



Design and Development of Visual Analysis System for Enterprises Economic Operation Indicators in Big Data Era

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Abstract

Based on B/S architecture, this paper has completed the construction of the visual analysis system of enterprise economic operation indicators. Among them, the realization of D3.js visualization framework by JS in the client is not only conducive to the display of economic indicators, but also conducive to the realization of dynamic interaction and animation effects. The visual analysis system is based on the needs of users, with programming language and visual technology as the means, and the basic technologies of data collection, data storage and data processing, which are common in big data technology, are used from data acquisition to data display. It not only improves the accuracy and convenience of data query, but also facilitates to check and understand the status of various indicators of economic operation and the relationship between indicators, providing strong data support for the final decision-making of enterprises. At the same time, the system not only achieves the goal of fine management of enterprise economic operation indicators, but also achieves the effect of effectively reducing labor cost and improving work efficiency, and further promotes the development of enterprise fine and information.

Keywords: economic operation indicators; visual analysis system; visualization technology; SVG

1.Introduction

Economic operation indicators is a quantitative representation of the operation law of market economy in various fields. Through the level of indicators and their relationship, combined with the comprehensive analysis of the current situation of market economy operation, we can make a basic judgment on the economic operation state and development trend, and provide important data reference for the formulation of economic operation strategy. [1] The economic operation indicators of enterprises refer to the indicators generated during the production and operation of enterprises, including financial indicators, business indicators, product indicators and user indicators. Specific indicators, such as profitability indicators, solvency indicators, operational indicators, development indicators and other financial indicators. On the one hand, enterprise economic operation indicators are used to summarize the current situation of enterprise operation, on the other hand, they are used to accurately

assist enterprises to formulate development strategies, so they play an important role in enterprise operation.

With the continuous development of market economy, enterprise managers put forward higher requirements for the accuracy, interaction and diversity of economic indicators. In the era of big data, through the technologies of big data collection, processing, analysis, visualization, etc., it is very easy to improve the accuracy and intersection of data, so that enterprises can get accurate and comprehensive analysis results when displaying economic operation indicators. [2] Therefore, in this paper, based on the background of big data, the enterprise economic operation indicators analysis system combined with Web and big data technology can not only effectively evaluate the enterprise's operating conditions and work results, but also speed up the analysis of enterprise data, measure and evaluate the capabilities of various departments, and stimulate the fighting spirit and enthusiasm of various departments. Therefore, establishing an effective enterprise economic operation indicators visual analysis

system plays a vital role in the development of enterprises.

2. Introduction of key technologies

2.1. Big data technology

Big data refers to the data collection whose data set scale has exceeded the data processing capacity of general database software. It has the characteristics of large data scale, fast data flow, diverse data types, low value density and data authenticity. When processing big data, we need to use technology to ensure the comprehensiveness, efficiency and accuracy of data processing. The technology used here refers to big data technology, which aims to process, analyze and extract information from extremely complex large data sets. It includes data collection, data storage, data calculation and cleaning, data query and analysis, data visualization and other technologies. Data collection refers to the process of collecting data from databases, storage systems, Internet platforms, etc. Collection data sources can come from the following four kinds: The first is databases, such as NoSQL databases such as Redis, MongoDB and HBase. The second is system log, which is generally used to collect log data generated in the platform. The tools that need to be adopted are distributed architecture. Its advantage is that the data collection and transmission speed is fast, and it is highly reliable and extensible. The third is network data, which needs to be obtained by means of web crawler, website open API, etc. The advantage of web crawler is that it can extract unstructured and semi-structured data. The fourth is perceived device data, which needs to automatically collect the data contained in pictures, videos, etc. by means of sensors and intelligent terminals. Data storage needs the help of HDFS, which is the main component of Hadoop. Its characteristics are as follows: First, when one node fails, other nodes will take over the work; Second, it adopts streaming data access, which can be used to process data in batches, thus improving the data throughput efficiency. Data calculation and cleaning refers to the program to identify and correct errors in data, which includes inconsistent data, invalid values and missing values, etc. This process is completed by computer operation. When the data is found to be inconsistent, the serial number, variable name, error type, etc. should be marked out for later check and correction. When there are invalid and missing values, it can be estimated and deleted. In the process of data cleaning, mathematical statistics, data mining and custom data cleaning rules should be used to transform dirty data into data that meets the requirements of users. Data query and analysis need the help of Hive and Impala tools. The working principle of Hive tool is to translate SQL language into MR program, thus converting it into database table, and it has query function. In addition, Hive has the advantage that it can

process query analysis in batches for a long time. It needs HDFS and MapReduce to provide storage and calculation functions during its operation. Impala tool is a supplement to the function of Hive tool, which can provide efficient SQL query. Its operating principle is to use SELECT, JOIN, statistical functions and other query data from HDFS by using distributed query engine, which reduces the query speed and is more suitable for real-time interactive SQL query. Data visualization is to show the analyzed data to guide decision-making. Visualization tools such as ECharts, which is a chart library and a high-quality visualization front-end framework. Its feature is that it can provide a variety of charts, and it also supports custom drawing. Figure 1 shows the framework of big data technology.

