

Automatic Layout Generation for Graphical Design Magazines

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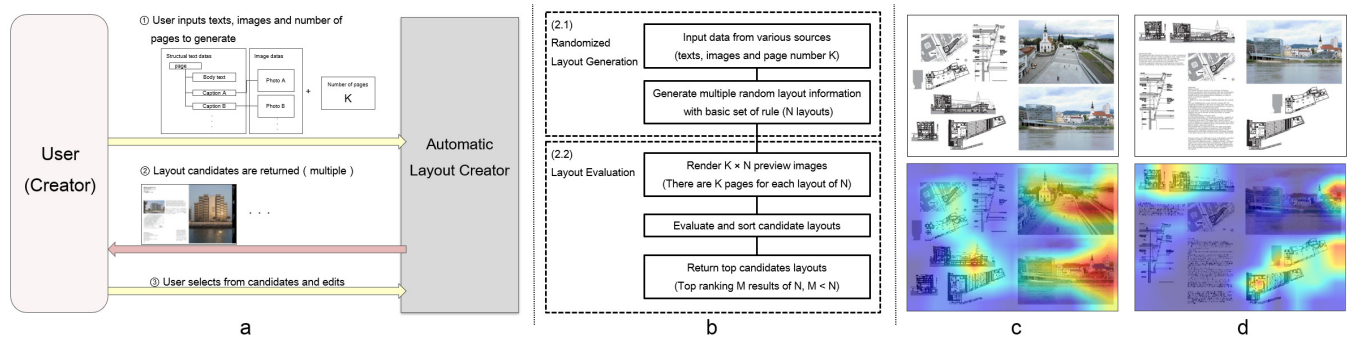


Figure 1: a) Outline of our proposed system. b) Processing flow. c) Automatically generated layouts with high score result (score:0.82), d) results with low score result (score:0.32).

ABSTRACT

We propose a system that automatically generates layouts for magazines that require graphical design. In this system, when images or texts are input as the content to be placed in layouts, an appropriate layout is automatically generated in consideration of content and design. The layout generation process is performed by randomized processing in accordance with a rule set of minimum conditions that must be satisfied for layouts (minimum condition rule set), where a large number of candidates are generated. The appearance, style, design, and composition of the work are evaluated by a learning-to-rank estimator, top scores are returned to the user. Users can greatly improve the efficiency of layout creation/editing by selecting from among automatically generated candidate layouts.

CCS CONCEPTS

• **Computing methodologies** → **Image representations; Neural networks.**

KEYWORDS

Document layout generation, Image Representations

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1 INTRODUCTION

Existing methods for layout creation for magazines and books are generally performed manually using document layout software (e.g. Adobe InDesign), which are very laborious.

Recently, Generative Adversarial Network (GAN) technology has been making remarkable progress, but there have been only a few studies that use GAN for layout generation. As a very recent example, [Li et al. 2019] proposed a GAN framework that combines a generator for arrangements of graphic elements based on a particular graphical design and a discriminator that determines the arrangement, showing interesting results.

However, a disadvantage of using GAN is that the layout is generated from among known accumulated feature distributions. So far, it is difficult to create something with a high degree of novelty. When creating a magazine that requires graphical design, it is desirable that there be several novel variations to determine the taste and design style to use.

In this research, we propose a new automatic layout generation method that combines the random layout generation process using a minimum condition rule set, and an evaluation process for the generated work. Using this method, it is possible to generate multiple novel layouts while retaining their original design taste/style.

2 METHOD

The outline of our proposed system is shown in Figure1 a). When the user inputs texts, images, and information on the number of pages, multiple layout candidates are generated and returned.

The processing flow is shown in Figure1 b), which consists of randomized layout generation (2.1) and layout evaluation (2.2).

2.1 Randomized Layout Generation

In the layout generation phase, a large number of layout candidates are generated from input texts, images, and the total resulting number of pages to produce, abiding by the minimum rule.

The minimum rules are described as follows:

- Texts or images do not leave out of the paper.
- Any of texts and images do not intersect mutually.
- Align one or more corners of the text block or image with the corners of the layout grid.

We use the data structure format of generated layout information used in the work of [Yang et al. 2017]. A large number of generated candidate information is rendered, and then evaluated in the layout evaluation process described in 2.2.

2.2 Layout Evaluation

In the layout evaluation phase, a layout evaluation model is used on a large number of candidate layout images to determine whether or not it have a layout with the design taste/style learned from original magazine. An outline of the layout evaluation model is shown in Figure2 .

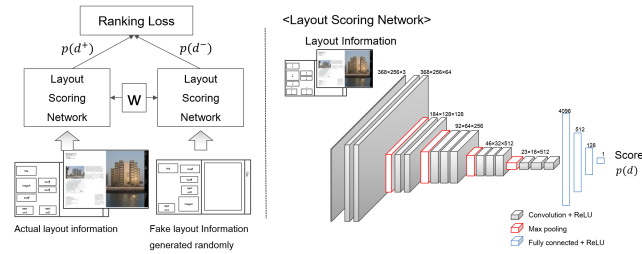


Figure 2: Layout Evaluation Model.

The layout evaluation model is a learning-to-rank network inspired by [Zhao et al. 2018] that outputs a continuous score indicating whether or not it have a layout with the design taste/style learned from original magazine. We learn the learning-to-rank network by using the layouts created from the actual magazines as positive examples and using the fake layouts generated randomly (using the same text and images) as negative examples.

The input tensor is given as 2-page layout images (RGB) unlike [Zhao et al. 2018]. This can be expected to be a more preferable feature in which not only the appearance in one page but, the dependency between pages is also considered. In addition, for ease of learning, center loss [Wen et al. 2016], is used instead of the contractive loss.

In the layout evaluation phase, a score is calculated every two pages, and the average is obtained as the final score of the layout.

3 EXPERIMENTS

3.1 Experimental Settings

In the experiment, we used 15 years worth of magazine layout data of the monthly magazine "a+u" published by A+U Publishing Co.,Ltd, related company of Shinkenchiku-sha Co.,Ltd. This magazine is an architectural magazine which is characterized by high-quality graphics and stylish design. Of the total 4674 pages, 4000 pages were used as training data, and the rest was used as validation data and test data. Sets of two consecutive pages were concatenated and resized to an input resolution of 368×256 as network input.

3.2 Experimental Results

Examples of the generated results are shown in Figure1 c) and d). c) shows an example with a high score, d) shows an example with a low score. The upper row shows a preview image of the generated layout, and the lower shows the visualization result of Grad-cam[Selvaraju et al. 2017].

"a+u" magazines have a layout that intentionally inserts a little space between text and images. Considering the visualization results of Grad-cam, it is apparent that in c), the well-balanced arrangement of the six images on the left page and the right-alignment the two images on the right page lead to the high scores. On the other hand, in d), the slight misalignment of the two figures at the top of the left page, and the unnatural spacing in the arrangement of the three images on the right page leads to a low score.

For the experiment, we set the randomly generated number of candidates N to 100. The processing time using the CPU, was approximately 3 minutes for generation and 2 minutes for evaluation.

4 CONCLUSIONS

In this study, we proposed an automatic layout generation system combining random generation with a minimum condition rule set, and an evaluation of how closely the generated result fits the target design style/taste. In this method, it is possible to generate multiple novel layouts while retaining their original design taste/style.

Future areas of improvement include, speeding up processing to perform in real-time during the magazine production process. In order to speed up the generation, it is important to reduce the number of generated candidates required. Also, in addition to random generation, the use of [Li et al. 2019] and reinforcement learning approaches may be effective.

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