Design of Inshore Water Monitoring System Based on IOT

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Abstract. In recent years, countries around the world have deployed a large number of advanced unmanned submersibles in the deep sea to build a complete underwater surveillance system. For the effective detection of threat from underwater, underwater should build three-dimensional multi-dimensional early warning detection system, the development potential of new communication technologies right. This paper designed an offshore environmental monitoring systems. The system includes two subsystems, which waters the information detection subsystem enables real-time monitoring of water information, data distribution subsystem monitoring data can be sent to the specified users through the default network. The system is deployed to the port and nearby offshore waters can achieve anti-submarine reconnaissance information network set up, the next step with advanced acoustic detector can play an important role in the anti-war underwater unmanned underwater vehicles..

1. Introduction

In recent years, countries around the world have deployed a large number of advanced unmanned submersibles in the deep sea to build a complete underwater surveillance system. To effectively deal with the threat from underwater, the research community should build three-dimensional multi-dimensional underwater early warning detection system, the development of new technologies for submarine communication, building support for potential cover system, improve the acoustic information support capabilities, training of water professionals, such as several sound pronged approach to enhance the underwater offensive and defensive capabilities. In recent years, our military and civilians have repeatedly salvaged US U.S. underwater submersibles (UUVs) and submarine fixed submersibles in the waters near our naval base. They have repeatedly monitored the US military in the relevant seas on the eve of my major training and exercises. Unmanned submersibles and submarine fixed submersibles. It is reported that some countries of the hydrological and environmental data to master the use of the waters have been relatively full, on his country's surface ships and submarines voiceprint information collection is quite complete. Through the use of big data analysis techniques, even underwater activities can accurately identify the submarine hull number.

At present, there is some research on the large-scale monitoring and satellite inversion of the ocean, and there is no report on the large-scale monitoring of the peninsula and the adjacent sea area of the port.
This paper aims to achieve the monitoring of certain information in offshore waters and its impact on the surrounding marine environment by designing an offshore water monitoring system.

2. Design of Monitoring System for Offshore Waters Based on ZigBee

The system has a number of terminal nodes in wireless sensor networks, routing node and a network coordinator, the host computer data centers. Terminal nodes dispersedly deployed in the monitoring area, collecting water environment information, the router is responsible for forwarding the terminals route the data to the network coordinator, a network coordinator and obtain summary data sent by the host computer or embedded device designated network monitoring apparatus the collected environment information of each area is displayed in real time and saved to the database.

The structure of the monitoring system is shown in Figure 1.

![Figure 1](image)

**Figure. 1** Network outline design of monitoring system

ZigBee wireless sensor network architecture includes sensor nodes, gateway (router) and monitoring host. In order to reduce energy loss and packet loss, a cluster-tree network topology is adopted. Sensor nodes are equipped with microprocessors with low processing power, which are randomly deployed in port or nearby waters. They can connect detectors to collect underwater acoustic, water temperature and other monitoring parameters we need.

According to the different roles of sensor nodes in the network, they are divided into three types: the bottom common node, cluster head and network coordinator. The cluster head mainly completes data fusion and forwarding, and can process the data collected by the underlying common nodes of its cluster and send them to the nearest network coordinator. At the same time, the network coordinator can broadcast the data packets sent to the cluster under its jurisdiction. The network coordinator is mainly responsible for network construction and establishment. Basic network management functions such as standby registration and access control. Finally, the data information is transmitted to the router by wireless mode. Router is responsible for collecting all data sent by sensor network, establishing local database, sending data to monitoring host through Internet, and parameter information of offshore waters will provide decision-making basis for system users.
2.1. System Architecture Design
The parameters of the water environment are collected by the sensor nodes distributed in each collection point. The collected data are sent to the embedded gateway via ZigBee network. After data fusion, the data are forwarded to the database server through NB-IOT network. The data are displayed, recorded and the alarm values are set.

![Data flow diagram](image)

Figure. 2 Data flow diagram

3. System hardware design

3.1. Information Collection Node

![CC2530 circuit diagram](image)

Figure. 3 CC2530 circuit diagram

The sensor nodes of this system are of universal design and integrate Zigbee and mcu modules. The CC2530 unlimited serial communication module is based on the Zigbee2007/PRO protocol of CC2530. Embedded Processor Module with the present design uses a microcontroller STM32F105RCT6 STMicroelectronics STM32 series. Such LQFP64 chip package, using ARM Cortex-M3 32-bit kernel 56 pins. The main frequency is up to 72MHz. Herein above parameters meet design acquisition unit of control and communication.

