Application of Optical Fiber Sensing Technology in Internet of Things

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Abstract

Nowadays, the Internet of Things has developed into a research hotspot, and the optical fiber sensing technology has also been widely used in the development of the Internet of Things, and has attracted widespread attention. The core components of the Internet of Things are sensors, especially optical fiber sensors, and other types of sensors do not have the advantages. The Internet of Things has four main technical layers: application interfaces, data processing technologies, and data transmission networks. The transmission network, in the Internet of Things we will see the presence of a large variety of sensors that can be used to sense different environmental parameters such as temperature, gravity, optoelectronics, sound, vibration, and displacement. Provide the most primitive data information for the Internet of Things. At present, the application of fiber-optic sensing technology in the Internet of Things has aroused great concern from all walks of life. This article mainly discusses the definition and structure of the Internet of Things, as well as the principle and development status of optical fiber sensors, and focuses on the application of fiber-optic sensor technology in the Internet of Things. It is hoped that through the discussion in this article, we can have some positive impact on the application of fiber optic sensing technology in the Internet of Things.

Keywords

Optical fiber sensingtechnology, networking; principleandstatus, application, sensor network.

1. Introduction

The Internet of Things uses information-sensing devices such as radio frequency identification (RFID), infrared sensors, global positioning systems, and laser scanners to transfer and transfer information to each other through the Internet. A network implementation concept that enables intelligent identification, positioning, tracking, monitoring, and management. This concept was developed on the basis of the concept of the Internet. It is a network concept that extends and expands the user's end to the communication and exchange of information between any item and item. In recent years, with the continuous development of optical fiber communication technology, optical fiber sensing technology has emerged[1].

Since the development of fiber-optic sensor technology, fiber-optic sensors have been rapidly developed due to a variety of advantages, such as small size, high sensitivity, and strong anti-interference ability. Today, they have been widely used in many fields, such as: Pharmaceutical manufacturing, shipbuilding, civil engineering, etc. Especially with the rapid development of the Internet of Things, the status of fiber-optic sensing technology is becoming more and more important. In this article, we will introduce in detail the structure, classification, and some other application examples in the Internet of Things for fiber-optic sensors in the IoT, such as fiber optic gyroscopes, fiber optic hydrophones, fiber grating sensors, and fiber-optic current sensors. The Brillouin-effect continuous distributed optical fiber sensing technology, which is widely used in front-end applications of the Internet of Things, will also be introduced.

2. About the definition and composition of the Internet of Things

The Internet of Things refers to the use of infrared sensors, positioning systems, laser scanning and other sensing devices, following a specific agreement to closely link items and the Internet, thereby

completing information exchange and communication, and ultimately achieving intelligent identification, tracking, Locate and manage the network. The Internet of Things refers to a network that connects people, items, etc[2]. in any way and at any time to meet people's various needs. In other words, the Internet of Things is a network that connects objects.

The Internet of Things is mainly composed of three parts, namely, the sensing layer, network layer, and application. Among them, the sensory layer is the function of implementing intellisense, which involves the function of information acquisition, acquisition and recognition. The network layer communicates information and communicates. However, for the application layer, it mainly involves various types of applications, such as: grid applications, agricultural applications, and engineering construction security.

3. Principles and Development Status of Optical Fiber Sensors

3.1 Principle and Classification of Optical Fiber Sensors

Optical fiber sensors consist of several components, including light sources, transmission fibers, detectors, and signal processing equipment. Its working principle is to send light through the optical fiber to the modulator. In this way, the measurement parameters and the light in the modulation area act to change the light properties so that the light emitted by the light source becomes modulated. The signal light is then transmitted to the photodetector by means of an optical fiber, which in turn transforms the optical signal into an electrical signal. The signal processing device finally restores the physical quantity on the north side.

