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REVIEW ON INDOOR AIR QUALITY MONITORING SYSTEM

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Abstract

Smart cities follow different strategies to face public health challenges associated with socio-economic objectives. In smart cities, buildings play a key role and are closely linked to the wellbeing of people. In addition, they are equally important in order to achieve sustainability goals. Indoors, people spend much of their time. Indoor air quality, therefore, has a vital influence on health and well-being. With the rising elderly population, the promotion of occupational health and well-being needs environment-assisted living systems. In order to detect unfavorable indoor quality scenarios in useful time, living environments must also integrate monitoring systems. This paper reviews the current state of the art on indoor air quality monitoring systems based on Internet of Things and wireless sensor networks in the last five years (2014–2019). This document focuses on the architecture, microcontrollers, connectivity, and sensors used by these systems.

Keywords: *Environment issues, Air, Health, IoT, Monitoring, Quality, Contaminants, Wellbeing.*

I. INTRODUCTION

The concept of Internet of Things can be better defined as the ubiquitous presence of cyber-physical systems with advanced communication and sensing capabilities. Ambient-Assisted Living is recognized as a multidisciplinary area that helps individuals, particularly older adults, improve the overall quality of life. This field is closely linked to the ecosystem of new-age technology that, with ubiquitous computing, facilitates personal healthcare monitoring. Another important word that is often correlated with the Ambient-Assisted Living zone is Enhanced Living Environments. Information and Communications Technology endorse the proposal. In general, Enhanced Living Environments involve all the accomplishments focused on information and communication technology to enhance the Ambient-Assisted Living area [1]. Enhanced Living Environments concentrate on various

solutions driven by information and communication technology built with unique algorithms, frameworks, and platforms. These creative applications and flexible facilities guarantee an independent, secure and independent way of life.

In addition, Enhanced Living Environments make use of advances in the Internet of Things area to offer solutions focused on information and communication technology for better health and overall well-being. There are two principal components of a healthcare system: hardware and software. They work together to provide people with various healthcare applications and programmers to encourage general health and well-being in an omnipresent way [2]. Two important innovations leading to the advancement of advanced health systems are Improved Living Environments and Ambient-Assisted Living. Ambient-Assisted Living has tremendous potential to tackle many health issues when driven by Information and Communications technologies. Enhanced Living Environments, on the other hand, make use of medical sensors, wireless networking systems, microcontrollers, and platforms for open source applications. For healthcare systems based on Improved Living Conditions, Ambient Assisted Living technology promises environmental intelligence. It allows for 24/7 tracking and better environmental control. Without moving them to institutionalized settings, these advanced healthcare programmers offer direct or indirect assistance to preserve patient wellbeing in home environments.

In addition, these systems guarantee patients autonomous movements while promoting quality treatments. In order to track human health, physiological status, and different environmental parameters, the new-age healthcare systems integrate advanced technologies. With wireless networking systems such as Wi-Fi, Ethernet, Bluetooth, 3G, and ZigBee, real-time notifications are possible for such measurements. One of the main environmental health risks is Indoor Air Quality (IAQ). Therefore, it is necessary to conduct IAQ monitoring in all buildings to maintain the required level of comfort. Since humans spend more than 90% of their time inside buildings, tracking IAQ on a real-time basis for better living conditions and improved occupational health is crucial. Measurement and evaluation of IAQ helps in reliable decision-making on potential strategies so that individual efficiency can be increase.

The smart city must be addressed considering its major role in the design of Enhanced Living Environments to support and promote citizens' health. When creating policies and interventions in cities, a sustainable approach must be taken, and it is very closely linked to the design of construction. In addition, smart cities must take into account the indoor efficiency of their buildings. Outdoor conditions affect IAQ, but buildings play a crucial role in serving as a barrier for people. Therefore, for indoor quality control, it is important to develop efficient and cost-effective architectures. The operability of various systems is, however, a key challenge for smart cities. The criteria regarding the interoperability of heterogeneous architectures can be fulfilled by the Internet of Things [3]. In addition, the protection and privacy of individuals must be ensured, since these systems are capable of handling sensible data associated with the everyday lives of people. This paper discusses the current state of the art in the last five years (2014-2019) about IAQ monitoring systems based

on the Internet of Things and wireless sensor networks (WSN). The main objective is to present the architecture, microcontrollers, networking, and sensors used by these examined studies in a systematic literature review. The main contribution is to synthesize the current body of information and to find common threads and holes that open up new relevant and complicated future directions for study. This paper provides a comprehensive analysis of existing IAQ monitoring systems and highlights the materials and methods used and intends to summarize the primary outcomes and limitations in the analyzed studies.

