Representation of Engineering Drawings in SVG and DXF for Information Interchange

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Abstract: - Engineering drawings are mostly represented in drawing exchange file (DXF) format for information interchange. DXF format is recognized by CAD tools only, and results in a large file size, requiring heavy loading time. In this paper we have developed a technique to represent engineering drawings in scalable vector graphics (SVG) format. The discussion is concluded on a comparison of SVG with DXF, proving the former suitable, especially for World Wide Web.

Key-Words: - SVG, DXF, Engineering drawings, Vectorization, Computer aided designing

1 Introduction

Engineering objects are represented through engineering drawings from three standard orthographic views. These engineering drawings are used in the industry for manufacturing, machining and production of engineering components. These drawings may be manual or computerized one. Different computer aided designing (CAD) tools have evolved in past decades to develop computerized drawings. However the computerization of older manual drawings is a vital research area addressed by different researchers. The main research focus is on the vectorization of these manual drawings in raster formats after possible scanning. Another research aspect is on converting these drawings into a format supported by different CAD applications. The most widely used format supported by these tools for information interchange is drawing exchange file (DXF) format. DXF is basically a vector format. Another aspect is the representation of these engineering documents on World Wide Web. Scalable vector graphics (SVG) is an XML based standard [1] of W3C evolved to represent different graphical objects across World Wide Web. In this paper, we have employed a technique to convert different engineering documents/ drawings from raster to SVG and DXF formats.

Different algorithms have been proposed for raster to SVG conversion mostly depending upon data dependent triangulation (DDT), wavelet based triangulation (WBT) and watershed decomposition (WD). DDT approach is discussed in [2] while WBT is used in [3]. WB technique for raster to SVG conversion is presented in [4, 5]. A very good comparison of these techniques is discussed in [5, 6].

Another issue while dealing with the representation of engineering objects in SVG format is that engineering objects are nested into each other. It complicates the situation when arbitrary view points or page sizes are to be supported in a web browser. Scaling is not guaranteed to maintain relative association of the objects loaded in pages of different sizes. A solution to this problem is constraint SVG [7, 8, 9].

While representing engineering documents over World Wide Web, different flavors of browsers [10] are to be handled. Bandwidth of the medium imposes serious limitations on the size of the document to be transmitted between different sites.

Being a vector format SVG plays a very important role in this regard, however, a suitable compression technique [11] can also be added.

Section 2 demonstrates our approach while section 3 is dedicated to a comprehensive comparison of DXF and SVG formats from different critical aspects. The discussion is summarized in section 4 followed by future recommendations in section 5.

2 SVG and DXF Representations – Our Approach

In our approach we have used scanned manual drawings as input. These drawing images are binarized and gray scaled followed by a boundary trace. Our system is capable of generating output in both DXF and SVG formats. The flow of sequences is depicted in Fig. 1. The interface and the interaction of our application are shown in Fig. 2. Figure 3 is an AutoCAD 2005 view of a sample drawing in DXF format generated by our algorithm while Fig. 4 is the SVG output of our algorithm viewed using Adobe SVG viewer 3.03 plug-in for internet explorer.

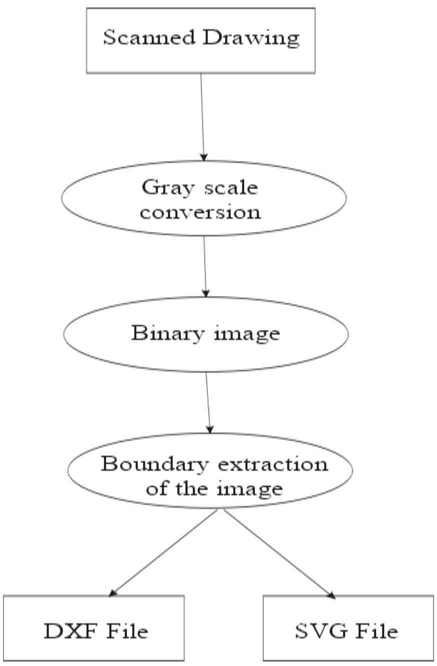

Fig. 1. Execution sequence of our approach

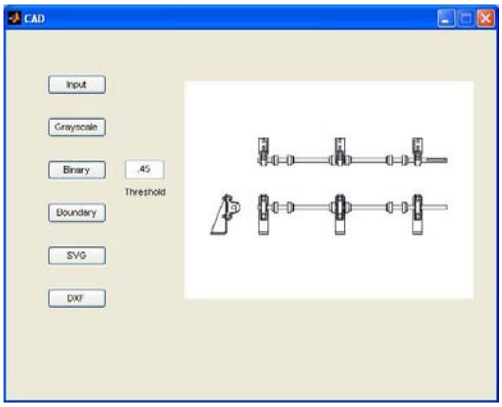

Fig. 2. Interface of the application

3 Comparison between SVG and DXF

We have compared both DXF and SVG formats on the basis of different parameters such as size of output file, time to load the document, support of 3D modeling, animation and rendering, user interactive editing, and the provision of different entities, layers and dimensions.

