Research and application of safety Assurance system for oil and gas construction project based on Internet of Things

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Abstract. The purpose of this paper is to establish the security mechanism and system of oil and gas resources through the study of the theory and technology of oil and gas resources security. In order to achieve the storage of oil and gas resources data management, security analysis and the future development trend of oil and gas resources indicators, based on the field of the existing SCADA system for the application object, aiming at the shortcomings of the current system, integration of emerging Internet of things technology, the Internet of things of sense, transmission and application of three layer hierarchical build mechanism, the design has realized the oil and gas production security system based on Internet of things, and apply it to the oil field construction projects. This paper mainly designs and develops the oil and gas resources security guarantee system, realizes the data analysis management, the forecast result visual display and the guarantee operation and so on function, has the important theory and the practical significance to the guarantee oil and gas resources security.

1. Technical introduction

1.1. Overall design of oil and gas production support system based on the Internet of Things

Internet of Things Architecture

The architectural composition of the Internet of Things can be described in Figure 1. Functionally, it is mainly composed of data. The acquisition layer, the data transmission layer and the data processing application layer are composed.

Figure 1 architecture of the Internet of Things
1.2. **Perception layer**
The perception layer is the bottom layer in the three-layer architecture of the Internet of Things, mainly through RFID reading and writing equipment, temperature, degree sensor, humidity sensor and other information sensing devices complete the collection and acquisition of the basic information of the object.

1.3. **The transport layer**
In the Internet of Things system, the transmission layer is in the middle layer, mainly composed of routers, switches, gateways and other network equipment data transmission network, to complete the transmission of the perception layer data to the application layer, through a variety of networking to achieve the sharing of the underlying data of the Internet of Things.

1.4. **The application layer**
The application layer is located at the top level of the Internet of Things system. It mainly completes the storage, computing analysis and processing of all the perceptive layer data. At the same time, it can provide users with different data access control interfaces based on different applications, so as to realize the control and access of the perceptive layer devices.

2. **Safety guarantee system for oil and gas construction projects**
The essence of the oil and gas resource security is the guarantee of dynamic balance between supply and demand of oil and gas resources, the judgment of its security indicators should be selected the related influence factors of oil and gas resource security safeguard combined with historical data analysis, based on oil and gas resource security connotation of universality and complexity, according to the representative, the principle of continuous dynamic, systematic, simplicity, extensive access to oil and gas resources data and all kinds of related information, consult experts summarizes the opinion at the same time, and in many scholars research on the index system of oil and gas resource security for reference, on the base of the analysis results reasonable sort merge, The ultimate goal is to construct the security guarantee index of oil and gas resources with clear hierarchy and logic. This paper selects 12 key indicators that can comprehensively reflect the safety of oil and gas resources. See Table 1.

| Early warning index system of oil and gas resource security guarantee | Oil and gas resource safety | Oil and gas storage and production ratio |
|---|---|---|
| | | Replacement rate of oil and gas reserves |
| | | Oil and gas production growth rate |
| Safety of oil and gas supply | Oil and gas reserves exploration |
| | Oil/gas supply ratio |
| | Annual oil and gas production |
| | Oil and gas consumption intensity |
| | Oil and gas consumption growth rate |
| Oil and gas market safety | Oil and gas external dependence |
| | Concentration of oil and gas imports |
| | International oil and gas market prices |
| | Oil price volatility |
2.1. System establishment
For the special environment of oil and gas production, it is a new requirement of oil and gas production informatization to adopt wireless transmission, strengthen production control, deeply dig massive data, and exchange data with other information systems of the group company. Compared with the traditional SCADA, the Internet of Things technology determines the inevitable trend of introducing the Internet of Things technology into the oil and gas production monitoring system. To this end, combining the traditional SCADA system structure with the technical architecture of the Internet of Things and the key technologies of the Internet of Things, this paper constructs the OIL and gas production support SCADA system based on the Internet of Things. The overall architecture of the system is shown in Figure 2.

