Visualization Research and Implementation Based on ATM Alarm Data

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***Abstract*—With the development of science and technology, it generates a large amount of data. Data visualization is an important branch to help people get a better understanding of the changing trend of data. Data visualization is a significant method to Big Data Analysis, which shows the importance of data in a visual form. By using data visualization, people can easily find the association between data. According to the requirement of ATM service, this paper designs and implements the information visualization system of ATM alarm data.**

Keywords—Alarm platform data storage; Geographic data; Time series data; Tableau; JavaScript

I. INTRODUCTION

Bank ATM machines are used to install monitoring equipment. When the ATM machine malfunction or other incidents, the monitoring device can send an alarm message and produce large amounts of valuable data to analyze, which includes the alarm message. All of the alarm information generated by ATM machine are stored in SQL Server databases and the local disk array. But most of the alarm data are false alarms, only a small fraction is true. Therefore, this project focuses on solving two aspects. Firstly, the complexity alarm data can be displayed more compendious by data visualization, which can help the company managers develop company strategy. Secondly, data visualization can clarify the relationship between network, equipment, fault, alarm, and find the reason. By eliminating the false alarm, data visualization can remind the true alarm, reduce the false alarm rate and improve the service level of operations.

II. SYSTEM DESIGN

It is shown as Fig.1. The figure below shows the full process of alarm platform[2] .

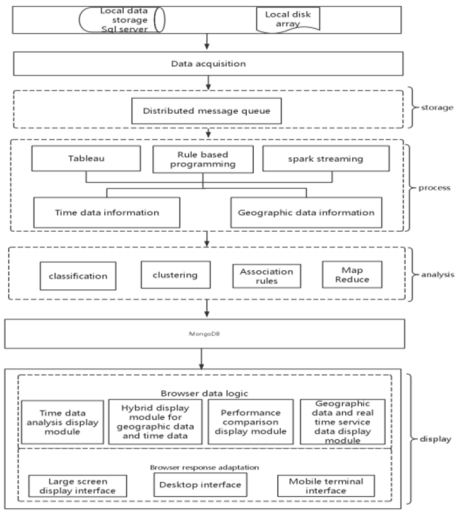

Fig. 1. General flow chart of alarm platform

A. Data Acquisition and Data Storage Module

Data acquisition module: ATM machines are installed monitoring equipment. When these ATM machines fail, the monitoring device can send alarm information and send alarm messages to the background database. The alarm information is sent to the Server SQL database in each places, and the disk array is used to store the unstructured data such as images. We can collect data from the Server SQL database and disk array.

Data storage module: we use a distributed message queue to temporarily store the alarm information, and preprocess data in the data processing layer.

B. Data Processing Module

Data processing module: The data processing layer deals with the temporary data, and the function is realized by Spark streaming. Spark streaming splits the data stream into a time slice, and deals with each time slice data in a similar manner. After that, it can clean, integrate and standardize data in a punctual way. It can deal with the

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duplicate data, isolated points, fuzzy data, nonstandard data. At the same time, we can use Tableau Module to process data.

The main goal of data cleaning is to remove unwanted fields and obtain the required data fields by a simple calculation, such as removing the vacancy value and unsuitable points, calculating rates.

Data integration mainly use mode integration to integrate different resource between different data sources. The processed data is stored in a database to facilitate data analysis work [3].

C. Data Analysis Module

Data analysis module: In practice, data analysis can help people make judgments to take appropriate actions. We use distributed data to process system, use Reduce Map to complete the data statistical analysis, use Spark machine to learn to complete the large data processing and analysis. At the same time, according to the structured data, we use Bias classification, K-means clustering, and multi-dimensional association rules analysis method to predict the alarm and fault. And the results of the analysis are stored in MongoDB.

D. Data Display Module

Data display module: The module is divided into two sub layers: the browser side responds to the appropriate of the sub layer, and the browser side data logic [4].Browser logical terminal data logical sub layer is responsible for data processing and presentation. We divided it into four modules: timing data display analysis module, geographic information and timing data display module, performance comparison and display module and geographic information and real-time business data display module. The browser side responds to the appropriate sub layer supports devices of different resolution sizes. Specifically, it can be divided into three types: suitable for large screen program, suitable for desktop interactive interface, and suitable for mobile terminal and the simplicity of the interface.

