

A Brief Analysis of Intelligent Methods in Environmental Protection Technology

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Abstract—This paper briefly introduces the intelligent methods in environmental protection technology, including the purpose, background, demand, application technology status of environmental protection, the key technical support of intelligent methods to environmental protection, the industrialization development of intelligent environmental protection technology, and the summary and prospect. It shows that intelligent methods play an important role in environmental protection technology, and the application of intelligent methods can better meet the needs of environmental protection, improve governance efficiency, and achieve sustainable development.

Index Terms—Environmental protection; Intelligent technology; Industrial development; Artificial intelligence; Technological innovation

I. INTRODUCTION

In the Internet era, people are exposed to more progressive resources, methods, and ideas, and how to use this advantage to conduct in-depth exploration of education has become one of the missions of education. In recent years, application-oriented undergraduate colleges and universities have developed rapidly, and are committed to creating application-oriented talents needed by society. How to make teaching more targeted and scientific is one of the problems that must be solved in the development of application-oriented undergraduate universities. This paper will explore the reform of teacher quality evaluation in application-oriented undergraduate universities.

II. THE IMPORTANCE OF ENVIRONMENTAL PROTECTION TECHNOLOGIES AND THE BACKGROUND OF SMART APPROACHES

The importance of environmental protection technology is to protect and improve the natural environment in which we live, and to ensure that humans and other living things can continue to survive in a healthy and sustainable environment. With population growth, industrialization and resource consumption, environmental issues such as climate change, air and water pollution, and soil degradation are becoming more and more prominent. Therefore, the development and application of environmental protection technologies is crucial.

Environmental protection technologies can reduce the negative impact on the environment, including reducing pollutant emissions, effectively treating waste, recycling resources, and promoting clean energy. These technologies

help to mitigate global climate change, improve air quality, conserve water resources, protect biodiversity, and more, thereby maintaining ecological balance and human well-being.

As an advanced technical means, intelligent methods play an important role in environmental protection technology. Based on technologies such as artificial intelligence and big data analytics, the intelligent approach provides intelligent monitoring, control and decision support by processing and analyzing large amounts of environmental data. The intelligent approach has the following background and characteristics:

1. Real-time monitoring and early warning capabilities: The smart approach can utilize advanced sensors and data acquisition systems to monitor environmental parameters in real-time and issue early warning signals. This makes it possible to detect environmental anomalies and dangerous situations at an early stage, helping to prevent accidents and mitigate environmental damage.

2. Intelligent control and optimization adjustment capabilities: Intelligent methods can intelligently adjust environmental control equipment and processes based on real-time monitoring data and environmental models to improve efficiency, reduce energy consumption, and reduce pollutant emissions.

3. Data analysis and decision support capabilities: Intelligent methods can use big data analysis and artificial intelligence technology to mine, analyze and model massive amounts of environmental data. Through data analysis, intelligent methods can discover patterns and trends, and provide scientific basis and decision support for environmental decision-making.

4. Fault diagnosis and maintenance optimization capabilities: Intelligent methods can apply machine learning and fault diagnosis techniques to detect, diagnose and predict faults in environmental protection equipment and systems. This helps to improve the operational reliability and maintenance efficiency of the equipment and reduce environmental risks.

In summary, the background and importance of intelligent methods in environmental protection technology are reflected in its real-time monitoring and early warning, intelligent control and optimization adjustment, data analysis and decision support, fault diagnosis and maintenance optimization, etc., which provide more efficient, accurate and



sustainable solutions for environmental protection.

III. DEMANDS IN THE FIELD OF ENVIRONMENTAL PROTECTION

Nowadays, global environmental problems are becoming more and more prominent, and human beings have an increasingly urgent need for environmental quality and sustainable development.

(1) Global environmental problems are becoming increasingly severe

Some of the major environmental challenges currently faced include:

1. Climate change: Climate change is one of the most important environmental issues on a global scale. Due to large-scale greenhouse gas emissions, global warming has led to extreme weather events, melting glaciers, rising sea levels, and other problems, which have a huge impact on ecosystems and human society.

2. Biodiversity loss: The rapid decline of biodiversity is another key issue. Deforestation, illegal wildlife trade, wetland degradation and other factors have led to species extinction and ecosystem destruction, threatening the global ecological balance and sustainable development.

3. Water scarcity: Many regions are facing water crises, including drought, water pollution, and poor water management. Water scarcity has had a serious impact on agriculture, industry and human life, exacerbating social instability and humanitarian crises.

4. Air pollution and declining air quality: Industrialization and urbanization have brought about a large amount of air pollutant emissions, resulting in a decline in air quality and posing a serious threat to human health and the environment. Problems such as smog and acid rain have become the focus of global attention.

5. Land degradation and desertification: Excessive agricultural exploitation, overgrazing, and irrational land use have led to land degradation and desertification. This has taken a toll on agricultural production and ecosystem functioning, and has exacerbated poverty and social instability.

In the face of these serious environmental problems, the international community needs to strengthen cooperation to find sustainable solutions in policy formulation, technological innovation and action implementation. Reducing greenhouse gas emissions, protecting biodiversity, improving water resources management and governance, reducing pollutant emissions, and promoting sustainable land management are all important measures to address global environmental challenges. Everyone should be aware of the seriousness of environmental problems and take positive actions to contribute to the protection of the planet and the future of humanity.

