Proceedings of the 4th International Conference on Materials Chemistry and Environmental Engineering
DOI: 10.54254/2755-2721/60/20240824

Application of electronic information in environmental protection

Yufeng Zhou

International Digital Economy College of Minjiang University, Fuzhou, Fujian, 350000, China

zyf@stu.mju.edu.cn

Abstract: In the 21st century, the growing recognition of the fragility of our planet's ecosystems and the urgency of addressing environmental challenges have spurred an increased emphasis on environmental awareness and protection. The intricate interplay between human activities and the natural environment has underscored the need for innovative approaches to safeguarding our planet for current and future generations. In this context, the fusion of information technology with environmental protection has emerged as a dynamic force for positive change, reshaping the way we understand and address ecological issues. This article delves deeper into the multifaceted applications of information technology in the realm of environmental protection, exploring their significance, benefits, and potential for shaping a sustainable future. At the same time, 3S technology, Internet of Things technology and network technology play a very important role in pollutant discharge monitoring, data sharing and timely response, which is very suitable for environmental protection.

Keywords: Electronic Information Technology, Environmental Protection, Application, Information Technology.

1. Introduction

Environmental issues have always been important challenges to address in economic development. In recent years, there has been a growing emphasis on environmental protection in society, with an increasing awareness of its significance. Nowadays, electronic information technology has become a crucial tool for effective environmental protection in our country. The use of digital environmental protection technology can provide technical support for environmental protection efforts. The application of information technology in environmental protection work can enhance the quality of environmental monitoring and play a significant role in environmental management decisions. In the era of digitization, only by fully utilizing electronic information technology in the environmental protection process can we advance the further development of environmental digitization. Only through the integration of electronic information technology with environmental protection can we meet the needs of social development and environmental governance, strengthen the concept of environmental protection informationization, and ultimately provide a better quality of life for the public. Finally, a solid foundation can be laid for the development of environmental information construction. This paper studies the application of various technologies in environmental protection and analyzes the role of

DOI: 10.54254/2755-2721/60/20240824

different technologies in different aspects, and finally puts forward suggestions on the application of science and technology in environmental protection.

2. Information Technology Relevant to Environmental Protection

2.1. 3S Technology

3S technology is the most common information technology in the field of environmental protection, including GPS, RS, and GIS. The development of environmental geographic systems, water resource management in key areas, environmental pollution warning systems, and other achievements all rely on the application of 3S technology [1]. RS technology can monitor data related to atmospheric pollution, the size of pollutant particles, and the distribution of pollutants, as well as collect information on water pollution and ecological environmental pollution. This allows workers to identify the type of water pollution, understand the distribution of pollution through visual data, and grasp the pollution situation of soil, water quality, vegetation, and other aspects of the ecological environment. GPS, as a data updating method in the GIS system, can store detailed records of various environmental monitoring devices, ensuring that monitoring devices can be updated in a timely manner after replacement. Workers can use GIS technology to establish a database containing comprehensive topographic maps, and this database can output corresponding maps based on different needs. GIS technology can also help workers establish an environmental spatial database, which includes environmental information and relevant geographical locations. Users can use this database to analyze and manage this information. Its application in environmental monitoring is also extensive, as it can perform real-time analysis of monitored data, store and process data information, and assist in the development of environmental governance decisions. Remote sensing (RS) technology, using satellite imagery and other advanced sensors, empowers us to monitor changes in land use, vegetation cover, and natural resource distribution. This real-time data collection not only aids in early detection of deforestation, urban expansion, and habitat loss but also informs disaster management and response strategies [2]. Geographic positioning systems (GPS) enable precise tracking of pollutant emissions, facilitating the identification of pollution hotspots and the formulation of targeted interventions.

