

Case Study: Using a Panoramic Immersive Image Interface to Access Engineering Design and Standards Data

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Abstract

In this case study an experimental web application will demonstrate how JAVA-based 360-degree immersive imaging can be used to access substation engineering design and construction data. This information is accessed from two types of panoramic immersive images; photographic images that provide access to as-built construction drawings and documents and 3D rendered CAD model images that access applicable Standards, Specifications and Compatible Unit design data.

Keywords: immersive imaging, panoramic, 360 degree, 3D CAD model, 3D rendered model, engineering standards, power substation, interactive image map, virtual camera, JAVA applet, compatible unit.

1. Introduction

Recent advances in JAVA applet architectures relating to immersive panoramic imaging technologies allow a web viewer to explore detailed virtual environments. These applications move panoramic images from a flat, 2D format into a more immersive experience allowing the user to pan, zoom and navigate a virtual environment complete with interactive hyperlink components. The purpose of this paper will be to demonstrate how an electric utility can use this technology to build an application that can access the complete set of engineering physical design and construction data for a 138/12kV electric power substation.

Technical and non-technical users of the application will have the ability to immediately retrieve engineering design data by selecting the applicable substation apparatus and equipment. Existing systems employed by utilities typically require a user to manually search drawing indices resulting in a longer information retrieval process.

In addition, the application is quite economical in that a client's workstation only requires the use of a web browser and two installed plug-ins: AutoDesk's Whip! and Adobe's Acrobat Reader. The user can view complex design drawings, bill of material data and Engineering

Resources without having CAD or database applications installed.

2. The User Interface

The application's starting point is an interactive image map of the 138kV power substation's plot plan shown in Figure 1. From here the user can activate one of several immersive "camera" locations and enter 360-degree virtual views of the substation. These "cameras" allow a user to pan around from several key vantage points and navigate the power substation's physical layout. By accessing embedded hyperlinks the user can access as-built construction drawings, material specifications and Compatible Unit data.

The immersive images are of two types: those that view the as-built substation layout via the panoramic photographic images of the as-built substation and those that view the designed substation via a 3D CAD model. In the latter case the images are created from rendered views of the 3D CAD design model of the substation.

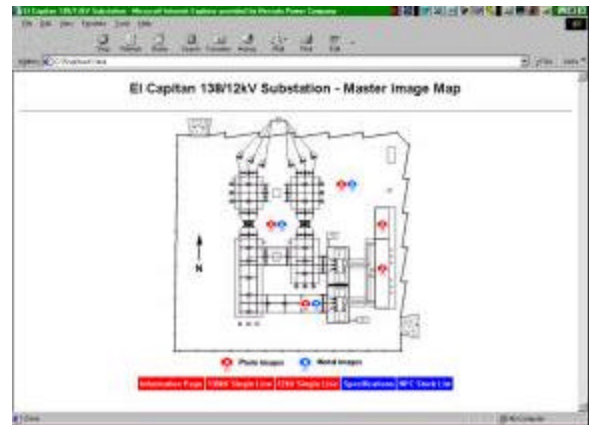


Figure 1. Interactive Substation Plot Plan

Using the photographic immersive images of the as-built substation the user is able to hyper-link to all construction physical CAD drawings of the substation, connection diagrams, construction bills of material and

manufacturer's equipment drawings by clicking on hyperlinked objects. Figure 2. shows a browser view of a substation photographic immersive image with hyperlinks. Drawings pertaining to the overall substation layout are accessed using a separate menu that is included on each page, (e.g. plot plans for initial, ultimate, electrical, conduit, foundation, grounding layout and steel structure layout).

The other type of immersive image navigates the 3D design model and is used to access Compatible Unit Standards information. The user can click on objects in the virtual substation, (i.e. transformers, power circuit breakers, CCVT's, etc...), and hyperlink to their associated Compatible Unit 3D model images and Compatible Unit bills of material. Figure 3. shows a browser view of a substation 3D model immersive image. Each page of this type also includes a link to the Master Compatible Unit Index where all compatible units are listed complete with links to 3D model images and their associated bills of material.

