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Design and Application of Oil Gathering Monitoring System based on IAAS Cloud Platform

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Abstract: :With the rapid development of science and technology as well as the petroleum industry, the role of a collective procurement monitoring system in petroleum resource management has become increasingly important. This article proposes a design scheme for an oil collective procurement monitoring system based on Infrastructure-as-a-Service (IaaS) cloud platform. By applying Internet of Things (IoT) technology and cloud platform technology to the oil field collective procurement process, it is possible to monitor the process in real-time, facilitate data collection, and analyze and predict data. This system utilizes the flexibility and scalability of IaaS cloud platforms with the aim of improving real-time monitoring capabilities and data processing efficiency in the collective procurement process.
Keywords: Oil gathering ;IaaS cloud platform; monitoring system; data forecasting; cloud computing

1. INTRODUCTION

Oil, known as the “lifeblood of industry” is one of the most important energy sources in the world today and has become a crucial cornerstone for development in many countries. With the rapid advancement of science, technology, and industrial revolution in the 20th century, oil as a foundational energy source has been widely applied across various sectors. It has replaced coal to become the 'primary energy' in the global energy structure due to its significant economic and strategic value, making it an indispensable material foundation for economic development and modernization processes worldwide. The existence of oil not only changes the nature of social development but also promotes it. Oil plays a very extensive role and function in socio-economic development, with its refined products permeating every aspect of people's lives and having an inseparable connection with their daily routines."

Although China has achieved certain achievements in the research and development of oil extraction technology, there are still many difficult problems to be solved. Traditional oilfield monitoring systems often adopt decentralized management, with isolated information between devices, making it difficult to achieve real-time monitoring and data analysis.

With the continuous progress of science and technology in recent years, integrating the Internet of Things into various industries has become a development trend. By incorporating IoT technology into the oil collection process, real-time monitoring of each stage of oil collection can be achieved. Furthermore, data analysis and prediction of the oil collection process can be conducted to provide accurate and real-time analytical results for management personnel, assisting them in making informed decisions.

At the same time, global IT companies are actively transitioning to cloud computing, which is also being widely applied and gradually becoming the strategic focus of the IT industry. Broadly speaking, cloud computing is a method of pooling numerous computing resources together and implementing automated management through software, requiring minimal human involvement while rapidly providing resources for services related to information technology, software, and the internet. Infrastructure as a Service (IaaS), as one of the three types of cloud computing services, relies on cloud service providers and utilizes existing technologies such as virtualization, distributed computing, and network storage to offer users general infrastructure services. Users can deploy middleware and application software based on these infrastructure resources. IaaS can provide comprehensive infrastructure services and become the cornerstone of the cloud computing service system [3]. Therefore, this system combines IaaS cloud platform services with IoT technology in designing an oilfield monitoring system to keep up with technological trends, improve oil extraction rates, and drive progress in the petroleum industry's development.

2. DEMAND ANALYSIS

2.1 Remote Monitoring

The system is able to collect data in real time from on-site devices and sensors, and transmit these data to the cloud platform for centralized processing and monitoring through the Internet. By interfacing with on-site devices, it collects various production data such as pressure, temperature, flow rate, etc. It ensures that the data can be transmitted to the cloud platform in real time, supporting high-frequency data updates and monitoring. Users can remotely log into the system via the network to view real-time data, generate reports, and perform analysis and prediction.

2.2 Analysis and Prediction of Production Data

During the process of oil collection, a large amount of real-time production data, real-time environmental data, and real-time consumption are generated every day. These data contain various connections and trends in oil production, most of which are hidden. The system needs to have the ability to analyze historical data, including but not limited to trend analysis and comparative analysis. It should be able to use statistical models and machine learning algorithms to predict future production data. It should also be capable of generating analysis reports and prediction reports that support charts and visualizations for easy user understanding and decision-making.

2.3 Stable and Efficient Data Storage

In the process of oilfield development, this system is not only used to monitor real-time production data, real-time environmental data, and real-time consumption in oilfield development but also to store and manage the data. In the currently widely used oilfield management systems, each production data is stored in its own local database. Once there are fluctuations in the database or downtime due to certain factors, it can easily lead to loss of production data. Therefore, a stable data storage environment is needed for the process of oilfield gathering and transportation. With the continuous development of cloud platform technology, this system adopts Alibaba Cloud's IaaS model which supports flexible scaling up and down and allows resources to be used on demand. This reduces IT resource preparation work caused by business peaks while avoiding excessive waste of resources after business peaks leave behind a large number of idle resources. It supports system continuity comprehensively through deployment in multiple regional data centers, disaster recovery backup, automated monitoring and recovery technologies while providing stability guarantee through Service Level Agreements (SLAs).