Our experiments showed that an SVG file is one fourth to that of DXF file in size, on average. A diagrammatic representation is shown in Fig. 5.

Our analysis resulted in another interesting fact about SVG format that its loading time is approximately one sixth to that of DXF format shown in Fig. 6.

It is worthy to mention that the loading time is not directly proportional to SVG file; instead a logarithmic increase in time with increase in file size is observed and is shown in Fig. 7.

The above facts favor for the suitability of SVG format to represent engineering drawings over World Wide Web.

There are some limitations of SVG also as it does not support 3D modeling implicitly, however it does support rendering and animation. DXF format is capable of handling 3D features, layers and dimensions of the line drawings. User interactive editing can be introduced in SVG documents with the help of CSVG [7, 8, 9]. Both the formats support different entities with DXF being capable of handling 3D entities as well. Both types of documents can be rendered. The comparison is summarized in Table 1.

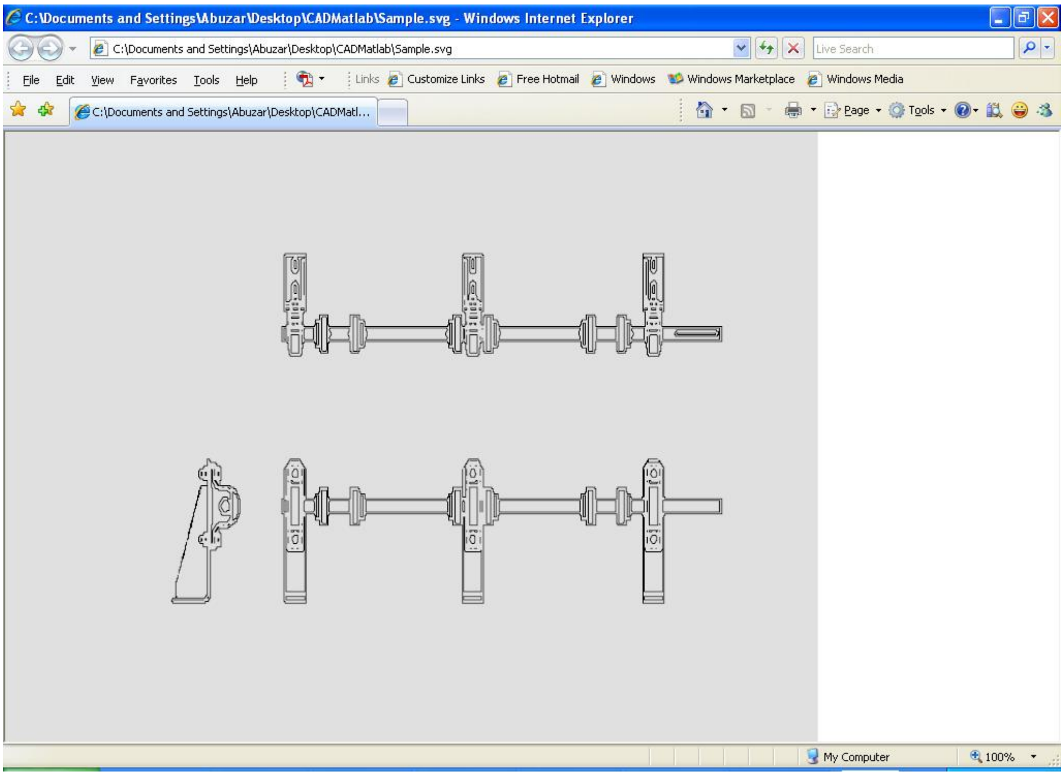

Fig. 3. SVG Output in web browser

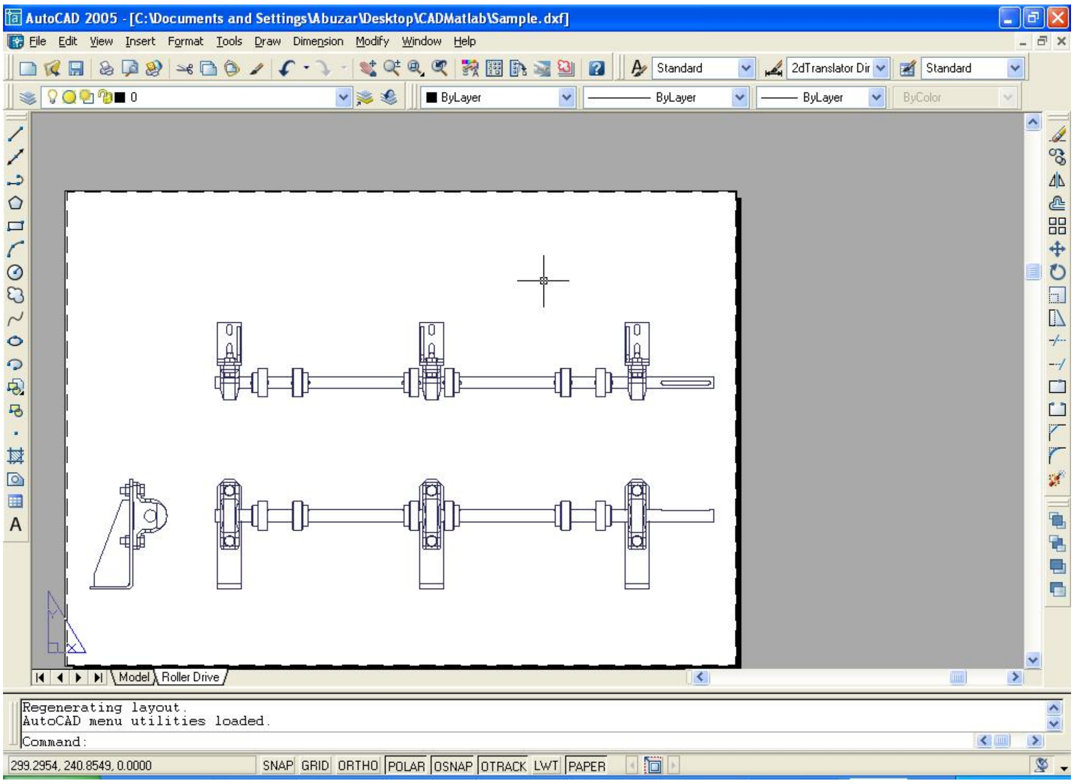

Fig. 4. DXF output in AutoCAD

4 Summary

