

Research on Unmanned Vessel Based on Internet of Things and Beidou Navigation

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Abstract

The unmanned vessel can use the Beidou navigation technology to accurately locate it. The image processing unit it carries relies on the neural network to process the collected images, and uses the Internet of Things technology to transmit information. Beidou navigation technology can be integrated with the Internet of Things to send the request information on the user terminal device to the satellite. After the satellite receives the signal, it can be sent to the control center. The control center processes and processes the user information, and sends data to the user. The application effectiveness and intelligence level of unmanned ships.

Keywords

Driverless Technology, Internet of Things, Beidou Navigation, location targeting.

1. Introduction

Unmanned Surface Vehicle (USV) is an important research topic in the field of surface ships, mainly used to perform dangerous tasks. Beidou Navigation is a global satellite navigation system developed, constructed and managed by my country. It has all the independent intellectual property rights and can provide users with all-weather global satellite positioning and navigation services. The positioning accuracy can reach millisecond and nanosecond levels^[1]. With the development of artificial intelligence technology and computer technology, the trend of automation has become more and more active, and the Internet of Things technology has gradually attracted the attention of the industry in the field of unmanned ships. my country's shipbuilding industry has also taken advantage of the opportunity to achieve leapfrog development in recent years. With the increasing maturity of unmanned technology and the development of various sensing technologies, unmanned ships have gradually entered people's field of vision, and have become more and more popular. Countries around the world attach importance to it, and experts predict that unmanned ocean-going ships will become the norm by 2027^[2]

2. System framework

Master chip. The STM32F103ZET6 chip is used as the main control. The operating frequency of this series of microprocessors is 72MHz, with a built-in Flash memory of up to 128K bytes and SRAM of 20K bytes. It has a wealth of general-purpose I/O ports^[3], which can quickly handle various complex Events, powerful computing power, cooperate with various modules, quickly and accurately control unmanned boats and send alarm information.

Navigation and data transfer. Beidou navigation equipment provides position information for the automatic driving and measurement of unmanned ships, which makes the accuracy of the

position information of unmanned ships reach centimeter level, thus making the driving route more accurate. The differential signal is obtained by setting up a base station receiver on the shore, and then transmitted by the radio station. At this time, the mobile station receiver installed on the unmanned ship receives the differential signal for calculation and provides it to the unmanned ship. The transmission system has the function of transmitting water surface data and real-time video. When the unmanned ship remote sensing system transmits data to the ground, the measurement signal is converted into a voltage signal, and then converted into a digital signal, which is transmitted to the display system on the shore base.

Sensor. The unmanned ship is equipped with a variety of sensors, including temperature sensors, pH sensors, and dissolved oxygen sensors to measure water quality. Attitude instruments to keep unmanned ships stable and horizontal acoustic doppler flow profiler (ADCP) to measure water flow. When the unmanned ship travels at the designated position, the surveyor controls the sensor to collect data through the control system. In the transmission process, the measurement signal is converted into a voltage signal, and then converted into a digital signal, which is transmitted to the display system on the shore base. The data in the larger memory will be saved and processed and analyzed after all measurements are completed.

Attitude meter. In order to ensure the smooth operation of the unmanned ship during the driving process, it is necessary to install the attitude sensor sensor on the hull to maintain the accuracy and reliability of the data. It integrates a low-noise accelerator and a solid-state compass through advanced wave dynamics algorithms, which can measure pitch, roll, etc., and fully calibrate the stability of the hull.

ADCP. It is a horizontal acoustic Doppler flow profiler. Its working principle is to configure several transducers on the ADCP to emit sound beams at a certain angle in the direction of the water flow. These sound pulses hit the scatterers (sand, stones, some plankton) scattering. When the transducer receives the scattered sound waves, the scatterer has relative motion, and there is a certain change in frequency, and the flow velocity can be measured according to this change.