(2) Problems with traditional methods

There are some problems with traditional methods of environmental protection that can limit their effectiveness and sustainability. Here are some common questions:

1. Lack of holism and systematization: Traditional approaches often address only specific environmental issues and lack a comprehensive consideration of the entire ecosystem and environmental system. This can lead to one-sidedness of governance measures that fail to address the root cause of the problem.

2. Reactivity and post-processing: The traditional approach tends to be an afterthought, i.e., taking action after an environmental problem has arisen. This reactive approach can lead to ineffective and costly remediation of environmental damage after it has already occurred.

3. Lack of innovation and technological leadership: Traditional methods often rely on traditional technical means and management methods, and lack the full application of innovative technologies and scientific progress. This can limit the efficiency and sustainability of environmental protection.

4. Lack of integrated participation and cooperation: Traditional approaches are often led by governments or specific institutions, with low participation from all sectors of society. This can lead to a lack of multi-stakeholder engagement and joint efforts, limiting the breadth and depth of environmental protection.

5. Difficult to monitor and assess: Traditional methods present challenges in environmental monitoring and assessment. Inadequate systems for data collection, information sharing, and evaluation make it difficult to fully understand environmental issues and assess governance effectiveness.

In the face of these issues, we need to shift to a more integrated, innovative and technology-led approach to environmental protection. These include:

1. Integrated ecological management: Implement integrated ecological management from the perspective of the entire ecosystem, focusing on the health and sustainability of the ecosystem.

2. Preventive and proactive measures: Take preventive measures to anticipate and prevent potential environmental risks by taking action as far as possible before environmental problems arise.

3. Innovation and technology leadership: Promote scientific and technological innovation, and fully apply advanced technological means in environmental protection, such as artificial intelligence, big data analysis, drones, etc., to improve the efficiency and accuracy of governance.

4. Diversified participation and cooperation: Promote the participation and cooperation of multiple stakeholders, establish a cross-departmental and cross-field coordination mechanism, form a consensus, and promote the implementation of environmental protection.

5. Fine monitoring and assessment: Establish a sound environmental monitoring and assessment system, strengthen data collection and sharing, monitor environmental changes in a scientific way, evaluate the effectiveness of governance, and provide a scientific basis for decision-making.

By adopting a more integrated, innovative and technology-led approach to environmental protection, we can more



effectively address global environmental issues and achieve sustainable development goals.

As a result, intelligent control methods have emerged to provide more efficient and sustainable solutions in the field of environmental protection.

IV. APPLICATION STATUS OF INTELLIGENT CONTROL METHODS

The intelligent control method refers to the use of artificial intelligence technology and automation technology to realize the intelligent control of the system. These methods usually use big data, machine learning, deep learning, and other technologies to model, predict, and optimize the system to achieve more efficient, stable, and sustainable control effects.

The intelligent control method uses advanced sensor technology, data analysis and processing algorithms to monitor and adjust environmental parameters in real time and improve the efficiency and accuracy of environmental governance. For example, in air pollution control, the intelligent monitoring system can automatically sense factors such as pollutant concentration, wind direction and speed, and intelligently regulate and control them according to real-time data to achieve accurate pollution control. In terms of water treatment, garbage disposal, energy utilization, etc., through intelligent control methods, online water quality monitoring and automatic management of sewage treatment equipment can be realized, which greatly improves the efficiency of treatment and reduces costs. In the field of waste disposal, the intelligent garbage sorting system can automatically identify and classify garbage according to its characteristics and attributes, and promote resource recovery and utilization. At the same time, the intelligent control method can also be applied to the utilization and storage of clean energy, improve energy utilization efficiency, and reduce the impact on the environment.

The following is the specific application status of intelligent control methods in different environmental protection fields:

(1) Air pollution control

The application of intelligent control methods in air pollution control is increasingly becoming the focus of attention. The following is the current application status of intelligent control methods in air pollution control:

1. Intelligent monitoring and early warning system: Through intelligent sensors and monitoring equipment, with intelligent algorithms and models, the concentration and distribution of air pollutants can be monitored in real time. These intelligent monitoring systems can provide detailed data and analyze and predict in real time through intelligent early warning systems, so that corresponding governance measures can be taken in a timely manner.

2. Pollution source location and tracking: Intelligent control methods can help accurately locate and track the source of air pollution. Through the establishment of pollution source emission model and the use of big data analysis technology, the accurate positioning and identification of pollution sources can be realized, so as to

carry out the implementation of pollution control measures in a targeted manner.

3. Intelligent control and optimization: Intelligent control methods can be applied to the regulation and optimization of air pollution control. Through intelligent algorithms and optimization models, combined with monitoring data and environmental factors, intelligent regulation and control of industrial production, traffic flow and other factors can be realized to reduce the emission and diffusion of pollutants and improve the treatment effect.

4. Intelligent decision support system: intelligent control method can provide a scientific basis for air pollution control decision-making. Through simulation models and data analysis, intelligent decision support systems can evaluate the impact and effects of different treatment schemes, helping governments and decision-makers to formulate more effective air pollution control strategies.

5. Intelligent emission supervision: Intelligent control methods can be used to intelligently monitor emissions from industrial enterprises and transportation. Through intelligent sensors, remote monitoring and data analysis, real-time monitoring and tracking of pollutant emissions can be realized, so as to strengthen the supervision and governance of emission behavior.

