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Research Article

Research on Web Visual Development Platform Based on Microservice

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In order to meet the needs of diversified terminal networks, a Web visual development platform based on microservices is proposed. According to the characteristics of network data distribution and resource attributes in the big data environment, select the service-oriented architecture as the basic data collaborative management system, establish a sample set containing various data types, calculate the density distribution of each type of data in the continuous function based on the sample set, and obtain the weight probability of the maximum and minimum density data of the data sample set by calculating the dispersion function. Finally, the weight of nodes in the visualization platform is established as the weight in the visualization matrix, and the high probability of edge subdivision is used to enhance the balance of edge development matrix. Comparative experiments show that the proposed method has strong applicability and high visualization effect for data with complex characteristics, data weight probability conforms to the expected value and Gaussian distribution, and the overall performance of the platform is excellent.

1. Introduction

With the development of science and technology, people's life is more and more inseparable from the network. The network can make users more convenient and accurate to obtain, share, and transmit relevant data, making information more valuable. With the increasing amount of terminal network data, in order to meet the big data environment, the Web visual development platform needs to classify, integrate, quantify, count, and interpret the information by means of charts, graphics, and modeling, so as to more effectively and clearly convey relevant information and facilitate communication and management. In recent years, network data visualization has become one of the research hotspots and emphases in the field of Internet.

Zhang et al. [1] proposed a three-dimensional information visualization method for terminal services. According to the distribution characteristics of Internet data, the browser and server architecture are designed, the data are preliminarily classified and counted, and then the processed targets are displayed in the form of quadtree organization by using dynamic search engine. However, the display method in the form of quadtree has high cost, large running load, and low efficiency of target search. Snow white et al. [2] proposed a data visualization method based on multiview collaboration, which simulates the traffic distribution of data nodes in the network, analyzes the change trend of traffic data, presents multilevel data views with collaborative interaction, has high simulation for relatively simple data in the network, but has poor visualization effect for data flows with complex distribution Wang et al. [3] developed VisConnectome, which provides a user interface including toolbox, toolbar, double slider filter, brain area property bar, and so on, which can run under any Microsoft Windows operating system and does not depend on other platforms. This method realizes the visualization of complex data and can provide reference for this paper. Yadong et al. [4] developed a three-dimensional visualization system of wind profile radar wind field based on B/S mode, which allows users to observe the three-dimensional wind field from any perspective.

Based on the above research, this paper proposes a design method of network data visualization development platform based on microservice, carries out specific data classification and management through the service-oriented basic framework in microservice, calculates the data density with strong complexity and poor consistency, and solves the problem of uneven data distribution in the visualization window according to the density probability ratio, realizing data collaborative management and presentation.

2. Web Visualization Uncertainty Probability Calculation

The focus of Web (World Wide Web) visualization development platform is to classify and refine various types of data information in the network and use key technologies to display information in the form of graphics or charts in a unified visual platform, so as to improve visual perception, reduce data dispersion, and facilitate research and management. In this paper, SOA (Service-Oriented Architecture) in microservice technology will be used for specific network information visualization. The architecture has strong independence and high coherence in the process of data conversion, which is convenient for the collaborative operation of visual information resources.

Firstly, a data probability set that can represent network uncertainty is given as $G_p = (V, E, F)$ [5]. In the set, V represents the network side information set; E represents the set of network edge nodes; $F = \{f_{ij}\}$ represents the density of the probability distribution of uncertain data, and $ij \in E$; then, $f_{ij}(w)$ is the weight value of the network data edge. If the weight value $f_{ij}(w)$ conforms to the continuous function, we obtained

$$\int_{-\infty}^{\infty} f_{ij}(w) d^2 w = 1. \tag{1}$$

In the formula, d^2 represents the distance between nodes in the network. In general, the continuity function can be explained by discrete function and the expression equation (2) is as follows:

$$f_{ij}(w) = \begin{cases} 1 - \lambda^*, & \text{if} \quad w = 0, \\ \lambda^*, & \text{if} \quad w = 1, \end{cases} \tag{2}$$

where $1 - \lambda^*$ represents the existence probability of network data edge in the visual block diagram, and the corresponding probability weight of this value is 1; λ^* indicates that there is no probability at the network data edge, and the corresponding probability weight is 0, which means that there is a positive infinite relationship between the distance between network node i and j. $(1/w)$ is used to represent the distance relationship between network nodes. In order to ensure the accuracy of data visualization uncertainty calculation [6, 7], the deterministic problem is expressed instead as long-distance weight solution, and the expected layout of network data visualization can be obtained. The generation process is shown in Figure 1.

