Attributed Graph Matching Based Line

Drawings Retrieval

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*Abstract* — Online maintenance of large volume document data such as Engineering drawings is very difficult. It is very common thing for Engineers and Designers to get some information from Engineering drawings which is generally slow and tedious process. This paper presents a method for line drawings retrieval from Engineering Drawings by their shape appearance, topological relations and contour properties. In this method line drawing is represented by an attributed graph (N-way tree), where each node corresponds to some meaningful properties of contour. The drawing retrieval is formulated as attributed graph matching. Inexact graph matching algorithms are inherently an NP-hard problem with exponential complexity. It is the aim of the proposed algorithm to reduce the complexity of the inexact graph matching process, while still producing an optimal solution for a known application. This is achieved by greatly simplifying graph to N-way tree data structure and compensating loss of robustness by hierarchy of matching process. The proposed algorithm is translation, rotation and scale invariant of given drawing image. Results show that proposed algorithm is accurate and fast in terms of shape matching of line drawings, and show promise for the application of shape matching.

Keywords — Graph Matching, Shape Matching, Line Drawings, N-way Tree, Attributed Graph, Image Contours, Topological Structure, Engineering Drawings

# Introduction (motivation & history)

For any architectural project, many multi-dimensional drawing documents are made and printed on large sheets. A big project contains many such drawing documents and the number increases continuously as the project grows. Architectural drawings need utmost attention to details; so that contribution can be flawless when the scale of project is very large it is impossible to fit the whole project in a single drawing document sheet even if the size of sheet is very big. In such cases, it becomes necessary to assign a symbolic object representation to some sections of a drawing. This eases the task of the architect to detect and identify objects and their functionality and purpose. These objects were printed all over project where ever it is necessary. Online maintenance of such large volume Engineering Drawings documents has become a major research area related to automatic Engineering Drawing interpretation. It is very common thing for designers and draft people to get some information. However, retrieving these documents generally is a slow & tedious work. To facilitate such retrieval, textual content such as keywords has been widely used which is a heavy work to generate such descriptions manually and also sometimes incapable of describing the true content in a drawing. There is almost no developed mechanism that supports automated drawing retrieval system to ease the drawing retrieval process. To ease this process of fetching we developed a new system to support automatic classification and retrieval of Engineering drawings based on their shape appearance, topological relations and contour properties, rather than relying solely on textual annotations or metadata.

Several works have been reported in the literature regarding image retrieval based on its content. In the work [attr grp], the drawings are first represented by attributed graphs, where graph nodes correspond to meaningful primitives extracted from the original drawing image, such as lines and curves, while the spatial relationships between these primitives are described by graph edges. The primitives generation is process of decomposing intersection points obtained from thinning drawing to single pixel width and then, a merge-split process is used to make them more meaningful. The primitives obtained from above process are treated as nodes of attributed graph and the Delaunay tessellation strategy is used to generate the structural description of engineering drawings. The problem of graph matching is solved using mean field theory. In the work [2d & 3D], the authors proposed algorithm of matching a 2D Engineering Drawing and 3D model for process plant. It is a topological structure based algorithm which based on the property of any 3D model and 2D engineering drawing have similar topologies if they are derived from the same process plant. A typical process plant 3D model mainly consists of thousands of basic components, including equipment, pipelines (i.e. pipes and piping components), valves, instruments, etc.  
Components are comprised of fourteen basic entities such as cylinder, scylinder, prism, cone, concone, squcir, squcone, box, torus, squtorus, sphere, wedge, saddle and oval. Contents in 2D drawing field are the set of component shapes, dimensions and projecting direction indicators. The proposed method consists of two primary steps: (1) preprocessing is applied to 3D model and 2D Engineering drawing to transform into attributed graphs; (2) methods to find similarity between two graphs. The preprocessing step of 3D model into attributed graph setups the components in the model as nodes of graph, type and insertion coordinate as nodes attributes and topological relations as edges. The preprocessing step of 2D drawing follows same as 3D like components as nodes and topological relations as edges but it additionally does the filtering of annotations and illustrations. The problem of graph similarity is solved using Max-Common sub graph and Min Edit Distance methods.

The remaining of this paper is arranged as follows: In section 2, we describe the engineering drawing decomposition process to convert the drawing image into attributed graph using image contours. In section 3, graph matching algorithm is outlined. At last, the experiments as well as some discussion are given in section 4.

# attributed graph construction

our proposed method of attributed graph construction has two primary steps: (A) preprocessing to drawing image to remove noise; (B) actual graph construction from contours of image obtained from preprocessed image.

## Preprocessing in detail

Paragraph goes here

## Graph construction

Paragraph goes here

# graph matching

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*a**b*    

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* A graph within a graph is an “inset,” not an “insert.” The word alternatively is preferred to the word “alternately” (unless you really mean something that alternates).
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An excellent style manual for science writers is [7].

# experimental results

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##### Acknowledgment

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1. G. Eason, B. Noble, and I.N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” Phil. Trans. Roy. Soc. London, vol. A247, pp. 529-551, April 1955. (*references*)

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1. J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68-73.
2. I.S. Jacobs and C.P. Bean, “Fine particles, thin films and exchange anisotropy,” in Magnetism, vol. III, G.T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271-350.
3. K. Elissa, “Title of paper if known,” unpublished.
4. R. Nicole, “Title of paper with only first word capitalized,” J. Name Stand. Abbrev., in press.
5. Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, “Electron spectroscopy studies on magneto-optical media and plastic substrate interface,” IEEE Transl. J. Magn. Japan, vol. 2, pp. 740-741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].
6. M. Young, The Technical Writer’s Handbook. Mill Valley, CA: University Science, 1989.