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The Role of Sensor in Environmental Monitoring

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Abstract: Environmental pollution has become the major problem for us in recent times. Harmful gases are discharged by industries and many others cause pollution. Hence, there is a need to monitor and control these harmful contaminants, especially in air and water. So the sensors in environmental monitoring, highlighting their diverse applications, such as measuring air quality, water quality, soil conditions, and more. Sensor devices also offer high sensitivity, and fast response as per the user requirements. The role of sensors in environmental monitoring is enabling data collection and give information for decision-making. These devices detect physical, chemical, and biological parameters, such as temperature, humidity, pollutants, and biodiversity. They provide accurate, real time data. Sensor also give early warning systems for natural disasters and pollution incidents.As technology advances, sensor networks enhance our ability to monitor and safeguard the earth supporting global efforts to protect ecosystems and human well-being.
Keywords: Advanced sensing systems, Smart sensing and monitoring, Environmental monitoring, Environmental pollution

1. Introduction:

Sensors play a important role in environmental monitoring by collecting data from the nature and atmospheric environment. These devices are designed to detect and measure various physical and chemical parameters, such as temperature, humidity, air quality, radiation levels, and more. The data collected by sensors is essential for measuring environmental conditions, tracking changes over time, and by giving us the decisions to protect and improve the environment. Sensors enable real-time monitoring, early warning systems, and data-driven policies, contributing to a sustainable and healthier Earth.

The objective of this review article is to present significant scientific contribution to development in sensors and their analytical role in environmental pollution screening and monitoring. The topics cover various types of sensors that are developed for environmental analysis .The main purpose of this review article is to highlight the design, functioning, and performance in the analysis of environmental contaminants using different types of sensors.

2. Previous Researches

The Clean Air Act classifies a number of substances as hazardous air pollutants (now called toxic air pollutants (TAPs) by the EPA) and regulates them under the NEMP program. The ACGIH sets Airborne Concentration Limits (APLs) of various HAPs. The APLs are considered to represent conditions in which almost all workers can be exposed to HAPs on a daily basis without causing any adverse health effects. The AAPLs are based on industrial experience and on human and animal experimental studies. Table 8 below lists a few HAPs and the related ACGIH APLs. The EPA has set two general discharge requirements for the industrial discharger prohibiting "interference" and "pass through." These requirements are intended to prevent the destruction of treatment works and the subsequent environmental damage. EPA also controls the discha rges of 126 "priority

pollutants," including metals, toxic organics, etc. Some components of sensor in environmental monitoring are given below

1. Sensor Element:- This is the important part of sensor and we can say heart of the sensor and it is responsible for detecting the specific environmental parameter, such as temperature, humidity, air quality, or radiation.
2. Transducer:- The changes in our environment like physical or chemical changes Converts into an electrical signal through transducer.For example, a thermocouple converts temperature into voltage.
3. Signal Conditioning Circuit:- it Amplifies, filters the raw electrical signal from the transducer to improve accuracy .
4. Output Interface:- it Provides the data in a usable format, such as analogical signals digital signals, or communicational protocols like USB, Bluetooth, or Wi-Fi etc.
5. Power Supply:- it supplies the energy to the components. This can be from batteries, solar panels, and any other depending on the applications .

These are some components from no. Of components which work together to collect data about the environment and provide us information for various applications, from weather monitoring to pollution control.

3. Functions of sensor in environmental monitoring:

Sensors play a crucial role in environmental monitoring .Here are some functions of sensors in environmental monitoring with data:

1. Data Collection:- Sensors are designed to measure various environmental status such as temperature, humidity, air quality, water quality, and air pollution and many more. They collect real-time data .
2. Monitoring:- Sensors monitor environmental conditions, providing us a continuous live stream of data. This allows for the detection of changes over time.
3. Alerting:- Sensors are programmed to trigger alarms or notifications when certain environmental parameters differentiated from acceptable levels. This helps in early warning systems for natural disasters or pollution events.
4. Data Logging:- Sensors record data time to time and creating a historical record of environmental conditions. This historic data is valuable for researches and policy-making.
5. Remote Sensing:- Many environmental sensors are equipped with remote communication capabilities, allowing data to be collected by remotely and from the difficult locations .
6. GIS and Mapping:-Geographic Information Systems (GIS) are often used to map sensor data.
7. Public Awareness:- Sensor data is made available to the public through websites or apps, it raising awareness towards environmental issues to the public and allowing every single person to take informed actions.

Overall, sensors are very useful for environmental monitoring, providing the data needed to better understand and protect our natural world and our earth.

4. Conclusions:

Over the years, sensors have been established for environmental analysis for improving our lives as well as world a better place to live. Despite the enormous prospective sensors, there is a lot of space in the field of sensing to develop fast and economical sensors having little or no impact on environment. Even though there are several sensors used commercially, but their usage are restricted because of their limited sensitivity, response time. As technology advances, sensors continue to improve our ability to understand and address environmental issues, it spreads awareness towards our environment.

