Classification of interior architectural styles using deep learning

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Introduction

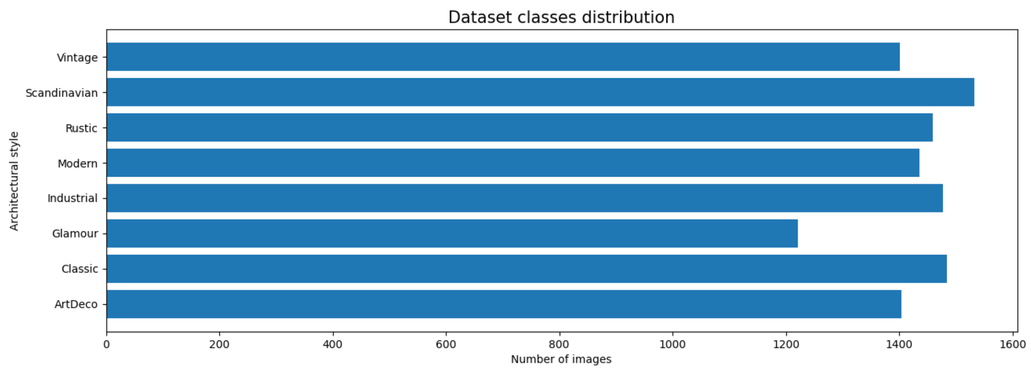
The research project focuses on classifying interior design in flats or houses. The development of automatic interior architectural style classification has practical applications in advertising and marketing of interior design services. Businesses drives the research and efforts, as it has the potential to improve both accuracy and efficiency of their advertising strategies. With the assist of modern deep neural networks, we aim to automate the process of classifying interior design styles, as current portals don't offer this feature.

Data

Data is important while training machine learning models because it serves as the input to the model, and is used to train and tune the model's parameters. The quality and quantity of data directly affects the accuracy and performance of the trained model.

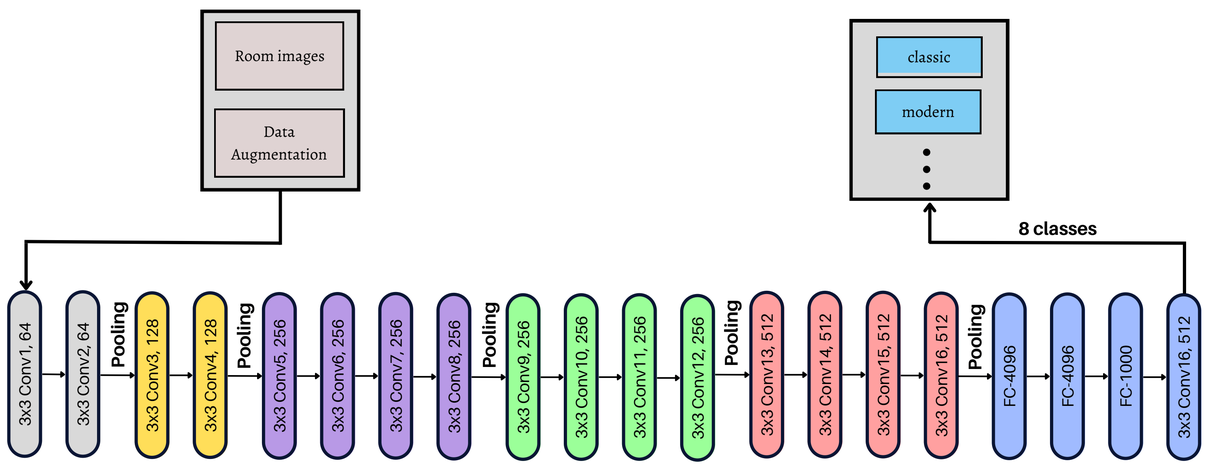
Collecting the data was a major challenge, as there are no publicly available datasets with real photographs of architectural interior design. Most of the real-life photos available on the internet do not have a specific interior design, which makes the task even more difficult. The data was entirely collected by us, consisting of around 10000 images, with balanced eight classes.

The data collection process was divided into:
1. Collecting images - scrapping images from the internet.
2. Pre-filtering of images, rejecting poor quality data.
3. Labelling of photos in cooperation with an interior design company.
4. Preprocessing and organising the photos - resizing, normalizing, augmentation, dividing the dataset into training, validation, and test sets.



Model

Both convolutional neural networks (CNNs) and visual transformers as classification models were used. Our approach involves fine-tuning pre-trained architectures on our annotated dataset[1]. For CNNs, we utilized popular models such as VGG19, ResNet34[2]. For the visual transformers - VIT-B-16[3].
VGG-19 is a convolutional neural network architecture that was developed for image classification. It consists of 19 layers including 16 convolutional layers and 3 fully connected layers. The network uses small convolutional filters of size 3x3 and a deep network structure with stacked convolutional layers to increase the representational power of the network. VGG-19 has been used in several computer vision tasks and has demonstrated state-of-the-art performance on multiple benchmarks.



