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Marine environment monitoring device based on artificial intelligence

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Abstract: *This project designs a new type of marine pollution and removal device. It is mainly used to monitor plastic, fishing nets and other garbage floating in the ocean. The device uses a metal shell and adopts a streamlined design, which is conducive to activities in seawater. It is equipped with a microwave radiometer, which passively receives microwave radiation from various objects to monitor all kinds of garbage or data existing in the ocean, and can transmit information to the Internet by using Internet of Things communication to achieve the function of monitoring the marine environment. When it detects that there is a lot of garbage in the sea area, it can send the real-time location to inform the marine department to send ships to clean it up in time. At the same time, it is equipped with infrared module and tracking to prevent collision with rocks and marine life. At the same time, it can be located by Beidou navigation for real-time tracking, so as to prevent the device from being recycled in time after an accident, thus bringing pollution to the ocean.*

Keywords: *Marine environmental monitoring, marine pollution prevention, microwave radiometer, Internet of Things, STM32, LoRa wireless transmission*

1. Introduction of system functions

When the device enters the ocean, the microwave radiometer will passively receive external radiation, and the signals received by the antenna will be input into their respective high-frequency channels through polarization dividers. The intermediate-frequency signals output by the high-frequency channels will be amplified by the intermediate-frequency amplifier, amplified by the low-frequency amplifier and compensated by DC, and then converted into digital quantities by the A/D converter, and the antenna temperatures in each field of view will be reflected by digital integration and calibration in the information processing and control unit. After that, the antenna temperature of each field of view will enter the STM32 controller. After the STM32 obtains the signal, it can analyze and process the data, and get the specific analysis map of the water quality and marine life in each sea area. After that, the controller will transmit the information to the cloud server through the LoRa wireless transmission module, and the corresponding general administration can obtain the specific location and environmental conditions of the current sea area, so as to realize the monitoring of the marine environment. If it is found that there are obvious pollution problems in this area, it can be protected by reasonable methods through the location obtained from the cloud server.

In the whole process, because the device is equipped with an infrared sensor, it can freely shuttle in the marine environment. When the infrared sensor detects that there are rocks and other substances in front, it will freely avoid obstacles or track, which can automatically avoid various marine organisms and rocks in the ocean and other external factors that will cause machine damage, so as to prevent it from failing in the complex marine environment as much as possible. In addition, the device can be positioned by Beidou satellite navigation system in the whole process, and the positioning function can clearly understand the operation of the device. When the device fails or the power is insufficient, it can be recovered and inspected on the spot according to the position of Beidou satellite navigation. Prevent it from sinking in the ocean and causing environmental damage[1-2].

In terms of power supply, the design of solar panels is adopted. As an environmental protection energy source in the new century, solar panels can provide power for the work of the device without pollution. At the same time, we specially designed an independent power supply circuit to ensure the stability of its power supply, as shown in Figure 1.

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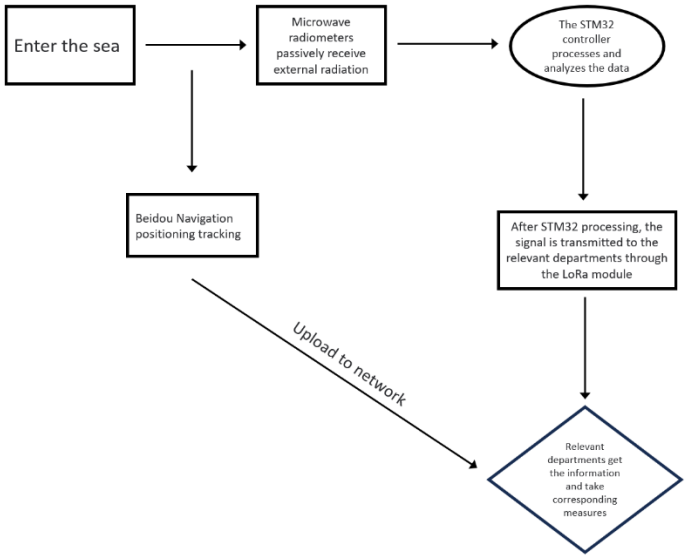

Figure 1: Flow chart of system operation

Second, the overall structure and principle of the system

The marine environmental monitoring device based on artificial intelligence is an important innovation in marine pollution prevention and control. The design part mainly includes main control unit, microwave radiometer, infrared sensor, Beidou positioning unit and LoRa wireless transmission unit.