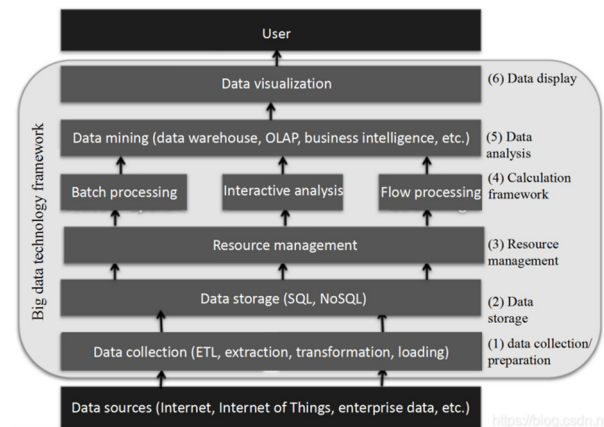


Figure 1 Big data technology framework

Big data technology framework consists of data collection, data storage, resource management, computing framework, data analysis and data display. [3] At present, the big data framework widely adopted by enterprises is Hadoop framework. As shown in Figure 2, Hadoop framework involves unstructured data collection Flume, structured data collection Sqoop, distributed file system HDFS, distributed database system HBase, resource management system YARN, distributed computing framework MapReduce, MR-based data warehouse Hive and other tools. Hadoop has the advantages of high scalability, high efficiency and high fault tolerance when processing data, among which high fault tolerance means that Hadoop can redistribute tasks that fail to save automatically.

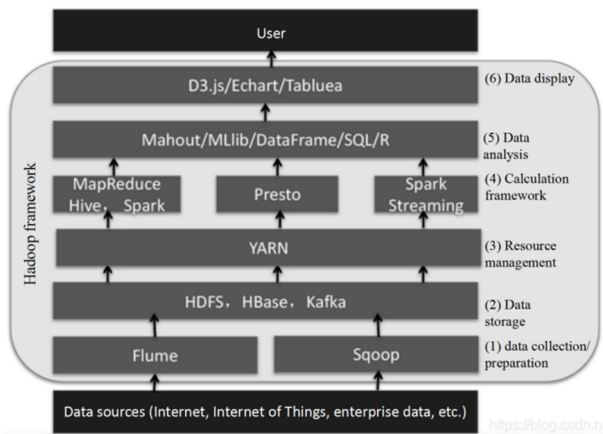


Figure 2 Hadoop framework

2.2. Web technology

Web, that is, the World Wide, a network information service system for publishing, browsing and inquiring information, is composed of Web servers distributed around the world. Web technology is divided into two parts, Web front-end and Web back-end.

The front-end of Web is mainly the development of visual layers, including UI layout, user interaction and back-end data request display. The foundation of the front-end development language is JS, CCS and HTML, among which HTML is a hypertext markup language that sets the content and basic structure of web pages. It is composed of tags, whose responsibilities include providing web information, pictures, web page layout, etc. The figure structure diagram of html document is shown in Figure 3, each child node can only have one parent node.

