

Design of Security Management System of Meteorological Observation Equipment in Jiangxi Province

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Abstract According to the current development status and requirements of meteorological observation equipment security work in Jiangxi Province, a security management system of meteorological observation equipment was developed to improve the scientific and precise level of current security management business. The system was elaborated in terms of design ideas, functional modules, and realization of functions. The system adopts the C/S architecture to realize the information management of security business of meteorological observation equipment such as radar and automatic weather stations. It provides functions such as maintenance registration, data statistics and table generation.

Key words Meteorological observation equipment; Security management system; Jiangxi Province

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With the continuous advancement of meteorological modernization work and the continuous development of meteorological observation technology in Jiangxi Province, the meteorological observation equipment in Jiangxi Province has greatly improved in terms of type, quantity and construction density. Up to now, Jiangxi Province has gradually established an integrated meteorological observation network covering a new generation of weather radar, wind profile radar, lightning location observation system, automatic weather stations and other installations, and there are thousands of installations. At the same time, new standards and new requirements will be faced by the operation monitoring, maintenance and supply of meteorological observation equipment. At present, for the operation monitoring business, Pei Chong *et al.*^[1] established the operation monitoring platform of national integrated meteorological observation system, which has been applied in the meteorological departments of Jiangxi Province. However, for another important link in the meteorological observation business in Jiangxi Province—the maintenance and maintenance business, there is no scientific and efficient management platform that is compatible with the rapidly developing meteorological observation network, which not only leads to asymmetry in the acquisition of front-end monitoring information and back-end maintenance information, but also easily makes a lot of valuable maintenance data information lose. Therefore, in order to ensure the balanced development of meteorological observation integrated services in Jiangxi Province, it is necessary to establish a security management system of meteorological observation equipment based on the business needs of Jiangxi Province. In this study, the system will be introduced from the aspects of design idea, system framework and function implementation.

1 Design ideas

The security maintenance business of meteorological equipment is one of the most important links in the observation business system. Meanwhile, the security business is also closely linked to all aspects of equipment operation, such as monitoring of status of equipment operation, and whether the daily maintenance of business personnel in each station is standardized. Therefore, the system should be designed from various dimensions of equipment operation, and reverse backward is performed from the end of the main business line of operation monitoring – supply – security business. Through the statistics and analysis of the guarantee situation, the operation status and fault rate of the observation equipment is obtained to provide effective technical support and decision-making basis for the scientific guarantee of meteorological observation equipment. The system is designed based on the C/S architecture mode. Each functional module is designed around the database of the central station, and clients and the central station are connected through local area network (Fig.1).

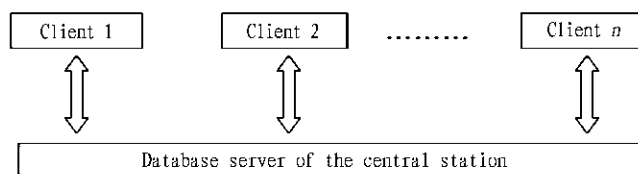


Fig.1 Overall framework of the system

2 Functional modules of the system

2.1 Registration of maintenance records Maintenance records are filled in by security personnel. A maintenance process is recorded and described in detail, including the type, replacement and maintenance process of maintained equipment. After being filled in, the maintenance records are input to the database by the system. This functional module is the core part of the system, and all other functions are extended based

on the module. The registration and input process is bound to the information table of the database. When the user fills in a maintenance form, the corresponding information is automatically matched in the database to form a wizard mode, which makes the filling of the maintenance form more efficient and reduces the probability of human error.

2.2 Authority setting The system is divided into two types of operation authority, including administrator and normal user operation. Because the system has the functions of adding, deletion, modification, query, etc. for the database. The adding and query functions are normal operation, and both normal users and administrators can operate. However, for the deletion and modification functions, incorrect operation must be shielded, so the deletion function of the system can only be performed by administrators.

2.3 Query and statistics of records The query mode can be arbitrarily set according to users' requirements. For example, statistics can be performed according to the maintenance status of a certain area or the fault maintenance status of a certain type of observation equipment in a certain period, and EXCEL tables are generated. This feature can provide very targeted data information for business management departments. For example, according to the number of spare parts in a region, as well as reasons for faults and other relevant information, problems and shortcomings of the area in terms of equipment operation management and fault prevention measures are comprehensively analyzed, and then rectification suggestions are proposed. Meanwhile, it cooperates with the equipment supply department to establish a reasonable plan for the future supply of equipment in the region. Besides, the fault rate of a specific type of equipment can be analyzed to determine which devices are stable and which devices have a high failure rate, and even further trace the design principle of the equipment and whether the operation environment has a hidden danger of affecting the operation of the equipment, thereby enhancing the accuracy of maintenance management of the equipment. It is clearly seen that the role of the system database is very important, and it links any links and any nodes in the maintenance process into an organic whole to make the integrated maintenance business system more scientific, efficient and reasonable.

2.4 Management of storage of spare parts How to manage the storage of spare parts properly to realize dynamic management has always been a problem to be solved. If the storage is equipped with too many devices, the storage of spare parts will be redundant. If it is equipped with few devices, its emergency role will be lost. For the above requirements, based on real-time changes in the storage of spare parts, the number of spare parts is analyzed to dynamically generate a reasonable allocation solution. The system divides the storage of spare parts into two types of operation. One is the output of equipment, which is bound to the maintenance records of the equipment. When maintenance personnel fill in maintenance records, the output records of spare parts are automatically generated. The other operation is the input of equipment, and the input records of spare parts are filled in by hand by maintenance personnel.