III. System Implementation

Big data analysis platform is divided into two phases to achieve. The first phase can complete the data analysis and display functions by visualization technology. The second phase can complete the depth of the data mining and mining visual display. This article only pays attention to the realization of the first phase.

In this paper, we focus on data processing and data analysis display function of visualization technology. We can see the data processing and visualization module flow chart below. It is shown as Fig.2.

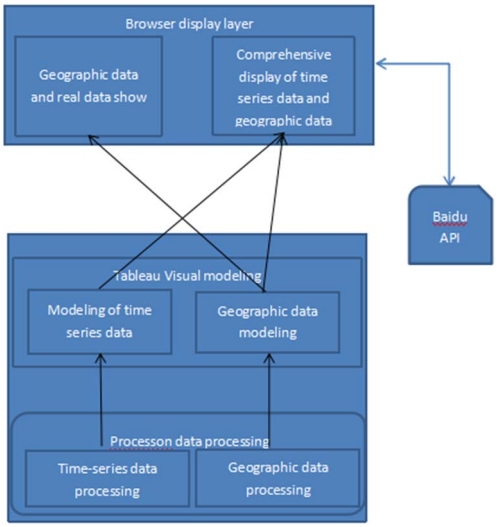

Fig. 2. Data processing and visualization module flow chart

A. Data Processing Technology

First, the data are from warning platform, alarm monitoring network system and alarm receiving center. According to business need, the paper use data from warning platform and alarm receiving center. The data are numerous and no rules, and most data are invalid data and cannot be used to visualize the invalid data. These data will seriously affect the operation of the server performance in visual analysis. In order to prevent the invalid data and ensure the effect of the visual system, firstly we should sort out the data on these two platforms to understand the structure and characteristics of the original data.

1) **Data processing:**It is shown as Fig.3. Our data come from the Server SQL database which is generated by the ATM machine. As the data is disorder, firstly we need to sort the data using procession technology. According to the business requirements, the data can be roughly divided into groups, such as time information, geographic information, marking information, type information, description information and other information.

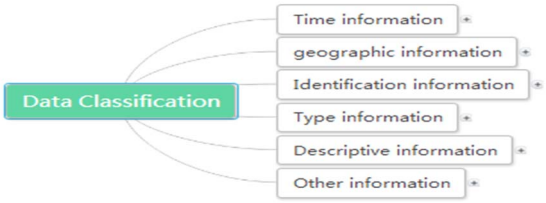

Fig. 3. Data Processing

2) **Visual modeling:** Due to the practical application system of data visualization in the process, a lot of data in a database record cannot be applied to data visualization processing, and part of the data cannot be applied directly on the data visualization, which need data transformation to be visual. Therefore, the main work of visual modeling is to make sure that which data can apply to visualize directly

and which data can be used only by statistical analysis and data transformation.

The visual modeling tool used in this system is Tableau.

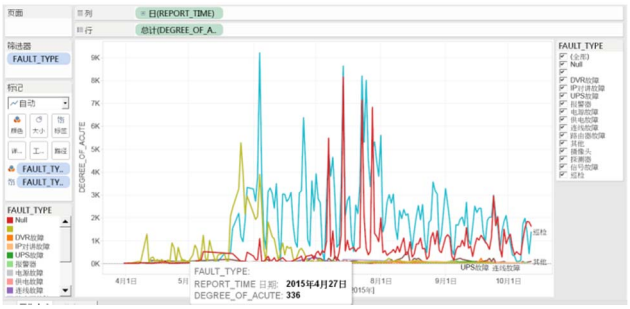

Fig. 4. Time series data modeling

As shown in Fig.4, according to the data, the ATM machine in each city on a period of time to failure to do the visual modeling [7].

Design goals: Alarm, fault and maintenance records are all closely related to the time. Through the display and analysis of these sequence features, we can find the characteristics and development of the business. It is very meaningful for predictive failure analysis to analyze, judge fault type and improve the efficiency of fault management. By adding the timeline, we can know the faults and the emergency degree changes corresponding to different fault from April to October.