2. Master control unit STM32

As the main control core, STM32 has high compatibility and low cost. In today's environment where STM32 chips are widely used, our deeper development of STM32 makes the combination of hardware and hardware simpler and faster, with lower requirements for operation.

3. Microwave radiometer

As a passive microwave remote sensing instrument, microwave radiometer is made according to the principle that all objects in nature radiate electromagnetic waves. Objects radiate electromagnetic waves in the whole spectrum of electronic waves, and its spectrum is similar to noise. This radiation is called thermal radiation. Different objects have different thermal radiation spectra, some objects radiate continuous spectrum, and some objects radiate discrete spectrum. By measuring and analyzing their radiation spectra, different objects can be distinguished. Microwave radiation generated by receiving organisms or other substances can be used to monitor the marine environment in real time and will not have adverse effects on marine life, as shown in Figure 2 and Figure 3.

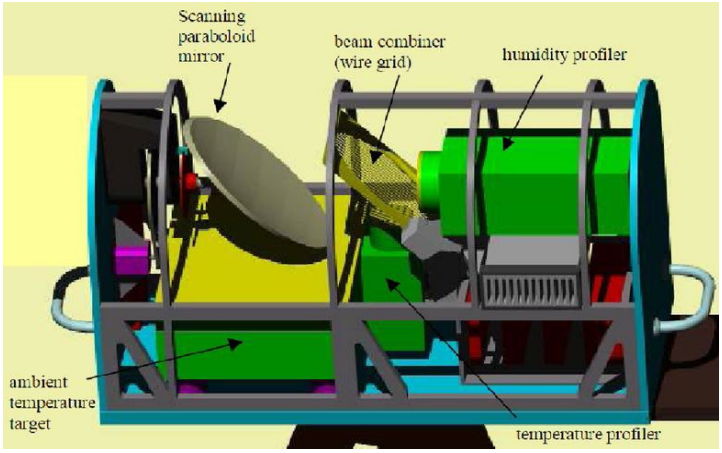

Figure 2: Basic structure diagram of microwave radiometer

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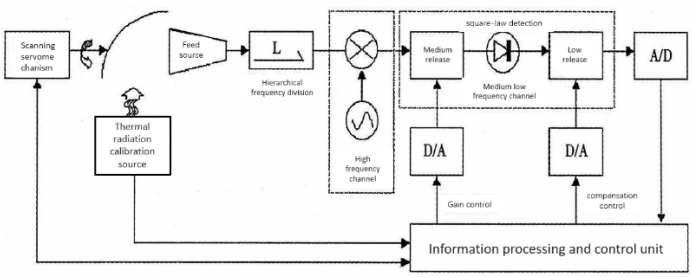

Figure 3: Working principle diagram of microwave radiometer

4. Infrared sensor

A sensor that uses the physical properties of infrared rays to measure. Infrared, also known as infrared light, has the properties of reflection, refraction, scattering, interference and absorption. Any substance can radiate infrared rays as long as it has a certain temperature (higher than absolute zero). The infrared sensor is not in direct contact with the measured object, so there is no friction, and it has the advantages of high sensitivity and fast response[3-4]. Using the characteristics of infrared ray, the obstacle avoidance function of the device can be realized to prevent it from colliding with reefs and marine life in seawater and causing economic losses, as shown in Figure 4.

