Automatic Title Block Location in Technical Drawings

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Abstract

This paper presents a method that automatically detects the location of the title block in scanned technical drawings. Numerous applications could benefit from such a tool. For example, it is useful to locate and zoom on the drawing title block, which can help in indexing technical drawings. As the title block is normally on the right-bottom corner of the drawing, it can also permit turning the drawing in the correct reading direction.

Our method of title block location is based on signal measurements computed on the drawing parts where the title block can be present. The usual drawing format norms are used to reduce the number of possible title block locations.

The method has been validated on a large database of technical drawings.

1 Motivation and position of the problem

This paper presents a method that automatically detects the location of a title block in scanned technical drawings such as mechanical or architectural drawings. Numerous applications, especially in the industrial market, could benefit from such a tool. Some examples are:

- Viewing tool for technical drawings: if the title block is normally on the right-bottom corner, once located, the drawing can be turned in the correct reading position. This is especially important for scanned drawings coming from microfiches, where it is not uncommon to find drawings upside-down.
- Indexing of technical drawings: in order to fill up a drawing database with the information contained in the title block, the user has to locate the title block and to zoom on it. Title block locating could also be the first step in automatic indexing of technical drawings, the following steps being the extraction of the indexing information itself.
- Automatic folding of printed technical drawings: it is indeed useful to fold the drawing with the title block on the visible part.

This paper is organised as follows: section 2 describes technical drawings with respect to the norms and usage in industry. It then extracts some characteristics of technical drawings, which will be used as parameters of our method. In section 3, we cover the state of the art in table and title block analysis. Section 4 presents our method. Section 5 describes our experiments and

results we obtain. Section 6 concludes this paper.

2 Description of Technical Drawings

An example of a technical drawing is presented in figure 1. Technical drawings follow some rules and recommendations (as International Standard Organisation ISO norms). They use standard paper formats. [ISO75] lists those formats for technical documents and provides their sizes. Usual paper formats are A and B series.

According to the ISO 5457 [ISO80], *Borders enclosed by the edges of the trimmed sheet and the frame limiting the drawing space shall be provided with all sizes*. Concretely, a drawn frame should limit the drawing space.