Figure 1 contains the probability function distribution of uncertainty on network data, which is roughly divided into four types. These four distribution probabilities are represented by function set F_1. Each network data edge of the data matrix layout in the figure corresponds to a probability

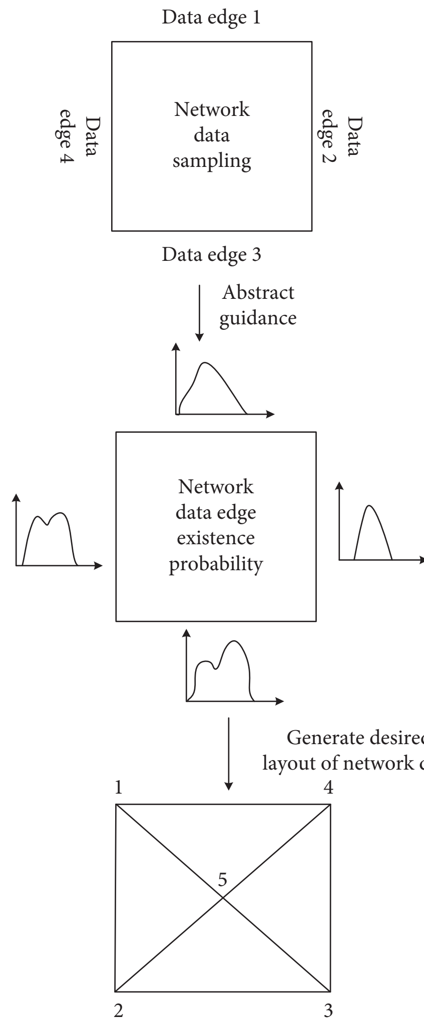

Figure 1: Network data visualization expectation layout generation process.

weight density function $f_{ij}(w)$. So far, according to the initially given data edge j, the expected weight probability is w_{ij}, and the formula is as follows in equations (3)–(5):

$$w_{ij} = \int_{-\infty}^{\infty} f_{ij}(w) \cdot w dw, \tag{3}$$

$$\text{stress}(P) = \sum_{i<j} \varphi_{ij}\left(P_i - P - d_{ij}\right), \tag{4}$$

$$\varphi_{ij} = \frac{1}{d_{ij}^2}. \tag{5}$$

In formula (3), w_{ij} represents the weight probability of network data in nodes during visualization [8]. Using the shortest path algorithm between data, the visual shortest matrix is $D = \{d_{ij}\}$. P_i in formula (4) represents the desired layout $P_i \in P^{n\times 2}$ of the visualization matrix, where P represents the matrix $n \times 2$ of size; n indicates the number of nodes of network data. According to the gravity algorithm, the probability uncertainty value of network data can be accurately calculated, the error of visual weight distribution can be reduced, and the overall efficiency can be improved.

3. Presentation of Complex Network Visualization Platform Based on Microservice

Collect all the data of complex network visualization to evaluate it precisely. Firstly, gather the Web data edge strength and then analyze the platform visualization.

3.1. Web Data Edge Strength Calculation. The data information in the Web is described and refined by edge connection. The edge strength value of each data edge is used as the bevel threshold of the visual matrix. The edge strength determines the gradient of the bevel of the visual matrix [9]. The gradient represents the distribution of network information, attributes, characteristics, and other data. The calculation steps of edge strength are as follows.