The application of intelligent control methods in air pollution control is still in the development stage, but some important progress has been made. With the continuous innovation and application of technology, intelligent control methods are expected to play a greater role in air pollution control, improve the efficiency and effect of governance, and promote the improvement of environmental quality.

(2) Water treatment

The application of intelligent control methods in water treatment is attracting more and more attention. The following is the current application status of intelligent control methods in water treatment:

1. Intelligent monitoring and early warning system: Through intelligent sensors and monitoring equipment, combined with data analysis and model algorithms, real-time monitoring and early warning of water bodies can be realized. These intelligent monitoring systems can collect data on indicators such as water quality, water temperature, and dissolved oxygen, and analyze them through intelligent early warning systems to detect water pollution problems early so that appropriate treatment measures can be taken.

2. Pollution source tracking and traceability: Intelligent control methods can help accurately locate and trace the source of water pollution. By establishing a pollution source emission model, using big data analysis technology and hydrodynamic modeling, the pollution source can be accurately located and identified, and then targeted treatment measures can be taken.

3. Intelligent decision support system: The intelligent control method can provide a scientific basis for water governance decision-making. Through simulation models, data analysis, and comprehensive evaluation, the intelligent decision support system can evaluate the effects, risks, and costs of different treatment options, and help governments



and decision-makers formulate more effective water treatment strategies.

4. Intelligent regulation and optimization: Intelligent control methods can be applied to regulation and optimization in water treatment. Through intelligent algorithms, models and control technologies, intelligent regulation and optimization of water pollution control facilities and systems can be realized. This helps to improve the efficiency of contaminant removal, reduce operating costs, and ensure that water quality meets environmental standards.

5. Intelligent network management system: The intelligent control method can be applied to the intelligent network system in water management. Through sensors, remote monitoring and data analysis and other technologies, real-time monitoring and operation management of water pollution control facilities, as well as intelligent allocation and scheduling of water resources can be realized. This can improve management efficiency and response speed, and realize the refined management of water treatment.

The application of intelligent control methods in water treatment is still in the development stage, but some important progress has been made. With the continuous innovation and application of technology, intelligent control methods are expected to play a greater role in water governance, improve governance efficiency and effectiveness, and promote the improvement and protection of water environment.

(3) Garbage disposal and resource recycling

The application of intelligent control methods in the field of waste treatment and resource recovery is gradually being valued and promoted. The following is the current application status of intelligent control methods in this field:

1. Intelligent garbage sorting system: Intelligent control methods can be applied to garbage sorting systems to provide automated and intelligent garbage sorting solutions. By leveraging technologies such as image recognition, machine learning, and deep learning, the intelligent waste sorting system can accurately sort waste, providing a basis for subsequent resource recycling and treatment.

2. Intelligent Identification and Sorting of Recycled Items: Intelligent control methods can help identify and sort recycled items. Through the use of image recognition and sensing technology, the intelligent recycling and sorting system can automatically identify the types of recyclable items and sort them into the corresponding processing lanes, improving the recycling rate and resource utilization efficiency.

3. Intelligent optimization of garbage collection and transportation routes: Intelligent control methods can be used to optimize garbage collection and transportation routes. By aggregating data and traffic information from a large number of waste generation points, intelligent algorithms can analyze and optimize the collection and transportation routes of garbage trucks to reduce travel distances and improve collection and transportation efficiency, reducing environmental impact.

4. Intelligent waste treatment facility management: Intelligent control methods can be applied to the intelligent

management of waste treatment facilities. Through sensors, remote monitoring and data analysis technology, metrics such as the operating status, energy consumption and exhaust emissions of waste treatment facilities can be monitored and managed in real time to optimize the operational efficiency and environmental performance of the facilities.

5. Intelligent resource recovery and reuse: Intelligent control methods can be applied to the resource recovery and reuse process. Through data analysis and model algorithms, valuable resources in garbage can be identified and recycled, and effectively reused and recycled, reducing dependence on natural resources and promoting sustainable environmental development.

The application status of intelligent control methods in the field of waste treatment and resource recovery is still developing and improving. With the advancement and innovation of science and technology, intelligent control methods are expected to provide more efficient, accurate and sustainable solutions for waste treatment and resource recovery, and promote the realization of circular economy and green development.

(4) Clean energy utilization

Intelligent control methods are more and more widely used in the field of clean energy utilization, and some important progress has been made. The following is the current application status of intelligent control methods in clean energy utilization:

1. Smart grid and microgrid: Intelligent control methods can realize the construction and management of smart grids and microgrids. Through intelligent monitoring, data analysis and control algorithms, smart grids can intelligently manage and optimize the scheduling of clean energy generation, energy storage and consumption in the power system to maximize the efficiency and reliability of clean energy utilization.

2. Intelligent wind farms: Intelligent control methods can be applied to the operation and management of wind farms. Through wind speed prediction, machine learning, and control algorithms, smart wind farms can realize intelligent control and optimization of wind turbines to improve the capture efficiency of wind energy and the life of wind turbines, and reduce the operation and maintenance costs of wind farms.

3. Intelligent photovoltaic power generation system: Intelligent control methods can help photovoltaic power generation systems achieve intelligent management and optimized operation. Through weather forecasting, data analysis, and control algorithms, the smart PV power generation system can adjust the angle and steering of the PV array in real time to capture solar energy to the maximum extent and intelligently allocate and manage electricity.

