

Design and Implementation of Graphic Editor in SVG Standard Monitoring System of Electrical Automation

Jianren Huang

Wenzhou Zhenan Technology City Construction Investment Group Limited, Wenzhou, 325000, China

Email:187171778@qq.com

Keywords: electrical automation, SVG; vector graphics; power system wiring diagram; power system graphics editor; real-time

Abstract: SVG is an open standard text vector graphics description language developed by W3C organization in electrical automation. Based on the new vector graphics standard of SVG in electrical automation, this paper will implement a visual graphics editing software for power system, which can realize the basic operations of drawing, zooming, modifying and deleting basic graphics objects, and also can display the wiring diagram and configure electrical parameters of power system quickly, accurately and dynamically. The graphical editor of power system realized in this paper has beautiful interface, clear structure, vectorization of graphical elements, strong real-time performance, and provides a powerful user interface. It has a wide application prospect in power system.

With the continuous development of power system, more and more data and information are available. Whether in power generation enterprises or power grid enterprises, enterprise leaders, production management departments and directly affiliated units need to know the basic situation of enterprise equipment in time in command, production and management, such as: operation status, defect status, overhaul status, test status, load status, etc. Real-time information. For power enterprises, only by combining modern information technology with power production, can they better adapt to and meet the requirements of the relevant departments of the state for the modernization of power operation and management.

Electric power system is a complex large-scale system. Graphic rendering and display technology in power SCADA system is one of the key tasks. By observing the electrical wiring diagram on the display screen, power dispatchers can not only grasp the real-time operation of power grid, but also realize some control functions through some operations when necessary. Therefore, displaying the wiring diagram and parameters of power system quickly, accurately and dynamically becomes the fundamental requirement of power system graphic editor design.

Most of the traditional power system graphics editors are generated by AutoCAD software. This kind of graphics has some limitations, which can not reflect the effectiveness and real-time performance of electrical equipment. Moreover, it has a single application scope, simple function, inflexible operation, poor scalability and can not be closely linked with the database. The main manifestations are as follows:

(1) The browsing form is single. The power system is large in scale, complex in structure and numerous in various kinds of electrical components. How to organize and manage them well and express them correctly, visually and systematically in the electrical wiring diagram is the most important function of the electric power graphics system.

(2) Manual editing of graphics lacks intelligence. This software requires users to edit the wiring diagram manually, which is a very detailed and tedious work. Because of the large number of factories and stations in the actual power system, manual generation of these wiring diagrams requires a lot of hard work, and after graphics generation, configuration parameters need to be redeveloped.

(3) The electrical components are all represented by bitmaps. When they are enlarged or reduced, there will be distortion, which will lead to the overall distortion of electrical wiring diagram and the

display is not beautiful.

(4) Information cannot be shared. Mappers of different lines can not share information. Each person keeps his own state chart. The dispatchers have to look at several state diagrams to have a clear grasp of the equipment status of the whole line. It is tedious and error-prone to check the work.

(5) Can not reflect real-time. The wiring diagram of electrical equipment must reflect the state transition of the equipment in time, and the current real-time state of the equipment can not be reflected quickly when the software is used for graphic conversion.

This research is to develop a set of power system graphics editor which combines editable manual editing and automatic generation, providing powerful functions of graphics drawing and editing, so as to realize the comprehensive visual management of power system information. [1] The power system graphics editor based on SVG standard in electrical automation realizes a SVG vector graphics standard in electrical automation, and a tool for visualizing human-computer interaction drawing and editing power graphics based on SVG file in Web-based electrical automation. By using the method of WYSIWYG, the required power graphics can be generated simply and quickly, which not only solves the above problems, but also shows clearly. It has beautiful appearance, clear structure, vectorization of primitives and strong real-time performance. It can provide a powerful user interface and has a wide application prospect in power system.

1. Introduction of SVG Standard in Electrical Automation

SVG in electrical automation is called Scalable Vector Graphics (Scalable Vector Graphics). It is an XML application standard formulated by W3C for describing graphics with vectors. [2] It has many advantages:

1) Compatibility: SVG in electrical automation is based on XML language, easy to publish in WEB, inherits the extensibility and cross-platform of XML, and describes vectorized graphics in text. Therefore, SVG in electrical automation can seamlessly connect with HTML, GIF, JPEG, PNG, SML, ASP, JSP, JavaScript and other popular network technologies.

2) Dynamic and interactive: In electrical automation, SVG supports DOM (Document Object Model), so it can access files directly and efficiently through scripts or programs. External events such as mouse clicks can drive SVG graphical objects in any electrical automation.

3) Text independence: In electrical automation, SVG is saved in the form of text, so the file is very small and easy to load.

