

Bouygues SpaceXYZ Floor Plan Detection : Room Type Detection

BOUYGUES
CONSTRUCTION

Chi Zhang, Qitong Wang, Kaihong Wang, Jiangshan Luo
Boston University Department Of Computer Science

Introduction

The goal of this project is to develop a machine learning model to estimate each type of the room in a given floor plan. The floor plans samples, which provided by Bouygues, are 272 PDF files, without a set of well-defined "ground truths". Our strategy mainly consists of two steps. First, we extracted discriminative features and labeled the ground truth from the training floor plans. Second, we developed two supervised classification models: Backpropagation Neural Network (BPNN) and Support Vector Machine (SVM), then analyzed their performances with model improvements.

Overview

Bouygues Group provided 133 training floor plans, which contain 2 buildings "Eko" and "Equation". The testing dataset contains 139 floor plans from the "Oxygen" building. We first created a converter that reads a PDF floor plan and convert it into an image (Fig 1.), then draw its segmentation image (Fig 2.) via OpenCV.

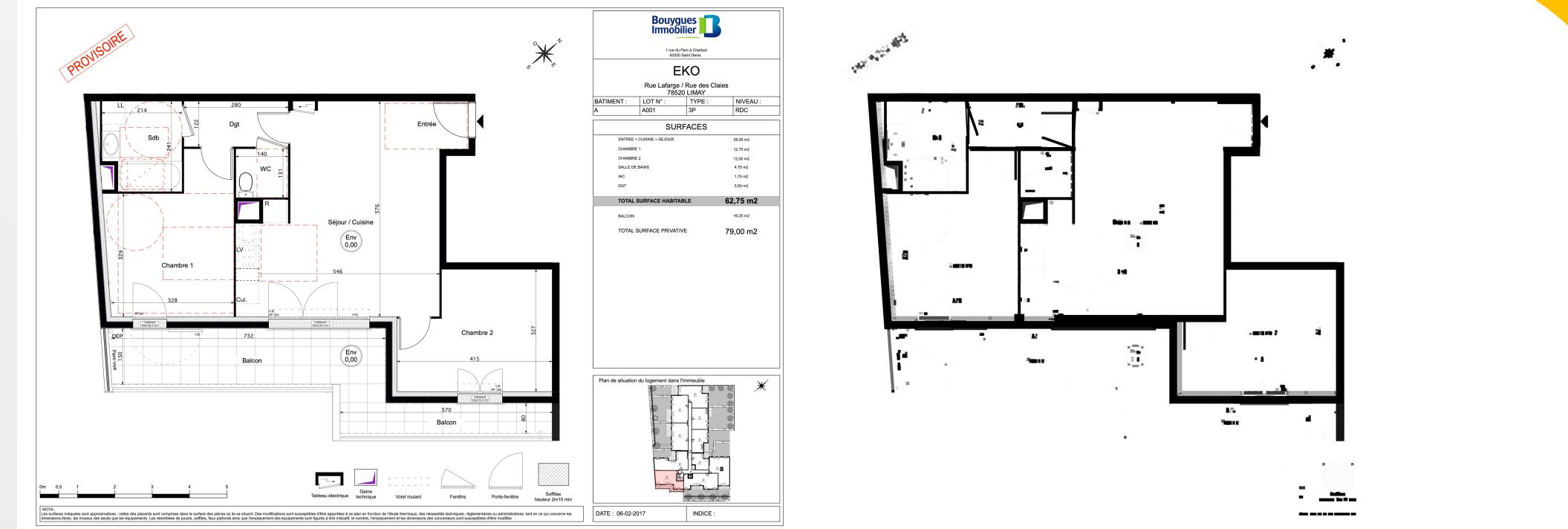


Figure 1.

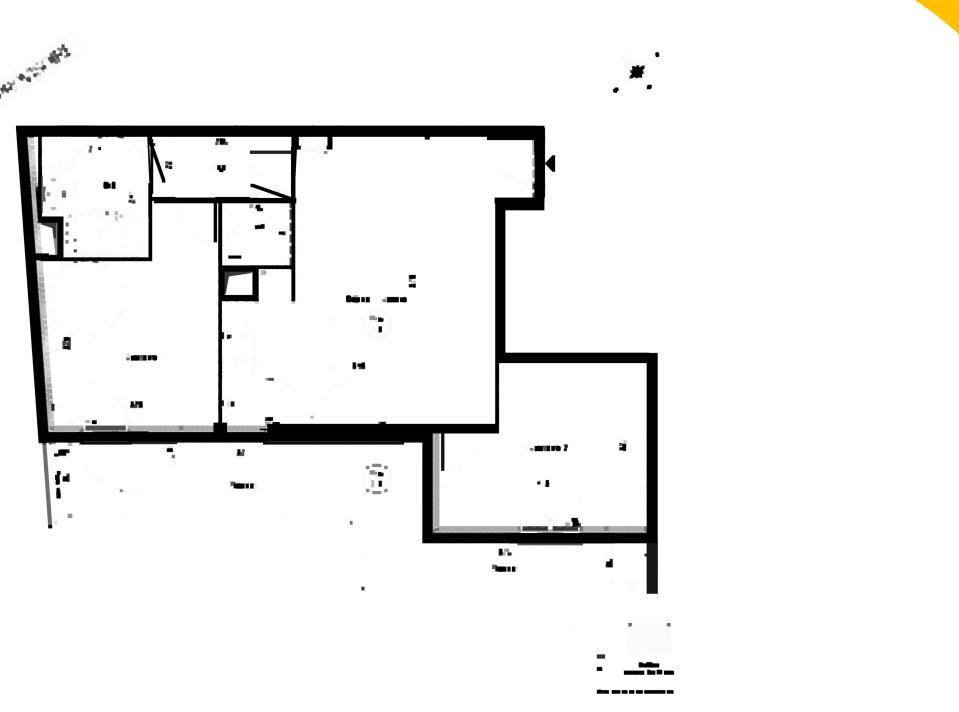


Figure 2.

Then we implemented a features generator, where inputs are a floor plan image and its segmentation image. Our features generator first finds all contours (rooms) in a segmentation floor plan, then calculates 3 features , with one additional feature for each room in this floor plan. In addition, we decided to define 6 labels for 6 type of main room that we want to detect in our models: living room, bedroom, bathroom, WC, intersection, and kitchen. We believe these 6 types of room can be well discriminated by our defined features. After running our features generator, we collected 686 training samples, and 185 testing samples, from "Eko", "Equation", and "Oxygen". For model metrics, we calculate the correct number of predictions and draw the confusion matrix.

Features Definition

Note that our target is to estimate the type of rooms given a floor plan. After analyzing these floor plan images and each main room's configurations, our hypothesis is these main rooms can be easily detected using several discriminative features, instead of running a computationally expensive Convolution Neural Network on the whole image, without compromise on the performance. Therefore, we decided to extract 4 discriminative and explainable features for each main room, which are relative room area, compactness of the room, density of the room, and adjacent room numbers.

1. Relative Area

The definition of one room's relative area is (see F1.).

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