4. Intelligent energy storage system: The intelligent control method can be applied to the intelligent management of the energy storage system. Through data monitoring, prediction and control algorithms, the intelligent energy storage system can intelligently regulate the storage, release and distribution of energy to meet the demand for clean energy and the balance of the grid.



5. Intelligent energy management and optimization: Intelligent control methods can provide solutions for intelligent energy management and optimization. Through intelligent algorithms, data analysis, and model prediction, energy consumption can be monitored and analyzed in real time, and energy supply and use strategies can be dynamically adjusted to achieve efficient use of energy and reduce carbon emissions.

The application status of intelligent control methods in the field of clean energy utilization is still developing and improving, but some encouraging results have been achieved. With the advancement and innovation of technology, intelligent control methods are expected to provide more intelligent, efficient and sustainable solutions for the development, utilization and management of clean energy, and promote the wide application and sustainable development of clean energy.

In general, intelligent control methods have a wide range of applications in various fields, and with the continuous development and innovation of artificial intelligence technology, the application prospects of intelligent control will be broader. It is expected to solve the limitations of traditional control methods, improve the stability, flexibility and efficiency of the system, and bring better development and sustainability to various industries.

V. KEY TECHNICAL SUPPORT

Behind the intelligent control method, there is a series of key technologies to support. The first is the development of sensor technology, and high-precision and high-stability sensors provide reliable data support for intelligent control. The second is the application of big data analysis and processing technology, through the mining and analysis of massive data, we can get more information and laws about the environment, and provide decision-making basis for environmental protection. In addition, the development of emerging technologies such as artificial intelligence, Internet of Things, and cloud computing also provides more possibilities for intelligent control methods.

For example:

1. Big data analysis: Big data technology can collect, store, and process large-scale data, and extract valuable information and knowledge from it through data mining, machine learning, and other methods. In intelligent control, big data analysis can be used for modeling, prediction, and optimization to help the system make intelligent decisions.

2. Machine learning: Machine learning is a method of having machines learn automatically based on input data and experience. Through machine learning, systems can learn patterns and patterns from data and make intelligent decisions based on that knowledge. In intelligent control, machine learning can be used for modeling, the design and optimization of control algorithms.

3. Deep learning: Deep learning is a branch of machine learning that learns and represents complex data by building multi-level neural network models. In intelligent control, deep learning can be used for tasks such as image recognition

and speech recognition to help the system achieve intelligent perception and decision-making.

4. Sensor technology: Sensor technology can be used to collect various parameters and status information of the system, such as temperature, humidity, pressure, light, etc. The data from the sensors provides the basis for intelligent control, so that the system can sense and monitor environmental changes in real time and make corresponding control decisions.

5. Communication technology: Communication technology is the basis for data exchange and communication between different components in an intelligent control system. Technologies such as wireless communication, Internet, and the Internet of Things can realize remote monitoring, remote operation and centralized management of intelligent control systems, and improve the flexibility and controllability of the system.

6. Cloud computing and edge computing: Cloud computing and edge computing technologies can provide powerful computing and storage capabilities to support data processing and decision-making in intelligent control systems. Cloud computing can centralize large-scale data and complex computing tasks, while edge computing enables real-time data processing and decision-making close to the data source.

These are some of the key technologies that together support the application of intelligent control methods. With the continuous progress of science and technology, these technologies are also constantly evolving and innovating, providing more possibilities and application scenarios for intelligent control.

Specifically:

(1) Sensor technology

Sensor technology has a wide range of applications in the field of environmental protection, mainly in the following aspects:

1. Air pollution monitoring: Air pollution is one of the most serious problems in the environment, and sensors can be used for air pollution monitoring. For example, combustible gas sensors, sulfur dioxide sensors, nitrogen oxide sensors, etc. can detect the concentration of various pollutants in the atmosphere, provide timely monitoring data, and provide a scientific basis for air pollution control.

2. Water quality monitoring: Water quality monitoring is also an important part of environmental protection, and sensors can be used to monitor water quality. For example, PH sensors, dissolved oxygen sensors, turbidity sensors, etc., can be used to detect water quality parameters and help determine whether the water quality is up to standard.

3. Garbage disposal: Sensors can be used for garbage disposal, for example, sensors used in landfills can monitor parameters such as temperature, humidity, oxygen content, etc., inside landfills, and these data are very important for garbage disposal and hazardous waste management.

4. Energy consumption control: Sensor technology can also be used to control energy consumption. For example, sensors used in smart buildings can monitor parameters such



as temperature, humidity, lighting, etc., to automatically adjust the indoor environment and energy consumption.

5. Environmental early warning: Sensors can be used for environmental early warning. For example, seismic sensors can detect earthquakes early and help earthquake-stricken areas carry out relevant emergency measures, and meteorological sensors can provide early warning and prediction of natural disasters such as typhoons, tornadoes, and floods.

6. Source Tracking: Sensor technology can be used to track and locate pollution sources. For example, vibration sensors, load cells, etc., used in factory production, can monitor the operation of production equipment, identify anomalies in the production process, and thus reduce pollutant emissions.

In short, sensor technology is widely used in the field of environmental protection, which can help environmental protection workers better understand the environment and polluting substances, provide scientific basis and data support, and contribute to environmental protection and sustainable development.