First, G_n represents the overall network; $e = (u, v)$ is used to represent any basic network data edge; the neighborhood set of data node u is $N(u)$; the neighborhood set of data node v is $N(v)$; the overall definition description set is $M(u/v)$, and the definition u of node $M(u)$ is described as follows:

$$M(u) = \frac{N(u)}{N(v)}. \tag{6}$$

Similarly, the definition v of node $M(v)$ in equation (7) is described as follows:

$$M(v) = \frac{N(v)}{N(u)}. \tag{7}$$

The definition set $M(u, v)$ represents the common connection point of network nodes u and v, and the expression formula is as follows:

$$M(u, v) = N(u) \cap N(v). \tag{8}$$

Let u^* and v^*, respectively, represent the two subdatasets of network nodes and $u^* \cap v^* = \varnothing$. In the process of data visualization, connect the data in the subdatasets u^* and v^*, and the $\zeta(u^*, v^*)$ expression formula is as follows:

$$s(u^*, v^*) = \frac{\zeta(u^*, v^*)}{|u^*||v^*|}, \tag{9}$$

where the expression meaning of $s(u^*, v^*)$ is the maximum ratio of connected data edges in the subdatasets u^* and v^*, and the refinement definition is as follows:

$$\begin{aligned} s(u^*) &= \frac{\zeta(u^*)}{|u^*|(|u^*| - 1)} \\ &= \frac{\zeta(u^*)}{C^2_{|u^*|}}. \end{aligned} \tag{10}$$

In the formula, $C^2_{|u^*|}$ represents the connection component of the data edge in the subset. Based on this, the data edge strength ζ is redefined and calculated. The formula is as follows:

$$T(\zeta) = \gamma_3(\zeta) + \gamma_4(\zeta). \tag{11}$$

In the formula, γ_3 represents the real-time density of data information distribution in the Web [10, 11]; γ_4 represents the operation threshold that the visualization matrix can connect the data edge, and the specific formula of γ_3 is expressed as follows:

$$\gamma_3(\zeta) = \frac{|N(u, v)|}{|M(u) + N(u, v) + M(v)|}. \tag{12}$$

It is obvious from the formula that there are data associations in sets $M(u)$, $N(u, v)$, and $M(v)$. Therefore, for data edge strength ζ, accurate judgment can be realized through the density relationship γ_3 between data edges in each set. Locating the edge strength threshold with large abnormal difference in the Web expectation distribution matrix based on formula (12) can not only ensure the uniformity of the data distribution of the expectation matrix but also reduce the steady-state error in the visualization process [12]. Each data edge of the matrix presents a high-quality normal distribution relationship to ensure the integrity of Web resource information.

3.2. Platform Visualization Parameter Calculation. In order to ensure the integrity and order of data under the Web visualization platform, the state broken line representation in SOA architecture will be adopted to visualize the elements of information attributes. The corresponding relationship between log information [13] and element mapping is shown in Table 1.

Table 1: Mapping relationship between network information data and visual elements.

Log information	Visual attribute element
Operation start time	Starting point X_1 coordinate
Operation end time	Y_1 coordinates of end
Operation duration	Y_1 value coordinates
Web property information	Corresponding segment length
Web feature information	Line color
Web status information	Line segment polyline ratio
Overall information architecture	Visualization window
Log serial number	Polyline point

In Table 1, the start time and end time of the operation are displayed by the broken line of the visual window, which corresponds to the horizontal X_1 and vertical Y_1 coordinates in the coordinate axis. The specific expression formula is as follows:

$$X_1 = \mathrm{RH}^* \frac{W_{\mathrm{WIN}} - 2^* X_M}{H_M} + X_M. \tag{13}$$

In the formula, W_{WIN} represents the actual time from the beginning to the end of the line display operation of the visual window; X_1 represents the abscissa value of the mapping point during data interaction in the visualization window; W_{WIN} represents the pixel width of the visualization window,

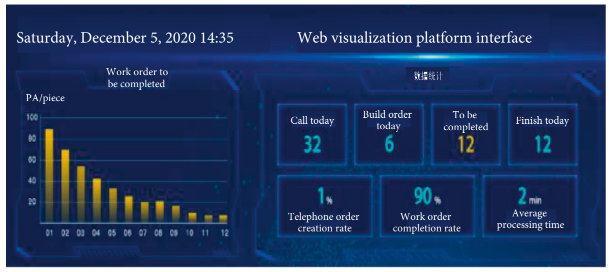

Figure 2: Data interface.