Through this modeling, we can chronological display the network alarm information, fault type, the degree of the emergency to find out what type of fault is most likely to occur, what period of time most likely occur, how emergency the degree is. According to the recording, we can analyze types and brands of equipment, fault distribution and repeated occurrence.

Illustrative elements: We make time as X-axis of graph, the degree of emergency as Y-axis, colors as the type of fault, the linear change as the degree of emergency.

3) **Data filtering based on rule programming:** In this paper, we use the SQL statement as the interface of the system to process the work of data filtering.

```
'use strict';

module.exports = function(app) {
  // Root routing
  var geo = require('../../app/controllers/geo.server.controller');
  app.route('/api/geoDemoDataFromA').get(geo.getGeoDataFromA);
  app.route('/api/geoDemoDataFromC').get(geo.getGeoDataFromC);
  app.route('/api/alarmDevGeoData').get(geo.getAlarmDevGeoData);
  app.route('/api/getTaskinfo').get(geo.getTaskinfo);
  app.route('/api/getAlarminfo').get(geo.getAlarminfo);
  app.route('/api/getEquipmentinfo').get(geo.getEquipmentinfo);
  app.route('/api/getEquipmentinfo2').get(geo.getEquipmentinfo2);
  app.route('/api/getFaultinfo').get(geo.getFaultinfo);
  app.route('/api/getBankinfor').get(geo.getBankinfor);
  app.route('/api/gettimeinfo').get(geo.gettimeinfo);
```

Fig. 5. Interface code

As shown in Fig.5, in this system the SQL statement can be used a interface to combine the system with Baidu API to make the real data visual represented on the Baidu map. At the same, we can filtrate and calculate data in the interface, such as the removal of the vacancy value and unsuitable isolated points, and the calculation of various ratios, etc.

B. Data Visualization and Specific Development

Through the data preprocessing, we can classify and filtrate the visual data. According to business needs, we divide the data into geography data and time series data, and make the data and business visual [8].

In this system, the early visualization work use the open source project developed by the Baidu front team to help us in develop. Based on the Baidu map API, we can build the LBS.

Alarm data and geographic information data are closely related. The information can be more visual and clear by displaying the alarm location, which is very useful. So the combination of geographic information service and alarm data binding is very important.

On the specific technical aspects, we adopt Baidu map API as the main geographic information interface, and use SQL statement as a programming language. By combining the he latitude and longitude data with SQL statement, we can draw data graphs on the Baidu map.It is shown as Fig.6. As shown below, we use the longitude and latitude to draw the fault ATM information graph.

Fig. 6. Fault network diagram

Elements: Each red dot on the map represents a faulty ATM machine. The text box at the top of the map can find out the fault type by inquiring the IP of failure equipment, and show the fault location on the map.

Problem and improvement: In the process of transmission real geographic data to Baidu map display, we can find that the transfer function package of Baidu only shows ten information points. So we improve the package function as shown below[9].

Fig. 7. Fault network display improvement

It is shown as Fig.7. We modify the calling function provided by Baidu and store the data into the customizable new maker. We can draw the points on the map and add event monitoring system, so that the information of every point can be represented on the map [3].

The same fault equipment information can be displayed in the same way. We can display the same fault and equipment information in the same way. Baidu API gives many display examples, which provides a great help for the project. For example, according to the emergency degree, we can draw thermodynamic diagram in the regional map as shown in the Fig.8.

Fig. 8. Fault emergency diagram

Element description: each point on the map represents a fault information. The graph shows the emergency degree of fault area. The deep of color represents the degree of emergency. By connecting with the chart, the data can load on Thermodynamic diagram, and show the degree of urgency. In this system, the value of urgency is 24 and 48, which respectively, represent the general and emergency.

IV. CONCLUSIONS

This article describes the system workflow, and mainly introduce data processing, data modeling, and the development process and the results show of some direct visualization. Next, it focuses on the real-time data by data storage, data processing and data analysis. The paper also researches on how to storage and preprocess everyday data efficiently. After that, the paper emphatically analyzes and resolves the judgment of alarms and the prediction of fault, and considers the the forecast accuracy as the most important evaluation criteria.

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