(2) Big data analysis and processing

There are many applications of big data analysis and processing in environmental protection, which can help environmental protection workers better understand environmental problems, improve decision-making efficiency and monitoring capabilities. The following are some specific applications of big data analysis and processing in environmental protection:

1. Environmental monitoring: Big data analysis can be used for the processing and analysis of environmental monitoring data. By collecting a large amount of environmental data, such as air quality monitoring data and water quality monitoring data, combined with big data analysis technology, a comprehensive analysis and prediction of environmental pollution sources, changing trends and influencing factors can be realized, so as to effectively guide environmental governance and policy formulation.

2. Traceability of pollution sources: Through big data analysis, the traceability information of pollution sources can be tracked and analyzed. By integrating big data sources such as environmental monitoring data, enterprise emission data, and traffic data, combined with model algorithms, specific pollution sources can be identified, their emissions can be traced, and targeted control measures can be taken to improve the treatment effect.

3. Early warning and prediction: Combined with big data analysis and machine learning algorithms, an environmental early warning and prediction system can be established. Based on historical environmental data and real-time data, the system uses model algorithms to analyze and predict possible environmental problems in the future, such as air quality deterioration and water pollution, so as to take corresponding measures for intervention and prevention as soon as possible.

4. Smart city planning: Big data analytics can be used for environmental aspects in smart city planning. By integrating various urban data, such as traffic data, socio-economic data, environmental data, etc., combined with spatial analysis and model establishment, urban environmental quality

assessment, resource utilization optimization and environmental protection facility planning can be carried out, and the sustainable development capacity of the city can be improved.

5. Feasibility assessment: Big data analysis technology can be used to evaluate the feasibility of environmental protection projects. By collecting relevant data and conducting multi-dimensional analysis, we can evaluate the cost, benefit, impact and other factors of environmental protection projects, and provide a scientific basis for government and enterprise decision-making.

In short, the application of big data analysis and processing in environmental protection can help us better understand environmental problems, monitor pollution sources, predict trends, and provide scientific basis and decision support, which will help promote the efficiency and effectiveness of environmental protection work. At the same time, it is necessary to pay attention to the privacy protection and legal use of data when using big data to ensure data security and compliance.

(3) Artificial intelligence

Artificial intelligence is becoming more and more widely used in environmental protection, and it can provide innovative solutions and more efficient decision support for environmental protection. Here are some specific applications of AI in environmental protection:

1. Intelligent monitoring and early warning: By combining sensor technology and artificial intelligence algorithms, an intelligent monitoring system can be developed to collect, analyze, and process environment-related data in real time, such as air quality, water quality, noise, etc. Based on this data, AI can predict and warn of environmental problems, detect anomalies in a timely manner, and take corresponding measures.

2. Intelligent emission control: AI can be used to monitor and control industrial emissions. Through technologies such as image recognition and sound recognition, artificial intelligence can automatically detect and identify pollution sources, assist monitoring agencies to track and inspect the emissions of enterprises, and provide real-time warnings and alarms.

3. Intelligent garbage sorting: Artificial intelligence can be used for the automation and intelligence of garbage sorting. Through image recognition and machine learning algorithms, artificial intelligence can automatically identify the type of garbage and guide users to correct sorting and recycling, improving the accuracy and efficiency of garbage sorting.

4. Smart energy management: Artificial intelligence can be applied to smart energy management systems to optimize energy dispatch and use strategies to improve energy efficiency and reduce energy waste by analyzing large amounts of energy consumption data and environmental conditions.

5. Automated monitoring and tracking: Using artificial intelligence vision and remote sensing technology, automated environmental monitoring and pollution source tracking can be carried out. For example, the use of satellite imagery and drone technology can monitor changes in forest cover, land



degradation and other conditions to help develop appropriate ecological protection plans.

6. Intelligent decision support: Based on big data and artificial intelligence algorithms, intelligent decision support systems can be developed to assist governments and enterprises in environmental decision-making. These systems can analyze complex environmental issues, assess the impact of policies, and provide sound recommendations and solutions.

In short, the application of artificial intelligence in environmental protection has great potential, which can improve the efficiency and accuracy of environmental monitoring, resource management, energy utilization, etc., and bring more innovative and sustainable solutions to environmental protection work. At the same time, it is necessary to strengthen data privacy protection and ethical norms when applying artificial intelligence to ensure its legality, security, and credibility.

(4) Internet of Things

The Internet of Things (IoT) is also widely used in the field of environmental protection, which realizes the intelligent monitoring, management and control of environmental data and resources by connecting sensors and devices with the Internet. Here are some specific applications of the Internet of Things in environmental protection:

1. Environmental monitoring: The Internet of Things can realize real-time monitoring of environmental pollution indicators. By installing sensors and monitoring equipment, such as air quality sensors, water quality sensors, etc., environmental data is collected at different locations and sent to a cloud platform for analysis and processing. In this way, environmental quality information can be obtained in a timely manner, problems can be identified and corresponding measures can be taken.

2. Intelligent waste management: Using the Internet of Things technology, the intelligent management of garbage cans and garbage recycling containers can be realized. By installing sensors on the bins, the capacity and filling level can be detected in real time, and when the waste is full, the system automatically sends a signal to alert the cleaning personnel. This can reduce waste overflow and reduce the waste of human resources.

3. Smart water management: IoT can be applied to the monitoring and management of water resources. Water quality and quantity data can be monitored in real time and transmitted to a central monitoring system through water quality sensors and flow monitoring devices. This helps to detect water pollution incidents at an early stage, optimize water resource allocation, and improve water supply efficiency.

