Journal of Computing and Electronic Information Management
ISSN: 2413-1660 | Vol. 15, No. 3, 2024

Summary and Optimization Analysis of Water Quality Detection System Based on IOT

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Abstract: In essence, the water quality monitoring system based on IOT is to detect the water quality data in different areas in real time and control water pollution effectively. It is an important problem to optimize the efficiency of upgrade detection based on IOT system and other technologies. In order to optimize and upgrade the IOT water quality monitoring system, this paper summarizes the working principles and functions of different types of IOT water quality monitoring systems at home and abroad, and puts forward some suggestions. On this basis, eight feasible system schemes including embedded system are summarized. If the technology can be improved and upgraded accordingly, it can be popularized and applied in a large area in the near future.

Keywords: Embedded system; BDS; Cloud service.

1. Introduction

In the current environment, water resources are in short supply and some water areas are polluted in a large scale. Therefore, it is urgent to strengthen water quality detection.

2. Research process (citing literature review)

2.1. Water quality monitoring system design of embedded IOT technology

In our country, the technology of bacteria detection, spectrum analysis, wireless remote sensing and automatic detection are mainly used to analyze water quality data, master data status, optimize detection structure and analyze water quality pollutants [1]. In terms of the system, Professor Tian Xiaowen and his team have developed a water quality monitoring system design based on embedded Internet of Things technology. The lower computer of the water quality monitoring system controlled thereby is responsible for real-time monitoring and transmission, and the upper computer is responsible for receiving and processing data. The water PH value, water temperature and TDS water quality can be monitored in real time. The detection efficiency can be improved by combining the APP module at the mobile phone end and other IOT modules [2].

The embedded water quality monitoring system is based on the microcontroller, and a set of simple monitoring closed loop is formed by the real-time monitoring function of the lower computer and the upper computer.

In fact, this embedded system is based on computer technology, software and hardware can be tailored to meet the strict requirements of the application system on function, reliability, cost, size, power consumption. From simple single- chip microcomputer systems to complex on-chip systems (SoC), and embedded devices related to the Internet, these systems usually have the characteristics of low power consumption, small size, high reliability, etc. In addition, the embedded operating system can not only make full use of EOS, but also provide friendly GUI and graphical interface, and support TCP/IP protocol and other protocols. And, in the relatively harsh environment, the embedded microprocessor can meet the needs of portable and virtual instruments.

However, the use of embedded systems also has its drawbacks, the first is that its software is highly dependent on hardware, software portability is poor. Secondly, because of its weak interactivity, it needs to ensure the accuracy of the core operating system, so its reliability is very important. If it is to be widely used, it needs more safeguards. In addition, the embedded system has small kernel, limited processing capacity, limited resources and limited functions.

Generally speaking, this kind of water quality detection system embedded with microprocessor is a relatively superior way to high manpower detection. It can be properly applied, upgraded and optimized.

2.2. Water quality inspection by remote lake operation machinery

In addition, significant research has been carried out on the lake water quality monitoring system. Wang Jialin and his team have used the IOT lake monitoring to conduct remote lake water quality monitoring through the IOT lake monitoring and transmission of the IOT remote lake operating machinery. Some problems have been solved through integrated CPU processing and information within the IOT core to enhance the efficiency and safety of lake water quality testing [3].

Water quality monitoring equipment is a multi-functional water quality detector, which can detect different pollution indexes such as COD, ammonia nitrogen and residual chlorine. Its principle is: when the water enters the sensor, the photoelectric conversion circuit of the sensor will amplify and shape the signal, and send the processed signal to the MCU directly. After analyzing and processing the data, the SCM sends instructions to the wireless communication module to make the water reach the corresponding position of the sensor. Then the pump is controlled to pump water, and the water level monitoring device is connected with the water quality detector by wireless communication module to ensure that the water quality detector can timely operate according to the water level detected by the water level sensor. When the water level falls to a certain extent, the sensor will send an alarm signal in time.

In the actual operation process, due to the various types of water pollution, different methods should be selected according to the actual situation when detecting different

types of pollutants. For example, when a water body is polluted by organic matter, the method of redox and ultraviolet absorption can be chosen; when a water body is polluted by inorganic matter, the photometric method can be chosen; when a water body is polluted by bacteria, the colorimetric method can be chosen.

2.3. Real-time monitoring of distributed nodes of fusion algorithm

Based on the NB-IOT network communication framework, Meng Lili and her team constructed a unified water quality detection and processing platform, and fused the sensor detection data to achieve real-time monitoring of distributed water quality treatment system [4].

Finally, through one or several fusion models, the sensor data are fused, and then the prediction model is established for simulation and error analysis. Through weighting and other methods, the problems of small and reliable model are solved.

For traditional transmission mode, a considerable amount of energy is used for unnecessary data transmission. The energy consumption of data transmission in sensor networks is much larger than that of data processing. Therefore, in large-scale wireless sensor networks, it is necessary to fuse the data before multi-hop transmission of sensor data to Sink nodes. Therefore, the DWT _ IRR algorithm proposed by R Wanger of Rice University in his doctoral dissertation can be used to solve the problem of dense and irregular node distribution in water quality monitoring.

