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Design and Implementation of Inertial Measurement Information Acquisition System Based on XML

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Abstract. Platform inertial measurement information acquisition system is to acquire, store and display inertial measurement information of inertial platform navigation system by means of data communication. Due to the different types of platform inertial navigation system, the communication protocols are diverse. In this paper conducts the repetitive coding problem caused by different formats of communication protocols and put forward an improved method based on XML template applied to format of data unit in protocols. This method greatly improved the generality of acquisition software. In the premise that the acquisition board is not replaced, this method according to the type of platform to change the XML template, without compiled twice time. The inertial information acquisition system has been applied in practice. Practice has proved that this method can significantly reduce the workload of code maintenance and cut down the cost of personnel.

1. Introduction

Platform inertial measurement information acquisition System acquire, store and display the inertial measurement information of the platform inertial navigation through data communication. The system needs to communicate with the underlying equipment according to the relevant protocol format. Due to different types of inertial navigation platforms different types of protocol frames and different communication protocols exist. As a result, the data processing complexity increases when data packet analysis is performed, and the communication format needs to be analyzed according to the corresponding protocol type.

XML is a structural markup language used to mark electronic documents, a language that can be used to mark data, define data types, and allow users to define their own markup language. Hao Chao[1] using C # language through Microsoft.NET FrameWork developed XML-based monitoring software rapid design system, using object-oriented and modular ideas to achieve the software scalability. Xianyu Long[2] adopted XML standard model file and put forward a framework for data exchange of device model. The model was actually used in SCADA system software developed independently by the company.

In order to reduce the waste of resources caused by various protocol types and the resulting data interface design in the common platform inertial measurement information acquisition system. Based on the design idea of scalable low coupling, the protocol of message format with descriptive language XML is adopted. Through the XML protocol to achieve the protocol format and content description.

By using XML file creation and parsing, a small number of code modifications are made to resolve the communication protocol of inertial platform inertial navigation system. The system function module is independent and scalable, which solves the problem of data analysis and interaction of heterogeneous protocol in data communication.

2. Protocol Description Based on XML Protocol

2.1. Introduction to XML technology

Extensible Markup Language is a subset of SGML that provides a uniform way to describe and exchange structured data. XML is scalable, self-describing, structured, content and presentation apart, giving it a natural advantage in data description and information sharing. XML technology provides a standard markup language that can be used for data exchange, initially used to describe the document elements on the WEB page [3-5]. Compared with other existing data exchange technologies, XML technology has the following advantages:

1) Good readability;2) Convenient and scalable3) Data content and form of separation;4) Facilitate the retrieval of information;5) Easily cross-platform applications;

2.2. The sample code to parse XML configuration files

Platform inertial measurement information acquisition system using C + + Builder 6.0 environment for software development. The handling of XML is mainly encapsulated in the TXMLDocument component, which is part of the Internet Components component. This component has the following property methods:

1) Use the control method to load the XML file;2) Use of control methods to save the XML file;
3) Read the node, attribute data;4) Add child nodes and set properties5) Formatting XML

This article only uses the first method and third method of the above attribute method, the following code parsing XXXXML intermediate file protocol parsing code example:

1.Form1->XMLDocument1->LoadFromFile("XXX.xml");//load XML document
2.IXMLNode *my=Form1-> XMLDocument1->DocumentElement->ChildNodes->GetNode(0); //get the first node
3._di_IXMLNodeList nodes=my->ChildNodes;4.int cc= nodes->Count;int *TaskID ; //create a task 5.ID dynamically String *TaskIDName; // create a task identifier name dynamically 6.TaskID=new int[cc] ; // create a task ID 7.TaskIDName=new String[cc]; // create a task identifier name
for (int i=0;i<cc-1;i++)// Circulate the task ID name and ID of the xml intermediate file to a dynamic array through the loop
{
TaskID[i]= StrToInt(nodes->Nodes[i]->ChildNodes->FindNode("ID")->Text);// get task ID
TaskIDName[i]= nodes->Nodes[i]->ChildNodes->FindNode("IDname")->Text ; } //get task identifier name

3. Design and Analysis of Common Platform Inertial Measurement Information Acquisition System

3.1. Composition of platform inertial measurement information

In the platform inertial navigation system, the accelerometer used to measure the acceleration of the carrier and the gyroscope to measure the angular velocity of the carrier are mounted on the inertial platform.

The system uses the precession of the gyroscope and applies torque control to the gyroscope to offset the rotation angle of the gyroscope in order to keep relative stability with the inertial space so that the gyroscope always tracks the specified navigation coordinate system. The inertial platform avoids the influence of carrier motion on the acceleration measurement and provides the measurement basis for the whole system[6].The inertial platform of the platform can avoid the influence of the

carrier motion on the inertial element, and the angle sensor on the frame corner can directly measure the attitude angle for navigation estimation.