4. Smart energy management: IoT can be used for remote monitoring and control of energy equipment. By connecting sensors and smart meters to energy devices (e.g., wind turbines, solar panels), energy generation and consumption can be monitored in real time, optimizing energy use and improving energy efficiency.

5. Wildlife conservation: IoT can be used for wildlife conservation and species conservation. For example, in

elephant conservation, by installing sensors and GPS devices on elephants, the location and behavior of elephants can be tracked in real time, helping conservationists monitor and protect elephants and reduce conflicts with humans.

6. Smart agriculture: The Internet of Things can be applied to the agricultural field to achieve smart agricultural management. Through the sensor to monitor soil moisture, temperature, environmental conditions and other information, the data is transmitted to the agricultural management platform, to achieve accurate irrigation, fertilization and pest monitoring of crops, improve the efficiency and quality of agricultural production.

To sum up, the application of the Internet of Things in the field of environmental protection can realize the intelligent monitoring, management and control of the environment and resources, and provide a more efficient, flexible and sustainable solution for environmental protection work. When implementing IoT applications, data privacy and security protections need to be considered, and legal and compliant use needs to be ensured.

(5) Cloud computing

Cloud computing is also widely used in environmental protection, helping to achieve environmental data processing, analysis, and collaboration by providing computing power and storage resources to users. Here are some specific applications of cloud computing in environmental protection:

1. Big data analysis: The field of environmental protection needs to process and analyze a large amount of environmental data and monitoring data. Cloud computing provides powerful computing and storage capabilities for efficient processing and analysis of massive amounts of data. Through the cloud computing platform, big data analysis technology can be used to mine hidden patterns and laws in data, deepen the understanding of environmental issues, and guide environmental decision-making.

2. Resource sharing and collaboration: Cloud computing provides a platform for resource sharing and collaboration between different environmental protection agencies and research institutions. Through cloud storage and cloud computing platforms, environmental data, research results and experiences can be easily shared, cross-agency cooperation and exchanges can be promoted, and the overall benefits of environmental protection can be improved.

3. Virtualization and sustainability: Cloud computing uses virtualization technology to virtualize multiple physical servers into one logical server and adjust resource allocation according to actual needs. This flexibility and optimal use of resources helps to reduce energy consumption and carbon emissions, contributing to environmental sustainability.

4. Disaster monitoring and response: Cloud computing can be used for disaster monitoring and response systems. Through the cloud computing platform, disaster-related data, such as earthquakes and floods, can be collected, analyzed, and shared in real time to provide early warning and response plans. This will help improve the efficiency and accuracy of disaster management and protect people's lives and property.

5. Smart city construction: Cloud computing plays an important role in smart city construction. By connecting the



sensors, monitoring equipment and city management system of each city to the cloud computing platform, the centralized management and analysis of various city data can be realized. This helps to optimize the use of urban resources, improve the quality of the environment, and provide smarter and more efficient urban services.

In short, the application of cloud computing in the field of environmental protection can provide powerful computing and storage capabilities to support big data analysis, resource sharing, and sustainable development. At the same time, cloud computing can also promote cooperation and collaboration among environmental protection agencies and improve the overall effectiveness of environmental protection. When applying cloud computing, you need to consider data security and privacy protection, and choose a reliable cloud service provider.

VI. INDUSTRIALIZATION OF INTELLIGENT ENVIRONMENTAL PROTECTION TECHNOLOGY

At present, intelligent environmental protection technology has become a fast-growing industry. The R&D and manufacturing of various intelligent environmental protection equipment are emerging, and the application scope of intelligent control systems is also expanding. At the same time, more and more enterprises are focusing on the environmental protection industry and investing a lot of resources in technology research and development and market promotion. All these provide a solid foundation for the industrialization and development of intelligent environmental protection technology.

(1) R&D and manufacturing of intelligent environmental protection equipment

The R&D and manufacturing of intelligent environmental protection equipment is to solve environmental problems, which combines advanced technology and the needs of environmental protection. The following are the general processes and key steps in the development and manufacturing of smart environmental protection equipment:

1. Market research: First of all, it is necessary to conduct market research, understand the needs and trends in the field of environmental protection, and determine the types and functions of intelligent environmental protection equipment that need to be developed.

2. Technical research: According to the results of market research, carry out technical research, including sensing technology, data processing technology, control algorithm, etc. These technologies will be used to make equipment smarter, enabling it to monitor, analyze, and respond to changes in the environment in real time.

3. Design and development: on the basis of technical research, the design and development of equipment is carried out. This includes mechanical structure design, circuit design, software development, etc. Pay attention to the sustainability, efficiency and intelligent characteristics of the equipment to ensure the stable operation and high performance of the equipment.

4. Prototyping and testing: After the design and development are completed, the prototype of the equipment is made, and the test is verified. Through testing, the performance, functionality and reliability of the equipment are evaluated, and necessary improvements and optimizations are made based on the test results.

5. Manufacturing: After the prototype verification is successful, it enters the mass production stage. Establish a stable production process and supply chain management system to ensure the quality, delivery cycle and cost control of equipment.

6. Marketing and sales: market and sell the produced intelligent environmental protection equipment. Through publicity and promotion, channel construction, etc., let users understand the function and value of the equipment, and provide perfect after-sales service.

In the R&D and manufacturing process of intelligent environmental protection equipment, interdisciplinary teams are required, including environmental engineers, mechanical engineers, electronic engineers, software engineers, etc. At the same time, it is important to comply with relevant laws, regulations and standards to ensure that the equipment meets environmental requirements and safety standards.