3 Realization of functions

3.1 Establishment of a database The system surrounds each functional module and describes the entire maintenance process in five data sheets (Fig.2).

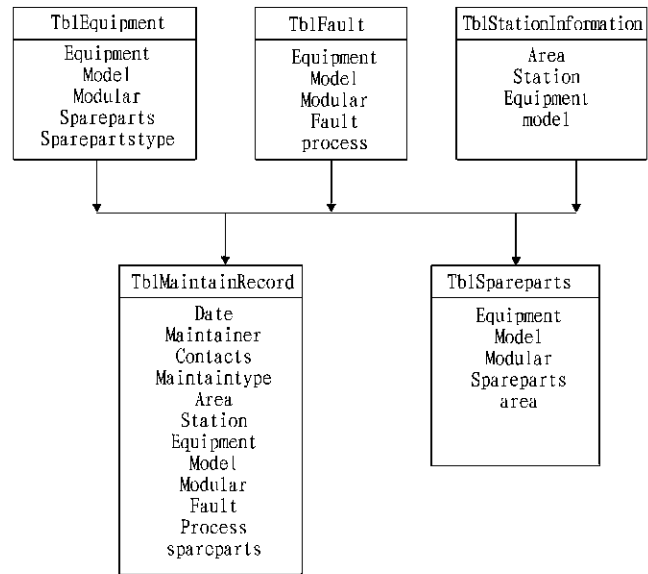


Fig.2 Structure of the system database

3.2 SQLHELPER class package of custom database operation ADO.NET is a COM component library and an object-oriented library interacting with data sources. It is used to access data in previous microsoft technology and is a data access interface that is preferred in the .NET programming environment. In general, a data source is a database, but it can also be a text file, an Excel table, or an XML file. ADO.NET allows developers to access data sources in a consistent manner and process and update the data contained in them^[2]. The system uses ADO.NET to perform related operation on the database. In order to avoid code redundancy, the system packages the functions of adding, deletion, modification and query of the database into the custom SQLHelper class^[3], and uses the Connection class to realize the connection with the database, and the interaction process needs to specify the corresponding operation, which is executed by the command object. The developers use the command object to send the sql statement to the database. The command object can be used to execute commands such as query, modification, insertion, and deletion. The following static methods are packaged in this class:

3.2.1 ExecuteNonQuery. It is usually used to execute Update, Insert, and Delete statements. For Update, Insert, and Delete statements, the return value is the number of rows affected by the command. For all other types of statements, the return value is -1. The codes are as follows:

```

public static int ExecuteNonQuery(string sql, params SqlParameter[] pms)
{
    using (SqlConnection con = new SqlConnection(constr))
    {
        using (SqlCommand cmd = new SqlCommand(sql,
  
```

```

con))
{
    if (pms != null)
    {
        cmd.Parameters.AddRange(pms);
    }
    con.Open();
    return cmd.ExecuteNonQuery();
}
}
}

```

3.2.2 ExecuteReader. The `DataReader` object allows developers to get the results from the `Select` statement of the command object. The data returned from the `DataReader` is a fast and just "forward" data stream. The developers can only extract the `SqlDataReader` data from the data stream in a certain order^[2]. The input of this method is the constructed SQL statement and the variable array of the `SqlParameter` type containing the SQL query variable. The codes are as follows:

```

public static SqlDataReader ExecuteReader (string sql ,
params SqlParameter[] pms )
{
    SqlConnection con = new SqlConnection (constr);
    using (SqlCommand cmd = new SqlCommand (sql,
con))
    {
        if (pms != null)
        {
            cmd.Parameters.AddRange (pms);
        }
        try
        {
            con.Open();
            return cmd.ExecuteReader (System.Data.
CommandBehavior.CloseConnection);
        }
        catch
        {
            con.Close();
            con.Dispose();
            throw;
        }
    }
}

```

4 Generation of excel tables

The system is realized by quoting Ionic.Zip.dll and NPOI.dll dynamic link libraries of NPOI 1.2.5. POI is a fully open source Java library that can read and write Microsoft OLE2 component files such as Excel and Word without installing Microsoft Office or corresponding environment. It supports almost

all file formats of Office97-Office2007. Therefore, NPOI is the .Net version of the POI project^[4]. The relevant codes are as follows:

```

IWorkbook wkbook = new HSSFWorkbook();
ISheet sheet = wkbook.CreateSheet("mysheet");
IRow row = sheet.CreateRow(0);
row.CreateCell(0).SetCellValue("date");
row.CreateCell(1).SetCellValue("maintainer");
.....
row.CreateCell(10).SetCellValue("maintenance
process");
row.CreateCell(11).SetCellValue("region");

for (int i = 0; i < dataGridView1.RowCount; i++)
{
    row = sheet.CreateRow(i+1);
    row.CreateCell(0).SetCellValue((dataGridView1.Rows[i].
DataBoundItem as TblMaintainRecord).date);
    row.CreateCell(1).SetCellValue((dataGridView1.Rows[i].
DataBoundItem as TblMaintainRecord).maintainer);
.....
}

```

5 Conclusions

The security management system of meteorological observation equipment in Jiangxi Province is an automation and information platform for provincial meteorological equipment security personnel. The system packages and integrates all links of security business to form a basic information database. Through the statistics and analysis of data, the effective information is extracted to provide decision-making basis for maintenance and management. At the same time, the information of maintenance process in the basic information database will provide data information with certain reference value and guiding significance for equipment maintenance. Since the system was put into operation, it has played an active role as an effective supplement to the security business system of meteorological observation equipment in Jiangxi Province.

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