2.2. Internet of Things (IoT) Technology

The foundation of IoT is the internet. It is defined as the connection of any item to the internet for information exchange and communication through information sensing devices such as QR code readers, radio frequency identification devices, infrared sensors, global positioning systems, and laser scanners, following agreed protocols. The goal is to achieve intelligent recognition, positioning, tracking, monitoring, and management. IoT technology can be divided into three levels: the perception layer, the application layer, and the network layer. The perception layer mainly accomplishes the identification of "things," the network layer transfers the information obtained from the perception layer, and the application layer integrates with relevant industries [3]. As of now, the application of IoT technology in environmental protection work is widespread and can have a significantly positive impact on environmental protection. The environmental pollution information monitoring system, for example, is based on IoT technology. Environmental sensing devices like pH meters and other environmental sensors gather information, which is then automatically transmitted to the monitoring center through wireless sensor networks, GPRS, satellites, etc. [4]. IoT technology is mainly applied in environmental monitoring, providing technical support for exploring pollution sources, detecting pollutant emission concentrations, and determining the nature of pollutants. It benefits the work of environmental pollution control, helping relevant departments evaluate the negative impact of environmental pollution on environmental quality. Real-time monitoring of environmental pollution using IoT technology can drive innovation in environmental governance, management philosophy, and control measures, allowing for timely control of contaminated environments and effective prevention and protection of uncontaminated environments. By seamlessly integrating environmental sensors into everyday objects and infrastructure, IoT technology empowers us to monitor air and water quality, soil health, and climate conditions with

DOI: 10.54254/2755-2721/60/20240824

unprecedented accuracy. In urban environments, IoT-enabled “smart” systems can monitor air pollution levels, noise pollution, and waste management efficiency, providing policymakers with essential insights to develop sustainable urban planning strategies. For instance, real-time monitoring of traffic emissions can inform traffic diversion plans, reducing localized air pollution and enhancing overall air quality.

3. Application of Network Technology

Network technology is essential for rapidly processing various environmental monitoring data in environmental protection work. Environmental monitoring devices require network technology when analyzing and processing the collected data. Network technology can analyze data resources and integrate them, enabling real-time resource sharing. This facilitates the timely acquisition of monitoring data for various departments, improving the utilization rate of monitoring data. Furthermore, to fully leverage the role of the environmental information platform, relevant personnel need to use network technology to add various monitoring data, guidelines for environmental monitoring and control, and operational norms to the platform. Forum functionalities can also be added to the platform to gather suggestions from workers and improve their technical capabilities. When it comes to how the Internet of Things (IoT) can protect the environment, it generally involves its role in monitoring, analyzing, and managing environmental data. The Internet of Things is a technology system that enables information exchange and communication through interconnected devices and sensors, which can collect and transmit various environmental parameter data. Here are the ways in which the Internet of Things is applied in environmental protection and its benefits:

3.1. Real-time Environmental Monitoring

IoT technology allows us to monitor environmental parameters such as air quality, water quality, soil health, noise levels, etc. in real time. By deploying sensors in cities, factories, natural ecosystems, and other locations, we can obtain a continuous data stream about the environmental conditions. This real-time monitoring can quickly detect pollution events, enabling governments and environmental organizations to take action more swiftly to mitigate environmental impacts [5].

3.2. Precise Pollution Source Localization

IoT technology can help determine the location of pollution sources. By installing sensors near pollution sources, emissions of pollutants can be monitored in real time. This helps accurately identify which companies or areas are causing pollution, allowing targeted regulatory and emission reduction measures to be implemented.

3.3. Early Warning and Emergency Response

IoT technology can issue alerts when environmental parameters exceed safe thresholds. For instance, when pollutant concentrations in the air reach hazardous levels, the system can automatically send alerts to relevant parties for prompt action to protect public health. This is crucial for emergency response and pollution event management.

3.4. Data Analysis and Prediction

The large amount of environmental data generated by IoT technology can be processed through data analysis and machine learning algorithms. This data analysis can reveal patterns and trends in environmental changes, helping scientists and policymakers predict future environmental challenges. Through such analyses, more effective environmental protection strategies and measures can be devised.

3.5. Resource Optimization

IoT technology can optimize the use of resources, thereby reducing waste and environmental impacts. For instance, in agriculture, IoT sensors can monitor soil moisture, weather conditions, and plant health status, assisting farmers in precise irrigation to reduce water wastage.