On the one hand, the R&D and manufacturing of intelligent environmental protection equipment can promote the development of environmental protection technology, and on the other hand, it can also provide effective solutions to solve environmental problems and achieve the goal of sustainable development and green development.

(2) The application scope of intelligent control system is expanded

The range of applications for intelligent control systems is constantly expanding, covering many different fields and industries. Here are some examples of the application range of intelligent control systems:

1. Industrial automation: Intelligent control systems play an important role in industrial production. It can monitor and control various parameters and variables in the production process to realize the automation and optimization of the production line. Intelligent control systems can improve production efficiency, quality and safety, and reduce energy consumption and labor costs.

2. Building and energy management: Intelligent control systems are widely used in building and energy management. It can automatically adjust indoor temperature, humidity, lighting and other parameters to achieve a balance between comfort and energy efficiency. The intelligent control system can also monitor energy usage to help optimize energy consumption and save costs.

3. Transportation: Intelligent transportation systems use sensors, communication, and control technologies to monitor and dispatch traffic flows in real time. Through the intelligent control system, it can realize the functions of road condition prediction, signal optimization, traffic scheduling, etc., improve traffic efficiency and reduce traffic congestion.



4. Agriculture and rural development: Intelligent control systems are widely used in agriculture and rural development. For example, smart irrigation systems can automatically adjust irrigation based on soil moisture and plant water requirements, improving water use efficiency. Intelligent agricultural robots can automatically complete tasks such as crop planting and picking, improving the efficiency and quality of agricultural production.

5. Healthcare: Intelligent control systems also have important applications in the field of health care. For example, smart medical devices can enable real-time monitoring and recording of patients' vital signs, providing telemedicine services and intelligent diagnosis. The intelligent control system can also be used for the control and operation of medical robots such as surgical robots and assisted living equipment.

6. Smart home: The smart control system is the core of the smart home. It can connect and control various smart devices in the home, such as smart lights, smart appliances, smart security, etc. Through the intelligent control system, users can realize remote control, scene mode, energy management and other functions to improve the convenience and comfort of home life.

Overall, the range of applications for intelligent control systems is constantly expanding and involves many key areas. With the continuous advancement of technology, intelligent control systems will play an important role in more industries to promote social progress and sustainable development.

(3) Development prospects of environmental protection industry

The development prospects of the environmental protection industry are very broad, mainly affected by the following factors:

1. Policy support: Governments around the world are paying more and more attention to environmental protection and sustainable development, and have introduced various policies and regulations to encourage the development of environmental protection industries. The government's policy support will provide a good development environment and market opportunities for the environmental protection industry.

2. Increasing public awareness: With the increasing seriousness of environmental problems, the public's attention to environmental protection is increasing. The increasing attention to issues such as clean water, improved air quality, and waste disposal will promote the rapid development of the environmental protection industry.

3. Technological progress: Scientific and technological innovation plays an important role in the environmental protection industry. The application of emerging technologies, such as intelligent perception, big data analysis, artificial intelligence, etc., provides more effective and sustainable solutions for environmental monitoring, pollution control, resource recycling, etc.

4. Market demand: The environmental protection industry covers many fields, such as air pollution control, water environment treatment, solid waste treatment, clean energy, etc. With the increasing demand for a healthy environment, the environmental protection industry will usher in a huge market demand.

Based on the above factors, the development prospects of the environmental protection industry are very optimistic:

1. Expansion of market scale: The market scale of the environmental protection industry will continue to expand, especially in the fields of air pollution control, water resources management, renewable energy, etc., which is expected to form a market size of hundreds of billions or even trillions.

2. Driven by technological innovation: The environmental protection industry needs to continuously innovate and introduce new technologies, which will promote scientific and technological progress and industrial upgrading, and promote the rapid development of environmental protection technology.

3. Increased employment opportunities: The development of the environmental protection industry will bring more employment opportunities, including environmental protection engineers, environmental protection technicians, environmental protection equipment manufacturers, etc.

4. Leading in sustainable development: The environmental protection industry is gradually becoming an important force leading sustainable development, which will promote the realization of the dual goals of economic growth and environmental protection.

In conclusion, the development prospects of the environmental protection industry are very broad, with the continuous promotion of policy support, public awareness, technological progress and market demand, the environmental protection industry will inject new impetus into economic development and have a positive impact on society and the environment.

VII. SUMMARY AND OUTLOOK

(1) The importance of intelligent methods in environmental protection technology

The importance of smart methods in environmental protection technology cannot be overlooked. With the development and innovation of science and technology, smart methods bring many important advantages and solutions to environmental protection. Here are a few important aspects of the smart approach in environmental protection technology:

1. Data collection and analysis: Smart methods can help collect, process, and analyze environmental data efficiently. Through sensors, monitoring devices, and IoT technologies, a large amount of environmental data can be obtained in real time, and intelligent algorithms can be applied for data analysis and mining. This helps to better understand environmental issues, identify sources of pollution, predict



trends, and optimize environmental protection strategies.