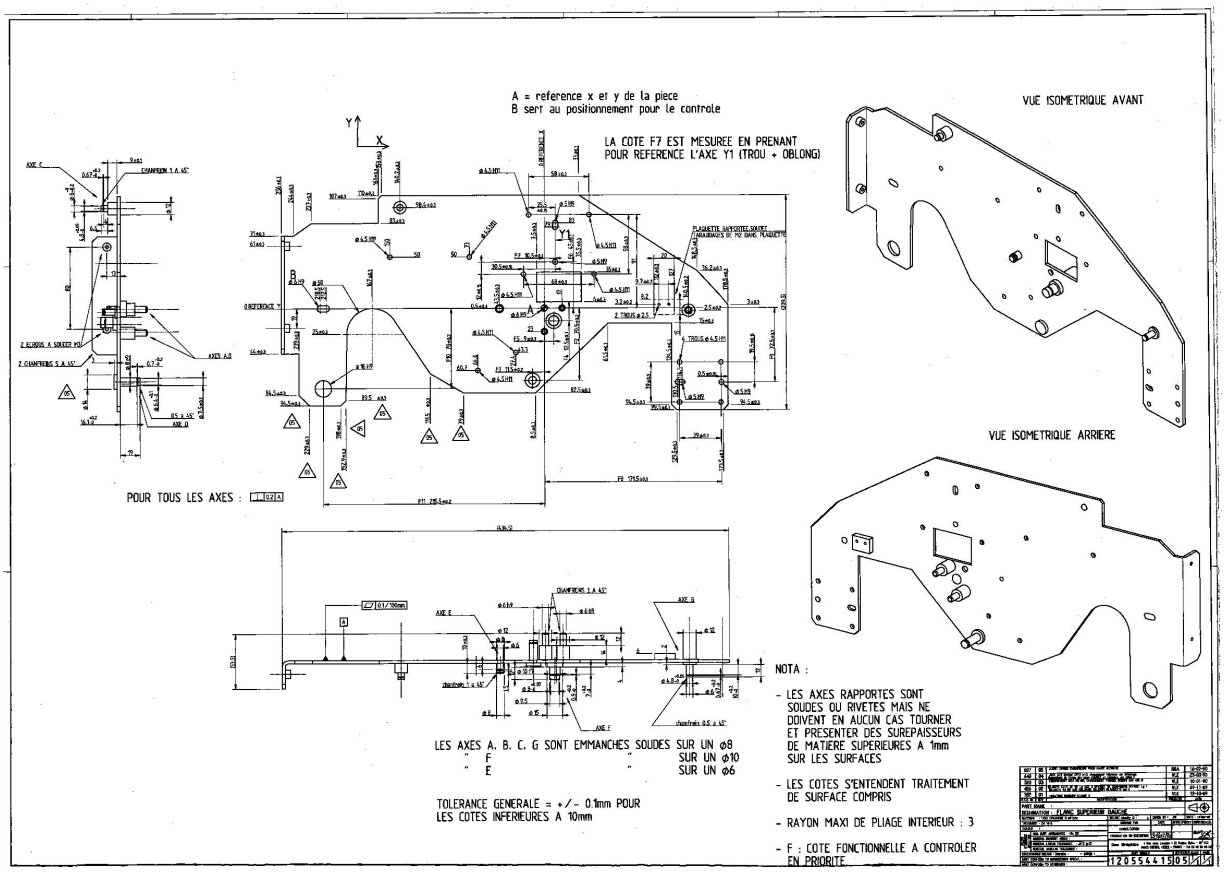

Figure 1: Example of Technical Drawing

All technical drawings must contain a title block to allow their identification. According to ISO 5457, *the position of the title block should be within the drawing space (…). The identification portion of the title block shall be at the right-hand bottom corner of the title block when seen in its normal direction of viewing, and have a maximum length of 170 mm*. According to ISO 7200 [ISO84], the title block is a table-like form, composed of various rectangular fields (see figure 2).

The standards, while giving some precise prescriptions to follow, leave some freedom.

Moreover, the industry usage shows that those standards are not always respected, especially for old drawings.