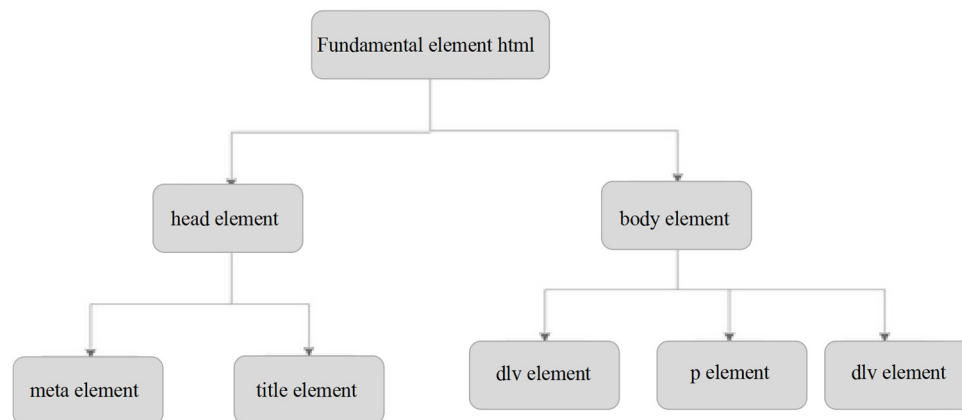


Figure 3 Structure diagram of html documents

CCS is responsible for designing UI styles, and it is a computer language that represents file styles such as HTML or XML. JS is to transmit the user request to the back end and display the back end data in the html page. The front-end framework is divided into two categories, one is UI style library, which contains button, cell, dialog, toast, article, icon and other elements. The other type is JS library, which generally includes DOM operation, ajax asynchronous get and post request encapsulation, page rendering and other functional means. Web back-end, mainly dealing with business logic with database through interaction. [4] It is responsible for data storage, module background function realization and so on. The development program of Web back-end is more complicated than that of front-end. Besides business logic, it also needs to consider security, stability, maintainability, scalability, scalability and other factors. In addition, it requires the following capabilities, such as programming language (Java, Go, SQL, database language), database (CRUD), framework (MVC, ORM, RPC).

2.3. Data visualization technology

Data visualization refers to the use of graphics and

image processing, computer and other technologies to visually explain data, such as modeling, animation and other display methods. The basic features of data visualization are as follows: First, understandability, which transforms fragmented data into specific structures. Second, inevitability, and finally, large-scale data will be processed by inductive summary. Third, it is one-sidedness. Visualization mode can't replace the data itself, it is just a specific way of data expression. Fourth, professionalism. Visualization process is the link of extracting professional knowledge from numerous data. [5] The process of data visualization is to first acquire data, then process the data by quality analysis, pretreatment, calculation, etc. to ensure the accuracy and availability of the data, and finally, to apply visualization, observing, analyzing and reasoning the visualization mode according to the needs of users to help users discover new knowledge or draw new conclusions. Data visualization methods include text visualization, network graph visualization, spatio-temporal data visualization and multi-dimensional data visualization. Data visualization requires the use of Excel, Processing, NodeXL, ECharts, D3 and other software and tools, among which D3 can provide a large number of complex chart styles other

than linear charts and bar charts, such as Voronoi charts, tree charts, circular clusters and word clouds. Various visualization display methods meet the system requirements. Figure 4 is a partial code of drawing dynamic histogram by D3. In Figure 4, the dynamics of dynamic histogram, canvas size, blank space around canvas, array, ratio of X and Y axes are defined.

```

<html>
<head>
  <meta charset="utf-8">
  <title>Let the chart move</title>
</style>
  .axis path,
  .axis line{
    fill: none;
    stroke: black;
    shape-rendering: crispEdges;
  }
  .axis text {
    font-family: sans-serif;
    font-size: 11px;
  }
  .MyRect {
    fill: steelblue;
  }
  .MyText {
    fill: white;
    text-anchor: middle;
  }
</style>
</head>
<body>
  <script src="http://d3js.org/d3.v3.min.js" charset="utf-8"></script>
  <script>
    var width = 400;
    var height = 400;
    var svg = d3.select("body")
      .append("svg")
      .attr("width", width)
      .attr("height", height);
    var padding = {left:50, right:30, top:20, bottom:20};
    var dataset = [6482,3786, 1777,1326,1246, 1212,1132, 1063,724];
    var xScale = d3.scale.ordinal()
      .domain(d3.range(dataset.length))
      .rangeRoundBands([0, width - padding.left - padding.right]);
  </script>
</body>

```

Figure 4 Partial code of dynamic histogram

2.4. Development environment

According to the above technical requirements, complete the construction and deployment of the development environment. The development environment of the system is divided into two parts, one is the construction of big data environment, the other is the development of Web application.

