber testing of VOC emissions and then discuss how the chamber test results are applied in various labeling and certification programs including the process, criteria, and the corresponding standard environmental chamber testing methods. Examples are drawn from widely used material emission testing and labeling programs. Sufficient details on the emission test methods and procedures are provided for readers to develop practical applications as well as a comprehensive understanding and appreciation of the principles and processes of material emission testing and labeling. For detailed implementation, readers are referred to product-specific testing methods and labeling programs that match their interests and needs.

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Dr. Shaweez Fathima S, D. B. a. D. P. S. D. M. R.
To Evaluate the Efficacy of Disinfection Methods for Operation Theatres at a Tertiary Care Hospital.
European Journal of Molecular & Clinical Medicine, Vol. **9** n°(4), (2022), pp. 1043-1051

Introduction Disinfectants play a vital role in global infection control as a crucial weapon against the transmission of nosocomial pathogens/infections combating global disease outbreak. Because of the multifactor causation of infections, the environment of operation theatre plays a great role in the onset and spread of infections Materials And Methods This is an analytical study conducted at a Teaching hospital, Sri Lalithambigai Medical College and Hospital, from July 2021-May 2022, with a 600- sample size collected before and after applying successive techniques of different disinfecting agents in operation theatres. Results In our study, the OT1 colony forming unit was higher than OT 2 CFU (Table 1 and 2) which may be due to human activity that significantly increases the bacterial count and reaches the peak at the end of the day in both the OTs Conclusion Newer less toxic disinfecting agents are alternative to formalin and may be used at short intervals for better outcome. The expenditure involved in use of these environment friendly disinfecting agents are worth the money spent, in comparison to formaldehyde considering the long-term harmful impact that can have on surgical personnel.

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