Platform-based inertial navigation system mostly multi-axis multi-frame system, which is designed to accurately control all aspects of space and design, in the structure of the various vertical to each other, the framework without mutual coupling[7]. The inertial navigation system needs to measure the following information:

1) Frame Angle information

The three-axis platform inertial navigation system is used to measure the frame angle, inner ring shaft frame angle and outer ring axis frame angle information. The four-axis platform inertial navigation system is used to measure the frame angle, inner ring shaft frame angle, outer ring shaft frame angle, and the frame angle of the axis. The frame angle sensor is mounted on the frame axis of the platform and the output circuit of the frame is completed by the frame angle sensor and the output of digital output. The data acquisition software collects the output of the frame angle digital output after the output circuit is converted.

2) Acceleration information

The accelerometer is mounted on the triaxial and four-axis platform inertial navigation system. The acceleration measured is the component of the axial acceleration along the platform axis. In addition to the accelerometer for acceleration measurement, the sensor is also used as the sensor of the platform system to adjust the loop[8]. The accelerometer analog quantity is transformed by the I/F conversion circuit (range conversion circuit) into the pulse number and the counting circuit is transformed into a digital quantity. This data acquisition software collects the pulse output after conversion.

3) Gyro torque current

The gyro plus moment current is the gyroscopic precession driven by the instruction current generated by the inertial navigation computer. Through the platform stable loop, the platform realizes the rotation of relative inertial space, or counterbalances the gyroscope drift and ground speed, so that the platform coordinate system is followed by a designated geographic coordinate system[9]. The data acquisition software collects the digital quantity of the torque current output of the gyro plus moment circuit.

4) Platform task status and location number

Platform main task status including flight navigation, lock to zero, end of zero lock , self-calibration, end of self-calibration, self - targeting, end of self – targeting etc. of twenty kinds of state. Each state corresponds to the position of the platform body, so the location number is different. If the task identity of the platform is self-targeting, the position number is from 1 to 2 if the XX platform adopts the two-position self-aim method. If three or four positions are used, the position number is 1~4.

3.2. Design of XML file format based on inertial measurement information

The general platform inertial measurement information acquisition system collects, displays and saves the above data, which is convenient for subsequent data processing and analysis. Due to the diversity of platform inertial navigation system, the use of different types of platform inertial navigation system with separate types of platform inertial navigation inertial measurement information acquisition system, need a number of personnel for maintenance, when agreement to change or increase the control command platform, need a number of researchers to inertial measurement information acquisition system for the corresponding code modifications, maintenance difficulties and high cost. Based on this paper, we propose a protocol based on the XML technology in the first section of this paper. The XML file format is as follows:

1) Platform task status and location number

The platform task identity XML file is used to specify the ID number and task ID name corresponding to the platform task identity. Different types of frame type platform system task identifier with ID number and the task of Chinese name is different, there is the same ID number corresponding to different task identifier name different phenomena, so to solve by means of as shown in figure 1:

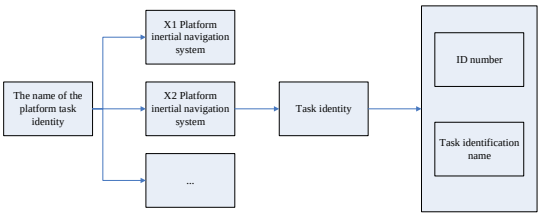

Figure 1: The XML file format of the platform task identity name.

2) XML file format of the protocol format

The protocol message format XML file is used to specify the parsing rules for valid data areas in different platform communication protocols. Due to the different types of frame type platform system corresponding to the instrument configuration and frame angle coordinate system, framework agreement from the angle of information data, accelerometer pulse output data, the position of the platform, mission of the position of bytes identify different platform. The solution is shown in figure 2.

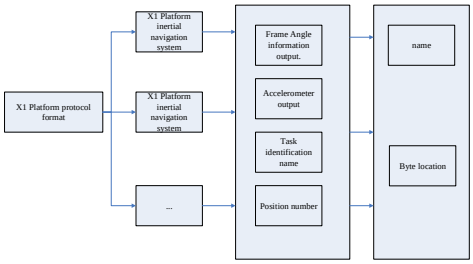

Figure 2: The XML file format of the platform protocol

3.3. The parsing process for the XML protocol specification template

Two structure types are defined according to the specification template that has been established for XML. The first structure is the task identity structure, which contains two attributes. When parsing XML template file as shown in figure 3: first of all, according to the corresponding platform type read the corresponding XML documents, access to the root of the XML document tag in the frame format of the number, for a total of several child nodes. Then the information of the frame subtag of the sub-node is resolved. Through the above process, the XML formalized description of the entire protocol structure is identified.