The requirements for building a big data environment are as follows: the architecture of big data system is based on Linux system, and Hadoop will complete cluster deployment, with a total of 6 units, one as the main node and the rest as data nodes. At the same time, the deployment of Content Grabber, Flume, Sqoop, HDFS, Spark and MapReduce functional components is completed under the framework of Hadoop 2.7.2. The requirements for developing Web applications are as follows: the whole system is to use Web technology to complete the development of the system and publish it to the Web side. Specific requirements are as follows: JS

is the client development language. On the server side, Tomcat server, Java technology development language and SpringMVC framework are used to build the Web server side. Among them, when building the SpringMVC framework, two configuration files, web.xml and spring-servlet.xml, need to be created in the WEB-INF directory. The code of the web.xml file is shown in Figure 5 below. Since then, the request is handled by the Spring Web MVC framework, in which < web-app>...</web-app > defines the deployment descriptor of the document. < display-name>...</display-name > defines the name of the web application, < servlet-name>... </servlet-name > defines the name of the servlet and < servlet-class > ... </servlet-class > specifies the fully qualified name of the servlet. < load-on-startup > ... </load-on-startup > indicates that the Servlet should be initialized when the container is started.

```

<?xml version="1.0" encoding="UTF-8"?>
<web-app version="2.5" xmlns="http://java.sun.com/xml/ns/javaee"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://java.sun.com/xml/ns/javaee
http://java.sun.com/xml/ns/javaee/web-app_2_5.xsd">
  <display-name>SpringMVC</display-name>
  <servlet>
    <servlet-name>spring</servlet-name>
    <servlet-class>org.springframework.web.servlet.DispatcherServlet</servlet-class>
    <load-on-startup>1</load-on-startup>
  </servlet>
  <servlet-mapping>
    <servlet-name>spring</servlet-name>
    <url-pattern></url-pattern>
  </servlet-mapping>
  <welcome-file-list>
    <welcome-file>index.jsp</welcome-file>
  </welcome-file-list>
</web-app>

```

Figure 5 Web.xml file code

The database selects MySQL. Through the brief introduction of the above key technologies, we have determined the overall environment of system development, the configuration of related software and tools, and at the same time, we have made clear the overall technical feasibility of the visual analysis system of enterprise economic operation indicators.

3. Requirements analysis

3.1. System requirements analysis

The visual analysis system of enterprise economic operation indicators is oriented to the economic organizations of various industries, aiming at changing the current difficulties of large amount of data, complex data items and difficult intuitive expression of enterprise economic operation indicators. In the process of system design, the practicability and advancement of system functions should be considered in the choice of visual expression methods. [6] In addition, the system also needs to meet the related work requirements such as enterprise workers' research data. Therefore, the overall goal of this system is to set up a visual analysis system

that supports interactive inquiry with enterprise operation indicators as the research object, and provide dynamic histogram, radar chart and other visual display methods, so as to provide tools for better studying and discovering the relationship between enterprise economic operation indicators.

Referring to the basic objectives of visual analysis system and the development of this system, the system requirements mainly include: providing data query function and providing flexible data sources for visual analysis system. Support a variety of visual display methods to break the previous relatively simple static data display mode, including the visualization methods related to economic indicators and other visualization methods. Support interactive visual analysis. Users can view the visual results of different situations by clicking and dragging the mouse.

3.2. Global design

The overall design of the visual analysis system of enterprise economic operation indicators is based on the idea of stratification. The basic principle of layering is to decompose the system functions, and realize the functions that should be completed in each layer. Each layer is a relatively independent individual, but the connection between layers can be realized through interfaces. The advantage of adopting the three-tier architecture is that it can effectively isolate the problems to be handled in each tier, which is conducive to making the system clearer and easier to maintain, and has stronger scalability, flexibility and security. [7]

The system adopts B/S architecture, which divides the visual analysis system into three layers: user layer, business logic layer and data access layer. In which the user layer is running in the browser. The logic layer is the core part of the system. The functional modules involved in this layer include data management module and visualization module. Its working principle is to analyze the requests sent by the user layer and send them to the data access layer. In this process, it is necessary to rely on HTTP and TCP/IP protocols to realize the interaction of data information. The data access layer receives requests, reads related data from relational database MySQL, and returns the query results to the business logic layer. In addition, this layer also involves the maintenance and update of the database.

4. Function realization

Managers can directly enter the visual analysis system of enterprise economic operation indicators by logging in through the browser. There are two functional modules in the interface of the home page of the system, namely, data management module and visualization module. The data management module is to manage

data centrally, and the visualization module is to show the results of analysis data. After viewing the data, the manager can exit the system by closing the window. The following is a description of the two functional modules. [8]

Data management module. Firstly, the external data of enterprises are collected by using Content Grabber web crawler tool, in which Content Grabber has the function of intelligently grabbing web page data. The types of data include industry development policies and market patterns. At the same time, it is also necessary to collect the internal data of the enterprise, such as financial indicators, business indicators and so on, with the help of Flume log collection tools. Secondly, the data transfer tool Sqoop is used to convert the data into a suitable format and store it in HDFS, and the stored data is calculated. The tools used in this module are Spark and MapReduce, and finally the data is stored in MySQL database for subsequent query. In the data management module, there are not only time information, but also user information and other attribute information, so the purpose of query can also be realized, and the function setting here is realized by SQL. [10] After testing the function of the data management module, managers found that the data in the module was complete and valuable data could be obtained.