In real life, there are many types of fiber optic sensors. However, we attribute these sensor types to two types, sensory and transmission[3]. Compared with traditional electrical sensors, fiber-optic sensors have many advantages, such as strong anti-interference ability, good insulation, and high sensitivity. Therefore, optical fiber sensors are currently in various fields.

3.2 Status Analysis of Optical Fiber Sensors

Since the appearance of optical fiber sensors, its advantages and applications have attracted the attention of people in various countries. And in-depth research on optical fiber sensing technology. Today, physical quantities such as displacement, temperature, speed, and angle can be measured with fiber optic sensors. Nowadays, many western developed countries will focus their attention on fiber optics control systems, nuclear radiation monitoring, civilian plans, and other aspects of optical fiber sensor research, and have achieved gratifying results.

China's research on fiber-optic sensors started late, and many research institutes and companies have conducted in-depth studies on fiber-optic sensors to promote the development of fiber-optic sensing technologies. In 2010, Zhang Xuping's "Brillouin Effect Continuous Distributed Optical Fiber Sensing Technology" passed the expert's appraisal[4]. The expert group believes that this technology is highly innovative and the technology has reached the world's advanced level. Therefore, it has broad prospects for development. The development of this technology is mainly the application of the Internet of Things technology, which has accelerated the development of the Internet of Things in China.

4. Position of Optical Fiber Sensing Technology in the Internet of Things

Sensors are an extremely important part of the Internet of Things. Therefore, the performance of the sensor determines the performance of the Internet of Things. It can be said that the main means for the Internet to obtain information is the sensor. In this way, the reliability and accuracy of the information collected by the sensors will have a certain impact on the control node processing and transmission of information. From this point of view, the reliability and anti-interference of sensors will play a decisive role in the application performance of IoT.

5. Application of Optical Fiber Sensing Technology in Internet of Things

Through the above analysis, we know that the development of the Internet of Things must rely on a large number of sensors to obtain various environmental parameters, so as to provide more reliable data information for the Internet of Things, and then through the system to obtain the results that people need. The following is a detailed discussion of the application of fiber optic sensing technology in the Internet of Things.

At present, there are four types of fiber optic sensors that are most widely used: fiber optic gyros, fiber optic hydrophones, fiber grating sensors, and fiber optic current sensors. Among them, there are three types of fiber optic gyroscopes: interference type, resonant type, and Brillouin type. Interferometric fiber optic gyroscope is a first-generation commercial stage with mature technology. Resonating fiber optic gyroscope is the second generation in the laboratory research stage. The Liyuan Fiber Optic Gyroscope is a third-generation fiber optic gyro sensor in the theoretical research stage. The fiber optic hydrophone is an underwater acoustic signal sensor based on fiber optics and optoelectronics technology. The sensor is based on highly sensitive fiber optic coherent detection. The sound signal in the water is converted into an optical signal, which is then transmitted to the signal processing system through an optical fiber and converted into a sound signal. This sensor can be classified into interference type, intensity type, and grating type according to principles; it is included in the products of fiber grating sensors. Strain sensors, temperature sensors and pressure sensors, among which optical fiber bragg grating sensors are the focus of research in recent years, most of them belong to light intensity type and interference type, and have advantages and disadvantages. Since the beginning of this year, the development of electric power has been rapidly advancing. Under such circumstances, in the face of strong current measurement problems, fiber-optic current sensors can avoid accidents caused by excessive electric power.

5.1 Application of Construction Project IoT

Nowadays, in the process of construction of highways and bridges, safety accidents such as tunnel collapses, fires, and cracks in bridges often occur. This not only poses serious threats to people’s life and property safety, but also results in certain economic development in China. Impact. However, if the fiber-optic sensor is placed in a building, it is possible to know in time whether the bridge is deformed or the load carried by the bridge, etc. It is also possible to detect whether the deformation of the tunnel is likely to occur by means of a tension sensor. We will use this information and When the Internet is connected, an optical fiber internet of things is formed, and then these infrastructure projects can be monitored over a long period of time to reduce or prevent the occurrence of security incidents.

