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## Application Status and Development Trend of Information Engineering Technology in Environmental Protection

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# Application Status and Development Trend of Information Engineering Technology in Environmental Protection

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**Abstract.** With the acceleration of industrialization in China, environmental pollution is becoming more and more serious. Therefore, the environmental protection is imminent. At present, information engineering technology has been developing swiftly and applied to many aspects of social life. To apply information engineering technology to environmental protection has proved to be an inevitable choice to conform to the development trend of the times. This paper will elaborate the internal relationship between information engineering technology and environmental protection, and summarize the application of information engineering technology in environmental protection. In addition, this paper will also state the future development trend of the application of information engineering technology in the field of environmental protection.

## 1. Introduction

Nowadays, environmental protection has become such a significant issue that people all over the world should be paid attention to it. In pace with the acceleration of industrialization and urban modernization, the degree of environmental pollution has gradually deepened. Air pollution and water pollution are not uncommon in China, which will have a negative impact on people's health and human future development. Accordingly, the importance of environmental protection is self-evident, and the environmental protection construction is also imminent.

In the past, the environmental protection work in China was often carried out in an artificial, localized and unscientific way, which led to inefficiency, poor integrity and many other problems. What's more, our country has a vast territory and the natural environment is complex, which also increases the resistance of environmental protection work to a certain extent. Under this circumstance, information engineering technology can be applied to the field of environmental protection to solve the problems mentioned above.

Information engineering technology has been developing rapidly in the past decades, which is part of one of the most frontier fields in the development of today's science and technology in the whole world. Information engineering technology contains lots of knowledge including electronics, communications, computers and other subjects. Applying the above-mentioned information engineering technology to environmental protection can greatly improve the efficiency of environmental protection work, ensure the smooth running of environmental work, and can also improve the comprehensive decision-making ability of environmental protection departments.



Today, information engineering technology has been widely used in the field of environmental protection, and quantities of achievements have been obtained. In the foreseeable future, many new technologies of information engineering will be applied to environmental protection construction in succession. These new technologies will promote environmental protection to develop to convenient and intelligent direction.

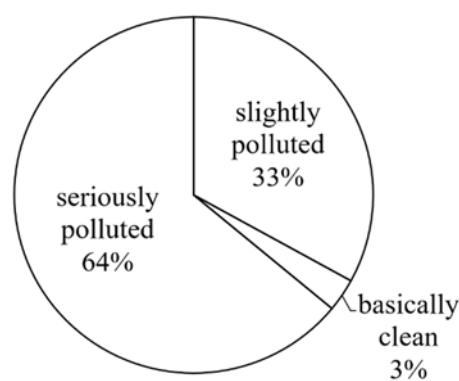
## 2. The relationship between information engineering technology and environmental protection

### 2.1. Analysis of Environmental Situation in China

This part mainly analyses the current environmental situation in Chinese Mainland, and elaborates the range and extent of environmental pollution in China, as well as the environmental pollution caused by urban development and industrialization, in order to apply information engineering technology to the field of environmental protection in China contrapuntally.

*2.1.1. Range of Environmental Pollution.* With the analysis the relevant data, we can draw a conclusion that the pollution level is higher in regions with faster economic development. This is because that many industries that cause environmental pollution, such as chemical industry, pharmaceutical industry, tobacco and alcohol industry, can largely promote the economic development of a region. In addition, environmental pollution not only exists on the earth's surface, but also in the ocean, air and many places below the earth's surface.

*2.1.2. Pollution from Urban Development.* In China, the rapid economic development of cities has polluted air, soil and water sources to a large extent. Many enterprises pursue economic interests too much and neglect environmental protection, which leads to the overuse of natural resources. According to related data, nearly one third of China's total water resources are groundwater, but about 90% of the groundwater in China is polluted to varying degrees. After monitoring groundwater in nearly 120 cities, the related department found that approximately 64% of urban groundwater was seriously polluted, about 33% of urban groundwater was slightly polluted, and only 3% of urban groundwater was basically clean.



**Figure 1.** Urban Groundwater Pollution in China

*2.1.3. Pollution from Industrialization.* Industrialization has caused waste water, gas and residue pollution, which are mainly caused by enterprises in steel, electricity and other industries. In recent years, the pollution of exhaust gas and waste residue is extremely serious, and the haze is one of the main manifestations. Many cities in China have been seriously polluted by haze weather since 2013. Haze makes the sky grey, and has a very bad impact on people's physical and mental health.