DOI: 10.54254/2755-2721/60/20240824

3.6. Individual Engagement

IoT technology empowers individuals to participate more directly in environmental protection. For example, smart home devices can monitor energy usage and remind people to reduce energy waste. Smartphone applications can provide information about nearby sustainable products and services, aiding consumers in making environmentally conscious choices.

Despite the numerous potential advantages of IoT in environmental protection, there are also challenges. Data privacy and security issues are two, as a large volume of environmental data needs to be collected, transmitted, and stored securely. Additionally, the manufacturing and maintenance of IoT devices may have environmental impacts, such as increased electronic waste and energy consumption. In conclusion, IoT technology holds significant potential for environmental protection Through real-time monitoring, data analysis, and resource optimization, IoT has the potential to advance more sustainable environmental management and protection, creating a healthier and more sustainable planet for us all.

4. Suggestions for the Application of Information Technology in Environmental Protection

This section will start with three aspects: strengthening environmental supervision, promoting supervision, and improving scientific and technological development.4.1 Strengthening Environmental Supervision Capability through Information Technology

First, continuously expand the depth and breadth of IoT technology applications. As core and key technologies of IoT mature, environmental supervision can become more in-depth and efficient. The breadth of IoT applications can expand from automatic monitoring of waste gas and wastewater to automatic monitoring of hazardous waste, heavy metals, and radiation sources. The number of water quality automatic monitoring stations can increase in key water areas, important drinking water sources, national boundary rivers, and major tributaries to enhance water environment forecasting, warning, and monitoring capabilities. Second, promote the efficient application of network communication technology. With the continuous development of network communication technology, wireless network coverage expands, network bandwidth increases, and network communication technology becomes more efficient, ensuring efficient information transmission. The digitization of environmental data has ushered in an era of big data analytics, enabling the extraction of meaningful insights from vast and complex datasets [6]. This data-driven approach enhances our ability to predict environmental trends, identify emerging challenges, and formulate targeted solutions. Machine learning algorithms can analyze historical data to forecast the impact of climate change on vulnerable ecosystems, facilitating proactive conservation efforts. Furthermore, the accumulation of environmental data over time fosters a more comprehensive understanding of the long-term consequences of human activities on the environment. By identifying patterns and correlations in data, scientists can assess the effectiveness of conservation strategies and adapt their approaches to achieve optimal outcomes.

4.1. Promoting Unified Supervision of Pollutant Emissions

First, establish a unified registration information management platform for national pollutant discharge permits to facilitate the unified management of national pollutant discharge enterprises and provide a guarantee for establishing an inventory and baseline of discharge units. Second, build a unified online information declaration and management platform for pollutant emissions and create an authoritative and comprehensive data management system with the authority of the Ministry of Environmental Protection. Third, construct a unified platform for managing information on environmental law violations to provide convenience for real-time supervision and reporting by the public, effectively curbing environmental violations. While the marriage of information technology and environmental protection offers immense promise, it also presents challenges and ethical considerations. The reliance on electronic devices and networks raises concerns about electronic waste and energy consumption. The rapid pace of technological advancement also demands continuous learning and adaptation to ensure that environmental protection efforts remain effective and relevant. Additionally, the equitable distribution of technological benefits must be considered. In many parts of the world, access to advanced

DOI: 10.54254/2755-2721/60/20240824

information technology is limited, creating a digital divide that can exacerbate environmental inequalities. Efforts to bridge this gap and ensure that marginalized communities have access to information and resources are integral to a holistic approach to environmental protection.