5.2 Application of Agricultural Internet of Things

China is a large agricultural country. Most people live in rural areas. Therefore, the development of agriculture is extremely important for the development of our country's economy. It can be said that in recent years, the development of the Internet of Things has made great progress in China's agricultural development. In general, the sensor technology is applied to the growth, harvesting, storage, and other aspects of crops. As a result, an internet of things is formed, so that agricultural production and management can achieve high production and low consumption.

In the growing process of crops, the temperature, humidity and soil composition of the crops are monitored by means of optical fiber temperature sensors, humidity sensors, etc., so that the monitoring information is fed back to the system in time, and these are then controlled by the control devices in the system. The parameter to a suitable value, so that the crop grows in a suitable environment, to achieve high-yield purposes. In addition to this, optical fiber sensors can also be used to sense the information of the food reserve environment and guide workers to turn over the food.

5.3 Perimeter Intrusion Prevention System Application

In recent years, a new field in the development of fiber-optic sensing technology is the perimeter intrusion prevention system. However, there are many types of sensors used in the current defense

system, so many solutions have emerged. However, technically speaking, they use the fiber perimeter intrusion sensor to obtain information on external intrusion factors and issue an alarm signal at the same time. Today, this technology has been widely used in power stations, military and other fields.

5.4 Other applications

In the actual application process, fiber-optic sensors have the advantage of anti-jamming. Therefore, fiber-optic sensors are generally used in places where electric sensors are not suitable, especially in national defense. Fiber-optic sensors are used in fiber guidance, aerospace, etc. Detection; however, in the power system, it is usually used in the rotor, voltage, transformer current, etc. of the super-large motor; in addition, the fiber optic sensor can also be used in the oil and gas production process for the underground temperature, the oil pipeline Road monitoring. Combining these with the Internet, we can form a larger Internet of Things. Only in this way can we effectively implement safe production and management.

6. Conclusion

On the whole, at present, due to its many advantages, fiber-optic sensors have attracted great attention from all walks of life. At the same time, they have also been widely used in people's daily lives. The core component of the Internet of Things is the sensor. In addition, in recent years, with the rapid development of sensing technology in China, the application of fiber-optic sensing technology in the Internet of Things has become the focus of people's research, and for people's production. And life has made tremendous contributions. Because sensors have a wide range of application prospects in the Internet of Things, in the next few years, the Internet of Things will have a market capacity of trillions of yuan, which can be said to be higher than the Internet industry alone. About 3 times.

In the process of actively developing the Internet of Things, if the development of sensor technology is stagnant, then the various sensors required for the Internet of Things must be imported from abroad. As a result, the sensor market will be occupied by foreign countries and it will lose more. Capital, in turn, has deprived the country’s economic development of protection. In the next few years, IoT technology will be widely used in various fields, which will make a huge contribution to the country’s economic and social development. Therefore, we must further study and explore the application of fiber optic sensors in the Internet of Things.

References

[1] Tang B, Cheng H. Application of Distributed Optical Fiber Sensing Technology in Surrounding Rock Deformation Control of TBM-Excavated Coal Mine Roadway[J]. Journal of Sensors, 2018, 2018(4):1-10.

[2] Zhang S, Zhang Z. Monitoring of temperature field variation of natural gas tank leakage based on optical fiber sensing technology[J]. Journal of Jiangxi University of Science & Technology, 2017.

[3] Yang Y, Yang D. Application of bridge continuous shape measurement system based on optical fiber sensing technology in bridge post-seismic detection[C]// International Conference on Optical Fiber Sensors. International Society for Optics and Photonics, 2017:103236J.

[4] Fei-Long W U, Jie X U, Zheng X L, et al. Research and Application of Optical Fiber Sensing Technology in the Submarine Cable Monitoring[J]. Electric Power Information & Communication Technology, 2016.