## 2.2. Summary of Information Engineering

Information engineering is a specialized subject which studies the theory, technology and engineering realization of information processing, playing an important role in the process of information socialization in the 21st century. It includes knowledge related to circuit theory, signal theory, electronic technology and computer technology, and has come into contact with the most up-to-date technology. Therefore, the application of information engineering technology to environmental protection will certainly improve the efficiency of environmental protection work [1].

Many colleges in China have set up information engineering major. It covers a wide range of knowledge at the undergraduate stage. The following table will introduce the main courses of information engineering.

**Table 1.** Main Courses of Information Engineering

Category	Specific courses
Signal theory	Signal and Linear System, Random Signal Processing, Digital Signal Processing, Digital Signal and Information Processing, etc.
Communication Theory and Circuit Theory	Circuits and Systems, Communication Electronic Circuit Information Theory, Coding Theory, Communication System Principles, etc.
Computer Science and Technology	Microcomputer Principle, C/C++ Language Programming, Computer Communication Network, etc.
Others	Practical Teaching and Professional Experiments on Information Engineering

## 2.3. Advantages of applying information engineering technology to environmental protection

The application of Information Engineering Technology in environmental protection is conducive to achieving greater results and improving work efficiency. When the environmental protection management system is improved, we can break the traditional environmental protection management model which restricts time and region. With the help of an environmental management system that contains accurate information, managers can analyze and study the information to ensure the feasibility of environmental protection work. Besides, with the help of network technology, we can build an online platform for the staff and the general public to communicate with each other so that we can further improve the efficiency of environmental protection work.

## 3. Application Status of Information Engineering Technology in Environmental Protection

### 3.1. Application of 3S Technology and Related Information Engineering Technology

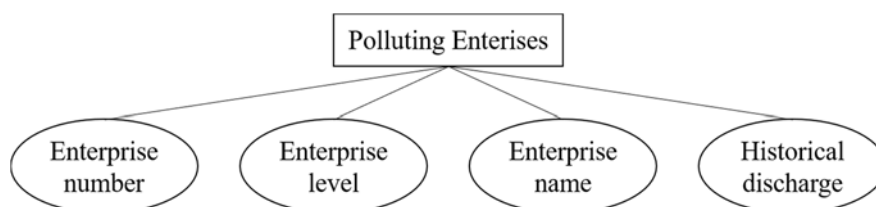
3S technology is the summation of remote sensing (RS), geographic information systems (GIS) and global positioning systems (GPS). 3S technology and related information engineering technology are widely used modern environmental protection, and will be introduced below in three parts.

**3.1.1. Remote sensing (RS).** RS is a modern integrated technology for remote monitoring and recognition of various surface features and phenomena by processing electromagnetic waves. RS can be used in vegetation resource survey, environmental quality monitoring and other environmental protection fields [2, 3]. For example, remote sensing images can reflect the hue, shape and other characteristics of water body. Professionals can get the information of pollution source, pollution scope and pollution area by analysing these images.

**3.1.2. Geographic information systems (GIS).** GIS is a computer software system specializing in geographic information management, generally composed of computer, software, spatial database, and graphical user interface and system personnels.

There is a great connection between GIS and database technology. In environmental protection work, geographic, pollution and detection information need to be managed through database. For instance,

after we collect the data of an enterprise's sewage discharge, we need to store these information into the database. We can describe these information and their internal relations through the E-R diagram shown below.



**Figure 2.** E-R Diagram of Polluting Enterprises and Their Attributes

In this E-R diagram, each rectangle represents a set of entities, and each ellipse represents an attribute of the set of entities. This E-R diagram represents the conceptual model of polluting enterprises. We can translate this conceptual model into a relational model and express it as follows:

Polluting Enterprises (enterprise number, enterprise level, enterprise name, historical discharge)

We can build a two-dimensional table which reflects the information of polluting enterprises through the above relation. In this relational model, the Enterprise Number attribute can uniquely identify a tuple, so it is called the primary key, and we underline it.

Similarly, we can build other two-dimensional tables containing environmental information, which can be combined to form a database. By building several large databases on the platform of GIS, we can manage and analyze the environmental information conveniently, efficiently and economically.

**3.1.3. Global positioning systems (GPS).** GPS is a system with real-time navigation and positioning capabilities. By making use of GPS, we can accurately locate environmental elements and pollutant sources, and record the relevant environmental information with the function of data acquisition in GPS. GPS is mainly used as a tool for GIS data updating and data acquisition. Furthermore, GPS also plays an important role in the emergency command of environmental pollution accidents.

### 3.2. Application of Office Automation Technology (OA)

Office Automation (OA) is a new way to office mode which combines modern office and computer technology. It is widely used in environmental protection departments. Online office platforms can enable the staff to share information and work together easily and efficiently so that they can abandon the inefficient traditional office methods.