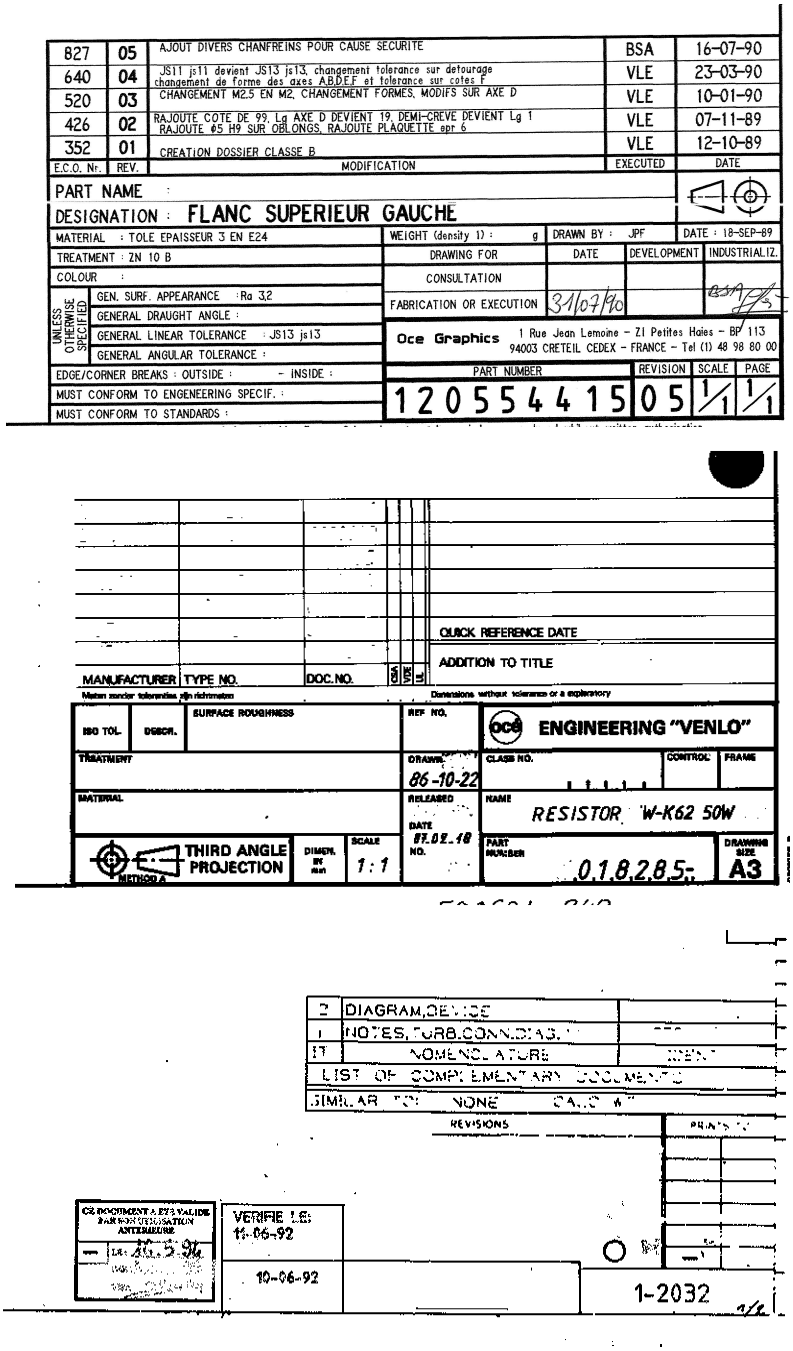

Figure 2: Examples of Title Block

However, the following rules hold:

- Standard paper formats are used (A4-A0 for European drawings).

- A drawn frame limits the drawing space.
- The title block is located in the drawing space and in one of the corners of the drawing. For A0 to A3 format, this corner is the right-down one, the drawing being in landscape position. For A4, the corner is the right-down one, the drawing being in portrait position.
- The title block is a looking-like table of width over 100mm and of height included between 40mm and 300mm.
- From our experience, the height of one of the title block fields is usually comprised between 5 mm and 30 mm. These heights permit to write inside the fields.

3 State of the art

Title Block location is related to table location. [LOP99] presents a survey on automated table processing. A table is a two-dimensional assembly of cells. If we do not rely on the content of the page to reconstruct the table, we have to extract the structure from the image. This structure is taken from the lines visible in the page. Various methods exist for extracting a whole table from an image. However, extracting a structure is not the same as locating it.

In the community of Document Analysis, few papers can be found discussing the title block location problem. [SYE99] addresses the problem of locating title block regions and the subsequent extraction of indexing keywords from such regions. It proposes to locate the title block using a technique called table hashing. The main disadvantage is that this method requires a learning step to establish a model for each structure to locate, which does not suit the variability of title block structures.

[ARI97] presents an application that helps in the extraction of information from Telephone Company drawings. This application is an ergonomic GUI dedicated to the location of a uniquely defined title block. It is used for operator assisted title correction. The application first extracts the straight lines of a sub-region of the drawing using the FAST method [CHH96]. The box with the largest area that meets certain conditions of width-to-height ratio is selected as the title field. As the authors design a specific solution in accordance with their need, their approach cannot be generalised easily.

To overcome the previous limitations, we develop our own method based on profile projection.

4 Our Method

The location of the title-block is computed from some specific signal measurements on corners selected from information issued from the standards.

4.1 Signal measurements

Signal measurements are computed on the drawing parts where the title block can be present. Following what we retain as the title-block description (section 2), we first construct various sub-

images corresponding to each possible title block location. On each of these sub-images, we compute a horizontal projection profile. Figure 3 presents projection profiles from the four corners. We can see that the signal with the greatest number of highest peaks and whose peaks are regularly spaced is the one of the title block.