4) High-quality display: Because of the vector image, users can zoom graphics freely without destroying the clarity of graphics to support infinite enlargement (without distortion). When image formats such as BMP and JPG are enlarged or reduced, different degrees of distortion will occur.

5) In electrical automation, SVG is not only a static image, but also a dynamic image, which can easily realize dynamic display. Using animation, we can realize the conversion function between different states of electrical equipment, which is convenient for users to operate.

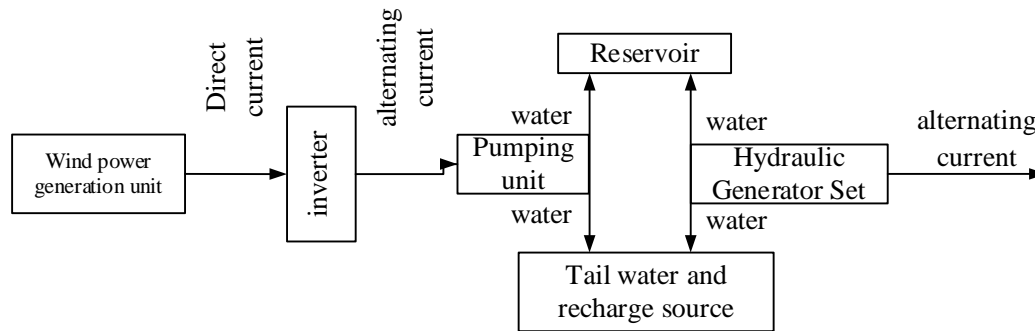
In view of the advantages of the above SVG standard in electrical automation, more and more images now adopt the SVG standard in electrical automation. SVG in electrical automation can satisfy the accuracy and real-time of power system graphics, which makes the application of SVG standard in electrical automation in power system graphics editing become a trend. [3]

2. Design of Power Graphic Editor of SVG Standard in Electrical Automation

In electric automation, SVG vector graphics editing system adopts object-oriented construction method. Firstly, all kinds of basic graphics elements are regarded as an object, such as line, rectangle, circle, arc, ellipse, curve, text, etc. Then, some basic graphics objects needed can be combined, defined as primitive objects, and all kinds of primitives are classified and organized to form primitive library. When drawing graphics, we can combine all kinds of primitives and basic graphics in the primitive library, so as to improve the efficiency and reusability of generating graphics. After drawing, the geometric and non-geometric attributes of primitives can be set, and

the state and configuration parameters of primitives can be controlled.

The architecture of the power graphics editor is designed as shown in Figure 1.



Wind power generation system with pumped storage

Fig. 1 Architecture diagram of power graphics editor

2.1 Data parsing module

In this system, the data analysis module mainly completes the storage and reading of SVG graphics files in electrical automation. Because the SVG file in electrical automation is based on XML format, the stored template file is stored in XML format standard. At the same time, due to the large number of electrical equipment in the power system, in order to have a clear structure and convenient storage, the hierarchical structure is adopted to store graphic elements. In electrical automation, SVG provides `<g></g>` element level, which creates a container in which graphic elements can be placed. The container can be used to identify elements and provide meta-attributes, so the container is used to store the status information of the meta-elements. [4] When parsing SVG files in electrical automation, hierarchical structure is also used to parse, such as parsing rectangle in `<g></g>` layer:

```
Elementgg = g. getElements ByTagName ("g");
```

```
NodeListchildNode = gg. getElements ByTagName ("rect");
```

Some other properties of the rectangle are obtained, and the specific objects generated by parsing are stored in the data management module. When the graphics are modified, they are stored in SVG format in electrical automation.

2.2 Data Management Module

This module manages and maintains the data of the whole program. The other modules call the graphics data through the data management module. The module mainly defines some data structures, including basic image objects, composite graphics objects and other data types. On the basis of defining these data structures, it provides a lot of methods to maintain them.

2.3 Editing graphics module

The function module of editing graphics is mainly composed of drawing module, editing module, layer operation module and tool management module. It is the core module of the whole system. Firstly, it completes the editing of basic graphic objects and meta-objects, such as the selection, movement, zooming, rotation, deletion and combination of graphic objects, and also includes setting the attribute data of meta-elements, such as color, line width, etc. Secondly, data exchange between data management module and data analysis module should be guaranteed. It can not only call data analysis module to open SVG files in electrical automation, generate corresponding graphics objects and add them to the graphics linked list of data management module, but also parse graphics objects in the graphics linked list of data management module into corresponding labels to generate SVG text in electrical automation. Component to coordinate the work of the two modules.