The main power supply module LR6-30P AA batteries and a circuit element portion nanfu nanfu card. Since the sensor node is powered by a common fifth battery, the working time is extended by setting the operating mode of the processor for long-term use. Specifically, an internal wake-up event is generated by a custom delay interval timing, and then enters a shutdown state after completion.
When the data acquisition and STM32 wake, wake-up data transmission module. 15ms delay, until the data transfer is completed, the data transfer module will be switched to the sleep mode again. The above-described approach can cope with a large problem CC2530 chip power consumption for data transmission, which lies dormant make no transfer tasks. As if to half a minute sampling interval, by rough calculation of the single brand LR6-30P Nanfu battery can work for more than fifty days.

3.2. Embedded Gateway
The module mainly includes ZigBee module, NB-IOT module, single chip module, power module and so on. Microcontroller modules STM32F105RCT6 microcontroller, a clock module using DS1302 clock chip. ZigBee CC2530 chip modules, which as a network coordinator, the complete flow of information nodes; BC95 chip module using the cellular network, instead of the traditional indoor things MCU system for WIFI module with the communication server, forwarding the data between the database servers. NB-IOT based network services, messaging realizes the remote terminal through TCP/IP protocol with the AT command; wherein BC95 chip also supports connections to a server.

4. System software part design

4.1. Transport layer design
Embedded gateway module by the device and NB-IoT embedded ARM board composition. The main gateway is to collect water quality data and upload the database, complete remote monitoring. ARM board ZigBee wireless network node acquired by the layer data using the HTTP protocol to upload data to the host, and whether the abnormality analysis data is stored in the database for retrieval at any time.

In addition, non-functional development of the following four modules:
(1) Monitoring: Accept the instructions sent by the client, and return the result to the client after making the corresponding operation.
(2) the reconnection: long link embedded device is detected with the server. If the device connection is interrupted, then re-establish the connection to the server, in order to ensure that the data acquisition equipment has been online.
(3) Timing: using the clock module detects the operating time set by the user equipment matches. If the time matches, the corresponding operation is performed.
(4) Data upload: collect data once every 30 seconds, and upload it to the database server through the wireless network.

4.2. Embedded Software Design
The embedded gateway consists of devices such as the NB-IoT module and the embedded ARM board. The main gateway is to collect water quality data and upload the database, complete remote control. ARM board ZigBee wireless sensor network acquired by the sensor data, using the HTTP protocol to upload data data service center, stored in mysql.

(1) Listening: accept the data query, device control and other commands sent by the Android mobile terminal, and return the result to the client after making the corresponding operation.
(2) disconnection reconnection: detect the long link between the embedded device and the server. If the device connection is interrupted, re-establish a connection with the server to ensure that the embedded device is always online.
(3) Timing: Use the clock module to detect whether the device operation time set by the user matches. If the time matches, the corresponding action is performed.
(4) Data upload: The data is collected every 0.5 minutes, and after analysis and filtering, it is uploaded to the database server for storage.
5. System test

5.1. Packet Loss Rate Test
In order to verify the stability and reliability of the system, the packet loss rate of NB-IoT is tested. The system in this paper uses the TCP/IP protocol to establish a connection after three handshakes, reducing the system loss rate and ensuring the integrity of the data uploaded to the server. Through the average transmission volume of the NB-IoT network to the server for every 500 packets, the background host receives 488 packets from the NB-IoT on average, and the loss rate of the test result is less than 3%, which can meet the system stability requirements.

5.2. Remote monitoring experiment
The simulation experiment was carried out in a certain water area in the suburb of Bengbu City, Anhui Province, China. The remote monitoring system designed above was used for testing. The monitoring results of this experiment are good, which proves that the system has high reliability.

6. Epilogue
Test showed that: according to the design requirements to achieve real-time online monitoring of coastal waters, remote control decision-making, historical data query, warning output function. Very good scalability of the system, water may further contain acoustic detection device erected offshore trans UUV system, it has a good prospect in coastal defense.
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