Design and implementation of automatic calibration system in ship docking

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Abstract: Calibration is in dock ship-borne equipment to determine the error model and the basic process of establishing unified coordinate system, to be combed through the calibration project, and to be combined with the existing equpment, so automatic calibration system is designed. The automation to be realized by integrated network communications, wireless control and database technology, and so on calibration device for remote control, all the controls are done automatically by the system monitor console. Test shows that the system design is reasonable, fully functional, and reliable, to fully meet the test requirements for calibration in dock.

Keywords*:* Calibration in dock, Wireless control, XML

1. Introduction

Calibration [1] is in dock all types of ships containing measuring and control equipment for the establishment of unified coordinate system and get the error model, organized by a more equipment, more units, more people to work together. In used artificial for standard school project Shi, due to ship contains measuring equipment more, and standard school project more, and standard school process complex, caused took consumption force; standard school work is in night work, personnel need upper and lower antenna, operation, has must of security hidden; test results of data need artificial finishing, variety reasons caused docking within standard school efficiency low, and artificial readings brings of data repeat rate low problem.

Based on the ship-borne equipment performance, proprietary equipment for calibration and control technology, and designed a set of automatic calibration system for ships in dock, system monitoring can be done on ship-borne equipment, calibration control tower, as well as data recording and calculation, and improve the efficiency of the work and level.

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2. System Solutions

Docking calibration work is a complicated system engineering, control object, shifted from a ship equipment including day bar feeder, TDD, has channel light televisions and telescopes, etc.; Attached calibration facilities very much, including multiple azimuth mark in four quadrants, the calibration tower integrated photoelectric target, etc., the combination of the winning school tower photoelectric target including form a complete set of standard signal source, and zero frequency converter in the school, etc.; Test project, each test item for repetitive operation, manual record from volume data.

In the test object, on the basis of the existing TT&C equipment capacity[2], generalizes the calibration with equipment/facilities, the existing TT&C equipment can be completed in the main control computer control of each subsystem in the state and parameter acquisition, including docking calibration needed for equipment, these devices use UDP multicast information in the form of interaction; Telescope, level of calibration facilities after the upgrade, have the ability to transmit digital signals, which the telescope image signal in the industrial TV monitoring after image processing in the host can send packets to the master to monitor computer, and the level of the serial data after capturing the monitoring computer serial port server through the device; Wireless control technology rapid development, to meet the needs of the remote control of the calibration tower, and the ship's side to build a communication link, need for reforming the antenna can be installed on the ship owners mast, use backup complete RF cable channel design, ship the wireless module through the room and main control computer communication network, the working principle of the whole system is shown in figure 1.

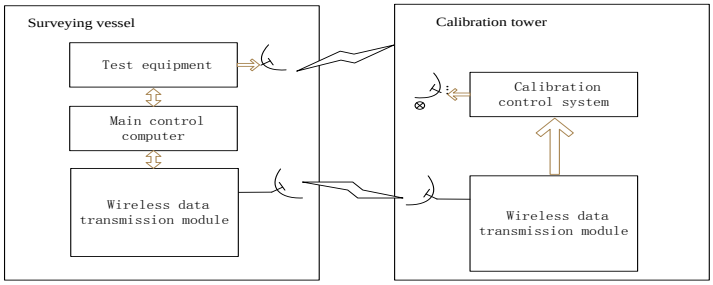

Fig1. Block diagram of the system

Calibration method based on the content of the project, the main monitoring computer for volunteers equipment calibration method and calibration facilities and the tower of equipment such as control object for deployment; According to the calibration procedure of the project, the main monitoring computer for

volunteers equipment calibration method and calibration facilities and step control tower equipment, etc, and the equipment information record and display; According to the calibration data statistics formulas of the project, the main monitoring computer of the calibration data to calculate the calibration results and conclusions are given.

3. The System Design

In figure 1, the calibration control system mainly includes the calibration tower terminal [3] (tower), vessel calibration control terminal (hereinafter referred to as the ship side) and other calibration facility (hereinafter referred to as the set, such as azimuth mark). Tower side including wireless data transmission module, the calibration control system and photoelectric standard, such as wireless data transmission module is used to build wireless RF channel, receive ship terminal control instruction, and issue calibration control system control related equipment; Ship side mainly include wireless data transmission module, parameter measurement and control equipment, the main monitoring computer and the calibration of equipment (such as electronic gradienter digital binoculars, etc.), wireless data transmission module and tower side form RF circuit, which constitute instruction circuit, main control computer is responsible for the control of all the volunteers, calibration equipment/facilities control and data acquisition.

3.1 Design of tower terminal

The main function of the tower side to receive instruction through wireless module sent by ship terminal, and resolve to achieve RF link switching, plus the cursor off, calibration equipment (answering machine, zero inverter, etc.) plus off and a control signal common source, to meet the need to control the boat end, its block diagram shown in Figure 2.