In this paper we have developed a technique to represent engineering drawings in SVG format. Our technique can generate DXF representation, as well. We have concluded that SVG representations are more suitable for the distribution of engineering documents over World Wide Web after an exhaustive comparison on the basis of critical features of these formats. SVG representations are more appropriate from the point of view of file size and loading time.

Table 1. Comparison between SVG and DXF formats

Parameters	SVG	DXF
File size	Less(approximately one fourth)	More
Loading time	Less(approximately one sixth)	More
3D provision	No	Yes
Rendering	Yes	Yes
User interaction	Yes(with CSVG)	Yes

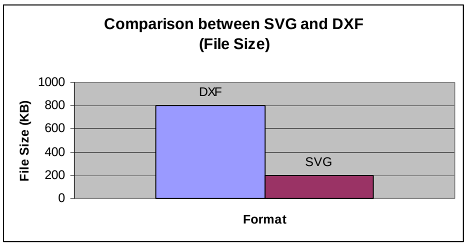

Fig. 5. Comparison between SVG and DXF w. r. t file size

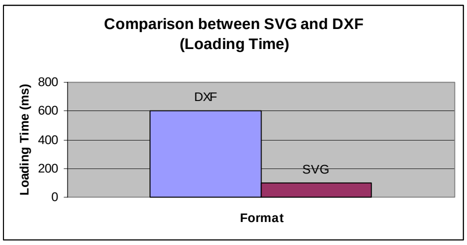

Fig. 6. Comparison between SVG and DXF w. r. t loading time

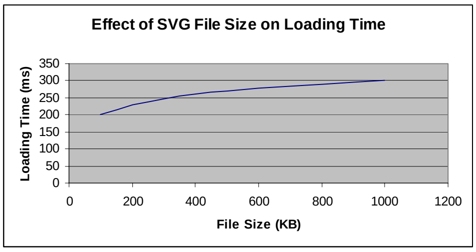

Fig. 7. Effect of SVG file size on loading time

5 Future Recommendations

Our approach can be extended to 3D modeling and visualization of engineering drawings. Interested readers may consult to [12, 13]. Another extension of our work may be the representation of different frames of a multi paged engineering document. Reading of [14] is recommended. Both these future recommendations can be implemented in a mobile computing environment [15].

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