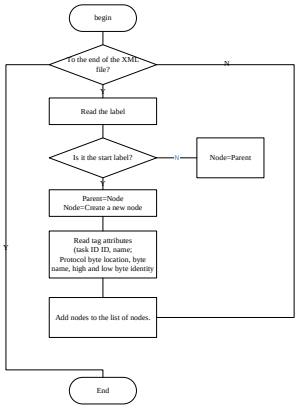

Figure 3: The parsing process for the XML file

4. Design and implementation of inertial measurement information acquisition system for platform inertial measurement

4.1. Description of system functions

Inertial navigation information acquisition software platform to achieve the following six functions: the card interface initialization, according to the corresponding platform type selection data storage paths, receiving navigation data, analytical processing navigation data, save the navigation data, show the navigation data. Among them, the board card interface is initialized and the data storage path is selected according to the type of the platform, which requires user participation, and the remaining functions are automatically realized by the software.

4.2. The description of the structure system

Platform inertial navigation information collection software consists of data acquisition module, data analytical processing module, configuration management module, data display module, data storage module and user interface.

1) Data acquisition module

The data acquisition module used API functions that call the underlying driver software to collect data. The underlying driver software is provided by the data acquisition board vendor, and the manufacturer will package the required functional functions into DLL and header files. Therefore, the collection module can only call the initialization and interrupt function of the corresponding plate card, and the data can be collected.

2) Configuration management module

The configuration management module implementation is resolved according to the platform type to use the configuration template in the valid data resolution area of the data receiving area, and the configuration template includes two parts. Through configuration templates to different types of platform framework from the Angle of the data, the accelerometer and gyro torque current task identification data, platform byte position, overcomes the problem of poor universality of software.

3) Data analysis module

The data analysis module analyzes the public data analysis area and the valid data analysis area respectively. The framework Angle data, accelerometer data, gyro plus moment current data, platform task identification and location number are analyzed in the valid data analysis area. The inertial information of different types of platforms is analyzed and stored in the corresponding variables to carry out subsequent data display and storage module.

4) Data display module

Depending on the platform type, the user's graphical interface is displayed according to the type of the platform selected. The user selects the corresponding type of platform inertial navigation and displays the inertial measurement information of the corresponding platform inertial navigation.

5) Data storage module

The data of inertial measurement information of different types of platform inertial measurement is stored according to the unified storage type. The system switches the data files according to the task handover and file size, ensuring the continuous unification of the files and the readability of the data files.

4.3. The workflow of the system

The workflow of the system is shown in figure 4. The first step is to initialize the data, which is to configure the receiving register before receiving it. If the receiving state is valid, the data is received, the read application control register is configured, the cache is applied, and the data can be read until the data is received. The receive cache is released, and the receiving state is checked if it continues to read. Repeat the above process, otherwise the receiving end.

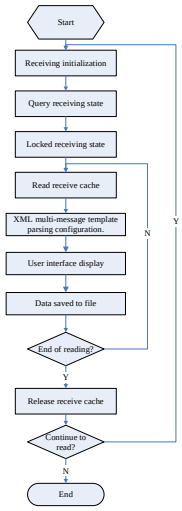

Figure 4: The workflow of the system

5. Conclusion

Due to the types of platform system framework system and instrument configuration caused by different communication protocols different kinds of difficulties, need many people maintain many sets of data acquisition software and repeat coding issues. This paper presents an xml-based message format specifications, greatly improving the inertial platform inertial navigation system information acquisition software versatility, ensures that different types of derivative according to the consistency and security of the exchange platform used to. The software has been used in the actual work. The practice proved: the method is significantly reduced code maintenance workload, the need to people before maintenance reduced set of software to one more person to maintain a set of software, reduce staff costs.

References

[1] Chao Hao, Zhe Yang, Rapid design technology of monitoring software based on XML[J], China Science and Technology Information, 2017(06): 36–37.
[2] Yulong Xian, Jingyang Zhang, Peng Chen, etc. An interactive standardization method for oil and gas pipeline equipment model based on XML[J], Electronic Science& Technology, 2017(04):28-32.
[3] Liansheng Yang, Aiping Li,Jiawei Li, etc. Research and implementation of data exchange interface for ship production design based on XML[J], Shipbuilding of China, 2016(04):164-174.
[4] Zhenjie Zhao, Yuehui Yan, Hao Wang, etc. Data exchange technology for heterogeneous PDM platform based on XML[J], Intelligent Manufacturing, 2017(04): 35–38.
[5] Jinyu Gao, Ping Cao, Run Chen, etc. Research on structured method based on XML[J]. Aeronautic Standardization & Quality, 2017(01): 45–47.
[6] Yuanjiu Lu, Inertial components[M]. Beijing: China Aerospace Press, 2009:Chapter 16 p169
[7] Yiyuan Deng, Hydrostatic floating gyro platform system[M].Beijing: China Aerospace Press,2012:Chapter 8. p121
[8] Ying Gu, The inertial guidance accelerometer technology overview[J].Winged Missiles Journal, 2001(06): 78–85.
[9] ErWei Wang, Haifeng Jiang, Gang Huang, etc, Based on the LabView gyro moment circuit testing method[J].Navigation and Control, 2016(05): 108–112.