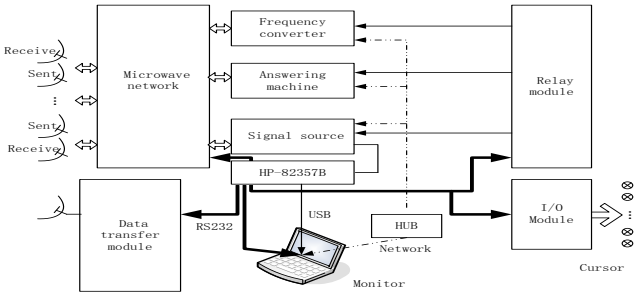

Fig2. Block diagram of the tower terminal

Tower terminal equipment includes microwave network module, relay module, I/O modules, digital modules, computer and monitor calibration with an answering machine, zero converter, signal source and other components, microwave network module for transponder signal source, zero inverter input and output RF signal link switch, to meet different sets of operating modes shipboard monitoring and control equipment to match the demand for radio frequency link; relay module is used to control devices plus power controlled by the microcontroller I/O level change controlled coupler relay-off, the paper of choice for the Panasonic relay SRD-05VDC-SL-C; I/O module for controlling cursor (light emitting diodes) on-off control by the microcontroller the corresponding port change to realize in order to match the needs of different measuring and control equipment; and data transmission module for receiving a control command ship terminal, sent to the monitoring computer instruction dispatch.

System interfaces including RS232 interface for controlling the microwave network module, relay module, I/O modules, digital modules, using the Modbus communication protocol to ensure reliability and reduce communication data interface; GPIB-USB interface is used to achieve universal signal source control, monitor and facilitate the portable computer control; a network interface for implementing calibration equipment, such as an answering machine, the parameter control zero drive; monitoring computer used to manage these interfaces, according to respond ship terminal control command.

3.2 Design of ship terminal

Ship end of tested equipment including antenna servo feed points system, and shimmer TV points system, and received points system, and launches points system and main monitoring computer, which main monitoring computer is ship end control of core, is responsible for completed test equipment work state switch, and records/analysis data and sent to Tower end control instruction,; wireless number biography module is and Tower end supporting equipment, for completed control instruction transmission, its principle diagram as Figure 3 by shows.

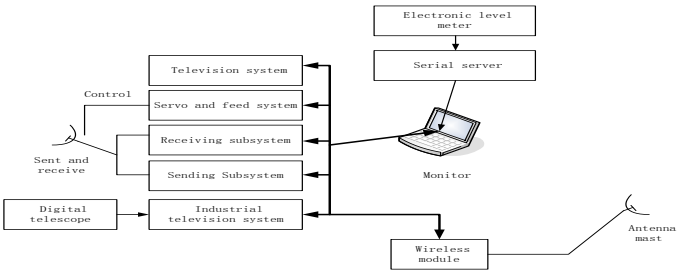

Fig3. Block diagram of the ship terminal

Ship equipment control based on the control mode of the existing equipment and means of minimizing software development difficulties. Software development monitoring system software based on the original, network traffic using network control, serial communications server control through the serial port. In design Shi, calls original software design by using of network class and serial class, respectively prepared corresponding of program has adapted new added equipment of control: digital telescope of image information through industrial electric points system for collection, and for image processing, get target of miss volume information, and to main monitoring computer, and days servo feed points system instrument constitute control loop; wireless module designing output interface for RS232, through configuration RS232 to network of suitable distribution device, completed network configuration, Likewise under the control of the main computer; network control of other tested devices are one-sided manner.

4. Design of Monitoring Software

The system monitor software consists of two parts: the tower control software and ship-borne Master software, prepared using c#[4], software has a modular design, through the design of appropriate class library file implementing the corresponding function, which Tower side of the control software for the new Institute, ship's master software for software adaptation.

4.1 Control software of tower side

Tower end the main functions of the control software is corresponding to ship end of control instruction, and RF switch link, calibration equipment parameter Settings, general source parameter, equipment of power outages, the cursor switch, etc. Software design can be divided into network, a serial port, USB, network class USES the Socket technology, serial port using c# to provide components to control, USB class using the HP-82357-b provide libraries to call. Its key technology to the RS232 bus Modbus protocol, Modbus protocol is a

main interface - polling protocol, this work USES the RTU mode, the main equipment for monitoring computer tower end, from the device for microwave network module, relay module, I/O module, data transmission modules, each module has a fixed device address to distinguish, main device sends the frame format for: [device address] [orders] [00] [00] [00] [05] [CRC low 8] [CRC high 8], to control the device response should command, frame format for feedback: [device address] [capabilities]] [data length data [1] [2] data, data[3] [CRC low 8] [CRC high 8].

4.2 Control Software of Ship Side

Ship master control software is to install the system monitor to the existing main monitoring software adaptability, volunteers need to realize the function of the control equipment technical status, read were the result of the data, the control tower, the work mode and data statistics, the generation of battle report printing, etc. Software design of the corresponding class library for the network, a serial port, XML[5](Extensible Markup Language), word classes, database, which need to add new class library for word classes, database, word classes are used to generate battle reports, because the battle report is a kind of fixed format documents, this article adopts the method of preset bookmarks for data entry; Database class used to store the process data, the result data, etc., to facilitate the query. Software compiled by the key technology for the XML file, the system design of the corresponding equipment and instrument calibration program is to interpret the XML files in the state of the parameters, such as calibration method for XML document needs to consider the optimization of project, such as multiple calibration project using the same equipment or facilities, can perform synchronous control and data entry.

5. Summary

By combing the existing equipment situation, combined with the contents of calibration involved in the project, is designed to automatically scale within a school ship dock system. Integrated use of networks, wireless communications, software engineering technology, developed a wireless module and tower-side control system, and the ship's main computer monitoring software revamp to achieve a boat-Tower automatic control facilities between collection and statistical functions. Practical application shows that the system design is reasonable, simple control, convenience, greatly liberated the human and shorten the calibration time.

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