Design and Implementation of a Real-time Monitoring Platform for Urban Air Quality Standards Based on SSH+Kafka Architecture

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ABSTRACT : *With the development of society, the country has taken necessary measures to the environmental pollution, carried out effective treatment, and accumulated valuable experience, but there are still many problems in air quality monitoring. Aiming at this problem, this paper preliminarily implemented a real-time monitoring platform for urban air quality standards based on SSH+Kafka architecture. The system completed an integrated full-cycle operation mode of air quality data collection, processing, analysis and comprehensive management, which could realize accurate monitoring of air quality. At the same time, through real-time monitoring and early warning of national air quality, to achieve "no disease prophet, no disease first cure", targeted to improve the environmental air quality suggestions and measures.*

KEYWORDS - *Air quality; Kafka. Real-time monitoring; Big data*

I. BACKGROUND INTRODUCTION

At present, the air pollution is becoming more and more serious, and the traditional system operation has been unable to accurately reveal the urban air pollution situation, unable to meet the public timely understanding of air pollution information. Aiming at this problem, this paper initially designed and developed a real-time monitoring platform for urban air quality standards based on SSH+Kafka architecture, which realized the operation mode of cycle integration, integrated air quality data, from collection, processing, analysis to comprehensive management and visualization, can complete accurate air quality monitoring. The system is convenient to deploy and real-time data update, which can provide good technical support and reliable data support for the monitoring and management of urban atmospheric environment quality.

Monitoring platform based on the different model, pattern for data visualization operation, the air quality success rate under different time and space, air quality grade days such as standard to analyze the urban air quality change the latest trend, after monitoring the monitoring area, it is concluded that overall urban air pollution, provide reliable decision basis for city managers .

II. TECHNOLOGY SELECTION

SSH is a comprehensive framework of Struts + Spring + Hibernate, which is a mainstream one at present as shown in Fig.1. Open Architecture for Web applications. The operating system integrated with SSH structure can be divided into four functional layers: display layer, service logic layer, data persistence layer and domain module layer, so as to support the development of Web applications with simple structure, high reusability and simple operation in a short period of time. Struts is the overall infrastructure of the entire operating system and is separated from the main functions of MVC.

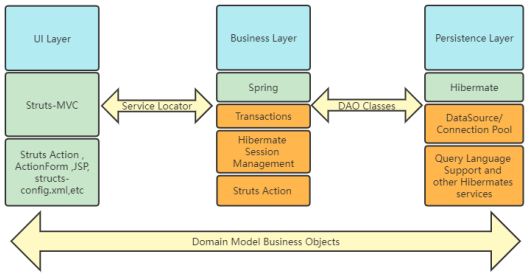

Fig.1 Basic flow of SSH system

Kafka is a distributed, send/subscribe information system. The main design objectives include: The method with time complexity of O(1) improves the ability of message persistence, and the access feature of constant time complexity can be maintained even for data segments above TB level. High throughput rate. Even on extremely cheap commercial equipment, it is possible to transmit more than 100 K signals per second in a single machine. It implements message grouping between Kafka servers and distributed consumption of information, and keeps messages sent in order in each Partition. At the same time, offline processing and real-time data processing are realized. Scale Out: supports online horizontal scaling.

As the Fig.2 shows, a common Kafka community includes several producers (possibly pages generated by the Web front end) View, even weblogs, system CPU, Memory, etc.), several brokers (Kafka supports horizontal scaling, usually the more brokers there are, the higher the cluster swallowing rate), several Consumer groups, and a set of Zookeeper groups. Kafka can manage the cluster computer configuration using Zookeeper, select the leader, and rebalance when a Consumer Group occurs. The Producer sends messages directly to the broker through the push model, while the Consumer orders and consumes messages from the broker through the pull model.

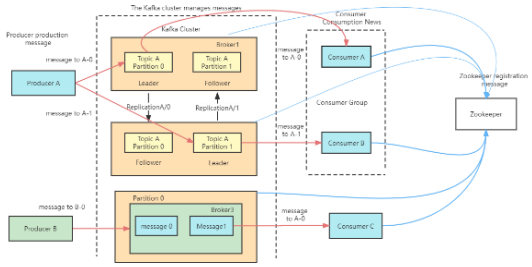

Fig. 2 Kafka architecture

It is very difficult from the beginning of a project to anticipate the requirements that will be encountered in the future. Messaging systems embed a hidden, data-based interface layer between handlers, and handlers at both ends need to satisfy this connection. This allows you to expand or adjust the handlers on both ends, as long as they comply with the same connection constraints.

The application must continue to perform as traffic increases, but similar bursts of traffic do not always occur; If a lot of information is being released with the goal of being able to cope with such spike calls, being on call is a huge loss. Using message queues, however, allows critical components to withstand sudden access shocks without being completely paralyzed by a sudden overload of requests.

In most applications, the method of data processing is the key. Most message sequences are themselves sequential and ensure that all data is processed in a certain order. Thus Kafka maintains the order of all messages in a Partition.

III. DESIGN OF STRUCTURE

The system micro-service framework is described as show in Fig.3 ; Gateway is a JHipster-generated application (Micro Service Application Micro Service Gateway selected when generated) that handles Web traffic and provides services for Angular/React applications. Several different gateways may appear partly if the Backends for Frontends mode is used, although this is not necessarily so; The JHipster Registry also provides a service to register all applications at installation time and get them configured correctly. It also provides a runtime monitoring dashboard. Consul provides service discovery functionality as well as key/value storage. It can be used as an alternative service to the JHipster Registry. Microservices is an application generated by JHipster (select MicroService Application when generated), which is mainly used to process REST applications. It is stateless, but can start multiple instances of them in parallel for load balancing purposes.