2. Intelligent monitoring and early warning: Intelligent methods can realize the intelligence and automation of environmental monitoring. Through the application of machine learning and artificial intelligence technology, environmental monitoring models and early warning systems can be established to monitor environmental parameters in real time, such as air quality, water quality, etc., and send out early warning signals in time once the threshold is exceeded. This allows environmental problems to be caught and dealt with earlier, reducing possible damage. [7] discussed that using wireless technologies like Wi-Fi or WiMAX, a VANET enables communication between and among moving vehicles as well as Road Side Units. As VANETs develop, their potential uses will increase. As well as safety apps, it is expected that automobiles will be able to run entertainment apps like those that allow passengers to share media or connect to the internet while on the go. Most of the time, this is what causes your mobile data plan to go over. Cooperation driving is intended to increase passenger and driver safety by allowing cars to exchange and receive emergency or help-related communications with one another. Keeping a safe distance between vehicles is essential for avoiding collisions, and inter-vehicle communication is a very efficient means of achieving this goal through the exchange of information between moving machines. Messages about reckless driving, gasoline leaks, and other issues are broadcast. Data transmission between automobiles via Li-Fi technology is accomplished by LED panels, with photodetectors on the receiving end for data reception. Due to the absence of a protocol requirement, the complexity of this application is greatly reduced. Using Li-Fi is a certain way to get lightning-fast data transfers and do your part to protect the planet.

3. Pollution source location and treatment: Intelligent methods can help locate and control pollution sources. Through data analysis and modeling, intelligent methods can accurately identify the location and scope of pollution sources and provide targeted remediation measures. This will help to speed up the resolution of environmental problems and effectively prevent the spread and further deterioration of pollution.

4. Resource Optimization and Conservation: Smart methods can optimize resource use and save energy. Through the application of optimization algorithms and intelligent control technologies, intelligent energy systems, water resources management and waste disposal can be realized. For example, in energy supply systems, smart methods can optimize energy dispatch and energy storage strategies, improve energy efficiency and reduce carbon emissions.

5. Decision support and planning: Intelligent methods can provide scientific basis and support for environmental protection decision-making. Through model simulation and data analysis, intelligent methods can evaluate the effects and risks of different environmental protection options and provide reference for decision-makers. This contributes to the

development of more scientific, feasible and sustainable environmental protection policies and plans. [8] discussed about a method, This scheme investigates a traffic-light-based intelligent routing strategy for the satellite network, which can adjust the pre-calculated route according to the real-time congestion status of the satellite constellation. In a satellite, a traffic light is deployed at each direction to indicate the congestion situation, and is set to a relevant color, by considering both the queue occupancy rate at a direction and the total queue occupancy rate of the next hop. The existing scheme uses TLR based routing mechanism based on two concepts are DVTR Dynamic Virtual Topology Routing (DVTR) and Virtual Node (VN). In DVTR, the system period is divided into a series of time intervals. On-off operations of ISLs are supposed to be performed only at the beginning of each interval and the whole topology keeps unchanged during each interval. But it has delay due to waiting stage at buffer. So, this method introduces an effective multi-hop scheduling routing scheme that considers the mobility of nodes which are clustered in one group is confined within a specified area, and multiple groups move uniformly across the network.

The importance of smart methods in environmental protection technology is reflected in improving efficiency, reducing resource waste, preventing environmental risks, and improving the quality of decision-making. They provide a smarter, more precise and more sustainable solution for environmental protection, and promote the development and progress of environmental protection.

(2) Future development trends and application prospects

The development prospects of intelligent methods in environmental protection technology are very broad, and the following are the future development trends and application prospects:

1. Integration of big data and artificial intelligence: With the continuous progress of big data technology and artificial intelligence, the application of intelligent methods in environmental protection will be more in-depth and extensive. The collection and analysis of big data will provide more comprehensive, detailed, and accurate information on environmental issues, and AI algorithms and models can better use this data for environmental monitoring, prediction, and decision support.

2. IoT and the development of smart sensors: Advancements in IoT technology and smart sensors will further drive the application of smart methods in environmental protection. By connecting the sensor network with cloud computing, real-time monitoring and remote control of environmental data can be realized. This results in more efficient, precise and sustainable solutions for environmental protection.

3. Smart Cities and Sustainable Development: Smart city construction has an increasing demand for environmental protection, and smart methods will play an important role in the planning and management of smart cities. Smart methods can help cities monitor and manage environmental quality,



optimize resource utilization, and provide solutions for intelligent transportation and energy systems to achieve sustainable urban development.

4. New and clean technologies: Smart approaches will facilitate the development and application of new and clean technologies. With a smart approach, we can better manage and optimize the access and storage of renewable energy, improve energy efficiency, and drive innovation and implementation of clean technologies. This will help reduce dependence on traditional energy sources and promote the development of an environmentally friendly economy.

5. Intelligent Decision Support Systems: Intelligent decision support systems will become more common and critical. By integrating big data analysis, simulation models, and intelligent algorithms, intelligent decision support systems can provide more accurate, comprehensive, and reliable information for environmental protection decision-making. This will help to formulate more scientific, feasible and sustainable environmental policies and accelerate the process of solving environmental problems.

In conclusion, intelligent methods have broad development prospects in environmental protection technology. As technology advances and innovates, smart methods will continue to improve their capabilities in environmental monitoring, early warning, governance, and decision support, making an important contribution to achieving sustainable development and building a better environment.

To sum up, smart methods are playing an important role in environmental protection technology. Through the application of intelligent control methods, we can better meet the needs of environmental protection, improve governance efficiency, and achieve sustainable development. With the continuous innovation of key technologies and the advancement of industrialization, it is believed that intelligent environmental protection technology will play a more important role in the future development.

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