Internet of Things information interconnection. On the basis of the Internet, the information collected by unmanned ships is combined with the Internet to form an interconnected information network, which realizes the interconnection of unmanned ships, people, unmanned ships and information at any time and any place. Through the Beidou positioning system, data collection equipment and other information sensing equipment, according to the agreed communication protocol, information exchange and communication are carried out to realize the intelligent identification, positioning, tracking and supervision of unmanned ships.

Ground control. The ground control part is mainly composed of communication system, computer system and remote control system. Driven by the rapid development of communication technology, navigation technology, robot, computer, propulsion system technology, etc., unmanned ships have been developed and applied^[4]. The communication system is to receive the video images transmitted by the remote sensing system of the unmanned ship, and the computer system transmits its observation value and the coordinate information of the station to the rover through the data link. The seawater sampling detection system takes the unmanned ship as the carrier, combines embedded development technology and wireless transmission technology, realizes multi-point continuous water quality data measurement in the target water area through remote control, and visualizes the display interface through the host computer, so that users can timely Learn about the water operation of the unmanned ship and the water quality of the samples^[5]. Control the trajectory of the unmanned ship and collect data through the remote control system. The differential signal is obtained by setting up a base station receiver on the shore, and then transmitted by the radio station. At this time, the mobile station receiver installed on the unmanned ship receives the

differential signal for calculation, and provides it to the unmanned ship for positioning. and control.

The ground charging pile adopts the method of solar power generation to achieve green environmental protection.

3. System circuit software design

According to the actual requirements of unmanned ships, the system equipment side-program structure diagram of this project is shown in Figure 1:

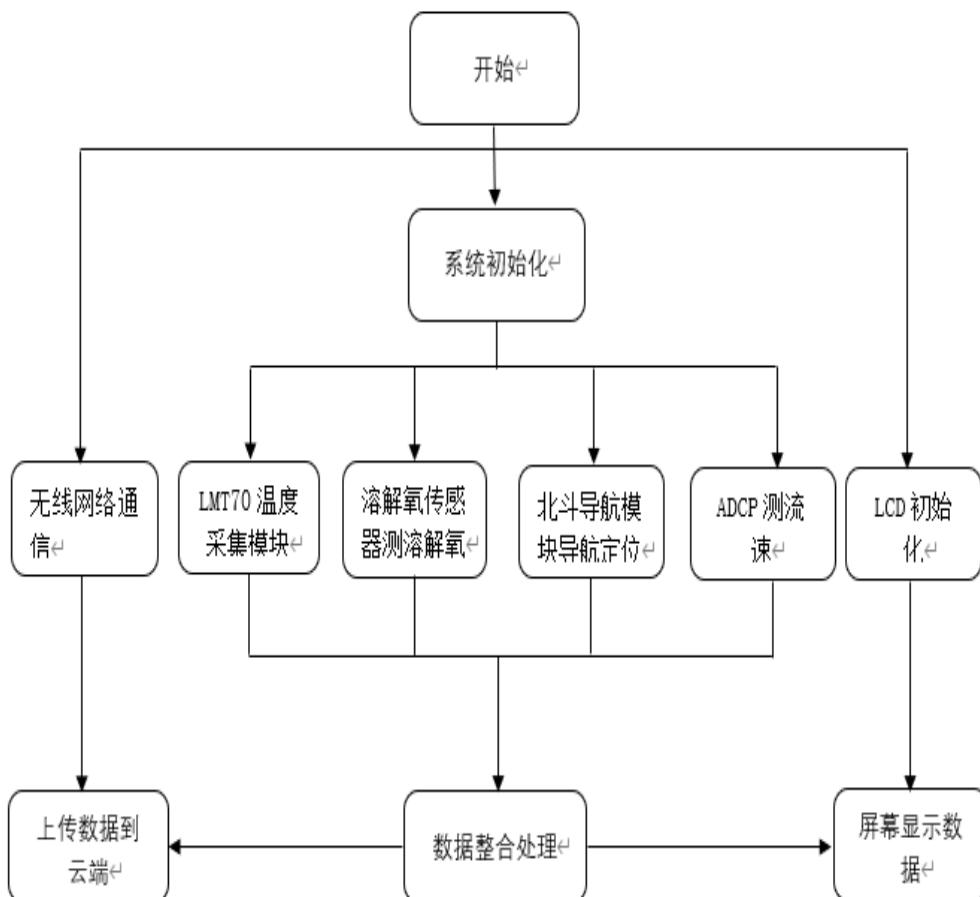


Fig. 1 Device side of the system - program structure diagram

4. System Simulation Verification

In this paper, Protues simulation software^[6] is used for system simulation debugging. The experiment effect of this system is simulated and debugged by taking advantage of its rich device library and perfect circuit simulation function for virtual single-chip microcomputer simulation.

System simulation circuit diagram. The simulation circuit diagram of this system includes various modules for realizing the functions of the unmanned vessel, which can simulate various functions required by the system in the simulation.

Unmanned boat navigation and positioning function. This function is specifically connected to the STM32F103ZET6 microcontroller through the Beidou navigation module ATK1218-BD. By configuring the message output format of the Beidou navigation module, the latitude and longitude information of the location of the unmanned ship can be received, and the positioning time can be adjusted by configuring the update speed of the Beidou. Take control.

Unmanned vessel information collection function. This function is mainly realized by the dissolved oxygen sensor, LMT70 temperature acquisition module and ADCP speedometer carried on the unmanned boat. The LMT70 module is used for contact temperature measurement, and the LMT70 module is waterproofed. When measuring the water temperature, it is placed in the water to measure the temperature; 4 transducers are configured on the ADCP, and the sound beam is emitted at a certain angle in the direction of the water flow. Objects in the impacting water scatter. By receiving the returned sound wave and delay time, the water speed is calculated; the dissolved oxygen sensor reduces the oxygen molecules dissolved in the water through the gas permeable membrane on the cathode, oxidizes the metal anode, and generates a current signal. The magnitude of the current is proportional to the concentration of dissolved oxygen, and the concentration of dissolved oxygen in the water is obtained through the magnitude of the current.

IoT data transmission function. This function mainly relies on the MINI5G adapter board, which provides 5~12V wide voltage power supply, supports USB3.0 interface, RM500U module 5G to Gigabit Ethernet, SIMCOM, and uses wireless network communication technology to collect data from unmanned ships. Real-time transmission to the control terminal.

5. Conclusion

In this paper, an unmanned boat is designed, using STM32F103ZET6 as the main control, by connecting to the Beidou navigation module, configuring a communication protocol, and transmitting the longitude and latitude information of the unmanned boat in real time; the operator remotely controls the unmanned boat. Under the guidance, cruise along the designated path, rely on several sensors carried by the unmanned vessel to collect various data, and transmit effective information to the control terminal in real time through wireless communication network technology and the Internet of Things.

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References

- [1] Xiuying Xie, Jian Wang, Guiqing Zhang, et al. Development of IoT Positioning Module for Construction Equipment Based on Beidou System [J]. Computer Engineering and Design, 2014 (10) : 3428-3434.
- [2] Longde Lv. Where will China's smart ships go in 3 years? [J]. Shipbuilding of Guangdong province, 2019(03):7-9.
- [3] Ning Li. Development and Application of STM32 Processor Based on MDK [M]. Beijing: Beihang University Press, 2008.
- [4] Feng Li. Research on key Technology of unmanned water Sampling Vessel [D]. Shandong University, 2016.
- [5] Bailin Wang, Mengqi Tang, Jia Li, Yunping Liu. Water quality monitoring and control system design based on unmanned ship [J]. Journal of ocean technology, 2019, 38(04):32-38.
- [6] Pusong Dong. Application of Protues in MCU System Design [J]. Modern Electronic Technique, 2008(14):153-154.