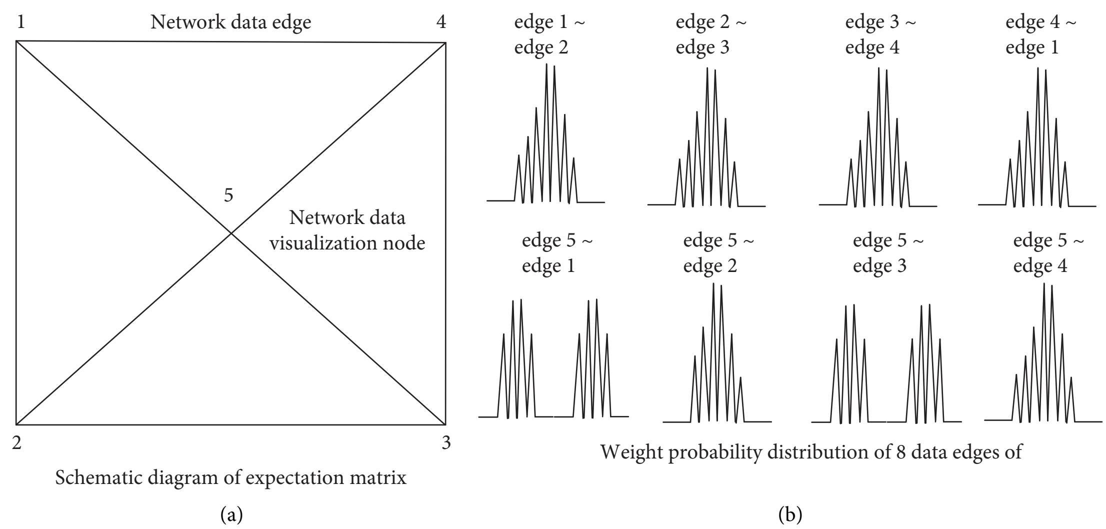

Figure 3: Expectation matrix and data edge probability distribution. (a) Schematic diagram of expectation matrix. (b) Weight probability distribution of 8 data edges of the matrix.

and the value range is $W_{\mathrm{WIN}} \geq 600$; H_M represents the total time of initial visualization setting; X_M represents the abscissa or x-axis X_1 of the visual window, and the blank width of the window edge position and the accurate value range of pixels is $X_M = [10 \sim 15]$.

Carry out coordinate conversion for various types of data attribute information [14, 15] in the Web according to formula (14) and calculate the ordinate value Y_1 of the mapping point in the visualization window. The expression formula is as follows:

$$Y_1 = N_C^{*}\mathrm{int}\left(\frac{H_{\mathrm{WIN}} - 2^{*}Y_M}{\mathrm{NUN}_C}\right) + Y_M. \tag{14}$$

In the formula, Y_1 represents the abscissa of the mapping point of information during data interaction in the visualization window; N_C^{*} indicates the initial sequence number of the Web information log. According to this parameter, it can be determined that in the whole data visualization process, the abscissa value Y_1 will remain unchanged, and the value of int is a positive integer function; Y_M represents the vertical coordinate FF of the visual window and the blank width of the window edge position, and the value range of pixels is $X_M = [10 \sim 15]$; NUN_C represents the total amount of Web online data.

4. Simulation Experiment

The Web visual development platform is applied to a power business hall to obtain the business data interface of the business hall on a certain day, as shown in Figure 2.

4.1. Experimental Setup. First, 2000 network data are collected in the database SQL, and 10~200 weight probability distribution points are randomly generated from these data. Combined with the discrete characteristics of network data distribution, these probability points are visually displayed by matrix distribution.

