

# Environmental Monitoring using AI: A Review

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## Abstract

Artificial Intelligence (AI) offers accurate disaster forecasts, pollution source detection, and comprehensive air and water quality monitoring in environmental monitoring. This paper delivers a general description about environmental monitoring value while presenting conventional method difficulties alongside potential AI-based solutions. The embedded computing system connects sensing devices which track environmental parameter changes including noise and air quality as well as water pollution disturbances from baseline conditions. AI technologies will boost pollution monitoring accuracy by advancing their algorithms and data collection systems while utilizing increased computational capabilities for better management of pollution control.

## 1. Introduction

Experiencing necessary environmental monitoring requires organized scientific observation and measurement and evaluation methods. observation, measurement, and evaluation of the natural environment and all of its components. Environmental monitoring serves two main functions by detecting existing ecological and health-threatening changes in the environment. AI technologies help organizations achieve both more efficient and effective environmental operations. Environmental monitoring uses technology effectively but involves paying attention to immediate expenses together with examining future advantages. AI has established itself as a foundational element

of environmental monitoring efforts during recent times since it boosts result objectivity while increasing access to underserved areas. AI models enable environmental monitoring systems by replacing sensing devices with monitoring devices to connect terminal testing devices with end customers while connecting directly to environmental protection departments along with personal digital display monitoring systems among others. Better environmental tracking combined with more accurate disaster prediction helps identify pollutants which results in improved resource management along with faster environmental issue responses.

## 2. Environmental Monitoring

Monitoring environmental elements demands systematic methods to collect and evaluate data which consists of conditions in air quality together with assessments of water qualities and soil qualities as well as meteorological measurements. The purpose of environmental monitoring builds information about environmental transformations by measuring their extent while analyzing policy performance and documenting human-made environmental effects. The multiple environmental monitoring systems concentrate their efforts on individual aspect areas including both air and water conditions. Environmental monitoring depends on different detection methods from remote sensing to satellite imaging alongside ground-based sampling. Environmental management decisions and conservation strategies receive guidance from monitoring data that government agencies

together with non-governmental organizations and businesses use for decision-making. How technology has developed environmental monitoring capabilities to produce superior collection analysis and interpretation of data. The field of environmental monitoring has progressed through remote sensing technology combined with IoT devices alongside big data analytics and artificial intelligence (AI) applications and mobile applications. The data goes through AI algorithms which identifies patterns alongside anomalies and potential safety risks. These developments increase our comprehension of environmental human-induced transformations while enabling better reaction methods to observed environmental modifications.

### 3. Detailed Monitoring Of The Environment

Detailed environmental monitoring has gained importance throughout the past years because of different factors including climate change and pollution alongside deforestation and dwindling natural resource availability. Detailed monitoring of the environment serves essential purposes which include the following reasons: 1. Conservation and Biodiversity 2. Climate Change 3. Natural Resource Management 4. Disaster Management 5. Human Health 6. Policy Development 7. Environmental Monitoring and Conservation 8. Environmental Decision-Making

### 4. The application of AI models to environmental monitoring

- Real-time data analysis and decision-making: Artificial intelligence (AI) can analyze vast volumes of data from sensors and satellites to spot trends, patterns, and variances, allowing for informed decision-making and real-time environmental condition assessments.
- Natural disaster prediction: AI models can examine past data and present environmental factors to forecast how

natural disasters like floods, wildfires, and extreme weather events will develop and affect society in the future.

- Monitoring air and water quality: AI can assist in tracking parameters related to air and water quality, identifying pollutants, and forecasting future levels, which helps with pollution control and water resource management.

- Identifying environmental violations: AI systems are able to examine sensor data and satellite imagery to identify unlawful mining, deforestation, and other infractions, which makes conservation and implementation efforts easier.

Monitoring of biodiversity and ecosystems: AI, in particular image processing and recognition methods, can be used to track wildlife populations, monitor biodiversity, and evaluate the health of ecosystems.

- Improving the efficiency of regulatory agencies and resource allocation, artificial intelligence (AI) can optimize the scheduling and prioritization of environmental inspections.

5. The following AI models are employed in environmental monitoring:

- Convolutional Neural Networks (CNNs): These systems are used for image-based tasks such as identifying wildlife in satellite imagery and detecting deforestation.
- Long Short-Term Memory (LSTM) networks: These networks use time series data to predict environmental quality levels.
- Machine learning algorithms: These are used to forecast future environmental conditions, analyze historical data, and find patterns in data.

### 6. Benefits of applying AI to environmental monitoring

- Enhanced efficiency and accuracy: AI systems are able to process enormous volumes of data and detect ambiguous environmental changes, resulting in more precise and prompt monitoring.

- Real-time analysis and decision-making: AI offers real-time environmental condition insights, facilitating improved resource management and speedier emergency responses.
- Better predictive abilities: AI can predict future environmental conditions, which aids in risk mitigation and preparation.
- Better adherence to environmental regulations and a quicker understanding of the state of the environment are made possible by AI's ability to detect possible environmental interference and optimize inspection schedules.

## 7. Conclusion

In summary, the integration of artificial intelligence and big data technologies holds great promise for tackling pressing environmental concerns and promoting conservation and sustainable management programs. Machine learning algorithms enable the analysis of large and diverse environmental datasets, facilitating the identification of patterns, anomalies, and hazards. Because they enable the prediction of future environmental conditions, these algorithms are crucial for environmental modeling and forecasting. However, data quality, model validation, and ongoing improvement must be given careful thought in order to ensure the accuracy and dependability of AI models. Transparency, accountability, and cooperation between data scientists and domain experts are essential, as is the ethical use of AI in environmental monitoring. AI has the potential to drastically alter the environment in general.

## 8. References

1. Sil, R., Roy, A., Bhushan, B., & Mazumdar, A. K. (2019, October). Artificial intelligence and machine learning based legal application: the state-of-the-art and future research trends. In 2019 International Conference on Computing, Communication, and Intelligent Systems (ICCCIS).

2. Pyayt, A. L., Mokhov, I. I., Lang, B., Krzhizhanovskaya, V.V., & Meijer, R. J. (2011). Machine learning methods for environmental monitoring and flood protection.

International Journal of Computer and Information Engineering.

3. Roy Choudhury, A. K. (2014). Environmental impacts of the textile industry and its assessment through life cycle assessment. Roadmap to sustainable textiles and clothing: environmental and social aspects of textiles and clothing supply chain.

4. R. Shinde, S., Karode, A. H., & Suralkar, S. R. (2017). REVIEW ON - IOT BASED ENVIRONMENT MONITORING SYSTEM. International Journal of Electronics and Communication Engineering and Technology

5. Zhang, D., Li, Y., & Zhao, Y. (2020). Artificial intelligence in environmental monitoring: A review. Science of The Total Environment, 727, 138664.

6. Hossain, M. S., Muhammad, G., & Alamri, A. (2019). Smart air pollution monitoring system using unmanned aerial vehicles and deep learning. Future Generation Computer Systems, 100, 137–147.

7. Ma, X., Cheng, L., & Wu, Y. (2021). A hybrid deep learning model for predicting water quality. Environmental Science and Pollution Research, 28, 51204–51218.

8. Norouzzadeh, M. S., et al. (2018). Automatically identifying, counting, and describing wild animals in camera-trap images with deep learning. PNAS, 115(25), E5716–E5725.

9. Reichstein, M., et al. (2019). Deep learning and process understanding for data-driven Earth system science. Nature, 566, 195–204.