2.4 Production Data Statistics and Query

In the traditional petroleum industry, most of the staff are still accustomed to using excel for data analysis and statistics of key production data through the use of excel. Although excel is very useful, today, with the rapid development of science and technology, mature statistical algorithms and data visualization are applied to the petroleum industry. It is a good thing to help the staff to improve their work efficiency. The system should be able to carry out multidimensional statistical analysis of production data, and provide flexible data query functions, and users can customize queries according to different conditions (such as time range, equipment number, production status, etc.). At the same time, the large data visualization screen is designed to display the key information to the user in an intuitive way, supporting a variety of visualization forms, such as line chart, bar chart, pie chart, etc.

3. SYSTEM OVER DESIGN SCHEME

This system is based on cloud computing technology, integrated front-end separation technology and machine learning algorithm to establish a monitoring system for oil gathering. Realize real-time monitoring of real-time monitoring data, a number of production data, energy consumption data in the process of oil collection; It can query the data according to the conditions, and easily obtain the required data; A variety of machine learning algorithms can predict future oil production data based on current oil production data to help oilfield workers make decisions; It can perform visual display and dynamically display key data on a large visual screen, which is convenient for staff to view in time. This system will help users to grasp production dynamics in time and improve management efficiency. The back-end technology stack uses Python for core logic processing and data analysis. Use Flask lightweight Teb framework for building Teb apis and handling back-end logic. The front-end technology stack is designed using Html, CSS, JavaScript and bootstrap framework. The database uses SqlLite to store data related to oil collection.

4. CLOULD PLATFORM DESIGN

In the era of smart Internet of Things, the world's major network companies have launched their own cloud platforms. However, foreign cloud platforms are usually expensive, and due to the long distance and slow network transmission speed, it is not convenient to use. In contrast, Alibaba Cloud, as a leading cloud platform provider in China, fully meets the design requirements of this paper's system in terms of data visualization, elastic computing and storage, permission control and system scalability. Therefore, after comprehensive consideration, this paper decides to use Ali Cloud server for system configuration.

The system will eventually be deployed on cloud servers that will run continuously in response to external requests. To ensure proper system running, you need to install necessary components on the cloud server to build and maintain the operating environment.

Log in to the official website of Alibaba Cloud, purchase the cloud server, open the security group port, install relevant components on the cloud server of the system, build the operating environment, and deploy the project on the Alibaba cloud server

5. CLIENT SOFTWARE DESIGN

The system uses the idea of separating the front and back ends to build, and the back end uses python for core logic processing and data analysis. Use Flask lightweight Teb framework for building Teb apis and handling back-end logic. The database uses SqlLite to store data related to oil collection. The front-end technology stack uses Html, CSS, JavaScript and bootstrap framework to design, and realizes data visualization and displays related charts through ECharts. In traditional Web development, the front-end mainly uses JSP, and JSP is not independently completed by the back-end developer, and needs to be jointly completed by the front-end and back-end. It can be seen that this development method is extremely low efficiency, and the coupling type is too strong, in order to perfectly solve this problem we use the front and back end separation development method. The front-end independently writes client code to provide interface interaction, and the back-end only needs to independently write server-side code to provide data interface, which greatly improves the development efficiency.

The main design of the system is the following interface, visualizing the large screen display, visualizing the key data on the large screen, facilitating the oilfield staff to obtain key information; Login interface, in order to ensure information security, only the correct input of the user name and verification code can enter the system; Background management homepage, after successful login, enter the background management system; Data query interface, which can query data according to the needs of staff, and quickly screen the required data; The prediction interface was analyzed, production data was predicted by various machine learning algorithm models, and the prediction accuracy of the model was evaluated by four indexes, namely, R square, RMES, MAE and standard deviation.

6. CONCLUSION

The process of oil collection and production is very complicated and the environment is usually very bad. In order to promote the efficiency and output of oil collection and production, improving the intelligent level of each link is the key to realize efficient oil collection and production. With the continuous development of the Internet of Things and cloud platform technology, it is combined with oil collection to achieve intelligent monitoring, prediction and analysis of oil collection, laying the foundation for the subsequent optimization of the oil collection process. The oil gathering

monitoring system based on IaaS cloud platform designed in this paper mainly monitors the important link of oil gathering in the oil production process, pays attention to important data, and can use machine learning algorithms to analyze and forecast the production data, providing accurate and real-time data analysis results for oil field workers to help them make scientific decisions.

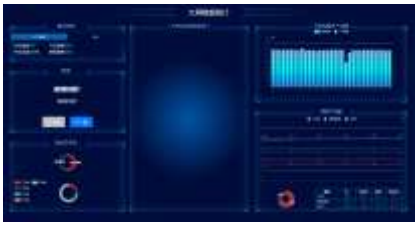

Figure. 1 Visual large screen display

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