Data Transmission System of Ocean Observation Buoy Based on Beidou Satellite System

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Abstract

The development of marine stereoscopic monitoring services puts higher requirements on the stability and reliability of ocean observation buoy communication. Beidou satellite system has functions of fast positioning, precise timing, two-way communication and strong confidentiality[1].Ocean observation buoys are far from shore stations, with large monitoring data and strong data confidentiality. So, Beidou satellite system full meets the demand for data transmission by ocean observation buoys. Based on the full understanding of the status of ocean observations and marine observation equipment, and in view of the data transmission requirements of ocean observation buoys, this paper designed a real-time data transmission system based on the Beidou system. And this system can provide support for the development of marine resources, responding to climate change and effectively avoiding marine meteorological disasters.

Keywords

Ocean observation buoy, Bijou satellite, satellite communication, real- time data transmission.

1. Introduction

With the rapid development of marine monitoring systems throughout the world, marine profile monitoring technology is also rapidly developing. At present, there are a wide variety of buoys and profile sensors used in the marine environment profile monitoring system in the world, and their working principles are different. However, in terms of communication methods, various research institutes have chosen satellite communications[2].The key to meaningful monitoring system is that the monitoring data can be acquired in real time/quasi-real time. In order to adapt to the requirements of the actual data transmission system used in ocean observation buoys, a real-time transmission system of ocean profile measurement data based on the Beidou satellite was designed.And this system is designed for the current status of marine profile data transmission systems.This design provides a new means of data transmission for real-time data transmission and accuracy of data processing of ocean buoy section profile measurement, and provides powerful support for early warning of marine disasters.

2. System Design Scheme

2.1 Overall Scheme

Every 10 minutes, the master MCU on the ocean observation body will supply power to the Beidou satellite communication module and activate the module from hibernation. The Beidou satellite communication module enters working mode immediately after it is activated, and then transmits

signals to the Beidou satellite terminal through the transmitting terminal. The satellite terminal receives the signals sent by the transmitter and processes the signals before executing. When the satellite terminal receives the signals sent by the transmitting terminal, there will be a process of processing the signals. And then, the signals will be forwarded to the receiving terminal of the shore station. After the forwarding is completed, the satellite station will send one of the three commands of data request[3], inquery and error to the master MCU. If the master MCU does not receive any command from the satellite station within 1.5 seconds, the connection will be considered as failed[4].In order to improve the success rate of data reception, Beidou communication module will repeatedly transmit signals until it is received, see Fig. 1.

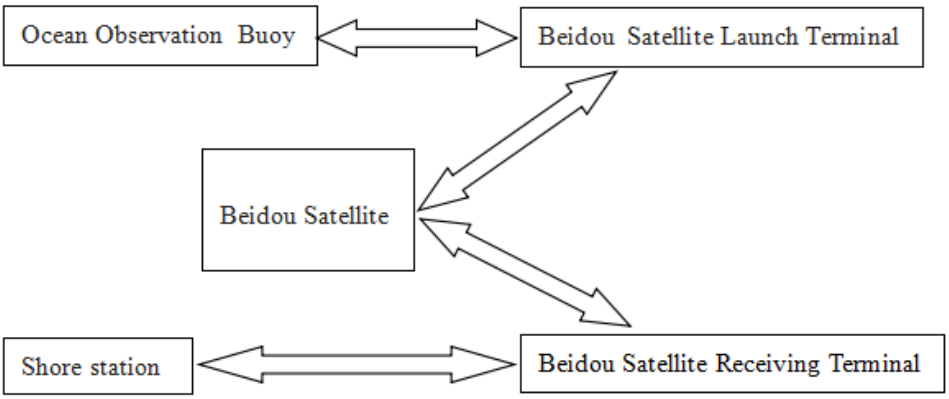

Fig 1. Overall system design flow chart

2.2 Hardware Design

The communication control board uses a low-power micro-MCU as the core, and integrates the reset circuit, serial ports chip, JTAG circuit, sensor data acquisition, satellite communication module, large-capacity data storage SD card and power control circuit to achieve satellite communication control functions. The low-power micro-MCU can provide buoy communication interface and Beidou satellite communication interface respectively through the serial port chip [5].

The master MCU enters the sleep mode after the system is powered on. When the ocean buoy communication interface has data transmission, the master MCU is awakened by the serial port interrupt and immediately enters the working mode to retrieve the stored data in the SD card. When the data transfer is over, the master MCU transmits the data to the shore station receiver using the Beidou communication module according to the communication protocol. When the buoy communication serial port has no data and the scheduled time is up, the MCU continues to transmit unsuccessful data after being interrupted, see Fig. 2.