2.4 Graphic Editing Module

Graphic editing is divided into two parts: one is the editing of basic graphics, which mainly provides basic graphics such as lines, rectangles, circles, ellipses, polygons, curves, texts, etc. The second part is the editing of electrical graphic elements generated by combination, such as three transformers, switches and other electrical equipment. Graphic object is the most basic object in the data structure of this system, and is the core part of graphic editing.

```
<defs>
<sym bolid="TGS_25@1">
<line y2="0"stroke-width="1"x1="5"x2="5"y1="10"/>
<ellipse fill="none"r="3"rx="3"cx="5"ry="3"cy="28"stroke-width="1"/>
<line y2="16"stroke-width="1"x1="13"x2="5"y1="24"/>
<ellipse fill="none"r="3"rx="3"cx="5"ry="3"cy="13"stroke-width="1"/>
<line y2="31"stroke-width="1"x1="5"x2="5"y1="41"/>
<line y2="41"stroke-width="1"x1="0"x2="10"y1="41"/>
<line y2="43"stroke-width="1"x1="2"x2="8"y1="43"/>
<line y2="45"stroke-width="1"x1="3"x2="7"y1="45"/>
<line y2="47"stroke-width="1"x1="6"x2="5"y1="47"/>
</sym bol>
</defs>
```

This switch can be invoked within the body of the image by identification, as shown in Figure 2.

```
<use xm lns: xlink="http://www.w3.org/1999/xlink"xlink: href="#TGS_25@1"/>
```



Figure 2 Predefined generated switches

The graphical editor of SVG standard in electrical automation realizes the function of fast state transition of electrical equipment. For the switch above, we pre-defined two kinds of switch state symbols: one is the switch state, the other is the closed state, which can be switched quickly according to the user's choice. This interaction is mainly realized by Javas-cript of SVG in electrical automation, which defines specific functions in onclick events of switching graphics.

3. Realization of SVG Standard Electric Graphics Editor in Electrical Automation

This system uses layered technology to manage various graphics objects, defines mouse events in the SVG elements of the corresponding layer of electrical automation, and connects a script to the event processor. When the mouse event occurs, the corresponding script program is triggered to add, modify, delete and configure the graphics object through the DOM interface to realize the functions of drawing, editing and storing graphics. At the same time, the system realizes rich interactive operation for DOM programming through Java script, and provides a powerful user interface.

3.1 Implementation of Graphic Object Layering Technology

For the sake of clear structure and convenient storage, hierarchical structure is adopted to store graphic objects. In electrical automation, SVG provides `<g>` `</g>` element hierarchy. It creates a container in which graphic elements can be placed. This container can be used to identify elements and provide attributes of graphic elements.

3.2 Realization of Graphic Editing Tool Interface

Graphic editing tools include drawing area, tool management area, menu bar and so on.

4. Conclusion

In the near future, SVG file format standard will replace other graphics formats to become the standard format of graphics and images in electrical automation. It is obviously meaningful to provide a power system graphics editor of SVG standard in electrical automation. The powerful characteristics of SVG standard graphics in electrical automation can better meet the accuracy and real-time of power system graphics, which makes the application of SVG in electrical automation become a trend of development in power system. The SVG power system graphics editor designed and implemented in this paper is a visual SVG vector graphics tool in electrical automation, which can display the wiring diagram and parameters of power system quickly, accurately and dynamically. It has a wide application prospect in power system.

References

- [1] Han Zhenxiang, Lu Jie, Qiu Jiaju. Scientific visualization and its application prospects in power system [J]. Power grid technology, 1996, 20 (7): 22-27.
- [2] Liu Xiao. Guidelines for SVG Application in Electrical Automation Based on XML [M]. Beijing: Beijing Kehai Training Center, 2001.
- [3] Shi Dongyuan, Lu Yansheng, et al. Preliminary study on SVG in electrical automation and its application in power system software graphics [J]. Relay, 2004, 32 (16).
- [4] Wang Jian, Chen Jianyun, Zhang Dongbo. Design and implementation of monitoring and drawing software based on SVG and Batik platform in electrical automation [J]. Journal of Pingdingshan Institute of Technology, 2006, (9).
- [5] Wan Benteng, Chen Ming. Vector Graphics Base Management Model Based on SVG in Electrical Automation [J]. Computer Engineering. 2006, 32 (3).
- [6] Zhao Jun, Gong Qin, Zhang Luqiao, He Linbo. Design of circuit switch state diagram based on SVG in electrical automation [J]. Microcomputer information, 2007, (23).
- [7] Apache Batik Electrical Automatio SVG Toolkit [EB/OL]. [http://xml-graphics a-pache org/batik/](http://xml-graphics-a-pache.org/batik/).2006.
- [8] Overbye TJ, Weber JD. Visuallization of Power System Data Sys-tem Sciences, 2000[A]. In: Proceedings of the 33rd Annual Hawaii Inter-national Conference on[C]. 2000.
- [9] Wu Bin. SVG in Electrical Automation: Future Web Graphics Standard [J]. PC World China, 2000.