OA requires a high bandwidth and speed of computer network transmission. Therefore, 1000M network technology is usually used as the network backbone, while 10M/100M technology is used for the desktop. It should be noted that 100M (100Mb/s) here refers to the network transmission rate. However, B/s (Byte/s) is often used in describing file sizes in computer systems. 1 Byte equals 8 bits. Therefore, we can get a conversion formula:

$$1\text{B/s}=8\text{b/s} \quad (1)$$

Therefore, the theoretical rate of 10M broadband is 1.25MB/s, and that of 100M broadband is 12.5MB/s. In office scenarios, the size of office documents is around 10KB-10MB, so 10M/100M network technology can meet the needs of desktop office automation.

## 4. Development Trend of Information Engineering Technology in Environmental Protection

### 4.1. Combination of 3S Technology and Expert System (ES)

Expert System (ES) is a program system with expert level and problem solving ability in a specific field. It can effectively use the experience and knowledge accumulated by experts for years to solve the

problems by simulating the thinking process of human experts [4]. ES is a branch of artificial intelligence, and it is highly valued.

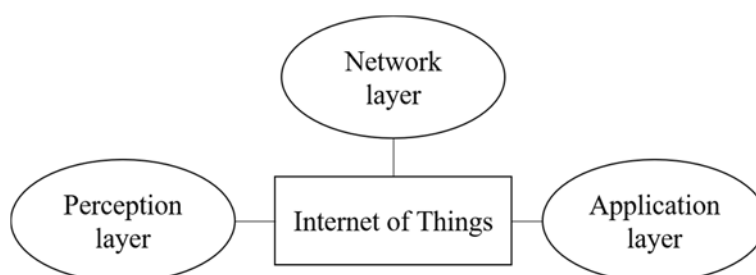
ES has the ability to analyze and solve problems in specific fields, which can be combined with 3S technology. Then environmental protection information system can carry on information analysis more accurately and efficiently. Besides this, the decision-making ability of environmental protection information system can also be improved.

#### 4.2. Development of Internet of Things and 40G/100G Ethernet Technology

In recent years, many new Internet technologies have come into people's lives. Among these new Internet technologies, Internet of Things, 40G/100G Ethernet and other technologies will gradually change the way of information storage and data processing in environmental protection in the future.

The Internet of Things (IOT) extends the user side to any item on the basis of the Internet to realize information exchange and communication. There are perception layer, network layer and application layer in the structure of the Internet of Things.

The perception layer obtains environmental information through sensor networks; the network layer transmits information through communication networks; and the application layer processes information through cloud computing platforms.



**Figure 3.** The Structure of Internet of Things

The IOT is widely used in environmental monitoring, water system detection and other fields in environmental protection [5]. Nowadays, monitoring devices with a large number of sensor nodes have been used to monitor the emission of pollution sources such as wastewater. Later, the information acquired by the monitoring equipment will be transmitted directly to the central system of the environmental protection departments through the network for real-time monitoring, which not only saves manpower and material resources, but also improves efficiency.

However, the data traffic will also be very large when there are too many devices used for monitoring. In order to ensure the smooth transmission of data and the stable operation of large environmental information database, high-speed network transmission technology like 40G/100G Ethernet technology is essential.

40G/100G Ethernet is also called the next generation ultra-high-speed optical transmission technology. Its technical standard is supported by IEEE 802.3ba. In the future, the booming development of new information engineering technologies will inevitably lead to the establishment of large-scale environmental information data centers by environmental protection departments at all levels. When provincial environmental protection departments collect data or coordinate the management of county environmental protection departments, data interaction between data centers of various departments necessarily requires 40/100Gbps to provide higher bandwidth protection. The adoption of 40/100G Ethernet technology can meet the massive bandwidth requirements of data center interconnection, and also can effectively reduce the power consumption of network equipment, thus helping environmental protection departments establish new data centers with high density and speed.

## 5. Conclusion

Modern environmental protection work needs the support of new technology. In recent years, the rapid development of information engineering technology has greatly promoted the informatization reform of environmental protection. Information engineering technologies such as database technology, computer network technology and information processing technology have been applied to the field of environmental protection. The application of these information engineering technologies in the field of environmental protection not only contributes to the development of the environmental governance industry in China, but also provides a scientific basis and guarantee for the sustainable development of environmental ecology in China. We can foresee that some time, when the environmental law enforcement officers come to an enterprise for inspection, the intelligent terminals in their hands can show much basic information of the enterprise, including the type of products, the examination and approval time of environmental impact assessment, the technological level of waste disposal and so on. In the future, the environmental protection work will be more convenient and intelligent.

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