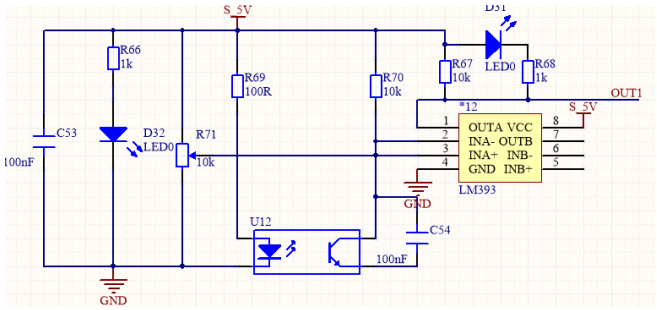

Figure 4: Circuit diagram of infrared sensor

5. Beidou positioning unit

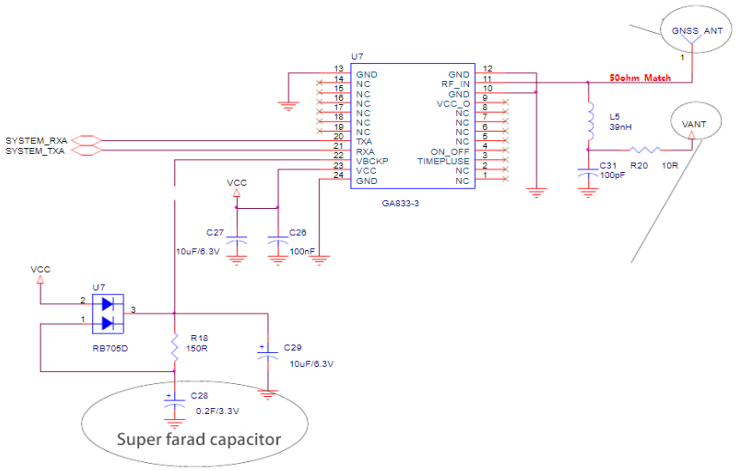

Figure 5: Circuit diagram of Beidou positioning unit

Beidou satellite navigation is a global satellite navigation system developed by China. The system adopts many technical means, such as polycrystalline oscillator, atomic clock, high frequency stabilization cycle, etc., thus achieving high-precision positioning and navigation services. Its positioning accuracy can reach about 3 meters, which can provide higher-precision positioning services in specific areas than other systems. The current position of the monitoring device can be implemented and transmitted to the cloud server through the main control, so as to quickly obtain the position of the

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polluted sea area and the specific environmental conditions here, as shown in Figure 5.

6. LoRa wireless transmission unit

LoRa wireless transmission module has the characteristics of low power consumption and long transmission distance. LoRa chipset connects sensors to the cloud to realize real-time communication of data and analysis[5]. After the main control unit of the device processes the information such as the location and environmental conditions sent by the sensor, it can transmit the specific information to the cloud server through LoRa wireless transmission, and the relevant management departments can analyze the marine environmental conditions here after obtaining the information, as shown in Figure 6.

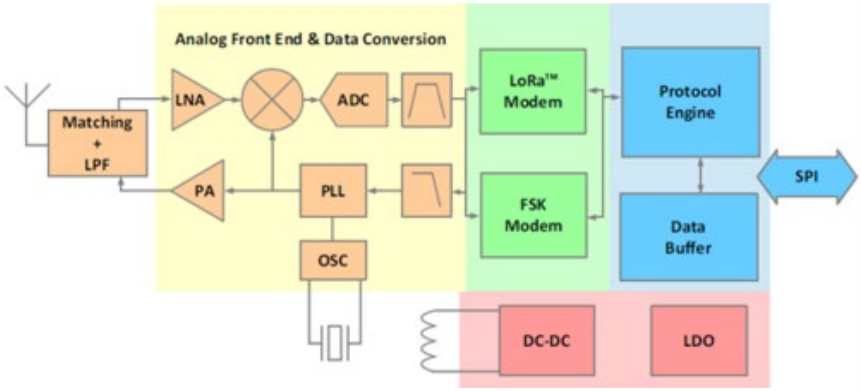

Figure 6: Schematic diagram of lora wireless transmission

7. Conclusion

This design adopts embedded and mobile design, applies LoRa wireless communication technology and Beidou satellite navigation system, collects biological information and environmental information in the ocean through sensors such as microwave radiometer, and accurately monitors the real-time situation of the marine environment. Reasonable structure and infrared obstacle avoidance design can ensure it to travel freely in the ocean and realize large-area coverage of the monitoring range. The power supply system of solar panels provides energy for the system continuously, so that it can transmit information to the cloud service platform through LoRa wireless communication and finally display it on the terminal server.

The device effectively solves the problem that the existing monitoring method is difficult to realize the overall monitoring of the ocean, and greatly reduces the cost of manpower and material resources. At the same time, the monitoring method of microwave radiometer through thermal radiation is not only accurate, but also solves the disadvantage that the traditional monitoring method may cause harm to marine life and the environment.

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