Landscape-freestyle: Restyling Site Plans for Landscape Architecture with Machine Learning

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ABSTRACT

A landscape site plan is a graphic representation to show the arrangement of landscape items (like trees, buildings, and paths) from a top view. Restyling a site plan includes adjusting the colors, textures and other artistic customization, which is the task that landscape architects spend more time to work on nowadays. Landscape-freestyle shows the potential of using machine learning for automatically restyling landscape site plans. Landscape-freestyle recognizes the features (locations and sizes) of each item (trees, buildings, and paths) by an object-recognition algorithm on a styled site plan or by reading data directly on an AutoCAD file site plan. The user can choose to upload a template image offered by themselves or a pre-set style template offered by Landscape-freestyle for restyling. If they upload templates themselves, a style-recognition algorithm is used to identify the items and their artistic customization from the template image and use it for styling. This work presents our first approach to restyle site plans: recognize tree images on site plans, extract tree features and redraw them with other style templates. This research aims to expose the importance of machine learning to benefit a traditional working flow in the design field in a friendly and fast way.

CCS CONCEPTS

• **Applied computing** → **Computer-aided design**.

KEYWORDS

machine learning, landscape architecture, automatic styling, computer-aided design

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1 INTRODUCTION

Nowadays landscape architects design their site plans with accuracy in size, locations, and design information by using a Computer-aided tool such as AutoCAD. Then, they import that output file into an editor such as Photoshop and keep testing different style possibilities and get polished landscape site plans to show to their clients. This repetitive process of restyling might take around 30 hours to 2-4 weeks.

Research has been done on using the machine learning algorithm to help with styling and architecture design. Deep Photo Style Transfer[3] is used to apply the style of a reference photography painterly on another photograph. The photograph can be styled by the scenario of the reference photograph. A Neural Algorithm of Artistic Style[2] that can produce new images with the content of the input images and the styles from various well-known artworks. Two-stage Sketch Colorization framework automatic colorize sketch and line art[5]. In the architecture field, Paul Merrell et al. [4] develop a prototype to generate a residential building layouts with the size and needs by the Bayesian network. In the landscape field, the book Digital Drawing for Landscape Architecture[1] discusses how computing and machine learning can take part into landscape design and redefine the relation between designers and their design, human-being, and nature. However, there are few practical attempts on the landscape site plan drawings specifically and Landscape-freestyle provides a novel approach for machine learning and restyling site plans.

2 IMPLEMENTATION

The workflow of Landscape-freestyle is divided into 3 phases:

- **Recognition of item features:** The prototype requires the information of the items and their features. If the user uploads a styled image, the information will be extracted by a trained image recognition algorithm (Figure 1 A). If the user uploads a CAD file, the information will be extracted from the CAD file (Figure 1 B).
- **Selection of the style from site plan uploaded by user or a default template:** The prototype requires a style as the template for restyling work. If the user uploads a template image, the styling information will be extracted by a trained style-recognition algorithm (Figure 1 C). If the user chooses a default template, the styling information will be extracted from a pre-set style database (Figure 1 E).
- **Application of the template for restyling:** Finally, we apply the styling information on items feature information to redraw the site plan and have it restyled (Figure 1 F).

Figure 1: Landscape-freestyle Modules. The red dots represent one option of the use of the software. A. Extract items information if users input styled images. B. Read and extract items information if users input CAD files C. Extract style information if users upload a style template. D. Generate style information if users choose a default template. E. Apply style information on items information to generate a restyled image

Figure 1 shows one option of restyling a site plan with tree features.

To set up the database, 452 landscape site plans of gardens and small parks with all kinds of styles from water-color style to photography style are collected and labeled with accurate item features manually. Tensorflow Object Detection API with the faster-rcnn-inception-resnet-v2-atrous-coco model is used for training data and

generate the model for object recognition and style recognition. Then Landscape-freestyle apply the selected style to the specific size and locations of each items.

3 CONCLUSION AND FUTURE WORK

This prototype aims to support landscape architects to restyle their landscape site plan and explore an approach of machine learning's application in landscape architecture drawing fields. It has the potential to expand its restyling function in other design fields like architecture design, pattern design, and photography. In the future, Landscape-freestyle will restyle other landscape site plan items like buildings, fountains, paths. We will do the user study for the UI/UX design and create a user-friendly GUI fits the working flow of landscape architect. We will also compare the prototype's accuracy, speed, and style effect with other styling algorithms for further improvement.

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