Figure 3 shows the matrix distribution diagram synthesized based on the probability points of Web data. The diagram contains 5 network nodes and 8 data edges. Each edge follows the existence probability $1 - \lambda^{*}$ of Web information in the visualization block diagram (see the calculation result of formula (2)), so the matrix meets the expected visualization effect of network data. Figure 3(b) shows the specific distribution probability of data in the 8 data sides of the expectation matrix.

As can be seen from Figure 3(b), except that the weight probabilities of data edge 5~edge 3 and data edge 5~edge 1 belong to bimodal distribution, the other data edges are single peak distribution.

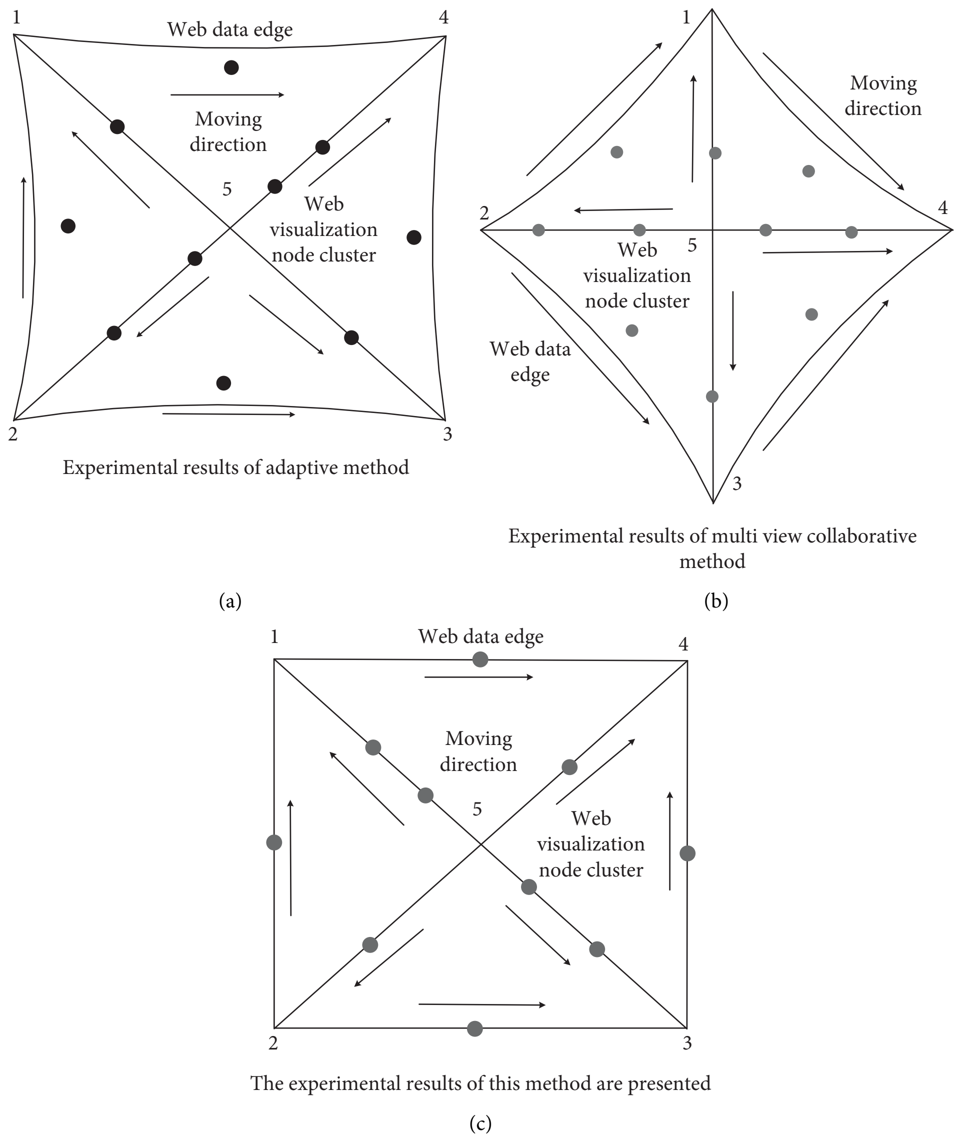

Figure 4: Network data visualization effects of three methods. (a) Experimental results of adaptive method. (b) Experimental results of multiview collaborative method. (c) The experimental results of this method.

