Research on Web-based Real-time Monitoring System on SVG and Comet

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Abstract
For the lack of real-time performance of browser technology in existing Web-based real-time monitoring system, takes use of SVG (Scalable Vector Graphics) and the Comet to design a new Web-based real-time monitoring system. In this system, JSON (JavaScript Object Notation) is the data transmission carrier, Comet is the key technology for system communication and data transmission, and SVG is a chart drawing tool in the browser side. So this system has a good real-time and is rich in the form of show.

Keywords: SVG, comet, Server-push, JSON, Web-based real-time monitoring

1. Introduction
With the sustainable development of computer and network technology, industrial equipment operation condition monitoring technology is far-reaching changed in the remote, distributed and networked direction. Existing real-time online monitoring system is commonly used by the C/S (Client/Server) architecture. While Web-based real-time monitoring system, which is based on the B/S (Browser/Server) architecture, provides greater flexibility and openness. And it makes the system easier to expand, maintain and manage. So it has been a great concern [1].

But there are two difficulties in the realization of Web-based real-time monitoring system: Firstly, Http is the communication protocol of Web. While Http is a request/response mechanism and connectionless. Thus, the real-time data in the Web server can not be send to the browser from the Web server. Secondly, how to display chart with real-time data in the browser. Using a bitmap image transmission and display, will consume many resources in the server and take a lot of communication bandwidth. So, it is likely to lead to inconsistencies in the display and the delay phenomenon.

In this paper, on the basis of predecessors’ achievements, we design and implement a Web-based real-time monitoring system on SVG and Comet for the above difficulties.

2. SVG Technology
2.1. SVG Basic Concepts
SVG is a family of specifications of an XML-based file format for two-dimensional vector graphics, both static and dynamic. The SVG specification is an open standard that has been under development by the World Wide Web Consortium (W3C) since 1999[2]. Its purpose is to create an extensible and open image format on the Internet. SVG achieves the organic unity of image and text. Not only does SVG support the frequently-used HTML tags, such as text, images, links, interactivity, CSS, JavaScript, but also it provides a large number of specific markers for graphics, images and animations. It provides chart's displaying in Web-based real-time monitoring system with a strong support[3].

2.2. The Advantages of SVG
Some advantages of SVG are listed as follows:
- Based on XML standard. SVG was based on XML at the start when it was designed. It lets SVG have a congenital superiority and have become a part of HTML5.
- High quality images. Because based on vector, the size of SVG file is connected with the
complexity of the graphics, and has nothing to do with the graphic specific size. Furthermore, SVG’s display size can be zoomed in and out in no level, and the change does not affect the quality of the graphics.
- Image is constituted by the text. SVG is a text format image. So you can just use notepad to generate a SVG image, without any image processing tools.
- A flexible file format. SVG consists of three parts: vector graphic, bitmap and text, so that SVG can be applied to the vector images and text objects, as well as can be included in the bitmap images. It is more flexible to extend the image file format.
- Support interactivity. SVG supports the SMIL (Synchronized Multimedia Integration Language). It makes that interacting in the image become possible. SVG can accomplish more complex applications by accessing or controlling all the elements, attributes and attribute values with using a scripting language to call SVG Document Object Model.
- Support character searching. Due to the special composition of SVG, it is possible to search character in the "image".
- The browser compatibility. Microsoft IE9.0+, Mozilla Firefox1.5+, Opera 8.0+, Chrome and Safari are native support SVG, while the previous versions of Microsoft IE8.0 need to install the plugin to gain support.

3. Comet and Pushlets
3.1. What is a Comet

Server-push is an already existing technology. It is implemented mainly through the client's socket or server-side remote calls in the early days. But Comet that mentioned in this paper is a push technology from the server to the browser. Alex Russell (the project lead of Dojo Toolkit) calls this server-push technology Comet, which is based on long http connection and has no need to install plugin in the browser. As a result of the relatively slow development of browser technology, there is no good support for the implementation of Comet, and it is difficult to provide a perfect solution to implement server-push in the application of pure browser. In recent years, because of the popularity of Ajax (Asynchronous JavaScript and XML) technology and the existence of demand for Comet in many practical applications, Comet begins to be getting more attention.

The past Web-based real-time monitoring system accesses to server-side data through the refresh timer mechanism. In this way, browser will re-request and access to everything on the page regardless of whether there is new data to be displayed. With the emergence of Ajax, the refresh timer mechanism reduces the amount of data transmission, but it does not change the traditional mode, request/response. Web-based real-time monitoring system using the Comet mechanism has a better real-time and fewer invalid data than which using the refresh timer mechanism. In the Comet mechanism, the browser initiates a Http long connection request to the server. Only when the server has new data to send or request timeout, the server gives response to the browser. The browser processes data which is got from the response, and enter the next polling. Figure 1 is the comparison of above two [4].

![Figure 1. The comparison between the refresh timer mechanism (A) and the Comet mechanism (B).](image-url)
3.2. Pushletst

Pushlets is an open source framework design by Just van den Broecke, and is a concrete realization of Comet. Pushlets, which is based on Servlet, pushes data into the dynamic pages of the browser from the server. It makes the server can actively and periodically update the browser’s page[5]. It is mainly used for monitoring the dynamic data source. The code structure of Pushlets is relatively simple, as well as it is facing the interface programming, which has very strong scalability. Above all, Pushlets is very suitable for building Web-based real-time monitoring system.