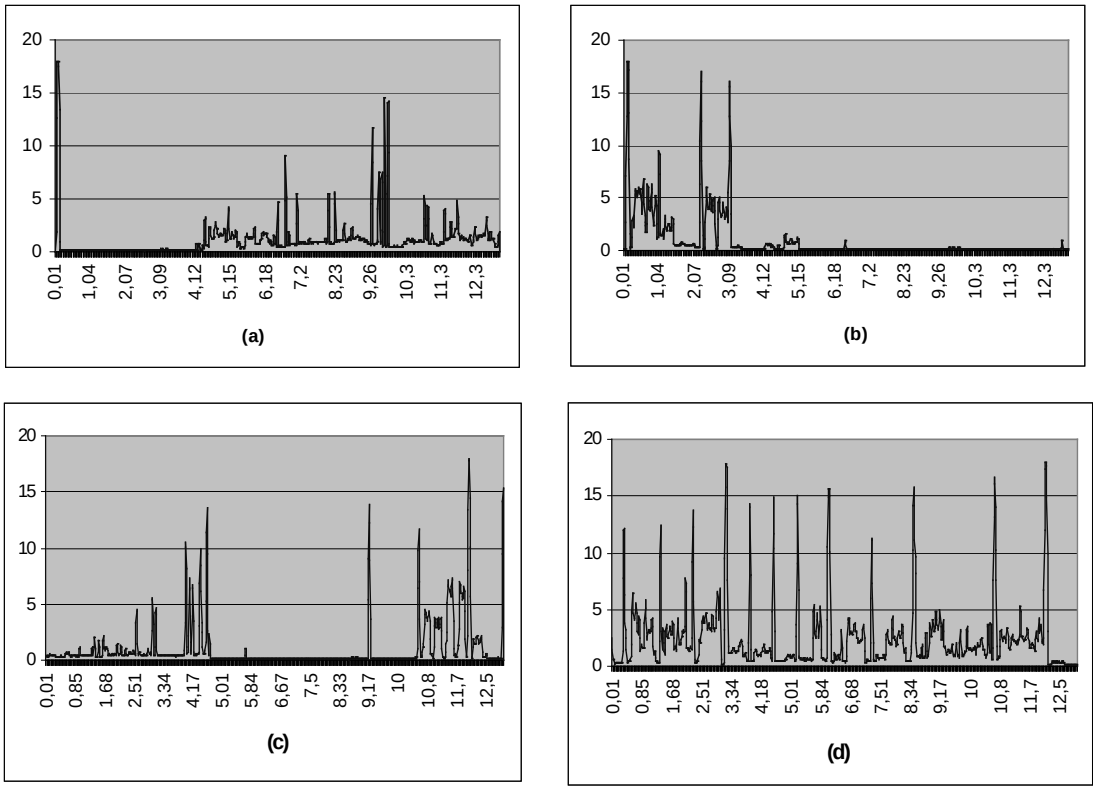

Figure 3: Four corner histograms of a technical drawing.

4.2 Information extracted from standards

The second aspect of the method is to minimise the number of corners candidate for the title block. In principle, 16 locations are possible. Those locations are analysed following four location corners and the reading direction of the title block. Figure 4 illustrates the four possible locations in one corner. The symbol 'A' provides the reading direction of the title block.

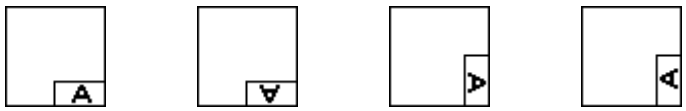

Figure 4: Possible title block locations in a given corner of drawing

The number of possibilities is reduced using information about the title block reading direction (portrait or landscape) and the location corner when the drawing is in the correct orientation. If the information of the title block reading direction and the expected location corner is given, only two corners can contain the title block. For example, if the reading direction

is landscape, and the expected corner location is right down, figure 5 shows the two possible locations.