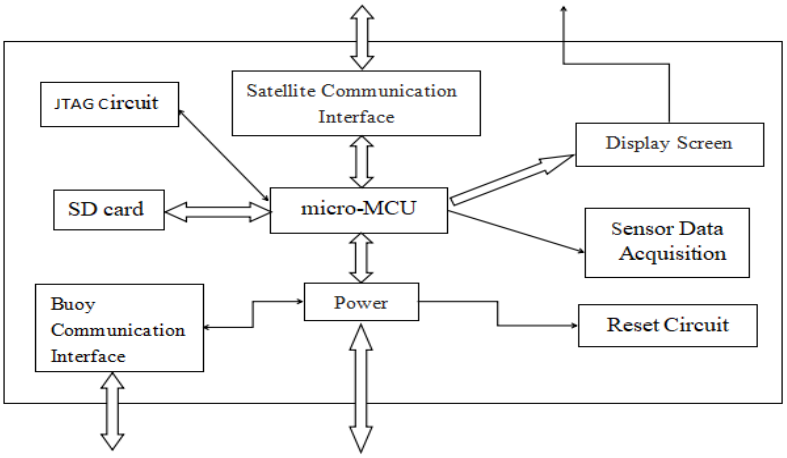

Fig 2. Hardware design block diagram

2.3 Communication Protocol Design

The flow chart of the data transmission and receiving ends of the Beidou satellite data is shown in Fig. 3.

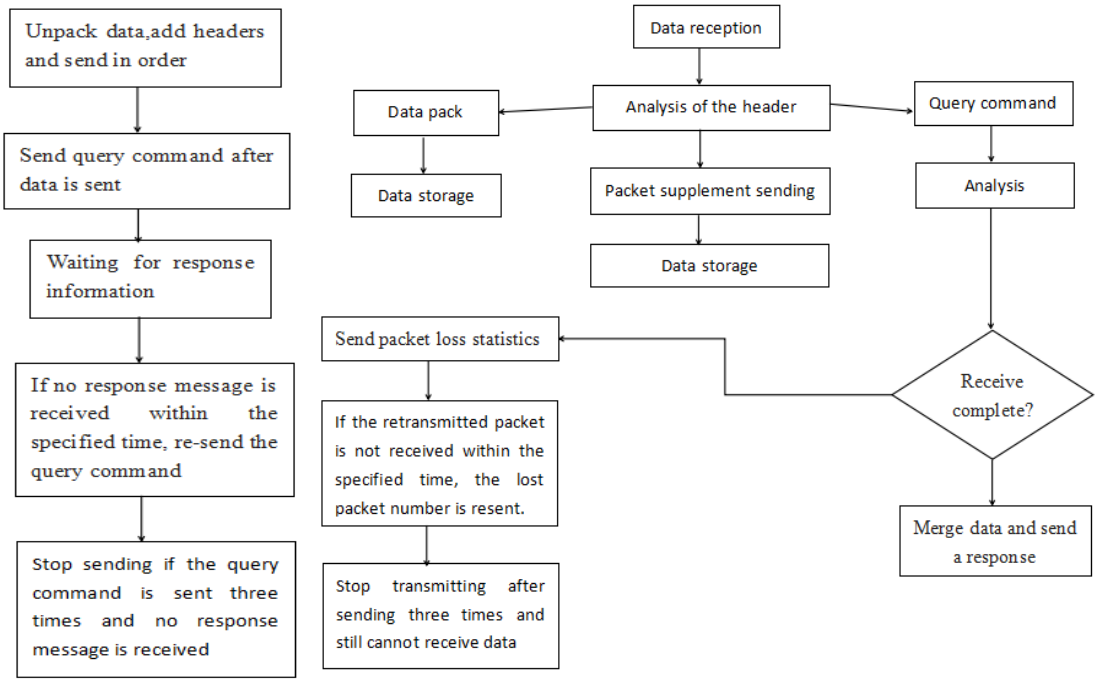

Fig 3. Data sender and receiver work flow diagram

The basic idea of developing a communication protocol is to pack and compress a large amount of data collected by sensors to reduce the amount of data sent. After the compression is completed, the data packet needs to be unpacked and the corresponding packet header is added.The satellite receiving end of the shore station shall remove the packet head, decompress the compression and combine the decompressed data. If there are data packets lost or damaged, the Beidou satellite data sender is required to resend the lost data packets until all the data are received[6].

3. Data Transmission Reliability Processing

In order to ensure the real-time reliability of data transmission of ocean buoys, the “response” communication mode is adopted during the actual application of Beidou Communication[1].After sending a set of data, the ocean buoy waited for the shore station's receipt information. If the shore station receives the data and returns the data transmission success flag after verification, the buoy will continue to send the next set of data after receiving it. If the shore station receives data check errors, it requests a retransmission. The Beidou communication control terminal enters sleep mode and waits to be interrupted to wake up and enter working mode when the buoy fails to receive the shore station receipt message or fails to resend the same set of data three times[7].

4. Conclusion

In view of the current situation of Marine profile measurement data transmission system, a real-time data transmission system of ocean profile measurement based on Beidou satellite is designed. The entire system design includes: overall scheme design, hardware system design, communication protocol design, data transmission reliability processing, shore station data acceptance design. It compensates for the inadequacies of the ocean buoys and shore stations. And it provides a new means of data transmission for real-time data transmission and accuracy of data processing of ocean buoy section profile measurement, and provides powerful support for early warning of marine disasters.

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