4. Construction of Web-based monitoring system on SVG and Comet

In this chapter, we firstly introduce the basic idea and the structure of Web-based monitoring system on SVG and Comet in the overall. Then, we describe how to transform JSON data format in Pushlets and how to use svg.jquery library to draw SVG images. Finally, we give two examples of our Web-based real-time monitoring system.

4.1. Basic Idea

In this Web-based real-time monitoring system, when the database has new inputting data, the server will take the data into JSON format, and deliver to all online browsers. The browser receives the data, calls the related JavaScript function to draw SVG images and show them on the page in the end.

4.2. Overall structure

Web-based monitoring system on SVG and Comet is constructed on the basis of the Pushlets. Its overall structure is shown in Figure 2. This system uses the subscription and distribution mechanism. As a subscriber, the user subscribes to the information from this system [6]. First of all, the user makes a subscription request to the server through Servlet. Then, the server creates a session for the user, which is used to record the status. And this session will be registered to SessionManager. Each Session has only key and its own Subscriber. As a subscriber, the user can receive all real-time dynamic information about the subscribing topic, and Subscriber is used to handle user’s requests, as the bridge between EventSource and ClientAdapter. When the new data of the corresponding subscribing topic is written to the database, EventSource gets the new data from database. EventSource finds all users who subscribe to the topic through Dispatcher, and then gets ClientAdapter from the Subscriber of the user, whose concrete realization is JSONAdapter. Next call the function in ClientAdapter to send data to each user. After receiving the data in JSON format, the browser calls the JavaScript function based on svg.jquery library to draw SVG images. Ultimately, let SVG images be displayed to the user [7].

![Diagram](image)

Figure 2. Overall structure of Web-based monitoring system on SVG and Comet.
4.3. Transformation of JSON Data Format in Pushlets

JSON is a lightweight data-interchange format and a subset of JavaScript. JSON is more compact than XML, and gets the browser’s built-in fast analytical support. It makes JSON be more suitable for Web-based real-time monitoring system [8]. Transformation of JSON data format in Pushlets needs to take measures both in the server and the browser.

In the server, Pushlets uses the interface, Client Adapter, to output the data. We delete the three concrete realizations of ClientAdapter, which are BrowserAdapter, XMLAdapter and SerializedAdapter, and concrete JSONAdapter, a new realization of ClientAdapter. JSONAdapter and XMLAdapter is substantially the same, but the only difference is the push function. JSONAdapter takes advantage of GSON, an open source framework of Google, to turn the Event object with data information into a string of JSON data, then outputs data, closes the output stream in the end.

In the browser, Pushlets handles the browser-side request and response data with ajax-pushlet-client.js. After using JSON as the data transmission carrier, we need to rebuild function _doRequest in ajax-pushlet-client.js. Function _doRequest invokes function _getXML to request XML data. So we create a new function, _getJSON, to request JSON data, with taking the place of function _getXML.

4.4. Using Svg.jquery Library to Draw SVG Image

Svg.jquery library written by Keith Wood, is a Jquery plugin. This library allows you to take advantage of the SMIL mechanisms of SVG to manipulate dynamically the SVG elements with JavaScript. Svg.jquery library is relatively perfect. Here to introduce its several common functions.

- It can dynamically load the SVG file and obtain a reference of the SVG elements in the file, so that to operate the SVG elements.
- It can dynamically draw basic SVG elements, such as circle, rectangle, ellipse, line and closed polygon, etc.
- SVG elements can be grouped. And the elements within a group can be given a same attribute value.
- It can dynamically load bitmap pictures in SVG, such as jpeg, png, etc.
- When drawing SVG images, it can realize the dynamic interaction of SVG by bounding a mouse click event function.
- Through adding the jquery.svganim extension, it can dynamically create SVG animation elements.
- Through adding jquery.svgplot expansion, the function image with axes can be draw easily as long as the function expression is given.

4.5. Running Instance of Web-based Real-time Monitoring System

Figure 3 (Left) is the diagram for monitoring the temperature of the operating equipment in power plant.

![Figure 3](image-url)

Figure 3. The diagram for monitoring the temperature of operating equipment in power plant (Left) and the diagram of temperature trend curve for the operating equipment (Right).
We use SVG basic elements to draw out a system image of power plant. Use different colors to identify different states of the monitored equipment, and display temperature readings next to the equipment being monitored. When Web-based real-time monitoring system is running, the temperature readings of the equipment will be updated in real time with the change of the data collected at the production site. The colour of the equipment will be changed according to the state of the equipment, when the threshold is reached.

Figure 3 (Right) is the diagram of temperature trend curve for the operating equipment. Its x-axis represents time, y-axis represents temperature. When Web-based real-time monitoring system is running, curve in the diagram is in real-time rendering with the changes of monitored equipment's temperature.

5. Conclusion
In this paper, in order to solve the problems in existing B/S monitoring system, which are the real-time performance and displaying chart in the browser, we design a new Web-based real-time monitoring system that is based on SVG and Comet. This system takes JSON as data transmission carrier. And Pushlets framework is the engine of communications and real-time data transmission. In the browser, it takes use of svg.jquery library to draw SVG images and generate charts. This new architecture, the same as a desktop application, provides us a rich Internet experience. It is a supplement to the traditional C/S real-time monitoring system, which not only has a certain reference value, but also has good application prospects.

References