Results

The evaluation of the model performance was done using accuracy, precision, recall and F1-score metrics. In our experiments, the VGG19 model performed best on the augmented images, achieving 0.8407 accuracy.

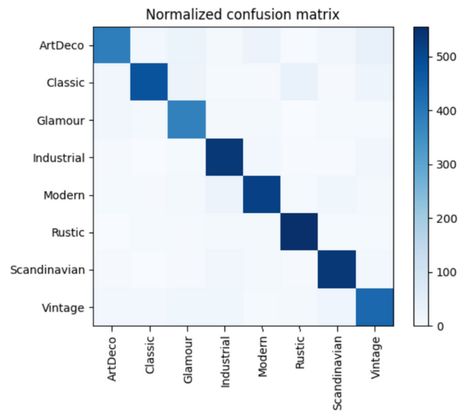
Model Type	Accuracy	Precision	Recall	F-score	Loss
VGG19	**0.8407**	**0.8422**	**0.8407**	**0.8399**	**0.7327**
ResNet34	0.4568	0.4825	0.4568	0.4527	1.5111
ViT-B-16	0.5386	0.5037	0.5386	0.5006	1.3865

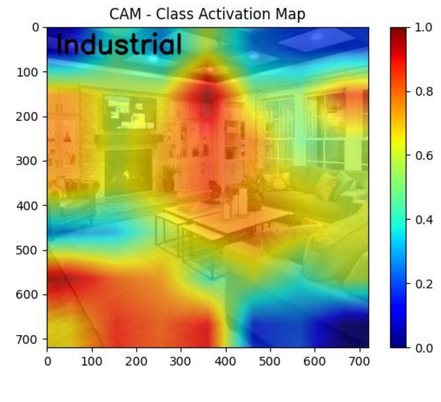
Demo

Scandinavian: 0.69
Industrial: 0.28
Glamour: 0.0

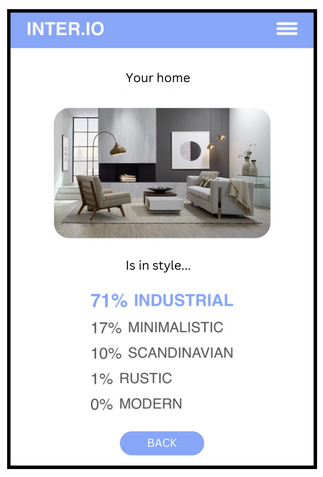
Modern: 0.94
ArtDeco: 0.02
Scandinavian: 0.01

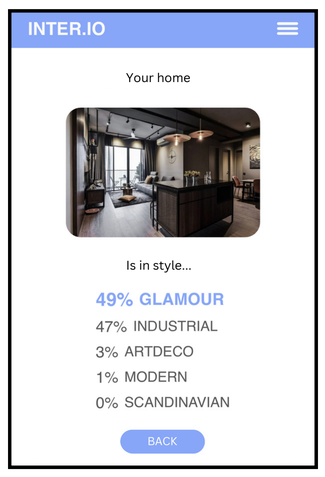
ArtDeco: 0.65
Glamour: 0.34
Classic: 0.0

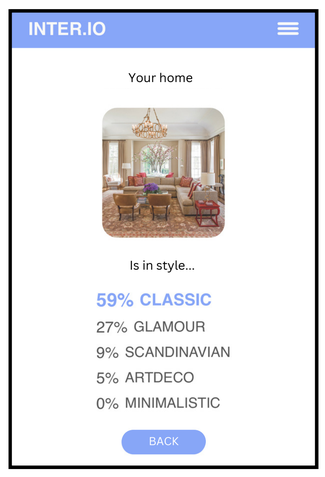




Application







References

[1] J. Kim, J. Lee. Stochastic Detection of Interior Design Styles Using a Deep-Learning Model for Reference Images. *Applied Sciences*, 10(20):7299, 2020
[2] M. Gao, D. Qi, H, Mu, J. Chen. A Transfer Residual Neural Network Based on ResNet-34 for Detection of Wood Knot Defects. *Forests*, 12(2):212, 2021
[3] Y. Yoshimura, B. Cai, Z. Wang, C. Ratti. Deep Learning Architect: Classification for Architectural Design through the Eye of ArtificialIntelligence. *CUPUM 2019*, 2019

Przedmiot przygotowanie do projektu badawczo-rozwojowego realizowany w ramach projektu Akademia Innowacyjnych Zastosowań Technologii Cyfrowych

Source code

Demo application

Projekt współfinansowany ze środków Unii Europejskiej w ramach Europejskiego Funduszu Rozwoju Regionalnego
Program Operacyjny Polska Cyfrowa na lata 2014-2020,
Oś Priorytetowa nr 3 "Cyfrowe kompetencje społeczeństwa" Działanie nr 3.2 "Innowacyjne rozwiązania na rzecz aktywizacji cyfrowej"
Tytuł projektu: „Akademia Innowacyjnych Zastosowań Technologii Cyfrowych (AI Tech)"
Porozumienie nr POPC.03.02.00-00-0001/20-00