In a microservice architecture, there are often multiple micro-businesses that are co-developed by different teams. This micro-business collaboration is used to fulfill service requirements (for example, user requirements) and to communicate with each other simultaneously or asynchronously. Integration testing for consumer microservices is challenging, and Test Double is often used for faster and cheaper test runs. However, Test Double often does not represent the actual microservice provider, and if the microservice provider modifies your API or messages, TestDouble will not be able to get them. The other approach is direct end-to-end software testing, which, while mandatory before generation, is weak, slow, expensive, and no substitute for integration testing.

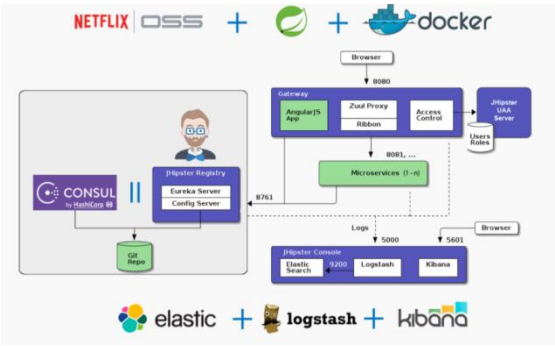

Fig.3 System microservice framework.

Display platform name, date and time.

The drawing of 3D map of China and the rendering of data by bar chart are displayed to display the air index data of each city more intuitively. Meanwhile, when the mouse moves to a city, the air index AQI data of the city will be displayed in suspension, which is more specific.

3D map can also be zoomed in, zoomed out, rotated and dragged operations, operation is more flexible the map has zoomed in, zoomed out, rotated and dragged functions, easy to view.

It is more intuitive and convenient to analyze the air quality index AQI and the quarter-on-quarter growth rate of AQI in a city by bar graph and curve graph.

AQI (severe pollution, heavy pollution, moderate pollution, light pollution, good and excellent) is displayed in the rectangle at the lower left corner. At the same time, click on an indicator rectangle, and the 3D bar chart in the map will show the cities with corresponding pollution levels.

The dynamic time switch menu at the bottom can be dynamically switched or manually specified. It also has the function of start switch and pause switch.

Clicking on a city will display the air quality index data of the city and the quarter-on-quarter growth value, as well as the comparative statistics of the air quality index AQI, the current value, the historical value and the optimal value.

IV. SYSTEM FUNCTIONS

China's three-dimensional map and bar chart were used to display the air index data of each city more intuitively. At the same time, when the mouse moves to a city, the air index AQI data of the city will be displayed in suspension, more specific. At the same time, 3Dmap can also be zoomed in, zoomed out, rotated, dragged and other operations, the operation is more flexible as show in Fig.4.

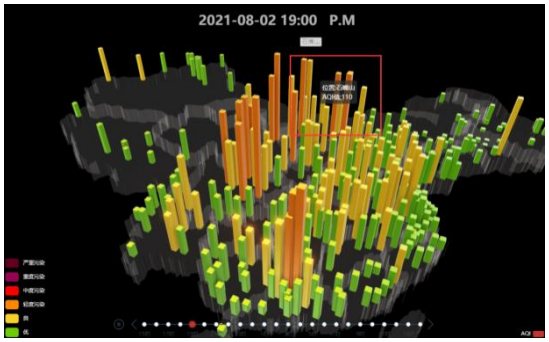

Fig.4 Main interface of the system

According to different AQI values display different colors, easy to distinguish; The color corresponds to the drawing of the histogram of the map; Click on different ranges at the same time, and the map and bar chart will display the urban air quality data of the corresponding index range values as show in Fig.5..

Display the air quality AQI index and quarter-on-quarter growth rate of a city at specific 24 hours. Place the mouse on the relevant graph to hover the AQI and quarter-on-quarter growth value of AQI corresponding to specific time.

The quantified display of AQI index data can visually show the air quality of the city at the time point according to the display quantity of the energy bottle.

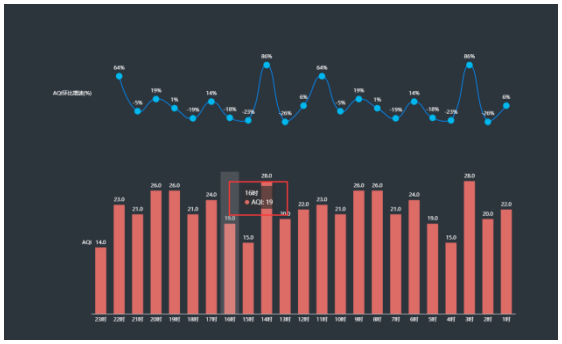

Fig.5 AQI Indicators of urban all-day air quality and month-on-month growth rate

V. CONCLUSION

The real-time monitoring platform of urban air quality standards based on SSH+Kafka architecture is of great significance for the dynamic monitoring of urban air quality. At the same time, through the different time, different space under the air quality standard rate, air quality level days and other standards to analyze the latest trend of urban air quality changes, monitoring each monitoring point area, the city's overall air pollution situation, to provide a reliable basis for urban managers to make decisions.

The monitoring platform based on

SSH+Kafka architecture can accurately monitor the urban air quality, but also solve a series of problems such as the poor spatio-temporal performance of the current monitoring data and processing methods, the low frequency of data use, and the inability to objectively and accurately reflect the urban air quality standards.

The real-time monitoring platform of urban air quality standards based on SSH+Kafka architecture can systematically and completely use the monitored air quality data, and use the latest scientific and technological means to mine valuable information from massive data. To meet the information needs of different units and departments, help regulatory departments to implement precise policies and take the initiative, so as to make the air quality of the living environment of Chinese residents to a new level.

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