4.2. Enhancing Integrated Development of 3S Technology

First, strengthen the improvement and key technology breakthroughs of environmental remote sensing equipment, such as imaging radar and imaging spectrometers, to enhance the accuracy and stability of data collection. Develop supporting software to enhance independent innovation capabilities. Second, utilize the characteristics of existing high-speed and high-bandwidth data communication networks to ensure the effective, fast, and stable transmission of data collection information. Enhance the integration level of 3S technology to achieve multidimensional information acquisition and real-time processing. Establish a new type of ground three-dimensional information and geographic-coded images to achieve real-time acquisition and processing, forming a fast and high-precision information processing flow. Finally, increase the application of data mining technology in environmental protection, standardize and improve data standards, and establish an environmental spatial information data warehouse. Enhance the application of data mining technologies such as statistical classification, neural networks, fuzzy techniques, and expert systems in the processing of remote sensing data information. As we gaze into the future, the integration of information technology and environmental protection holds the promise of a sustainable and harmonious coexistence between humans and the natural world. The evolution of smart cities, intelligent ecosystems, and data-driven conservation strategies will redefine the way we interact with and manage our environment. Collaborative efforts between governments, industries, academia, and civil society will be essential to leverage the full potential of information technology for environmental protection.

5. Conclusion

In conclusion, applying information technology to environmental protection and achieving environmental informationization is an inevitable requirement of global information development. It is beneficial to promote the realization of smart environmental protection. Only by effectively integrating information technology with environmental protection can we meet the requirements of social development and environmental governance, strengthen the concept of environmental protection informationization, and ultimately provide a better production and living environment for the public. Currently, the application of information technology in environmental protection is mainly reflected in IoT technology, 3S technology, data mining, and data warehousing technology. In the development of environmental informationization, efforts should be made to strengthen environmental supervision capabilities through information technology, promote unified supervision of pollutant emissions, enhance the integrated development of 3S technology, and establish a public-service-oriented government to achieve effective application of information technology in environmental protection. Finally, because information technology has not been fully popularized in environmental monitoring, the research in this paper is not detailed and comprehensive enough. In the future, it is inevitable that information technology and environmental protection will be integrated. Meanwhile, the people will improve their awareness of environmental protection, and various technologies will be more suitable for environmental monitoring and protection. There will also be important developments in monitoring pollution and discharge.

References

[1] Zhang, L., Cui, X., Wang, M., Hu, Q., & Yu, Y. (2010). The development and status of 3S technology in China. In 2010 2nd International Conference on Advanced Computer Control (pp. 214-217).

[2] Li, W., Zheng, N., Jun, Y., Guo, Y. J., & Shi, G. Q. Analyzing land use change of small towns based on RS technology: a case study in Huanghua town. Resources Science.

DOI: 10.54254/2755-2721/60/20240824

[3] Tayeb, S., Latifi, S., & Kim, Y. (2017). A survey on IoT communication and computation frameworks: An industrial perspective. In 2017 IEEE 7th Annual Computing and Communication Workshop and Conference (CCWC) (pp. 1-6).
[4] Alnahdi, A., & Liu, S. -H. (2017). Mobile Internet of Things (MIoT) and Its Applications for Smart Environments: A Positional Overview. In 2017 IEEE International Congress on Internet of Things (ICIOT) (pp. 151-154).
[5] Xu, B., Zheng, J., & Wang, Q. (2016). Analysis and Design of Real-Time Micro-Environment Parameter Monitoring System Based on Internet of Things. In 2016 IEEE International Conference on Internet of Things (iThings) and IEEE Green Computing and Communications (GreenCom) and IEEE Cyber, Physical and Social Computing (CPSCom) and IEEE Smart Data (SmartData) (pp. 368-371).
[6] Granell, C., Havlik, D., Schade, S., et al. (2016). Future Internet technologies for environmental applications. Environmental Modelling & Software, 78, 1-15.
[7] Cunningham, P. M. (2018). IEEE and Sustainable Development. IEEE Technology and Society Magazine, 37(3), 1-17.
[8] Khanna, M. (2010). Non-mandatory approaches to environmental protection. Journal of Economic Surveys, 15.
[9] Izumi & Ochiai. (1996). Environmental protection in the electronic and electrical industries. Journal of Materials Processing Technology.
[10] Jun, L. I., & Zong-Bao, H. U. (2004). Green environmental protection about electronic products and electron devices. Journal of Electron Devices.