Visualization module. The visualization module gathers dynamic and interactive histogram, pie chart and radar chart. The graphic display here is mainly realized by SVG. SVG refers to a text format, that is, vector diagram. SVG code can be written in HTML documents. Seven elements and multiple styles are defined in SVG. For example, SVG is used to set the gradient of graphics. Figure 6 below shows the code for setting the gradient. The horizontal linear gradient, the starting position of the gradient and the color of the gradient are set in the figure.

```
<defs>
<linearGradient id="myGradient" x1="0%" y1="0%" x2="100%" y2="0%">
  <stop offset="0%" stop-color="#F00" />
  <stop offset="100%" stop-color="#0FF" />
</linearGradient>
</defs>
<rect fill="url(#myGradient)" x="10" y="10" width="300" height="100">
```

Figure 6 Gradient code diagram

By setting SVG-related code, we can complete the visual operation. Through the test visualization module, the following functions can be realized: multidimensional data display, and multiple attributes or variables of data can be observed. Information display is more intuitive, and complex information is reflected in short graphics, which is helpful for managers to understand problems more intuitively. Easy to remember, images are easier to understand, and stay in a long-term memory state.

5. Conclusion

The enterprise economic operation indicators system is based on the application requirements of enterprise economic indicators, big data visualization technology and B/S architecture, and carries out the system demand analysis, overall design and system function module design. It not only realizes the design of visual analysis system, but also achieves the purpose of having flexible data sources. It also realizes the functions of visual analysis of various visual modes, interactivity and draggable pages. At the same time, the design of the system strengthens the fine management of economic indicators, effectively improves the accuracy and comprehensiveness of data information, thus reducing costs and improving economic benefits.

图 2

```
<html>
<head>
<meta charset="utf -8">
<title>让图表动起来</title>
<style>
.axis path,
.axis line{
fill: none;
stroke: black;
shape-rendering: crispEdges;
}
.axis text {
font-family: sans-serif;
font-size: 11px;
}
.MyRect {
fill: steelblue;
.MyText {
fill: white;
text-anchor: middle;
}
</style>
</head>
<body>
<script src= "http://d3js. org/d3.v3.min.js" charset=
"utf-8" ></script>
```

```
<script>
var width = 400;
var height = 400;
var svg = d3.select("body")
.append("svg")
.attr("width", width)
.attr("height", height);
var padding = {left:50, right:30, top:20, bottom:20};
var dataset = [6482, 3786, 1777, 1326, 1246, 1212, 1132,
1063,724];
var xScale = d3.scale. ordinal()
.domain(d3.range(dataset. length))
.rangeRoundBands([0, width —padding. left
—padding . right]);
var yScale = d3.scale. linear()
.domain([0, d3. max( dataset)])
.range([height—padding. top - padding. bottom, 0]);
```

图 3

```
<?xml version="1.0" encoding="UTF-8"?>
<web-app version="2.5" xmlns="http://java. sun. com/
xml/ns/ javaee"
xmlns:xsi="http: //www. w3. org/ 2001/XML Schema-
instance"
xsi:schemaLocation="http://java.sun.com/xml/ns/javaee
http://java.sun.com/xml/ns/javaee/web-app_2_5.xsd">
<display-name>Spr ing3MVC</display-name>
<servlet>
<servlet -name >spring</ servlet-name>
<servlet-class>org. springf ramework. web. servlet.
DispatcherServlet</servlet-class>
<load-on-startup>1</load-on-startup>
</servlet>
<servlet-mapping>
<servlet -name >spring</ servlet-name>
<url-pattern></url-pattern>
</servlet -mapping>
<welcome-file-list>
<welcome-file>indicators. jsp</welcome-file>
</welcome-file-list>
```

```
</web-app>
```

图 4

```
<defs>
<linearGradient id="myGradient" x1="0%" y1="0%"
  x2="100%" y2="0%">
  <stop offset="0%" stop-color="#F00" />
  <stop offset="100%" stop-color="#0FF" />
</linearGradient>
</defs>
<rect fill="url(#myGradient)" x="10" y="10"
  width="300" height="100">
```

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