5. The future scope of sensors in environmental monitoring :

1. Continued advancements in sensor technology will lead to more accurate and cost-effective environmental monitoring solutions.
2. Sensors will play a crucial role in the Internet of Things , enabling real-time data collection , which can be used for smarter decision-making in air and water quality, and climate monitoring.

3. Remote sensors, such as satellites and drones, will be increasingly used for large-scale environmental monitoring, helping track changes in ecosystems, deforestation, and climate patterns.
4. Environmental sensors may become more common, helping individuals monitor their personal exposure to pollutants and environmental hazards.

Overall, sensors will continue to be at the forefront of environmental monitoring, contributing to give information approach to managing our planet's resources.

References:

[1] Looney B., Falta R.W., editors. Vadose zone Science and Technology Solutions. Battelle Press; Columbus, OH: 2000. p. 1540.

[2] Wilson LG., Everett L.G., Cullen S.J., editors. Handbook of Vadose Zone Characterization & Monitoring. CRC Press; Boca Raton, FL: 1995.

[3] U.S. DOE. Assessment of the 2000 and 2001 Environmental Management Industry Times They Are A-Changin'. Prepared for the U.S. Department of Energy Office of Environmental Management, Office of Science and Technology (EM-50). Prepared by YAHSGS L1c.; Richland, WA: Aug, 2002.

[4] Stetter J. TES Workshop on Technology Needs as Part of a Conference on Analytical Chemistry and Applied Spectroscopy; Pittsburg, Pa. 2001.

[5] U.S. Department of Energy. From Cleanup to Stewardship, a Companion Report to Accelerating Cleanup: Paths to closure and Background Information to Support the Scoping Process Required for the 1998 PEIS Settlement Study. U.S. Department of Energy, Office of Environmental Management; Oct, 1999.

[6] U.S. Department of Energy (DOE) Market Study to Determine Needs and Present Usage of Chemical Sensor Systems for Environmental Analytical Applications. 325 Market St., Alton, Il. 62002: May, 1996. Final Report Submitted to: Characterization, Monitoring and Sensing Technology Crosscutting Program, Department of Energy, Ames Laboratory, Iowa State University, Ames, IA 50011-3020 Prepared by: The Unmark Group, Ltd.

[7] Inspector General (IG) Report. Departmental Position on the Office of Inspector General Report IG-0461. Groundwater Monitoring Activities at Department of Energy Facilities. To: Phillip L. Holbrook, Deputy Inspector General for Audit Services.

[8] 65 Federal Register 64746. Final Reissuance of National Pollutant Discharge Elimination System (NPDES) Storm Water Multi-Sector General Permit for Industrial Activities. Oct 30, 2000. Notice.

[9] 40 CFR Part 403. General Pretreatment Regulations for Existing and New Sources of Pollution. EPA; Washington, DC: 2000.

[10] 40 Code of Federal Regulations (CFR) Organic Chemicals, Plastics, and Synthetic Fibers. EPA; Washington, DC: 2003. Part 414, Section 111.

[11] Simiran Kuwera, Sunil Agarwal and Rajkumar Kaushik, "Application of Optimization Techniques for Optimal Capacitor Placement and Sizing in Distribution System: A Review", *International Journal of Engineering Trends and Applications (IJETA)*, vol. 8, no. 5, Sep-Oct 2021.

[12] Guru Saran Chayal, Bharat Bhushan Jain and Rajkumar Kaushik, "A Detailed Study of Electrical Vehicle with Improved Applications: A Review", *International Journal of Engineering Trends and Applications (IJETA)*, vol. 8, no. 6, pp. 31, Nov-Dec 2021.

[13] T. Manglani, A. Vaishnav, A. S. Solanki and R. Kaushik, "Smart Agriculture Monitoring System Using Internet of Things (IoT)," *2022 International Conference on Electronics and Renewable Systems (ICEARS)*, Tuticorin, India, 2022, pp. 501-505.

[14] R. Kaushik *et al*., "Recognition of Islanding and Operational Events in Power System With Renewable Energy Penetration Using a Stockwell Transform-Based Method," in *IEEE Systems Journal*, vol. 16, no. 1, pp. 166-175, March 2022.

[15] G. Kumar and R. Sharma, "Analysis of software reliability growth model under two types of fault and warranty cost," 2017 2nd International Conference on System Reliability and Safety (ICSRS), Milan, Italy, 2017, pp. 465-468, doi: 10.1109/ICSRS.2017.8272866.

[16] Kumar, G., Kaushik, M. and Purohit, R. (2018) “Reliability analysis of software with three types of errors and imperfect debugging using Markov model,” International journal of computer applications in technology, 58(3), p. 241. doi: 10.1504/ijcat.2018.095763.