Research on the design of lake water intelligent monitor

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Abstract: Recently, my country's industrial production has caused great damage to water resources, especially the pollution degree of inland lakes is getting worse every year. Therefore, the monitoring of the water quality of inland lakes in China has become important as one of the basic measures to protect the lake's water resources and environment. At present, most water quality monitoring methods in China are still in a relatively backward stage. The water quality monitoring methods have the disadvantages of low efficiency and insufficient timeliness of results, which cannot meet the needs of current water quality monitoring. The purpose of this study is to design a lake water intelligent monitor with autonomous mobility and sustainable uninterrupted monitoring capabilities. To optimize the design of water quality monitor, this paper analyzes the existing water quality monitors, summarizes the deficiencies that exist in the existing water quality monitor products and draws the use requirements of the product, and proposes the design direction of the new intelligent water quality monitor; At the same time, according to the technical principles required for the design of water quality monitoring instruments, the feasibility of product design is analyzed; finally, the overall design of the lake water intelligent monitor with independent mobility and sustainable uninterrupted monitoring capability is realized.

1. Introduction
Water is an important part of our ecosystem and a necessary condition for living beings. According to United Nations data, China is a country with severe water shortages. The per capita water resources are only a quarter of the world average. Facing the situation of shortage of water resources, water pollution is intensifying, which greatly threatens people's health and restricts economic development. In view of the severe water pollution situation, we need to protect water resources and the environment for the sake of human health and sustainable development of society. As one of the important measures to protect and manage water resources, water quality monitoring can timely and accurately reflect the monitoring of water areas, and provide a reliable guarantee for the research and treatment of water pollution.

2. Early-stage research on product design of lake water intelligent water quality monitor
2.1 Overview of water quality monitoring
Water quality monitoring first emerged abroad and developed for many years. Today, with the development of high technology, water quality monitoring methods are more standardized and internationalized, realizing rapid and continuous automated monitoring and analysis on site. The products are mainly divided into 3 categories.
2.2 Water Quality Monitor Market Research
At present, water quality monitoring mainly includes laboratory monitoring, automatic monitoring station monitoring and mobile monitoring. Table 1 summarizes the advantages and disadvantages of each monitoring form.

Table 1. Water quality monitoring survey

| Monitoring Form                        | Advantages                              | Disadvantages                                      |
|---------------------------------------|-----------------------------------------|---------------------------------------------------|
| laboratory monitoring                 | The result analysis has high precision and extensive testing items | The monitoring period is long, and the data collection and transmission speed is slow. |
| automatic monitoring station monitoring| It can reflect the change of water quality online and record the water quality objectively. | The use cost is high and the station is fixed, which cannot fully reflect the water quality. |
| mobile monitoring                     | Easy to use, good flexibility and wide monitoring range. | Can't monitor water quality for a long time.       |

2.3 Problems and Demands of Lake Water Quality Monitor
The requirements resulting from a comprehensive problem analysis of the water quality monitor are as follows:
1. Reduce the influence of human factors to realize the autonomy of water quality monitoring
2. Share monitoring data in real time to improve monitoring efficiency
3. Realize the flexibility of the water quality monitor
4. Improve the long-term cruise monitoring capability of the water quality monitor to maintain the sustainability of the monitoring results

3 Research on product design principles of the lake water quality monitor

3.1 Feasibility study of various technologies in the field of lake water quality monitoring
(1) GPS technology is widely used in the field of water quality monitoring. In the design of an water quality monitor, a GPS module is required, including a wireless signal transmitter and receiver.
(2) Internet of Things has the ability to predict the situation, transmit information, and process data. Only one IoT data transmission module is needed to realize real-time online transmission.
(3) Solar energy is the most widely used new energy technology in the field of lake water quality monitoring. It saves a lot of manpower and material resources and uses the latest patented standard body material. It has strong impact resistance and puncture resistance.
(4) Propeller technology also provides formal power for unmanned water quality monitoring equipment in the field of water quality monitoring. Some marine robot in an experiment installed two propellers at the bottom to realize the movement function of the machine on the water surface.

3.2 Summary of key technical points of the design principle of the lake water quality monitor

Table 2. technical points of the design principle of the lake water quality monitor

| Type   | Purpose of Usage | Technical Characteristics                                      |
|--------|------------------|---------------------------------------------------------------|
| GPS    | navigation       | The technology is advanced and stable, meets the needs of water quality, and has low cost, small size, and easy to use |
The instrument has the ability to monitor and improves the flexibility of the water quality monitor.