II. INDOOR AIR QUALITY AND ENHANCED LIVING ENVIRONMENTS

People usually spend most of their time inside residential or commercial buildings. Therefore, real-time monitoring of indoor environmental quality (IEQ) for enhanced occupational health and overall well-being is essential. The assessment of IEQ is typically based on specific parameters, such as light, sound, thermal comfort, and air quality conditions. A composition of IAQ, thermal comfort, acoustics, and lighting is presented in the IEQ in buildings. Poor IEQ is generally understood to have a negative effect on occupational health, especially on older adults and infants. The Internet of Things has been shown to have a huge effect on the daily life of the modern generation [4]. In many applications, including assisted living, home automation, and e-health, this definition will be further used. It is also referred to as an optimal solution with e-cient data and computational tools for developing innovative software applications. The monitoring of IAQ is one of the most important Internet of Things applications in human life. Significant growth in the area of Information and Communication Technology and developments in the Internet of Things are leading to significant opportunities for the implementation of scalable information systems in the healthcare sector. Researchers, however, need to resolve the problems associated with healthcare systems related to security, protection, and privacy [5].

Monitoring human physiological status aids in the understanding of an individual's medical condition. For people at high risk, such as older adults, patients with respiratory health, and newborns, it is more important as symptoms may be identified ahead of time. Environmental conditions in living environments are closely related to general well-being and wellbeing. Real-time monitoring can assist in identifying and preventing important health conditions on time. However, to advise effective clinical diagnostics, experienced physicians will further interpret and process the monitored physiological and environmental data. Adverse health effects are caused by poor IAQ levels above specific threshold levels. Difficulty breathing, dizziness, headaches, restlessness, coma, high blood pressure, accelerated heart rate, and asphyxia are some of the most common symptoms. Information about the on-going trends of the IAQ can be given by continuous IEQ monitoring [6].

For Improved Living Conditions, this knowledge may be further used to prepare interventions. With developments in the field of Internet of Things technology, smart homes need to be fitted with solutions for tracking the real-time climate. Using open source software for data collection, transmission, and analysis will make it possible. In addition, for various

monitoring tasks, such as noise monitoring, activity detection, and light and thermal comfort assessment in buildings, micro sensors may be used. In addition, bad IAQ is known as a possible concern for individuals who are either suffering from sexually transmitted diseases or are addicted to the use of tobacco. In the United States, the Environmental Protection Agency is responsible for controlling indoor and outdoor pollution. Poor IAQ was listed as one of the five most important environmental threats to public health in recent EPA reports [7].

Particulate Matter (PM) is determined as a multifaceted combination of liquefied and solid biological, as well as mineral material, particles that are suspended in the air. Several researchers have recognized it as one of the potential pollutants that has a direct relation to individual health and well-being. PM usually includes dirt, dust, soot, smoke, and liquid droplets that can penetrate the lower airways in the human body. As a consequence, possible adverse health effects are caused by them. Repeated exposure to PM in the indoor environment is known in developing countries as the primary cause behind growing cases of acute lower respiratory infections. Mortality in young children, chronic obstructive pulmonary disease, cardiovascular disease, and lung cancer among adults are further correlated with it. Powerful correlations are found between the airborne PM levels sampled from the populated cities in developed countries all over the world.

III. CONCLUSION & DISCUSSION

The air quality data can be evaluated by health professionals to support the decision process on medical diagnostics. Moreover, it will be possible to associate patient diseases with their environmental conditions. The incorporation of notifications using mobile devices is essential to alert the building occupations or city managers on time. However, the key findings are relevant and future studies on IAQ monitoring systems will encourage Improved Living Conditions and Sustainable Smart Cities. This current study has established many limitations. There are also other studies where wireless sensor networks and IoT, as well as air quality, are used for precision agriculture and home applications. The same study could be used in the future to track air quality in agricultural fields and in areas close to different industries.

IV. REFERENCES

[1] K. A. Kulkarni and M. S. Zambare, “The Impact Study of Houseplants in Purification of Environment Using Wireless Sensor Network,” Wirel. Sens. Netw., vol. 10, no. 03, pp. 59–69, 2018, doi: 10.4236/wsn.2018.103003.

[2] P. Ruano et al., “We are IntechOpen , the world ’ s leading publisher of Open Access books Built by scientists , for scientists TOP 1 %,” Intech, no. tourism, p. 13, 2016, doi: http://dx.doi.org/10.5772/57353.

[3] P. P. Shrimandilkar, “Indoor Air Quality Monitoring For Human Health,” vol. 3, no. 2, pp. 891–897, 2013.

[4] J. Li, M. Li, J. Xin, B. Lai, and Q. Ma, “Wireless sensor network for indoor air quality

monitoring," Sensors and Transducers, vol. 172, no. 6, pp. 86–90, 2014.
[5] G. Parmar, S. Lakhani, and M. K. Chattopadhyay, "An IoT based low cost air pollution monitoring system," Int. Conf. Recent Innov. Signal Process. Embed. Syst. RISE 2017, vol. 2018-Janua, no. February, pp. 524–528, 2018, doi: 10.1109/RISE.2017.8378212.
[6] and M. K. B. Sagar Godase, Rahul Padalkar, "Implementation of IoT basd Indoor Air Quality Monitoring System," Curr. Glob. Rev. Spec. Issue, vol. 10, no. Special issue, pp. 12–20, 2017, doi: 2319-8648.
[7] J. Cynthia, M. N. Saroja, P. Sultana, and J. Senthil, "IoT-based real time air pollution monitoring system," Int. J. Grid High Perform. Comput., vol. 11, no. 4, pp. 28–41, 2019, doi: 10.4018/IJGHPC.2019100103.