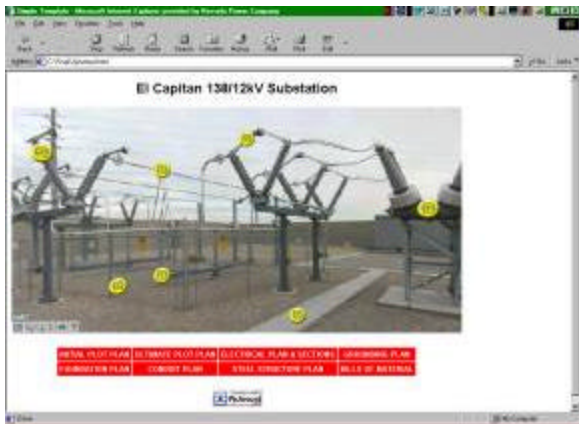


Figure 2. Photographic Immersive Image in Browser



Figure 3. 3D Model Immersive Image in Browser

CAD drawings are displayed to the user in .DWF format, (Drawing Web Format), using the AutoDesk WHIP! plug-

in. The .DWF format allows one to display, pan, zoom and print drawings of AutoCAD origin inside a web browser. .DWF is a lightweight vector file format that preserves the security and precision of source DWG files, while ensuring the speedy display of drawings.

3. Access to Engineering Documents

Using the immersive panoramic images several types of Nevada Power Company Substation Engineering documents are accessed; as-built physical construction drawings and their associated bills of material, NPC Material Standards, Compatible Unit Standard model images and Compatible Unit bills of material data.

3.1 Physical Construction Drawings

The physical construction drawings are 2D AutoCAD drawings of the as-built substation. These were created by referencing the 3D model of the substation. This methodology conserves both disk space and time as one can alter the 3D physical substation model and the changes are automatically reflected in the construction drawings, from which it is referenced, (AutoCAD XREF) [1]. One changes the 3D model to make physical alterations to substation while annotations and dimensions are revised by editing the associated 2D construction drawings. By placing objects in specific layers an array of physical construction drawings can be generated from the 3D model. NPC substation drawing categories are listed in Table 1 below.

Drawing Series	Description
E11	Conduit Plan and Details, Underground Feeder Plan
E12	Initial Plot Plan, Grounding Plan and Details
E13	Electrical Plan and Sections
E14	Ultimate Plot Plan, (fully built-out substation)
E15	Switchgear Physicals
E20	Foundation Plan and Details
E21	Steel Structure Layout and Details

Table 1. NPC Substation Drawing Categories

3.2 Compatible Units

Compatible Units are the standard construction units used by NPC Engineers to design the substation's physical layout. A typical unit consists of two components: a 3D AutoCAD model assembly and an itemized bill of materials. These bills of materials are stored in Microsoft Access tables and are displayed as HTML.

4. Preparation of the Immersive Images

The photographic images were created by taking a series of digital photos at several key locations in the substation, each covering a 360-degree pan. The digital images were then electronically “stitched” together. The application used to stitch the images was PixMaker 1.0 developed by Pixaround, a Singapore based company. Figure 4. shows a typical stitched photographic source raster image. This application produces a raster image that coupled with a JAVA applet can be viewed in a web browser. This browser-based image has additional zoom, pan and hyperlink capabilities.

Creating the 3D model images required a more complex preparation process. An AutoCAD 3D physical model of the substation, (the one originally used to prepare physical construction drawings), was imported into 3D Studio MAX where materials and textures maps were applied. Next virtual cameras were created with focal lengths identical to those of the cameras used for the photographic images. Rendered stills were generated using the virtual cameras covering 360-degree pans. Pixmaker was again used to stitch a raster source image which is shown in Figure 4.

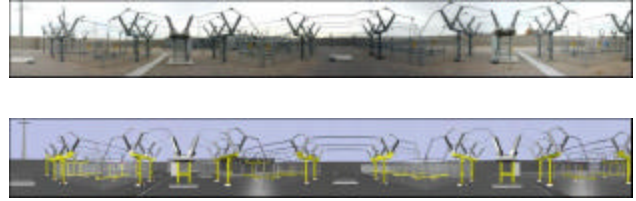


Figure 4. Photographic and 3D Model Source Images

5. Summary

This application creates an economical, information-rich visual data map of a HV power substation. Technical and non-technical users alike can use it to access substation technical information in a visual manner. This application is very light and economical in that client workstations are not required to have any other applications but a web browser and two installed plug-ins: Whip! and Adobe Acrobat Reader. Neither AutoCAD nor a database is required on the client workstation.

6. References

[1] Autodesk, AutoCAD 2000 User Manual, Autodesk, Sausalito, 1999