4.2. Visual Layout Effect of Network Data. Figure 4 shows the experimental results of adaptive network three-dimensional visualization method, multiview collaborative visualization method, and this platform. The data summary node 5 in the figure is divided into 10 node clusters, which represent 10 weight probability peaks, respectively. Whether it conforms to the distribution of the expected matrix can be determined by the trend of the peak. The higher the similarity of the matrix, the better the effect of data visualization, the more the network data follows the Gaussian distribution.

As can be seen from Figure 4, in the visualization matrix in Figure 4(c), the central node contains 10 node clusters, of which 4 nodes move towards data edge 3 and edge 1. Finally, edge 5~edge 3 summarize 2 cluster nodes and edge 5~edge 1 summarize 2 cluster nodes. Compared with the expected visual distribution matrix, there are double nodes on data edge 1 and edge 3, which also shows that the weight probability belongs to bimodal distribution and has high similarity with the expected matrix. The summary nodes 1 and 3 in Figures 4(a) and 4(b) have only one node cluster, which does not well reflect the bimodal distribution of the desired layout, and the visualization effect is poor.

4.3. Visual Runtime Comparison. The second group of simulation experiments will compare the running time of the three algorithms, and the test results are shown in Figure 5.

As can be seen from Figure 5, the final time required for visual processing of all tasks in this method is the shortest, which is much better than the other two methods, and can save more than half of the time. The running time curves of the other two methods have increased significantly when the test data are 1000. There are two main reasons for this

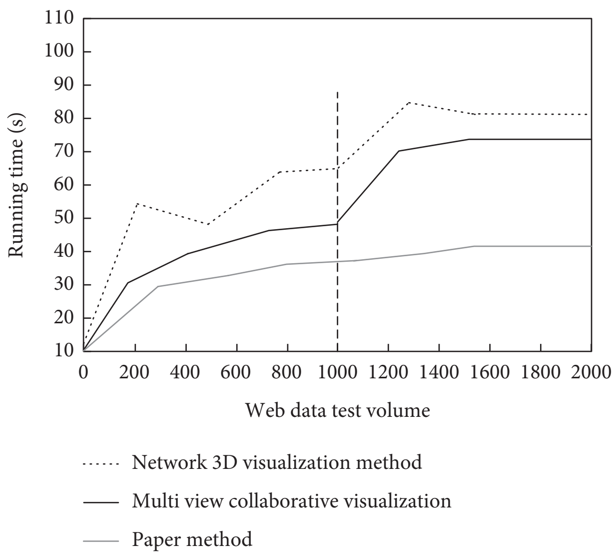

Figure 5: Comparison curve of running time of three methods.

phenomenon. First, before data visualization, there is no classification and integration of the original data, resulting in too chaotic position of the initial random point, and the random value will have an impact on the running time. Second, 1000 data values exceed the maximum threshold of the algorithm matrix distribution. The demand for energy function values increases with the increase in the amount of data. When exceeding the critical point, certain energy compensation will be carried out to ensure the balance, so the time required will suddenly increase. In contrast, by calculating the distribution of probability function, this paper makes energy compensation in advance, reduces time consumption, and improves the stability of overall visualization.

5. Conclusion

This paper espouses the data processing method of micro-service-oriented architecture, which effectively improves the problems of large demand for Web visualization and chaotic data distribution. And the conception process is progressively from rough to fine, so it is not easy to have local minimum deadlock in the process of data processing and make the conception layout conform to the characteristics of Gaussian distribution. By calculating the weight probability of different types of data to improve the visualization of the visual network window, ensure the high unity of the window slope threshold and improve the stability while enhancing the visualization effect.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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