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Indoor Air Quality Monitoring and Purification System

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A B S T R A C T

The primary goal of this system is to analyze the parts per million (PPM) value in enclosed spaces and improve air quality through effective purification methods. According to the World Health Organization (WHO), household air pollution resulted in approximately 3.2 million deaths in 2020, including over 237,000 deaths among children under the age of 5. Despite the known health risks, air quality monitoring systems are not being effectively implemented due to their high initial costs and ongoing maintenance expenses.

Keywords: Air pollution, Air Quality Monitoring, Air Quality, Purification, MQ135, NodeMCU, Thingspeak, AQI.

1. Introduction

Air pollution is a significant global issue, accounting for 11.65% of total deaths and being a leading risk factor for diseases. Nearly all of the world's population (99%) is exposed to air pollution levels that increase the risk of conditions such as heart disease and strokes. Raising awareness about air pollution and its effects on health can create a need for efficient air purification systems in workplaces and homes. Research has shown that air pollution contributes to premature deaths and respiratory and heart issues. By implementing effective air purification systems, the impact of harmful particles, such as dust and pollutants, can be significantly reduced, creating a clean and breathable indoor environment.

2. Literature Survey

2.1 Smart air purifier suitable for small public spaces

Excessive pollution in the natural environment, including air, can have detrimental effects on living organisms, particularly for those residing in large urban areas. Both outdoor and indoor spaces are susceptible to such pollution. Existing ventilation systems in buildings often lack effective monitoring and purification mechanisms for incoming air. The aim is to address this issue by providing building occupants access to clean air that is free from mechanical and chemical pollutants, in accordance with World Health Organization (WHO) recommendations. This initiative seeks to improve indoor air quality, enhance living standards, and reduce the adverse effects of pollution, ultimately contributing to the creation of a healthy and breathable environment..

2.2 Monitoring of Urban Ambient Air Quality at Location of Preschool and School Facilities in Serbia

The adverse effects of exposing children to environmental pollutants during crucial periods of physiological development can have lasting impacts on their health, functioning, and disease risk. This paper aims to shed light on the limited practice of ambient air quality (AQ) monitoring near preschools and schools in Serbia, as part of the local AQ monitoring network. Conducted as a cross-sectional study from 2015 to 2020, measurements were taken in front of kindergartens, primary and secondary schools in urban areas, including SO2, NO2, soot, and PM10. The results were obtained from the continuous public health program conducted by the Institute of Public Health of Serbia, indicating that only PM10 and B(a)P values at some locations exceeded annual limit values in front of selected facilities in 2020. Overall, both the total number of urban AQ measuring points monitored by the local Institutes of Public Health network and those in front of educational facilities increased during the study period.

2.3 IoT based Air Quality Monitoring and Controlling System using Raspberry Pi

With the exponential growth of population and industrialization, pollution has significantly increased, resulting in detrimental effects on individual health and the overall population. To address this issue, an Internet of Things (IoT) based Air Pollution Monitoring System is proposed, which monitors pollution levels and air quality through a web server using the internet. Sensors can be deployed at various locations to collect data, which can then be uploaded to the Google cloud, enabling monitoring from anywhere in the world. This system aims to prevent health hazards caused by harmful gases such as CO2, smoke, and carbon monoxide exceeding safe limits. Real-time air quality data can be displayed on an LCD and a webpage, making environmental

monitoring accessible and easy. This project proposes an air quality monitoring and controlling system that utilizes IoT technology to monitor and check air temperature, humidity, and pollution levels in specific regions, with the goal of improving overall air quality.

2.4 Indoor Air Quality Monitoring and IoT Platform for Smart Building Management

Indoor air quality is a critical global issue that is being addressed by public health experts, environmental entities, and industry professionals in order to improve the health, comfort, and well-being of building occupants. In line with smart city initiatives, real-time monitoring systems are being promoted to identify unfavorable indoor air quality scenarios for creating healthier living environments. This paper introduces and discusses an Internet of Things (IoT)-based indoor air quality monitoring system for smart building management. The focus of this paper is on the design aspects of the platform, including sensor types, microcontroller selection, overall architecture, and connectivity. Additionally, preliminary results are presented based on a minimal implementation to showcase the feasibility and reliability of the proposed platform.

2.5 Use Case of Building an Indoor Air Quality Monitoring System

On average, we spend approximately 90% of our time indoors, making indoor air quality (IAQ) a critical concern. IAQ has gained increased attention from environmental organizations, local authorities, and citizens due to its significant impact on public health. As a result, monitoring indoor environments has become crucial to improve IAQ and involve citizens in managing their indoor spaces, aligning with the goals of many Citizen Science (CS) projects. In this study, a use case of IAQ monitoring in a European project with a focus on Smart Cities and citizen engagement is presented. However, the high cost of traditional stationary air quality (AQ) monitoring stations poses challenges for CS projects as it inhibits scalability and citizen involvement. IAQ monitoring has become a growing concern due to its direct implications on human health and daily life. Despite this, interactive and informative IAQ monitoring that can engage citizens is not yet widespread, largely due to the cost-prohibitive nature of monitoring devices and concerns about data quality from low-cost devices. This limitation hinders the efforts of CS projects to scale indoor air quality monitoring and bring momentum to this important area of study.

2.6 A Review on IAQ Using IOT at Campus Environment

Environmental pollution, particularly air pollution, is a pervasive concern that is not limited to outdoor areas. Indoor spaces can also harbor harmful substances, and poorly constructed houses and buildings without proper standards are often associated with higher exposure to indoor pollutants, leading to negative health effects. Many substances can cause health problems and serve as parameters for assessing Indoor Air Quality (IAQ) according to guidelines established by the World Health Organization (WHO) for indoor information sources and exposure levels. Monitoring indoor air pollution can be achieved through a system that provides information on the level of air quality. The integration of the Internet of Things (IoT) allows for the collection of data parameters related to IAQ from the environment, which is crucial for analysis and monitoring. This paper conducts a systematic literature review to investigate the role of IoT in IAQ monitoring in light of its growing importance.

2.7 Building an Indoor Air Quality Monitoring System based on the architecture of Internet of Things

In order to ensure that indoor air quality remains safe and within acceptable levels, this study conducted an evaluation of indoor air pollutants and selected an appropriate Air Quality Index (AQI) evaluation method based on fine particulate matters, CO, and CO2 levels in the AQI. Comparison was made with the CO2 evaluation standard proposed by ASHRAE, as well as the CO and fine particulate matters standards proposed by AQI. Simulation results revealed a non-linear relationship between fine particulate matters, CO, and AQI values. When any of the indices exceeded the safe limit, the maximum value among all the indices was set as the current AQI, resulting in an unsatisfactory indoor air quality rating. Based on the ASHRAE CO2 index, the recommended AQI level should be less than 50, and the CO2 index should be less than 450 ppm for achieving the best indoor air quality. The experimental results of the indoor environment data were analyzed, and load control was implemented using fuzzy logic rules. The goal of this study was to improve the quality of living in residential spaces and maintain good indoor air quality, thus reducing the risk of asthma and respiratory issues, especially in children and individuals with allergies, as well as enhancing office efficiency and reducing the chances of sleep disruptions caused by high CO2 concentrations.

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