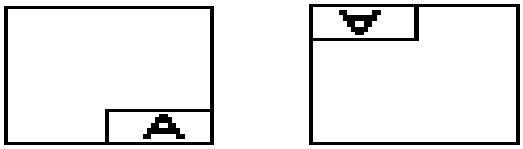

Figure 5: Possible title block locations when the reading direction and the expected location are known (landscape, right down)

The information needed (reading direction and expected corner location) is provided through a list of drawing formats.

4.3 Steps of the method

The various steps of the method are the following ones:

- **Format detection:** the title block position depends on the drawing format. To detect the format, we extract the drawn frame of the drawing and compare its size to standard sizes. To extract the drawn frame, we use the algorithm of line detection exposed in [CHE98]. This method detects lines using projection profiles on image strips.
- **Cropping the images:** the format knowledge reduces the number of corners we have to look for from 16 possibilities to 2. We then cut the possible corners, following the general size of the title block.
- **Line extractions:** in each corner, the horizontal lines are extracted using the method [CHE98]. This step provides a horizontal line distribution as shown in figure 3.
- **Parameter computation:** to characterise the horizontal line distribution, we compute some parameters. We first merge lines closer than a first threshold, several merged lines giving one valid line. Then, we form groups of valid lines by grouping lines that have a spacing inferior to a second threshold. For the two groups closest to the drawn frame, the following parameters are computed:
    - original number of lines,
    - number of merged lines,
    - number of valid lines,
    - average spacing between valid lines,
    - standard deviation of the spacing between valid lines,
    - distance between the drawing border and the first line of the group.
- **Decision step**: This step has to choose the corner that contains the title block. It compares the group parameters computed in the previous step with parameters that model the title block described in section 2. We design two title-block models, a precise one, and a less strict one. Each of those models patterns a group of lines in sufficiently important number to represent a

table, close to the drawing frame, regularly spaced, and with a spacing that allows writings. The decision is taken according to the following rules:

- If only one of the candidate corners corresponds to the precise model, then it is chosen as the correct corner.
- If several candidate corners correspond to the precise model, the drawing is rejected (no decision taken).
- If none of the candidate corners correspond to the precise model, then the preceding tests are made using the less strict one.

In the development of the method, the focus is put on rejecting drawing rather than making confusion. Let us note that the less strict title-block model accounts for about 20% of our drawings: it detects in particular small title blocks (less than 4 lines). To ensure the robustness of the algorithm, we clean up the image and enhance the lines using morphological algorithms combined with image reduction.

5 Experiment

5.1 Results

The method has been tested on numerous technical-drawing types coming from 5 companies. The test database is a set of 5557 mechanical and electrical drawings. Formats are standards, A0 to A4. Drawing resolution is 400 or 600 dpi. Drawing images are black and white, TIFF format compressed with the compression CCITT group 4.

The treatment time is less than 1 second for A0 format with a Pentium III PC, 128 Mb RAM.

Table 1: Experiment results

Number of drawings	Recognition rate	Confusion rate	Rejection rate
5557	**87 %**	**1.4 %**	**11.6 %**

Results of the experiment (table 1) show a low confusion rate, due to the presence of tables similar to a title block in the drawings. The only way to eliminate those confusions is to read and interpret the content of the table. Rejection cases are due either to the quality of the scanned drawing or to a non-respect of one of the rules of section 2.

5.2 Analysis of rejection and confusion cases

Rejection cases are mainly due to two causes:

- Problem with the drawing frame, whether it is not present, or it is partially erased, or bent.
- Problem with the fields of title block (partially erased, bent, or too noisy)

Confusion rate is mainly due to the presence of tables on other corners of the drawing.

6 Conclusion

We present in this paper a fast and reliable method for locating the title block in technical drawings [NAJ01a]. The number of parameters is small, and each of those parameters has a physical meaning. Thus, the parameter value can be deduced from standards and usage in the industry. This ensures the method's robustness with respect to the variability of real world title-blocks. The algorithm has been extensively tested and validated on a large database of technical drawings.

Several applications of our method have been presented in section 1: indexing of technical drawings [NAJ01B], viewing tool, or automatic folding. All these applications provide added value to the global document workflow, automating painful end-user tasks.

7 Bibliography

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