![Diagram](image)

Figure. 2 Safety assurance system for oil and gas construction projects
The figure above shows the flow and storage of data streams and video streams between units of the Oil and gas production assurance system based on the Internet of Things. The single well data, pipe network data and station database data are collected into the configuration software of the station and operation area, and then stored in the real-time/historical database of the oilfield company through the data verification engine of the operation area for data exchange and synchronous application of other information projects and unified construction projects of the oilfield.

2.2. System Contents
Based information system requirements can be based on all kinds of oil and gas, oil and gas safety indicators, according to the different security level indicator, to provide risk assessment for oil and gas resource security, security in the analysis of the result of the forecast information, and according to the different degree of security, to make the corresponding emergency measures, to improve all kinds of contingency plans. In this way, our country can deal with emergencies calmly and avoid the occurrence of general international market price fluctuation or temporary domestic supply and demand contradiction, which will cause the national economy to suffer great losses. See Table 2, Table 3 and Table 4 for the input and output information of relevant business processes and business data [1-10].

Table 2 Work and business analysis

| The business process | Business Activity name | Description of business activities                          |
|----------------------|------------------------|-------------------------------------------------------------|
| Oil and gas resource risk warning | Risk assessment | All aspects of risk assessment for the safety of oil and gas resources |
|                      | According to risk      | The risk evaluation results are visually displayed in the user interface, and the query and analysis are realized |
Risk early warning

| Risk early warning | On the basis of the early warning to generate warning degrees |
|--------------------|--------------------------------------------------------------|
| Emergency plan for oil and gas resources risk is formulated | Formulate emergency plan of risks |
|                    | According to different degrees of early warning, formulate corresponding emergency plans, improve various emergency measures |
| Oil and gas resource dynamic monitoring | Oil and gas resource data management |
|                    | Data acquisition, data format conversion, data import and data update for oil and gas resources |
|                    | Oil and gas resource information query |
|                    | Display oil and gas information as required |
|                    | Statistical analysis of oil and gas resources |
|                    | Make special statistical analysis of oil and gas resources |
|                    | Data file output |
|                    | Export and archive oil and gas data and analysis results |

Table 3 Data input table

| source | The serial number | User view name                      | Ready to hang                      |
|--------|-------------------|-------------------------------------|------------------------------------|
| Oil and gas center | 1 | Base block empty label information | Security guarantee basic information module |
|        | 2 | Block pattern |                                      |
| Oil and gas center | 1 | Base block database | Security guarantee basic information database |
|        | 2 | Oil and gas exploration and development database |                                      |
|        | 3 | Oil and gas trade number database |                                      |
|        | 4 | Dynamic oil price database |                                      |
| Oil and gas Resources safety assurance Expert Group | 1 | Oil and gas resource safety evaluation index library | Safety assurance evaluation information database |
|        | 2 | Risk warning information database |                                      |
|        | 3 | Emergency plan database |                                      |

Table 4 Data output table

| where | The serial number | User view name | note | note |
|-------|-------------------|----------------|------|------|
| Task data folder | 1 | The report | Security assurance early warning process and result information | |
|        | 2 | Statistical charts | | |
|        | 3 | The document | | |
|        | 4 | Thematic maps | | |
|        | 5 | The emergency response plan | | |

3. System development

This system adopts C/S architecture, and takes ArcGIS Engine as GIS platform, WPF as cartography system and C# as development language to develop the oil and gas resource security guarantee system under the environment of Visual Studio 2010. ArcEngine is used to realize the basic GIS function, and the mathematical calculation formula of the prediction model is transformed into computer language through programming, and the prediction of future indicators is finally realized, so as to realize the guarantee effect. The technical route of system development is shown in Figure 3.
4. Conclusion
The introduction of Internet of Things technology makes the oil and gas production monitoring system function more perfect. Through sensing, radio frequency, communication and other technologies, we can have a comprehensive perception of the production objects, realize automatic collection and control of production data, automatic collection of production data, automatic monitoring of production environment, automatic control of production process, and guarantee of the state of equipment connected with things. Collected data, accurate, stable, complete, controlled equipment, and safe, stable, sensitive.

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