Combining with this algorithm, we can make full use of the relativity of sensing data, transform it effectively, and avoid the hot issues, averaging the energy of bottleneck node and cluster head node to the whole node network.

2.4. ZigBee data transfer

In Gannan Tibetan area, where water resources are seriously polluted, Ma Zhenxin and Ma Guojun jointly designed a set of wireless sensing technology based on continuous monitoring of water level, water temperature +, etc., and used various sensors to transmit the collected information to the database through the ZigBee mode for analysis, so as to quickly obtain the relevant information and facilitate the rapid response measures [5].

ZigBee wireless network technology can communicate with thousands of tiny sensors in coordination, and lower energy consumption, the use of radio transmission data, transmission efficiency. Zigbee technology is introduced in the water quality detection system, which can support the data transmission between various electronic devices with low power consumption and low complexity.

But the technology requires Zigbee chips to be produced in large quantities. In many cases, it is not attractive in an environment with many nodes, sensitive to cost and strong signal interference. In this case, LoRa module can be selected for modulation and frequency hopping, because of its better anti-jamming performance, compact size, easy to integrate into the detection equipment, with long-distance communication, anti-jamming, flexible expansion and other advantages, is a reliable wireless connection solution.

BDS positioning simulation analysis

In order to expand the network coverage of water quality testing and optimize the functions of data cloud storage, Zhang Zhaozhi proposes to utilize the short message communication and group management functions of the Beidou system, with professional sensors, customized data collection modules and stable dual communication links, develop a water quality monitoring system with two functional modules, namely front-end monitoring and central monitoring, to realize the monitoring, alarm and information release of water quality information, and provide decision-making support for water pollution prevention and control and water conservancy utilization [6].

In the BDS measurement, BDS positioning is used for digital processing to further optimize the BDS measurement and control results. Combined with the development trend of Beidou positioning technology, based on the theory of multi-rate signal processing technology, the echo signal is processed by quadrature conversion, so the digital down conversion is realized.

2.5. Unmanned surface vehicle (USV)

Vasudevan Shriram K. and his team designed an unmanned surface vehicle based on the IOT system to investigate the performance quality of biochemical indicators such as PH, dissolved oxygen, etc., generate a characteristic map for each parameter, and then transmit it to a cloud in real time to track the quality of the water [7].

The application of USV in water quality detection is relatively mature, but there are still some problems such as low positioning accuracy, lack of autonomous cruising ability and limited water quality detection scope. At the same time, the application of USV in water environment monitoring is limited because of the limitation of USV's own characteristics and using environment, such as using fixed wing UAV or propeller UAV as carrier, carrying different sensors and limited monitoring range. In the application of unmanned surface vehicle (USV), the performance of USV can be improved by adding multi-sensor system and communication system. In the future, more scientific research and engineering practice are needed in the aspects of USV water quality detection and autonomous cruise. With the development of sensors, we can use more precise sensors to obtain higher resolution images and data in water quality detection. In the aspect of multi-sensor data fusion, we can adopt the method based on feature extraction, and use the data information obtained by USV and other devices to carry out the fusion; in the aspect of communication, we can adopt the USV data transmission technology based on "cloud-edge-end" architecture under 5G network; in the aspect of software development, we can develop corresponding software packages and tools based on Linux operating system to further improve the accuracy and efficiency of USV water quality detection and autonomous cruising.

2.6. Using solar 3D printing sensor data

In the Elsevier Journal, Nakayama Rei has developed a water quality monitoring system based on the Solar 3D Print Internet of Things that can measure water turbidity and water levels intermittently and upload monitoring data to Ambient (an open cloud platform) for visualization and anomaly detection [8].

Using solar 3D printing technology, we can quickly and accurately fabricate conductive sensing layers with different shapes and structures according to different design requirements without other external energy. At present, solar 3D printing technology still has some problems such as high manufacturing cost and low material quality, which can be improved by using wind power and solar panels.

2.7. Monitoring data of automatic connection sensors for cloud services

Sugiharto Wibowo Harry realizes the development of the Internet of Things using wireless sensor networks and IaaS cloud computing services, realizes the real-time collection and display of water quality data, the system can be continuously run to detect water pollution levels, and the proposed framework can develop wireless network sensors with an unlimited number of nodes and has good universality [9].

Water monitoring cloud services automate connectivity to sensors, monitoring devices or mobile applications to help businesses gain more processing power and storage space in their data centers. Provides faster and more economical data collection, analysis and storage solutions for water treatment businesses. It can also help businesses streamline water quality monitoring processes and reduce costs. But data security and risk management issues should be linked to cloud services by periodically updating software to detect vulnerabilities and backing up data periodically to reduce the risk of data leakage.

3. Research conclusion

Generally speaking, all kinds of water quality detection technology based on IOT system in the world have great theoretical feasibility, which is needed for the development of different regions. With more and more comprehensive water quality testing indexes, the research and development of water quality parameter testing equipment at home and abroad should be continuously strengthened, and more intelligent and comprehensive water quality testing instruments should be developed, so as to lay the foundation for the future application and promotion of IOT to purify the world water environment.

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