Through the implementation of Internet of Things technology, the purpose of human-computer interaction, remote monitoring and real-time sharing is achieved.

The module generates energy from the energy stored in the external solar panel and the internal lithium battery to form a charging system.

The above technical advantages are simple structure, small size, mature technology and low cost.

4. Design practice of lake water intelligent monitor products

4.1 Design survey
Water quality monitoring instruments for inland lakes are not popular. Because water quality monitoring is not comprehensive enough, pollution on lake shores occurs from time to time. The purpose of the water quality monitor is mainly used for aquaculture or scientific research. The monitoring base station monitors the water area of the designated area fixedly.

4.2 Design positioning
This design positioning includes environmental positioning, user positioning, functional positioning, color positioning, and material positioning, as shown in Figure 1.

![Fig. 1 Design positioning](image)

4.3 Design innovation
This design innovation mainly has the following two aspects:

1. The new appearance is more in line with the needs of the water environment, has a larger solar energy receiving area, and improves the utilization rate of solar energy.

2. Random maneuverability in intelligent areas, improve the flexibility of monitors, increase the random diversity of monitoring samples, and improve the accuracy of monitoring results.
4.4 Description of appearance and structure design
The main design concept of this intelligent water quality monitoring instrument is "efficient monitoring". Design description from the following aspects:

4.4.1. Appearance design
As shown in Figure 3 the shape design is inspired by the lotus leaf floating on the water surface. Because it has a larger contact area with the water surface, it can provide greater buoyancy in the water, and at the same time use the larger exposed area on the upper part of the instrument to attach the solar cell Board to provide the required energy for the instrument.

The upper surface of the water uses a rounded upper shell and slope design, which is conducive to the discharge of the upper part of the instrument and is not easy to cause the problem of water accumulation. Considering the identification of the night, which emits a bright light through the night to remind passing boats and other equipment to pay attention.

4.4.2. Structural design
Instrument is mainly composed of four modules, namely a power supply module, a processor module, a power module, and a detector module.

Structural design layout planning is based on the concept of intensive product structure, with the central processor as the core, and the layout of functional modules around it. As a power supply module, the battery cooperates with the solar energy to arrange the battery on the upper part of the instrument, which is convenient for the connection of the power supply line.

As shown in Figure 4, the intelligent water quality monitor is divided into power supply system, detection system (including PH detector, turbidity detector, acid and alkali detector, ammonia nitrogen detector, temperature detector, etc.), central processing system, transmission system, propulsion system. The design concept between the systems is "a core system coordinates various subsystems". According to this design concept, the intelligent water quality monitoring system takes the central processing system as the core and connects the various subsystems.
4.4.3. Working form
As shown in Figure 4.16, in the case of large water areas, multiple intelligent water quality monitors coordinate and cooperate to jointly monitor the water quality.

The working form of a single water quality monitor is to randomly monitor the mobility in the water environment. In order to avoid the impact of the water flow on the monitoring results, the monitoring method is to stay at a maneuvering point for 15-20 seconds, and then real-time monitoring data of the area is transferred to the terminal.

Fig. 4 System design

Fig. 5 Working form pictures

5. Summary
In the context of modern Internet of Things technology and smart technology, the efficiency of water quality monitoring is constantly improving. In the future, the trend of water quality monitoring products will be toward autonomy, informatization, and motorization. After systematically analyzing the current status of domestic and foreign water quality monitoring products, this paper proposes to design a "high efficiency" intelligent water quality monitor. On the basis of existing products, further develop innovative ideas and optimize the monitoring mode of the water quality monitor.
In terms of monitoring methods, the intelligent water quality monitor has expanded the monitoring range of the original water quality monitor. In terms of monitoring range, the intelligent water quality monitor solves the shortcomings of the traditional fixed monitoring station with the function of regional mobility, and improves the flexibility of the monitor. In terms of energy supply, the intelligent water quality monitor improves the use of solar energy through a new structure and exterior design based on sustainable energy design principles. This article is discussing the design idea of intelligent water quality monitoring. The next step is to increase the degree of intelligence of the water quality monitor, make it more autonomous, improve the automatic monitoring capability, and use big data and artificial intelligence technology to effectively monitor the changes in water quality.

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